

# Controlling Overabundant Jackal Populations: from Theory to Practice



MATE



3RD INTERNATIONAL JACKAL  
SYMPOSIUM  
02-04. NOVEMBER 2022  
GÖDÖLLŐ, HUNGARY

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# Golden Jackals in Israel

- The Golden Jackal (*Canis aureus*) distribution in Israel is widespread, including the desert area.
- Typically, jackals are most abundant close to agricultural villages.
- However, in recent years populations have been established within urban areas.



# Golden Jackals in Israel

- Jackal presence generates human - wildlife conflicts in several respects:
  1. As diseases vectors (mostly rabies).

A jackal infected with rabies



# Golden Jackals in Israel

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  1. As diseases vectors (mostly rabies).
  2. Inflicting damage to agricultural infrastructure (e.g., watering systems).



A jackal infected with rabies



# Golden Jackals in Israel

- Jackal presence generates human - wildlife conflicts in several respects:
  1. As diseases vectors (mostly rabies).
  2. Inflicting damage to agricultural infrastructure (e.g., watering systems).
  3. Depredation of domestic pastured livestock and endangered wildlife such as mountain gazelle (*Gazella gazella*).

Bitten calf in pasture



Preyed Mountain gazelle



A jackal infected with rabies



# Managing wild populations

Managing overabundant wild populations is expected to be the most effective when applying both:

1. Direct control by culling - very common.
2. Indirect control by reducing the availability of limiting factors (e.g., key resources) - but application is complicated.



# Overabundance of canids

Is enabled by two mechanisms:

1. The increase of available resources (Yom-Tov et al. 1995, Dolev 2006, Dolev et al. 2010, Borkowski et al. 2011, Reichmann 2013, Kapota 2014, Talmon 2015).
2. High predictability of resources (Berger-Tal 2013):
  - Enabling animals to allocate less time & energy towards exploration.
  - So, more resources for breeding and rearing of young.
  - Resulting in higher recruitment rates.

# Controlling overabundant canids

1. Commonly done via **culling** (Fryxell J. et al. 2001; McDonald JR J.E. et al. 2007; Reichmann A. 2010).
  - This management protocol is only partially effective.
  - **Why?**  
It reduces population size & competition for food and space.
  - **Thus enhancing:**  
(1) recruitment, (2) survival and (3) immigration rates, which compensate for the reduced population size (Boyce M.S. et al. 1999; Choquenot D. 1991; Frederiksen M. et al. 2001; Kokko H. 2001).

# Controlling overabundant canids

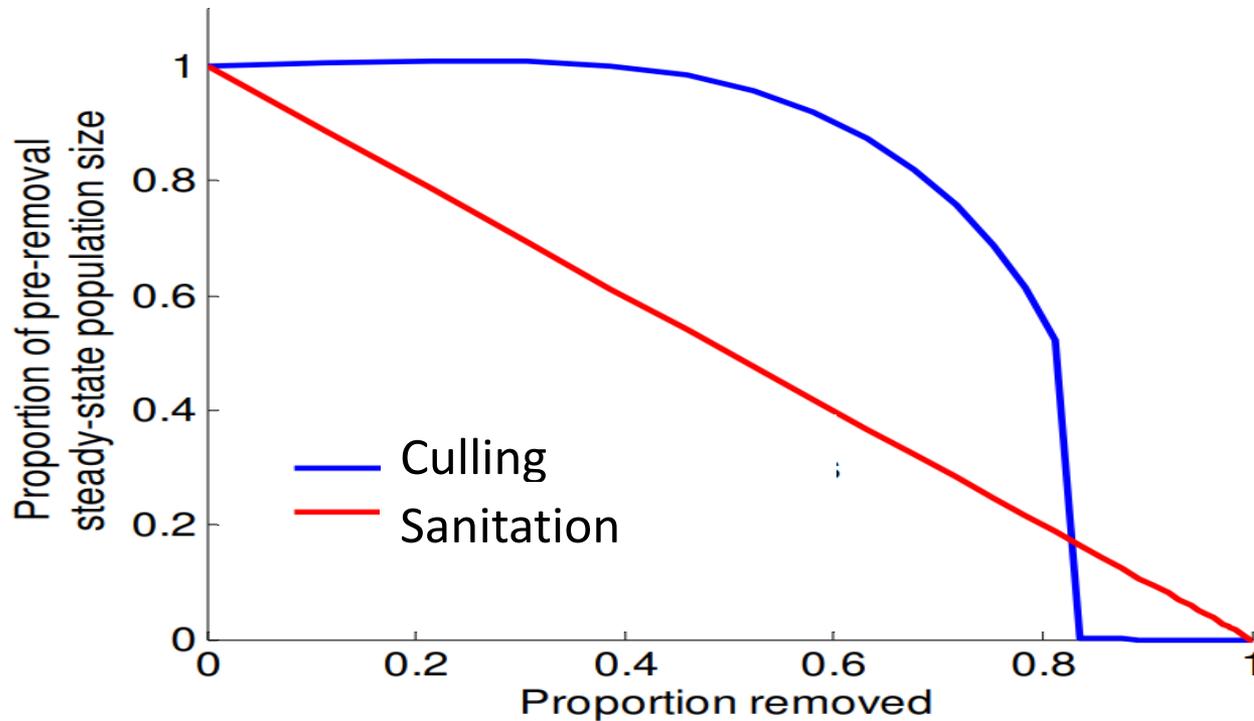
2. Sanitation - The alternative approach is resource reduction (mainly food).

Reducing food levels would:

- Increase **competition**.
- Decelerate **survival & recruitment rates**, and accelerate **emigration rate** (Kapota et al. 2016).
- Bringing the population down to a new steady-state, set by the **new level of food**.
- The reduction in population size is expected to be proportional to the **reduction in food levels** (Bino G. et al. 2010, Kapota 2014, Talmon 2015, Kapota et al. 2016, Kapota & Saltz 2018).

# Controlling overabundant canids

Management model for controlling jackal population (Kapota 2014)



Reduction in steady-state population size.

- Culling - slow decrease in population size up to a threshold (about 70%). Over threshold → population crash.
- Sanitation (remove food) - linear decrease of population size.

# Controlling overabundant canids

- Our work suggests that long term, and widespread sanitation in rural lands has the potential of being an effective way to control canid populations.

Journal of Applied Ecology



Journal of Applied Ecology 2010, 47, 1262–1271

doi: 10.1111/j.1365-2664.2010.01882.x

**Abrupt spatial and numerical responses of overabundant foxes to a reduction in anthropogenic resources**

Gilad Bino<sup>1\*</sup>, Amit Dolev<sup>2</sup>, Dotan Yosha<sup>3</sup>, Amichay Guter<sup>3</sup>, Roni King<sup>4</sup>, David Saltz<sup>5</sup> and Salit Kark<sup>1</sup>

SCIENTIFIC REPORTS

OPEN

**Determinants of emigration and their impact on survival during dispersal in fox and jackal populations**

Received: 01 October 2015

Accepted: 16 March 2016

Published: 06 April 2016

Dror Kapota<sup>1</sup>, Amit Dolev<sup>2</sup>, Gilad Bino<sup>3</sup>, Dotan Yosha<sup>4</sup>, Amichay Guter<sup>4</sup>, Roni King<sup>2</sup> & David Saltz<sup>1</sup>

Animals disperse in response to poor resource conditions as a strategy of escaping harsh competition

The Journal of Wildlife Management; DOI: 10.1002/jwmg.21509

Research Article

**Unequal Density Dependence Between Survival and Recruitment Affects Harvesting Effectiveness**

DROR KAPOTA,<sup>1</sup> Mitrani Department of Desert Ecology, Jacob Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Midreshet Ben-Gurion, 84990, Israel



2015

Movement ecology of an overabundant Golden jackal (*Canis aureus*) population in an environment rich with anthropogenic food resources

Thesis submitted in partial fulfillment of the requirements for the degree of "Master of Science"

By: Idan Talmon

Demographic and Movement Responses of Red Foxes and Golden Jackals to Spatial and Temporal Changes in Food Availability

Thesis submitted in partial fulfillment of the requirements for the degree of "DOCTOR OF PHILOSOPHY"

by

Dror

Kapota

2014

Submitted to the Senate of Ben-Gurion University of the Negev

## Fencing:

Cowsheds, henhouses,  
fishponds, compost farms

Decrease  
access to food

## Sanitation:

Remove carcasses, shut  
down garbage dumps

Decrease  
available food

Reduction of  
food availability

## ORV

Statistical tool:  
can immunize  
up to ~ 60% of  
the population

Decreased  
carrying capacity

## Culling

Local and  
temporary  
effect

Reduction  
jackal/vector  
density

Reduce rabies  
expansion

Reduce wildlife &  
domestic predation

# Cattle carcass effect in 12 hours...



# From theory to practice

- Theory and principles from short term research - give us the main frame.
- Application of insights in a wide scale for long term:
  - Adjustments and variety of solutions.
  - Execution costs.
  - Maintenance for long term.

The following information represent variety of jackal management methods, and their results.



# Efficacy of Jackal control

## Different management protocols

### Type of control implemented

1. No action
2. Poisoning
3. Culling only
4. Sanitation only
5. Fencing
6. Sanitation + culling



# Management protocol consequences:

## 1. No action

### Failure of Roe deer (*capreolus capreolus*) reintroduction

- 1997-2016, 36 Roe deer released to the wild (hard released).
- With little jackal culling, most were preyed by jackals within few weeks.
- Only few (~4) survived for few years.



# Management protocol consequences:

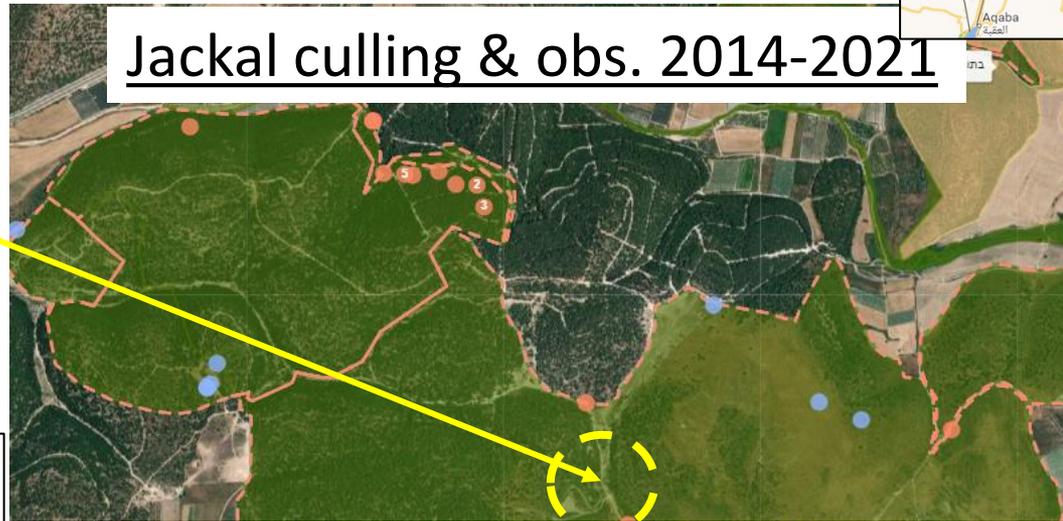
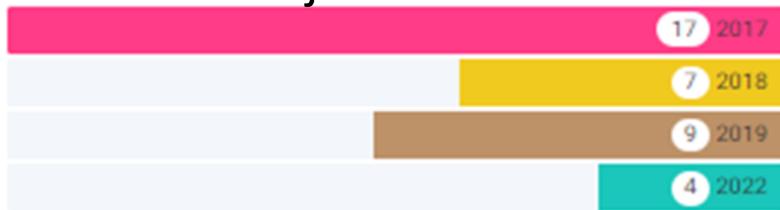
## 1. No action

