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Structure and Size of a River Cooter (*Pseudemys concinna*) Population in Gallatin County, Illinois over Twelve Years of Study

Prepared by:
Michael J. Dreslik
Division of Biodiversity and Ecological Entomology
Section of Biotic Surveys and Monitoring

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Illinois Department of Natural Resources
Illinois Wildlife Preservation Fund
Small Projects
One Natural Resources Way
Springfield, Illinois 62702-1271

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INTRODUCTION

Studies on the life history and ecology of an organism are necessary for formulating conservation strategies. Such studies are often difficult to conduct with turtles because their longevity compared with most organisms. Only a few turtle ecology and life history studies exceed ten years (e.g. Congdon *et al.*, 1994). Thus much of the conservation and management strategies based on short-term studies lack important quantification of demographic vital rates and population size. Determination of long-term trends in demographic vital rates, population size, and even population structure is only determinable though long-term studies.

Range-wide the River Cooter (*Pseudemys concinna*) populations appear stable in the southern United States (www.natureserve.org) but populations along the northern range limit in Illinois and Indian receive protection (Levell, 1997). Thought extirpated as recently as 1981 (Morris and Smith, 1981), *P. concinna* remains extant in Illinois but listed as state endangered (Nÿboer, *et al.*, 2006). The first record of the *P. concinna* in Illinois was a specimen collected in the Wabash River near Mt. Carmel in Wabash County (Garman, 1890). Presently, the species exists in Alexander, Gallatin, Hardin, Jackson, Massac, Randolph, Jersey, Union and White counties (Moll and Morris, 1991; Smith, 1961 and Cahn, 1937). Despite the broad geographic distribution, the ecology of the *P. concinna* remains poorly understood in Illinois (Smith, 1961; Cahn, 1937) and throughout the species' range (see Ernst *et al.*, 1994 for review). The lack of ecological information is because of the species' wary nature, its rather inaccessible habitat and its herbivorous diet (which reduces incidental capture with baited traps). However, in Illinois, a greater problem is obtaining large numbers for study. Surveying in 1988 discovered a population of *P. concinna* in a series of backwater lakes near the Ohio River in Gallatin County (Moll and Morris, 1990).

Broadly distributed in the south and southeastern United State, *P. concinna* range extends from the panhandle of Florida and the Gulf coast south, north to Missouri, Southern Illinois and Indiana, eastward to coastal Virgina (Ernst *et al.*, 1994). Isolated populations occur in Tennesee, West Virginia, and Kentucky (Ernst *et al.*, 1994). In Illinois *P. concinna* occurs in backwaters and floodplain lakes of the Mississippi, Ohio, and Wabash Rivers of southern Illinois (Plate 1; Appendix I). Although populations exist more interior, these drainage typically drain into one of the major river systems (Plate 1; Appendix I). Within Gallatin County *P. concinna* populations cluster in two lake systems (Plate 2), one in the northeast part of the county (Clark, Beaver, and Horseshoe ponds) and in the southeastern cluster (Big, Black, Fish, Fehrer, and Hulda Lakes and Long and Round ponds). Although not documented from every water body in the southeastern system, *P. concinna* occurs in Big Lake, Black Lake, Long Pond, Round Pond, and Running Slough (Plate 3).

Always considered as rare in Illinois or difficult to capture, the biology of *P. concinna* in Illinois remained poorly known (Cahn, 1937, Smith, 1961). Regarded as so rare or difficult to capture, Cahn (1937) reported that long-term study was the only alternative for gathering ecological data. I have studied the *P. concinna* population at Round Pond, Gallatin County, Illinois since 1994. Research at Round Pond has answered many key ecological questions of both a conservation and scientific nature. These studies included diet, conservation, spatial biology, and demographics. Chiefly herbivorous at Round Pond, *P. concinna* grazing mainly on algae from submerged debris

(Dreslik, 1996, 1997a, 1999). The herbivorous diet is typically of populations range-wide but occasionally juveniles will show some tendencies toward carnivory (Ernst *et al.*, 1994). At Round Pond, *P. concinna* is an active forager that grazes algae from submerged debris such as logs (Dreslik 1996, 1997a, 1999). Thus it appears that its food resources would be abundant and warrants little concern.

Over the last decade several studies have focused on population structure (Dreslik, 1996, 1997b; Dreslik and Moll, 1994,1996; Dreslik and Warner, 2002; Dreslik, Phillips and Warner, 2005; Dreslik, Kuhns and Phillips, 2005). These studies have specifically examined population size, density, biomass, and size, sex and stage structure. After the initial survey (Dreslik and Moll, 1996), if Round Pond's density represented that of the remaining lakes in the system, the total estimated number of *P. concinna* in the region would be 565 individuals. Sex ratios were in equality for most years and juveniles represent a high proportion of the turtles captured (Dreslik, 1996, 1997b; Dreslik and Moll, 1994, 1996). These studies have found the population to appear stable but these were all point estimates thus lacking a temporal component. Much work has focused on the growth of the species (Dreslik, 1996, 1997b; Dreslik and Moll, 1994, 1996, Dreslik and Warner 2002). Male and female growth rates do not differ but females grow to larger sizes than males (Dreslik,1996, 1997b; Dreslik and Moll, 1994, 1996). Such slow growth rates to larger body sizes in *P. concinna* lead to delayed sexual maturity (Dreslik, 1996, 1997b; Dreslik, Phillips, and Warner, 2005). Based on growth, *P. concinna* possesses delayed sexual maturity whereby males would mature between 8 to 15 years and females between 13 – 24 years (Dreslik, 1996, 1997b). Finally, there is significant variation in the growth rates of cohorts with some potentially maturing faster than others (Dreslik and Warner, 2002).

Some work has identified the status, threats and conservation measures (Dreslik, 1996, 1998; Dreslik and Moll, 1996; Dreslik and Phillips, 2006; Dreslik *et al.*, 1998). A complex suite of wetland drainage, pollution, channelization, and levee construction has drastically reduced the suitable habitat of *P. concinna* in Illinois (Dreslik and Phillips, 2006). Turtle species showing these characteristics are often susceptible to chronic and severe perturbations (Congdon *et al.*, 1993). Both intrinsic and extrinsic factors threaten *P. concinna* in Illinois (Dreslik, 1998, Dreslik and Moll, 1994, 1996). Intrinsic factors include demographic and genetic instability (Dreslik, 1998; Dreslik and Moll, 1994, 1996). Initially estimated as a small population of ca.150 individuals (Dreslik, 1997b), *P. concinna* at Round Pond could face the problems of demographic sotchasticity. Because Round Pond is a small population it is critical to determine if there is an exchange of individuals among the lakes in the region (Dreslik, 1996). Extrinsic threats include environmental perturbation and habitat destruction in the forms of pollution and clear-cutting activities (Dreslik and Moll, 1996). Few populations of *P. concinna* occur on protected land, although there are more recent records from the Cache River basin. Thus it is paramount to acquire or protect lands with known populations (Dreslik, 1998). Finally, Dreslik *et al.* (1998) recommended surveys along the Ohio and Mississippi rivers to document additional populations.

Studies focusing on the summer movement of turtles revealed that an individual would continually expand its home range nearly the size of the lake (Dreslik *et al.*, 2000; Dreslik *et al.*, 2003). Also, at least one individual made an inter-populational movement to nearby Long Pond during the monitoring period (Dreslik *et al.*, 2000, Dreslik *et al,*. 2003). Thus migration rates between wetlands could be prevalent than once expected and the entire region may be functioning as a panmictic population (Dreslik, 1996,1998; Dreslik and Moll 1994, 1996; Dreslik *et al.*, 2001; Dreslik *et al.,* 2002). Using this long-term monitoring data I examined the temporal trend in population size. From 1994-2003, I have captured, marked, and monitored over 150 individual *P. concinna* from Round Pond, Gallatin County. By continuing monitoring the marked population, I can determine long-term trends in demographic vital rates, population size and even population structure. The objective of my study was to continue monitoring marked and new individuals in the population and assess the mark recapture data for temporal trend in population size, structure, sex and juvenile to adult ratios, and growth rates.

STUDY SITE

LOCATION AND MAJOR FEATURES

Round Pond is a 24.5 ha member of a chain of floodplain lakes found approximately 4 km west of the confluence of the Ohio and Wabash rivers and NNE of Old Shawneetown in eastern Gallatin County, Illinois (Plate 4). Located on the floodplain side of the Shawneetown levee, Round Pond is unlike many other floodplain pond and lakes in southern Illinois (such as those found in the Pope and Massac counties). Thus, Round Pond seasonally floods from the Ohio and Wabash rivers. Along Round Pond's western boundary are the heavily forested and rocky Shawneetown Hills. The woodlands from the hills run down and adjoin with some of the woodlands along the west side of Round Pond.

Seven floodplain lakes occur in the region (Plate 5) and all are remnant floodplain sloughs and oxbows of both the Wabash and Ohio rivers. Running north to south the chain begins with Hulda Lake (13.4 ha), then the Round Pond and Long Pond (4.3 ha) complex to the west. A chain of three lakes east of Round Pond running from north to south are Fehrer Lake (12.3 ha), Black Lake (3.0 ha), and Big Lake (36.1 ha). Finally, at the southern extreme is Fish Lake (25.1 ha). Juxtaposed in matrix of remnant floodplain forest and agriculture, these floodplain lakes were once one large lake and swamp complex during presettlement (see below).

PRE-SETTLEMENT STRUCTURE

Surveyors records compiled by the INHS allowed construction of a GIS basemap of presettlement vegetation for Illinois (Plate 6). Before settlement, upland and lowland forests dominated the entire county, much similar to the structure remaining in the Shawnee National Forest. Interestingly however, three large floodplain lakes and many associate swamplands dominated the central part of the county (Plate 6). As a result from cultivation, farmers and settlers cleared much of the woodlands and drained and ditched the swamps and other wetlands. Hulda Lake is all that remains of the approximately 2,300 ha most northern of lakes. The southwestern lake was roughly 890 ha in size and once drained into the Saline River. The southwestern lake connected to the northern lake by a complex of swamplands. Because of draining, only several small ponds and some small sloughs are all that remains of the southwestern lake (Plate 7). Round Pond, Long Pond, Fish Lake, Black Lake, Fehrer Lake, and Big Lake as well as several sloughs are all that remains of the approximately 442 ha southeastern lake (Plate 7). Although fragmented, many of the current lakes retain some of the cypress and buttonbush swampland habitats.

HABITAT STRUCTURE OF ROUND POND

Round Pond is a large open body of water (Plate 8a) with its deepest part being ~17 feet. The northern two coves are shallower and water depth may not exceed 6 feet. Remnants of a floodplain forest that is nearly contiguous with the woodlands of the Shawneetown Hills, bound the extreme northern part of Round Pond. A band of Buttonbush (*Cephalanthus occidentalis*) Swamp that extends down the eastern shoreline dominates Round Pond's shoreline. Three Spatterdock (*Nuphar luteum*) colonies inhabit the waters off the southwestern, southeastern, and eastern shorelines (Plate 8b). A modified stream empties into the northwest cove and a small slough empties from Round Pond into Long Pond (Plate 9). Several of the lakes in this complex have large cypress trees; however, Round Pond lacks this feature.

Because of the near of the Lakes to the rivers and to each other, during spring flooding, Round Pond connects directly or through sloughs, creeks, and agricultural drainage ditches to the Ohio River. In times of severe flooding the scene may be reminiscent of the major presettlement lake that once occupied the area. Nevertheless, because of the flooding there is a direct exchange of both lacustrine and riverine species making Round Pond unique in ichthyological and herpetological assemblages. Also these flooded sloughs and ditches and the relative near of the lakes may also provide corridor habitat for aquatic species. Thus the entire lake and wetland complex may serve as demes forming a metapopulation on the landscape scale.

TURTLE ASSEMBLAGE

In the United States the lower Mobile turtle Basin is the most species rich comprising 16 species and many are endemic map turtles (*Graptemys*). Within the upper Mississippi River basin Round Pond is one of the most turtle species rich assemblages documented (Dreslik and Phillips, 2005). Round Pond's turtle assemblage is diverse comprising ten species with a mix of species having lacustrine and riverine affinities (Dreslik *et al.*, 2005; Plate 10). In order of abundance, the assemblage consists of Red-eared Slider (*Trachemys scripta*), Eastern River Cooter (*Pseudemys concinna*), Common Snapping Turtle (*Chelydra serpentina*), Stinkpot (*Sternotherus odoratus*), Ouachita Map Turtle (*Graptemys ouachitensis*), Spiny Softshell (*Apalone Spinifera*), False Map Turtle (*Graptemys pseudogeographica*), Common Map Turtle (*Graptemys geographica*), Painted Turtle (*Chrysemys picta*), and Smooth Softshell (*Apalone mutica*). Only one other turtle community in the upper Midwest reached ten turtle species attributed to two subspecies – the False Map Turtle (*Graptemys pseudogeographica pseudogeographica*) and the Mississippi Map Turtle (*Graptemys pseudogeographica kohnii*). According to global species richness maps for turtles, based on current distributions, published by the Smithsonian Institution, only two species may not occur in the waters of Round Pond. They are the Alligator Snapping Turtle (*Macrochelys temminckii*) and the Eastern Mud Turtle (*Kinosternon subrubrum*).

HUMAN USE

Small cabins and trailers occupy the western shoreline and a beach encompasses the southern shore. The main recreational use of the lake by the residents is fishing. Lots do not reach the shoreline, but instead landowners have an easement in their deeds for access to the water. The duration of the easement I once heard was for 100 years. Many of the residents do maintain boat docks along the lack and there are areas of manicured grass especially along the northern end. Most of the residents are retirees and only live on the lake during the warmer spring, summer, and fall months when the floodwaters have receded. Most of the housing by the residents are typical pull behind trailers and there are only four to six small permanent buildings for housing (two on the north end and approximately four on the south end). There is a building on separate property on the south end of the lake that used to be a bass fishing club and its owner maintains the beach on the south end. Finally, there are a few other permanent structures in the way of pavilions. The residents have been agreeable to the turtle research conducted on the lake and in conversation express their concern for protecting Round Pond.

OTHER SPECIES OF OCCURRENCE

There are two large raptor species which use the lake. Although not nesting on the Round Pond, Bald Eagles nesting on nearby Fehrer Lake have used Round Pond for foraging ground in the past as well as Osprey. Migratory waterfowl often use Round Pond as a stopover point during Spring and Fall migrations. However, because of a lack of an avifaunal inventory of the site, it remains unknown what other bird species may occupy the bordering habitat.

Also there are several nongame fish species which are of interest. Round Pond holds large populations of Bowfin (*Amia calva*), Gar (*Lepisosteus sp.*), and Paddlefish (*Polyodon spathula*). Presumably flooding also strands Paddlefish in the lake in a similar fashion as many of the riverine turtle species but Paddlefish can persist because the lake is long and deep. Again, a full inventory of the fish assemblage is lacking but if it is similar to the turtle assemblage there will be fish species that occupy both riverine and lacustrine environments.

Finally, there are two snake species of general conservation interest that occur at Round Pond. The Copperbelly Waternsnake (*Nerodia erythrogaster neglecta*) is a species of Federal and State concern routinely basks and forages along the shoreline. The final species is the Copperhead (*Agkistrodon contortix*). Although not a state listed species, this is one of Illinois' four species of venomous snakes. Being a venomous snake has caused population declines of the Copperhead because of human persecution and habitat loss. Although locals stated the Copperhead occurred in the nearby Shawneetown Hills, I did not observe it until 2004. In 2004 we found two individuals on the road alongside Round Pond. One of which was the gravid female pictured here. Although not a freshwater turtle, the Eastern Box Turtle (*Terrepene carolina*) is widespread in the floodplain and upland woodlands of most of Illinois. The Eastern Box Turtle is one of the most well-known turtle species to the public. I have marked several dozen Box Turtles at the site but no formal research has occurred on their ecology at the site.

