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RESEARCH ARTICLE

Common snipe (*Gallinago gallinago*) population trend using 12 years of data across different Italian regions

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Abstract

The common snipe (*Gallinago gallinago*) is a popular migratory game bird in Italy, especially in the northern regions. An effective management plan for this species requires setting up a population monitoring scheme to estimate its conservation status. For waders subject to hunting, like the common snipe, such monitoring must also be based on quantitative and qualitative data collected for consecutive hunting seasons. Among these data, the demographic trends, the frequency and distribution during postnuptial migration, hunting bags, plumage collections, and habitat use are essential to improve the management and conservation of this species. The aim of this work was to explore variations in common snipe abundance in the span of 12 hunting seasons in 5 Italian regions: Emilia-Romagna, Latium, Marche, Piedmont, and Umbria. Data on common snipe abundance in each region and year were reported in the form of an abundance index (Indice Cynégétique d'Abondance [ICA]) and a harvest index (Indice Cynégétique de Prélèvement [ICP]), which correspond respectively to the number of common snipes flushed and harvested during a hunting trip. Considering pooled data from all regions, our findings revealed no significant variations in common snipe abundance and harvest rate from 2010–2011 to 2021–2022. However, significant differences emerged in the

5 explored regions. These results underscore the importance of maintaining long-term monitoring programs for evaluating the conservation status of the common snipe population, such as presence and abundance, which are critical for sustainable hunting and conservative management of the species in Italy.

KEYWORDS

abundance index, *Gallinago gallinago*, harvest index, hunting bag, migration, pointing dogs, wildlife management, wintering population

Assessing species abundance is of paramount importance in developing effective strategies to ensure their long-term survival and maintain their ecological role within a given ecosystem. For game species, accurately determining abundance is even more critical, as it directly informs the appropriate harvest rates needed to ensure sustainable use. The common snipe (*Gallinago gallinago*) is a scolopacid species globally classified as least concern on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (BirdLife International 2019). However, given the decreasing trend in its population in Europe (BirdLife International 2021), it is crucial to delineate appropriate conservation and management interventions. Analyzing variations in the abundance of snipe populations and comparing them with trends in harvest data allows for a discussion of the potential causes of changes in the species' abundance, environmental preferences, and harvest rates (Devort 1997). The study of families of birds like the Scolopacidae enables us to evaluate the state of wetlands and the management actions needed for their conservation. The common snipe, although partially resident in western Europe, has a wide geographical range and is mostly migratory (Cramp and Simmons 1983). According to Stroud et al. (2004), Kirby and Delany (2009), and Rodrigues et al. (2022), one of 3 biogeographic populations is present in Italy. This population, whose trend is described as declining or stable for the period 2009-2018, breeds in Europe (west of the Urals) and mainly winters in both southern and western Europe and northwest Africa (mostly north of the Sahara). The entire species population, including the subspecies Faroe snipe (*G. g. faeroeensis*), could range between 15 to 29 million mature individuals, an estimate that needs to be backed by more accurate data (Bird Life International 2023).

The common snipe is commonly found in Italy with a population widely distributed in inlands and along coastal areas, especially during winter (Spina and Volponi 2008). In Italy the common snipe is hunted from the third Sunday of September to 31 January, excluding Tuesdays and Fridays (article 18, paragraph 1 and 5, law 11-2-1992 number 157). The daily hunting bag is set by the regional administrations at 5 common snipes or 10 among snipes, ducks, and other waders. Nevertheless, the species' cryptic behavior makes population estimations challenging (Zenatello et al. 2014). From 2009 to 2018, the species showed a stable trend in Italy, with a minimum of 2,857 individuals distributed across 323 sites counted during the International Waterbird Census (Zenatello et al. 2021).

In this context, the data collected by hunters can be very useful in assessing the species conservation status and enabling national authorities to develop and enforce sustainable harvesting of this species. Such data can shed light on the phenology of populations migrating through and wintering in Italy and can provide important information regarding their demography. Studies on the common snipe within the European context, supported by contributions of hunters and ornithologists, covered various aspects including biology and migration, the collection of biological samples (with 30,000 wings analyzed), hunting bags (Devort et al. 1997), dietary preferences through the examination of digestive tracts (Tuck 1972, Swift 1979, Veiga 1984, Grisser 1988, Beck et al. 1995), preferred habitats (Olivier 1992, 2000*b*), and ringing data (Olivier 1996). However, to the best of our knowledge and based on the current available scientific literature, studies on the abundance of the common snipe, especially in Italy, are so far still widely overlooked. Assessing this critical parameter is essential for evaluating the species' health in relation to the specific habitat characteristics used, and the effectiveness of management strategies for the conservation of the species and the wetlands it frequents. The very nature of wildlife as a resource necessitates that any form of harvesting be grounded in a thorough understanding of the distribution and status of the species (Duffey and Watt 1971).

