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A note on the biodiversity of Ghadamgah spring–stream system in Fars province, southwest Iran

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A spring-stream called "Ghadamgah" in Fars province, southern Iran, which holds more than 60 aquatic vertebrate and plant species belonging to 46 genera and 33 families is almost the biologically richest water body of Fars province. The diversity is especially in its endemic fishes which are under threats nowadays. One of the factors, if not the one, which has kept this system more or less in its natural status is the religious beliefs in this place and the rituals of indigenous believers acting as a sanction against environmental destruction for many years till recently. But now this does not retain a high priority and has become displaced by economic and political factors. Water diversion, drainage rehabilitation, water pollution, and drought, development of intensive aquaculture and introduction of non – native fish species are the main factors affecting the biological diversity of this system. Thus, conservation of this very small fragile hotspot habitat is very important.

Key words: Biodiversity, conservation, Ghadamgah, Iran

INTRODUCTION

Iran is considered as a center for the origin of many species. The wide ranges of geographical and geological conditions coupled with the climatologically diverse environments provide this enormous diversity. Iran lies in the Palearctic zoogeographical realm bordering the Oriental and African ones (Coad & Vilenkin 2004), so of considerable interest in this respect. Northern and western Iran is considered as part of Irano-Anatolian biodiversity hot spot which contains many centers of local endemism. To date 164 mammal species, 517 birds, 200 reptiles, 20 amphibians, 161 freshwater fishes and 8000 plants have been reported from this country (Jalili & Jamzad 1999, Coad 2006a,b, Zokaei 2005), which are distributed in a wide variety of ecosystem types. However, there are some regions of particularly species richness and endemisms which are under particular threat, and unknown locality of Ghadamgah Spring-Stream System is one. There is no documented information on this spring-stream system and this paper deals with the first report on vertebrate and vascular aquatic plants biodiversity of Ghadamgah which is one of the biologically richest water bodies of a kind in Fars province.

MATERIAL AND METHODS

The fishes, amphibians, reptiles and plant specimens were collected from Ghadamgah spring-stream system (30, 15N, 52, 25E, 1660m Alt) in the endorheic Kor River basin (southwest of Iran, Fars province) (Figs. 1, 2), and identified to the species level and were deposited at CBSU (Collection, Biology Department, Shiraz University) and HSU (Herbarium of Shiraz University). For

