Special feature

BROWN BEARS AND DAMAGE PREVENTION: THE TRENTINO EXPERIENCE IN THE ITALIAN ALPS

Matteo Zeni

Large Carnivores Office, Forestry and Wildlife Service, Autonomous Province of Trento, Via GB Trener 3, 38019 Trento, ITALY
Contact: matteo.zeni@provincia.tn.it

1. Background

After the collapse of brown bear *(Ursus arctos)* numbers throughout the Alps due to environmental overexploitation and direct persecution arising from competition for resources, atavistic fears and government bounties, only a tiny relict population of bears persisted which slowly dwindled away during the 20th century. The last stronghold of Alpine bears was in the western portion of Trentino, Italy. Despite early legal protection of the species (from 1939) and some willing but naïve and unsuccessful attempts to recover the population through the release of captive-born young bears in 1959, 1969 and 1974, by the beginning of the 1990s the relict population was considered biologically extinct: only a few old individuals survived in the Brenta Dolomites range, without any indication of reproduction (Fig. 2, page 2).

In an effort to save the species in the Central Alps, a complex and ambitious project, LIFE Ursus[1,2], was

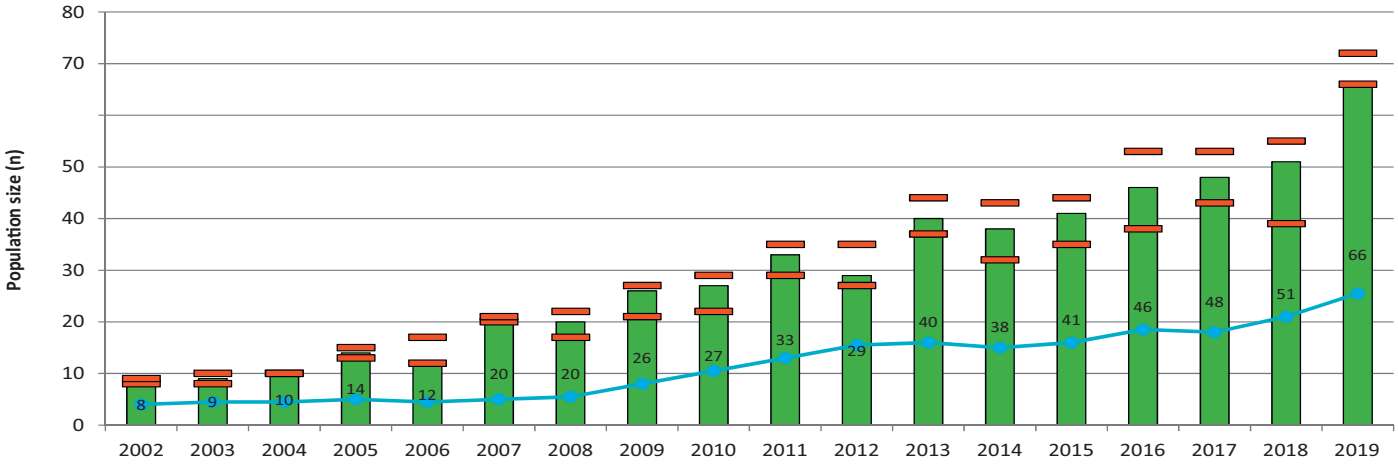

Fig. 1 Growth of the Central Alps brown bear population (excluding cubs), showing minimum and maximum annual estimates (red), the minimum certain number of individuals per year determined retrospectively using all available data (green) and effective population size Ne, i.e. estimated number of reproductive individuals (blue). *Source: APT Forestry and Wildlife Service.*

[1] https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=120
[2] https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=1731

Fig. 2 Probably the last native Alpine bear, an almost blind old male, captured by a trail camera in March 2000. It was repeatedly seen stalking young Slovenian females, trying to mate, but without success. The old bear died, presumably of natural causes, in the spring of 2002.
(Photo: C. Groff, APT Forestry and Wildlife Service archive)

