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Conservation Status of an Endemic Kinosternid, *Kinosternon sonoriense longifemorale,* in Arizona

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Abstract. – The Sonoyta mud turtle (*Kinosternon sonoriense longifemorale*) is a member of the unique desert riparian fauna isolated along the Rio Sonoyta watershed in northern Sonora, Mexico, and southern Arizona. This subspecies occupies six sites along the Rio Sonoyta, a pool at Quitovac in Sonora, and one pond at Quitobaquito Springs in Organ Pipe Cactus National Monument in Arizona. Since the mid-1980s, population estimates for the US population have ranged from 39–153 individuals. In 2006–2007, the human-made Quitobaquito Pond began losing water, and discussions were held concerning the fate of the turtles. During three salvage efforts all Sonoyta mud turtles encountered were captured and transported to temporary holding facilities. Because the minimum number of turtles needed for re-establishment was unknown, we conducted a Population Viability Analysis (PVA) to determine the number of Sonoyta mud turtles that should be held in an assurance colony. Results from both our PVA and previous work suggested that juvenile survivorship has the strongest effect on female transition rates from nonreproductive to reproductive age classes and in turn population growth; thus, a wide range of age classes should be maintained in an assurance colony.

Key Words. – Reptilia; Testudines; *Kinosternon sonoriense longifemorale*; Arizona; Sonoyta mud turtle; Population Viability Analysis; assurance colonies

Aquatic ecosystems in the southwestern United States have been heavily impacted directly and indirectly by humans (Turner et al. 2003; Miller et al. 2005) and subsequently, sharp declines in associated fauna have been observed (Minckley and Deacon 1991; Rosen and Schwalbe 2002). To complicate matters, many of these desert watersheds lay along an international border and, thus, are shared and managed by two countries (Varady and Mack 1995). Increasing water diversions for agriculture and urban development in northern Sonora, Mexico, have increased the rate of drawdown on aquatic ecosystems there (Hendrickson and Minckley 1985; Unmack and Fagan 2004; Rosen and Melendez 2010).

The Rio Sonoyta is a minimally impacted stream that originates along the Arizona/Sonora border, flows westward through the town of Sonoyta in Sonora, and maintains some surface flow to the west within the Reserva de la Biosfera El Pinacate y Gran Desierto de Altar. The western reach of the Rio Sonoyta is adjoined by Organ Pipe Cactus National Monument in Arizona. Down-cutting of cienegas has severely degraded the upstream portion of the river so that permanent water within the town of Sonoyta is currently maintained by sewage effluent (Rosen et al. 2010).

Historically, the Rio Sonoyta was a tributary of the Colorado River drainage, but eruptions within the Sierra Pinacate Volcanic Field diverted the Rio Sonoyta away from its westward course toward the Colorado River Delta and southward toward the Gulf of California ~100,000 ybp (Ives 1964; Turner 1983). The resulting diversion and isolation has led to the evolution of a taxon distinct from the Sonora mud turtle (*Kinosternon sonoriense sonoriense*), the Sonoyta mud turtle (*Kinosternon sonoriense longifemorale*; Iverson 1981). The Sonoyta mud turtle only occurs within the Rio Sonoyta drainage, at Quitovac in northern Sonora, and Quitobaquito Pond and channel, associated with Quitobaquito Springs in Organ Pipe Cactus National Monument (OPCNM) in Pima County, Arizona. Populations, particularly within the Rio Sonoyta proper, are intermittently fragmented, and only connected during periods of high rainfall (Rosen et al. 2010). The Quitobaquito Springs population in OPCNM is further geographically isolated by nearby Mexico Highway 2 (Fig. 1) and has not had an aquatic connection with the Rio Sonoyta in recent times.

