

Geographic Distribution and Biology of *Neurergus kaiseri* as Native and Endemic Species In the west of Iran

Mahdi Reyahi- Khoram¹, Nemat Dalvand¹, Mohamad Karami-Nour¹

¹Department of Environment, Hamadan Branch, Islamic Azad University, Hamadan, Iran,
P.O.BOX: 65138-734, Professor Mosivand st., Hamadan, Iran,
Email: phdmrk@gmail.com

ABSTRACT

Amphibians are usually adversely affected by anthropogenic influences. The aim of the present study is to determine the geographic distribution and biology of *Neurergus kaiseri* as native and endemic species in Iran. This research was conducted in Lorestan province in the west of Iran through direct field observations and documentary analysis. The major habitat of this species is situated in cold waterfall pools. The external body surfaces of this elegant species, is marked with red pigment and therefore is as ornamental species which attracts many people. *N. kaiseri* is a rare species and is not used as food in Iran, but it has few natural predators. Because of the benefits of educational programs, it is recommended that educational programs in environmental science and biodiversity be arranged for local people to provide a better understanding of environmental conservation and also to enable them to learn about the Importance and other characteristics of *N. kaiseri*.

Keywords : Biodiversity; conservation; endemic; Environment; *Neurergus Kaiseri*

INTRODUCTION

All species have a role and provide the fabric of life on which humanity depends: from the smallest bacteria in the soil to the largest mammal in the ocean. The dynamics of species and habitats are interrelated with the water cycle, the mineral cycle and the energy flow. These processes together determine the state of ecosystems that people manage and on which they depend. Environmental pressures such as habitat change, pollution, overexploitation, biological invasions and climate change are accelerating the global species extinction rate, making it perhaps a thousand times more rapid than the estimated natural rate of one in a million species a year [9].

Iran is a land of diversity. This diversity can be found in the country's geological formation, land form, soil, climate and

longitude. For example, elevation ranges from 26 below to 5770 m above Mean Sea Level, Temperature ranges from -35°C during the winter in the northwest, to 50°C in the summer on the Persian Gulf shoreline and Precipitation ranges from 2000 mm southeast of the Caspian shoreline to 10 mm in the central desert. In fact, Iran possesses the most diversified biological regions among the southwestern countries of Asia [14]. A recent study in Iran has shown that Iran with about 1.65 million square kilometers surface area is a large country and after Turkey is the richest country of plant diversity in the Middle East. The rich flora and fauna and unique landscapes of this land and its old civilization attracted many biologists and orientalists [13]. The climatic diversity of Iran has resulted in the growth of 7576

plant species, the occurrence of 517 bird species, 208 reptile species, 170 fish species, 164 mammal species and 22 amphibians [17].

Amphibians are usually adversely affected by anthropogenic influences. Decline of amphibian populations could have a significant impact on both natural ecosystems and human welfare. Their conspicuous role is noted to be of particular importance in tropical forests, where in acting as both predator and prey species, they play a key role in trophic dynamics. The second most recognized importance of amphibians is their potential role as indicators of global environmental health and resilience. They inhabit both aquatic and terrestrial habitats, and are thus exposed to aquatic and terrestrial pollutants—to which they are particularly sensitive due to their highly permeable skin. Furthermore many amphibians interact with a large range of other species in the local environment during their lifetime [10].

Class Amphibia is made up of three orders: Anura (frogs and toads), Caudata (salamanders), and Gymnophiona (caecilians). Most of the research work focuses only on Anura, whereas less research has been conducted on Caudata and Gymnophiona [5].

Relatively few species of Caudata occur in Iran. These consist of seven species of the genera *Paradactylodon*, *Triturus*, *Neurergus*, and *Salamandra* (family Salamandridae). The genus *Neurergus* comprises four species distributed in Iran, Iraq, and Turkey. In Iran, three of these have been reported from first order streams located on the western and southern edges of the Iranian Plateau. These are: (1) *Neurergus crocatus*, Species Authority: [4] from northwestern Iran, northeastern Iraq, and southeastern Turkey; (2) *Neurergus*

microspilotus, Species Authority: [15] from western Iran and Iraq; and (3) *Neurergus kaiseri*, Species Authority: [18] from the southern Zagros Range in Lorestan and Khuzestan Provinces in southern Iran [21].

