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Monitoring of Peregrine Falcons in the Ariège Pyrenees and Toulouse, Midi-Pyrénées region, France

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Abstract Since the 1980s, the volunteers of the ornithological group of the Nature Midi-Pyrénées association have been monitoring the Peregrine Falcon *(Falco peregrinus)* population in the Ariège Pyrenees and in the Toulouse agglomeration. The data collected over the last 30 years show stability of the Ariège population: little variation has been observed in brood size, occupation rate of the sites or reproductive success. Only the increasing number of known nesting sites is significant, due to better knowledge of the territory by observers over time. In 2017, the breeding population was estimated to be 24 pairs. Urban monitoring proved the presence of individuals in passage, wintering or resident in Toulouse. Since 2002, downtown Toulouse has been visited by several individuals of both sexes and interactions between males and females have been observed since 2005. Despite the multiplicity of possible eyries or nesting sites in Toulouse, and the massive presence of Peregrine Falcons and dedicated bird watchers, no case of breeding has been reported. In addition to monitoring, measures to protect and support the presence of the species have been put in place. In the Pyrenees, in the light of the growth of human activities near nesting sites, some sites are now subject to official protective measures, coupled with constant vigilance and awareness. In Toulouse, to encourage the breeding of the individuals present, two nesting boxes were installed in 2016, on two buildings frequented by a female and a male. In 2017, a first attempt to reproduce in one of these installations confirmed the value of such developments in urban areas.

Keywords: Peregrine Falcon, monitoring, nesting, rupestrian, urban, nest box, Ariège, Pyrenees, Toulouse

Összefoglalás Az 1980-as évek óta a Nature Midi-Pyrénées egyesület végzi a vándorsólyom állomány monitoringját az Ariège Pireneusokban és Toulouse agglomerációjában. Az elmúlt harminc év adatsorának elemzése az ariège-i állomány stabilitását mutatja: kis eltérések figyelhetők csak meg a fészekaljak méretében, a foglalt revírek arányában vagy a költési sikerben. Egyedül az ismert fészkelőhelyek számának emelkedése jelentős, ami a terület egyre részletesebb megismerésének köszönhető. 2017-ben az állományt 24 párra becsültük. A városi monitoring Toulouseban átvonuló, telelő és helyi madarak jelenlétét egyaránt igazolta. 2002-től kezdődően gyakoribbá vált mindkét előfordulása a belvárosban, és 2005-től a hímek és a tojók közötti interakciók is megfigyelhetők voltak. A számos alkalmas revír vagy fészkelőhely, a vándorsólymok jól érzékelhető jelenléte és az elkötelezett madarászok ellenére eddig nem sikerült a faj költését bizonyítani Toulouseban. A monitoring tevékenységgel párhuzamosan védelmi intézkedések is történtek a faj megóvása érdekében. A Pireneusokban, a fészkelőhelyek közelében az erősödő emberi tevékenységek miatt egyes helyek jelenleg a „hivatalos védelmi intézkedések" védelmét élvezik, állandó megfigyeléssel párosítva. Toulouseban a jelenlévő egyedek fészkelését elősegítendő két fészekláda került kihelyezésre két épületen, amelyeket egy hím és egy tojó rendszeresen látogatott. 2017-ben az első költési kísérlet megerősítette az ilyen jellegű fejlesztések fontosságát a városi környezetben.

Kulcsszavak: vándorsólyom, monitoring, fészkelés, szikla, város, fészekláda, Ariège, Pireneusok, Toulouse

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Introduction

In 1987 passionate ornithology volunteers formed the "Rapaces" group within the Nature Midi-Pyrénées association. Since its creation, the protection of Peregrine Falcon *(Falco peregrinus)* has been the priority of the group, focusing on the area of the Piedmont Ariège and in Toulouse, capital city of Midi-Pyrénées region. After a census of the sites used by the species, monitoring of this breeding population was quickly established involving local ornithologists and falconers.

From 1988 to 1994 the observations were very intensive with a special regard to possible human disturbances. Some volunteers also invested time in the search for new cliff sites likely to be occupied. This was also encouraged by the introduction of regulatory protection measures (APPB – Biotope Protection measures issued by the Prefecture) covering certain rock nesting sites for raptors.

From 1995 to 2000 the intensity of monitoring of the sites decreased because volunteers focused more on monitoring and safeguarding other sensitive species (Monneret 2017). During that period, emphasis was put on raising awareness among climbers about the APPB regulations, and monitored pairs suffering disturbances.

