Peregrine Falcon populations – status and perspectives in the 21st century
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Population trends of the Peregrine Falcon in the Volga-Ural region (Russia) for twenty years

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Abstract

The territory of the European part of the Volga-Ural Region (918 462 km2) has been surveyed by the author and colleagues in 1988-2007. A total of 452 nesting territories of the Peregrines were found, projecting a total of 900-1000 pairs for the region. Biologically the territory of the region is divided into 4 zones: the Ural Mountains forested plains, forest-steppe and steppe. The largest part of the breeding territories (72,1%) is located in the mountains and in foothills of the Urals, where the Peregrines are breeding exclusively on cliffs along rivers and lakes. A total of 37 nests (22,7%) were found in the taiga forest plains west of the Urals. There, 54,1% of the nests were located on the moss tussocks and raised humps amongst bogs, 27% in other raptor species nests on trees and on triangulation towers and 8,1% on river precipices. The remaining 4,4% of known nest sites were found in the forest-steppe east from the Urals. Cliff breeding (72,7% of the nests) dominates in this part of the region. The remaining nests were found mostly in the other raptor species nests.

In general cliff breeding dominates in the surveyed region – 85,7% (N=295). There the falcons use niches (86,6%), or ledges open from above (9,9%) or ledges with overhung (2,0%), or, rarely on the top of the cliff (1,6%).

Often the Peregrines occupy niches used as breeding sites by Eagle Owl – 30,4%.

Egg laying starts from 1 April to 26 May. Chicks hatch from 4 May to 28 June, most commonly from 8 to 28 May and fledge from 13 June to 7 Augusts (most commonly 17 June to 7 July). In the Ural Mountains a total of 57,9% of chicks fledge by 57,9%, most of them fledge after 20 June. Clutch size (N=17) varies between 1 and 4, making an average 2,94. Brood size (N=58) varies from 1 to 4, or 2,69 on average. Breeding rate is 2,38 fledglings per successful eyrie (N=221).

Literature suggests sharp decline of the Peregrine numbers in 1950-1970's and its recovery from 1980's. It appears that the cause of the decline was contamination by organochlorines. Since 1994 we stopped recording crashed eggs, common in the region in the earlier seasons. In the past 10 years the numbers of the Peregrine increased at least 3-4 times and still increasing. It is predicted that in the future decade the numbers will increase 1,5 times.

Key words: Peregrine Falcon, *Falco peregrinus*, distribution, status, breeding biology, Volga-Ural region

Study area

The Volga-Ural region covers the eastern part of the Russian plain (Middle Volga), Ural mountains and nearest part of Western Siberia. Only western part of the region that geographically locates in Europe is under consideration in this paper (Fig. 1). Eastern border of the region under consideration is geographical border between Europe and Asia – main ranges of Northern and Middle Ural and the Ural River valley, southern, western and northern borders are administrative borders of districts and republics. The territory of the region is 918 462 km^2 in area.

Methods

Surveys were carried out by authors with colleagues in 1988-2007. The total length of field routes were near 98 000 km, near 70 000 km from which were vehicle routes, near 19 000 km – routes on different rivers and water bodies and near 5 000 km – pedestrian routes.

The most part of the territory was surveyed one time, only breeding populations on 3 rivers (Vishera, Chusovaya and Belaya rivers within Sverdlovsk, Perm districts and the Republic of Bashkortostan) were monitored several years. Also 5 study plots were set up with 1027 km^2 in area, which visited almost every year (Fig. 2).

Figure 1. Volga-Ural region on the World map

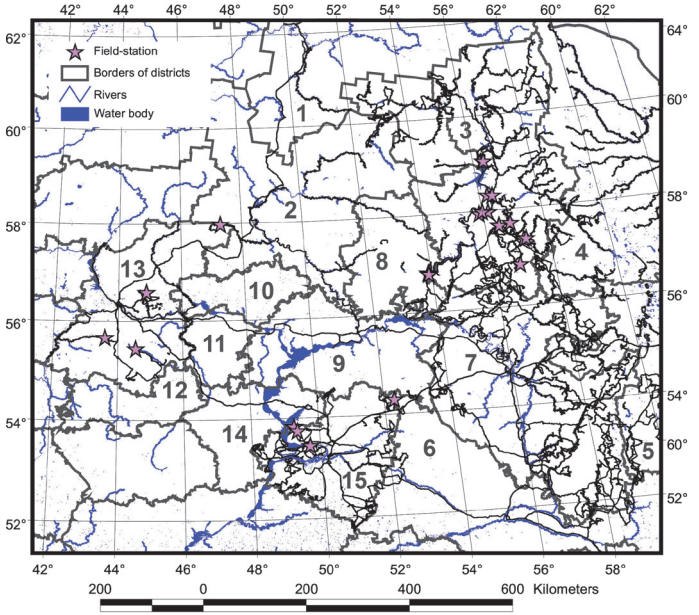

Figure 2. Trip routes and field-station in Volga-Ural region (numbers of districts are similar ones in the Table 1-3

Breeding territories of the Peregrine Falcon were found mostly during water routes and the lesser part – during the pedestrian routes.

Breeding territories in the paper are those territories where nests of Peregrines (living or empty but occupied) were found, or broods with recently fledged young or adults with agitated behaviour or anxiety calls. Possible breeding territories were recognized as the records of adults with preys regularly registered on the same territory in breeding season (June).

