

Rio Sonoyta Mud Turtle

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Objectives

Determine population status and trends; obtain information on life history and natural history to better understand and protect the populations at Quitobaquito and elsewhere.

Introduction

The Sonoyta mud turtle, *Kinosternon sonoriense longifemorale*, is endemic to a small area in southwestern Arizona and northwestern Sonora. The only U.S. population, at Quitobaquito, declined from several hundred in the 1950s to fewer than 100 in the 1980s (Arizona Game and Fish Department 2005). A decline in 1989-90 was attributed to drought and high temperatures. The subspecies is listed as an ESA Candidate (FWS) and is threatened by groundwater pumping, possibly exacerbated by reduction of surface flow by transpiration in dense thickets of exotic saltcedar (*Tamarix ramosissima*) in the Rio Sonoyta. It is not known or thought to be significantly impacted by border-related issues such as pollution, wildfire, off-road traffic, other exotic species, although poaching is known at Quitobaquito and could be a threat.

Staff at Organ Pipe Cactus National Monument (OPCNM) began monitoring the Sonoyta mud turtle in 2001. This chapter reports on the results of monitoring from 2001 to 2005, with an emphasis on population estimates. The strengths and weaknesses of this monitoring are discussed and recommendations are provided.

Methods

The Quitobaquito Springs/Rio Sonoyta Conservation Assessment and Strategy (2004) recommends annual monitoring with two sampling periods to allow intra-year population estimation using mark and recapture. Sampling effort varied between years but was consistent between 2004 and 2005 (Table 5-1). In 2004 and

2005, sampling occurred on two occasions, 2-3 weeks apart in September-October, using 12 hoop and 14 minnow traps baited with sardine and hotdog. Most of the procedures were originally described by Rosen (1992). Each captured turtle is permanently notched, or its existing mark is carefully read and recorded, and the individual is sexed, weighed, and measured (including measurement of plastral growth annuli). Trap station, release time, and any other pertinent notes are also recorded. All 12 hoop traps and 6 minnow traps are deployed in Quitobaquito Pond, while the other 8 minnow traps are set in the channel pools upstream of the pond (Figure 5-1). As part of the climate monitoring program, a rain gauge is maintained at the Quitobaquito EMP site and checked at the end of each month. Water levels are monitored as part of a surface waters monitoring program.

Due to low sample sizes and there being only one sampling effort in 2003, both within-year and inter-year population estimates were generated. The Chapman version of the Lincoln-Peterson Index was used to compute population estimates as follows:

n_1 = # individuals recorded in the 1st survey period

n_2 = # individuals recorded in the 2nd survey period

m = # individuals recorded in the 1st survey period and recaptured in the 2nd survey period

Chapman Estimate = $(n_1 + 1)(n_2 + 1)/(m + 1) - 1$

Standard Error (SE) = square root of $(n_1^2(n_2 + 1)(n_2 - m)/(m + 1)^2(m + 2))$

If a survey period includes multiple trap nights, then each individual (indicated by permanent mark) is counted once towards the number of individuals. Within-year estimates were limited

to yearling and older turtles (carapace length > 40 mm) because young of the year may not have been present during the first survey period. For between-year estimates, the second survey was limited to yearling and older turtles because young of the year would not have been present during the first survey period. These adjustments were necessary to insure that recruitment did not violate the assumption of a closed population.

Results

Sampling efforts and total captures for 2001 to 2005 are summarized in Table 5-1. Both the number and spatial arrangement of hoop and minnow traps has changed over the years but was consistent in 2004-2005. In 2001, there were two 2-night trapping sessions and on both occasions the second night had many fewer captures than the first night. In all years, the second night had fewer captures than the first night. While Rosen

Table 5-1. Sample effort and number of captures for the Sonoyta mud turtle at Quitobaquito Pond and Springs, 2001 - 2005, Organ Pipe Cactus N.M.

Year	Date	Captures	Hoop traps	Minnow traps
2001	23-Oct	29	10	18
2001	24-Oct	5	10	18
2001	31-Oct	16	10	18
2001	1-Nov	6	10	18
2002	12-Jun	18	12	8
2002	30-Jul	11	11	9
2002	12-Sep	34	14	11
2002	10-Oct	13	13	10
2003	26-Sep	37	10	12
2004	15-Sep	26	12	14
2004	13-Oct	9	12	14
2005	5-Oct	18	12	14
2005	21-Oct	15	12	14