Activities were reduced from 2000 to 2010, often limited to simply checking the presence of pairs on a sample of known sites. Serious coordination of monitoring started again in 2011 with the objective of updating the data collected in the 1990s. Surveys carried out censuring the breeding population found 31 nesting sites to date in the study area. The very exhaustive censuring of breeding pairs conducted between 2012 and 2014 is now restricted to observations of half of the known sites.

It is now possible to summarize the actions of volunteers over the last thirty years in Pyrenees and Toulouse city. Through the analysis of the collected data, we will attempt to document the status of the Peregrine Falcon breeding population in the study area.

Material and methods

Geography of the study area in Pyrenees

The studied area in Pyrenees *(Figure 1)* is located in the southwest of France in the region of Ariège, on the border with Spain and Andorra. It extends over approximately 1,600 km^2 from the valleys of the Couserans in the west to the valleys of Haute-Ariège and the Pays Cathare in the east (Frémaux & Ramière 2012).

The population density of the region is 31 inhabitants/km^2. The economic activities in the mountainous part of Ariège are mainly composed of extensive agriculture, forestry, tourism and industry (agro-food, paper and textile production, quarrying, and hydroelectricity).

Figure 1. Map of the studied area in Pyrenees Ariègeoises (Ariège department) the studied area is surrounded. Toulouse city is 90 km North of Foix

1. ábra A vizsgált terület térképe Ariègeoises-ben. A vizsgált terület körberajzolva. Toulouse 90 km-re van Foix-től

Environment and habitats in Pyrenees

The nesting sites are between 400 and 1,600 m above sea level, on the hills and mountains of the Pyrenees Ariégeoises. The majority of the areas are oriented to the north, northeast and southwest *(Figure 2)*.

The soil geology is quite heterogeneous with the presence of calcareous, granitic and schistose substrates. The vegetation of the mountains is dominated by mixed beech-fir forests. The valley bottoms and the hills offer more open landscapes with wooded areas, pastures, meadows, hedges, wasteland, copses, sessile and pedunculate oak and hazel forests. Consequently Peregrine Falcon nesting sites in the study area have varied characteristics. In

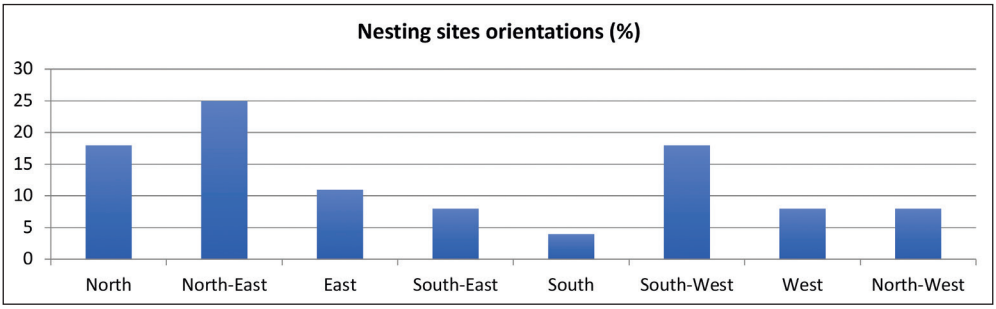


Figure 2. Percentage of nest sites by geographic exposure in the studied Pyrenees area
2. ábra A fészkelőhelyek százalékos megoszlása a vizsgált területen

the east, the areas are mainly on large cliffs sometimes more than 100 m high that dominate an open landscape. We found the highest densities of couples in this section. In the west, the areas are mainly on cliffs some tens of metres high that overhang a more closed landscape and sometimes even entire forests. In general, less than 20% of the nesting sites are on granitic rock cliffs.

Geography of Toulouse area

Toulouse is the capital of the former Midi-Pyrénées region (now Occitanie following the fusion with the Languedoc-Roussillon region). Toulouse is a city of about 480,000 inhabitants, the fourth largest in France. Its urban community involves 37 communes, covers 466 square km and has 800,000 inhabitants. Toulouse is located at the convergence of many territories occupied today by Peregrine Falcons in rocky environments, from the Pyrenees to the Causses in Lot (Boudet 1989) and Aveyron areas (Frémaux & Ramière 2012). However, the great plain of the Garonne river offers very few potential sites and is currently not occupied by the Peregrines: they are only occasionally observed in winter, especially around areas of old gravel pits for potential prey hunting.

The nearest known nesting sites are 54 kilometres away in the rocky areas of the Aveyron gorges and 70 kilometres away in urban areas (Albi city). The agglomeration of Toulouse is at an altitude of only 141 metres but has many attractive buildings for Peregrines (Drewitt 2014, Sale 2016). Religious buildings, as well as apartment buildings or even factories, offer many choices to perch and nest for the Peregrines (Drewitt 2014). This urban jungle also offers them many opportunities to hide from ornithologists!

