

Migration of Soaring Birds over Bulgaria

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Abstract: The paper contains data on total migration numbers of 35 species of raptors and 5 species of soaring water birds on 35 sites in different parts of the country during 7297 days for the period 2004-2011. The visual observations were carried out using methods approved by Ministry of Environment and Waters. To make the presentation and analysis of the results easier the territory of the country was divided into three migration regions – *Via Aristotelis*, *Via Balcanica*, *Via Pontica*. The results obtained for above mentioned regions allowed drawing the completed picture of soaring bird migration over the entire territory of Bulgaria. During the both migration periods the migration streams over *Via Aristotelis* Region were the smallest. The soaring migrants were more numerous over *Via Balcanica* Region and most numerous – over *Via Pontica* Region. Whereas the autumn migration along *Via Aristotelis* and *Via Pontica* was more intensive, along *Via Balcanica* it is conversely – the spring migration was more intensive than the autumn one. Total estimates of migration streams of soaring birds in Bulgaria are up to 734 000 ind. in spring and up to 922 000 ind. in autumn. It is necessary to be emphasized that the present assessments are rather rough and incomplete, especially as regards *Via Aristotelis* and *Via Balcanica* Regions, due to the small number of observation points in these territories. Nevertheless this first approximation could be used for better planning and development of wind energy in Bulgaria.

Key words: bird migration, soaring birds, raptors, water birds, migration regions, Bulgaria, Balkan Peninsula, *Via Pontica*, monitoring, *Via Aristotelis*, *Via Balcanica*, wind energy, wind farms

Introduction

The territory of Bulgaria occupies an important biogeographic position in the Balkan Peninsula, Europe and West Palearctic. It also plays also significant role for migration of soaring birds from eastern parts of Europe to the wintering areas in Africa.

Many papers contain data about soaring bird migration over different regions of Bulgaria (PATEV 1950, KUMERLOEVE 1956, BALAT 1962, ROBERTS 1978, 1979, ROBEL *et al.* 1978, MICHEV, SIMEONOV 1978, DONCHEV 1980, 1984, MICHEV 1984, SIMEONOV *et al.* 1990, MILCHEV 1998, BSPB 2005). The most comprehensive of them is published by MICHEV *et al.* (2011a), who had studied the autumn migration of soaring birds on the Western Black Sea migration route (*Via Pontica*) in the area of Burgas Bay for a long-term period (between 1979 and 2003).

Despite of the numerous papers in this relation, there is not yet a complete, broad minded research on soaring birds' migration over the entire territory of the country. Many aspects of soaring birds' migration through Bulgaria as the exact migration routes, number and dynamics of different migrant species, peak days, etc. remain without answer yet. In fact, there are two maps of migration routes across the territory of Bulgaria (MICHEV, IANKOV 1995 and POVVIK AD 2011), Fig 1.

The maps are based on expert assessments of migration routes and are only partially correct due to insufficient data about many parts of the country. More important is however the fact that both maps do not give any idea for the amount of migration streams in the Bulgarian air space as a whole.

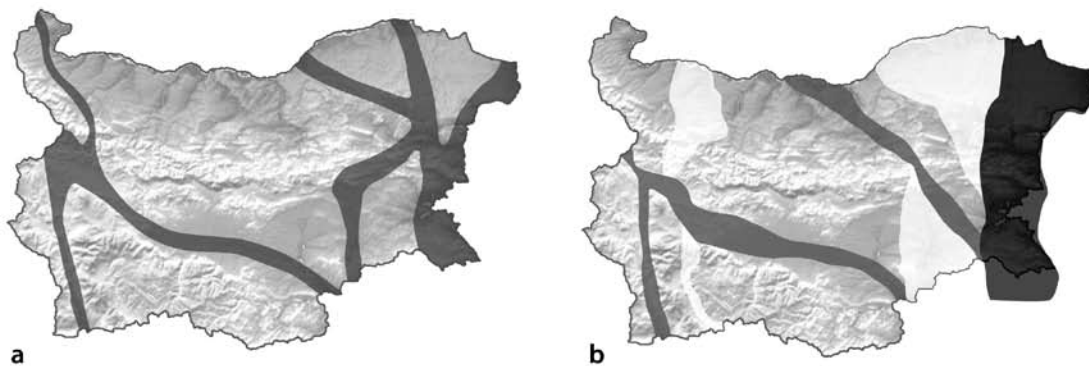


Fig. 1. Migration routes across the territory of Bulgaria: a – according to MICHEV, IANKOV (1995); b – according to POVVIK AD (2011).

