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# Notes on the Distribution and Abundance of the Endangered Kaiser's Mountain Newt, *Neurergus kaiseri* (Caudata: Salamandridae), in Southwestern Iran

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***Abstract.*—The Endangered Kaiser's Mountain Newt, *Neurergus kaiseri*, is a species endemic to the southern Zagros Range in Iran. Until now, *N. kaiseri* had been reported from only five localities. The present study describes eight new localities that increase the species' known range from 212 km$^2$ (minimum convex polygon) to 789 km$^2$ at elevations between 930−1395 meters. The localities are generally dispersed; nearest neighbor distances among the 13 localities average 4.61 km (range, 0.93−12.39 km). The streams are separated from one another by steep and rocky terrain with vegetation cover of mature open oak woodland in the west and sparse scrubland or thin oak-pistachio woodland in the central area and east, thus potentially isolating many of the populations from each other. We surveyed 12 of the 13 localities with newts 1−2 times and counted a total of 1,277 adults, post-metamorphic sub-adults, and larvae (mean per stream, 106; range, 2−650) in a total of 4.23 km of stream reaches. Most of the observed newts (86%) were found in just two of the localities.**

*Key Words*.—distribution; Kaiser's Mountain Newt; *Neurergus kaiseri*; range; southwestern Iran

## Introduction

Relatively few species of Caudata occur in Iran. These consist of seven species of the genera *Paradactylodon*, *Triturus*, *Neurergus,* and *Salamandra* (family Salamandridae; Baloutch and Kami 1995). 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) *N. crocatus* (Cope 1862) from northwestern Iran, northeastern Iraq, and southeastern Turkey; (2) *N. microspilotus* (Nesterov 1916) from western Iran and Iraq; and (3) *N. kaiseri* (Schmidt 1952) from the southern Zagros Range in Lorestan and Khuzestan Provinces in southern Iran. Details of distribution and abundance of the newts of the genus *Neurergus* are poorly known.

*Neurergus kaiseri*, Kaiser's Mountain Newt (Fig. 1), was first described as a subspecies of *N. crocatus* from two streams surrounding Shahbazan rail station, Lorestan Province, Iran (Schmidt 1952). The first of these streams is Shahbazan stream, located 8 km southwest of Ab-I-Cezar (Dez River) at approximately 1,200 m elevation. The other location is 8 km north-northeast of the upper part of the Tove Stream at a spring emerging from a cave at 1,000 m elevation (Schmidt 1952). Schmidtler and Schmidtler (1975) reported on their visits to the Shahbazan region in 1968 and 1970. These authors elevated the subspecies to a full species based on specimens collected at Tove Stream (11 km north of Shahbazan, Lorestan Province). In 1995, Schultschik and Steinfartz (1996) visited the site near Shahbazan and described the habitat. In recent years, the staff of the Regional Department of Environment in Khoramabad collected new data and discovered two new locations in the Hajibarikab and Shahzadehahmad Streams in Lorestan Province (Convention of International Trade on Endangered Species [CITES]. Available from http://www.cites.org [Accessed September 2012]). Sharifi et al. (2008) also reported this newt from Talezang Stream in Khuzestan Province. Thus, at that time, *N. kaiseri* had been reported from a total of five streams: Shahbazan, Talezang, Shahzadeahmad, Hajibarikab, and the type locality in Tove.

*Neurergus kaiseri* has been designated a Critically Endangered species by the International Union for Conservation of Nature (IUCN) because of its highly fragmented breeding habitat and also because it occupies a small range during its reproductive period (IUCN Red List of Threatened Species. Version 2009.1. Available from

**Figure 1**. An adult *Neurergus kaiseri* with typical black and white lateral sides and a narrow band of orange on the dorsal side. (Photographed by Mozafar Sharifi).

http://www.iucnredlist.org [Accessed 04 August 2012]).

