LIFE Oxyura Technique Assessment Report 2021

Techniques implemented and results

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Preface

This national assessment is carried out in the framework of:

— Recommendation n° 185 of the Berne Convention Permanent Committee, adopted 18 November 2016, on the eradication of the ruddy duck (*Oxyura jamaicensis*) in the Western Palearctic by 2020 (Council of Europe 2016).

— EU regulation n° 1143/2014 concerning the prevention and management of alien invasive species (AIS) introduction and propagation (Council of Europe, 2014).

— The 2015-2025 national plan to eradicate the ruddy duck, validated by the Water and Biodiversity Directorate on 24 June 2016 (Ministère de l'Ecologie du Développement Durable et de l'Energie, 2016).

— The implementation of the EU AIS regulation listing the ruddy duck as a species of concern for the European Union, transcribed into national law by Decree n° 2017-595 of 21 Avril 2017 regarding the control and management of the introduction and propagation of certain animal and plant species, and the Decree of 14 February 2018 regarding the prevention of the introduction and propagation of alien invasive animal species in Metropolitan France.

— The national strategy on AIS, Axis II "Operations for the management of gestion species and restoration of ecosystems", Objective 5 "Control widespread alien invasive species", Action 5.3 "Implement national combat plans".

— The EU project LIFE Oxyura, led by the OFB in partnership with the SNPN, which lasts from October 2018 to December 2023. This financial instrument strengthens past actions in order to achieve two objectives: eradication of the population in the wild by 2025 and control and eradication of the captive population by 2030 (European Commission, 2018).

This assessment report covers the period from the 1th of January to 31 December 2021. The information it contains is derived from the results of censuses, field surveys and destruction operations carried out by the OFB and the SNPN - Grand-Lieu RNN. Concerning observations outside of Grand-Lieu Lake, this assessment report is also based, to a large extent, on information gathered from the naturalist community, in particular through regular consultation of the ornithological data of the Visionature network.

1 Background

1.1 A conservation issue for the white-headed duck

The LIFE Oxyura project responds to a conservation issue of a diving duck species, the white-headed duck - *Oxyura leucocephala* (European Commission, 2018). This species range is subdivided in two geographically isolated populations. One of them, located in the western Mediterranean, is threatened (Green & Hughes, 1996; Hughes et al., 2006). Currently only present in Spain and to a lesser extent in Morocco and Tunisia, it used to nest in Italy and France, the last sedentary pair being observed in Corsica in 1966. In 1977, the population was close to extinction, with 22 individuals recorded in southern Spain. Conservation measures have enabled it to recover, with a fairly stable population of around 2,500 individuals. This increase is associated with occasional sightings of isolated birds in France since the 1980s. (Figure 1).

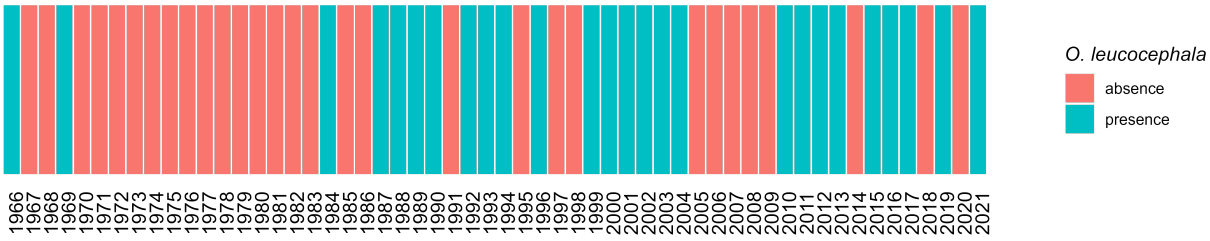

Figure 1: Evolution of the white-headed duck presence in France

The Iberian white-headed duck population faces a new threat since the introduction of a closely-related species, the ruddy duck - *Oxyura jamaicensis* (Gutiérrez-Expósito et al., 2020). This species, native to North America, is a potential competitor for nesting sites and food resources. Although they probably diverged genetically 1-2 million years ago (Muñoz-Fuentes et al., 2007), these two species nevertheless produce fertile hybrids, of which 69 specimens have been observed in Spain since 1991 (Gutiérrez-Expósito et al., 2020). This genetic introgression would likely lead to the extinction of the Iberian white-headed duck population in favour of a hybrid population or a new nucleus of ruddy duck. This transition could be rapid due to the aggressive behaviour of male ruddy ducks during the breeding season, favouring their access to female white-headed ducks (Figure 2) (Gutiérrez-Expósito et al., 2020).

Figure 2: Two males in breeding plumage fighting in Mayenne - France; a ruddy duck to the left, a white-headed duck to the right. © Eric Médard

In view of conserving the white-headed duck, the Spanish authorities carried out a systematic campaign to destroy ruddy ducks and hybrids in their territory until 2007. Since then, a few occasional sightings have been made[1]. Initially introduced in the UK, the threat of the ruddy duck returning to Spain cannot be ruled out as long as the species is still present on the European continent. Under pressure from the white-headed duck conservation issue, the British authorities in association with local ornithological organisations implemented an eradication plan in 2005[2], which reduced the population from 6000 individuals to 12 individuals in 2019 and 2020. Breeding in the wild was observed every year between 1953 and 2018, with 2019 marking the end of the population renewal (Henderson, pers. comm.). However, two small nuclei have been established on the continent, one in France remaining at around 200 individuals between 2004 and 2018 thanks to the efforts of the French Biodiversity Agency (OFB) and the French National Nature Protection Society (SNPN), and one in the Netherlands of around 80 individuals [3]. In order to prevent natural breeding in France, the LIFE Oxyura project, led by the OFB, was set up in 2018 to support the 2015-2025 national management plan. In particular, it enabled the hiring of four officers specifically to control the ruddy duck throughout France for five years (European Commission, 2018).

[1]The last three sightings date from 2011, 2014 and 2020, respectively
[2]The plan was set up after a 5-years research phase
[3]Some birds have been observed in Belgium, but are not corresponding to an entire population

1.2 The ruddy duck in brief

The ruddy duck is a small duck with a long tail cocked at 45°, which is characteristic of the *Oxyura* genus (Figure 3).

- Length : 25-43 cm
- Female weight : 450-845 g
- Male weight : 500-700 g

Figure 3: A pair of ruddy ducks in summer. © OFB

The male's plumage is predominantly red with a black head and white cheeks (Johnsgard & Carbonell, 1996). The bill is blue in the breeding season. The female has brown plumage with dark brown on the upper parts of the head and darker-striped light brown on the lower parts. The undertail feathers are white. Regardless of sex, the C-shaped bill of the ruddy duck is the main feature distinguishing it from the white-headed duck, whose bill is S-shaped. Juveniles have a similar profile to the female and can be mistaken for young common pochard. In its native range, the ruddy duck winters on large, shallow bodies of water (coastal bays or lowland lakes). Its preferred nesting sites are smaller bodies of water with extensive riparian vegetation consisting of sedges, reeds and willow saplings. The ruddy duck feeds on aquatic plants, molluscs, worms and insects (Sanchez et al., 2000; Woodin & Swanson, 1989). Midge larvae and nymphs (*Tendipedidae*), specifically *Chironomus*, are the primary food sources during the breeding season (Siegfried, 1973).