We assessed abundance and harvest rate of the common snipe during post-nuptial migration and wintering in 2010–2021 in 5 Italian regions, each characterized by distinct environments. We also evaluated common snipe abundance across different land cover types in the study regions.

STUDY AREA

We conducted the study during the Italian snipe hunting seasons from 2010–2011 to 2021–2022. Our study area included 48 sample sites within 5 Italian regions: Emilia-Romagna, Latium, Marche, Piedmont, and Umbria, and hosts some of the highest densities of snipes in Italy during winter (Figure 1). The Italian peninsula presents a geological and orographic complexity with a significant gradient in elevation (from 0 to 4,810 m above sea level at Mont Blanc) and in longitude (from 47°29′ N to 35°29′ N). The climate in Italy exhibits characteristics that vary significantly between the central and northern regions. In Latium, Marche, and Umbria, regions with temperate climate, summers and autumn are typically warm, whereas winters can just occasionally be cold, particularly in mountainous areas. Conversely, in Emilia-Romagna and Piedmont, continental climate regions, winters are marked by cold and foggy conditions, accompanied by warm summers. Temperature measurements taken during our study period (from September 2010 to January 2022) reveal a range of temperatures from 2.9°C to 22.4°C in the central regions, while northern regions show temperatures ranging from 0.6°C to 23.4°C. These data underscore the climatic diversity across the Italian peninsula, influenced by geographic and orographic factors.

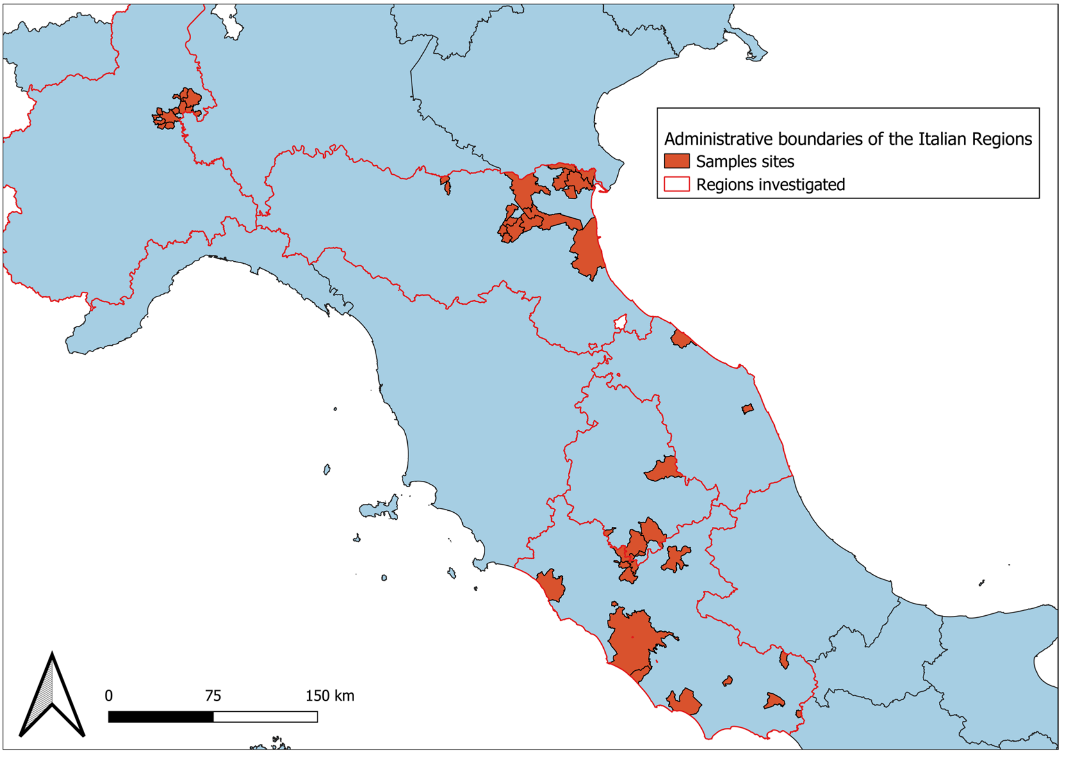

FIGURE 1 Sample locations (indicated by colored lines) of common snipe across the 5 regions investigated across Italy during hunting seasons spanning from 2010–2011 to 2021–2022.

