Bulletin of Regional Natural History
Formerly Bollettino della Società dei Naturalisti in Napoli

Recent human-bear conflicts in Northern Italy: a review, with considerations of future perspectives

Mattia De Vivo[1,2*]

DOI https://doi.org/10.6093/2724-4393/10633

***Correspondence:**
mattiadevivopatalano@gmail.com
https://orcid.org/0000-0002-9115-1941

Affiliation:
[1]Biodiversity Program, Taiwan International Graduate Program, Academia Sinica and National Taiwan Normal University, Taiwan
[2]Department of Biogeography, University of Trier, Germany

Conflict of Interest: The author declares that he has no conflict of interest.
Financial Disclosure Statement: During the writing of this article, the authors was supported by internal funding from Academia Sinica

Submitted: 14 Aug. 2023
Revised: 01 Dec. 2023
Accepted: 04 Dec. 2023
Published: 27 Dec. 2023

Associate Editor: Roberto Sacchi

Abstract

The killing of a runner in Northern Italy by a brown bear (*Ursus arctos arctos*) and the subsequent investigation of such matter highlighted a Human-Wildlife Conflict (HWC) that has been present in Trentino since the introduction of bears for conservation during the *Life Ursus* Project. Such conflict may be exacerbated as both human and bear populations get bigger. In this paper, I summarize the information we have about the WHC in Trentino, the attacks on humans and the legal procedures available. Several trends (e.g., increase of problematic bears) were already noticed and predicted in the past. The current legal instruments do not strictly define what a "dangerous bear" is, which lead to very subjective measures. Unless mitigation solutions are adopted (e.g., bear spray) or expanded (e.g., communication on the subject), WHC may disrupt the work done until now for bear conservation in the Italian Alps, due to a negative perception from the local population, which seems to be amplified by local politicians.

Keywords: Conservation, HWC, Italy, Trentino, Bear, attack

Riassunto

L'uccisione di un runner nell'Italia settentrionale da parte di un orso bruno (*Ursus arctos arctos*) e l'investigazione che ne è seguita hanno evidenziato il conflitto uomo-natura (Human-Wildlife Conflict, HWC) presente in Trentino sin dall'introduzione degli orsi per motivi conservazionistici durante il Progetto *Life Ursus*. Tali conflitti potrebbero esacerbarsi nel momento in cui entrambe le popolazioni (umana e ursina) aumentano di dimensione. In questo articolo, riassumo le informazioni che

abbiamo riguardanti il WHC in Trentino, gli attacchi agli umani e le procedure legali disponibili. Diverse tendenze (per esempio, l'aumento di orsi problematici) sono state notate e predette già in passato. Gli attuali mezzi legali non definiscono in maniera stretta cosa sia un "orso pericoloso", il che porta a misure altamente soggettive. A meno che non siano adottate soluzioni per mitigare il conflitto (per esempio, lo spray anti orso) o altre soluzioni già presenti non sono migliorate (per esempio, la comunicazione sull'argomento orso), il WHC potrebbe danneggiare in maniera irreparabile il lavoro fatto finora per la conservazione degli orsi nelle Alpi italiane, a cause di una percezione negativa da parte della popolazione locale, la quale sembra essere amplificata dai politici locali.

Parole chiave: Conservazione, conflitto uomo-natura, Italia, Trentino, orso, attacco

How to cite

Mattia De Vivo (2023). Recent human-bear conflicts in Northern Italy: a review, with considerations of future perspectives. Bulletin of Regional Natural History (BORNH), Bollettino della Società dei Naturalisti in Napoli. Vol. 3, n. 3, pp. 7 - 23 ISSN: 2724-4393.

Introduction

The brown bear (*Ursus arctos*) was once widespread in its circumpolar range, but it became locally extinct in several North American and European areas during the 19th and 20th Century, due to direct and indirect (e.g., accidental road kills coupled with habitat loss and fragmentation) human persecution (Kaczensky et al., 2011, 2013; Tosi et al., 2015; McLellan et al., 2017; von Hardenberg, 2017). This led to the decline of several local populations, especially in Europe (Linnell et al., 2008; Tosi et al., 2015; McLellan et al., 2017, von Hardenberg, 2017). Generally, Human-Wildlife Conflicts (HWC) between human and bears (Ursidae) arise because of the overlap between human settlements or resources (e.g., flocks or beehives) and bear ranges, which can lead to potential encounters and competition between the two; e.g., the bear feeds upon resources used by humans such as livestock, beehives and ungulates or human leftovers in trash bins (Linnell et al., 2008; Kaczensky et al., 2011, 2013; Tosi et al., 2015; Penteriani et al., 2016, 2020; von Hardenberg, 2017; Støen et al., 2018, 2020; Bombieri et al., 2019; Krofel et al., 2020). Such conflicts hindered conservation and rewilding plans in the past, while also impeding bear dispersal and connectivity among metapopulations (Kaczensky et al., 2011, 2013; von Hardenberg, 2017; Corradini et al., 2021).

One of the most notorious WHC with bears arises when these animals attack humans (see Penteriani et al., 2020 for a review on such a subject). Brown bears attacking humans are generally thought to be rare (Tosi et al., 2015; Bombieri et al., 2019; Penteriani et al., 2020), especially in Europe; from 2000 to 2015, roughly 18 attacks per year have been reported in the continent, with 8 of such yearly attacks reported in Romania only (Bombieri et al., 2019). However, attacks tend to be more frequent where the bear population density increases (Linnell et al., 2008; Tosi et al., 2015; Støen et al., 2018; Bombieri et al., 2019; Penteriani et al., 2020; ISPRA-MUSE, 2021). Furthermore, media coverage may exacerbate or exaggerate the risk posed by predator

attacks (Tosi et al., 2015; Penteriani et al., 2016; Bombieri et al., 2018, 2019; Lennox et al., 2018) and it would lead to perceive such animals as something to remove (e.g., Tosi et al., 2015; Lennox et al., 2018). For mitigating such conflicts, removal or culling of dangerous individuals is proposed for calming down the general population (Krofel et al., 2020; ISPRA-MIUR 2021), although such approaches are becoming less popular, and the efficacy of removal is questioned (Lennox et al., 2018; Human-Bear Conflicts Expert Team of the IUCN SSC Bear Specialist Group, 2019).