Quitobaquito Springs is composed of a pair of natural springs that seep up a fault in fractured granite and gneiss rock that runs along the base of the Quitobaquito Hills and flows through a human-made stream channel south into Quitobaquito Pond (Fig. 1). The springs are locally well known and historically have been used as a waypoint for travelers and irrigation (Nabham 1982; Bennett and Kunzmann 1989). The area has been under the full authority of the National Park Service (NPS) since 1957,

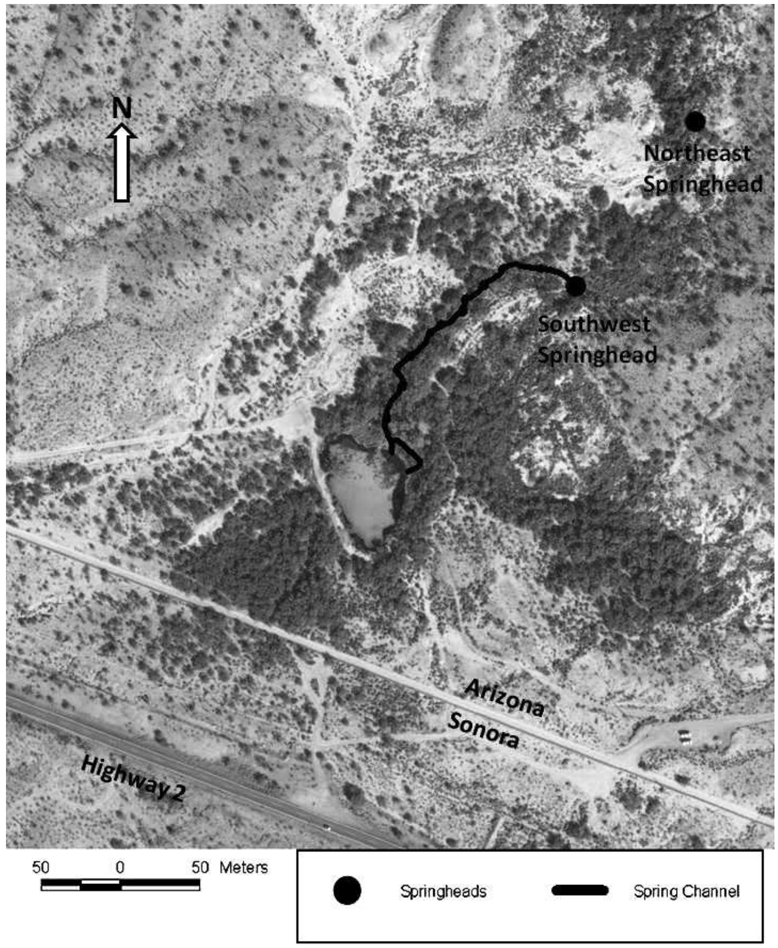

Figure 1. Aerial photograph of Quitobaquito Pond and Springs, Organ Pipe Cactus National Monument, Pima County, Arizona. The northeast springhead is connected to the southwest springhead via an underground pipe.

after which grazing and irrigation ceased and the pond became overgrown with bulrush (*Schoenoplectus americana*). In 1961, the pond was drained and deepened and spring water was directed to the pond through an underground pipe. These alterations eliminated the shallow water and ditch habitat used by Sonoyta mud turtles. In 1989–1990, a small shallow area and nesting island were constructed, as was the 244-m stream channel that connects the springheads to the pond (Bennett and Kunzmann 1989; Rosen and Lowe 1996). Since then, Quitobaquito Pond has averaged 2700 m^2 in surface area and 63.5 cm in depth in the shallow end and 106 cm in the deep end, with seasonal fluctuations of 2–10 cm in depth.

Rosen and Lowe (1996) suggested that Sonoyta mud turtle abundance was likely in the hundreds in the 1950s but decreased considerably because of the manipulations to the human-made pond in the 1970s. These habitat manipulations included removing the shallow, heavily vegetated habitat where juvenile turtles were frequently observed. Over the winter of 1989–1990, substantial shallow-water habitat was created, and juvenile survivorship and density markedly increased over the next several years (Rosen and Lowe 1996). Historical population estimates from 1982–1995 monitoring efforts, calculated from Jolly–Seber models, ranged from 68–143 (Fig. 2: Rosen and Lowe 1996). Throughout this time period, the Quitobaquito population tended to exhibit a heavily male-biased sex ratio (2M:1F). Life-table analysis conducted by Rosen and Lowe (1996) confirmed a stable and possibly increasing population (λ = 1.57). Variation in juvenile survivorship had the strongest negative effect on reproductive transition rates (number of females that transition from nonreproductive to reproductive age classes) and in turn population growth rate (λ; Rosen and Lowe 1996).

