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Research Article

Population Status and Threats to Galliform Bird in the Arjo-Didessa River Valley, Southwestern Ethiopia

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The study was conducted to assess the species composition, population size, public knowledge, and threats to Galliform birds in the Arjo-Didessa River Valley, Southwestern Ethiopia. Data were collected from January 2018 to December 2020, covering both the dry and wet seasons. The study area was classified into four habitat categories: farmland, forest, grassland, and riverine areas. A line transects survey and point count routes were employed in the open habitats and dense habitats, respectively, to collect data. The species' composition and relative abundance of Galliformes were estimated by timed species counting and encounter rates. To assess public knowledge and threats, direct inventories, questionnaire surveys, key informant interviews, and informal communications were employed. Three Galliform species, namely, Clapperton's Francolin (*Pternistis clappertoni*), Helmeted Guineafowl (*Numida meleagris*), and Stone Partridge (*Ptilopachus petrosus*), were recorded in the area. The Helmeted Guineafowl were abundant (66.83%), Clapperton's Francolin was common (30.14%), and Stone Partridge was a rare (3.03%) species. The population size of Galliformes recorded in the area was 461 during the dry season and 365 during the wet season, with a mean population size of 124.5 ± 11.5, 276 ± 33, and 12.5 ± 3.50 individuals of Clapperton's Francolin, Helmeted Guineafowl, and Stone Partridge, respectively. The recorded flock size of Galliformes ranged from 1 to 22 individuals per flock. There was a statistically significant difference ($F = 90.06$, $df = 3$, and $p < 0.05$) in the population size of Galliformes between habitats, where the highest mean was recorded in the farmland (141.5 ± 7.5) and the lowest in the riverine (61.5 ± 43.5) habitats. The majority of the respondents (86.36%, $n = 286$) have prior knowledge and awareness about guineafowl and francolin species. They use these species mainly as a source of food (55.06%), eggs and meat consumption, a source of income (28.48%), and other values (16.45%), including foster-rearing and medical practices. In addition, guarding, trapping, scarecrows, and related crop raid protection measures were employed in the area to protect crops from crop damage by these birds. Although there is factual public understanding and a positive attitude towards Galliformes in the study area, habitat destruction and loss, agricultural intensification, overgrazing, fire, fuelwood collection, agrochemicals, and hunting and egg collection were observed as major threats affecting the species and their habitats. Further research and community-based conservation interventions are, therefore, essential to thoroughly monitor the population trends of Galliformes and maintain their habitats in the region.

1. Introduction

Galliformes are a diverse group of heavy-bodied birds commonly referred to as gallinaceous or gamebirds [1]. This group encompasses about 309 recognized species categorized into five families, including the Phasianidae (pheasants, partridges, turkeys, chickens, quails, grouse, and peafowls), Numididae (guineafowls), Cracidae (chachalacas, guans, and curassows), Megapodiidae (scrubfowl, brush turkeys, malleefowl), and Odontophoridae (New World quails) [2–5]. Galliformes are mainly terrestrial, sedentary, and gregarious and inhabit a wide range of habitats, including forests, farmlands, grasslands, and riparian areas [6–9]. They serve as seed dispersers and good bioindicators of environmental and habitat quality [10]. They

also play an important role in sociocultural practices, aesthetic values, and economic attributes [3, 11, 12]. Among Galliformes, different species such as partridges, quails, francolins, guineafowls, and turkeys have been widely introduced, domesticated, and reared in common farmyard poultry and captive breeding programs, significantly contributing to food production, recreational sports, ornamental collections, plumage, and trade [3, 12]. They are widely domesticated and usually hunted as gamebirds for food due to their prized meat both for flavor and supposed medicinal value [13, 14]. Despite being one of the most diverse and widespread groups, Galliformes are among the most threatened birds [1, 15, 16]. About 26.4% of Galliformes have declined globally and are on the brink of extinction in the IUCN RedList category [5, 12, 17]. Threats including overexploitation, recreational and sport hunting, trade, and cultural practices have highly affected these birds [1, 18, 19], which are further aggravated by habitat destruction, agricultural intensification, human disturbance [12, 20], livestock encroachment, invasive species, disease, and climate change [12, 21, 22].

