International Zoo Yearbook

Int. Zoo Yb. (2015) **49:** ••–••
DOI:10.1111/izy.12075

Captive breeding the Critically Endangered Egyptian tortoise *Testudo kleinmanni* Lortet, 1883, for an *in situ* recovery project in Egypt

H. ZWARTEPOORTE
Rotterdam Zoo, PO Box 532, 3000AM Rotterdam, The Netherlands
E-mail: henk.zwartepoorte@rotterdamzoo.nl

The Egyptian tortoise *Testudo kleinmanni* (Family Testudinidae) is a small-sized tortoise with a carapace length of up to 140 mm that inhabits an arid to semi-arid range extending over the coastal regions of Egypt and Libya, and some interior desert areas of Israel. The species is almost completely herbivorous. Population sizes have been under severe pressure for decades. Causes of the decline are overgrazing by cattle, intensification of agriculture and overcollecting for the international pet trade. In Egypt the species is virtually extinct. Since 2000, the breeding programmes of both the European Association of Zoos and Aquaria and the European Studbook Foundation have been coordinated. In the northern Sinai desert, a recovery project has been established, supported by the local Sweirki Bedouin tribe and coordinated by Nature Conservation Egypt. Linking the *in situ* project to the *ex situ* breeding programmes forms the basis for the conservation and recovery of the Egyptian tortoise in Egypt.

Key-words: capacity building; captive breeding; Egyptian tortoise; *in situ*/*ex situ* link; private breeders; recovery project; role of zoos.

BIOLOGY AND STATUS IN THE WILD

The Egyptian tortoise *Testudo kleinmanni* inhabits an up to 120 km-wide coastal range from western Libya to eastern Egypt, as well as isolated patches in the Negev desert in Israel (Loveridge & Williams, 1957; Baha El Din *et al*., 2003; Baha El Din, 2006). The habitat consists predominantly of desert to semi-desert coastal sand dunes. The tortoise feeds mainly on perennials and herbal plants. The active period of the species lasts from early autumn through winter to early spring. During the hot summer months, the species aestivates, whereby it remains in rodent burrows or digs its own holes underneath grass tussocks and bushes. Mating occurs in autumn and early winter, and eggs are laid 6–8 weeks later. The eggs hatch in early spring, and the juveniles are very secretive and remain hidden. Because of their small body size, juveniles are vulnerable to predation by small carnivores and larger birds, and the effects of the extreme dry weather conditions.

Causes of species decline

By the end of the 1990s, the species appeared to be on the brink of extinction in Egypt. However, in the year 2000 a small population was discovered in the Zaranik Protected Area in the northern parts of the Sinai desert (Baha El Din *et al*., 2003). By that time, the species was also recorded as Endangered in Israel and Libya (IUCN, 2014). Causes of the decline are loss of habitat for the benefit of agriculture and use for cattle, and development for tourism. However, the massive exports occurring for the international pet trade are significant. In Israel, military activities play a role in the declines of the species. At the time of writing the Egyptian tortoise is Red Listed as Critically Endangered (IUCN, 2014).

Legal protection

The Egyptian tortoise is protected internationally by being listed on Appendix 1 of the

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2014), although this does not mean the species is safe. Illegal trade continues. During the past two decades, there have been several confiscations of illegal shipments from Libya. In October 2005 and November 2006, 275 and 408 animals, respectively, were confiscated at airports in Rome and Milan, Italy (S. Micarelli, Bioparco di Roma, pers. comm.). However, even during the 1980s, confiscations from markets in Egypt were reported, although exact numbers are not known. These animals were held in rescue centres in Egypt. The origin of the tortoises in the rescue centres is unknown as confiscations also took place at the Libyan/Egyptian border, where legislation was poorly enforced. At the time of writing, the status of the Egyptian tortoise in Libya is still unknown, but for a long time it was estimated that populations were stable. The effects of the most-recent civil war have not been researched.

STATUS IN CAPTIVITY

During the 1980s, the Egyptian tortoise was rarely kept in captivity. The awareness of the existence of this species in the wild was limited within both the zoo and private sectors. For the low numbers of individuals exported, mainly out of Egypt by the international pet trade, large amounts of money were required. Prices ranged between 200 and 400 Euros (500–1000 Dutch Guilders). The prices fluctuated and those cited here are taken from personal observations at pet-market trade shows. During the 1990s, larger numbers were exported to European countries, Japan and the United States of America. In Holland, prices went down to around 80 Euros. Almost all the animals offered in the trade were in poor physical condition, and affected by dehydration, liver and kidney damage, and endoparasites. The journey from their countries of origin to their final destinations in captivity had been long and arduous, and the majority of these exported Egyptian tortoises did not survive for long in zoos and private collections.