2 Management methods

2.1 Management methods adapted to the biological life cycle

2.1.1 Insights into the biological life cycle of the ruddy duck in France [4]

A ruddy duck population has been established in France since 1974. At the onset of the first cold weather, most of them gather as from late November on Grand-Lieu Lake, in the Loire-Atlantique department, to spend the winter. They form part of a group of about 20,000 wintering ducks of various species in the central area of the lake (Figure 4). This period is favourable for estimating the size of the French population as almost all the birds are visible at this site.

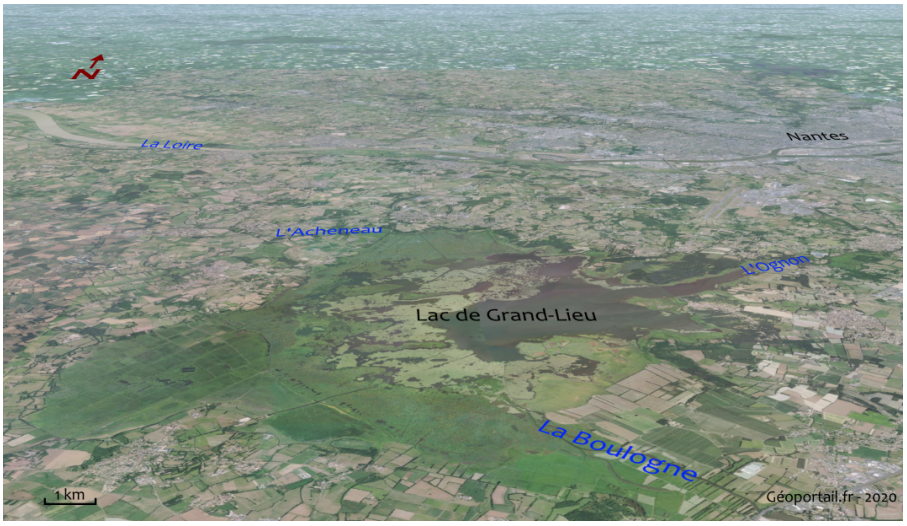

Figure 4: Geography of Grand-Lieu, a lowland lake in western France (47° 05' 45" N, 1° 40' 3" W).The lake has two tributaries, the Boulogne and the Ognon, and flows into the Acheneau which in turn flows into the Loire. The light green areas are water lily beds which disappear in winter. © Geoportail

The ducks move from the east to the west of the central area of the lake, depending on the wind and the disturbance caused by any predators present or the few professional fishermen (Figure 5). Until mid-February, the birds stay away from the edges of the lake and show fleeing behaviour as soon as they are approached within 500m.

[4] The information in Section 2.1.1 is based on observations made by staff from the Grand Lieu SNPN and French Biodiversity Agency, as well as by bird watchers and professional ornithologists.

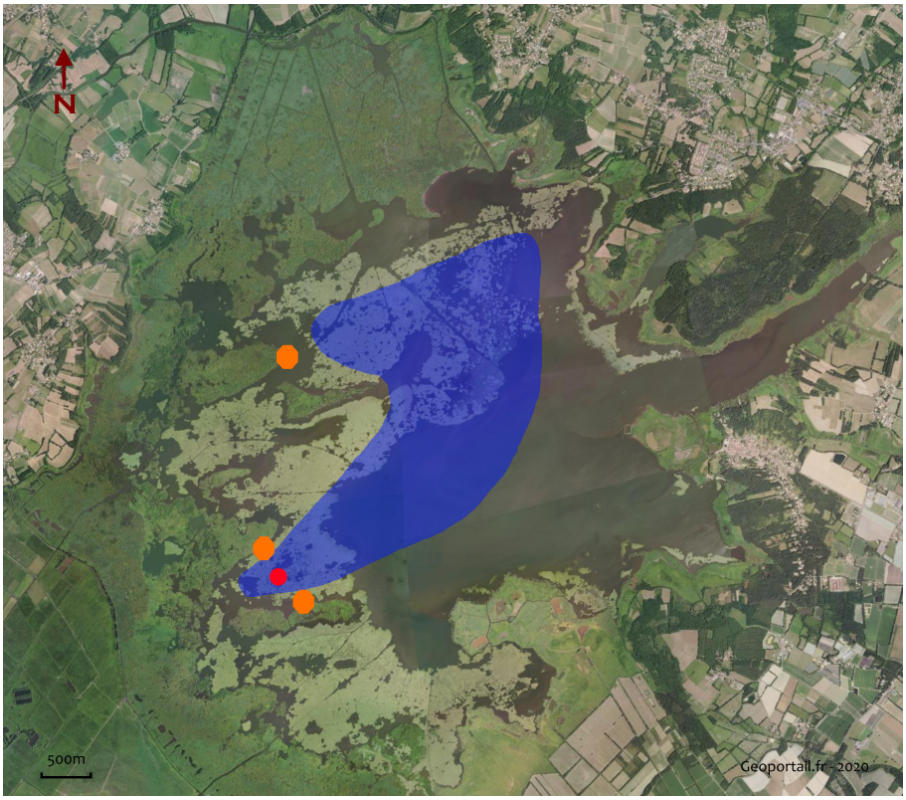

Figure 5: Area where ruddy ducks spend the winter (blue) - Location of hides (orange) - Location of the calling cage (red). © Geoportail

From mid-February onwards, in good weather, the ruddy ducks show the first signs of breeding behaviour. They then move closer to the banks, particularly in the coves beside the riverine woodland to the north of the wintering area and around the islands to the west (Figure 5). The males acquire their breeding plumage in late winter without forming pairs. Only part of the population remains on Grand-Lieu to breed, the rest gradually moving to smaller ponds, mainly in the north-western quarter of France. The maximum dispersal of the birds is unknown[5]. It is therefore not ruled out that there are also connections with the other European populations (notably the Netherlands one).

The first nuptial displays are observed in late winter, when the weather is mild. The male calls throughout the breeding season, which lasts until the end of summer, both day and at night (S. Reeber & A. Laroche, pers. comm.). This call is very characteristic and thus enables the species to be identified. Ruddy ducks make their nests in the vegetation, for example in sedge clumps. They often lay eggs in the nests of other duck species. The first chicks are seen in May at the earliest, but the breeding peak is usually around early July.