In Toulouse, Peregrine Falcons are regularly frequent in two sectors: an area covering the historic centre of the city and a sector on the outskirts of the agglomeration, north near the airport zones and south near a former industrial zone. During periods of migration, as elsewhere, one-off data may be obtained for various sectors that are not regularly visited (Ramière 2011).

Climate

The average rainfall is about 1,000 mm/year (Saint-Girons meteorological station – Météo France data) and increases with altitude. The study area is at the eastern edge of the oceanic influence dominated by a north-western airflow. The eastern part (Haute-Ariège, Pays Cathare) is under a Mediterranean influence with a drier climate than in the west (Couserans).

General objectives

In France, since the collapse of the populations between 1945 and 1970, mainly caused by the use of organochlorine pesticides, the capturing of young birds and shooting, the Peregrine Falcon has gradually recolonized its old territories with a net renewal since the 1980s (Thiollay 2004, Monneret 2008, 2017). The Nature Protection Act of July 10, 1976 and the full protection of raptors since 1972 rendered illegal the persecution of these birds (Yeatman-Berhelot 1995, Nidal 2015).

Much of the destruction has been stopped, but some persists and other problems have appeared (Ratcliffe 1993). Thus, from the beginning of the monitoring in the 1990s, there is a suspicion that capture by some unscrupulous falconers seems to be the main factor in the failure of reproduction. Furthermore, mountain sport practices such as climbing, paragliding and gliding are considered to be disturbing factors. It is the same for hunting or animal photography in the immediate proximity of the nesting areas.

Today, the practice of capturing live birds seems to have been abandoned, probably thanks to the progress of the artificial incubation in aviaries. Destruction by illegal shooting also appears to be in decline, but it is difficult to evaluate precisely these factors.

However, the pressure of anthropogenic activities on nesting sites does not diminish. The rise of mountain tourism, new practices of free flight (wingsuit, base jumping), the increasing use of drones, model aircraft, via-ferrata and climbing are causing too many intrusions on rupestrian environments and are disturbing factors during nesting (Monneret 2017). To a lesser extent forestry can also have a negative impact while logging under the cliffs.

The knowledge and monitoring of the breeding population coupled with the surveillance of the effects of human activities on the nesting sites enable the possible threats to be identified and thus to determine the protection measures to be set up (Monneret 2017). This is the main goal of volunteers in this action.

Interspecific competition and predation

The Ariège Pyrenees have a diversity of habitats favourable for many birds that nest in rocky environments. In the study area, two species in particular are in direct competition with the Peregrine Falcon for the eyrie choice: the Northern Raven *(Corvus corax)* and Egyptian Vulture *(Neophron percnopterus)* (Monneret 2017). 25% of the known sites are affected by this competition where the Peregrine Falcons breed in the immediate proximity of one, or even both of the other two species.

Several scenarios have been observed during monitoring. In the case of the Northern Raven, we often see an exchange of eyrie from one season to the next. Sometimes the Ravens drive the Peregrines out at the beginning of the incubation forcing the latter to change eyrie and carry out a replacement egg laying. In the case of the Egyptian Vultures, the Peregrines have the advantage of being installed before the arrival of the migratory Vultures. As a result, the Falcons often take the upper hand, but depending on the individuals and the degree of aggressiveness of their territorial behaviour, the situation can be reversed.

Reproduction losses associated with these interactions between species seem marginal and are rarely observed. The predation of eggs or chicks by ravens is also difficult to measure without the permanent presence of observers (Cugnasse 2012). However, we know that in the event of human disturbance during nesting, Peregrine Falcon broods are more vulnerable to corvid predation. The latter are less fearful of humans and return more quickly to the cliffs.

The predation by Eurasian Eagle Owls *(Bubo bubo)* has not been studied much during monitoring. Since 2010, on one site in particular, we have twice observed a Peregrine couple trying to set up a few dozen metres from the eyrie of an Eagle Owl. Falcons were observed in February-March and disappeared in April and we then found this couple confined a few kilometres away for the rest of the season, without nesting.

According to the monitoring data of the Eurasian Eagle Owl in Ariège (Thomas Buzzi, Nature Midi-Pyrenées), the presence of this nocturnal raptor was noticed at least once between 2002 and 2017, near 20% of the known nesting sites of Peregrine Falcons (within a radius of max. 2 km). No specific listening campaign has yet been undertaken to check the presence of these owls at all the peregrine sites.

