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This series summarizes current knowledge of status, trends, threats, and conservation measures for meadow-breeding waders across Europe. The articles arose from the workshop 'Threats and protection of meadow birds in Europe', held on 29 September 2014 at the IWSG annual conference in Haapsalu, Estonia. Editor: Mo Verhoeven.

Meadow-breeding waders in France: Population sizes, distribution and conservation challenges

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In this study, we aimed to gather knowledge of the distributions, population sizes and trends of the six species of waders breeding in meadows in France: Northern Lapwing *Vanellus vanellus*, Black-tailed Godwit *Limosa limosa*, Common Redshank *Tringa totanus*, Eurasian Curlew *Numenius arquata*, Ruff *Philomachus pugnax* and Common Snipe *Gallinago gallinago*. France also hosts a population of Eurasian Oystercatcher *Haematopus ostralegus* but it mainly breeds on rocky coasts and we chose not to include this wader species as a grassland species. The populations of Northern Lapwing, Eurasian Curlew and Common Snipe are decreasing and the Ruff hardly nests anymore in France. The intensification of agriculture is thought to be the main reason for these widespread declines, especially the associated earlier mowing, high densities of grazing livestock and the change of meadows into grassland monocultures. That said, certain small localized populations of Common Redshank and Black-tailed Godwit are increasing slightly. These two species rely on wet meadows that are maintained through local policy decisions. Agri-environmental schemes have not yet been efficient in increasing wader populations in France. More ambitious agri-environmental schemes on large areas are needed with monetary compensation encouraging farmers to postpone mowing and include wetlands or natural meadows. More regular and standardized monitoring of shorebird populations is also needed to compare and detect potential changes in numbers. A new national survey (LIMAT) has recently been implemented and will run over two years in France (2021–2022) to estimate the population size of waders and duck species in France. It has the ambition to be conducted every six years to detect population trends over time and aid conservation efforts.

Keywords

wader conservation
agri-environmental scheme
land use changes
agricultural expansion
breeding distribution
bird census
grassland

INTRODUCTION

Meadow-breeding waders are declining worldwide (Wilson *et al.* 2004, Meltofte *et al.* 2018). Several recent papers in the journal *Wader Study* reviewed the state of these species

in several European countries (Kubelka *et al.* 2018, Thorup 2018, Jóhannesdóttir *et al.* 2019, Roodbergen & Teunissen 2019, Mischenko 2020, Lislevand *et al.* 2021). We join this common effort and present an overview of the situation for meadow waders in France.

A major cause of the decline in wader breeding populations is related to poor reproductive success. There has been increasing evidence that the decline of these species is highly linked to agricultural practices promoting intensive farming, which is detrimental to waders using these landscapes to breed (Chamberlain 2018, Vickery & Tayleur 2018, Walker *et al.* 2018).

At least six species of meadow-breeding waders are found in France: Northern Lapwing *Vanellus vanellus*, Eurasian Curlew *Numenius arquata arquata*, Black-tailed Godwit *Limosa limosa limosa*, Ruff *Calidris pugnax*, Common Snipe *Gallinago gallinago*, and Redshank *Tringa totanus totanus*. We did not consider the Eurasian Oystercatcher *Haematopus ostralegus* to be a meadow bird in our study, since it mainly breeds on the shoreline in France.

These species are all listed as huntable in France. However, their hunting status must comply with the requirements of European Bird Directive 2009/147/EC and must respect the AEWA agreements of which France is a member. The conservation actions carried out for these species in France are therefore partly dictated by these commitments and may differ among species. Two species are subject to a hunting moratorium for now: the Eurasian Curlew and the Black-tailed Godwit (see details in *Species Accounts*). In this article, we review the trends of the breeding populations of meadow waders in France and threats to them.

Agriculture in France

In 2018, the useful agricultural area declared to the Common Agricultural Policy (CAP) was 27 million hectares in France, i.e. 50% of the French territory (Sirami & Midler 2021).

The farming intensification in France is similar to that of other European countries (Zellweger-Fischer *et al.* 2018), starting with the decline in the number of farmers. In 1955, there were 2.5 million farmers compared to less than 400,000 in 2020 (INSEE 2020). This trend implies a change in the average size of farms, in agricultural policy and in land use. The cultivated areas increased from 11 million ha in 1980 to 13 million ha in 2004; while meadows decreased from 19 million to 14.5 million ha. Simultaneously, there was an increase in livestock farming with 15 million cattle and 6.7 million pigs in the 1950s compared to 19 million and 15 million respectively in the early 2000s (Desriers 2007). These very general figures show an overall intensification of French agriculture in the second half of the 20th century (Puech *et al.* 2020).

