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MONITORING

IOD 2022

17th International Bearded Vulture Observation Days

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The IOD 2022 were organised by the following IBM-members[1] and associated organisations[2]:

ASTERS [1]

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GREEN BALKANS [2]

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LANDESFORSTKORPS SÜDTIROL[2]

PARC NATIONAL DES ECRINS[2], PARC NATUREL RÉGIONAL DU QUEYRAS[2]

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The International Observation Days (IOD) *are an annual monitoring event for Bearded Vultures organised by the International Bearded Vulture Monitoring network (IBM). The monitoring action takes place in the first two weeks of October with a synchronous and coordinated survey on the focal day and covers large parts of the Alpine arc (since 2006), parts of the Massif Central (since 2012), the eastern part of the French Pyrenees (since 2016), several regions in Spain (since 2017) and some selected sites in Bulgaria (since 2018). The aim of this expanding network is to establish a Europe-wide monitoring of the Bearded Vulture population where time-synchronised observations on the focal day allow to make an approximate estimate of the population size and age class distribution. A monitoring action of this scale and the fact that birds are identified on an individual level whenever possible, is unique and generates baseline information for survival analyses and demographic modelling, which give valuable insight into the reintroduction progress. Furthermore, the number of participants during the IOD increases every year and thus the IOD represents a big public event that helps to increase awareness for the conservation of the Bearded Vulture as a flagship species.*

1 Abstract

On the 8th of October, during this year's Focal Day, a total of 1’160 observers benefited from mostly favorable weather conditions and participated in the 17th annual Bearded Vulture census. Despite unfavorable weather conditions at some observation sites on the north side of the main Alpine ridge (30% of sites), visibility was generally good (47%) or moderate (24%). As a result, 638 Bearded Vultures were observed at 271 out of the 723 occupied sites (37%).

Collaborating with 19 IBM partners and several associated organisations, synchronous observations were conducted at 677 sites on the focal day and at additional 46 sites during the IOD period. Experts and monitoring responsibles, familiar with the local situation, played a key role in estimating the population size in their respective regions and identifying individual birds. By compiling, evaluating, and summarizing the observations and estimates across the monitoring area, an overview of the age class distribution was obtained and compared with the predicted population size based on demographic modeling (Schaub et al., 2009) at the Alpine scale.

The Alpine population of Bearded Vultures was estimated to range between 288 and 377 individuals, slightly lower than the estimate of 413 individuals from the demographic model. However, consistent with previous years, the estimated age class distribution closely matched the predicted values of the demographic model, with a slight underestimation of the number of subadult birds due to difficulties in accurate identification in the field. The estimated age class distribution was as follows: 61% adults, 4% subadults, 10% immature, and 13% juveniles. The population estimate and age class distribution were derived from observation data collected during the focal day, combined with estimates of unobserved individuals present in the specific region, including territorial birds, fledglings, and GPS-tagged birds (N = 80 in 2022), among others.

The Bearded Vulture population in the Massif Central was estimated to vary between 6 and 13 individuals, while approximately 12 to 22 individuals were estimated to be present in the Aude region of the French Pyrenees. In Spain, outside of the Pyrenees, the Bearded Vulture populations were estimated to range between ±2 individuals in Maestrazgo and 35-65 individuals in Andalusia and Rioja. Consistent with previous years, no Bearded Vultures were observed in Bulgaria, where the species has been considered extinct since 1972.

During this year's IOD, multiple Bearded Vulture individuals were identified in the Alps (N=71), the Massif Central (N=6), and Spain (N=17), while an additional 26 individuals in the Alps were identified with lower probability. Furthermore, 68 animals were tracked using GPS, but only 12 out of the 45 animals present in the Alpine region could be visually identified by observers. These individual-based data are valuable for understanding the life-history of the Bearded Vultures and can be used to calculate parameters for demographic modeling. The availability of such international-scale individual-based information is unique and enables the estimation of survival rates and monitoring of the project's progress in understanding the development of the Bearded Vulture populations.

2 Key facts

Monitoring organisation

- 19 IBM-partners and several associated organisations coordinated the IOD 2022
- 1'161 observers participated in Austria, Bulgaria, France, Germany, Italy, Spain and Switzerland
- 723 sites were occupied during the IOD period, 677 of them on the focal day (8.10.2022)
- 47% good, 24% moderate and 30% unfavourable weather was reported at the observation sites

Observation results

- 638 Bearded Vulture observations during the IOD period, 529 of them on the focal day 8.10.2022
- Bearded Vultures observed at 271 out of 723 sites (37%)
- observed age class distribution (number of observations per age class)
  - adult (N = 386, 61%)
  - subadult (N = 27, 4%)
  - immature (N = 66, 10%)
  - juvenile (N = 86, 13%)
  - unknown (N = 73, 11%)

Age class distribution & populations estimates

- estimated age class distribution in the Alps (individuals)
  - adult (N = 206, 64%)
  - subadult (N = 53, 6%)
  - immature (N = 51, 11%)
  - juvenile (N = 48, 13%)
  - unknown (N = 22, 6%)

- estimated number of Bearded Vulture individuals:
  - Alps: 288 - 377
  - Massif Central: 6-13
  - Pre-Pyrenees (FRA): 12-22
  - Spain[1]: 35-65
  - Maestrazgo (ESP) ±2
  - Bulgaria: 0

Individual based data

- 71 (Alps), 6 (Massif Central) and 17 (Spain) individuals were identified with certainty
- 26 individuals were probably identified in the Alps
- GPS-data is available for 68 individuals during the IOD period 2022
- in the Alps 12 (~27%) of the 45 GPS-tagged individuals were identified by the observers

[1] *Only for monitored parts (e.g. no survey in Spanish Pyrenees and other mountain ranges)*

3 Preface

Once again, over 1'100 participants decided to make a visible statement for the Bearded Vultures in Europe. Thanks to their commitment and the coordination of 25 locally responsible organisations, the International Bearded Vulture Observation Day (IOD) was held for the 17th time. We are pleased that the majority of the participants were able to benefit from suitable weather conditions, which also increases the quality of the population estimates that can be obtained thanks to this event.

4 Methods

4.1 Organisation

The monitoring is coordinated and executed simultaneously over the four Alpine zones (eastern, central, north-western and southern Alps), in the Massif Central, in parts of the French Pyrenees, Spain and Bulgaria by local IBM-partners and associated organisations (***Figure 1***). This ultimately allows to gain information about Bearded Vulture presence thus reducing the chance of double counts and allowing us to get the big picture of Bearded Vulture distribution.

With a further releasing partner in the German Alps, the observer network has been expanded in this region of the Eastern Alpine range in the last years. In the previous years, the monitoring network has evolved in the Pyrenees (department Aude in France) in order to reveal exchanges between the separated populations from the Alps and the Pyrenees. Since 2017, our Spanish colleagues (and IBM-partner since 2019) organise the IOD within parts of Andalusia and Castilla y León and share their results with the IBM-network to contribute to get a more comprehensive picture of the Bearded Vulture population in western Europe. A new observer network is also establishing in the eastern parts of Europe in Bulgaria, where the *Green Balkans* participate at the IOD since 2018 and thus raise awareness for the regionally extinct species. As in the previous years, no IOD was organised on Corsica.

Time Period
The 2022's international survey was held between the 8th and the 16th October with the focal day on Saturday 8th of October. The buffer period of one week is chosen to allow more flexibility for areas where the weather conditions are not suitable on the focal day.

All dates are decided on mutual agreement among the IBM partners and take into account partner's availability, other ornithological appointments and the birds' reproductive behaviour (see future dates). The fact, that Bearded Vultures are active in nest building during October, makes this a suitable period to observe the birds and record possible new territories and breeding pairs.

4.2 Monitoring Area

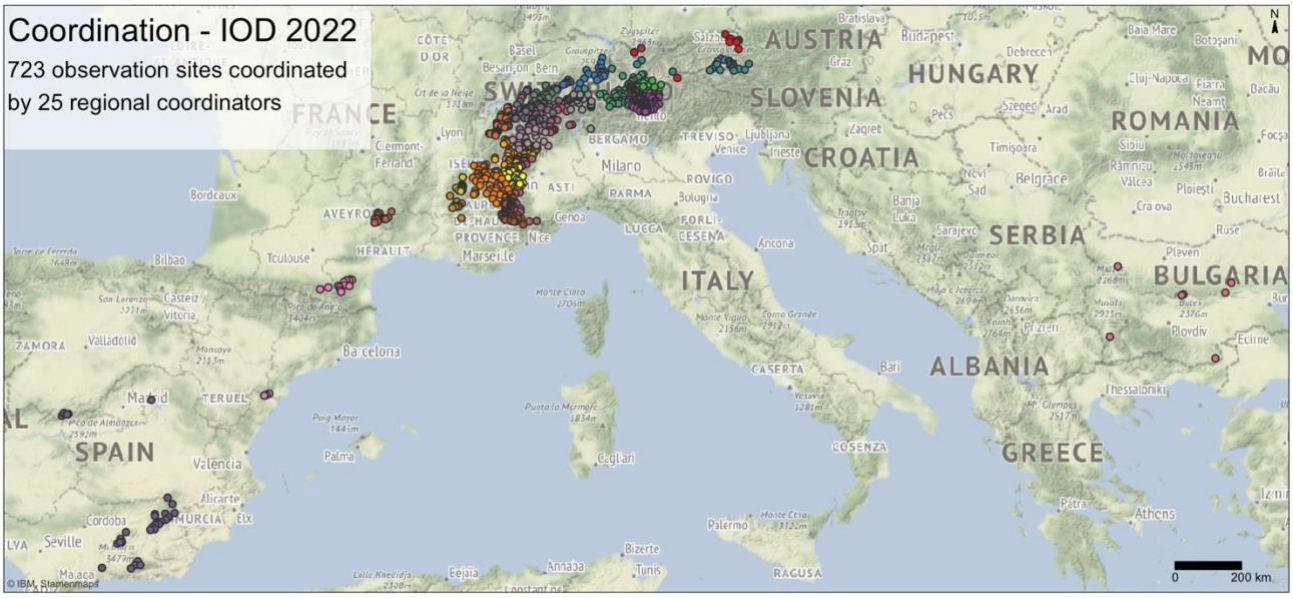

Figure 1. The IOD-monitoring area is regionally coordinated by 19 IBM-partners and associated organisations.