The sample sites are characterized by a great diversity of climates and land cover types, including agricultural wetlands, herbaceous wetlands, corn fields, rice fields, other agricultural crops, and natural wetlands areas. All of these land cover types are used by common snipes as foraging sites or shelters during wintering. Rice fields, divided into permanent and rotated, represent a flat surface surrounded and divided by small embankments, at different levels and designed to retain water. Corn fields have different dimensions, from a few tens of square meters to several tens of hectares (in the presence of intensive monoculture), with chopped stubbled corn or uncultivated land. In meadows the grass is present for more than a year. In the first year (one crop cycle), it is called pasture. If the grass cover is maintained for over 5 years, it is called a stable, permanent or marl meadow. Ponds and marshes are small shallow bodies of water inside of which marsh plants emerge. River and lake banks have riverbeds with wide courses, slow water flow, and valleys when they are closed basins, separated from other wetlands by embankments. Other (small ditches, canals, etc.) can be defined as reclaimed lands bordering the previously described environmental types, surrounding the hydrographic basins, and resulting from the reclamation of wetlands. Currently cultivated more or less intensively, especially for cereals, wetlands include a series of biotopes suitable for both common snipe resting and feeding.

METHODS

Data collection

In 2010–2011, the Ufficio Studi e Ricerche Faunistiche e Agroambientali carried out the Common and Jack Snipe Project (Tramontana 2014). The aim of the project was to study the long-term population trend, distribution, and movements of both the common and jack snipe (*Lymnocryptes minimus*) in Italy, their habitat preferences, hunting bag data, and the impact of local environmental changes on population dynamics in some Italian survey sites. From 2016 to 2021, the project was continued in cooperation with the Club del Beccaccino (a non-profit organization composed of common snipe hunters) and ACMA (Associazione Cacciatori Migratori Acquatici, a non-profit organization composed of waterfowl hunters) to collect plumage and evaluate sex and age ratios (Tramontana and Sorrenti 2018).

This program aimed to describe the population trend of the common snipe in the period from 2010–2011 to 2021–2022, in the monitored regions. The program explored variations in common snipe abundance from the beginning of the hunting season (third Sunday of September) until the end of January.

From 2010–2011 to 2021–2022, the program distributed about 100 field bag notebooks to volunteer hunters specializing in common snipe hunting every hunting season. During hunting trips, volunteer hunters were instructed to pay particular attention to avoid double counting of the same bird, keeping in mind each landing site and, in the case of doubt, discarding additional individuals.

Upon returning from field activities, hunters recorded, for every hunting trip, the number of common snipes sighted and hunted, hunting days, species' behavior (quiet, standard, or intractable), sampling effort (hours), temperature, elevation and wind, and land cover type and quality. Land cover was divided into 6 categories: rice fields, corn fields (stubbled or not stubbled), meadows (grazed or not grazed), ponds and marshes, river and lake banks, other (e.g., arable lands or sown temporary covered by water, small channels with sewage water). As for habitat quality, following Devort et al. (1997), we assigned 4 categories based on water depth: 1 = bad, water level between ≥0 mm and ≤5 mm; 2 = sufficient, water level between >5 mm and ≤15 mm; 3 = good, water level between >15 mm and ≤25 mm; 4 = optimal, water level between >25 mm and ≤35 mm. We used these experimental parameters for all land cover types examined except for river and lake banks and the category defined as other.

In our analyses, we considered the starting and ending dates of the hunting season, and we used the term hunting trip to indicate the data collected during the sampling activity. The information collected enabled us to estimate the abundance of the common snipe using 2 cynegetic indexes: Indice Cynégétique d'Abondance (ICA), indicating the number of common snipes counted during each hunting trip, and Indice Cynégétique de Prélèvement (ICP), representing the number of common snipes harvested. We standardized each index considering an average hunting trip duration of 3.5 hours. This time interval represents the average duration of a Eurasian woodcock (*Scolopax rusticola*) hunting trip in Europe (Fadat 1979, Cau and Boidot 2006, Tuti et al. 2023). However, as reported by Tramontana and Sorrenti (2019) and Tramontana et al. (2023), this parameter has proven to be similar for both the common and jack snipe. We calculated ICA and ICP for the 5 monitored Italian regions using the following formula: ICA = number of common snipe counts/standardized hunting trip (i.e., 3.5 hours); ICP = number of common snipe harvested/standardized hunting trip (i.e., 3.5 hours).

Statistical analysis

We explored the variation in common snipe abundance (i.e., ICA) and harvest rate (i.e., ICP; both standardized for sampling effort) across years, considering both pooled data from all regions and divided by region, using different sets of generalized additive models (GAMs; Zuur et al. 2009) implemented in the gamair (Wood 2006) and mgcv (Wood 2017) R packages. We decided to use GAMs because linear models tested using the R package gvlma (Pena and Slate 2006) have limited predictive performances, even if assumptions are met. We checked the performance of the models through the cumulative distribution function (CDF) of the chi-square distribution (Moore et al. 2021).