MATERIALS AND METHODS

CAPTURES

I trapped turtles using unbaited fyke nets, baited hoop traps, trammel nets, dip nets and by hand. I checked once - twice daily and weighed (with pull spring scales or electronic balances), sexed (using secondary sexual characteristics), aged (annuli counts on the left pectoral scute), and marked all turtles (Cagle, 1939). I measured the following morphological characteristics using metric calipers: carapace length (CL), carapace width (CW), shell height (SH), plastral length (PL), left pectoral scute length at the seam (LPECT) and all annuli on the left pectoral scute. I sexed individuals by using foreclaws elongation and vent extension beyond the carapacial margin, this resulted in the smallest sexable male being 97 mm PL. All individuals under 97 mm PL were of unknown sex, those with defined foreclaws and long pre-anal tail lengths, were male and those individuals greater than 97 mm PL and lacking both male characters were female. Adult cut-off values were 216 mm PL for females and 166 mm PL for males. I partitioned each sex to stage classes. For females, juveniles were between 97 – 120 mm PL, immature 121 – 170 mm PL, subadults between 171 – 215 mm PL. For males, juveniles were 97 – 120 mm PL, 121 – 150 mm PL, and subadults from 151 – 165 mm PL. From this data I calculated overall sex ration, juvenile (juveniles, immature and subadults added together) to adult ratios, and the proportions of each stage class overall and by sex.

ANALYSIS

I summarized the captures of each sex/stage class by year then partitioned the data set into by effort (trap hours) and gear type to obtain an overall capture rate. Once classified, all captures I tested all ratios using Chi-square tests and then examined linear trends in the ratios with time using linear regression. I tested to see if size structure differed between years of surveys using Kolomogorv-Smirnov cumulative probability tests. I calculated population sizes using the closed population Schnabel and Schumacher-Eschmeyer regression estimators and tracked the trend in population size using linear regression. To test the assumptions of population closure, I conducted a regression of the proportion of recaptures in the sample for each one-week sampling period by the cumulative number of marked individuals available for capture. The population is closed if the y-intercept equals zero and there is a significant linear trend. I classified individuals into birth year cohorts then modeled growth rates using nonlinear regression. For growth analysis I chose four mark/recapture models, Fabens, Gompertz, Logistic, and Richards. For each model I estimated asymptotic size based on the mean of the largest 10% of the individuals captures and allowed free estimation of asymptotic size for a set of eight candidate models. For the growth analyses I only used the first and last capture to reduce pseudoreplication. I then used Akaike's Information Criteria (AIC) to determine which mark/recapture individual growth model best fit the data. Once chosen, I then partitioned the data set into cohorts and reran the best fit model by sex and cohort to determine variation in growth rates.

RESULTS

CAPTURE RATE

Over the last 12 years I have captured 227 individuals 368 times (Appendices II & III). Ninety-one were between-year captures (Appendix II) and 49 were within-year captures (Appendix III). Across all years, I only captured four hatchlings, all in the same year (Table 1). Capture rates of individuals were variable per year but over the duration of the study averaged 36 individuals. The most abundant captures were the adult stage class for males and the immature stage class for females (Table 1). I have only captured 25 adult females during the study (Table 1).

The most effective capture method for all years was trammel nets, which typically yielded high capture rates over a shorter period (Table 2). Trammel nets had a capture rate estimated at 0.2 days per turtle (Table 2). The trammel nets worked as an interruption trap, capturing turtles when they are moving. However, trammel nets also have an increased possibility of accidentally drowning turtles if unattended and typical should only be set during the day and checked every two hours, at the maximum. Thus, trammel nets are effective for targeted sampling within a wetland.

Single set fyke nets with wings and leads produced the second highest capture rate (Table 2). Fyke nets had an overall capture rate estimated at 1.2 days per turtle (Table 2). Fyke nets are typically initially unbaited, however become baited with capture of fish, and have a low probability of drowning turtles when partially submerging the barrel. These nets are also an interruption type method because of the long wings and leads. Fyke nets may remain unattended so long as part of the barrel is above the water. Thus although labor-intensive when initially setting, they have a low cost in effort to check.

Baited hoop traps had the poorest success in capturing *P. concinna* at Round Pond (Table 2). The capture rate of baited hoop traps was 46.6 days per individual. Baited hoop traps only function as attracting turtles to the trap and rarely do they function as an interruption method. Although I captured some turtles on staple baits (sardines in oil) and captured more with vegetable baits in 2004, they are still orders of magnitude poorer in efficiency compared to the other methods.

Although one can easily place and check baited hoop traps, one would need to be in place on average of 47 days to capture a *P. concinna* (Table 2). Fyke nets would only need to be in place for roughly a day and trammel nets a few hours (Table 2). Therefore trammel nets are preferable to dtermine overall occupancy and fyke nets for detailed demographic data. For example to capture 10 *P. concinna* it would take ~ 6 days with one fyke net and ~432 days with one hoop trap (Table 3). Using the typical sets I have placed at Round Pond (3 fyke nets and a dozen hoop traps) those 10 *P. concinna* would take ~ 2 days to capture with fyke nets and 36 days with hoop traps (Table 3).

SEX AND STAGE STRUCTURE

Considerable variation exists in the proportion of each sex captured over the study (Figures 1,2). The proportion of females in the total capture sample ranged from 46 – 75%, males from 4 – 47%, and individuals to young to determine sex (juveniles and hatchlings) ranged from 6 – 21% (Figure 1). When focusing on adults, females ranged from 0 – 67% of the sample and males from 33 – 100% (Figure 2). Thus consistently the adult population is more toward males. Overall there was also variation in stage composition among years whereby juveniles ranged from 7 – 36% of the sample, immatures from 22 – 75%, subadults from 0 – 18%, and adults from 12 – 64% (Figure 3). When examining the stage structure of females, juveniles ranged from 6 – 100% of the sample, immature from 0 – 79%, subadults from 0 – 22%, and adults from 0 – 43% (Figure 4). Finally when examining the stage structure of males, juveniles ranged from 0 – 29% of the sample, immature from 0 – 29%, subadults from 0 – 28%, and adults from 30 – 100% (Figure 5).

The overall sex ratio was equal for all years except 1998 and 2004 when I captured more females and the difference was so large that it resulted in an overall difference (Table 4). Of these females the majority were subadults through juvenile stage classes (Table 1). In any one year the operational sex ratio did not differ, however the accumulated differences resulted in a population that was adult male biased (Table 4). In 1994, 1998, 2002, and overall *P. concinna* captures were biased toward juveniles (Table 4), mostly younger female stage classes (Table 1). None of demographic structure ratios showed a linear pattern, either decreasing or increasing, with time (Figure 6, Table 5).

SIZE STRUCTURE

Turtles of middle size classes (90 – 170 mm PL) represented the largest proportion o f the sample, thus producing one large mode 90 – 150 mm PL for females and 140 – 190 mm PL for males (Figure 7). There is a secondary mode from 250 – 310 mm PL for females, but that is lacking in males (Figure 7). When examined by years these modes remain readily apparent (Figure 8). The size structures for some pair-wise comparisons differed (Table 6). For females, there were fewer individuals of larger sizes for the 1996-1997, 2000, and 2006 samples compared to 2004 (Table 6). For males, most pair-wise comparisons differed showing greater fluctuation in the sizes of males captured between years (Table 6). Overall 2006 had fewer individuals of all size classes and was more uniform compared to 2002 whereas 2004 had larger modes and composition of individuals from all size classes compared with 2002 (Table 6). The same results was present for the differences among the 1996-97 sample compared to the 1998-99 sample (more individuals of all size classes) and the 2002 sample which had more individuals of medium sizes (Table 6).

POPULATION SIZE AND DENSITY

For this study, the y-intercept did not significantly differ from zero ($y_{int} = 0.105$, $p = 0.327$) therefore I set the final test the y_{int} at zero. The population met the assumptions of closure across the entire duration of study (slope = 0.003, $F_{1,25} = 57.93$, $r^2 = 0.699$, $p << 0.001$). There was a definite linear trend in the number of recaptured individuals in the sample to the cumulative number of marked turtles in the population (Figure 9). Both the Schnabel and Schumacher-Eschmeyer population estimates yielded similar results for each year when compared (Table 5). Initial population estimates were ~ 130 individuals and in the last 12 years they have grown to ~ 320 individuals. The similarity of the error around these estimates across years suggests the trend is not a refinement of the population estimate, but rather, an increase in population size (Table 7, Figure 10). Over the last 12 years of study the *P. concinna* population has been significantly increasing at the rate of 16±3 individuals a year ($F_{1,7} = 29.40$, $r^2 = 0.808$, $p = 0.010$).

GROWTH AND SEXUAL MATURITY

Of the eight models tested the Fabens mark/recapture analogue with a fixed asymptotic size fit the data best (Table 8). Growth is most rapid through earlier age classes, 0 – 10, then tapers slowly though ages 11 – 20, and nearly ceases near age 25 (Figure 11). Growth rates between males and females were near identical; however, females grow much larger than males (Table 9). Finally, there is great variation in the growth rates of different cohorts where females range from rates of 0.056 – 0.094, and males from 0.109 – 0.188 (Table 10). These fluctuations in cohort specific growth rates shows the sexes do differ in growth rates and the difference is masked when not accounting for cohort. When graphically represented with the sizes of sexual maturity, these small fluctuations in growth rates among cohorts can explain the wider variation in the ages of sexual maturity (Figures 12, 13).

DISCUSSION

CAPTURE RATE

Although over the last 12 years the number of captures of *P. concinna* has varied annually, I have identified 227 individuals from Round Pond. The finding that hatchling captures are rare is not surprising as hatchling turtles are the most cryptic and can easily escape the nets used for this study. Hatchlings of *P. concinna* and other turtle species occupy the button bush border of Round Pond (Dreslik *pers. obs.*). The button bush habitat lacks enough trapping effort because of the need to capture and quantify the adult/reproductive population. Thus, in future years I will target hatchling turtles and build this trapping regime into the rotation. Most likely, the best would be employing small collapsible minnow traps that are of similar design to standard hoop traps but with smaller meshing. These traps will have wings and leads attached to them of finer mesh and this server as smaller versions of the fyke nets and I would set them in shallow water of the button bush swamps.

As reviewed by Gibbs and Amato (2000), one of the most important factors in turtle conservation is the age/stage structuring of the population. This is because of the composite factors of delayed sexual maturity and high juvenile mortality (see review by Gibbs and Amato, 2000). One alarming factor is that over the study I have only identified 25 adult females from Round Pond. Although I may have missed adults, many adults are recaptured and few new individuals are added annually. The stability of turtle populations rests on the number of breeding adult females in the population (Congdon *et al.*, 1993, 1994). The data to run a population viability analysis on *P. concinna* is lacking, therefore efforts to protect the adult population must be enacted until we determine if the population is viable. Even a small 10%

annual loss in adult females can the population to decline severely, even in a species as widely distributed as the snapping turtle (Congdon *et al.,* 1994). Future efforts need to identify the possible threats to adults so conservation measures can prevent additional anthropogenic losses.

The best method too rapidly capture *P. concinna* were trammel nets. Trammel nets require an extensive amount of time to tending and risk drowning turtles if left unattended, thus they are inefficient for long-term demographic studies. Fyke nets are superior for capturing large numbers of *P. concinna* with less tending but are more expensive initially to purchase. Although baited hoop traps did capture *P. concinna* in every year their yield precludes them from use because of the numbers and durations one would have to trap a site to yield one capture for occupancy and demographic studies. Thus, I recommended that trammel nets for status surveys where efforts concern occupancy and fyke nets for more detailed demographic studies.

SEX, STAGE AND SIZE STRUCTURE

Reports of sex ratios are widespread through the turtle literature; both equal and biased ratios (see Gibbons, 1990 for review). Explanations for biases in sex ratios vary from anthropogenic pressures such as increased road density (Aresco, 2005; Marchand and Litvatis, 2004; Steen and Gibbs, 2004, 2005), biases in capture methods (Ream and Ream, 1966), differing incubation temperatures (Vogt and Bull, 1984), or other aspects of differential survival. Few studies have examined the fluctuations in demographic ratios of long-lived turtle species. This is most likely because the data required needs to come from at least a decade of research and few programs last that long. In only two years (1998 and 2004) was the overall sex ratio biased, toward females, but the bias was so marked it resulted in an overall difference. Only one of these years (2004) was unusually successful with captures whereas 1998 was an average year. Most striking is annually the adult population annually did not differ from equality. Only when considering the entire sample did a bias occur toward adult males. Regardless, adults make up a smaller component of the population than do the other classes. There were no associated fluctuations in either of these ratios across time suggesting stability in the population.

A consequence of turtle's life histories is the greater abundance of younger size classes over adults (see Gibbs and Amato, 2000 for review). This is because of the generalities of most turtle life shitories of high adult survival, delayed sexual maturity, and high juvenile mortality (Congdon *et al.*, 1993, 1994), thus to produce stability turtles must have populations predominated by younger age classes. Once individuals attain maturity, they must have near guaranteed annual survival rates. There is great variation among the ratios annually at Round Pond but the general trend suggests a successfully recruiting population, in most years. Typical of many turtle populations, smaller stages are lacking, but it is unknown whether it is natural from high juvenile mortality rates or an artifact of sampling. As with most published studies on other turtle species (see Ernst *et al.*, 1994 for review), adults typically comprise most of the populations. Thus, structurally the *P. concinna* population at Round Pond fits the mold of a healthy population; however, it is the numbers of individuals that warrants concern.

POPULATION SIZE AND DENSITY

Only three studies quantified population sizes of *P. concinna*. At Rainbow Springs Run, Florida, estimates were at a density of 170 turtles/ha (Marchand, 1942) and at three sites along the New River in West Virginia densities ranged from 0.7 to 2.3 turtles/ha (Buhlmann and Vaughan, 1991). For Round Pond was from 1994-1996 and densities measured 5.1, 5.2 and 7.8 turtles/ha (Dreslik, 1997b) but and from 1997-1999 were 9.5, 8.7, and 7.3 turtles/ha for an overall across all years of 7.3 turtles/ha (Dreslik *et al.*, 2005). From 2002 and 2004 the density of *P. concinna* had increased to 9.3 and 10.9 turtles/ha respectively (Dreslik *et al.*, 2005). This increase in the number of turtle has continued to 2006 where the density is 11.3 turtles/ha. Thus within twelve years, the density of *P. concinna* at Round Pond has doubled. This rate of increase may seem small but considering the slow response of turtle populations because of their life histories it represents a relatively rapid increase in population size.

The differences in population estimates across years are attributable to differences in methods. Earlier estimates used the Schnabel population estimator (Dreslik, 1997), whereas the later ones used the Schumacher-Eschemeyer (Dreslik *et al.*, 2005). However, Dreslik *et al.* (2005) treated each year separately and for this report I treated the sample as a whole and tested for violations in the assumptions of closed models. Treating the sample as a whole will be the standard method for future studies until there is a violation in the population closure assumption. If a violation occurs, future studies can either return to a yearly schema or include a robust sampling design using closed models for within year estimates and open models for between year estimates.

If the density of *P. concinna* is representative of that for the other ponds in which it occurs in the region, then the regional population size may be large. Round Pond is approximately 24.5 ha when using GIS basemaps, thus the current density of turtles at the site is either 13 or 14 (Schnabel and Schumacher-Eschmeyer estimates respectively). Following the same logic and extrapolating the population sizes for the other lakes, the population sizes are 54 – 58 for Long Pond (4.2 ha), 464 – 500 for Big Lake (36.1 ha), 38 – 41 for Black Lake (3.0 ha), 157 – 169 for Fehrer Lake (12.2 ha), 322 – 347 for Fish Lake (25.1 ha), and 172 – 86 for Hulda Lake (13.4 ha). This results in a total regional population size of 1522 – 1643 *P. concinna*. This estimate is rough, as it assumes that density is homogeneous among populations, all other sites have populations of *P. concinna*, and the population estimate for Round Pond is accurately. Such an estimate requires validation by trapping a few of the other sites and determining if *P. concinna* occur in Fehrer, Fish, and Hulda lakes.

GROWTH AND SEXUAL MATURITY

Individuals from the 1998-2002 cohorts may have escaped capture with fyke nets either because of differential habitat use in juveniles or biases inherent in the size of the fyke nets we used. Although I have data for ten cohorts of females, and four for males, my sample sizes are small and results preliminary. A previous study for Round Pond reported a growth rate of 0.087 for females and 0.136 for males (Dreslik, 1997b). When considering the mean growth rate of all cohorts my results are similar to those previously reported for Round Pond, however I can examine yearly effects.