4.3 Data collection and observation protocol

Where weather conditions permitted, posts were occupied between 10:00 and 15:00 at least. The teams were composed of one or more observers, at least one of them being experienced, equipped with binoculars and, depending on availability, telescope and camera. For each observation site and Bearded Vulture sighting the following information was recorded:

<u>Observation site:</u>

- Date and site occupancy (time)
- team/partner and observer names
- site name, address and coordinates
- weather conditions
- total number of observed Bearded Vultures
- presence/observation of other species

<u>Bird observation:</u>

- date
- time and duration of the observation
- age of the bird[2]
- bird name / hypothesis
- picture if possible

[2] *In age classes: juvenile (1.cy), immature (2.-3.cy), subadult (4.-5.cy) adult (≥6.cy)*

4.4 Data Analysis

All data is collected at the end of the day by the local administrators who will review the reported observations. The local administrators work in close cooperation with field assistants/observers and other nearby local administrators responsible for the surrounding monitoring areas. Based on e.g. individual markings, temporal overlap of the sightings, knowledge about known territorial birds and their juveniles that still remain in the area, they are able to critically assess the number of observations and judge to how many individual Bearded Vultures the IOD observations refer to. GPS-tagged birds that were not observed, are added to the estimate and also serve as a measure for detection probability.

The population estimate should be based only on data from the focal day in order to avoid, that individuals are observed and thus counted twice in two different regions. Since individual identification is challenging, it is thus not always possible to assess whether several observations have been made of the same individual. Therefore, the final estimate includes a minimal and a maximal count number, namely accounting for a stricter versus a less conservative analysis.

After a critical assessment of possible double counting, these results are summarised over the whole monitoring area in order to get an overview of the estimated Bearded Vulture populations. Finally, the resulting population estimates of the IOD are compared with the estimates deduced from the demographic model of Schaub et al. (2009).

4.5 Age classification

Per definition the IBM always uses calendar years (cy) for age specifications (***Table 1***).

Table 1. IBM-standard age classification.

Entry in the IBM (life stage)	Calendar year (cy)	Real age (years) Jan-Feb | Mar-Dec		Life history event
juvenile (1. year)	1	-	0	*hatch*
immature (2. year)	2	0	1	*non-territorial*
immature (3. year)	3	1	2	*non-territorial*
subadult (4. year)	4	2	3	*non-territorial*
subadult (5. / 6. year)	5	3	4	*potential nesting*
adult (≥ 6. year)	6	4	5	*potential breeding*
adult (≥ 6. year)	≥7	5	≥6	*potential breeding*

5 Results and Discussion

5.1 Weather conditions

The overall weather situation was favourable in 2022 with 47% good, 24% moderate and 30% bad weather conditions at the observation sites (
Figure 2. Weather conditions at the observation sites reported by the observers in the field during the IOD 2022. Most of the observers (70%) profited from good or moderate weather conditions while at the northern side of the Alpine range some sites faced bad weather conditions (30%).
). In 2021 77% of the sites reported favourable weather. Unfavourable weather conditions decrease the detection probability of the individuals and should therefore be considered for the interpretation of the population estimates.

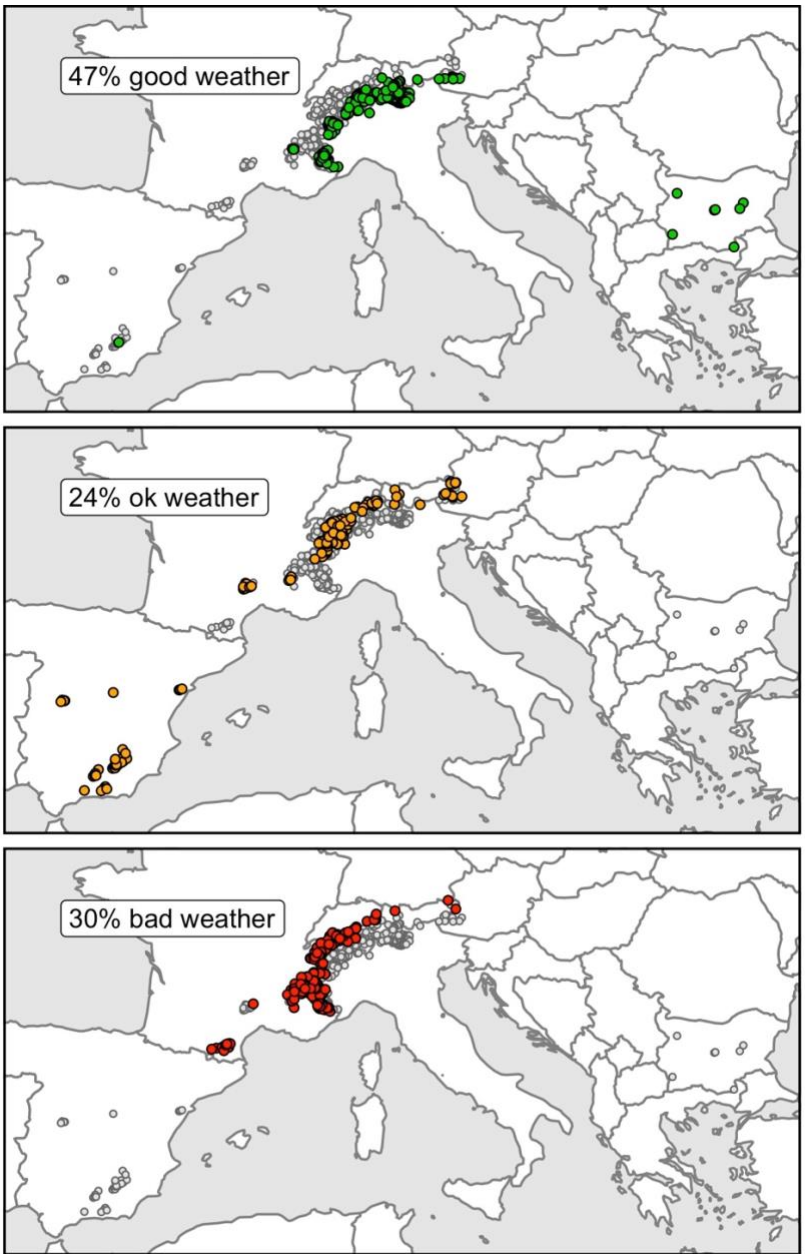

Figure 2. Weather conditions at the observation sites reported by the observers in the field during the IOD 2022. Most of the observers (70%) profited from good or moderate weather conditions while at the northern side of the Alpine range some sites faced bad weather conditions (30%).

5.2 Observation data

In 2022, a total of 1'161 observers have occupied 723 observation sites in the Alps, in the French Pyrenees (department "Aude"), parts of Spain as well as Bulgaria *(**Figure 3** and **Table 2**).*

The second IOD has been organised in the German Alps, where four birds have been released since 2021. Through the new reintroduction site, hopefully more people in this region will be made aware of the Bearded Vulture reintroduction project.
As in the previous years, the western regions of the Alps remain the most thoroughly surveyed areas together with the area of the Stelvio National Park in the North of Italy. With additional observation sites close to the Spanish border near the Pyrenees, the IBM monitoring network plans to cover regions that might serve as a connection between the Bearded Vulture populations from the Alps and the Pyrenees. As it is known that Bearded Vultures in Spain move between the mountainous areas in the South and the region of Castilla y Léon, Castilla-La Mancha and La Rioja in the North, the observer network has been expanded in these areas.

In the eastern part of Europe, several observations sites in Bulgaria were also occupied for the first time in 2018, even though so far, no Bearded Vultures are known to be present in this region. However, it is planned to start releasing Bearded Vultures in 2025 in Bulgaria and therefore it is important to build up an observer network. Further, with this reintroduction site, the established population should serve in the future as a stepping-stone area between the Alpine and Greek and Turkish Bearded Vulture population.

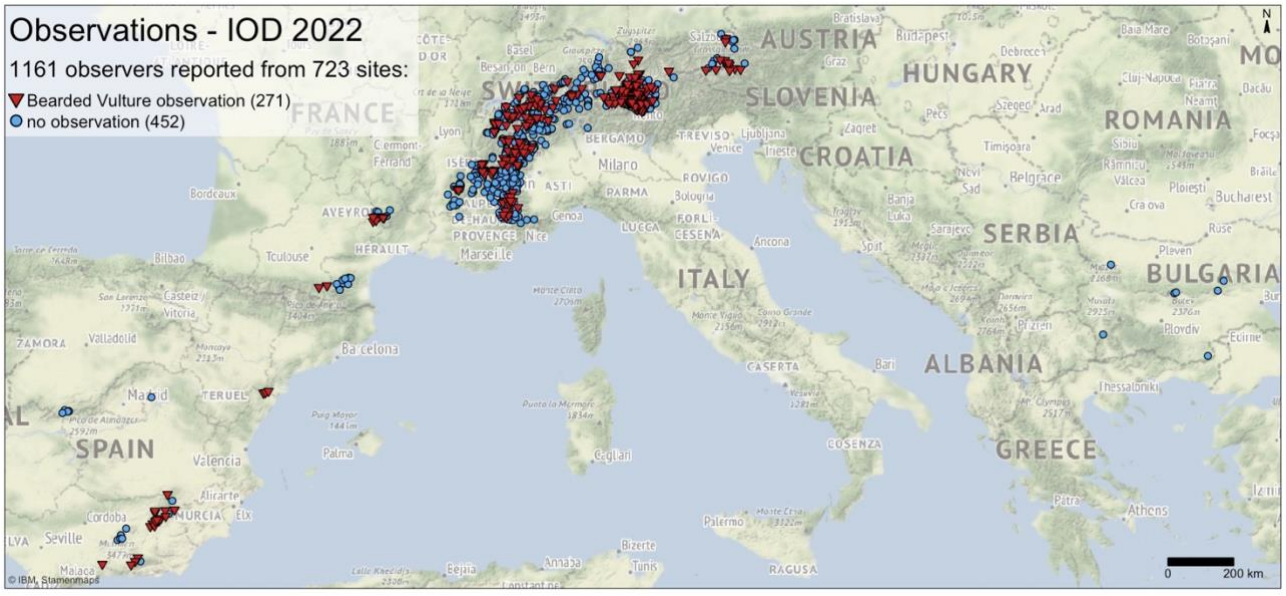

Figure 3. Distribution of all 723 observation sites during the IOD 2022 in Europe. Red triangles depict sites where Bearded Vultures have been observed at least once during the IOD period 8th-16th of October 2022 (N=271) while no observations have been reported from sites marked with a blue dot (N=452).