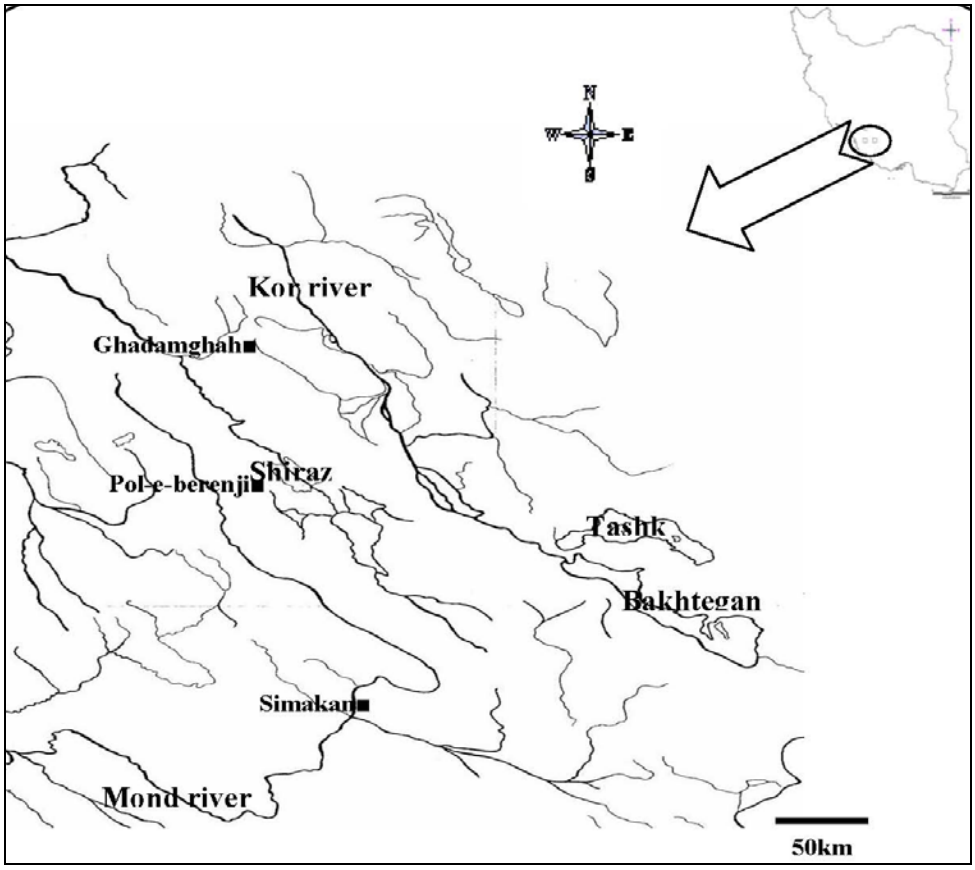

FIG.1. – Map of Iran and Fars showing position of Ghadamgah spring-stream system in Fars province.

the nomenclature identification of fishes, Coad (2006b), amphibians and reptiles, Leviton et al. (1992) and Anderson (1999) were consulted and followed. To show the rich biodiversity of Ghadamgah, the fish data were compared with two other similar natural water bodies of Fars province, Pol-e-Berenji (52º 30E, 29º 28N) and Simakan (52º 02E, 28º 39N) (Fig. 1).

RESULTS

HABITAT AND WATER ANALYSIS

Ghadamgah is a natural spring-stream system made of a large pool having head system and few canals used to irrigate the adjacent lands. The bottom is generally muddy or has small gravels. The water is almost clear with dominant aquatic plants. Analysis of water in the month of Nov. at 3 different sites showed that the water temperature was 17.1°C with pH of 7.28, dissolved Oxygen 4.76 mg/l, %O2 saturation, 60.23; salinity 0.2, Nitrate 2.46 mg/l, Nitrite 3.33 mg/l, Phosphate 1.28 mg/l, and Ammonium 0.22 mg/l. The climate of Ghadamgah region is continental with warm summers and cold winters (3.2 – 31.1°C). Mean rainfall is 42.04 millimeter, most of it falling in winter and spring.

FIG. 2. - Ghadamgah spring – stream in Fars province (spring season).

BIODIVERSITY

Overall 61 aquatic vertebrate and plant species belonging to 46 genera and 33 families were identified (Tables. 1, 2).

ICHTHYODIVERSITY

Ghadamgah is home to 8 fish species about 6 species of which are endemics (75%) (Fig. 3). They are *Seminemacheilus tongiorgii*, *Barbatula farsica*, *Cobitis linea*, *Capoeta damascina*, *Capoeta aculeata*, *Petroleuciscus persidis*, *Alburnus mossulensis* and *Aphanius sophiae*. The endemic fishes of this water body (*Seminemachielus tongiorgii*, *Aphanius sophiae*, *Capoeta aculeata* and *Petroleuciscus persidis*) comprise 18.18% of the total endemic fishes of Iran. The Ghadamgah ichthyofauna is dominated by Cyprinidae with 4 species (50%), followed by Balitoridae (2 species or 25%), Cobitidae (1 or 12.5%) and Cyprinodontidae (1 or 12.5%). According to Coad (2006a) the endemic fish species of Iran comprise 33 named species in 20 genera and 6 families which represent 20.5% of the native ichthyofauna of 161 recognized species. In comparison with two similar localities in the same province; Simakan spring-stream with 6 species (1 endemic, 1 introduced and 4 natives) and Pol-e-Berenji with 7 fishes species (2 endemics, 2 introduced and 5 natives) Ghadamgah has more endemic species. The Ghadamgah endemic fishes are 4.5 times more than Simakan and about 3 times more than Pol-e-Berenji. Moreover, the ichthyofauna compositions in Ghadamgah were quite different from the other two systems. Biogeographic factors are likely to be related these marked differences in fish assemblages. The endemic fishes are restricted to small areas with small populations; hence, any threat could have serious consequences. For these reasons they must be considered as threatened or vulnerable.