Given the increase of both human and bear populations, it is plausible that WHCs, including bear attacks, may increase if precautions are not taken (Tosi et al., 2015), as shown by a recent example from Northern Italy: on 5 April 2023, a jogger was mauled by a European brown bear (*U. arctos arctos*) in the Autonomous Province of Trento (Trentino-Alto Adige/Südtirol region, also known as "Trentino"). That was the first bear-caused fatality in Italy in modern times (Giuffrida, 2023a; Tondo, 2023). Genetic analyses seemed to find a female individual known as "JJ4" as the culprit and such bear was captured on 17 April (Giuffrida, 2023a; Salvatori, 2023; Tondo, 2023). JJ4 was already known due to her attack on two other people in 2020 (ISPRA-MIUR, 2021; Groff et al., 2020, 2022; ISPRA, 2023; Tab. 1) and for a false attack on a cyclist (Groff et al., 2023): given her recidivism, the governor of the Autonomous Province of Trento ordered the culling of the bear (Giuffrida, 2023a). However, the execution was halted after a legal appeal by animal right activists (Tondo, 2023) and a forensic analysis seemed to show that the jogger was actually attacked by a male bear, which led to protests from environmental groups and the request of freeing JJ4 (Giuffrida, 2023b; but see Zamattio, 2023). In addition, the accident sparked a public debate about the presence of the bears in Northern Italy (Ansa, 2023; Nast, 2023; Salvatori, 2023; WWF Italia, 2023; Zamattio, 2023).

Such an event, together with the public coverage it received, highlighted the presence of the HWC in the area surrounding the Italian Alps at a worldwide level. In this paper, I briefly summarize the modern (from 1999 to now) conflicts between bears and humans and the attacks in such areas, while also discussing the current laws and procedures regarding this population and its problematic individuals. I also briefly discuss how the situation may evolve, according to potential measures and the local human population's attitude.

Materials and Methods

For writing this review regarding the story of the project and bear attacks in the region, while also understanding the legal protocol available in Trentino and potential future directions, I researched articles, theses, book chapters, technical reports and news throughout Google and Google Scholar, using English ("bear", "brown bear", "Alps", "Northern Italy", "wildlife human conflict", "mitigation", "attack", "false attack") and Italian ("orso", "orso bruno", "Alpi", "Trentino", "Nord Italia", "attacco", "falso attacco") keywords and the scientific name of the considered species and subspecies. Additionally, I also used the information from the references (i.e., other articles or Italian technical reports) of the considered research articles and book chapters.

Table 1: List of reported bear attacks on humans in Northern Italy from 2014 to 2023. Data from Groff et al. (2015, 2016, 2018, 2021), Tosi et al. (2015), ISPRA-MIUR (2021), ISPRA (2023) and news reports.

Year	Description of the event	Fate of the bear
2014	The female bear Daniza attacked a mushroom collector on 15 August. She was with her cubs.	After being sedated in a capture attempt, Daniza did not recover and died on 11 September 2014.
2015	The female bear KJ2 attacked a jogger and his dog on 10 June. She already started to do several bluff attacks from 2008. She was probably with her cubs, although the presence of the latter was proven only after the attack and not during it.	The bear was caught and equipped with a radio collar.
2017	The female bear KJ2, while she was with her cubs, attacked an elderly man walking his dogs on 22 July.	Given that this was her second attack, KJ2 was culled by forest rangers on 12 August 2017.
2020	The female bear JJ4 attacked two people, a man and his son, on 22 June, around late afternoon. She was with her cubs.	Initially, the province wanted the culling of JJ4. A legal appeal rejected the culling request and JJ4 was equipped with a radio collar.
2020	The 2-years old male bear M57 attacked an off-duty policeman on 22 August, around 10:30 PM.	Given that he exhibited risky behavior before the attack (e. g., following people and eating from trash bins), M57 was caught and he is currently in captivity in Hungary.
2023	The male bear MJ5 attacked a man with his dog on 5 March, around 8 AM.	At the time of the writing of this article, the bear was not caught and removed from the population yet. The province government wanted the culling of the animal, but that was halted by a legal appeal.
2023	A runner was mauled by a bear on 5 April. Initially, JJ4 was accused of the attack. A forensic analysis seemed to indicate that the attack was done by a male individual, which contradicts the genetic analyses.	The circumstances of the attack are still not very well understood, also because JJ4's radio collar was not functioning. JJ4 was caught and she is currently in captivity, managed by the forest rangers. Her execution was halted by a legal appeal.

Results and discussion

From Life Ursus to the current situation: brief story of the current Alps bear population

The brown bear was almost extinct in the Alps in the 20th Century, due to human persecution and activities (Duprè et al., 2000; AA. VV., 2011; Tosi et al., 2015; von Hardenberg, 2017). For reinstating the bears

in this area, a Life project called "Life Ursus" (AA. VV., 2011; Tosi et al., 2015; von Hardenberg, 2017; LIFE Public Database, 2021) was financed to the Adamello Brenta Nature Park in cooperation with the Province of Trento and the Italian Wildlife Institute. For doing so, 10 bears were imported from Slovenia for allowing restocking in 1999: such decisions stemmed from the genetic similarity between Alpine and Slovenia bears (Tosi et al., 2015; LIFE Public Database, 2021).

From a crude matter of numbers, the project is regarded as a success: a minimum vital population (MVP) was established and the economic compensations for WHCs were similar to the expected ones (Tosi et al., 2015; Groff et al., 2018). Regarding the MVP, it was estimated at 40-60 individuals and Tosi et al. (2015) reported that the population would have reached 60-94 individuals by 2017. At least 100 bears were estimated to be present in the area in 2022 (Groff et al., 2023) and more than 130 bears might be present in 2025 (ISPRA-MIUR, 2021), with a potential carrying capacity that may reach 205 according to potentially suitable areas (Tosi et al., 2015). However, the population seems to be isolated from its Slovenian source, potentially due to high density of human infrastructures and activities in low valleys that hinders bear dispersal (Kaczensky et al., 2013; Peters et al., 2015; Corradini et al., 2021). Additionally, it was already noted in Tosi et al. (2015) that the public perception on bears in the area, initially positive, started to switch through a negative one because of some conflicts that the local populations had with the bears (e.g., false attacks by the bears, livestock damages and incursions of bears in human areas), which also lead to illegal killings. Such conflicts (damage events and compensations) increased after the publication of that article (Groff et al., 2018, 2022).