Fig. 3 Brown bear female with three yearling cubs, newly emerged from their den in Western Trentino.
(Photo: M. Vettorazzi, APT Forestry and Wildlife Service archive)

developed by Adamello Brenta Nature Park with the participation of the Autonomous Province of Trento (Provincia Autonoma di Trento) and the National Wildlife Institute (ISPRA). Between 1999 and 2002, ten wild-born brown bears were captured in southern Slovenia, transported to Italy and released in Tovel Valley in the Brenta Dolomites. The newcomers did not waste time: what happened next is history, and daily news (Fig. 3). Just a decade since the last Slovenian bear was released in Trentino, there were more than 40 bears in the area including cubs. After another decade, this number has doubled (Groff et al., 2013; Groff et al., 2020) (see Fig. 1, page 1, for the growth trend and Fig. 4 for the geographic distribution).

These bears live in an ecologically rich and diverse landscape, with olive trees and glaciers just 15 km apart, where both natural and agricultural foods are abundant and easily available (Figs. 5, 6). But this lush, extremely varied environment is also teeming with people and infrastructure. Such a high level of proximity between bears and humans brings greater trophic opportunities for bears, but also leads to close encounters and damage to livestock, orchards and apiaries, making it difficult to build a new, more positive relationship between the species. In order to mitigate conflicts, a strengthened management programme to prevent damage by bears has been implemented since 2002. In this article, I present a summary of this programme, including a brief summary of what has worked or not worked and what, in the view of my department, still needs to be improved.

2. Conflict management

The Autonomous Province of Trento (APT) has financed damage prevention measures such as fences and livestock guarding dogs (LGDs) and compensated bear damage since 1976. To cope with the increasing complexity of coexistence since the LIFE Ursus project and the increase in bear numbers, the management system has been refined over time. The re-

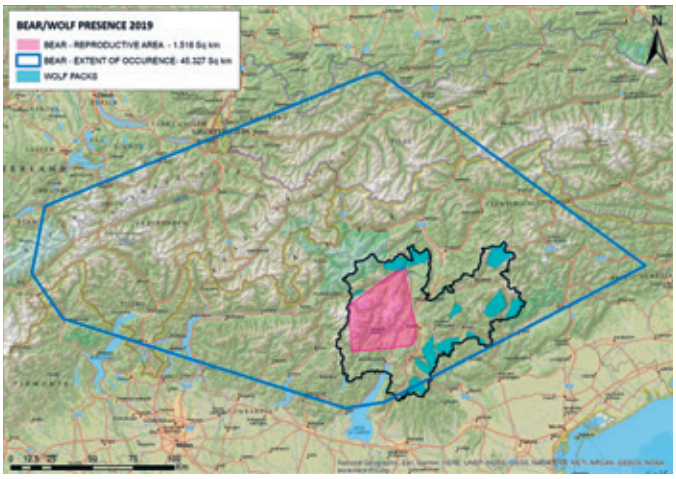

Fig. 4 The Autonomous Province of Trento, northern Italy, showing the core area of the Alpine bear population (pink shading) and recently established wolf packs (blue shading). The blue line indicates the maximum area of exploratory/dispersal movements of male bears. *Data: APT Forestry and Wildlife Service.*

Fig. 5 A young brown bear emerges from tree cover in the evening hours in Val d'Ambiez, Dolomiti di Brenta.
(Photo: M. Zeni, APT Forestry and Wildlife Service archive)

Fig. 6 Bear country: a large male brown bear is captured by a trail camera in Sporeggio Valley, Dolomiti di Brenta.
(Photo: M. Zeni, APT Forestry and Wildlife Service archive)

sponsible body is the APT Forestry and Wildlife Service (Servizio Foreste e Fauna), by means of the Large Carnivores Office (Settore Grandi Carnivori), comprised of a coordinator, two wildlife biologists and two damage prevention and compensation managers. Ten damage prevention assistants (with ten deputies) support the Large Carnivores Office in the field in ten different districts, with the help of 53 damage supervisors. Since 2011 there has been a similar management structure for the wolf *(Canis lupus),* which has expanded rapidly since its return to the province and by the end of 2019 there were at least 13 breeding packs (Groff et al., 2020) (Fig. 4).

2.1 Prevention measures

Measures to prevent damage by bears are mostly based on the loan or financing by APT of electric fences for apiaries and electric fences and/or LGDs for livestock and, in some cases, of wooden fences with electric wiring for livestock and permanent 'bee huts' (small wooden buildings to protect beehives), with funds from the EU Rural Development Programme (RDP) (Table 1).

