Biogeographia – The Journal of Integrative Biogeography 36 (2021): s003
SPECIAL SECTION: Citizen Science in Biogeography
https://doi.org/10.21426/B636050885

Citizen science project on Alpine ibex, *Capra ibex*, in the Orobie Alps

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Keywords: Alpine ibex, citizen science, photography contest, Orobie Alps.

SUMMARY

The Alpine ibex is one of the finest examples of how human's attitude towards nature is changing by becoming aware of biodiversity conservation. On the 30th anniversary of the first Alpine ibex reintroduction in the Orobie Alps, a three year long Citizen Science Project started in June 2017 ('Stambecco Orobie e Lombardia'). Nowadays, a complementary tool that can be used in data collection is citizen science; its use among scientific community is increasing and it is considered a new opportunity for the future of science. A three-year project (from 2017 to 2019) took place in the Orobie Alps (Bergamo, Italy), with the collection of 2,530 photographs of Alpine ibex (*Capra ibex ibex*). A total of 735 citizen scientists took part in the project by gathering data and collecting pictures (225 in 2017, 248 in 2018 and 262 in 2019). Photographs, complete with technical descriptions, were posted on the project's Facebook page and the Instagram page and each one was georeferenced on the ArcGis platform and a web mapping application. The georeferenced images helped comparing the expansion zones of Lombard Alpine ibex colonies to the ones identified in a preliminary study. The images also turned out to be a useful tool in monitoring population health. These methods may help to avoid data dispersion and may raise public awareness of Alpine ibex conservation policies.

INTRODUCTION

The return of the Alpine ibex *Capra ibex ibex* Linnaeus, 1758, to the Alps began at the end of the 19th Century thanks to the pioneering and visionary Swiss reintroduction project and it represented a major success for nature protection in Europe (Giacometti, 2006). The case of the Alpine ibex is one of the finest examples of how human's attitude towards nature is changing by becoming aware of biodiversity conservation (AA.VV., 2014).

In the early 1980s, a small ibex population was still present in the Italian Alps (Peracino and Bassano, 1989). For this reason, the Lombardy Region started an extraordinary Alpine ibex restocking plan named "Progetto Stambecco Lombardia" (Tosi et al., 1989). The Orobie Alps appeared to be one of the most suitable areas for the project to take place, thanks to the slope of the mountains, the sun exposure and the optimal altitude; furthermore, the Orobie Alps are large enough to support a minimum vital ibex population. The project began in 1987, with the first release program in Alta Val Seriana (Bergamo – Italy) and ended in the same area in May 1990 with the reintroduction of 87 individuals of Alpine ibex (Tosi et al., 2012). Twenty years later, according to a census carried out in summer 2008, 1,026 ibex were present in the Orobie Alps (Gagliardi and Tosi, 2012).

Nowadays in the Alps (France, Switzerland, Italy, Austria, Germany and Slovenia) 178 ibex colonies are known and more than 53,000 ibex are estimated (Brambilla et al., 2020), living at altitudes that range from 1,500 to 3,000 meters above sea level (a.s.l.) (Grignolio et al., 2003).

The Alpine ibex is listed on the Conservation of European Wildlife and Natural Habitat by the Bern Convention and by EC Habitat Directive 43/92 and it is classified as of Least Concern by the IUCN (International Union for Conservation of Nature) (Boitani et al., 2003).

On the 30th anniversary of the first ibex reintroduction in the Orobie Alps, a three year long Citizen Science Project (2017-2019) named 'Stambecco Orobie e Lombardia' (www.stambeccoorobie.it) started in June 2017 after being commissioned by Club Alpino Italiano (CAI) Bergamo Section and scientific Committee (CAI).

Dedicated social media accounts (Facebook www.facebook.com/stambeccoorobie and Instagram www.instagram.com/stambeccoorobie/?hl=it) promoted the Citizen Science Project and 10,000 flyers were distributed to the Lombardy Alpine refuges and the main mountain shops in the cities.