In addition to geographic isolation, major threats to the Sonoyta mud turtle include nutritional stresses because of dietary constraints and water loss. Ernst and Lovich (2009) described the diet of the nominate Sonora mud turtle as primarily carnivorous to omnivorous depending on the benthic fauna of the stream or pond system but stated that turtles will shift to plant material in systems where animal material is scarce (Hulse 1974; Ernst and Lovich 2009). Quitobaquito Pond exhibits low invertebrate abundance, which combined with the high abundance of Quitobaquito pupfish, appears to generate considerable competition for a limited resource (Walters

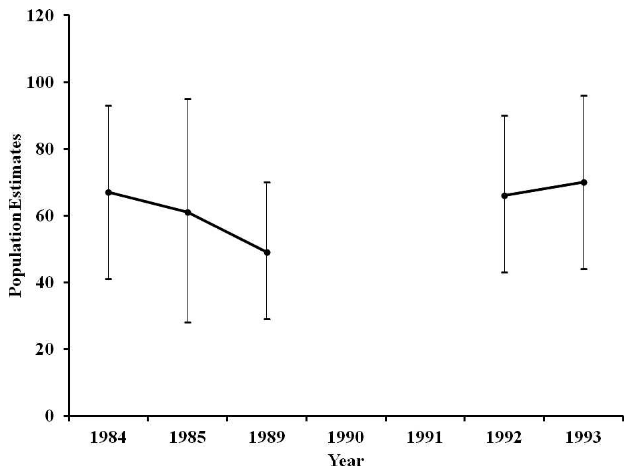

Figure 2. Jolly–Seber population estimates and 95% confidence intervals for Sonoyta mud turtles, Quitobaquito Pond and Springs, Pima County, Arizona, based on the 1982–1995 sampling periods.

and Legner 1980; Rosen 1987). Fecal samples from Sonoyta mud turtles at Quitobaquito were primarily composed of plant material, suggesting that they forage primarily on algae (Rosen 1987). When compared to other populations, turtles occurring in Quitobaquito Pond exhibit lower lipid storage rates, slower growth rates, smaller sizes, and smaller clutches than other populations of Sonora mud turtles (Rosen 1987).

Discussions regarding the status of the endemic Sonoyta mud turtle were convened by US Fish and Wildlife Service (USFWS) in 1997. In 2001, a multi-agency conservation team consisting of representatives from Arizona Game and Fish Department, Comision de Ecologia y Desarrollo Sustentable del Estado de Sonora, Comision Nacional de Areas Naturals Protegidas (CONANP) Reserva de la Biosfera El Pinacate y Gran Desierto de Altar, USFWS, OPCNM, and University of Arizona began conservation planning efforts and re-initiated ecological monitoring at Quitobaquito Pond, as well as sites in Sonora, Mexico. As a result of the evidently small population sizes and geographic isolation, the USFWS identified the Sonoyta mud turtle as a Candidate for listing as Threatened under the Endangered Species Act (USFWS 1997).

In 2006, Quitobaquito Pond began losing water at a very rapid rate. The water loss was attributed to a leak in the retaining berm or pond bottom, combined with increased evapotranspiration from a prolonged drought period. Water levels reached an all-time low of ~51 cm below the long-term average. The consequence of temporary water loss on the turtle population is unknown but was of immediate concern. Sonora mud turtles vary in estivation ability, depending on whether they originate from permanent or ephemeral streams (Ligon and Peterson 2002). Because the turtles in Quitobaquito occupy a permanent water source, their estivation ability may be limited. To ensure the survival of this population, three emergency salvage efforts were conducted during 2007–2009, resulting in a total of 63 Sonoyta mud turtles being captured and transported into assurance colonies at the Phoenix Zoo (TPZ), Phoenix, and the Arizona–Sonora Desert Museum (ASDM), Tucson, Arizona. Although the 63 turtles do not represent the entirety of the Quitobaquito population, they do represent a significant portion. These turtles were to remain in captivity until the cause of water loss could be identified and corrected.