Neurergus kaiseri is one of the most endangered species and is belong to the order Caudata of the class Salamandridae and Phylum Chordata. Taxonomically classified under the family Salamandridae and the genus name of these species is *Neurergus*. *N. kaiseri* is also the smallest species of *Neurergus* that exists. Indeed, this newt is an endemic species of this genus in Iran, with common names of Luristan newt, Emperor spotted newt, Zagros newt and Iranian harlequin newt.

N. kaiseri is included in the Red List of International Union for Conservation of Nature (IUCN) and classified as Critically Endangered (CE) species (A2d; B2ab(iii,v) ver. 3.1) [12]. However, a multitude of factors including human activities and climatic changes have largely contributed to the dramatic decrease in population.

At the Fifteenth meeting of the Conference of the Parties of Convention on International Trade in Endangered Species of wild fauna and flora (CITES) which met in March 2010 in Doha, Islamic Republic of Iran has proposed To put *N. kaiseri* in Appendix I of CITES. This proposal was approved and adopted as proposed.

The aim of the present study is to determine the geographic distribution, habitat, population and biology of *Neurergus kaiseri* as native, threatened and endemic species in Iran.

MATERIALS AND METHODS

Study Area

Lorestan province consists of 9 big cities with an area of about 28294 square kilometers ($46^{\circ}51'$ - $50^{\circ}3'E$ and $32^{\circ}37'$ - $34^{\circ}22'N$). The province is mountainous, part of the Zagros chain, from northwest to southeast of Iran. The highest point of the province is Oshtoran Kooh peak at 4,050 m. The low-lying area in the southern part of the province is approximately 500 m above sea level [11].

Lorestan province is a mountainous region and 60% of its area has a slope higher than 12% and whole the region has been located in Karkhe and Dez basin and has various forests. Total area of the province forests is 885000 ha [8].

Data collection and preparation

This research was conducted during 2012 through 2013 in Lorestan province in the west of Iran through direct field observations and documentary analysis during the years of study. Through the period, using the map, Global Positioning System (GPS) and in some cases through afoot surveying or using car, the geographical location of relevant habitat was identified [7]. In order to evaluate the climatology status of the area, data of meteorology organization was used. For general identification of the area, digital maps and Geographic Information System (GIS) were used and on this basis, the topological status of the area was identified.

RESULTS AND DISCUSSION

Spatial distribution

Results of this research proved that *N. kaiseri* is found in six regions in southwest of Iran. These regions include Vojenab, Kool sat, Dare too, Tale zang, Haji barikab and Shahzade ahahmad region. Geographical specifications of each of the above habitats are mentioned in Table 1. Some of these habitats are located in Luristan province and some are located in Khuzestan province (Figure 1).

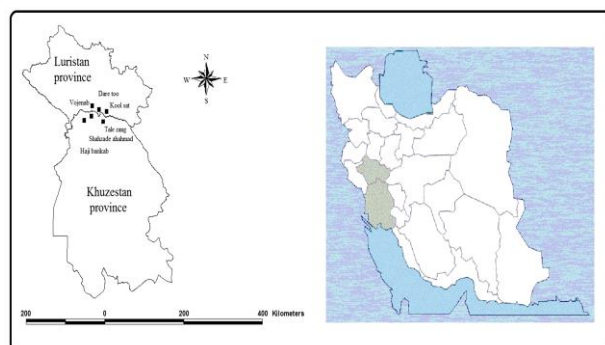


Figure 1. Genaral status of *N. kaiseri*

habitats in Iran

Table 1: Spatial information of 6 first-order stream in Khuzestan and Luristan provenances in Iran that occupied by *N. kaiseri*

Site	Latitude	Longitude	Altitude (Elevation)	province
Vojenab*	N:33° 1'39"	E:48° 38 ' 12"	1000	Luristan
Kool sat*	N:32° 52'23"	E:48° 43 ' 48"	1050	Luristan
Dare too*	N:32°49'40"	E:48° 42 ' 00"	1200	Luristan
Tale zang*	N:32°47' 10"	E:48° 52 ' 30"	1100	Khuzestan
Haji barikab*	N:32°51'10"	E:48° 23 ' 00"	1000	Khuzestan
Shahzade ahahmad*	N:32°55'00"	E:48° 33 ' 00"	1050	Khuzestan

*: The species was observed in the mentioned habitat during surveys.

