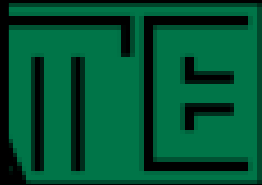
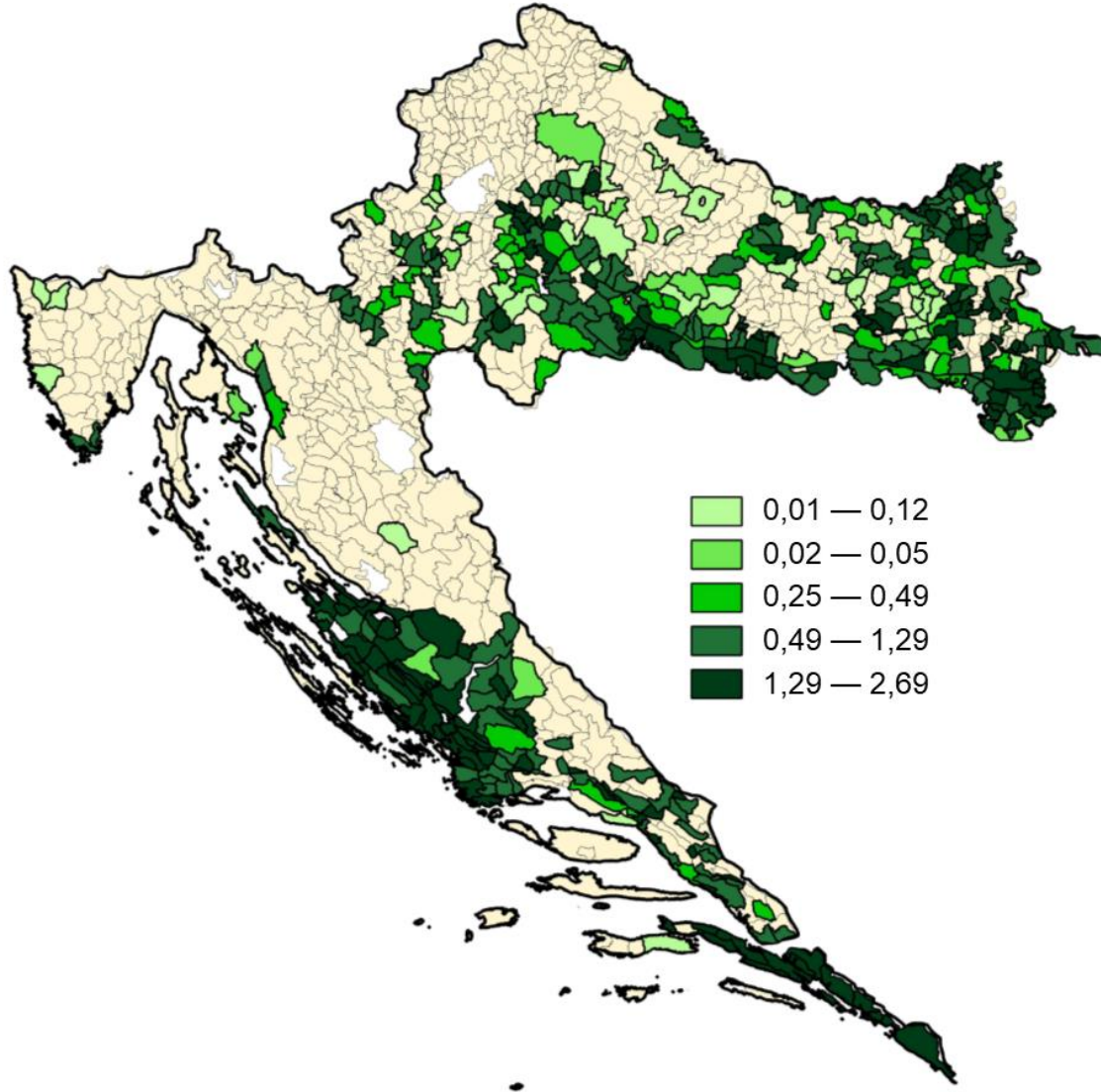


# GOLDEN JACKAL AS A CASE STUDY OF POPULATION CONTROL IN CROATIA

Šprem N., Barukčić V., Ilić I., Pokorny B.



# GOLDEN JACKAL IN CROATIA

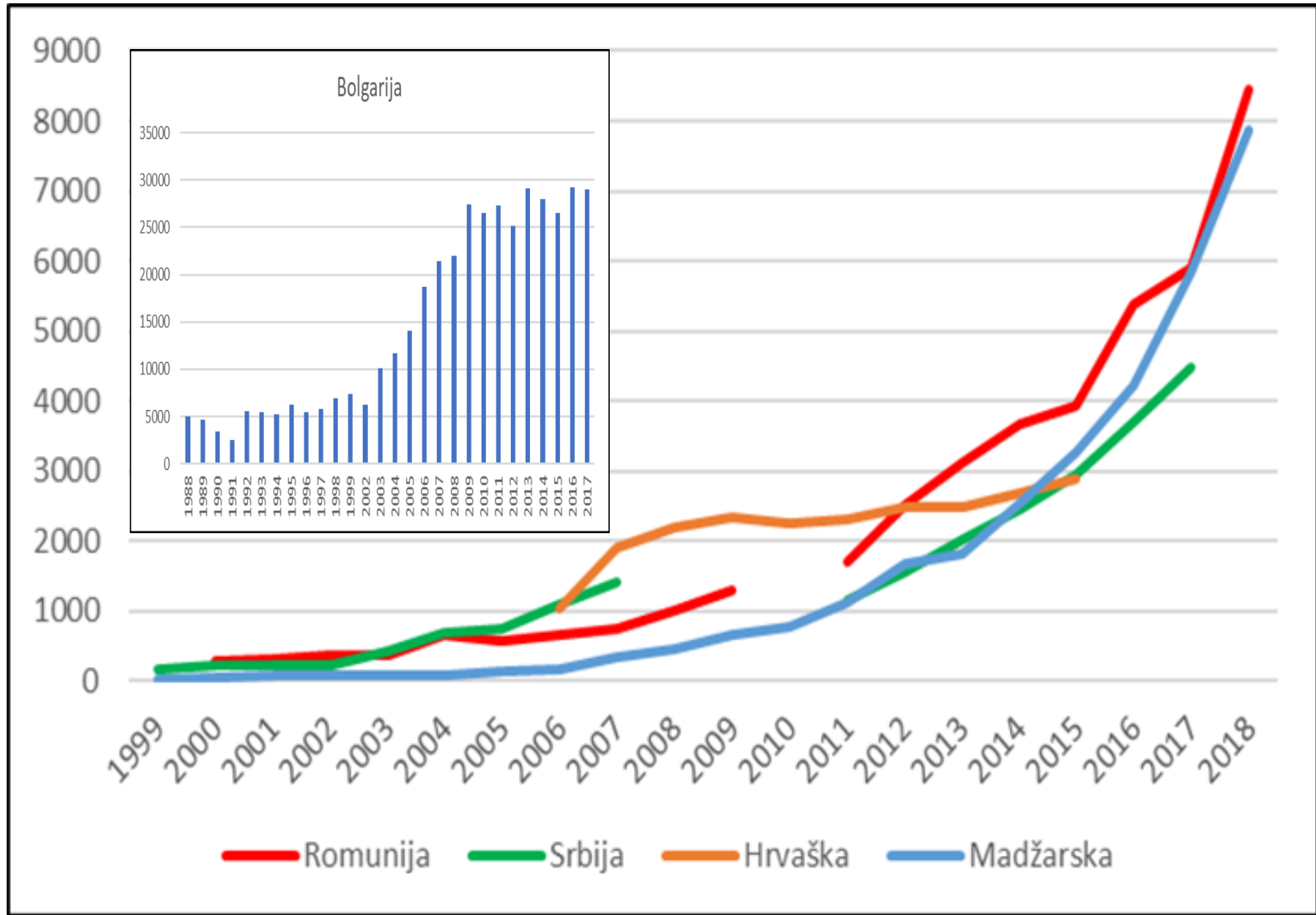


## HISTORY of THE SPECIES in CROATIA:

- **First record from 1491 (island of Korčula)** → since then, permanently present in Dalmatia (Jeričević 1952)
- Dalmatian population is different from Pannonian-Balkan one → both considering morphometric traits (Kryštufek & Tvrtković 1990a) and genetic outlook (Fabbri et al. 2014, Stronen et al. 2022)
- In early 1990s → jackals started inhabiting several islands (Kryštufek 2011, Martić 2018)
- First record in the continental part → at the end of 19th century (Kryštufek & Tvrtković 1990b)
- Since 1998 → rapid increase of both abundance and spatial distribution in the continental Croatia (Bošković 2012, 2013)
- **Last estimation of population size** → **approx. 8,000 individuals** → 6,700 from Pannonian-Balkan and 1,300-1,400 from Adriatic population (Ranc et al. 2018)

Density of golden jackal harvest (individuals/1,000 ha) in the period 2011–2015  
(Bezmalinović 2019)

# Fact 1: Huge increase of abundance in „domicile“ European countries



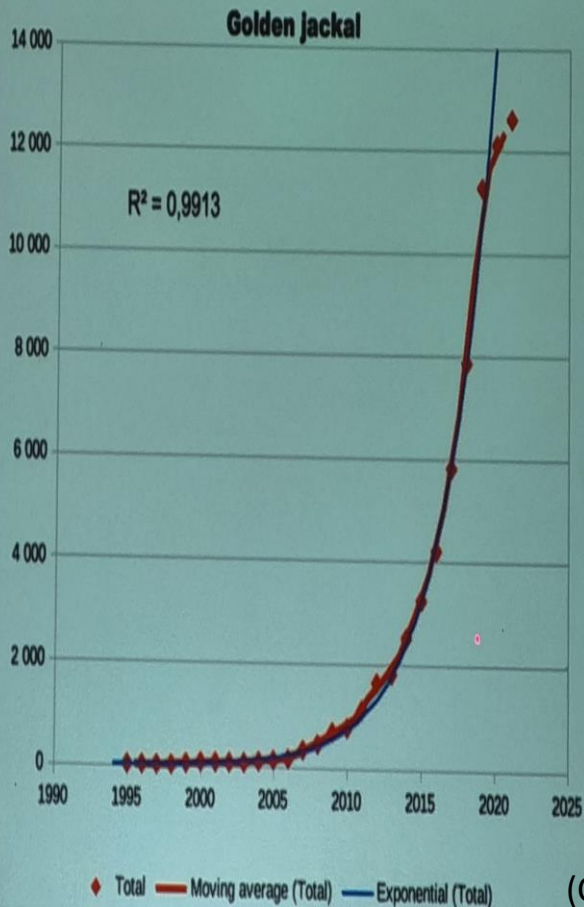
Annual harvest of golden jackal in Romania, Serbia, Croatia, and Hungary, 1999-2018

(from [Potočnik et al. 2019](#); based on [Penezić 2016](#); [RZS 2019](#) (for Serbia), [Farkas et al. 2018](#), [Papp et al. 2018](#) (for Romania), [Csányi et al. 2018](#) (for Hungary), [Bezmalinović et al. 2018](#) (for Croatia); [Stoyanov 2018](#) (for Bulgaria))

