ASSESSING THE IMPACT OF BEARS, WOLVES AND JACKALS ON EXTENSIVE LIVESTOCK PRACTICES IN NORTH-EASTERN ITALY

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INTRODUCTION

In Friuli Venezia Giulia (north-eastern Italy) the main carnivores which may come into conflict with human activities are the brown bear (*Ursus arctos*), the grey wolf (*Canis lupus*) and the golden jackal (*Canis aureus*).

Within the Region:

- From one to seven bears are genetically identified each year.
- Seven wolf packs are estimated to be present, at the very least.
- About 25-35 golden jackal packs are estimated to be present, at the very least.

Research questions:

i. Is there a difference in terms of predatory pressure among predators?
ii. Is there a difference in terms of the overall number of predated individuals, also taking into consideration the affected livestock species and responsible predator?
iii. Is there a difference in terms of number of predatory events among seasons?
iv. Is there a variation in terms of compensations (€) recorded per year and considering each predator?
v. Is there a difference in terms of number of predatory events between farms that use and don't use mitigation measures?

METHODS

Data on carnivore predations (from 2009 to 2021) were collected by the regional wildlife technicians in collaboration with the researchers of the University of Udine and the members of the Regional Forestry Service.

To answer questions (*i*), (*ii*), (*iii*) and (*v*), both the chi-square and Fisher's exact test (in the case of contingency tables showing values < 5) were used. The eventual difference among more than two categories was subsequently explored through the *pairwise nominal independent function* (*pnif*). To answer the question (*iv*) we used linear regression models.