Table 2. Number of observation sites and observers per region during the IOD 2022 (focal day 08.10.2022).

Zone	Country	Region	occupied sites in October 2022									Total
			8.	9.	10.	11.	12.	13.	14.	15.	16.	
Alpine range			**609**	**18**	**3**	**5**	**2**	**5**	**2**	**10**	**1**	**655**
East	AUT	Kärnten	4									**4**
	AUT	Salzburg	13	1	1							**15**
	AUT	Tirol	3					2		1		**6**
	DEU	Bayern	4									**4**
	ITA	Trentino-Alto Adige	1									**1**
Central	AUT	Tirol	3									**3**
	CHE	Central Switzerland	23									**23**
	CHE	Eastern Switzerland	61									**61**
	CHE	Ticino	25									**25**
	CHE	Western Switzerland	6							2		**8**
	DEU	Bayern	2	1								**3**
	ITA	Lombardia	66									**66**
	ITA	Piemonte	9									**9**
	ITA	Trentino-Alto Adige	25	11								**36**
North-West	CHE	Western Switzerland	59	4	2	5	2	3	2	6	1	**84**
	FRA	Rhône-Alpes	65							1		**66**
	ITA	Piemonte	46									**46**
	ITA	Valle d'Aosta	36	1								**37**
South-West	FRA	Provence-Alpes-Côte d'Azur	79									**79**
	FRA	Rhône-Alpes	41									**41**
	ITA	Piemonte	38									**38**
Massif Central			**15**									**15**
	FRA	Languedoc-Roussillon	9									**9**
	FRA	Midi-Pyrénées	6									**6**
Pre-Pyrenees			**13**									**13**
	FRA	Languedoc-Roussillon	12									**12**
	FRA	Midi-Pyrénées	1									**1**
Spain (withouth Pyreenees)			**33**									**33**
	ESP	Andalucía	21									**21**
	ESP	Castilla y León	3									**3**
	ESP	Castilla-La Mancha	5									**5**
	ESP	Comunidad Valenciana	3									**3**
	ESP	Extremadura	1									**1**
Bulgaria			**7**									**7**
	BGR	Blagoevgrad	1									**1**
	BGR	Haskovo	1									**1**
	BGR	Montana	1									**1**
	BGR	Sliven	2									**2**
	BGR	Stara Zagora	2									**2**
Sites total IOD 2022			**677**	**18**	**3**	**5**	**2**	**5**	**2**	**10**		**723**

Table 3. Number of Bearded Vulture sightings for each region during the whole IOD period 2022 (focal day 08.10.2022). 0 values indicate dates where sites were occupied but no Bearded Vulture have been observed.

Zone	Country	Region	Bearded Vulture observations in October 2022									Total
			8.	9.	10.	11.	12.	13.	14.	15.	16.	
Alpine range			**533**	**13**	**3**	**9**	**3**	**3**	**2**	**13**	**0**	**579**
East	AUT	Kärnten	7									**7**
	AUT	Salzburg	13	0	0							**13**
	AUT	Tirol	3					0		0		**3**
	DEU	Bayern	2									**2**
	ITA	Trentino-Alto Adige	0									**0**
Central	AUT	Tirol	6									**6**
	CHE	Central Switzerland	9									**9**
	CHE	Eastern Switzerland	91									**91**
	CHE	Ticino	4									**4**
	CHE	Western Switzerland	4							5		**9**
	DEU	Bayern	0	0								**0**
	ITA	Lombardia	183									**183**
	ITA	Piemonte	0									**0**
	ITA	Trentino-Alto Adige	18	7								**25**
North-West	CHE	Western Switzerland	25	6	3	9	3	3	2	7	0	**58**
	FRA	Rhône-Alpes	83							1		**84**
	ITA	Piemonte	13									**13**
	ITA	Valle d'Aosta	14	0								**14**
South-West	FRA	Provence-Alpes-Côte d'Azur	26									**26**
	FRA	Rhône-Alpes	20									**20**
	ITA	Piemonte	12									**12**
Massif Central			**19**									**19**
	FRA	Languedoc-Roussillon	8									**8**
	FRA	Midi-Pyrénées	11									**11**
Pre-Pyrenees			**2**									**2**
	FRA	Languedoc-Roussillon	1									**1**
	FRA	Midi-Pyrénées	1									**1**
Spain (without Pyrenees)			**38**									**38**
	ESP	Andalucía	29									**29**
	ESP	Castilla y León	0									**0**
	ESP	Castilla-La Mancha	3									**3**
	ESP	Comunidad Valenciana	6									**6**
	ESP	Extremadura	0									**0**
Bulgaria			**0**									**0**
	BGR	Blagoevgrad	0									**0**
	BGR	Haskovo	0									**0**
	BGR	Montana	0									**0**
	BGR	Sliven	0									**0**
	BGR	Stara Zagora	0									**0**
Total Bearded Vulture observations IOD 2022			**592**	**13**	**3**	**9**	**3**	**3**	**2**	**13**	**0**	**638**

5.3 Telemetry data

5.3.1 IBM-monitoring area

During the IOD-period GPS-data of 68 Bearded Vultures with satellite tags have been retrieved in the Alpine range, the Massif Central, the Pyrenees, north-eastern Spain and Corsica[3] (***Figure 4***). Another GPS-tagged bird (Eglazine) was flying in the North (Netherlands & Belgium) during this time and was therefore not included in the map and analysis. Although this data is not part of the IOD, this information is collected as representative of their positions and to detect areas of monitoring deficiencies. Some of these birds still show their individual marking patterns (bleached feathers) and can therefore be identified by observers. Exceptions are the wild-hatched birds which have been GPS-tagged but not marked by bleaching their feathers.

GPS-data can serve as an indicator to assess the risk of double counting of individuals. The wide range movement patterns of some birds (***Figure 4***) underline the importance of using only observational data from a narrow period (focal day) for population estimation to avoid double counting.

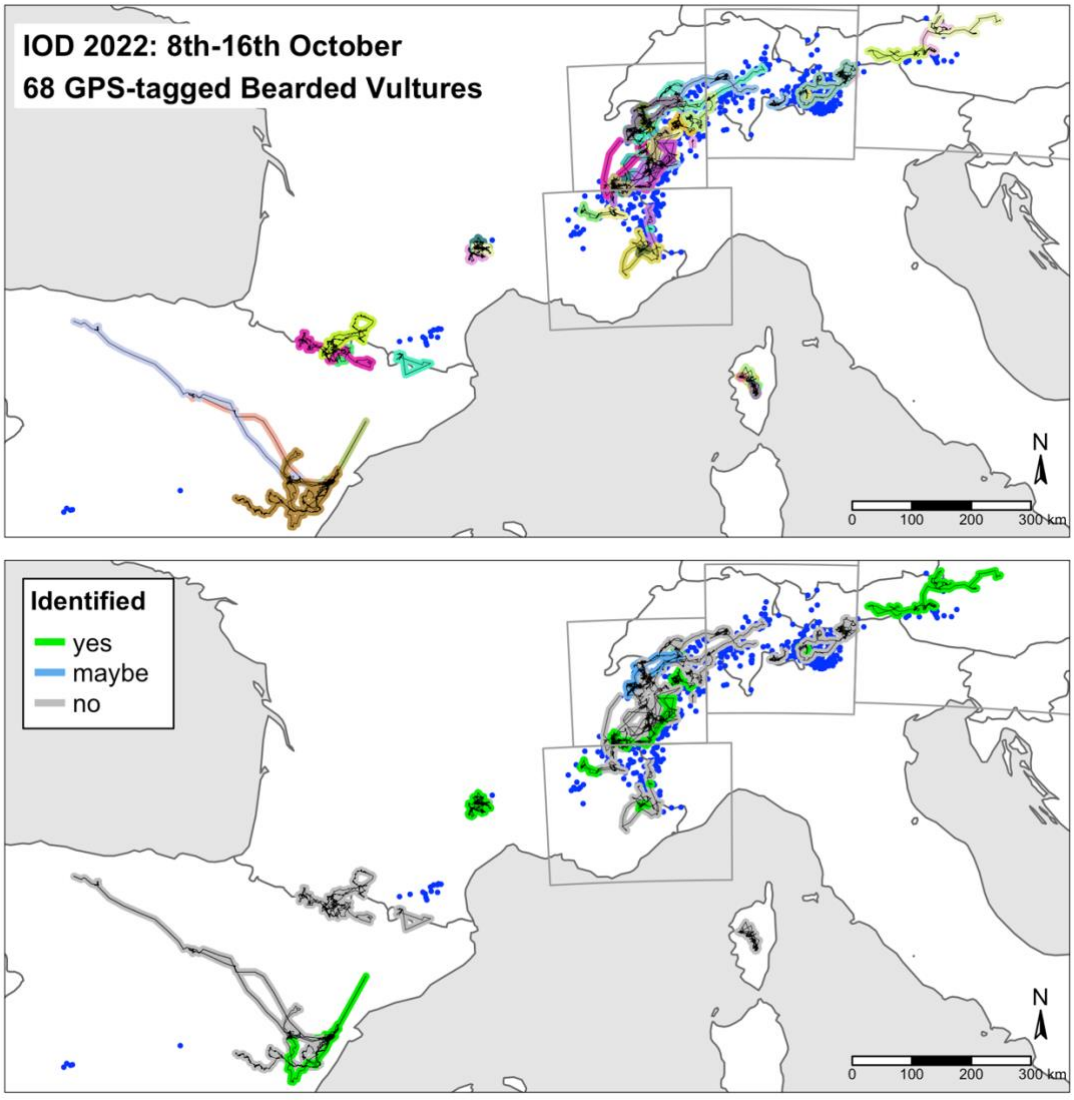

Figure 4. 68 GPS-tagged Bearded Vultures during the IOD period. The GPS-track of Eglazine is not displayed on this map, as the bird was on an excursion in the North during the IOD-period. Blue dots = occupied observation sites.

