



INTERNATIONAL  
BEARDED VULTURE  
MONITORING

IOD 2018

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## 13<sup>th</sup> International Bearded Vulture Observation Days

Focal day - October 6<sup>th</sup> 2018  
IOD Period - October 6<sup>th</sup>-14<sup>th</sup> 2018





# Imprint

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**Version**

02.09.2019

**Recommended form of citation**

Lauper, M (2019): 13th International Bearded Vulture Observation Days - IOD 2018. Survey report, International Bearded Vulture Monitoring (IBM); ed. Vulture Conservation Foundation. pp 1-39.

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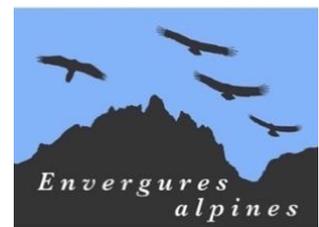
ASTERS <sup>1</sup>  
 ENVERGURES ALPINES <sup>1</sup>  
 LPO GRANDS CAUSSES <sup>1</sup>  
 NATIONALPARK HOHE TAUERN <sup>1</sup>  
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# 1 Abstract

Between the 6<sup>th</sup> and 14<sup>th</sup> of October 2018, the International Observation Days (IOD), an annual monitoring event for bearded vultures, took place for the 13<sup>th</sup> time. This monitoring action is organised by the International Bearded Vulture Monitoring network (IBM) and covers large parts of the Alpine arc (since 2006), parts of the Massif Central (since 2012) and the eastern part of the French Pyrenees (since 2016), several regions in Spain (since 2017) and for the first time some selected regions in Bulgaria. 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, 6<sup>th</sup> of October in 2018, 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. In addition, the number of participants during the IOD increases every year, which promotes the public awareness for the conservation of this flagship species.

Even though, the weather conditions were less favourable compared to last year with 40% of the total 640 observation sites reporting good, 24% mediocre and 35% unfavourable weather, more than 1'040 observers occupied observation sites in the field and reported 701 bearded vulture observations. Once more, such a large-scale survey would not have been possible without the effort and expertise of the regional coordinators of the 14 IBM-partners and 4 associated organisations. Their background knowledge and their familiarity with the local situation enables them to evaluate the IOD-observation data and to give an estimate about the population size in their region. These estimates and the observations were compiled, evaluated and summarised over the entire monitoring area in order to get an overview of the age class distribution and to compare the estimates on the alpine scale with the predicted population size from demographic modelling (Schaub et al. 2009)<sup>1</sup>.

The population within the Alpine range, was estimated to vary between 208 and 284 individuals respectively, slightly lower than the model estimate of 292 individuals. However, the estimated age class distribution is fairly well in line with the predicted values of the demographic model<sup>1</sup> with the exception of the subadult birds, which are difficult to identify correctly in the field (55% adults, 7% subadults, 20% immature, 13% juveniles). Both estimates are based on a combination of the observation data collected during the focal day and the knowledge about individuals that have not been observed but are supposed to be present in the region (territorial birds, in some exceptional cases also their fledglings, GPS-tagged birds (N = 38 in 2018) etc.).

In the Massive Central the estimated population size is three individuals, and at least five, possibly nine, individuals have been observed in the Aude region of the French Pyrenees. The IOD in Andalusia and Castilla y León revealed a minimal and maximal number of 28 and 40 bearded vultures, respectively. As expected, no bearded vultures have been observed in Bulgaria where the species has been considered extinct since 1972.

55 bearded vultures could be identified on an individual level, while another 13 birds were identified with high probability. Each of these identifications provides valuable information about the life-history and survival rates of these birds and contributes to the unique data collection of the IBM, which is monitoring the development of the bearded vulture reintroduction project since 1999.

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<sup>1</sup> Schaub, M., Zink, R., Beissmann, H., Sarrazin, F., & Arlettaz, R. (2009). When to end releases in reintroduction programmes: demographic rates and population viability analysis of bearded vultures in the Alps. *Journal of Applied Ecology*, 46(1), 92-100.

## 2 Key facts

### Monitoring organisation

- 14 IBM-partners and 4 associated organisations coordinated the IOD 2018
- 1'044 observers participated in Austria, Bulgaria, France, Germany, Italy, Spain and Switzerland
- 620 sites were occupied during the focal day (6.10.2018) another 20 during the IOD period
- weather situation at the observation sites: 40% good, 24% mediocre and 35% unfavourable

### Observation results

- 701 bearded vulture observations during the IOD period, 658 of them on the focal day 6.10.2018
- bearded vultures observed at 199 out of 640 sites (31%)
- observed age class distribution (number of observations)
  - adult (N = 390)
  - subadult (N = 13)
  - immature (N = 61)
  - juvenile (N = 65)
  - unknown (N = 65)

### Age class distribution & populations estimates

- estimated age class distribution in the alps (individuals)
  - adult (N = 134; 55%)
  - subadult (N = 17; 7%)
  - immature (N = 49; 20%)
  - juvenile (N = 33; 13%)
  - unknown (N = 12; 5%)
- estimated number of bearded vulture individuals
  - Alps: 208 – 284
  - Massif Central: 3
  - Pre-Pyrenees (FRA): 5-9
  - Spain<sup>2</sup>: 28-40
  - Bulgaria: 0

### Individual based data

- 47 (Alps), 3 (Massif Central) and 5 (Spain) individuals could be identified during the IOD 2018
- 13 (Alps) individuals could be identified with high probability during the IOD 2018
- GPS-data is available for 38 individuals during the IOD period 2018, for 36 on the focal day
- in the Alps 6 (~20%) of the 26 GPS-tagged individuals were identified by the observers

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<sup>2</sup> Only for monitored parts (e.g. no survey in Spanish Pyrenees, ...)

## 3 Background

During the International Observation Days (IOD) volunteers and experts search for bearded vultures throughout the Alps and surrounding areas in a simultaneous and coordinated survey. This, in conjunction with other monitoring data, allows us to get an estimate of the number of bearded vultures living in the Alps and the Massif Central. In particular, the joint efforts across the Alps allow to distinguish between bearded vulture individuals thus providing basic data for estimating population numbers. Further, these observations provide essential data for building and improving demographic models which enable us to assess the success of the reintroduction project. Furthermore, the observation days represent a big public event that helps to increase the awareness for this endangered species.

## 4 Methods

### 4.1 Organisation

The monitoring is planned and executed simultaneously over all the alpine territories, in the Massif Central and in parts of the French Pyrenees by local partners. This ultimately allows us to gain information about bearded vulture presence thus avoiding/reducing the chance of double counts and allowing us to get the big picture of bearded vulture distribution. Since 2017, our Spanish colleagues (and new IBM-partner since 2019) also organise the IOD within parts of Andalusia and Castilla y León with the aim to share their results with the IBM-network and to contribute to get a wider picture about the bearded vulture population in Europe. The Spanish observer network is growing and in 2018 more than 100 people participated at the IOD. A new observer network is also establishing in the eastern parts of Europe in Bulgaria, where the *Green Balkans* participate at the IOD for the first time and thus raise awareness for the regionally extinct species.

### 4.2 Area

A network of partners allows to cover a large proportion of the area in the Alpine arc and the Massif Central, while the Alpine range is divided in the four geographic regions eastern, central, north-western and south-western Alps (see dashed rectangles in **Figure 2**). As in the previous years, monitoring was expanded towards the Pyrenees (department Aude in France) in order to reveal exchanges between the separated populations. For the second time, data from Spanish observation sites in National Park Sierra Nevada, Sierra de Gredos and Parque Natural de Cazorla, Segura y las Villas is included in the IOD report. Several observations sites were also occupied in Bulgaria for the first time in 2018. No IOD was organised on Corsica and the region around Maestrazgo in 2018 (**Figure 2**).

### 4.3 Time Period

The 2018's international survey was held between the 6<sup>th</sup> and the 14<sup>th</sup> October with the focal day on Saturday 6<sup>th</sup> 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. The fact, that bearded vultures are active in nest building, makes this a suitable period to observe the birds and record possible new territories and breeding pairs.

## 4.4 Data collection and observation protocol

The survey took place between 10:00 am and at least 15:00 pm. For each observation site and bearded vulture sighting the following information was recorded:

### Observation site:

- date
- team/partner
- site name, address and coordinates
- site occupancy (time)
- weather conditions
- total number of observed bearded vultures
- presence/observation of other species
- observer name

### Bird observation:

- date
- time and duration of the observation
- age of the bird<sup>3</sup>
- bird name / hypothesis
- picture if possible

The teams are composed of one or more observers, at least one of them being experienced, equipped with binoculars and, depending on availability, telescope and camera.

## 4.5 Data Analysis

All data is collected at the end of the day by the local administrator 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 for example 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. The population estimate should only base on data from the focal day in order to avoid that individuals are observed twice in two different regions. GPS-tagged birds that were not observed, are added to the estimate and also serve as a measure for detection probability.

Since it is not always possible to assess whether several observations have been made of the same individual, 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 population in the Alpine range, the Massif Central and parts of the Iberian Peninsula. Finally, the resulting population estimates of the IOD are compared with the estimate that can be deduced from the demographic model of Schaub et al. (2009).

