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Full Length Research Paper

A three years study of the diversity and density of waterfowl and waders in Sorkhrud International Wetland (October 2007 – March 2010)

Mohsen Ahmadpour [1]*, Mohammad Hosein Sinka Karimi[2], Seyed Mahmoud Ghasempouri[3], Mousa Ahmadpour[1] and Younes Yaghobzadeh[4]

[1]Young Researchers Club, Qaemshahr Branch, Islamic Azad University, Qaemshahr, Iran.
[2]Young Researchers Club, Nour Branch, Islamic Azad University, Nour, Iran.
[3]Department of Environmental Science, Faculty of Natural Resources and Marin Science, University of Tarbiat Modares, Iran.
[4]Department of Environmental Science, University of Allameh Mohaddes Nouri, Iran.

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A three year study of the seasonal changes in the biodiversity and the density of the waterfowl and wader were carried out in Sorkhrud International Wetland which is a part of Feridonkenar's intentional wetlands (registered in Ramsar Convention). Birds were counted through the total count method. The study included 119592, 140901 and 139160 waterfowl and waders were counted in the winter of 2007, 2008 and 2009 respectively. The average density of species in this wetland varied from 64 to 76 birds in a ha. In all of the mentioned years, maximum density started with waterfowl and continued by waders in one month period respectively. Common Teal *(Anas crecca)*, White-fronted Goose *(Anser anser)* and Mallard (*Anas platyrhynchos*) were the dominant species in almost all years. Overwintering birds formed the major population of the migratory birds of the area. On the average, Sorkhrud International Wetland had hosted 21 species, 133217 birds, a species richness of 0.22 and 1.14 for Menhinick and Margalef respectively, a species diversity of 0.68 for Simpson, 0.7307 for Pauly and 1.66 for Shannon-Wiener.

Key words: Sorkhrud international wetland, waterfowl and waders, biodiversity indices.

INTRODUCTION

Presently, there are 50 different definitions for a wetland available (Dugan, 1990). However, according to the International Wetlands Convention, the wetland is a place were water is the main factor in its plant and animal environment; hence, wetlands refer to all river, lake, coastal, forest and pond areas as well as fish farms, canals and the like with a maximum depth of 6 m during the tide (Ramsar Bureau Convention, 2000).

Wetland ecosystems are natural bounty important for human societies, as well as, other dependent ecosystems (Tradgill, 1999). Destroying wetlands causes the extinction of native species depending on these special habitats (UNEP, 2001). Iran has more than 250 wetlands covering a total area of 2.5 million ha. Twenty two of them covering an area of 1.8 million ha are registered as international wetlands in Ramsar Convention and are also known with the same title (Ramsar Bureau Convention, 2010).

Biodiversity is one of the most important current issues related to wildlife conservation which reached a milestone through the establishment of the biodiversity convention at the earth summit in 1992. The issue of biodiversity is a necessity for the human life, economic issues,

*Corresponding author. E-mail: M_ahmadpour_en@yahoo.com. Fax: +981125288251.

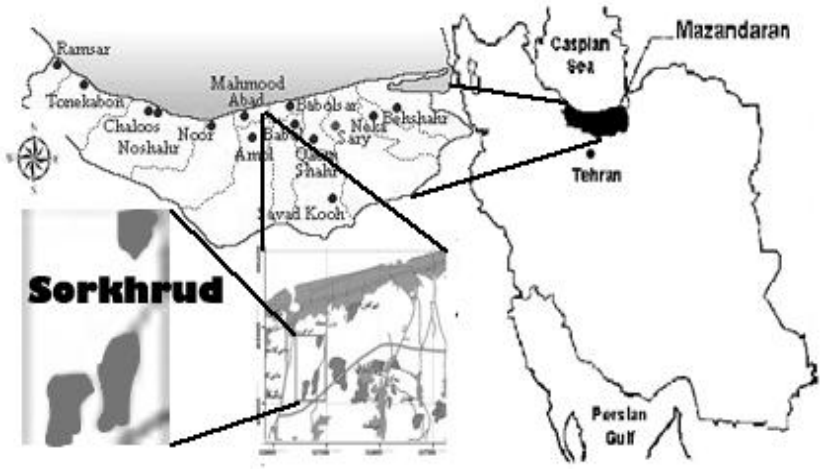

Figure 1. The geographical position of Sorkhrud International Wetland in Iran.

sustainability and the performance of ecosystems (Singh, 2002). Waterfowl are the most important organisms with aesthetic, recreational, social and many other values (Elmberg et al., 1994).