In response to current, pressing issues including the dewatering of the pond and subsequent habitat improvements, we reassessed the conservation status of this desert kinosternid. Our objective was to construct an individual-based Population Viability Analysis (PVA) model based on the available population monitoring data from 1982–1995 (summarized in Rosen and Lowe, 1996) and 2001–2006 monitoring efforts. Population viability models calculate the risk of extinction or decline and expected time to extinction or chance of recovery (Akçakaya and Sjögren-Gulve 2000). Although the demographic data are sparse for this population, a PVA would still provide comparative results on risks of decline within this population.

METHODS

Population Parameters. — Although considerable population monitoring had been conducted in the past, no set monitoring protocol had been adopted by OPCNM. We developed standard trapping methodology for the Quitobaquito pond and spring complex, which was initiated in 2001. Monitoring was conducted using baited hoop nets and modified, double-ended minnow traps (the opening was widened to accommodate small turtles). Traps were baited with sardines and hotdogs and set at predetermined locations throughout the Quitobaquito pond and springs complex. Traps were set in late afternoon and checked the next morning. All turtles captured were weighed, measured, examined to determine sex, and given a unique mark. Marks consisted of filing a notch into a combination of marginal scutes. The 2001–2006 monitoring included two annual trapping events (sampling periods), with the exception of 2003 when only one trapping event was conducted. We calculated population size using the Chapman modification of the Lincoln–Peterson population estimator for small sample sizes (Seber 1982), based on within-year mark–recapture periods.

We calculated age-structured survival using catch curves, or the log frequency distribution of the catch by age (Chapman and Robson 1960), to provide stage-based survival estimates for use within our PVA models. Age was estimated by use of annulus counts collected during the 1982–1995 monitoring period, because that sampling period was of a much longer duration and provided a more robust age distribution. Unfortunately, during many of the earlier monitoring periods, annuli were only recorded at time of first capture for many individuals; thus, we were not able to validate annuli for this population. Annuli have been reported as an accurate method of aging a population of Sonora mud turtles occurring in a permanent spring (van Loben Sels et al. 1997); therefore although they have not been validated for this subspecies, we felt that, even if there is some deviation in annuli/year, they provided a useful first effort for constructing age-based matrices. To provide survivorship estimates based on more recent sampling periods, we calculated annual survivorship using Jolly–Seber models of 2001–2006 mark–recapture data in Program MARK (White and Burnam 1999) for individuals of unknown sex that were <7 yrs old and males and females that were ≥ 7 yrs old.

Little is known about the reproductive ecology of Sonoyta mud turtles, although within Sonora mud turtles, it appears that clutch size and frequency is fairly variable among populations (Hulse 1982; Rosen 1987). Rosen and Lowe (1996) set fecundity at 2 hatchlings/yr, based on a clutch size of 4 ($n = 3$), to simulate worst-case scenarios, assuming nutritional stress might affect egg quality and hatchability. We used Rosen and Lowe's (1996) reproductive parameters in our model development.

PVA Model Development. — Our PVAs were calculated using four 3-stage models based on female survivorship in RAMAS Metapop (Akcakaya 2002). All simulations were set to run 1000 replications for 50 time steps (50 yrs). The three stages were divided among 3 age classes (0–1 yr, 2–6 yrs, and 7–12 yrs). The 2001–2006 survivorship values were used within the PVA models. Because we could not generate survivorship estimates for zero to 1-yr-old turtles, we used estimates derived for the 2- to 6-yr-old age class by Rosen and Lowe (1996). We set initial population size for Model 1 at 65 females (based on current population estimates). Carrying capacity (K) was set at 70 females based on the assumption that resources are a limiting factor within Quitobaquito; therefore, turtles are living near or at K. Initial numbers of individuals for Model 1 were 10 (0–1yr), 20 (2–6 yrs), and 35 (7–12 yrs). Starting population numbers for Model 2, the initial recovery-based model, were 0 (0–1 yr), 0 (2–6 yrs), and 13 (7–12 yrs). For Model 3, we doubled the number of adults, at 0 (0–1 yr), 0 (2–6 yrs), and 26 (7–12 yrs). For Model 4, we introduced juvenile individuals to Model 2 with a starting population of 5 (0–1 yr), 5 (2–6 yrs), and 13 (7–12 yrs).