Most turtle species typically have high juvenile mortality rates (Congdon *et al.*, 1993, 1994; Iverson, 1991; Frazer *et al.,* 1991) and low adult mortality, thus delaying maturation to older ages (Congdon *et al.,*1993, 1994; Iverson, 1991; Frazer *et al.,* 1991). Age at sexual maturity is a life history characteristic subject selection pressures (Stearns, 1992). The viability of turtle populations hinges on the survival of mature adults because of delayed sexual maturity (Congdon *et al.,*1993, 1994). Many reproductive characteristics in turtles co-vary with body, such as clutch size and body size in *Pseudemys concinna* (Iverson, 2001). Cohorts that grow faster will attain sexual maturity and a larger body size at an earlier age, therefore faster growing individuals have a greater per capita reproductive output compared to their slower growing counterparts. For example, compare the earlier maturing 1995 cohort to the later maturing 1988 cohort. Assuming one instance of nesting occurs and clutch size averages 14 eggs (Iverson, 2001), then over 30 yrs the earlier maturing cohort has a 55% greater reproductive output in egg production compared to the later maturing cohort. The capacity to lay multiple clutches and variation in clutch size with female size would only increase this gain in reproductive output. Although we lack the data for Round Pond, work in Florida suggests that *Pseudemys concinna* can lay up to five or six clutches with annual egg production averaging 70 eggs (Jackson and Walker, 1997). Except for these two extreme cohorts, most cohorts matured between 12 and 15 yrs. Variation between the extremes suggests age at sexual maturity may also be a variable characteristic. Because dictated by environmental and genetic variation dictates the plasticity in growth rates of ectotherms, this variation transfers to the age of sexual maturity. Other research has found such variability in ages of sexual maturity through long-term data collected on *Emydoidea blandingi*, where the range of sexual maturity spanned seven years (Congdon and van Loben Sels, 1993).

Growth rates are responsive of climate and this trend appears strong for the first year of growth, where survival rates are the lowest. Survival rates of juvenile turtles through their first year of growth seldom exceed 50% (Shine and Iverson, 1995; Congdon *et al.,* 1993, 1994; Iverson ,1991; Frazer *et al.,* 1990), thus turtles exhibit a type III survival curve whereby mortality decreases with age (Shine and Iverson, 1995). A predicted mechanism to increase survivability is to grow rapidly through periods of high mortality (Williams, 1966). However, the relationship between cohort-specific growth rates and cohort-specific survivability (i.e. do faster growing cohorts exhibit higher survival rates) in turtle populations is unknown. The dynamics of cohort-specific growth and survival rates can have implications on the demography and viability of turtle populations, especially when considering the plasticity in growth rates and variability in the age of maturity we observed.

CURRENT CONSERVATION STATUS

CURRENT AND HISTORIC ELEMENT-OF-OCCURRENCE RECORDS

There have been four major compilations of locality records for *P. concinna* in Illinois (Dreslik, 1998; Moll and Morris, 1991; Smith, 1961; Cahn, 1937). Of the 45 records identified for *P. concinna* in Illinois, 38 of those are unique. Only seven records occur for site repeated and of those only Round Pond and Horseshoe Lake, Alexander County span multiple years. Forty records at least have dates with two pre- 1900's (Garman 1890). Cahn (1937) summarized eight records in his monograph, one was added in the 1950's, one in the 1970's, eight in the 1980's, 13 in the 1990's, and six t in the 2000's. There are four published distributional summaries for *P. concinna* in Illinois. Cahn (1937) placed eight localities on his map recording them Mt. Carmel, Chester, Metropolis, Cairo, Elizabethtown, Murphysboro, Union County, and Horseshoe Lake and Smith (1961) added a record for Jersey County. In the intervening years to 1988 the species was thought extirpated in Illinois, however a status survey conducted in 1988 found the species remained extant in Illinois (Moll and Morris, 1991). This survey resulted in five additional locations for the species in the state, eight if including the Indiana encounters in the Wabash River. A decade later a follow-up survey conducted from 1994 – 1996 added eight sites (Dreslik, 1998).

The largest known cluster of the species is the floodplain lakes of southeastern Gallatin County, as *P. concinna* occur at all trapped sites (Dreslik, 1996, 1998). Although additional work does need to occur within the region to determine if *P. concinna* occur in all lacustrine systems as well as, within the Wabash and Ohio rivers proper. Since first documented in 1988 (Moll and Morris, 1991), documentation of *P. concinna* remains constant within the region. However, all the lakes and ponds occur on private land and there is no state holding or protected site for *P. concinna* within the region. Such an acquisition or incentive for current landowners warrants pursuing to secure the species in this region.

The situation at Horseshoe Lake is somewhat different. Initially *P. concinna* were reported from the lake by Cahn (1937), but he also stated that they were extirpated from the lake in 1930 when it dried. However a specimen was deposited into the survey with a 1936 date (INHS 2155), a second collected by P. Smith and J. List in 1951 (INHS 6014), and in 1985 M. Morris and M. Morris (SIUC-R 2172) all confirm that the species may still occur in the lake. What remains unknown is if the species still occurs at Horseshoe Lake and what the population size is. Despite being heavily used for sport fishing and hunting location it could definitely represent a population on protected lands, an attribute the species is suffering from a lack of. Thus, one objective should be a limited survey to determine the presence/absence of the species at the site and if found a more detailed survey that would allow estimation of population size.

INFORMATIONAL REQUIREMENTS FOR PREPARATION OF A RECOVERY PLAN

The current trend in the Illinois Department of Natural Resources to compile recovery plans for listed species. Many of these plans are soliciting of recovery teams but some species would not require such an effort depending on the complexity of the issues surrounding them. It is readily apparent that some species would not require such a group and *P. concinna* is one such species. Due to the fact that they receive little attention both a conservation and research aspect in Illinois, there are very few experts in the state to form such a team. Thus, a recovery plan could be constructed by one or two individuals in conjunction with the IDNR's Endangered Species Program. However, before a recovery plan can be constructed there are several issues or knowledge gaps that need filled and these gaps are not unique to *P. concinna*.

***Full Status Survey.* –** The first task that must be completed before implementing a recovery plan is determining the number of extant populations. Although there are nearly 50 records of the species' occurrence in Illinois, using the decade rule only 9 have occurred from 1997 – 2007, thus many sites require re-verification. Ideally the survey would encompass four years of sampling broken up into logical geographic units: 1) Little Wabash River at Mt. Carmel to the confluence of the Ohio and Wabash rivers, 2) the confluence of the Ohio and Wabash rivers to the confluence of the Mississippi and Ohio rivers, 3) the confluence of the Mississippi and Ohio rivers to the confluence of the Mississippi and Illinois rivers, and 4) the interior southern Illinois rivers and lacustrine systems. Sampling should first target the historic locations within the region then expand to probably locations based on habitat and proximity records. When sampling the interior southern Illinois focus should be given on lower order rivers and their associated floodplain lacustrine systems. With the recommended trapping method above, site should be sampled with multiple trammel nets with a base of five nets for five trap days per site. Trapping locations should be restricted to beds of aquatic macrophytes and near fallen snags to increase the probability of capture. Once the status survey is completed, detectability and occupancy rates can be calculated to determine if additional sampling is required for sites without a capture. It has been over a decade since the last status survey was completed and that one focused on southeastern Gallatin County. This survey can be easily accomplished over the four field seasons because *P. concinna* remain extremely active through-out much of the warmer months.

Habitat Suitability Model. – One threat that faces many declining or protected species is the limited amount of suitable habitat. Thus, to be proactive the amount of suitable habitat within Illinois should be determines. This can be accomplished in concert and shortly following the status survey, a habitat suitability model needs to be constructed for the species in Illinois. Surveyors can collect specific broader scale habitat data at each site sampled during the survey. Such data includes, but should not be limited to, the use of the surrounding landscape, mean wetland depth, flow rates, normal pool area, aquatic system type, distance from major river, physiogeographic division, road density in the surrounding landscape, presence and distance from dams, distance to other known populations, wetland substrate composition, presence or absence of emergent aquatic macrophytes, soil type of the surrounding landscape and the amount of upland habitat. Once data is collected a subsequent GIS model can be created to predict the amount of suitable habitat. This model can then be used to target acquisitions, direct land conservation, and determine how much already protected land is suitable for *P. concinna*.

Additional Biological Information. – Because turtles are so long-lived the data collection to answer many questions easily take decades of study. There are several important biological aspect of the species that we have little or no information on and are imperative for recovery. The major data gaps will aid in constructing more precise conservation plans, those that are species-specific. Much of this lacking information is critical to the process of constructing population viability analyses (PVAs) and for delineating critical nesting habitat.

We have little information on reproductive output and this information is required to construct PVA. Specifically data on clutch size, clutch frequency, and female reproductive cycle are necessary to construct PVAs. That data expressly enters into the calculations of the number of new individuals entering into a cycle and hence is paramount for determining recruitment rates. Other data such as egg size and offspring size are important for determine maternal investment. This data is important in obtaining an understanding if limitations to female reproductive output are based on female size, health, or age.

Next, because females leave aquatic system to nest terrestrially, the terrestrial habitat is an important consideration in conservation planning. Because females can make extensive overland forays to nest they are often exposed more to mortality from predation and anthropogenic factors such as road mortality. Thus it is critical to determine when females will nest, how far they will move from the wetland to nesting sites, and how long they spend out of their home wetland. Nest sites are crucial to the conservation of turtles and although they may only represent one point in space and time given an individual's entire activity period, the actually location or habitat type that females choose is critical to conservation. Thus, good conservation planning needs to include information on the nesting habitat and the associated survivorship of nests.

The most overlooked class in any turtle study is immature individuals. Often there are ontogentic differences in habitat use (see Ernst *et al.*, 1994 for review). Thus, in order to accurately ensure we are protecting all critical habitat we must have knowledge if ontogenetic shifting occurs and if so what is the critical habitat for the younger age classes. In most species of turtle juvenile survival is thought to be low and that the low survival rates are offset by the high survival rates of adults (Congdon et al, 1993, 1994). However, comprehensive life tables do not exist for most species of turtles and *P. concinna* is one such species. Survival rates are required in PVAs in order to forecast the number of individuals remaining in each age class and transition to the next one. In addition, it is unknown what stage class of *P. concinna* are the dispersers. Thus, an understanding of juvenile behavior, activity, and spatial dynamics should determine not only their requirements but determine if they are the dispersing, or founding, class.

Although this study spans twelve years now, from the perspective turtle life histories it is still nascent. Unfortunately because of their longevity, long generation times, and delayed sexual maturity the data required for comprehensive conservation efforts for turtles may take decades. In fact, individuals that have hatched in 1994 (the beginning of the study) would still have not yet attained sexual maturity. Also, requisite data on survival rates of adults, necessary for PVAs, will take decades of population monitoring to accrue. Thus, it is imperative that wrok continues along estimating survival rates of all stage classes utilizing this marked population. Finally, continued monitoring effort will still allow tracking of population size and in the future may provide an estimate of the carrying capacity of the lake and the region. In addition, such monitoring would also allow us to track population growth and ensure a swift conservational response if a perturbation did occur.

Conservation Genetics. – Populations of rare and sensitive species are often subjected to stochastic events (demographically, genetically, and environmentally), such that, slight perturbations can often send them toward extinction. Whereas most conservation planning focuses on demographic and environmental issues, the resolution of genetic issues is becoming more prevalent. Recognizing the need for including genetic information in conservation planning has increased (Stinchcombe *et al.*, 2002). Since 1995, more conservation plans included the tasks of colleting genetic information and monitoring genetics for recovery (Stinchcombe *et al.*, 2002). Conservation genetics deals with the factors of inbreeding depression, the loss of genetic diversity, and the restriction of gene flow in highly fragmented landscapes (Frankham *et al.*, 2002). Probably the leading genetic factor driving population declines is inbreeding depression (Amos and Blamford, 2001). The effects of inbreeding depression widely range but can include a reduction in fecundity and survival (*see* Hendrick and

Kalinowski, 2000 *for review*). Critical to the long-term survival of a species is its adaptive variation. When populations are small and are isolated on the landscape, there is little opportunity for the transmission of beneficial genes among populations. Such populations often follow their own evolutionary pathway and do not have the ability to receive beneficial mutations that have evolved in a neighboring isolated population.

Three avenues of information will greatly improve our ability to conserve *P. concinna* in Illinois; an assessment of population health, matrilineal relationships, and rates of genetic flow. Basic to most conservation genetic studies are assessments of population health. Such studies include information on allele frequencies, heterzygosity, levels of inbreeding, and effective population sizes. In addition, such genetic information can be incorporated in PVAs to provide an assessment of both demographic and genetic health. Next, it is important to determine how many founder lines derived the population under study. This can be accomplished by determining how many family lines are present in the population. Because turtles are so long-lived in many small populations it is possible that only a few founders have started and continued the population. In addition, determine the pedigree for a population can be couple with demographic information to determine is certain suites or family lines survive, grow, or reproduce better than others. Finally, a larger scale study can determine on what scale the populations operate and whether genetic flow is occurring among them. Thus, it is important to determine the number of genetically effective migrants and the relatedness of populations. For example, the floodplain lake system in southeastern Gallatin County can exist anywhere on a gradient from panmixia if relatedness and genetic flow rates are high to discretely isolated units. This interpretation will greatly affect conservation decisions and planning.

Currently much of this data for Round Pond is being accumulated in the form of blood samples from all individuals captured. If monitoring is extended to other lakes within the region then two tools can be used to answer these questions. Microsatellite markers can be used to determine the genetic health of the population and information on the genetic flow among populations and mtDNA will be used to determine the family lines within the aquatic systems. Ideally, several more years of sampling is required to generate large sample sizes, but nonetheless a genetic study of the populations in southeastern Gallatin County is at its beginnings.

Population Viability Analysis. – Upon completion of the aforementioned knowledge gaps, a PVA can then be constructed for the population and be used for other populations of the species in the state. With a baseline PVA questions regarding de-listing can be answered. Such questions as how many individuals comprise a viable population, how many populations do we need in Illinois for the species to be secure in say ten localities, and what is the population size we need to maintain in the state to accomplish this? In addition, PVA can serve as a management guide where risk assessment can be conducted, forecasting predicted responses to the population given certain scenarios. For example, if we observe a ten percent increase in adult mortality what is the likely result to population growth, or if we increase nest survivorship by 20% how much faster will the population grow? Thus, the final outcome of future endeavors will provide the most powerful tool for constructing a recovery plan and preserving the long-term persistence of *P. concinna* in Illinois.

