



The mysterious apennine brown bear and his conservation in Central Italy

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Head of a female Apennine bear showing the black area around the eyes already noted by the great zoologist Carlo Luciano Bonaparte (Photo courtesy Antonio Macioce)

see Gippoliti & Groves, 2018).

The European continent may appear at first sight particularly impoverished as biodiversity is concerned. Is this due to biogeographical factors or/and to the long history of civilization here, that had a tremendous impact on biomes and biodiversity? Probably all these factors had a role, yet there is another issue that has received so far little attention; i.e. has been European biodiversity properly studied and described? This is clearly a concern specifically for Mammals as I will show with example from the genus *Rupicapra*. At the beginning of the Twenty Century the Italian zoologist Lorenzo Camerano assembled at the Turin Zoological Museum a rich collection of chamois skins and skulls from most of Europe and reached the conclusion that there were three clearly distinct groups; *pyrenaica* from the Iberian Peninsula; *ornata* from the Apennine and *rupicapra* from the rest of the range (Camerano, 1916). He considered them three distinct species but later a more conservative approach prevailed and a single species was recognized for most of the Century. Only one hundred years later genomic data have revealed that effectively three distinct groups seems to exist despite a history of ancient hybridization already suggested by Camerano (for an overview,



Several Apennine bears (mainly females or subadult males) are living close to humans, fortunately without any incident so far (Photo courtesy Michele Fallucchi)

In the last five years the Società Italiana per la Storia della Fauna “Giuseppe Altobello” has actively promoted a more aggressive approach to conservation of the small Apennine brown bear population, reduced to not more than 60 individuals mostly centered in the Abruzzi, Lazio and Molise National Park (PNALM) where the only breeding nucleus exists (while males move over a large area reaching the Sibillini Mountains to the north). This population was described as a new subspecies, *Ursus arctos marsicanus* by Giuseppe Altobello in 1921 but zoologists such as Carlo Luciano Bonaparte and Theodor Knottnerus-Meyer had already advanced the hypothesis that the bear from the Apennine belonged to a different taxon. It seems that Bonaparte observed at least a skin of Apennine bear, noting a black patch around the eyes that he had never seen previously. Knottnerus-Meyer, while director of the Rome Zoo, had a young male bear between 1913-1914 and immediately declared it belonged to a different species. The presence of the bear and of an endemic chamois species offered a further critical motivation to create the Abruzzo National Park in 1922, saving these two taxa from almost sure extinction.

Bear conservation in the EU and the overlooked demise of the Apennine bear

As in most of the rest of the world, no intraspecific taxonomic units have been accepted by bear experts in Europe (Swenson et al., 2011). Accordingly, it has been emphasized that the Balkan bear population would appear to satisfy all criteria to serve as a source population for future reintroduction projects in Western Europe. This approach to brown bear conservation in Europe has been challenged with specific reference to the small isolated Apennine brown bear population whose only breeding nucleus is found in the PNALM (Guacci et al., 2013). The original description of *U. arctos marsicanus* Altobello, 1921, based on limited materials, was rightly dismissed by Pocock (1932) who was well aware of the considerable morphological variability found in *U. arctos*. Yet this view has been shared without any further study of new materials throughout the 20th Century, a period of taxonomic inertia for European mammalogy (Gippoliti

& Groves, in press).

According to early genetic studies (Randi et al., 1994), this population belongs to the western brown bear clade 1b together with the Balkan populations, and showed negligible differentiation. But later both Randi (2003) and Lorenzini et al. (2004) indicated that differences in mitochondrial DNA and microsatellites suggest the status of a distinct Management Unit. Furthermore, there is mounting evidence for a considerable phenotypic distinctiveness of Apennine brown bears – specifically of its skull (Conti, 1954; Loy et al., 2008; Colangelo et al., 2012), to the extent that all these authors accepted *marsicanus* as a valid



A fully adult male showing a darker coloration than females (Photo courtesy Antonio Macioce)

taxon. Capasso Barbato et al. (1993), while discussing the cranial characters of extant *U. arctos* populations and *U. spelaeus*, confirmed that *marsicanus* share some peculiarities with *spelaeus*, as already evidenced by Conti (1954). Recently Meloro et al (2017) studied the mandible of several *Ursus arctos* subspecies and found that the Apennine bear have a mandible with very thick corpus below the canine region, a relatively long diastema, a wide long and thick molar crushing area.