# Fact 1: Huge increase of abundance in „domicile“ European countries

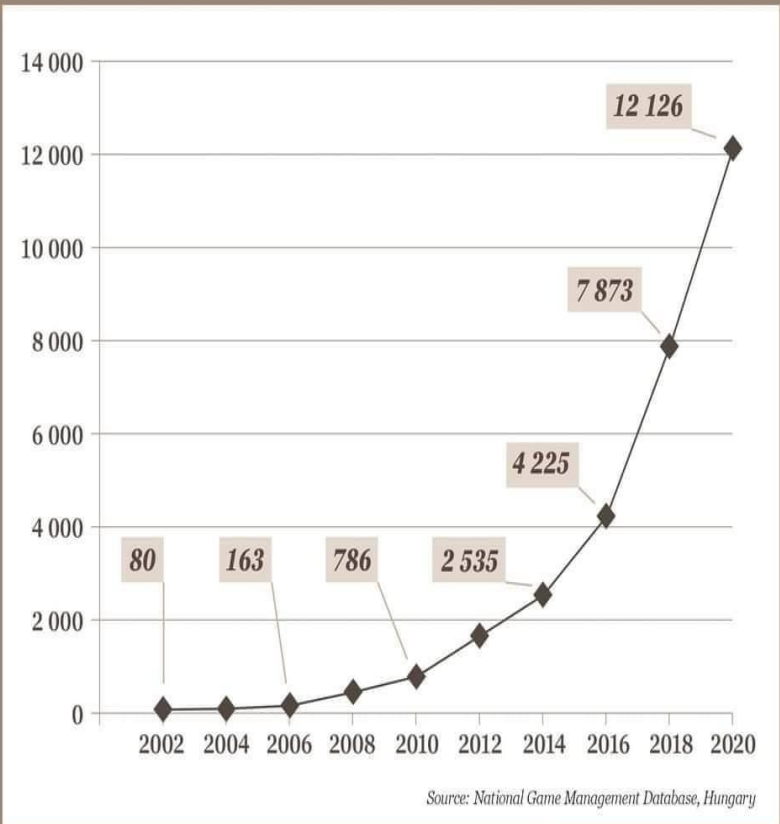
## The story at national level

The hunting bag of the jackals has shown exponential growth [except after around 2020]

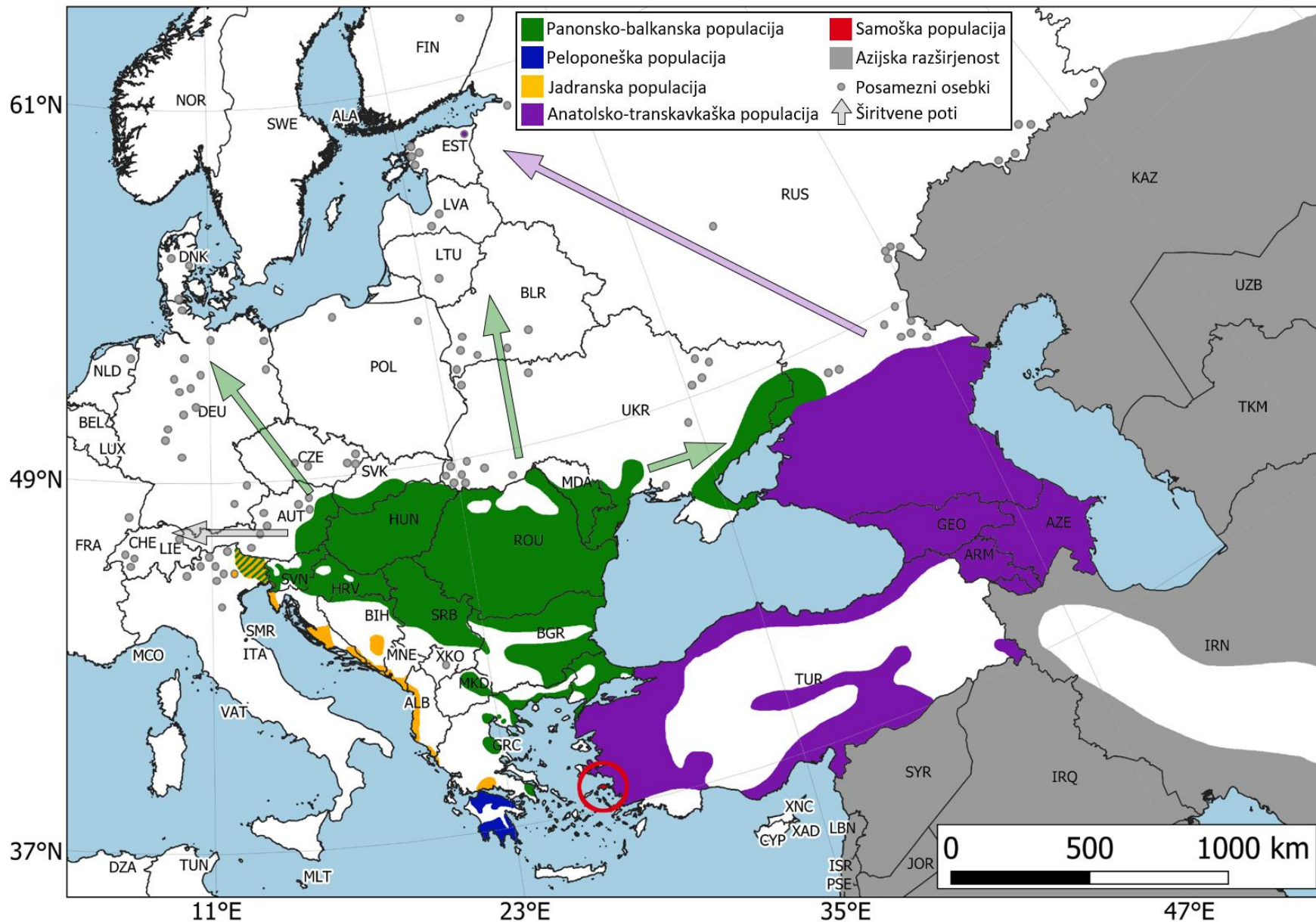


(Csányi 2022)

Golden Jackals shot by hunters  
increased **15 075%**  
in Hungary since 2002



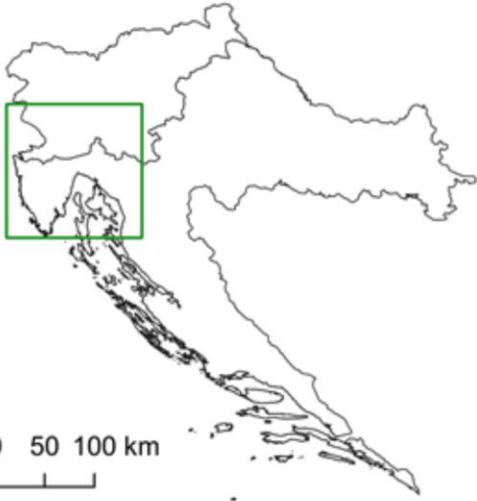
## Fact 2: Fast expansion of the species in Europe



(from Potočnik et al. 2019; adopted from Ambarli et al. 2016; Spassov & Acosta-Pankov 2019)