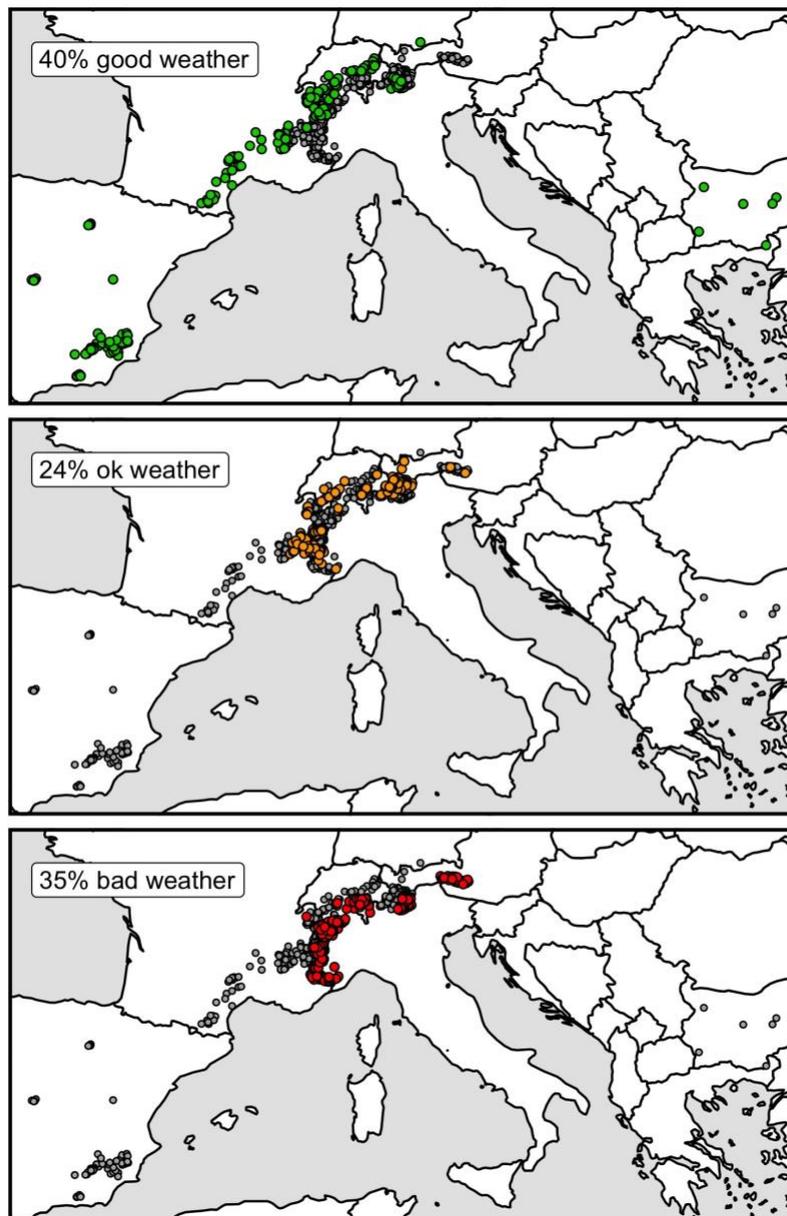
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<sup>3</sup> *In age classes: juvenile (1.cy), immature (2.-3.cy), subadult (4.-5.cy) adult (≥6.cy)*

## 5 Results and Discussion

### 5.1 Weather conditions

The overall weather situation was less favourable than in 2017 with 40% good, 24% mediocre and 35% unfavourable weather situations at the observation sites (**Figure 1**). However, sites in the Alpine range, especially the southern Alps, were affected by less favourable weather (30% good, 28% decent, 42% bad weather). Unfavourable weather conditions decrease the detection probability of the individuals and should therefore be considered for the interpretation of the population estimate.



*Figure 1. Weather conditions at the observations sites reported by the observers in the field during the IOD 2018. More than half of the sites were affected by non-optimal weather conditions, especially south of the main Alpine ridge.*

## 5.2 Observation data

In 2018, a total of 1'044 observers have occupied 640 observation sites in the Alps, the Massif Central, spanning to the Pyrenees to the department “Aude”, parts of Andalusia and Castilla y León as well as Bulgaria (**Figure 2 and Table 1**). The area covered by the observers during the IOD has increased over the years. However, it has not been possible to cover the complete Alpine range (~188'000 km<sup>2</sup>) simultaneously.

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 León, Castilla-La Mancha and La Rioja in the North, the observer network has been expanded in these areas.

In the eastern part of Europe, in Bulgaria several observations sites 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, in the future this region could serve as a stepping-stone area between the Alpine and Greek bearded vulture population and to establish an observer network in this area thus makes sense in the long-term perspective.

**Bearded vulture observation:** ● no (441) ▲ yes (199)

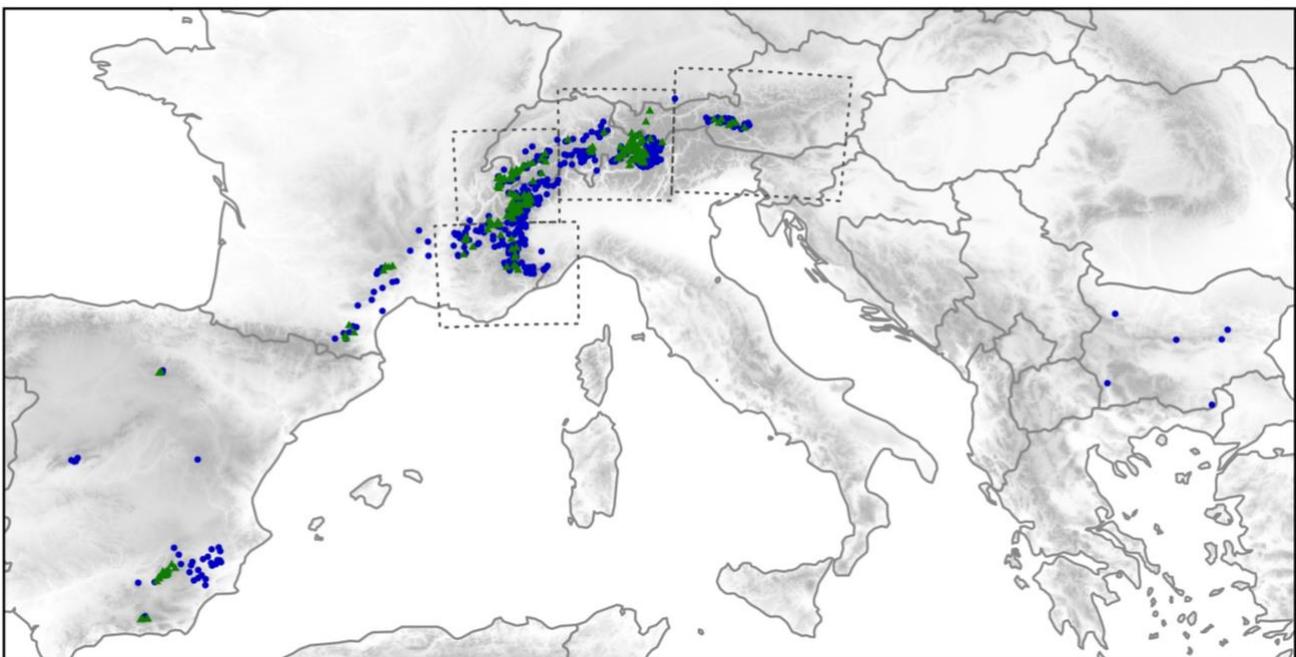


Figure 2. Distribution of all 640 observation sites during the IOD 2018 in Europe. Green triangles depict those sites where bearded vultures have been observed at least once during the IOD period 6<sup>th</sup>-14<sup>th</sup> of October 2018 (N=199) while no observations have been reported from sites marked with a blue dot (N=441). The area of the Alpine range is geographically divided into the eastern, central, north-western and south-western Alps (dashed rectangles from right to left).

Table 1. Number of observation sites and observers per region during the IOD 2018 (focal day 6.10.2018). In the bottom lines the results of the five previous years that highlight a continuous increase of monitoring effort.

Zone	Country	Region	Occupied sites in October 2018										Total	Observers
			6.	7.	8.	9.	10.	11.	12.	13.	14.			
<b>Alpine range</b>			<b>528</b>	<b>4</b>	<b>2</b>	<b>7</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>547</b>	<b>862</b>
<b>East</b>	AUT	Kärnten	6			1							7	54*
	AUT	Salzburg	23									1	24	
	AUT	Tirol	2										2	
	DEU	Bayern		1									1	
<b>Central</b>	AUT	Tirol							1			1	2	333
	AUT	Vorarlberg						1					1	
	CHE	Central Switzerland	15										15	
	CHE	Eastern Switzerland	54										54	
	CHE	Ticino	28										28	
	CHE	Western Switzerland	3										3	
	ITA	Lombardia	69										69	
	ITA	Piemonte	3										3	
ITA	Trentino-Alto Adige	39										39		
<b>North-West</b>	CHE	Western Switzerland	32										32	223
	FRA	Rhône-Alpes	65										65	
	ITA	Piemonte	21	1		2					1		25	
	ITA	Valle d'Aosta	33	2	2	4				1			42	
<b>South-West</b>	FRA	Provence-Alpes-Côte d'Azur	67										67	252
	FRA	Rhône-Alpes	36										36	
	ITA	Piemonte	32										32	
<b>Massif Central</b>			<b>19</b>									<b>19</b>	<b>45</b>	
	FRA	Languedoc-Roussillon	10										10	
		Midi-Pyrénées	5										5	
		Rhône-Alpes	4										4	
<b>Pre-Pyrenees</b>			<b>10</b>										<b>10</b>	<b>24</b>
	FRA	Languedoc-Roussillon	9										9	
		Midi-Pyrénées	1										1	
<b>Spain</b>			<b>57</b>	<b>1</b>									<b>58</b>	<b>106</b>
		Andalucía	24	1									25	
		Castilla y León	4										4	
	ESP	Castilla-La Mancha	5										5	
		La Rioja	4										4	
		Región de Murcia	20										20	
<b>Bulgaria</b>			<b>6</b>										<b>6</b>	<b>7</b>
		Blagoevgrad	1										1	
		Haskovo	1										1	
	BGR	Montana	1										1	
		Sliven	2										2	
		Stara Zagora	1										1	
<b>Sites IOD 2018 total</b>			<b>620</b>	<b>5</b>	<b>2</b>	<b>7</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>		<b>640</b>	<b>1044</b>
<i>IOD 2017</i>													573	923
<i>IOD 2016</i>													528	774
<i>IOD 2015</i>													496	708
<i>IOD 2014</i>													415	634
<i>IOD 2013</i>													437	596

\*simultaneous chamois survey with 380 hunters, which were also looking out for bearded vultures at the same time

Table 2. Number of bearded vulture sightings for each region during the whole IOD period 2018 (focal day 6.10.18). 0 values indicate dates where sites were occupied without bearded vulture observations.