Human-bear WHC: damage and event types

Generally, bear-related damages in the area tend to be on beehives, crops and livestock (Tosi et al., 2015; Groff et al., 2018, 2022, 2023; Corradini et al., 2021). Precisely, damages on beehives accounted for roughly 38% of the damaging events and 39.9% of the bear damages' reimbursement costs, followed by livestock with 35.4% and 35.6%, respectively during the time period 1999-2017 (Groff et al., 2018). Therefore, beehives and livestock damages accounted for 73.4% of the damage events and 75.5% of the compensations. Crops followed suit, with 19.9% of the events and 21.6% of the compensations (Groff et al., 2018). Sheep and goats are usually the most attacked farming animals (Tosi et al., 2015; Groff et al., 2018). These kinds of damages are in line with the usual WHC present with brown bears around the world (Krofel et al., 2020).

In 2022, which is the last year with available data at the time of the writing of this article, the situation was similar: there were 301 cases of damage events by bear activities. However, the Large Carnivore Report shows the data for 150 of them, given that the damage compensation's requests were not all completed (Groff et al., 2023). 105 of the reported events were directed to livestock or poultry, causing the disappearance, the injuring or killing of 364 animals (Groff et al., 2023). In the year before (2021), the damage events were also 301: 113 of these were directed to livestock, causing the disappearance or killing of 572 animals. In

contrast with the period 1999-2017 and the other previous years (Tosi et al., 2015; Groff et al., 2018, 2019, 2020, 2021), poultry was the most impacted vertebrate in the last two available years (Groff et al., 2022, 2023). Crops and beehives were impacted by 68 events each in 2021 (Groff et al., 2022), while in 2022 31 and 46 events were reported for crops and beehives respectively (Groff et al. 2023). Therefore, roughly 83.14% of the damages in the last two available years were related to agriculture or animal farming. In 2021, the damages were compensated with €172,373.94 given to the damaged people and they were the highest reported ever for the area (Groff et al., 2022), although they are still in the range of the expected amount of reimbursement per number of bears (Duprè et al., 2000; Tosi et al., 2015; Groff et al. 2018). The sum dropped to €76.786,51 in 2022, albeit this estimate was not regarded as "definitive" by Groff et al. (2023).

Several bears are also known to be confident in the area and/or to be feeding on anthropic food leftovers: such behavior may lead to having more encounters with humans or even bears that follow people (ISPRA-MIUR, 2021; Groff et al., 2021, 2022, 2023). Additionally, confident bears tend to get close to human settlements (ISPRA-MIUR, 2021) and they may damage human infrastructures (e.g., Groff et al., 2021). For now, damages to infrastructures are the least reported kind of damage in Trentino (Tosi et al. 2015; Groff et al., 2018, 2022, 2023), but confident individuals would probably be the most common "problematic" bears in the area in the future (ISPRA-MIUR, 2021). At least 52 road accidents involving bears have been reported since the start of the project (Groff et al., 2023) and illegal killings started to happen at least since 2013 (Tosi et al., 2015).

The WHCs in the Alps slightly mirrors what happens in another area of Italy, the Central Apennines, between humans and a morphologically and genetically distinct Italian endemic brown bear population (the Apennine bear *U. arctos marsicanus*; Loy et al., 2008; Benazzo et al., 2017; Swenson et al., 2020). The Apennine bear is critically endangered, but it is sometimes illegally killed because it causes damage to the agricultural-farming sector, mostly on livestock (Ciucci & Boitani, 2008). Such killings have been shown to critically slow down conservation attempts (Ciucci & Boitani, 2008; Benazzo et al., 2017). Additionally, habituation caused by food conditioning is reported for the area, which increases the risk of human-bear encounters (Ciucci & Boitani, 2008; Forconi, 2020). However, no attacks on humans are reported from Apennines in modern times (Ciucci & Boitani, 2008; Benazzo et al., 2017) and the bear seems tolerated by the majority of the population, although some people have the feeling that their life is restricted by bear protection (Glikman et al., 2023).

Summaries of bear attacks in Trentino

According to the data from Groff et al. (2015, 2016, 2021), Tosi et al. (2015), ISPRA-MIUR (2021), ISPRA (2023) and news reports (e.g., Ansa, 2023; Giuffrida, 2023a), there were 7 official reported bear attacks on humans from 2014 to 2023 in the Province of Trento (Tab. 1). This equates to 0.7 attacks per year. Such an estimate would furtherly drop if we consider that, from 1999 (the year in which Slovenian bears started to be present in the area) to 2013, no attack on humans has been reported from the region (Tosi et al., 2015;

ISPRA-MIUR, 2021). This change may stem from an increase of both bear and human population densities (Bombieri et al., 2019). Another potential attack is reported in Groff et al. (2015), in which it is written that a man suffered an arm injury after encountering a bear; however, no physical contact between the person and the bear was reported and it is plausible that the man injured himself while running away.

The attacks happened from March to August, with 5 out of 7 happening in summer months (Tosi et al., 2015; Groff et al., 2015, 2016, 2021; ISPRA-MIUR, 2021; ISPRA, 2023). In the attacks in which the culprit is sure (6), 4 of the attacking bears were females with cubs (ISPRA-MIUR, 2021; Tab. 1); such an estimate would increase to 5 out of 7, if JJ4 is confirmed as the culprit of the last attack. That being said, the presence of cubs in the first KJ2's attack was confirmed only afterwards and not during the encounter (Groff et al., 2016). All the attacked people were adult men. On 3 occasions, dogs were present (Tab. 1); however, their behavior was not reported, and it is therefore not possible to make inferences about the relationship between bear attacks and presence of dogs (Bombieri et al., 2019; Krofel et al., 2020). 1 out of 7 attacks was fatal, which is roughly 14.29% of the attacks. Beside MJ5 (Ansa 2023), all the reported bear specimens were captured, although only one (KJ2) was culled (ISPRA-MIUR, 2021). The first reported attacking bear, Daniza, died after being sedated (Groff et al., 2015; Tosi et al., 2015). At the time of the writing of this article, all the other caught bears were in captivity, with one of them (M57) translocated in a shelter in Hungary (Groff et al., 2022). The Autonomous Province of Trento asked for the execution of the other bears, but legal appeals from animal rights groups halted the procedures (Tab. 1).

