CONSERVATION OF THE LAST SURVIVING LIZARD POPULATION IN THE CAUCASUS – THE STEPPE-RUNNER *EREMIAS ARGUTA TRANSCAUCASICA* IN ARMENIA

FINAL REPORT

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COVER PHOTO: BEN VERBOOM

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INTRODUCTION

The first conservation activities towards the protection of a declining population of the unique, poorly known and endangered steppe-runner, *Eremias arguta transcaucasica* Darevsky, 1953 were supported by RSG in 2008-2009. This subspecies is among the rarest and most endangered taxa of Armenia and even though classified previously as “threatened” (ed. Movsesyan, 1987 in the Red Data Book of Armenia), no special measures were taken so far to obtain information on its distribution, abundance, ecology and systematics and initiate effective conservation. The steppe-runner range in Armenia is isolated from the main distribution area spread across NE Romania, Moldavia, S Russia, Ukraine, Kazakhstan, W China, W Mongolia, Armenia, Azerbaijan, Georgia, Turkey, NW Iran, Kyrgyzstan, Tajikistan, and Uzbekistan. The area of subspecies E. a. transcaucasica in Armenia is severely degraded because of human use and more than 90% of local lands are ploughed.

According to the reviewed literature (Chernov, 1939; Dal, 1949; Darevsky, 1957; Aghasyan, 2009), 5 localities of steppe-runner presence were earlier found in Armenia, to the south-east of the Lake Sevan. At present, only one locality is still retaining the subspecies (Map 1) Originally, this endemic subspecies of the steppe-runner was described from the vicinities of the Martuni town (Darevsky, 1953), but in subsequent years intense anthropogenic development has led to disappearance of this lizard in this and few other localities. Then, in 1961 twenty seven individuals were relocated by I. Darevsky and F. Danielyan from the Martuni surroundings to the site located 20 km away from the Gavar town. During the past 37 years steppe-runners have colonized the lake shoreline and established new stable population of 80- 150 individuals, but their habitats were later swept down by sand mining and the subspecies was thought to be wiped out to extinction. In a trip in 2006 (T. Hayrapetyan, unpublished data), we have found a previously unknown population of the steppe-runner in a restricted grassland area near the Lake Sevan about 5 km away from the known populations. The surveys conducted in 2008 have revealed an alarming status of this vestige population as it is significantly fragmented and patches have been continuously destroyed by agriculture. Urgent conservation actions are needed here before it becomes too late.

Map 1. Distribution of *E. arguta* (red point is existing, blue points are extinct populations)

Wildlife conservation can be efficient only if it relies on sound scientific information about the target taxon. So, the principal goal **of this project was getting the first-hand knowledge on ecology, distribution and abundance of the steppe-runner and using it as a background for further conservation-oriented projects**. The overall objective of the project was **creating a comprehensive database and establishing the information background for in situ conservation**. The project also contained a component of capacity building in form of involving the biology students of the Yerevan State University in project activities to let them gain practical knowledge, skills and experience in field research and conservation of the stepperunner.

The following set of activities was defined for implementation within this project:

1. Perform GIS mapping, spatial analysis of the steppe-runner distribution area and identification of key conservation sites by using the GIS technologies
2. Assess the up-to-date abundance of steppe-runners

3. Assess the environmental factors (soil and vegetation cover), higher plant flora and vertebrate fauna which affect the steppe-runner status
4. Identify and describe the limiting factors faced by the steppe-runner population
5. Develop recommendations for conservation

METHODS

Most of field surveys were conducted in August-October 2008 and May-August 2009 to estimate steppe-runner distribution and numbers and to collect data and materials for morphological research.

Here we show the distribution of the steppe-runner numbers recorded during the surveys.

