

(RESEARCH ARTICLE)



Influence of public hunting lands on water birds of internationally recognized conservation areas in Armenia

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Abstract

The paper is aimed at identification of the use of the Public Hunting Lands (PHL) by hunters in Armenia, and determination of the risks for priority waterbird species. In Armenia, the Government has allocated 40 PHLs, with a total area of 5,426.48 square kilometres, which do not overlap with the nationally protected areas, but overlap with the internationally recognized conservation sites, important for protection of breeding populations of waterbird species and their congregations during migrations: Important Bird and Biodiversity Areas (IBAs), Emerald Sites protected under Bern Convention, and critical sites for migratory waterbirds, recognized under African-Eurasian Waterbird Agreement (AEWA sites). Thus, PHLs overlap with 40,660 ha or 10% of the total IBA's area, 84,933 ha or 8% of Emerald Sites, and 14,864 ha or 8% of AEWA sites. Some of the most frequently visited PHLs overlap with all three categories of the mentioned conservation sites, imposing threat of illegal shooting of the priority waterbird species (listed in national legislation and/or in international agreements). Among 200 priority bird species recorded within the overlapping areas, there are eight species with 50-100% of their Armenian population inside the overlapping areas. To reduce the risks of illegal hunting for the priority bird species it is necessary:

- To review the PHLs and exclude overlapping areas,
- To set up other alternative PHLs, and
- To begin a process of wetland restoration instead of lost ones, with the main aim to increase breeding habitats and stopover points for the waterfowl and waders.

Keywords: AEWA; Emerald Sites; Hunting lands; Important Bird Areas; Threatened species; Waterbird migration

1. Introduction

Hunting in Armenia has been a traditional activity for a long time. Until 1991, when Armenia was part of the Soviet Union, it was regulated by a single hunting union, a state organisation that was responsible for licensing the hunters, for their education and control. After independence in the period of 1992s till 2012, the hunting unions became non-governmental member-based organisations and started growing gradually, reaching a point of four registered hunting unions in 2013 and 25 unions in 2020. The function of education of hunters remains the responsibility of hunting unions, while the function of control over the performance of the hunting rules by hunters, as well as harvesting species and their number was delegated to the State Environmental Inspection Body (Decision 733-L of Prime Minister of 11 June

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2018). Currently, in Armenia there are over 50,000 members of hunting unions, including 10,000 to 20,000 active hunters (Department of Bioresources Management of the Ministry of Environment, personal communication). For the hunting in the country, there are 40 Public Hunting Lands (PHL), with a total area of 5,426.48 km² have been allocated (Governmental Decision 860-N of 18 August 2016). The existing PHLs are located outside the Protected Areas of Armenia; however, they are overlapping with international priority conservation areas, such as Important Bird and Biodiversity Areas (IBA) (Aghababyan *et al.* 2022b), Emerald Sites, the areas protected under Bern Convention (Fayvush *et al.* 2016), and critical sites for migratory waterbirds protected under African-Eurasian Agreement for Migratory Waterbirds (AEWA sites). Such an overlap creates risks of accidental or on-purpose shooting of globally and nationally protected bird species, as it was shown on examples of White-tailed Lapwing *Vanellus leucurus* (Aghababyan 2021), Northern Lapwing *Vanellus vanellus* (Aghababyan *et al.* 2021a), and Common Pochard *Aythya ferina* (Aghababyan *et al.* 2021b). The mentioned risks in overlapping areas emerge mainly due to poor recognition of waterbird species by the hunters and lack of their skills of differentiating the game birds from the protected species (Aghababyan 2021, Aghababyan *et al.* 2021a, Aghababyan *et al.* 2021b). The risks of illegal hunting also emerge for Raptors, which are purposefully being shot for trophies or fun (Aghababyan *et al.* 2019, Aghababyan & Khanamirian 2020, Aghababyan & Stepanyan 2020). The overlapping also creates risks for game bird species within internationally recognized conservation areas, as it is shown on the example of the Chukar *Alectoris chukar* (Aghababyan *et al.* 2022a). To understand the pattern of the risks for different areas, and to prioritize mitigation measures for those risks, it is important to understand how the hunting lands are utilized by the hunters, and what species, among waterbirds, raptors, and game birds, are influenced negatively.

This paper is the first step of that flow and is dedicated to determination of the risks for waterbirds of national and/or international concern in the overlapping areas.

1.1. Study area

The study area includes entire Armenia, which is a relatively small (29,743 sq km), landlocked mountainous country, where elevation ranges from 375 to 4090 m above sea level (Figure 1). Such large range in elevations creates various climatic conditions and therefore many different landscapes, including semi-desert, juniper woodland, deciduous forest, mountain steppe, and sub-alpine area. The terrain is rigorous containing number of deep canyons, cliffs, and rocky outcrops (Aghababyan *et al.* 2015).