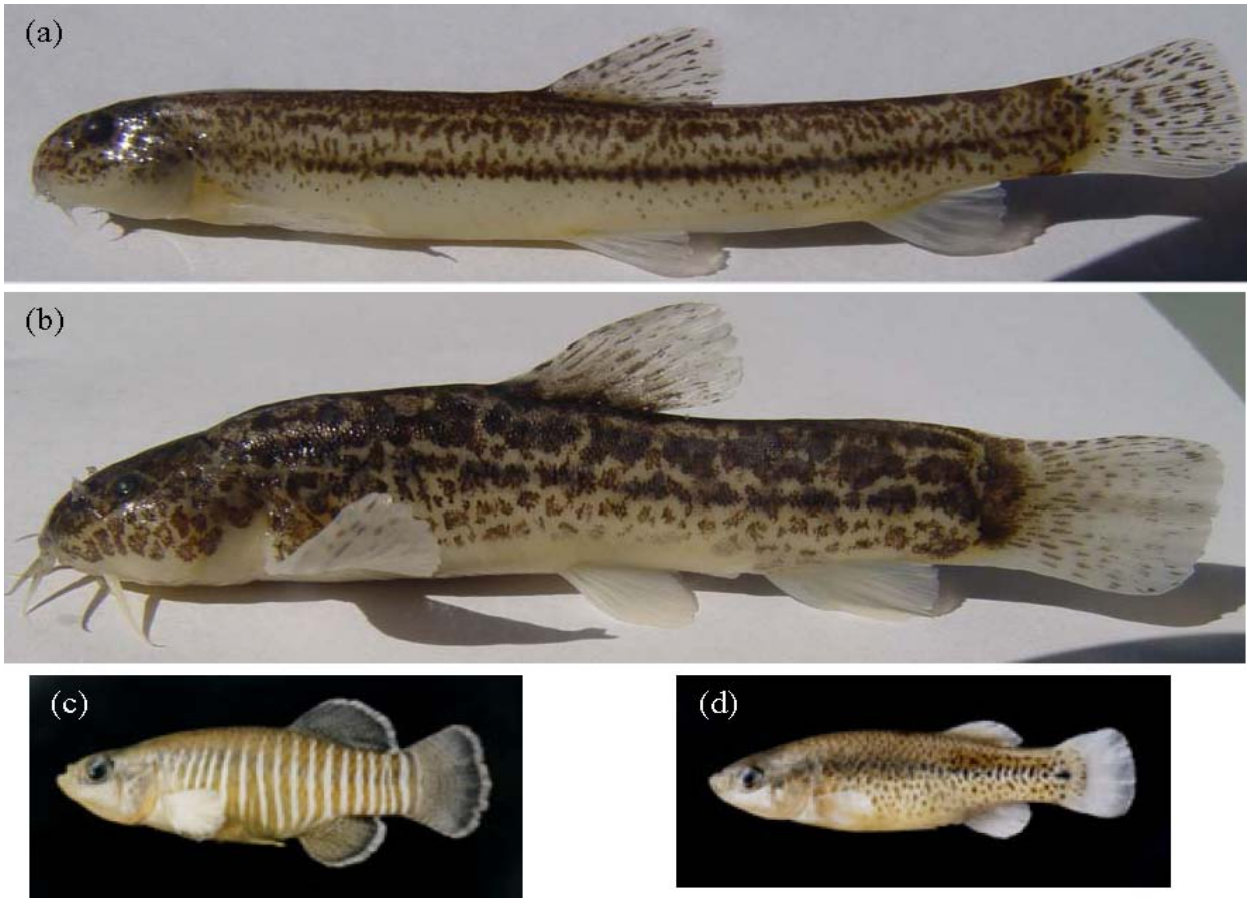

FIG. 3. - Three endemic fishes of Ghadamgah spring-stream system a, *Cobitis linea* (Cobitidae); b, *Seminemacheilus tongiorgii* (Balitoridae); c, male *Aphanius sophiae*; d, female *A. sophiae* (Cyprinodontidae).