Found breeding territories were mapped. For processing the data of surveys we used GIS software (ArcView 3. 2a, ESRI, CA, USA), (Karyakin, 2000, 2004). Data of surveys were used to identify typical breeding biotopes for Peregrines. Following data of satellite images Landsat ETM+ and vector maps M 1: 200 000 the total area or total length of possible breeding biotopes was estimated. Density of Peregrines in breeding biotopes in study plots or routes (for rivers) were extrapolated on area or length of possible breeding biotopes.

Results

Distribution, number and nesting habitat

The Peregrine Falcon was known to inhabit the Volga-Ural region a long time ago. Eversman (1866) noted Peregrine as a common breeder in the region and nesting in chalk cliff-faces along the Kama and the Volga rivers. Bogdanov (1871) considered the falcon being not rare in the Kazan and Simbirsk districts and inhabiting stone river cliffs. Sabaneev (1874) noted Peregrines breeding the all territory of the Perm district, but falcons were registered less often in the north of district. Ruzskiy (1893) recognized Peregrines as a rare breeding species of the Kazan district; the author found nests of Peregrines only in woods at the Chistopolskiy and Mamadyshkiy regions. Sushkin (1897) observed Peregrines in Bashkiria in all territories with cliff-faces, and following his data the highest number of falcons was in the eastern part of Bashkiria in the South Ural mountains. According with surveys of Ushkov (1927) the Peregrine Falcon was common breeding species in the Kama river region: he recorded Peregrines breeding along the Kama, Usva, Vilva and Chusovaya rivers. Peregrines were noted to nest on the Epiphany church-tower in the center of Kazan and in raven's nests on pines in the Raifa forest in 1920's (Pershakov, 1929). Vorontsov (1949) found Peregrines inhabiting the all cliffs along the Chusovaya, Sylva and Usva rivers in the Perm district. Also he (1967) revealed Peregrines to be sufficient rare species in the Gorkiy district, breeding of which were confirmed only for vicinities of the Gorkiy State University's biological station in 1951 and 1953.

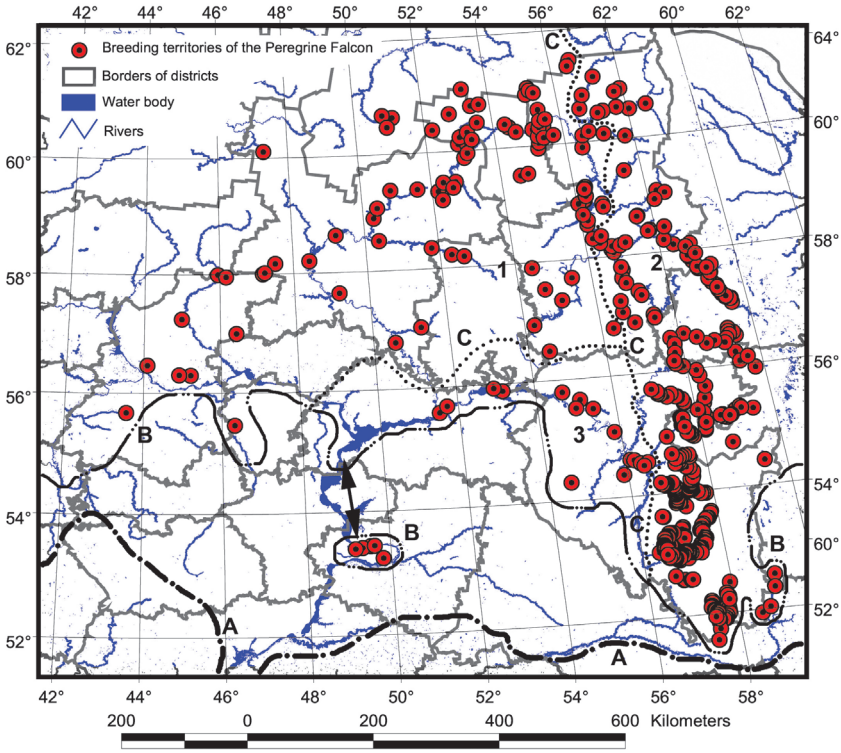

Figure 3. Map of breeding range of the Peregrine Falcon in the Volga-Ural region. Labels: A – historic range, B – recent range, C – borders of the Peregrine breeding populations; breeding population locations: 1 – Volga-Kama taiga, 2 – Ural Mountains, 3 – Volga-Ural forest-steppe, 4 – Trans- Ural steppe

However reports about Peregrines were finished in 1970-80-s. Grigoryev with colleagues (1977) observed no Peregrines in the Middle Volga region confirming the most rarity of the species. Ilichev and Fomin (1988) found Peregrines to be extremely rare in Republic of Bashkortostan, projecting only 10 pairs remained to breed in mountain regions of republic. Shepel (1992) surveyed only a pair breeding in the Perm district – in the Sylva river valley, and estimated a total of 13 pairs to breed with density 0.10 pairs/1000 km^2. However author had already revealed 332 pairs of Peregrines to breed in the Ural region at the beginning of 1990-s, and a total of 500 pairs were estimated to breed in the region (Karyakin 1998).

A total of 452 nesting territories of Peregrines were found in the European part of Volga-Ural Region in 2007 (Fig. 3. Tab. 1).

