Sustainable Management and conservation of the Mugger Crocodile (*Crocodylus palustris*) in Iran

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Abstract: Small populations of Mugger crocodiles, with an estimate of more than 500 individuals, are distributed in the southeastern part of Iran, namely, the Sistan and Baluchestan province. The area is known as the western most global range of the species. The main characteristic of the population is that it has been divided into several sub-populations which are scattered. As a management option, the main areas of crocodile habitats have been designated as "protected areas" and "International wetland sites". The local name for the species in Iran is 'Gandou". The crocodiles occupy vast ranges of natural and artificial water bodies as their habitats. Crocodiles use any available resources as food like fish, birds, dogs and villager's livestock. However, they are mainly dependent on fish. The nesting season for the crocodiles in Iran has been reported to be in May and, consequently, the eggs hatch in July. Hatchlings have mean total length and weight of 30.47 cm and 84.29 g respectively. One of the most specific and important behaviors of the Mugger is burrowing which is mostly used as refuge, even by the hatchlings. Evidence indicating of nesting in the burrows is not found in the literature. Migration or movement between habitats is another considerable behavior of Muggers, which provides potential threat for the crocodiles that have to cross roads resulting in death by automobiles. Fortunately, as a unique situation in the world, there is no hunting of crocodiles in Iran and local people based on their cultural beliefs respect crocodiles and refrain from harming the species, although they have very close contact with crocodiles. Drought and flooding remain as the main natural threats for the crocodiles. Mugger crocodiles are listed in Appendix I of CITES, which prohibits commercial trade in that species.

Introduction

All the crocodilian species, as "key stone" species in their habitats, are threatened by variety of factors in which, habitat destruction and loss and unsustainable utilization seems to be the main ones. Conservation and

management of the species, in most parts, needs to have enough information on their life cycles and habitats. In this regard, contact with the local people, traditional believes as well as legal protection of the species play important roles too.

Material and Methods

The existing literatures polished on the species biology and ecology as well as management would be collected. Some other information would be collected through short field studies. Population size, life cycle, threatening factors, mortality and distribution patterns and habitat types would be the main subjects to work on. The population of the crocodile and the management measures in place in the country would be the main items based on which we could define that it meets the criteria to introduce the sustainable use of the species at national level and state that if the management measures have been efficient and sufficient enough. Comparison the global situation of the species with some similar species as well as the possible international cooperation which could be helpful for the sustainable use of the species would be studied too. In this regard the "Action Plans" prepared by the scientific bodies would be as the key references and guidelines. The experiences of other countries would be a leading help for some discussions.

Aims and Objectives

The thesis supposed to provide sufficient information at national level as well as some in global level based on which plan for the introduction of the sustainable use of the species in the range states. This information later on could be used as a reference for some measures at regional and global level like preparing proposals for CITES in order to amend the appendices. It would be encouraging information to focus on some international cooperation between the range states to have harmonized and cooperative work to conserve the species and down list its conservation status as a "Vulnerable species". Encouraging the national relevant organization to support the local measures to increase the population size and mitigate the threats would be another expected result. Crocodile farming in Iran, according to the poverty in the distribution range would be an incentive to protect and conserve the species and help the people using the natural resources but it would need for very restrict and intensive management.

Discussion on the Results

In the action plan prepared by Crocodile Specialist Group for the Mugger crocodile (da Silva and Lenin, 2010), the potential for sustainable management of the species lies in "Moderate" level and "Sustainable use schemes" receives moderate priority. The current global wild population of the species is estimated to be more than 7000 non-hatchling specimens, in case that there are thousands in breeding farms without any specific uses in India and some farms have been established in other countries like Pakistan. Based on the number of the crocodiles, it seems that there is enough stock and technical support to introduce Mugger farming for commercial purposes in some range states, including in Iran.

Considering the situation in Iran, especially the respect of local people to the species, and the legal protection afforded to the species, as well as the artificial habitats provided to the crocodiles by the local people, introduction of private crocodile farming initiative with close supervision and control of government in different phases and steps, could potentially be a successful conservation and management enterprise with commercial benefits to the local people. This would require the provision of breeding stock through ranching or farming activities managed or supervised by the government, using the capacity of interested private sectors.

More public awareness and education activities, training workshops and courses, preparing educational and training materials, breeding and rearing regulations, financial support to local people and securing the survival of the wild population would be the basic preliminary needs. The local and artificial ponds in most of the villages, some of which are used by crocodiles, could be a very practical model to be used as a breeding system, but with some oversight, like regularly feeding of the crocodiles and providing them more safe and secure places. However, as a CITES Appendix-I listed species, commercial international trade is the species in prohibited. Based on the CITES Resolutions and Decisions, some possible solutions related to ranching of the species could be introduces in the range states, such as using of the F2 generations.

Given that the species is globally threatened species and listed in Appendix I of CITES, a series of programs could be conducted in all range states to increase the population size to improve the status of the species. The existing farms in India could play a critical role in providing the breeding stock for other states, such as Iran, along with some training and capacity building programs. To be introduced in international markets, the species should meet the one of the criteria for obtaining trade permits under Appendix II of CITES: *Scientific*

Authority of the State of export has advised that such export will not be detrimental to the survival of that species (Article IV, paragraph a of CITES).

Recommendations:

1- Establishment of Mugger crocodile farms with conservation aims
2- Conducting of proper public education and awareness programs
3- Conducting of farming/ranching programs and juvenile crocodile release to natural habitats
4- Designation of sanctuaries for introduction and release programs
5- Using the capacity of local people for conservation and research plans
6- Engagement of the local people in captive breeding programs
7- Preparing of sufficient breeding stock for private sectors, specially local people
8- Improvement of local tourism, Eco-Tourism plan and activities which provides incentive and incomes for the local people
9- International cooperation of the Mugger crocodile range states to establishment and expanding of crocodile farms and meeting CITES criteria for international trade of the species
10- Conducting proper and needed conservation activities in all range states to change the “threatened species” status of the species