French agriculture is, however, diversified according to the country's regions. Cultures of oilseed or protein crops are mostly located in the north, centre-west and east, whereas the Rhone and Loire valleys are predominantly devoted to market gardening, wine production and fruit production; wine production is also broadly present in the south and in the Champagne. The agriculture practised in the rest of mainland France (forest excepted)

is mostly a mix of farming types: cereals (e.g. wheat, corn or barley), oilseeds (e.g. rapeseed or sunflowers) or protein crops (e.g. broad beans) and livestock grazing. In mountain ranges, there is rather extensive livestock grazing (Ben Arfa *et al.* 2009, APCA 2011).

Meadows, where most breeding waders are found, represent 20% of the useful agricultural area (Faïq *et al.* 2013). Since the 1950s, the number of farms has decreased from 2,307,000 in 1955 to 589,800 in 2003 (Desriers 2007). Additionally, forage crops (including meadows) decreased from 19,706,000 to 14,572,000 ha and livestock increased considerably. This reflects an intensification of agriculture (Desriers 2007). Since the beginning of 2000, we have also witnessed a downgrading of the surface from permanent meadows (natural or present for more than five years with no rotating system) to temporary meadows (rotary system less than six years and lower biodiversity) while the total meadow surface remained the same. This illustrates the underlying changes associated with the intensification of agriculture: changes in plant cover and declines in the number of species.

Number, threats, and distribution of waders breeding in French meadows

In France, numerous monitoring programs of nesting shorebird populations have taken place, but these surveys often had a local or regional focus (Tables 1 & 2). Most of the data come from a compilation of naturalistic surveys (especially in the 1970s and 1980s) where census methods were not necessarily described. Trends are therefore hard to define since comparisons between monitoring projects are not always directly possible. Only a few large surveys provide information on breeding populations (Dubois & Mahéo 1986, Deceuninck 2001, Issa & Muller 2015). Sparse and local breeding population censuses do not allow identification of reliable trends at a national scale. The French distributions of meadow-breeding waders presented in this study are summarized in Fig. 1. There is no distribution map for the Ruff because its breeding status needs to be confirmed.

SPECIES ACCOUNTS

Northern Lapwing *Vanellus vanellus*

Distribution

Most of the breeding population is found in the marshes of western France (Charente-Maritime, Vendée, Loire-Atlantique) and on the plains of the Alsace (Fig. 1a). There is also a slightly smaller population in the centre of France, along the major rivers.

Main breeding habitat type

Lapwing breeds in three main habitats: (1) grazed wet meadows, where the height of grass stays below 10 cm, a habitat that is well represented especially in the marshes of western France, (2) spring cereal crops where the bare

Table 1. National population status for meadow-breeding waders in France (Hagemeijer & Blair 1997, Issa & Muller 2015, Robin *et al.* 2016, UICN France 2016). For population size and trends, quality is scored according to Thorup (2006), as follows: 0 = no data; 1 = poor data quality; 2 = estimated from some good surveys; 3 = some regions well covered, <50% of total counted; 4 = >50 % of total counted; 5 = full coverage.

Species	UICN national status*	Population (pairs)	Year of pop size estimate	Data quality	% of world breeding population
Northern Lapwing <i>Vanellus vanellus</i>	NT	12,000–18,000	2010/2011	3/4	<1%
Black-tailed Godwit <i>Limosa limosa limosa</i>	VU	129–164 146–171	2010/2011 2015	5	<1%
Eurasian Curlew <i>Numenius arquata arquata</i>	VU	1,300–1,600	2010/2011	5	1%
Common Redshank <i>Tringa totanus totanus</i>	LC	1,502–1,721	2010/2011	4	<1%
Common Snipe <i>Gallinago gallinago</i>	CR	83–94	2010/2011	4	<<1%
Ruff <i>Calidris pugnax</i>	NC	0–2	2010/2011	1	<1%

*CR = Critically Endangered, LC = Least Concern, NC = Not considered (low numbers), NT = Near Threatened, VU = Vulnerable.

Table 2. Estimation of breeding population size (number of breeding pairs) of waders through national surveys. Arrows indicate population trends (Dubois & Mahéo 1986, Deceuninck 2001, Issa & Muller 2015).

Species	1983/1984	1995/1996	2010/2011
Northern Lapwing	17,400–20,300 (↔)	18,000 (↔)	12,000–18,000 (↔)
Black-tailed Godwit	38–51 (↗)	165 (↗)	164 (↓)
Eurasian Curlew	1,230–1,360 (?)	2,000 (↓)	1,600 (↔)
Common Redshank	430–496 (↔)	1,400 (↓)	1,800 (↗)
Common Snipe	150–250 (↔)	200 (↓)	100 (↔)
Ruff	5–13 (↓)	18 (↓)	2 (↔)

ground offers suitable breeding opportunities, and (3) edges of inland water bodies and small mudflats. Lapwing, like Curlew, can also breed in drier habitats compared to the waders considered in the current article.