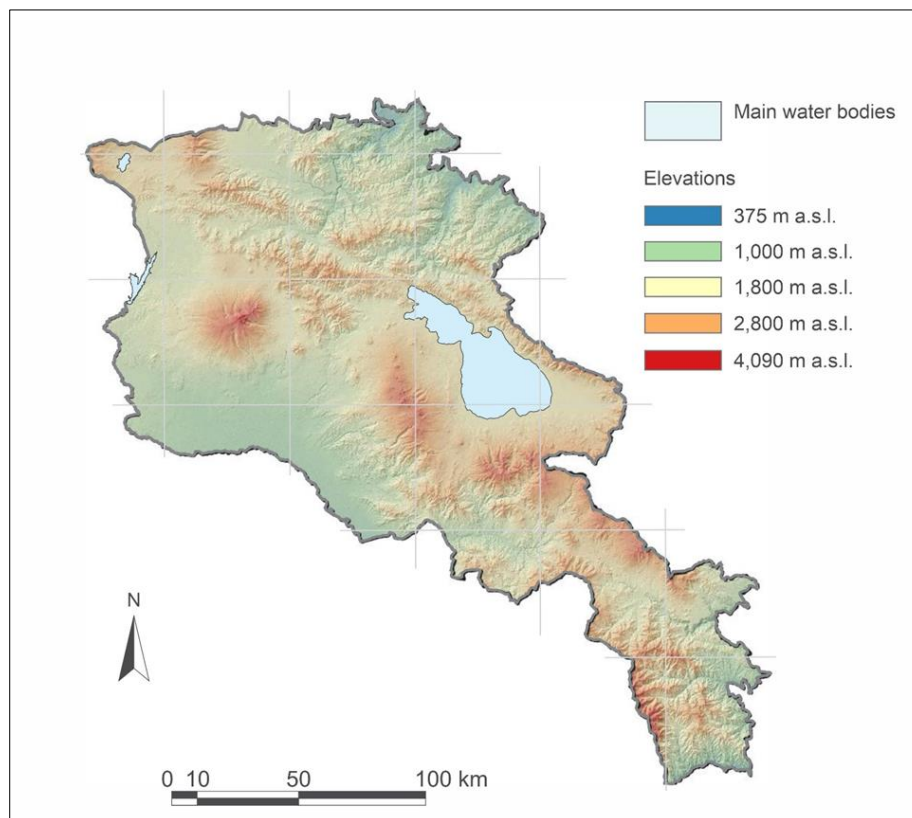


Figure 1 Terrain map of Armenia

2. Material and methods

2.1. Collection of data on use of Public Hunting Lands by hunters

Information on the possible hunting pressure on the areas of international conservation concern was gathered by conducting questionnaire surveys of the heads and members of seven Hunting Unions. Hunters' responses were kept anonymous to reduce the risk of false reporting, as the questions about harvesting could be rather sensitive. Considering that, we asked the Hunting Unions to collect the filled-out questionnaires in closed envelopes, which contained no personal information. The survey was conducted in the period from 5th of March till 10th of May of 2022 after closing the 2021–2022 hunting season (Order 314-N of the Minister of Environment, 11 August of 2021). A total of 820 questionnaires were issued (65–75 members per union; median = 73), which generated 394 responses, contributing to the survey. The following questions and answers' options were included in the questionnaire:

- How often do you hunt? For answering the question, the following options were provided: several times per year, once per year, not every year.
- Which hunting lands do you mainly visit for hunting – mark the lands on the map and prioritize the most often visited with numbers – 1,2,3, where “1” means most often used PHL and “3” least often used one; for answering the question a map of the hunting lands was supplied in the questionnaire.
- In which province do you live – tick the province in the list below? For answering the question, a list of 11 provinces was given below the question.

The interviews were conducted with the staff of the State Inspectorate for Nature Protection and Mineral Resources as the body that is responsible for monitoring of the hunting process. The semi-structured interviews with the inspectors from four provinces of Ararat, Armavir, Shirak and Lori, were aimed at determination of inspectors' ability to detect poaching of various protected species. The answers were recorded on the blank, but the voice recording of the interview wasn't conducted to keep the atmosphere rather relaxed and informal. The last interview was conducted with the owners of Armash fish-farm, as one of the most popular areas for waterbird harvesting. The interview was semi-structured and was aimed at obtaining a rough idea on the total number of hunters who visit the fish-farm annually for waterbird hunting. As for previous case, the answers were recorded on the blank, but no voice recording was used. In Armenia the involvement of an Institutional Review Board (IRB) is not required by the legislation, and there were no IRB involved.

To analyse hunting statistics, for each year in the period of 2014-2019, we obtained data on the timing of the hunting season, game species, and the national annual bag recorded for waterfowl (ducks, coots, and moorhens). These data were gathered from decrees of Ministry of Nature Protection of the Republic of Armenia (2014, 2015b, 2016, 2017, 2018; later renamed as the Ministry of Environment of the Republic of Armenia, 2019).

2.2. Collection of data on bird distribution and abundance

The data on bird distribution and abundance was collected with the aim to compare the breeding ranges of priority species with the overlapping areas. Systematic collection of data on breeding waterbird numbers and distribution was initiated as part of a National Bird Monitoring Program, conducted annually since 2003, with application of the standard European Monitoring Grid (10x10km) to Armenia (Council of Europe 2018) resulting in 374 count squares being outlined for the country. The count squares were allocated to one of three groups: “annual counts” where, once counting commenced, the squares were surveyed and the birds counted each year thereafter; “systematic counts” where, once counting commenced, the squares were surveyed every 2–3 years thereafter; and “opportunistic counts”, where counts were carried out when the opportunity arose. During the period of 2003–2019 a total of 325 squares were visited at least once, including 147 squares with systematic data collection (Figure 2). The systematic count squares were selected to represent different parts of the country and all types of habitats in Armenia.

In all three groups of the squares the data was gathered from two survey methods, standard counts, and opportunistic observations (Voříšek *et al.* 2008). The volunteer force was widely used for the data collection (Keller *et al.* 2020).

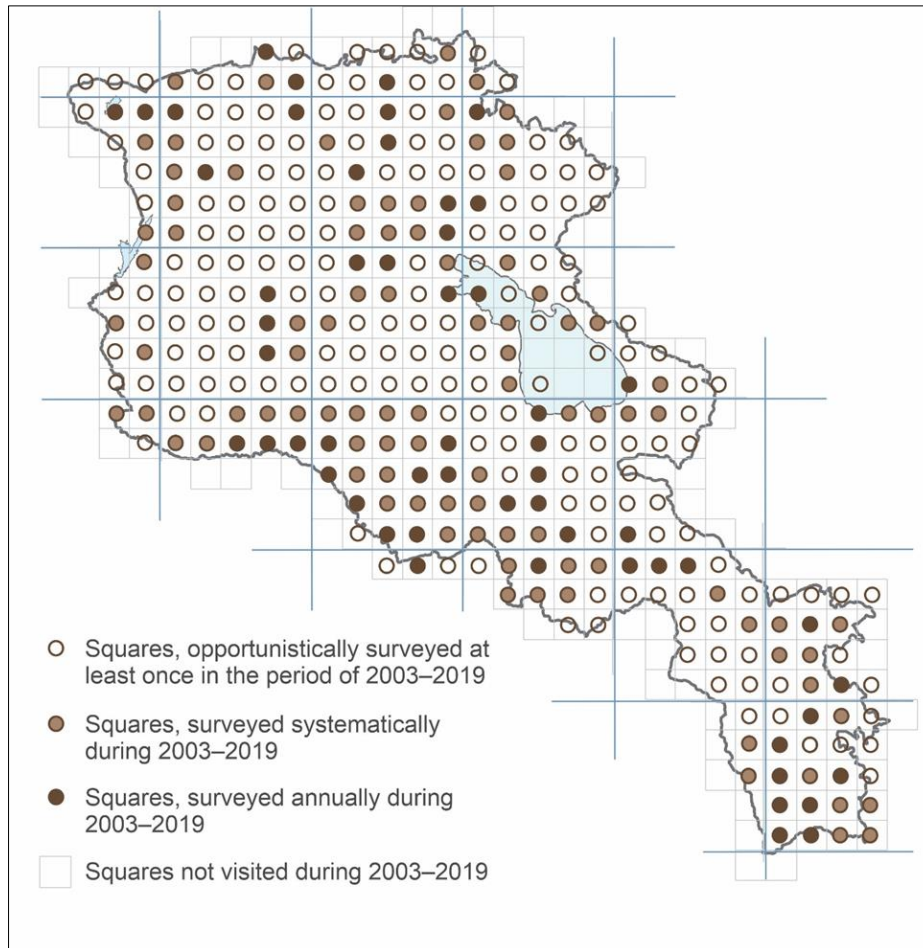


Figure 2 Bird survey areas in Armenia. Bold lines indicate 50 x 50 km squares, and grey lines indicate 10 x 10 km squares.