2.2. Compensation

If damage by bear (or wolf) is suspected to have occurred, an inspection by a damage supervisor almost always follows within 24 hours (98% of cases). Self-certification is permitted in limited cases, generally concerning minor damage, e.g. a few poultry. In such cases, the affected person calls an emergency number to report the damage, provides pictures and fills out a self-certification form.

The full value of damaged items is refunded, usually within 60 days. Prices for livestock and apiaries are set every few years during a round-table with stakeholders' organisations. Compensation is not provided if the owner received damage prevention equipment from APT but did not use it properly. Whenever possible or appropriate, and in all cases when damage occurs, APT damage prevention assistants and supervisors inspect prevention equipment to assess if it is being used properly. A major, pre-arranged inspection, aiming to check 25% of loaned or financed fences (randomly selected) is currently under way. Data are not yet available.

2.3 Other mitigation tools

Other important means of conflict mitigation concern the management of bears. An emergency number is available nonstop, year-round, to report any incidents or damages. One of the 20 officers of the APT Forestry and Wildlife Service answers calls concerning large carnivores, providing information and support and dispatching damage supervisors or the emergency team, as appropriate. The emergency team is actually composed of seven teams of two operatives each (and a vet, if necessary) and is ready to act, 24/7, from 1st March to 30th November in the event of an emergency (e.g. a wounded bear, a bear attack, the persistent presence of a bear near settlements or livestock, etc.).

Table 1 Damage prevention measures loaned or financed by the Autonomous Province of Trento to mitigate damage by bears and wolves.

Duration	Conditions	Description
Electric fences (bear and wolf)		
Temporary use – emergency cases and during summer grazing of livestock in alpine pastures	Free loan (generally up to four months)	Mobile netting and multi-wire fences, up to 500 m depending on herd size (night corrals)
Long-term use	Free loan (after eight years the farmer can ask for a new fence; damaged items are repaired and fences recycled if no longer used)	Mobile netting and mobile/ semi-permanent multi-wire fences. Up to 250 m for apiaries, depending on the number of beehives, and up to 500 m for livestock, depending on herd size (night corrals)
Long-term use	Acquisition costs compensated: 90% for beehives and sheep/goats, 60% for cattle/equines	Mobile netting and mobile/ semi-permanent/permanent multi-wire fences. Up to 250 m for apiaries, depending on the number of beehives, and up to or more than 500 m for livestock, depending on herd size (night corrals)
Livestock guarding dogs (bear and wolf)		
Long-term use	Acquisition costs compensated: 90% for sheep/goats, 60% for cattle/equines	Pups of Maremmano-Abruzzese breed (mean market price 850 EUR)
Housing modules, to allow permanent presence of shepherds (bear and wolf)		
Temporary use – summer season in alpine pastures	Free loan (where permanent buildings are not available, up to four months)	Simple shelters (transported by helicopter to alpine pastures)
Wooded fences with electric wiring to protect livestock (bear and wolf), permanent apiaries or 'bee huts' (bear)		
Long-term use	Acquisition costs compensated: 60% of permanent, traditional wooded fences with electric wiring; 60% of permanent wooden 'bee huts'	Traditional wooden fences with electric wiring (up to or more than 500 m), permanent wooden 'bee huts'

A bear capture team is also available, formed of up to seven APT staff and one or two vets. Since 2006, 28 different bears have been captured in 41 separate capture events. This team may act to help injured bears or orphaned cubs, to fit bears with GPS/VHF collars for research or management or to capture/euthanise problem bears. Six bear dogs (Russo-European Laika and Jamthund), working with six specialised handlers, are also ready to act, including aversive conditioning of habituated or food conditioned bears (Fig. 7), investigation of bear-vehicle collisions and collection of genetic samples (e.g. at damage sites). Bear dogs belong to ancient, Nordic breeds (primitive spitz), traditionally used in Russia and Fennoscandia to hunt large wildlife (e.g. brown bear, moose, wild boar). They are reactive, agile dogs with strong instincts to hunt using their eyes and ears as much as their sense of smell. They silently search for and find prey, then they stalk and stop it, barking, waiting for their handler to come. Bear dogs have been used by agencies in North America and, more recently, also in Europe to manage bears (e.g. by aversive conditioning). They are also useful for finding genetic samples.