RESULTS AND CONCLUSIONS

We found a significant difference ($\chi^2 = 61.12$, $p < 0.001$) in terms of number of predatory events among predators: bears (n = 81, 53.29%), wolves (n = 54, 35.53%), jackals (n = 17, 11.18%) and in terms of number of predated individuals per predator ($\chi^2 = 225.08$, $p < 0.001$). However, in the latter case the only significant differences (*pnif*, $p < 0.001$) were recorded comparing bears (n = 206, 46.08%) and jackals (n = 27, 6.04%), as well as wolves (n = 214, 47.88%) and jackals (**Fig. 1**). For what concerns bears, sheep (n = 163, 78.74%) were significantly (*pnif*, $p < 0.001$) more predated than both goats (n = 32; 15.46%) and cattle (n = 12, 5.80%); and the same significance was observed for wolves: sheep (n = 191, 89.25%), goats (n = 22, 10.28%), cattle (n = 1, 0.47%). Regarding jackals, only predations at the detriment of sheep were observed (n = 27, 100%) (**Fig. 2**).
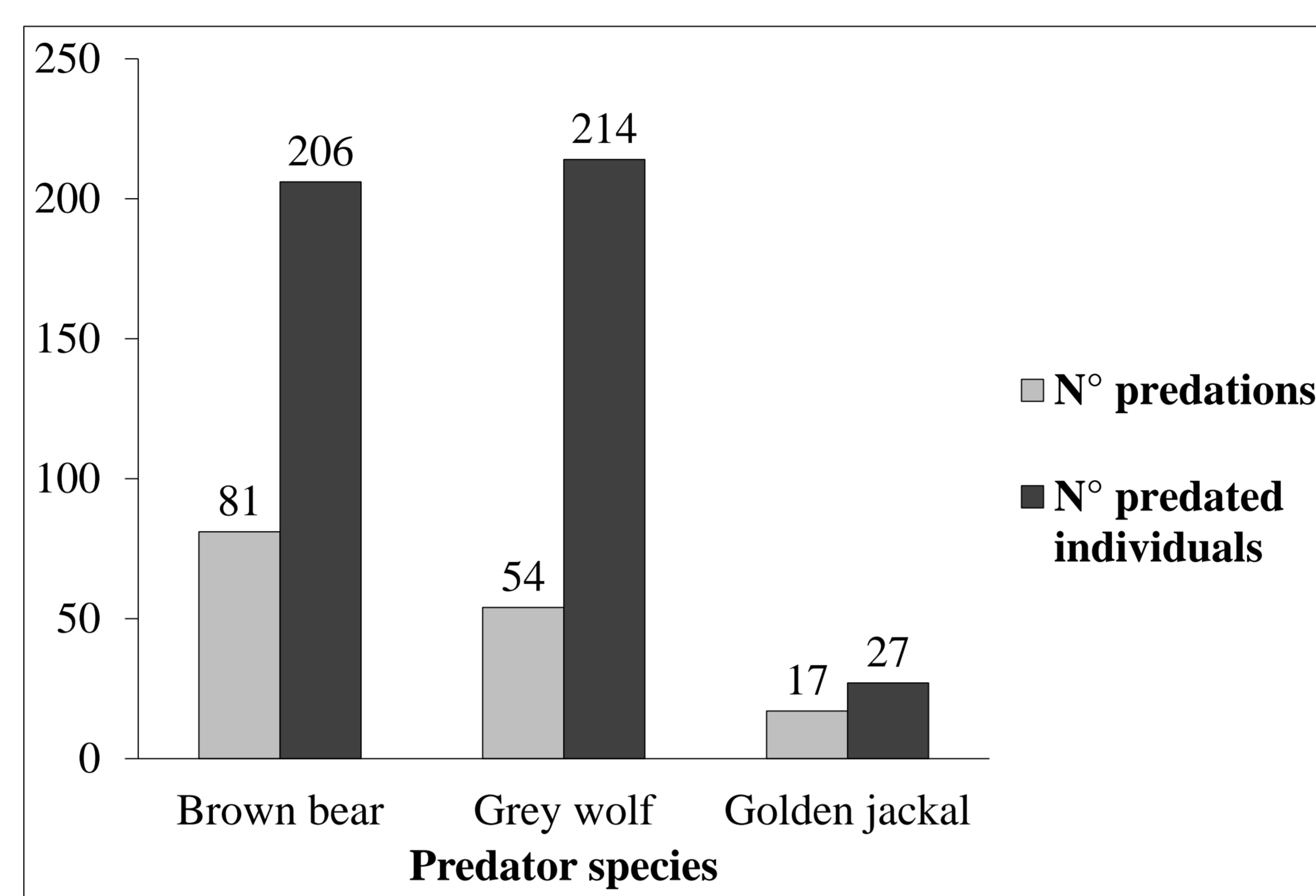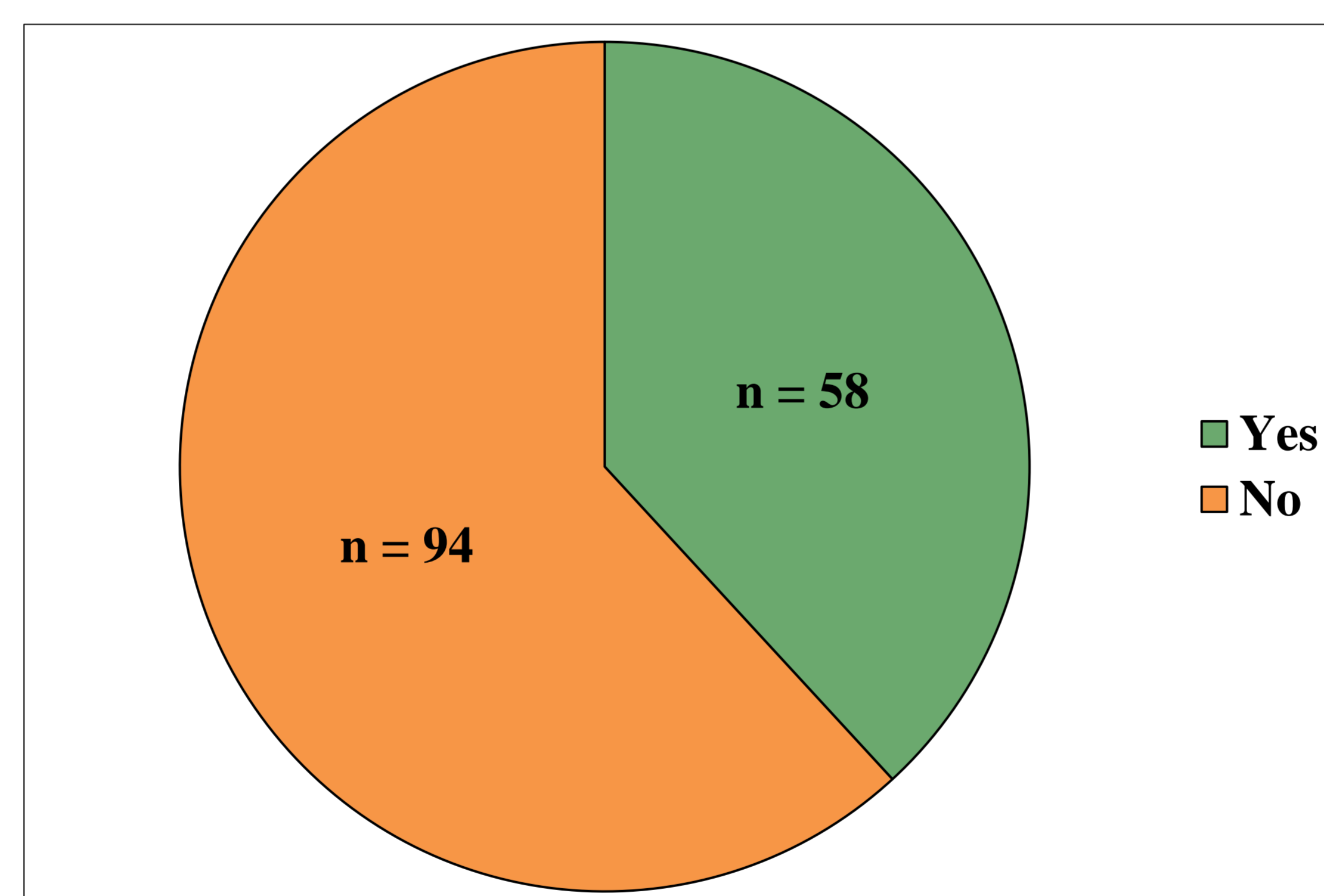