Besides studbook/breeding programmes for so-called assurance colonies, protection of the habitat requires high priority. For a long time, there was limited interest in the protection of wild populations of Egyptian tortoises. However, the confiscation of numerous illegal shipments during the past few decades has resulted in a turning point in this attitude.

REPRODUCTION IN CAPTIVITY

The role of the private sector

The conservation component Within both the Dutch–Belgium Turtle and Tortoise Society [Nederlands–Belgische Schildpadden Vereniging (NBSV)] and the European Studbook Foundation (ESF), the Critically Endangered status of the Egyptian tortoise as well as the necessity for successful captive reproduction have received much attention. The aim of conservation efforts is to establish a genetically and physically healthy assurance colony. The work of ESF focuses on avoiding commercial activities as far as possible, so the decision was made that the offspring born within the *T. kleinmanni* studbook should not be sold. High prices still play a vital role in the demand for tortoises within the international pet trade. The ESF launched a programme to transfer the juveniles hatched within the *T. kleinmanni* studbook on a breeding-loan basis to other studbook participants as well as to new studbook participants. The recipients are asked to pay a contribution to an *in situ* recovery project in Egypt of 100 Euros per tortoise. Since the start of that initiative in 2008 until the time of writing in 2014, 7457 Euros has been collected for the recovery project in this way.

Since 1997, numerous *in situ* projects have been financially supported by the NBSV. The first was a recovery/breeding/reintroduction project for the African spurred tortoise *Geochelone sulcata* in Senegal. This was followed by other projects, such as the funding

of a breeding station for indigenous species in Nepal, funding the building and enlarging of a breeding centre for Vietnamese freshwater turtles of the *Cuora* genus in northern Vietnam (coordinated by Cologne Zoo, Germany), funding a breeding and translocation initiative for the Seychelles giant tortoises, a field-research awareness/education project in Tanzania for the threatened Pancake tortoise *Malacochersus tornieri*, building breeding pools at the El Parque Historico de Guayaquil in Ecuador for the Brown tortoise *Rhinoclemmys melanosterna*, building a quarantine and veterinary treatment room at the Cuc Phuong Turtle Rescue Centre in Vietnam, and a breeding and head-start programme for the Mary River turtle *Elusor macrurus* in Australia. The most recent project, from 2012 to 2014, was the building of a breeding and education centre for threatened freshwater turtle and tortoise species within the Budo Holi conservation area in south-eastern Nepal.

In 2007 and 2008, the conservation project supported by the NBSV was the *in situ* recovery project for Egyptian tortoise. Over 7 years 4771 Euros has been collected, including a significant donation of 1500 Euros by a Shell partner HSN Steel structures. In total, 12 228 Euros has been contributed to both the *in situ* and *ex situ* conservation efforts for the Egyptian tortoise (Zwartepoorte & Verhoeks, 2014).

The captive-breeding component At the beginning of the 1980s, the first imports of the Egyptian tortoise to western countries were reported. Reproduction only occurred in very few collections. The first private breeding result in Europe was reported by Philippen & Serbent (1986). Reproduction within populations of Egyptian tortoise managed by ESF participants and NBSV members improved significantly over the past two decades (Philippen & Serbent, 1986; Verhoeks, 2006; Zwartepoorte, 2007; Bulsing, 2008). From a founding population of just a few dozen, the ESF studbook population now numbers 445 specimens (Plate 1). The number of breeders has increased from just one or two in 2003 to 13 in 2012, and 74% of the studbook population is captive hatched (Zwartepoorte & Verhoeks, 2013). These increases do not indicate that husbandry and breeding are easy. Large numbers of founder animals have died over the past two decades and the majority of these are ♀♀. As captive-breeding results improved, it became obvious that the majority of captive-bred offspring hatched were ♂. This appears

Plate 1. Egyptian tortoise *Testudo kleinmanni* **hatching in a private collection.** *Henk Zwartepoorte, EAZA EEP* Testudo kleinmanni *Coordinator*.

to be caused by the fact that almost all breeders incubate the eggs at around 30°C (pers. obs and pers. comm. from studbook participants). Within the studbook, it is now recommended that eggs should be incubated at 33°C in order to hatch ♀♀ (Highfield & Martin, undated).