We compared the full model (i.e., the one containing the covariate year) with a null model to explore the amount of variance explained by the full model compared to the intercept-only model, and to assess the effect of the considered covariate on the response variable. We then performed model selection based on the Akaike's Information Criterion corrected for small sample sizes (AIC_c; Akaike 1974) and ΔAIC_c (Burnham and Anderson 2002). In the presence of models with $\Delta AIC_c < 2$ (hence considered as competitors of the best model), we selected the best model based on the Akaike's weight (ω_i), which indicates the proportion of variance explained by each model compared to all the other models (Burnham and Anderson 2004). For each GAM, we assessed the family distribution of residuals using the R package fitdistrplus (Delignette-Muller and Dutang 2015) and checked model predictive performance (i.e., goodness of fit) using the gam_check R function. Goodness-of-fit results indicated good predictive performances (Wood 2017). We evaluated common snipe abundance across different land cover types, considering pooled data from all regions and sampling years, using the chi-squared test because all values in the contingency table were >5 (Fisher 1922). Thereafter, we implemented the pairwise nominal independent function (pnif; Mangiafico 2024) for pairwise comparisons between land cover types. We conducted statistical analysis using the R software (version 4.3.3; R Core Team 2024).

RESULTS

For our analysis, we used 2,999 trips registered in the bag field books, taken by 57 specialized hunters, with their pointing dogs. During these trips, more than 12,283 hours were spent searching for common snipes, resulting in 27,719 contacts with individual birds. The best model of common snipe abundance and harvest rate, using pooled data from all regions, included only the intercept. This indicates common snipe abundance and harvest rate did not vary across years (Table 1; Figure 2).

As for common snipe abundance (i.e., ICA), considering the Emilia-Romagna, Latium, and Marche regions, the best model was the one including only the intercept (Table 1), also indicating that common snipe abundance did not vary across years (Figure 3A,C,E). Conversely, regarding Piedmont and Umbria regions, the best model was the one including the covariate year (Table 1). We observed weak evidence of a decline in common snipe abundance across years in the Piedmont region (GAM, R^2 = 0.27, P = 0.08) and moderate evidence of a decline in the Umbria region (GAM, R^2 = 0.51, P = 0.02; Figure 3G,I). With regards to the common snipe harvest rate (i.e., ICP), considering the Emilia-Romagna, Marche, and Umbria regions, the best model was the one including only the intercept (Table 1),

TABLE 1 Generalized additive models of indexes of common snipe abundance (ICA) and harvest rate (ICP) in Italy, 2010–2021. Indexes standardized common snipe abundance and harvest rate values based on sampling effort. We ranked models based on Akaike's Information Criterion corrected for small sample sizes (AIC_c) and Akaike's weight (ω_i).

Region	Sets of models	Model ID	Covariate	AIC_c	ΔAIC_c	ω_i
All regions						
	ICA	Null	~1	48.84	0.00	0.86
		1	Year	52.48	3.64	0.14
	ICP	Null	~1	12.24	0.00	0.67
		1	Year	13.70	1.46	0.33
Emilia–Romagna	ICA	Null	~1	58.66	0.00	0.87
		1	Year	62.47	3.80	0.13
	ICP	Null	~1	23.91	0.00	0.87
		1	Year	27.71	3.80	0.13
Latium	ICA	Null	~1	52.65	0.00	0.97
		1	Year	59.43	6.78	0.03
	ICP	1	Year	27.98	0.00	0.58
		Null	~1	28.60	0.62	0.42
Marche	ICA	Null	~1	48.19	0.00	0.87
		1	Year	51.99	3.80	0.13
	ICP	Null	~1	35.40	0.00	1.00
		1	Year	50.60	15.20	0.00
Piedmont	ICA	1	Year	61.91	0.00	0.51
		Null	~1	61.99	0.08	0.49
	ICP	1	Year	29.33	0.00	0.82
		Null	~1	32.38	3.05	0.18
Umbria	ICA	1	Year	69.92	0.00	0.92
		Null	~1	74.89	4.98	0.08
	ICP	Null	~1	20.83	0.00	0.78
		1	Year	23.33	2.50	0.22

indicating common snipe harvest rate did not vary across years (Figure 3B,F,J). Conversely, regarding Latium and Piedmont regions, the best model was the one including the covariate year (Table 1). We observed weak evidence of a decline in common snipe harvest rate across years in the Latium region (GAM, R^2 = 0.30, P = 0.07) and moderate evidence of a decline in the Piedmont region (GAM, R^2 = 0.43, P = 0.02; Figure 3D,H).

We observed common snipe in all 6 land cover types (Table 2). Considering pooled data among regions and years, the chi-squared test revealed strong evidence that common snipe abundance differed among land cover types ($\chi 2$ = 64.92, $P < 0.001$). Common snipes were more abundant in rice fields compared to all other land cover categories (pnif, $P < 0.001$; Figure 4).