Table 1. Distribution of the Peregrine breeding territories in the Volga-Ural region

	District	The breeding population locations				
		Volga-Kama taiga	Ural mountains	Trans- Ural steppe	Volga-Ural forest-steppe	Total
1	Republic of Komi	7				7
2	Kirov district	23				23
3	Perm district	47	42			89
4	Sverdlovsk district		34			34
5	Chelyabinsk district		24	1		25
6	Orenburg district		1	2		3
7	Republic of Bashkortostan	1	225	1	12	239
8	Republic of Udmurtia	16			1	17
9	Republic of Tatarstan				3	3
10	Republic of Mari-L					0
11	Republic of Chuvashia					0
12	Republic of Mordovia					0
13	N.Novgorod district	8				8
14	Ulyanovsk district					0
15	Samara district				4	4
Total number of breeding territories		102	326	4	20	452
%		22.57	72.12	0.88	4.42	100

Considering the increasing of the Peregrine number during last decade a total of 1000 pairs are estimated to breed in the European part of Volga-Ural Region (Tab. 2).

Distribution of the Peregrine in the region is not uniform, but submits to the certain laws. There two types of nesting biotopes for the Peregrine: the first – cliffs along river and lakes, second – large bogs, located near river valleys. Breeding Peregrines out of those biotopes seem to be an exclusive event. The highest number of breeding territories of the Peregrine was registered in the forest zone in coniferous-broadleaved forests, southern and middle taiga. A number of Peregrines in forests of northern taiga is sufficient lesser, that connected at first with the little area of breeding biotopes in the zone. Several pairs of Peregrines inhabit the steppe zone, where occupy cliff-faces on water reservoir banks.

Table 2. Estimated number of the Peregrine Falcon in the Volga-Ural region. Number districts are similar ones in the Table 1 and Fig. 2 (numbers of the model districts are bold)

District	Real breeding territories	Possible breeding territories	Total breeding territories	Observing areas (km^2)	Areas of breeding biotopes (km^2)	Total areas (km^2)	Density (pairs per 1000 km^2 observing areas)	Density (pairs per 1000 km^2 total areas)	Estimated numbers with out increasing number (pairs)	Estimated numbers with increasing number (pairs)
1	1	6	7			23864.8			12	12
2	4	19	23	18120.0	25885.7	120800.0	1.27	0.27	33	43
3	87	2	89	21168.9	42337.8	160600.0	4.20	1.11	178	249
4	25	9	34	4196.5	6994.2	29975.3	8.10	1.89	57	85
5	20	5	25	3061.4	4373.4	20409.3	8.17	1.75	36	43
6	1	2	3			75712.9			5	5
7	237	2	239	25886.3	43143.8	143600.0	9.23	2.77	398	478
8	2	15	17	6315.0	9021.4	42100.0	2.69	0.58	24	27
9	0	3	3			68000.0			6	6
10	0	0	0			23200.0			No data	
11	0	0	0			18300.0				
12	0	0	0			26200.0				
13	2	6	8			74800.0			12	12
14	0	0	0			37300.0				
15	4	0	4			53600.0			5	5
Total	383	69	452			918462.3			766	964
Average in model districts	375	52	427	78748.2	131756.5	517484.6	5.4	1.4	726	924

The southern border of the range in the Middle Volga region takes place along the Volga river valley up to the Kama mouth, further along the lower reaches of the Kama and Belaya rivers that is between N 55° and 56°, then comes abruptly down to the south in the Ural mountains to N 51.50°, behind the Ural mountains – along the border between southern and northern forest-steppes (between N 54° and 55°). Several pairs are known to breed to the south of the range, also little breeding groups are recorded to inhabit Samara Luka (Samara district) and the Iriklinskoye water reservoir (Orenburg district).

Table 3. Distance between neighbors of the Peregrine in the Volga-Ural region

Distance between neighbors (km)		Minimum	Maximum	Median	Known breeding territories
Volga-Kama taiga	1	3. 85	67. 10	25. 64	4
	2	10. 40	127. 02	41. 12	21
	8	7. 91	63. 88	31. 59	14
	3	5. 42	94. 86	26. 85	58
	Total	3. 85	127. 02	30. 57	97
Ural mountains	3	2. 33	69. 25	23. 20	48
	4	3. 40	23. 19	10. 80	28
	5	1. 75	58. 41	11. 90	23
	7	0. 70	47. 50	5. 53	224
	Total	0. 70	69. 25	9. 07	323
Volga-Ural forest-steppe	7	6. 54	86. 05	34. 05	12
	9	20. 09	90. 07	48. 52	3
	15	6. 16	26. 12	15. 27	3
	Total	6. 16	90. 07	33. 33	18
Steppe region behind Ural mountains		18. 16	37. 71	26. 12	3
Total in region		0. 70	127. 02	14. 90	441

The territory within the range may be divided into 4 regions – Volga-Kama taiga, Ural mountains, Volga-Ural forest-steppe and Transural steppe, which are inhabited specific breeding groups of the Peregrine.

Ural mountains

The largest part of the breeding territories (72.1%) is located in mountains and in foothills of the Urals, where Peregrines are breeding exclusively on cliffs along rivers and lakes. Also Peregrines nesting at river cliffs in forest-steppe clusters of eastern pre-Ural are referred to this population.

The Ural mountain breeding group of Peregrines is the most prospering now. The number of pairs increased to breed last two decades and now it is higher in 5 times than earlier. Now the average distance between nests of different pairs is 9.07 km (N=323; range 0.7-69.2 km) (Tab. 3).