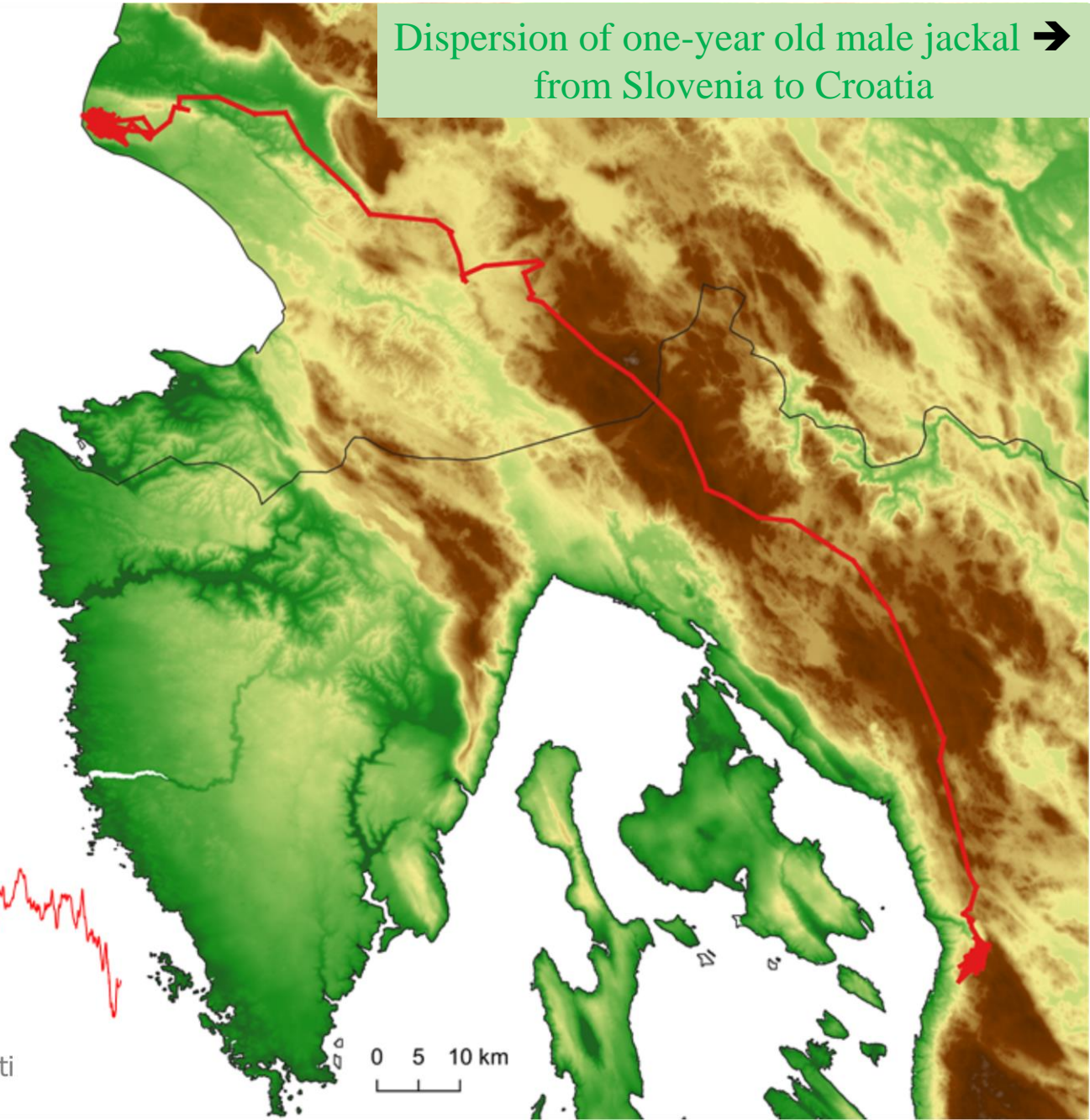
### Fact 3: High dispersal potential

Dispersion of one-year old male jackal →  
from Slovenia to Croatia

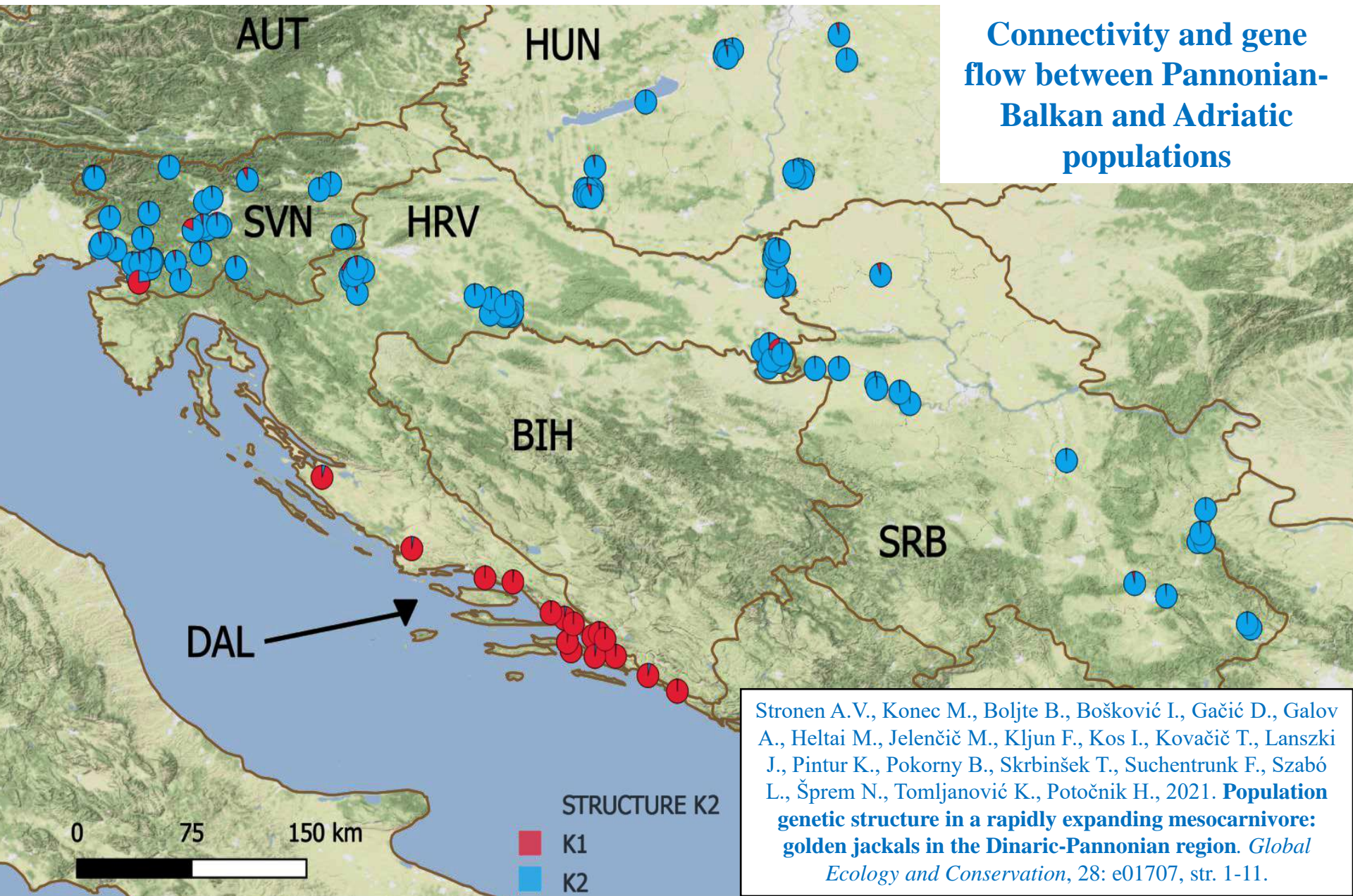


Distance of dispersion: **178,5 km**

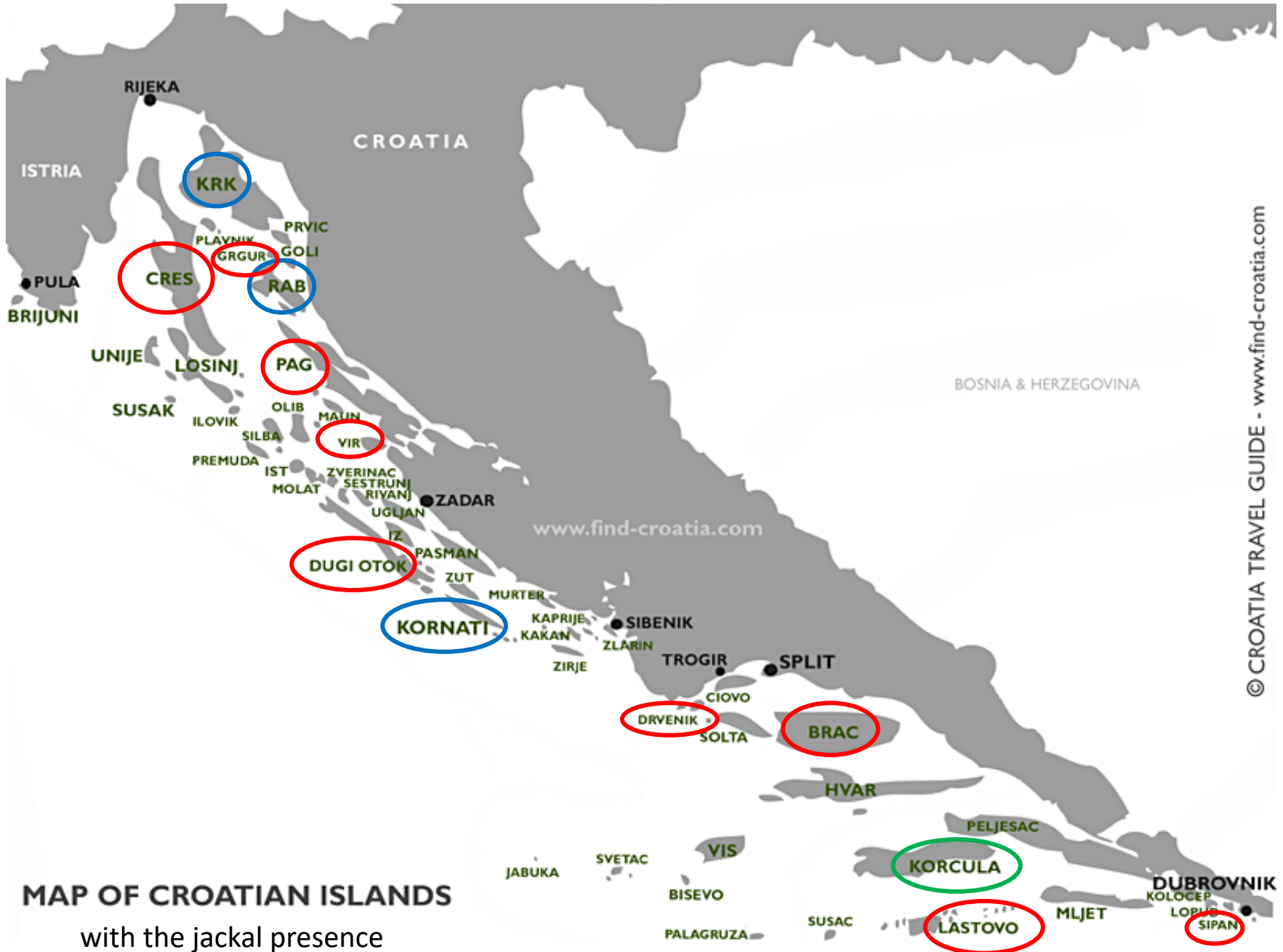
Travelled in 14 days



### Fact 3: High dispersal potential



## Fact 4: Ability to colonize also remote island by swimming





## Fact 5: Hybridization and introgression of dog's genes



Galov et al. (2015)

# Fact 6: Habituation to people, presence in (sub)urban areas

## Snimili smo čaglja u Zagrebu. Lovci upozoravaju: Mogu biti opasni ako se nakote

Martina Pauček Šijvak  
25.3.2021.

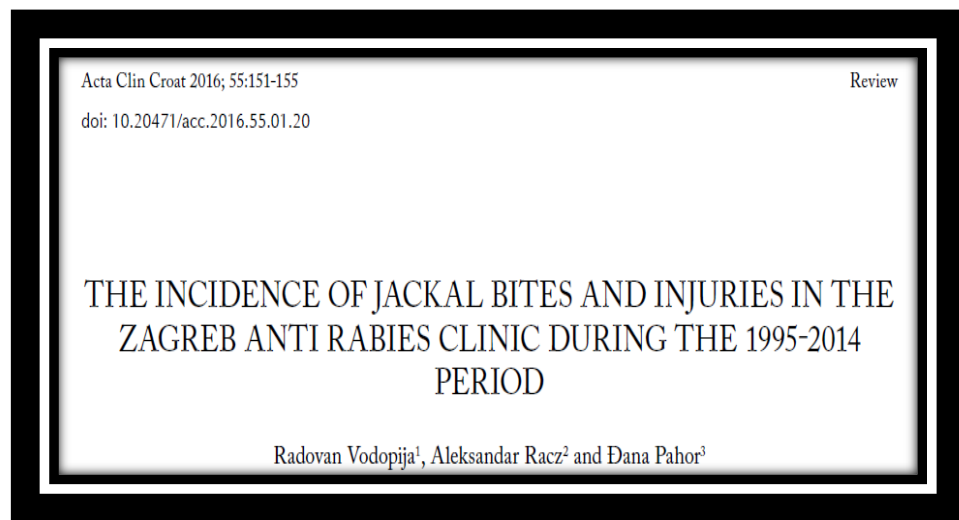


Jackals on Pelješac Peninsula, Croatia  
(photo credits: Baldo Mirković 2017)

## Fact 7: More frequent attacks on livestock



## Fact 8: Direct human-jackal conflicts...



# ... A STRONG NEED FOR POPULATION CONTROL → Active management

Country	Status
Albania	Protected species
Austria	Game species (but only in some regions)
Belarus	Without status, nonprotected
Bulgaria	Game species
Bosna and Herzegovina	Game species
Czech Republic	Protected species
Montenegro	Game species
Denmark	Protected species
Estonia	Game species
Finland	Not defined <sup>1</sup>
France	Not defined <sup>1</sup>
Greece	Without status, nonprotected
Croatia	Game species
Italy	Protected species
Latvia	Game species
Lichtenstein	Protected species
Lithuania	Game species
Hungary	Game species
Moldova	Game species
Germany	Protected species
Netherland	Protected species
Poland	Game species (since 2017, huntable since 2019)
Romania	Game species
Russia	Game species
North Macedonia	Protected species
Slovakia	Game species
Slovenia	Game species (since 2014, huntable since 2020)
Serbia	Game species
Switzerland	Protected species
Turkey	Game species
Ukraine	Game species

Status of golden jackal in European countries, in 2019 (review in [Potočnik et al. 2019](#))

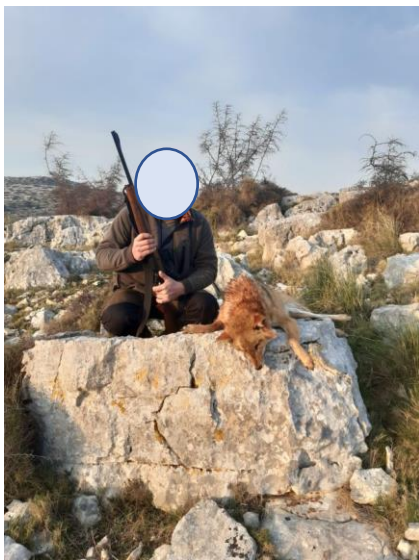
# JACKAL POPULATION MANAGEMENT in CROATIA



- Jackal hunting is allowed all year around → hunting is banned for pregnant females or when they lead cubs
  - Night vision devices are allowed
- In last years → the state paid 600-800 HRK (approx. 100 EUR) for each jackal shot

# History of jackal (hunting) on Croatian islands

## History of jackal (hunting) on Croatian islands



## RAB ISLAND:

- First record in 2006
- Three populistic hypotheses about the origin → all of them based on speculating about introductions →
- By hunters, foresters or NGOs 😊

## KORK ISLAND:

- First record in 2015 → 3 individuals shot
- In 2019/20 → 20 harvested jackals
- Since 2019 → monetary award for hunters provided by municipality → 15,000 HRK (2,000 EUR) per head
- Award also for road-killed jackal → 4,500 HRK (600 EUR)

## KORNATI ISLANDS:

- First record in 2020 → predation on sheep → like at all other islands
- Although being National Park → hunting is now allowed → 15 were shot in 2022
- Also albino jackal → or probably hybrid?