The location of the ducks during moulting after breeding has not been clearly identified. On the one hand, the sudden gathering of the population at the wintering site suggests the existence of a potential site where the ducks gather to moult (see analysis in Appendix A). On the other hand, a few individuals located during the same period at very distant sites suggest that the birds moult, camouflaged, close to their nesting site in the vegetation. The moulting behaviour of the native North American population is also poorly identified

[5]In the British island context, maximum dispersal appears to be about 150km, but continental European birds are known to have originated from the founder population in England

(Baldassarre, 2014). Males appear to moult as early as August, after breeding. Some have been seen in large, open areas. The main hypothesis for females is that individuals moult on the nesting sites camouflaged in the vegetation.

2.1.2 The winter strategy

The main difficulty in winter on the Grand-Lieu lake is getting close enough to the birds to have them within shooting range. For this purpose, several complementary tools are used. Investigations have shown that chasing them in boats combined with the use of guns is not very effective and above all counterproductive in terms of disturbing other species that find refuge on the lake in winter. The LIFE programme has enabled the construction of 3 hides positioned on the banks as close as possible to the area occupied in winter (Figure 5 and Figure 6). In windless conditions, these shooting stands are ideal for firing high-precision rifles capable of hitting targets at long distances (300m maximum). The area occupied by the birds during winter shooting campaigns is often far from the stands, so the birds must be moved. An unobtrusive boat can be used to gently bring the birds closer to the shooting stands (Figure 7). From mid-February onwards, playbacks[6] combined with plastic decoys positioned near the shooting stands are used to attract the ducks.

Figure 6: One of the three hides built on Grand-Lieu Lake with funds from the LIFE Oxyura project. © OFB

[6] An audio system to transmit the sound of the males' nuptial calls

Figure 7: Unobtrusive boat with electric motor for gently bringing birds towards the shooting location. © SNPN

An alternative to shooting is capturing ducks with a cage trap. A bird can be lured either with food or by using fellow ruddy ducks. The first option is not selective and may disturb other species. It is also not very effective on ruddy ducks due to their diet, so the use of live decoys is favoured. In partnership with Branféré Zoo[7], the Grand-Lieu SNPN and OFB are developing this approach (Figure 8). The English experience shows that cage traps are time-consuming to use. In order to minimize handling time, the cage developed within the LIFE framework is fitted with an automatic trap door that opens at regular intervals. Photographic traps transmit images by telephone before the trap doors are opened. If a ruddy duck is spotted, the team arrives before it opens to capture the bird.

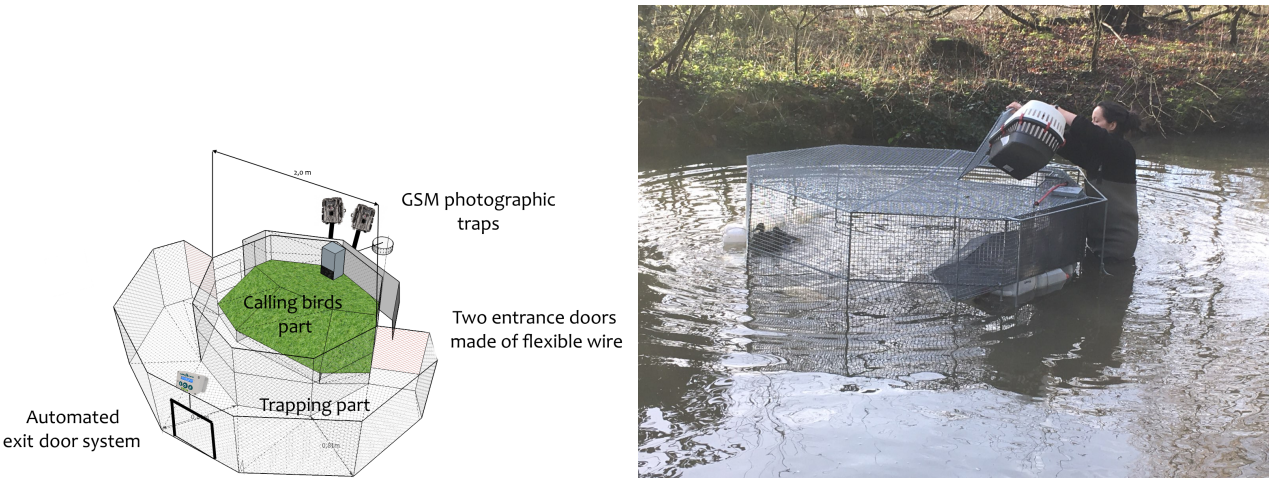

Figure 8: Calling cage under testing at Branféré Zoo. © Diagram: Jean-Marc Gillier, © Photo: Branféré Zoo

[7]Zoo located in Morbihan and member of the French Association of Zoological Parks (AFDPZ)

2.1.3 The summer strategy

Some of the birds nest on Grand-Lieu Lake from spring to the end of summer. The suitable areas vary according to water levels and are not very accessible. The most suitable approach is by boat from the centre of the lake. The males are often found near the nests on the edge of the vegetation and are an indicator of the presence of a female and her nest. Another method is to detect birds calling at night using a sound amplifier. Once the birds have been located, they are shot using a high-precision rifle from a boat stabilised by water lilies. Nests are also occasionally located during surveys in the riverine woodland. In this case, trap cages positioned on the nests are effective for capturing females (Figure 9).

Figure 9: Cage trap system on nests, here an example with a common pochard. © Alain Caizergues

As in winter, an alternative at Grand-Lieu Lake is to attract the birds. The sexual activity of the ducks can be exploited to attract them to the hides which are still situated in the water in spring. The combination of playbacks and ruddy duck-shaped decoys is the most attractive solution. Attempts to shoot with rifles fitted with silencers and night vision equipment are possible under favourable weather conditions (little wind and clear nights). In addition, the use of a calling cage is a solution considered throughout the summer season given the continuous sexual activity during this period.

At the end of winter, some birds leave Grand-Lieu Lake to nest in smaller ponds with suitable riparian vegetation. For this part of the population, the main challenge is locating them. The main detection method is regular surveying of historical sites of ruddy duck presence and potential nesting sites (Figure 10). Bird watchers and professional ornithologists observations are also used and are particularly useful for detecting birds outside the main range of ruddy duck in France. Once located, officers secure the area and adapt their approach to the birds and the shooting solution according to the local configuration.

Figure 10: Boat survey during the breeding season. © Valentin Boniface

2.2 Management of the captive population

The last study focusing on the captive ruddy ducks in France dates from 2014 with a total of 203 birds counted in 26 departments. Among these individuals, 103 were held by recreational breeders in 21 departments, 80 were detained by 10 zoos in nine departments and 20 were detained by six professional breeders in five departments.