AMPHIBIANS

Out of 20 species of amphibians recorded from Iran, 4 species are found in Fars province of which 3, namely *Bufo viridis*, *Rana ridibunda* and *Hyla savignyi* are found in Ghadamgah spring-stream system. They comprise 75% of the recognized species of Fars province and 15% of total amphibian species of Iran. *Bufo viridis* and *Rana ridibunda* are widely distributed in Iran and Fars but *Hyla savignyi* has narrow distribution range.

REPTILES

Natrix tessellata and *Natrix natrix* (Colubridae) are the only two water snakes of Iran and the former was identified in Ghadamgah. Caspian turtle, *Mauremys caspica ventrimaculata* (Emydidae) was another reptile species collected from this water body. This is the only freshwater turtle of Fars province.

PLANTS

Forty five plant species of 3 types (emergent, submerged and marginal) were identified in this stream (Table 2).

DISCUSSION

Freshwater organisms are bound to hydro geographic systems and their distribution is linked to the hydro geographic history of the inhabited areas. Therefore, geological events might have differently

TABLE 1. -Vertebrate diversity in Ghadamgah Spring-Stream system.

Class	Order	Family	No. Species
Fishes	Cypriniformes	Cyprinidae	*Capoeta damascina* *Capoeta aculeata* *Petroleuciscus persidis* *Alburnus mossulensis*
		Balitoridae	*Seminemacheilus tongiorgii* *Barbabatula farsica*
		Cobitidae	*Cobitis linea*
	Cyprinodontiformes	Cyprinidontidae	*Aphanius sophiae*
Amphibians	Anura (= Salientia)	Ranidae Bufonidae Hylidae	*Rana ridibunda* *Bufo viridis* *Hyla savignyi*
Reptiles	Squamata Testudines	Colubridae Emydidae	*Natrix tesselata* *Mauremys caspica ventrimaculata*

affected the evolutionary history of freshwater organisms and terrestritial animals and plants (Bohlen et al. 2006). Ghadamgah spring-stream system is part of Irano-Anatolian biodiversity hot spot which contains many centers of local endemism. The topographically complex and intensive system of mountains and closed basins that make up the Irano-Anatolian hotspot form a natural barrier between the ecosystems and indigenous cultures of the Mediterranean basin and the dry plateaus of western Asia. Although Ghadamgah covers only about 0.00003 percent of Fars province, it contains about 60 vertebrate and plant species and therefore it is one of the biologically richest water bodies of Fars province. It can be considered as a regional biodiversity hotspot or micro hotspot. Biodiversity in inland water systems reflects the interaction between the available stock of species and environmental condition. The stock of species in a system is the end product of the initial genetic pool and a variety of evolutionary processes, such as speciation, extinction and infiltration from other systems, all of which make a contribution over time (Goren & Ortal 1999). These factors might have caused the rich diversity of Ghadamgah spring-stream system. However, this biodiversity is under threats. Some major changes have affected this aquatic habitat: water diversion which has caused a sever reduction in water level especially pumping of water from the aquifer which used to feed the system; drainage rehabilitation which changes the whole structure of the system; water pollution from domestic and agricultural sources which led to high level of pollution; drought in recent years which has caused a sharp decrease in water level in the system, especially during dry seasons and the development of an intensive aquaculture industry in the region which adds a high nutrient load and introduced into the system. Many exotic fishes such as *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella*, *Carassius auratus*, *Pseudorasbora parva* as well as predatory fishes such as *Oncorhyncus mykiss*, *Gambusia holbrooki* are other threats to biodiversity of the region, especially Ghadamgah. These factors which make habitat alterations can change the entire aquatic system. Large–scale habitat alterations during the past decades have caused worry about

decreasing biodiversity world wide (Simila et al. 2006). There is no doubt that many ecosystems and species need conservation actions to alleviate the ecologically harmful consequences that habitat modifications are causing (Simila at al. 2006). Human - caused habitat changes are rapidly proceeding in many areas, both locally and regionally (Simila et al. 2006), and many species are currently suffering from this habitat alterations and there is an urgent need to assess and protect habitats to facilitate future survival of these species. Biodiversity conservation is linked to cultural, social, economical and political conditions of the region as well as religious beliefs of its people. A symbiotic relationship exists between biological diversity and cultural diversity, and this relationship constitutes a determining factor in ensuring sustainable human development, religious beliefs and rituals (such as invariable part of the cultural milieu) (Negi 2005). Ghadamgah (footstep place) is one of the religious places of Fars province and one of the factors, if not the one, which has kept this system more or less in its natural status is the religious beliefs in this place and the rituals of indigenous believers acting as a sanction against environmental destruction for many years till recently. But now this does not retain a high priority and has become displaced by economic and politic factors.