Like any group of birds waterfowls depend on the particular condition of their habitats, such as water depth and temperature, vegetation, food supply, etc. (Elmberg et al., 1994). Therefore, comparison study of birds in a habitat over several years can provide useful information about conditions of a given habitat (Torres, 1995).

The environmental organization has established several wildlife refuge areas to repair and compensate for the damages to the nature. Five wildlife refuges, namely Feridounkenar, Semaskande, Dashte Naz, Dodange and Miankaleh, have been established in Mazandaran. Feridounkenar, Sorkhrud and Azbaran lagoons were registered in Ramsar Convention as international hunting-prohibited lagoons. These refuges are in the form of forest-wetland ecosystems. With important ecological, economical, social, environmental improvement values and the like.

As it is easy to observe birds in the nature, any potential threats to their habitat can be identified through the continuous study of the species diversity, population changes and their living conditions. Studying the annual diversity and changes in the populations of the birds in the three wetlands of Sorkhrud aims to perceive their significance and quality. Concerning the realm of this research, some other studies have also been carried out by Khaleghizadeh and Behrouzi-Rad (2004); Amini and Sehhatisabet (2007); Akosim et al. (2008); Nanda et al. (2010); Rajpar and Zakaria (2010). Most previous researches in Iran are related to the monthly study of the species diversity of waterfowl and waders while there are few scientific reports on the analysis of the multiyear census (Perez-Arteaga and Gaston, 2004).

The main aim of this study was to obtain further information about the species diversity in the mentioned locations over several past years. On the other hand, we try to have a comparison between native people and local trappers' conservation method (a kind of CCA: community conserved area which recently is considered with IUCN and governmental protection. We also found the Damgah owners' method is more sustainable than other methods. This result also had confirmed results shown by the MCCA/MAWD-Finland final report: Vuosalo-Tavakoli et al. (2007) (the Finish project entitled MAWD).

MATERIALS AND METHODS

The target area

Sorkhrud wetland is located in the Western part of Feridonkenar International Wetlands; it is man-made wetland consisting of three parts known as Damgah. The eastern damgah lies at longitude 36° 39' east and at latitude 52° 29', the western damgah of this wetland lies at longitude 36° 39' east and at latitude 52° 27' and the new damgah lies at longitude 36° 39' east and at latitude 52° 28'. This area is -23 m above sea level. Sorkhrud Wetland is 103 ha large (Figure 1). These areas are valuable places for migratory birds as their winter habitat. Siberian Crane (Grus leucogeranus), for example, migrates to this area every year.

The eastern damgah is in fact a harvested rice fields and damgah keepers are the local rise farmers that traps instead of hunt the waterfowls. Due to flat surface of the rise fields, the high level of ground water and the seasonal rainfalls, the area is flooded in early autumn. There are also streams flowing into these areas. The fields are commonly surrounded by fences and hedges, by forest or man planted trees, thus, providing safe and tranquil haven for the birds. In addition to the material food available in this wetland, the damgah-keepers spread tons of wheat, barn, straw, millet and the like to insure the food security of the migrating birds. Man-made wetlands have proud valuable wintering habitat for migratory waterfowl and waders (Viliani, 2010; Tourenq et al., 2002).

Table 1. Analysis of existing relationships of the species richness of Menhinick and Margalef, and the species diversity of Simpson, Shannon - Weiner and Pauly.