Volga-Ural forest-steppe

The Volga-Ural breeding group was probably damaged very much during the period of number decreasing of Peregrines and has not restored yet. The most part of found pairs (72.7%, N=11) nest at cliff-faces. The density that Peregrines breed at cliffs in the middle part of the Belaya river is similar with the Ural mountain breeding group. However a number of Peregrines is decreased downstream of the river and only pairs are surveyed in the lower part of the river. At first it is connected with disappearing of river cliffs.

A pair was note to nest in a building of the White-tailed Eagle *Haliaeetus albicilla* placed on poplar amongst flooded forest in the Belaya estuary After the Nizhnekamskoye water reservoir level raising the nesting tree was fallen dawn and Peregrines have nested on a peat island at the distance of 2 km from the old nest. Also we found a pair of Peregrines nesting in the building of the Grey Heron *Ardea cinerea* on poplar in the zone of reservoir influence. However Peregrines have not bred here already last 5 years.

Peregrines inhabiting the Kama river valley seem to prefer nest sites similar with birds inhabiting the Belaya river, unfortunately we did not find any nests. A nest of Peregrines were noted on river precipice near Nizhnekamsk in 2005 (Khanov, Volkova 2005).

There are flooded forests, flood islands and river cliffs in the south of Tatarstan and in the Ulyanovsk district however Peregrines have not already being recorded in those territories. Probably it is connected with insufficient surveys of territories.

There is isolated breeding group to the south in Samara Luka (Samara district), where falcons nest at rocks of the Zhiguli mountains extremely irregular. We found 4 breeding territories but one of them is abandoned now. The main reason of number decreasing is the human disturbing and the Eagle Owl *Bubo bubo* preying. The Peregrine was disappeared in that territory during the depression period that is confirmed by findings of old nests, but began to nest once again in 1990's.

Peregrines have registered regular on the Aslikul Lake (Ural foothills in Bashkiria) since 1990's, however nests of falcons have not found yet, probably they nest at cliffs on the southern side of the lake.

Transural steppe

Peregrines nesting on the Iriklinskoye water reservoir are the isolated breeding group of the Transural steppe. It is seems to be single breeding group in the steppe region. We believe that a phenomenon of Peregrines inhabiting the steppe zone in that region is the new event and connected with two processes – construction of the reservoir and spreading of Peregrines from

mountains regions located at the distance of 60-70 km to northwest. Flooding the reservoir has brought to the changing of all fauna at the steppe Ural river valley. Many ducks and waders – the main preys of Peregrines – began to nest on reservoir. Also river cliffs attracted to nest birds from mountain regions where falcons bred under similar conditions. Four pair were found to breed on Iriklinskoye reservoir however the Saker Falcon *Falco cherrug* has begun to breed here and forced out two pairs of Peregrines since 1990-s. Only two of four pairs bred successfully in 2002, breeding territories of other pairs were occupied by Sakers.

Volga-Kama taiga

The second breeding group on number of Peregrines is the Volga-Kama taiga group. That territory is largest in area in the Volga-Ural region. Despite it only 22.57% of breeding territories are known here and the most part of them is not confirmed by found nests. The main part of breeding territories of that group was identified as a result of registering adults with agitated behavior or anxiety calls and fledglings. A first it was connected with difficulty of searching nests because they coincided with extensive peatbogs. A total of 37 nests (22.7%) were found in the taiga forest plains west of the Urals. There, 54.1% of the nests were located on the moss tussocks and raised humps amongst bogs, 27% in other raptor species nests on trees (3 – in nests of the Black Kite *Milvus migrans* and 2 – in nests of the White-tailed Eagle) and on triangulation towers (2 – in raven's nests *Corvus corax* and 1 – in a nest of the Golden Eagle *Aquila chrysaetos*) and 8.1% on river precipices. Single pairs are known to nest on the top of dam in the center of bog where peat were extracted earlier, pulled out roots of a tree in the wet cut, on a heap of wood garbage on the side of water reservoir, on a grassed roof of the abandoned building. The portion of untypical nesting events was 10.8%. Probably many pairs of Peregrines occupied nests of raptors have placed on trees, but their nests were found more difficult, and the portion of tree-nesting Peregrines in the all recorded pairs was little. Now the all known pairs nest on tussocks amongst bogs there. The number of Peregrines increases in that breeding group but slower than in the Ural mountain group. The increasing of number are projected in two times for last decade. Now Peregrines are noted to inhabit bogs small in area while Peregrines were registered only on large bogs 10 years ago.

In general cliff breeding dominates in the Volga-Ural region – 85.7% (N=295) (Tab. 4). There the falcons use niches (86.6%), or ledges open from above (9.9%) or ledges with overhung (2.0%), or, rarely on the top of the cliff (1.6%). Often Peregrines occupy niches used as breeding sites by Eagle Owl *Bubo bubo* – 30.4%. Peregrines were twice observed to occupy raven's nests on cliff ledges but both nests were old, ruined and covered by the soil layer.