# Objectives of this preliminary study → to determine:

- the best hunting method
  - hunting effort
- the effect of habitat type
- the effect of weather conditions and moon phase on hunting success

Preliminary study → but, emphasising the importance of hunters as well-skilled  
**CITIZEN SCIENTIST!**





# Material and methods

- **Study area** → 2,000 ha large model hunting ground in central Croatia
- **Along Sava River** → (45°16'15"N, 16°54'41"E)
- **Interest and collaboration of individual hunter(s)**
- **Croatian hunting records**  
(<https://epoljoprivreda.mps.hr/>)
- **Habitat map of the Republic of Croatia**  
(<https://www.bioportal.hr/node/15>)
- **QGIS 3.4**

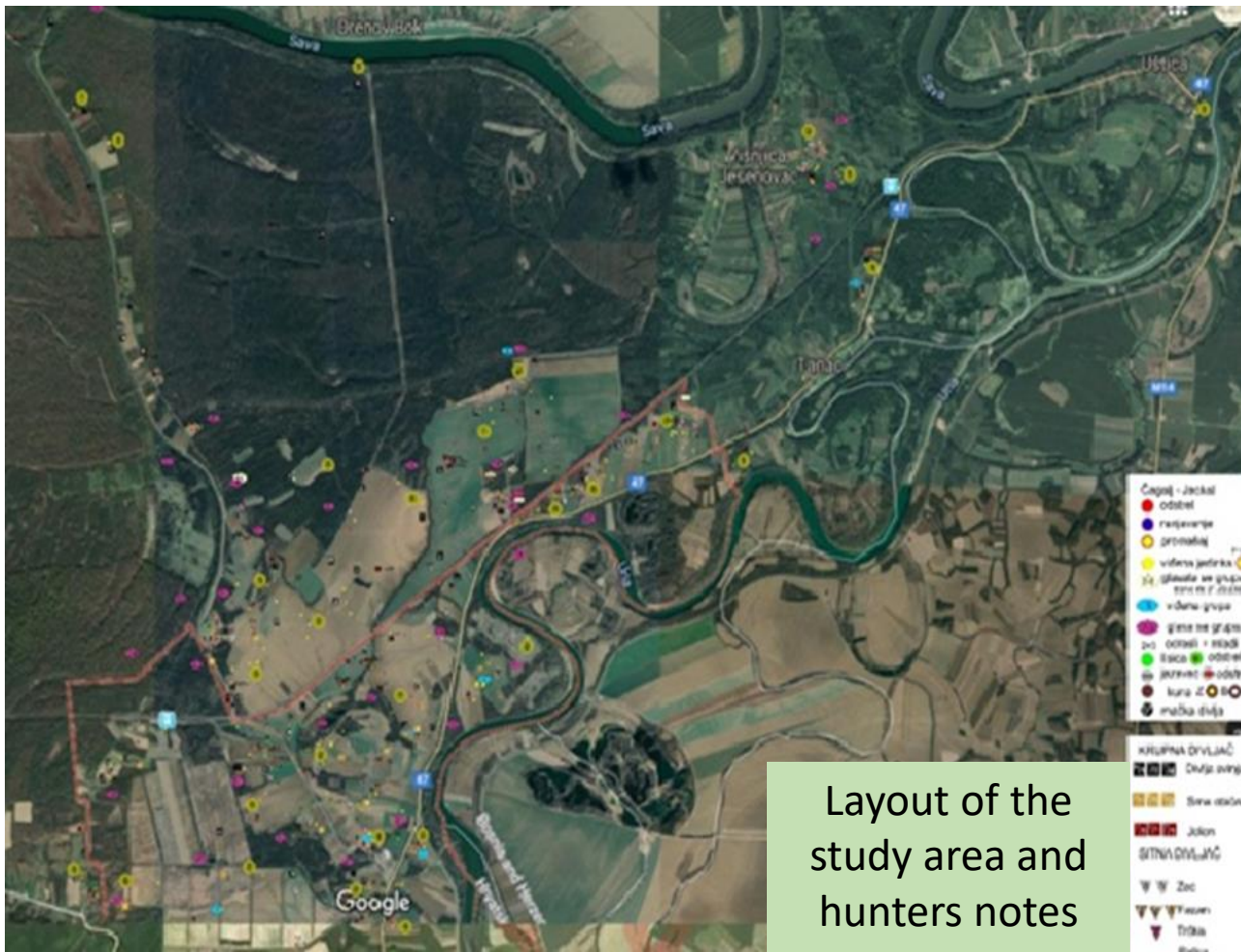


## Data collection

- During 2020/2021 → 52 hunting days/nights
- Acoustic method → thermal scope → shot with 222 Remington

# Descriptive results

- 191 jackals were sighted
- 70 jackals were culled
  - 14 were wounded
  - 56 were missed

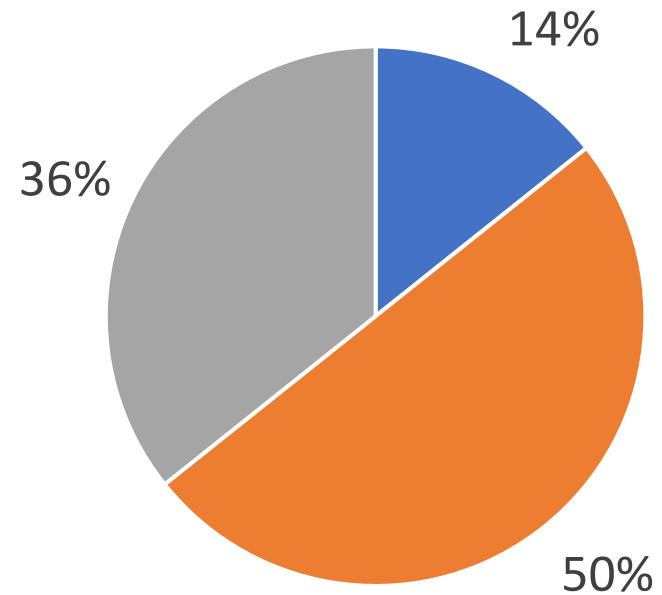
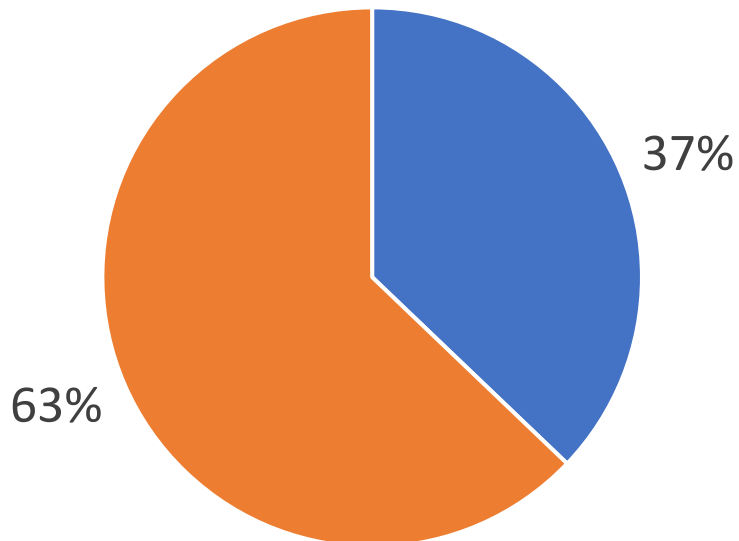