Since the resumption of regular monitoring in 2012, the disappearance of adults during breeding is very rarely observed. We cannot pronounce on the possible disappearance of individuals by predation by the Eagle Owls. It would really be necessary to observe the capture by the nocturnal raptor or to analyse their pellets.

Monitoring of rupestrian Peregrine Falcons

Methodology

In the Pyrenees, the observation protocol on known sites corresponds to a minimum of 3 visits per season lasting from 2 to 3 hours during the following periods:
– from February to March: to check the installation and confinement of couples,
– from April to May: to verify the incubation and rearing of chicks,
– from May to June: for the counting of young in flight.
An observer is assigned to monitor one or more sites. Insofar as possible, each observer keeps the same sites for several seasons in a row. A coordinator collects the data, leads the monitoring and writes the annual reports. Currently there are 10 to 15 volunteers regularly involved in monitoring.

The prospection of new nesting sites is carried out in February and March when the couples are the most demonstrative (parades, cries, territorial defence).

Difficulties

This action is carried out by a group of passionate volunteers who do this monitoring in their spare time according to their availability. Consequently, the observations were sometimes variable and heterogeneous over the study periods from 1988 to 2000 and from 2012 to 2017.

In addition, the Nature Midi-Pyrénées association is involved in the monitoring and protection of many species of raptors (Bearded Vulture – *Gypaetus barbatus,* Eurasian Eagle Owl, Egyptian Vulture, Booted Eagle – *Hieraaetus pennatus*, Short-toed Snake Eagle – *Circaetus gallicus*, Golden Eagle – *Aquila chrysaetos*). Depending on the year and priorities, volunteer mobilization can vary from one species to another.

Finally, the search for new sites is sometimes very difficult given the significant snowfall in the Pyrenean massif until April and May. Access to valley bottoms is often impassable before the end of spring.

Analyses

On looking at these data *(Table 1)*, we can identify monitoring periods with a variable level of observations. As previously stated, volunteer involvement in the Peregrine Falcon monitoring has sometimes been reduced, depending on the monitoring priorities of other sensitive species. Because of this, an overall statistical study covering the entire 1988–2017 period is not possible. In addition, the monitoring period is not continuous, with incomplete results in the 2000s *(Table 2)*.

There are nevertheless 2 sets of data that can be compared, with similar and continuous observations: the periods 1988–1994 and 2012–2017 *(Table 3)*. We will try to compare 4 comparable factors between these two periods: brood size, reproduction failure rate, site occupancy rate and the number of known sites.

Assessment

On the basis of these results, we observe that between the periods 1988–1994 and 2012–2017 there was:
– a reproductive failure rate down 12%
– a stable brood size for producing couples
– an increase in the number of known nesting sites by 26%
– a site occupancy rate down 6%
– an increase in the estimate of the breeding population of 17%

Protection measures

Thanks to the mobilization of volunteers in the monitoring and protection of the Peregrine Falcons but also other rupestrian raptors present in the study area (Golden Eagle, Bearded Vulture, Egyptian Vulture and Eurasian Eagle Owl), 3 nesting sites benefited from reinforced regulatory protection through Biotope Protection Prefectural Orders (APPB).

Table 1. Summary of observations during the period 1988–2017 in Pyrenees Ariégoises
1. táblázat A megfigyelések összegzése 1988–2017 között Pyrenees Ariégoises-ban

Year	Number of visited sites (A)	Number of sites occupied by established couples (B)	Number of couples with regular checking (C)	Number of nesting failures (D)	Number of producer couples (E)	Number of juveniles in flight (F)
1988	13	10	9	5	4	8
1989	14	12	12	2	10	23
1990	15	14	10	4	6	10
1991	15	14	9	6	3	7
1992	17	16	15	4	11	20
1993	19	16	15	6	9	18
1994	15	12	12	5	7	15
1995	9	7	5	1	4	9
1996	8	6	6	1	5	9
1997	9	7	7	3	4	6
1998	7	6	5	3	2	4
1999	6	5	5	1	4	7
2000	17	15	13	5	8	12
2012	24	20	17	7	10	21
2013	25	20	16	8	8	15
2014	25	20	18	5	13	29
2015	17	13	10	2	8	16
2016	16	13	9	1	8	12
2017	20	17	14	3	11	23
Average	**15**	**13**	**11**	**4**	**7**	**14**

(A) sites visited at least once during the breeding season, (B) established couples with 2 adults or 1 adult and 1 immature, (C) couples checked until juveniles' flight, (D) couples with regular checking who did not reproduce, (E) couples with at least 1 juvenile

Over a defined area, these orders regulate human activities and prohibit any ravages of species and their habitats. The bans focus on noise pollution, the use of pesticides, the deposition of waste, the over-flight by motorized devices, free flight, forestry, etc. Practices such as hunting or climbing are authorized between dates outside the breeding periods of raptors.