According to the IUCN evaluation, the most important threats to this species are likely illegal trade and the presence of non-native fish as a result of the damming of Dez River, which extends the reservoir close to the known localities of *N. Kaiseri*. *Neurergus kaiseri* has also been included in Appendix I of the Convention of International Trade on Endangered Species (CITES, *op. cit*.). In addition, other factors which are known to have deleterious effects on amphibians (e.g., loss of habitat, increased UV-B radiation exposure, chemical contaminants, climate change, and road accidents; Stuart et al. 2004) may also pose threats to *N. kaiseri*.

In the present study, our main objective was to determine the distribution of *N. kaiseri* based on data for the species in its breeding streams. We also report counts of individuals from nearly all known localities for the species. Finally, we use this dataset to consider some aspects of the conservation biology of this Critically Endangered species.

## Materials And Methods

***Study area.***—The Iranian basin is a large triangular depression flanked by the Elbourz Mountains in the north and the Zagros Range in the west. The Zagros Range extends diagonally from eastern Turkey to north of the Persian Gulf and Pakistan border. This range is part of a greater geographic unit arising from the east of the Anatolian Plateau of Turkey and extending southward to include Iran, Afghanistan, Pakistan, and further east to the western edge of the Tibetan Plateau. The Zagros Range acts as a barrier to incoming air masses from the west, and receives precipitation according to the elevation and longitude. In general, the northern and western portions of the range receive considerably more rainfall than areas in the south and east. Vegetation cover in the distribution range of *N. kaiseri* ranges from thin scrublands on steep rock outcrops to dense woodlands with diverse tree species. In areas where soil is well developed, an open oak-pistachio woodland may be present. These woodlands are dominated by Brant's Oak (*Quercus brantii)* and by two species of pistachio (*Pistachio vera* and *P. khonchic*). These tree species may play an important role in supporting primary production in the streams because the substrate of all streams visited with *N. kaiseri* were covered with leaves of oak and pistachio.

***Study species.***—*Neurergus kaiseri* is easily distinguishable from the other two newts of the genus *Neurergus* in Iran because of its long and narrow band of orange color with several round areas of white color (Fig. 1). This gives a wavy appearance to *N. kaiseri*. The dorsal and lateral

sides of the animals are black whereas the underneath is orange. Between the eyes at the top of head, there is a white patch that narrows toward the snout. On the back of each eye, there is one orange patch that extends towards the jaw. Specimens observed during the current study and those described by Sharifi et al. (2008) are consistent with Schmidt's (1952) description of specimens from Tove, the type locality of *N. kaiseri*.

**Sampling methods.**—We searched first order streams, irrigation channels, and small ponds in the general area of known habitat for *N. kaiseri* on six occasions: late March 2006, late March 2011, early May 2011, late May 2011, mid-June 2011, and April 2012. These streams were all located in the southern Zagros Range in the Lorestan and Khuzestan Provinces in south-western Iran. At each site, we (at least two of the authors was present for each survey) searched for and counted adults, post-metamorphic subadults, and larvae within the stream and along the stream banks during daytime, usually between 1000 and 1600 h. We investigated crevices under loose rocks and in bedrock to find sheltering animals. We also looked for resting individuals within tall grasses, sedges, and rocks near the water's edge. In early March, when the newts typically begin to appear in the breeding streams, we focused primarily on the slow-flowing stream sections and stream-side pools where newts exhibit their elaborate mating behavior. In May and June, when the stream discharge had decreased considerably, adults, post metamorphic individuals, and larvae were visible in the stream.

We determined the geographic coordinates and elevation of each site using a Garmin global positioning system unit (GPSMAP 60CSx; Garmin International, Inc., New York, New York, USA). We used Google Earth (Google, Inc., Mountain View, California, USA) and ArcGIS 9.3 (ESRI, Redlands, California, USA) to determine linear distances between localities and to calculate the area of the minimum convex polygon encompassing all localities where newts have been observed. We report site coordinates at 0.1º precision to protect the species per guidelines (Chapman, A.D., and O. Grafton. 2008. Guide to Best Practices for Generalising Sensitive Species Occurrence Data. Available from http://www.gbif.org/?doc_id=1233 [Accessed on 14 September 2013]). Precise coordinates and a detailed map have been accessioned at the Florida Museum of Natural History (University of Florida, Gainesville, Florida, USA) to be made available for bona fide research or conservation purposes.