In the 19th and early 20th centuries, Lapwing was considered a rare and occasional breeder in most French wetlands (Mayaud 1936). French demographic expansion probably began in the 1940s due to the decline of hunting pressure and egg consumption (especially during World War II; Dubois & Mahéo 1986) and slowdown of wetland drainage (from World War II to the 1970s). The Lapwing's ecological plasticity allows the species to breed in various habitats including field crops. The breeding population started to decline in the 1970s (Table 3). However, this trend has not been spatially homogeneous. For example, in central France, Sologne hosted between 5,000 and 10,000 pairs in 1975 (Perthuis 1976, 1981) compared with 5,000 in 1984. More recently, the numbers in Charente-Maritime decreased from 760–885 pairs in 2010 to 496–511 pairs in 2016. Likewise, the populations in the east of the country also seem to be declining. However, in a marsh in the west, the Marais Breton, the numbers seem to remain stable. Here, Delattre (2006) estimated a population of 2,107–3,660 pairs in 1986, 1,761–2,914 pairs in 1990, and 1,277–

2,339 pairs in 2006. In 2015, Trolliet *et al.* (2016) estimated that this population was still at 2,500 pairs (Table 3).

Demographic parameters

A few studies (Delattre cited in Thibaud 1993) show a very variable hatching success, oscillating between 0.45 to 0.72 in the Marais Breton between 1986 and 2006.

Black-tailed Godwit *Limosa limosa limosa*

In France, a hunting moratorium on Black-tailed Godwit has been in place since 2008. In 2019, the Minister of Ecology decided to extend twice the moratorium on hunting this species for one year until 31 July 2021 to meet the recommendations of the international single species action plan under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (Jensen *et al.* 2008).

Distribution

Almost all (90%) of the national breeding population of Black-tailed Godwits is located in four main marshes along the Atlantic coast, specifically in Charentais, Poitevin, Breton and Brière (Fig. 1b). However, some pairs breed along the estuary of Manche, such as the Seine or