The enormous development of wind energy during last years required collecting information about the parameters of bird migration over many sites designed for wind farms. So recently great amounts of data were collected mainly for northeastern regions of Bulgaria. Parts of all these monitoring data are included in this paper. Its aim is to present first assessment of soaring bird migration streams over the whole territory of Bulgaria, based on large amount of collected observations. Detailed species account is a subject of another article.

Materials and Methods

The report contains data on total number of 35 species of raptors and 5 species of soaring water birds in 35 sites (excluding Burgas) in different parts of the country for the period 2004-2011. These sites with UTM grid, observation periods and the total amount of observations – 7297 days (2985 in spring and 4312 in autumn) are presented in Table 1.

Additional visual observations during 8 days in spring (30 April-7 May 2011) and 8 days in autumn (8-15 September 2011) were carried out to look for migrating soaring birds with the RV Academic in Black Sea. Both observations have been done along the coast and in the open sea (up to 250 km from the coast) in front of Varna.

The visual observations were carried out using methods, recommended by Ministry of Environment and Waters (http://www.moew.government.bg/recent_doc/biodiversity/Methodika_VEP.pdf) Concisely it is presented as follows. The observation points were manned daily by one or more observers, between 08.00 and 18.00 h EET. Each observer used binoculars and a telescope, and covered air space

with diameter up to 8 km. Species not identified with certainty were logged as a species pair where possible (e.g. Pallid *Circus macrourus* and Montagu's Harriers *C. pygargus*) or simply to genus. It was also difficult to separate migrants from some resident or lingering birds which hunted in the area of the watch points, such as Marsh Harriers *C. aeruginosus*, Eurasian Sparrow – hawks *Accipiter nisus* and Common Kestrels *Falco tinnunculus*. Data collected included number of individuals, time, distance and direction from the watch point, direction, height and character of flight. Direction of flight, as well as an estimate of distance from the watch point, was determined using particular landmarks at known distance/direction. The height of flight was estimated visually. When possible, migrant flocks were counted in tens or hundreds, while estimates were made of the larger flocks of storks and pelicans. Whenever possible, repeat counts of the same flock were made and the mean noted. We believe that count accuracy of the estimates of larger flocks was within 10-15% of the actual number.

To make the presentation and analysis of the results more clear the territory of the country was divided into three migration regions as it follows:

- **Via Aristotelis** Region – incorporates watersheds of the rivers Iskur, Struma and Mesta; reaches Serbia and FYR Macedonia to the West and 24th meridian (which crosses the town of Velingrad) to the East. The highest mountains on Balkan Peninsula – Rila (with the highest peak Musala 2925 m) and Pirin (with the highest peak Vihren 2915 m) are situated in its eastern part. The region includes the following 100 km squares of UTM net: FL, FM FP, GL и GP – partially and GM and GN – fully. This region contains one migration route described by Aristotelis and named so by the well-known Bulgarian naturalist Nikolay Boev.

Table 1. List of sites, observation periods and number of days with visual observations of soaring migrants in each site during the period 2004-2011 (in UTM order).