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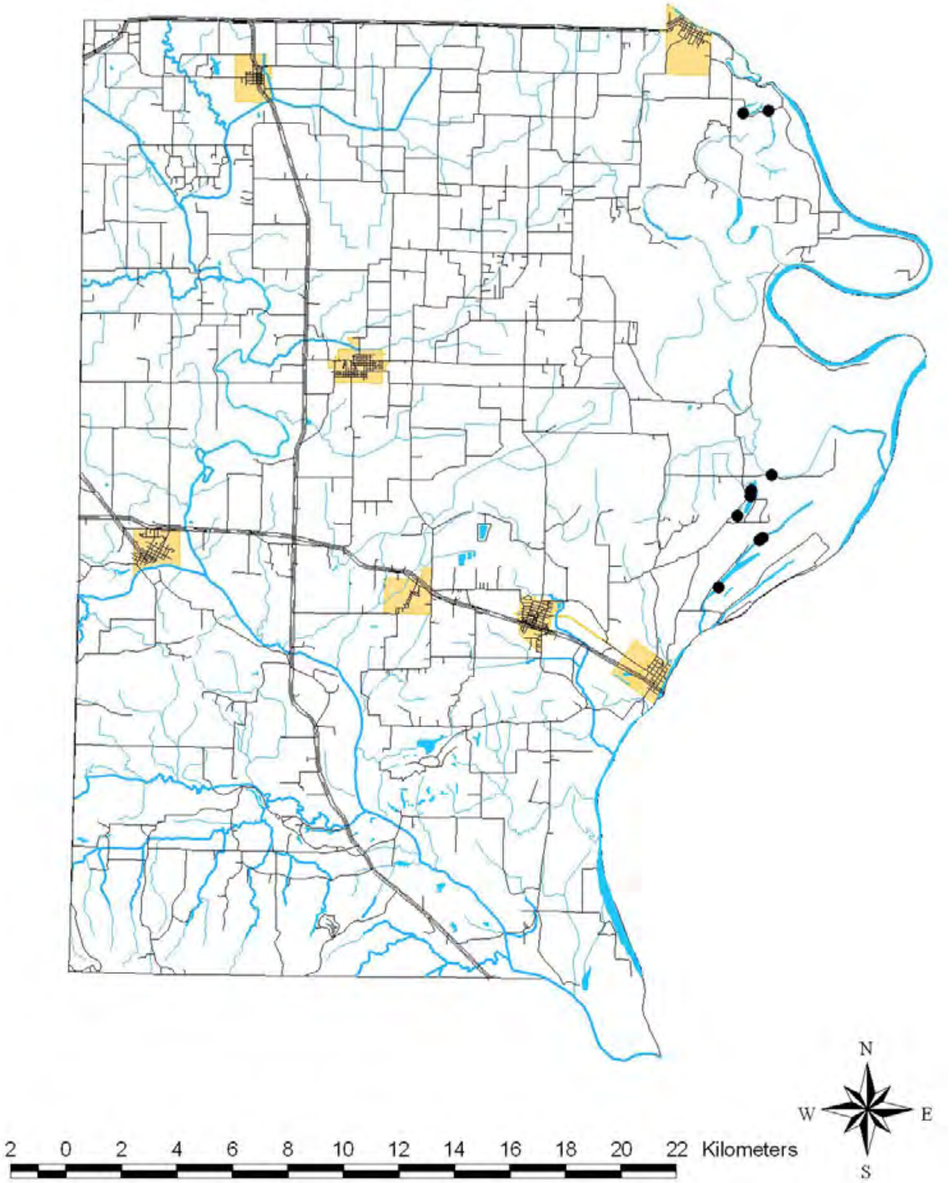

Plate 2: Known occurrences of the River Cooter, *Pseudemys concinna* in Gallatin County. Data is from museum specimens, photographic vouchers and verified sightings.

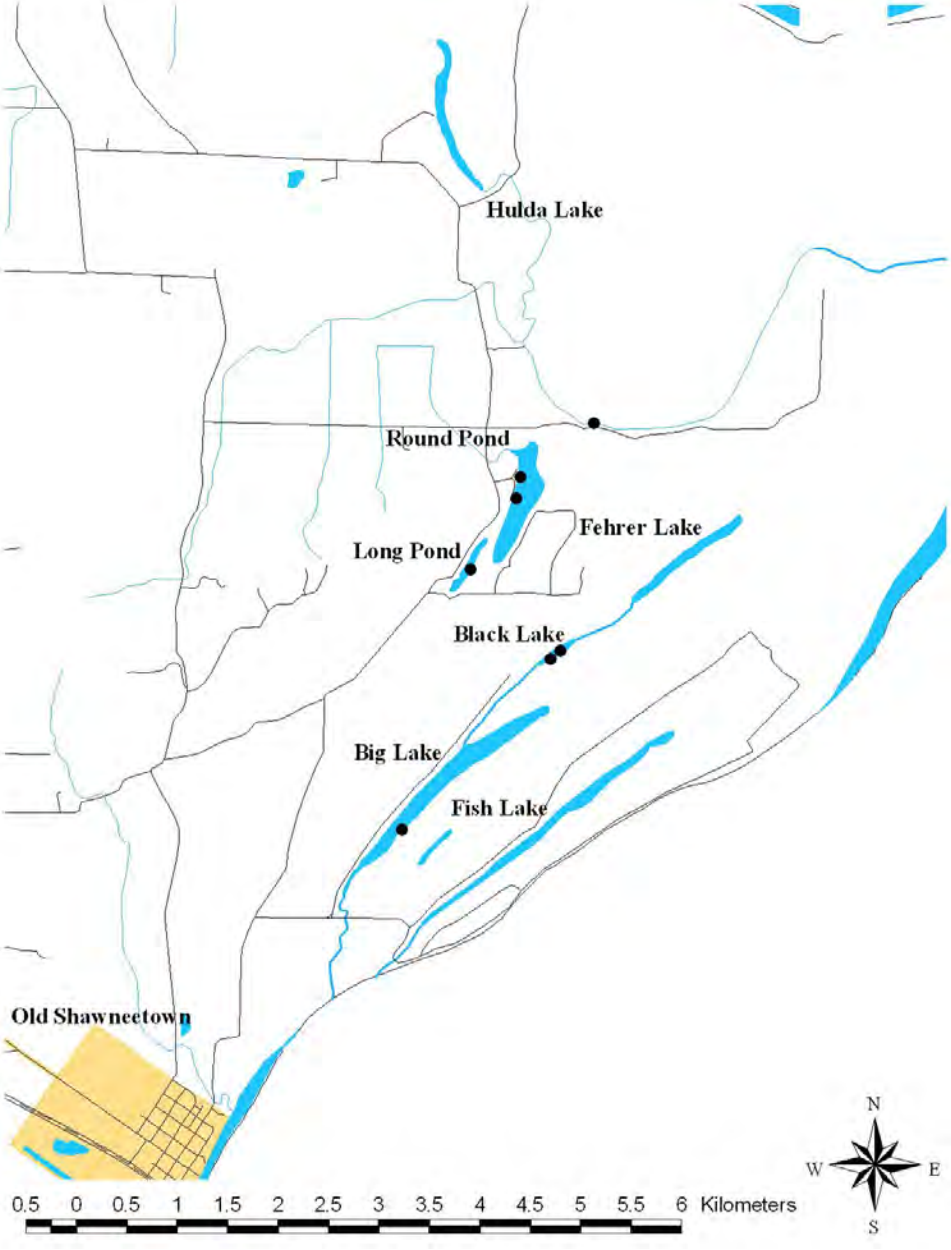

Plate 3: Known occurrences of the River Cooter, *Pseudemys concinna* in southeastern Gallatin County. Data is from museum specimens, photographic vouchers and verified sightings.

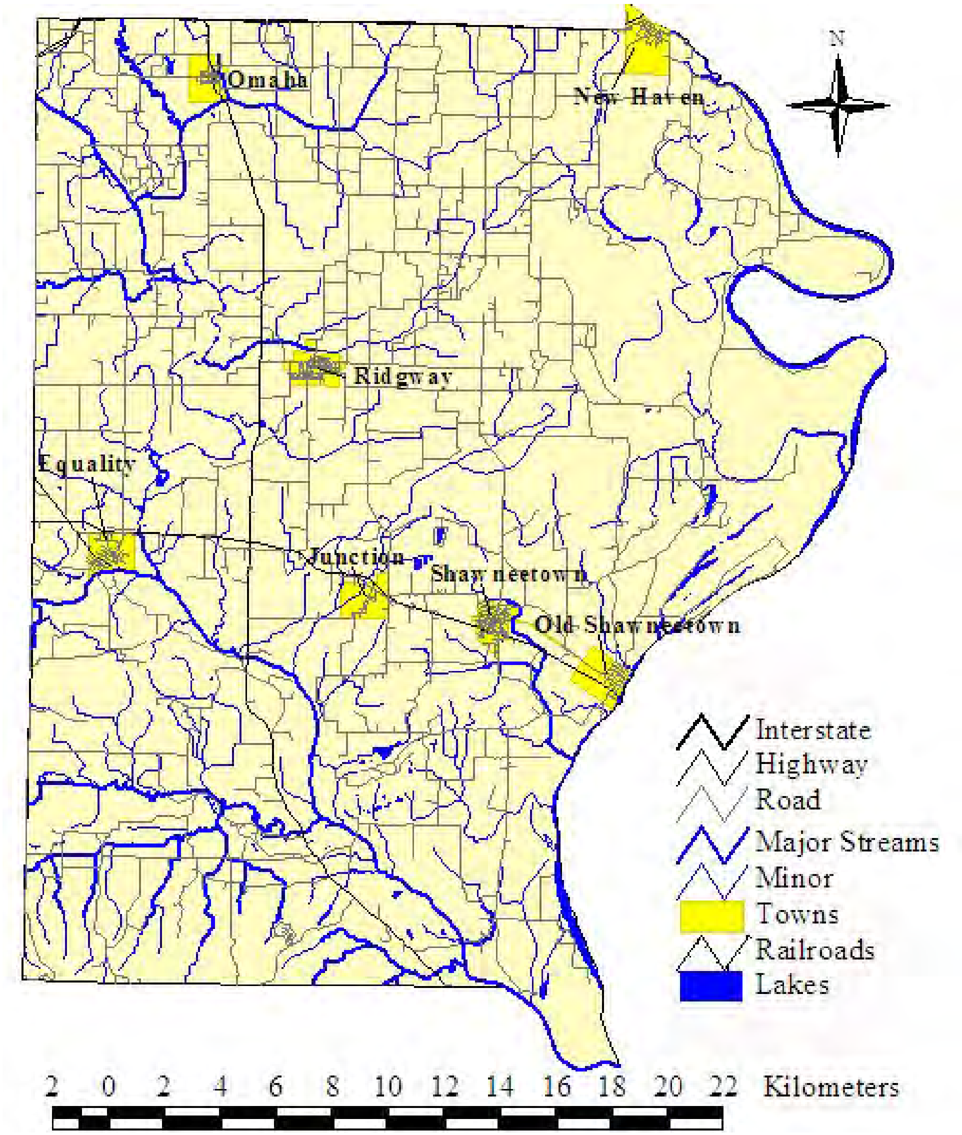

Plate 4: Map of wetlands, road system and towns of Gallatin County, Illinois.

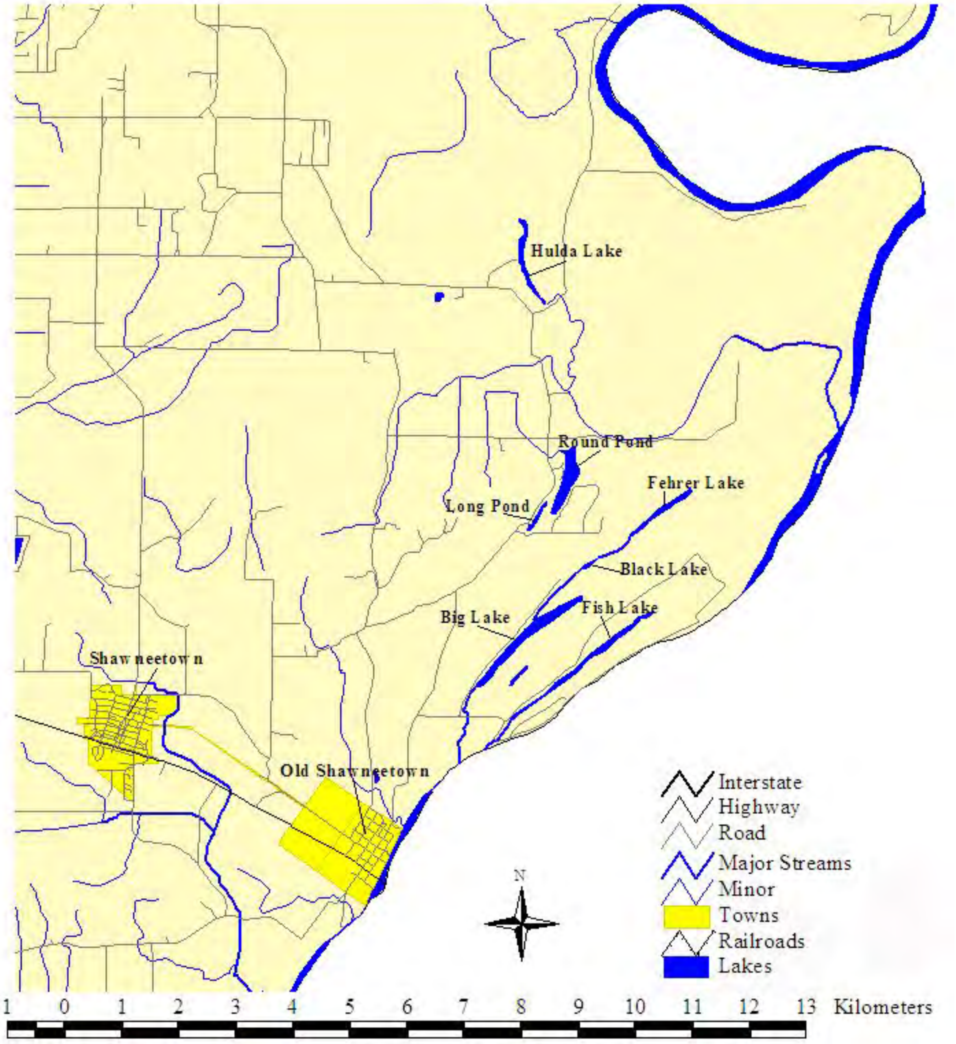

Plate 5: Close-up map of towns, road system, and major wetlands of southeastern Gallatin County, Illinois.

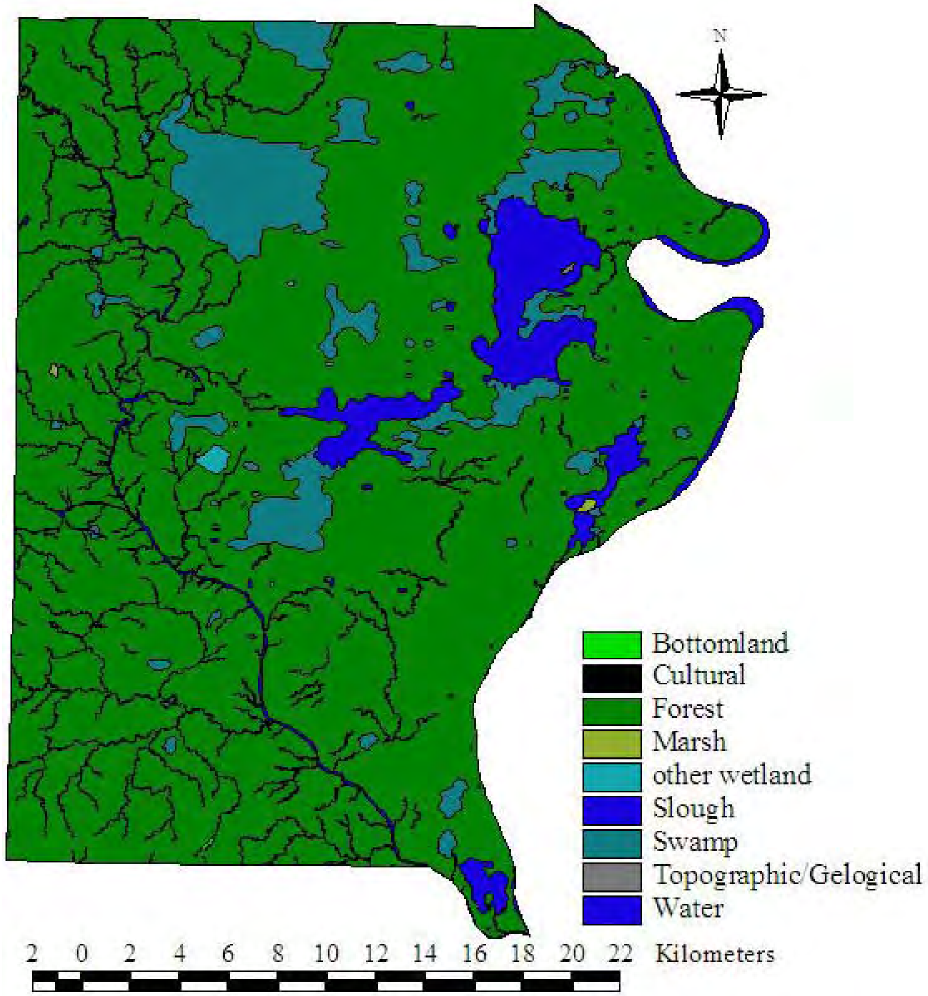

Plate 6: Pre-settlement habitat map of Gallatin County, Illinois.