The focus of this article is the *in situ* and *ex situ* link for the recovery and conservation of a Critically Endangered tortoise species, with an emphasis on cooperation between European Association of Zoos and Aquaria (EAZA) zoos and private breeders. Further details about captive breeding, such as egg laying, incubation protocols, rearing and diet, can be found on the Tortoise Trust Web site (Highfield & Martin, undated).

The role of EAZA institutions

The captive-breeding component Around 1998, the British and Irish Association of Zoos and Aquariums (BIAZA) started the first studbook/breeding programme in which just a few dozen specimens were registered. The first breeding results were reported by Jersey Zoo (now Durrell Wildlife Conservation Trust), Channel Islands, in the late 1990s. In 2000, EAZA established a European Endangered species Programme (EEP) at ZSL London Zoo, UK, and Rotterdam Zoo, The Netherlands, because of the Endangered status of the species (IUCN, 2000). The basic starting population numbered only 40 tortoises mainly of wild origin. The departure of the studbook keeper from ZSL London Zoo resulted in the studbook/breeding programme being continued by the author at Rotterdam Zoo. The first significant breeding results were reported by the end of that decade. After slow progress during the first few years, the number of participating EAZA institutions rapidly increased, resulting in 40 historic institutions in 2014. The number of institutions with breeding Egyptian tortoises increased to 16 in 2014. The total EEP population increased to 677 registered specimens as at 31 December 2012 (unpubl. data from non-published Sparks studbooks). At the time of writing, the total registered population of Egyptian tortoise in the EEP is 190.143.319 (652: ♂♂.♀♀.??) at 32 institutions, of which *c.* 50% are captive hatched. The current living population is 130.111.81 (322). Two large confiscations in Italy in 2004 and 2005 increased the EAZA population by 171 animals (Zwartepoorte, 2008). Between 2009 and 2011, 90 of these confiscated tortoises were moved to nine other EAZA institutions and two private collections. After confiscation and upon arrival at the receiving locations, a significant number of animals died as a result of their poor physical condition caused during the initial period of capture and transport. Of the original 171 confiscated, 81 remained at Bioparco in Rome, Italy, where the tortoises had been housed immediately after confiscation. Six institutions succeeded in breeding the confiscated adult founder animals, and 55 hatchlings were reported to the EEP studbook between 2011 and 2013 (unpubl. data from non-published Sparks studbooks). The Egyptian tortoises confiscated in Italy originated from Libya so these animals will always be managed separately within the EEP as the potential for reintroductions in the future has to be considered. In order to breed genetically healthy individuals, it is recommended that all EEP participants keep the tortoises that originate from Libya in pairs because these animals are wild caught and not related; therefore, each individual can be thought of as a founder.

IN SITU CONSERVATION

The *T. kleinmanni* project in Egypt

During the past two decades, conservation initiatives for the Egyptian tortoise have been taken by Sherif and Mindy Baha El Din (Baha El Din & Attum, 2000; Baha El Din *et al*., 2003). These initiatives were carried out with assistance of ZSL London Zoo and the United Kingdom based Tortoise Trust (http://www.tortoisetrust.org). For the past few years, Omar Attum, formerly of Indiana–Purdue University, Fort Wayne, IN, USA, but more recently at Indiana University

Southeast, New Albany, IN, USA, has also contributed to the *in situ* conservation programme. Based on the results reported by field researchers, in which small remnant populations were rediscovered, a recovery programme was developed. Studies were carried out to assess the feasibility and effects of fenced oases within the natural habitat. These oases in the Zaranik Protected Area were created in order to keep cattle out and give the plant life a chance to recover and grow. When these oases turned out to be successful, new opportunities were created for locations in which to release confiscated tortoises. A few small groups of Egyptian tortoise equipped with radio transmitters were released, resulting in the collection of important information on the routes the tortoises take. The pilot project was successful and additional animals were released. In order to learn more about the Egyptian tortoise, a training-and-education programme was initiated with the local people of the Sweirki Bedouin tribe (Attum, Baha El Din *et al*., 2007). Previously, the Sweirki were tortoise collectors and they demonstrated excellent knowledge about the area. However, they also turned out to be very dedicated tortoise conservationists. Through these training and education measures, the Sweirki could be guaranteed an income, and families could secure an extra income by making and selling embroidery to tourists in local markets. Local schools also became involved in the project. These actions provided a basis for awareness about and protection of the Egyptian tortoise and its habitat.