# Sex and age categories of culled individuals



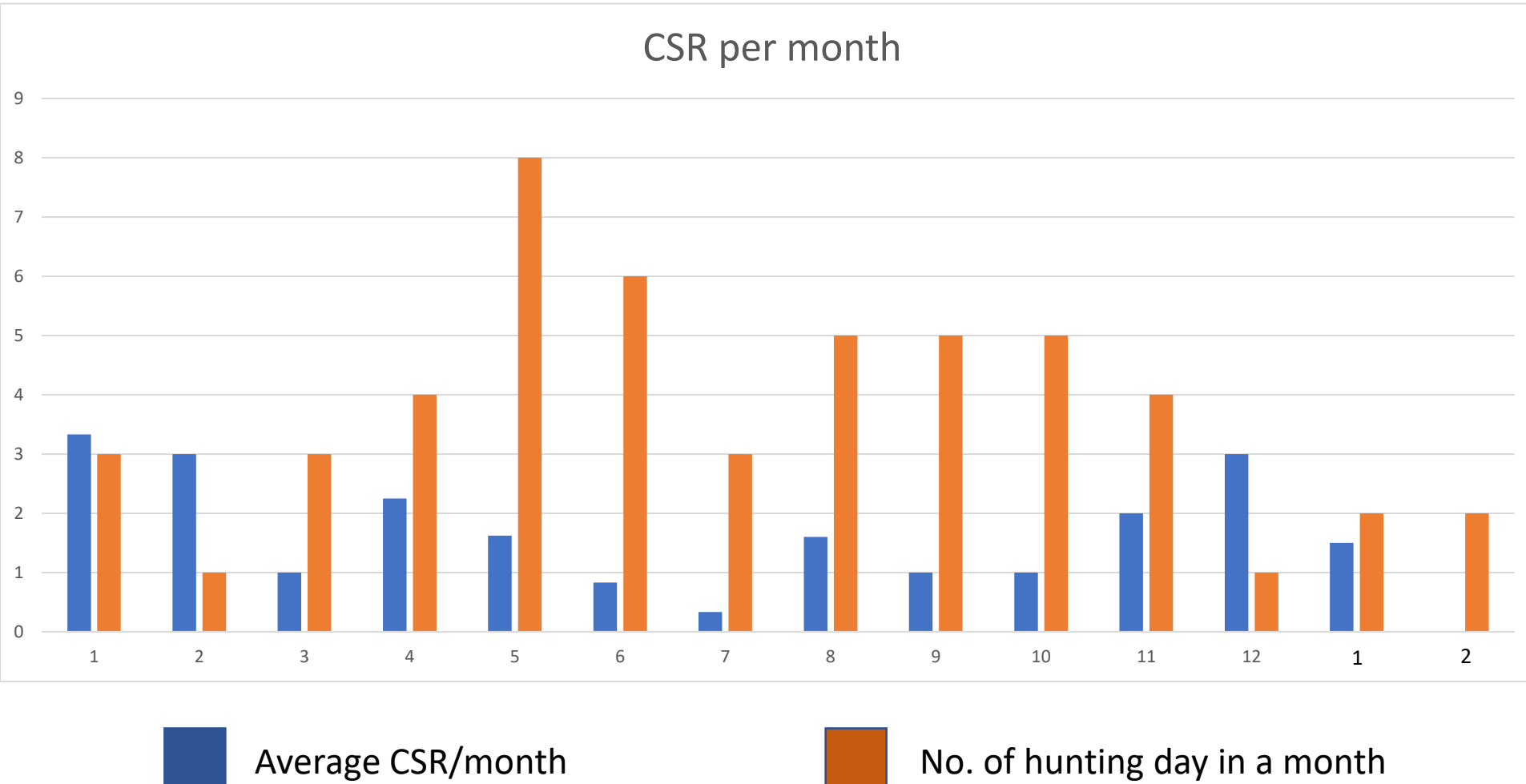
■ Females ■ Males

■ Juvenile ■ Young ■ Adult



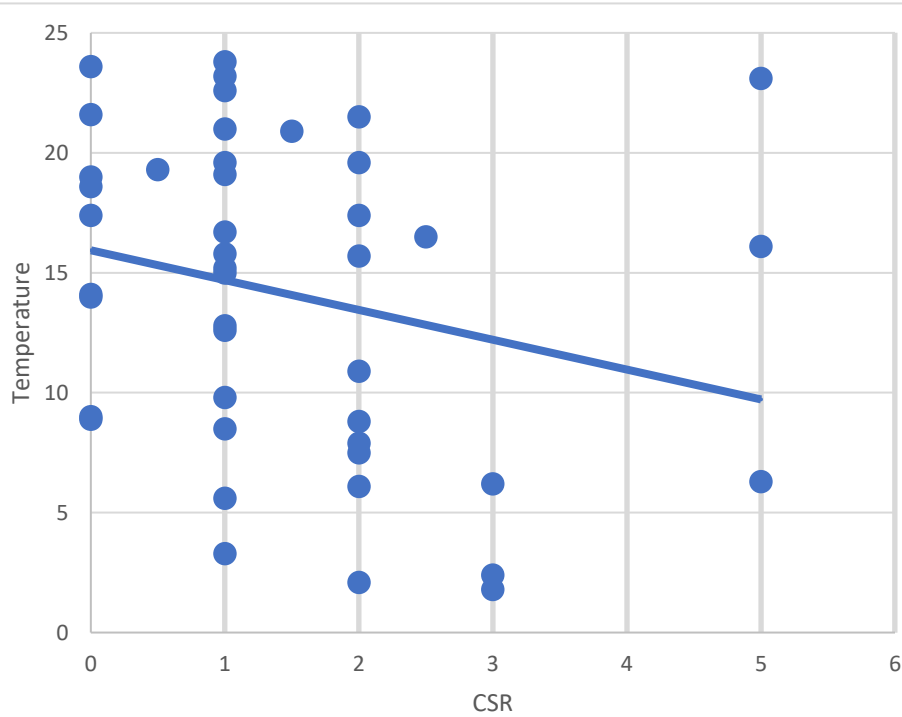
# Hunting efficiency per day

Average culling success rate (CSR) = 1.4 shot jackals/hunting day



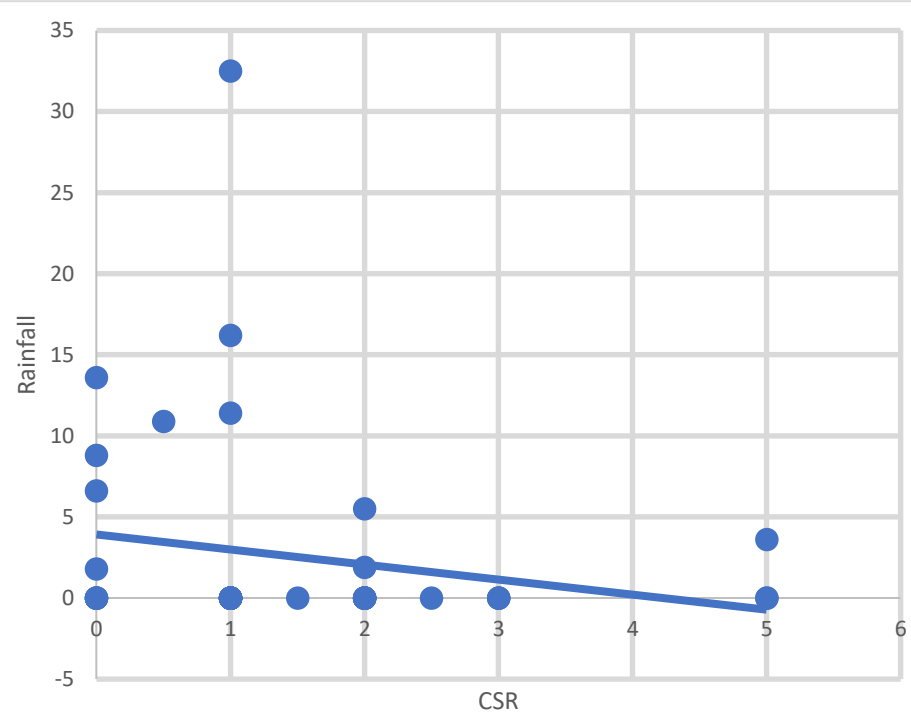
# The influence of weather condition

## Temperature



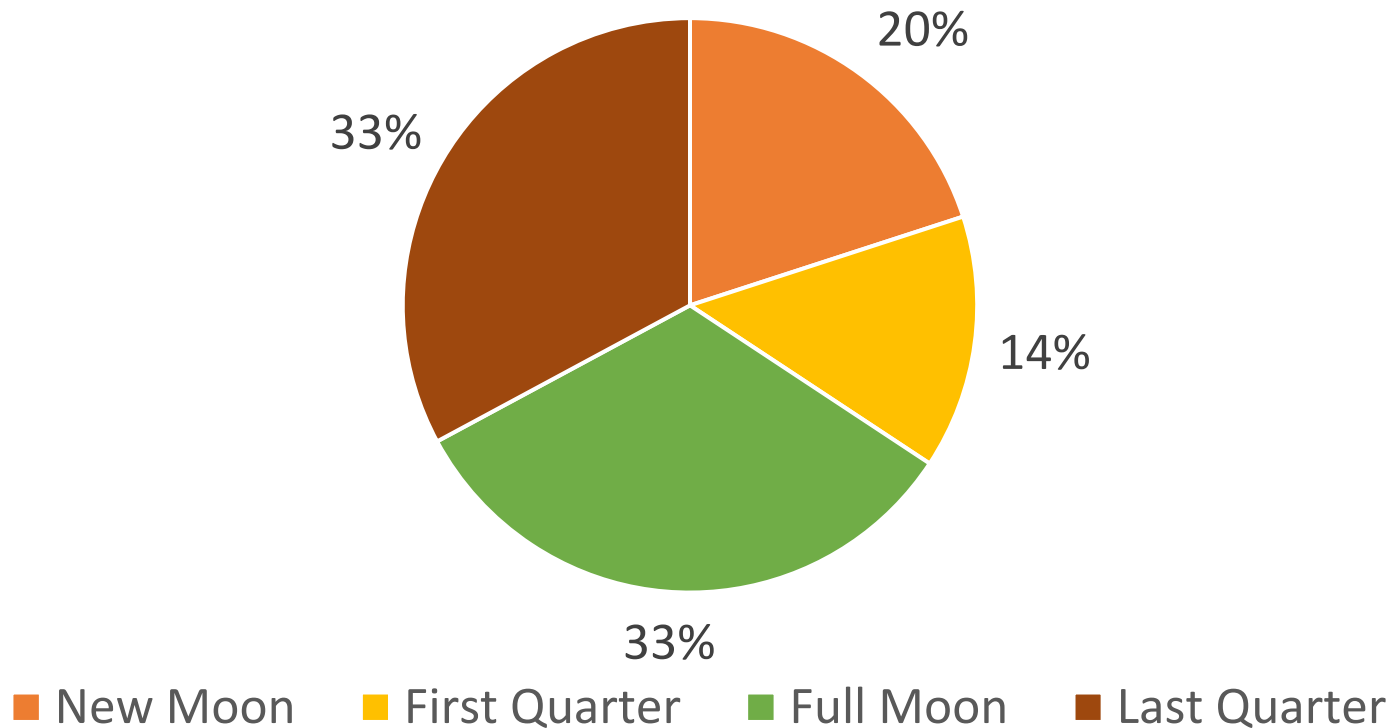
$$y = -1.2415x + 15.931$$
$$R^2 = 0.0597$$

## Rainfall



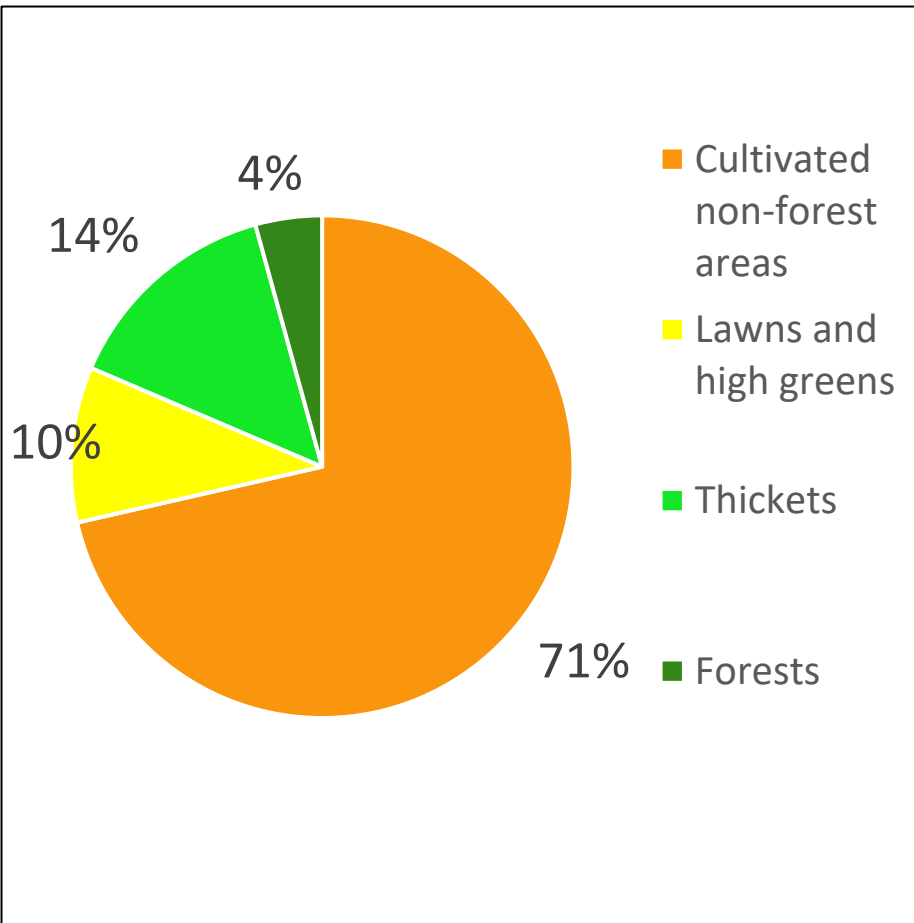
$$y = -0.9281x + 3.9241$$
$$R^2 = 0.038$$

# The influence of moon phase

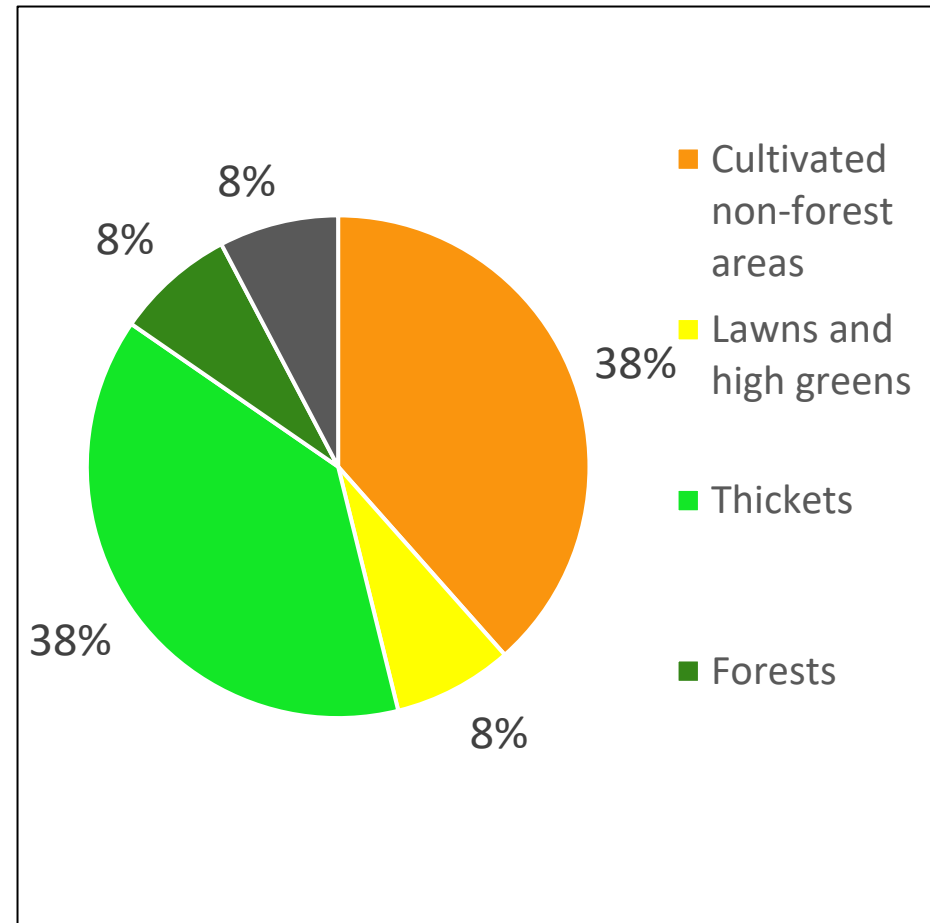


The proportion of culled jackals  
per moon phase

# The shot effectiveness per habitat „type“



Culled individuals



Wounded individuals



## Summary about this preliminary Croatian study

- **Using thermal scopes in combination with the acoustic method** → the best option for efficient jackal hunting
- Acoustic method → imitation of the sound of a hare, a bird or another jackal
- **Average culling success rate** → 1.4 jackals/hunting day
- Young males were culled the most
- **Open, cultivated areas are the best place for successful hunting**
- **Winter months are better for successful hunting**
- Temperature, rainfall, and moon phase → without significant effect on hunting effectiveness