It is worthy noticing that, if JJ4 is confirmed as the bear of the most recent accident, 4 out of 7 attacks came from 2 bears, which seem to be in agreement with the idea that bear attacks are rare and usually few bears in the populations cause issues (AA. VV., 2011; Tosi et al., 2015; Bombieri et al., 2019; ISPRA-MIUR, 2021). Furthermore, both Daniza and M57 were reported near human settlements, and the latter also followed people before the attack: therefore, they both showed dangerous behavior before attacking people (ISPRA-MIUR, 2021).

Although it is probably premature to draw conclusions from only 7 attacks, the reported data seems to agree with the worldwide trends observed by Bombieri et al. (2019): the majority of the attacks were from females with cubs; the attacks mostly happened during summer, which is the period where human recreational activity increases; the death rate of such attacks is around 14.3%; bears usually attack unaccompanied people, probably because groups are easier to detect and avoid. The majority of the people that get attacked are usually adult men at the worldwide level (Bombieri et al., 2019); in the case of the Alps, adult men represent all the victims (Tab. 1).

Regarding false attacks (i.e., charging without any physical contact), Tosi et al. (2015) reported at least 8 cases during the period 1999-2014, which were mostly caused by females with cubs. From 2015 to 2022, further 16 certified cases were reported by the Large Carnivore Reports (Groff et al., 2016, 2017, 2018, 2019, 2021, 2023). No false attacks were reported in 2019 (Groff et al., 2020), and 2021, although "threatening behaviour" was reported in the

latter year in a single instance (Groff et al., 2022). In 11 of these 16 cases, the charge was surely done by a bear with cubs (Tab. 2), confirming how this category of bear is the one who tends to perform this kind of action (e.g., Tosi et al. 2015). Two of the reported bears, KJ2 and JJ4, also performed "true" attacks (Tab. 1 and 2).

The legislative landscape: the PACOBACE

In the Autonomous Province of Trento, the interregional management protocol for the management of the bear is called PACOBACE (AA. VV., 2011). Such protocol also gives guidelines about how to define a bear "dangerous" for the human population. Specifically, a "damaging bear" is a bear that "repeatedly causes material damage to

Table 2. List of reported bear false attacks on humans in Northern Italy from 2015 to 2023. Data from Groff et al. (2016, 2017, 2018, 2019, 2021, 2023).

Year	Description of the event
2015	On 14 June, an unidentified bear accompanied by three cubs performed a bluff charge.
2015	On 24 July, an unidentified bear with two cubs performed a false attack.
2016	On 13 June, a false attack by two unidentified bears was reported.
2016	On 12 July, KJ2 was reported to engage in false attacks. She was with her cubs (reported as "two-three" in number)
2016	On 24 September, an unidentified female bear with at least two cubs performed a false attack.
2017	On 2 July, a mushroom picker was chased by an unidentified female with a cub for 30 meters.
2017	On 21 July, a woman was chased by a bear. The bear was not identified, but it is hypothesized it was KJ2, given that such encounter happened nearby where this individual attacked a person.
2018	On 6 June, at 8:20 PM, the female bear KJ1 chased a person, who suffered minor injuries while trying to escape. The bear was with her cubs.
2018	On 15 August, a man suffered minor bruises while running away from the female bear F12, which tried to chase the man after seeing him. The bear was with another bear.
2018	On 21 November, a couple heard a siren and a female bear with at least one cub was running and hissing at them. The woman tripped, while her husband let his dog loose, which ran towards the bear. After that, the bear ran away and disappeared. Both the bear and her cub were not identified.
2020	On 12 July, a bear bluff-charged a cyclist.
2020	On 26 August, a bear bluff-charged a jogger.
2020	On 29 August, a bear bluff-charged a forest warden.
2022	On 22 June, JJ4 performed a false attack on a biker. She was with cubs.
2022	On 31 July, a man with his dog was chased by a female bear with a cub.

property[...] or repeatedly uses sources of food linked to the presence of man[...]". According to the protocol, a bear who does single or sporadic damage should not be regarded as "damaging". A "dangerous bear", instead, is less strictly defined and there are several categories of dangerous bears. A scale of dangerousness is used, according to the behavior exhibited by the bear. According to PACOBACE, "the degree of dangerousness increases when there is repetition of potentially dangerous behaviour by the same bear." From a theoretical perspective, each case is evaluated differently (AA. VV., 2011; ISPRA-MIUR, 2021; ISPRA, 2023). It is also implicit that the behaviors regarded as most dangerous are the ones that allow the removal of the animals from the population by the authority (ISPRA-MIUR, 2021).

Bear killing was only allowed after getting authorization from both the Minister of Environment and the Italian Institute for Environmental Protection and Research, ISPRA (AA. VV., 2011); such rule was changed in 2018, and now only a consultation with ISPRA is required, while the province has the power to order the removal, capture or killing of the bears (Groff et al., 2021, 2022). Legal appeal is possible, as shown by the cases of MJ5 and JJ4 (Groff et al., 2021, 2022; Ansa, 2023, Giuffrida, 2023b). ISPRA usually considers culling necessary if prevention and deterrent actions (e.g., rubber bullets and noises) do not work on the considered bears (ISPRA-MIUR, 2021).

The lack of strict criteria and definitions for dangerous bears has been criticized by WWF Italy, which called for reducing subjectivity by applying a more stringent definition of "dangerous" (WWF Italia, 2023). In fact, JJ4 and MJ5 were already ordered by the Autonomous Province of Trento's governor to be put down after a single attack in 2020 and 2023, respectively, before animal right activists' appeals (Groff et al., 2020, 2022; Ansa, 2023; Giuffrida, 2023b). Therefore, the culling requests seem to be in contrast with the "repetition of potentially dangerous behaviour" highlighted by PACOBACE. Critically, JJ4 was regarded as "potentially dangerous" by ISPRA in 2021 (ISPRA-MIUR, 2021) and not strictly dangerous; only after the second offense the animal was regarded as "dangerous" (ISPRA, 2023), although the 2020 culling request by the province came already at the first offense (Giuffrida, 2023b) and also before the false attack it performed (Groff et al., 2022). Other potential examples, Daniza and M57, did not attack multiple people but exhibited different risky behaviors (ISPRA-MIUR, 2021); in such cases, given the seriality of one of the behaviors, the bears should be regarded as "dangerous" without any issue, but it is controversial how many "repetitions" are enough for entering in such a category and if doing different risky behavior equal to a repetition (i.e., if a bear doing two different risky behaviors equals to a bear doing a single kind of risky behavior twice). In the case of KJ2, two attacks on humans were enough for the "dangerous" labeling and the culling (ISPRA-MIUR, 2021).