N	UTM Grid	Site and District	Spring		Autumn	
			Period	Days	Period	Days
1	FN65	Dragoman, Sofia	01.03-30.04.2010	61	10.08-31.10.2010	82
2	GM02	Orelyak Peak, Blagoevgrad	15.04-30.04.2007	15	15.08-30.09.2007	35
3	GN38	Kameno Pole, Vratsa	01.03-30.04.2010 01.03-30.04.2011	122	10.08-31.10.2010 10.08-10.10.2011	143
4	GP03	Zlatiyata, Montana	01.03-30.04.2008	61	10.08-10.10.2008	62
5	GP34	Oryahovo, Vratsa	18.03-13.05.2010	57	18.08-30.10.2009	71
6	LF89	Krumovgrad, Kurdzhali	16.03-15.05.2008	60	16.08-30.10.2008	78
7	LJ13	Gulyantsi, Pleven	01.03-30.04.2010	61	10.08-31.10.2010	82
8	MG43	Shtit, Haskovo (2 points)	01.03-30.04.2010	122	10.08-31.10.2009 10.08-31.10.2010	328
9	MH21	Malenovo, Yambol	01.03-30.04.2011	61	01.08-31.10.2011	92
10	MH33	Byala, Sliven	01.03-30.04.2010 01.03-30.04.2011	122	10.08-31.10.2010 10.08-31.10.2011	164
11	MH43	Rakovo, Sliven (2 points)	01.03-30.04.2011	122	10.08-31.10.2010	164
12	MJ02	Obretenik, Ruse	16.03-10.05.2011	55		0
13	MJ67	Tutrakan, Silistra	14.03-14.05.2011	61	14.08-31.10.2010	79
14	MJ91	Gabritsa, Shumen	15.03-15.05.2010	61	01.08-31.10.2010	93
15	NH32	Dryankovets, Burgas	01.03-30.04.2010 01.03-30.04.2011	122	10.08-31.10.2010 10.08-31.10.2011	164
16	NH41	Bryastovets, Burgas	01.03-10.05.2011	71	10.08-31.10.2010	82
17	NH69	Izvorsko, Varna	01.03-15.05.2009	76	10.08-31.10.2009	82
18	NJ21	Krasen Dol, Dobrich	14.03-15.05.2011	63	15.08-31.10.2010	78
19	NJ27	Babuk, Silistra	16.03-15.05.2008 15.03-15.05.2009	119	15.08-30.10.2007 15.08-30.10.2008 15.08-31.10.2009	235
20	NJ30	Momchilovo, Varna	14.03-15.05.2011	63	04.08-31.10.2010	107
21	NJ34	Tervel, Dobrich	15.03-15.05.2010	60	15.08-30.10.2009	78
22	NJ34	Bezmer, Dobrich	23.03-30.04.2009	39	16.08-30.10.2009	76
23	NJ54	Lozenets, Dobrich	15.03-15.05.2011	61	15.08-31.10.2010	78
24	NJ61	Draganovo, Dobrich	01.03-20.05.2010	81	01.08-15.11.2010	107
25	NJ63	Ovcharovo, Dobrich	23.03-04.05.2009	44	10.08-31.10.2009	83
26	NJ71	Slaveevo, Dobrich	14.03.20.05.2011	68	10.08-15.11.2011	97
27	NJ73	Metodievo, Dobrich	15.03.-15.05.2009 01.03.-20.05.2010	142	15.08-31.10.2008 15.08-31.10.2009 01.08-15.11.2010	263
28	NJ74	Tsarevets, Dobrich	01.03-20.05.2010	81	01.08-15.11.2010	107
29	NJ81	Senokos, Dobrich (2 points)	15.03-15.05.2010	106	10.08-31.10.2010	164
30	NJ92	Konare, Dobrich	15.03-15.05.2010	61	16.08-30.10.2009	75
31	PJ00	Kavarna, Dobrich	01.03-31.05.2005 15.03-15.05.2006 15.03.15.05.2007 15.03-15.05.2008 20.03-15.05.2009	344	15.08-15.11.2004 15.08-15.11.2005 10.08-30.10.2006 03.08-31.10.2007 07.08-30.10.2008 15.08-30.10.2009	496
32	PJ02	Belgoun, Dobrich	15.03-15.05.2010	62	12.08-30.10.2009	80
33	PJ10	Cape Kaliakra, Dobrich	15.03-15.05.2009	63	15.08.-31.10.2008	78
34	PJ21	Kamen Bryag, Dobrich	20.03.-15.05.2009 01.03.-20.05.2010	56 81	15.08.-15.11.2009 01.08.-15.11.2010	95 107
35	PJ31	Shabla, Dobrich	01.03.-20.05.2010	81	01.08.-15.11.2010	107
Total				2985		4312



Fig. 2. Migration regions on the territory of Bulgaria with studied sites (according to MICHEV *et al.* 2011b).