2.3. Data analysis

For analysis of overlap of the PHLs with the internationally recognized conservation areas we used ArcGIS 10.1, where we generated new polygons of the overlapping areas, measured these areas, and then calculated the percent of the overlapping area from the area of the specific internationally recognized conservation area, e.g., a percent of overlapping area from the total areas of IBAs, where the area of IBAs is taken as 100%.

For analysis of the frequency of use of the various PHLs they have conditionally been divided into several categories. To set up the categories, we first have extrapolated the number of visits (of a PHL) by the total number of hunters, assuming that there are 10,000 active hunters in the country. Also, we assumed the minimal number of visits of the PHLs by the hunters in the following way:

- For the answer “Infrequently visited”, we assume that the hunter visits the PHL mentioned once every two years and assign the value 0.5 for the response.
- For the answer “Regularly visited”, we assume that the hunter visits the PHL mentioned once per year and assign the value 1 for the response.
- For the answer “Most frequently visited”, we assume that the hunter visits the PHL mentioned twice per year and assign the value 2 for the response.

Then, the categories have been set up in the following way: if the computation shows that the area can be visited by over 1,000 hunters per year, it is considered belonging to the category “Most frequently visited”; if the area is visited by less than 1,000 but over 188 times (the number of days within a hunting season, meaning that there is at least one hunter per day in the certain PHL), then the area is considered belonging to the category “Regularly visited”; if the area is visited by less than 188 times but at least once (in the context of the current survey), then the area is considered belonging to the category “Infrequently visited”; and eventually, if there are no visits reported within the current survey, the area is

considered belonging to the “Rarely visited”. It should be stressed once again that the number of visits is assumed as minimal to compare the frequency of use of the PHLs, as the real number of visits is still a subject of a different study.

For analysis of the interrelations between the frequency of use of various PHLs with other characteristics (like the province where the hunters live) we used a cross-tabulation analysis, where the PHLs were put into the rows, the frequency of hunting was put as columns, while at the crossing the number of responses was generated. Similarly, the cross-tabulation analysis of PHLs and the provinces, where the hunters live, was conducted.

For analysis of waterbirds’ ranges, individual-specific breeding codes (Voříšek *et al.* 2008) were used to confirm breeding, and then the mapping of the breeding distribution of various waterbird species was implemented on the 10 x 10 sq km grid. A given square was considered to be occupied if pairs were recorded, through incidental observation or standardised count, in any year of the 17-year (2003–2019) study.

Then, the composition of priority bird species (the species included in IUCN Red List, Red Book of Animals of Armenia, Resolution 6 of Bern Convention, or Annex II of AEWA) was extracted for the overlapping areas (Table 1).

3. Results

3.1. Overlap of the Public Hunting Lands with the international priority conservation areas

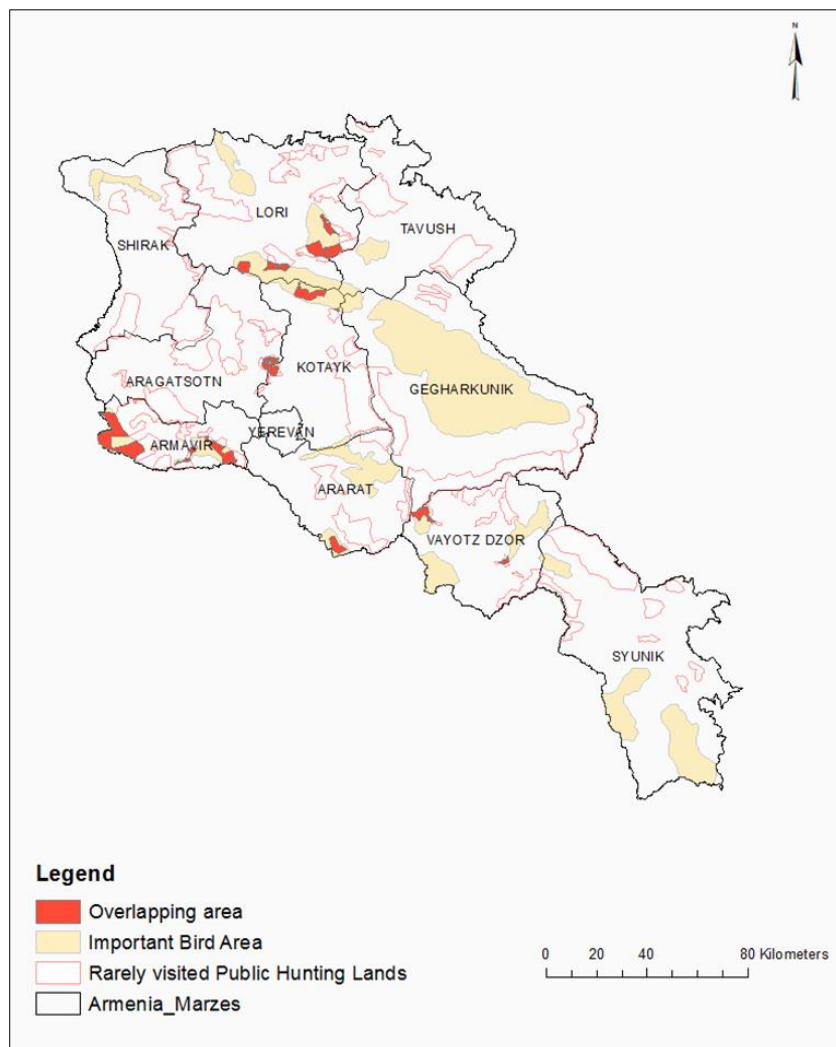


Figure 3 Overlap of the areas of Public Hunting Lands and Important Bird and Biodiversity Areas. The black lines indicate dividing of the country into provinces (marzes); the empty polygons outlined with pink indicate Public Hunting Lands; the yellow polygons indicate Important Bird and Biodiversity Areas; the red polygons indicate overlapping areas.

In total the area of overlap of the PHLs with the existing 18 IBAs represents 40,660 ha or 10% of the total IBAs' area (Figure 3). Three of the overlapping areas are located in Ararat Plain covering wetland habitats and semi-deserts of the western part of the republic. The others are located at the grasslands often alternated with the woodlands.

The overlapping areas of PHLs with the existing 23 Emerald Sites equates to 84,933 ha or 8% the total Emerald Sites' area (Figure 4). The Emerald Sites cover a larger area than the IBAs and thus there are more areas overlapping with the wetlands of Ararat Plain, semi-deserts of the foothills of various mountain ridges, as well as grasslands and woodlands.