Zone	Country	Region	Bearded vulture observations in October 2018											Total
			6.	7.	8.	9.	10.	11.	12.	13.	14.			
<b>Alps</b>			595	5	3	9	4	5	5	11	1		<b>638</b>	
<b>East</b>	AUT	Kärnten	0	1		2			2				<b>5</b>	
	AUT	Salzburg	4			1	3	4		3	1		<b>16</b>	
	AUT	Tirol	0		1	2				3			<b>6</b>	
	DEU	Bayern		0									<b>0</b>	
<b>Central</b>	AUT	Tirol						1		3			<b>4</b>	
	AUT	Vorarlberg					1						<b>1</b>	
	CHE	Central Switzerland	8										<b>8</b>	
	CHE	Eastern Switzerland	88										<b>88</b>	
	CHE	Ticino	4										<b>4</b>	
	CHE	Western Switzerland	0										<b>0</b>	
	ITA	Lombardia	137										<b>137</b>	
	ITA	Piemonte	0										<b>0</b>	
ITA	Trentino-Alto Adige	11										<b>11</b>		
<b>North-West</b>	CHE	Western Switzerland	40										<b>40</b>	
	FRA	Rhône-Alpes	220										<b>220</b>	
	ITA	Piemonte	0	1		3			2	2			<b>8</b>	
	ITA	Valle d'Aosta	4	3	2	1			1				<b>11</b>	
<b>South-West</b>	FRA	Provence-Alpes-Côte d'Azur	39										<b>39</b>	
	FRA	Rhône-Alpes	40										<b>40</b>	
	ITA	Piemonte	0										<b>0</b>	
<b>Massif Central</b>		<b>11</b>										<b>11</b>		
	FRA	Languedoc-Roussillon	8										<b>8</b>	
	FRA	Midi-Pyrénées	3										<b>3</b>	
	FRA	Rhône-Alpes	0										<b>0</b>	
<b>Pre-Pyrenees</b>		<b>7</b>											<b>7</b>	
	FRA	Languedoc-Roussillon	7										<b>7</b>	
	FRA	Midi-Pyrénées	0										<b>0</b>	
<b>Spain</b>		<b>45</b>	<b>0</b>										<b>45</b>	
	ESP	Andalucía	40	0									<b>40</b>	
	ESP	Castilla y León	0										<b>0</b>	
	ESP	Castilla-La Mancha	1										<b>1</b>	
	ESP	La Rioja	4										<b>4</b>	
	ESP	Región de Murcia	0										<b>0</b>	
<b>Bulgaria</b>		<b>0</b>											<b>0</b>	
	BGR	Blagoevgrad	0										<b>0</b>	
	BGR	Haskovo	0										<b>0</b>	
	BGR	Montana	0										<b>0</b>	
	BGR	Sliven	0										<b>0</b>	
	BGR	Stara Zagora	0										<b>0</b>	
<b>Observations IOD 2018 total</b>			<b>658</b>	<b>5</b>	<b>3</b>	<b>9</b>	<b>4</b>	<b>5</b>	<b>5</b>	<b>11</b>	<b>1</b>		<b>701</b>	

## 5.3 Telemetry data

### 5.3.1 IBM-monitoring area

During the observation period GPS-data of 38 out of 39 bearded vultures with satellite tags have been retrieved in the Alpine range, the Massif Central, the Pyrenees, north-eastern Spain and Corsica<sup>4</sup> (**Figure 3**), while Arcana's (BG954) tag did not send data during this period. 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-born birds (e.g. Gemapi, Neige and Gypsy, Roc Genèse) 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 3**) underline the importance of using only observational data from a narrow period (focal day) for population estimation to avoid double counting.

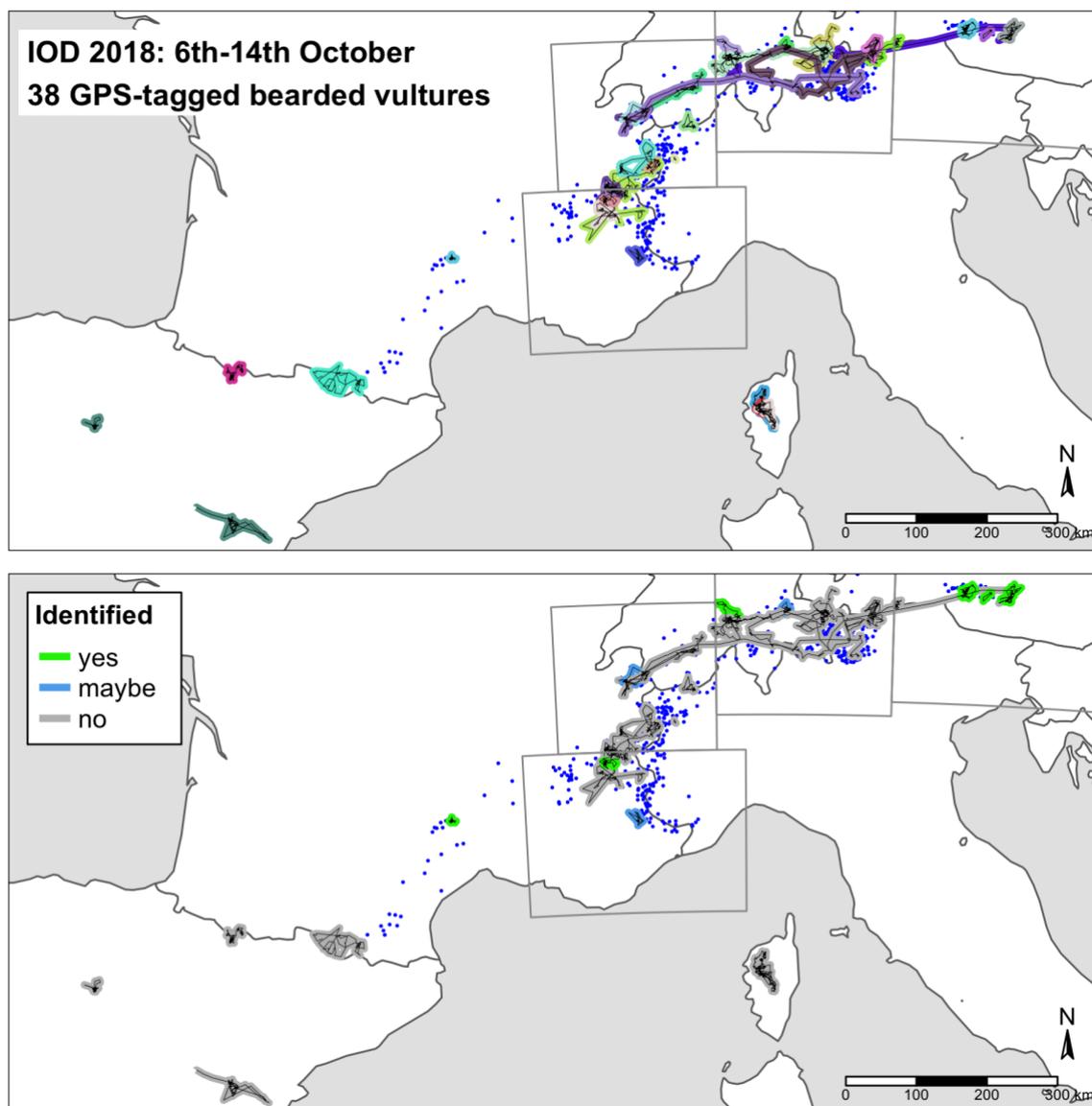


Figure 3. 38 GPS-tagged bearded vultures during the IOD periode. Blue dots = occupied observation sites.

<sup>4</sup> No IOD was organized on Corsica in 2018.

### 5.3.2 Alpine range

During this year's IOD GPS-data in the Alpine range was available from 29 birds during the IOD period and from 27 birds on the focal day (6.10.2018). Out of the 29 GPS-tagged birds 6 individuals could be sighted and identified, while 3 birds were identified with high probability by observers. The GPS-tags of Ewolina (BG838) and Roman (BG854) did not send data on the focal.

Compared to the year 2017, where more than 50% of all GPS-tagged birds have been sighted and identified, only around 20% of all GPS-tagged birds could be identified in the Alps in 2018. Unfavourable weather conditions could have been the reason, why the birds were not identified despite they were observed and thus included in the estimate leading to an overestimate of the actual number of birds present in the region.

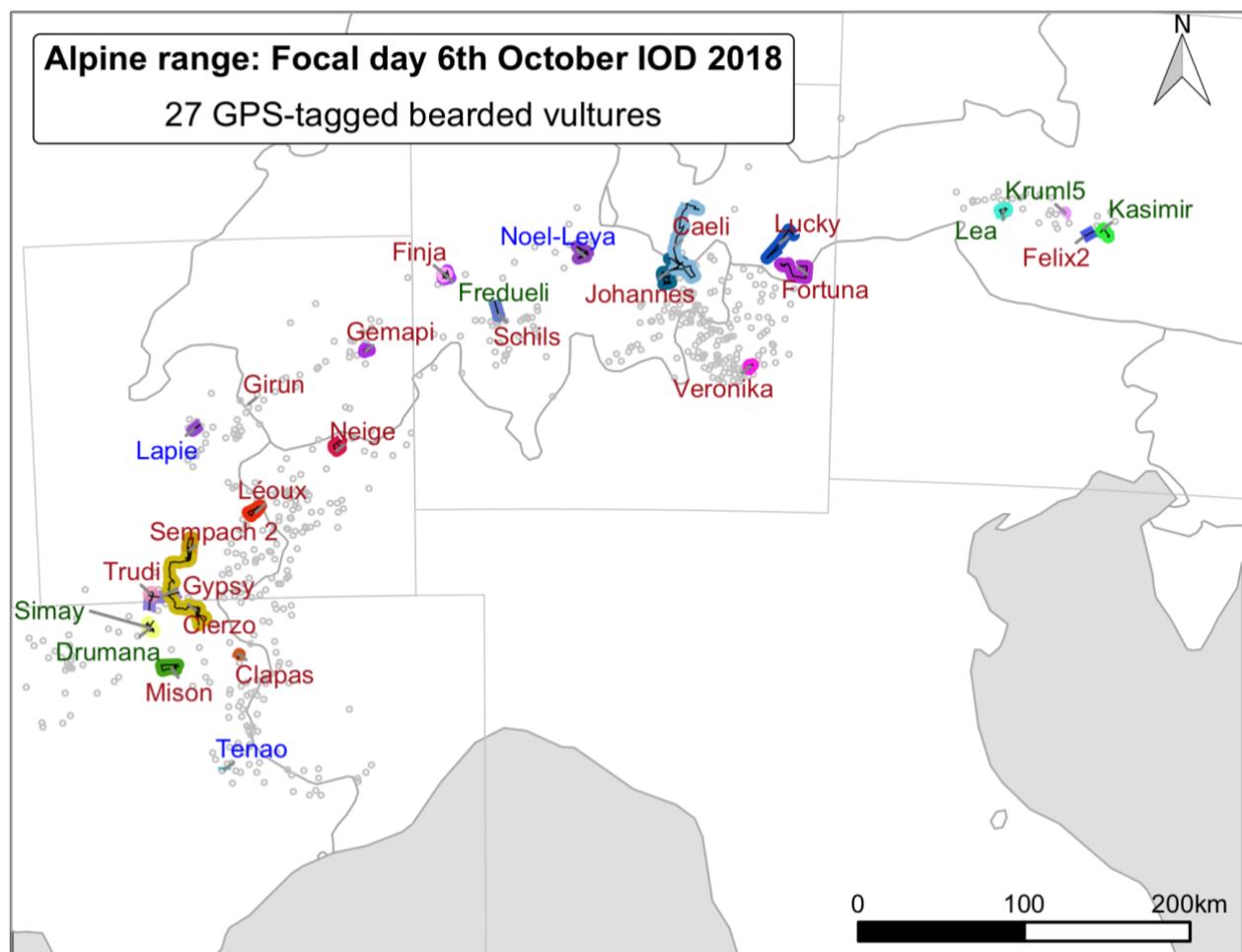


Figure 4. Positions of 27 bearded vultures tagged with GPS transmitters that were present in the Alpine range during the focal day (6.10.2018). Observation sites that were occupied during the IOD-period are marked with grey circles. During the IOD-period 6 birds have been identified (green labels), 3 birds (Lapie W251, Tenao BG755, Noel-Leya BG797) have been identified with high probability (blue labels) and 18 birds couldn't be identified (red labels). The GPS-tags of Ewolina (BG838) and Roman (BG854) did not send data on the focal.