Despite these measures and warning signs put in place, these regulations are not rigorously respected. Site monitoring by birders remains imperative to ensure continued awareness of users.

Many other sites would deserve to have stronger regulatory protections, but many steps are required for the introduction of APPB regulations that make the process heavy and tedious. At least 30% of peregrine breeding sites are equipped for climbing (fixed ropes, pitons, etc.). These climbing routes seem relatively unfrequented, but once again, without continuous surveillance, it is very difficult to know if disturbances are occurring. For the birds' safety, charters with climbers could be established.

Table 2. Comparison of monitoring results and definition of various periods (indicated by different background colours)
2. táblázat A monitoring eredmények összehasonlítása és az egyes időszakok meghatározása (eltérő háttérszínnel jelölve)

Year	Number of known nesting sites	Completeness of sites check	Rate of occupied sites (B)/(A) in %	Failure rate of couples checked (D)/(C) in %	Number of juveniles per producing couple (F)/(E)
1988	22	56 to 83% of known sites are checked	77	56	2,0
1989	22		86	17	2,3
1990	22		93	40	1,7
1991	22		93	67	2,3
1992	22		94	27	1,8
1993	24		84	40	2,0
1994	24		80	42	2,1
1995	25	23 of 34% of known sites are checked	78	20	2,3
1996	27		75	17	1,8
1997	27		78	43	1,5
1998	27		86	60	2,0
1999	27		83	20	1,8
2000	27	63% of known sites are checked	88	38	1,5
2012	28	55 to 86% of known sites are checked	83	41	2,1
2013	28		80	50	1,9
2014	28		80	28	2,2
2015	29		76	20	2,0
2016	29		81	11	1,5
2017	31		85	21	2,1
Average	**26**		**83**	**35**	**2**

Table 3. Sites and breeding statistics during the 1988–1994 and 2012–2017 periods
3. táblázat Fészkelőhely és költéssiker statisztikák az 1988–1994 és a 2012–2017 közötti periódusokban

Period	Average breeding success rate (%)	Average brood size per producing couple	Known sites	Average occupancy of sites (%)	Density of known sites (site / 100 km²)	Estimation of the breeding population in the study area (1600 km²)	Density of breeding pairs in the study area (1600 km²) (pairs / 100 km²)
1988–1994	59	2	23	87	1.4	20.0 in 1988	1.25
2012–2017	71	2	29	81	1.8	23.5 in 2017	1.47

Monitoring of urban Peregrine Falcons

Wintering Peregrines in Toulouse agglomeration

Peregrine Falcons were first reported wintering in the Garonne plain around Toulouse in the middle of nineteenth century (Companyo 1863, Lacroix 1875). For the recent period, the first Peregrine Falcon data available in Toulouse dates back to November 1981 and was probably related to migratory passage or occasional winter visits (Bousquet 1984, Joachim *et al.* 1997). During the following years, yearly observations were reported during autumn and winter months (Bousquet & Joachim 1987, 1988, 1989, 1991, 1994).

It was not until 1991 that complete wintering in downtown Toulouse was established (Defos du Rau 1992). A falcon was regularly seen on the tower of the Jacobins church and was seen hunting over the Garonne river. For the following 10 years, the species was subject to few detailed observations in the town and all of them concerned passage or wintering.

