TREWEEK
ENVIRONMENTAL CONSULTANTS

Survey of reptiles and amphibians at Amulsar (Armenia)

Final Report

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CONTENTS

EXECUTIVE SUMMARY

Treweek Environmental Consultants (TEC) undertook an additional baseline assessment of the reptile and amphibian species potentially affected by the proposed gold mining project at Amulsar, Armenia, in September 2015. The survey area was defined as the areas affected by the mining project, with some surrounding habitats that seemed favourable to vipers. One visit was also made to the Arshak set-aside area NW of Goryak.

Surveys were done between 31.08.2015 and 06.09.2015 by two persons using classical field survey methods, sampling in suitable habitats. All reptiles seen were identified to species, most were photographed, when possible caught and DNA sampled. GPS coordinates were obtained for all specimens. Shed skins were all collected and identified in Montpellier, France. The short time allocated to the survey (7 days), small number of people involved and timing of the survey limited its exhaustiveness**.** The list of species observed cannot thus be considered as complete and more species certainly occur in the study area.

The survey produced observations of one species of amphibian and 10 species of reptile, including three either globally threatened (according to IUCN) or regionally threatened (i.e. listed in the Armenian Red Data Book), namely *Telescopus fallax, Vipera eriwanensis,* and *Montivipera raddei*. An additional 7 species of reptile were found in the Jermuk - Gndevaz region during the current or earlier surveys, but away from areas directly affected by mining. None of these species are locally or globally threatened or near-threatened.

Most of the mining project infrastructure will be at high altitude, limiting potential impacts on reptile communities. Only one protected species (*Vipera eriwanensis*) will potentially be affected by the open pits and adjacent infrastructure. The most important area for reptiles is at lower altitude where the heap leach facility and adjacent infrastructure are planned. Reptile diversity was found to be high here, with 12 species present, including all three threatened ones.

As a result of this survey it can be concluded that the **impact** of the mining project on reptiles and amphibians will be relatively low to minimal for most species, certainly at a national level. No Endangered or Critically Endangered species will be exposed to significant adverse effects. However three species listed in the Red Book of Armenia occur in the project affected area, two of which are included in the IUCN Red List. Most of the infrastructure will be above 2000 m a.s.l. where reptile communities are relatively impoverished. The area where most reptile diversity is concentrated consists of the stony slopes and rocky outcrops on the N and W edge of the proposed heap leach

area. The best way to limit impacts on the reptiles would be to safeguard as many of these habitats as possible by keeping the size of the heap leach infrastructure to a minimum and controlling incidental habitat damage outside the proposed footprint. Residual impacts are likely and can be offset through protection of reptiles within the proposed Jermuk National Park.

Mitigation for impacts on reptiles should focus on minimising the extent of habitat destruction (including gravel roads etc) in the mountains, particularly where infrastructure is proposed in meadow steppe habitat. Both *Vipera eriwanensis* and *Montivipera raddei* would benefit from education or awareness-raising to diminish their destruction human destruction. All species would benefit from increased knowledge on their distribution, allowing identification of the most important areas for reptile conservation.

1 Introduction

Lydian International (Lydian) and Geoteam CJSC (Geoteam) requested Treweek Environmental Consultants (TEC) to undertake an additional baseline assessment of the reptile and amphibian species potentially affected by its proposed gold mining project at Amulsar, Armenia. This report presents the findings and observations from a survey undertaken in September 2015.

1.1 Background

Several surveys of reptiles and amphibians had already been undertaken between 2008 and 2011 and again in 2013, by Geoteam and the Armenian Institute of Zoology and Hydroecology. These had shown two species of amphibians and nine species of reptiles to be present in the Amulsar area. However, incidental sightings by ornithologists in 2013-2015 were made of five additional species, including two that are listed in the Armenian Red Book and are included in the global IUCN Red List, highlighting the need for further study to confirm locations of important habitat that might be affected by mine development. When the presence of the latter two species was also confirmed by a local reptile enthusiast, the decision was made to organise an additional, specific field survey in the autumn of 2015. This survey was undertaken by Pierre-André Crochet, a herpetologist from France.

1.2 Objective of the Survey

The objectives of the survey were to:

1) expand the available records of reptiles and amphibians and produce an updated list of species potentially affected by the mining project,

2) assess the situation of the Radde's viper *Montivipera raddei* and Armenian Mountain-steppe viper *Vipera eriwanensis* in the study area, evaluate the impact of the mining project and propose mitigating measures, and

3) work with local herpetologist (Mxitar Arshakyan), providing preliminary training in specialised monitoring techniques.

2 Summary of available information

2.1 National data

Armenia has eight species of amphibian and 50 species of reptile, 30 of which are listed as globally threatened by IUCN. Eleven of Armenia's native species - two amphibians and nine reptiles - are endemic to the Armenian Highlands and the Lesser Caucasus Mountains and are declining rapidly. Human impact on native ecosystems, primarily through mining and agriculture, has caused habitat loss or fragmentation for these species.