### Failure of Roe deer (*capreolus capreolus*) reintroduction

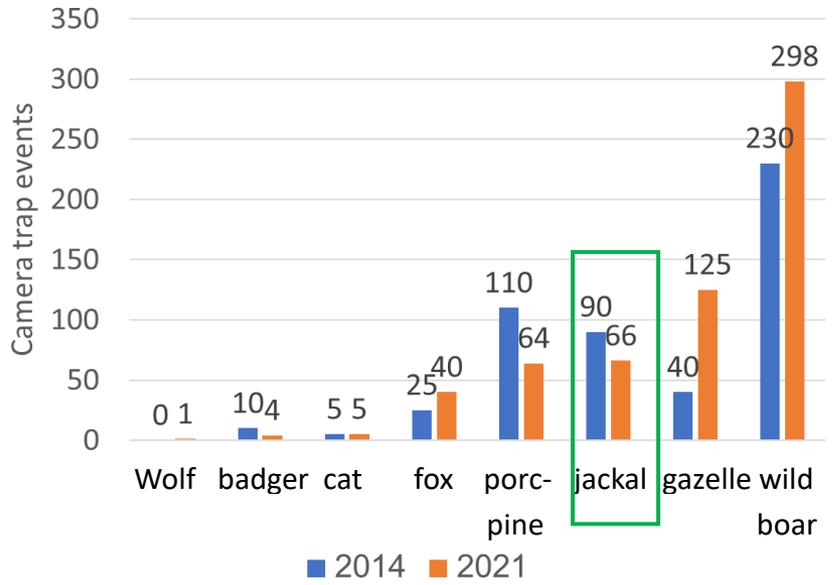


#### Reintroduction site

# of jackals culled



Jackal culling & obs. 2014-2021



Summary: jackal predation on roe deer → reintroduction failure

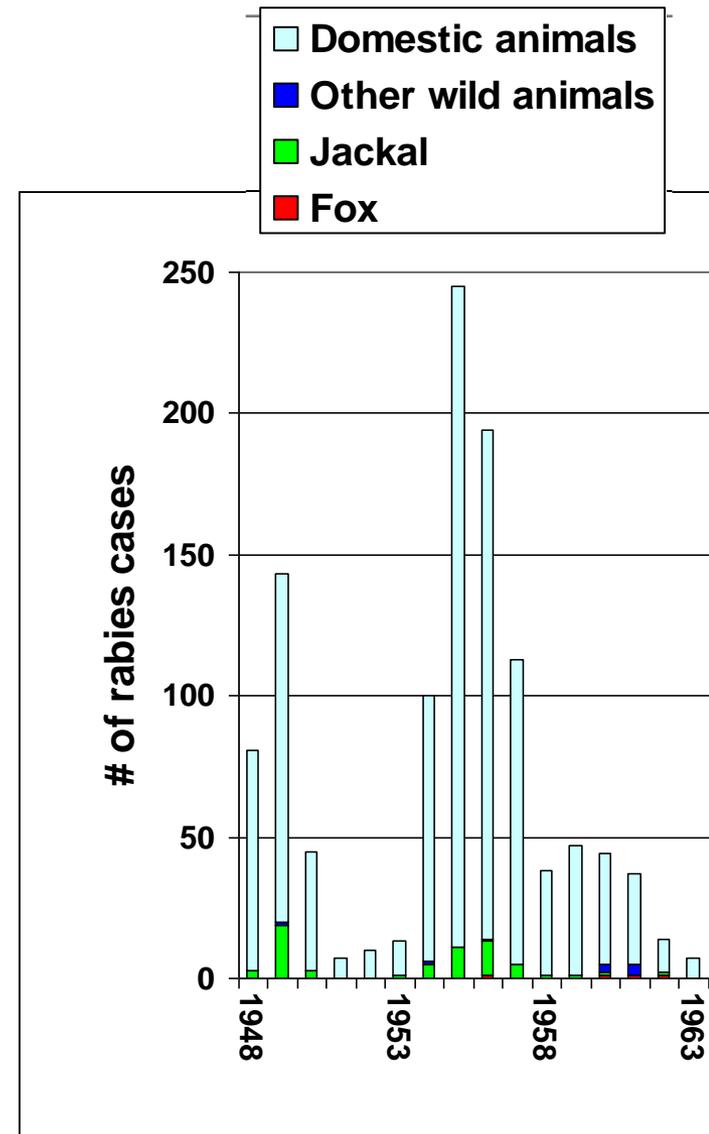


2014-2021  
 ● direct obs.  
 ● Culling

# Management protocol consequences:

## 2. Poisoning

- Up to 1960 - jackals were very common. But, little data except reported rabies cases.
- Most cases documented in dogs. For jackals - only anecdotal.

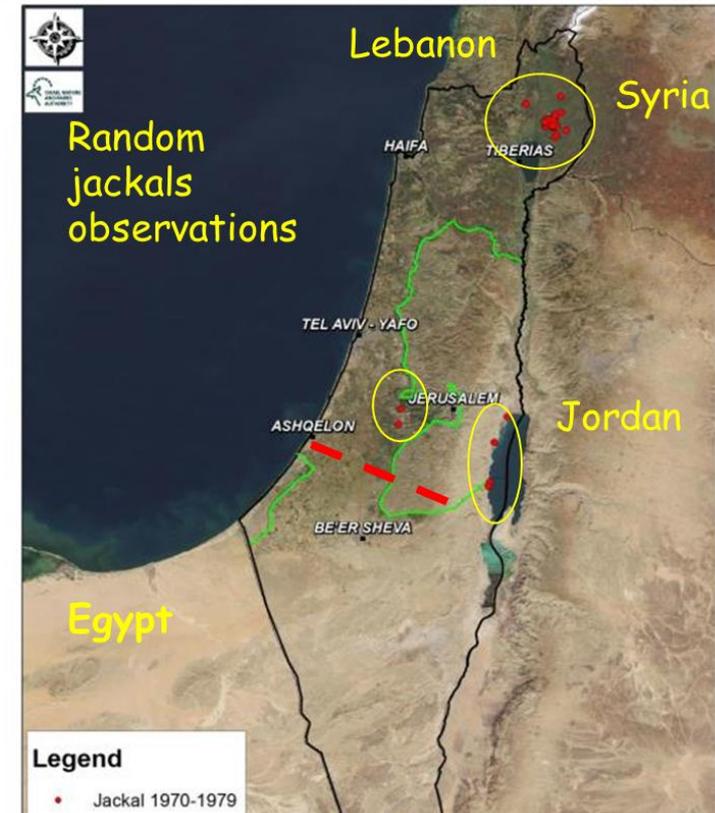


# Management protocol consequences:

## 2. Poisoning

- 1964 - Nationwide eradication by poisoning to control rabies.
- (1) Caused decline of non-target species (other predators & raptors);  
(2) Rodent eruption;  
(3) large damage to agriculture.
- Long recovery of Jackals, north of desert line.

(Mendelssohn & Yom-Tov 1999)



# Management protocol consequences:

## 2. Poisoning

Insights from the 60's poisoning:

- Non-selective methods cause **wide ecological damage**.
- Poisoning becomes **Illegal methods** in Israel (exception: the Veterinary Institute may apply **Strychnine** if a rabies eruption is extrim).

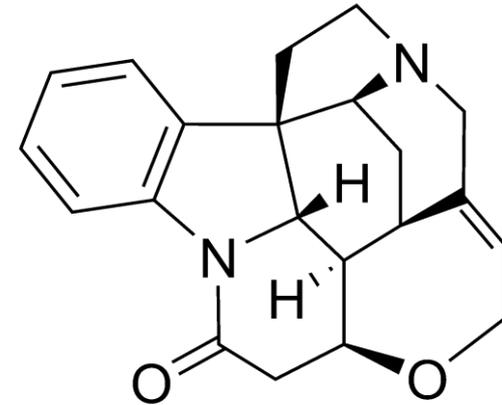
Even at the last enormous rabies eruption (2017-2018), poisoning was not applied.

Jerusalem Post > Israel News

### The number of rabid animals rose 250% last year, mostly from abroad

The data were based on actual bodies of animals examined in Agriculture Ministry labs and suspected of being infected with rabies.

By JUDY SIEGEL-ITZKOVICH Published: JANUARY 16, 2018 18:20  
Updated: JANUARY 17, 2018 16:39



# Management protocol consequences:

## 3. Culling only

- The most common method throughout the years.
- What is the short & long term effect?
- We studied the management effects during the last rabies eruption (2017-2018) at in Harod valley.



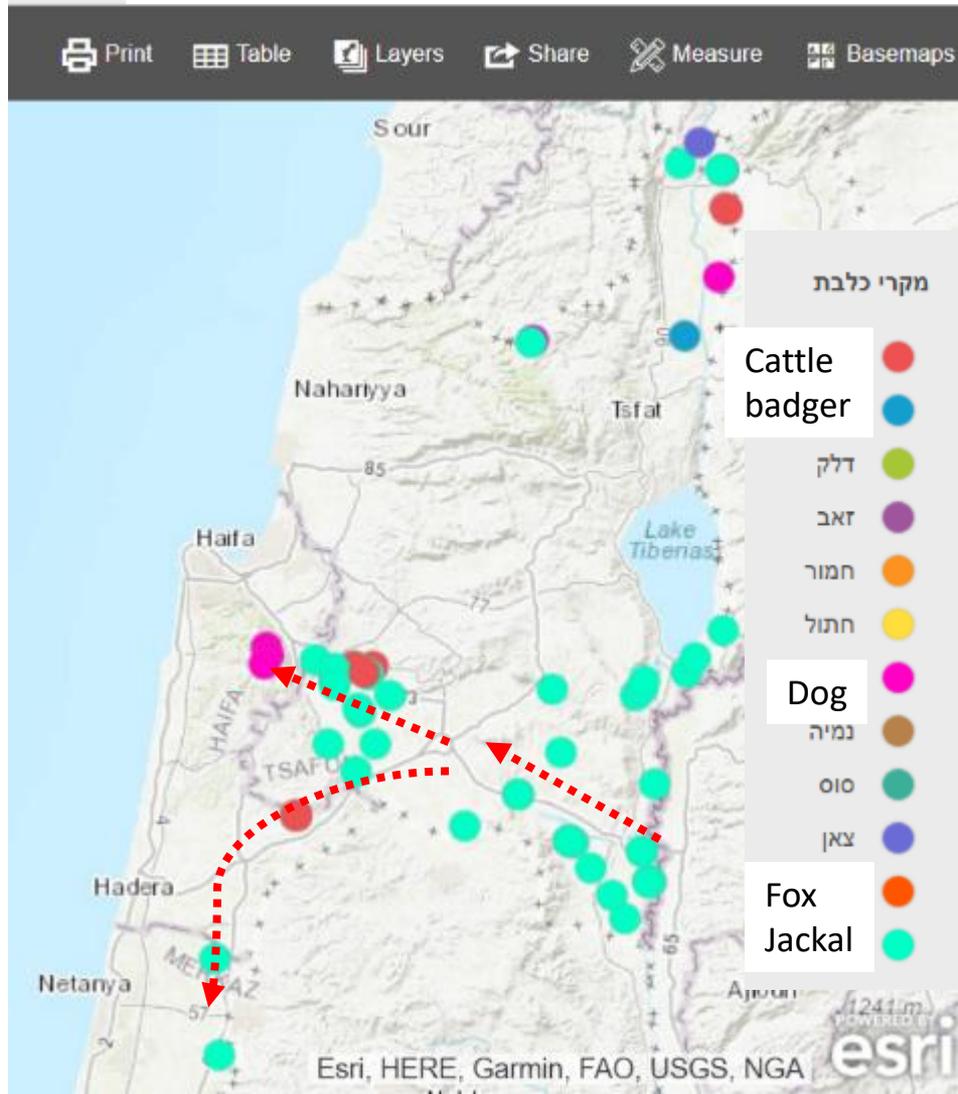
# Management protocol consequences:

## 3. Culling only

- Penetrated from Jordan.
- Moved West & South
- Jackal was the main vector.
- Spatial dynamics appear as stepping-stone (villages and fish ponds that channeled the progression)

1. What do we know about jackal population/density?
2. We were required to make drastic management against jackals → culling!

Distribution of rabies cases 2018



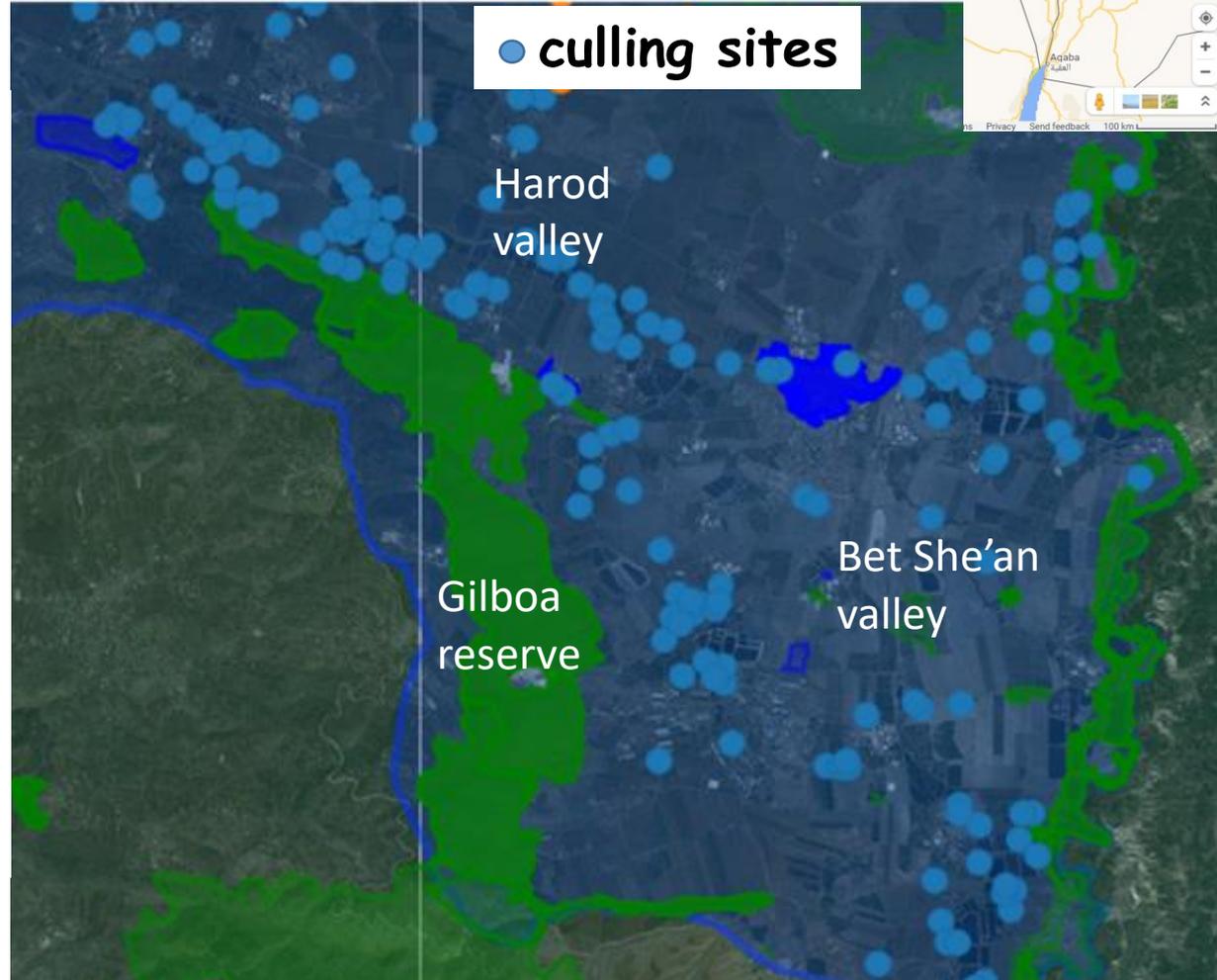
# Management protocol consequences:

## 3. Culling only



### Jackal culling

- High Jackal culling ~ 2300 (!) in a ~ 400 km<sup>2</sup> area within half a year.