PHYSICAL AND BIOLOGICAL HABITAT EVALUATION

N. kaiseri habitat is situated in the impassable mountain regions of Luristan and Khuzestan provinces on the west and south of Iran. Despite other newts, this species is very rarely observed in rivers. Means, The major habitat of this species is situated in cold waterfall pools. One of the main factors contributing to survival of this species is favorable climate and abundant water sources particularly with high oxygen dissolved in water.

The bed of pools is varied to some extent, however, in most cases the bed of its habitat is covered with rubble, gravel, and sand.

Physicochemical quality of water, serves as habitat for *N. kaiseri* was tested in the laboratory using different methods and the summary of results obtained was presented in Table 2.

Table 2: Summary of water quality characteristics at selected habitat sites in the study area

Parameters	Value
Dissolved Oxygen	5-6 (mg/l)
Turbidity	2-10 (NTU)
Electrical Conductivity (EC) as micro siemens/cm ($\mu S/cm$)	0.3- 0.5($\mu S/cm$)
pH	6.2-6.5
T ^{0C}	11-16

Water pools and waterfalls in the study area are ideal habitat for *N. kaiseri*. These pools are shallow and surrounded by trees such as wild chestnuts, mountain almond, wild Pistachio, wild pear, fig, myrtle, straw and some of herbaceous perennial plants and also thorn plants that maybe would become very big. Pools and streamlets where this species is found are covered

with different algae and the presence of straw. These areas are widely considered to be the most ecologically important areas which could prepare suitable habitat conditions as the safe regions for *N. kaiseri*. Direct observations of the pools and waterfalls in the studied area showed that the most dominant species of the different algae was Euglena.

Algae and other single-celled organisms, called plankton, form the basis of the food chain and devote almost all their energy toward producing protein, carbohydrates, vitamins, amino acids, and other nutrients.

Algae and other single-celled organisms are vital for the life cycle of the newts particularly their larvae as the larva feed on algae and organic matter during their development. On the other hand, Fungi are multi-celled organisms made up of several complex cells. Many multi celled organisms live on the algae. Multi celled organisms are most likely eaten by newts' larvae.

Other plants of the region may include ferns. Fern grow in moist, humid areas and rich-soiled valleys along riverbanks. This plant species is widely distributed in the habitats of *N. kaiseri*, because of abundant and permanent water resources and high humidity conditions.

The mammals which exist around the *N. kaiseri* habitat are Wild boar (*Sus scrofa*), Brown bear (*Ursus arctos*), Wolf (*Canis lupus*), Common fox (*Vulpes vulpes*) and Cape hare (*Lepus capensis*). The birds of the region include Chukar partridge (*Alectoris chukar*), See-see Partridge (*Ammodramus griseogularis*) and Rock dove (*Columba livia*).

Reptiles include several species of gecko, such as warner's leaf toed gecko (*Asaccus elisae*), leopard gecko (*Eublepharis macularius*), large scaled rock agama (*Laudakia nupta*), Large Whip Snake

(*Coluber jugularis*), Ravergier's Whip Snake (*Coluber ravergieri*) and Dice Snake (*Natrix tessellate*).

Amphibians are a powerful influence on the ecology of the surrounding pools and rivers. *N. kaiseri* is one of the several species of Amphibian in the study area. Other Amphibians such as Marsh frog (*Rana ridibunda*) and European green toad (*Bufo viridis*) distributed around the edge of riparian zones. Some species of crab, bee, ant, butterfly, grasshopper, and various species of aquatic insects with hard exoskeletons live abundantly in the habitat of *N. kaiseri*.

Biologic and aesthetic values

In view point of environment, the aesthetic value is always subjective and is extremely difficult to measure. One person may see a beautiful animal species as an aesthetically valuable while another may value the trees which stand at the rivers banks. Aesthetic value is used within the environmental literature to describe the qualities ascribed to landscape, seascapes and other environments [16].

Based on repeated experimental observations, *N. kaiseri* feeds on most small invertebrates particularly insects and their larvae. The length of this species is about 14 cm and can hunt its prey inside the water, outside the water, or on the surface of water. Preying inside the water and in the surface of water is much easier for *N. kaiseri* than outside the water.