N	Date	Number of records *E.arguta*
1	12-15 September 2008	85
2	10-11 October 2008	1
3	22 March 2009	0
4	21 April 2009	1
5	7-10 May 2009	3
6	31 May 2009	4
7	5-8 June 2009	11
8	21-26 June 2009	10
9	30 June-3 July 2009	9
10	6-9 July 2009	13
11	19-22 July 2009	9
12	15 August 2009	2

The project consisted of field work and lab work in the following fashion:

Field surveys. The surveys were conducted from April to October, the steppe-runner activity period in Armenia. Estimation of population size was based on two approaches:

1. Surveys on random plots. The surveys covered 50 random sampling plots of size 20x20 m over the total area of 900 ha (1927-1991 m a.s.l., E 40◦; N 39◦; Gegharkunik Province, Armenia) in which we recorded lizards, co-existing animals, habitats and weather conditions. Habitat variables included soil type, vegetation and geomorphology and were studied from topographic maps and satellite images. All plots were actively photographed.

2. Visual analysis of steppe-runners. In each lizard, we recorded and measured the following parameters: 1) Correct GPS coordinates; 2) Description of habitat type; 3) Sex (male, female or juvenile); 4) Age in years (whenever possible); 5) Weight (measured with electronic scales up to 0.01 grams); 6) Body length and tail length; 4) Digital vouchering of specimens. Digital vouchering included photographing from all angles to aid morphological studies and individualization. All lizards were released into the wild immediately after measurements.

Laboratory work. It involved the following components: 1) Georeferencing of the record sites and locality/landscape characteristics to fit the GIS software; 2) Analysis of quantitative morphometric data. Data was be analyzed later using STATISTICA 6.0 (Statsoft, Inc.). Population was split into males and females for comparative analyses.

RESULTS

The steppe-runner *Eremias arguta transcaucasica* population is restricted to the eastern foothills of the Geghama Ridge in the Gegherkunik Province, eastern Armenia. The landscape is mountain grassland. Elevations at which we recorded lizards ranged from 1927 to 1991 m a.s.l. The soil is mainly mountain chernozems (black-carbonate) with small fractions of sands. The climate of area is continental and mountainous: cold and snowy in the winter (mean annual air temperature – 9ºC) and quite warm, cloudy and humid in the summer (+25ºC). Maximum of precipitation occurs in the spring and early summer, whereas July and August are the driest months.

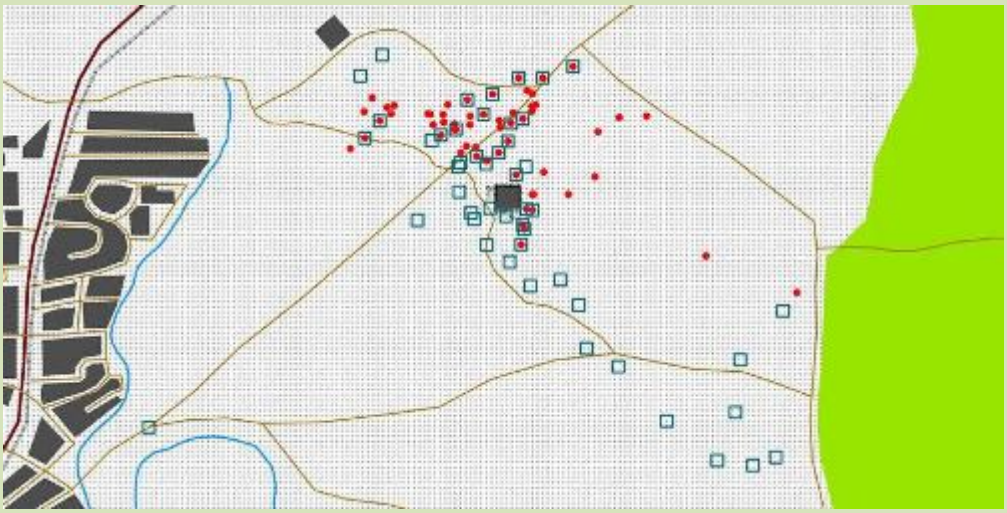
However, in 2009 the weather was abnormally cold and rainy what made many troubles for our field research. The early survey period (March-April) was cold and snowy, so the first lizard was recorded only in the 21st of April beneath the stone under the sunny, but windy weather. The steppe-runner is a diurnal species and becomes active after 11:00 pm when the ground warms up.