Potential future directions

The WHC between bears and humans in Trentino will probably increase in future years, given the potential appearance of new problematic bears (ISPRA-MIUR, 2021). In a MsC thesis published in 2021, bear spray was regarded as a potential way to deal with brown bears in the area (Neri, 2021).

Specifically, such measure would be the most transferable (i.e., suitable to the context) in the Trentino area, given that it is the one respecting the majority of the parameters taken in consideration by the Suitability, Feasibility and Acceptability (SFA) framework (Neri, 2021). Other studies showed how this measure may strongly reduce the risk of injury in case of close contact with a bear (Smith et al., 2008). Currently, bear spray is illegal in Italy, due to the concerns about its use as a weapon (Neri, 2021 and references therein), although there are already requests for making it available in the country (e.g., see the discussion about the "Acceptability" of the spray in Neri 2021, and WWF Italia, 2023). The building of wildlife corridors, which would help the species to reconnect with the source population (Peters et al., 2015; Corradini et al., 2021) and would also reduce the bear population density in the Alps (WWF Italia, 2023), seems to not be feasible right now due to cost issues (Neri, 2021).

For what concerns other potential measures, the level of communication and preventions adopted in the Alps has been criticized, particularly the spread of knowledge that would help local communities-bears coexistence and actions that would lead to less confident bears, such as bear-resistant trash containers (Tosi et al., 2015; ISPRA-MIUR, 2021; WWF Italia, 2023). Both actions have been shown to potentially reduce WHC between bears and humans (Krofel et al., 2020). Bombieri et al. (2019) reported the lack of fit activities for increasing the knowledge of the general population regarding bears' activities at worldwide level, especially regarding the presence of females with cubs, which are the category of bears that potentially attack more people. For what concerns bear-resistant bins, although their current amount is not regarded as sufficient (ISPRA-MIUR, 2021), they are currently being implemented and they will increase in number in the future (Groff et al., 2022, 2023).

Prevention measures are also implemented for defending livestock, including livestock guarding dogs (LGD) and electric fences (Groff et al., 2022, 2023). Between 2009 and 2019, an average of €66,956 per year has been spent for prevention in the area; such sums also include prevention from wolf-related (*Canis lupus*) damages since 2012 (ISPRA-MIUR, 2021), although the economic impact of prevention actions for the latter was comparably low from 2012 to 2017 (Groff et al., 2022). In 2022, around €143,600 were spent for such activities (Groff et al., 2023). It would not be surprising if such sum increases in the future, given the potential increase of damaging bears in the next few years.

Furthermore, an analysis based on different stakeholder's opinions is necessary, given that some classes (e.g., shepherds) may see the beard in a less positive way compared to other groups due to potential bear-related damages, as it already happens with the Apennine bears (Glikman et al., 2023). This may also lead to potential proposals about management in the area (e.g., Marino et al., 2021). Critically, the population should be involved in communication, management, and prevention activities as much as possible. Communication activities organized with the direct involvement of the population is especially important, given that such involvement will increase the efficacy of this approach (Krofel et al., 2020). Furthermore, public involvement in bear management can help to make the

population feel both safer and responsible toward bears (Majić et al., 2011; Glikman et al., 2023).

At the same time, the population should be approached for reducing its fear of the bear (e.g., Johansson et al., 2019); a fearful population may be prone to commit illegal killings, hindering conservation practices in the area (Tosi et al., 2015), as it already happened in other European nations (Kaczensky et al., 2011, 2013) and in Italy, both in Central Alps in the past (Tosi et al., 2015; von Hardenberg, 2017; Swenson et al., 2020; ISPRA-MIUR, 2021) and Apennines (Ciucci & Boitani, 2008; Glickman et al., 2023). Reducing the fear toward such animals would be a potential way to even have economic advantages, given that brown bears are potential tourist attractions, and their value would cover the damage costs (Tattoni et al., 2017), although this strategy has caveats associated with it (see Das & Chatterjee, 2015) and it may not be perceived as a benefit by some stakeholders (Glikman et al., 2023).

A negative attitude toward bears may also be influenced by local politicians' attitude, as already noted by Tosi et al. (2015). For example, the current governor of the Autonomous Province of Trento has called for the culling of bears after one single instance of risky behavior (Groff et al., 2020, 2022; Ansa, 2023; Giuffrida, 2023b); as already discussed, this seems in contrast with the PACOBACE. In addition, the governor said that around 50-70 bears need to be relocated (Salvatori, 2023; Zamattio, 2023); such numbers do not seem to correspond to the reality of the population. Precisely, around 19 bears were regarded as dangerous or potentially dangerous between 2005 and 2020; all but 2 individuals were dead or in captivity at that time. Among the living bears, there was JJ4 too (ISPRA-MIUR, 2021). Currently, JJ4 and MJ5 are the alive bear considered by ISPRA (2023) for removal; the individual M62, who was on the list due to overconfident behavior (ISPRA, 2023), died probably because of the attack of another bear (Ufficio Stampa Provincia Autonoma di Trento, 2023). Groff et al. (2022) also reports the female specimen F43 as a "problem bear" due to "overconfident behaviour": however, she died in September 2022, after being sedated by the rangers who tried to change her radio collar (Ansa, 2023; Groff et al., 2023). If the estimates of ISPRA-MIUR (2021) are right, there might be at most around 15 dangerous individuals to be removed from the population from 2021 to 2025. Therefore, the 50-70 individuals cited by the governor seem to be an exaggeration (see also Zamattio, 2023). It is recognized that fear toward predators may be used to promote populist parties (Von Hohenberg & Hager, 2022) and such parties may use fear in general for promoting environmentally unsustainable or unreasonable policies (see Atkins & Menga, 2022, and references therein). Given this, for avoiding potential excessive negative exposure, it is hoped that better local media management is implemented, as suggested by Tosi et al. (2015).