Figure 1. Difference in terms of number of predations and number of predated individuals per carnivore species.


	Brown bear	Grey wolf	Golden jackal
Goat	32	22	0
Sheep	163	191	27
Cattle	12	1	0
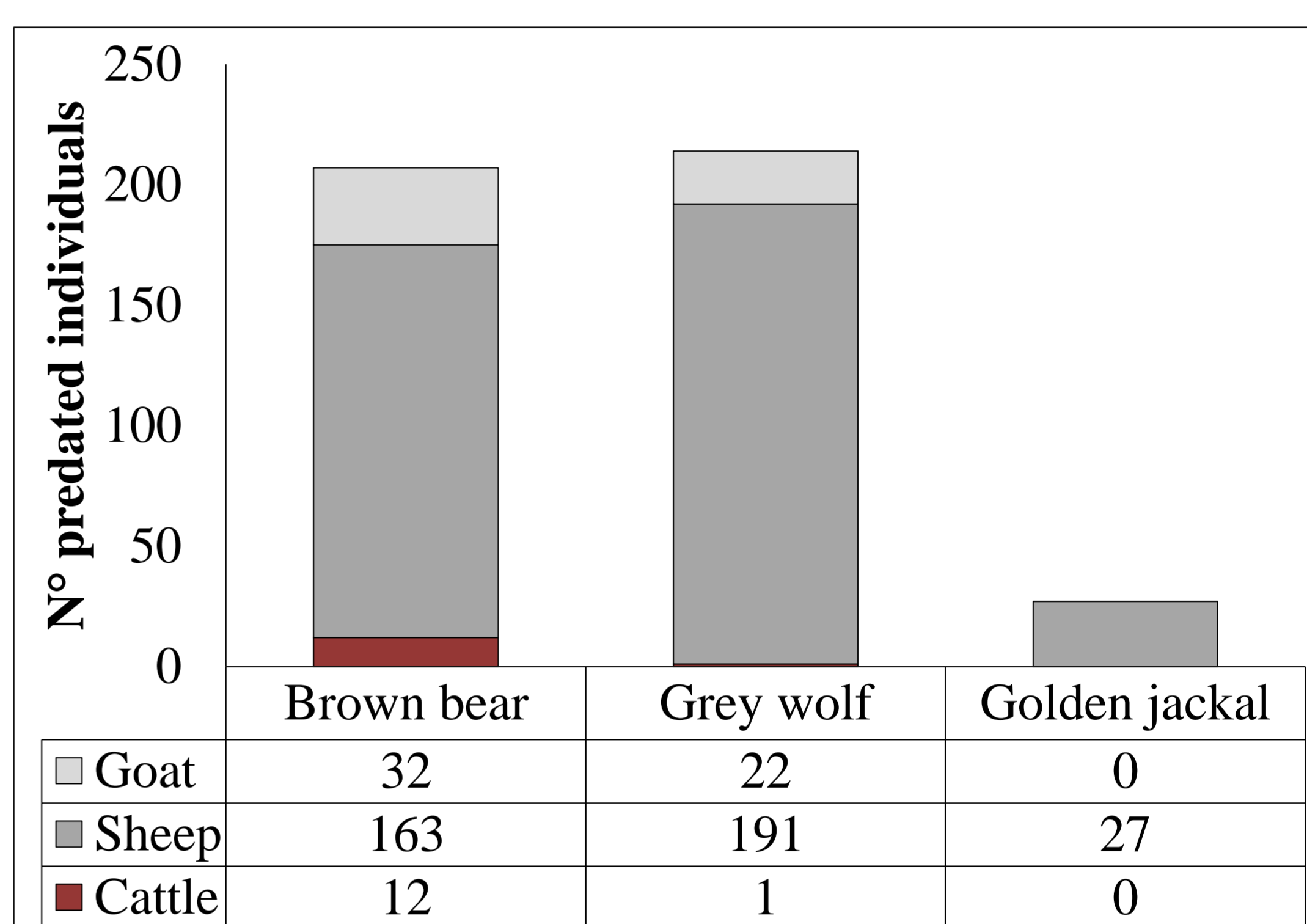
Figure 2. Difference in terms of number of predated livestock species by each predator.

A significant difference ($\chi^2 = 57.75$, $p < 0.001$) in terms of number of predations was recorded among seasons: autumn (n = 25, 16.45%), winter (n = 12, 7.89%), spring (n = 53, 34.87%), summer (n = 62, 40.79%), with the only exception of spring vs summer (*pnif*, $p = 0.34$). A significantly higher ($\chi^2 = 16.12$, $p < 0.001$) number of predations was observed in farms which did not use mitigation measures (n = 94, 61.84%) compared to those that used them (n = 58, 38.16%) (**Fig. 3**). For what concerns bears, no significant variations (LM, $R^2 = 0.008$, $p = 0.77$) in terms of compensations was observed among years. Conversely, a significant high variation (LM, $R^2 = 0.45$, $p = 0.01$) was observed for wolves (**Fig. 4**).