# Management protocol consequences:

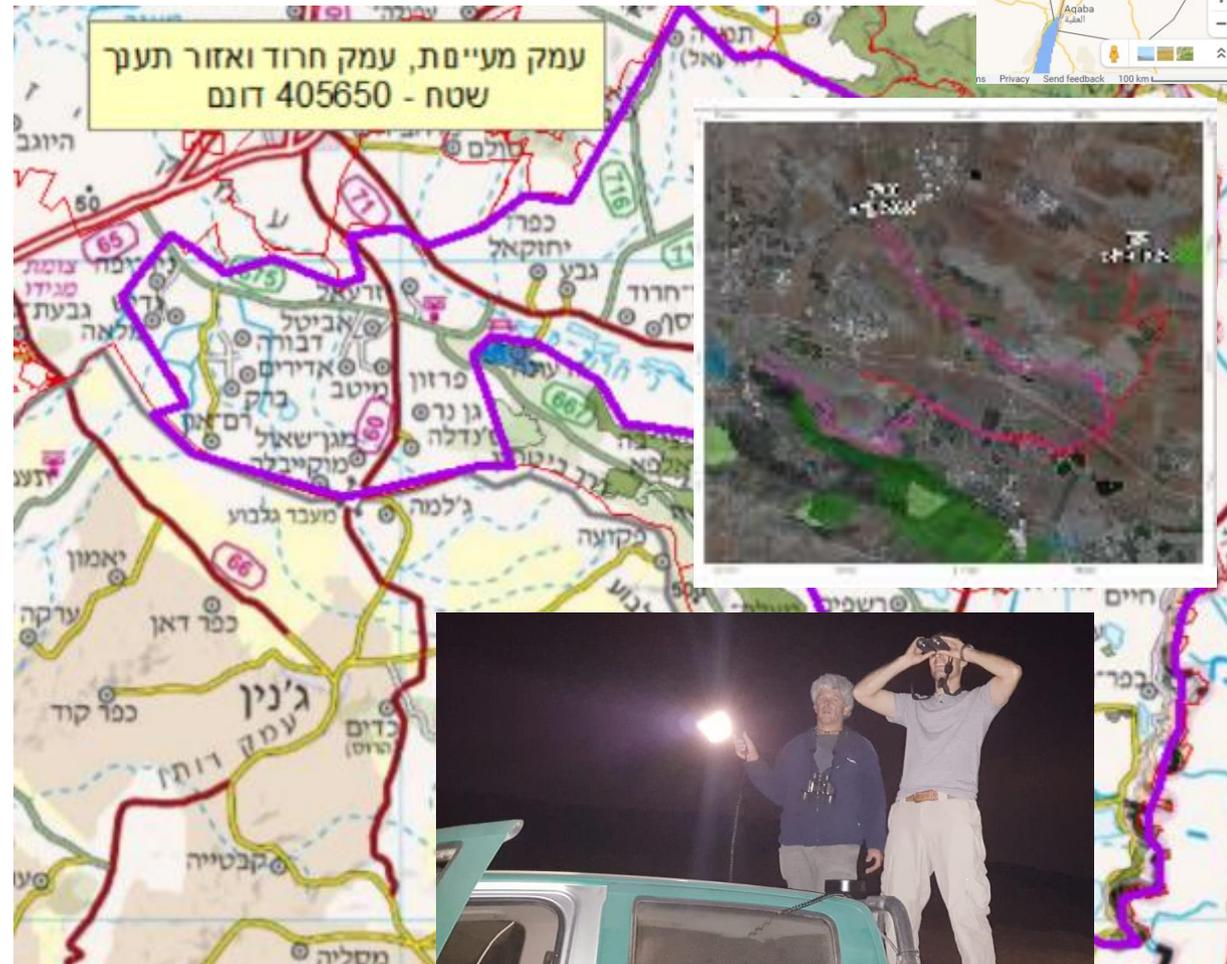
## 3. Culling only

Harod region: Jackal  
population size  
estimation

Eastern valleys:

- Similar topography.
- Agriculture villages.
- Similar agricultural crops.
- Vehicle spot light transects in representative regions.

Eastern valleys



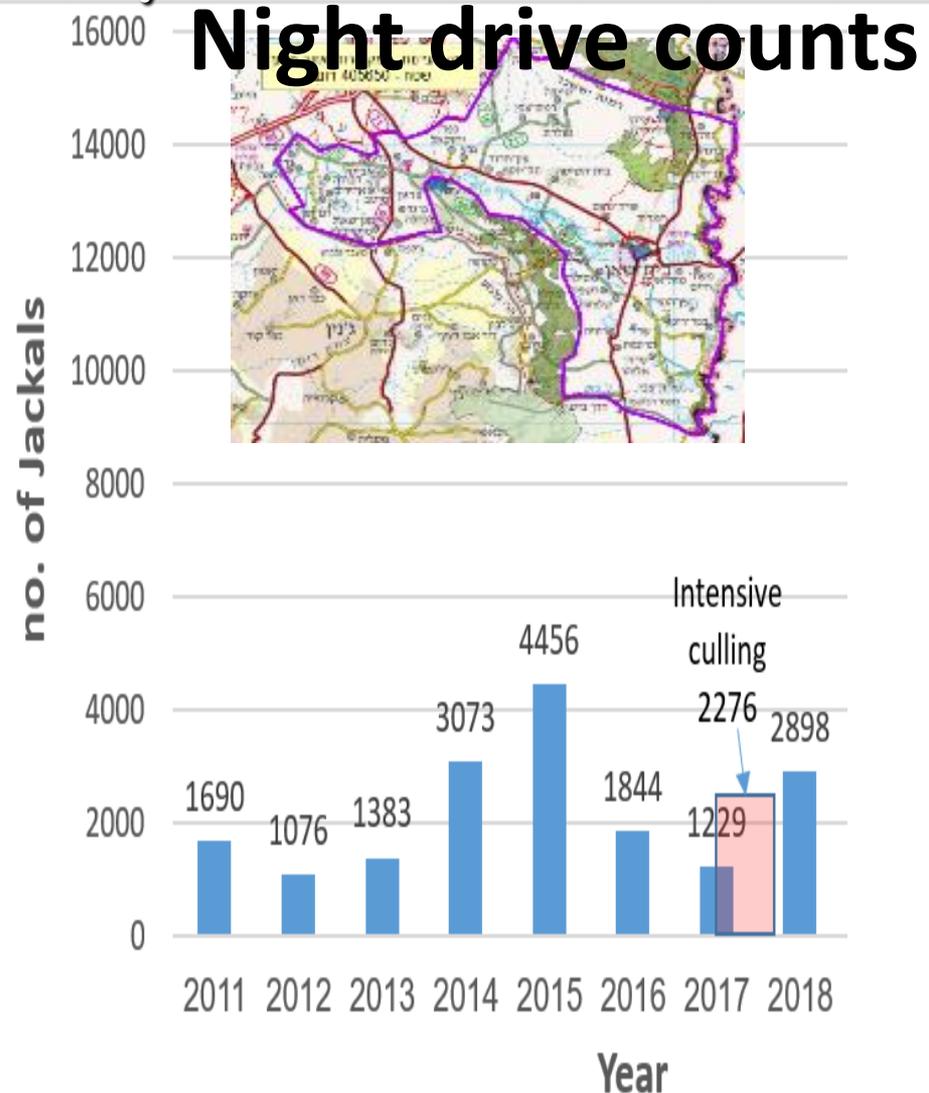
# Management protocol consequences:

## 3. Culling only

Harod region: Jackal population size estimation

Insights:

- A few thousand jackals in a limited area.
- Decrease after intensive jackals culling → **compensation**



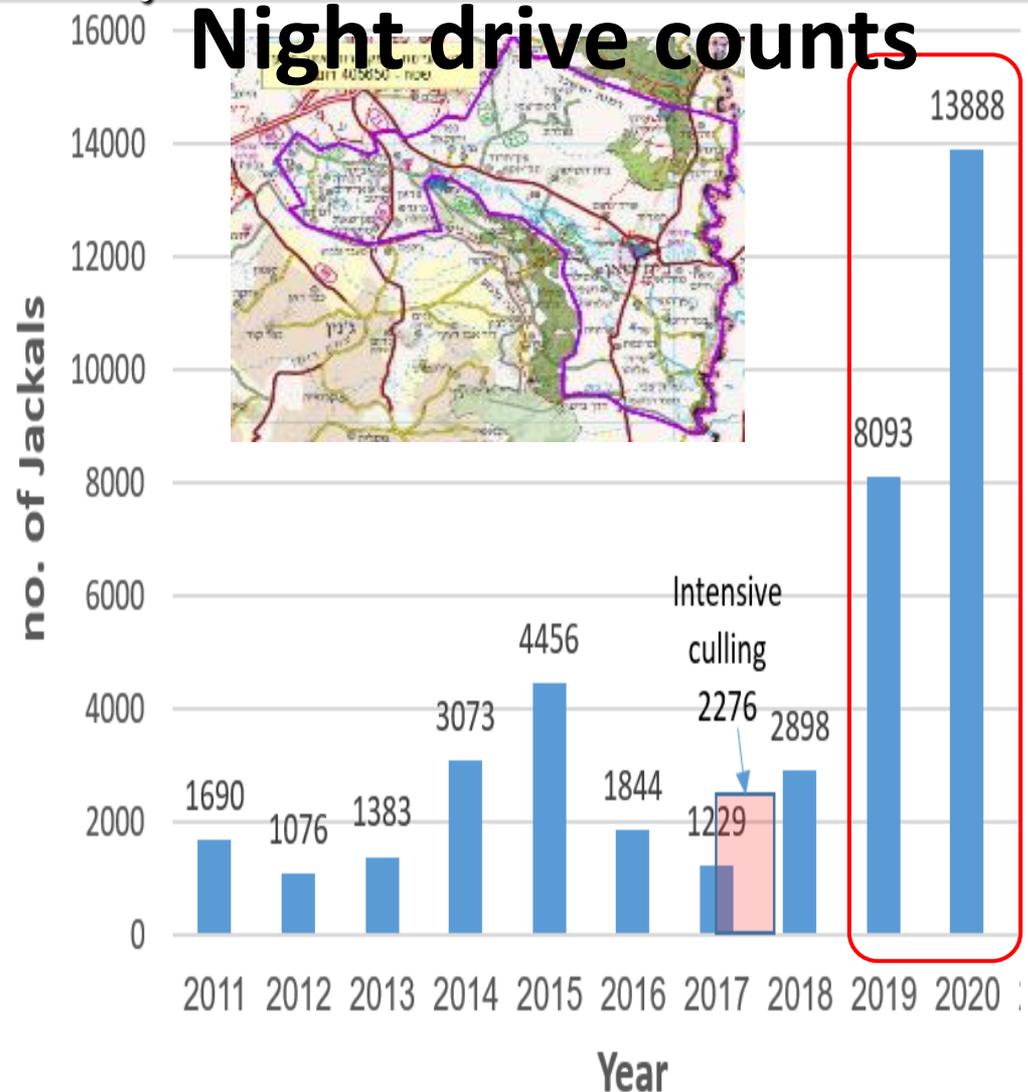
# Management protocol consequences:

## 3. Culling only

Harod region: Jackal population size estimation

Insights:

- A few thousand jackals in a limited area.
- Decrease after intensive jackals culling → compensation
- **Over compensation** - in less than 2 years ~ 4 times than former population size!



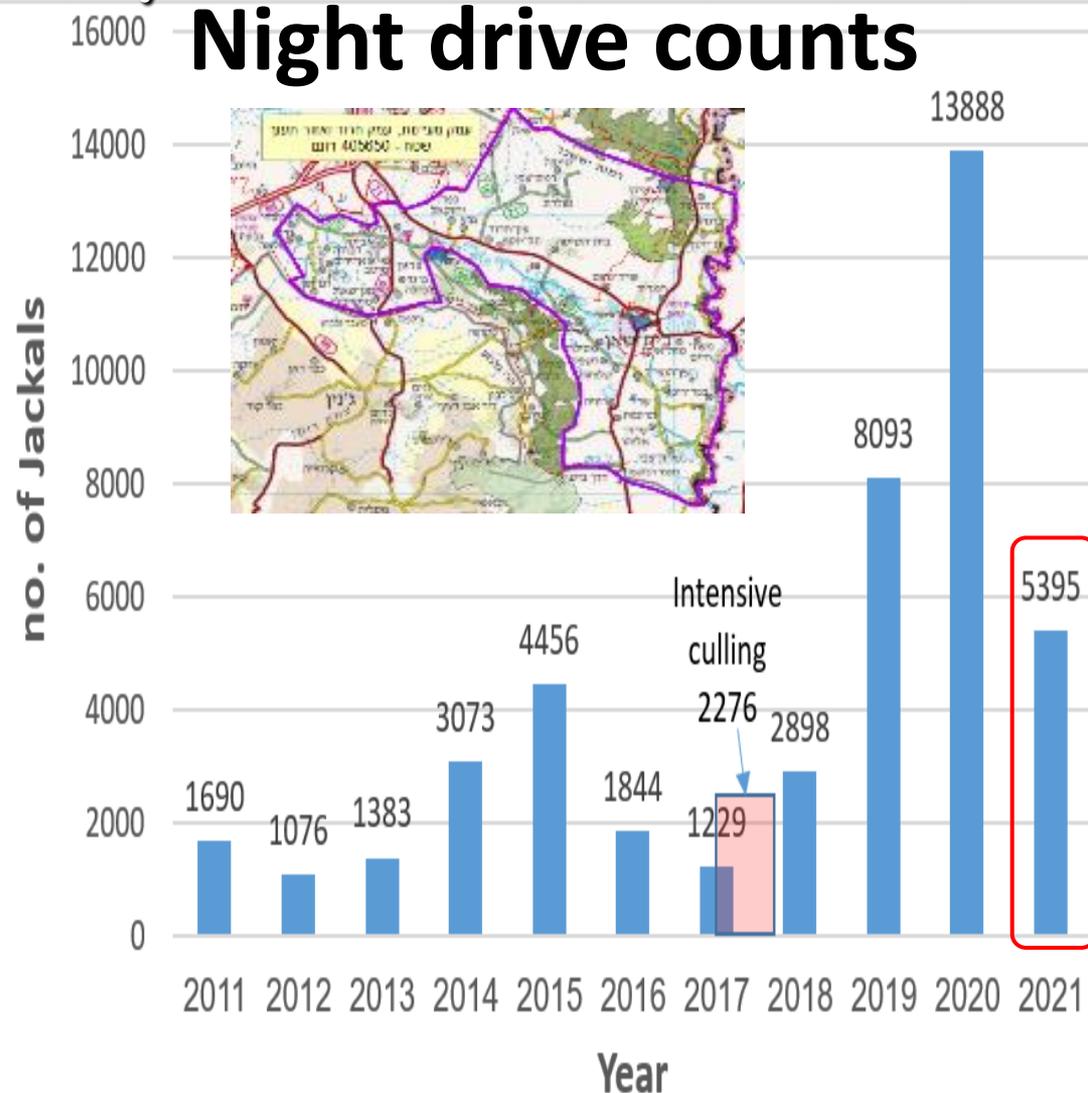
# Management protocol consequences:

## 3. Culling only

Harod region: Jackal population size estimation

Insights:

- A few thousand jackals in a limited area.
- After intensive culling > 1000 jackals.
- Over compensation - in less than 2 years ~ 4 times than former population size!
- Back to steady state?