## Results

We surveyed a total of 15 sites for *N. kaiseri*: Talezang (Shevi), Hajibarikab, Shahzadehahmad (four separate sites, three of which had no *N. kaiseri*), Tove, Shaikhon, Vojenab, Kerser, Darehgol, Choobeh, Tafo, Bozorgab, and Pifeh. These included 11 streams, one spring, and three pools constructed on karst springs (one for irrigation and two for domestic animals), all on first order streams. We located newts at 12 of these sites, eight of which were not previously known to be occupied by this species (Table 1). The surveys included four of the five previously known localities for the species (Shahbazan was not visited). The extent of the range of *N. kaiseri* (i.e., minimum convex polygon encompassing sites) increased from 212 $km^2$ for the original five localities to 789 $km^2$ for the original plus new localities, and the maximum linear distance of the range of the species increased from 46.65 km for the original five localities to 61.31 km for all localities. The extent of aquatic habitat remains quite small, as we found newts in only a total of 4.23 km of stream reach (Table 1). The localities were generally dispersed; the average distance between nearest neighbour localities was 4.61 km, ranging from 0.93 km between Hajibarikab and Shaikhon Streams to 12.39 km between Talezang and Tove Streams.

The number of newts observed at the 12 sites varied widely, from two to 650 individuals (Table 1). The total number observed among all sites was 1,277, with 86% of the observations occurring in two sites, Bozorgab and Kerser.

In the eastern part of the range of *N. kaiseri*, Talezang Stream begins as a small first order stream, but much water is added at Talezang Fall (Fig. 2) such that the stream develops into a medium-sized river in a short distance. We observed most of the *N. kaiseri* at this site above the Talezang Fall. Newts below this fall were few and presumably were swept down by spring flushes. Aquatic habitats used by *N. kaiseri* varied. In the reach above Talezang Fall, we saw newts in both pools and riffles as the stream was small. In the reach below the fall, we saw the newts in the stream fringes well away from

**Table 1.** Details for the 12 first-order stream sites occupied by Kaiser's Mountain Newt (*Neurergus kaiseri*) that we visited during this study, and one site known to have newts but not visited. "Newt reach" refers to the length of stream along which we observed newts. "Newts observed" refers to number of adults, subadults, and larvae. In streams that we visited more than once, the number of individuals reported is the maximum number among the visits.

| Locality | Generalized Coordinates | Elevation | Visits | Newt reach | Newts Observed | Reference[1] |
|---|---|---|---|---|---|---|
| Talezang (Shevi) | 32.8 º N, 48.8 º E | 991 m | 1 | 1,200 m | 11 | a, current study |
| Hajibarikab | 32.9 º N, 48.3 º E | 1,004 m | 1 | 55 m | 67 | b, current study |
| Shaikhon | 32.9 º N, 48.3 º E | 960 m | 1 | 200 m | 2 | current study |
| Shahzadehahmad | 32.9 º N, 48.6 º E | 1,262 m | 1 | 900 m | 2 | b, current study |
| Vojenab | 33.0 º N, 48.6 º E | 930 m | 1 | 75 m | 8 | current study |
| Tove | 32.8 º N, 48.7 º E | 990 m | 1 | 20 m | 2 | c, d, current study |
| Kerser | 33.0 º N, 48.2 º E | 995 m | 2 | 900 m | 450 | current study |
| Darehgol | 33.0 º N, 48.2 º E | 1,227 m | 2 | 35 m | 25 | current study |
| Choobeh | 33.0 º N, 48.2 º E | 1,395 m | 1 | 35 m | 23 | current study |
| Tafo | 33.0 º N, 48.2 º E | 1,387 m | 2 | 60 m | 27 | current study |
| Bozorgab | 32.9 º N, 48.5 º E | 1,332 m | 2 | 600 m | 650 | current study |
| Pifeh | 33.0 º N, 48.5 º E | 1,381 m | 1 | 150 m | 10 | current study |
| Shahbazan | 32.8 º N, 48.6 º E | 1,200 m | | f | | c, d, e |
| | | | Total | 4,230 m | | 1,277 |

[1] References: a) Sharifi et al. (2008); b) http://www.cites.org (Accessed September 2012); c) Schmidt (1952); d) Schmidtler & Schmidtler (1975); e) Schultschik & Steinfartz (1996); f) we did not visit Shahbazan Stream during the current study.

strong water currents. Terrestrial habitats surrounding Talezang Stream include thin oak-pistachio open woodlands.

