

# Restoration of water flow of Khor Virap Marsh Ramsar site as an important step for rehabilitation of wetland biodiversity of River Arax in Ararat Valley (Armenia)

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## ABSTRACT

A freshwater marsh of semi-artificial origin fed by irrigation canal, Khor Virap occupies 350 hectares of the ancient Arax riverbed. The area consists of reedbeds surrounded by irrigation and drainage canals. The ornithological importance of the site is evident: over 100 species of waterbirds are recorded here, of them 30 are breeding. Of particular interest is successful breeding of globally threatened Marbled Teal (*Marmaronetta angustirostris*) and vulnerable White-headed Duck (*Oxyura leucocephala*) and nationally threatened Pygmy Cormorant (*Phalacrocorax pygmaeus*), Gadwall (*Anas strepera*) and Black-winged Stilt (*Himantopus himantopus*). In 2009 on 60 hectares of the marsh Khor Virap State Sanctuary was established to protect wetland biodiversity and Khor Virap Marsh was designated as wetland of international importance (Ramsar site). Although direct measurements were not done, seems Khor Virap Marsh plays significant role for flood mitigation

downstream and for sediment trapping. Complex studies carried out in the area during 2010-2012 have shown that the ornithofauna of Khor Virap suffers significantly from summer water level shortages as consequence of unsustainable use of water for irrigation upstream and fires during the winter period. Scientifically substantiated the need to increase the inflow and maintain the water in the marsh at the higher level which will allow maintaining the mosaic of reedbeds and open water as variety of habitats for waterfowl. In addition, higher water level will improve conditions for breeding of Cyprinidae of commercial importance, such as Crucian Carp (*Carassius carassius*), Bream (*Abramis brama*) and Carp (*Cyprinus carpio*). Options for restoration of water flow are discussed both from technical and environmental points of view, as well as anticipated positive outcomes for local communities.

## Introduction

Khor Virap Marsh Restoration Plan has been developed for the rehabilitation of Khor Virap Marsh based on the results of the studies carried out during 1997-2013 under the various 'wetland' projects funded by the Ramsar Small Grants Fund, UNDP/GEF, Global Peatland Initiative, World Bank Small Grants Fund, Swiss Development and Cooperation Agency, Critical Environmental Partnership Fund, LakeNet, Ramsar Convention "Evian Programme", Research Support Scheme of the Open Society Support Foundation, Nagao Natural Environment Foundation, Armenian National Science & Education Fund. Author takes this opportunity to thank all mentioned organizations for their contributions in protection of wetlands in Armenia.

collector through secondary and tertiary canals (depending on water level). The area is the part of Ararat Artesian basin where the ground waters are on 6 m and more depth. However, in areas around Hrazdan-Araks collector, the ground water table reaches a depth of 2 meters, depending on the level of water in the collector. One of the main reasons for that there are a number of weirs constructed over the collector, for irrigation intakes. If the latter are removed the ground water level will significantly increase.

## Soils

The natural soils of the area are meadow brown soils formed both in the result of human activity and from the impact of

## Dependence of Biodiversity on Water Level

High water level (see Photos 1 and 2) during the breeding season creates mosaic of emergent vegetation and open water which provides shelter and excellent foraging conditions to at least 100 species of birds, of them at least 30 breeding. High level water creates excellent breeding conditions for Cyprinidae of commercial importance, such as Crucian Carp, Bream and Carp. Low level water (see Photos 3 and 4) during the breeding season, especially sharp drop in the water level during the incubation period, causes adverse effect on populations of waterfowl. In the years with low level water waterfowl hatchlings practically are not observed, and Crucian Carp is the only remaining fish species.

## Other Values of Khor Virap

Except from prominent environmental values, surroundings of Khor Virap Marsh are of exceptional archaeological, historical, cultural and religious values, which makes the site perspective for tourism development. The chain of hills engirding the marsh from the south and south-west literally strewn with archaeological artifacts. Here are located the ruins of ancient Town Artashat (Photo 5).