# Management protocol consequences:

## 4. Sanitation only

Jackal management in the Carmel National park:

- 21 campgrounds that host ~ 2 million visitors/year.
- A lot of garbage → attract wildlife (jackal and wild boar at most).

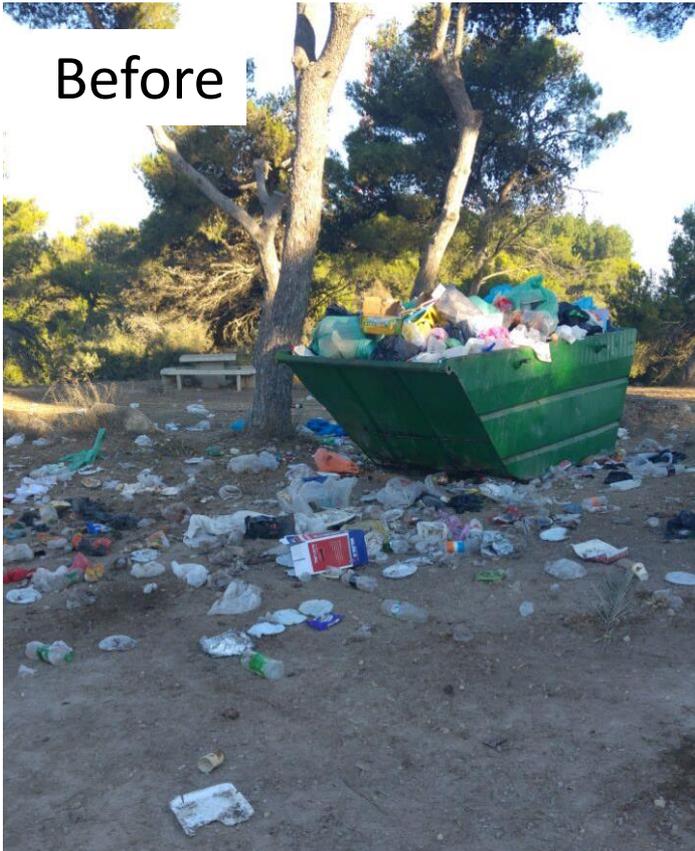


# Management protocol consequences:

## 4. Sanitation only

- In 2017 we installed animal-proof garbage bins in Carmel National Park.

Before



After



# Management protocol consequences:

## 4. Sanitation only

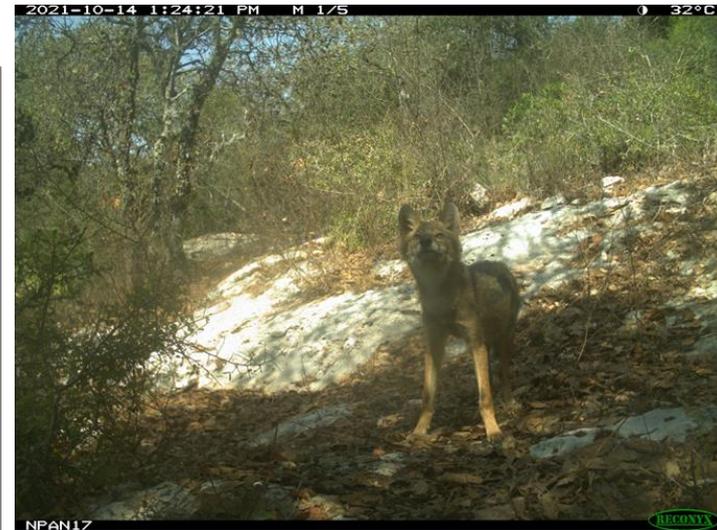
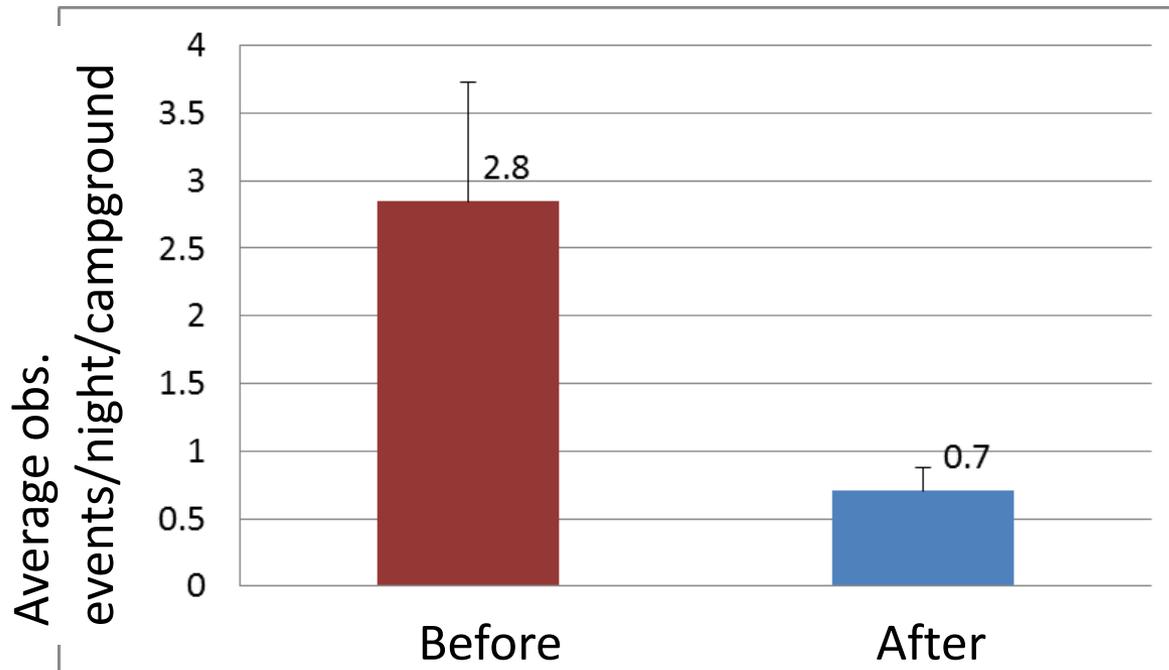
- We build inaccessible (for wildlife) garbage cans.
- Deliver the responsibility to the visitors!
- How it's effect jackal activity?



# Management protocol consequences:

## 4. Sanitation only

- We surveyed 12 campgrounds, 3 camera traps each, for 2 weeks.
- Timing: year "before" (May 2016) vs. year "after" (May 2018) the new bins were installed



- We found a -fold decrease (paired T-test,  $p=0.057$ ) in jackal activity after construction an inaccessible garbage cans.

# Management protocol consequences:

## 5. Fencing only

- Fish ponds serve as a jackal food source:
  1. Constant supply of dead fish in the pond.
  2. Fish waste dumped on the banks of the pond.

How can we manage it?

Regulation of fish waste



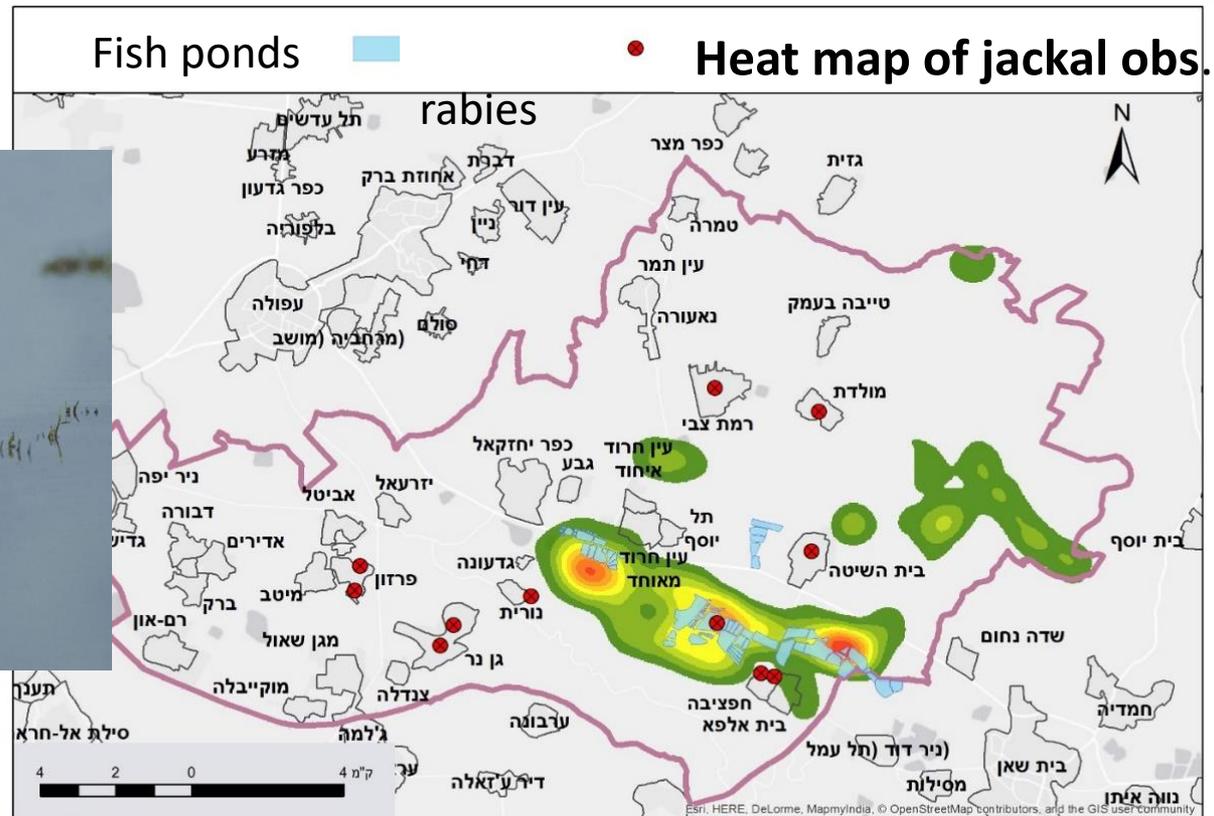
?



# Management protocol consequences: 5. Fencing only

Former data:

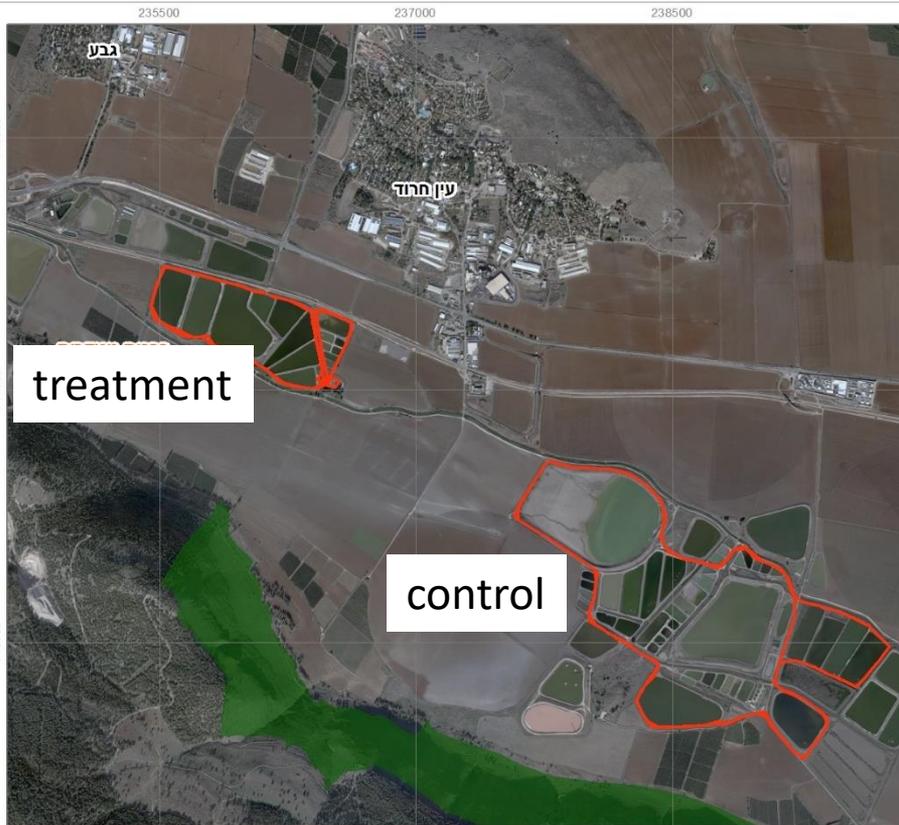
- Spatial distribution of fishpond and jackal → high jackal occupancy in vicinity of fishpond.



# Management protocol consequences:

## 5. Fencing only

- We use electric fence (6 wires & electric gate) for 3 months.
- Surveys were by spotlight transect and camera traps.