Knowledge about the population status, habitat preference, and threat to birds is of paramount importance to species conservation. It also provides crucial baseline information to comprehensively monitor population trends and devise sustainable species conservation and ecosystem management interventions. Subsequently, public knowledge and attitudes are vital to understand the interests of communities and contemplating conservation needs in a way that strengthens conservation efforts and positively impacts decisions that significantly influence the long-term success of conservation [23, 24]. However, such ecological information is rudimentary in many species of birds, including Galliformes.

In Ethiopia, Galliformes are among the most recognized and predominantly hunted groups of birds, practically in rural areas. There are about 16 species and 25 subspecies of Galliform birds that exist in the country [25, 26]. Among these, three francolin species, including the Black-fronted Francolin (*Pternistis atrifrons*), Harwood's Francolin (*Pternistis harwoodi*), and Moorland Francolin (*Scleroptila psilolaema*), are endemic to Ethiopia [8, 25, 27]. Nonetheless, Galliformes are among the less studied birdsin the country. Consequently, there is a need to study the population status, trends, and habitat preferences of the species throughout their range, including the Didessa River Valley. Hence, the present study was conducted to assess the species composition, relative abundance, population size, public knowledge, and threats to Galliform birds in the Arjo-Didessa River Valley, Western Ethiopia.

2. Materials and Methods

2.1. Study Area. The study was conducted in the Arjo-Didessa River Valley area. It is located in the Bedele Zuria and Jimma-Arjo districts along the Buno Bedeleand East Wellega administrative zones of the Oromia Regional State, Ethiopia. It is located at a distance of 395 km from Addis Ababa at 36°39′60.0″E and 8°40′00.0″N (Figure 1). The river basin is a part of the lowland plains of the Sudan-Guinea savanna biome, which covers parts of the western regions of the country. Its catchment is estimated to cover an area of 27,000 km^2 [28]. The Jimma-Arjo district covers an area of 741.41 km^2. The total population of the district was 86,329, of which 42,093 were maleand 44,236 were female households [29]. Bedele Zuria district covers an estimated area of 745.0 km^2. Its population size is 77,687, consisting of 38,654 male and 39,033 female households [29]. The study site covers an estimated area of 1,486 km^2 with an altitude elevation ranging between 1280 and 2524 m a.s.l. The area is characterized by a humid tropical climate with a mean annual rainfall ranging between 1200 and 2200 mm during which the peak rainy season spans from May to October. The mean annual maximum and minimum temperature of the study area range from 36.5 to 16.8°C. The specific administrative kebeles included in the present study include five from the Bedele Zuria District, i.e., Ambelta, Bekelcha Beftu, Chefe Jalela, Haro Tatesa, and Kolosere, and five including Bedasa Dedesa, Sefera Tabia, Gudeya, Luguma Sefera Tabia, and Meta from the Jimma-Arjo District (Figure 1).

The LandUuse of the sub-basin comprises croplands (56%), forest (19.6%), shrubland (12.4%), savannah grassland (6%), settlement (5%), and riverine areas (0.2%) [30]. Its climate features consist of the upland (above 2500 m asl), midland (1500 m–2500 m asl), and lowland (below 1500 m asl) areas which account for about 0.1%, 81.5%, and 18.4% of the total area, respectively. The habitat features of the Bedele Zuria District consist of agricultural farmlands (4,719.57 hectares), grazing land (9,848.45 hectares), forest (1,0682.7 hectares), and other (724 hectares) land uses categorized under Dega (16%), Woina-Dega (64%), and Kola (20%) climate conditions. Agriculture represents the main practice in the study area in which more than 88% of the surrounding communities depend on mixed (crop production and livestock rearing) farming systems. Maize, sorghum, coffee (*Coffee Arabica*), and teff are the main cash crops. The area also supports potential biodiversity resources (flora and fauna) and is known to encompass varieties of wildlife species including mammals, birds, reptiles, and amphibians. However, the ever-increasing anthropogenic pressure, settlement expansion, agricultural intensification, and continuous conversion of forests and grassland habitats to farmlands changed the scenario, and the annual rate of deforestation in the area has increased to 2.6% [31].