At the time of writing, three local Sweirki field technicians are working in the Zaranik Protected Area. They collect important information on the natural behaviour of the Egyptian tortoise, such as daily routines, nutrition, mating and egg laying, and the recovery of the vegetation. Every 10 days, a specific tortoise is followed and observed from sunset to sundown. Data on weights and measurements are collected too (Plate 2). A remarkable and unexpected outcome of the Bedouin ranger work was the discovery in 2013 of 25 very young juvenile tortoises outside the protected area, meaning that there are still some small surviving wild populations.

Plate 2. Sweirki Bedouin ranger taking measurements of a Egyptian tortoise *Testudo kleinmanni* **in the Zaranik Protected Area in the northern Sinai in Egypt.** *Dr Omar A. Attum, Indiana University Southeast***.**

The recovery possibilities have to be researched further, and the data collected during the field research will form the basis for this once it is fully collated and analysed (Attum, Esawy *et al*., 2007). The present politically unstable situation in the region is delaying the implementation of the plans necessary to improve the conservation programme. A possible reintroduction to the wild is one of the major aims of the recovery project but this is not feasible at the time of writing (Attum, Esawy *et al*., 2007).

Although the costs of supporting this recovery project for Egyptian tortoises have been relatively low to date, further funding for development and execution of the plans in the pipeline are needed. Various aspects of the recovery project require attention, such as further education and training for local

people, enlargement and security of the protected areas, and field-research and travel costs. Involvement of the local people is a fundamental aspect of the success of the project.

Basem Rabia Motwaly of Nature Conservation Egypt runs a continuous programme of awareness and education activities, including slide shows in schools and in the open air in small villages in the region. In 2012, locally made Egyptian tortoise T-shirts were donated to school children. As a nature conservation officer, Mr Motwaly is primarily coordinating the recovery project in the northern Sinai, including the Zaranik Protected Area, and he also guides and steers the work of the Sweirki rangers.

In February 2014, Mr Motwaly spent 10 days at Rotterdam Zoo in order to learn more about studbook keeping, breeding-programme coordination and nutrition. There was also the opportunity to study the protocols for the reproduction and husbandry of reptiles, with an emphasis on tortoises. This visit was also used to hold in-depth discussions on the progress and feasibility of the project, and develop a management plan for the next 5 years. The initiative for this 5-year management plan is dependent on the Egyptian coordinator, who has the support of Rotterdam Zoo, which represents the European branch of the Turtle Survival Alliance (TSA). This link provides an important herpetology tool in the form of an international communication and cooperation network.

In the short term, it will be of primary importance that the capacity and size of the protected area are determined before a full-scale reintroduction can be formally discussed and assessed for risks.

DISCUSSION

The future and feasibility of the Egyptian tortoise recovery project in the region can only be successful if the local human population is involved. In this respect, the involvement of the Sweirki Bedouin is one of the keys to success. The aim is to establish similar measures for recovery programmes in Libya and Israel in the near future. With the 5 year management plan in place, including *in situ* and *ex situ* partners, a foundation has been laid for future cooperation. The involvement of Egyptian governmental organizations is vital.

The captive populations within both the EAZA and ESF collections can be considered assurance colonies from which future reintroductions can be carried out, in line with International Union for Conservation of Nature *Guidelines for Reintroductions and Other Conservation Translocations* (IUCN, 2013). Extensive DNA sampling of both wild and captive specimens must be one of the most important tools to achieve this aim. Fundraising is a lynchpin to a successful recovery programme, and EAZA and ESF need to continue with this work as well as investigating other funding options. With the *in situ* involvement of the Egyptian government as well as local Bedouin people in the natural habitat of the Egyptian tortoise in the northern Sinai region, and the *ex situ* assurance colonies of both the EAZA EEP and ESF studbooks, the groundwork has been laid for the successful future recovery of a Critically Endangered species.