[3] *No IOD was organized on Corsica in 2021.*

5.3.2 Alpine range

During this year's IOD, GPS-data in the Alpine range was available from 45 GPS-tagged birds during the IOD period and on the focal day (08.10.2022). Out of the 45 GPS-tagged birds 12 individuals could be sighted and identified, while 1 bird (Sunny W397) was identified with some uncertainty by observers. In summary, 27% of the GPS-tagged birds have been sighted and identified, which is considerably less compared to 2021 (36%).

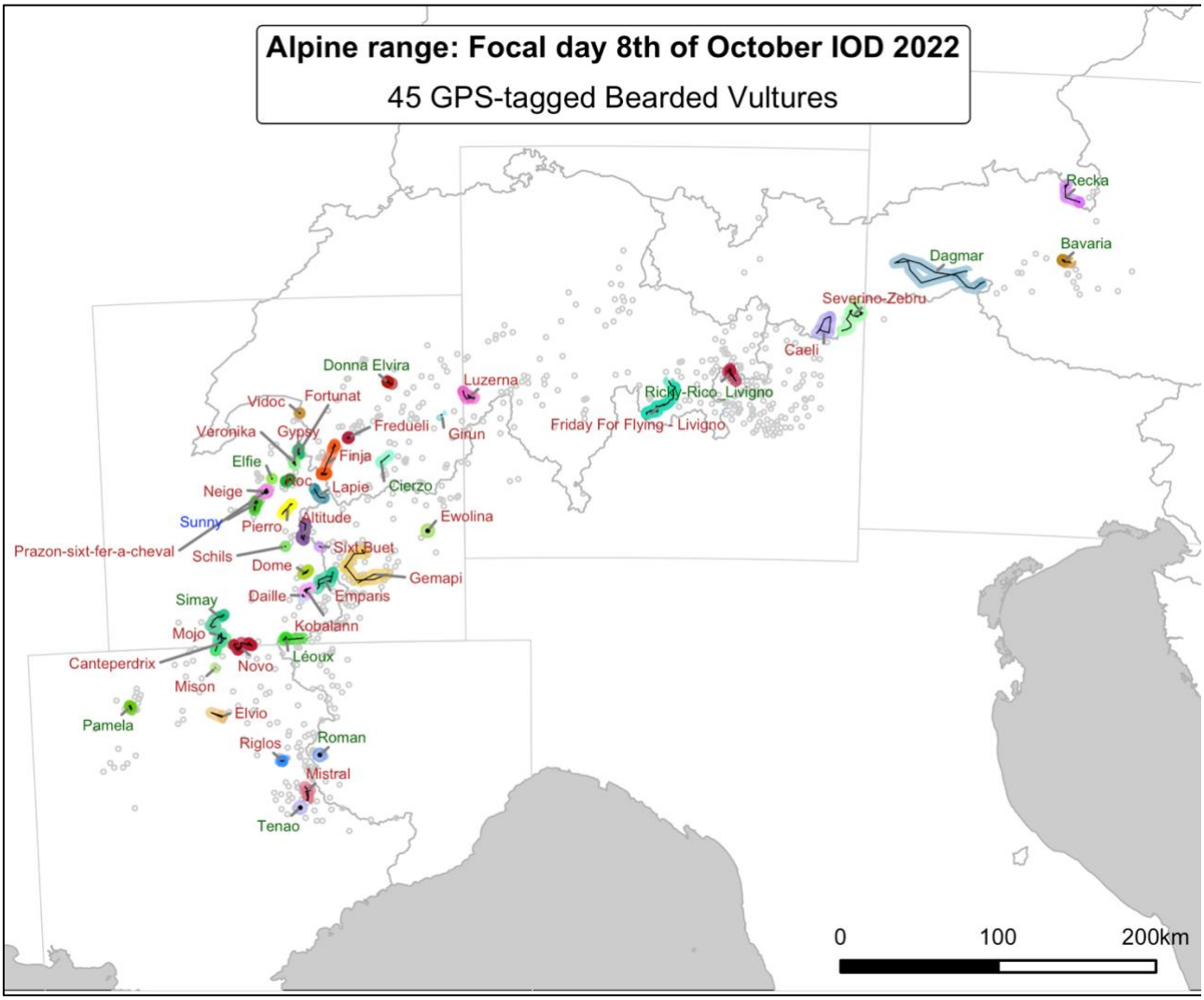

Figure 5. Positions of 45 Bearded Vultures tagged with GPS transmitters that were present in the Alpine range during the focal day (8.10.2022). Observation sites that were occupied during the IOD-period are marked with grey circles. During the IOD-period 12 birds have been identified (green labels), one bird (Sunny W397) has been probably identified (blue labels) and 32 birds couldn't be identified (red labels).

Table 4. 71 birds, 34 males and 31 females, with active GPS-tag during the IOD period 2022. No IOD was organised in Corsica.

Animal	BirdID	Sex (m/f)	Age class	Hatch	Days with pos.	Pos. on focal day	Observed (yes / maybe / no)
Alpine range	**45**	**21 / 28**					**21 / 1 / 32**
Cierzo	899	m	adult	2016	9	23	yes
Léoux	950	f		2017	9	13	yes
Roman	854	m		2015	6	1	yes
Tenao	755	m		2013	9	3	yes
Ewolina	838	f		2015	9	1	no
Gemapi	W196	f		2016	9	16	no
Girun	904	f		2016	5	5	no
Gypsy	W209	m		2017	9	13	no
Mison	W230	f		2017	9	4	no
Neige	W198	m		2016	9	1	no
Schils	802	m		2014	8	17	no
Veronika	321	f		1999	9	3	no
Pamela	1031	f	subadult	2019	9	24	yes
Simay	983	m		2018	9	23	yes
Altitude	W313	f		2019	9	7	no
Caeli	998	m		2018	9	24	no
Elvio	1026	m		2019	9	12	no
Emparis	W284	f		2019	9	47	no
Finja	1003	f		2018	9	76	no
Fredueli	1001	m		2018	9	82	no
Lapie	W251	m		2018	9	11	no
Mistral	1022	m		2019	9	23	no
Pierro	W301	m		2019	9	45	no
Sixt Buet	W285	f		2019	9	7	no
Bavaria	1112	f	juvenile	2021	9	48	yes
Donna Elvira	1117	f		2021	9	48	yes
Sunny	W397	m		2021	9	74	maybe
Fortunat	1068	m		2020	9	34	no
Friday For Flying - Livigno	W396	m		2021	9	4390	no
Kobalann	1063	f		2020	9	45	no
Luzerna	1071	f		2020	9	85	no
Novo	1098	m		2021	9	69	no
Prazon-sixt-fer-a-cheval	W346	u		2020	9	75	no
Severino-Zebru	W372	m		2021	9	144	no
Vidoc	W356	u		2020	9	16	no
Dagmar	1145	f		2022	9	21	yes
Elfie	W437	u		2022	9	14	yes
Recka	1147	f		2022	9	27	yes
Ricky-Rico_Livigno	W466	m		2022	9	22	yes
Canteperdrix	1136	f		2022	9	71	no
Daille	W480	u		2022	9	13	no
Dome	W478	u		2022	9	46	no
Mojo	W440	u		2022	9	10	no
Riglos	1138	m		2022	9	16	no
Roc	1127	m		2022	9	46	no
Massif Central	**6**	**3 / 3**					**4 / 0 / 2**
Layrou	761	m	adult	2013	9	14	yes
Cévennes	1032	m	subadult	2019	9	62	no
Fario	1079	f	immature	2020	9	285	yes
Ophrys	1078	f		2020	9	108	yes
Aven	1067	f		2020	9	36	no
Rei del Causse	1128	m	juvenile	2022	9	72	yes
Pyrenees	**8**	**4 / 4**					**0 / 0 / 8**
Roc Genèse	-	m	adult	2016	9	4	no
Alos	992	m	subadult	2018	9	13	no
Amic*	995	m		2018	9	79	no
Celest	1073	f	immature	2020	9	57	no
Dena*	1104	f		2021	9	17	no
Peyre	1116	m		2021	9	48	no
Pradines	1122	f		2021	9	55	no
Pyrenees	1094	f		2021	9	1218	no
Corsica	**5**	**3 / 2**					**0 / 0 / 5**
Luna	959	f	adult	2017	7	6	no
Muntagnolu	890	m		2016	9	6	no
Cintu	1042	m	subadult	2019	9	267	no
Orba	1041	f		2019	9	25	no
Sulana	1144	m	juvenile	2022	9	6066	no
Spain (without Pyrenees)	**6**	**3 / 3**					**2 / 0 / 4**
Bassi	1033	m	subadult	2019	9	90	yes
Amic*	995	m	subadult	2018	9	79	no
Dalila	1109	f	immature	2021	9	158	no
Dena*	1104	f	immature	2021	9	17	no
Esperit	1135	m	juvenile	2022	9	27	yes
Ereta	1132	f	juvenile	2022	9	27	no
Excursion (NDL & BEL)	**1**	**0 / 1**					**0 / 0 / 1**
Eglazine	1069	f	immature	2020	9	45	no

** birds have been observed in two different regions (this data shows that double counting can occure during IOD)*

5.4 Individual-based data

During the IOD 2022 period 71 individuals have been identified with high probability in the Alpine range. 11 of them in the eastern Alps, 31 in the central Alps, 10 in the north-western Alps, 19 in the south-western Alps. Another 6 birds have been identified in the Massif Central and 17 in Spain (***Table 5, Table 6 and Table 7***). Some birds could not be identified with certainty (Alps N = 26), these are marked as "maybe" observed in. Such individual-based monitoring is only possible due to the international collaboration, information exchange and the coordination of marking patterns within the international Bearded Vulture monitoring network.