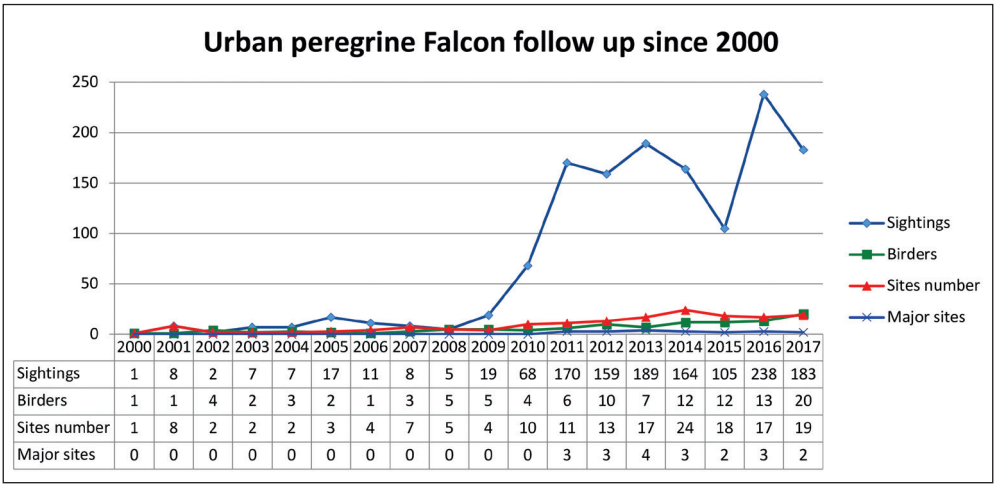
In 2000, an adult Peregrine regularly used a balcony as a platform for an overnight stay and as a regular larder on a tall private building on the banks of the Garonne south of downtown. At the same time two Peregrines, a male and female, were seen in the town (M. Viallet, L. Kergoat, T. Buzzi, pers. com.). A nest box was installed on the top of the private building on March 4th, 2001 by two birders (G. Téhel and P. Fioramonti). However, this nest box was never occupied and had to be removed a few months later because of refection work on the building after the explosion at the AZF chemical plant on September 21st, 2001. Some observations of Peregrines were reported at this site during the winter of 2001–2002 but after that the site was not used again.

A complete new wintering season was documented in 2001 (L. Kergoat, pers. com.) on the same site. In the same year two birds were seen together and stayed in the city centre during the winter until March but there were no further sightings until the month of September when, again, a bird was seen. Wintering seemed regular and at least one bird was present in the following years on the same sites.

Interestingly in 2001, an injured juvenile female Peregrine Falcon was found on the ground 5 km south of Toulouse, 9 days after the AZF explosion (equivalent to 40 tons of TNT) on September 21st. She was scrawny and nearly featherless and was taken to the Toulouse veterinary school for medical care. Close examination confirmed burn lesions on her feet, beak and eyelids. She was able to eat by herself one month after her admission (Bonnet *et al*. 2004).

Resident Peregrines in Toulouse

It was not until 2005 that the annual quartering of an individual was clearly proven. During passage periods (November and February) individuals were regularly observed, sometimes with interactions between birds, but this did not lead to any reproduction. In 2007, two birds were recorded as completely over-wintering in the city centre. In 2008, another bird passed the winter on a site on the outskirts of Toulouse. Its area of presence did not seem to overlap with that of the individual confined to the city centre (A. Balthazar, pers. com.). On this



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sightings	1	8	2	7	7	17	11	8	5	19	68	170	159	189	164	105	238	183
Birders	1	1	4	2	3	2	1	3	5	5	4	6	10	7	12	12	13	20
Sites number	1	8	2	2	2	3	4	7	5	4	10	11	13	17	24	18	17	19
Major sites	0	0	0	0	0	0	0	0	0	0	0	3	3	4	3	2	3	2

Figure 3. Urban Peregrine Falcon follow up since 2000. The graph presents for the period 2000 to 2017, the annual number of Peregrine Falcon observations within the Toulouse urban area as registered in the Nature Midi-Pyrénées association database (BazNat) completed with personal data, the annual number of birders involved, the overall number of observation sites and the major sites which are defined as sites with more than 20 observations during the year

3. ábra A vándorsólyom megfigyelések, a megfigyelők száma és a megfigyelési helyek alakulása Toulouseban 2000–2017 között. Az adatok a Nature Midi-Pyrénées Egyesület adatbázisából származnak, kiegészítve egyéni megfigyelésekkel

same site, two birds would be observed until the month of March in 2009 but there was no follow-up and the two individuals were not recorded further.

In 2010, many perch sites were identified downtown because observations increased *(Figure 3)* and thanks to the use of digiscoping individual identification of Peregrines was possible. In addition to occasional observations of migrating individuals, four birds were identified as residents: a male in historic downtown, a small female, who was ringed, on the eastern banks of the Garonne river, a large female localised to the extreme east of the city and a wintering male on the Airbus industries site north of Toulouse, by Blagnac Airport *(Figure 4)*.

The habits and territory of each falcon have been studied. Interactions between the falcons were rarely observed but the Peregrines could observe each other from high perches and were observed as having synchronic feedings. The small female falcon was ringed with a blue plastic ring on her left leg with a white V6 dated April 28, 2002, in Dima, Biscaye, Spain (340 km away from Toulouse). Her territory was between the two other downtown birds. She was last seen in December 2015, and then her territory was taken over by the nearby large female who rapidly reduced her frequentation of the east of the city. She is now the female partner of the couple that attempted breeding in 2017 in the nest box put up in south of Toulouse. During winter she regularly continues to hunt Feral Pigeons *(Columba livia domestica)* and perch in her downtown territory that is 3.3 km north of the nest box. Her male partner was a newcomer in 2016 and stays most of the time in the vicinity of the nest box site. The downtown male has not modified its habits since the disappearance of the ringed female.