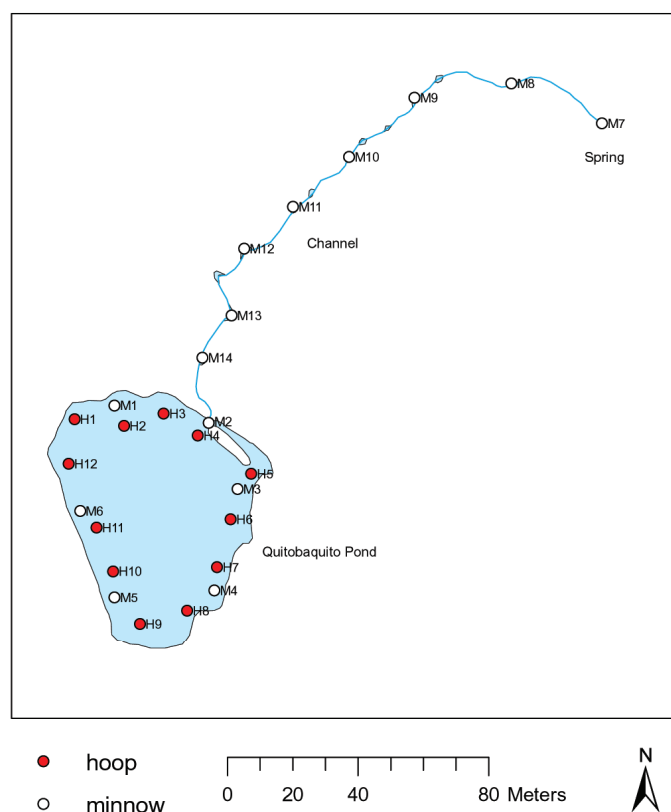


Figure 5-1. Sonoyta mud turtle trap locations at Quitobaquito Pond and Springs, Organ Pipe Cactus N.M.

Table 5-2. Within-year population estimates for yearling and older turtles (carapace length > 40 mm) at Quitobaquito Pond and Springs, 2001-2005, Organ Pipe Cactus N.M. See text for definitions.

Survey1	Survey2	n ₁	n ₂	m	Year	Estimate	SE
10/23-24/01	10/31-11/1/01	28	19	6	2001	81.9	22.8
6/12-7/30/02	9/12-10/10/02	26	39	6	2002	153.3	47.7
9/26/03		36			2003		
9/15/04	10/13/04	24	4	1	2004	61.5	26.8
10/5/05	10/21/05	14	7	1	2005	59.0	28.0

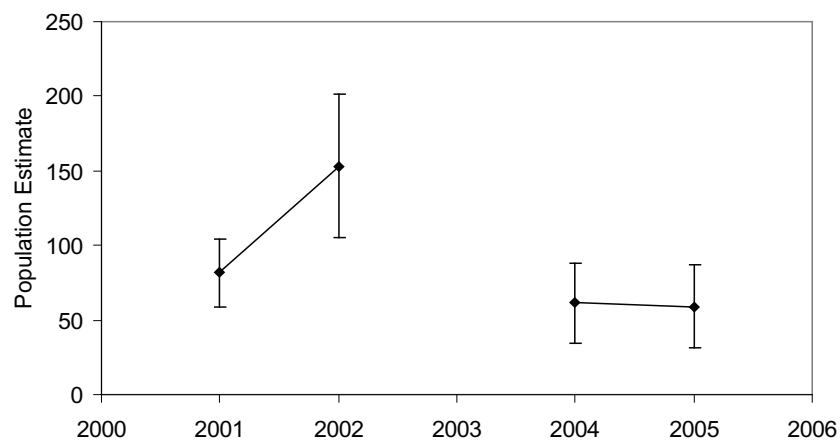


Figure 5-2. Within-year population estimates and standard error for yearling and older turtles (carapace length > 40 mm) at Quitobaquito, 2001 - 2005, Organ Pipe Cactus N.M.

(1992) provides instructions for trapping and processing captures, it does not specify what arrangement of traps to use and when or how often to conduct surveys. A formal monitoring protocol is currently being developed with the aim of standardizing the surveys.

Between 2001 and 2005, the population estimate for yearling and older turtles ranged from 59 to 153 with wide standard errors (Table 5-2, Figure 5-2). However, the estimate peaked in 2002 and has shown a depressed level for 2004 and 2005. A within-year estimate was not possible for 2003 due to the single sample. However, the between-year estimates suggest that the population declined between 2002 and 2003 (Table 5-3,

Figure 5-3).

From 1992 to 2002, total annual rainfall at Quitobaquito declined from 14.9 to 1.4 inches and has since rebounded to 11.7, 7.5, and 8.7 inches for 2003, 2004, and 2005, respectively (Figure 5-4). Although there are some gaps in the record, water level with respect to the overflow point in Quitobaquito Pond is depicted in Figure 5-5. For the period 1999-2005, the lowest point of -11.5 inches occurred on 7/28/05. The water level has since fallen to approximately 18 inches below the outflow pipe on June 22, 2006. This is believed to be a result of reduced inflow related to vegetation encroachment and leakage in the channel (OPCNM 2006). Efforts have been undertaken to

Table 5-3. Between-year population estimates for all Sonoyta mud turtles at Quitobaquito, 2001 - 2005, Organ Pipe Cactus N.M.