2.2 Summary of earlier surveys and results for Amulsar

During earlier surveys two amphibian species were recorded as present: *Bufo viridis* (Green Toad) and *Rana macronemis* (Long Legged Wood Frog). Both are widespread in mainly wetlands. Neither are included in the RA Red Book.

Based on previous field activities and review of the literature and the habitats in the Project-affected area, the following species of reptile were considered likely to occur: *Hemorrhois (Coluber) ravergieri*, (Ravergier's (Multicolor) whip snake), *Coronella austriaca* (smooth snake), *Platyceps (Coluber) najadum* (Dahl's whip snake), *Natrix tessellata* (dice snake), *Elaphe sauromates/quatuorlineata* (blotched snake/Eastern four-lined rat snake), *Pelias (Vipera) eriwanensis* (Armenian mountain-steppe viper), *Montivipera raddei* (Armenian viper or Radde's viper), *Eryx jaculus* (Western sand boa), *Pseudopus apodus* (European glass lizard), *Lacerta vivipara* (average lizard) and *Darevskia valentini* (Valentine's rock lizard). In addition, sightings of *Lacerta strigata, Laudakia caucasia* and *Ophisops elegans* were made by ornithologists during their surveys.

The Project-affected area provides good habitat for several species of reptile: rock piles and rock streams are good shelters for lizards and whip snakes. Two species of viper (Armenian mountain-steppe viper and Radde's/Armenian rock viper) are listed in the RA Red Book as Vulnerable and on the IUCN Red List as Vulnerable and Near Threatened, respectively. This area has appropriate

conditions for these species, and while they were not found in the herpetological surveys of Amulsar, they were seen during the ornithological studies (2013) and the survey of Brown Bear (2015).

3 Approach and Methods

3.1 Survey Area

The survey area was defined as the areas affected by the mining project, with some surrounding habitats that seemed favourable to vipers. Just one visit was made to the Arshak set-aside area NW of Goryak. Areas affected by mining are based on documents provided by Geoteam.

3.2 Methods for surveying

3.2.1 Sampling strategy and survey set up

Surveys were done between 31.08.2015 and 06.09.2015 by Pierre-André Crochet (PAC) and Mxitar Arshakyan, a local amateur naturalist from Gndevaz. Classical field survey methods were employed, with unstratified sampling comprising walking slowly through habitats, mostly during morning, turning over stones.

Habitats were selected based on previous experience in similar regions (Eastern Turkey and Azerbaijan). More time was spent in habitats that looked more promising in term of reptile diversity, and also in habitats that looked favourable for Radde's and Armenian mountain steppe vipers as these two species were highlighted in the objectives of the survey. The result is that some parts of the study area visited several times and some parts never visited (see Figure 1). In particular, high altitude areas were visited less often and the lowest altitude areas received the most visits as they were considered to be potentially more species-rich.

All reptiles seen were identified to species, most were photographed, and when possible were caught and DNA sampled. GPS coordinates were obtained for all specimens. Shed skins were all collected and determined in Montpellier with Philippe Geniez (EPHE – CEFE), using a combination of published determination keys (mostly in Arakelyan *et al*. 2011), specimens preserved in the BEV collection in Montpellier (EPHE – CEFE) and photos in the private photo collections of PAC and PG.