Figure 3. Difference in terms of number of predatory events occurred in farms which used (in green) or did not use (in orange) mitigation measures.
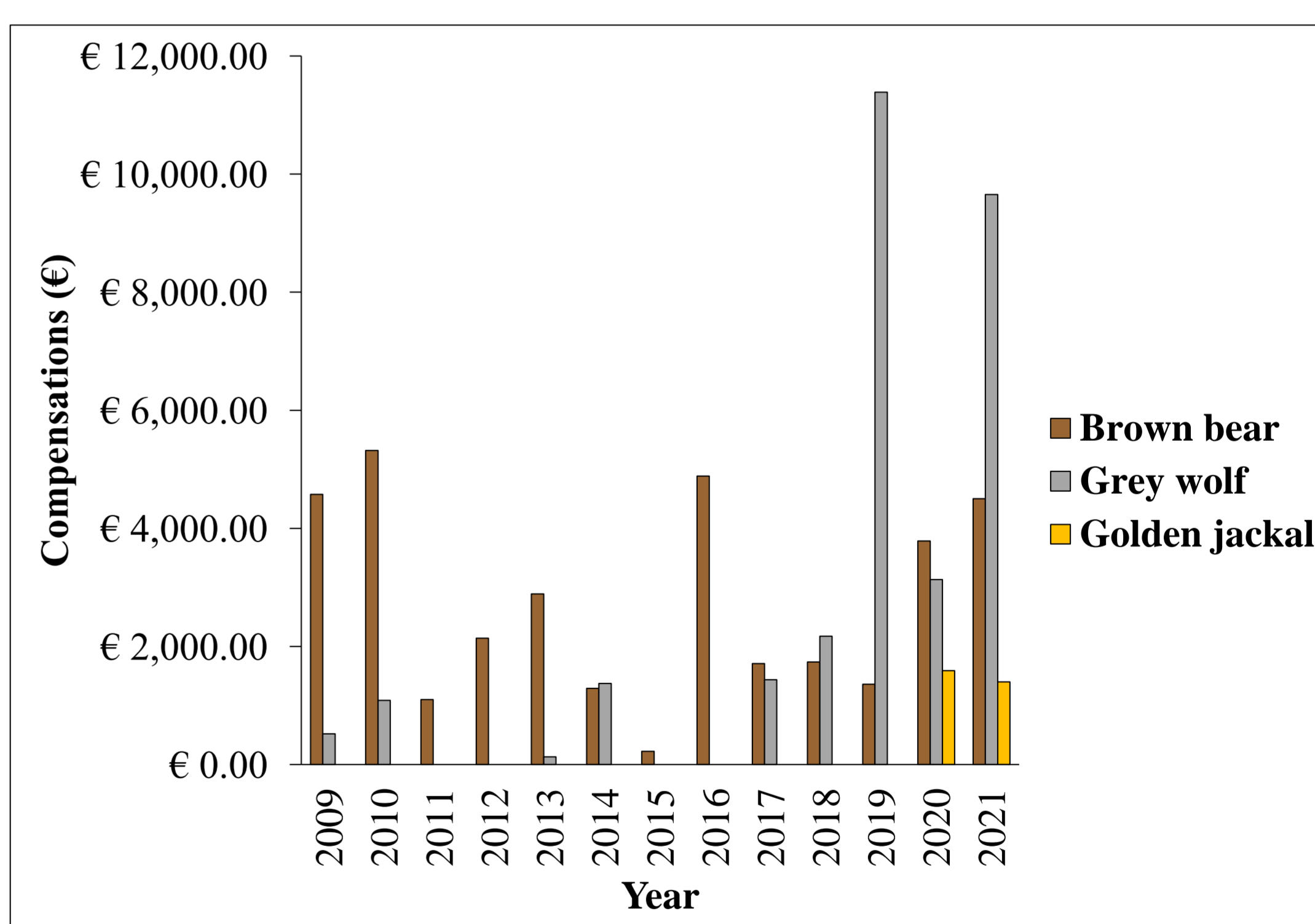
Figure 4. Trend of compensations (€) per each predator from 2009 to 2021.

The higher number of individuals predated by wolves underlies the impact that wolves may have on livestock practices, especially in the light of its recent re-appearance in the Region. Sheep confirmed to be easier to predate because of their smaller size and poor anti-predatory strategies. The higher number of predations recorded during the warm seasons match the transhumance period, during which animals are moved at higher elevations to feed in open pastures and, therefore, are more likely subjected to carnivore attacks. The high number of predations recorded in farms that did not use mitigation measures, suggests that the latter may effectively deter predators. Regarding bears, we did not observe significant variations in terms of compensations per year. However, data variability reported by the R^2 did not allow us to elaborate strong inferences. Conversely, for wolves, higher compensations were registered especially in the latest years. As for jackals, compensations were given starting from 2018 when the species was included in the list of 'potentially damaging carnivores' for human activities.