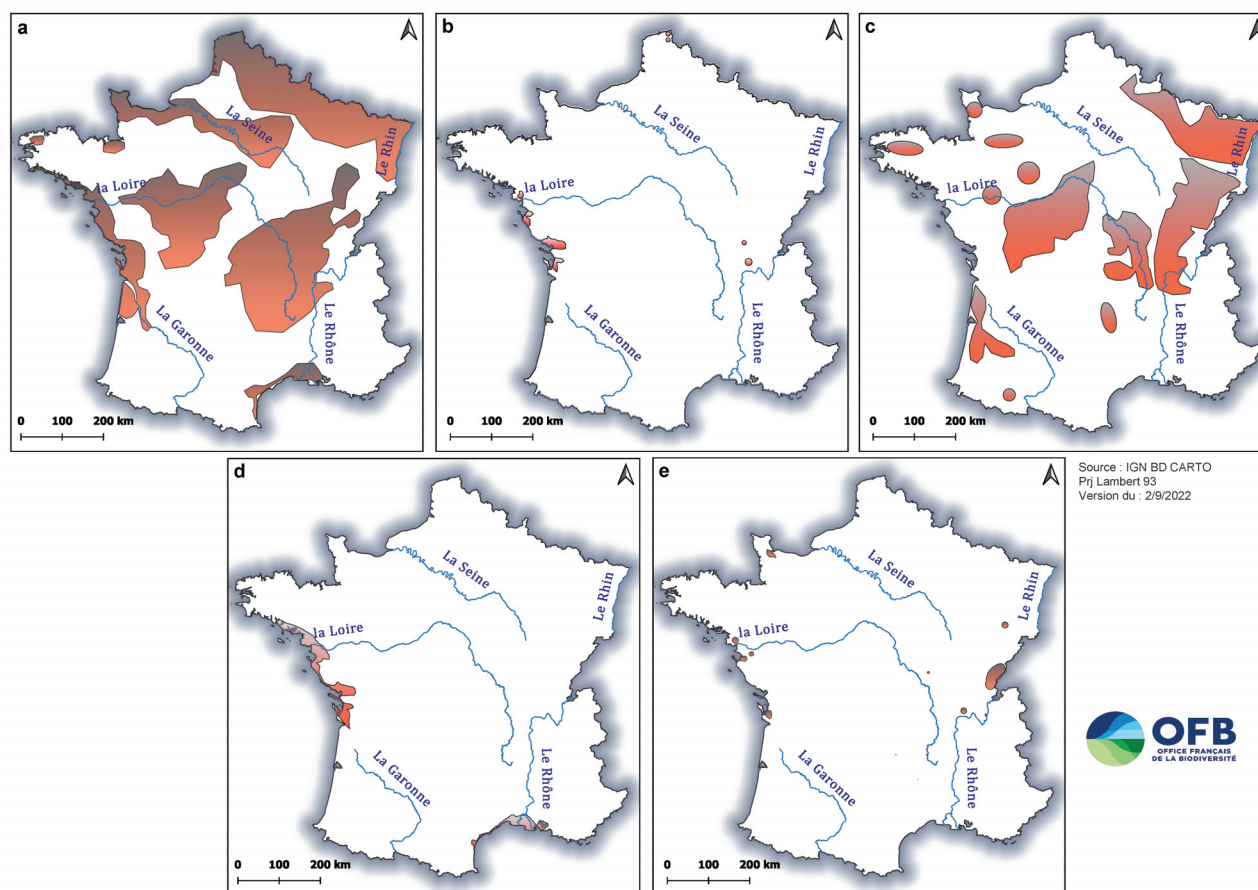


Fig. 1. Distribution of meadow-breeding waders breeding in France: **(a)** Northern Lapwing, **(b)** Black-tailed Godwit, **(c)** Eurasian Curlew, **(d)** Common Redshank, **(e)** Common Snipe.

Somme estuaries and in the north department. The Val de Saône region seems to host 1–2 pairs and is the only inland breeding area in France for this species.

Main breeding habitat types

Natural wet meadows, grazed or even mowed, constitute the main breeding habitat of this species only when water tables are high. These habitats are found in open marshes and alluvial meadows. The Black-tailed Godwit seems to have particular needs, i.e. large wet meadows with large areas flooded in spring on which extensive cattle grazing takes place, and with no additional fertilizers used (Phelippon & Dulac 2016). It is therefore obvious that only extensive agriculture can promote the maintenance of this habitat. Indeed, this type of agriculture uses adapted cattle breeds and adapts the load to water levels. Generally, it does not use fertilizing, which results in a later exploitation of the plots as well.

Trends

France hosts a small population, and the species has only been considered a regular breeding bird since the 1970s (Table 4, Fig. 2). The population increased between the 1980s and 1996 (from 127 to 159 pairs) mainly in the marshes of Vendée (western France). Since then, the population has remained stable, and France annually

Table 3. Changes in the French breeding population of Northern Lapwings 1961–2011.

Period	Estimated breeding pairs
1961	39,500–40,000 (Spitz 1961)
1964	31,450–45,240 (Spitz 1964)
1979	21,000 (Enquête EEC in Dubois & Mahéo 1986)
1983–1984	17,400–20,300 (Dubois & Mahéo 1986)
1995–1996	16,000–18,000 (Deceuninck & Mahéo 1998b)
2010–2011	12,000–18,000 (Caupenne & Trolliet in Issa & Muller 2015)

welcomes between 130 and 180 pairs with significant fluctuations. For example, hydraulic management in Brière has an impact on their settlement and reproduction; spring flooding and grazing pressure are also important elements (Lebrun 2016, Petit 2018). The practice of extensive agriculture (making it possible to have higher water tables in spring) as undertaken in the Breton Marsh, for example, is likely to maintain the local breeding population.

Table 4. Changes in the French breeding population of Black-tailed Godwits 1960–2020. Data source is ENRM (2022), except where otherwise indicated.

Period	Estimated breeding pairs	
1960	15–20	(Spitz 1961)
1975	35–50	
1980–1981	45–62	(Dubois & Mahéo 1986)
1984	38–51	(Dubois & Mahéo 1986)
1985–1989	85–110	(Broyer & Bernard in Yeatman-Berthelot & Jarry 1994)
1996	127–159	(Deceuninck & Mahéo 1998b)
2000	81–87	
2001	84–90	
2002	103–109	
2003	127–136	
2004	111–126	
2005	133–148	
2006	127–142	
2007	131–166	
2008	144–164	
2009	164–181	
2010	150–177	
2011	129–164	
2012	111–145	(Caupenne <i>et al.</i> in Issa & Muller 2015)
2013	112–153	
2014	140–175	
2015	146–171	
2016	143–170	
2017	151–182	
2018	156–184	
2019	135–171	
2020	116–147	(ENRM in press)

Demographic parameters

A recent study (Murarusu 2018) carried out in the Marais Breton reported a nest survival rate of 0.32 (95% CI: 0.20–0.88), which corresponds to what was found by Roodbergen *et al.* (2012).