There were only few sunny days in May, June and August 2009. Moreover, there were no steppe-runner records during the sunny days (air temperature ca. 28^{o}C) when the soil remained wet, even though other reptiles (e.g., striated lizard *Lacerta strigata* and grass snake *Natrix natrix*) were active and visible. September 2008 was warm and dry. Generally, high amounts of precipitation have led to rich wild herbage and agricultural crops.

Spatial distribution of E. a. transcaucasica

Spatial distribution of steppe-runners is related to habitats and most of individuals were found on elongated hills surrounded by field crops and intersected by numerous field roads and tracks. Neighbouring hills were empty of steppe-runners. The range of this subspecies is very small, with a core of only 0.48 km^{2}, and consisting of one patch (marked by red on Map 3). The longest distances between lizard records were 1.47 km in NW-SE direction and 0.47 km in NESW direction. Lizardc preferred the north-eastern (76% of records) and western (21%) slopes of hills. Slope declivity and elevations apparently did not affect the distribution of lizards, as they were recorded on different declivities up to 5^{o} in the bottom, middle and top parts of the slopes. Meantime, most records are associated with slope declivities of 9^{o} (22%) and 18^{o} (28%).

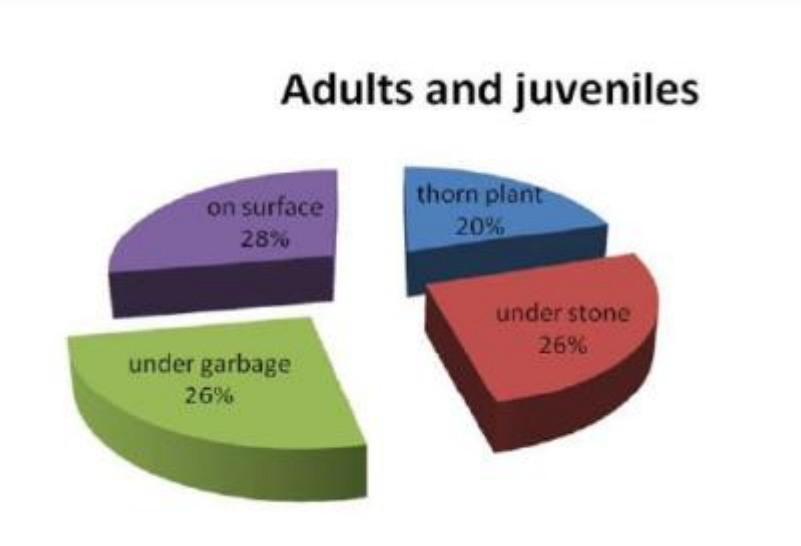
Map 2. The topographic map of the steppe-runner *Eremias arguta transcaucasica* range. The red points indicate the steppe-runner records and the blue quadrates are the random sampling plots of 20x20 m.