This route is used more often by soaring migrants on a width front. Poorly studied with 5 sites.

- **Via Balcanica** Region – incorporates the territory between the two other migration regions. Its western border is the 24th meridian; to the East it reaches the western border of *Via Pontica* Region. The Central Balkan Range with highest peak Botev (2376 m) is situated in its middle part and perpendicularly on the migration direction. This region includes the following 100 km squares of UTM net: KF, LF, LJ, MF, MJ и NH – partially and KG, KH, LG, LH, MG, MH – fully. It is not known how many migration routes cross this region, but certainly they are used more often by soaring migrants on a width front. Poorly studied with 6 sites.

- **Via Pontica** Region – incorporates the easternmost parts of the country; its western border follows the line Ruse – Aytos (Karnobat) – Malko Turnovo and the eastern one follows mainly the Black Sea coast; these borders are well defined on the base of combined visual and radar observations of pelicans and white storks (Michev *et al.* 2011). This region includes partially the following 100 km squares of UTM net: NG, NH, NJ and PJ. For raptors, as well as for black storks (these species do not roost in and around Burgas wetlands) the western border should be extended to the town of Karnobat. The borders of this region coincide with those of a flyway under the same name. *Via Pontica* flyway is used more often by

soaring migrants on a narrow front. Relatively well studied with 23 sites (there are some more studied areas in this region which have been situated very close to each other and are not included here). The visual observations in some sites are made more than one year. In such cases the biggest number is taken into account only.

The amount of migration streams over each region is calculated summation of the total numbers of soaring birds in observation points in the region with equal geographical latitude only. This approach allows double counts and overlapping of data to be eliminated.

Results and Discussion

The relatively great number of observation days (7297) in 35 sites across the country is a good basis to draw a complete picture of migration over the entire air space of Bulgaria. This will be made by describing the the migration above three regions consecutively.

Soaring bird migration over *Via Aristotelis* Region

There are some scientific publications about the migration in the vicinity of Sofia and Rupite locality at the town of Petrich (NANKINOV *et al.* 1979, NANKINOV 1982), which prove that the bird migration follows the valleys of rivers Iskur, Struma and Mesta.

Table 2. Soaring bird number (ind.) at 5 sites of *Via Aristotelis* Region during spring and autumn migration (2004-2011).

N	UTM grid	Site and District	Number (ind.)	
			Spring	Autumn
VA1	GM02	Peak Orelyak, Blagoevgrad	28	107
VA2	FN65	Dragoman, Sofia	2020	1016
VA3	GP03	Zlatiyata, Montana	1302	2236
VA4	GN38	Kameno Pole, Vratsa	612	575
VA5	GP34	Oryahovo, Vratsa	1058	854
Average			1000	960

During the period 2004-2011 the soaring bird migration over this migration region was studied at 5 sites observation points, included in Table 2.

As it can be seen from the Table, the spring migration in this region as a whole was slightly more intensive than the autumn one. However the autumn migration in two sites (VA1, VA3) dominated upon the spring one.

Two sites with relatively equal geographic latitude have been chosen for measuring of migration streams of soaring birds over this region: VA5 Oryahovo, Vratsa district and VA3 Zlatiyata, Montana district. Totally 2360 spring and 3090 autumn migrants have crossed both sites. The region's width at Sofia latitude is about 120 km, which could be covered by about 15 observation points (each one with diameter of 8 km). Then the soaring bird's number could reach 18 thousand birds during spring migration and 23 thousand during autumn migration.