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TABLE 2. -Plant diversity of Ghadamgah spring -stream .

Taxon	Family	Species	Ecological Feature
Plants	Alismataceae	*Alisma lanceolatum* WITH.	Emergent
	Apiaceae	*Apium nodiflorum* (L.) LAG.	Emergent
	Brassicaceae	*Barbarea plantaginea* DC.	Emergent
	Ranunculaceae	*Batrachium trichophyllum (* CHAIX *)*	Submerged
	Apiaceae	*Berula angustifolia*	Emergent
	Poaceae	*Brachiaria eruciformia* (SM.) GRISEB.	Marginal
	Butomaceae	*Butomus umbellatus* L.	Emergent
	Ceratophyllaceae	*Ceratophyllum demersum* L.	Submerged
	Cyperaceae	*Cyperus longus* L.	Emergent
	Cyperaceae	*Cyperus rotundus* L.	Emergent
	Poaceae	*Echinochloa colonum* (L.) LINK	Marginal
	Poaceae	*Echinochloa crus- galli* (L.) P. BEAUV.	Marginal
	Cyperaceae	*Eleocharis palustris*	Emergent
	Cyperaceae	*Eleocharis quinqueflora*	Emergent
	Onagraceae	*Epilobium hirsutum* L.	Marginal
	Onagraceae	*Epilobium parviflorum* (SCHREB.) DC.	Marginal
	Cyperaceae	*Fimbristulis bisumbellata*	Emergent
	Asteraceae	*Inula britannica* L.	Marginal
	Juncaceae	*Juncus inflexus* L.	Emergent
	Lythraceae	*Lythrum junceum* BANK & SOLAND	Marginal
	Lythraceae	*Lythrum salicaria* L.	Marginal
	Fabaceae	*Medicago sativa* L.	Marginal
	Lamiaceae	*Mentha longifolia* (L.) HUDSON	Marginal
	Haloragaceae	*Myriophyllum spicatum* L.	Submerged
	Brassicaceae	*Nasturtium officinale* R. BR.	Emergent
	Fabaceae	*Ononis spinosa* L.	Marginal

TABLE 2. (Cont.).

Plants	Poaceae	*Paspalum distichum* L.	Marginal
	Plantaginaceae	*Plantago coronopus* L.	Marginal
	Plantaginaceae	*Plantago lanceolata* L.	Marginal
	Plantaginaceae	*Plantago major* L.	Marginal
	Plantanaceae	*Platanus orientalis* L.	Marginal
	Poaceae	*Poa annua* L.	Marginal
	Potamogetonaceae	*Potamogeton amblyphyllus* C. A. MEY	Submerged
	Potamogetonaceae	*Potamogeton nodosus* POIR.	Submerged
	Potamogetonaceae	*Potamogeton pectinatus* L.	Submerged
	Potamogetonaceae	*Potamogeton perfoliatus* L.	Submerged
	Salicaceae	*Salix excelsa* S. G. GEMELIN	Marginal
	Primulaceae	*Samolus valerandi* L.	Emergent
	Rosaceae	*Sanguisorba minor* SCOP.	Marginal
	Cyperaceae	*Scripoides Holoschoenus* (L.) SOJAK	Emergent
	Sparganiaceae	*Sparganium erectum* L.	Emergent
	Fabaceae	*Trifolium pratense* L.	Marginal
	Fabaceae	*Trifolium repens* L.	Marginal
	Typhaceae	*Typha Grossheimii* POBED.	Emergent
	Scrophulariaceae	*Veronica anagallis-aquatica* L. ssp.	Emergent
	Scrophulariaceae	*Veronica Anagalloides* GUSS	Emergent
	Zannichelliaceae	*Zannichellia palustris* L.	Submerged