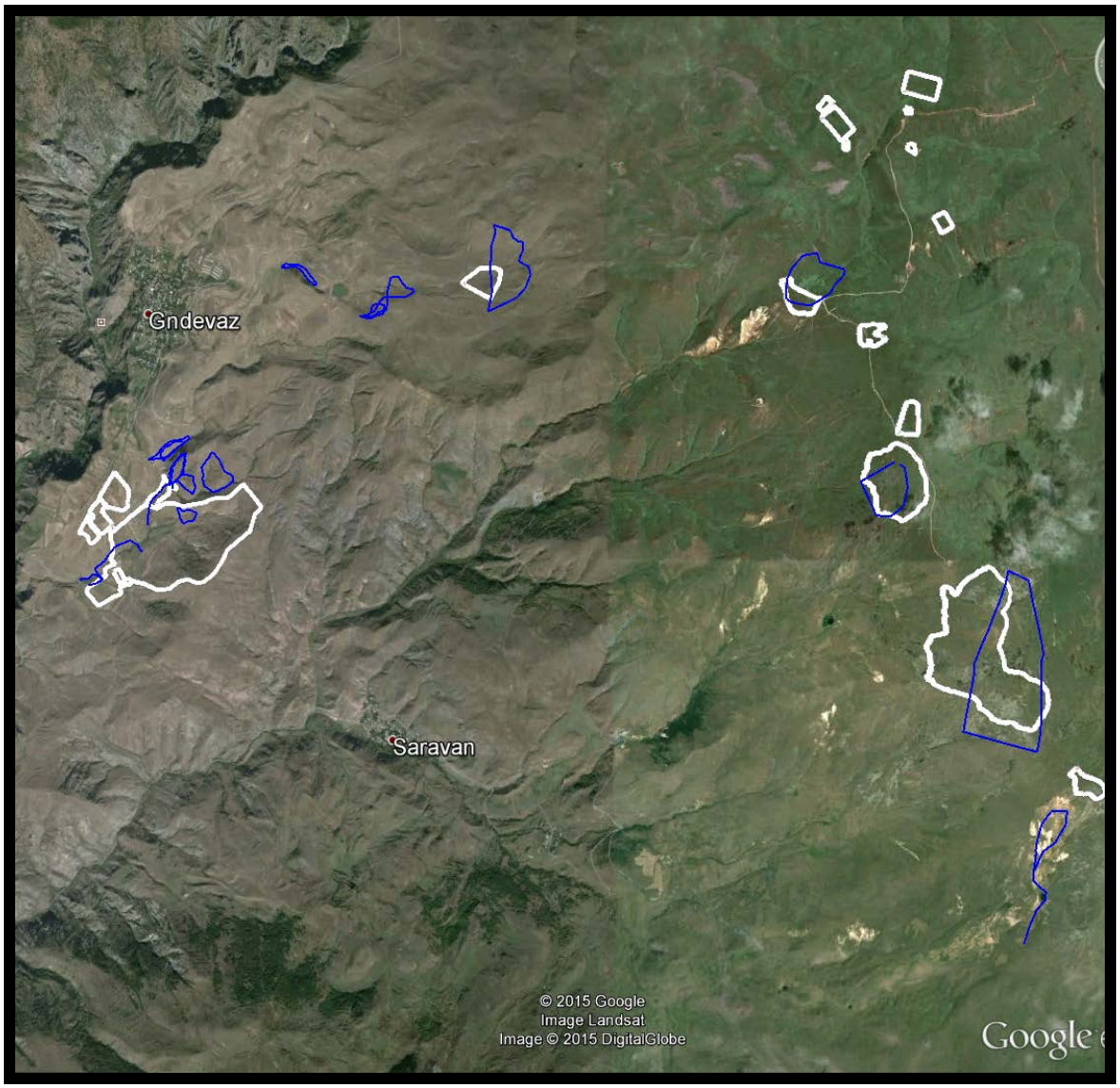

***Figure 1**: visits made during the reptile survey in September 2015 (blue lines) and areas affected by the mining (in white).*

3.2.2 Interpreting results

Due to the relatively cool to cold nights, no nocturnal field surveys were attempted. Cloudy to rainy weather in the late afternoon precluded doing surveys in late afternoon, even though this time is often productive for snake surveys. Several reptile species (mainly fossorial or semi-fossorial) are notoriously difficult to detect in late summer (see Arakelyan *et al*. 2011 for example). Colleagues from the CEFE have made repeated visits to the same localities in Eastern Turkey, in habitats similar to the study area and failed to find several species that were common in spring (P. Geniez pers. com.) during late summer visits. Ideally, surveys for these species would be conducted earlier in the year. The species most likely affected are snakes of the genus *Eirenis*, *Rhynchocalamus*, *Typhlops* and *Eryx*. Some lizards also have reduced activity in autumn compared with spring, and the fact that only freshly hatched juveniles of Radde's rock lizard *Darevskia raddei* were seen, but no adult in the study area, is probably a consequence of lower autumn activity of adults.

In summary, the short time allocated to the survey (7 days), small number of people involved (only one person with significant experience) and timing of the survey certainly limited its coverage. Direct evidence comes from several species observed during the other faunistic surveys (see below) but not specifically during this survey. The species list provided here cannot thus be considered as complete and more species certainly occur in the study area (see Chapter 4). However the results area sufficient to confirm key habitat areas and to determine which species have suitable habitat present and are potentially affected by mining activities.

4 Results

4.1 Species list

The following species were found in this survey, or have been observed during previous ecological surveys in areas affected by the mining project or their vicinity. For each species in the Red **ook** of Armenia (http://www.mnp.am/red_book_fauna/) or on the IUCN Red List (http://www.iucnredlist.org) the Red List category is given (NT = near-threatened, Vu = vulnerable).