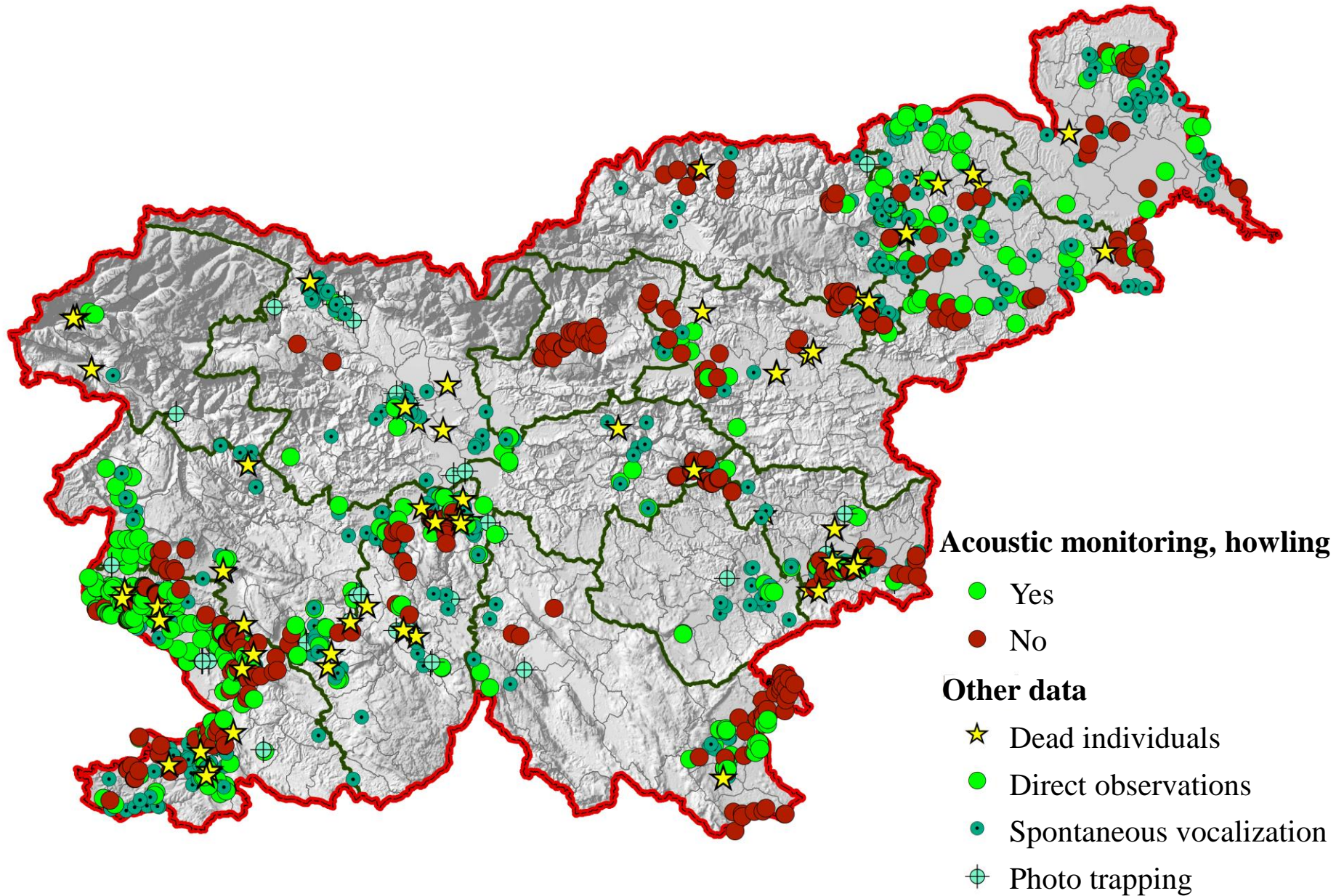
**A case study with a very preliminary results → however, it indicates a great potential of HUNTERS as very important CITIZEN SCIENTISTS**

# MONITORING of GOLDEN JACKAL in SLOVENIA: an important step from passive to active collection of data

110  
Lovska zveza Slovenije



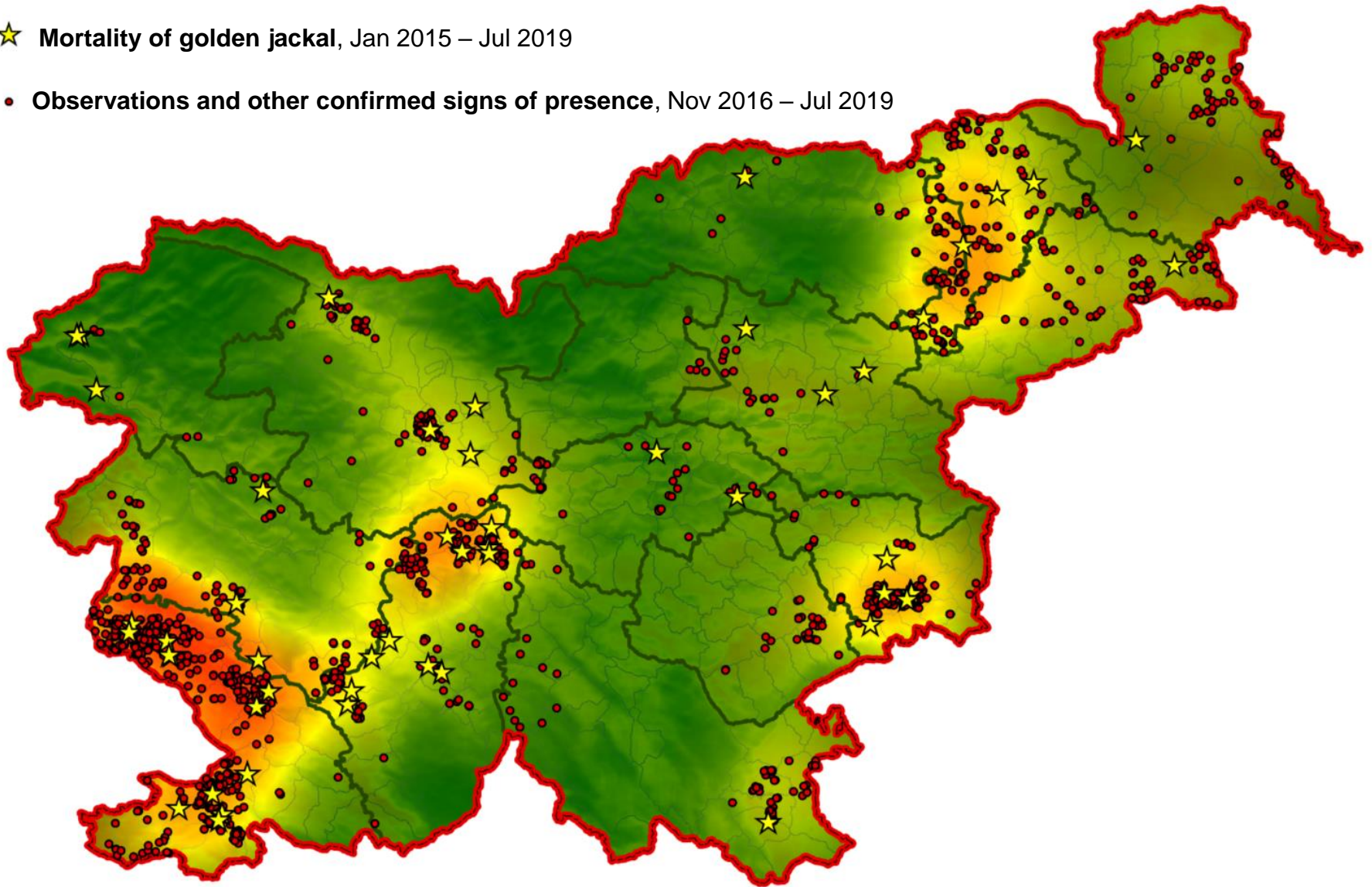
# GOLDEN JACKAL in Slovenia: monitoring 2016-2019 (Potočnik et al. 2019)



# GOLDEN JACKAL in Slovenia: monitoring 2016-2019 (Potočnik et al. 2019)

★ Mortality of golden jackal, Jan 2015 – Jul 2019

● Observations and other confirmed signs of presence, Nov 2016 – Jul 2019



Our work has been implemented in population management...



ČRTNA KODA

ZLATOROGOVA  
KNJIŽNICA

ŠAKAL

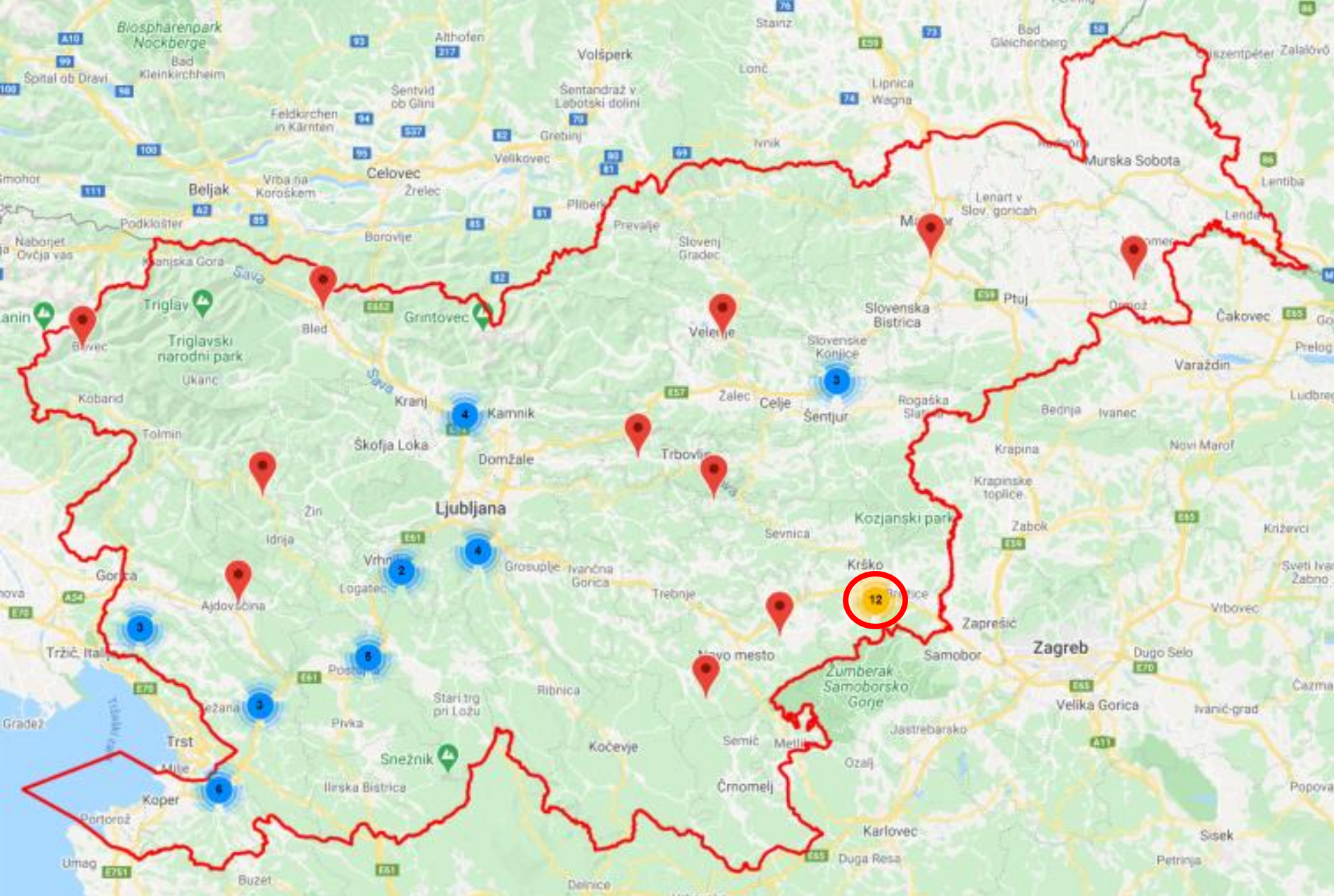
Hubert Potočnik, Boštjan Pokorny,  
Katarina Flajšman, Ivan Kos