Relationship	Calculation formula	The range of changes
Margalef species richness	$\mathrm{Rmf} = \frac{S-1}{Ln(N)}$	
Menhinick Species richness	$\mathrm{Rmn} = \frac{S}{\sqrt{N}}$	
Simpson species diversity (Simpson,1949)	$D = 1 - \sum_{i-1}^{S} \left[\frac{n_i(n_i-1)}{N(N-1)}\right]$	$1 = \frac{1}{S}$
Shannon-Wiener species diversity	$\mathrm{H}' = -\sum_{i-1}^{S} [p_i \ln p_i]$	$\log_2(S)$
Pauly Species diversity	$\mathrm{j} = \frac{\mathrm{H}'}{\mathrm{H}'_{\mathrm{MAX}}}$	

Wetland birds, including waders and waterfowl, have been studied in this research. The research method included two parts: field and library and were counted through the total count method, this method is from Wetland International (WI) offer and done by a binocular (10 x 50). The bird census in this area started in late September and lasted till mid March every other week each year. Each time the census was conducted once in the morning and in the afternoon. The average monthly number of birds in the study area in 3 years was between 19932 to 23483 in count. It covers at least 21 different species. The average annual number of the species and their population, density and frequency percentages, and the rates of biodiversity indices according to the existing relationships (the species richness of Menhinick and Margalef, and the species diversity of Simpson, Shannon - Weiner and Pauly) about waders and waterfowl each year were analyzed using past excel software programs through the following formulas shown in Table 1.

In these relations, S is the number of species, N is the total population, n_i is the number of species n, p^i is the relative frequency of the species i, Rmf is the species richness index of Margalef, Rmn is the species richness index of Menhinick, D is the species richness index of Simpson, H' is the species diversity index of Shannon-Wiener and j is the species diversity index of Pauly.

RESEARCH FINDINGS

After recurrent studies on the Sorkhrud International Wetland from October 2007 to March 2010, 119592, 140910, and 139160 birds of 21 species of waders and waterfowl were counted in these three years respectively (Table 2). The annual biodiversity indices of waterfowl and waders in Sorkhrud International Wetland show that the highest species diversity belongs to 2008 (Table 3).

DISCUSSION

One of the tools related to wetland or lake quality is the use of diversity indices. If the diversity is greater, the formed societies would be more complex and thus, more stable. These societies are more capable in response to environmental changes (Magurran, 2003).

The annual study of the population and diversity of waterfowl and wader species over the area shows that the number of waterfowl was higher than the number of waders (Table 2, Figure 2, 3 and 5). It seems that one of the reasons for such a difference in the populations of these two groups of birds is that the habitat provided was to the benefit of the waders, tending towards waters with suitable depths. Therefore, a limited marginal low-depth land is appropriate for waders to feed and meeting their feeding behaviors maybe one reason for their small population. Hence, waders are seen in the wet and shallow margins of wetlands to be able to use the food in and margins of water (Quan et al., 2002). A sharp drop in the number of birds was once recorded in 2008 showing that autumn migrants passed this area but overwintering migrants had not entered the area till then. Moreover, a dramatic rise in the frequency of the birds was observed in December 2009 signifying the sudden influx of overwintering birds to the city. It can probably occur once every few years depending on climatic conditions. According to Figure 2, the time of the largest monthly population of four dominant species in Sorkhrud wetland is Common teal (*Anas crecca*); a dominant species in all of the involved years. The largest part of Common teal population entered the area in early autumn in 2007 and 2008; however, the largest part of its population entered the area in December 2008. A delay phase in migration was probably in direct relationship with the late coldness in Northern latitudes where Iranian Anseriformes starts its migration there. Figure 2 (The annual changes in the number of waterfowl in Sorkhrud wetland in different month) shows that the highest number of waterfowl belonged to January every year while the highest number

Table 2. The annual frequency of waterfowl and waders in Sorkhrud International Wetland (October 2007 to March 2010).