Table 3. Soaring bird's numbers (ind.) in 6 sites of *Via Balcanica* Region during spring and autumn migration (2004-2011).

Code	UTM Grid	Site and District	Number (ind.)	
			Spring	Autumn
VB1	MH33	Byala, Sliven	7587	2216
VB2	LF89	Krumovgrad, Kurdzhali	1058	573
VB3	LJ13	Goulyantsi, Pleven	692	939
VB4	MH21	Malenovo, Yambol	12236	2967
VB5	MH43	Rakovo, Sliven	3954	2731
VB6	MG43	Shtit, Haskovo	4666	922
Average			5000	1700

Soaring bird migration over *Via Balcanica* Region

There is small amount of scientific papers about soaring birds migration in this region (LAMBERT 1961, DONCHEV 1974, PETROV 1980, ZALLES, BILDSTEIN 2000, SHURULINKOV *et al.* 2005). It is known that the migrants cross the Balkan Range along several gorges but there are not exact figures.

During the period 2004-2011 the soaring bird migration over this migration region was studied in 7 sites, presented in Table 3 (the site VB7 Obretenik, Ruse district with 2016 spring migrants and without autumn data was not taken into account).

As one could see from the table, the spring migration in this region (with exception of VB3 Gulyantsi, Pleven district) was more intensive then the autumn one.

Two sites with relatively equal geographic latitude were chosen for measuring the migration streams of soaring birds over the region: VB1 Byala and VB5 Rakovo, both in Sliven district. Totally 11 541 spring and 4947 autumn migrants crossed both sites. These data are rather incomplete as the width of the region of Karnobat is about 240 km, which could be covered by about 30 observation points (each one with diameter of 8 km). Then the soaring bird's number could reach 173 thousand birds for spring and 74 thousand for autumn period.

Soaring bird migration over *Via Pontica* Region

Nowadays this it is the most studied migration region in Bulgaria. The data collected include long-term period of 1979-2003 and the region borders are well defined (MICHEV *et al.* 2011a).

During the period 2004-2011 the soaring bird migration over this migration region was studied in 23 sites, included in Table 4 (the site Burgas with

Table 4. Soaring bird numbers (ind.) in 23 sites of *Via Pontica* Region during spring and autumn migration (2004-2011).

Code	UTM grid	Site and District	Number (ind.)	
			Spring	Autumn
VP1	NJ27	Babuk, Silistra	4370	2359
VP2	NJ34	Bezmer, Dobrich	6249	8488
VP3	PJ02	Belgun, Dobrich	1567	4922
VP4	NH31	Bryastovets, Burgas	155 313	270 527
VP5	MJ91	Gabritsa, Shumen	28 721	8386
VP6	NJ61	Draganovo, Dobrich	19432	32051
VP7	NH32	Dryankovets, Burgas	61 518	59 468
VP8	NH69	Izvorsko, Varna	44238	240 859
VP9	PJ00	Kavarna, Dobrich	708	23 442
VP10	NJ92	Konare, Dobrich	1664	2555
VP11	NJ21	Krasen Dol, Shumen	12671	12 812
VP12	NJ54	Lozenets, Dobrich	27 037	20 954
VP13	NJ73	Metodievo, Dobrich	21 096	47 954
VP14	NJ30	Momchilovo, Varna	14 379	6521
VP15	NJ63	Ovcharovo, Dobrich	8103	44 398
VP16	NJ81	Senokos, Dobrich	23 612	54 127
VP17	NJ34	Tervel, Dobrich	3874	3904
VP18	NJ74	Tsarevets, Dobrich	3888	6497
VP19	MJ67	Tutrakan, Silistra	2003	1008
VP20	NJ71	Slaveevo, Dobrich	75 195	299 206
VP21	PJ10	Cape Kaliakra, Dobrich	258	4542
VP22	PJ21	Kamen Bryag, Dobrich	376	22557
VP23	PJ31	Shabla, Dobrich	224	20137
Average			22 500	52 000

maximum 315 688 autumn migrants for 1979-2003 was excluded).