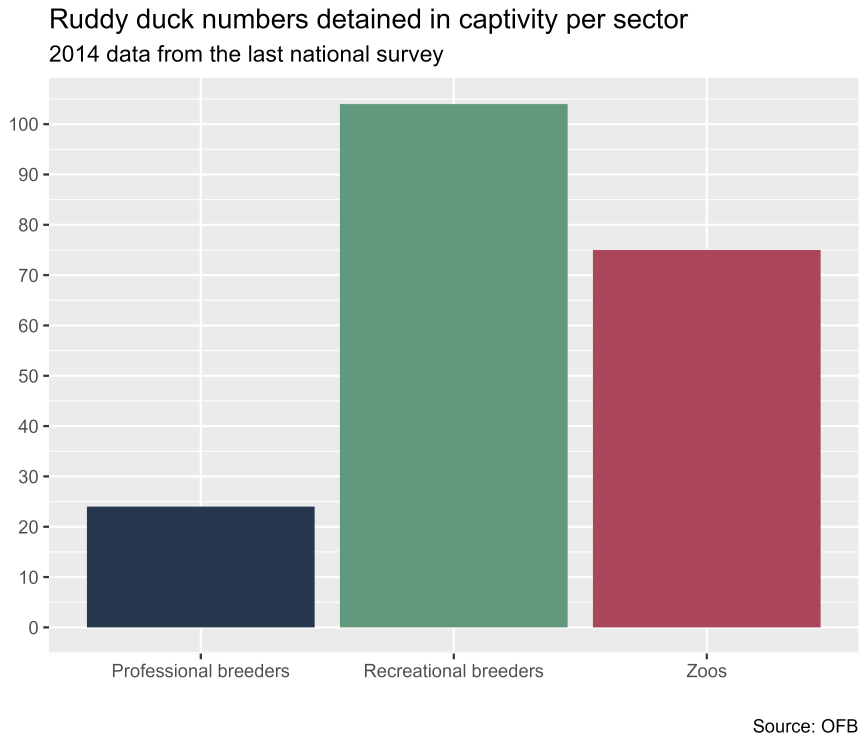

Figure 11: Ruddy duck numbers detained in captivity per sector

The current legislation, which is a translation of the European regulation of the 14 February 2018 on the prevention and management of the introduction and spread of invasive alien species on the metropolitan territory, forbid the detention, transportation, sale or acquisition of the ruddy duck. Except for some zoos authorized to display captive ruddy ducks, breeders who previously detained individuals at this date were authorized to keep their birds until their death, if they declare their birds to the prefecture of their residency place before the 31 December 2019 and if they don't do any breeding (at least eggs destroyed).

In order to monitor the captive population evolution, a survey on the breeders identified in 2014 will be conducted in 2022. It will allow to evaluate at which extent is the legislation respected, and thus conclude on the renewal of the captive population and its threat for the wild population.

On the other hand, the new legislation may lead recreational breeders of diving ducks to turn to another species of the *Oxyura* genus. The lake duck, also called Argentine ruddy duck (*Oxyura vittata*), native from South America, may also hybridize with other *Oxyura* species, and notably the white-headed duck. To date, it is difficult to estimate the number of captive lake ducks in France, but if some of them escape into the wild, they are likely to provoke, as the ruddy duck before, the same issues of genetic introgression in the white-headed duck. It is thus paramount to prevent this species introduction into the wild, notably by promoting new legislation or preventive actions.

Figure 12: Argentine ruddy duck, *Oxyura vittata*, male

3 Results in their historical context

3.1 Population status in 2021

At the beginning of 2021, the number of ruddy ducks reached 14 individuals on Lake Grand Lieu[8]. The trend is a decrease of 75% compared to the previous winter. We have to go back to 1994 to find similar numbers (Figure 13).

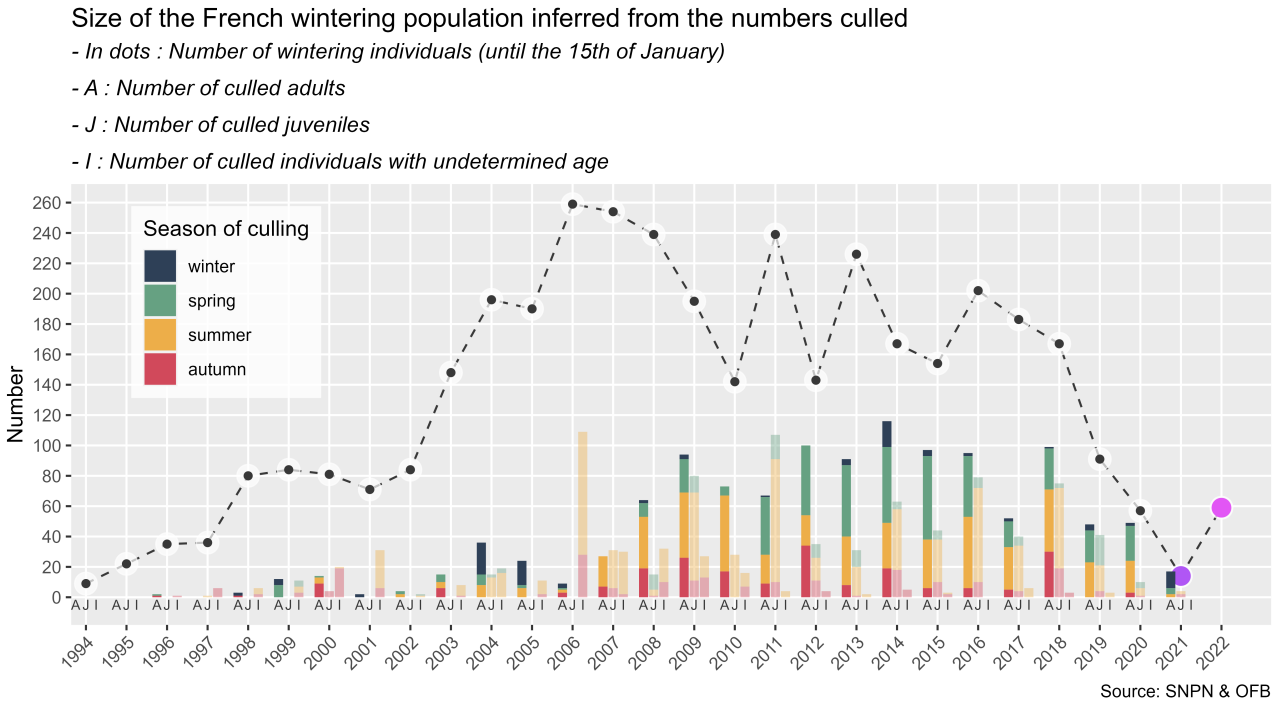

Figure 13: Numbers of the French wintering population with respect to the numbers culled. Numbers before culling in mid-January 2021 in purple, and numbers of the resulting population in mid-January 2022 in pink.