Table 3. 39 Birds with active GPS-tag during the IOD periode 2018. No data is available from Arcana (BG954) during the IOD period and from Ewolina (BG838) and Roman (BG854) during the focal day (14.10.18). No IOD was organised in Corsica in 2018.

Animal	BirdID	Sex	Bird type	Age class	Days with pos.	Pos. on focal day	Observed (yes/probably/no)
<b>Alps</b>							<b>6/3/20</b>
Tenao	755	m	released	adult	9	2	probably
Veronika	321	f	released	adult	9	23	no
Lea	840	m	released	subadult	9	10	yes
Noel-Leya	797	m	released	subadult	8	11	probably
Ewolina	838	f	released	subadult	8	0	no
Felix2	793	m	released	subadult	9	2	no
Fortuna	843	m	released	subadult	9	33	no
Roman	854	m	released	subadult	5	0	no
Schils	802	m	released	subadult	9	7	no
Sempach 2	841	f	released	subadult	9	26	no
Trudi	842	f	released	subadult	7	1	no
Cierzo	899	m	released	immature	9	276	no
Gemapi	W196	f	wild-hatched	immature	9	10	no
Girun	904	f	released	immature	9	2	no
Gypsy	W209	m	wild-hatched	immature	9	10	no
Johannes	964	m	released	immature	9	9664	no
Léoux	950	f	released	immature	9	11	no
Lucky	909	m	released	immature	9	6	no
Mison	W230	f	wild-hatched	immature	9	10	no
Neige	W198	m	wild-hatched	immature	9	7	no
Drumana	980	m	released	juvenile	9	10	yes
Fredueli	1001	m	released	juvenile	9	107	yes
Kasimir	991	m	released	juvenile	9	27	yes
Krum15	W245	u	wild-hatched	juvenile	9	4	yes
Simay	983	m	released	juvenile	9	99	yes
Lapie	W251	m	wild-hatched	juvenile	9	6	probably
Caeli	998	m	released	juvenile	9	75	no
Clapas	975	m	released	juvenile	9	5	no
Finja	1003	f	released	juvenile	9	94	no
<b>Massif Central</b>							<b>2/0/0</b>
Layrou	761	m	released	adult	9	79	yes
Arcana *	954	f	released	immature	0	0	yes
<b>Pyrenees</b>							<b>0/0/2</b>
Calandreto	948	m	released	immature	9	273	no
Roc Genève		m	wild-hatched	immature	9	11	no
<b>Corsica</b>							<b>0/0/4</b>
Ercu	958	m	released	immature	9	37	no
Luna	959	f	released	immature	9	6	no
Muntagnolu	890	m	released	immature	9	4	no
Bonifatu2018	W271	u	wild-hatched	juvenile	9	9	no
<b>Animal</b>							<b>Observed (yes/probably/no)</b>
<b>Spain</b>							<b>0/0/2</b>
Alos	992	m	released	juvenile	9	9	no
Amic	995	m	released	juvenile	9	9	no

## 5.4 Individual based data

During the IOD 2018 period 55 individuals have been identified with high probability. 6 of them in the eastern Alps, 30 in the central Alps, 5 in the north-western Alps, 6 in the south-western Alps, 3 in the Massif Central and 5 in Spain (**Table 4**). Another 13 birds could not have been identified with certainty. These “probably” identified birds, 1 of them in the central Alps, 5 in the north-western Alps and 7 in the south-western Alps are marked as “probably identified” in **Table 5** and **Table 6**.

*Table 4. Summary of bearded vulture individuals that were (“probably”) identified during the IOD-period 2018.*

Row Labels	Identified with high probability	Probably identified	Total
East	6		6
Central	31	1	32
North-West	5	5	10
South-West	6	7	13
<b>Subtotal</b>	<b>48</b>	<b>13</b>	<b>51</b>
Massif Central	3		3
Spain	5		5
<b>Grand Total</b>	<b>56</b>	<b>13</b>	<b>69</b>

For the Alpine range, the 47 identified birds account for about 16% of the total estimated population size predicted by the demographic model by Schaub et al. 2009 (292 individuals). The identified birds are mostly territorial birds and their chicks or recently released birds that can be identified by means of bleached feathers or GPS-locations. The identification of bearded vultures on individual level forms the basis for long-term life history data, the core element for demographic modelling, that allows to predict the development of the reintroduced bearded vulture population.

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. 60 bearded vultures that were identified (13 of them with some uncertainty = probably identified) in the Alpine range during the IOD 2018 grouped by the region where they have been observed.

Identification	Bird	BirdID	Sex	Age (cy)	Tag	Territory	Region	Zone
yes	Alexa	100	f	31		Gastein/Rauris		Eastern Alps
yes	Andreas Hofer	260	m	23		Gastein/Rauris		
yes	Kruml5	W245	u	1	GPS	Gastein/Rauris	Hohe Tauern NP (AUT)	
yes	Kasimir	991	m	1	GPS			
yes	Lea	840	m	4	GPS			
yes	Blick	524	m	12		Planeil	Vinschgau (ITA)	
yes	Freduei	1001	m	1	GPS		Central Switzerland (CHE)	
probably	Noel-Leya	797	m	5	GPS			
yes	Diana-Stelvio	W07	f	19		Albula		Central Alps
yes	Tantermozza	W46	m	12		Albula		
yes	Albula2018	W248	u	1		Albula		
yes	GT117		-	-		Bergün		
yes	GT116		-	-		Bergün		
yes	Retia	357	f	19		Buffalora		
yes	Ingenius	621	m	9		Buffalora		
yes	GT031		f	-		Foraz		
yes	GT061		-	-		Foraz		
yes	Folio	463	f	14		Maloja		
yes	Rurese	559	m	11		Maloja	South-eastern Grisons (CHE)	
yes	Ofenpass2018	W262	u	1		Ofenpass		
yes	Ortler	439	f	15		Ofenpass		
yes	Livigno	W08	m	19		Ofenpass		
yes	GT010		f	-		Ova Spin		
yes	GT038		f	-		Poschiavo		
yes	GT057		m	-		Poschiavo		
yes	Moische-Livigno	W11	f	17		Sinestra		
yes	Samuel	526	m	12		Sinestra		
yes	GT090		-	-		Spöl		
yes	GT048		-	-		Tantermozza		
yes	Zebbru	W12	m	17		Tantermozza		
yes	Cic	186	m	26		Livigno		
yes	Moische	146	f	28		Livigno		
yes	Tell	283	m	22		Valle del Braulio		
yes	Stift	393	f	17		Valle del Braulio	Stelvio NP, Trentino & Sondrio (ITA)	
yes	Felice	375	f	18		Zebrù		
yes	Heinz-Serraglio	W45	u	12		Zebrù		
yes	Ubario-Livigno	W273	u	1		Livigno		
probably	Guillaumes	411	f	16		Derborence_Vérouet		North-Western Alps
probably	Gildo	299	f	21		Derborence_Vérouet	Wallis & Berner Oberland (CHE)	
probably	Diana-Valais	301	m	21		Leukerbad		
yes	Phenix Alp Action	W01	m	22		Bargy		
yes	GT089		-	-		Bargy		
yes	GT099		m	-		Bargy bis	Haute Savoie (FRA)	
probably	Zufall	493	f	13		Bargy bis		
probably	Lapie	W251	m	1	GPS	Bargy		
yes	Stelvio	W02	u	21		Termignon	Savoie (FRA)	
yes	Jausiers	413	f	16		Val d'Isère		
yes	Volcaire	905	m	3			Baronnies (FRA)	
probably	Basalte	716	m	7		Malaval		South-Western Alps
yes	Drumana	980	m	1	GPS		Isère (FRA)	
yes	Simay	983	m	1	GPS			
probably	Bellemotte	708	f	7		Bonette		
yes	Cuneobirding	491	f	13		Chambeyron-Ubayette		
probably	Stephan	616	m	9		Chambeyron-Ubayette		
probably	Tenao	755	m	6	GPS		Mercantour (FRA)	
probably	Guy	W250	u	1				
probably	Orion	W253	u	1				
yes	Rocca	516	m	12		Source de la Tinée		
probably	Girasole	549	f	11		Source de la Tinée		
yes	Kirsi	764	m	6			Vercors (FRA)	

Table 6. Bearded vultures that were identified in the Massif Central (3 individuals) and Spain (5 individuals) during the IOD 2018 grouped by the region where they have been observed.

Identification	Bird	BirdID	Sex	Age (cy)	Tag	Territory	Region	Zone
yes	Layrou	761	m	6	GPS		Grands Causses (FRA)	Massif Central
yes	Arcana	954	f	2	GPS			
yes	Adonis	794	m	5				
yes	Vera	752	f	6		Borosa	Andalusia (ESP)	Spain
yes	Guadalquivir	751	m	6		Borosa		
yes	Tono	486	m	13		Guadalest		
yes	Encina	713	f	7		Poyos de la mesa		
yes	Sansón	767	m	6		Poyos de la mesa		

## 5.5 Estimated number of bearded vultures

### ***E<sub>foc</sub>* - 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 3**). 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<sub>foc</sub>* = estimate based on observations (focal day) **Table 7**). Furthermore, regional coordinators were requested to communicate with nearby partners to avoid double counting of bird individuals.