Electric fence

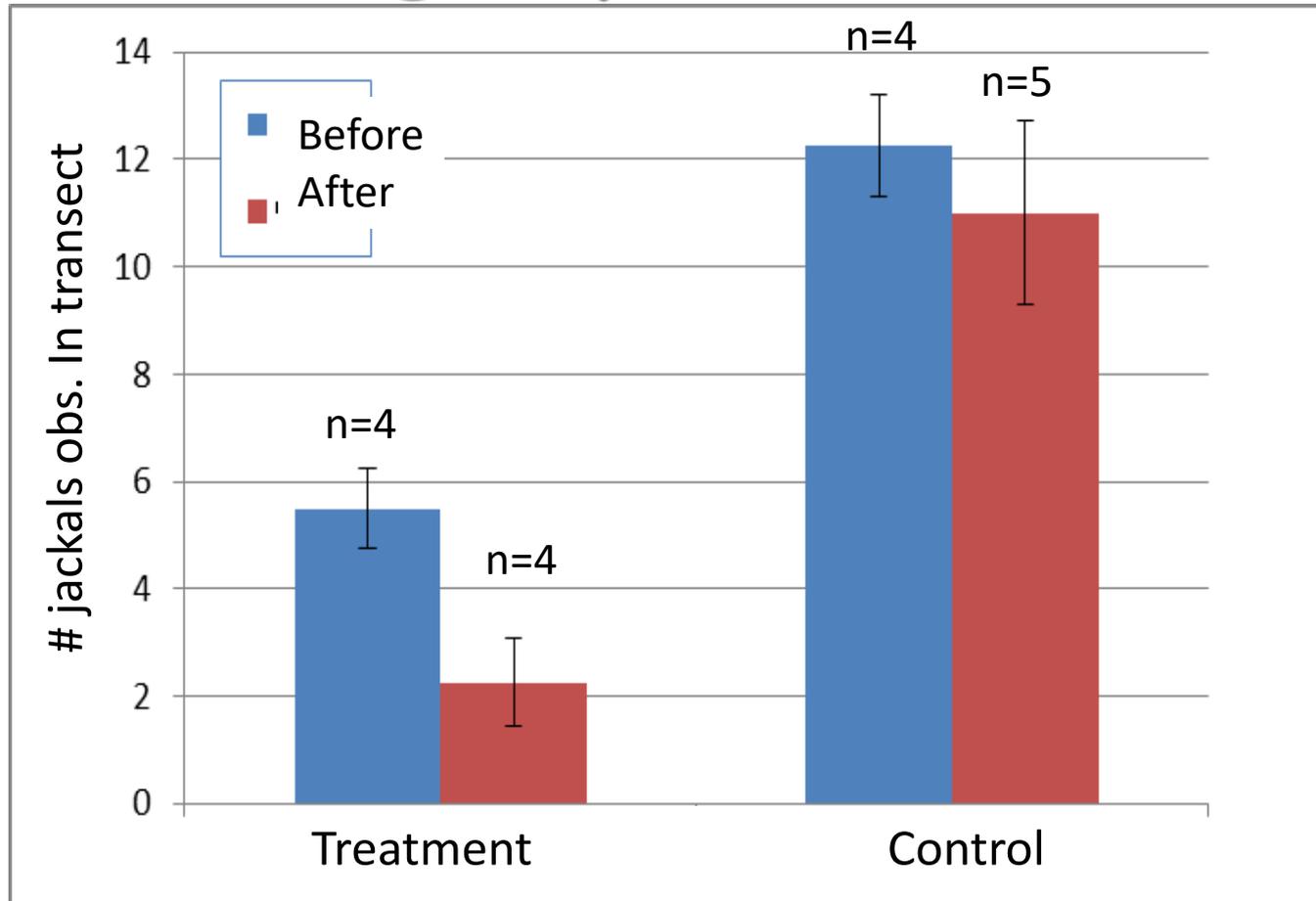


Electric gate

# Management protocol consequences:

## 5. Fencing only

Spot light  
transects

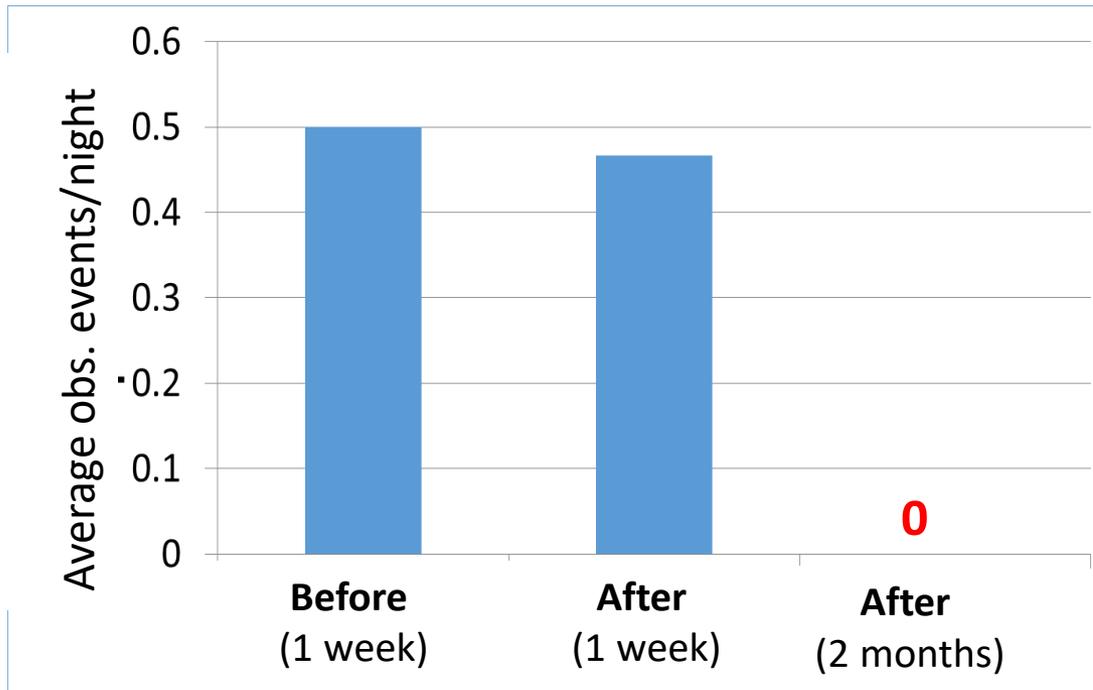


- Treatment: ~2.5 times decrease ( $p < 0.05$ ) with jackal amount.
- Control: no difference.

# Management protocol consequences:

## 5. Fencing only

### Camera trap survey



- No documented jackal by camera trap after 2 months.
- Effective, but can not be applied at large scale due to lack of funding!

# Management protocol consequences:

## 6. Sanitation & culling

Based on a study of the relationship between Mountain gazelle & jackals in the Golan Heights.

### Mountain gazelle (*Gazelle gazelle*)

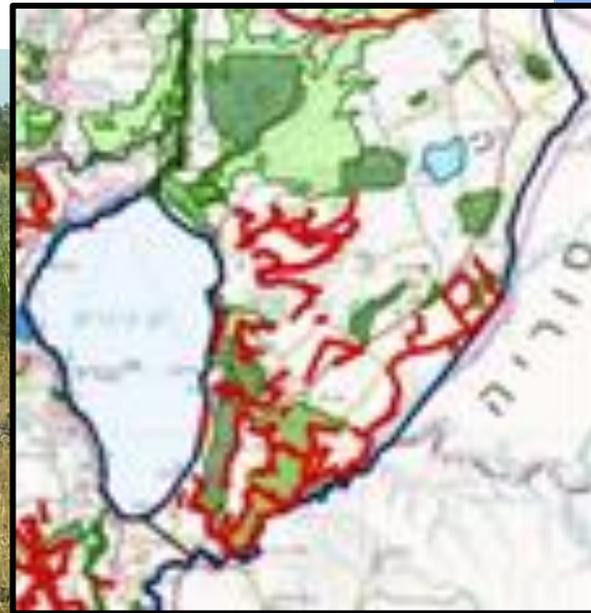
- Small-medium size antelope ~ 25 kg.
- Endangered - Found mostly in Israel ~ 5,000 ind. (IUCN 2022)
- The Golan Heights population was established from a relocation of 300 ind.



# Management protocol consequences: 6. Sanitation & culling

## Mountain gazelle surveys in Southern Golan heights

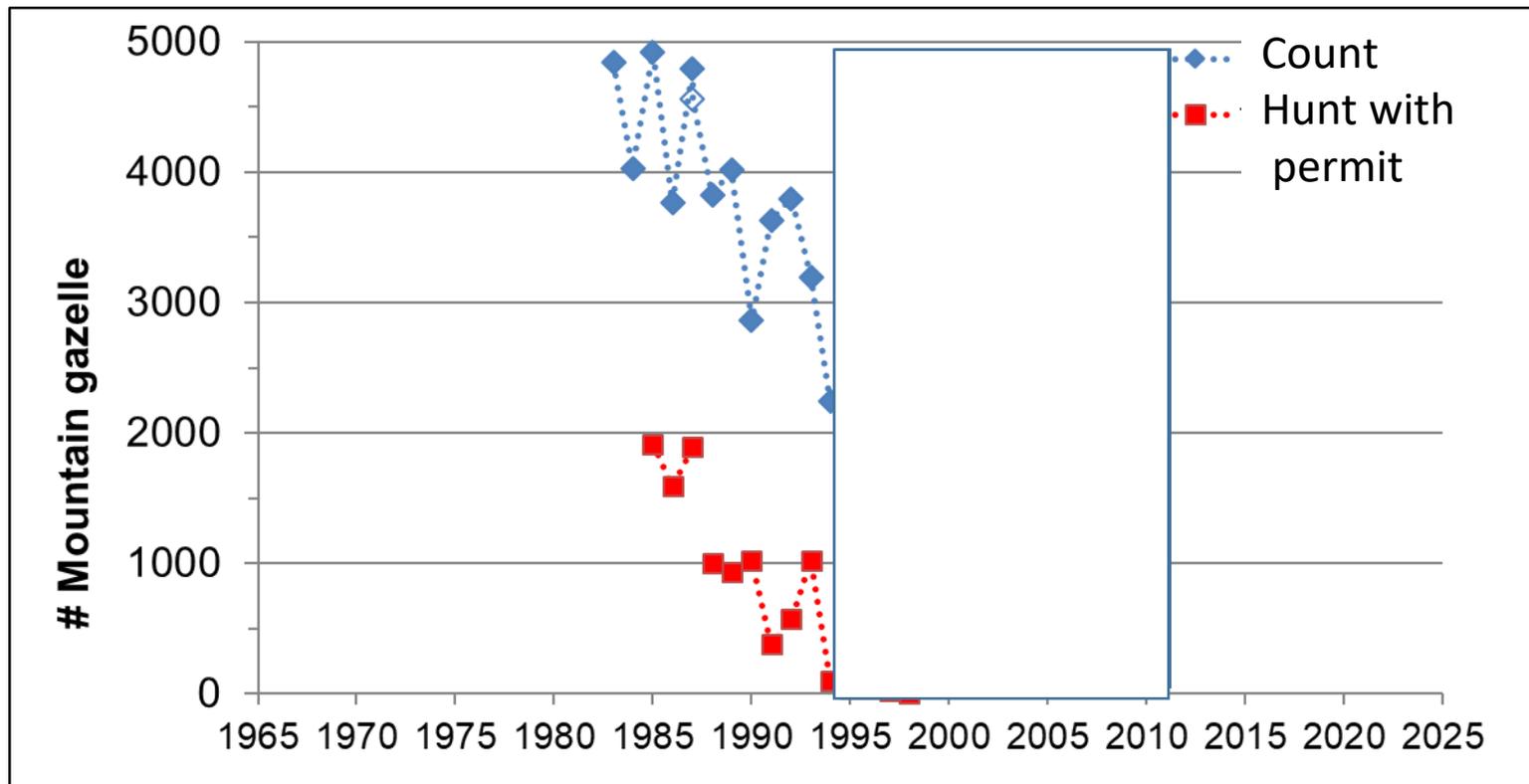
- Began in 1984
- Annual drive counts in January
- Counts indicated a pop. 4000-5000



# Management protocol consequences:

## 6. Sanitation & culling

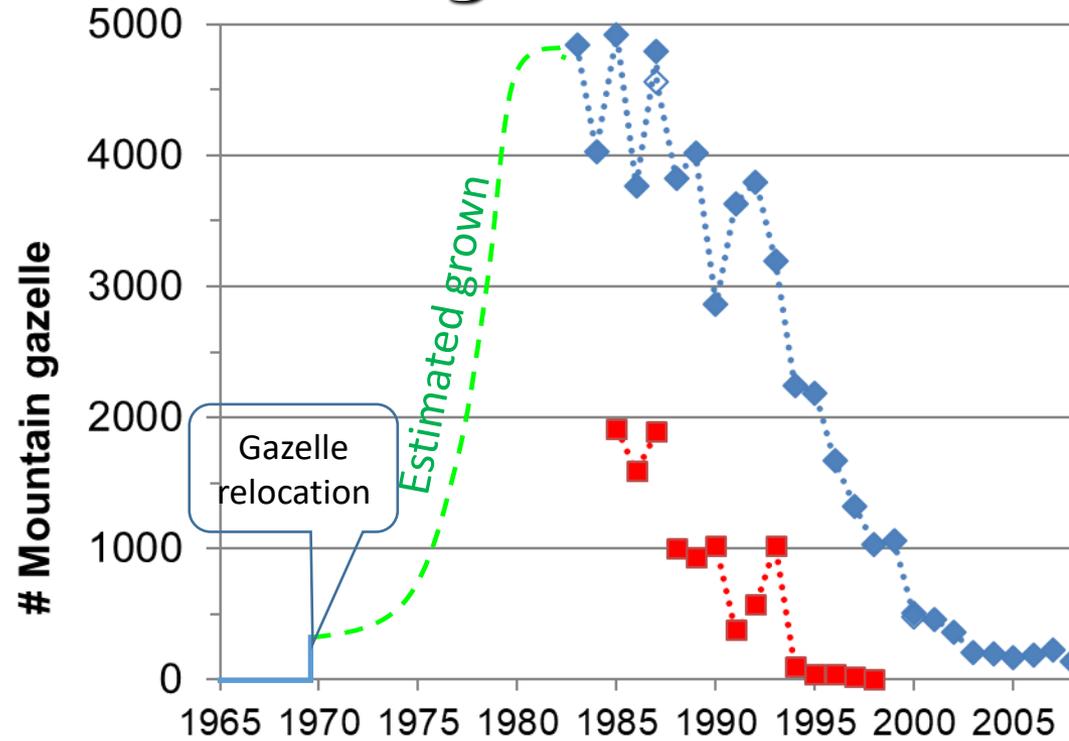
- Hunt initiated due to Concerns of Foot and Mouth outbreak
- Hunt ceased in 1994, when the gazelle population fell below 2500.
- But population continued to decline to near extinction (<150)