After the 2020-2021 wintering period, ruddy ducks were observed at 26 sites, 15 less than the previous year (Figure 14). This result is coherent with the wintering numbers trend. These sites are located in the same areas as in previous years (See details per department in Appendix B).

[8] A few isolated individuals can be observed elsewhere in France, but they do not necessarily belong to the French population and are therefore not taken into account here

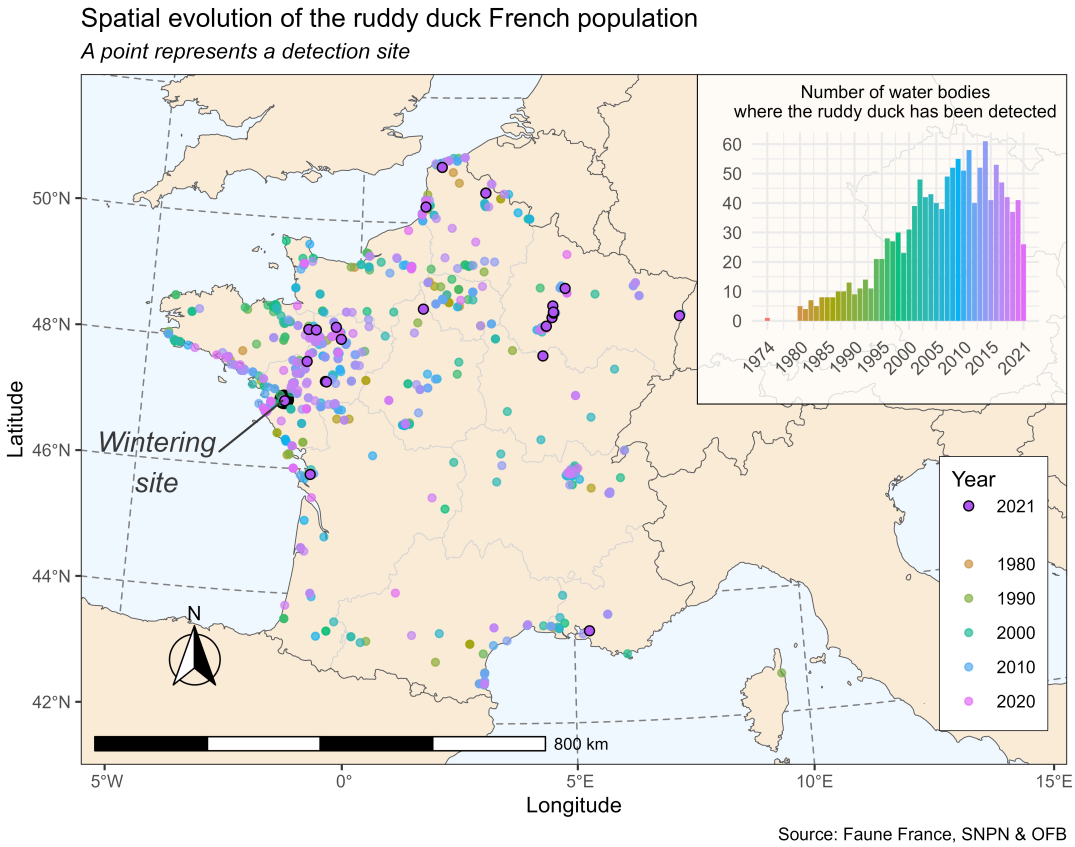

Figure 14: Trends in spatial range of ruddy ducks - See the **interactive map** for the historical details of the sites.

3.2 Detection and culling in 2021

Continuous work is carried out by the LIFE project field officers who survey potential bird habitats throughout the year. Online ornithology platforms[9] are also routinely consulted to detect part of the birds. This partnership is essential because the birdwatching community covers the whole of France and allows for the rapid recognition of new areas. Finally, the officers from the OFB's departmental units assist this detection work by transmitting information during their field missions.

Surveys by LIFE officers were divided as follows: 2/3 monitoring of historical sites of ruddy duck presence, 1/3 exploration of sites with high presence potential. This year, LIFE officers made 237 visits to 45 sites (Figure 15).

[9]http://www.faune-france.org - http://www.observation.org - BDBiodiv

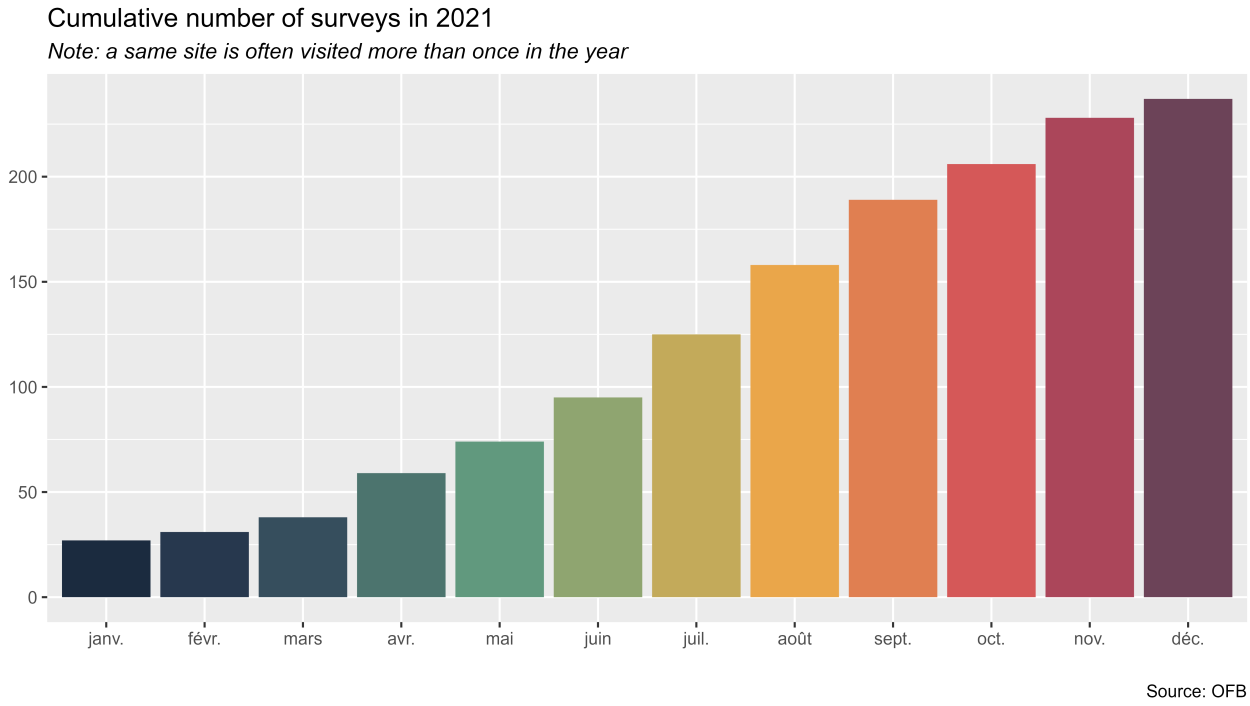

Figure 15: Cumulative number of surveys in 2021.