### ***E<sub>hyp</sub>* - 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<sub>hyp</sub>* = hypothetically present birds) composed of the estimate based on observations (focal day) *E<sub>foc</sub>* 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 7**).

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<sub>GPS</sub>* – 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 153 and 177 individuals (*E<sub>foc</sub>*). 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 vary between 188 and 261 individuals (*E<sub>hyp</sub>*). Based on GPS-data we know, that 29 tagged birds were present in the Alpine range during the IOD 2018. However, 20-23 of these individuals (*E<sub>GPS</sub>*) were not identified by observers and should therefore be added to the estimate (*E<sub>hyp</sub>*). 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 208 and 284 individuals.

These numbers are only slightly higher compared to the results obtained during the last IOD in 2017, where the weather conditions were much more favourable compared to this year (**Table 8**). These estimates of hypothetically present birds *E<sub>hyp</sub>* represent 71% (conservative) or 97% (optimistic) of the total population that is predicted by the demographic model from Schaub et al. 2009 (predicted population size = 292, **Figure 6 and Table 10**) with a higher variance than the estimates from the last year (conservative = 208 (77%), optimistic = 251 (92%) with exceptionally favourable weather conditions). However, looking at the estimates based on observations only, it was possible to observe 52% or 61% respectively of the birds predicted by the model – only a bit less than in 2017.

Table 7. 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 2018.

	Country	Region	$E_{foc}$ - Estimate based on observations (focal day)		$E_{hyp}$ - Estimated number of hypothetically present birds		
			min	max	min	max	
Alpine range	<b>East subtotal</b>		<b>9</b>	<b>9</b>	<b>13</b>	<b>32</b>	
	AUT	Hohe Tauern NP	4	4	8	25	
	ITA	Vinschgau	5	5	5	7	
	<b>Central subtotal</b>		<b>64</b>	<b>77</b>	<b>73</b>	<b>99</b>	
	CHE	Central Switzerland	2	2	2	2	
	CHE	South-eastern Grison	42	51	48	69	
	CHE	Ticino	1	1	1	1	
	ITA	Stelvio NP, Sondrio, Brescia & Trentino Alto Adige	19	23	22	27	
	<b>North-west subtotal</b>		<b>55</b>	<b>63</b>	<b>74</b>	<b>88</b>	
	CHE	Wallis & Berner Oberland	14	15	23	27	
	FRA	Haute Savoie	12	16	12	16	
	FRA	Savoie	26	29	29	34	
	ITA	Valle d'Aosta & Gran Paradiso NP	3	3	10	11	
	<b>South-west subtotal</b>		<b>25</b>	<b>28</b>	<b>28</b>	<b>42</b>	
	FRA	Baronnies	1	1	1	1	
	FRA	Isère	11	12	11	15	
	FRA	Mercantour	12	14	12	14	
	FRA	Vercors NP	1	1	1	1	
	ITA	Alpi Cozie	0	0	0	0	
	ITA	Alpi Marittime - WAON	0	0	3	11	
				<b>153</b>	<b>177</b>	<b>188</b>	<b>261</b>
	+ GPS-tagged birds that have not been observed during the IOD					<b>20</b>	<b>23</b>
	<b>Total Alpine range</b>					<b>208</b>	<b>284</b>
	<b>Massif Central</b>	FRA	Grands Causses & Cevennes NP	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
	<b>French Pyrenees</b>	FRA	Aude	<b>4</b>	<b>9</b>	<b>5</b>	<b>9</b>
	<b>Spain</b>	ESP	(without Pyrenees)	<b>23</b>	<b>32</b>	<b>26</b>	<b>38</b>
+ GPS-tagged birds that have not been observed during the IOD					<b>2</b>	<b>2</b>	
<b>Total Spain</b>					<b>28</b>	<b>40</b>	
<b>Bulgaria</b>	BRG		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	

Table 8. Comparison of the estimated number of bearded vultures in the Alpine range based on the survey during the IOD 2018 in comparison to the estimates from the last five years.

	$E_{foc}$ - Estimate based on observations (focal day only)		$E_{hyp}$ - Estimated number of hypothetically present birds	
	min	max	min	max
<b>IOD 2018</b>	<b>153</b>	<b>177</b>	<b>208</b>	<b>284</b>
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

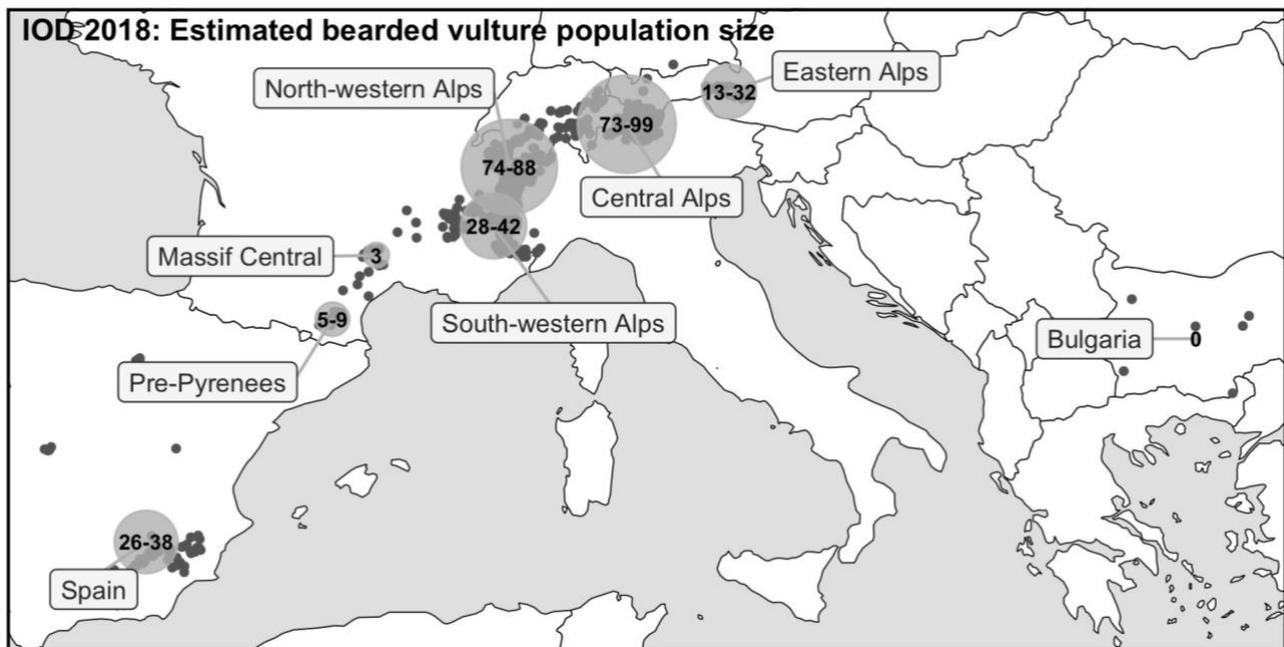


Figure 5. Overview of the estimated bearded vulture population size  $E_{hyp}$  on the regional level within the monitoring area of the IOD 2018. Estimates of the populations size are based on estimates derived from observations during the focal day of the IOD 2018  $E_{foc}$  and an estimated number 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 9**).

Table 9. IBM-standards age classification.

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

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 2018 is very similar to the last year's estimate. Similar as in 2017, most of the birds observed on the focal day were adults (55%), immatures (20%) and juveniles (13%). In fact, similarly to last year's results, the proportion of sighted birds aged in their 5<sup>th</sup> 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 6**). The results from **Figure 6** indicate that the percentage of juveniles, immatures and adults coincide quite well with the model predictions, while especially the number subadultes is underestimated by the observations from the IOD. Generally, the number estimated based on observations is slightly lower than the number predicted by the model.

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 stable birds (adults) 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. Therefore, it is easier to identify birds of this age class.
- A. In general it is considered difficult for non professional ornitologist to determine the age of young vultures (especially subadult and immature) 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 2018. 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	$E_{foc}$		$E_{hyp}$		Model Schaub et al. 2009	
	absolut	mean(min,max)	%	mean(min,max)	%	absolut	%
adult	390	94	57%	134	55%	157	54%
subadult	13	4	2%	17	7%	40	14%
immature	61	31	19%	49	20%	59	20%
juvenile	66	24	15%	33	13%	36	12%
unknown	65	11	7%	12	5%	-	-
<b>Total</b>	<b>595</b>	<b>164</b>	<b>100%</b>	<b>245</b>	<b>100%</b>	<b>292</b>	<b>100%</b>