# Management protocol consequences: 6. Sanitation & culling

## Working hypothesis

- Jackals prey mostly on newborn gazelles

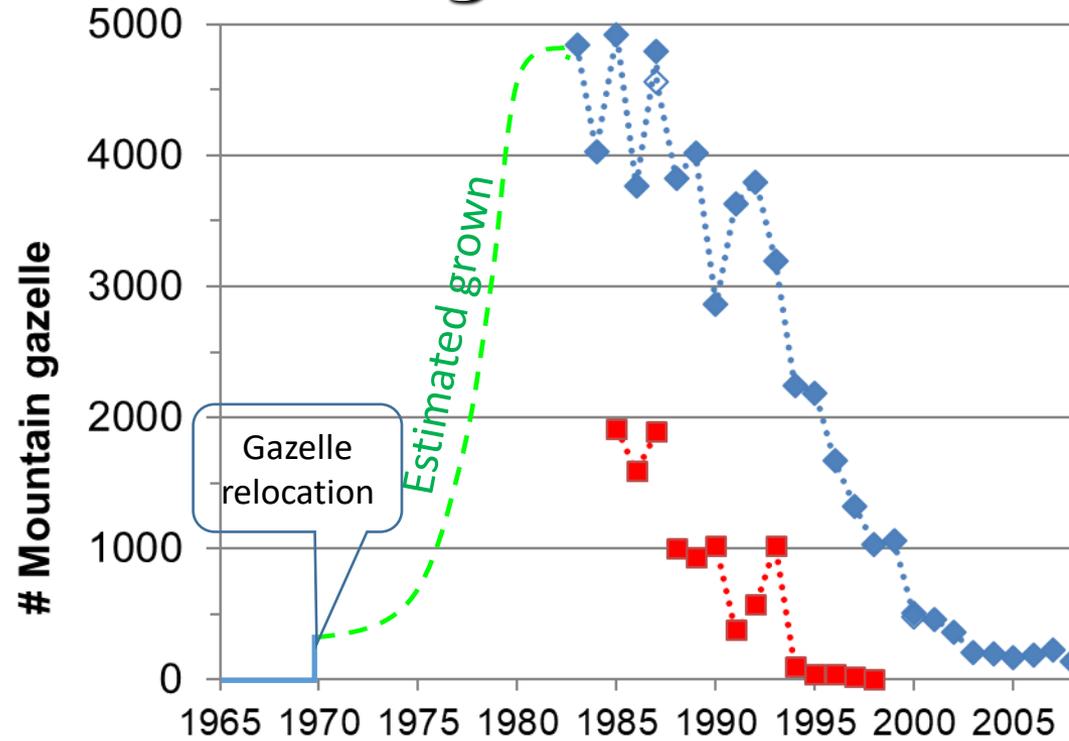


# Management protocol consequences:

## 6. Sanitation & culling

### Working hypothesis

- Jackals prey mostly on newborn gazelles
- In 1970s Golan jackal density =  $0.2/\text{km}^2$  gazelle pop. grows exponential
- In 1980s Golan jackal density =  $2.5/\text{km}^2$  (cattle availability) but gazelle recruitment sufficient due to swamping.



(Mendelssohn & Yom-Tov 1999)

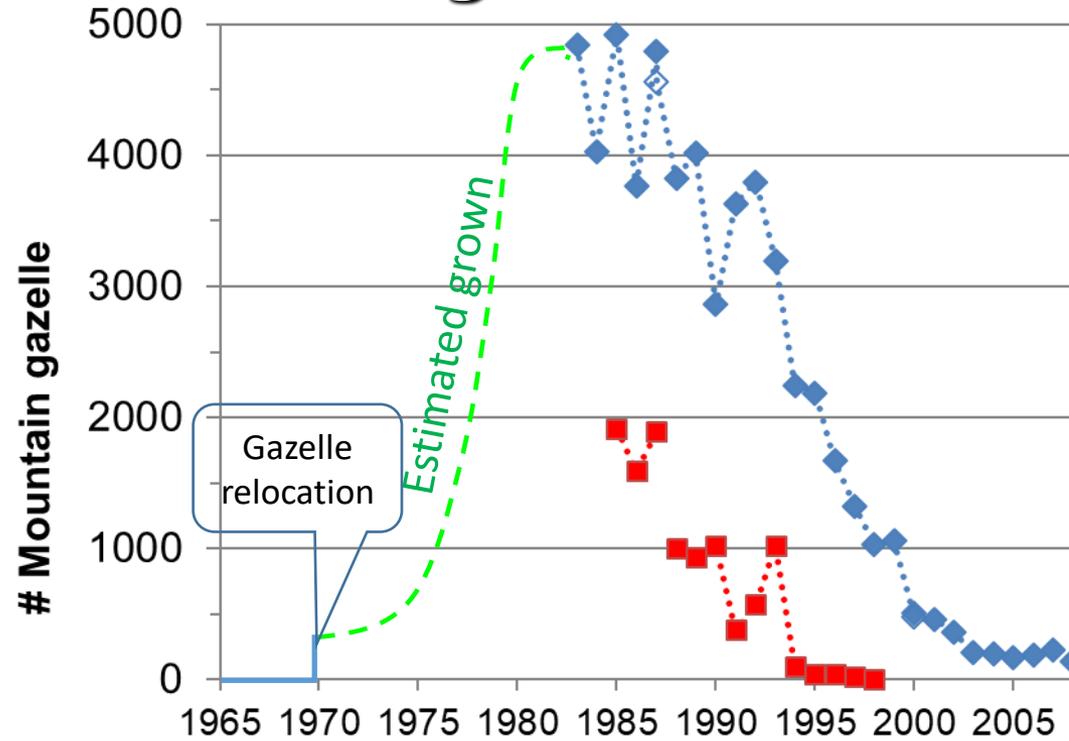
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- Hunt disrupts equilibrium: **Overabundant jackals** (due to cattle) remove most gazelle kids bringing about the crash.

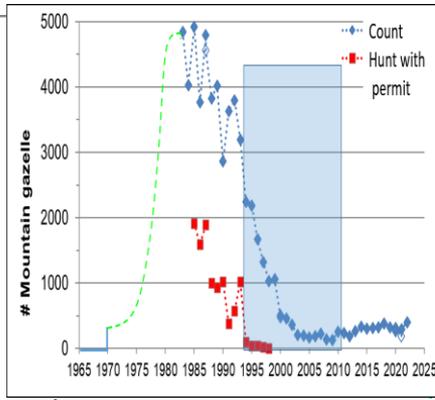
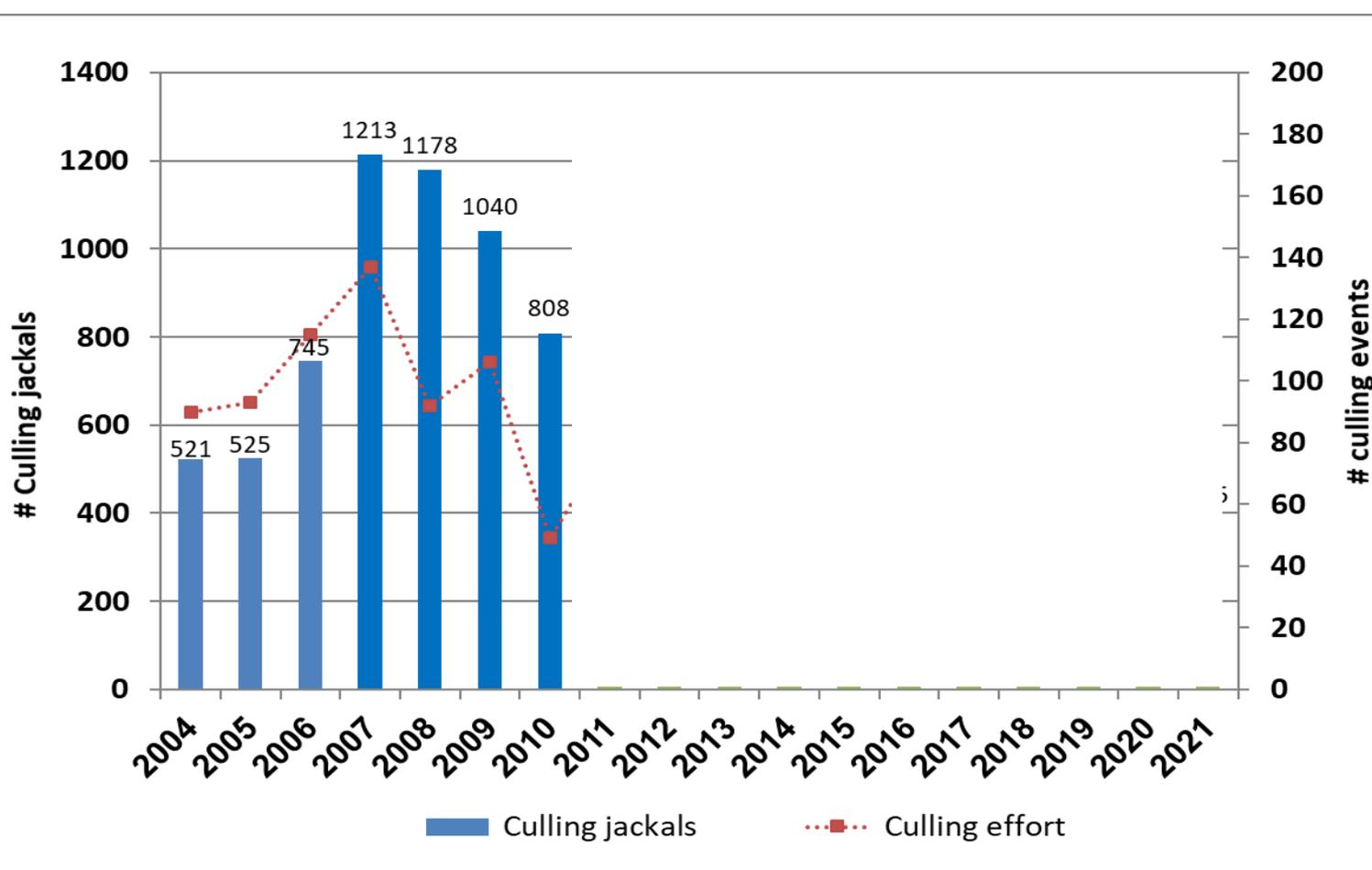


# Management protocol consequences:

## 6. Sanitation & culling

### Jackal management - culling only.

- Up to 1,200 culling jackal/year →



# culling events

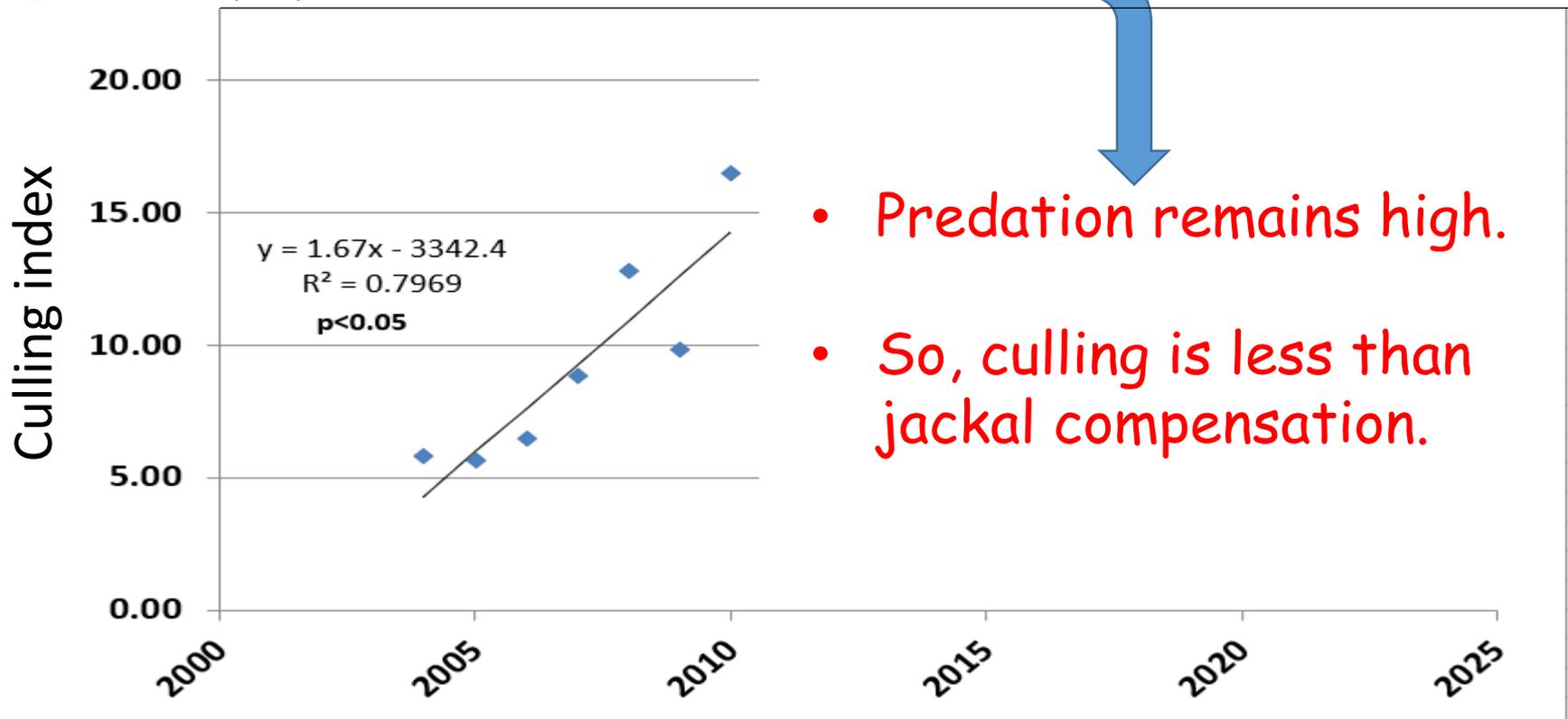
# Management protocol consequences:

## 6. Sanitation & culling

Jackal management - culling only.