*Table 5. 58 Bearded Vultures that were identified (16 of them with some uncertainty = maybe identified) in the eastern and central Alps during the IOD 2022 grouped by the region where they have been observed. *The tag of Fortuna stopped working on the 6.10.2022.*

	Bird	Observed (yes / maybe)	BirdID	Sex (m/f)	Hatch	Tag	Territory	Region
Eastern	**16**	**11 / 5**		**6 / 9**				
	Alexa	yes	0100	f	1988		Gastein/Rauris	Hohe Tauern NP (AUT)
	Andreas Hofer	yes	0260	m	1996		Gastein/Rauris	
	Glocknerlady	maybe	0718	f	2012		Gschlöß	
	Ambo	yes	0392	f	2002		Heiligenblut	
	Fortuna	yes	0843	m	2015	GPS*	Heiligenblut	
	Lechtal2022	yes	W479	u	2022		Lechtal	
	Natura	yes	0464	f	2005		Lechtal	
	Charlie	yes	0910	f	2016		Mallnitz	
	Felix2	yes	0793	m	2014	GPS	Mallnitz	
	El Dorado	maybe	0372	f	2001		Prägraten	
	Joker	maybe	0420	f	2003		Prägraten	
	Lea	maybe	0840	m	2015		Prägraten	
	Bavaria	yes	1112	f	2021	GPS		
	Dagmar	yes	1145	f	2022	GPS		
	Madagaskar	yes	0665	m	2011			
	Pinzgarus	maybe	0558	m	2008			
Alpine range	**42**	**31 / 11**		**16 / 18**				
	Recka	yes	1147	f	2022	GPS		Bavaria (DEU)
	Noel-Leya	maybe	0797	m	2014	GPS	Vaettis	Central Switzerland
	Sardona	maybe	0624	m	2010			
Central	Diana-Stelvio	yes	W07	f	2000		Albula	Grison (CHE)
	Avers2022	yes	W462	u	2022		Avers	
	GT0116	yes		m			Bergün	
	GT0117	maybe		f			Bergün	
	Buffalora2022	yes	W433	u	2022		Buffalora	
	Ingenius	yes	0621	m	2010		Buffalora	
	Retia	maybe	0357	f	2000		Buffalora	
	Moische	yes	0146	f	1991		Livigno	
	Folio	maybe	0463	f	2005		Maloja	
	Rurese	maybe	0559	m	2008		Maloja	
	Müstair2022	yes	W470	u	2022		Müstair	
	Livigno	yes	W08	m	2000		Ofenpass	
	Ortler	maybe	0439	f	2004		Ofenpass	
	Jo	maybe	0169	f	1992		Ortler	
	GT0171	yes		f	1999		Ova Spin	
	GT038	yes		f			Poschiavo	
	GT057	yes		m			Poschiavo	
	Samuel	yes	0526	m	2007		Sinestra	
	Spöl2022	maybe	W459	u	2022		Spöl	
	Gionny	yes	W441	u	2022		Tantermozza	
	GT048	yes		f	2009		Tantermozza	
	Zebru	yes	W12	m	2002		Tantermozza	
	GT062	yes		f			Trupchun	
	Urbano	yes	W122	m	2013		Trupchun	
	GT031	yes		f				
	Yolanta	yes	W453	u	2022			
	GT080	maybe		m				
	GT090	maybe		f				
	GT0129	yes		f			Foscagno	Stelvio NP, Trentino & Sondrio (ITA)
	GT0132	yes		m			Foscagno	
	Cic	yes	0186	m	1993		Livigno	
	Ricky-Rico_Livigno	yes	W466	m	2022	GPS	Livigno	
	Temperatio	yes	0495	f	2006		Val Martello	
	Stift	yes	0393	f	2002		Valle del Braulio	
	Tell	yes	0283	m	1997		Valle del Braulio	
	Bepi-Zebrù	yes	W464	u	2022		Zebru	
	Felice	yes	0375	f	2001		Zebru	
	Heinz-Serraglio	yes	W45	m	2007		Zebru	
	Planeil2022	yes	W488	u	2022		Planeil	Vinschgau (ITA)

Table 6. 39 Bearded Vultures that were identified (10 of them with some uncertainty = maybe identified) in the north- and south-western Alps during the IOD 2022 grouped by the region where they have been observed.

		Bird	Observed (yes / maybe)	BirdID	Sex (m/f)	Hatch	Tag	Territory	Region
Alpine range	North-western	**18**	**10 / 8**		**9 / 7**				
		Fontvieille	yes	0520	f	2007		Valnontey	Gran Paradiso (ITA)
		Michegabri	yes	0488	m	2006			
		Elfie	yes	W437	u	2022	GPS	Aravis	Haute Savoie (FRA)
		Sunny	maybe	W397	m	2021	GPS		
		Simay	yes	0983	m	2018	GPS		Savoie (FRA)
		Stelvio	yes	W02	u	1998			
		Gelas	maybe	0279	f	1997			
		Linky	maybe	W130	m	2013			
		Nonno Bob	maybe	0548	m	2008			
		GT0126	yes		f			Kandertal	Wallis und Berner Oberland (CHE)
		GT0138	yes		m			Kandertal	
		Smaragd	maybe	0675	m	2011		Zermatt	
		Cierzo	yes	0899	m	2016	GPS		
		Donna Elvira	yes	1117	f	2021	GPS		
		Elena	yes	0613	f	2010			
		Gildo	maybe	0299	f	1998			
		Guillaumes	maybe	0411	f	2003			
		Pablo	maybe	0359	m	2000			
	South-western	**21**	**19 / 2**		**12 / 8**				
		Léoux	yes	0950	f	2017	GPS	MVG	Alpi Cozie (ITA)
		Roman	yes	0854	m	2015	GPS	Maira	Alpi Marittime (ITA)
		Italia 150	yes	0660	m	2011		Usseglio	
		Basalte	yes	0716	m	2012		Malaval	Haute Dauphiné (FRA)
		GT0140	yes		m			Malaval	
		GT0141	maybe		f				
		Bellemotte	yes	0708	f	2012		Bonette	Mercantour (FRA)
		Rimani	yes	W93	f	2011		Chambeyron-Ubayette	
		Hubertus 2	maybe	0446	m	2004		Katschberg	
		Girasole	yes	0549	f	2008		Source de la Tinée	
		Rocca	yes	0516	m	2007		Source de la Tinée	
		GT036	yes		f			Source de lUbaye	
		Sereno	yes	0348	m	2000		Source de lUbaye	
		Tenao	yes	0755	m	2013	GPS	Val dEntraunes	
		GT150	yes		m				
		Stephan	yes	0616	m	2010			
		Ambane	yes	W469	u	2022		Archiane	Vercors (FRA)
		Gerlinde	yes	0759	f	2013		Archiane	
		Kirsi	yes	0764	m	2013			
		Pamela	yes	1031	f	2019	GPS		
		Telemark	yes	1101	m	2021			
		97	71 / 26		43 /42				

Table 7. Bearded Vultures that were identified in the Massif Central (6) and Spain (17) (without the Pyrenees) during the IOD 2022.

	Bird	Observed (yes / maybe)	BirdID	Sex (m/f)	Hatch	Tag	Territory	Region
Massif Central	**6**	**6 / 0**		**4 / 2**				
	Adonis	yes	0794	m	2014		Jonte amont	Massif Central (FRA)
	Layrou	yes	0761	m	2013	GPS	Jonte amont	
	Calandreto	yes	0948	m	2017			
	Fario	yes	1079	f	2020	GPS		
	Ophrys	yes	1078	f	2020	GPS		
	Rei del Causse	yes	1128	m	2022	GPS		
Spain (without Pyrenees)	**17**	**17 / 0**		**9 / 8**				
	Bassi	yes	1033	m	2019	GPS		Maestrazgo (ESP)
	Esperit	yes	1135	m	2022	GPS		
	Blimunda	yes	0633	f	2010		Cazorla	Andalusia (ESP)
	Miguel	yes	0800	m	2014		Cazorla	
	Tono	yes	0486	m	2006		Cazorla	
	Guadalquivir	yes	0751	m	2013		Castril	
	Seprona	yes	0895	m	2016		Castril	
	Vera	yes	0752	f	2013		Castril	
	Aragon	yes	1143	m	2022			
	Bernar	yes	1088	f	2020			
	Capitel	yes	W429	f	2021			
	Curro	yes	1057	f	2020			
	Grefa	yes	1107	f	2021			
	Leo	yes	1054	f	2020			
	Llopis	yes	1086	f	2020			
	Paz	yes	1139	m	2022			
	Pozo Alcón	yes	0888	m	2016			

5.5 Estimated number of Bearded Vultures

E_{foc} - Based on observations (focal day):

Although the total amount of observations gathered during the IOD can be used as an indicative of the presence of Bearded Vultures, it is not possible to use data from the whole week (IOD-Period) due to the high mobility of the species (***Figure 4***). In order to omit the possibility of double counting birds and to create a more accurate picture of the Bearded Vulture distribution, only observations from the focal day were used to determine the approximate number of birds (E_{foc} *= estimate based on observations (focal day)* ***Table 8***). Furthermore, regional administrators were requested to communicate with nearby partners to avoid double counting of bird individuals.

E_{hyp} - Hypothetically present birds:

During the focal day it is not possible to observe and identify every single bird that is known to be present in a specific region. A second estimate (E_{hyp} = *hypothetically present birds*) composed of the estimate based on observations (focal day) E_{foc} and the number of individuals that were missed during the survey but that should be present in the region (e.g. territorial breeding pairs) should therefore give a picture of the expected number of Bearded Vulture individuals on the regional level (***Table 8***).

However, as the number of counted birds during the IOD depends on multiple external factors (weather conditions, observer etc.), these estimates are best used as a proxy for population trends and to be compared between years rather than directly and solely as a population size estimation.

E_{GPS} – GPS-tagged non-territorial floater birds:

Most of the GPS-tagged birds are non-adult floater birds, which do not necessarily stay in a certain area for a longer time period. Therefore, GPS-tagged individuals, which have not been observed during the IOD should be added to the subtotal of hypothetically present birds in order estimate the overall Alpine Bearded Vulture population.

Final estimate:

We estimate the number of Bearded Vultures observed on the focal day in the Alpine range to vary between 209 and 248 individuals (E_{foc}). Together with the birds that are known to be present in the region (mainly territorial birds from the breeding pairs), the estimate sums up to 256 – 344 individuals (E_{hyp}). Based on GPS-data we know, that 45 tagged birds were present in the Alpine range during this year's IOD. However, 32-33 of these individuals (E_{GPS}) were not identified by observers and should therefore be added to the estimate (E_{hyp}). Through the combination of estimates based on observation data, expert knowledge about territorial birds and GPS-data results it can be assumed that the number of Bearded Vultures in the Alpine population varies between 288 and 377 individuals.