Model 1 simulated conditions based on population parameters calculated using 2001–2006 data to determine current population status within Quitobaquito. Models 2–4 were recovery-based models testing minimum number of animals needed to recover the OPCNM population while reducing extinction risk and population-halving events. Model 2 was based on initial numbers of female turtles held within assurance colonies at TPZ and ASDM. In Model 3, we doubled the number of adult females, and in Model 4, we introduced juveniles in both the 0–1 yr and 2–6 yr age classes.

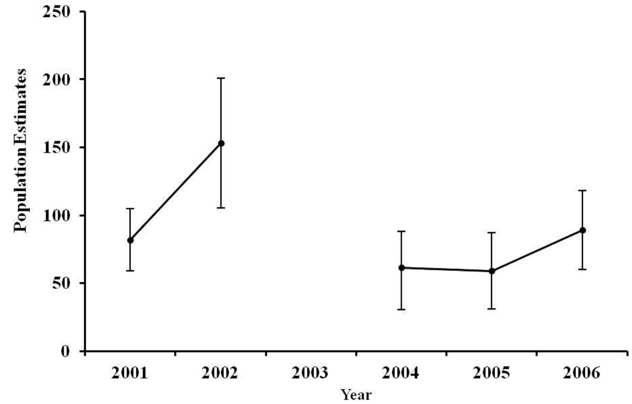

Figure 3. Lincoln–Peterson population estimates (± 1 SE) for Sonoyta mud turtles, Quitobaquito Pond and Springs, Pima County, Arizona, based on the 2001–2006 sampling periods.

RESULTS

Population Parameters. — We captured 153 individual Sonoyta mud turtles (48 males, 34 females, and 71 juveniles of unknown sex) between 2001 and 2006. Juveniles of unknown sex comprised 46% of captured individuals. The adult sex ratio was nonsignificantly male-biased, ($\chi^2 = 2.38$, $p = 0.10$, df $= 1$). Population estimates from 2001–2006 ranged from 39–153 adult Sonoyta mud turtles (Fig. 3), although the 2002 estimate may have been inflated because there was only one recapture during the second sampling period. An estimate was not calculated for 2003 as there was only one sampling period that year.

Many people assisted with monitoring throughout all sampling periods, resulting in inconsistencies in identifying subadult male and female turtles (Fig. 4a). Rosen and Lowe (1996) found that Sonoyta mud turtles reach sexual maturity at 6 yrs and did not include any unknown sex individuals at 7 yrs within the age distributions. Fortunately, long-term monitoring at Quitobaquito has allowed us to follow a subset of subadult turtles until sexual maturity based on onset of secondary sexual characteristics. Based on age and size data from our mark–recapture efforts, we observed that the growth curve for the Quitobaquito population flattens out and begins to diverge between the sexes at 6–8 yrs of age (Fig. 4b). In light of these results, we also grouped individuals under 7 yrs as unknown sex (Fig. 4c). Age-structured annual survival estimates from 1982–1995 captures were 0.83 for males, 0.89 for females ≥ 7 yrs, and 0.72 for turtles <7 yrs. Jolly–Seber-based annual survival for 2001–2006 was 0.95 for males and females ≥ 7 yrs of age and 0.63 for turtles <7 yrs of age. Jolly–Seber-based annual survival varied little from age-structured survivorship calculated here and Jolly–Seber estimates reported in Rosen and Lowe (1996; Table 1).