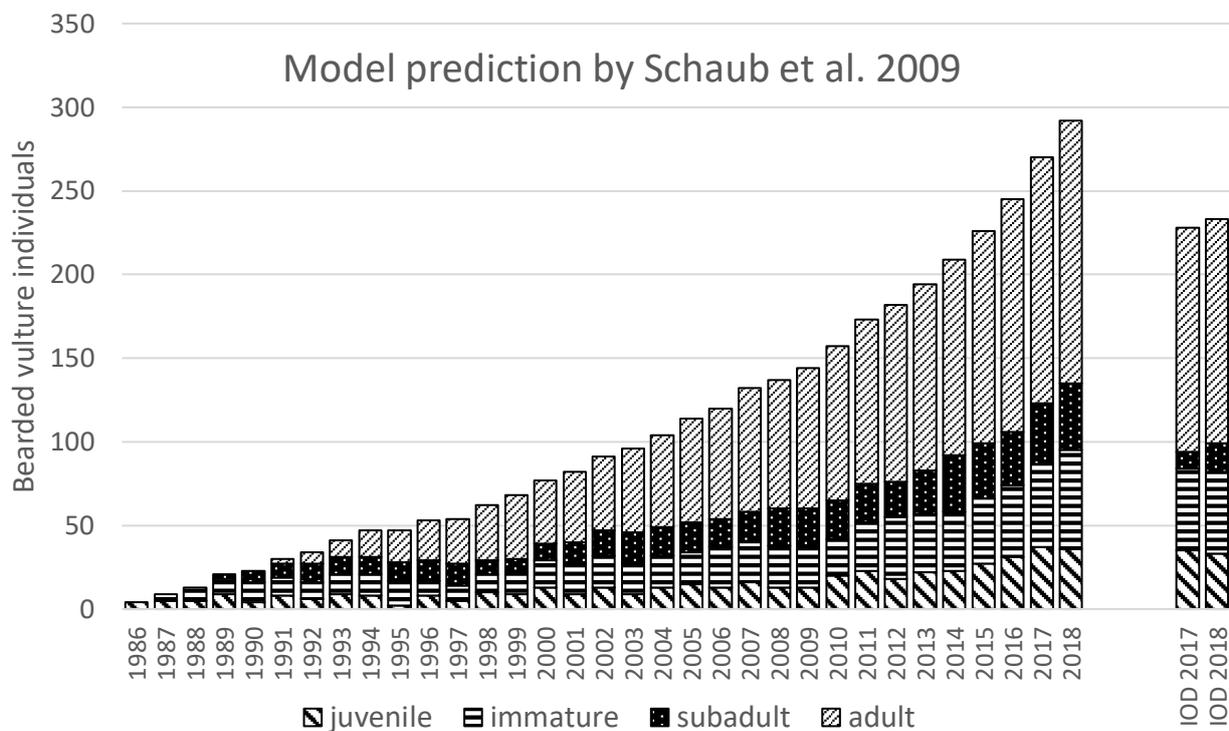


Figure 6. Predicted number of bearded vultures per age class according to the demographic model by Schaub et al. 2009<sup>a</sup> in comparison to the estimated number of birds that should hypothetically be present based on observation data (IOD 2018) and expert knowledge from regional coordinators. (\*mean of minimal = 208 and maximal = 284 estimated number of hypothetically present bearded vultures and the GPS-tagged birds that have not been identified during the IOD 2018; birds with unknown age are not included).

## 5.7 Spatial distribution of age groups

From 640 sites 701 bearded vulture sightings have been recorded during the whole period, 658 during the focal day (**Table 2**).

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 7 - Figure 13**) 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.

### 5.7.1 Alpine range

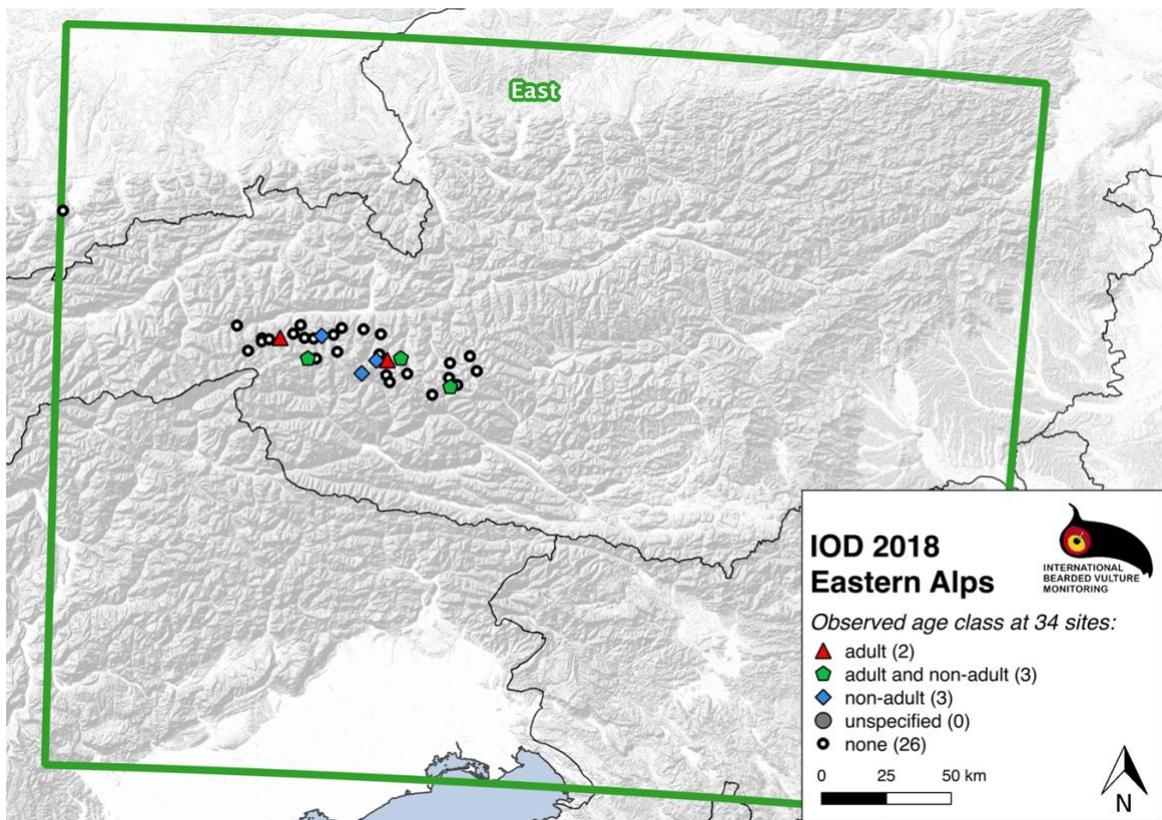


Figure 7. Age class distribution observed at 34 sites in the Eastern Alps during the IOD 2018. Estimated number of bearded vulture individuals in this sector: 9-14 adult, 1-5 subadult, 1-8 immature and 2-5 juvenile birds. Total 13 – 32 bearded vultures (GPS-tagged floaters not included).

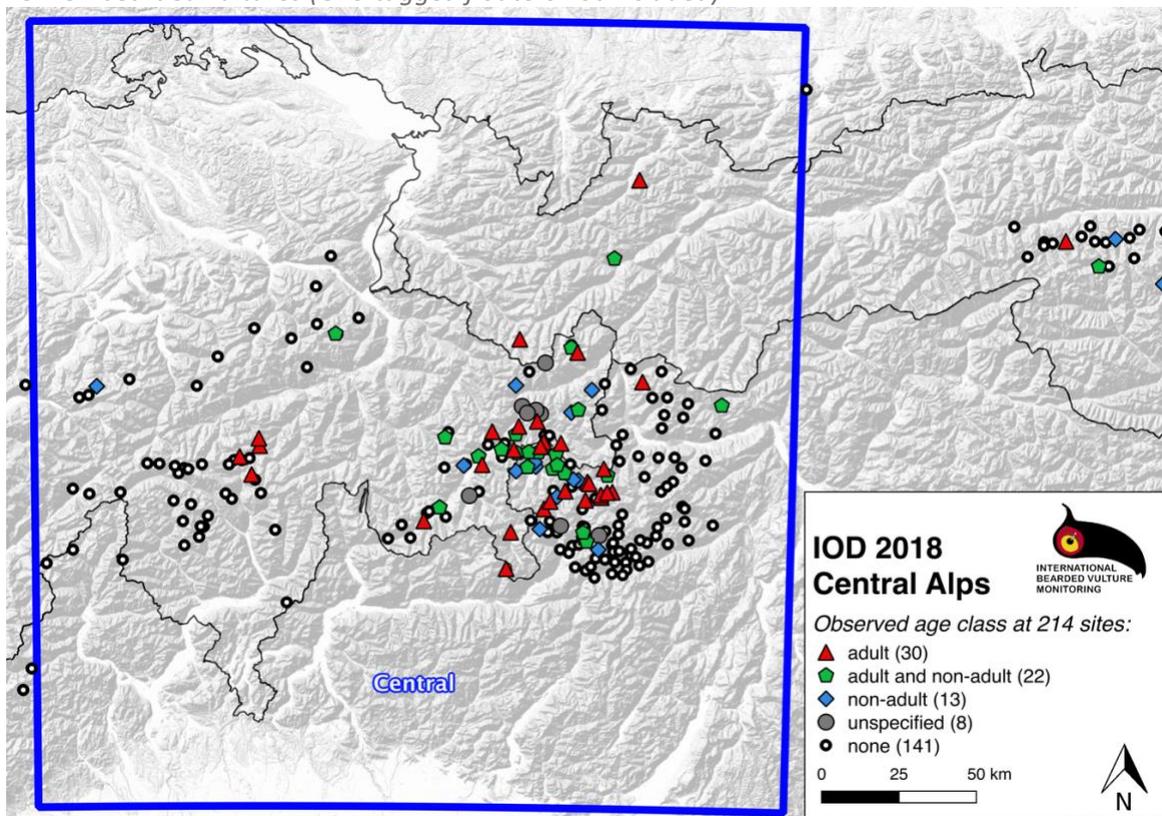


Figure 8. Age class distribution observed at 214 sites in the Central Alps during the IOD 2018. Estimated number of bearded vulture individuals in this sector: 43-52 adult, 4 subadult, 11-20 immature, 9-14 juvenile and 6-9 unspecified birds. Total 73 – 99 bearded vultures (GPS-tagged floaters not included).