The estimates of hypothetically present birds E_{hyp} represent 70% (conservative) or 91% (optimistic) of the total population that is predicted by the demographic model from Schaub et al. 2009 (predicted population size = 413, **Figure 7** *and* ***Table 10***) with a lower variance than the estimates from the year 2021 (conservative = 284 (75%), optimistic = 381 (100%) with better weather conditions). However, looking at the estimates based on observations only, it was possible to observe 51% or 60% respectively of the birds predicted by the model – less than in 2021. In good weather conditions (thermals) the activity and flight distance of the birds increase, which can lead to double counting. In addition, it is expected that with good visibility, more observations will be possible.

Table 8. Estimates of minimal (conservative) and the maximal (optimistic) number of Bearded Vulture individuals observed during the focal day (E_{foc}) and hypothetically present (E_{hyp} = observed and known not-observed birds) in each region during the IOD.

Population	Country	Region	E_{foc} - Estimate based on observations (focal day)		E_{hyp} - Estimated number of hypothetically present birds	
			min	max	min	max
Alpine range	**East subtotal**		**18**	**24**	**21**	**32**
	AUT	Hohe Tauern NP	18	24	21	32
	GER	Allgaeu	-	-	-	-
	Cenral subtotal		**94**	**106**	**110**	**146**
	GER	Bavarian Alps	1	1	1	1
	CHE	Central Switzerland	3	3	3	3
	CHE	Grison	57	66	63	90
	CHE	Ticino	2	3	2	3
	ITA	South-Tyrol	-	-	8	14
	ITA	Stelvio NP, Sondrio, Brescia & Trentino Alto Adige	31	33	33	35
	North-west subtotal		**64**	**79**	**90**	**124**
	CHE	Berner Oberland	2	2	4	5
	CHE	Wallis	18	23	24	44
	FRA	Haute Savoie	8	10	14	19
	FRA	Savoie	25	26	28	26
	ITA	Valle d'Aosta & Gran Paradiso NP	11	18	20	30
	South-west subtotal		**33**	**39**	**35**	**42**
	FRA	Baronnies	-	-	-	-
	FRA	Haute Dauphiné	6	7	8	10
	FRA	Mercantour	12	14	12	14
	FRA	Vercors NP	7	7	7	7
	ITA	Alpi Cozie	2	2	2	2
	ITA	Alpi Marittime - WAON	6	9	6	9
Subtotal Alpine range			**209**	**248**	**256**	**344**
+ not observed GPS-tagged birds					32	33
Total Alpine range			**209**	**248**	**288**	**377**
Massif Central	FRA	Grands Causses & Cevennes NP	6	13	6	13
+ not observed GPS-tagged birds					2	2
Total Massif Central					**8**	**15**
French Pyrenees	FRA	Aude	2	2	12	20
+ not observed GPS-tagged birds					0	2
Total French Pyrenees					**12**	**22**
Spain (wihtout Pyrenees)	ESP	Andalusia, La Rioja, Castile y Leòn, Castile la Mancha	20	24	**35**	**65**
Maestrazgo	ESP	Maestrazgo	2	2	**2**	**2**
Bulgaria	BRG		-	-	-	-

Table 9. Comparison of the estimated number of Bearded Vultures in the Alpine range based on the survey during the IOD 2022 in comparison to the estimates from previous years (no estimate from 2020).

	E_{foc} - Estimate based on observations (focal day only)		E_{hyp} - Estimated number of hypothetically present birds	
	min	max	min	max
IOD 2022	**209**	**248**	**288**	**377**
IOD 2021	236	284	284	381
IOD 2019	215	257	256	344
IOD 2018	153	177	208	284
IOD 2017	152	182	208	251
IOD 2016	149	178	172	218
IOD 2015	120	153	166	199
IOD 2014	87	95	112	130
IOD 2013	87	98	117	128

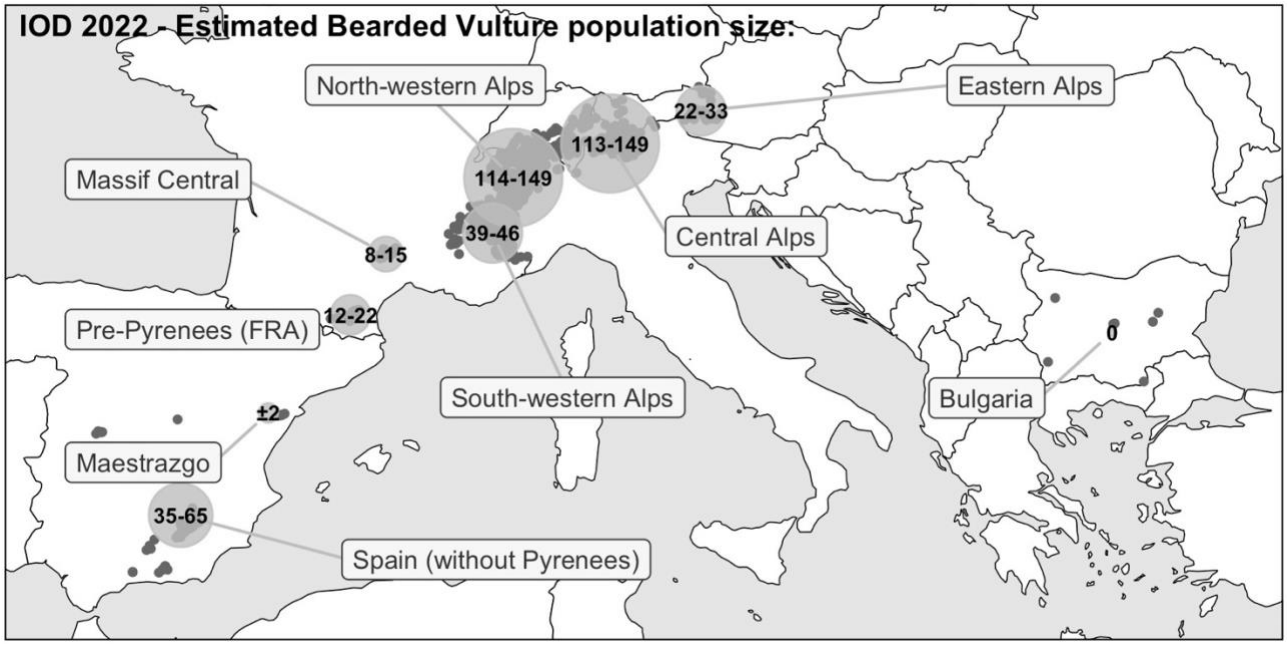

*Figure 6. Overview of the estimated Bearded Vulture population size E_{hyp} on the regional level within the monitoring area of the IOD 2022. Estimates of the populations size are based on estimates derived from observations during the focal day of the IOD E_{foc} and an estimated number of birds that were not observed but should be present in the region (mostly territorial birds). *The estimate for Spain is based on observation data from the occupied observation sites (grey dots) without taking the Bearded Vulture population of the Spanish Pyrenees into account. In Spain Bearded Vultures roam between mountainous areas in the south and in central and northern Spain. No IOD was organised in Corsica (FRA) where a small population of 4 breeding pairs survived. Since 2016 a restocking program is ongoing on Corsica to support this small island population. Since their extinction in 1972, no Bearded Vultures are present in Bulgaria.*

5.6 Proportional distribution of age classes in the Alpine range

By looking at the total number of observations during the IOD it is possible to get an overview of age class distribution, which should be representative of the general Alpine Bearded Vulture population. Per definition the IBM always uses calendar years (cy) for age specifications (***Table 1***).

Comparing the results from the absolute numbers of observations with the estimated number of individuals per age class indicates that, even though there is some variation, observation data can be used as an estimate for the age class distribution. The estimate of the age class distribution based on the data collected during the IOD 2022 is similar as in the last year's estimate. Most of the birds observed on the focal day were adults (61%), followed by juveniles (13%), immatures (10%) and subadults (4%). In fact, similarly to last year's results, the proportion of sighted birds aged in their 5th calendar year or older (subadults & adults - potentially in age to establish a territory) almost reaches 2/3 of the total number of observations (***Table 10***).

Finally, the results were compared to the expected number of living individuals per age class derived by the demographic model designed by Schaub et al. (2009) *(**Table 10, Figure 7***). The results from ***Figure 7*** indicate that the percentage of juveniles coincide quite well with the model predictions. However, the proportion of subadults and immatures are underestimated, while the proportion of adults is overestimated by the observations from the IOD.

There are multiple and additive explanations for the observed discrepancies in the age class distribution (A) and total estimate of the population size (B):

A. More adult birds might be easier to recognise, detect and monitor as they settle into a region and are territorial. In addition, many observation sites were situated in the core area of known breeding units.
A. Juveniles are also easier to detect as they are easier to discern from the other age classes and often the parents have already been detected and the territory is therefore regularly visited. Additionally, released birds up to 2 to 3 years can be identified individually thanks to the bleached feathers.
A. In general, it is considered difficult for non-professional ornithologists to determine the age of young vultures (especially subadult) and could therefore represent the number of observations under the category "unknown".
B. The model of Schaub et al. (2009) is based on survival rates over the whole Alpine area and does not take differences in regions into account.
B. The model of Schaub et al. (2009) is based on only two survival rates. One for juveniles (1.cy) and one for all older birds.

Table 10. Proportion of Bearded Vultures per age class based on observations reported during the focal day during the IOD 2022. Based on these observations the regional coordinators estimated a minimal and maximal number of Bearded Vultures per age class (estimated from observations E_{foc}). The estimate of the birds that are hypothetically present also includes territorial birds, the birds that are known to be present in the region, as well as the GPS-tagged birds that have not been identified during the IOD-period (estimated hypothetically present E_{hyp}).