ACKNOWLEDGEMENTS

I thank Omar Attum and Basem Rabia Motwaly for useful *in situ* data and support. I thank my Rotterdam Zoo colleague Ardaan Gerritsen for carefully reading of the manuscript and giving useful advice for improvement.

REFERENCES

Attum, O., Baha El Din, M., Baha El Din, S. & Habinan, S. (2007): Egyptian tortoise conservation: a community-based, field research program developed from a study on a captive population. *Zoo Biology* **26:** 397–406.

Attum, O., Esawy, M., Farag, W. E., Gad, A. E., Baha El Din, S. M. & Kingsbury, B. (2007): Returning them back to the wild: movement patterns of repatriated Egyptian tortoises, *Testudo kleinmanni* Lortet, 1883 (Sauropsida: Testudinidae). *Zoology in the Middle East* **41:** 35–40.

Baha El Din, S. (2006): *A guide to the reptiles and amphibians of Egypt*. Cairo: The American University in Cairo Press.

Baha El Din, S. & Attum, O. (2000): The herpetofauna of Zaranik Protected Area, Egypt, with notes on their ecology and conservation. *Herpetological Bulletin* **37:** 17–21.

Baha El Din, S., Attum, O. & Baha El Din, M. (2003): The status of *Testudo kleinmanni* and *T. werneri* in Egypt. *Chelonian Conservation* **4:** 648–655.
Bulsing, P. (2008): Kweeksucces met *Testudo kleinmanni* Lortet 1883 en toch heel veel om over na te denken. *Trionyx* **6**(3): 54–64 and *Trionyx* **6**(4): 86–101.
CITES (2014): *Appendices I, II and III*. Châtelaine, Geneva, Switzerland: Convention on International Trade in Endangered Species of Wild Flora and Fauna. Available at http://cites.org/eng/app/appendices.php
Highfield, A. C. & Martin, J. (undated): *Captive breeding of the Egyptian tortoise* Testudo kleinmanni. London: The Tortoise Trust. Available at http://www.tortoisetrust.org/articles/kleinmanni.html
IUCN (2000): *The IUCN Red List of Threatened Species*. Gland, Switzerland, and Cambridge, UK: International Union for Conservation of Nature.
IUCN (2013): *Guidelines for reintroductions and other conservation translocations* (version 1.0). Gland, Switzerland: IUCN Species Survival Commission.
IUCN (2014): *The IUCN Red List of Threatened Species*. Gland, Switzerland, and Cambridge, UK: International Union for Conservation of Nature. Available at http://www.iucnredlist.org
Loveridge, A. & Williams, E. E. (1957): Revision of the African tortoises and turtles of the suborder Cryptodira. *Bulletin of the Museum of Comparative Zoology* **115:** 161–557.
Philippen, H. D. & Serbent, C. (1986): Zur biologie und ökologie von *Testudo* (pseudotestudo) *kleinmanni* der ägyptischen landschildkröte. *Die Schildkröte N.F.* **1**(4): 3–20.
Verhoeks, R. (2006): De Eyptische landschildpad, lastig te houden. *Trionyx* **4**(3): 70–79.
Zwartepoorte, H. (2007): Die Ägyptische Landschildkröte (*Testudo kleinmanni*) – Sehr beliebt und kritisch bedroht. *Draco* **8**(32): 74–78.
Zwartepoorte, H. (2008): The Egyptian tortoise: linking captive population management with wild population protection. *TSA Newsletter* **August:** 22–23. Available at http://www.turtlesurvival.org/storage/documents/magazines/TSA_Aug2008_Newsletter_Lite.pdf
Zwartepoorte, H. & Verhoeks, R. (2013): *Studbook breeding programme:* Testudo kleinmanni *Egyptian tortoise: annual reports 2010–2012*. Reeuwÿk: European Studbook Foundation. Available at http://www.studbooks.eu/images/pdf/testudo%20kleinmanni%20annual%20report%202010-2012.pdf
Zwartepoorte, H. & Verhoeks, R. (2014): *Studbook breeding programme:* Testudo kleinmanni *(Egyptian tortoise): annual reports 2012–2013*. Reeuwÿk: European Studbook Foundation. Available at http://www.studbooks.eu/images/pdf/2014/annual%20report%202012-2013%20testudo%20kleinmanni.pdf

Manuscript submitted 20 March 2014; revised 6 September 2014; accepted 23 September 2014