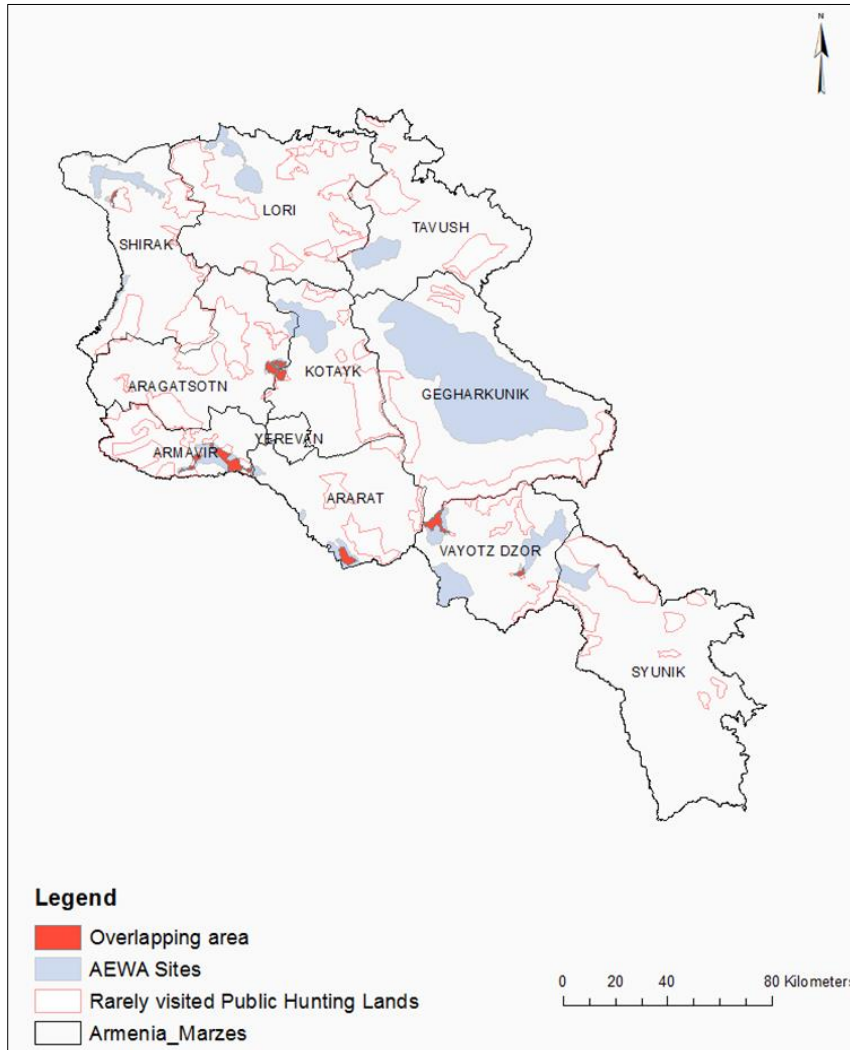


Figure 4 Overlap of the areas of Public Hunting Lands and Emerald Sites. The black lines indicate dividing of the country into provinces (marzes); the empty polygons outlined with pink indicate Public Hunting Lands; the blue polygons indicate AEWA Sites; the red polygons indicate overlapping areas.

The overlapping areas of PHLs with the existing 18 candidate critical sites for migratory waterbirds (AEWA sites) is 14,864 ha or 8% (Figure 5). AEWA sites have lower percent of the overlapping areas than the others and nevertheless, these sites represent the key wetland areas, which serve for the migratory waterbirds.

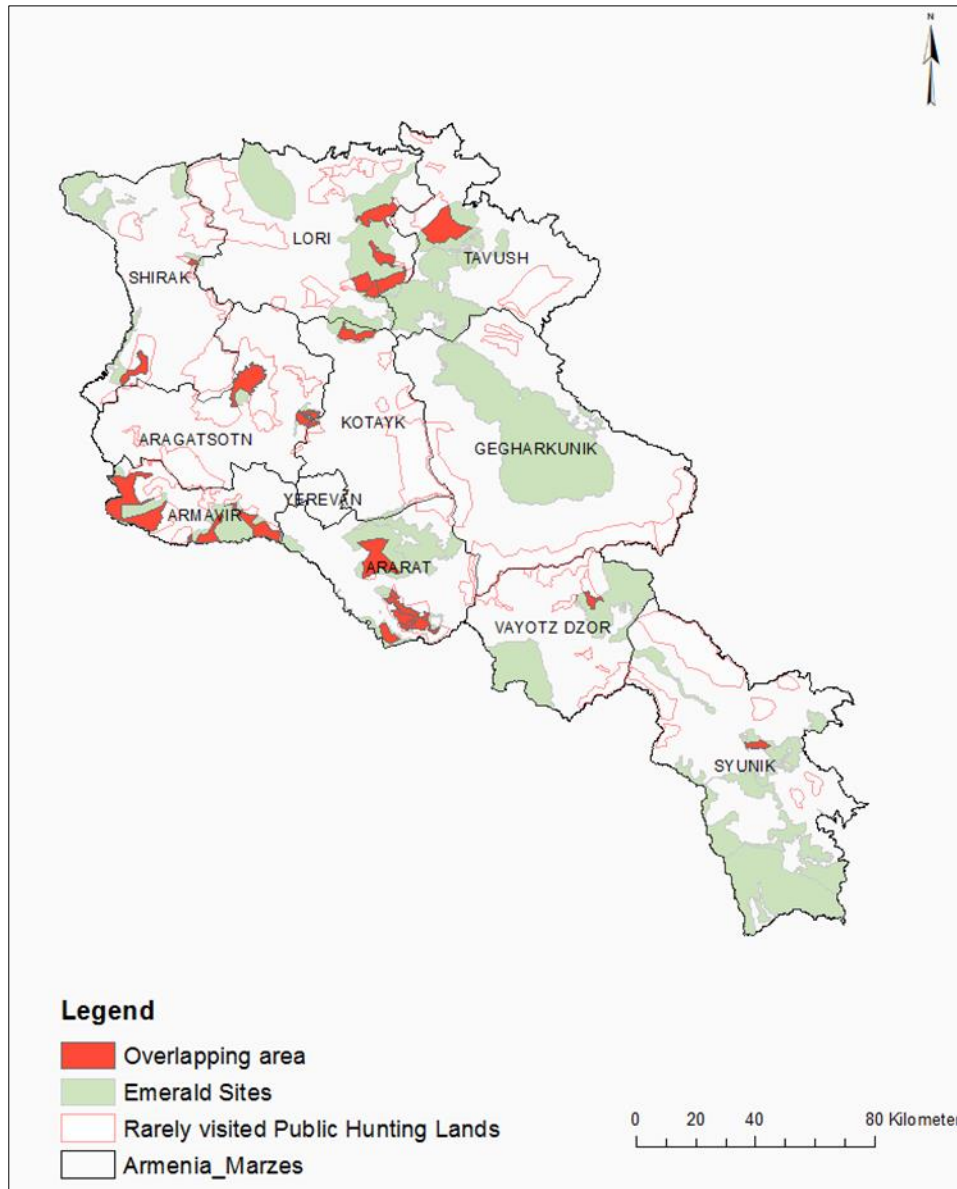


Figure 5 Overlap of the Public Hunting Lands and candidate critical sites for migratory waterbirds. The black lines indicate dividing of the country into provinces (marzes); the empty polygons outlined with pink indicate Public Hunting Lands; the green polygons indicate Emerald Sites; the red polygons indicate overlapping areas.