Table 4. Locations of nests of the Peregrine in the Volga-Ural region

The breeding populations locations	Rocks, cliffs					Bogs			Clay and sandy breakages			In nests of birds on:				Other type	Total	Proportion (%)
	Upper part	Center	Lower part	Top	Total	Hummock	Range	Total	Top	Niche	Total	Trees	Geodetic triangles	Rocks	Total			
Volga-Kama taiga					0	17	3	20	2	1	3	7	3		10	4	37	12. 54
Ural mountains	193	39	7	3	242			0			0			2	2	0	244	82. 71
Steppe region behind Ural mountains	2	1			3										0	0	3	1. 02
Volga-Ural forest-steppe	5	2		1	8			0			0	2			2	1	11	3. 73
Total	200	42	7	4	253	17	3	20	2	1	3	9	3	2	14	5	295	100
Proportion (%)	85. 76					6. 78			1. 02			4. 75				1. 69	100	

We noted several tree-nesting pairs of Peregrines (N=9): height of nest location varied from 10 to 25 m, made at average 17.6 m. The most part of recorded nests (N=255) was on cliffs (in upper part of cliffs – 79.21%): the average height of nest location was 51.0 m (range 3–170 m).

Breeding cycle

Table 5. Times of breeding the Peregrine in the Volga-Ural region

The breeding populations locations	Times of breeding									
	Clutching eggs			Hatching chicks			Fledging juveniles			Total number of registered breeding
	Earliest	Latest	Average	Earliest	Latest	Average	Earliest	Latest	Average	
Volga-Kama taiga	09.04	20.05	28.04	12.05	22.06	31.05	21.06	01.08	10.07	35
Ural mountains	01.04	26.05	15.04	04.05	28.06	18.05	13.06	07.08	27.06	209
Steppe region behind Ural mountains	01.04	04.04	02.04	04.05	07.05	05.05	13.06	16.06	14.06	7
Volga-Ural forest-steppe	02.04	05.05	09.04	05.05	07.06	12.05	14.06	17.07	21.06	12
Total	01.04	26.05	16.04	04.05	28.06	19.05	13.06	07.08	28.06	263

The Peregrine Falcon in the region seems to be a migrant, though some birds were recorded during a winter season, especially near settlements. But that facts seems to be accidental.

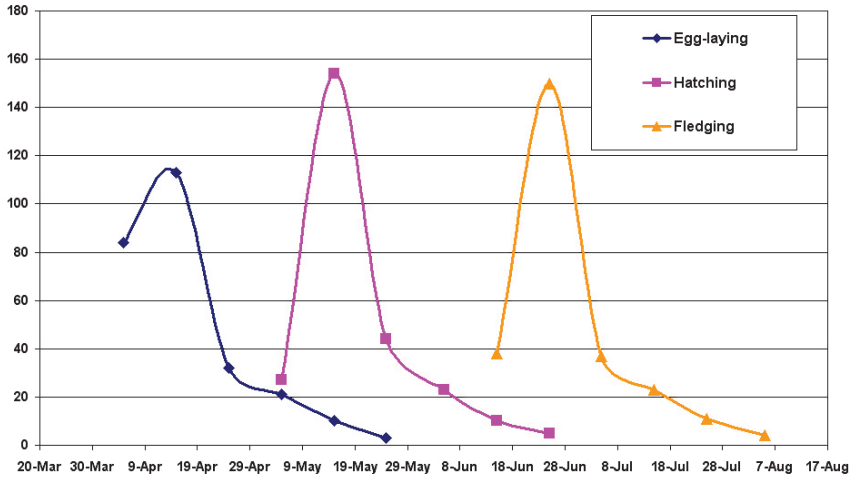

Figure 4. Times of breeding the Peregrine Falcon in the Volga-Ural region

In the south of the region first birds are noted on their breeding grounds at the beginning of March. The most part of birds return to their breeding

territories since 20 March to 10 April. The end of spring migration notes in the middle of May. Only single birds are recorded migrating in May and they are mostly tundra Peregrines *F. p. calidus*, preferring to migrate through large wetlands.

The egg-laying was noted since 1 April to 26 May. The laying period in the region was spread across 1.5-month period with most egg-laying starting in the period between 5 and 25 April (Tab. 5., Fig. 4). Snowstorms and drops in temperature in May can initiate the terms of egg-laying being later for 5-10 days, however as a rule they increase the period between first and latest laying. Birds inhabiting bogs on plains lay eggs later than mountain falcons for 1-2 weeks in spite of the conditions for breeding in mountains are more difficult than in plains. Terms of spring have an influence on terms of Peregrine breeding, however the difference between breeding dates across the years being insignificant.

Chicks hutches between 4 May and 28 June (the most hutching was observed between 8 and 28 May) and fledge on 13 June – 7 August (the most fledging – on 17 June – 7 July). 57.89% of chicks fledges by 25 June, while the most part – after 20 June, in mountain regions of the Ural.

After fledgling the young were fed by parents nearby the nest site during next 2 weeks. Later, breeding in cliffs along small rivers of South Ural falcons move on wetlands in steppe and forest-steppe regions. At first it is connected with disappearing of preys (ducks move to large water bodies, ravens, crows and pigeons – to farms situated in the zone of foothills). At the beginning of August Peregrines disappear from breeding sites. And to the end of August only single birds remain mostly on precipices of large rivers. Behavior of falcons breeding along large rivers is different, Peregrines spend all time until migration in breeding territories. After fledgling of chicks Peregrines breeding in bogs remain mostly in their own breeding territories, however the area of hunting grounds increases significantly. Ducks and gulls that inhabit large lakes amongst bogs seem to influence upon distribution of falcons. In years of poor food falcons also move in valleys of nearest large rivers.

Autumn migration starts gradually at the end of August. Local birds leave the region by the end of September. October records of Peregrines were rare and mostly it was tundra Peregrines.