The relative increase in Black-tailed Godwit populations mainly relies on two local sites only. It is possible that intensive agricultural practices (e.g. earlier water evacuation and earlier mowing) associated with the modification of food resources and linked to climate

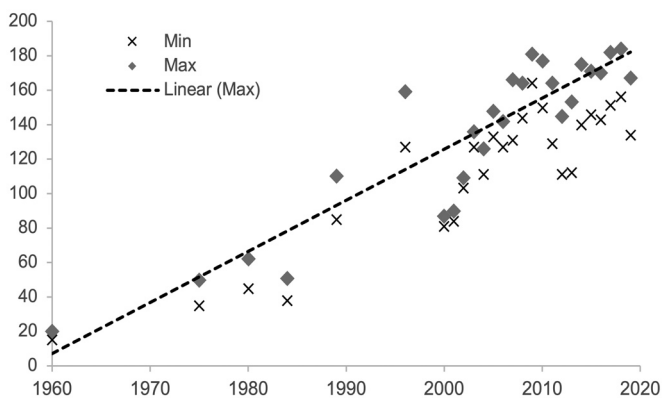


Fig. 2. The number of breeding pairs of Black-tailed Godwit in France from 1960 to 2020 (from Spitz 1961, Dubois & Mahéo 1986, Broyer & Bernard in Yeatman-Berthelot & Jarry 1994, Deceuninck & Mahéo 1998a, Robin *et al.* 2016, ENRM 2022).

warming could affect the production of chicks through food deficiencies and/or destruction of the broods (Robin *et al.* 2016).

Eurasian Curlew *Numenius arquata arquata*

The Eurasian Curlew subspecies *Numenius arquata arquata* is a huntable species in France outside the breeding season. A nation-wide hunting ban was effective from 2008 to 2012, after which hunting was again allowed on the coasts. In 2018 it was again forbidden everywhere.

Distribution

The Eurasian Curlew is found in open areas up to an altitude of 800 m. Half of the French population occurs in the Val de Saône and its tributaries (Seille, Grosne, Drugeon, Lanterne, etc.; Fig. 1c). On the Atlantic coast, Eurasian Curlews breed in the southwest in Gascony, in the Monts d'Arrée in Brittany and in the Cotentin Marshes in Normandy. Farther inland, it breeds at the foot of the Pyrenees, in the plains of Deux-Sèvres, Vienne and Sarthe. It also nests in the Loire Valley, Alsace.

Main breeding habitat types

Breeding Curlews use different habitats for their reproduction: meadows in the Val de Saône, moors and peat bogs in Gascony and Brittany, and hay meadows (generally wet marshes and valleys) in the other sites. More rarely, it nests in grazed areas, wasteland and cultivation. Curlews often nest in habitats with a taller vegetation compared to the other breeding waders considered in this study.

Trends

Eurasian Curlew appear to have colonized most known sites used for breeding today fairly recently (i.e. second half of the 20th century). However, it was undoubtedly already found in Brittany and in Aquitaine in the 18th century (Sigwalt 1992, Fouquet 2013, Trolliet 2018). The

French population is now estimated at 1,300–1,600 breeding pairs and is considered to have declined since the late 1990s (Table 5). This slow decline masks strong regional disparities. There is a strong decline in historical nesting areas such as Gascony, Brittany, Normandy and Alsace. Meanwhile, the population of the Val de Saône has increased since the 1980s (Broyer & Roché 1991) to almost 400 pairs today. However, disparities exist according to the sites, even within this core area. Agricultural practices, predation and disturbance explain these variations.

Demographic parameters

The productivity is measured as the number of fledged young per pair. This parameter, given the pressures (predation, early mowing, disturbance), seems more suitable to estimate the viability of the French populations than the number of eggs or chicks produced. However, data on the productivity of the Eurasian curlew were scarce.

In Deux-Sèvres and in Vienne, in the western plains of France, productivity was estimated at 0.95 fledglings per pair from a sample of 17 pairs monitored in 2002. In the same area, the productivity recorded in 2010 and 2011 was only 0.37 (Gilet *et al.* 2002, Turpaud-Fizzala *et al.* 2012), 0.41 in 2015 and 0.24 in 2016 (Poirel 2017). In Alsace, the number of fledglings was estimated at 0.5 per breeding pair (Sigwalt 1989) at the end of the 1980s. Such low fledging success is also observed in other nesting areas such as the Drugeon valley for example in the east of the country (C. Barbaz & M. Sauret pers. comm.).

Common Redshank *Tringa totanus totanus*

Distribution and main breeding habitats

The Common Redshank mainly breeds in the large coastal Atlantic marshes from western Morbihan to Gironde and around the Mediterranean coast (Fig. 1d). Potential breeders are identified more occasionally in the retro-littoral marshes bordering the English Channel.

Redshanks breed in different types of wetland habitats ranging from soft or brackish coastal marshes (e.g. salt marshes) to Mediterranean sansouire (saltwater habitats) and grazed wet meadows. Much of the breeding population is located in the Breton marshes and secondarily in the Poitevin and Charentais marshes (Fig. 1d). Therefore, Redshank mainly breeds in the western part of France, where extensive cattle grazing is prevalent.