- → Culling index =  $\# \text{culled} / \# \text{culling effort}$ .

Significant increase, with almost no effect on gazelle population size.



# Management protocol consequences:

## 6. Sanitation & culling

Golan heights  
~ 1000 km<sup>2</sup>



### Jackal management - adding sanitation.

- Main agricultural use- cattle in pasture:
  - 25,000 cows.
  - ~ 5% yearly death rate carcasses/year → abundant food source for jackals.
- Promotion insurance program for **removing carcasses** (by Ministry of Agriculture all over Israel) within 24 hours to recycling, or to vulture feeding station.



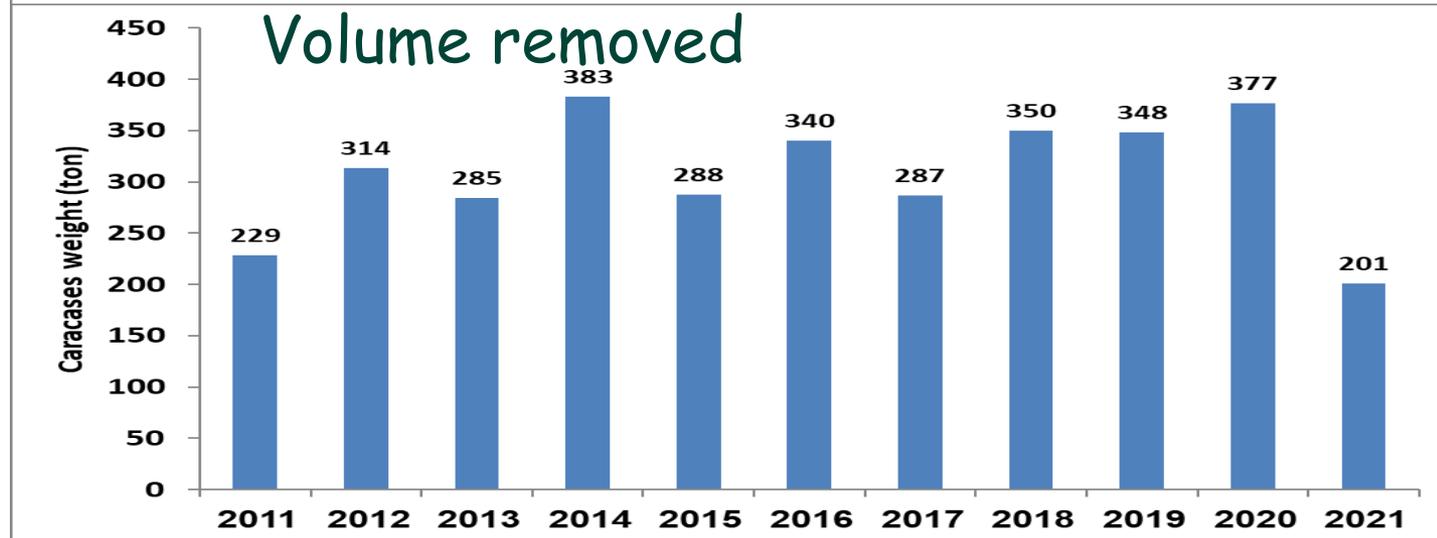
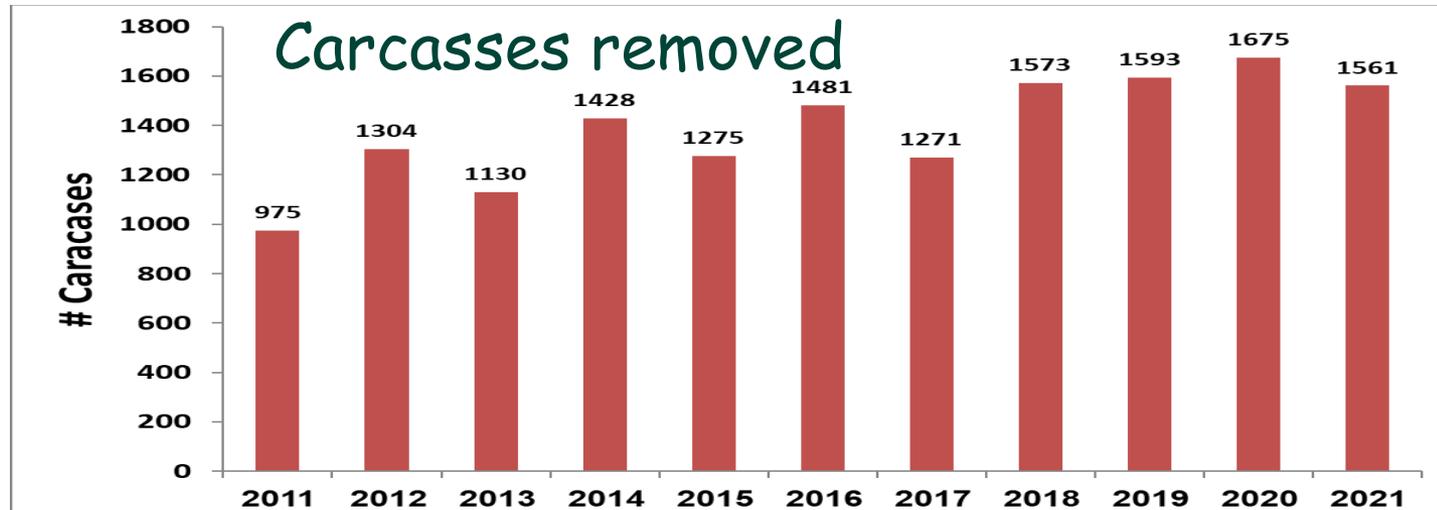
# Management protocol consequences:

## 6. Sanitation & culling

### Jackal management - adding sanitation.

- Average -  $1337 \pm 64$  carcasses /year.

- Average estimated weight -  $314 \pm 15$  tons/year.

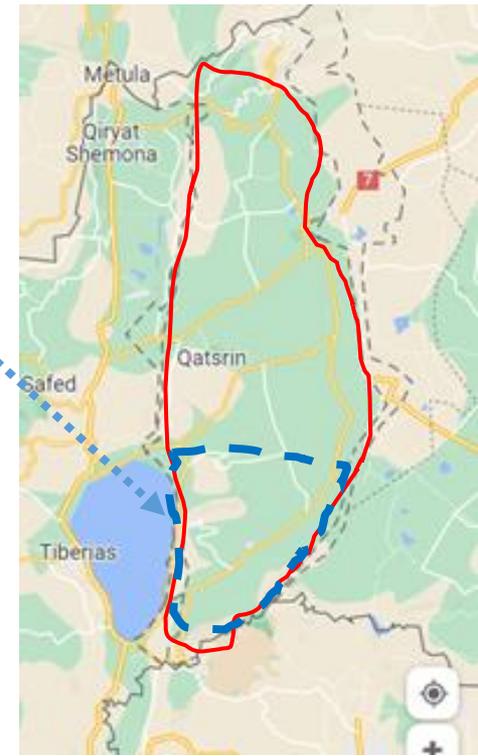
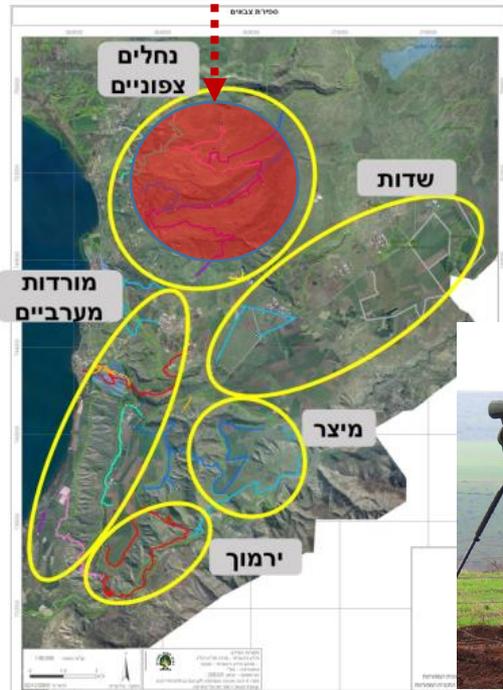


# Management protocol consequences:

## 6. Sanitation & culling

### Jackal management - adding sanitation.

- What is the effect on jackal population size/density?
- Hard to estimate directly. Done by 2 methods:
  1. Jackal culling efforts.
  2. Gazelle counts.

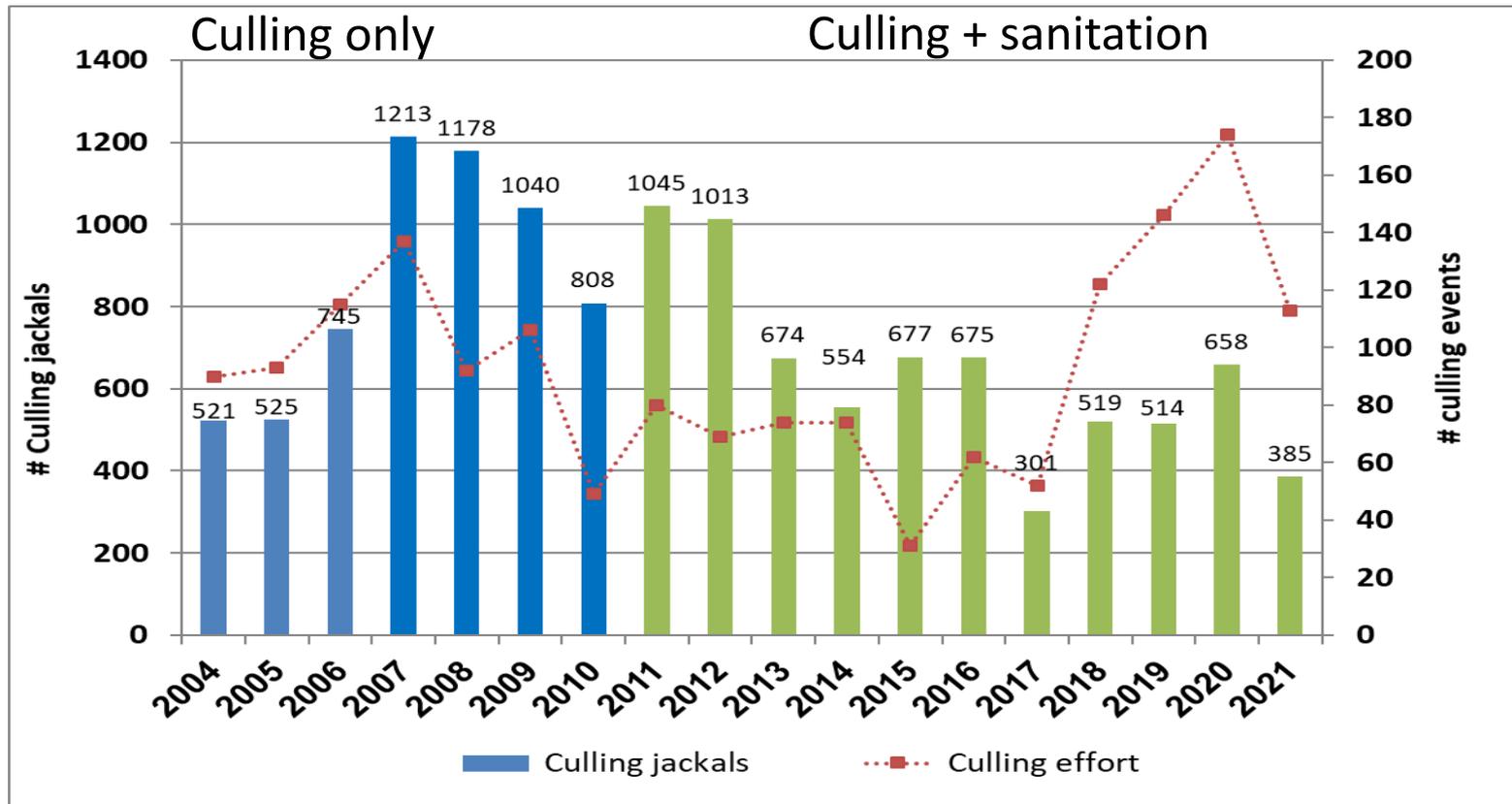


# Management protocol consequences:

## 6. Sanitation & culling

Jackal management - adding sanitation.

- Adding sanitation - decrease culling while increases the culling efforts.