2.2. Data Collection. A preliminary survey was conducted from November to December 2017 to assess the habitat features and identify key areas. Indirect evidence, such as feathers and calls, was used to confirm the presence of Galliformes in the area. Information about these birds' occurrence and historical distribution ranges was also solicited through structured interviews and informal communications. After their occurrence was confirmed, field inventory and data collection were carried out from January 2018 to December 2020 during both the dry (October to April) and wet (June to August) seasons. The study area was classified into four habitat categories: farmland, forest, grassland, and riverine areas through stratified random sampling techniques based on the vegetation features to

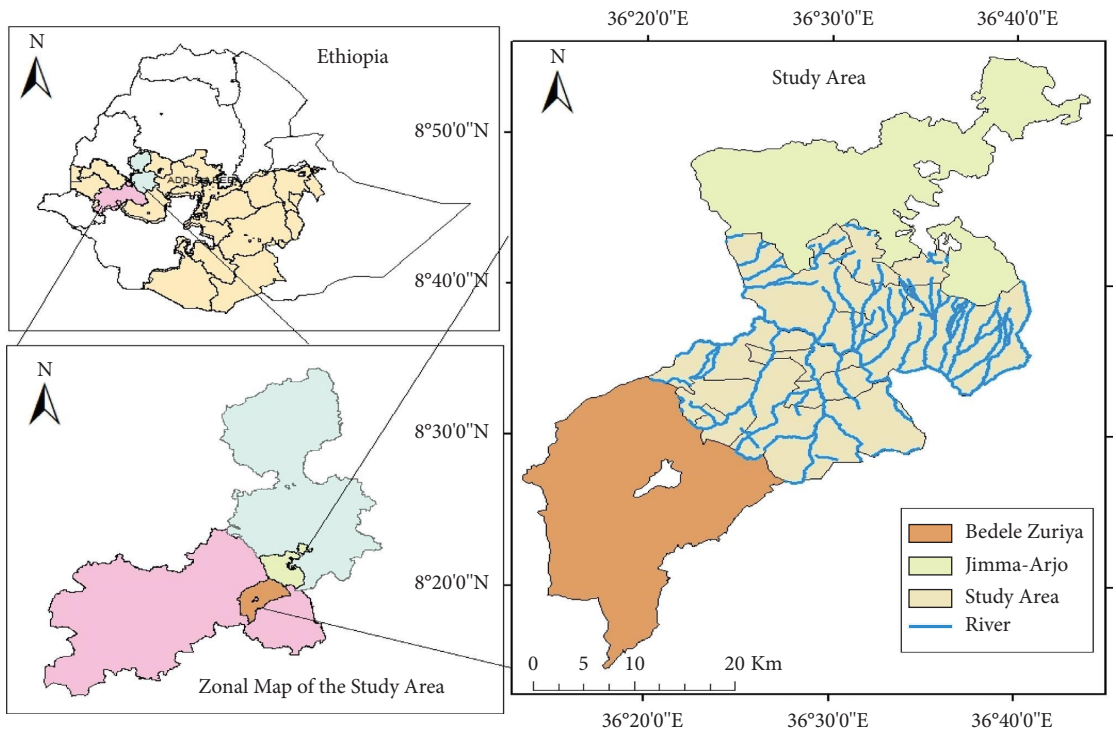

Figure 1: Map of the study area in the Arjo-Didessa River Valley.

collect Galliform data from these habitats. A total of 74 point count routes within a 50 to 250 m radius distance between count stations were located and used in the forest habitats. The point count survey was carried out at a walking speed rate of 1.5 km/hr in bushy areas and 2.5 km/hr in open habitats. The point count surveys were employed by moving across a predetermined counting route to standardize data collection following Bibby et al. [32] and Sutherland [33]. About 68 line transects ranging between 2 and 5 kilometers in length with a 500×125 m distance in between the transects were established and employed in the farmland, grassland, and riverine habitats following Bibby et al. [32] and Sutherland [33]. A 200 m distance between points was maintained to reduce the probability of double counting and avoid bias in population estimation [33]. The sighting distances were set at 50 to 100 m in the dense woodland forest and riverine areas and extended up to 250 m in the open farmland and grassland habitats (Table 1).