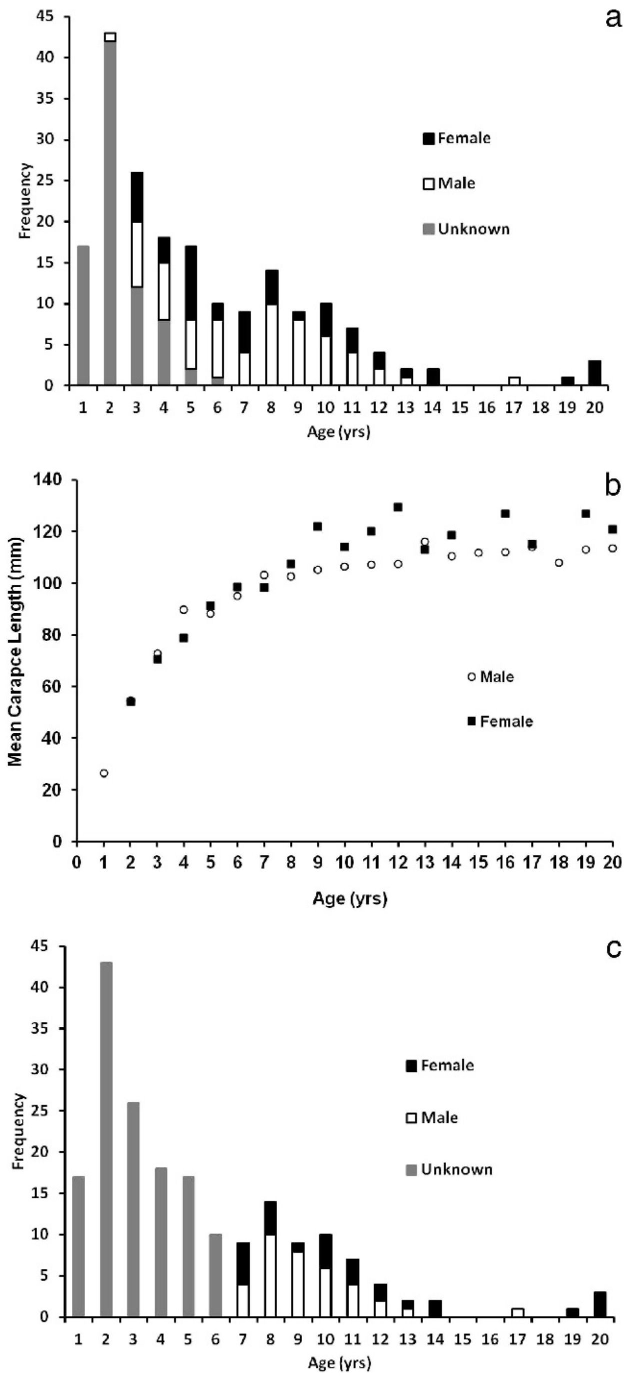

Figure 4. Age frequency distributions from (a) raw data, (b) growth curves, and (c) adjusted sex frequency classifying all turtles <7 yrs as juveniles for Sonoyta mud turtles at Quitobaquito Pond and Springs, Pima County, Arizona. Based on the 1982–1995 sampling periods.

Using the initial population numbers, survivorship values, and fecundity input into RAMAS for Model 1, a female reproductive transition value of 1.79 was calculated. We used the calculated value of 1.79 for Models 1 and 4. In recovery Models 2–3, we lowered the female reproductive transition to 0.64, the value reported by Rosen and Lowe (1996) based on lowest juvenile survival rates for recovery, to simulate missing juveniles in the initial population structure.

PVA Model Results. — Based on current population estimates, Model 1 predicted that the Quitobaquito population of Sonoyta mud turtles is increasing significantly with $\lambda = 1.26$ (Table 2). Models 2 and 3, which calculated the likelihood of recovery by using only adult turtles, predict that the total estimated population size remains low with minimum abundance at 10.4 and 16.2, respectively, and calculated the probability of a population-halving event occurring at 42% and 50%, respectively (Table 2). Model 4, which added five prereproductive turtles in both prereproductive age classes, predicted that population sizes doubled, and the probability of the population halving was reduced to zero (Table 2). Based on iterations within Model 4, the smallest viable population to return a zero extinction risk was 24 females (0–1 yr [$n = 8$], 2–6 yrs [$n = 8$], and 7–12 yrs [$n = 8$]).