English name	Scientific name	Year		
		2007	2008	2009
White-fronted Goose	*Anser anser*	16123	19250	20055
Common Teal	*Anas crecca*	37300	50500	46600
Mallard	*Anas platyrhynchos*	14700	22400	19365
Common coot	*Fulica atra*	7650	2595	517
Pintail	*Anas acuta*	16150	13850	20700
Common snipe	*Gallinago gallinago*	3850	4270	4100
Green sandpiper	*Trinago ochropus*	3600	3620	4070
Great white heron	*Egretta alba*	83	80	173
Little egret	*Egreta garzetta*	130	141	226
Lapwing	*Vanellus vanellus*	3950	4591	7270
Grey heron	*Ardea cinerea*	82	54	122
Red-breasted goose	*Branta ruficollis*	0	0	3
Cormorant	*Phalacrocorax carbo*	90	96	226
Pochard	*Aythya ferina*	2650	2130	1560
Shelduck	*Tadorna tadorna*	0	40	26
Mute swan	*Cygnus olor*	3865	5170	1523
Whooper swan	*Cygnus cygnus*	1447	482	668
Wigeon	*Anas penelope*	93	274	393
Gadwall	*Anas strepera*	3520	5930	5658
Shoveler	*Anas clypeata*	4270	5320	5810
Falcated duck	*Anas falcate*	34	108	95
	Total	119592	140901	139160

[1] Falcated Duck in the population peak years for study area each year has been observed by the authors in the month of February and March. Since, the mentioned species had been reported in Iran so far, the authors believe that more studies are needed to ensure and only having a complete check list from FDK protected wetland.

Table 3. The annual biodiversity of waterfowl and waders in Sorkhrud International Wetland (October 2007 to March 2009).

Year / Index	2007	2008	2009
Margalef species richness	1.5	1.43	1.39
Mnhynyk species richness	0.17	0.33	0.16
Species diversity Simpson	0.73	0.69	0.62
Species diversity Shannon-Wiener	1.79	1.65	1.48
Species diversity Paulv	0.7369	0.7787	0.6726

of waders belonged to February. This one month difference between the maximum observed numbers for these two groups indicates the existing time difference in their migration which is not paid enough attention to, so far. Hence, we can confidently say that waders migration reach its peak one month later. In general, the results of our investigations show that the highest numbers of migrants in this wetland are presently in February and March. Generally speaking, Sorkhrud Wetland has rather good figures in terms of the number of birds, Menhinick and margalef species richness and Simpson, Shannon-Wiener and Pauly species diversity (Figure 4). Comparing the indices calculated in Hana Dam Lake Wetland in Semiron, Esfahan done recently, the figures were reported to be at the same levels but with a slight difference. It should be noted that the mentioned lake is regarded as one of the regions in IBA (Important Bird Area).