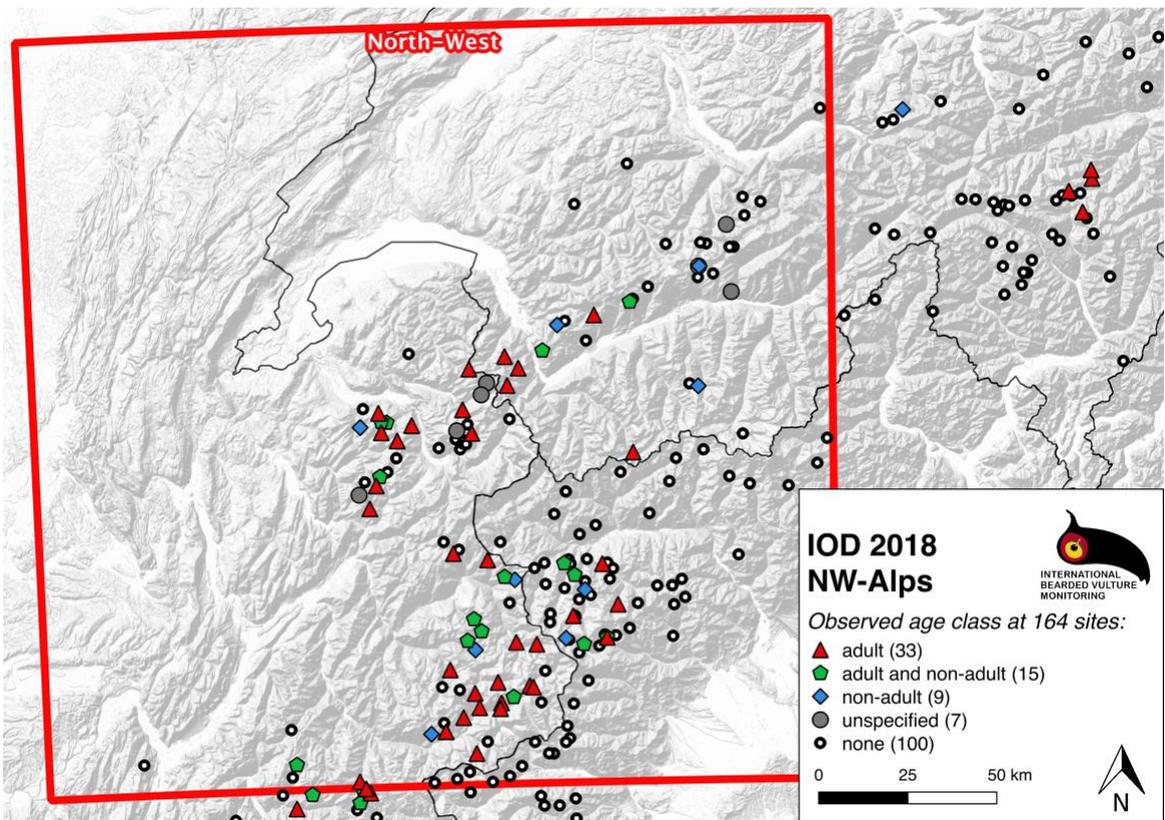


Figure 9. Age class distribution observed at 164 sites in the north-western Alps during the IOD 2018. Estimated number of bearded vulture individuals in this sector: 55-62 adult, 1-2 subadult, 12-14 immature, 5-8 juvenile and 1-2 unspecified birds . Total 74 – 88 bearded vultures (GPS-tagged floaters not included).

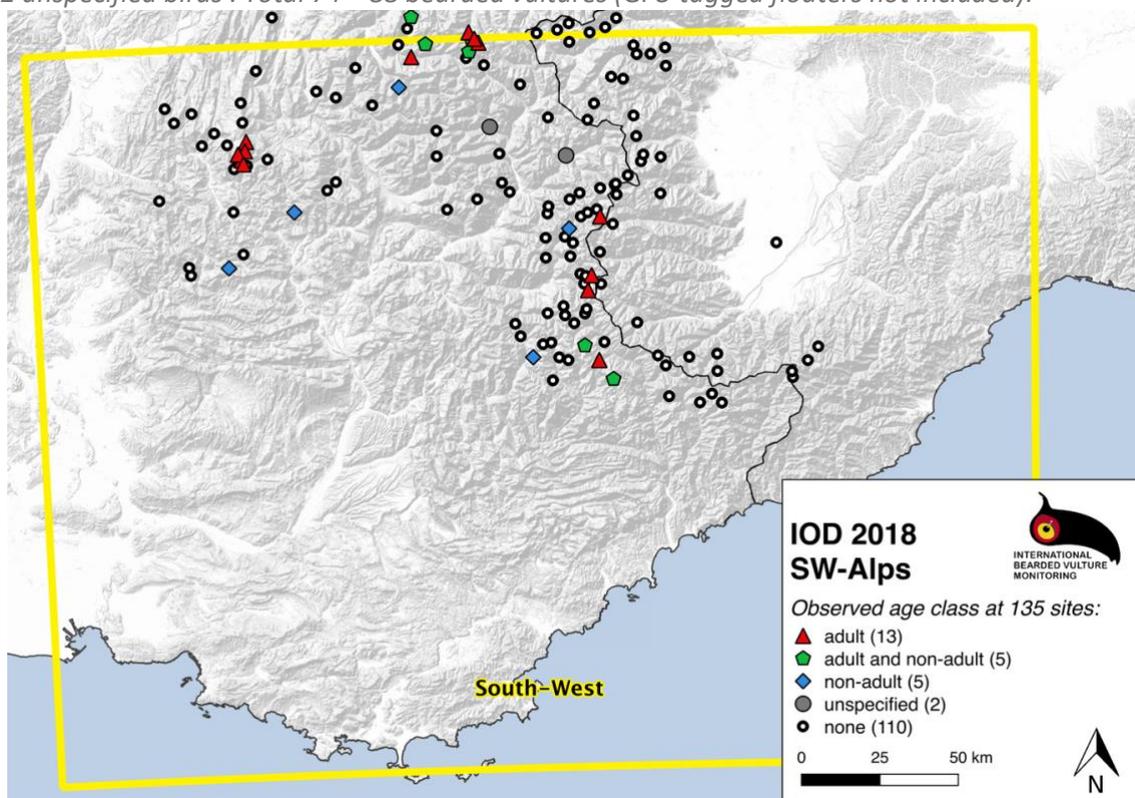


Figure 10. Age class distribution observed at 135 sites in the north-western Alps during the IOD 2018. Estimated number of bearded vulture individuals in this sector: 12-19 adult, 2 subadult, 5-9 immature, 7-9 juvenile and 2-3 unspecified birds. Total 28-42 bearded vulture (GPS-tagged floaters not included)s.

### 5.7.2 Massif Central & French Pyrenees

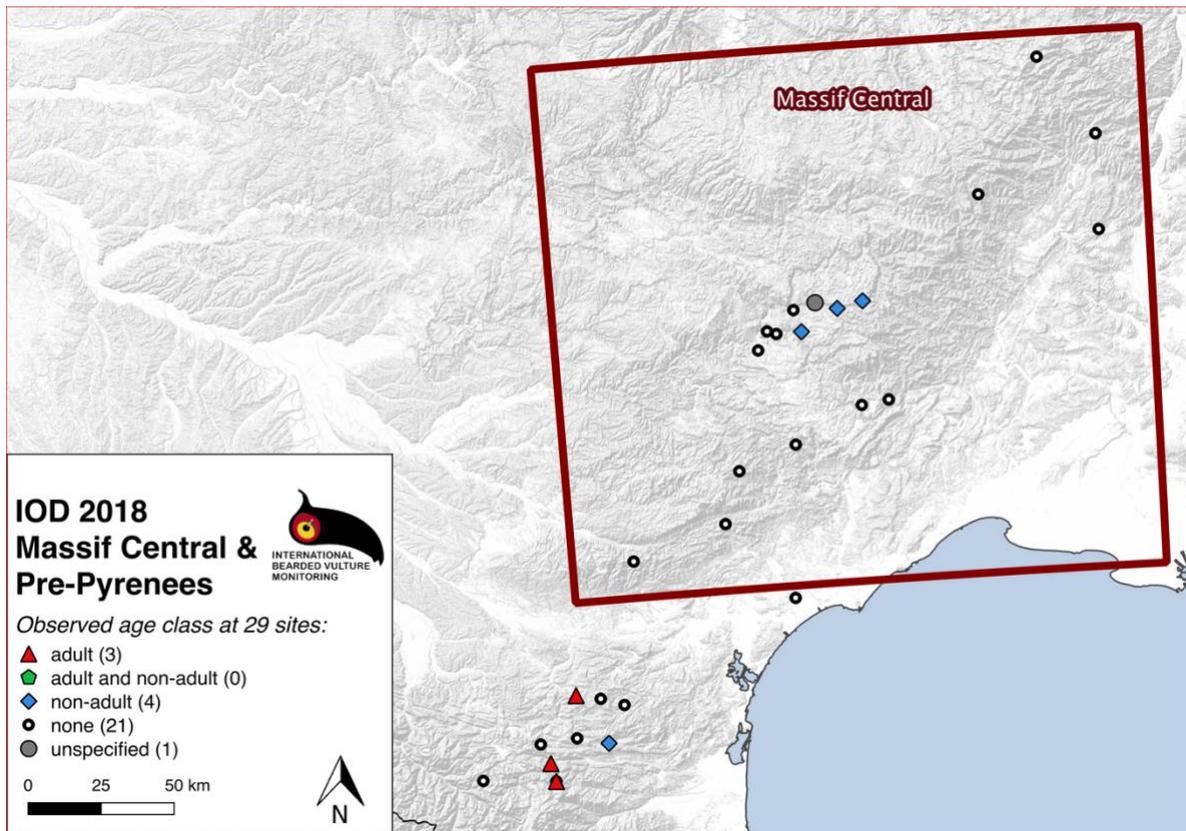


Figure 11. Age class distribution observed at 29 sites in the region between the Massif Central and the french Pyrenees during the IOD 2018. Estimated number of bearded vulture individuals in this sector: 4-8 adult, 3 subadult, 2 subadult and 1 immature bird. Total 8 - 12 bearded vultures (GPS-tagged floaters not included).