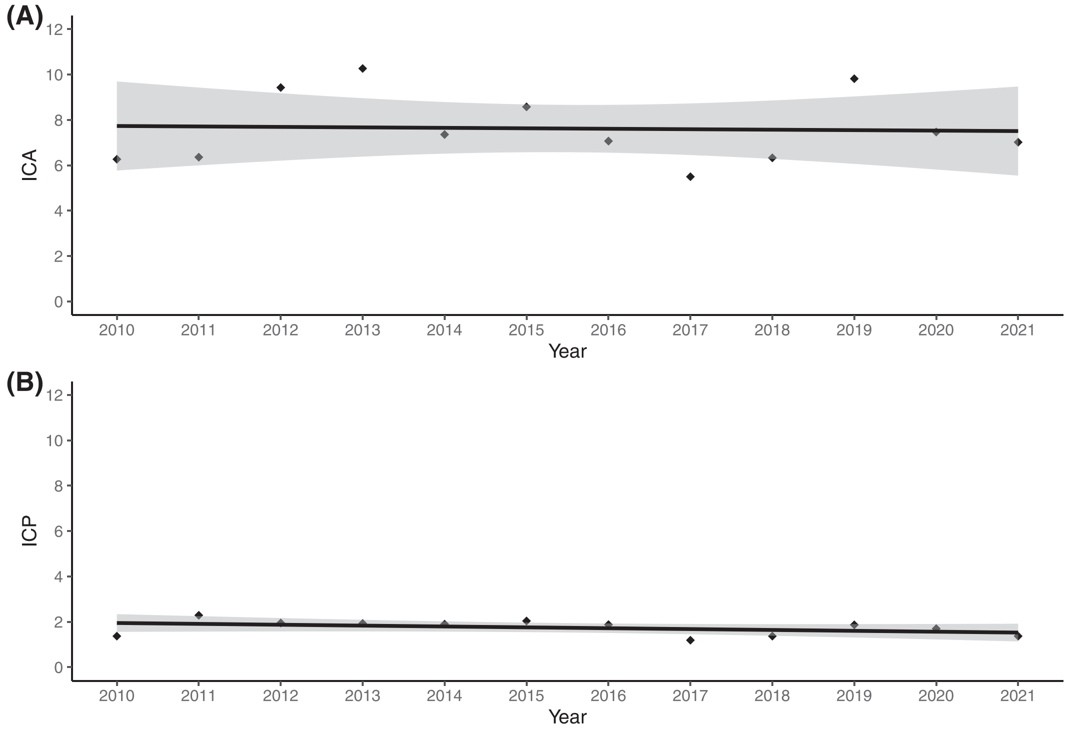

FIGURE 2 Variation in indexes of common snipe abundance (ICA; A) and harvest rate (ICP; B) across years in Italy. Indexes standardized common snipe abundance and harvest rate values based on sampling effort. Shaded grey areas indicate 95% confidence intervals.

DISCUSSION

Our study revealed that common snipe abundance varies over the years depending on the monitored region, with evidence for declining common snipe abundance observed in the Umbria and Piedmont regions. We also found evidence for declines in the common snipe harvest rate in the Piedmont and Latium regions.

The common snipe is a regular and abundant passage migrant and winter visitor, with a winter population hard to estimate but including at least a few thousand individuals, widely distributed across inland and coastal areas. It also breeds irregularly and sparsely in continental Northern Italy (Spina and Volponi 2008) with just 7 nesting sites reported from 1958 to 1996 (Lardelli et al. 2022). According to Tinarelli et al. (2010), in Italy, the common snipe wintering population is estimated at >15,000 individuals, and the population trend analysis conducted in Emilia-Romagna in the period 2000-2009 indicated a moderate increase over time. However, these data should be cautiously considered given the difficulties to census the species due to its elusive behavior and the land cover types it frequents. A recent study conducted by the Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA; Zenatello et al. 2021) during the period 2009-2018 as part of the winter censuses of waterbirds revealed a stable common snipe population trend in Italy, thus matching the findings obtained in our research.

Despite the absence of proper analyses due to the limitations of our data, we speculate that the differences in common snipe abundance observed across regions may be associated to the different and changing environmental conditions characterizing the northern and central Italian regions. Given that the common snipe is highly dependent on the presence of water (Olivier 1992), soil conditions (specifically the presence or absence of water) may influence the presence and abundance of common snipe in each region. Indeed, a species that extensively uses wet