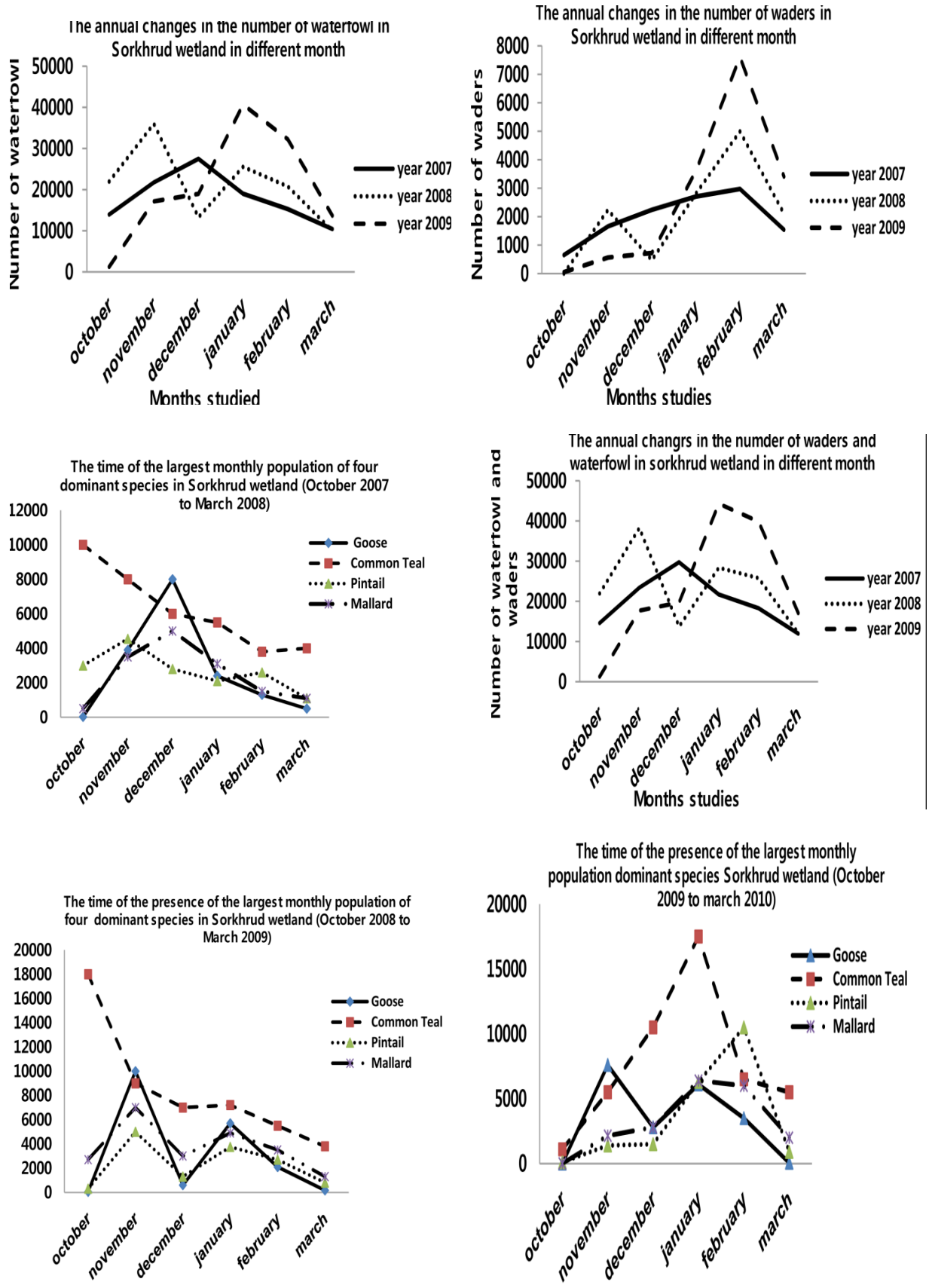

Figure 2. Exhibit presence of waterfowl and waders in Sorkhrud International Wetland.