Bufotes viridis – green toad (= *Bufo variabilis*)

Laudakia caucasia – Caucasian rock agama

Lacerta media – eastern three-lined lizard

Dolichophis schmidti – Schmidt's whip snake

Eirenis modestus – ring-headed dwarf snake

Eirenis punctatolineatus – dotted dwarf snake

Hemorrhois ravergieri – spotted whip snake

Telescopus fallax – cat snake (**Red Book of Armenia Vu**)

Macrovipera lebetina – Levantine viper

Montivipera raddei – Radde's viper (**Red Book of Armenia Vu, IUCN Red List NT**)

Vipera eriwanensis – Armenian mountain-steppe viper/ Armenian meadow viper (**Red Book of Armenia Vu, IUCN Vu**)

A few additional species were found during this survey or in surveys of the proposed Jermuk National Park in the Jermuk - Gndevaz region but away from areas directly affected by mining. None of these species are locally or globally threatened and they are not discussed further. They are:

Darevskia raddei – Radde's rock lizard

Darevskia valentini – Valentin's rock lizard

Lacerta agilis – sand lizard

Lacerta strigata – Caspian green lizard

Ophisops elegans – snake-eyed lizard

Coronella austriaca – smooth snake

Elaphe sauromates – blotched ratsnake

4.2 Reptile diversity and distribution

Most of the mining project infrastructure will be at high altitude, limiting risk of impacts on reptile communities. Based on maximum altitudes reported in Arakelyan *et al*. (2011), the open pits are only likely to affect *Coronella austriaca, Vipera eriwanensis, Lacerta agilis* and *Darevskia valentini* and the latter two species have not been found in the mining area so far. The only protected species considered to be potentially affected by the open pits and adjacent infrastructure is *V. eriwanensis* (see below).

Further down (above the Gndevaz reservoir) more species could possibly occur and be exposed to impacts, but apart from *Lacerta media*, none of these have been observed in surveys, although *V. eriwanensis* is probably present (see below). Other protected species are considered unlikely to occur, at least in any sizeable population.

The most important area for reptiles is at lower altitude where the heap leach facility and adjacent infrastructure are planned. The combination of moderate altitude (1600 to 1700 m asl) and diverse habitats including stony slopes with open bushy vegetation and rocky outcrops explains why this area had the highest diversity of reptiles in this survey. 12 species were observed, including the 3 protected species *T. fallax, V. eriwanensis* and *M. raddei*, (Fig. 2).

Although the survey time spent in various habitats and localities varied, with more time spent around the proposed heap leach area, (due to the more promising habitats and previous reports of Radde's Viper in the vicinity), there is no doubt that the heap leach area is the most important of the areas affected by the mining project for two of the three protected species (*T. fallax* and *M. raddei*) as well as having the highest reptile diversity in the Study Area. The most important habitats for the reptiles within this area are the stony slopes, rocky outcrops and stream that runs through apricot plantations towards Arpa gorge. Stony slopes and rocky outcrops are the preferred habitats of most of the species recorded there, while the presence of water nearby is essential for several species

(including the Green Toad *B. viridis* which reproduces in aquatic habitats). Minimizing the impact of proposed infrastructure on these habitats would be the best way to minimize impact of the project on the reptile and amphibian communities of the Project-affected area.