Clutch size, brood size and breeding rate

clutch size (N=17) varies between 1 and 4, making an average 2.94. Brood size (N=58) varies from 1 to 4, or 2.69 on average. Breeding rate is 2.38 fledglings per successful eyrie (N=221) (Tab. 6). Probably average sizes of clutch and brood are higher because dead clutches and late broods which some fledglings

have flied away from, were include in the analysis. For example monitoring two pairs of Peregrines in the Kama station we recorded the average brood size (N=23) as 2.83 fledglings per successful eyrie (Tab. 7).

Table 6. Data on breeding of the Peregrine in the Volga-Ural region

The breeding populations locations	Number of eggs in a clutch				Number of all clutches	Number of all eggs	Number of chicks in a nest				Number of all broods	Number of all chicks	Number of fledglings in an breeding area				Number of all fledgling broods	Number of all fledglings	Number of all registered breeding	Proportion (%)
	1*	2*	3*	4			1	2	3	4			z	2**	3	4				
Volga-Kama taiga		1			1	2		1	2	1	4	12	3	5	17	8	33	96	38	12.84
Ural mountains	2	3	4	5	15	44	7	10	25	5	47	122	37	71	53	16	177	402	239	80.74
Steppe region behind Ural mountains									2	2	4	14			2	1	3	10	7	2.36
Steppe region behind Ural mountains				1	1	4		1	2		3	8	2	3	2	1	8	18	12	4.05
Total in the region	2	4	4	7	17	50	7	12	31	8	58	156	42	79	74	26	221	526	296	100
Average ± SD	2.94±1.09						2.69±0.86						2.38±0.92						100	

The results of the monitoring of a Peregrine pair are in the Table 7. The pair no 16 were noted to nest every year since 1987. We monitored the pair since 1989. Falcons occupied the old nest of the Black Kite situated on a pine on the edge of river precipice since 1988 to 1991. The female were absent in 1991, she seemed to be killed by the Eagle Owl, the dead clutch was found in the nest. We observed that pair with new young female in the breeding territory in 1992, but the pair did not bred. Next year Peregrines occupied a nest which had been originally built by Black Kites and situated also in a pine on the pinnacle of 30 m canyon and 2 km from the previous nest. In 1994, falcons bred in another nest 1 km from previous, also built by Kites

and similar situated. That nest had been occupied by Peregrines till 1996. In 1997, the male was new in the pair, and data of falcon nesting was on 2 week later than usually on the pinnacle of a cliff 1,5 km from previous nest, where had bred till 2000. The territory was not monitored for late two years. Thus Peregrines produced 29 fledglings for 12 years (2.42 fledglings per year or 2.90 fledglings per successful eyrie at average). The neighbor pair, has nested on a peatbog since 1988, produced 36 fledglings (2.77 chicks per year at average), and moreover 3 chicks regularly fledged during last 6 years, but the brood of 4 chicks were not registered during 13 years of monitoring. The size of broods seems to increase from 1-2 to 3-4 fledglings in the region for last 6 years.

Table 7. Data on breeding of the Peregrine in the Kama field-station (Perm district)

Year	Pair16						Pair17
	Number of eggs	Death of eggs (%)	Number of chicks	Death of chicks (%)	Number of fledglings	Breeding success	Number of fledglings
1988	Pair wasn't breeding						2
1989	3	33.33	2	0	2	66.67	3
1990	3	0	3	0	3	100	3
1991	4	100	Female is dead			0	3
1992	Pair wasn't breeding						2
1993	4	75	1	0	1	25	3
1994	4	0	4	25	3	75	2
1995	3	0	3	0	3	100	3
1996	4	0	4	0	4	100	3
1997	4	25	3	0	3	75	3
1998	4	0	4	25	3	75	3
1999	4	0	4	0	4	100	3
2000	4	25	3	0	3	75	3
Average on successful nests	3.73	16.83	3.10	6.45	2.90	77.80	2.77
Average on all nests	3.42	24.39	2.58	6.45	2.42	70.73	2.77

Discussion

Distribution of Peregrines in the region at the end of 19th – beginning of 20th century were similar with that mentioned above – the species was common in mountain regions and more rare in plain regions where prefer large river valleys and bogs. However following data of researchers distribution of Peregrines in 1970-80's was different. Literature suggests sharp decline of the Peregrine numbers in 1950-70's and its recovery from 80's. Similar process

was observed in Western Europe (Bauer 1977; Dyck et al. 1977; Garzon, 1977; Willgons 1977; Ratcliffe 1990). The Peregrine population crushing seemed to be in 1950-60's, and the number of falcons has recovered in Western Europe since 1970's (Cade et al., 1988), however it begun to increase in the Volga-Ural region decade later. Undoubtedly the main reason of Peregrine number decreasing in the all range was organochlorine (especially DDT) pollution of environment. Exactly after prohibition of DDT use the number of Peregrines became to recover in Europe (Ratcliffe, 1990; Cade et al., 1988). The high level of organochlorine contamination in eggs of Peregrines was noted from the Kola Peninsula (Henny, 1994, 1996) and the Kolyma tundra (Potapov, 1994, 1996). Both cases of pesticide contamination seemed to be during the wintering. DDT used in the Volga-Ural region on a large scale (including spraying by airplanes) to struggle against taiga ticks – carriers of encephalitis. The number of ill people was so large, that it seemed to be the epidemic of encephalitis. The organochlorine contamination in Peregrines is known to induce eggshell thickness, as a result of that many clutches were crushed by females during the period of incubation. Clutches of Peregrines with crushed eggs had been recorded only till 1994, and the number of such records decreased in 6 times for 7 years (Fig. 5), that indicated the decreased organochlorine poisoning of falcons in the regional population.