As one may see from the Table, the number of the spring migrants was twice less than that of the autumn migrants. Nevertheless in 6 or 1/4 of all the 23 sites the spring migration was more numerous.

The relatively big number of studied sites in the last years allows drawing a line, which connects the sites with most numerous soaring migrants along *Via Pontica*: VP20 Slaveevo, VP8 Izvorsko, VP4 Bryastovets and Burgas (Fig. 3b).

Two sites with relatively equal geographic latitude have been chosen for measuring of migration streams of soaring birds over this region: VP4 Bryastovets and VP7 Dryankovets. In total about 217 000 spring and about 330 000 autumns

soaring migrants have crossed both sites. These data are rather incomplete as the width of the region at Bryastovets is about 40 km, which could be covered by about 5 observation points (each one with diameter of 8 km). Hence, we could calculate roughly that the soaring bird numbers in this region could reach 543 thousand birds for spring and 825 thousand for autumn period.

Until now there are two quantitative assessments of autumn migration streams along Bulgarian Black Sea coast.

According to BSPB (2005) ‘...in autumn about 414 000 white storks were recorded to pass along the Black Sea coast (overlapping was not calculated) over the observation points...’ (it remains not clear how the overlapping was avoided as almost all observation points are situated along the migration direction from North to South). In our opinion this

Table 6. Calculated maximum total number of soaring birds in the migration regions of Bulgaria during the period 2004-2011.

Migration region	Maximum total number of soaring migrants (ind. in thousands)			
	Spring migration	%	Autumn migration	%
<i>Via Aristotelis</i>	18	2,4	23	2,5
<i>Via Balcanica</i>	173	23,6	74	8,0
<i>Via Pontica</i>	543	74,0	825	89,5
Bulgaria	734	100	922	100

overlapping could be avoided if only data from areas with equal latitude are taken into account. Such areas are Panitsovo and Banya (totally 188 242 ind.). However these figures are significantly smaller compared to the reported 414 000 white storks.

According to MICHEV *et al.* (2011a) the autumn migration number of white storks at Burgas reaches its maximum of 230 000 ind. in 1999.

During the autumn of 2011 we managed to organize a new study on soaring bird migration at Burgas http://www.ecolab.bas.bg/main/field/atanosovsko_lake/migration/migration as a part of International counts of soaring birds in Western Palearctic. The data collected during this study will contribute to receive more precise assessment of soaring bird migration in this region.

Overall picture of soaring birds migration over the territory of Bulgaria

The results obtained for the three migration regions allowed drawing of a complete picture of soaring bird migration over the territory of Bulgaria. The results are presented in Table 6.

From the Table it becomes clear that the most important migration region in Bulgaria is *Via Pontica*. There is also an obvious trend of increasing of migration streams from West to East (Fig. 3a, b).

Conclusions

During both migration periods the migration streams over *Via Aristotelis* Region are the smallest. These streams are more numerous over *Via Balcanica* Region and the largest – over *Via Pontica* Region. Whereas the autumn migration along *Via Aristotelis* and *Via Pontica* is more intensive, along *Via Balcanica* it is conversely – the spring migration is more intensive than the autumn one. The estimates of total migration streams of soaring birds over Bulgaria are up to 734 000 ind. in spring and up to 922 000 ind. in autumn. It is necessary to be emphasized that the present assessment is rather rough and incomplete especially as regards *Via Aristotelis* and *Via Balcanica* regions, due to the insufficient number of observation points in these territory. Nevertheless this first approximation could be used for better planning and development of wind energy in Bulgaria.