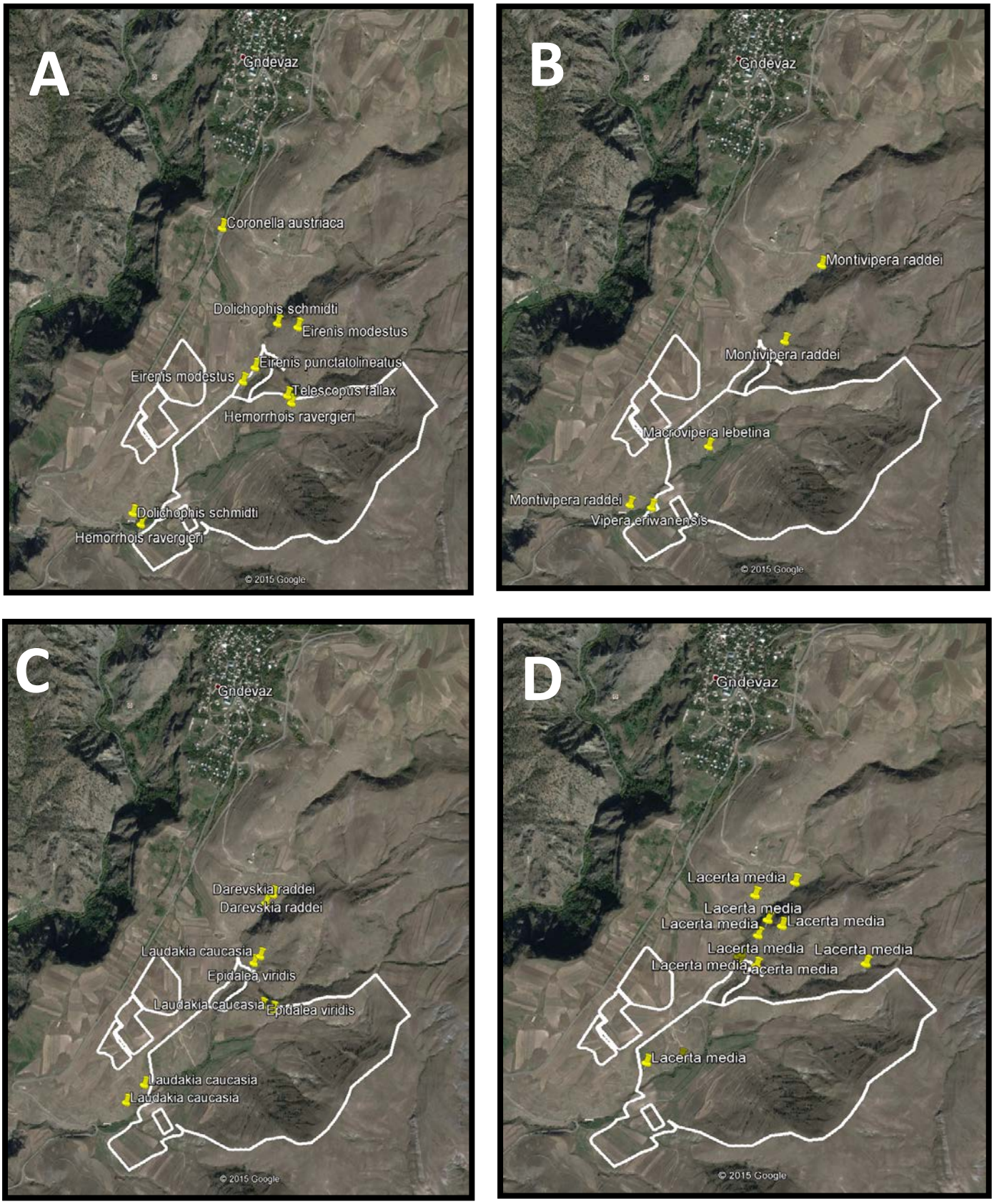

***Figure 2**: Records of colubrid snakes (A), viperid snakes (B), lizards and toad (C) and Lacerta media (D) in and around the heap leach facility.*

5 Red list species: impacts and possible mitigation

Montivipera raddei Radde's viper is distributed across eastern Turkey, north-western Iran and southern Armenia (see http://maps.iucnredlist.org/map.html?id=22993). In Armenia it occurs in rocky mountain habitats between 1300 and 1800 m a.s.l. (with a record as high as 2700 m, Arakelyan *et al*. 2011). Globally the species is listed as near-threatened because "it has experienced significant and continuing declines as a result of habitat loss and overexploitation, but less than 30 percent over the past three generations" (Nilson *et al*. 2009). In Armenia, it is listed as Vulnerable in the Red Book of Armenia (http://www.mnp.am/red_book_fauna/) because the population has been sharply decreasing in recent times. Main causes of declines are said to be habitat change and illegal harvesting (presumably for the pet trade). According to Mxitar Arshakyan the species is also killed by locals when they encounter it. There is no estimate of population size for Armenia but the species has a rather wide distribution all along the mountains running between the Araks valley and Lake Sevan and at least 29 populations are reported from Armenia by Arakelyan *et al*., 2011.

The species often performs seasonal "migration" between hibernation habitats (rocky outcrops or boulders offering access to deep underground microhabitats) and less xeric habitats used during summer (such as grassy habitats along streams, open forests, steppes, etc.). These movements can reach several hundred metres in Iran (R. Behrooz pers. com.). In Gndevaz, M. Arshakyan suggested that the populations of Radde's Viper undertake similar movements between the rocky outcrops used in winter and spring and the lower cultivated areas used in summer. It is interesting that despite spending several hours in the area where three adults had been photographed in June (gorge south of cow farm, northernmost point in Figure 2B) the species was not observed close to the rocky outcrops in September. Two shed skins were found closer to the stream and cultivated area. It is thus reasonable to imagine that the persistence of the species in the area affected by the mining project depends on continuing access to both the rocky outcrops used in winter and spring (gorges) and more humid habitats used in summer (cultivated areas and grassy areas closer to the stream).

The impact of the mining project on the species can be anticipated to be relatively small or negligible on the national scale. The favourable habitats affected by the heap leach facilities would cover a maximum of 2 km^2 and there are much larger expenses of favourable habitats for the species outside the mining project (occurrence of the species in the Arpa gorge west of Gndevaz has been confirmed by M. Arshakyan). The project will thus reduce the total population size by reducing

favourable habitats in a proportion that is impossible to estimate based on current data but is thought unlikely to cause significant impacts at national level. Due to the status of the species in the RA Red Book, however, it is important to ensure a "no net loss" outcome.