Survey1	Survey2	n ₁	n ₂	m	Year	Estimate	SE
2001	2002	48	59	16	2001	171.9	33.8
2002	2003	63	36	7	2002	295.0	86.0
2003	2004	37	24	5	2003	157.3	50.8
2004	2005	30	20	3	2004	161.8	63.4

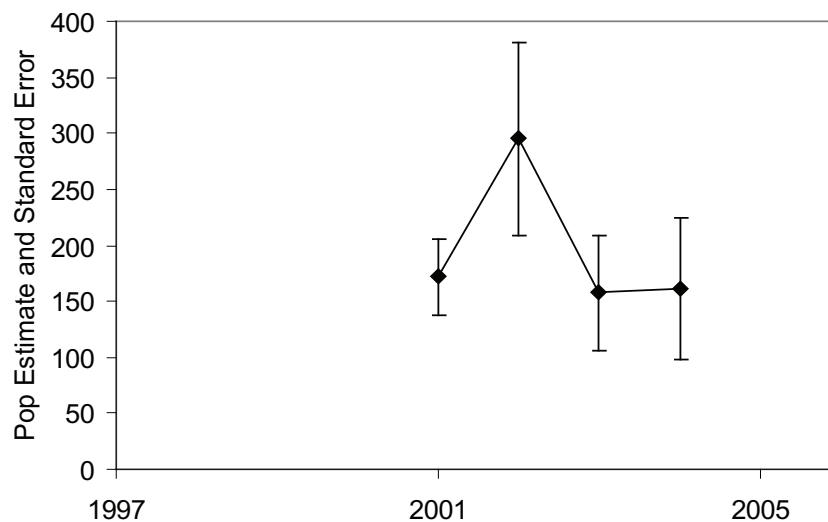


Figure 5-3. Between-year population estimates and standard error for all Sonoyta mud turtles at Quitobaquito, 2001 - 2005, Organ Pipe Cactus N.M.

restore flow and the pond level had recovered to - 8.5 inches by September 21, 2006 (OPCNM data).

Discussion

Declining rainfall and pond levels may be directly or indirectly related to the apparent reduction in mud turtle numbers at Quitobaquito. Effects may be realized through higher temperatures, altered food availability, increased competition with pupfish, or some other factor. Specific research would be needed to investigate potential causes of decline. Some discussion of the strength of current population estimates should be considered before launching any new research.

All the population estimates given here are crude and do not account for differential catchability as

a function of age. There is an increase in catchability with age and/or size in the Sonoran mud turtle (Rosen 1987) that does not approach a plateau of equal catchability, which is an assumption of these computational methods, until full adult size reached. This "full adult size" is likely around 90-100 mm CL at Quitobaquito, although it has not been specifically evaluated for this population. If recruitment varies with climate, as found by Rosen and Lowe (1996) for Quitobaquito, the age structure and thus the bias of the estimate will vary to give a high estimate in years with good recruitment and low or close to accurate when juveniles are few. The contributions of young age classes may have been especially strong following the peak in 2002. The dataset should be thoroughly reviewed using a modified age-

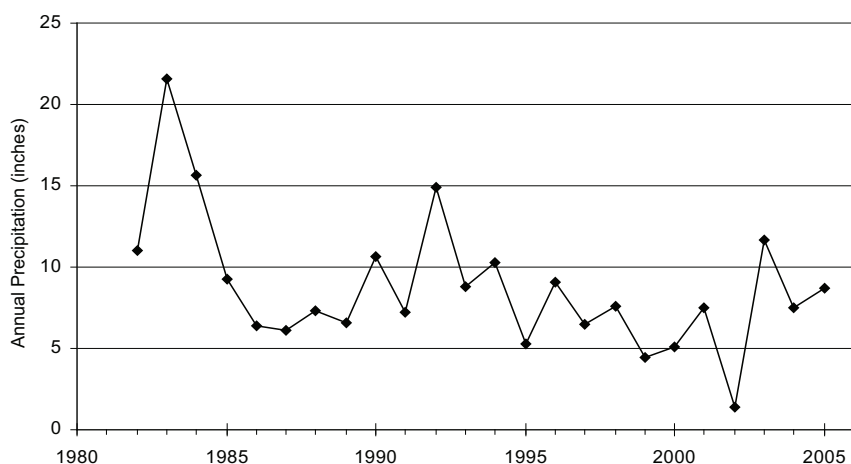


Figure 5-4. Annual precipitation at Quitobaquito rain gauge, 1982 - 2005, Organ Pipe Cactus N.M.