Age class	Observed	Estimated				Predicted	
	focal day only	Efoc		Ehyp		Model Schaub et al. 2009	
	absolut	mean(min,max)	%	mean(min,max)	%	absolut	%
adult	346	145	63%	206	64%	**217**	53%
subadult	22	14	6%	35	6%	**63**	15%
immature	41	28	12%	51	11%	**80**	19%
juvenile	73	24	11%	48	13%	**53**	13%
unknown	55	18	8%	19	6%	-	-
Total	**537**	**229**	**100%**	**359**	**100%**	**413**	**100%**

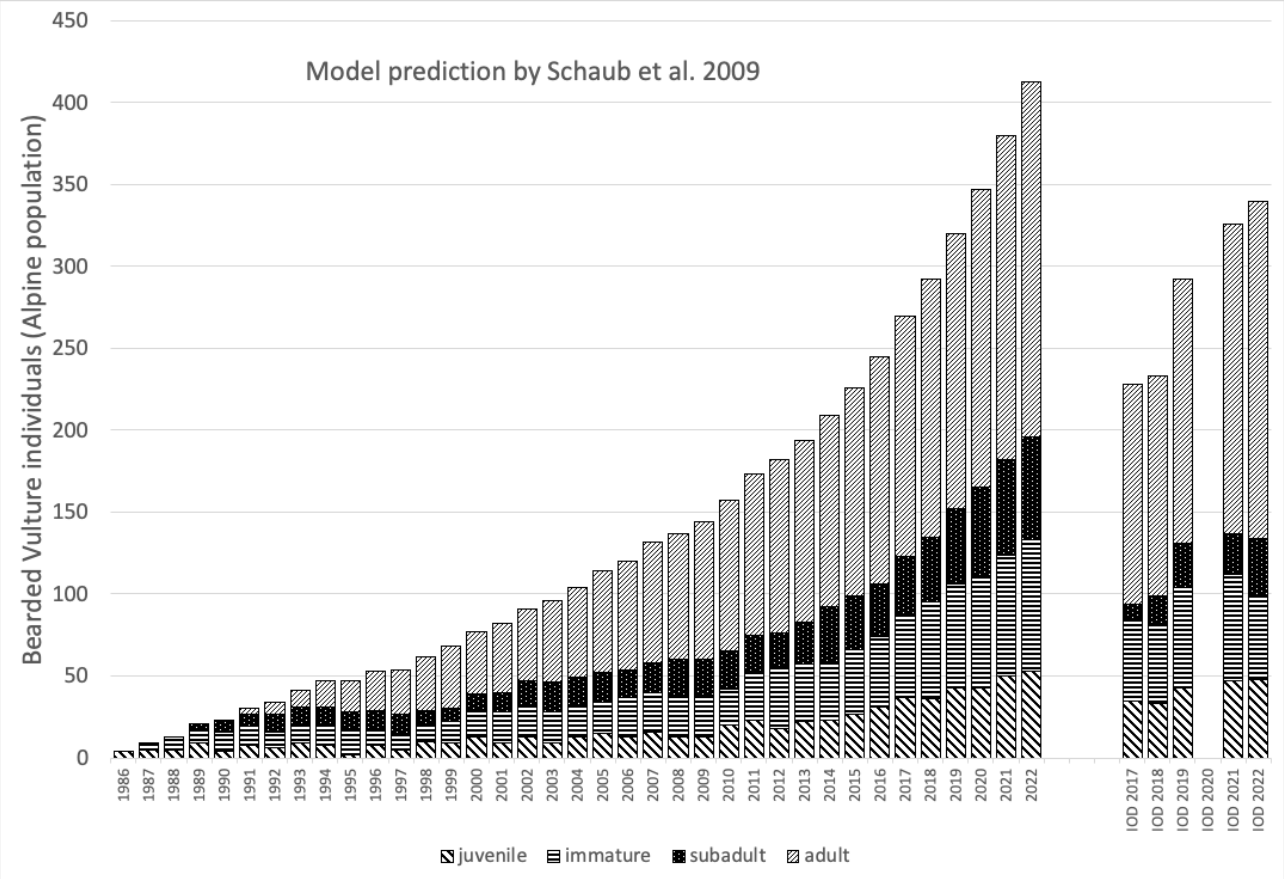

Figure 7. Predicted number of Bearded Vultures per age class according to the demographic model by Schaub et al. 2009[1] in comparison to the estimated number of birds that should hypothetically be present based on observation data (IOD) and expert knowledge from regional coordinators.

5.6.1 Spatial distribution of age groups

From 723 sites 638 Bearded Vulture sightings have been recorded during the whole period, 529 during the focal day (***Table 3***).

In terms of reintroduction and resettlement of a species like the Bearded Vulture, it is of interest to gain a picture of the spatial distribution of different age classes. In particular, the presence of sexually mature adult birds can be an indicator for the formation of new reproductive units in the periphery of the species' distribution.

The following figures (***Figure 8 - Figure 14***) show the presence of Bearded Vultures subdivided in the two age groups adult and non-adult (juvenile, immature, subadult) at the regional level and give a more detailed overview on the Bearded Vulture distribution during the whole observation period. Each symbol on the map represents the position of an observation site, while the white dots represent sites where no Bearded Vulture was observed.

5.6.2 Alpine range

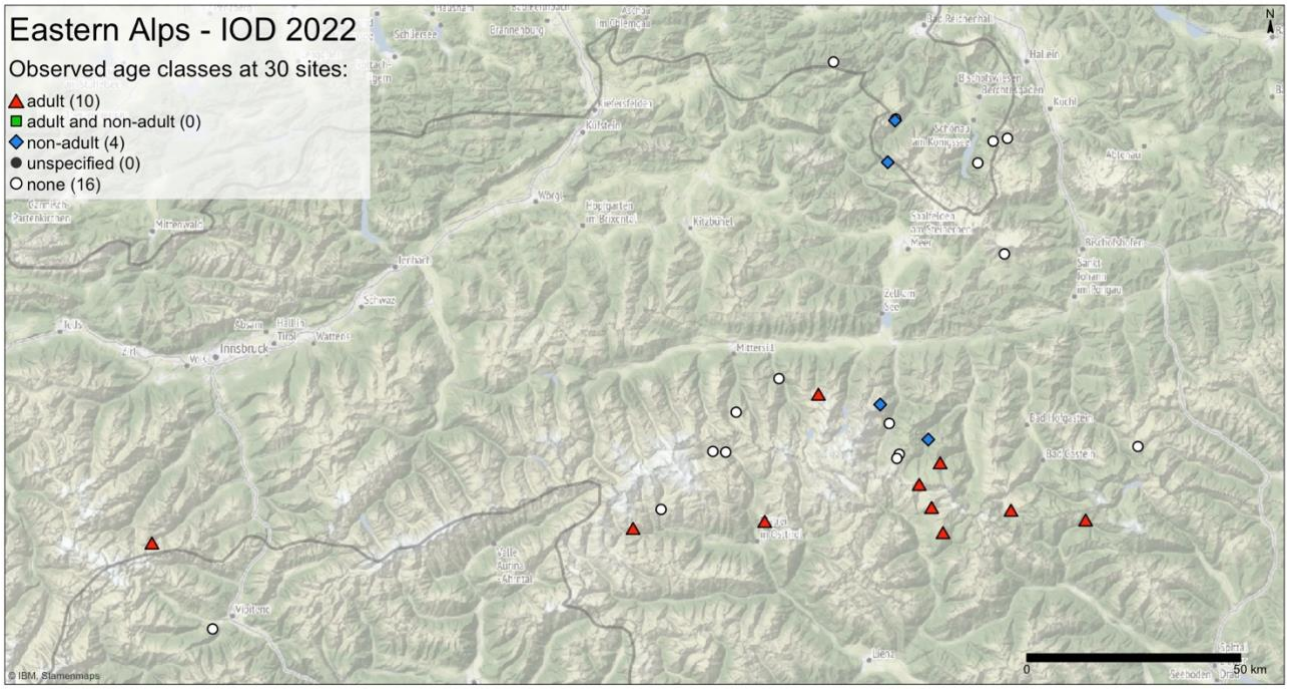

Figure 8. Age class distribution observed at 30 sites in the Eastern Alps during the IOD 2022.

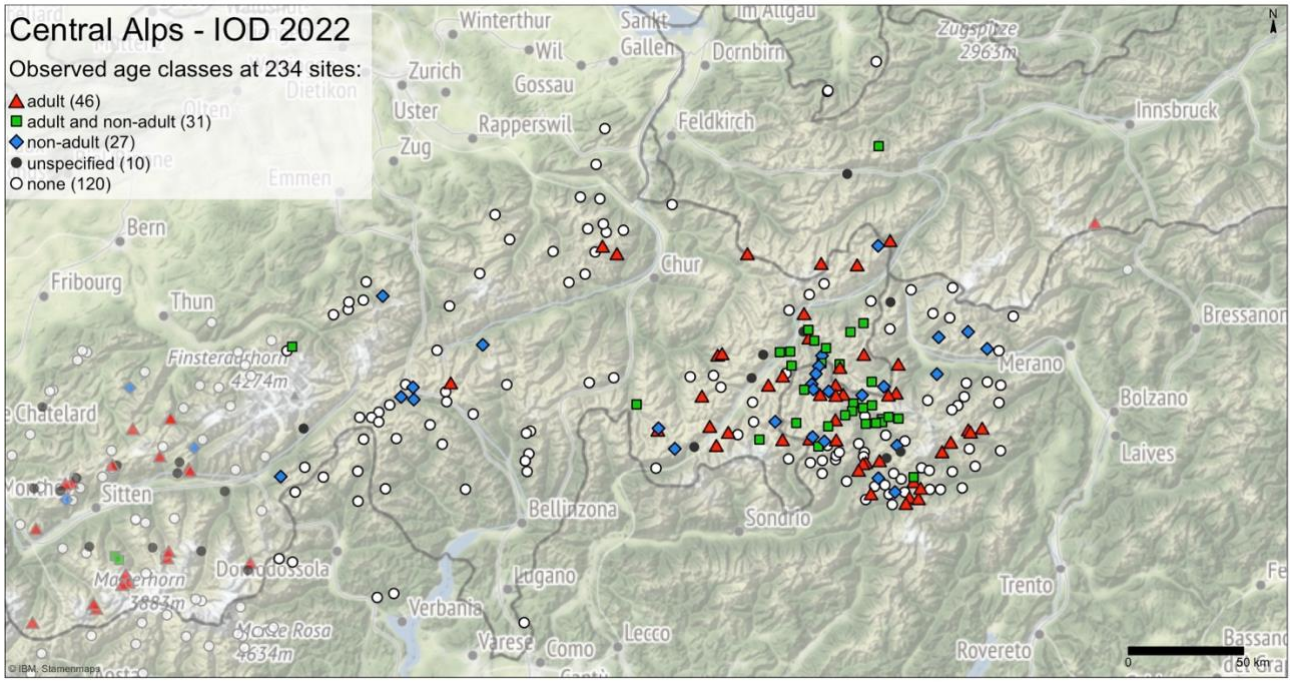

Figure 9. Age class distribution observed at 234 sites in the Central Alps during the IOD 2022.