In terms of mitigation measures, capture and translocation of specimens prior to the works is not recommended, as this would have no medium- to long-term effect on the population size and would not compensate for loss of habitats in terms of population size or persistence. Therefore the mitigation strategy should focus on efforts to: 1) limit destruction of favourable habitats to the extent possible by limiting incidental damage and minimising physical footprint to avoid as much of the viper habitat as possible and 2) take steps to promote acceptance of local people towards snakes through local education and awareness-raising. If the mining project destroys some favourable habitats but contributes to reducing illegal destruction, local populations of Radde's Viper would benefit, possibly more than compensating for local loss of habitat. A third possibility (3) would be to increase knowledge on the distribution and habitat use of the Radde's Viper around Gndevaz to locate other important habitats / subpopulations and evaluate their risk of destruction. The proposed National Park could play a key role in protecting reptile populations if suitable habitat occurs. Ensuring long-term protection of important habitats outside the mining project that could be otherwise lost to agriculture or other human activities would be another efficient way to mitigate impact of the mining project, potentially within the proposed Jermuk National Park.

Vipera eriwanensis Armenian Meadow Viper has a fragmented distribution in Eastern Turkey and Armenia (subspecies *eriwanensis,* see http://maps.iucnredlist.org/map.html?id=164679) and North-western Iran (subspecies *ebneri*). The subspecies *eriwanensis* inhabits mountain steppes and meadows, more rarely open forest and other xerophytic vegetation with shrubs and grass, between 1200 m and 3000 m a.s.l. It is listed as globally Vulnerable because "its Extent of Occurrence is less than 20,000 km², its distribution is severely fragmented, and there is a continuing decline in the extent and quality of its mountain steppe habitat due to overgrazing and agricultural conversion" (Tuniyev et al. 2009). It is listed in the Red Book of Armenia as Vulnerable although populations are considered stable (http://www.mnp.am/red_book_fauna).

As can be seen from Figure 3, this is the protected species that will be the most affected by the mining project as it occurs potentially in most / all of the proposed mining areas. It has been found from the rocky slopes of the heap leach area to the stoneless meadows around the base camp in the mountains and can potentially occur as high as the highest open pit areas.