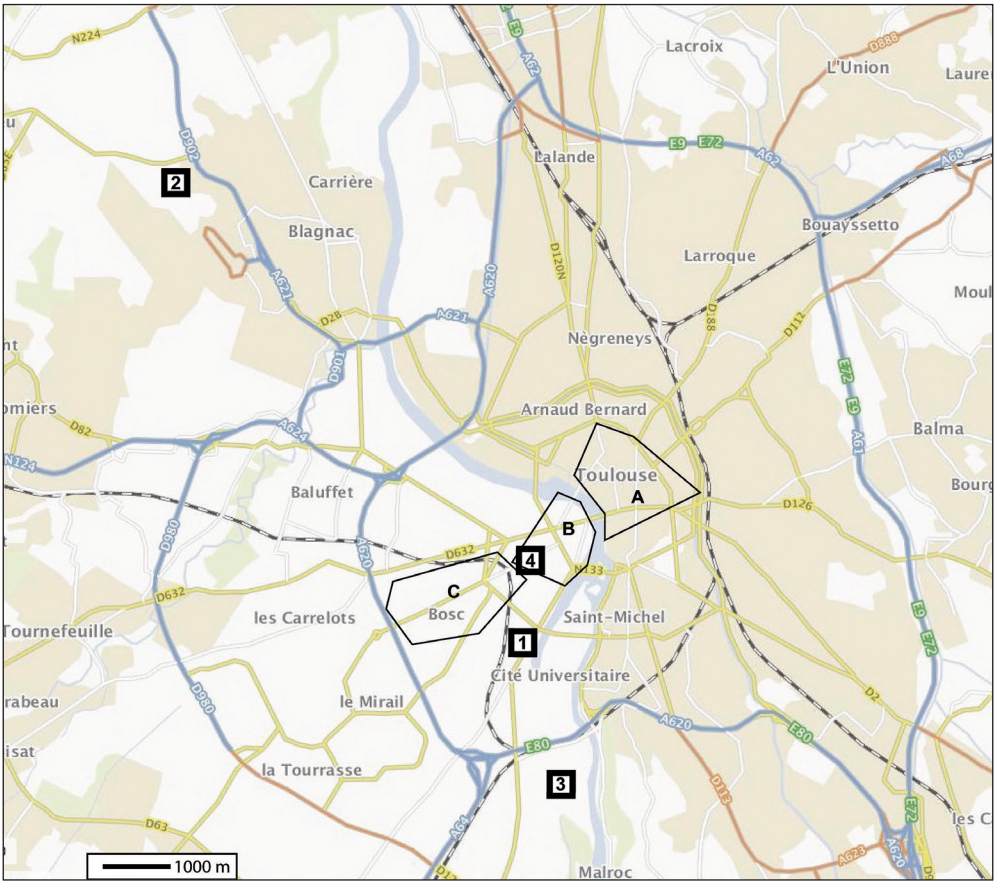


Figure 4. Map of Toulouse city with the localisations of the nest boxes (numbered square 1: 2000, 2: 2010, 3: September 2016, 4: November 2016) and the three historic territories of downtown individuals (A: male, B: ringed female, C: large female)

4. ábra Toulouse térképe a kihelyezett költőládák helyének feltüntetésével (1: 2000, 2: 2010, 3: 2016 szeptember, 4: 2016 november). A betűkkel jelzett területek egy-egy madár régebbi területét tüntetik fel (A: hím, B: gyűrűzött tojó, C: nagy tojó)

Nest boxes and first breeding attempt in Toulouse

The absence of spontaneous breeding in Toulouse led ornithologists to set up nest boxes to try to encourage it. Around 2010, a nest box was set up on the roof of the Airbus A380 assembly workshop north of Toulouse by Blagnac airport by birders working for Airbus Industries *(Figure 4)*. The goal was to retain a wintering Peregrine Falcon on the site to reduce the nuisance associated with the presence of numerous Feral Pigeons. Since then the nest box was moved under the roof to protect it. This nest box was never used for nesting despite the regular nearby wintering of a male Peregrine Falcon. In 2016, a pair of Peregrines was observed on a former industrial site south of the city and monitored *(Figure 4)*.