Photo 1. Hrazdan-Araks Collector – high level water



Photo 3. Hrazdan-Araks Collector – low level water



The objective of this observation is to bring the project into compliance with the environmental and social requirements set by the legislation of the Republic of Armenia and socio-economic development of local communities. The restoration plan designed to eliminate, mitigate or minimize possible environmental and social adverse impacts that may occur during the drought seasons and especially during the drought years, as well as during the floods.

## Materials and methods

During 1997-2013 complex hydrobiological, botanical, zoological observations using conventional methods have been carried out on weekly, monthly or seasonal basis, depending on objectives of studies.

surface humidity regimes. Throughout long-term cultivation activity these lands were influenced by irrigation waters, sludge and sedimentation fractions, mineral and organic nutrients, especially potassium. The irrigated brown meadow soils are characterized by weak genetic separation and significant profile capacity. The composition of humus is about 1.5 – 2.0%. The soil reaction is alkaline (pH 8.1-8.5), and the soil absorption level is 30-40mg, in 100mg of soil. Soils have sufficient hydro-physical properties. The undercrust density is 1.15 g cm<sup>-3</sup>; in medium and lower layers increases, by reaching 1.5 g cm<sup>-3</sup>. The porosity is 50-60. Water penetration speed in the first hour changes in large intervals - 50-120 mm hour<sup>-1</sup>.

## Terms of Reference for Restoration of Khor Virap Marsh

- Bring the project into compliance with requirements set by the legislation of the Republic of Armenia;
- Construct the inlet and outlet sluices in a way that will ensure the movement of water in secondary and tertiary canals and in the marsh;
- Maintain the water level in the marsh at the height, ensuring the creation of an optimal mosaic of emergent vegetation and open water;
- Maintain the Poqr Vedi community lands drained and suitable for cattle grazing;
- Provide pumping station for irrigation of agricultural lands;
- Ensure the normal use of the water of Hrazdan-Araks collector, downstream.

King Artashes I founded the town "at the location of the confluence of the Araks and Metsamor rivers" in 176 B.C., Artashat served as the capital of the Kingdom of Armenia from 185 BC until 120 AD. Artashat is the venue of the first ever theatre show performed in the history of Armenia. King Artavazd II (55-34 BC) managed to stage and direct The Bacchae of Euripides on Artashat amphitheatre in 53 BC. Just behind the hills, only 500 m far from the marsh, the

## ARMENIAN THIRD AND SMALLEST RAMSAR SITE

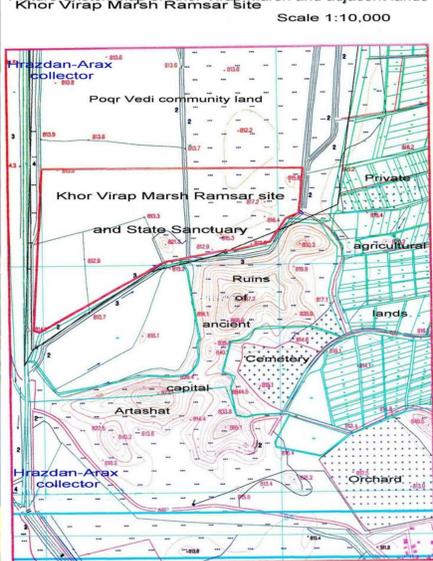
Name: Khor Virap Marsh.  
Date of designation: 25 July 2007.  
Location: Ararat Province.  
Surface: 50.28 ha.  
Altitude: 814 m above sea level.  
Geographical coordinates: 39°53'16"N 044°34'18"E.  
Protective status: State Sanctuary (IUCN Category IV). Located in the ancient Arax riverbed in the central part of the country, close to the capital city of Yerevan, this freshwater marsh of semi-artificial origin consists mainly of reed beds fed by an irrigation canal and surrounded by drainage channels. The site is important for over 100 species of migratory waterbirds of which 30 species are breeding here, including globally threatened Marbled Teal (*Marmaronetta angustirostris*) and endangered White-headed Duck (*Oxyura leucocephala*) as well as nationally threatened species such as Pygmy Cormorant (*Phalacrocorax pygmaeus*) and Gadwall (*Anas strepera*). The site also supports a number of mammal species such as Jungle Cat (*Felis chaus*), European otter (*Lutra lutra*), and the only non-native wild mammal Coypu (*Myocastor coypus*). Large numbers of dragonfly species occur, including nationally endangered *Hemianax ephippiger*. The marsh plays a significant role in flood mitigation downstream and in sediment trapping. It is used for hunting, fishing, reed harvesting and to a lesser extent for cattle grazing. The area surrounding the site is of social and cultural value, especially the Khor Virap Monastery, which was built on the site of the ruins of the ancient capital Artashat. The site itself is threatened by a decrease in water level due to unsustainable use of water for irrigation, overgrazing, fires during the winter period, and poaching. A management plan does not currently exist but is planned. Ramsar Site no. 1989. Most recent RIS information: 2011.  
Other Ramsar sites: Lake Arpi (Shirak Province, 3,230 ha) and Lake Sevan (Gegharkuniq Province, 490,231 ha).