In the western part of the distribution of *N. kaiseri*, four streams (Kerser, Darehgol, Choobeh, and Tafo) are located close together. The average nearest neighbor distance among these streams is 1.28 km. Kerser Stream is large

**Figure 2**. Talezang Fall in the southern Zagros Range divides *Neurergus kaiseri* habitat. Newts in the stream below this fall were few, presumably because any newts here are vulnerable to being swept away by spring flushes. (Photographed by Mozafar Sharifi).

**Figure 3.** Kerser Stream contains a substantial number of *Neurergus kaiseri*. In April 2012, 450 *N. kaiseri* were observed in this stream. (Photographed by Mozafar Sharif).

**Figure 4.** A mature open woodland containing at least four separate streams and springs (Kerser, Darehgol, Choobeh, and Tafo) with *Neurergus kaiseri*. (Photographed by Mozafar Sharifi)

**Figure 5.** A very dry rocky environment with sparse vegetation contains *Neurergus kaiseri* at the base of the valley in an ephemeral spring in Vojenab. (Photographed by Mozafar Sharifi)

and located at the bottom of a big valley (Fig. 3), whereas the other three streams are small and located at higher elevations (Fig. 4). A large number of newts (450; Table 1) were found at Kerser. Terrestrial habitat in this area is a mature open oak woodland with no human settlement. However, a small community of nomads have temporary residence at the shore of the Kerser Stream from early March to late summer.

In the central part of the range for *N. kaiseri*, four streams are located in relatively different vegetation cover compared with the mature oak woodland in the western part of the range (Hajibarikab, Shaikhon, Shahzadehahmad, and Vojenab). This landscape (Fig. 5) is characterized by very rough topography, very shallow soil, and very sparse vegetation cover. Vegetation cover is dominated by several scrub species such as mountain almond (*Amygdalus* sp.), although isolated individual oak and pistachio trees are present. All four streams are ephemeral, but at any time of year, even in dry years, there are small isolated pools that have enough water to maintain a small number of newts. Pifeh and Tove streams are also located in areas with rough topography and very open scrubland. Bozorgab Stream at the middle of the distribution range is located in a mature, open woodland similar to the streams in far west. We found the greatest number of newts (650; Table 1) in this stream.

## Discussion

Despite the additional localities documented for *N. kaiseri* in the present study, the species' range, number of known localities (13), and total number of individuals observed (1,277) remain small. These findings suggest that true population size for the species is also small. Although we did not determine detection probability in our study, which would have allowed us to estimate population size, we conducted the visual encounter surveys at various times during late March until mid-June (when most adults are in the aquatic habitat for mating), which is likely when detection probability reaches its highest value. Every spring an unknown number of *N. kaiseri* are harvested for national trade, presumably from among these few sites. An example of *N. kaiseri* harvested for sale in a pet shop in central Tehran in spring 2012 is shown in Fig. 6.

The large distances between many of the localities and the inhospitable intervening terrain suggest that the newt populations at many of the sites may be isolated from one another. Although some salamander species may disperse up to several kilometers (Hanski 1999; McDonough-Haughley and Paton 2007), the nearest neighbour distances for several sites for *N. kaiseri* far exceed 5 km. Even in some streams that are close to each other, dispersal between the streams may be nil because of very steep, dry terrain. For example, Shaikhon and Hajibarikab Streams are only 500 m apart, but

**FIGURE 6.** *Neurergus kaiseri* for sale in a pet shop in central Tehran in spring 2012 (http://greenblog.ir/index.php/archives/12069 [Accessed April 2012]), two years after this species was amended to Appendix I of CITES. (Unknown photographer).

they are separated by a ridge 400 m higher than the streams. By contrast, there may be connectivity among some sites, perhaps in a metapopulation structure. For example, in the four streams in the westernmost portion of the species' range (Kerser, Darehgol, Choobeh, and Tafo), the streams are located in the same catchment and the average nearest neighbour distance between the sites is 1.28 km. Moreover, count data suggest that the lowest site in this catchment (Kerser Stream) contains a relatively large population that may act as a source population for other streams.