The reproduction of Redshank seems to have been documented in many marshes, at least since the beginning of the 20th century (Bonnet de Paillerets 1927, Glegg 1932, Guérin 1936). It was located near maritime borders of the English Channel, southern Brittany and the Atlantic in the 1970s and 1980s and was mainly located on the Atlantic coast in 2010. The marshes of Vendée in the western part of the country host nearly 75% of the breeders. Since the 1980s, the population has increased near the Atlantic coast (Table 6).

Table 5. Changes in the French breeding population of Eurasian Curlews 1959–2011.

Period	Estimated breeding pairs
1959–1960	1,165 (Spitz 1961)
1963	1,020–1,085 (Spitz 1963)
1979	760–940 (Dubois & Mahéo 1986)
1983–1984	1,230–1,360 (Dubois & Mahéo 1986)
1990–1993	1,400–1,600 (Sigwalt <i>in</i> Yeatman-Berthelot & Jarry 1994)
1995–1996	1,698–1,966 (Deceuninck & Mahéo 1998a)
1998–2002	1,500–1,800 (BirdLife International 2004)
2010–2011	1,300–1,600 (Caupenne & Trolliet <i>in</i> Issa & Muller 2015)

Table 6. Changes in the French breeding population of Common Redshank 1961–2011.

Period	Estimated breeding pairs
1961	900–1,100 (Spitz 1961)
1976	1,000 (Dubois & Mahéo 1986)
1979	620 (Dubois & Mahéo 1986)
1983–1984	429–496 (Dubois & Mahéo 1986)
1985–1989	1,400 (Trolliet <i>in</i> Yeatman-Berthelot & Jarry 1994)
1995–1996	1,137–1,347 (Deceuninck & Mahéo 1998b)
2010–2011	1,447–1,657 (Deceuninck & Issa <i>in</i> Issa & Muller 2015)

Common Snipe *Gallinago gallinago*

Distribution and main breeding habitat types

Currently, French breeders are sparse, mainly located in post-glacial wetlands of the Massif Central and the Jura mountains. The Drugeon Valley in the northern Jura Mountains holds approximately 50% of French breeding pairs (Fig. 1e). Elsewhere, breeding attempts were much more rare (Ain, Alsace, Charente-Maritime, Loire-Atlantique, Manche, Nièvre, Pas-de-Calais), and were mainly limited to large wetland areas. The main breeding habitats in France are post-glacial bogs (e.g. Drugeon Valley and Massif Central bogs) and sometimes wet meadows.

Trends

The breeding population of Common Snipe is decreasing in France (Table 7). In the early 1980s, the population was estimated at 200–300 pairs (Dubois & Mahéo 1986). The number of pairs is now less than 100 (45–60 in 2018), a drop of 75% in 30 years. This decline is explained by the disappearance of many wetlands, drainage, and by the abandonment of extensive grazing, but might also be related to global warming which may lead to a drying of bogs in spring and summer.

Table 7. Changes in the French breeding population of Common Snipe 1979–2018. Data source is ENRM (2022), except where otherwise indicated.

Period	Estimated breeding pairs
1979	400–600 (Dubois & Mahéo 1986)
1983–1984	150–250 (Dubois & Mahéo 1986)
1995–1996	200 (Deceuninck & Mahéo 1998a)
2000	200
2002	150–200
2004	130–140
2006	120–150
2008	110–160
2010	56–93
2011	83–94 (Issa & Muller 2015)
2012	37–62
2014	30–48
2016	60–82
2018	45–60

Ruff *Calidris pugnax*

Ruff is not considered in the French Red List (i.e. species breeding with very low numbers in France).

Distribution and main breeding habitat types

Historically, the Ruff has been a sporadic breeder in France since at least “the beginning of the 20th century” (Dubois & Mahéo 1986), and population numbers have remained low. Breeding mainly takes place in the west of the country, in Audierne Bay, Brière, Marais Breton and Marais Poitevin (Bardin 1938, Blanchon & Dubois 1982). The French population was estimated at 5–13 pairs in 1984 (Dubois & Mahéo 1986) and at 0–18 pairs in 1995/1996 (Deceuninck & Mahéo 1998a). In 2010/2011 only the Brière seemed to accommodate a maximum of 2 pairs. The Ruff mainly breeds in wet meadows.

Trends

The population trend of Ruffs in France is currently negative. This is likely explained by the fact that France is at the limit of the species’ breeding range and by the general loss of wetlands. It is not clear whether recent remaining pairs are still present.