Plate 8: A) Photograph of Round Pond, Gallatin County, Illinois facing northeast into the northeastern cove. Fyke nets are visible along the shorelines. B) Spatterdock colonies and cypress trees of Black Lake, Gallatin County, Illinois.

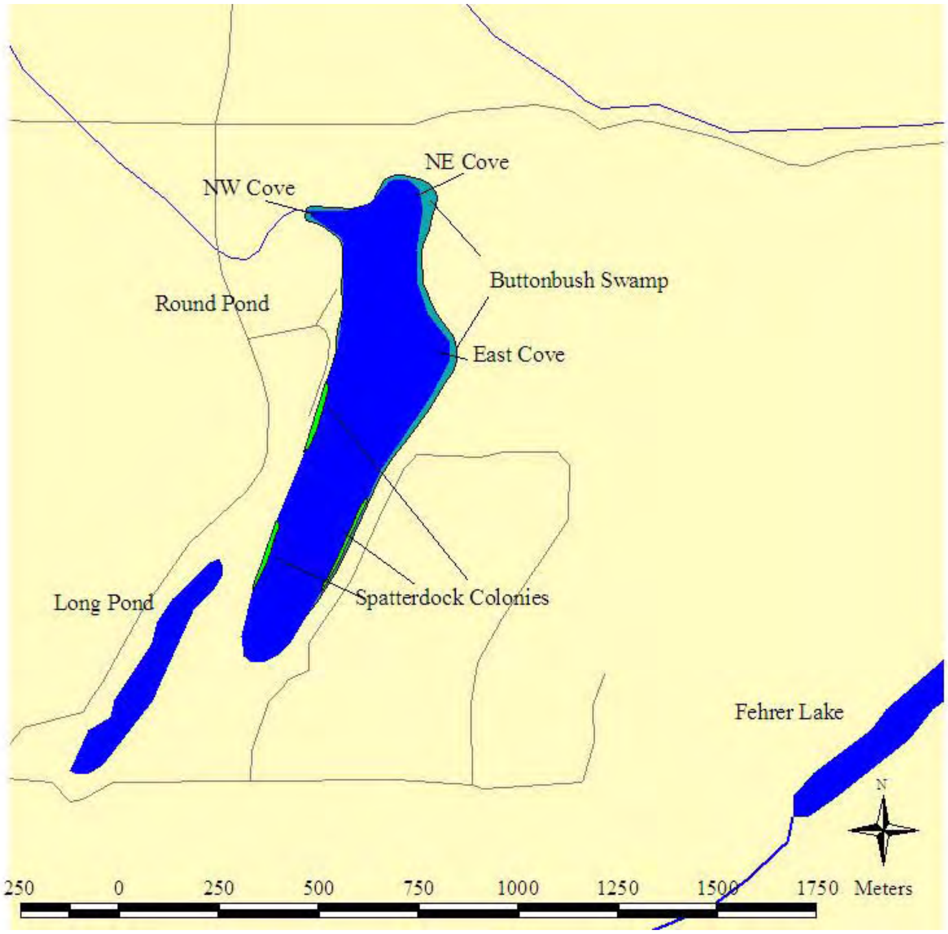

Plate 9: Map of Round Pond, Gallatin County, Illinois highlighting the spatterdock colonies and the buttonbush swamp.

Apalone mutica

Apalone spinifera

Chelydra serpentina

Chrysemys picta

Graptemys geographica

Graptemys ouachitensis

Graptemys pseudogeographica

Pseudemys concinna

Sternotherus odoratus

Trachemys scripta

Plate 10: Pictures of the ten freshwater turtle species that occur at Round Pond, Gallatin County, Illinois.

Table 1: Number of River Cooters (*Pseudemys concinna*) captured at Round Pond, Gallatin County from 1994 - 2006. The total column only includes the initial capture of an individual whereas the annual columns include between-year recaptures of individuals.

		1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2002**	**2004**	**2006**	**Total**
Females	Adult	5	5	3	-----	2	3	-----	14	4	25
	Subadult	4	-----	-----	-----	1	7	-----	12	3	17
	Immature	10	6	3	-----	10	20	15	18	7	50
	Juvenile	8	4	1	3	8	2	4	9	6	39
Males	Adult	5	3	6	1	1	13	3	23	9	43
	Subadult	2	1	-----	-----	-----	-----	2	2	1	5
	Immature	5	1	1	-----	-----	-----	2	2	-----	10
	Juvenile	5	-----	-----	-----	-----	1	-----	-----	1	6
Unknown	Juveniles	3	2	1	1	6	6	2	6	2	28
	Hatchlings	-----	-----	-----	-----	4	-----	-----	-----	-----	4
Total		**47**	**22**	**15**	**5**	**32**	**52**	**28**	**86**	**33**	**227**

Table 2: Trapping effort for River Cooters (*Pseudemys concinna*) captured at Round Pond, Gallatin County from 1994 – 2006 by year and gear type. The data includes all captures including recaptures and is summarized by the total number of hours and days it took to capture a single individual.

Hoop Traps	**Trap Hours**	**Trap Days**	***P. concinna***	**Hours/Turtle**	**Days/Turtle**
1998	1636.8	68.2	3	545.6	22.7
1999	569.2	23.7	1	569.2	23.7
2002	2794.4	116.4	2	1397.2	58.2
2004	15470.6	644.6	17	910.0	37.9
2006	8621.3	359.2	3	2873.8	119.7
Total	**29092.5**	**1212.2**	**27**	**1118.9**	**46.6**
Fyke Nets					
1994	802.4	33.4	54	4.9	0.6
1995	1215.4	50.6	23	52.8	2.2
1996	431.5	18.0	16	27.0	1.1
1997	119.5	5.0	5	23.9	1.0
1998	666.0	27.8	23	29.0	1.2
1999	2596.7	108.2	63	41.2	1.7
2002	1450.3	60.4	29	50.0	2.1
2004	3065.8	127.7	89	34.4	1.4
2006	1822.5	75.9	34	53.6	2.2
Total	**9601.3**	**400.1**	**336**	**28.6**	**1.2**
Trammel Nets					
1994	25.9	1.1	4	6.5	0.3
1995	1.5	0.1	1	1.5	0.1
Total	**27.4**	**1.1**	**5**	**5.5**	**0.2**
Overall	**38721.2**	**1613.4**	**367**	**105.5**	**4.4**

Table 3: Predicted number of hours and days required to capture a set number of *P. concinna* derived from regression of the number of hour per method and number of *P. concinna* captured at Round Pond, Gallatin County, Illinois from 1994 - 2006. The typical sets are what has been run on average in any given census year at Round Pond.

Turtles	**Fyke Nets**		**Hoop Traps**		**Difference**		**Typical Sets**	
	Hours	**Days**	**Hours**	**Days**	**Hours**	**Days**	**3 Fyke**	**12 Hoop**
10	136.1	5.7	10373.0	432.2	10236.9	426.5	1.9	36.0
50	1875.2	78.1	50373.0	2098.9	48497.8	2020.7	26.0	174.9
100	4049.1	168.7	100373.0	4182.2	96323.9	4013.5	56.2	348.5
200	8397.0	349.9	200373.0	8348.9	191976.0	7999.0	116.6	695.7
500	21440.4	893.4	500373.0	20848.9	478932.6	19955.5	297.8	1737.4

Table 4: Significance tests (χ^2) for demographic ratios for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, covering sampling from 1994 - 2006. The χ^2 value is above and the alpha level is below. Significant deviations from equality are highlighted in bold. All α-levels were Bonferroni corrected and set at 0.005 and for the total analysis individuals were only considered based on their stage at first capture to remove the effects of pseudoreplication.

Ratio		**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2002**	**2004**	**2006**	**Total**
Overall Sex Ratio	χ^2	2.27	5.00	0.00	1.00	18.18	7.04	5.54	8.45	2.61	23.02
	p	0.132	0.025	1.000	0.317	<**0.001**	0.008	0.019	**0.004**	0.106	<**0.001**
Operational Sex Ratio	χ^2	0.00	0.50	1.00	1.00	0.33	6.25	3.00	2.19	1.92	7.84
	p	1.000	0.480	0.317	0.317	0.564	0.012	0.083	0.139	0.166	**0.005**
Juvenile:Adult Ratio	χ^2	13.09	0.80	1.14	1.00	11.64	4.26	15.38	0.45	0.81	51.98
	p	<**0.001**	0.371	0.285	0.317	**0.001**	0.039	<**0.001**	0.502	0.369	<**0.000**
Female Juvenile:Adult Ratio	χ^2	18.85	8.33	3.57	3.00	17.38	26.56	19.00	32.40	13.60	138.16
	p	<**0.001**	**0.004**	0.059	0.083	<**0.001**	<**0.001**	<**0.001**	<**0.001**	<**0.001**	<**0.001**
Male Juvenile:Adult Ratio	χ^2	9.94	2.60	5.29	1.00	1.00	12.14	3.57	20.19	7.73	35.78
	p	**0.002**	0.107	0.022	0.317	0.317	<**0.001**	0.059	<**0.001**	**0.005**	<**0.001**

Table 5: Regression statistics for trends in demographic ratios for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois, covering sampling from 1994 - 2006. *F* is the *F* - statistic, r^2 is the regression coefficient, b_1 is the slope of the regression line, *n* is the sample size, and *p* is the significance level.

	F	r^2	b_1	***n***	***p***
Sex					
Overall	0.060	0.008	-0.140	9	0.814
Operational	1.199	0.146	-0.065	9	0.310
Juvenile:Adult					
Overall	0.002	0.000	0.011	9	0.963
Female	0.006	0.001	0.026	7	0.941
Male	1.889	0.274	-0.098	7	0.228

Table 6: Results of Kolmogorov-Smirnov cumulative probability tests on size structure distributions for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County sampled from 1994 - 2006. The alpha level is above and the Kolmogorov-Smirnov D-max is below. Significant deviations from equality are highlighted in bold. All α-levels were Bonferroni corrected and set at 0.0033 and for the total analysis individuals were only considered based on their stage at first capture to remove the effects of pseudoreplication.

Females (28)

	1994-95	**1996-97**	**1998-99**	**2002**	**2004**	**2006**
1994-95	-----	0.413	0.407	0.008	0.010	0.534
1996-97	0.162	-----	0.011	0.011	**0.001**	0.186
1998-99	0.163	0.300	-----	0.097	0.097	0.708
2002	0.310	0.300	0.226	-----	**0.000**	**0.002**
2004	0.302	0.355	0.226	0.434	-----	0.225
2006	0.148	0.200	0.130	0.350	0.192	-----

Males (23)

	1994-95	**1996-97**	**1998-99**	**2002**	**2004**	**2006**
1994-95	-----	**0.000**	**0.000**	**0.001**	**0.000**	**0.000**
1996-97	0.511	-----	**0.000**	**0.000**	0.021	**0.002**
1998-99	0.570	0.464	-----	**0.000**	0.117	0.008
2002	0.409	0.464	0.505	-----	**0.000**	**0.000**
2004	0.521	0.308	0.241	0.456	-----	0.320
2006	0.570	0.385	0.338	0.484	0.192	-----

Overall (28)

	1994-95	**1996-97**	**1998-99**	**2002**	**2004**	**2006**
1994-95	-----	0.377	0.935	0.272	0.007	0.099
1996-97	0.167	-----	**0.002**	**0.002**	0.213	0.650
1998-99	0.111	0.343	-----	0.237	0.040	0.213
2002	0.183	0.343	0.189	-----	**0.000**	**0.001**
2004	0.313	0.194	0.258	0.411	-----	1.141
2006	0.226	0.136	0.194	0.379	0.094	-----

Table 7: Comparison of population estimates and their associated standard errors for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois.

	Schnabel		**Schumacher-Eschmeyer**	
	N	**S.E.**	**N**	**S.E.**
1994	123	17.7	135	12.8
1995	126	19.4	127	17.8
1996	176	27.1	205	52.5
1997	198	30.8	247	51.5
1998	231	32.3	276	49.5
1999	215	21.8	219	22.8
2002	250	24.2	269	30.5
2004	301	23.1	324	27.7
2006	315	22.6	340	25.9

Table 8: Akaike's information criteria corrected for small sample size (AIC_C) for determining which class of capture-recapture individual growth models best fits data for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois. Models were fit to the population data using 66 capture-recapture intervals. Fixed models had the parameter of asymptotic size fixed as the mean of the largest 10% of the individuals (266.5 mm PL). RSS is the residual sums of squares from the nonlinear regressions, *K* is the number of parameters estimated for each model, and w_i is the Akaike weight of each model.

Model Class	**RSS**	**Variance**	***K***	**AIC_C**	**ΔAIC_C**	**Likelihood**	**w_i**
Fixed Fabens	17767.1	269.20	2	164.58	0.00	1.00	0.49
Free Fabens	17741.9	268.82	3	166.73	2.16	0.34	0.17
Free Baker	16644.4	252.19	4	167.17	2.59	0.27	0.14
Fixed Gompertz	19862.9	300.95	2	167.77	3.20	0.20	0.10
Free Gompertz	19786.9	299.80	3	169.86	5.28	0.07	0.04
Fixed Richards	19862.9	300.95	3	169.97	5.39	0.07	0.03
Fixed Logistic	22564.4	341.88	2	171.43	6.85	0.03	0.02
Free Richards	19843.6	300.66	4	172.21	7.63	0.02	0.01
Free Logistic	22248.0	337.09	3	173.22	8.64	0.01	0.01
					Total	**2.02**	

Table 9: Parameters of the individual growth rate models for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois. Models were fit to the population data using 66 capture-recapture intervals for populations, 46 intervals for females and 20 intervals for males. Hatchling size (*h*) was set at 37.9 (*n* = 4 S.E. = 1.54). The Fabens models had the parameter of asymptotic size fixed as the mean of the largest 10% of the individuals from each class (32 overall, 20 females, 9 males). All estimates are give ± 1 standard error.

Fabens	A	k (days)	
Population	265.4±3.4	$2.21x10^{-04}\pm1.48\ x10^{-05}$	
Females	277.5±2.8	$2.51x10^{-04}\pm2.01\ x10^{-05}$	
Males	228.3±5.4	$2.50x10^{-04}\pm2.08\ x10^{-05}$	
Baker	**J**	**b**	**k (days)**
Population	658717.09±2859723.89	2.31±0.66	$7.11x10^{-05}\pm7.60\ x10^{-05}$
Females	30976.69±144995.20	1.80±0.77	$1.20x10^{-04}\pm9.48x10^{-05}$
Males	15770.80±91303.39	1.79±1.04	$2.14x10^{-04}\pm1.44x10^{-04}$

Table 10: Characteristic growth rate parameters (*k*), 95% confidence intervals (95% C. I.), percent relative precision of estimates (PRP), and sample sizes (*n*) for cohort specific growth curves of *Pseudemys concinna* capture at Round Pond, Gallatin County, Illinois from 1994 -2004. Parameter estimates are based on nonlinear regression using the Fabens (Fabens, 1965) mark/recapture analogue for the von Bertalanffy growth equation. Asymptotic size (*A*) and proportion of body size remaining to grow from hatching (*b*) were fixed at *A* = 299, 219 mm PL, *b* = 0.884, 0.842 for females and males respectively. These values were derived from a previously published study from this site (Dreslik, 1997b).