Table 8. Registration of nests with crushed eggs of the Peregrine in the Volga-Ural region during 1988-1998

Year	Total number of nests	Nests with crushed eggs	Successful nests or empty on different reasons	Proportion of nests with crushed eggs (%)
1988	8	4	4	50
1989	9	4	5	44.44
1990	5	3	2	60
1991	15	3	12	20
1992	4	1	3	25
1993	11	2	9	18.18
1994	12	1	11	8.33
1995	64	0	64	0
1996	86	0	86	0
1997	30	0	30	0
1998	16	0	16	0
Total	260	18	242	6.92
Proportion (%)	100	6.92	93.08	

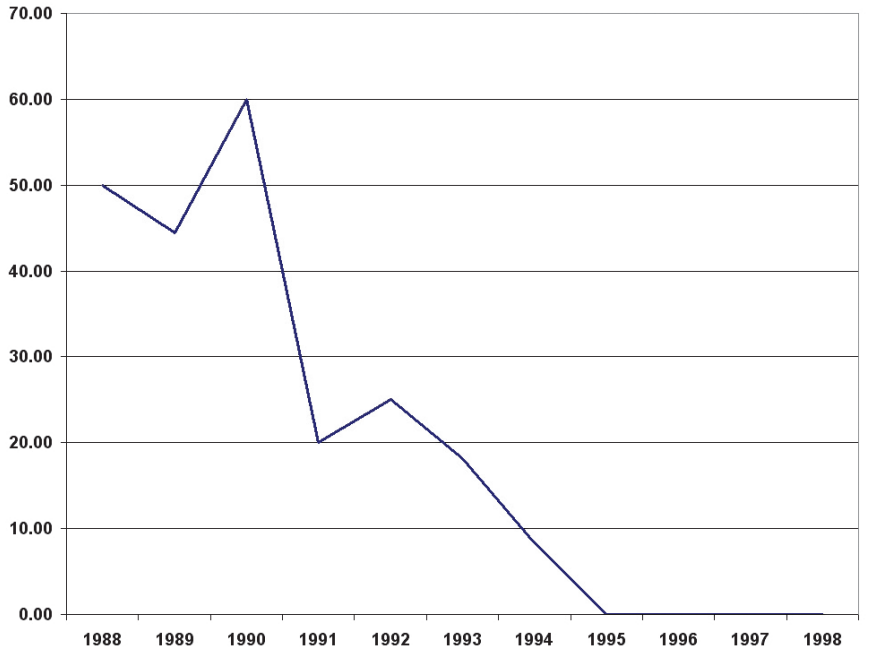

Figure 5. Registration of nests with crushed eggs of the Peregrine in the Volga-Ural region during 1988-1998

Russia later than Europe refused to use DDT, that perhaps influenced recovering of Russian Peregrine population to be later. Fortunately the Peregrine number recovering coincided with the crushing of agriculture and chemical industry at the end of 1980's – beginning of 1990's, that accelerated rates of Peregrine number increasing.

There is the number of the Peregrine Falcon increasing in the Volga-Ural region since 1990's to recent time. The number of breeding Peregrines has increased 1.5-2.5 times in different districts of the region since 1990 to 2007. The number has increased 20-70 % in some districts for last decade; the average increasing in the region is 40%. The most increasing is noted in the Perm district (70%) and in the Republic of Bashkortostan (50%). Now a total of 1000 pairs are estimated to breed in the European part of the region and 1300 pairs – on the territory including Sverdlovsk and Chelyabinsk districts.

Following the results of researching we can predict the process of Peregrine population recovering in the region.

Remaining in the mountain regions of the South Ural and wetlands of the Volga-Kama taiga the number Peregrines started to recover in 1980's.

The two largest breeding groups – Southern Ural and Upper Kama – started to increase. Cliff-nesting birds became to distribute from the first group: Peregrines once again inhabited river cliffs of the Southern Ural then extended through the Middle to the Northern Ural. At first birds had nested only in large cliffs enclosed by forested islands or flood forests from the river-bed. Only after several years birds started to occupy any cliffs. Under conditions of Peregrine number increasing Eagle Owls also nesting in cliffs became significantly to impact on the falcon distribution. Exactly Eagle Owls have become the main reason of the cliff-nesting falcon number limitation since 1990's. Peregrines started to inhabit rocks along forested ravines and small rocks along steppe slopes of valleys the foothill zone at the end of 1990's and then the area of biotopes suitable for nesting increased in 2 times. Perhaps the number of Peregrines in some territories now is more than in 19th century. However Peregrines have not inhabited towns but nest in river cliffs near Ufa and other towns of the republic of Bashkortostan and catch pigeons (*Columba livia*) and Jackdaws (*Corvus monedula*) in the territory of towns. Falcons are known to try to nest in niches of concrete buildings of the Chaykovsk plant, in the dam of the Kama water reservoir in the Perm Kray and in the mill factory in vicinity of Ekaterinburg, however the all facts of breeding were unsuccessful due to the death of birds.