Khor Virap Marsh is located within the administrative territory of Poqr Vedi community and the lands of the marsh outside Khor Virap State Sanctuary are community owned. That's why multiple meetings and interviews with Mayor, Community Council members and inhabitants of Poqr Vedi Village were organized to reveal the attitude of local population to the area in terms of socio-economic needs.

## Environmental Conditions\*

\*Source: Mott MacDonald, 2009. Rehabilitation of Khor-Virap Pumping Station Environmental Management Plan with Checklist of Impacts. MCA-Armenia Program to Facilitate Poverty Reduction Through Economic Growth. Yerevan, 42 pp.

## Picture Sketch Map of Khor Virap Marsh and adjacent lands



Khor Virap monastery (Photo 6) is located. Khor Virap's notability as a pilgrimage site is attributed to the fact that Saint Gregory the Illuminator was initially imprisoned here (Photo 7) for 13 years by King Tiridates III. Saint Gregory subsequently became the king's religious mentor, and they led the proselytizing activity in the country. In the year 301, Armenia was the first country in the world to be declared a Christian nation.

Photo 2. Khor Virap Marsh – high level water



Photo 4. Khor Virap Marsh – low level water



## Climate

Khor Virap Marsh climate is sharply continental and dry. Summer is hot; the average air temperature in July is 28C°; the highest recorded 42 C°. Winter is cold; the average temperature in January is -6C°; the lowest recorded -38C°. The average number of non-frost days is about 200. The average annual precipitation is slightly higher than 200 mm. The snow layer is not permanent. The annual evapotranspiration is over 1200 mm. The average number of drought weeks is 12; the average number of days with dry winds is 120.

## Hydrology

Khor Virap Marsh intakes water from Hrazdan-Araks

## Water Regime

Hrazdan-Araks collector (see Picture) is the main nourishment source for Khor Virap Marsh. Other sources are precipitations and ground water; the role of the latter is insignificant. The water level seasonal fluctuations usually have high levels in spring and beginning of summer, and low levels in winter. This regime creates quite favorable conditions for waterfowl during the breeding season. During the maximum level the marsh may merge with the collector, leaving up to 400 ha lands under the water, of them 300 ha community owned lands. During the minimum level less than 30 ha of the marsh remains wet. The marsh completely loses connection with the collector, the water becomes stale and acquires smell of hydrogen sulfide and methane.

## Expected Outputs

- Better water quality in the marsh;
- Higher habitat diversity;
- Better breeding conditions for waterfowl;
- Better spawning conditions for fish;
- Drainage of waterlogged lands upstream;
- Better irrigation conditions for agricultural lands;
- Flood mitigation downstream.

## Expected Benefits

- Increased opportunities for ecotourism development;
- Improved socio-economic conditions of local inhabitants;
- Improved sanitary-epidemiological situation.

The monastery attracts large number of tourists. Of interest for visitors is the releasing of doves with the hope they will fly to Mount Ararat, the symbol of Armenian nation. On a clear day the Biblical Mount Ararat, could be observed in details (Photo 8).