The two individuals were regularly seen on an 80-metre high industrial chimney used as perch for hunting, as a larder and dormitory. It is situated on the banks of the Garonne River and offers a clear view to the southern plain and to the centre of Toulouse. The site offers an abundant and varied food resource during migration periods and is closely located to downtown (3.3 km) for gathering Feral Pigeons. The Nature Midi-Pyrénées association decided to install nest boxes and two were constructed with the help of municipal services. Thanks to the strong naturalist commitment of the managers of the two selected buildings and the prospect of limiting the cost of the fight against invasive Feral Pigeons, our project has been very well perceived and quickly realized. On September 22nd, 2016, the first nest box was installed during renovation work on the industrial chimney south of Toulouse. During the renovation work the Peregrine pair stayed close to the site, and quickly started visiting and appropriating the nest box. A new flashing security light was installed on the top of the chimney and it took no time for the male to get used to it but it was 10 days before the female perched on rest cavities immediately by the flashing lights. Since then, volunteers have been providing a daily follow-up. At the end of February, a first mating was observed near the chimney and the incubation of eggs began on April 2. The female systematically incubated at night and the male only for short daytime periods with the impression that he had an impatient expectation of being relieved by his mate. Two visits of other Peregrines coming from downtown were observed with, in both cases, a quick response from the couple to keep away the unwanted intruders. Daily matings persisted during changeovers. After a normal incubation period of one month the female was no longer sitting on the eggs but was outside the nest box most of the time and no feeding was observed. We have found no explanation for this breeding failure and no remaining clues when the nest box was visited the following August. The couple was still regularly on the chimney all year long with some visits to downtown buildings. In 2018, monitoring of the breeding period will be carried out: the first couplings were observed on January 28th, 2018.

On November 17th, 2016, with the support of the council of the Department of Haute-Garonne, a second nest box was installed a month later on a downtown building once regularly frequented by a female. Use of this nest box was never observed despite the presence of the female mate of the couple less than five meters away on a balcony used as a larder and perch.

The first city breeding in a nest box in France was in 1989 in Albi, a city that is only 70 km east of Toulouse. The nest box is situated on the tower of Sainte-Cécile cathedral and has been monitored using webcams since 2007. Breeding in Albi has been successful since 2001 with 3 to 4 chicks regularly produced for most breeding seasons. Since then nest boxes are blooming in the region. In Auch, 70 km west of Toulouse, a nest box for Peregrines was installed on the cathedral in 2017 (March 3rd). In Carmaux, 85 km northeast of Toulouse, a nest box was installed on the tower of the cathedral (November 2017). In the city of Montauban, 50 km north of Toulouse, Peregrines are regularly reported downtown with a couple observed since 2016 and a nest box project is on-going.

Discussion

If it is difficult, with the data collected, to precisely define the evolution of the breeding population between 1988 and 2017, but we do not observe any significant variations in the brood size, the occupation rate of the sites or the failure rate of the reproduction between 1988–1994 and 2012–2017. From one season to the next, fluctuations in brood size and failure rate mainly depend on the meteorological factors: significant rainfall in the spring being unfavourable (risk of submersion of eggs, difficulties in prey supply during rearing juveniles).

The only data that has increased significantly is the number of known sites. This increase can be explained by a real increase in the number of breeding pairs, but also by a better knowledge of the territory by observers over time. It should be noted that the western part of the study area is the least explored area and it is therefore possible that the number of breeding pairs is underestimated in this sector.

In the studied area, the carrying capacity of the environment does not seem to be saturated. The best sites are probably all occupied, but birders still identify many potentially favourable cliffs.

Unlike the mountains of eastern France, here in the Ariège, the Peregrine Falcon must, in addition to the Eurasian Eagle Owl and the Northern Raven, coexist with other raptors with territorial behaviour such as the Golden Eagle, the Bearded Vulture and the Egyptian Vulture. The influence of these interspecific competitions on breeding sites is difficult to measure, probably limited, but very real in the most favourable rupestrian areas. Predation on the Peregrines by the Eurasian Eagle Owl has not been sufficiently studied to draw conclusions.

The actions of the Peregrine Falcon monitoring group have led to a clarification of the species status in Ariège and at least shown the stability of the breeding population. Some sites benefit from regulatory protection (APPB), but ensuring the rules are respected by users of rupestrian environments demands constant vigilance, year after year. Finally, periodic monitoring of nesting pairs is still necessary in view of the growth of potentially disturbing human activities around breeding sites.

To date, despite resident and regular wintering Peregrine Falcons for more than 30 years and 3 nest boxes available, no reproduction has occurred in Toulouse. The first reported attempt was in 2017 in a nest box recently installed, but failed for reasons unknown. We will continue monitoring the city Peregrine population in Toulouse and hope for successful nestings in the coming years.

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