DISCUSSION

The Rio Sonoyta drainage has experienced extensive prehistoric geologic changes and recent anthropocentric changes, each resulting in less suitable habitat for Sonoyta mud turtles. In particular, the Quitobaquito population is completely isolated within a fairly inhospitable, arid environment in the transition zone between the Sonoran Upland and Lower Colorado River Valley biomes (Turner and Brown 1982). The Quitobaquito population has continued to persist through the maintenance of a permanent pond and spring channel. Even though methodology differed between sampling periods, comparisons of population estimates between Rosen and Lowe (1996) and the present study suggest that this population has remained fairly stable with some minor fluctuations (Figs. 2 and 3).

The male-biased sex ratio at Quitobaquito has been a constant concern throughout all sampling periods. Rosen and Lowe (1996) suggested that nutritional stress upon females may result in a reduction in annual survivorship or at least the ability to reproduce. Survivorship estimates based on both Jolly–Seber and age-structured models were very similar, suggesting that differences between estimates of annual survivorship may be more a result of variation in calculations than a real-world phenomenon (Koper and Brooks 1998). Thus, other physiological or methodological factors likely contribute to the observed male-biased sex ratio. Sonora mud turtles exhibit temperature-dependent sex determination (Ewert et al. 2004), which may explain the male-biased sex ratios at Quitobaquito; however, nothing is known about Sonoyta mud turtle nesting ecology. Additionally, the observed sex ratio may simply be a function of sampling technique (Ream and Ream 1966).

For the Quitobaquito population to persist, it is essential that reproduction and juvenile survivorship be maintained through constant maintenance of shallow water habitat and continual monitoring for introduced predators. If this is the case, then the Quitobaquito

Table 1. Annual survivorship of adult (7–12 yrs old) and juvenile (<7 yrs old) Sonoyta mud turtles at Quitobaquito Springs, Pima County, Arizona.

	Survival analysis	Adult male	Adult female	Juvenile
Rosen and Lowe (1996)	Jolly-Seber	0.90 ± 0.17	0.85 ± 0.04	0.54, 0.70, 0.85, 0.64[a] 0.84[b]
Riedle et al. (this study)	Age-structured	0.83[c]	0.89[c]	0.72[c]
	Jolly–Seber	0.95 ± 0.04[d]	0.95 ± 0.05[d]	0.63 ± 0.08[d]

[a] Survivorship by year for 2 yr olds (1984, 1985, 1989, 1992).
[b] Mean survivorship for 3–4 yrs.
[c] Calculated from 1982–1995 data.
[d] Calculated from 2001–2005 data.

population must have a higher recruitment rate to maintain $\lambda \geq 1$. Rosen and Lowe (1996) found that following the improvements to the spring channel and shallow-water pond habitats, both juvenile survivorship and λ increased. Our PVA models support the importance of prereproductive females to the Quitobaquito population.

Traditionally, most chelonian life histories are characterized by low annual fecundity, low hatchling and juvenile survivorship, and a long lifespan because of high adult survivorship (Wilbur and Morin 1988; Congdon and Gibbons 1990). With increasing numbers of long-term studies on turtle demography, we are beginning to understand that life-history strategies may vary depending on body size, growth rates, annual fecundity, mortality, and habitat (Iverson 1991a; Shine and Iverson 1995; Cunnington and Brooks 1996). Hellgren et al. (2000) concluded that high adult mortality in Texas tortoises (*Gopherus berlandieri*) resulted in early maturation, smaller clutch sizes, and, therefore, a greater importance placed on hatchling and juvenile survivorship. The yellow mud turtle (*Kinosternon flavescens*) also exhibited similar patterns: juvenile survivorship and annual nesting frequency had the most profound effect on population stability (Iverson 1991b).

A better understanding of these life-history patterns, particularly identification of sensitive life stages, is of utmost importance when outlining conservation strategies for any species (Heppell 1998). Long-term monitoring of the Sonoyta mud turtle at Quitobaquito has provided some important demographic data required to begin modeling these life-history stages. Future work is needed to strengthen the current monitoring protocol, as well as studies designed to gain an understanding of this population's reproductive ecology.