### 5.7.3 Spain

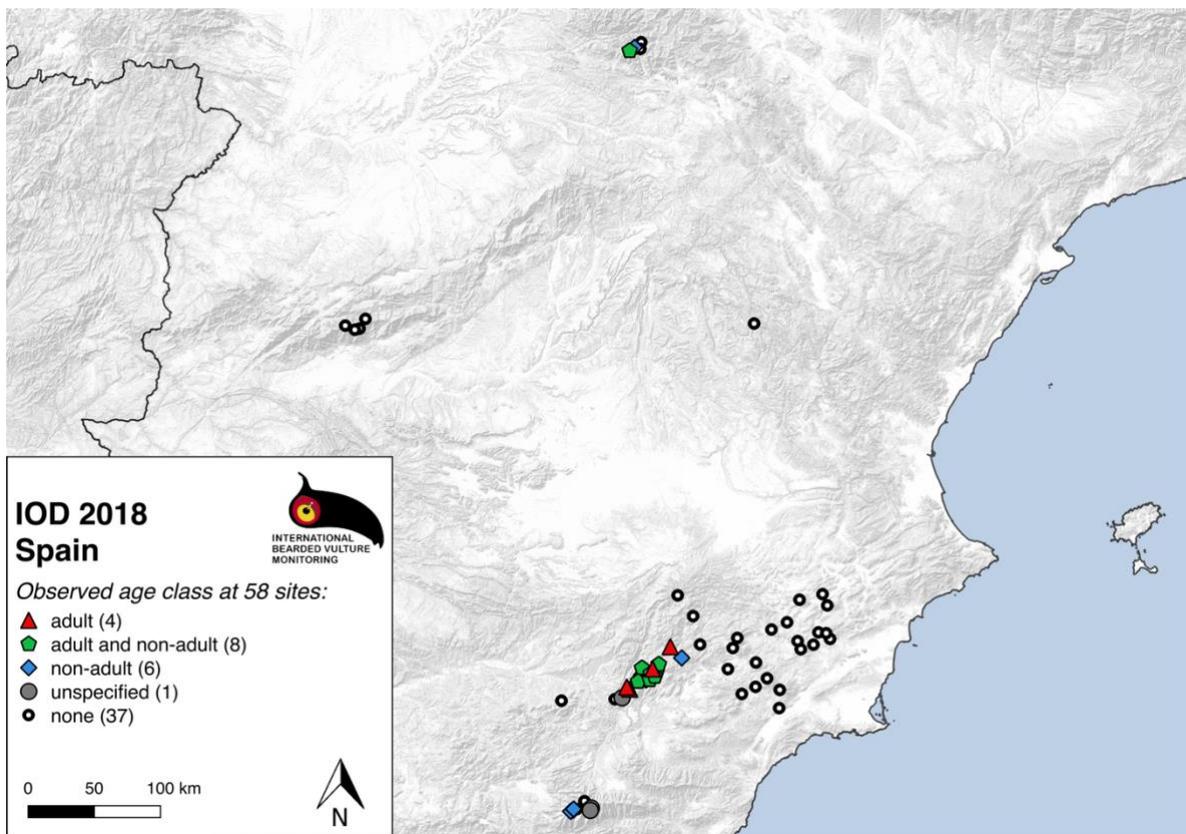


Figure 12. Age class distribution observed at 58 sites in Spain during the IOD 2018. Estimated number of bearded vulture individuals: 11-19 adult, 3 subadult, 6-7 immature and  $\leq 3$  juvenile birds. Total around 26-38 bearded vultures.

## 5.7.4 Bulgaria

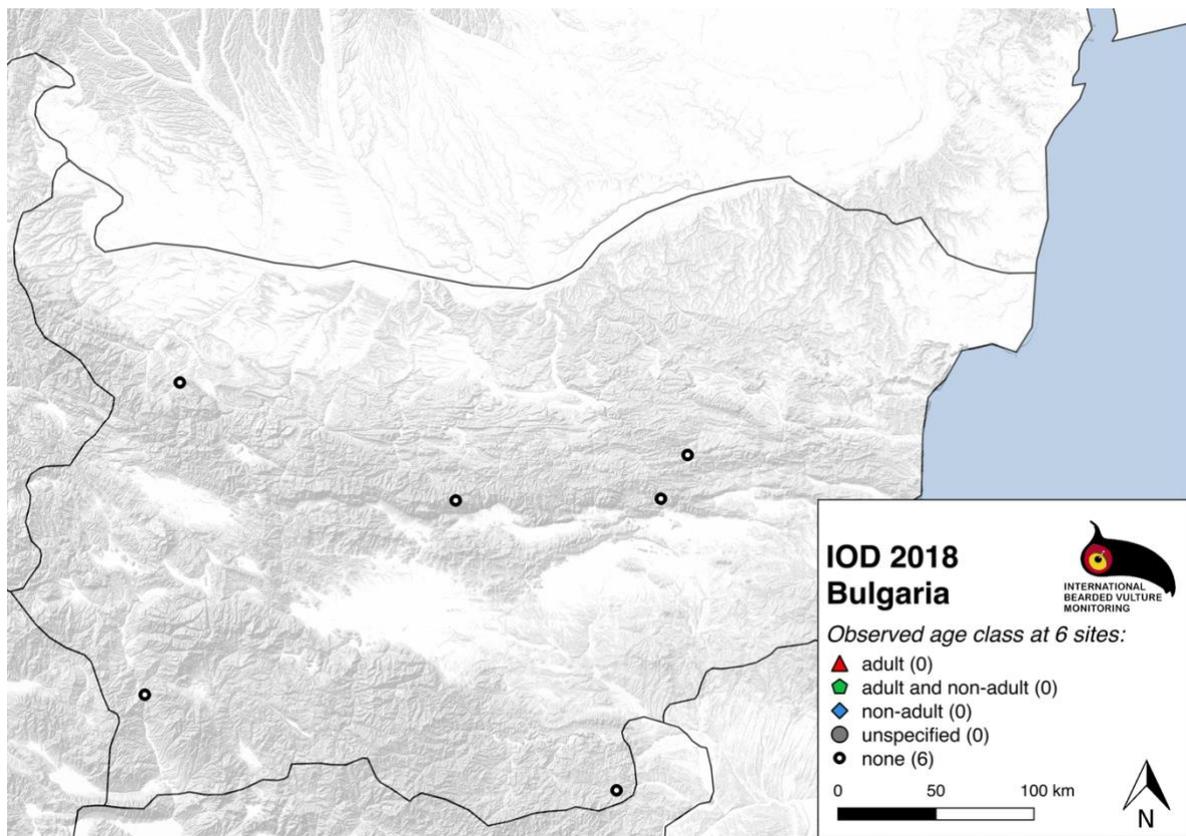


Figure 13. Age class distribution observed at 6 sites in Bulgaria during the IOD 2018. At the moment no bearded vultures are present in Bulgaria, since their extinction in 1972.

## 6 Outlook 2019

The IBM steering committee fixed the date for the next International Observation Day:

**Period 12<sup>th</sup> - 20<sup>th</sup> of October 2019**

**Focal day is the 12<sup>th</sup> of October 2019.**

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.

## 7 Acknowledgements

*Special thanks go to the IBM members for the organisation of the census on the regional level and to all participants of the observation days:*

- ◆ Servizio Aree Protette, Coordinamento GEV - Città Metropolitana di Torino (*A Lingua & GEV C Arlaud, A Levrino, C Calco, Cerrato M, Roberto C, Prinzi K, Basso N*)
- ◆ Carabinieri Forestali -Stazione di Pragelato (*Luca Damiani*)
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- ◆ Servizio Tutela della Fauna e della Flora - Città Metropolitana di Torino (*Francesco Campra e René Gonnet*)
- ◆ Azienda Faunistica- venatoria Albergian (*M Ferrier, A Vignetta, E Audibussio*)
- ◆ Parco Alpi Cozie rangers (*S Alberti, G Ferrero, G Roux Poignant & E Boetto, G Borello, A Cellerino, R Chaulet, B Felizia, B Frache, L Giunti, V Mangini, C Metti, D Miletto, S Vuillermoz*) & our volunteers (*A Cocco, P Massara, D Zonari*)
- ◆ Unione Montana del Pinerolese (*R Janavel & F Barile, N Bianciotto, G Camelliti*)
- ◆ Carabinieri Forestali Torre Pellice (*M Salsotto*)
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- ◆ Vautours en Baronnies (*Julien Traversier*)
- ◆ LPO Drôme
- ◆ Conseil Départemental de la Drôme (*Laurent Flenet*)
- ◆ Envergures alpines
- ◆ LPO Briançon
- ◆ PNR Queyras
- ◆ PN Ecrins
- ◆ Green Balkans (*Ivelin Ivanov, Iliyan Stoev, Ivaylo Klisurov, Konstantin Dichev*)
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- ◆ Hohe Tauern Nationalpark with the observer network
- ◆ Tyrolian hunting association
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- ◆ Plan de Recuperación y Conservación de Aves Necrófagas (*José Ramón Benítez, Enrique Ávila, Emilio Heredia, Luis Cardente y Equipo*) Estrategia Lucha Contra el Veneno (*Jesús Olivares y Joaquín Pérez*)
- ◆ Fundación Gypaetus (*Pakillo Rodríguez, Ana y Julio Moreno*)
- ◆ Parque Natural de Cazorla, Segura y Las Villas (*Teresa Moro, Amas y Voluntarios*)
- ◆ Parque Natural de Sierra Mágina (*Alfonso Arias y Cristóbal Rojas*)
- ◆ Dirección del Parque Natural de Castril (*JM Montoro, Amas and volunteers*)
- ◆ Parque Nacional de Sierra Nevada (*Blanca Ramos, JM Barea, Pablo Galdo, Amas and volunteers*)
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- ◆ Castilla La Mancha, provincia de Albacete (*JA López Donate, Miguel Fajardo, Antonio Catalán, Amas and volunteers*)
- ◆ Castilla León, provincia de Ávila (*Nicolás González, Mariano Hernández, Sergio Rastrero, Amas and volunteers*)
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- ◆ Murcia (*Mario León, Emilio Aledo, Nestor Yelo y Amas*)
- ◆ LPO Grands Causses
- ◆ Parc national des Cévennes

- ◆ Parc naturel régional des Grands Causses
- ◆ ALEPE
- ◆ LPO Aveyron
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- ◆ 3 Jagdaufseher des Südtiroler Jagdverband
- ◆ Forststation Schlanders (*Ofö Klaus Bliem*)

*Numerous people participated and supported the International Bearded Vulture Monitoring event in 2018. Some of them could not be mentioned or remained unknown to the IBM office. We acknowledge them just as much as those observers mentioned in the long list that follows.*

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Sarah Wirth	Susanne Egger	Violetta Fontana
Sebastian Geiersberger	Susi Bäbler	Vittorio Saccoletto
Sébastien Bossand	Suzanne Houot	Walter Borney
Sébastien Bregeon	Sylvain Combe	Walter Huber
Sébastien Leduc	Sylvain Falconnat	Walter Pucher
Selene Cavallari	Sylvie Argoud-Puy	Walter Valentini
Sepantona Bergamin	Sylvie Genève	Werner Ruinelli
Sepp Rattensberger	Sylvie Lauthier	Werner Schuh
Serena Frau	T Marchal	Xavier Pete
Serge Lenogue	T Rutkowski	Y Lazennec
Séverine Haberer	Tamara Emmenegger	Yann Blanchard
Séverine Magnolon	Theo Köhli	Yann Bridet
Severine Reveil	Théo Laval	Yoann Caillot
Severino Moranduzzo	Theo Mazet	Yolanda De Domingo
Sibylle Bachmann	Therese Plüss	Yves Bötsch
Silvana Signorell	Thierry Arzac	Yves Hodoul
Silvano Togni	Thierry Chevalier	Yves Jacquemoud
Silvia Alberti	Thierry Vincent	Yves Roullaud
Silvia Compagnoni	Thomas Bredel	Yves Zabardi
Silvia Kaserer	Thomas Wehrli	Yvonne Bollinger
Silvia Salomoni	Timia Sanchez	Zian Bisson
Silvio Bolis		