DISCUSSION

Threats and conservation

In general, this review demonstrates that the waders breeding in French meadows are in decline. However,

small populations of some species appear to be stable or increasing. It should be noted that these populations (Common Redshank, Black-tailed Godwit) remain very small compared to those in some other European countries.

Meadow waders and agricultural policies

Eurasian Curlew, Black-tailed Godwit, Northern Lapwing, Common Redshank, and to a lesser extent Common Snipe and Ruff, are very dependent on meadows. Therefore, several interrelated factors are suspected to affect the reproduction of these species: the loss and fragmentation of their breeding habitat, the increasing level of predation and the development of agricultural practices (Trolliet *et al.* 2016, Moneuse *et al.* 2020, Silva-Monteiro *et al.* 2021, Kaasiku *et al.* 2022).

This development of agriculture has a strong impact both on the diversity of crops and on the plot size, generally resulting in a detrimental impact on biodiversity (Dudley & Alexander 2017). Furthermore, agricultural practices currently use a lot of mineral and/or organic supplements and involve early mowing (Broyer 2001, Humbert *et al.* 2012). Agricultural intensification also diminishes the quality of the habitat through the fragmentation or drainage it generates (Johnson 2001). In general, we can assume that the increases of the meadow-breeding wader population will be very limited due to the widespread and continuing agricultural intensification of their breeding habitats. At a more local scale, localized efforts can help preserve some small populations.

Except for Northern Lapwing, which can nest in ground dedicated to field crops in spring, most nesting habitats are part of the Natura 2000 network (e.g. Black-tailed Godwit ~98%). These meadow areas currently appear safe, due to the extensive administrative authorization required for development or destruction of Natura 2000 lands. Additionally, it is generally in these areas that agri-environmental schemes (AES) are implemented. The implementation of AES slowed the decline in several strategic areas for breeding waders while ensuring sustainable agricultural practices (Chamberlain 2018). For example, the measures of late mowing carried out in the Val de Saône maintained favourable habitats for breeding Eurasian Curlew. However, this network does not guarantee sustainable agriculture from an environmental point of view because it is closely linked to the contractual policy of the AES. The level of environmental requirements of the AES is an individual choice of each farmer. This therefore implies a heterogeneity of actions on the same site and there is not yet a common national plan for the conservation of meadow waders.

The farm management practices cannot be homogeneous for all waders as their requirements may differ. Black-tailed Godwits and Lapwings will prefer areas that are extensively grazed in early spring with highly hydromorphic areas flooding, while the Eurasian Curlew will prefer large meadow areas (Durant *et al.* 2008, Issa & Muller 2015). However, we assume that late mowing (after 1 July) and

extensive grazing are likely to benefit all species while also being acceptable for farmers. Mowing after 15 July would be ideal since most waders will have finished nesting and the chicks will be flying, but this would be hardly acceptable by farmers (no advantage in terms of yield). The absence of chemical fertilizers leads to a diversity of habitats and prey species capable of ensuring food for waders and their chicks, and also limits early agricultural intrusions in spring (i.e. early mowing, wrapping). Finally, in many meadow areas, agricultural management tends to limit spring flooding to allow rapid access to plots, which is also detrimental. This leads to earlier mowing and, therefore, to the destruction of the broods.

AES are a contractual tool. In France, each farmer chooses the measure according to their operating choices (often, for the most ambitious measures from an environmental point of view, there is a limited aid ceiling). Most nesting areas for waders are exploited by numerous operators and owners. There can therefore be several types of AES with various environmental ambitions (and some accept nitrogen amendments or early mowing). In fact, the heterogeneity of practices leads to fragmentation of meadow habitats. Collective AES (including one with a single specification) are rarely put into practice because it conflicts with the individual choices of operators.

For the most demanding species, such as Black-tailed Godwit, Common Snipe and Ruff, the presence of a flooded area is a necessity. Some AES contracts allow for this. For instance, in the Breton marsh, a specific contract requires the presence of 20% of the contracted surface to be flooded on 1 May. Although AES are individual measures that involve one's own choices of operators, hydraulic management is very often carried out collectively. It is therefore difficult to impose a particular hydraulic management on a farmer because the hydraulic choices made are not theirs alone. However, AES occasionally allow water to be kept, which can then promote the nesting of Black-tailed Godwits or Redshanks, for example. These actions are confined to territories and their sustainability is not guaranteed. However, in the Poitevin marsh, more than 3,000 ha was contractualized in 2020 (out of 20,000 ha AES contracts). Finally, they come up against the choice of operation, sometimes with the impossibility of guaranteeing this flooding due to deficient collective management of hydraulic systems and aid ceilings. Additionally, if an area remains in water for too long, this can generate an absence of vegetation on the plots. This means, for the control administrations, that this zone is not agricultural, and the farm will then be cut off from aid. Since this can be risky for the farmer, this regulation doesn't help to promote such measures.