Conclusions

Several measures for limiting bear-human conflicts were proposed in the past and some of them seem to be already enacted (e.g., communication and bear-resistant trash bin); however, such measures seem not to be implemented enough and it is hoped that they will be more used and fine-tuned to the Trentino context in the future. Critically,

communication regarding the risk of meeting a bear with cubs during spring and summer is needed. At the same time, it should be suggested to go in groups during excursions, given that bears seem to mostly attack people who are alone or together with just another person. Calls for the legalization of the bear spray may increase in the future and it is desirable that such a solution would be used, given its efficacy.

In any case, mitigation measures should also consider the Trentino local context and it is absolutely necessary to involve the population as much as possible, given that it could potentially make the bears more accepted by individuals and reduce the possibility of a second conservation failure, after the one in the 20th Century.

The PACOBACE needs to be updated for re-defining what a "dangerous bear" is, given that the current definition is currently too loose and it leads to too much subjectivity. Given the previous case of KJ2 and the presence of a scale of dangerousness, the limit of "dangerous behaviors" could be put at two in case of attacks to humans or any action that would lead to the removal from the population. In addition, the PACOBACE absolutely has to define if two different risky actions done by bears are equal to repetition or if only two offenses of the same behavior are regarded as such.

Acknowledgements

I would like to thank Jen-Pan Huang, Gianluca Damiani and an anonymous reviewer for the suggestions on the manuscript.

Supplementary Data

A preprint, based on the first draft of this article, is available on EcoEvoRxiv (https://ecoevorxiv.org/repository/view/5696/, doi: 10.32942/X2V59H).

References

AA. VV. (2011). Supra-regional Action plan for the conservation of the brown bear in the Central-Eastern Alps - PACOBACE. Quaderni di Conservazione della Natura. 32 bis. Available at: https://www.hwctf.org/_files/ugd/7acc16_07aa035bcd75444fa3bc730e21947dc4.pdf (Accessed 16 May 2023).

Ansa (2022). Bear F43 dies during capture to replace radio collar. ANSA.it [news]. Available at: https://www.ansa.it/english/news/general_news/2022/09/06/bear-f43-dies-during-capture-to-replace-radio-collar_18ae0ea4-73d6-407e-9470-42ad4f73772e.html (Accessed 21 June 2023).

Ansa (2023). Trento court suspends second bear culling order. ANSA.It [news]. Available at: https://www.ansa.it/english/news/general_news/2023/04/22/trento-court-suspends-second-bear-culling-order_2512f762-cdba-4672-9ae3-4fadb5f644c6.html. (Accessed 22 May 2023).

Atkins E., Menga F. (2022). Populist ecologies. *Area* **54**(2), 224–232. doi: 10.1111/area.12763.

Benazzo A., Trucchi E., Cahill J.A., Maisano Delser P., et al. (2017). Survival and divergence in a small group: The extraordinary genomic history of the endangered Apennine brown bear stragglers. *Proc Natl Acad Sci USA* **114**(45) E9589-E9597. doi: 10.1073/pnas.1707279114.

Bombieri G., Nanni V., Delgado M.D.M., Fedriani J.M., López-Bao J.V., et al. (2018). Content analysis of media reports on predator attacks on humans: toward an understanding of human risk perception

and predator acceptance. *BioScience* **68**(8), 577–584. doi: 10.1093/biosci/biy072.

Bombieri G., Naves J., Penteriani V., Selva N., Fernández-Gil A., et al. (2019). Brown bear attacks on humans: a worldwide perspective. *Sci. Rep*. **9**(1), 8573. doi: 10.1038/s41598-019-44341-w.

Corradini A., Peters W., Pedrotti L., Hebblewhite M., Bragalanti N., et al. (2021). Animal movements occurring during COVID-19 lockdown were predicted by connectivity models. *Glob. Ecol. Conserv.* **32**, e01895. doi: 10.1016/j.gecco.2021.e01895.

Das M., Chatterjee B. (2015). Ecotourism: A panacea or a predicament? *Tour. Manag. Perspect.* **14,** 3–16. doi: 10.1016/j.tmp.2015.01.002

Dupré E., Genovesi P., Pedrotti L. (2000). Studio di fattibilità per la reintroduzione dell'Orso bruno (*Ursus arctos*) sulle Alpi centrali [Feasibility study for the reintroduction of the brown bear (*Ursus arctos*) in the Central Alps). Istituto nazionale per la fauna selvatica "Alessandro Ghigi". Available at: https://www.isprambiente.gov.it/public_files/studio-fatt-reintr-orso-bruno.pdf (Accessed 31 May 2023). Italian.

Forconi P. (2020). Orsi bruni marsicani (*Ursus arctos marsicanus*) problematici, abituati all'uomo o affamati? Sintomi, cause ed evoluzione del fenomeno [Marsican brown bears (*Ursus arctos marsicanus*, Altobello 1921) problematic, habituate to humans or hungry? Symptoms, causes and evolution of the phenomenon]. In: Guacci C. (ed). Orso bruno marsicano, verso una strategia di conservazione integrata [Marsican brown bear, toward an integrated conservation strategy]. Bologna (Italy): Palladino Editore; p. 121–153. Available at: https://www.researchgate.net/publication/342768410_Orsi_bruni_marsicani_Ursus_arctos_marsicanus_problematici_abituati_all%27uomo_o_affamati_Sintomi_cause_ed_evoluzione_del_fenomeno (Accessed 20 June 2023). Italian.

Giuffrida A. (2023a). Italy captures brown bear that fatally mauled jogger. The Guardian [news]. Available at: https://www.theguardian.com/world/2023/apr/18/italy-captures-brown-bear-fatally-mauled-runner-andrea-papi-animal-rights (Accessed 16 May 2023).

Giuffrida A. (2023b). Bear held for killing jogger in Italy is innocent, say animal activists. The Guardian [news]. Available at: https://www.theguardian.com/world/2023/may/09/bear-held-for-killing-jogger-in-italy-is-innocent-say-animal-activists (Accessed 16 May 2023).

Glikman J.A., Frank B., D'Amico D., Boitani L., Ciucci P. (2023). Sharing land with bears: Insights toward effective coexistence. *J. Nat. Conserv*. **74**, 126421. doi: 10.1016/j.jnc.2023.126421.

Groff C., Bragalanti N., Rizzoli R., Zanghellini P. (2015). 2014 Bear Report. Forestry and Wildlife Department of the Autonomous Province of Trento. 96 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/12924/230851/file/bear_report_14.pdf. (Accessed 22 May 2023).