Data collection was carried out twice a day during the morning from 06 : 00–10 : 00 a.m. and afternoon from 14 : 00–18 : 00 p.m., when most birds were prominently active [32]. A waiting period of three to five minutes before counting was applied to minimize disturbance. Field surveys and data collection were carried out once per month for about 14 to 22 days. A group of four individuals were involved in the fieldwork. A pair of binoculars (Vortex-Optics Diamondback 8×42) and a digital camera recorder (Canon Rebel T6) were used to aid in counting and further species identification. For each Galliform species encountered, the number of individuals, location, and habitat features were recorded. The maximum number of individuals per survey considered the population size of the species in the counting routes to avoid bias in population estimation. Species identification and taxonomic classifications were executed based on bird guidebooks including Redman et al. and Ash and Atkins (2009) [25, 26]. Morphometric parameters, including plumage pattern, body size and shape, and calls, were used to aid in species identification. Direct inventories, questionnaire-based surveys, focus group discussion, structured key informant interviews, and informal communications were employed to assess public knowledge, the attitude of local communities, and possible threats to Galliformes. A total of 286 participants were selected from adjacent kebeles, i.e., the smallest administrative unit in Ethiopia, through purposive and systematic random sampling techniques [34] following the equation as follows:

$$\begin{aligned} n &= \frac{N}{1 + N(e)^2} \\ &= \frac{5,820}{1 + 5,820(0.08)^2} \\ &= 152, \end{aligned} \tag{1}$$

where n is the sample size, N is the population size, e is the precession level, i.e., ±8%, at a 95% confidence interval, and $p < 0.05$. In addition, about 134 participants were selected using a purposive sampling technique. Key informant interviewees were selected from the adjacent villages based on their proximity to the escarpment areas through purposive sampling methods targeting community elders, farmer households, and agriculture and forest management offices based on management experience, hunting practices, and participation in farming activities. The public attitude was

Table 1: Characteristics of sampling blocks across survey sites in the study area.

Habitat type	Area coverage (km^2)	Number of transects	Number of points counting routes	Length of transects	Width of transects
Farmland	833.87	32	—	2.5–5.00	500 × 125 m
Forest	271.39	—	74 (50–250-m)	—	—
Grassland	89.38	24	—	2.00–3.65	450 × 120 m
Riverine	44.40	12	—	2.5–3.85	320 × 115 m

assessed to understand the opinions and ways local communities perceive these birds. Hence, a positive attitude was defined as the way local people perceive these birds related to their ecological, sociocultural, and aesthetic values and economic attributes, while negative attitude was stated as the concern of participants about the effects and costs posed by these birds associated with crop damage, loss and related disturbances as well as related factors that hinder the conservation of the species in the area. Participants who have prior knowledge about these birds were chiefly included to assess public attitudes as negative, positive, or who have neutral thoughts towards the conservation significance of these birds. Informal communications were also conducted to solicit information about Galliformes hunting and egg collection practices in the area.

2.3. Data Analyses. Data analyses were computed through an MS Excel spreadsheet (version 19) and SPSS software (version 26). Descriptive statistics were used to present the population size and threats of Galliformes. The relative abundance of Galliform species was determined by using encounter rates that give crude ordinal scales of abundance [32, 35]. The encounter rate for each species was calculated by dividing the number of Galliformes recorded by 100 field hours as follows:

$$\text{Encounter rate} = \frac{\text{Total number of indi vidu al birds observed}}{\text{Period of observation in hours}} \times 100. \quad (2)$$

Encounter rate values were used to categorize each species under five abundance score categories, i.e., <0.1 for rare, 0.1–2.0 uncommon, 2.1–10.0 frequent, 10.1–40.0 common, and >40 for abundant [32, 35]. One-way ANOVA was employed to infer the associations between Galliform population abundance across spatiotemporal gradients. A chi-square test was used to assess the associations between public knowledge, awareness, and attitude of respondents towards Galliformes across age, gender, levels of education, and occupational status. Data measurement values were presented as mean ± SE. Variables tested at $p < 0.05$ in a 95% confidence interval were retained as statistically significant.

3. Results

3.1. Species Composition and Relative Abundance. Galliform birds belonging to three species grouped under three distinct families were recorded. Clapperton's Francolin (*Pternistis clappertoni* (*Phasianidae*)), Helmeted Guineafowl (*Numida meleagris* (*Numididae*)), and Stone Partridge (*Ptilopachus petrosus* (*Odontophoridae*)) were the recorded species in the study area. Among these species, Helmeted Guineafowl was abundant and Clapperton's Francolins were common in terms of relative abundance. The Stone Partridge was a frequent species in the area (Table 2).