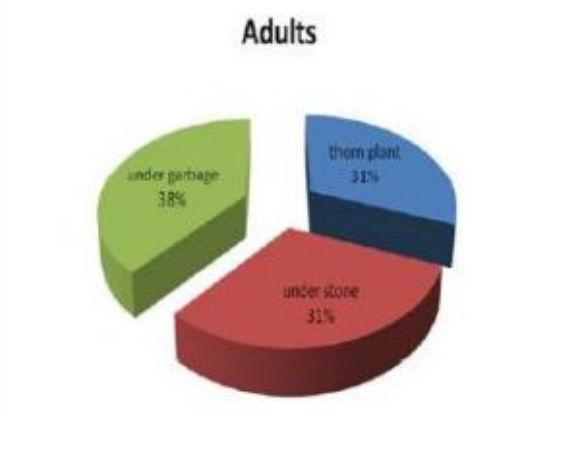


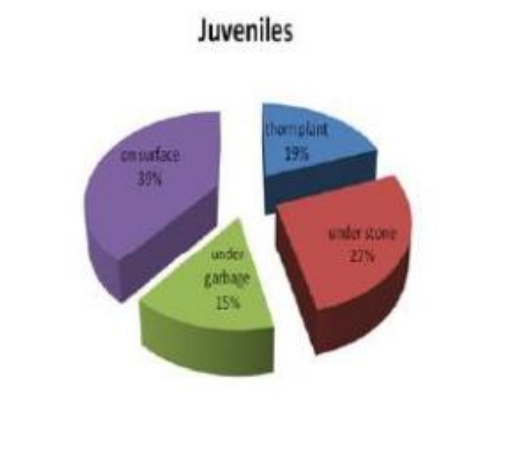
Map 3. The satellite image of the steppe-runner *E. a. transcaucasica* range marked by red line.

The soil composition of steppe-runner microhabitats still needs to be studied in more details. We noted that this lizard prefers the stony-clayey hill slopes as against the agricultural fields, sandy patches, places with vegetation cover more than 90% or very stony terrain, and like garbage dumps too. Obviously, suitable microhabitats must contain appropriate shelters for lizards which can be stones, garbage, bases of thorny scrubs or rodent burrows. All these kinds of shelters occurred in record sites in similar proportions.

However, we found some differences in habitat selectivity among adults and juveniles. Juveniles were often found in grass and among small stones, whereas adults were frequently recorded in underground shelters beneath the stones or among the heaps of stones, garbage or rodent burrows.







Samples of vegetation were collected across the sampling plots for identification by Dr. Ilona Stepanyan (Scientific Centre of Zoology and Hydroecology NAS RA). Steppe-runners preferred the communities of families Asteraceae (*Achillea biebersteinii* 50% of plants on squares, *Artemisia absinthium* 60%, *Carduus nutans* 80%, *Centaurea depressa* 60%, *Carduus arabicus* 60%), Caryophyllaceae (*Diantus cretaceus* 50%), Convolvulaceae (*Convolvulus arvensis*), Fabaceae (*Trifolium dubium)*, Euphorbiaceae (*Euphorbia orientalis*), Lamiaceae (*Thymus kotschyanus* 90%, *Teucrium polium* 80%) and Poaceae (*Aegilops tauschii* 90%, *Bromus japonicas* 90%). The following shrubs growing on hills are usually used by lizards as shelters: Asteraceae (*Cirsium vulgare*), Apiaceae (*Astrodaucus orientalis*), Fabaceae (*Astragalus maximus, Astragalus sevangesis)*, Lamiaceae (*Salvia nemorosa, Scutellaria orientalis*), Ranunculaceae (*Adonis aestivalis*), Scrophulariaceae (*Linaria curdica*), Solanaceae (*Hyoscyamus niger)*. The sites with widespread wormwood species *Artemisia fragrans* were ignored by stepperunners.

The steppe-runner co-exists with the striated lizard *Lacerta strigata* and outnumbers it (only 49 striated lizards were recorded by us), but the range of *L. strigata* is much wider.

Number of records of two lizard species on 50 random plots.

	N	Mean	SE	Std.Dev.	Min	Max
E. arguta	50	1.42	0.32	2.24	0	9
L. strigata	50	0.84	0.18	1.28	0	6

Within the steppe-runner range, we also found the grass snake *Natrix natrix* (one juvenile) and used to encounter quite often the green toads *Bufo viridis* (at least 19 individuals). We also came across 2 individuals of *Natrix tesselata* and one *Coronella austriaca*. On the neighbouring hills the rock lizards *Darevkia unisexualis* are widespread. Among mammals, we recorded voles (*Microtus* spp.) and red fox (*Vulpes vulpes*).

Abundance of E. a. transcaucasica

In 2008-2009 we found 148 individual steppe-runners over the territory of 9 km2 (900 ha), of which 72 (48.6%) were recorded within the sampling plots and 76 (51.3%) were found outside of them (Chi-square =0, df=1, P=1).