The short-term goal of a PVA is to identify means by which to minimize risk of extinction, while promoting long-term conditions by which species retain potential for recovery without intensive management (Beissenger and McCullough 2002). The Quitobaquito population is unusual in that its existence is entirely dependent on habitat manipulation and maintenance by humans. Although the Quitobaquito population has remained stable for the last 30 yrs, it is our responsibility to continue to improve the understanding of the ecology of Sonoyta mud turtles to further their conservation. This is particularly true in light of the limited spatial distribution and fragmentation of the population of this unique chelonian taxon, these being two important factors influencing the persistence of chelonians in the arid habitats of the southwestern United States and northwestern Mexico (Fagan et al. 2005; Hall and Steidl 2007).

Current Population Status

In 2006–2007, with a noticeable drop in water levels within Quitobaquito Pond, OPCNM renovated the springhead with little subsequent effect on spring flow, suggesting that an unidentified and substantial leak remained. In 2008, OPCNM staff installed a diaphragm wall along the earthen berm that forms the pond dam, again with little effect. In 2009, OPCNM staff continued to make improvements to the pond and try to determine the cause of the water loss. Because of the low water level, bulrush encroached significantly into the shallow ends of the pond's perimeter; bulrush was removed from the pond shallows (by hand) and retaining berm (with a backhoe). All bulrush was searched thoroughly for mud turtles; four were found and removed. To identify the

Table 2. Results from Population Viability Models using RAMAS Metapop for Sonoyta mud turtles at Quitobaquito Springs, Pima County, Arizona. Population Viability Models based on mark–recapture data collected from 2001–2006. Initial female population size is categorized as the number of individual turtles in the age classes 0–1:2–6:7–12 yrs.

Model	Initial population size	Extinction risk	Estimated minimum abundance	Prob. of population halving	λ
1	10:20:35	0	41.1	0.18	1.26
2	0:0:13	11%	10.4	0.42	0.96
3	0:0:26	3%	16.2	0.50	0.96
4	5:5:13	0	32.5	0.00	1.25

leak, tracer dye was added to the water, which resulted in the detection of a possible leak in the pond's southeast corner. To repair the leak, a temporary dam was constructed, isolating the south end of the pond. This portion of the pond was drained to allow addition of several layers of clay and bentonite to seal the pond bottom. The temporary dam was removed, and the pond level had risen 32 cm as of Fall 2011. Bulrush removal and spring channel maintenance are ongoing.

Because of the continued dewatering of Quitobaquito between 2004 and 2007, a growing concern for its inhabitants, 13 turtles (5 males, 5 females, 3 unknown sex) were captured during the 2007 census and transported to a holding facility at the ASDM. Unfortunately, 12 of these turtles were predated by a raccoon (*Procyon lotor*). In 2008, 31 additional turtles (18 males, 13 females) were captured and transported to a temporary facility at TPZ. In 2009, the turtles at TPZ along with an additional 37 wild-captured individuals (3 males, 13 females, 21 unknown sex), were transferred to greatly improved (i.e., predator proof) facilities at ASDM. The addition of a substantial number of unknown sex individuals was added based on the preliminary results of our PVA.

The pond was sampled for six net nights of hoop trapping and by hand on 18–26 October 2010. Twenty-nine turtles (51–113 mm carapace length) and two hatchlings (32–39 mm carapace length) were captured. In 2011 the water level at Quitobaquito had stabilized just below normal levels; thus, a subset of 12 (6 male, 6 female) Sonoyta mud turtles were released back into Quitobaquito on 13 July 2011. A second subset of 7 males and 5 females were released on 13 September 2011. A more standardized sampling effort was initiated on 5–6 October 2011, resulting in the capture of 43 adults and 12 hatchlings. One adult was a recapture from the 13 July release. The Lincoln–Peterson estimate with the Chapman modification for this sampling period was 156 ± 49.

An additional 12 turtles containing a mix of ages is scheduled for release in summer 2012. To ensure the perpetuation of this subspecies, a small population (8 males, 12 females, and 4 subadults) will be maintained in a permanent assurance colony at the ASDM. Considering the number of adult turtles and hatchlings captured after the salvage efforts, the renovations to Quitobaquito pond have appeared to have little impact on the turtle population there. It is hoped that, with the recent renovations and stabilization of the water levels, this population will continue to persist long into the future.

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