Although the present study reports several new localities for *N. kaiseri,* it is not adequate to provide a basis for re-evaluation of the conservation status of the species. There are still many questions that should be answered before such evaluation is made. Further study is required to determine whether there are additional newt localities within the known range or in the adjacent areas. The significance of small ephemeral streams with only a few newts observed is also not clear without a better understanding of the seasonal activity pattern of *N. kaiseri*. Whereas the life cycle of adult *N. kaiseri* is characterized by periodic migrations between two critical habitats (aquatic for breeding and terrestrial for foraging), there is virtually nothing known about activity of this mountain newt during the long period of cold and wet autumn and winter when the animal is in its terrestrial habitat. Finally, all data for the abundance of *N. kaiseri* presented in this study are unadjusted count data. Therefore, determination of detection probability is necessary for at least the populations in the two streams with the highest count data.

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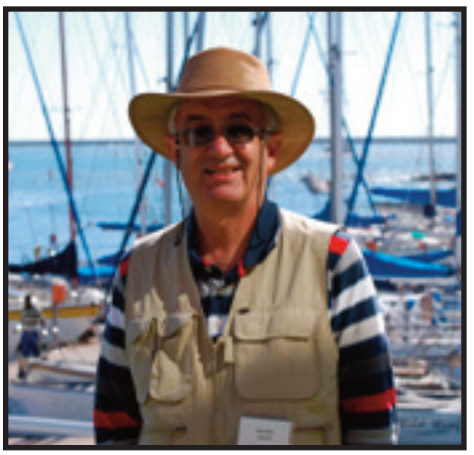

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**Hossein Farasat** is currently a Ph.D. candidate in the Department of Biology, Razi University, Kermanshah, Iran. He earned his M.Sc. from Razi University. His present research focuses on the ecology and genetic diversity of fragmented populations of *Neurergus kaiseri*. His main interest is to examine whether these fragmented populations are structured by a metapopulation. He is also keen to apply his findings in conservation of this critically endangered and endemic species of Iran. (Photographed by Somaye Vaissi).

**Somaye Vaissi** is a Ph.D. student in systematic zoology in the Department of Biology, Razi University, Iran. She has earned her M.Sc. and B.Sc. in zoology from the same department. She is currently the curator of a Captive Breeding Facility for *Neurergus microspilotus* at Razi University funded by the Mohamed bin Zayed Species Conservation Fund. Her current research activities with two species of *Neurergus* involve several topics associated with husbandry and health of the newts in captivity. These include their nutrition, growth, development, and health. She has contributed in detecting chytrid fungus and other diseases such as red-leg syndrome and rickettsial inclusions in the newts. (Photographed by Mozafar Sharifi).

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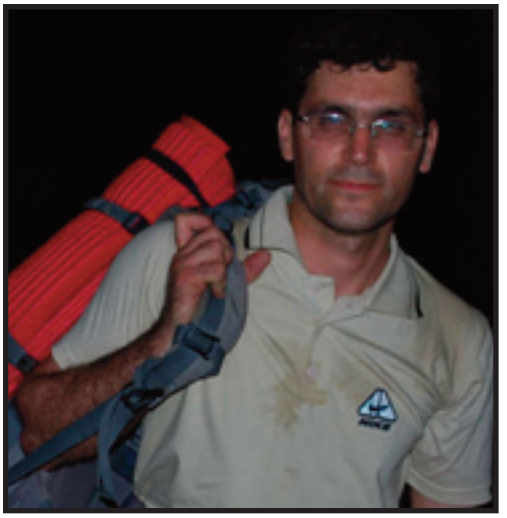

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