Groff C., Angeli F., Asson D., Bragalanti N., Pedrotti L., et al. (2016). 2015 Bear Report. Autonomous Province of Trento's Forestry and Wildlife Department. 48 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/12923/230833/file/

Bear_report_2015_en.pdf. (Accessed 22 May 2023).

Groff C., Angeli F., Asson D., Bragalanti N., Pedrotti L., et al. (2017). Bear Report 2016 of the Forestry and Wildlife Department of the Autonomous Province of Trento. Autonomous Province of Trento's Forestry and Wildlife Department, 48 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/13856/242602/file/Rapporto%20Orso_2016_ENG.pdf (Accessed 31 May 2023).

Groff C., Angeli F., Asson D., Bragalanti N., Pedrotti L., et al. (2018). 2017 Large Carnivores Report. Autonomous Province of Trento's Forestry and Wildlife Department, 56 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/14245/248974/file/Rapporto_Grandi_carnivori_20171_ENG.pdf (Accessed 31 May 2023).

Groff C., Angeli F.., Asson D, Bragalanti N., Pedrotti L,, Zanghellini P. (2019). 2018 Large Carnivores Report. Forestry and Wildlife Department - Autonomous Province of Trento. 60 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/14454/250967/file/Rapporto%20Grandi%20carnivori_2018_ENG.pdf (Accessed 31 May 2023).

Groff C., Angeli F., Asson D., Bragalanti N., Pedrotti L., Zanghellini P. (2020). 2019 Large Carnivores Report. Forestry and Wildlife Department - Autonomous Province of Trento. 64 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/14572/252411/file/2019%20Large%20Carnivores%20Report.pdf (Accessed 31 May 2023).

Groff C., Angeli F., Bragalanti N., Pedrotti L., Zanghellini P., Zeni M. (2021). 2020 Large Carnivores Report. Autonomous Province of Trento's Forestry and Wildlife Department. 68 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/14817/255336/file/2020%20Large%20Carnivores%20Report.pdf (Accessed 22 May 2023).

Groff C., Angeli F., Baggia M., Bragalanti N., Pedrotti L., et al. (2022). 2021 Large Carnivores Report. Autonomous Province of Trento's Wildlife Department. 56 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/15005/257807/file/2021%20Large%20Carnivores%20Report.pdf (Accessed 22 May 2023).

Groff C., Angeli F., Baggia M., Bragalanti N., Zanghellini P., Zeni M. (2023). Rapporto Grandi Carnivori 2022. 60 pp. Available at: https://grandicarnivori.provincia.tn.it/content/download/15225/261518/file/Rapporto_Grandi_Carnivori_2022.pdf (Accessed 17 July 2023). Italian.

Human-Bear Conflicts Expert Team of the IUCN SSC Bear Specialist Group 2019. Approaches to Human - Bear Conflict Management. Available at: https://demo.acubedt.com/rwd_bsg/admin/resource/files/1b7e48edda41819df956d40a70ad2575.pdf. (Accessed 23 May 2023).

ISPRA (2023). Orsi problematici in Provincia di Trento: piano e azioni [Problematic bears in Trento province: plan and actions]. ISPRA [press news]. Available at: https://www.isprambiente.gov.it/it/istituto-informa/comunicati-stampa/anno-2023/orsi-problematici-in-provincia-di-trento-piano-e-azioni (Accessed 18 May 2023). Italian.

ISPRA-MUSE (2021). Orsi problematici in provincia di Trento. Conflitti con le attività umane, rischi per la sicurezza pubblica e

criticità gestionali. Analisi della situazione attuale e previsioni per il futuro Available at: https://grandicarnivori.provincia.tn.it/content/download/14763/254684/file/Documento%20ISPRA%20su%20orsi%20problematici%20(1).pdf (Accessed 17 May 2023). Italian.

Johansson M., Flykt A., Frank J., Støen O-G. (2019). Controlled exposure reduces fear of brown bears. *Hum. Dimens. Wildl.* **24**(4), 363–379. doi: 10.1080/10871209.2019.1616238.

Kaczensky P., Jerina K., Jonozovič M, Krofel M., Skrbinšek T., et al. (2011). Illegal killings may hamper brown bear recovery in the Eastern Alps. *Ursus* **22**(1), 37–46. doi: 10.2192/URSUS-D-10-00009.1.

Kaczensky P., Chapron G., von Arx M., Huber D., Andrén H., Linnell J. (2013). Status, management and distribution of large carnivores – bear, lynx, wolf & wolverine – in Europe. A large carnivore initiative for Europe report prepared for the European Commission (contract 070307/2012/629085/SER/B3). Available at: https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/task_1_part2_species_country_reports.pdf (Accessed 17 May 2023).

Krofel M., Elfström M., Ambarlı H., Bombieri G., González-Bernardo E., et al. (2020). Human–bear conflicts at the beginning of the twenty-first century: patterns, determinants, and mitigation measures. In: Penteriani V, Melletti M, editors. Bears of the World. 1st ed. Cambridge (UK): Cambridge University Press; p. 213–226. doi: 10.1017/9781108692571.016.

Lennox R.J., Gallagher A.J., Ritchie E.G., Cooke S.J. (2018). Evaluating the efficacy of predator removal in a conflict-prone world. *Biol. Conserv.* **224**, 277–289. doi: 10.1016/j.biocon.2018.05.003.

LIFE Public Database (2021). Life 3. 0 - Life project public page. Available at: https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.dspPage&n_proj_id=1731 (Accessed 17 May 2023).

Linnell J., Salvatori V., Boitani L (2008). Guidelines for population level management plans for large carnivores in Europe. A Large Carnivore Initiative for Europe report prepared for the European Commission (contract 070501/2005/424162/MAR/B2). Available at: https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/guidelines_for_population_level_management.pdf. (Accessed 17 May 2023) .

Loy A., Genov P., Galfo M., Jacobone M.G., Vigna Taglianti A. (2008). Cranial morphometrics of the Apennine brown bear (*Ursus arctos marsicanus*) and preliminary notes on the relationships with other southern European populations. *It. J. Zool.*. **75**(1), 67–75. doi: 10.1080/11250000701689857.

Majić A., Marino Taussig de Bodonia A, Huber D., Bunnefeld N. (2011). Dynamics of public attitudes toward bears and the role of bear hunting in Croatia. *Biol. Conserv.* **144**(12),3018–3027. doi: 10.1016/j.biocon.2011.09.005.