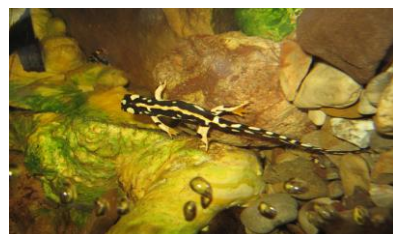


Figure 2. Horizontal position of *N. kaiseri* in aquarium

The external body surfaces of this elegant species, is marked with red pigment, a color that is psychologically evocative and powerful (Figure 2 and 3). *N. kaiseri* is as important ornamental species which attracts many people whether one is rich or poor, more educated or less educated, religious or not, man or woman, we are all the same because of the unique and beautiful Motion of the species. The body of this species is more flexible in its moves and it looks beautiful in the water and makes people happy. More importantly, *N. kaiseri* is one of the rare species in my world and therefore, its value is the highest among the other newt species. Endemic species are extremely vulnerable genetic reserves of every land. *N. kaiseri* is one of the endemic of southwest of Iran and should be managed as a genetic reserve.

As mentioned above, *N. kaiseri* has a special impression due to its special elegance. That is why many people maintain this endemic animal as for decorative purposes because of its unique body shape and public style.



Figure 3. Real position of *N. kaiseri* in the Habitat.

Unfortunately, most often *N. kaiseri* is not maintained in conformity with scientific standards. For this reason, in most cases, people cannot maintain *N. kaiseri* in their aquarium for decoration purposes.

Due to endemic nature of *N. kaiseri*, it has important practical value for research and education. Hence, it is necessary that this species be protected by Department of environment (DoE) of Iran.

The ecotourism value of *N. kaiseri* is also considerable and rapidly rising, particularly for protecting habitat and ecosystems as a tool for management and conservation of this species. With regular programs and developing the vocational education and training sector and also provide access to excellent support services, could be turned into an ecotourism attraction in the study area. The future of ecotourism development in the area should keep a balance among the environmental, economic, and socio-cultural aspects in order to guarantee long-term benefits to the recipient communities.

Ecotourism attractions may be divided into three categories: focal or flagship attractions (which provide the main reason for visiting an area), complementary attractions (they give added value to the area and encourage a longer stay for the tourist), and supporting attractions (the physical facilities and tourist services found in that place). The two first categories correspond to the natural and cultural heritage of the area. The latter category facilitates visitation to the area [3]. In contrast, overdevelopment of an area for ecotourism can result in a number of negative impacts, such as environmental degradation. On the other hand, controlled development of ecotourism will help to preserve *N. kaiseri* and provide employment and income to local people.

THREATENED STATUS

N. kaiseri is a rare species and is not used as food in Iran. Almost no one can be found in Iran to prey *N. kaiseri* for food consumption. Therefore, it seems that there is no threat for *N. kaiseri* with respect to prey. But it has few natural predators. The most important predators of *N. kaiseri* are Dice Snake (*Natrix tessellate*) and Ravergier's Whip Snake (*Coluber ravergieri*). Other predators include water crabs which are the most significant predators of *N. kaiseri* larva. Means, the larva of *N. kaiseri* is preyed by water crabs. Water crabs are highly abundant in its habitat; they are perhaps the most important natural threatening factors.

Climate change is one of the most important threats to the ecosystems. Climate change and other changes in the environment that are global in nature have been recognized as potential problems for amphibian populations [2]. Moreover, there is some evidence that short-term changes in weather may affect amphibian population declines. Dry periods associated with global warming are correlated with amphibian and reptile losses. Changes in ambient temperature may influence amphibian behaviors, including those related to reproduction. Potentially, changes in ambient temperature on a global scale could disrupt the timing of breeding, periods of hibernation, and the ability to find food [2].

The human construction may affect wildlife in a number of different ways. One of the most important of which was threatening the wild life.

Increased construction of tourism and recreational facilities has increased the pressure on *N. kaiseri* habitats. The most important of them was the construction of railroad or dam. Railroad provided access

to the habitat of *N. kaiseri* for non-local people. This led to increased availability of foreign travel to the habitat. While, there is not a formal program that is designed specifically for the Hospitality Industry, Travel and Tourism Management. Dam construction in the area and introduction of non-native fish are considered the greatest threats to this species.