Because of the limited financial resources available for a long term monitoring, citizen science (Trumbull et al., 2000) is now used as a complementary tool in data collection: its use among the scientific community is increasing (Follett and Strezov, 2015) and it is considered a new opportunity for the future of science (Lukyanenko, 2019). Furthermore, in protected areas, photographs collected by tourist can be a great resource in supporting fauna monitoring work (Rafiq et al., 2019). Citizen science, along with photo collection, has been frequently used for estimating wild animal populations, in particular species that show specific individual differences in appearance, enabling them to be distinguished from one another. Photographic samplings, combined with citizen science, has been applied to monitor populations of several species population such as the tiger *Panthera tigris* (Linnaeus, 1758) (Karanth, 1995), the African elephant *Loxodonta africana* (Blumenbach, 1797) (Morley et al., 2007), the zebra *Equus quagga burchelli* (Gray, 1824) (Foster et al., 2007), the spinner dolphin *Stenella longirostris* (Gray, 1828) (Tyne et al., 2014), the Alpine ibex (Sandfort, 2005), and the koala *Phascolarctos cinereus* (Goldfuss, 1817) (Dissanayake et al., 2017).

The aim of our project was to involve local people and trekkers in the observation and

monitoring of the spatial distribution and of the presence of disease in the Alpine ibex population in order to improve the species conservation policies after 30 years from its reintroduction in the study area.

METHODS

The project took place in the Central Italian Alps, more specifically in the mountainous Orobie Alps area (WGS84 reference system: 45°40'- 46°10' N, 9°25'- 10°20' E, Lombardy, Italy). It is a 750 Km^2 area with altitudes varying from 1,100 metres in the valleys to 3,052 meters a.s.l. at the highest peak (Pizzo Coca) and it is characterized by a continental temperate climate. In this area there are also human settlements and trekkers excursions, which mainly take place along the Club Alpino Italiano's trails network. During summer, herds of cows, goats and sheep are sent out to pasture.

The project lasted three years (from 2017 to 2019). From 1st June to 30th November of each year, Alpine ibex observation and data collection process took place within the study area via photos taken by citizens using a bottom-up approach (Newman et al., 2012). The project's Facebook or Instagram page (@stambeccoorobie) received the photos, with a maximum of five photos per participant. Each photo was complemented by technical information (photographer name, date, time, altitude a.s.l., site description, and GPS coordinates), then filed onto Microsoft Excel spreadsheets and georeferenced on the ArcGis platform and a web mapping application (https://globo.maps.arcgis.com/apps/webappviewer/index.html?id=18a4641d8bcc4c65a5c81dfa93623142). The use of wildlife camera traps and animal foraging was not allowed.

Through the project website and social media pages, participating citizen scientists received guidelines for species recognition and data collection. To avoid the increasing digital divide, each year an info brochure about the project was printed and distributed to the Club Alpino Italiano's refuges and to the sports shops in Lombardy.

All the received photos were checked on a daily basis by the project's scientific committee, then feedback was given to individual photographers and photos were posted on the project's Facebook and Instagram page after checking. Each image was analysed separately in order to establish species, sex, age category, altitude, animal identification code (A.I.000n) and surrounding environment, then data were inserted in a database. Photos not corresponding to the study area, or with wrong animal subject were deleted. Each photo was also checked for the technical quality of the picture, information content and the possibility of identification of individual ibex. Photographs evaluated as functional for identification were examined using a combination of distinguishing characters (natural markings) like frontal horn ridges (male), frontal horn lines (female), presence of damages and width at basis. (Sandfort, 2005). In the meantime, a photo contest was also organised each year with a jury awarding prizes to the best 10 photos.

RESULTS

Over the project's three-year period, 2,530 photos were sent: 612 in 2017, 803 in 2018 and 1,115 in 2019. The photos were checked separately and no errors were recorded in species recognition nor in other data.

Data gathering and observations were performed by 735 citizen scientists (225 in 2017, 248 in 2018 and 262 in 2019) with more men (76%) than women (24%) taking part. The StambeccoOrobie Facebook page (@stambeccoorobie) had 2,563 followers (41% of whom are women and 59% men) with the best represented age group being 35-44 (26%), followed by 45-54 (23%) and 25-34 (22%). The page had a lot of interaction through the exchange of messages with 391 different citizen scientists (53%). The analysis of the georeferenced photos in the last year of the

project (most recent data) shows that 38% (427/1,115) of observations took place close to trails paths above 2,300 metres (Fig. 1).