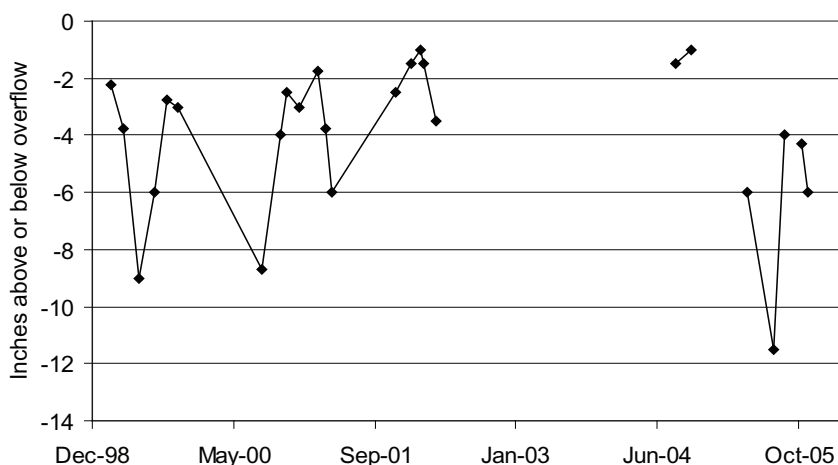


Figure 5-5. Water level at Quitobaquito Pond with respect to overflow point from 1999 to 2005, Organ Pipe Cactus N.M.

stage computational model like the one applied by Rosen and Lowe (1996) to estimate population size and survivorship.

Further, the low estimates for 2004 and 2005 are based on a very small sample sizes for the second survey period. A single night or trapping per survey period may be insufficient if captures are low or greater precision is desired. Results for 2006 and an additional set of computations to compare within-year to between year estimators will be needed to re-examine the low estimates for 2003-2005. Given the problems discussed above, this

result should be viewed with suspicion. However, a true value at or below the current estimates of 62 and 59 yearling plus older turtles in 2004 and 2005, respectively, should be viewed as cause for immediate alarm for the Quitobaquito population.

In general, the declining values for population estimates appear to identify a real trend of population decline during the early years of the 21st century. In climatic terms, such a decline is not unexpected. From 1977-1984, the Arizona Upland, and OPCNM in particular, experienced

its strongest rainfall period on record, and during 1990-1995 there were also years of excellent rainfall, after which drought began to grip the region. The 21st century has thus far been very dry, with some years of remarkably severe drought at OPCNM.

Since (1) various connections occur between turtle food supply and terrestrial vegetation, (2) declining water levels from reduced springflow and/or increased evaporation also likely affect turtle food supply, (3) the turtle population appears nutritionally stressed to begin with at Quitobaquito (Rosen and Lowe 1996), (4) energetic limitations likely reduce clutch frequency (Rosen 1987), and (5) dry conditions around aquatic environments could affect egg survivorship by desiccation it is reasonable to expect a decline in the Sonoran mud turtle population during drought. Rosen and Lowe (1996) correlated recruitment with rainfall in preceding years, adding to this expectation.

Therefore the declining population trend suggested by our computations is expected, and is not necessarily unusual. However, the very low estimates since 2002 highlight the importance of sampling in 2006. Sampling in 2006 should be done early, if practical, in case a population collapse is occurring. Even though we should expect a “low normal” result for 2006, the drought minimum population sizes we may document during 2006 and, should drought persist, in subsequent years will offer a clearer picture of the population threat to the Sonoyta mud turtle at Quitobaquito associated simply with low effective population size. This should reinforce the awareness that this population is potentially vulnerable even without abnormal or unnatural population declines or catastrophe. Further, it should also reinforce our awareness that species conservation in the Mexican portion of Rio Sonoyta Valley is a key supplement for U.S. conservation, particularly for aquatic species.

Additional Recommendations

- Until a new protocol is developed, conduct minimum of 2 nights trapping per year, one

per survey period. Conduct 2 consecutive nights per survey period if captures are low and/or higher precision is needed. Successive, within-year trapping sessions should be at least 2 weeks apart but no more than one month apart.

- Summarize results of annual surveys and report to Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and Quitobaquito/Rio Sonoyta Workgroup within one month after completion of annual monitoring.
- Develop a monitoring protocol according to National Park Service standards and with input and review by subject area experts and interested agencies.
- Continue water flow monitoring and conduct more frequent water quality monitoring.
- Investigate possible causes of mortality such as predators, disturbance to nest sites, parasites, food, contamination, and poaching.

Acknowledgements

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