Individual bears implicated in attacks on humans or several episodes of damage ('problem bears') may be removed from the population and either placed in permanent captivity or euthanised, if prevention measures and multiple aversive conditioning actions fail to deter the bear from its problematic behaviour. This protocol is in accordance with the Alpine Bear Interregional Action Plan (AA.VV, 2010), agreed with the Ministry of the Environment, other Alpine regions of Italy and ISPRA.

To keep bears away from garbage, which is a particularly dangerous cause of food conditioning, bear-proof organic waste bins have been installed, starting

Fig. 7 Bear dog in action: aversive conditioning of a young, food conditioned bear (frame from a smartphone video).
(Photo: M. Baggia, APT Forestry and Wildlife Service archive)

in locations where young bears were attracted by garbage, and 240 organic waste bins have been modified by APT to be bear-proof. More bear-proof bins will be provided in the future.

2.4 Measures implemented and compensation paid

APT invests tens of thousands of euros each year on damage prevention measures (Fig. 8). From 1998 to 2019, a total of 1,318 electric fences were donated to farmers. Of these, 1,020 were entirely paid by APT,

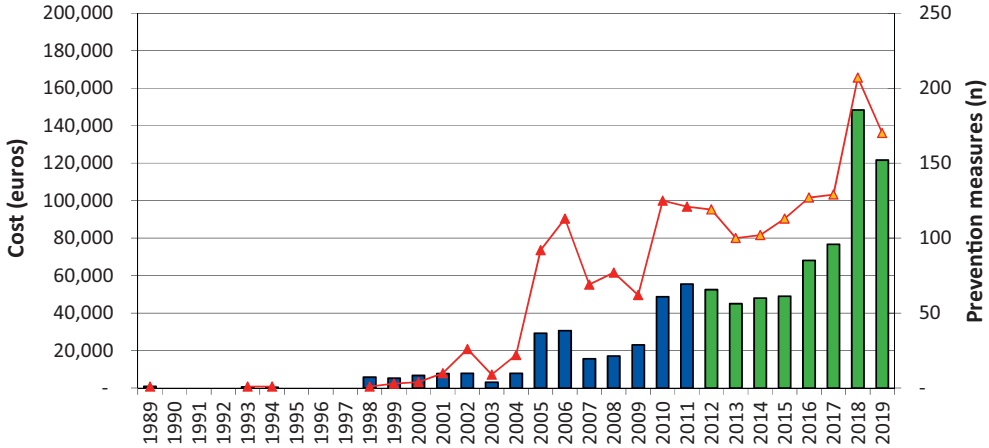

Fig. 8 Number (line) and economic value (bars) of prevention measures distributed by the Autonomous Province of Trento since 1989. Ten bears were released in the area in 1999-2002 as part of the LIFE Ursus project and wolves have been naturally recolonising the province since 2012.
(Data: APT Forestry and Wildlife Service)

Fig. 9 Multi-wire mobile fences to prevent brown bear damage to beehives. *(Photos: Daniele Asson, APT Forestry and Wildlife Service archive)*

Fig. 10 Multi-wire, semi-permanent electric fence to prevent large carnivore attacks on livestock. *(Photo: APT Forestry and Wildlife Service archive)*

279 partly by the LIFE Arctos[3] project and partly by APT and 19 partly by the LIFE DinAlp Bear[4] project and partly by APT. Each fencing unit included an energiser and batteries plus netting or multiple wires (Figs. 9, 10). During the same period, an additional 147 electric fences were co-financed (60 or 90% of the costs).

From 2014 to 2019, 53 pups of the Italian Maremmano-Abruzzese LGD breed were financed by APT (Fig. 11). On average, 15 housing modules per season are placed on high pastures (mainly sheep and goat pastures), to promote the permanent presence of shepherds near flocks during the summer season, where permanent buildings are not available (Fig. 12). Additionally, from 2016 to 2019, 14 wooden fences and five 'bee huts' were financed from the EU RDP.