42

ŠAKAL

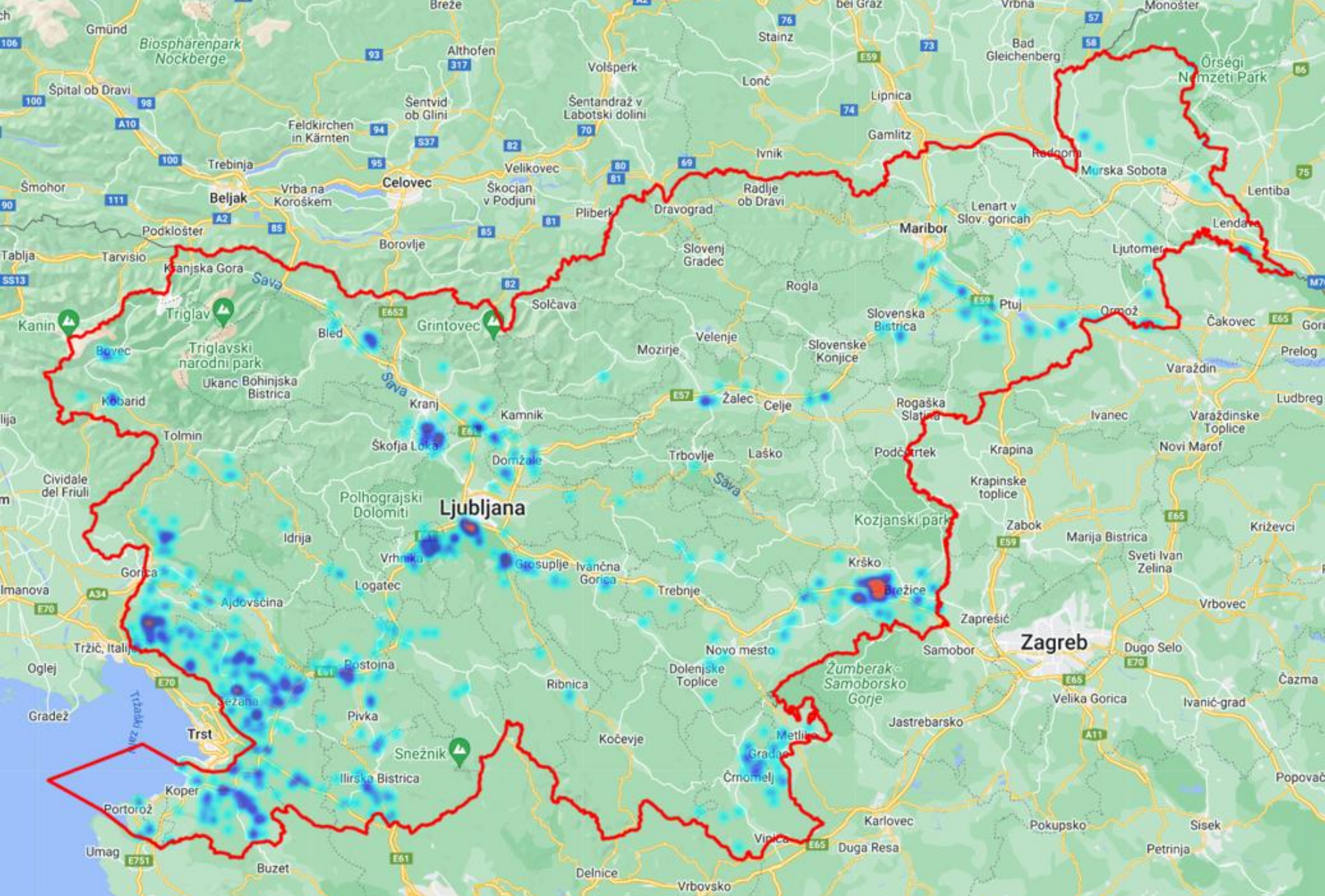
Hubert Potočnik, Boštjan Pokorny,  
Katarina Flajšman, Ivan Kos





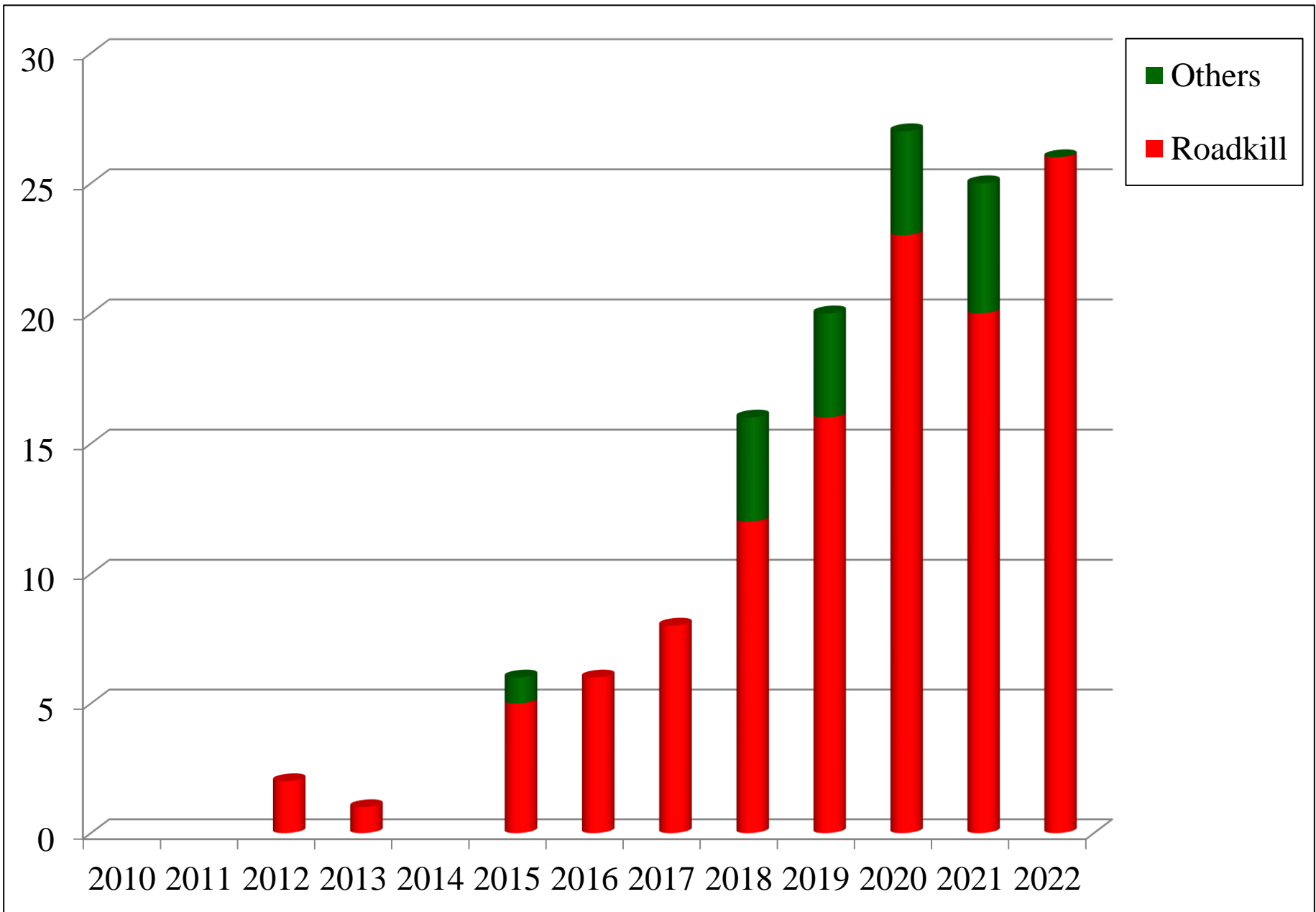
## Registered mortality of GOLDEN JACKAL in Slovenia

1 Jan 2015 – 31 Dec 2019 (Osliš 2022)



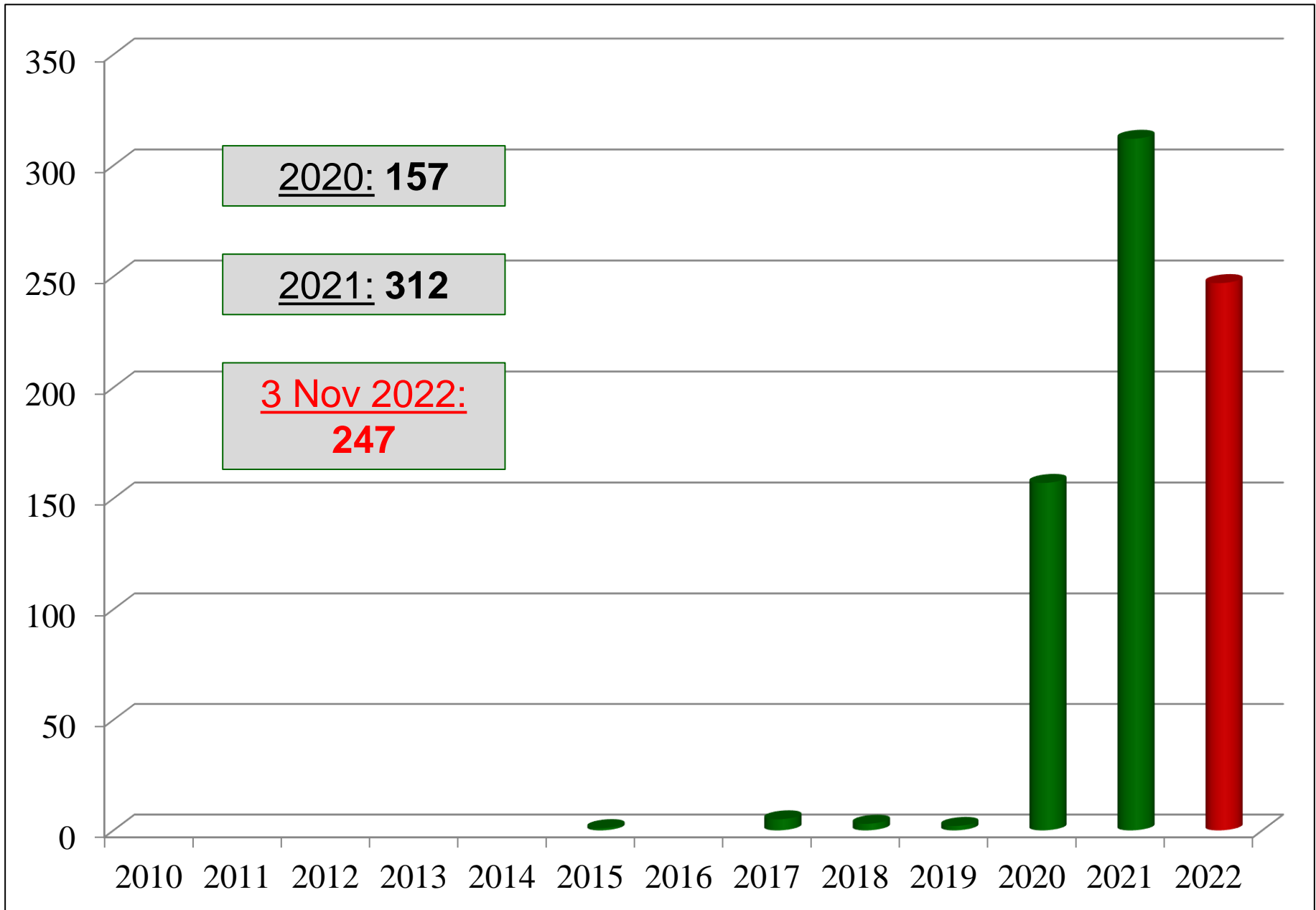
## Registered mortality of GOLDEN JACKAL in Slovenia