3.2. Use of Public Hunting Lands by hunters

The results of the analysis of the frequency of use of the PHLs (Table 2) show that among the 40 PHLs only four (10%) are used most frequently, being visited 1,158 to 2,513 (in average – 2,110±318) times per annum, while 12 (30%) are used regularly being visited 203 to 711 (in average – 444±56) times per annum, and the other eight (20%) are used infrequently being visited 51 to 152 (in average – 117±11) times per annum. The rest of 16 PHLs are estimated to be visited rarely or just occasionally (Table 2, Figure 6). At the meantime, it should be stated that the use of PHLs is significantly ($\chi^2 = 2397.029$, $df = 207$, $p < 0.001$) influenced by the province, where the hunters live. Thus, for example, all 58 hunters that inhabit Ararat province, hunt in the PHLs, located in Ararat; all 41 hunters that inhabit Armavir province, hunt in the PHLs, located in Armavir; all 37 hunters that inhabit Shirak province, hunt in the PHLs, located in Shirak. Hunters, which live in Yerevan, mostly hunt in PHLs located in Armavir (65%), Ararat (16%), and Aragatsotn (11%) provinces.

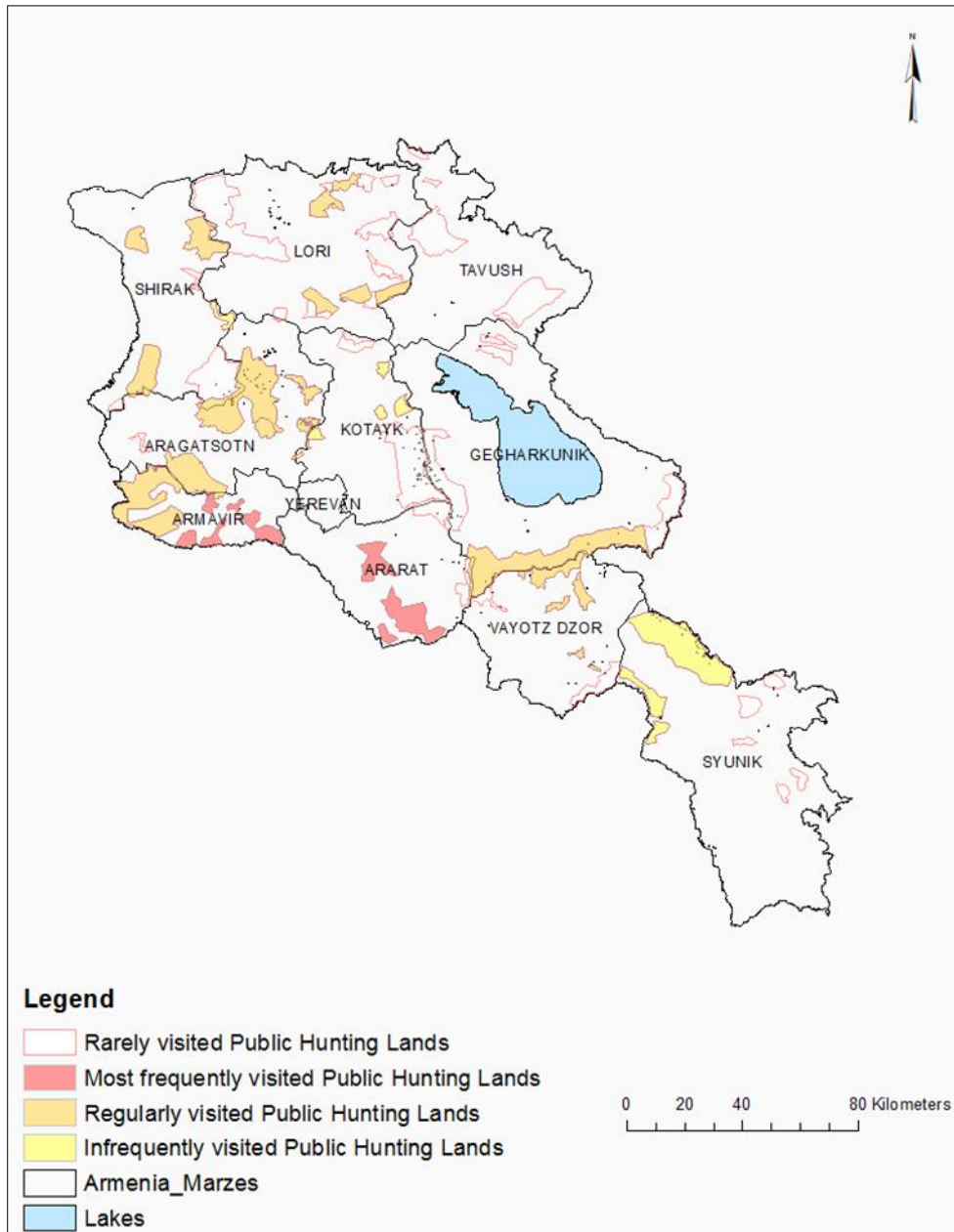


Figure 6 Use of the Public Hunting Lands by Hunters. The black lines indicate dividing of the country into provinces (marzes); the empty polygons outlined with pink indicate rarely visited Public Hunting Lands; the pale-yellow polygons indicate infrequently visited Public Hunting Lands; the orange-yellow polygons indicate regularly visited Public Hunting Lands; the red polygons indicate most frequently visited Public Hunting Lands

3.3. Fauna of priority waterbird species in the frequently hunted areas of overlap

The fauna of the priority species, which occur in the overlapping areas includes the species protected by International Union for Conservation of Nature (IUCN), Red Book of Animals of Armenia, Resolution 6 of the Bern Convention, Annex II of AEW. In total, in Armenia there are ten hotspots, which hold significant number of protected waterbirds in breeding season and large congregations of waterbirds in migration period. Among those hotspots, the ones, which are located in Ararat Plain overlap with the PHLs (Figure 7). In these overlapping areas, there are 129 priority waterbird species recorded (Table 1).