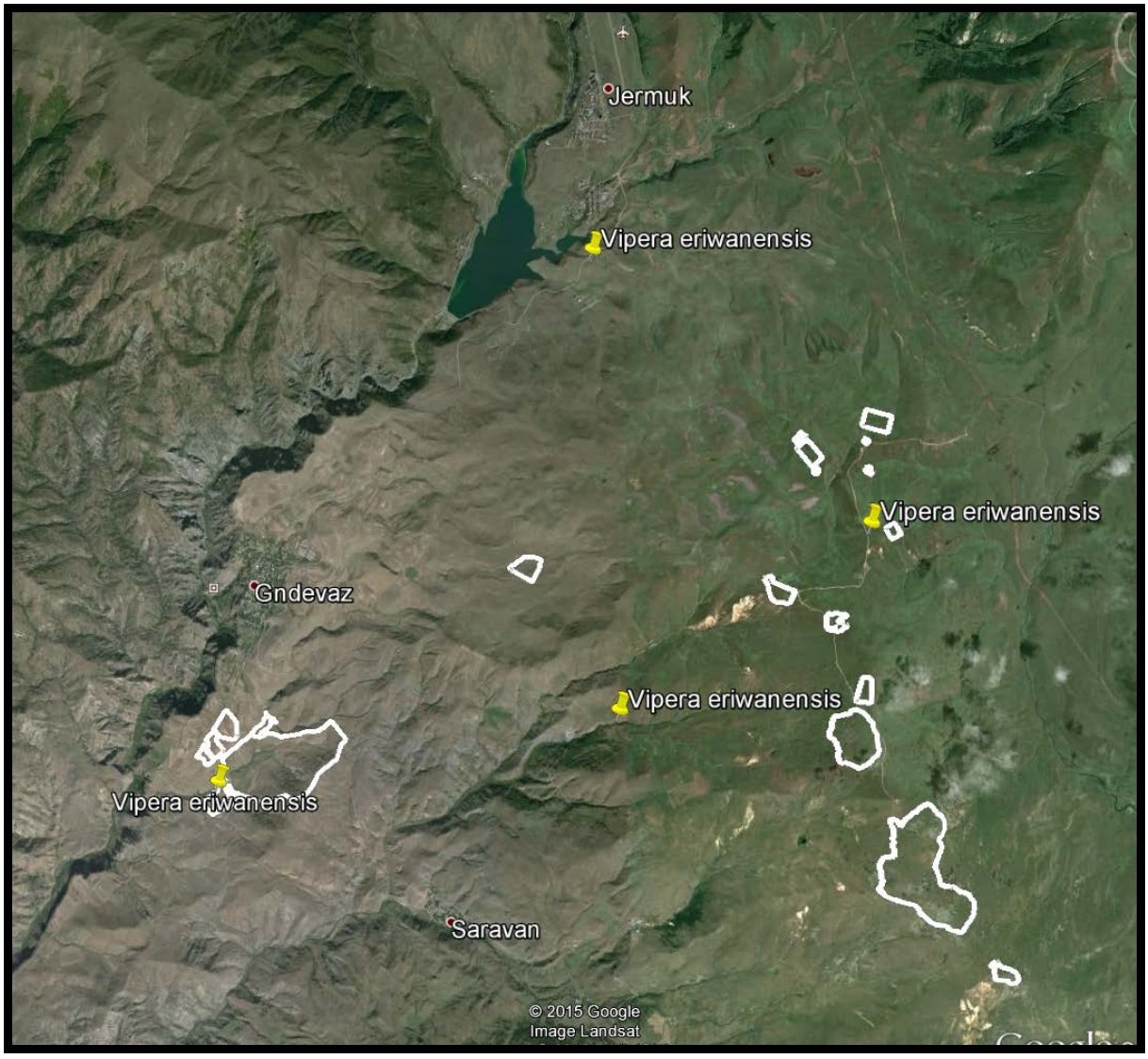

Figure 3 *Records of Vipera eriwanensis in the Jermuk – Gndevaz area.*

Large expanses of favourable habitats where the species occurs are present outside the area of the mining project and therefore it is unlikely that the impacts of the mining project would jeopardize the species' long-term survival in the area. Most efficient mitigation measures are likely to be 1) limitating footprint of infrastructure and roads to minimize loss of habitats and 2) reducing destruction / removal of individuals through education and awareness-raising. In the long term, improvement of knowledge about distribution would allow identification of areas with highest densities that would constitute targets for monitoring and, if relevant, legal protection to prevent habitat loss to agriculture or other human impacts, including within the area proposed for the National Park.

Telescopus fallax The Cat Snake (Plate 1) has a very wide distribution in the Eastern Mediterranean region from Croatia to Azerbaijan and the Persian Gulf, including large parts of Armenia (http://maps.iucnredlist.org/map.html?id=157258). It is globally listed as Least Concern because of

this large distribution and lack of evidence for decline. In the Red Book of Armenia it is listed as Vulnerable because abundance is low throughout its range (http://www.mnp.am/red_book_fauna). The species inhabits Mediterranean / dry steppe xeric landscapes from sparse forests and orchards to semi-deserts, usually in stony habitats (Arakelyan *et al.* 2011). It is an inconspicuous species, mostly nocturnal, that can be found by day under stones. The record from this survey constitutes the first observation for the Jermuk area. Due to its secretive habits the species is poorly known but based on its ecology, most of the favourable habitats for the species are found outside (i.e. south of) the mining project. The impact of the mining project on the Cat Snake is difficult to evaluate but is probably negligible on the national and global scale. Due to its secretive nature, the species is rarely encountered by man and intentional or accidental destructions must be very rare. The only possible mitigation measure would be to safeguard as much of the stony slopes habitat around the heap leach area as possible (see Figure 4 below).

Plate 1 Telescopus fallax*, heap leach area, 31 08 2015. Photo PAC.*

6 Conclusions

As a result of this survey it can be concluded that the impact of the mining project on reptiles and amphibians will be relatively low to minimal for most species, certainly at a national level. No Endangered or Critically Endangered species will be exposed to significant adverse effects.

However, three species listed in the Red Book of Armenia occur in the Project-affected area, two of which are Vulnerable or Near-Threatened globally. Most infrastructure will be above 2000 m a.s.l. where reptile communities are relatively impoverished. Mitigation for impacts on these species should focus on minimising the extent of habitat destruction (including gravel roads etc) in the mountains, particularly where infrastructure is proposed in meadow steppe habitat. Both Armenian montane-steppe or meadow viper and Radde's viper would benefit from education or awareness-raising to diminish human destruction of snakes in the area. All species would benefit from increased knowledge on their distribution, allowing identification of the most important areas for reptile conservation.

The area where most reptile diversity is concentrated consists of the stony slopes and rocky outcrops on the N and W edge of the proposed heap leach area (Figure 4). The best way to limit impacts on the reptiles would be to safeguard as many of these habitats as possible by keeping the size of the heap leach infrastructure to a minimum and controlling incidental habitat damage outside the proposed footprint. Residual impacts are likely and can be offset through protection of reptiles within the proposed Jermuk National Park.