Monitoring nest sites along the Chusovaya River we registered the number of Peregrines increasing more than in 10 times. One pair was registered to breed here in 1987, 3 pairs – in 1993, 8 – in 1995, 10 – in 1997, and 13 – in 2000. And falcons, at first, start to occupy that cliffs which had been inhabited by Peregrines from time immemorial, by the way many cliffs are named in honor of falcons. After 20 years of their disappearance falcons start to nest in the Sylva cliffs, where Vorontsov (1949) had already hunted at the end of 1930's. Peregrines have regularly nested here since 1985. Also Peregrines have been regularly noted to nest in Obvinskiy Bay near Ilyinskoe since 1987, where F. A. Teplouchov had already hunted falcons in 1889 and in 1893 (skins of birds are kept in the collection of the Perm folk museum).

Unlike regions of the Ural Mountains the Peregrine number in the plain part of the region recovers slower. We monitored 3 pairs in the territory 1000 km^2 near the Kama station in 1987. The first pair of Peregrines occupied nests of Black Kites in cliff-faces along the water reservoir, the second – a nest of Ravens on the geodetic triangle, the third nested in a peatbog near the colony of gulls every year. We had already noted 6 pairs breeding in that territory in 1994, and 8 pairs – in 1999. However increasing the number of breeding pairs all new pairs of falcons became to nest on tussocks and hills amongst bogs. The pair had nested on triangular after changing a partner moved on a bog to nest. The pair had occupied regularly nests of Black Kites

also after changing a partner became to nest on a river precipice as tundra Peregrines. Thus the number of Peregrines increased in the region but tree-nesting birds were changed by ground-nesting birds. And the most number of Peregrines breeding in the plain part of region is closely connected with large bogs. However if Peregrines had inhabited only nature bogs at the beginning of 1990's, falcons started to nest in bogs transformed by peat-cutting, wetlands on the sides of water reservoirs and wet cuts at the end of 1990's. In the last case the pair nested on the overturned spruce on the cut lesser 1 km^2 in area.

The number of Peregrines increases in South Ural last 8 years, while the structure of breeding groups of the Peregrine Falcon on the south of the region changes because the number of Sakers recovers. For example, after a pair of Sakers appearing and breeding successfully on the Zilair River, two pairs of Peregrines, that had regularly nested with the distance 3-5 km between nests, moved, and the distance between them reached 7 km, and was 5.5 and 1.5 km accordingly from the nest of Sakers. Similar events were registered on the Iriklinskoe water reservoir. As a result of Sakers occupying cliffs had been inhabited by Peregrines, Peregrines were forced to occupy lesser cliffs several km from and not bred. Probability of influence of such events to decrease the number of Peregrines is little. However it may to hamper Peregrines spreading in steppe and forest-steppe regions of Transural. At the same time Sakers have completely disappeared in Pre-Ural regions where Peregrines may spread without any obstacles.

Now the number of Peregrines has reached its limit in South Ural and is close to it in Middle Ural. However there are wide possibilities for Peregrines to inhabit plain part of the region and urban territories.

However negative fluctuations are also surveyed in some subpopulations. The lowest number of Peregrines is noted on several forest-steppe areas along the Volga River (Samara district) where as a result of high human disturbance pairs are registered breeding very irregular and only on cliffs. Some breeding territories were disappeared in last decade. The number of Peregrines in a forest-steppe zone of the Kama River (Republic of Tatarstan) slowly increases due to the birds spreading from the northern areas through river cliff-faces. However the tree-nesting population inhabited the mouth of the Belaya River (Republic of Tatarstan, Republic of Bashkortostan) has completely disappeared. The similar fluctuations are recorded in forest-steppe areas of the Ural Mountains foothills where insignificant growth of number of falcons are noted but the tree-nesting pairs have completely disappeared and all falcons are surveyed to breed only on cliffs. And in the most cases the changing of nesting places from trees to cliffs is observed on long-term breeding territories as a result of change of partners or full replacement of adults on young birds. In the Nizhniy Novgorod district Peregrines have not

been surveyed to breed in a forest-steppe area of the right side of the Volga but the number of falcons has been stable on forest territories of the left side of the Volga where falcons are rare and prefer large bogs to breed. Also in the Kirov and Perm districts (flat part of forest zone) the number of falcons increases only due to the ground-nesting birds inhabiting bogs. Occupation of small bogs is surveyed. However the species was registered only on large bogs 10 years ago. Tree-nesting Peregrines have not recorded in the districts as well as in the all region during last 5 years; all surveyed birds are noted breeding only on the ground on bogs. The cliff-nesting population of the Ural Mountains is the most successful, the number of which has increased 3 times in last decade. However the most productive South Ural population has been endangered now. Large areas that Peregrines inhabited including 50 breeding territories (20% of the total known breeding territories) were destroyed as a result of intensive construction of water reservoirs and mounting skiing resorts.

We believe the disappearance of tree-nesting birds in the Urals Mountains is impacted by spreading the birds from the South Ural population. The tree-nesting birds with lower number and breeding success have been replaced by most successful cliff-nested birds. The similar situation is observed in the flat part of the region where tree-nesting birds was replaced by grown-nesting. Thus 7% of pairs used to nest on trees at the beginning of 1990's, 4% - at the end of 1990's, and now such pairs are not registered at all or predicted only in the western edge of the region - in the Nizhniy Novgorod district. Nevertheless, restoration of the tree-nesting population of Peregrines in the European part of Russia is very important. We believe the most perspective territory for this purpose is the middle and upper reaches of the Volga where Peregrines are still extremely rare.

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