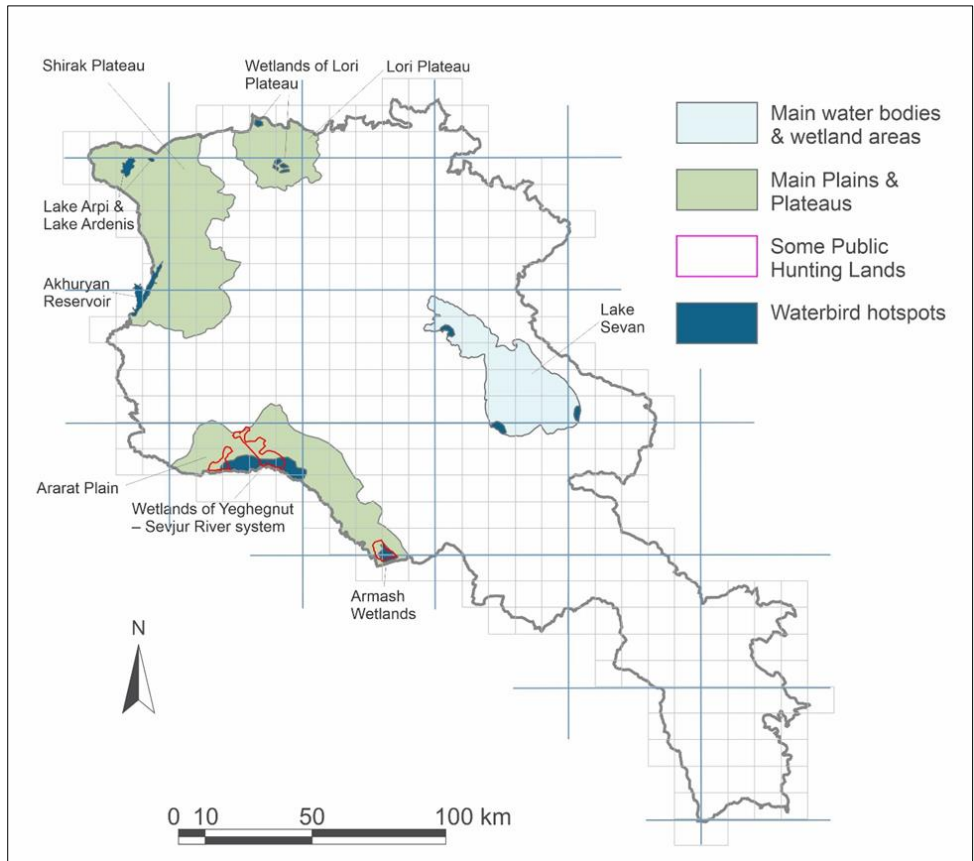


Figure 7 Waterbird hotspots and Public Hunting Lands. The pale blue polygons indicate water bodies; the pale green polygons indicate main plains and plateaus; the empty polygons outlined with red indicate Public Hunting Lands; the dark blue polygons indicate waterbird hotspots.

Table 1 Priority species, which occur within the areas of overlap.

Latin names	English names	IUCN Red List	RDB Armenia	Res 6 Bern convention	AEWA Annex II
ANATIDAE					
<i>Cygnus olor</i>	Mute Swan		VU		X
<i>Cygnus columbianus</i>	Tundra Swan		VU	X	X
<i>Cygnus cygnus</i>	Whooper Swan		VU	X	X
<i>Anser albifrons</i>	Greater White-fronted Goose		VU	X	X
<i>Anser erythropus</i>	Lesser White-fronted Goose	VU	VU	X	X
<i>Anser anser</i>	Graylag Goose		VU		X
<i>Branta ruficollis</i>	Red-Breasted Goose	VU	EN	X	X
<i>Tadorna ferruginea</i>	Ruddy Shelduck			X	X
<i>Tadorna tadorna</i>	Common Shelduck				X
<i>Mareca penelope</i>	Eurasian Wigeon				X

<i>Mareca strepera</i>	Gadwall				X
<i>Anas crecca</i>	Common Teal				X
<i>Anas platyrhynchos</i>	Mallard				X
<i>Anas acuta</i>	Northern Pintail				X
<i>Spatula querquedula</i>	Garganey				X
<i>Spatula clypeata</i>	Northern Shoveler		VU		X
<i>Marmaronetta angustirostris</i>	Marbled Teal	VU	EN	X	X
<i>Netta rufina</i>	Red-crested Pochard				X
<i>Aythya ferina</i>	Common Pochard	VU			X
<i>Aythya nyroca</i>	Ferruginous Pochard	NT	VU	X	X
<i>Aythya fuligula</i>	Tufted Duck				X
<i>Aythya marila</i>	Great Scaup				X
<i>Clangula hyemalis</i>	Long-tailed Duck				X
<i>Melanitta fusca</i>	White-Winged Scoter	VU	DD		X
<i>Melanitta nigra*</i>	Common Scoter*				X
<i>Bucephala clangula</i>	Common Goldeneye				X
<i>Mergellus albellus</i>	Smew			X	X
<i>Mergus serrator</i>	Red-breasted Merganser				X
<i>Mergus merganser</i>	Common Merganser				X
<i>Oxyura leucocephala</i>	White-headed Duck	EN	EN	X	X
GAVIIDAE					
<i>Gavia stellata</i>	Red-throated Loon			X	X
<i>Gavia arctica</i>	Arctic Loon			X	X
PODICIPEDIDAE					
<i>Tachybaptus ruficollis</i>	Little Grebe				X
<i>Podiceps cristatus</i>	Great Crested Grebe				X
<i>Podiceps grisegena</i>	Red-necked Grebe		VU		X
<i>Podiceps auritus</i>	Horned Grebe				X
<i>Podiceps nigricollis</i>	Black-necked Grebe				X
PHALACROCORACIDAE					
<i>Phalacrocorax carbo</i>	Great Cormorant		VU		X
<i>Microcarbo pygmeus</i>	Pygmy Cormorant		VU	X	X
PELECANIDAE					
<i>Pelecanus onocrotalus</i>	Great White Pelican		VU	X	X
<i>Pelecanus crispus</i>	Dalmatian Pelican	NT	EN	X	X
ARDEIDAE					
<i>Botaurus stellaris</i>	Great Bittern			X	X