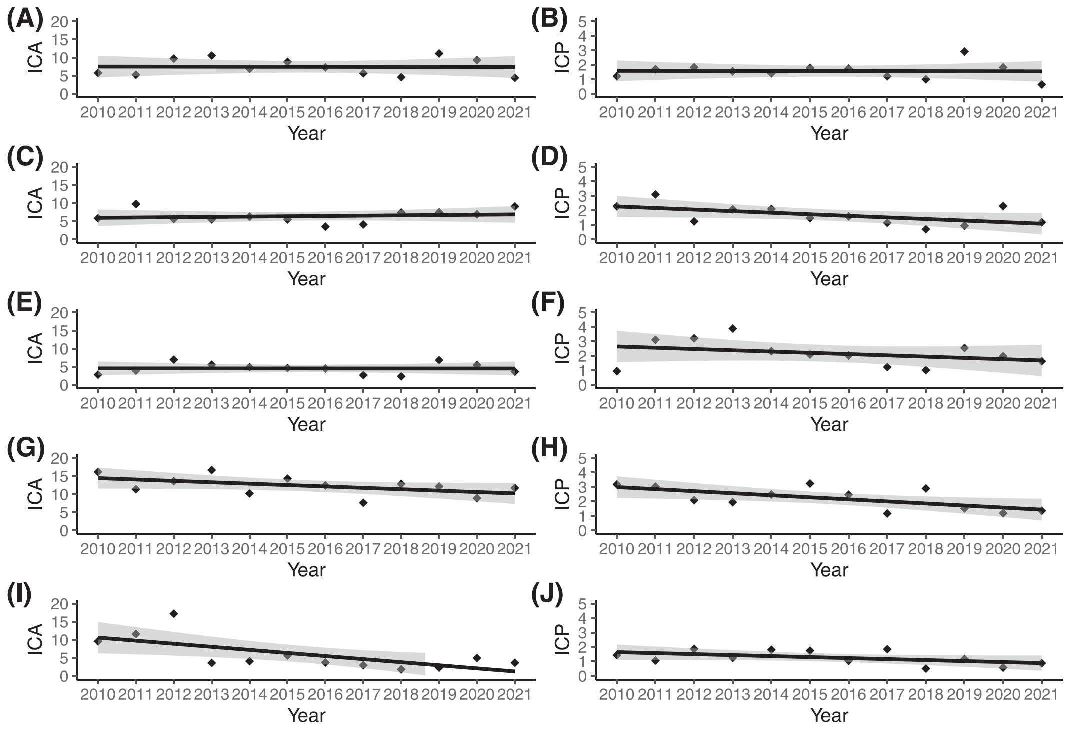

FIGURE 3 Variation in indexes of common snipe abundance (ICA) and harvest rate (ICP) across years in Emilia–Romagna (A, B), Latium (C, D), Marche (E, F), Piedmont (G, H), and Umbria (I, J) regions in Italy. Indexes standardized common snipe abundance and harvest rate values based on sampling effort. Shaded grey areas indicate 95% confidence intervals.

and muddy areas may encounter varying opportunities to exploit trophic niches, depending on how winter temperatures and other factors influence soil properties, such as the relative hardness of the ground (Olivier 2000*a*). The common snipe, and Family Scolopacidae to a broader extent, select habitats based on these properties, which in turn are typically influenced by rain and other meteorological variables. In Italy, the trend of annual and seasonal average cumulative rainfall did not change significantly from 1961 to 2020 (Fioravanti et al. 2021). Nevertheless, an exceptional climatic event that included a severe drought that lasted until autumn was observed in the 2017–2018 season (Desiato et al. 2018). Because of climate change, southern and central Italian regions have been experiencing more severe droughts than northern regions, particularly in recent years. This intensified drought likely explains the decline in common snipe abundance observed in the Umbria region, where harsh climate conditions may have reduced both the quantity and quality of wetlands available for the species. In the northern regions studied, the species may also have been affected by the 1.5°C increase in average winter temperatures recorded over the past 50 years (Arpa Piedmont 2010). All of these factors, at least in some of the investigated regions, might have diminished the trophic resources available for the common snipe, where in the past it was normally present during migration and wintering (Tramontana and Sorrenti 2017), in turn reducing the number of monitored individuals.

We observed the highest number of individuals in rice fields, indicating that this cover type plays a significant role in the conservation of the species. This is particularly important given the profound transformations that rice fields are currently undergoing. These changes are mainly due to the introduction of new agricultural techniques, which could alter the quality and availability of habitat offered by rice fields for the staging and feeding of common snipe in Italy during the post-nuptial migration and wintering. Today, around 55% of the rice in Italy is cultivated

TABLE 2 Index of common snipe abundance (ICA) in each land cover category by region in Italy and sampling year. The index standardized common snipe abundance based on sampling effort.