From the observation data derived from the various sources available, the number of birds actually detected without the breeding period is looked for[10]. To make this estimation, we assume that two successive observations of a ruddy duck [11] on the same site correspond to two different individuals if over one month has elapsed between observations. Naturally, major sources of error[12] result in an uncertain estimation. However, this approach remains the best indicator of bird detectability outside the wintering period.

Using the method described above, we estimate that 52 different individuals were detected. Among these, 33 adults of which 17 males and 16 females. The remaining 19 individuals were juveniles or individuals of undetermined age. The wintering population consisted of 14 individuals. The detection rate for adults that wintered in France is thus 236%[13].

In parallel with detection, the culls performed by SNPN and OFB officers eliminated 21 individuals[14], of which 17 were adults: 10 males and 7 females. The remaining 4 individuals were juveniles[15] &[16]. The culling rate for adults that wintered in France is 121%. The culling rate for detected adults is 52%[17].

[10] A ruddy duck may be observed repeatedly at a site by one or more bird watchers or professional ornithologists
[11] Observations are considered to be potentially of one single individual only if the age and sex characteristics are identical
[12] There are two sources of error in this estimation of the number of birds detected: i) the time interval between two observations for which individuals are considered different, and ii) individuals that have travelled between several sites and are therefore counted as many times as they are detected
[13] A detection rate over 100% is not necessarily an error as it is likely that birds from a population not wintering in France are detected.
[14] During the autumn-winter period, juvenile birds are of adult size but with female plumage. Birds culled during this period are systematically sexed and aged by dissection
[15] Very few individuals are not retrieved and could be adults
[16] A higher number of juveniles culled than detected is possible due to the uncertainty in the estimation of the number detected
[17] We cannot estimate the effectiveness for juveniles because we do not have the number of young produced during the year

An interesting indicator is the proportion of adults culled before they have reproduced. Indeed, by definition, they have not had time to produce young and therefore contribute to population renewal, which has a significant impact on the decline in numbers the following winter. This rate of culling before reproduction amounts to 107%.

In order to make comparisons from year to year, the detailed culling time series is presented in Figure 13. Historical detection and culling efficiencies are presented in Figure 16.

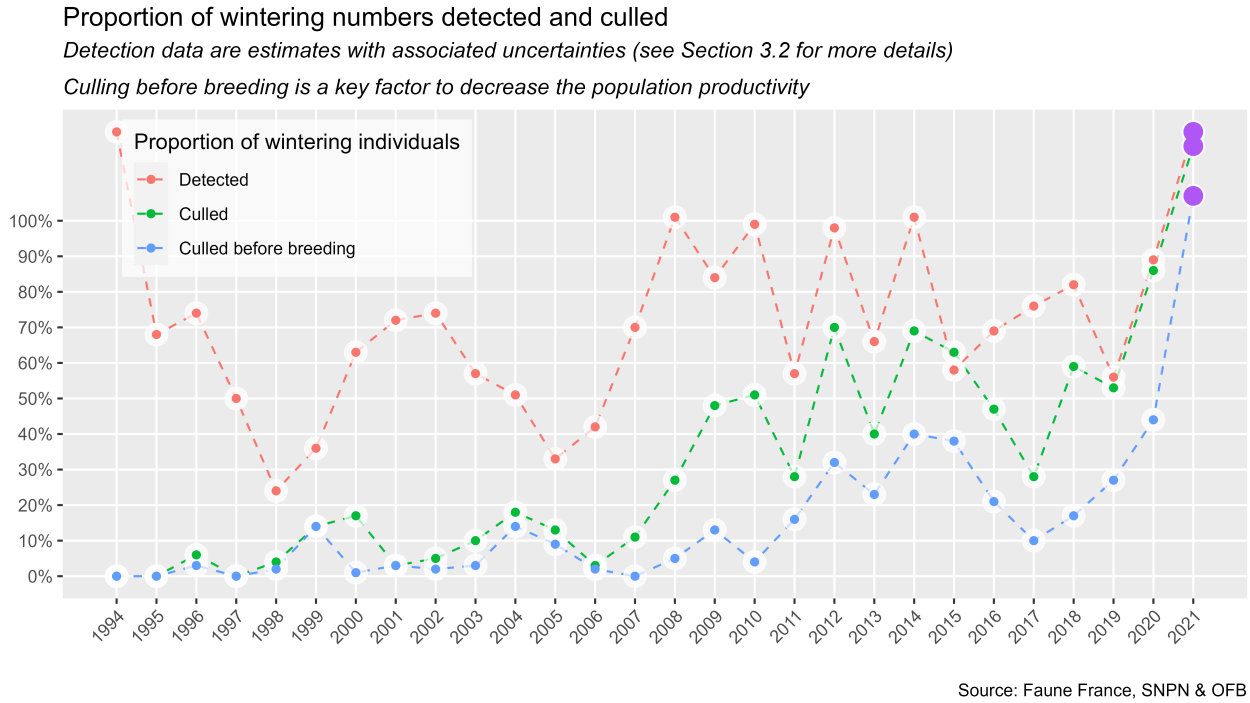

Figure 16: Proportion of wintering numbers detected and culled. Please note that these figures are only estimates and therefore uncertain.

4 Discussion and perspectives

4.1 An encouraging trend threatened

The population decrease over six consecutive years demonstrates the effectiveness of the eradiction actions set up in France. The sharp decrease observed the last four years allowed to reach a wintering population of six individuals on the Grand-Lieu lake at the beginning of December 2021. While the LIFE final objective was almost reached[18], fifty birds arrived on the lake mid-December, raising questions on the species dynamics.