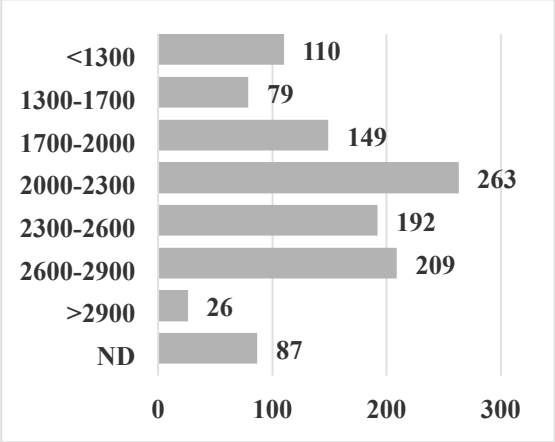

Figure 1. Number of photographs (on the x axis) by elevation of the shooting location (on the y axis) for 2019.

A dedicated web page, with a multiple layers system, allows displaying the geo-referenced photos during the three-year observations, the Club Alpino Italiano's trails network and refuges, as well as the Lombard ibex subpopulations expansion zones identified in a preliminary study (Tosi et al., 1991) (Fig. 2).

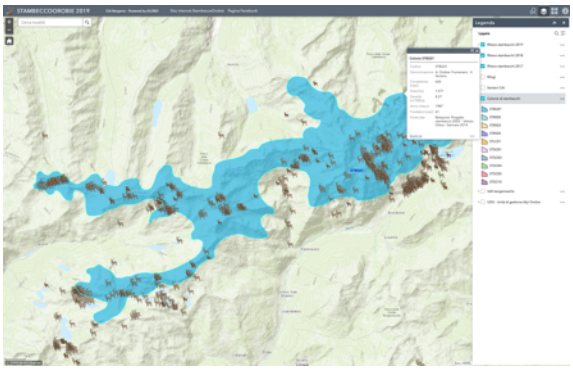

Figure 2. Screenshot of the map's webpage showing the distribution of the specie. In cyan Alpine ibex colonies (STBG01) as identified in a preliminary study (year 1991) while the icons point out the photos collected by citizen science project (2017, 2018 and 2019).

Figure 3. Alpine ibex with a just broken and fallen horn (photo shooting date 07.02.2017).

Figure 4. Alpine ibex (A.I. 0089) with a broken and fallen horn (photo shooting date 28.02.2017).

Figure 5. Alpine ibex (A.I. 0089) with both broken and fallen horns (photo shooting date 03.02.2019).

Photos turned out to be of support in monitoring the health of the ibex population. For example, figure 3 highlights an Alpine ibex

with a broken and fallen horn. A sequence of photos of the same animal (A.I.0089) taken in different periods (year 2017 and year 2019) allowed the project to document the progressive fall of the horn (Fig. 4 and 5).

Several photographs also highlighted animals affected by *Trombicula autumnalis* (Shaw, 1790) (Fig. 6).

Figure 6. Alpine ibex affected by *Trombicula autumnalis* (photo shooting date 24.11.2019)

DISCUSSION

The gathered photos created new knowledge and linked up stakeholders, likely fostering the development of experiential tourism initiatives. The Alpine ibex turned out to be a charismatic species that contributes to the attractions of the Alpine landscape (Bassano, 2006) and its presence near footpaths makes the area more attractive to tourists (Pellicioli, 2019). Photos have proven to be a suitable tool for the study of the Alpine ibex since they are easy to recognise and have individual characteristics - especially their horns - which make individual animals and sex identifiable.

The successful outcome of the project was determined by people's desire to take part in it and in the photography contest. No violations of the rules were detected, especially those relating to the use of photo traps and animal artificial foraging, which can potentially have a negative impact on animals' wellbeing and on their spatial distribution.

After ten years from the last census (Gagliardi and Tosi, 2012), photo georeferencing highlighted the current distribution of the ibex colonies within the Orobie Alps. In particular, it was found that the most commonly frequented areas, especially in the summer, are more extensive than the ones that were identified 10 years before. This leads to the assumption that the census method models currently used in order to estimate wild ungulate populations could be supplemented with new methodologies capable of supporting the population's status and defining it more accurately.