		ICA				
Year	**Land cover**	**Emilia-Romagna**	**Latium**	**Marche**	**Piedmont**	**Umbria**
2010	Corn fields	NA	0.62	NA	NA	2.10
	Meadows	NA	1.75	2.28	NA	9.01
	Other	NA	8.38	NA	10.15	3.29
	Ponds and marshes	4.51	2.86	2.53	NA	7.60
	Rice fields	6.43	NA	NA	14.75	NA
	River and lake banks	4.38	5.25	NA	NA	1.92
2011	Corn fields	NA	1.94	NA	NA	NA
	Meadows	2.78	2.69	4.76	0.58	NA
	Other	1.75	3.43	1.75	8.91	1.17
	Ponds and marshes	4.64	12.96	1.98	0.85	NA
	Rice fields	5.72	NA	NA	8.33	NA
	River and lake banks	2.86	3.69	3.07	NA	5.41
2012	Corn fields	18.67	4.13	NA	NA	14.00
	Meadows	5.37	4.09	NA	NA	3.89
	Other	3.18	1.50	NA	8.00	2.96
	Ponds and marshes	7.45	3.76	4.88	NA	9.63
	Rice fields	10.49	NA	NA	10.60	NA
	River and lake banks	3.50	1.36	NA	NA	4.38
2013	Corn fields	NA	2.95	NA	2.92	1.75
	Meadows	8.75	4.86	NA	NA	11.08
	Other	3.50	3.86	3.07	1.17	NA
	Ponds and marshes	3.37	5.61	6.71	NA	2.33
	Rice fields	11.25	NA	NA	16.59	NA
	River and lake banks	NA	3.88	NA	NA	4.20
2014	Corn fields	NA	1.17	NA	4.08	3.50
	Meadows	10.06	3.80	NA	2.50	3.50
	Other	NA	6.88	NA	12.10	9.33
	Ponds and marshes	3.23	4.28	5.06	NA	4.32
	Rice fields	6.73	NA	NA	7.83	NA
	River and lake banks	NA	6.55	NA	NA	4.61
2015	Corn fields	NA	NA	2.10	6.85	1.40
	Meadows	4.20	5.25	NA	NA	5.25
	Other	3.35	1.98	3.83	8.52	3.00

(Continues)

TABLE 2 (Continued)

Year	Land cover	ICA Emilia-Romagna	Latium	Marche	Piedmont	Umbria
	Ponds and marshes	8.43	2.75	NA	NA	NA
	Rice fields	9.35	NA	NA	13.91	NA
	River and lake banks	NA	2.42	1.38	NA	5.50
2016	Corn fields	3.50	1.47	NA	NA	1.75
	Meadows	NA	3.01	0.70	NA	2.50
	Other	3.18	3.50	1.79	13.63	4.50
	Ponds and marshes	4.26	1.17	NA	0.58	3.50
	Rice fields	8.05	NA	NA	11.16	NA
	River and lake banks	4.38	2.23	3.71	NA	2.19
2017	Corn fields	2.10	NA	NA	5.83	NA
	Meadows	15.31	3.50	NA	1.38	NA
	Other	8.75	2.82	1.36	7.39	NA
	Ponds and marshes	5.19	22.88	NA	NA	NA
	Rice fields	3.41	NA	NA	6.23	NA
	River and lake banks	4.90	6.13	2.99	2.16	1.96
2018	Corn fields	NA	1.75	NA	NA	NA
	Meadows	3.61	6.85	3.50	NA	3.50
	Other	2.80	1.93	1.68	11.94	NA
	Ponds and marshes	2.87	1.95	NA	NA	NA
	Rice fields	5.89	NA	NA	12.56	NA
	River and lake banks	NA	7.66	2.85	NA	NA
2019	Corn fields	NA	4.20	NA	1.50	NA
	Meadows	NA	4.12	0.78	NA	1.17
	Other	NA	2.92	1.14	7.00	NA
	Ponds and marshes	NA	8.17	2.00	NA	NA
	Rice fields	11.02	NA	NA	12.50	NA
	River and lake banks	NA	9.36	4.35	1.81	NA
2020	Corn fields	NA	1.40	NA	NA	7.44
	Meadows	6.46	1.17	2.57	NA	NA
	Other	1.17	4.79	1.81	7.58	5.60
	Ponds and marshes	1.96	7.29	3.69	NA	2.45
	Rice fields	11.32	NA	NA	7.84	NA
	River and lake banks	1.75	10.89	4.48	1.40	2.45
2021	Corn fields	NA	3.00	NA	NA	NA

TABLE 2 (Continued)

Year	Land cover	ICA				
		Emilia-Romagna	Latium	Marche	Piedmont	Umbria
	Meadows	NA	9.80	2.08	NA	NA
	Other	1.75	6.19	1.47	4.38	NA
	Ponds and marshes	4.90	6.65	NA	NA	NA
	Rice fields	NA	NA	NA	12.52	NA
	River and lake banks	NA	9.22	7.17	NA	NA

Note: NA = Data not available.