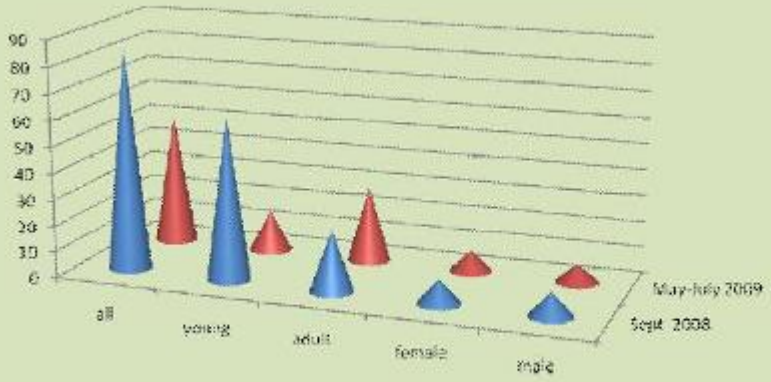
1. In September 12-15, 2008 we recorded 85 individuals over 0.25 km2, with the longest distance between the outer points equal to 620 m. Mean abundance of lizards over 20 random sampling plots (20x20 m) of total area 0.008 km2 was 2.8 ± SE 0.63 (range 0-9) individuals) or 71.25 lizards (77% were juveniles) on hectare
2. In May-August, 2009 we detected 62 steppe-runners over 8.75 km2. Mean abundance over 30 random sampling plots (20x20 m) over 0.012 km2 was 0.5 ± SE 0.18 (range 0-3) individuals or 12.5 lizards (27 % of young after first hibernation) on hectare.
3. Totally, in 2008-2009 we recorded 72 steppe-runners over 50 random sampling plots. Mean abundance of lizards over the area of 0.02 km2 was 1.4 ± SE 0.32 (range 0-9) individuals or 36 individuals (66.7% were juveniles) on hectare.

The mean abundance of steppe-runners in 2008-2009.

	N plots	Mean	Min	Max	SD	SE
2008	20	2.8	0	9	2.8	2.63
2009	30	0.5	0	3	1.0	0.18
2008-2009	50	1.4	0	9	2.2	0.32

We have also studied the distribution of adults vs. juveniles, males vs. females during the study period.

We have recorded an unexpectedly low number of juvenile steppe-runners in the spring 2009. Before hibernation in the winter 2008-2009 juveniles constituted 67% of population, but in the spring 2009 their proportion slumped to 10% and in the summer 2009 ever more to 3%. Obviously, most of juveniles failed to survive the winter. We used to record many juveniles in the wild, but conditions for their wintering were unsuitable. Another problem is ploughing that kills many juveniles. Earlier, similar situation was found in the presently extinct steppe-runner population near Martuni which kept declining during the 2-3 years after the start-up of ploughing techniques and later vanished (Darevsky and Danielyan, unpublished data).



Some reproductive characteristics

Because of quite harsh climatic conditions of the Sevan Lake basin, local steppe-runners breed late, from mid-May to June. We recorded pregnant females in late June (26 June 2009) and early July (6 July 2009). Palpation of females observed on 19 July 2009 did not confirm the presence of eggs inside. Egg numbers which can be estimated by palpation are 3-4, but actually vary from 3 to 6 (usually 4-5). Subsequent clutches consist of fewer eggs.

The first juveniles become visible in the first decade of September. Whether the stepperunner in Armenia produces the second clutch is unclear.