Overall, since 1998 nearly 1,500 electric fences have been directly distributed or financed in Trentino, involving almost as many people (farmers and beekeepers). Despite this, increasing numbers of bears and the recent, rapid return of wolves have led to an increase in the mean annual number of damage events (Figs. 14, 15). Bear damage is increasing, in some years due to the activity of particularly active problem bears but, overall, following the increase in bear numbers and expansion of the population, with increasing damage to agricultural crops (Fig. 16), which are compensated by APT although not protected by

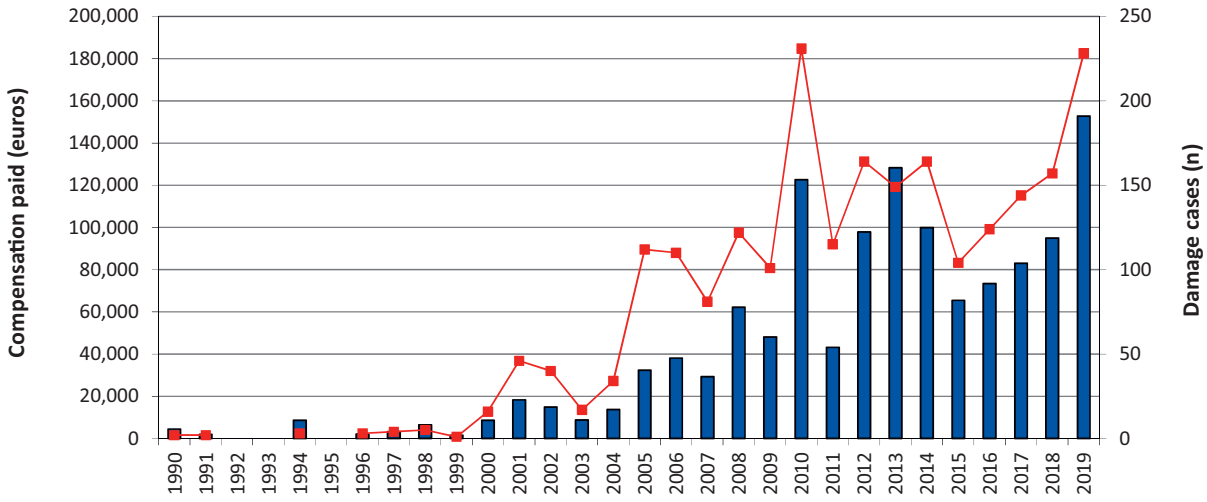

Fig. 14 Number of cases of bear damage (line) and compensation paid (bars) in Trentino since 1990. Peaks often relate to the activity of problem bears, i.e. single bears particularly inclined to cause damage. *(Data: APT Forestry and Wildlife Service)*

[3] http://www.life-arctos.it/ [4] https://dinalpbear.eu/en/

Fig. 11 Electric netting and Maremmano-Abruzzese LGD to prevent wolf and bear predation on livestock.
(Photo: D. Asson, APT Forestry and Wildlife Service archive)

Fig. 12 Housing module transported by helicopter to a summer pasture lacking shelter for shepherds.
(Photo: M. Zeni, APT Forestry and Wildlife Service archive)

prevention measures. (This is expected to change in 2021, when it will become necessary for professional farmers to insure against damage by large carnivores.) There is also increasing damage to livestock and apiaries in recently colonised areas, where prevention measures are uncommon.

3. Conclusions and Recommendations

Further growth of the bear population (numbers, possibly also density and a slow but steady expansion of the core area, i.e. the female range) is expected for western Trentino. An increasingly fast and strong comeback of the wolf is expected for the whole of the province. Such a scenario will require an even stronger commitment of the APT Forestry and Wildlife Service in the years to come, notwithstanding the complex organisation described and the many measures implemented and inspected, in order to cope with the future challenges of coexistence.

What has worked - Trentino Forestry and Wildlife Service is highly committed to preventing and compensating damage by carnivores and, through its responsive emergency team, has proven very effective in the last two decades, helping the bear population to grow, even in a highly human-dominated landscape where the probability of conflict is inherently high. When wolves started to return, this well-practiced organisation was ready to deal with them as well. If properly installed and maintained, electric fences are highly effective at preventing damage to beehives and livestock. In the case of livestock, this is especially true if there is also close human vigilance, and even more so if LGDs are also present. Without the great efforts made by APT in the field of damage prevention and compensation, the Alpine bear population would probably not have even become re-established.