1 Jan 2020 – 3 Nov 2022 (Oslis 2022)



***Roadkill and other registered losses of GOLDEN JACKAL in Slovenia  
2010-2022 (Oslis 2022).***





*Harvest of GOLDEN JACKAL in Slovenia,  
2010-2022 (Oslis 2022).*

# ORIGINAL SLOVENE ON-LINE AVAILABLE DATABASES (Lisjak)

Browser address bar: <https://apl.logos.si/LIS/>

Navigation: Datoteka Uredi Pogled Prijjubljene Orodja Pomoč

Tools: Predlagana mesta Get more Add-ons

Right side icons: Home RSS Print Stran Varnost Orodja

**lovski informacijski sistem** **Lisjak** uporabnik: POKOR, OLJKA (Uporabnik)

LOGOS.SI

odjava podpora

Menu: organizacija **odstrel in izgube** škode – objekti kinologija letni načrt

Sub-menu: urejanje pregledi **evidence** kategorizacija

**rezultati iskanja** **počisti**

zap.št.:

status:

datum odvzema:  1.8.2013  15.9.2013

čas odvzema:

lovsko upravljavsko območje:

lovišče:

krajevno ime odvzema:

revir:

kvadrant:

vrsta odvzema:

vrsta evidence:

divjad:

količina:

šifra divjadi:

strukturni razred:

ocenjena starost:

kategorija divjadi:

biološka masa:

transportna masa:

Najdenih zapisov: 22 **kopiraj v odložišče** **Prenesi datoteko**

datum	lovišče kvadrant	vrsta odvzema	divjad	strukturni razred	ocenjena starost	iztreb.teža	bruto vrsta kupca	št.izjave usp.osebe
03.08.2013	OLJKA	povoženo na cesti kuna belica	kuna belica skupaj					
04.08.2013	OLJKA N4K0	odstrel	sma	dve in več letni srnjaki	2	20,0	član	011696
05.08.2013	OLJKA N4K1	odstrel	sma	dve in več letni srnjaki	2	20,0	pogodbeni odjemnik	1209020249
10.08.2013	OLJKA N1K4	drugo	sma	dve in več letne sme	2			
16.08.2013	OLJKA	odstrel	lisica	samicice				
26.08.2013	OLJKA	neznano	poljski zajec	poljski zajec skupaj				
26.08.2013	OLJKA N2K0	povoženo na cesti	sma	mladiči moškega spola	0			
01.09.2013	OLJKA N1K2	odstrel	sma	mladice	1	15,5	pogodbeni odjemnik	1209020250
01.09.2013	OLJKA N2K1	odstrel	sma	mladice	1	14,0	član	011697
02.09.2013	OLJKA N1K4	odstrel	sma	mladiči moškega spola	0	8,0	pogodbeni odjemnik	1309020251
02.09.2013	OLJKA N3K3	odstrel	sma	mladice	1	12,5	pogodbeni odjemnik	1309020252
04.09.2013	OLJKA N1K2	odstrel	sma	mladice	1	15,0	član	011698
05.09.2013	OLJKA N1K2	odstrel	sma	mladiči moškega spola	0	9,0	pogodbeni odjemnik	1309020253
06.09.2013	OLJKA N0K5	odstrel	sma	mladiči ženskega spola	0	8,0	pogodbeni odjemnik	1309020254
06.09.2013	OLJKA N2K1	odstrel	sma	mladiči ženskega spola	0	8,0	pogodbeni odjemnik	1309020255
08.09.2013	OLJKA N1K1	odstrel	sma	mladice	1	15,5	pogodbeni odjemnik	1309020256
08.09.2013	OLJKA N0K6	odstrel	sma	mladiči ženskega spola	0	9,0	član	011699
08.09.2013	OLJKA M9K4	odstrel	sma	dve in več letne sme	2	14,5	pogodbeni odjemnik	1309020257
10.09.2013	OLJKA N0K1	odstrel	sma	mladiči ženskega spola	0	9,0	član	011700
12.09.2013	OLJKA N0K7	odstrel	sma	dve in več letne sme	2	15,5	pogodbeni odjemnik	1309020258
13.09.2013	OLJKA M9K5	odstrel	sma	mladice	1	9,0	za potrebe LD	/
14.09.2013	OLJKA N1K4	odstrel	sma	dve in več letni srnjaki	2	18,0	član	03901

Left sidebar (Prijubljeno):

- Kazalci okolja MOP
- Kluwer Academic Publish...
- KOPA hitre povezave
- Lovska zveza Slovenije
- Mat'Kurja
- MSN.com
- PinkPonk
- Radio Station Guide
- REC Slovenia
- Roe Deer research group
- Tujerodne vrste v Sloveniji
- Visoka šola za varstvo oko...
- Wild Boar Symposium 2012
- Behavioural ecology of Si...
- Scopus 2012
- NLB Klik - NLB
- European Wildlife Network
- UP, FAMNIT
- OPLOJENOST SRNJADI\_re...
- OPLOJENOST SRNJADI\_vz...
- Vrstica s prijubljenimi
- Google
- WebMail ERICo, 2013

Bottom: Ogled predlaganih mest

# ON-LINE HUNTING INFORMATION SYSTEM

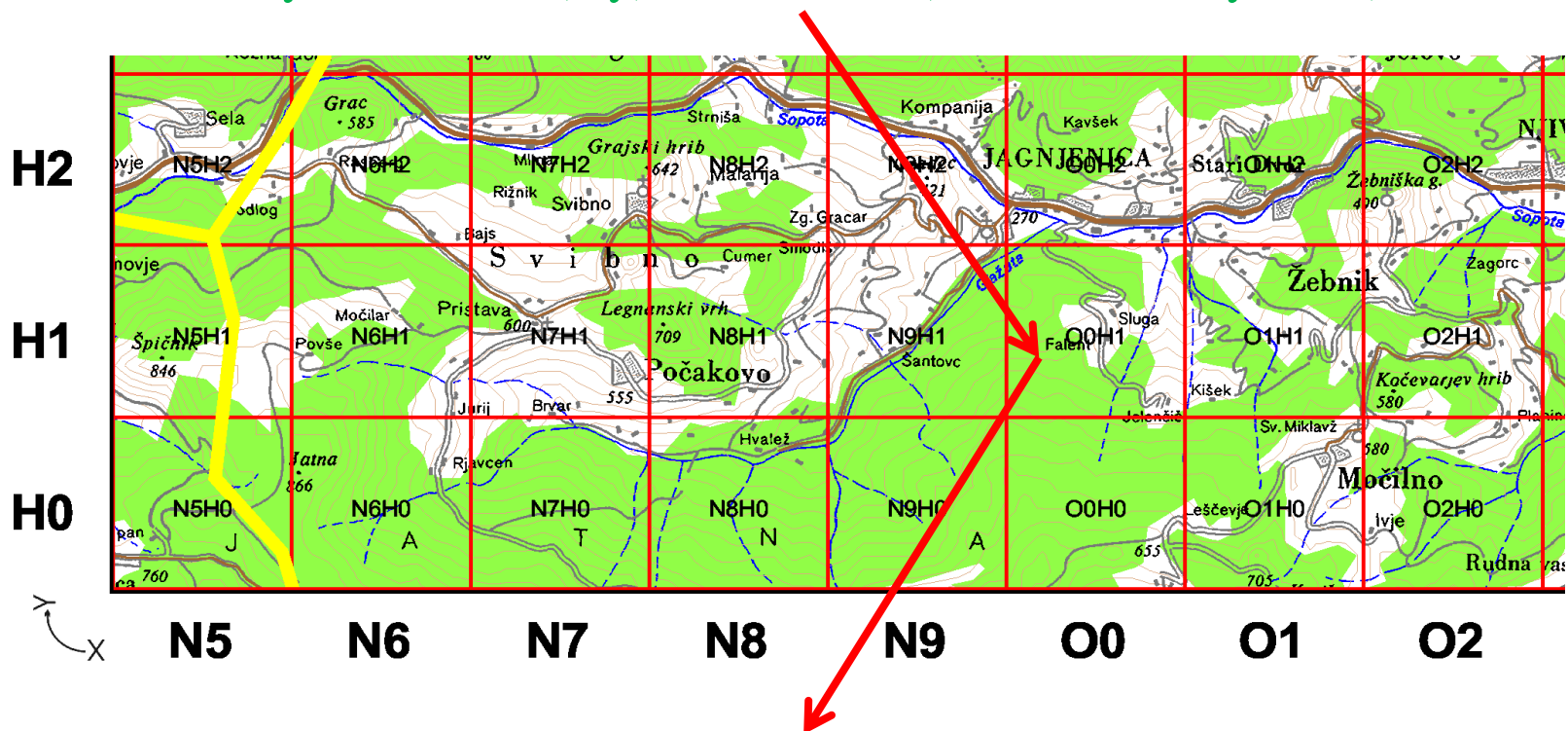
- **Developed by the Slovene Hunters Association** → yearly budget for the system: 5,000-10,000 EUR
- **All data have to be put into the system immediately** → up to end of the month at the latest
- **Many essential data for every ungulate (and large carnivore) shot or died due to any other reasons** → species, sex, assessed age, body mass, antler mass, CIC points, health status, veterinarian number, hunter, area, and location
- Data have been available since 2006 → **>800,000 individuals at the moment**
- **On-line availability** → fantastic opportunity for the science

# On-line available hunting information system provides and enables several

## SPATIAL INFORMATION and ANALYSES

>800,000 individuals → also geo-referenced in a very high spatial resolution!

- in 1 x 1 km grid (from 2006 to 2014)
- by exact GPS (x,y) coordinates (since 1 January 2015)



Many environmental data available: habitat structure, climate, culling density of wildlife etc.



# Step Change

*Science Transformation in EuroPe  
through Citizens involvement in HeAlth,  
coNservation and enerGy rEsearch*

**H-2020 Citizen Science project → in Slovenia: WILDLIFE  
MONITORING in collaboration with HUNTERS**

# H-2020 StepChange: MONITORING of WILDLIFE with the help of CS in Slovenia



Prijava v sistem SRNA  
*Logging into the system SRNA*  
Spremljanje in Raziskovanje Narave z Aplikacijo

E-pošta / E-mail \*

29568

Geslo / Password \*

.....

Zapomni si me na tej napravi *Remember me on this device*

✓ PRIJAVA *LOGIN*

 REGISTRACIJA BREZ LOVSKE IZKAZNICE

*REGISTRATION WITHOUT HUNTING LICENCE*

 POZABLJENO GESLO *FORGOTTEN PASSWORD*

## App SRNA → Monitoring and Research of the Nature with the help of App:

- **In first two months → 766** registered observation of wildlife by hunters → large mammals and some bird species
- **32 registered observations of golden jackal →** at 7th place considering species frequency → after five ungulates and European hare
- **Much more registered observation of jackals than of other carnivores →** brown bear (18), wolf (5), badger (8), wild cat (3), red fox (28) ...



Photo credits: Janez Tarman

*Thank you for your attention!*