Consequently, for example, Black-tailed Godwit nests are found in meadows owned by conservation or environmental protection organizations; in the Breton marsh, most of the Black-tailed Godwits nest on land of the NGO Ligue pour la Protection des Oiseaux (LPO). Specific

environmental leases, disconnected from the AES are often deployed there. The farmers of these plots are often convinced about the practice of extensive agriculture to favour biodiversity.

A suitable protection network?

The contractual approach (via the AES) is clearly not sufficient. It protects meadow habitat but only offers a partial response to the challenges faced by meadow-breeding waders. It is therefore necessary to consider the possibility of having a more regulatory approach on the most important areas. National nature reserves are too small to accommodate these breeding birds and secure their conservation. Therefore, expanding reserves is an option to protect larger breeding areas. We can also theorize about the establishment of collective agri-environmental measures in the sectors at stake. This also requires that the financial compensation be sufficient. For example, in the Saône Valley, where Curlews breed and AES (financial support) are used to delay mowing, this subsidy must exceed the framework of the selling price of hay during early mowing. This payment should also be paid quickly. In recent years, many AES have been paid after years of delay which has resulted in great discouragement for operators involved in species conservation and a mistrust of farmers towards the AES system.

Management plans for Black-tailed Godwit and Eurasian Curlew

The French government implemented national management plans for two wader species: the Black-tailed Godwit and the Eurasian Curlew.

Black-tailed Godwit management plan 2015–2020 (Trolliet 2014) – The plan aims at gathering knowledge on population trends as well as estimating survival and fidelity to the sites. Concerning the objectives linked to the habitats, it is a question of perpetuating the management practised on the breeding areas or even extending it to other sites to extend the breeding area. One action was to improve the specifications of the AES implemented on the meadows. For this purpose, they should carry out hydraulic management favorable to the species, favour the extensive grazing and allow the acquisition of favorable sites. Some of these actions were implemented locally in the Breton and Poitevin marshes (Leray & Lecoq 2020).

Eurasian Curlew management plan 2015–2020 (Fouquet 2013) – This plan aims to gather information on the breeding population (number of breeders, productivity) and on its habitat (description and change). Various actions have been taken, integrating for example the characterization and spatio-temporal use of habitats, the study of reproductive success, the implementation of measures favourable to Curlew reproduction, and the protection of sites that host the Eurasian Curlew. Unfortunately, too few actions have been implemented due to a general lack of financial support (Patrelle-Lombard *et al.* 2021).

The success of these two plans depended in part on agri-environmental policies. However there are no 'collective' or special measures for these species at the breeding sites. The importance of agriculture at breeding sites is clearly specified and these plans are based on general measures that depend above all on the will of the farmer and on the policies of different counties. It is therefore regrettable that these plans were not accompanied by targeted environmental measures.

Conservation

Various studies (e.g. Minton 2003, Franks *et al.* 2018) clearly show the conservation measures to be carried out to establish reproductive success allowing populations to persist and increase (late mowing, protection of nests, maintenance of wetlands, etc.). However, the keys to success rely on: (1) the orientations of the future Common Agricultural Policy and its translation into French policy (guaranteeing farmers incentive funding), (2) the pursuit of an action plan for shorebird meadows with dedicated and ambitious resources and (3) setting up long-term monitoring systems to assess the nesting population and its reproductive success at regular time intervals.

Currently, agricultural policy in France for 2023–2027 (including AES during that period) is still under discussion. Therefore, it is difficult to see the extent to which they will contribute to the conservation of nesting shorebirds. Likewise, the national management plans for the Black-tailed Godwit and the Eurasian Curlew are ending. The ministry is currently considering extending them in the form of a Multi-Species Action Plan (Leyrer *et al.* 2018).

Studies on reproductive success and actions improving it should be made in the future to aid the recovery or maintenance of the populations. As mentioned in this document and other literature, the breeding success of meadow waders in Europe greatly depends on agricultural management (Silva-Monteiro *et al.* 2021).

Perspectives

Sparse and local breeding population censuses do not allow us to obtain reliable trends at a national scale. Only small populations are subject to more detailed monitoring. A collaboration between LPO and the French Office of Biodiversity (OFB) will be conducted in 2021 and 2022 to establish a national monitoring scheme. The survey based on probability sampling, called LIMAT, consists of a reproducible protocol carried out in order to estimate the population sizes of waders, ducks and grebes breeding in France. This study should be conducted at regular time steps (every 6 years) to fit reporting obligations under Article 12 of the European Birds Directive in particular. Through the LIMAT survey, more detailed monitoring will be carried out to determine the nesting populations and the parameters that may affect reproductive success (e.g. disturbance and predation).

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