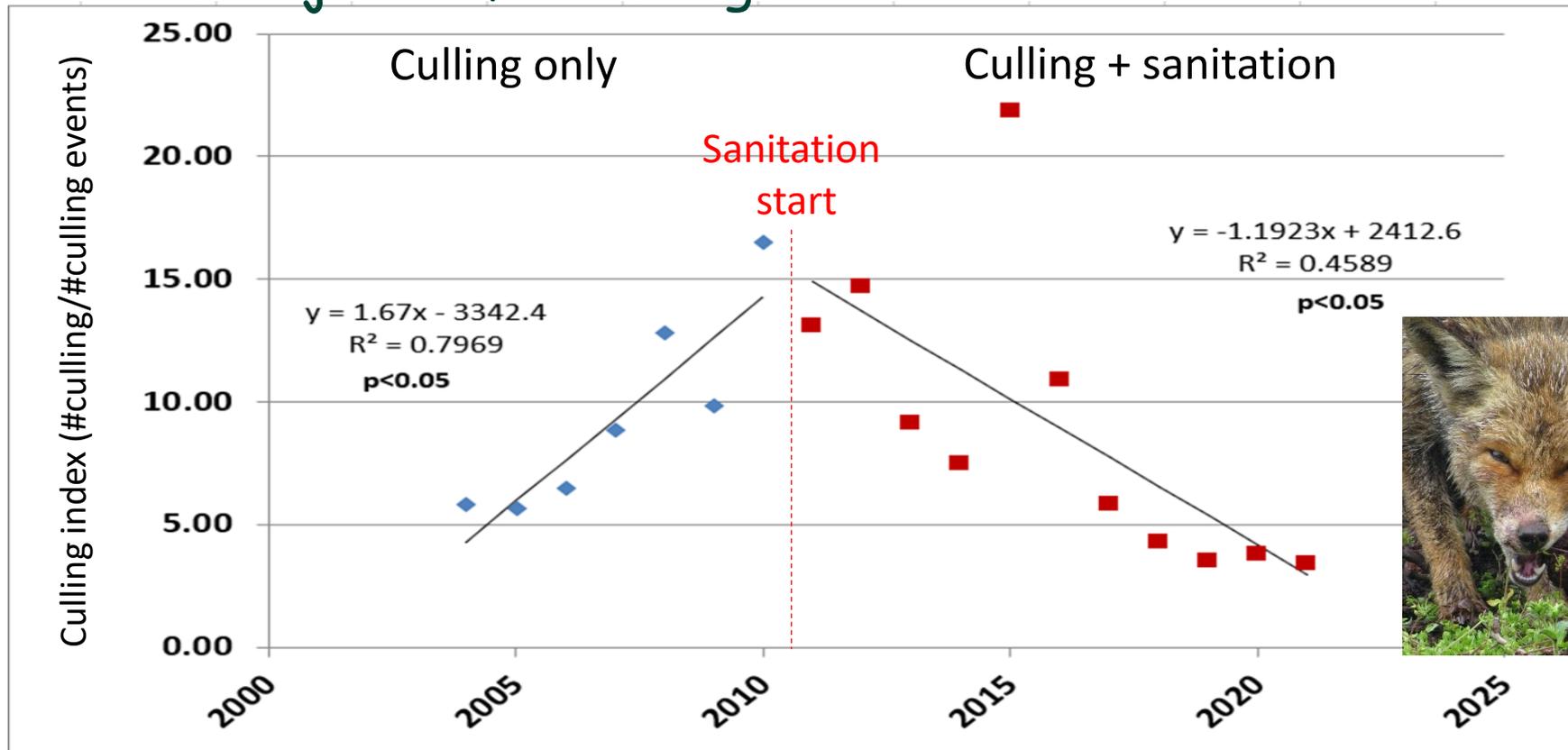


# Management protocol consequences:

## 6. Sanitation & culling

### Jackal management - adding sanitation.

- Culling only - increase effort without jackal reduction.
- Adding sanitation - decreases culling index, means less available jackal for culling.



# Management protocol consequences:

## 6. Sanitation & culling

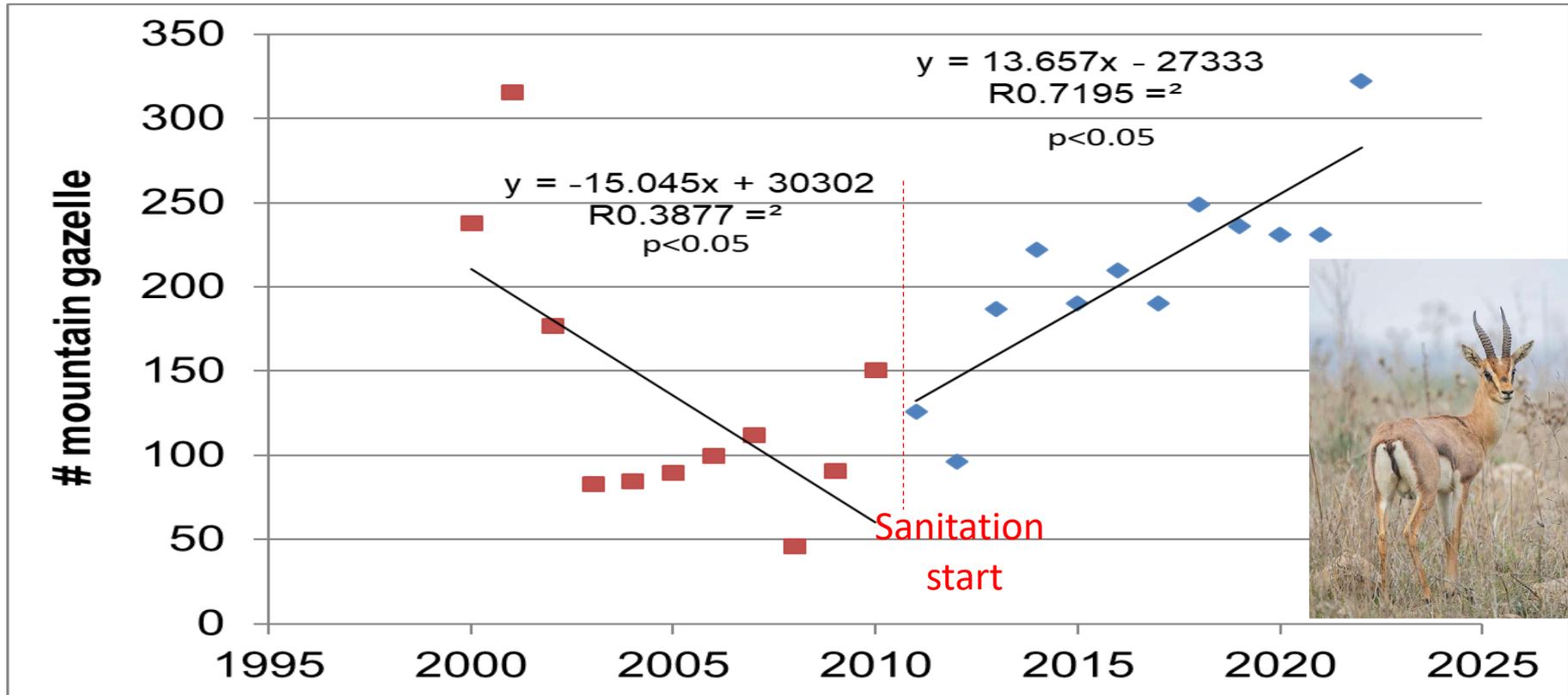


Jackal management - adding sanitation.

- Culling only - gazelle population keep decrease.
- Adding sanitation - gazelle population begins recovery!!

Culling only

Culling + sanitation



# Summary

While theory has unraveled best practices to deal with overabundant populations, we found that the key issues to controlling jackal populations are:

1. A long-term process that requires a **combination** of several methods that must be based on the **decrease of available anthropogenic food sources**.
2. Limiting **access** and direct control.
3. Culling as **complementary** management.



ISRAEL NATURE  
AND PARKS  
AUTHORITY

# THANK YOU

2015-03-11 11:37:13 AM M 2/5

22°C

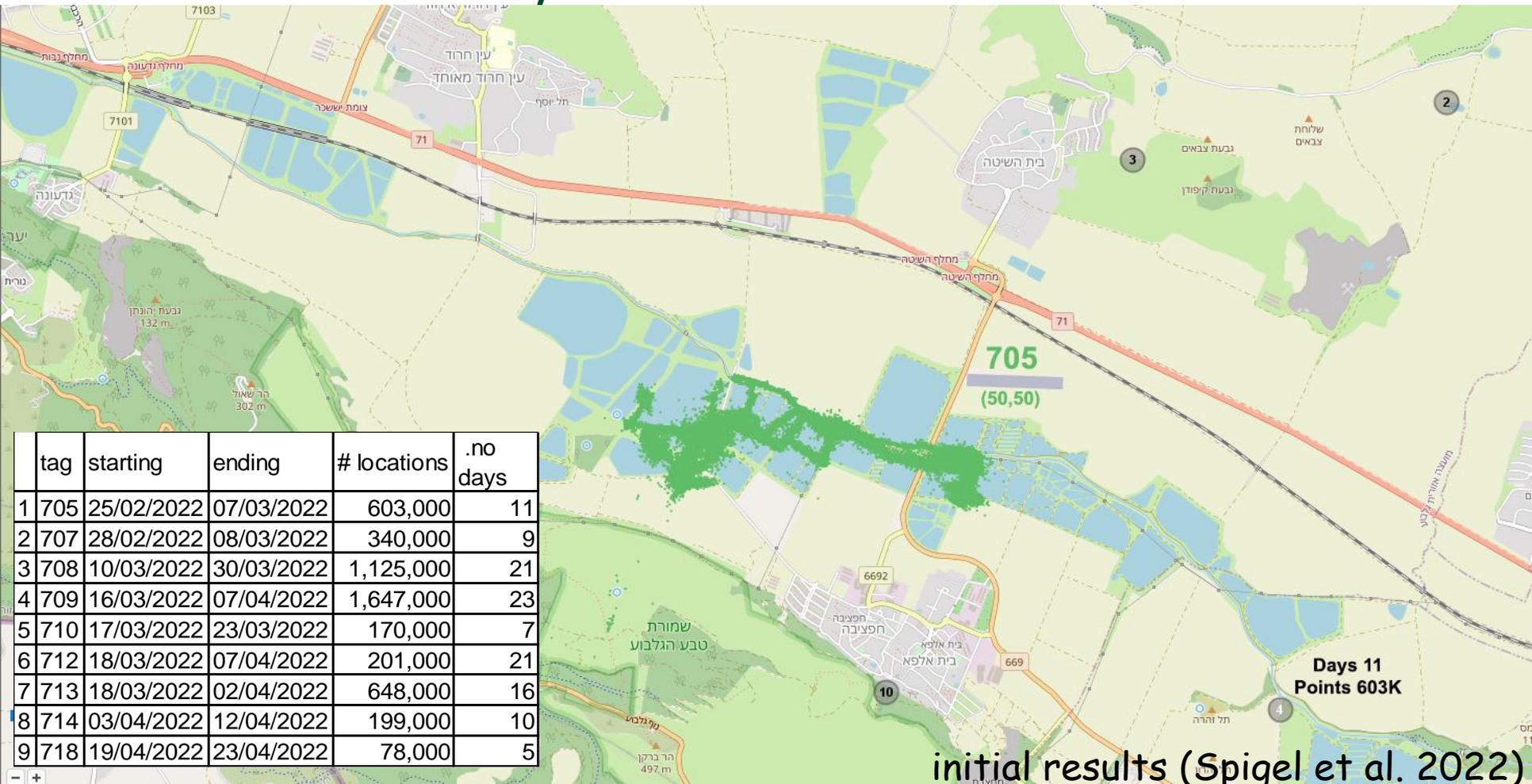


NPAN10

RECONYA

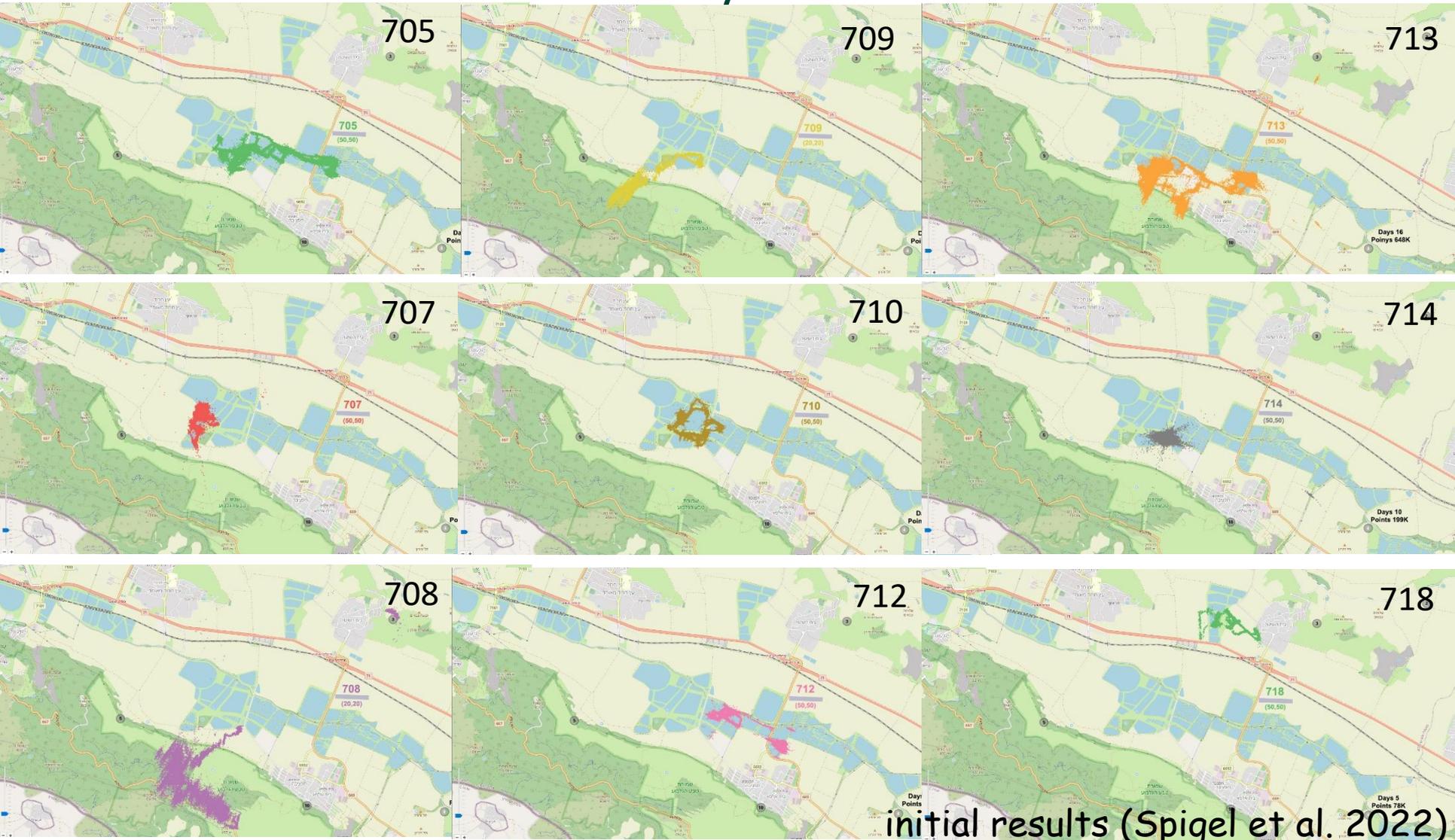
# Next step with jackal tracking: using ATLAS system

- Movement in Harod valley
- Location every ~ 10 sec.



# Next step with jackal tracking: using ATLAS system

- Movement in Harod valley



initial results (Spigel et al. 2022)