Other threats to this species include pet trade, loss and degradation of the habitat and also increased ultraviolet black light (UV-B) radiation that pose a threat to *N. kaiseri* [21]. Some of live animals are used for pet trade. Illegal pet trade is very important threats to *N. kaiseri*. The practice of keeping pets is widespread in many parts of Iran, and wildlife markets are a feature of most large towns. Most often *N. kaiseri*, are kept by families in bad conditions. Illegal collecting for national and international pet trade is the main threatening factor for the existence of this species. Comparable results were obtained by Sharifi *et al.*; They surveyed a total of 15 sites for *N. kaiseri* in southern Zagros range in Iran: Tale zang, Haji barikab, Shahzadeh ahmad (four separate sites, three of which had no *N. kaiseri*), Tove, Shaikhon, Vojenab, Kerser, Darehbol, Choobeh, Tafo, Bozorgab, and Pifeh [20]. These included 11 streams, one spring, and three pools constructed on karst springs, all on first order streams. They concluded that their study, reports several new localities for *N. kaiseri*, but it is not adequate to provide a basis for re-evaluation of the conservation status of the species. Sharifi *et al.* also reported the morphology of *N. kaiseri* collected from Taleh Zang stream and it has been demonstrated that the Females were recognized from males upon their swollen bodies, indicating presence of enlarged ovarian follicles, and/or the flat shape of the cloacae [19]. Eggs are laid singly or in small clumps on aquatic

vegetation or on rocks. They consider that the appearance of the animals in early spring and their disappearance in summer suggests that this newt requires both terrestrial and aquatic habitats.

The results of the present study demonstrate the aesthetic Values of *N. kaiseri* in the study area, although there are only a few studies that focus on the definition of the concept and its application to ecotourism in the habitat. It may appear that the aesthetic values identified during the planning, design and implementation stages of the project. But, environmental values are 'the various ways in which individuals, processes and places matter, our various modes of relating to them, and the various considerations that enter into our deliberations about action.' However, some of scientists claim that environmental values to be 'moral guidelines' that serve as the basis for 'environmental concern and action'. Thus, environmental values are normative positions that ascribe relative or absolute goodness or badness to certain things – individuals, processes and places, but also species and other components of environments [16].

Amphibian populations have suffered alarming worldwide declines in recent decades. According to the first global assessment of the status of amphibian species, more than 40% of the world's 5743 amphibian species have experienced recent declines, a situation far worse than that reported for mammals or birds. It is widely believed that most declining amphibian species are being affected simultaneously by multiple stressors [6]. Based on the research and studies that it has performed in England, one of the potential hazard to amphibians is acid precipitation. Amphibian embryos and larvae are vulnerable to both direct and indirect effects of low pH, but although local effects have been reported there is no

evidence to link acidification with widespread amphibian declines. In recent years, attention has therefore shifted to five other possible culprits: increased exposure to UV-B, emerging diseases, the spread of alien species, direct exploitation and climate change [1]. Recent changes in the global climate might impact adversely on amphibian populations. The forest has consequently become drier, and amphibian breeding less successful. But, it is therefore uncertain as to whether recent climate change is a significant cause of amphibian declines. Some of researches make recommendations to address this issue, by suggesting improved methodologies to investigate climate changes an agent of amphibian declines [1]. As previously mentioned, threatened status of this species in Iran will become more serious and the potential extinction risk will also rise increasingly.

Because of the benefits of educational programs covering the basics of environmental science and ecology, it is highly recommended that educational programs in environmental science and biodiversity be arranged for local people to provide a better understanding of environmental conservation and also to enable them to learn about the biology, behavior, sensitivity, Importance and other characteristics of *N. kaiseri*. These environmental and biodiversity education programs help local people to acquaint with the local biodiversity problems, and create an interest, motivation, commitment and action. From the analysis, it is apparent that active biodiversity education program increases the skills, knowledge and interest in order to protect and conserve local natural resources and biodiversity. Ecotourism is one of the best strategies of management of natural resources and increasing income of local people. To maintain adequate populations

of the species and extent of critical habitats in the study area, it is recommended that appropriate scale in ecotourism development be a part of planning for program innovation.

CONCLUSION

The present study represents a scientific assessment of the status of *N. kaiseri* habitat in Iran. Our results show that several cultural and ecological factors are associated with a sharp decline of these native species. *N. kaiseri* is under serious threat, mainly in the form of habitat loss and habitat degradation. In order to prevent the increasing threatened situation of *N. kaiseri*, it is required to have an efficient management system and also suitable monitoring.