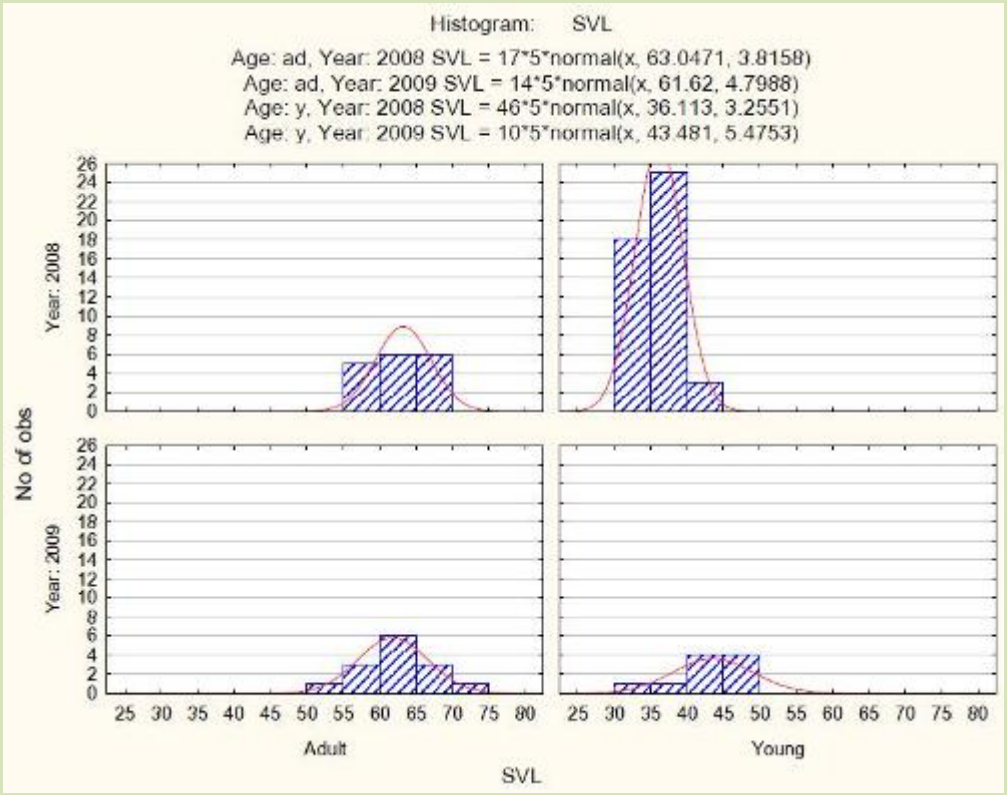
Some measurements of E. a. transcaucasica

The maximum body length equals 71.02 mm (31 May 2009) and the maximum weight is 14.2 g (15 Sept 2008) in males and 67.2 mm (13 Sept 2008) and 11.1 g (13 Sept 2008) in females. According to literature data, body size of this subspecies of lizards may reach up to 85 mm (Darevsky, 1953).

Year	Age	Mean	N	SD	SE	Min	Max
2008	adult	**63.05**	**17**	**3.82**	**0.93**	**56.50**	**69.50**
2008	young	**36.11**	**46**	**3.26**	**0.48**	**30.50**	**42.80**
2009	adult	**61.62**	**14**	**4.80**	**1.28**	**52.45**	**71.02**
2009	young	**43.48**	**10**	**5.48**	**1.73**	**33.68**	**49.93**
All Groups		**46.33**	**87**	**12.84**	**1.38**	**30.50**	**71.02**

Males appear to be larger than females, but differences in their body lengths and weights are statistically insignificant ($P > 0.05$). The juveniles captured in mid-September had body length 30.5-42.8 mm. It is possible to divide all juveniles on two groups according to SVL (figure 3): lizards with body length 30-40 mm and 40-45mm, which is possible, reflect expended time of lay of eggs or incubation or appearance of two clutches. After first hibernation the body size of lizards vary in 34-50 mm.

The body length (SVL) distribution of adults and juveniles steppe-runners in sampling of 2008 and 2009



SUMMARY BACKGROUND FOR THE STEPPE-RUNNER (*Eremias arguta transcaucasica*) CONSERVATION

The endemic subspecies of the steppe-runner *E. a. transcaucasica* is the rarest and most endangered reptile in Armenia. That this lizard has survived in just one population makes it extremely prone to extinction through isolation and consequent ecological, demographic and genetic impairments. So, it is really urgent to propose, develop and implement the targeted and locally focused conservation measures. Currently, this lizard occurs only in one refuge located among the crop fields in proximity to a village.