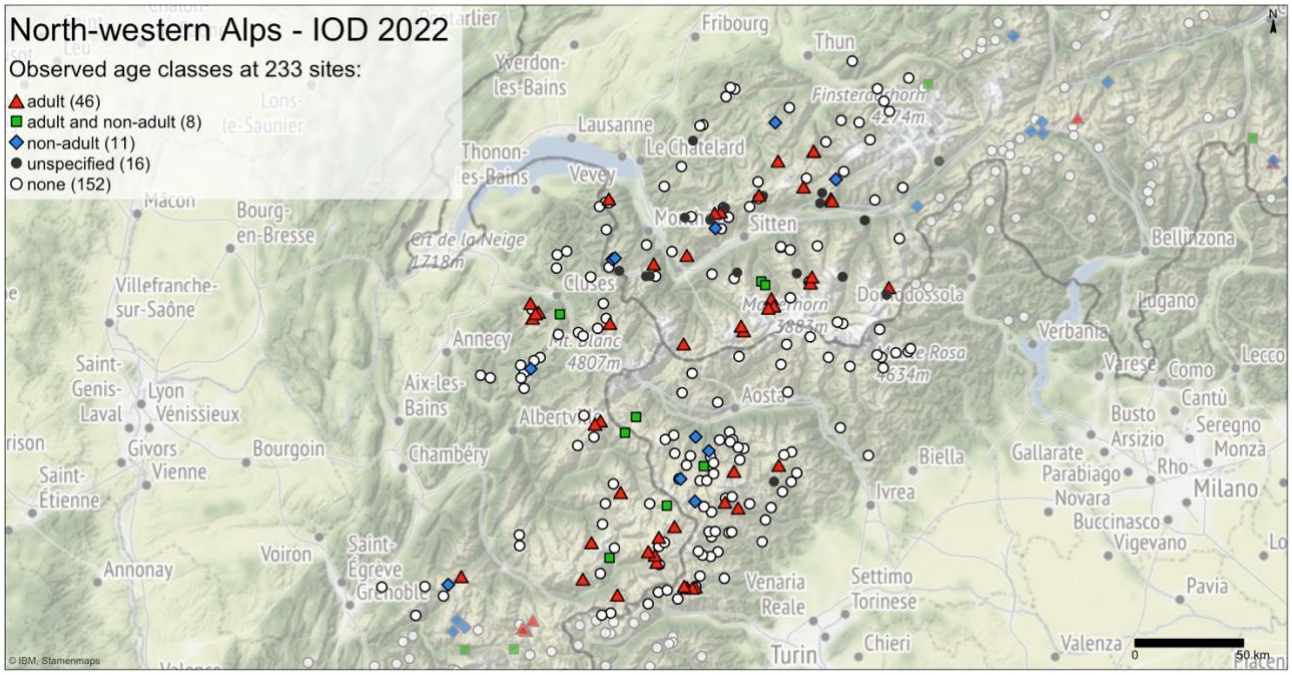

Figure 10. Age class distribution observed at 233 sites in the north-western Alps during the IOD 2022.

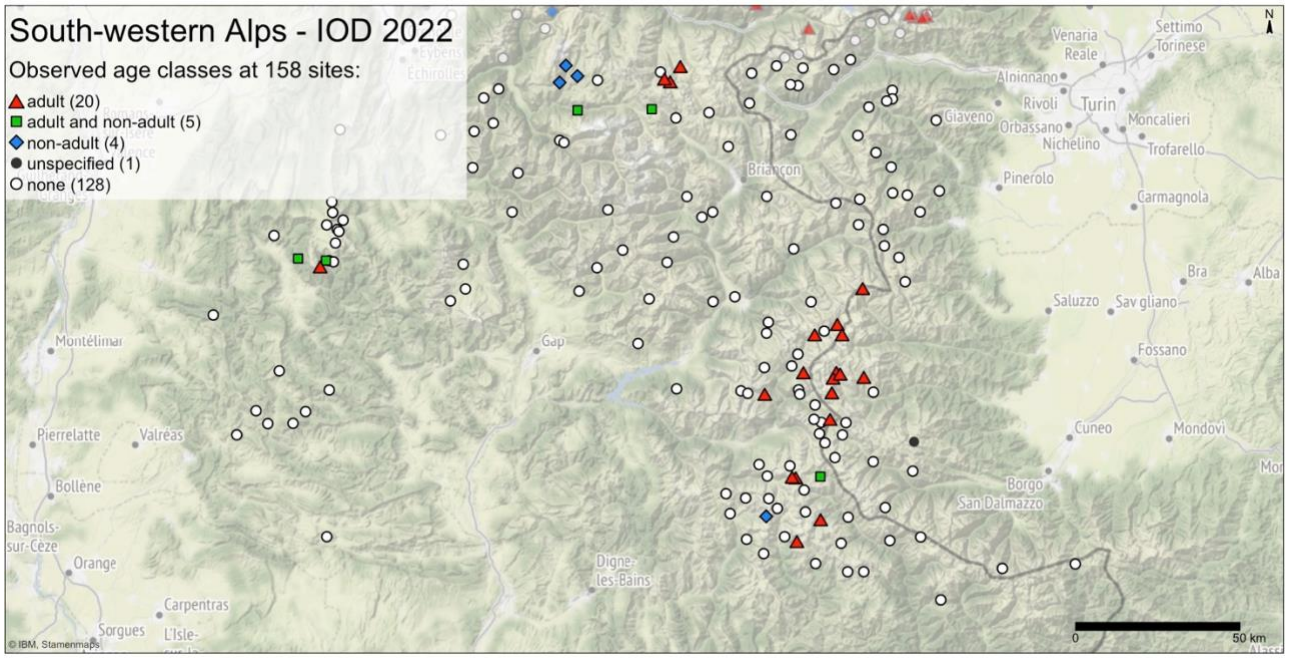

Figure 11. Age class distribution observed at 158 sites in the south-western Alps during the IOD 2022.

5.6.3 Massif Central & French Pre-Pyrenees

Figure 12. Age class distribution observed at 28 sites in the region of the Massif Central and the French Pyrenees during the IOD 2022.

5.6.4 Spain (without Pyrenees)

Figure 13. Age class distribution observed at 33 sites in Spain during the IOD 2022.

5.6.5 Bulgaria

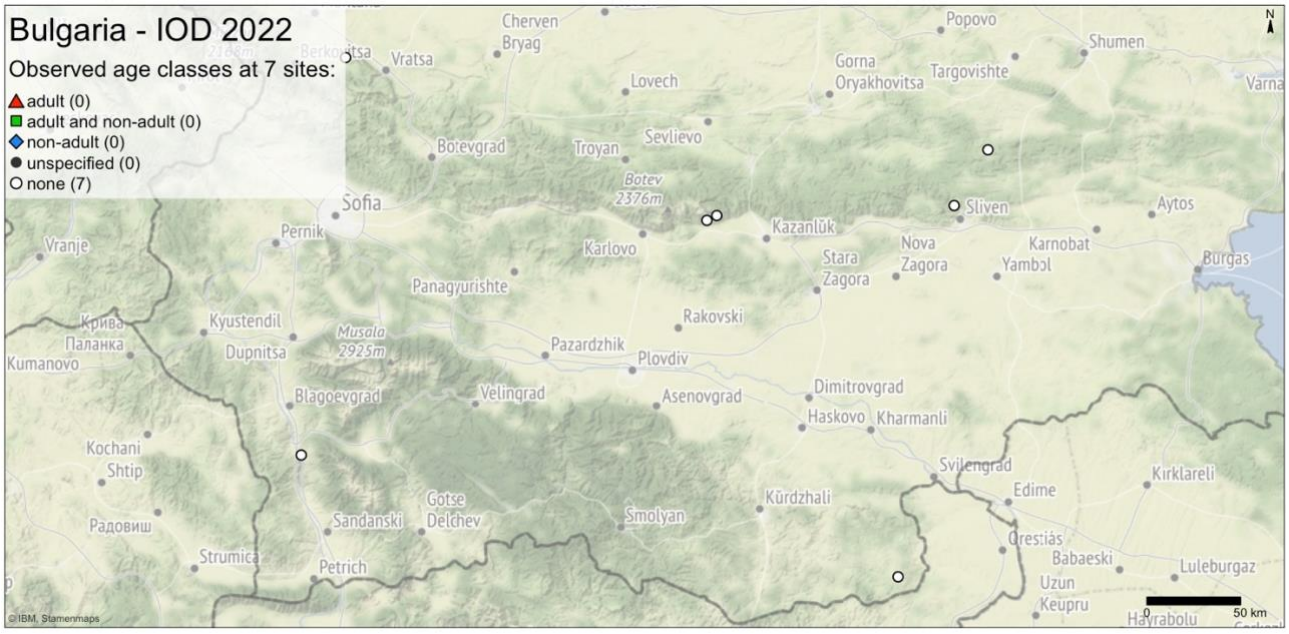

Figure 14. Age class distribution observed at 7 sites in Bulgaria during the IOD 2022.

6 Outlook 2023

For 2023 the focal day is planned for the 14.10.2023 which sets the start for the IOD-period during the following week. Based on last years' experience and feedback from IBM partners, it has become apparent that it is very impractical organisationally to plan for two dates. So that participants can plan the date better, it was therefore decided in plenary to select one date for the focus day and to decide according to the weather conditions whether it makes sense to carry out or cancel the IOD locally. This will have consequences on the possibility of population estimates locally and at population scale.

Focal day **Sat 14th of October 2023**
Period **14th - 21th of October 2023**

Even though a period of one week was chosen for public communication, we would like to stress the importance of focused observation intensity. Observations can be cumulated only within the core period. Therefore, **the count by specialists and volunteers on observation posts shall be carried out only during the focal day.**

The focal time for the count starts at 10 am to at least 3 pm.

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