These shape features can be functionally associated with the high consumption of hard mast by Apennine bears and are also supported by parallel studies on its cranial morphometry that highlighted changes in regions of masticatory muscles. The skull of *U. arctos marsicanus* is characterized by an enhancement of the distance across the zygomatic arches and an expansion of the supraorbital apophysis, with consequent facial broadening. This could indicate a wider space for the temporal muscle that passes through the zygomatic arch and attaches at the coronoid process. The enlargement of the temporal fossa also contributes to the distinction of the Apennine bear in the



ventral view of the skull, whereas the palatal region appears more invariant among the Western bear populations

Skull of an adult male. The pronounced forehead, typical for this species, is clearly visible (Photo courtesy Jacopo Conti)

(Colangelo et al., 2012). This exceptional situation can hardly be explained simply as the result of 'genetic drift' due to isolation from the main continental bear population in the last 400-700 years.

At this point, one would surely have expected a revision of conservation policies both nationally and at the EU level. Nothing of the kind happened. Guacci et al. (2013) called for a more incisive

conservation strategy for this endemic Italian taxon, including, if necessary, captive breeding and a bank of biomaterials - an aspect that is not considered in the National Action Plan (Ministry of the Environment, 2011), but is pursued in Spain through semen collection from live individuals or post-mortem recovery of epididymal spermatozoa.

Actually, conservation authorities and bear researchers continue to emphasize ecological connectivity between Apennine protected areas to create new breeding nuclei and reduction of human-induced mortality. If such an approach should not lead to positive results (for instance due to female brown bear philopatry and thus dispersal avoidance outside their natal range), no alternative strategy seems to exist - or, better, the only available way to maintain genetic variability and increase range size in the future should be to bolster this population with individuals from the closest viable wild population, as done elsewhere. Even if this intervention should vigorously follow the IUCN Guidelines for reintroductions and other conservation translocations, it is obvious that, given the unique status of *U. arctos marsicanus* among brown bears, no candidate population does in fact



exist. As was also stressed by Randi (2003), “there should be distinct conservation managements for the Alpine and Apennine brown bear populations, and the Apennine brown bears should be managed as an Evolutionary Significant Unit (ESU)”. It needs to be emphasized that, although the small population size (about 50 individuals, including circa 13 breeding females; cfr. Ciucci et al., 2015), is obviously a cause of concern, so far no obvious effects of inbreeding has been reported. Although captive-breeding is not generally considered a viable option for brown bear conservation, it has been stressed by Guacci et al. (2013) that release of orphan bears is a common practice in several parts of the world. Thus, if it is necessary to save a threatened taxon, captive-bred cubs could be released adopting a similar methodology. Although starting a captive breeding program is a considerable risk with this current population status, it should be stressed that in the last decade of the 20th Century four individual Apennine brown bears have been maintained in captivity (roughly 10% of adult wild population) without any serious attempt to breed these bears being done - this because of the assumption that captive-bred bears could not be successfully released back to the wild. But, apart from captive breeding, it is time to recognize that our goal in Central Italy is the conservation of *U. arctos marsicanus* - an endemic taxon - and not simply the conservation of the brown bear Apennine population.

A last authoritative scientific contribution was published in late 2017. Benazzo et al. (2017) performed whole-genome sequencing of six Apennine bears comparing it with Iberian and Balkan *Ursus arctos* and divergence time was estimated at 3000-4000 years. They found evidence of two evolutionary processes with opposite outcomes: active maintenance of variation at specific families of genes and fixation by drift of several deleterious alleles. Their results thus support the view that, even in small populations, the random loss of variation does not affect all sites in the same way, and their work further contribute to the general debate about the relative

For comparison, the skull of a brown bear of the Alpine population, (Photo courtesy Jacopo Conti)

role of drift and selection when the effective population size is very small. Interestingly, Benazzo et al. conclusion that “On the other hand, the recognition of the Apennine bear as an Italian iconic endangered taxon, the possible risk of introducing aggressiveness genes and deteriorating the relatively peaceful human–bear coexistence in central Italy, and the current levels of variation at relevant immune and olfactory genes suggest avoiding genetic rescue.” (Benazzo et al., 2017) fully overlap the suggestion of Gippoliti (2016) and strongly departs from the orthodoxy of bear management in Europe. They also stated that “If direct evidence of inbreeding depression will be reported in the future, the genetic rescue option should be reconsidered”. It is a great regret that this latter sentence received considerable emphasis on the press, despite lack of any evidences that inbreeding depression is occurring. The PNALM announces that 12 cubs from six females have been counted in this last breeding season, confirming that stasis of population size is not due to breeding problems but to other reasons, possibly related to the high density of bears around the PNALM area.

We at the Società Italiana per la Storia della Fauna “Giuseppe Altobello” will continue to ask for a scientific approach to conservation of *Ursus arctos marsicanus*. We do it for the scientific, cultural and economic value of this particular bear population but we also think that if Europe really wish to be an international model of environmental sustainability, it must learn to recognize and effectively save first the hidden biodiversity inside its borders.

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