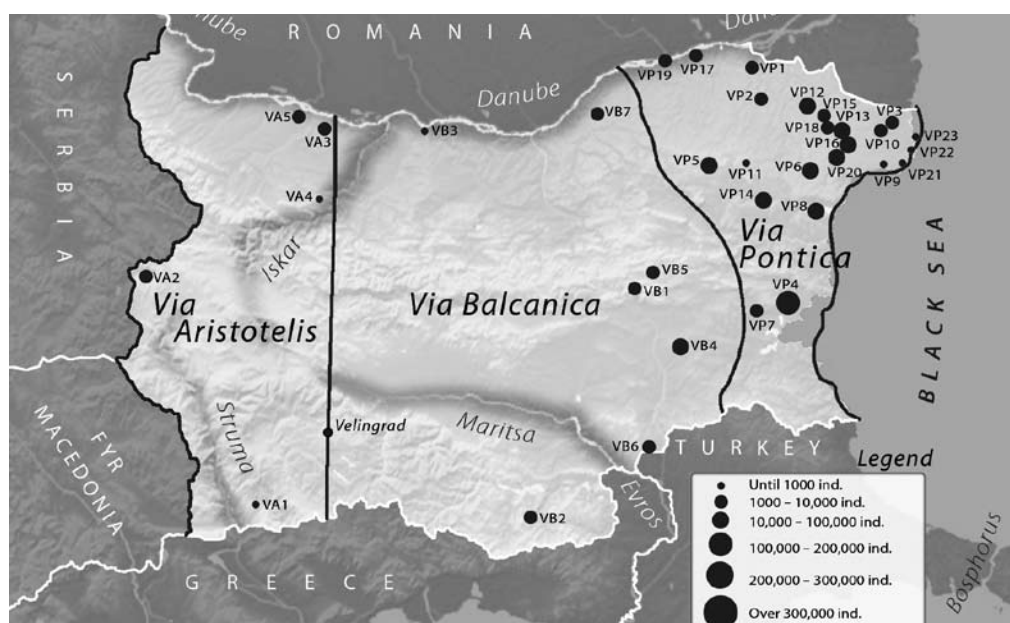


Fig. 3a. Total number of soaring spring migrants in Bulgarian air space over 35 sites during the period 2004-2011

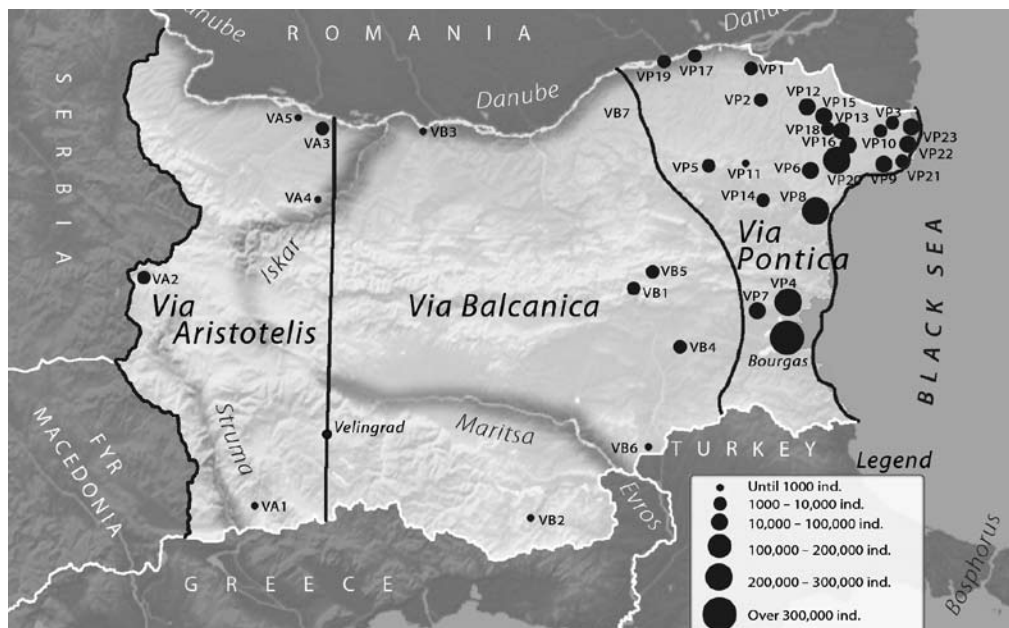


Fig. 3b. Total number of soaring autumn migrants in Bulgarian air space over 35 sites during the period 2004-2011

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