	Females				**Males**			
Cohort	***k***	**95% C.I.**	**PRP**	***n***	***k***	**95% C.I.**	**PRP**	***n***
1987	0.072	0.061, 0.083	15.2	11	0.134	0.077, 0.191	42.4	6
1988	0.056	0.031, 0.082	45.4	11				
1989	0.082	0.063, 0.100	22.7	5	0.132	0.095, 0.169	28.0	6
1990	0.083	0.074, 0.092	10.6	8	0.130	0.081, 0.179	37.5	7
1991	0.074	0.065, 0.084	12.6	14	0.115	0.044, 0.186	61.9	4
1992	0.091	0.072, 0.111	21.4	8	0.109	0.064, 0.151	40.1	6
1993	0.084	0.074, 0.094	11.8	6				
1994	0.093	0.078, 0.107	15.6	21	0.123	0.099, 0.147	19.2	9
1995	0.094	0.084, 0.104	10.3	16	0.166	0.093, 0.240	44.4	6
1996	0.083	0.068, 0.097	17.9	9				
1997	0.089	0.080, 0.098	10.2	24	0.188	0.153, 0.224	18.8	12
1998	0.080	0.055, 0.105	31.6	7				
1999	0.070	0.062, 0.078	11.9	6				
2000	0.079	0.064, 0.095	19.5	7				
2001	0.071	0.058, 0.085	19.1	4				

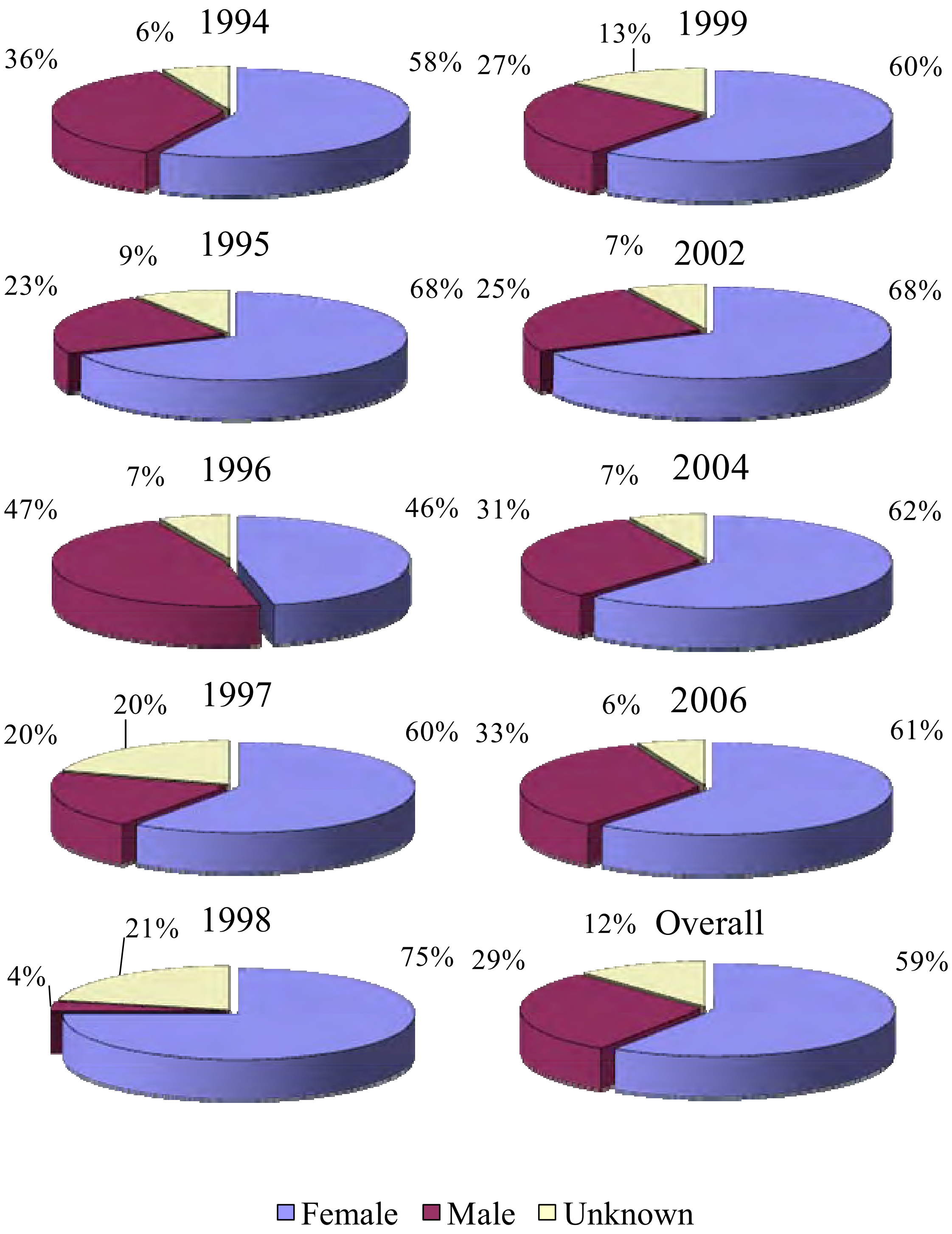

Figure 1: Pie charts of the overall sex ratios, including individuals of undeterminable sex, for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois covering sampling from 1994 - 2006. For the total analysis individuals were only considered based on their stage at first capture to remove the effects of pseudoreplication.

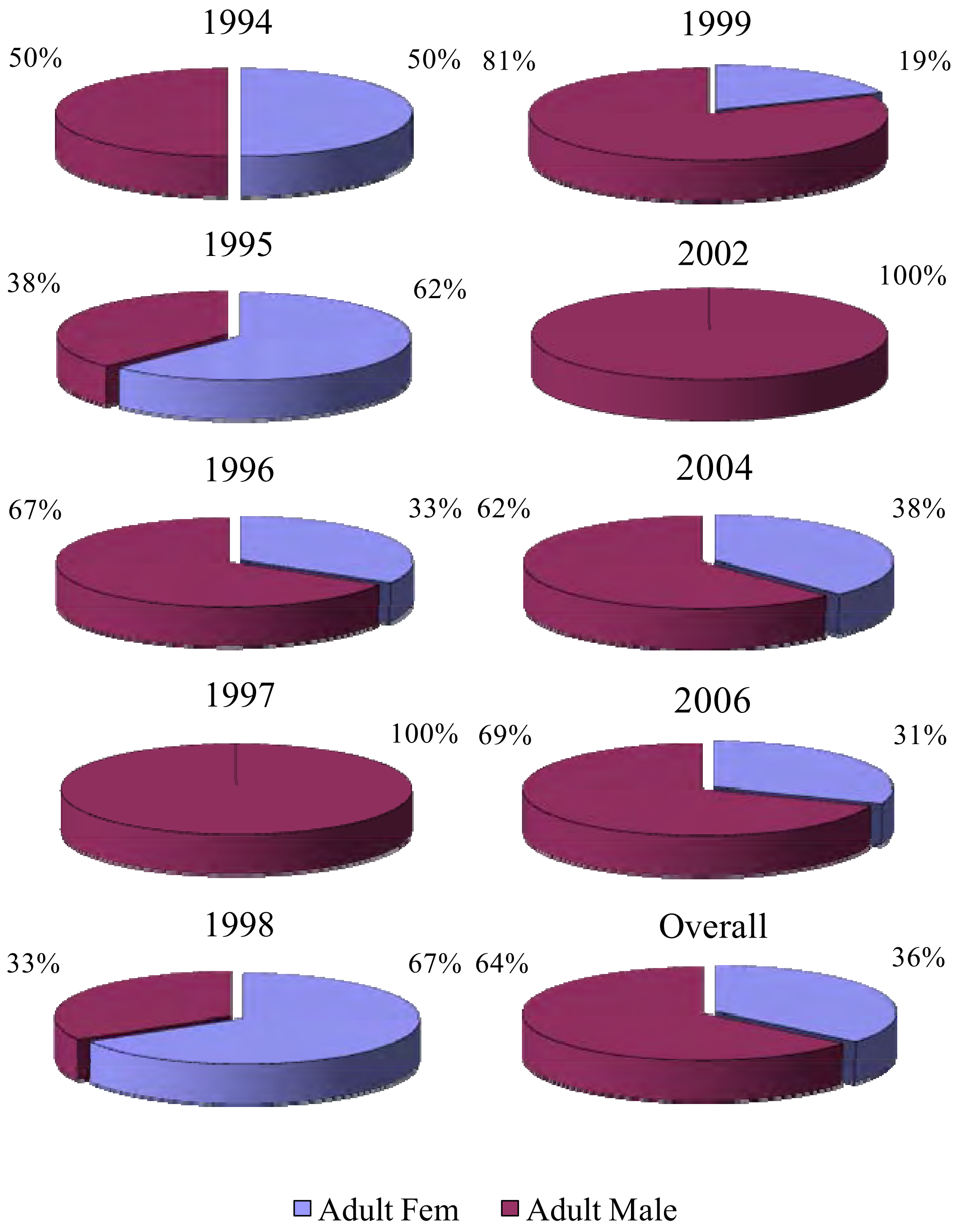

Figure 2: Pie charts of the operational sex ratios, only adult individuals, for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois covering sampling from 1994 - 2006. For the total analysis individuals were only considered based on their stage at first capture to remove the effects of pseudoreplication. Percentages are females - upper right and males - upper left.

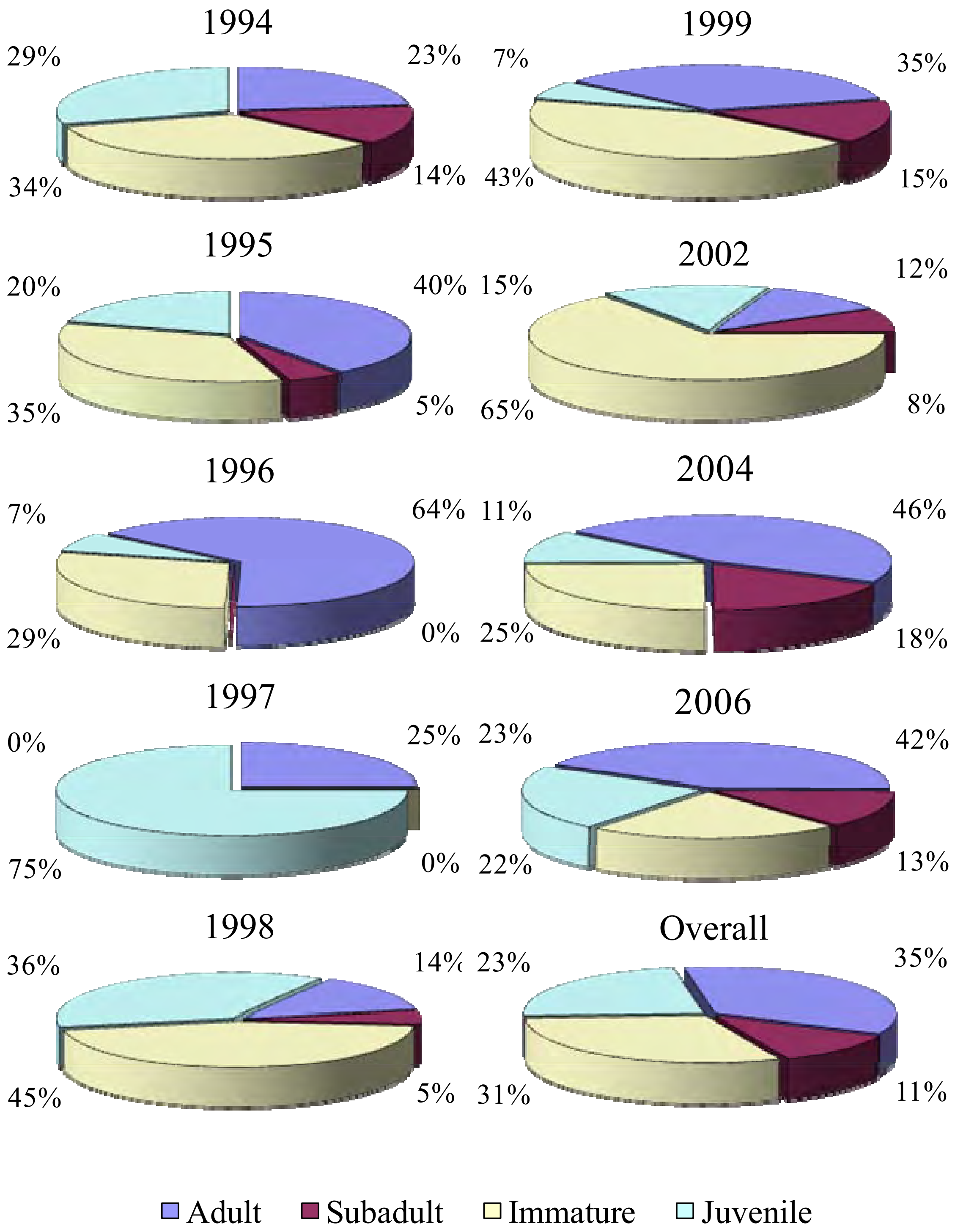

Figure 3: Pie charts of the overall stage ratios, including both males and females together, for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois covering sampling from 1994 - 2006. For the total analysis individuals were only considered based on their stage at first capture to remove the effects of pseudoreplication. Percentages are adults - upper right, subadults - lower right, immatures - lower left, and juveniles - upper left.

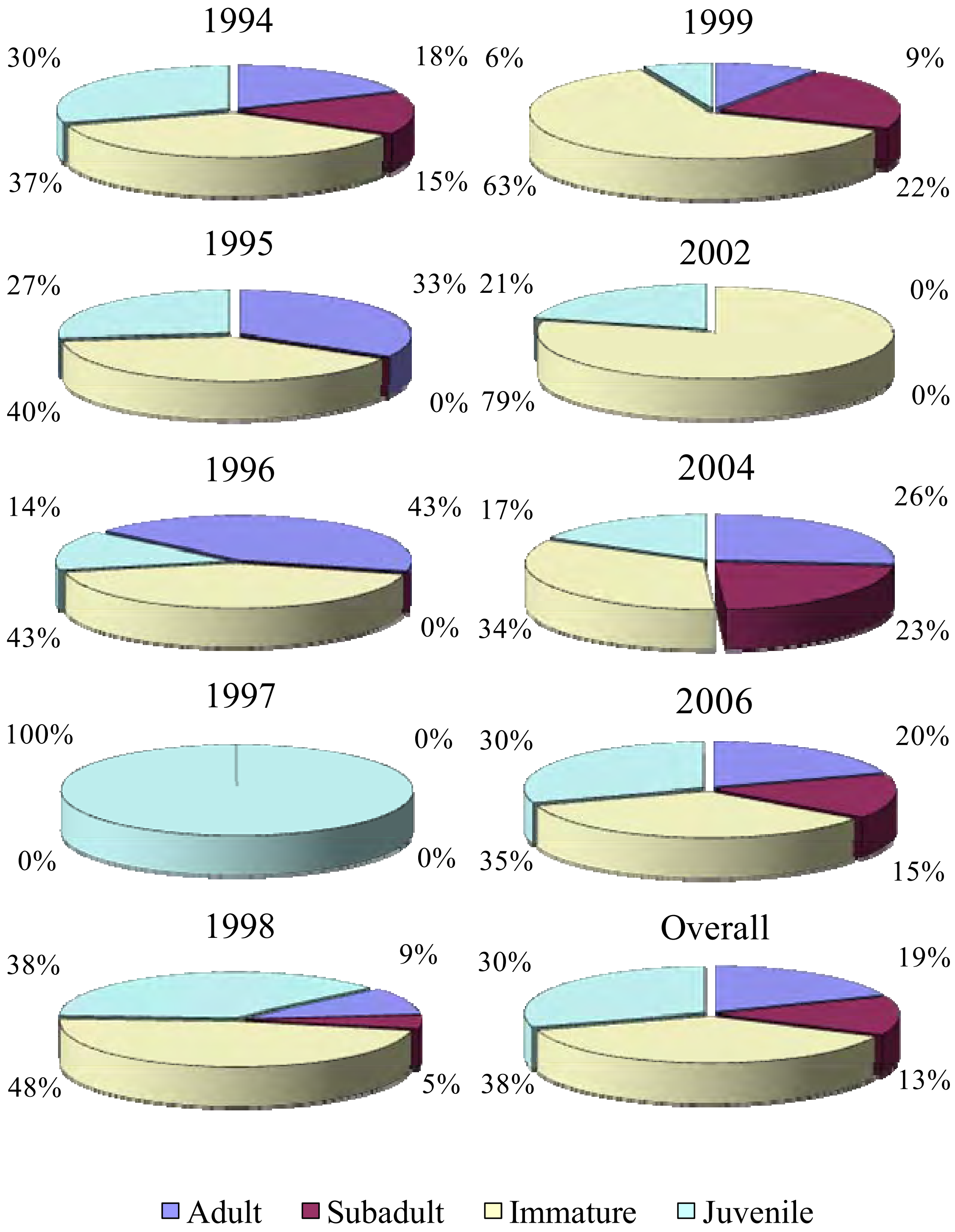

Figure 4: Pie charts of the female stage ratios for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois covering sampling from 1994 - 2006. For the total analysis individuals were only considered based on their stage at first capture to remove the effects of pseudoreplication. Percentages are adults - upper right, subadults - lower right, immatures - lower left, and juveniles - upper left.