3.2. Population Size. The total number of Galliform individuals recorded in the study area was 413 ± 48 (mean ± SE) with a record of 461 individuals during the dry season and 365 individuals during the wet season. However, there was no statistically significant difference in the number of individuals recorded between dry and wet seasons ($\chi^2 = 64.80$, d$f = 1$, and $p > 0.05$). Among the three species, the species with the highest population size record was helmeted guineafowl, both during the dry and wet seasons, with 309 and 243 individuals, respectively. However, the stone partridge population record was the lowest during both the dry (16 individuals) and wet (nine individuals) seasons. The wet and dry season population counts showed statistically significant differences in Clapperton's Francolin ($F = 9.68$, df = 1, and $p < 0.05$) and Helmeted Guineafowl ($F = 31.634$, df = 1, and $p < 0.05$), but not in Stone Partridge ($p > 0.05$). In the present study, the flock size of Galliformes ranged from one to 22 individuals per flock during the dry season and one to 13 individuals during the wet season. Among the three species, Helmeted Guineafowl recorded the highest flock size during the dry season (22 individuals per flock) and Clapperton's Francolin (13 individuals per flock) during the wet season (Table 3).

3.3. Galliform Habitat Use. The three Galliform species were recorded in the four habitat types in the study area, and their population size varied across the spatiotemporal gradients, with the highest mean Galliform abundance recorded in the farmland (141.5 ± 7.5; mean ± SE) and the lowest in the riverine (61.5 ± 43.5; mean ± SE) habitats (Table 4). There were statistically significant differences in Galliformes abundance between the different habitats ($F = 90.06$, df = 3, and $p < 0.05$). The study also showed significant differences

Table 2: Species composition and relative abundance of Galliformes in the study area.

Species	Family	Abundance				
		Dry	Wet	Mean ± SE	*RA (%)	Category
Clapperton's francolin (*Pternistis clappertoni*)	*Phasianidae*	136	113	124.5 ± 11.5	30.14	Common
Helmeted guineafowl (*Numida meleagris*)	*Numididae*	309	243	276 ± 33	66.83	Abundant
Stone partridge (*Ptilopachus petrosus*)	*Odontophoridae*	16	9	12.5 ± 3.5	3.03	Frequent
Total		461	365	413 ± 48	100	

*RA = relative abundance.

Table 3: Flock size of Galliform species in the Arjo-Didessa River Valley.

Season	Galliform species		
	Clapperton's francolins	Helmeted guineafowls	Stone partridges
Dry	1.00–12.00	4.00–22.00	1.00–6.00
Wet	3.00–13.00	1.00–7.00	1.00–5.00
Combined	1.00–13.00	1.00–22.00	1.00–6.00

Table 4: Galliform abundance across habitats and seasons in the Arjo-Didessa River Valley.

Habitats	Season	Galliformes species			Total	F	df	P value
		Clapperton's francolin	Helmeted guineafowl	Stone partridge				
Farmland	Dry	58 ± 6	76 ± 21		134 ± 18		3	
	Wet	46 ± 7	103 ± 19		149 ± 57			
Forest	Dry	22 ± 4	93 ± 17	16 ± 4	131 ± 55	90.06		0.001
	Wet	40 ± 9	65 ± 7	9 ± 2	114 ± 16			
Grassland	Dry	20 ± 7	71 ± 16		91 ± 51			
	Wet	22 ± 3	62 ± 6		84 ± 40			
Riverine	Dry	36 ± 11	69 ± 19		105 ± 33			
	Wet	5 ± 2	13 ± 2		18.5 ± 8.5			

in habitat use where Galliformes were mainly recorded in the farmland habitat both during the dry (134 ± 18; mean ± SE) and wet (149 ± 57; mean ± SE) seasons, and it was statistically significant ($p < 0.05$). Among the three Galliform species found in the area, stone partridge were recorded only in the woodland forest habitat during both dry (16 ± 4; mean ± SE) and wet (9 ± 2; mean ± SE) seasons, while Clapperton's francolin and helmeted guineafowl were recorded in all four habitats with varying numbers.