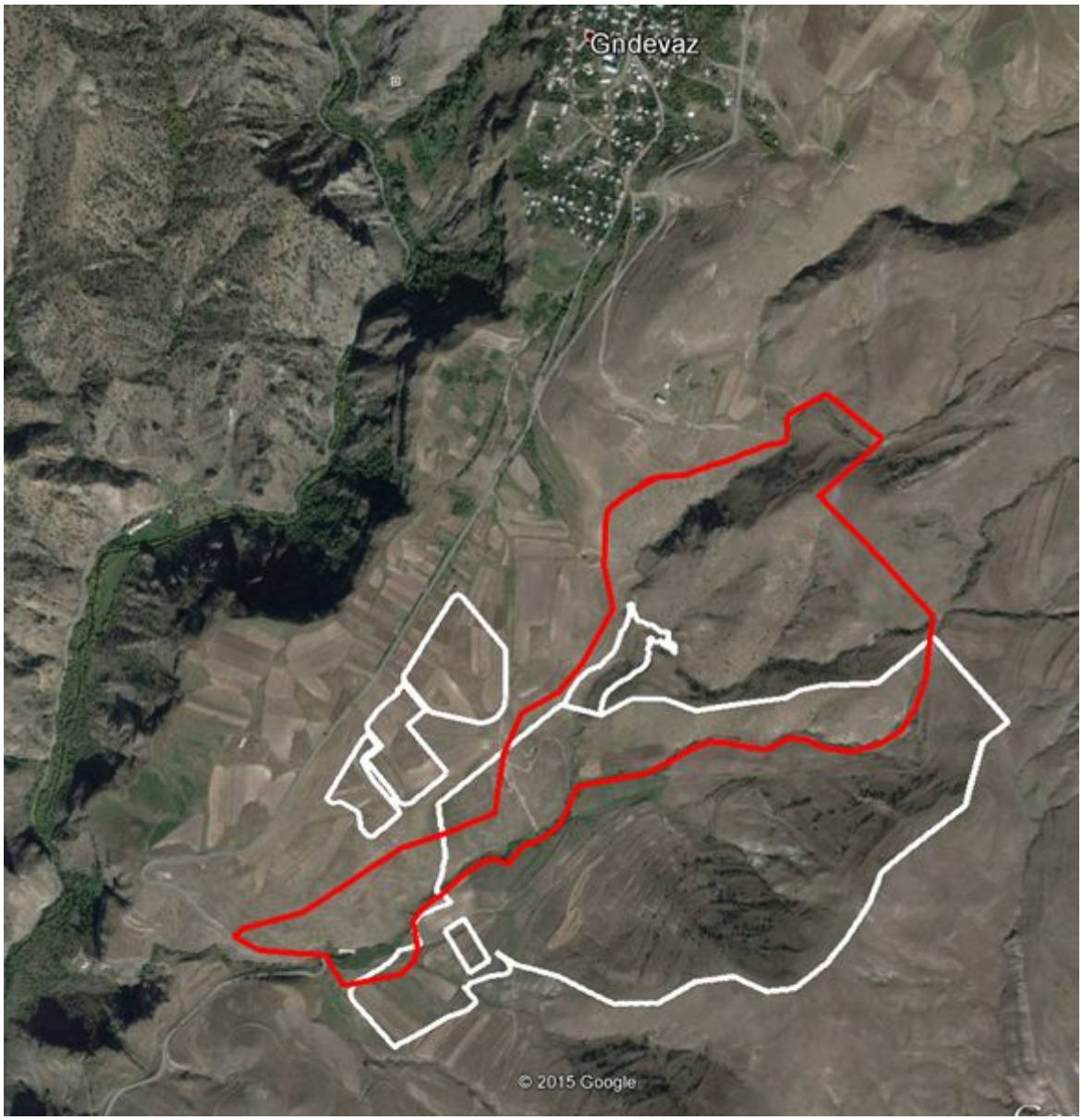

Figure 4 *Most important habitat for reptiles (in red), including Radde's Viper, in the mining project area with heap leach infrastructure (in white).*

7 Literature and references

Arakelyan, M.S., Danielyan, F.D., Corti, C., Sindaco, R., Leviton, A.E. (2011). Herpetofauna of Armenia and Nagorno-Karabakh. Society for the Study of Amphibians and Reptiles, Salt Lake City, USA.

Nilson, G., Andrén, C., Avci, A., Akarsu. F. (2009). Montivipera raddei. The IUCN Red List of Threatened Species 2009. http://www.iucnredlist.org/details/22993/0. Downloaded on 30 October 2015.

Tuniyev, B., Nilson, G., Agasyan, A., Orlov, N., Tuniyev, S. (2009). Vipera eriwanensis. The IUCN Red List of Threatened Species 2009. http://www.iucnredlist.org/details/164679/0. Downloaded on 30 October 2015.

8 Appendix

Attached files sent with the report:

- List of all records (Armenia reptile survey raw data.xls)
- Location of all records and location of field visits (Armenia - survey results.kmz)