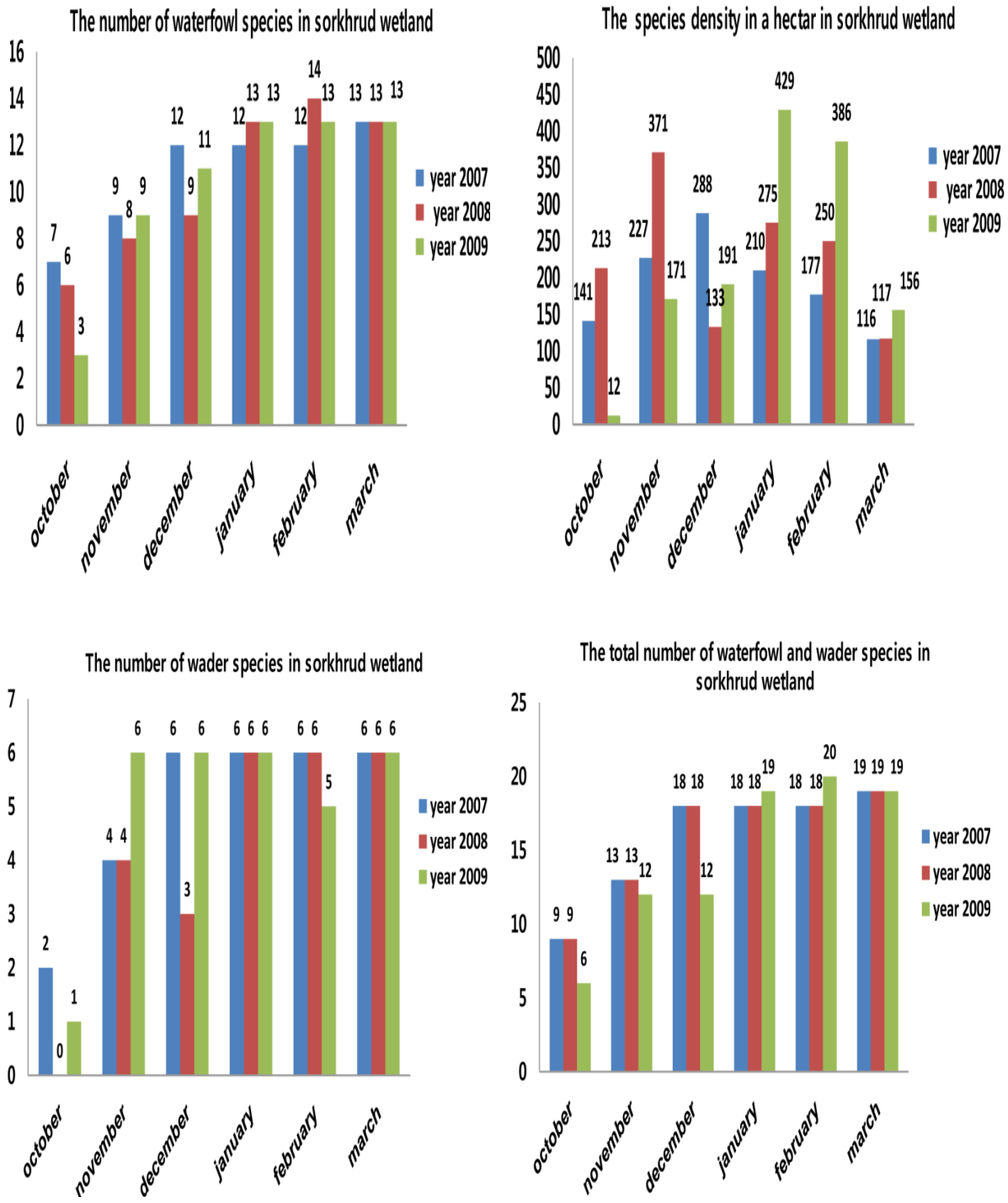

Figure 3. The monthly average number of waterfowl and waders Sorkhrud International Wetland (October 2007 to March 2010).

Conclusion

Finally, yearly hunting licenses for water birds, should issue according every year's birds conditions. Although, estimation for the maximum sustainable yield did not exist yet but weather conditions and yearly birds' counts could be a temporal alternative for this purpose. The results point to the usefulness of the farmer operated wild life refuges as oppose to the government operated in which hunting is prohibited.