3.4. Threats to Galliformes. The present study showed that habitat destruction and loss (32.18%), agricultural intensification (19.93%), overgrazing (14.34%), and deliberate fire and burning of farmlands and adjacent forest habitat patches (11.88%) were the primary threats affecting Galliformes and their habitats in the study area, while fuelwood collection (6.29%) and application of agrochemicals (4.20%) such as weed killers and insecticides constituted a less proportion of threats (Figure 2).

3.5. Public Knowledge and Attitude towards Galliformes. Among the participants, 60.84% were males and 39.16% were females categorized under the age groups <18 (4.54%), 18–30 (31.12%), 31–45 (40.91%), and ≥45 years old (23.43%). About 49.30% of the respondents were illiterate, only 20.98% had completed high school, and 13.64% possessed a college diploma or above. Accordingly, the occupational status of respondents consists of farmers (40.91%), unemployed (24.47%), government employees (21.33%), and others (13.29%) (Table 5).

The majority (86.36%, $n = 286$) of participants have background knowledge and awareness about guineafowls and francolins (Figure S1). They also perceived these birds as an important source of food, meat, and eggs (55.06%), income (28.48%), and other purposes (16.45%), such as foster rearing and traditional medical practices. There were statistically significant differences in the knowledge and awareness of respondents towards Galliformes with respect to age ($\chi^2 = 10.45$, $df = 3$, and $p < 0.05$) and levels of education ($\chi^2 = 13.08$, $df = 3$, and $p < 0.05$), while gender and occupational status of respondents have no significant effect on the knowledge and awareness of the participants ($p > 0.05$). In the study area, about 72.06% of the respondents had a positive attitude towards Galliformes owing to their socioeconomic attributes, while 18.62% had a negative attitude, which was mainly attributed to causing crop damage and loss during the sowing and early growing seasons. There was a statistically significant difference in the attitude towards Galliformes across the age ($\chi^2 = 14.49$, $df = 3$, and $p < 0.05$) and occupational status ($\chi^2 = 10.20$, $df = 3$, and $p < 0.05$) of respondents,

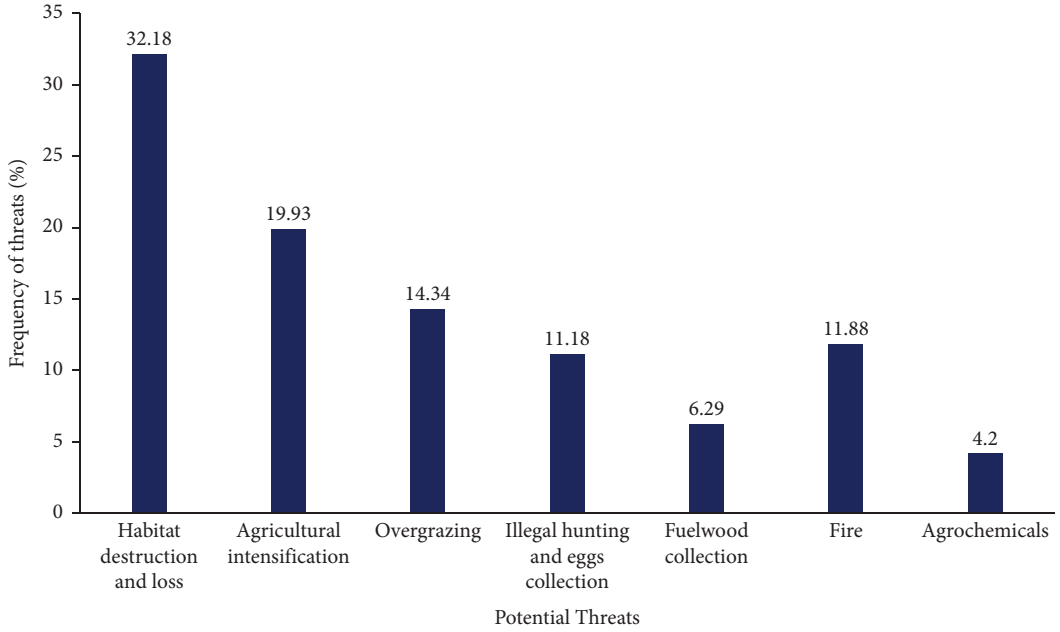

Figure 2: Conservation threats to Galliformes and their habitats in the study area.