Photos also turned out to be of support in monitoring the health of the population, a priority given its state of conservation (Brambilla et al., 2015), and in defining the role wild animals could potentially play in the transmission of infectious and parasitic diseases shared with domestic animals in the Alpine pastures (Gaffuri et al., 2006; Rossi et al., 2019; Luzzago et al., 2020). Despite the presence in the area of numerous flocks of sheep and goats in pasture, no cases of hybridisation between Alpine ibex (*Capra ibex*) and domestic goats *Capra hircus* Linnaeus, 1758 were reported in our study, in contrast to other areas of the Alps (Couturier, 1962; Giacometti et al., 2004). Sequences of photos of adult males with one or both horns broken, taken in different periods, were of particular importance. These damages to the horns were probably caused by alterations of congenital or metabolic origin due to the old age, leading to bone tissue fragility or by trauma due to social and territorial rivalry (Fig. 4 and 5: images from the same animal). The photos also showed the presence of several male ibex affected by *Trombicula autumnalis* (Fig. 6), a parasite capable of infesting humans too (Genchi et al., 2010), as well as cases of foot rot (*Dichetobacter nodosus*). On the opposite, no subjects were found to be affected by infectious keratoconjuntivitis (Giacometti et al., 2002a).

On a behavioural point of view, the fact that 38% of the photographic observations of Alpine ibex occurred in the study area above 2,300 meters (Fig. 1) might be due to social

competition with other wild ungulates living at lower altitudes (Jaeggi et al., 2020). Also, the climate variations recorded in recent decades contributed to modifying the species behaviour (Grignolio et al., 2004, Paul et al., 2020), the use of grazing (Aubulet et al., 2009) and also the horn growth (Giacometti et al., 2002b; Bergeron, 2008).

Overall, this three-year project proved to be an effective tool with which to raise public awareness of Alpine ibex population issues and to extend knowledge about wild animals, since they are a fundamental element in local biodiversity in the Alps, favouring an increase in environmental awareness. The used methods enabled us to monitor the ibex population at a lower financial cost than other methods and researchers were able to focus their energies on data elaborating rather than data gathering. Indeed, by analysing the total number of photos taken in 2019 in the 10 most popular places, about 221 days of trekking were calculated (Club Alpino Italiano average time http://geoportale.caibergamo.it).

Thanks to numerous interactions and exchanges of messages, the use of social media proved to be a valid tool in getting citizen scientists involved and in educating people to a responsible approach to fauna resources. We believe that the used method could be successfully applied to the study of Alpine ibex population and it could be used together with normal biological monitoring activities and species census work in a non-invasive way, especially in protected areas. These study methods should be used in the future and their full potential exploited, including the strength of new technologies such as artificial intelligence, which may help to avoid data dispersion and favour an increase in public awareness of ibex conservation policies.

ETHIC STATEMENT

The project's authors and partners took part in the project 'Stambecco Orobie e Lombardia' freely with no financial interests, for the exclusive purpose of supporting Alpine ibex and Orobie Alps conservation policies.

ACKNOWLEDGEMENTS

The authors would like to thank: the Club Alpino Italiano's scientific committee (Alberto Ghedina, Giuliano Cervi and Giovanni Margheritini), the Club Alpino Italiano's (CAI) Bergamo section (Paolo Valoti, Riccardo Marengoni, Gege Agazzi, Stefano Morosini and Alessandra Gaffuri), Parco Regionale Orobie Bergamasche (Yvan Caccia).

Thanks also to Claudio La Ragione (Parco Orobie Valtellinesi), Anna Bonettini (Parco Regionale Adamello), Rossella Rossi and Eugenio Carlini (Istituto Oikos), Marco Valle (Museo Scienze Naturali Bergamo) and Paolo Lanfranchi (Università di Milano).

The project's technical partners: Globo (Marco Deligios), Swarovski Optic Italia (Franco Cernigliaro and Pasquale Alfieri), Sport Specialist (Romano Andreoletti), Garmin Italia (Stefano Viganò), Elleerre (Gian Luca Rota).

Photographers: Francesco Guffanti (fig. 3), Mirco Bonacorsi (fig. 4 – 5) and Stefano Rinaldi (fig. 6).

The photographic contest jury: Daniele Carrara, Matteo Zanga and Fabrizio Zanchi. In accordance with citizen science principles, we would like to thank all contributing citizen scientists.

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Submitted: 23 September 2020

First decision: 25 October 2020

Accepted: 8 May 2021

Guest editor for the special sectionCitizen Science in Biogeography: Stefano Martellos