<i>Ixobrychus minutus</i>	Little Bittern			X	X
<i>Nycticorax nycticorax</i>	Black-crowned Night-heron			X	X
<i>Ardeola ralloides</i>	Squacco Heron			X	X
<i>Bubulcus ibis</i>	Cattle Egret				X
<i>Egretta garzetta</i>	Little Egret			X	X
<i>Ardea alba</i>	Great White Egret			X	X
<i>Ardea cinerea</i>	Grey Heron				X
<i>Ardea purpurea</i>	Purple Heron			X	X
CICONIIDAE					
<i>Ciconia nigra</i>	Black Stork		VU	X	X
<i>Ciconia ciconia</i>	White Stork			X	X
THRESKIORNITHIDAE					
<i>Plegadis falcinellus</i>	Glossy Ibis		VU	X	X
<i>Platalea leucorodia</i>	Eurasian Spoonbill		EN	X	X
PHOENICOPTERIDAE					
<i>Phoenicopterus roseus</i>	Greater Flamingo		DD	X	X
ACCIPITRIDAE					
<i>Haliaeetus albicilla</i>	White-tailed Eagle		EN	X	
<i>Circus aeruginosus</i>	Western Marsh-harrier			X	
PANDIONIDAE					
<i>Pandion haliaetus</i>	Osprey		VU	X	
RALLIDAE					
<i>Rallus aquaticus</i>	Water Rail				X
<i>Porzana porzana</i>	Spotted Crake			X	X
<i>Zapornia parva</i>	Little Crake			X	X
<i>Zapornia pusilla</i>	Baillon's Crake			X	X
<i>Crex crex</i>	Corn Crake		VU	X	X
<i>Gallinula chloropus</i>	Common Moorhen				X
<i>Porphyrio poliocephalus</i>	Grey-headed Swamphen		DD		
<i>Fulica atra</i>	Common Coot				X
GRUIDAE					
<i>Grus grus</i>	Common Crane		EN	X	X
<i>Anthropoides virgo</i>	Demoiselle Crane		VU		X
HAEMATOPODIDAE					
<i>Haematopus ostralegus</i>	Eurasian Oystercatcher		VU		X
RECURVIROSTRIDAE					

<i>Himantopus himantopus</i>	Black-winged Stilt		VU	X	X
<i>Recurvirostra avosetta</i>	Pied Avocet		VU	X	X
BURHINIDAE					
<i>Burhinus oedicephalus</i>	Eurasian thick-knee			X	
GLAREOLIDAE					
<i>Glareola normanni</i>	Black-winged Pratincole	NT	VU	X	X
<i>Glareola pratincola</i>	Collared Pratincole		VU	X	X
CHARADRIIDAE					
<i>Charadrius dubius</i>	Little Ringed Plover				X
<i>Charadrius hiaticula</i>	Common Ringed Plover				X
<i>Charadrius alexandrinus</i>	Kentish Plover		VU	X	X
<i>Charadrius leschenaultii</i>	Greater Sand Plover		EN	X	X
<i>Charadrius asiaticus</i>	Caspian Plover			X	X
<i>Charadrius morinellus</i>	Eurasian Dotterel			X	X
<i>Pluvialis apricaria</i>	Eurasian Golden-plover			X	X
<i>Pluvialis squatarola</i>	Grey Plover				X
<i>Vanellus spinosus</i>	Spur-winged Lapwing			X	X
<i>Vanellus gregarius</i>	Sociable Lapwing	CR	EN	X	X
<i>Vanellus leucurus</i>	White-tailed Lapwing		VU		X
<i>Vanellus vanellus</i>	Northern Lapwing	NT			X
SCOLOPACIDAE					
<i>Calidris alba</i>	Sanderling				X
<i>Calidris minuta</i>	Little Stint				X
<i>Calidris temminckii</i>	Temminck's Stint				X
<i>Calidris ferruginea</i>	Curlew Sandpiper	NT			X
<i>Calidris alpina</i>	Dunlin				X
<i>Calidris falcinellus</i>	Broad-billed Sandpiper				X
<i>Calidris pugnax</i>	Ruff			X	X
<i>Lymnocyptes minimus</i>	Jack Snipe				X
<i>Gallinago gallinago</i>	Common Snipe				X
<i>Gallinago media</i>	Greater Snipe	NT	VU	X	X
<i>Scolopax rusticola</i>	Eurasian Woodcock				X
<i>Limosa limosa</i>	Black-tailed Godwit	NT	VU		X
<i>Limosa lapponica</i>	Bar-tailed Godwit			X	X
<i>Numenius phaeopus</i>	Whimbrel				X
<i>Numenius arquata</i>	Eurasian Curlew	NT	VU		X

<i>Tringa erythropus</i>	Spotted Redshank				X
<i>Tringa totanus</i>	Common Redshank				X
<i>Tringa stagnatilis</i>	Marsh Sandpiper				X
<i>Tringa nebularia</i>	Common Greenshank				X
<i>Tringa ochropus</i>	Green Sandpiper				X
<i>Tringa glareola</i>	Wood Sandpiper				X
<i>Xenus cinerea</i>	Terek Sandpiper			X	X
<i>Actitis hypoleucos</i>	Common Sandpiper				X
<i>Arenaria interpres</i>	Ruddy Turnstone				X
<i>Phalaropus lobatus</i>	Red-necked Phalarope			X	X
LARIDAE					
<i>Ichthyaetus ichthyaetus</i>	Great Black-headed Gull				X
<i>Ichthyaetus melanocephalus</i>	Mediterranean Gull			X	X
<i>Hydrocoloeus minutus</i>	Little Gull			X	X
<i>Chroicocephalus ridibundus</i>	Common Black-headed Gull				X
<i>Chroicocephalus genei</i>	Slender-billed Gull			X	X
<i>Larus canus</i>	Mew Gull				X
<i>Larus fuscus</i>	Lesser Black-backed Gull				X
<i>Larus cachinnans</i>	Caspian Gull				X
<i>Larus armenicus</i>	Armenian Gull		VU		X
<i>Sternula albifrons</i>	Little Tern		VU	X	X
<i>Gelochelidon nilotica</i>	Gull-billed Tern		VU	X	X
<i>Hydroprogne caspia</i>	Caspian Tern			X	X
<i>Thalasseus sandvicensis</i>	Sandwich Tern			X	X
<i>Sterna hirundo</i>	Common Tern			X	X
<i>Sterna paradisaea</i>	Arctic Tern			X	X
<i>Chlidonias hybridus</i>	Whiskered Tern		VU	X	X
<i>Chlidonias niger</i>	Black Tern			X	X
<i>Chlidonias leucopterus</i>	White-winged Tern			X	X
ALCEDINIDAE					
<i>Alcedo atthis</i>	Common Kingfisher			X	
MOTACILLIDAE					
<i>Motacilla citreola</i>	Citrine Wagtail		VU		
LOCUSTELLIDAE					
<i>Locustella luscinioides</i>	Savi's Warbler		EN		
ACROCEPHALIDAE					

<i>Acrocephalus melanopogon</i>	Moustached Warbler			X	
<i>Acrocephalus agricola</i>	Paddyfield Warbler		EN		

Table 2 Visits of Public Hunting Lands.