Table 5: Sociodemographic characteristics of the studied participants.

Parameters	Variables	Frequency	Percentage
Gender ($n = 286$)	Male	174	60.84
	Female	112	39.16
	Total	286	100.0
Age group ($n = 286$)	≤18	13	4.54
	18–30	89	31.12
	31–45	117	40.91
	≥45	67	23.43
	Total	286	100
Levels of education ($n = 286$)	Illiterate	141	49.30
	Elementary grade	46	16.08
	High school grade	60	21.98
	College diploma and above	39	13.64
	Total	286	100
Occupational status ($n = 286$)	Farmers	117	40.91
	Unemployed	70	24.47
	Government employee	61	21.33
	Others	38	13.29
	Total	286	100.0

while gender and levels of education had no significant effects on public attitude ($p > 0.05$) (Table 6). Hunting and egg collection activities were commonly practised in the study area and about 63.97% of the participants have experienced Galliformes hunting activities. They commonly used live traps and leg-hold snares set near the foraging areas, drinking spots, and roosting sites (Figure S2). Moreover, those who perceived Galliformes as pests predominantly employed guarding (67.39%, $n = 31$), trapping and snaring (17.39 ($n = 8$), scarecrow (10.87, $n = 5$), and other measures (4.35, $n = 2$) as a main crop damage prevention mechanisms (Figure 3).

4. Discussion

The Arjo-Didessa River Valley is an important potential area for the three Galliform bird species. These species have a significant population that is distributed across diverse habitat types to fulfil their ecological requirements. The study also showed a significant difference in Galliformes population assemblage across spatiotemporal gradients that can be attributed to the variations in habitat features and anthropogenic pressure. In the study area, deliberate burning of forest and adjacent farmland areas were commonly practiced and possibly resulted in habitat destruction

Table 6: Public attitude towards Galliform birds in the study area.

Parameters	Variables	Public attitude				χ^2	df	P value
		Positive	Negative	Neutral	Sum			
Gender	Male	108	27	16	151	10.82	1	0.06
	Female	70	19	7	96			
	Total	178	46	23	247			
Age	<18	6	2	0	8	14.49	3	0.02
	18–30	46	19	12	77			
	31–45	81	15	3	99			
	>45	45	10	8	63			
	Total	178	46	23	247			
Levels of education	Illiterate	97	23	12	132	13.08	3	0.08
	Elementary grade	26	7	4	37			
	High school grade	34	7	5	46			
	College diploma and above	21	9	2	32			
	Total	178	46	23	247			
Occupational status	Farmer	77	19	6	102	10.20	3	0.001
	Gov. employee	34	13	4	51			
	Unemployed	40	8	11	59			
	Others	27	6	2	35			
	Total	178	46	23	247			

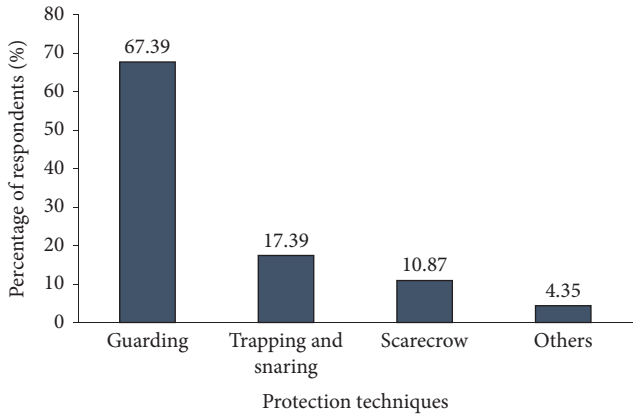

Figure 3: Major crop raid protection techniques in the Arjo-Didessa River Valley area.

and changes in landscapes, which in turn influenced the distribution ranges of the species. Environmental features including microclimate, habitat size, quality, and vegetation structure often influence the accessibility of resources supporting the ecological requirements of birds, including food sources, proper cover, roosting sites, competition, and predation pressure, which in turn determine the abundance, species composition, resource use, and distribution patterns of birds [36, 37].