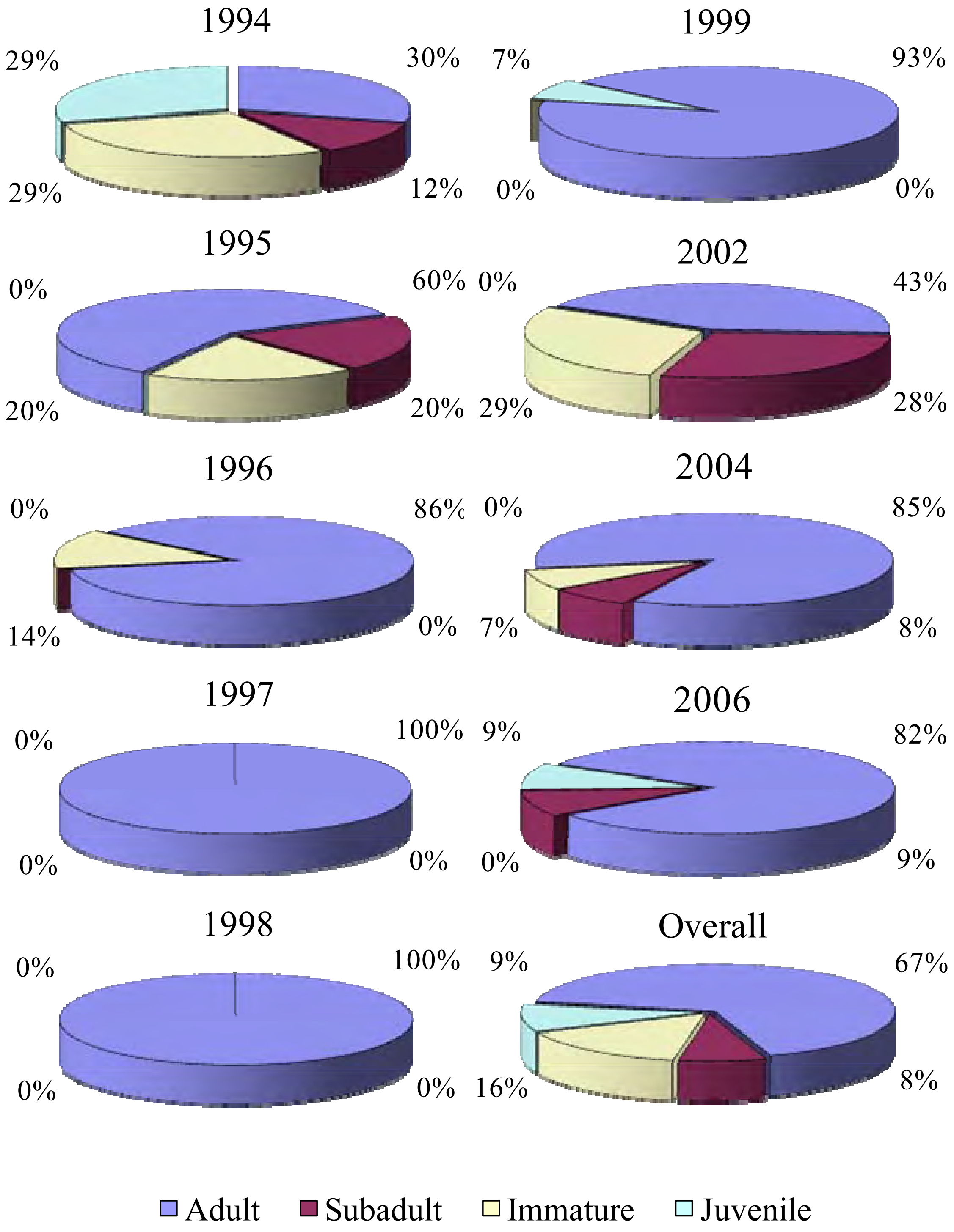

Figure 5: Pie charts of the male stage ratios for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois covering sampling from 1994 - 2006. For the total analysis individuals were only considered based on their stage at first capture to remove the effects of pseudoreplication. Percentages are adults - upper right, subadults - lower right, immatures - lower left, and juveniles - upper left.

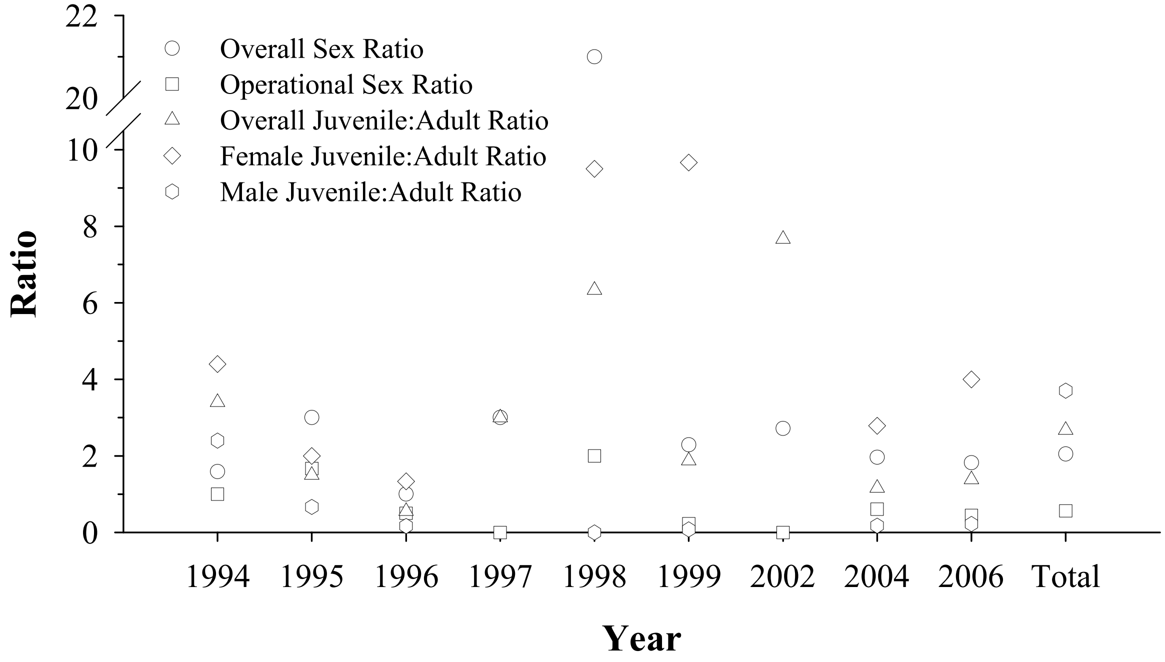

Figure 6: Plot of the demographic ratios for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois from 1994 - 2006. The sex ratios are expressed as the number of females per male and the juvenile to adult ratios are expressed as the number of juveniles per adult.

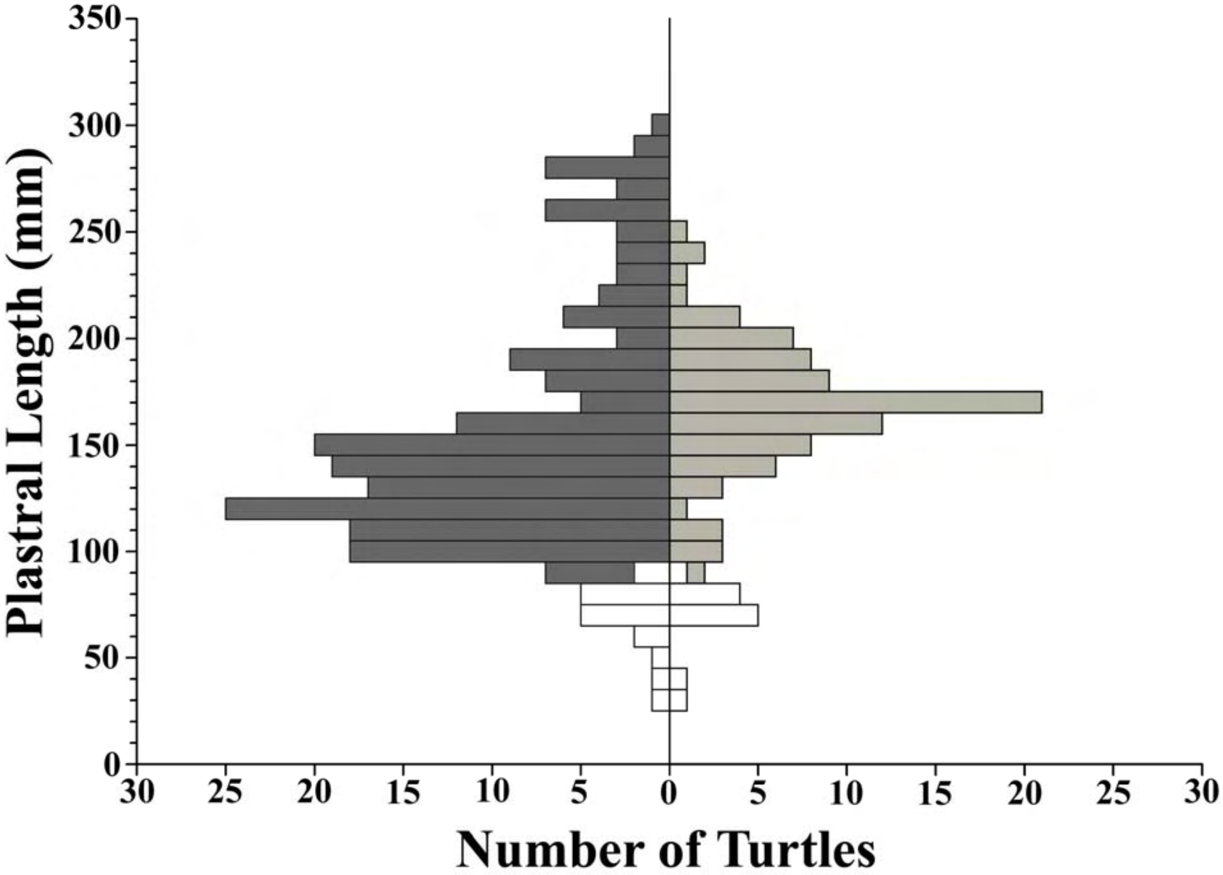

Figure 7: Size structure for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois from 1994 - 2006. Unknown juveniles are white, females are dark grey, and males are light grey.

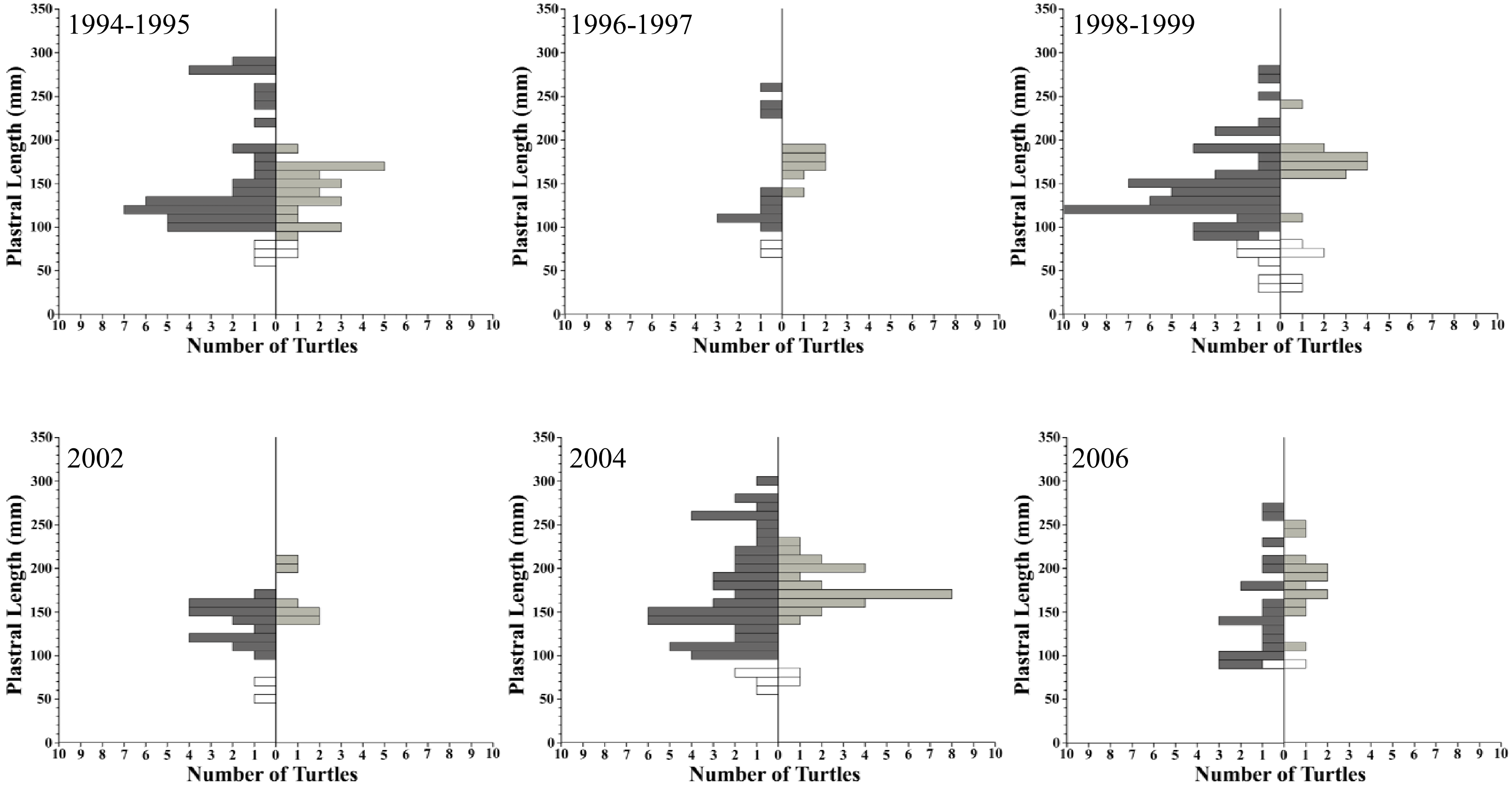

Figure 8: Two-year size structure frequencies for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois from 1994 - 2006. Unknown juveniles are white, females are dark grey, and males are light grey.