Name of PHL	% of total visits among questioned hunters	Number of annual visits extrapolated for 10,000 active hunters	Conditional category
Armavir 003	19%	2,513	Most frequently visited
Armavir 002	17%	2,475	Most frequently visited
Ararat 003	14%	2,284	Most frequently visited
Ararat 002	8%	1,168	Most frequently visited
Lori 002	5%	711	Regularly visited
Shirak 001	5%	685	Regularly visited
Gegharkunik 003	4%	609	Regularly visited
Aragatsotn 001	5%	609	Regularly visited
Armavir 001	4%	558	Regularly visited
Shirak 002	4%	508	Regularly visited
Vayots Dzor 001	3%	431	Regularly visited
Aragatsotn 003	2%	330	Regularly visited
Vayots Dzor 002	2%	254	Regularly visited
Aragatsotn 002	2%	228	Regularly visited
Shirak 006	1%	203	Regularly visited
Lori 005	2%	203	Regularly visited
Syunik 001	1%	152	Infrequently visited
Kotayk 001	1%	127	Infrequently visited
Kotayk 002	1%	127	Infrequently visited
Syunik 002	1%	127	Infrequently visited
Vayots Dzor 003	1%	127	Infrequently visited
Kotayk 003	1%	127	Infrequently visited
Kotayk 004	1%	102	Infrequently visited
Shirak 004	0%	51	Infrequently visited

Among these waterbirds, there are 81 species, which belong to the potentially huntable birds and include 30 species of ducks, geese, and swans, eight species of rails, gallinules, and coots, and 43 species of waders. Among those, there are several species, which are critically vulnerable due to such overlap. These species are: White-headed Duck (*Oxyura leucocephala*) with 100% of the country's population located within the overlapping area, White-tailed Lapwing (*Vanellus leucurus*) with 100% of the country's population located within the overlapping area, Spur-winged Plover (*Vanellus spinosus*) with 100% of the country's population located within the overlapping area, Marbled Duck (*Marmaronetta angustirostris*) with 80% of the country's population located within the overlapping area, and Ferruginous Pochard (*Aythya nyroca*) with 90% of the country's population located within the overlapping area. Less threatened but still significantly vulnerable species are Kentish Plover (*Charadrius alexandrinus*) with 70% of the

country's population located within the overlapping area, Collared Pratincole (*Glareola pratincola*) with 70% of the country's population located within the overlapping area; and Northern Lapwing (*Vanellus vanellus*) with over 50% of the country's population located within the overlapping area.

4. Discussion

The paper demonstrates that the PHLs in Armenia have been allocated without proper consideration of distribution of priority conservation species, internationally recognized conservation sites, and distribution of game bird species. The obtained results correspond to the goals of the study, as they estimate the risks for various priority waterbird species, and in addition show the level of use of the PHLs by hunters.

Specifically, it was shown that the most frequently used PHLs are located in Ararat Plain and are overlapping with the important waterbird hotspots, which are recognized as IBAs, Emerald Sites, and AEWAs. These overlapping sites hold high diversity of waterbirds in breeding season and significant aggregations in migration season (Fayvush *et al.* 2016, Aghababyan *et al.* 2022b). Among these species, there are several critically important for conservation, such as White-headed Duck, White-tailed Lapwing, Spur-winged Plover, Marbled Duck, Ferruginous Pochard, Kentish Plover, Collared Pratincole, and Northern Lapwing, which can strongly decline due to such pressure. Moreover, hunting in these areas can also impact the congregatory populations of migratory waterbirds, which also include a number of threatened species, such as Black-tailed Godwit (*Limosa limosa*), Eurasian Curlew (*Numenius arquata*), Greater Snipe (*Gallinago media*), and others.

It appears that the overlapping of PHLs with the priority conservation areas in wetland dominated sites of Ararat Plain creates serious risks to the waterbird fauna including five species with 75-100% of distribution range located within the PHLs and other three species with 50-75% of distribution range located within the PHLs. The waterbirds are one of main objects of harvesting, as it is demonstrated by another study (Masaytis & Slobodyanik 2022), which shows that about 68% of the questioned hunters (n=45) prefer harvesting ducks, geese, and coots (rather than terrestrial game, like Grouse and Partridges), and these hunters would most probably not miss the opportunity of harvesting the rails, gallinules, snipes, lapwings, sandpipers, and other waders. The possibility of shooting the protected species and the difficulties of controlling was also reported by the State Inspection Body, which also states their being understaffed (with only 3-4 inspectors per province) and underfinanced. It is therefore justified that the number of those species show a moderate to steep decline as was demonstrated in other studies (Aghababyan 2021, Aghababyan *et al.* 2021a, Aghababyan *et al.* 2021b, Aghababyan *et al.* in review).

From another side, it appears that the PHLs were established without serious consideration of the real distribution of the game animals, and as a result, they are used unevenly, with a strong pressure on several areas and almost no visits to many others.

Also, it should be mentioned that the wetlands in Armenia have been consistently and purposefully reduced over the last century (Jenderedjian 2005, Jenderedjian *et al.* 2002, Jenderedjian *et al.* 2004) and the current Emerald Network covers most of the wetlands located in non-protected areas (Fayvush *et al.* 2016). It means that potential sites for harvesting waterbirds, which will not conflict with the international priority areas, are very restricted, and thus for setting up waterbird hunting, the restoration of wetlands in Ararat Plain should be considered. Such practice can be combined with establishment of hunting enterprises, taking the hunting in the country to a completely different level of sustainable management.

4.1. Management implications

Taking the mentioned above into consideration it is strongly recommended to implement the following actions:

- Review the PHLs and exclude those areas, which overlap with the sites of international conservation importance, especially those overlapping areas, which carry risks to the priority bird species.
- To set up other alternative PHLs, which will consider a real distribution of the game animals.
- Conduct a feasibility study of wetland restoration in Ararat Plain, as well as in the mountain plateaus, aimed at increase of breeding habitats and stopover points for the waterfowl and waders in order to provide alternatives for those hunting lands, which will be excluded for conservation purposes.

5. Conclusion

The observed overlapping of PHLs with the important waterbird hotspots, which are recognized as IBAs, Emerald Sites, and AEWA Sites creates serious risks for many breeding and migratory waterbird species. The proposed review of the PHLs can help in improvement of both: sustainability of the hunting and protection of threatened species. Restoration of the wetlands can be a strong supplement, which can potentially create an alternative for the large hunters' community in Armenia.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have no relevant financial or non-financial interests to disclose.

Statement of ethical approval

According to Armenian legislation, the survey of hunters on their use of Public Hunting Lands doesn't require any permits.

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