The helmeted guineafowls and Clapperton's francolins were widely distributed in different habitat types. However, the stone partridges were entirely restricted to the woodland forest patches. The consistent occurrence and preference of this species in woodland forest areas may be attributed to the accessibility of the necessary resources, such as foraging niches, breeding sites, roosting areas, and protective cover, in the forest area compared to other habitats. Previous reports have also shown stone partridge's preference for woodland forests and rocky hillside areas with bushes and Hyparrhenia grass at an elevation of 620–1400 m asl [5]. However, a strong association of the species with open forests and farmland habitats was reported [38]. Studies also describe that forest-restricted birds are less tolerant of habitat modification and hence have smaller distribution ranges [39].

In the present study, anthropogenic disturbance pressure related to agricultural intensification, settlement expansion, and investment activities resulted in habitat destruction and loss that affected vegetation structure and ecological niches and hence potentially influenced the composition, status, and distribution of Galliformes. Anthropogenic intrusions, including hunting activities and agricultural intensification, the availability of food resources, and the structure and composition of habitat vegetation cover, impact ecological traits and hence influence the abundance, composition, distribution, and habitat use of birds [40–43]. Deforestation, clearance of thorn scrub for cultivation, fuelwood collection, mining, hunting, and egg collection for food and a source of income were reported as the main threats to the survival of Harwood's francolin (*P. harwoodi*) and Erckel's francolin (*P. erckelii*) in the Central Highlands of Ethiopia [44, 45]. Overhunting and habitat degradation due to agricultural conversion are also reported as the major threats causing the population decline of Clapperton's francolin [8]. In agreement with the findings of the present study, habitat destruction, loss of foraging and nesting areas, overgrazing, deforestation, human disturbance, settlement expansion, firewood collection, hunting, and predation activities were reported as the main threats affecting helmeted guineafowls and their habitats in Ethiopia [46]. The consistent practices of burning farmlands and adjacent habitat patches in the study area were supposed to confiscate leftover straws, weed dumps, and pests. However, these activities affect essential resources such as foraging niches and resting sites, which in

turn alter the habitat utilization and distributions of species since fires have potential effects on biological, ecological, and environmental features [47]. In the study area, the application of agrochemicals, illegal hunting, and egg collection activities was also observed as major threats to Galliformes. Land-use practices and the use of agrochemicals such as pesticides and the removal of adequate grass cover for nesting, arthropods, and weeds affect the essential food sources of the species and their chickens during the breeding season, contributing to the decline of the helmeted guineafowl population, their egg-laying, chick survival, and reproductive success in South Africa [48].

The majority of residents in the study area have prior knowledge, awareness, and a positive attitude about guineafowl and francolins. They perceived them as important due to their economic and sociocultural attributes such as sources of food, income, enjoyment, foster rearing, and medicine, which are in line with the findings reported in Ghana [49]. However, such illegal hunting and egg collection activities commonly practiced in the study area can potentially affect Galliform populations. This is aggravated by snaring and trapping practices used to catch these birds, which can make them susceptible to predation risk during capture. Farmers who perceived Galliformes as pests predominantly employed guarding, scarecrows, snaring, and trapping measures to protect against possible crop damage and disturbance by these birds in the area, which was in agreement with other findings [50].

5. Conclusion

The study area supported a potential population of three species of Galliform birds including the Clapperton's Francolin (*P. clappertoni*), Helmeted Guineafowl (*N. meleagris*), and Stone Partridge (*P. petrosus*). The Helmeted Guineafowl and Clapperton's Francolins were widely distributed across diverse sets of habitats. However, the Stone Partridge was entirely restricted to woodland forest areas. Guarding, trapping, and scarecrows are the predominantly employed crop raid protection measures to protect against crop damage by these birds. There is a factual public understanding and a positive attitude towards guineafowls and francolins which have essential implications for the conservation of the species. However, Galliformes and their habitats in the area are under immense anthropogenic pressure owing to a wide array of interrelated threats including habitat destruction and loss, agricultural intensification, fire, fuelwood collection, and agrochemicals. Illegal hunting and egg collection activities are also commonly practised which potentially affect the population of Galliformes and hence urge immediate conservation intervention to sustainably maintain the species and protect their habitats in the region.

Data Availability

The field datasets and figures used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Supplementary Materials

Figure S1: Galliform birds survey and species identification. Figure S2: Galliformes hunting practices in the study area. (*Supplementary Materials*)

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