Current status

The steppe-runner *Eremias arguta* has wide distribution, but its subspecies *E. a. transcaucasica* is very rare, endangered and spatially confined only to a small area in the Lake Sevan basin (Ananjeva et al, 2004, Sindaco and Jaremchenko, 2008). Its population in Armenia is very small and isolated and, though registered in the Red Data Book of Armenia, no special conservation measures are proposed or implemented yet. The core range of this reptile in the country is located outside of protected areas; the closest (2-3 km away) is the Lake Sevan National Park.

Current factors causing loss or decline

The principal threat to this population is habitat destruction, fragmentation and modification because of agricultural activities, as well as collection by humans.

1. MORTALITY of adults and especially juveniles for insufficient wintering conditions. Most of shelters have been destroyed by ploughing and other land cultivation techniques.
2. OVERGRAZING.
3. ROAD MORTALITY. Steppe-runner habitat is intersected by many dirt roads. In spite of infrequent traffic, agricultural machinery causes substantial deterioration of habitats and kills lizards themselves. Roads also cause habitat fragmentation and increased isolation of patches.

4. USE OF HABITAT AS GARBAGE DUMP. Garbage is scattered throughout the area. This is a controversial issue: on the one hand, garbage provides plenty of shelters, but on the other hand, it attracts predators (gulls *Larus* spp., daws *Corvus monedula*, magpies *Pica pica*, rooks *Corvus frugilegus*) preying on lizards and competitors (rodents).
5. COLLECTION OF LIZARDS BY LOCALS AND POACHERS
6. HABITAT TRANSFORMATION for expansion of agricultural activities.

The main threats to population of *E.arguta* (agriculture activity, overgrazing, vicinity of village, garbage dump, predators)

Recommended actions for conservation.

Conservation actions need to encompass different levels in parallel to ensure habitat quality and connectivity; population welfare; and public awareness.

Habitat Protection

1. The newly discovered population occurs is severely fragmented and needs urgent protection. Establishment of sanctuary here would avert further habitat destruction through agricultural development.
2. Garbage utilization and establishment of at least one sanitary disposal site are essentially needed.
3. Wherever possible, habitat corridors should be established and maintained to ensure connectivity between isolated patches of the range.
4. Livestock grazing should be stringently controlled.

Species Management

1. Captive breeding is an important approach to save the steppe-runner population from imminent extinction through the release of lizards into the wild sites where threats are no longer active and conservation efforts are ongoing.
2. Potential release sites should be carefully identified and described. They should be suitable to the maximum possible extent for juveniles to be translocated from agricultural landscapes, situated far from human settlements and be protected some way.

Scientific Research

1. It is essential to monitor the existing and translocated steppe-runner population and its patchy sub-populations
2. Large-scale presence-absence surveys should be undertaken along the entire south-eastern coast of the Lake Sevan
3. It is important to continue systematic (morphometric and genetic) and ecological field research activities that we began in this project. Detailed well-designed surveys and genetic studies are most desperately needed.

Education

Local people are almost unaware of the desperate status of the steppe-runner and kill them intentionally or not. Raising public awareness about the steppe-runner and other rare wildlife in Armenia should constitute an essential component of any conservation effort.

EDUCATION AND CAPACITY BUILDING

This project provided a good opportunity for students of the Faculty of Biology of the Yerevan State University to get practical knowledge, skills and experience in field research and conservation of the steppe-runner. Prof. Felix Danielyan and I have organized the training courses for a field research team of seven university students recruited as volunteers. The training courses included such topics as field survey techniques, habitat description, georeferencing and digital vouchering. The 2nd year of baccalaureate student Ms. Anna Vardanyan was involved to build up the new generation of conservation biologists. She made an oral presentation "The last population of the steppe-runner *Eremias arguta transcaucasica*" in the Conference of Biology Students, Yerevan on 2-4 March, 2009.

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