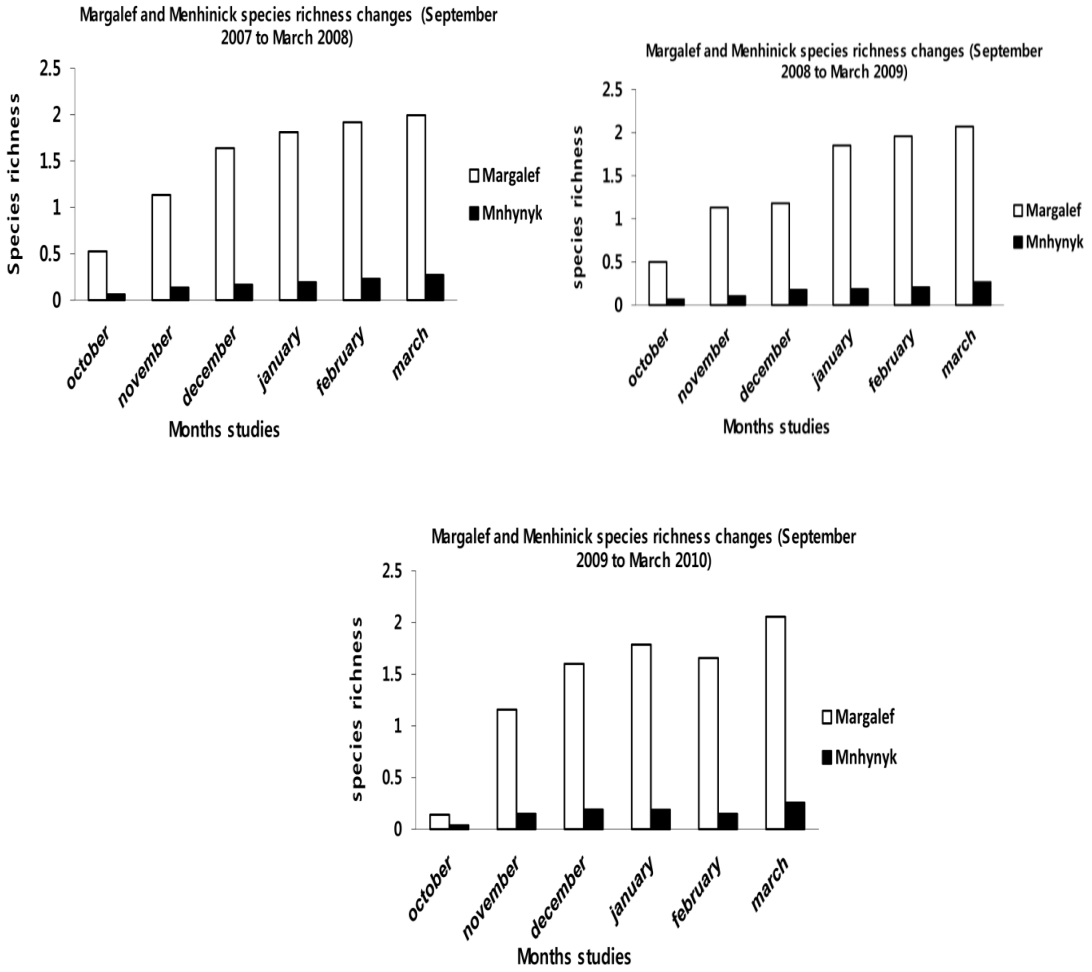

Figure 4. Margalef and Menhinick species richness changes in Sorkhrud International Wetland (September 2007 – March 2010).

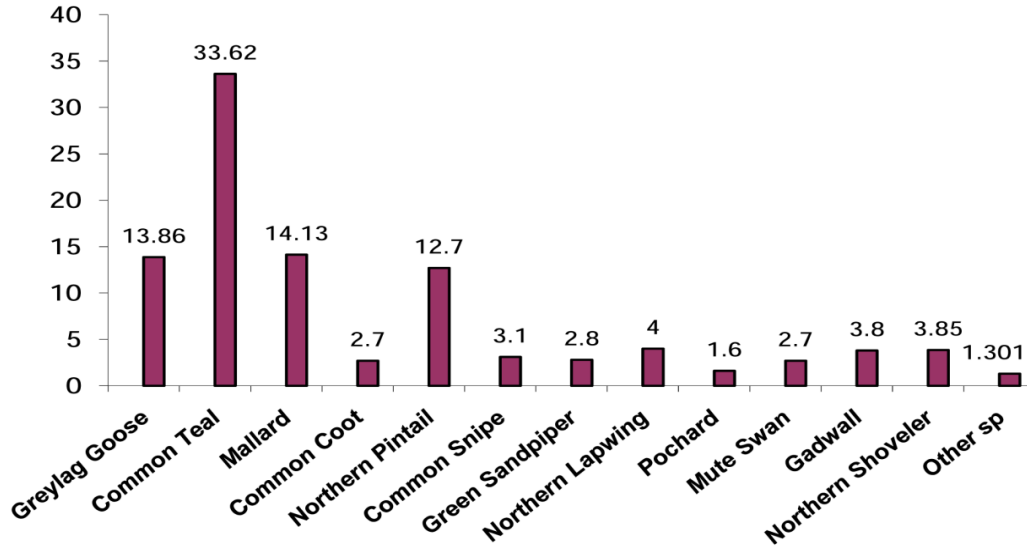

Figure 5. The frequency percentages of waders and waterfowl in Sorkhrud International Wetland (September 2007 – March 2010).

On the other hand, the area is under two kinds of moderates: first, under the management of the local administration with at least one hundred years history and the second one, is government management and licensing for both waterfowl hunting and protection of rare species. In other protected regions of Iran, CCA management by local people has not been reported previously, especially with similar historical record.

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