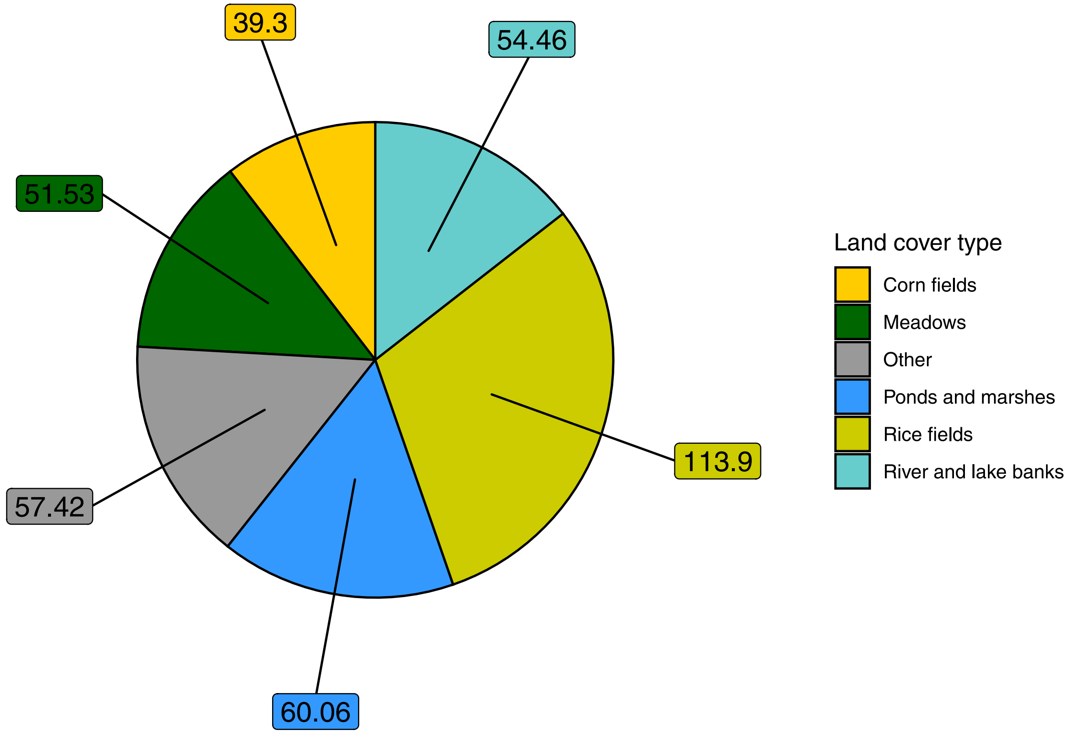

FIGURE 4 Index of common snipe abundance (ICA) in each land cover type, considering pooled data from all regions and sampling years in Italy, 2010–2021. The index standardized common snipe abundance based on sampling effort.

using the buried row sowing technique, which differs from traditional techniques (Mazza 2023). This technique requires soil leveling using laser-controlled blades and fertilizer spreaders instead of precision seeders, reducing water stagnation, and, consequently, the habitat available for the common snipe. In addition, the use of rice varieties with lower heights than in the past has increased. Traditional varieties with heights of 150 cm have now been replaced by recent varieties around 60 cm tall. This may have further contributed to degrading the ideal foraging habitat for the common snipe (Tramontana 2014).

Harrison (1982) noted that a site attracts snipes only if it combines 3 factors: an open site with adjoining tidal reservoirs and small ponds, a broken cover of vegetation, and a large biomass of invertebrates. Combining these conditions is difficult because of the specificity of the landscapes investigated. Moreover, designing a management plan that can be applied at all latitudes and for the same land cover type is extremely challenging. Each management method has its own advantages and can respond to a local need. However, only a combination of 1 or several methods enables the enhancement of snipe habitat and the creation of conditions that favor the conservation of the common snipe (Olivier 1992). In spite of these limitations, the method used to flush the birds (i.e., the use of pointing dogs and the data from hunting trips) is well established to evaluate the abundance of several migratory wader species, including the common and jack snipe (Tramontana 2015), woodcock (Tuti et al. 2023), and common quail (*Coturnix coturnix*; Tramontana et al. 2023).

MANAGEMENT IMPLICATIONS

Our results give an important baseline to the management and conservation of the common snipe in Italy. They also highlighted that a longer and more accurate monitoring period will be necessary to outline a more accurate trend of the species. The variations in common snipe abundance recorded among regions during the monitored period indicate that the harvest rate should be carefully planned, considering the species' population trend. This is particularly important for the Umbria region, where the species has been experiencing a significant population decline. Some erratic movements are possible during the wintering period, depending on weather, temperature, and soil conditions. This could have generated variation in common snipe presence in different Italian regions during the investigated period. Our study confirms the importance of establishing national long-term monitoring programs to evaluate the species trend and abundance in relation to land cover types and climatic variations. Our findings, along with those collected in other studies, are crucial for guiding the management of game species and ensuring sustainable hunting practices, thereby preventing potential risks of population declines.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ETHICS STATEMENT

The data on snipes were gathered by hunters during routine hunting activities and in compliance with the project's protocols; therefore, institutional authorizations were not required to collect the information necessary for this research.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable request from the corresponding author.

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