ACKNOWLEDGMENTS

This research was supported by Islamic Azad University (Hamadan Branch). The authors would like to thank department of environment of mentioned university. The authors also thank Mr. Mohsen Amiry, the expert of Lorestan provincial directorate of environmental protection, for their collaboration in this study.

REFERENCES

- [1] Beebee TJC, Griffiths RA.. The amphibian decline crisis: A watershed for conservation biology. *Biol Conserv* 2005; 125:271–285.
- [2] Blaustein AR, Walls SC, Bancroft BA, Lawler JJ, Searle CL and Gervasi SS. Direct and Indirect Effects of Climate Change on Amphibian Populations. *Diversity* 2010; .2: 281-313.
- [3] Ceballos-Lascurain AH. Integrating Biodiversity into the Tourism Sector : Best Practice Guidelines. International Coordinator of BPSP Study on Biodiversity/Tourism Director General
- PICE Programme of International Consultancy on Ecotourism Camino Real al Ajusco 551. Mexico. 2001.
- [4] Cope ED. 1862. On *Neurergus crocatus* from Iran and Iraq; *Proceedings of the Academy of Natural Sciences of Philadelphia* 1862; 343.
- [5] Davenport JM, Summers K.. Environmental influences on egg and clutch sizes in lentic- and lotic breeding salamanders. *phyllomedusa* 2010; 9: 87-98.
- [6] Davidson C, knapp RA.. Multiple stressors and amphibian declines: dual impacts of pesticides and fish on yellow-legged frogs. *Ecol Appl* 2007; 17: 587–597.
- [7] Demers M. *Fundamental of Geographic Information System*. John Wiley & Sons. New York. 2009.
- [8] Drikvand A et al.. Investigation of forest area and density changes in Middle Zagros using aerial photos interpretation and GIS in the various distances of the village (a case study: Kakareza region, Lorestan province). *J Biodivers Environ Sci* 2013; 3: 42-48.
- [9] EEA (European Environment Agency). *The European Environment state and outlook 2010, biodiversity*, EEA Publications office, Denmark; 2010.
- [10] Gardner T.. Declining amphibian populations: a global phenomenon in conservation biology. *Anim Biodivers Conserv* 2001; 24: 25-44.
- [11] Gholami M, Mirzaei S, Jomehzadeh A. Gamma background radiation measurement in Lorestan province, *Int J Rad Res* 2011; 9: 89-93.

[12] IUCN (International Union for Conservation of Nature). 2014. IUCN red list of threatened species. [10 July 2014] www.iucnredlist.org

[13] Jafari SM, Akhane H. plants of jahan nama protected area, golestan province, N. Iran. Pak J Bot 2008; 40 :1533-1554.

[14] Makhdom MF. Management of protected areas and conservation of biodiversity in Iran. Int J Environ Stud 2008; 65: 563–585.

[15] Nesterov PV. Trois formes nouvelles d'Amphibiens (Urodela) du Kurdistan. Ezhegod Mus Zool Nauk Petrograd 1916; 21:1–30.

[16] Prior JD. The Roles of Aesthetic Value in Ecological Restoration: Cases from the United Kingdom. *PhD Thesis*. Edinburgh University. 2012.

[17] Reyahi khoram M, Norisharikabad V, Abdollahi R. Survey on Khan_Gormaz Protected Area (KGPA) and its ecotourism attractions. Proc.4th International Colloquium on Tourism & Leisure. 2010.

[18] Schmidt KP. Diagnoses of new amphibians and reptiles from Iran. Nat Hist Miscellan 1952; 93: 1–2.

[19] Sharifi M, Rastegar-Pouyani N, Akmal V, Assadian Narengi S. On distribution and conservation status of neurergus kaiseri (caudata: salamandridae). Russ J Herpetol 2008; 15(3):169 – 172.

[20] Sharifi M, Farasat H, Vaissi S. Sexual size dimorphism in Neurergus kaiseri (Caudata: Salamandridae) in south-western Zagros Mountains, Iran. Amphib Reptile Conserv 2012; 6:1-8.

[21] Sharifi M, Farasat H., Barani-Beiranv H., Vaissi S., and Foroozanfar E. Notes on the Distribution and abundance of the endangered Kaiser's mountain newt, Neurergus kaiseri (caudata: salamandridae), in southwestern Iran. Herpetol Conserv Biol 2013; 8:724–731.