Marino F., Kansky R., Shivji I., Di Croce A., Ciucci P., Knight A.T. (2021). Understanding drivers of human tolerance to gray wolves and brown bears as a strategy to improve landholder–carnivore coexistence. *Conserv. Sci. Prac.* **3**:e265. doi: 10.1111/csp2.265.

McLellan B.N., Proctor M.F., Huber D., Michel S. (2017). *Ursus arctos*. The IUCN Red List

of Threatened Species 2017. e.T41688A121229971. doi: 10.2305/IUCN.UK.2017-3.RLTS.T41688A121229971.en.

Nast C. (2023). A fatal bear attack fuels a fight over rewilding. Wired UK [news]. Available at: https://www.wired.co.uk/article/rewilding-italy-bear-attack (Accessed 16 May 2023)

Neri L. (2021). Humans or bears: why not both? The creation of an analytical framework to assess the transferability of non-lethal measures to mitigate the human-bear conflict and its application to the Trentino-Alto Adige (Italy) case. [master's thesis]. Utrecht University. Available at: https://studenttheses.uu.nl/handle/20.500.12932/39912 (Accessed 16 May 2023).

Penteriani V., Bombieri G., Del Mar Delgado M., Sharp T., Yamazaki K., et al. (2020). Patterns of bear attacks on humans, factors triggering risky scenarios, and how to reduce them, p. 239–249. In: Penteriani V., Melletti M. (Eds). *Bears of the World*. 1st ed. Cambridge (UK): Cambridge University Press; doi: 10.1017/9781108692571.018.

Penteriani V., Delgado M.D.M., Pinchera F., Naves J., Fernández-Gil A., et al. (2016). Human behaviour can trigger large carnivore attacks in developed countries. *Sci. Rep.* **6**(1):20552. doi: 10.1038/srep20552.

Peters W., Hebblewhite M., Cavedon M., Pedrotti L., Mustoni A., Zibordi F., et al. (2015). Resource selection and connectivity reveal conservation challenges for reintroduced brown bears in the Italian Alps. *Biol. Conserv.* **186,**123–133. doi: 10.1016/j.biocon.2015.02.034.

Salvatori G. (2023). Cull or save? Italy wrestles with the fate of rewilded bear that killed a jogger in the Alps. Euronews [news]. Available at: https://www.euronews.com/green/2023/04/17/culling-or-relocation-italy-debates-fate-of-a-bear-that-killed-a-jogger (Accessed 16 May 2023).

Smith T.S., Herrero S., Debruyn T.D., Wilder J.M. (2008). Efficacy of bear deterrent spray in Alaska. *J. Wildl. Manag.* **72**(3), 640–645. doi: 10.2193/2006-452.

Støen O.-G., Ordiz A., Sahlén V., Arnemo J.M., Sæbø S., et al. (2018). Brown bear (*Ursus arctos*) attacks resulting in human casualties in Scandinavia 1977–2016; management implications and recommendations. *PLoS ONE* **13**(5), e0196876. doi: 10.1371/journal.pone.0196876.

Støen O.-G., Ordiz A., Elfström M., Hertel A.G., Sahlén V., et al. (2020). Effects of human disturbance on brown bear behavior, p. 250–259. In: Penteriani V., Melletti M. (eds). *Bears of the World*. 1st ed. Cambridge (UK): Cambridge University Press;. doi: 10.1017/9781108692571.019.

Swenson J.E., Ambarlı H., Arnemo J.M., Baskin L., Ciucci P., et al. (2020). Brown bear (*Ursus arctos,* Eurasia) p. 139–161. In: Penteriani V., Melletti M. (eds). *Bears of the World*. 1st ed. Cambridge (UK): Cambridge University Press; doi: 10.1017/9781108692571.013.

Tattoni C., Grilli G., Cioll. M. (2017). Advertising value of the brown bear in the Italian Alps. *Ursus*. **27**(2):110-121. doi: 10.2192/URSU-D-16-00011.1.

Tondo L. (2023). Italian court suspends order to put down bear that killed jogger. The Guardian [news]. Available at: https://www.theguardian.com/world/2023/apr/14/italian-court-suspends-order-to-put-

down-bear-that-killed-jogger (Accessed 16 May 2023).

Tosi G., Chirichella R., Zibordi F., Mustoni A., Giovannini R., et al. (2015). Brown bear reintroduction in the Southern Alps: To what extent are expectations being met? *J. Nat. Conserv.* **26**, 9–19. doi: 10.1016/j.jnc.2015.03.007.

Ufficio Stampa Provincia Autonoma di Trento (2023). M62, probabile la morte causata dall'attacco di un orso adulto. [M62, death probably caused by an adult bear's attack]. Available at: https://grandicarnivori.provincia.tn.it/News/M62-probabile-la-morte-causata-dall-attacco-di-un-orso-adulto. (Accessed 23 May 2023). Italian.

von Hardenberg W.G. (2017). Another way to preserve: hunting bans, biosecurity and the brown bear in Italy, 1930–60, p. 55-75. In: von Hardenberg W.G., Kelly M., Leal C., Wakild E. (Eds) *The Nature State: Rethinking the History of Conservation*. 1st ed. New York (NY): Routledge;.

Von Hohenberg B.C., Hager A. (2022). Wolf attacks predict far-right voting. *Proc Natl Acad Sci USA*. e2202224119. doi: 10.1073/pnas.2202224119.

WWF Italia (2023). Un nuovo documento per la coesistenza uomo-orso nelle Alpi (A new document for human-bear coexistence in the Alps). Available at: https://www.wwf.it/pandanews/animali/un-nuovo-documento-per-la-coesistenza-uomo-orso-nelle-alpi/. (Accessed 18 May 2023). Italian.

Zamattio M. (2023). Il professore della Sapienza: «A uccidere Andrea Papi è stata Jj4, la genetica non è discutibile». Corriere della Sera [news]. Available at: https://corrieredeltrentino.corriere.it/notizie/cronaca/23_maggio_10/il-professore-della-sapienza-a-uccidere-andrea-e-stata-jj4-la-genetica-non-e-discutibile-725fcea1-407a-487d-8dd5-9977bf3e1xlk.shtml (Accessed 18 May 2023). Italian.

Bulletin of Regional Natural History (BORNH) ISSN 2724-4393.