The censuses performed after the arrival of the birds mid-December 2021 (59 individuals) on the Grand-Lieu site allowed to estimate the numbers of youngs in the population. Indeed, the ruddy duck sex-ratio is around 60% biased towards males for adults, and at equilibrium for youngs (Tableau et al., 2023). Using these data as well as the number of wintering males and females observed, we are able to estimate the proportion of juveniles among individuals presenting a female's plumage type in winter (which include young males and females of all ages). The wintering population in 2021-2022 thus seem to be composed of around 25% of youngs (*i.e* 15), and thus of 75% of adults (*i.e.* 44; see Tableau et al. (2023) for more details). In comparison with the 14 birds observed during the 2020-2021 winter, this number of 44 adults would imply a survival of 300% between the 2020-2021 and 2021-2022 winters, which is strongly unlikely for this species (Tableau et al., 2023). This population increase thus excludes the possibility of an exceptional breeding the previous year but rather suggests that new individuals migrated from another population. In France, such a population should have been noticed by the national bird watching network composed of dedicated birdwatchers and professional ornithologists. Among other European populations, only the Netherlands one may be sufficiently important in term of reproductive dynamics and abundance to provide such numbers of individuals. The connection highlighted between populations thus induces that the ruddy duck management should be conducted at the European scale and highlights the importance of coordinating culling operations with other countries.

On the other hand, with the decrease of the population, less culling operations were conducted, which resulted in a decrease of collaborations among field officers and LIFE officers. A too sharp decrease of the implication of field officers would be harmful for the complete eradication of the species. The LIFE team thus dedicates increased time in communication and awareness operations in order to keep historical collaborators motivated and implicated in the long term pursue of such a project.

4.2 An upswing in the impact of the LIFE project

The estimated detection rate is well above 100%, which is not related to the arrival of mature individuals from other wintering sites, but rather to a methodological bias [19]. The effective detection rate must certainly be around those of previous years, slightly below 100%. This correction is coherent with the number of culled adults. Despite remaining uncertain, these numbers still show a good detection rate during the 2021 breeding season.

For the second consecutive year, the culling rate of wintering adults in France was above 80%. The culling of adults before breeding has sharply increased and represents a historic record, which is mainly due to the culling operations led by LIFE officers on the Grand-Lieu lake edges before migration. Reaching this culling rate when the population size has decreased substantially is very positive for many reasons. It is *a priori* more difficult to detect birds present in lower densities because the groups are less detectable. This point must however be put into perspective because the decrease in numbers appears to reduce the distance travelled between wintering and

[18] Taking into account numbers recorded before the beginning of the LIFE project, the aim was to reach a population of less than 10 individuals before the end of 2023.

[19] Some birds have moved from one site to another during the monitored months and have thus been falsely counted several times. Culling these birds has failed due to the size of the sites or to insufficient security conditions.

nesting grounds, which facilitates surveying and therefore detection. However, officers have to deal with adult birds that are more cautious after culling campaigns in previous years. Over the long term, strong selection pressure caused by this culling level promotes the survival of the wariest discreet bird's or those which best avoid the shootings, therefore enabling the propagation of their associated genes.

Between 2016 and 2019, juveniles represented 40% of the culled individuals while in 2020 and 2021, they represented only 17% and 25% of the culled individuals, respectively. As the population decrease was the sharpest this same year[20], this change in the population structure of culled individuals reflects a substantial decrease in reproduction in the wild. Several complementary factors may explain this lower productivity. On one hand, the good culling rates of adults before breeding has most certainly led to a decrease of the breeding success. On the other hand, a lower reproductive success has also been observed in 2020 and 2021 on the Grand-Lieu lake for other diving duck species, such as common pochards (A. Caizergues & S. Reeber, pers. comm.)[21]. This decrease may thus be linked to the combination of several environmental factors, notably a sharp drop of the water levels in April and May and a small late flood mid-June (J.-M. Gilliers, pers. comm.). Indeed, excessively rapid shifts of water levels during the breeding season often induce clutches failures in diving ducks. On the other hand, the wetland vegetation[22] of the Grand-Lieu lake underwent delays in spring as well as an overall decline, which is another adverse factor for nesting success. Finally, the population may also have reached a critical size reducing its ability to efficiently produce numerous offspring. This process, known as the Allee effect (Kuparinen & Uusi-Heikkilä, 2020), may be due to the low encounter probability between two parteners when bird density is low for example.

4.3 Alternative methods still being deployed

The responsiveness and effectiveness of the field officers ensure that the culling rate of detected birds is good and the improvement margin for both detection and culling is therefore low.

Nevertheless, even a small-scale improvement in culling rates before reproduction could have a significant impact on the capacity of the population to recover. It is for this reason that considerable effort has been implemented within the LIFE framework to test different capture methods, notably in winter (Section 2.1.2).

The use of shooting stands was part of the first 2020 winter tests and enabled the culling of two females. However, this method remains unreliable due to the difficulty to attract birds near the shooting stands. During the 2021 winter, no birds were culled with this method. In March 2021, the ruddy ducks came near the Grand-Lieu lake shores, and were observed in coves with banks covered by willow trees. Thanks to this behaviour (observed for the first time), the shooting operations were a success [23]. On the other hand, the cage trap design was completed at the end of 2020, but authorizations to detain females ruddy duck were only obtained in June 2021 [24]. The avian flu virus episode in France due to the H5N8 virus since autumn 2020 has also prevented the first tests from being carried out. Captive ruddy ducks were collected since the 2021 summer thanks to the collaboration with Aviornis, and will be used as calling females next winter. It is important to test this method without undue delay because it could also be applied to the Netherlands, where culling by shooting is difficult due to the urbanization of sites inhabited by the ruddy duck.

[20] A 62% drop of the population size between the 2020/2021 and 2021/2022 winters before the arrival of new individuals from another wintering population

[21] 190 common pochard females with chicks were counted in spring 2020 compared to 385 on average over five previous springs and 480 over 10 years.

[22] mainly aquatic or herbaceous marsh vegetation.

[23] Four operations were set up and allowed to cull six of the 16 individuals detected the previous months.

[24] Competency certificate and opening authorization.

5 References

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A Evidence of moulting in coastal areas?

The moulting season of ducks is a vulnerable period that is propitious for capturing them. If, as with other species, ruddy ducks gather together in this period of the year, it would therefore be efficient to identify the moulting sites. This aspect of ruddy duck ecology is poorly known within its natural range. The low number of sightings during this period shows that the birds are more wary at this time.

Throughout the year, ruddy ducks in France are mainly observed in areas less than 100 km from the coast (Figure 17). This could reflect the potential species' dependence on coastal habitats, notably during the moulting season. Analysis of the positions of the sites where the ruddy ducks are observed shows that the birds sighted during the moulting season[25] are more numerous in coastal areas than during the rest of the year. This could be evidence that some of the population moults in coastal areas. Unfortunately, this result is not significant enough to conclude that the moult occurs in coastal areas, and therefore to consider carrying out specific surveys to identify a potential moulting site. A plausible hypothesis concerning the presence of ruddy ducks in this area in autumn is the utilization of the wastewater treatment lagoons of seaside resorts as a food source and refuge area during the hunting season.