What has not worked so well - Some electric fences are poorly maintained. The major inspection currently under way is aimed at quantifying the extent of the problem and fixing it. Better communication with farmers and beekeepers and tighter control are also needed. Another emerging issue is related to LGDs: if not properly socialised while young, such dogs may act too aggressively towards hikers and bikers, who are ever-present in the Alps.

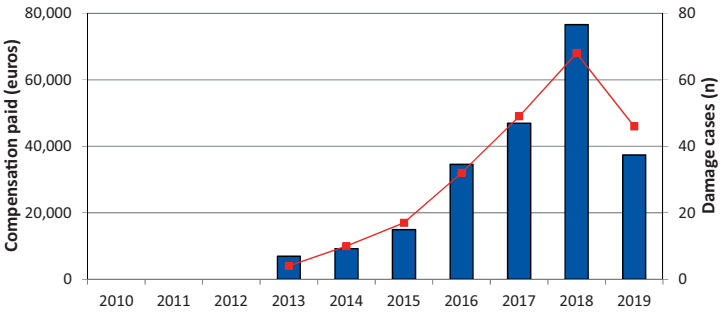

Fig. 15 Number of cases of wolf damage (line) and compensation paid (bars) in Trentino since the recent return of the species. The reduced level of damage in 2019 compared to 2018 occurred despite a doubling in the number of wolf packs from seven to 13 and may be a result of the adoption of prevention measures. However, an increase in damage is expected in subsequent years as the species continues to recolonise the province.
(Data: APT Forestry and Wildlife Service)

There are several major issues that need to be addressed. First, increasing polarisation between pro- and anti-bear people, enhanced by mass media and social networks, often exacerbated by fake news, complicates bear management. Furthermore, increasing pressure from animal rights extremists greatly affects APT's ability to effectively manage problem bears, which are increasing as the bear population expands and are responsible for much of the damage and cause many complaints among rural people. Second, attacks on people are on the rise: defensive attacks by bears (usually females protecting their cubs) sometimes require hospitalisation of victims. In the western Trentino Alps, relatively 'numerous' bears live alongside the many humans (both residents and tourists) who frequent the area without knowing much about bears, how to avoid them or how to manage close encounters. Moreover, bear spray, an effective defensive tool which is widely used in North America and increasingly available in several European countries, is forbidden in Italy. Third, despite a long-term campaign, there is still insufficient communication about large carnivores. A recent political shift in the APT administration has further undermined the communication effectiveness of the Large Carnivores Office.

Fig. 16 A female genetically identified as F5 ventures out of the forest, looking for plums under the cover of darkness. *(Photo: M. Zeni, APT Forestry and Wildlife Service)*

Coexistence between bears and people in the Alps, the most anthropised mountain range in the world, brings important challenges for the years to come. To ensure a future for bears, great efforts by local and national governments are needed. In our opinion, the Autonomous Province of Trento must continue to secure funds for prevention measures. With the expanding trend of the bear population, neighbouring regions will probably soon have to do the same. The communication campaign must be improved, above all concerning prevention and management of damage as well as of close encounters. Bear spray should be legalised and steps taken to prevent bears becoming food conditioned.

We have to be more effective in managing problem bears, including removing them when necessary. This may, as a side effect, help increase acceptance by local communities of possible future releases of bears from Slovenia or Croatia, which would be desirable to increase the genetic variability of the Alpine bear population (the current population has only seven founders: two males and five females). We also need to achieve better communication with stakeholders. Human dimensions is, and always should be, a central discipline in the management of large carnivores. Animal rights extremism is a serious matter and, if not properly managed, could damage the delicate balance of coexistence between local communities and bears.

For more information on large carnivores and their management in Trentino, annual reports are available from the APT website[5] in Italian, English and, since 2019, also German.

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[5] https://grandicarnivori.provincia.tn.it/Rapporto-Orso-e-grandi-carnivori