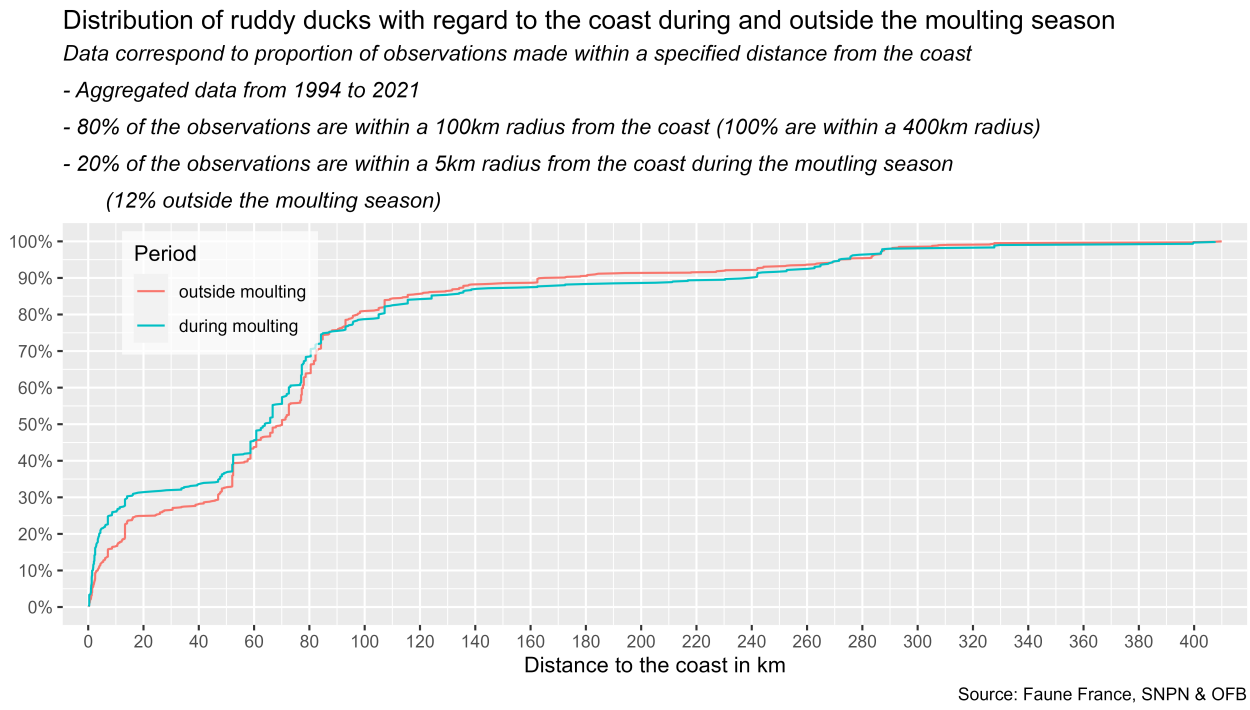

Figure 17: Distribution of ruddy ducks with regard to the coast during and outside the moulting season.

[25]This period is defined in the analysis as between the 1th of August and the 1th of December, from the evidence provided by Baldassarre (2014)

B Data by department

For the detail of the historical observation sites, see the **interactive map online**.

Table 1: Table of individuals culled and number of sites occupied by department

Department	Year	Numbers culled by category				Total	Number of sites
		Female	Male	Young	Under-temined age		
44-Loire-Atlantique	**2019**	7	11	23	0	41	5
	2020	9	13	7	0	29	2
	2021	4	7	0	0	11	1
	< 2019	189	301	350	100	940	33
53-Mayenne	**2019**	3	4	0	0	7	4
	2020	4	0	0	0	4	3
	2021	1	0	1	0	2	3
	< 2019	134	130	192	47	503	43
85-Vendée	**2019**	3	4	14	3	24	3
	2020	5	6	1	0	12	4
	2021	0	0	0	0	0	0
	< 2019	40	28	50	83	201	20
35-Ille-et-Vilaine	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	1
	2021	0	0	0	0	0	1
	< 2019	81	43	11	66	201	19
49-Maine-et-Loire	**2019**	1	3	4	0	8	4
	2020	2	2	2	0	6	4
	2021	0	1	2	0	3	3
	< 2019	15	26	20	11	72	21
80-Somme	**2019**	6	3	0	0	9	3
	2020	0	1	0	0	1	2
	2021	0	0	1	0	1	1
	< 2019	6	15	4	13	38	14
56-Morbihan	**2019**	0	0	0	0	0	2
	2020	0	0	0	0	0	1
	2021	0	0	0	0	0	0
	< 2019	9	9	6	2	26	15

Department	Year	Numbers culled by category				Total	Number of sites
		Female	Male	Young	Under-temined age		
72-Sarthe	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	4	4	4	12	24	12
17-Charente-Maritime	**2019**	0	0	0	0	0	1
	2020	2	1	0	0	3	4
	2021	0	0	0	0	0	1
	< 2019	6	3	6	4	19	13
79-Deux-Sèvres	**2019**	0	0	0	0	0	1
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	1	6	0	8	15	9
37-Indre-et-Loire	**2019**	0	1	0	0	1	1
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	3	3	0	0	6	3
41-Loir-et-Cher	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	1	0	4	0	5	7
59-Nord	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	1
	2021	0	0	0	0	0	2
	< 2019	1	1	1	0	3	18
13-Bouches-du-Rhône	**2019**	0	0	0	0	0	1
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	1
	< 2019	1	1	0	1	3	17
61-Orne	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	1	2	0	0	3	4

Department	Year	Numbers culled by category				Total	Number of sites
		Female	Male	Young	Under-temined age		
50-Manche	**2019**	0	0	0	0	0	1
	2020	0	2	0	0	2	2
	2021	0	0	0	0	0	0
	< 2019	0	1	0	1	2	12
62-Pas-de-Calais	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	1	0	0	1	1
	< 2019	0	0	0	2	2	11
34-Hérault	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	0	1	0	1	2	6
33-Gironde	**2019**	0	0	0	0	0	1
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	0	0	0	2	2	5
36-Indre	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	1
	2021	0	0	0	0	0	0
	< 2019	0	0	0	1	1	9
51-Marne	**2019**	0	0	0	0	0	3
	2020	0	1	0	0	1	1
	2021	0	1	0	0	1	5
	< 2019	0	0	0	1	1	7
77-Seine-et-Marne	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	0	1	0	0	1	6
27-Eure	**2019**	0	0	0	0	0	3
	2020	1	0	0	0	1	2
	2021	0	0	0	0	0	0
	< 2019	0	1	0	0	1	5

Department	Year	Numbers culled by category				Total	Number of sites
		Female	Male	Young	Under-temined age		
89-Yonne	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	0	1	0	0	1	2
19-Corrèze	**2019**	0	0	0	0	0	0
	2020	0	0	0	0	0	0
	2021	0	0	0	0	0	0
	< 2019	0	1	0	0	1	1