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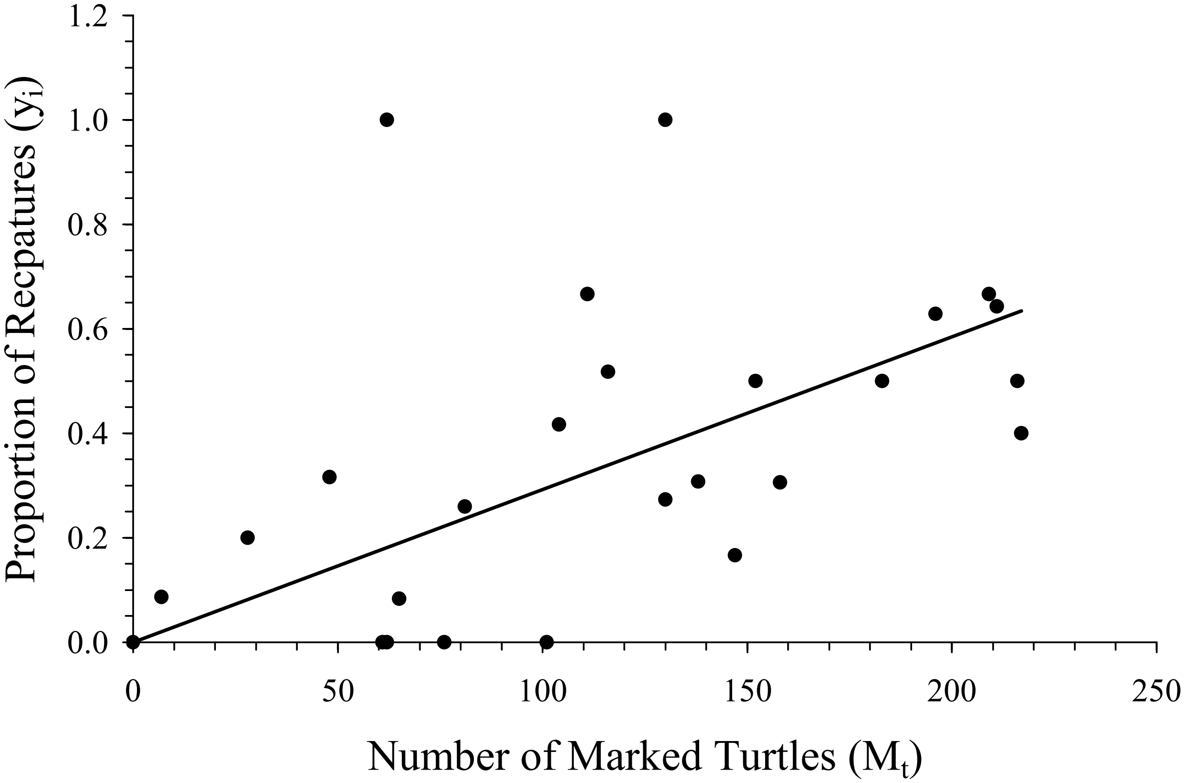

Figure 9: Regression test for the assumptions of population closure and equal catchability for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois from 1994 - 2006.

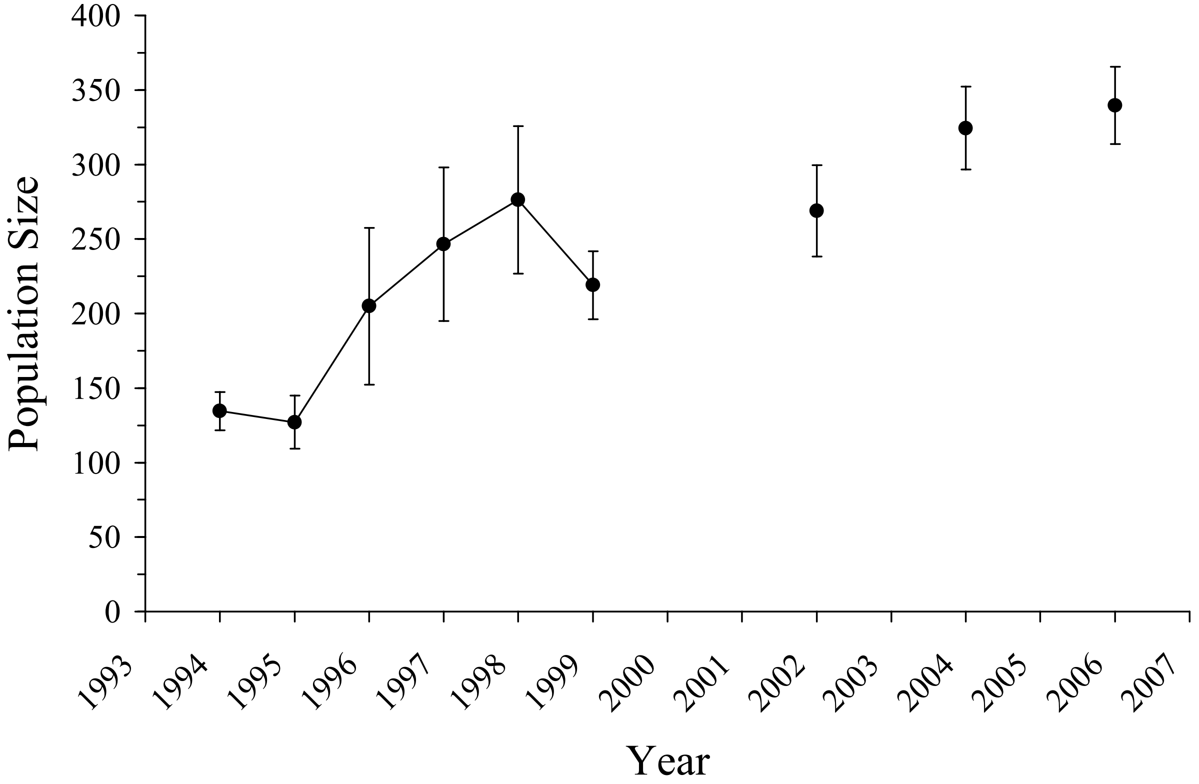

Figure 10: Population sizes using the Schumacher-Eschmeyer regression method and standard errors for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois from 1994 - 2006.

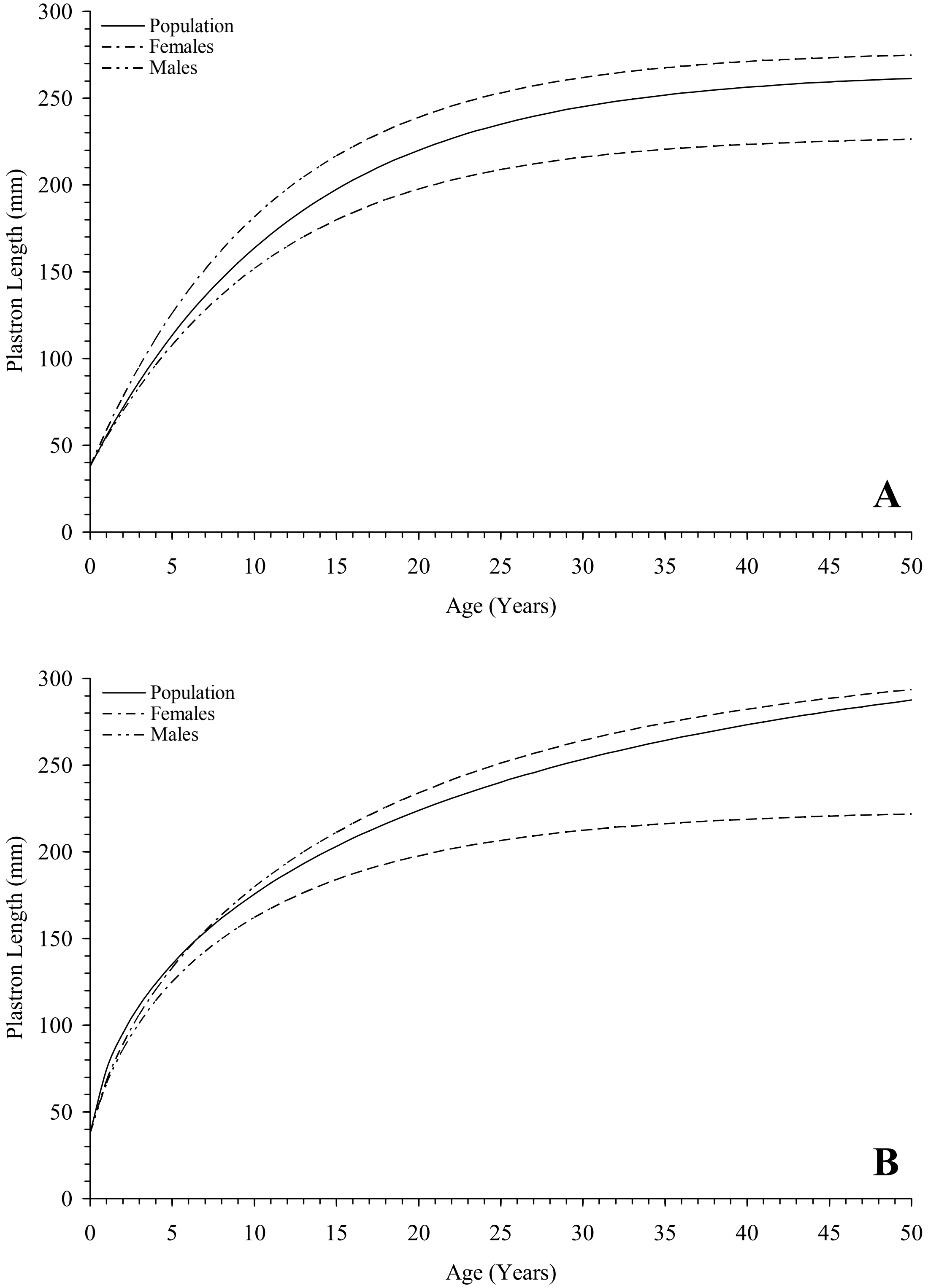

Figure 11: Individual growth curves (population, females, and males) using the Fabens (A) and Baker (B) interval analogue growth equations for the River Cooter (*Pseudemys concinna*) population at Round Pond, Gallatin County, Illinois from 1994 - 2006.

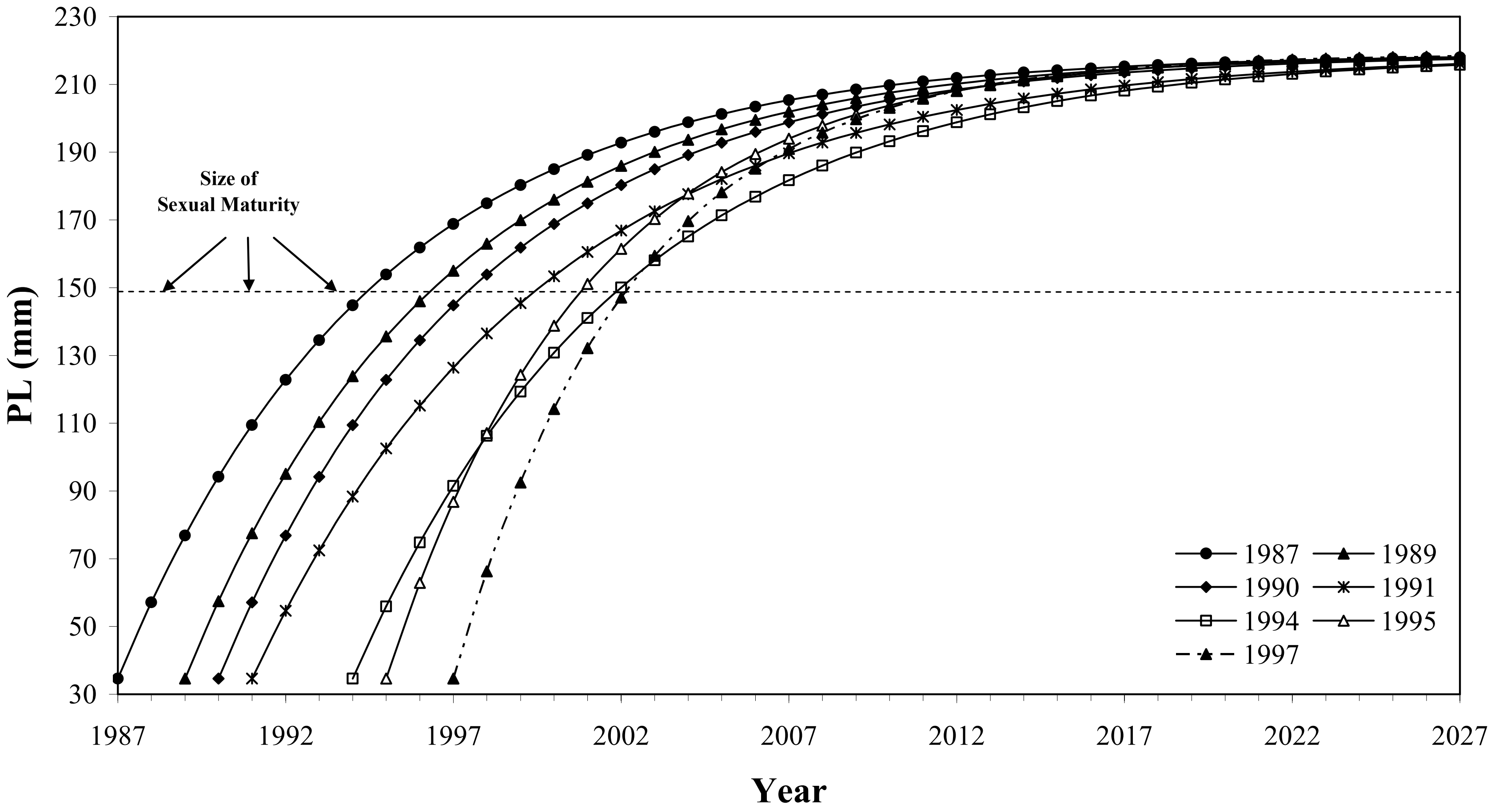

Figure 13: Growth curves for cohorts of male *Pseudemys concinna* captured from 1994 – 2004 at Round Pond, Gallatin County, Illinois using the von Bertalanffy growth equation. Estimated size of sexual maturity based on the development of secondary sexual characteristics is noted as the horizontal dashed line.

APPENDIX I
P. concinna Localities

Record	Year	Collector	Common Location	County	Z	N	E
Published	1851	C.A. Lesuer	Wabash River, New Harmony, IN	White	16	417388	4220809
USNM 9659	1878	R. Ridgway	Mt. Carmel	Wabash	16	433148	4252129
UIMNH 2359	1931	A.R.Cahn	Chester	Randolph	16	252150	4199823
INHS 2155	1936		Horseshoe Lake	Alexander	16	292148	4112094
Published	1937	A.R. Cahn		Wabash	16	433145	4252127
Published	1937	A.R. Cahn		Massac	16	346470	4113339
Published	1937	A.R. Cahn		Alexander	16	306756	4098046
Published	1937	A.R. Cahn		Hardin	16	384574	4145250
Published	1937	A.R. Cahn		Jackson	16	293841	4182677
Published	1937	A.R. Cahn		Union	16	300664	4149313
Published	1937	A.R. Cahn		Alexander	16	292195	4112934
INHS 6014	1951	P.W. Smith & J.C. List	Horseshoe Lake	Alexander	16	292148	4112094
Published	1972	M.J. Lodato	Lost Lake, Bull Island	White	16	419010	4224356
Published	1981	S.J. Walsh	Pere Marquette State Park	Jersey	16	192190	4327625
SIUC-R 2172	1985	M. & M. Morris	Horseshoe Lake	Alexander	16	293360	4109735
Published	1987	J. Iverson	Rend Lake	Franklin	16	332400	4218074
Published	1987	M.A. Morris & G. Rose	Norris City Reservoir	White	16	384496	4204274
Published	1988	E.O.Moll	Beaver Pond	Gallatin	16	403811	4193265
Published	1988	E.O.Moll	Big Lake	Gallatin	16	402040	4176109
Published	1988	M. Ewert	Lost Lake	White	16	419955	4224606
Published	1988	M. Ewert	Old Channel Lake	White	16	419955	4224606
Sighting	1993	M. Redmer	Bay Creek	Pope	16	366837	4123973
Published	1994	M.J. Dreslik	Long Pond	Gallatin	16	402720	4178694
Published	1994	M.J. Dreslik	Running Slough (Bickett's Ditch)	Gallatin	16	403940	4180142
Published	1994	M.J. Dreslik	Black Lake	Gallatin	16	403608	4177885
INHS 12746	1994	M.J. Dreslik	Round Pond	Gallatin	16	403170	4179400
INHS 12747	1994	M.J. Dreslik	Black Lake	Gallatin	16	403516	4177803
Published	1996	M.J. Dreslik	Ribeyre Island	White	16	411258	4217874
Published	1996	M.J. Dreslik	Greathouse Island	White	16	406271	4198650
Published	1996	M.J. Dreslik	Sandy Slough	White	16	410967	4213570
Published	1996	M.J. Dreslik	Jerry Slu	White	16	411113	4219008
SIUC-R 3126	1998	J. Schwegman	Loon Lake	Massac	16	360116	4107050
INHS 14225	1998	L.M. Page *et al.*	Fort Massac State Park	Massac	16	348420	4111910
INHS 14852	1999	M.J. Dreslik & A.R. Kuhns	Round Pond	Gallatin	16	403210	4179610
INHS 16207	2000	J.K. Tucker	Portage Island, MO	Jersey	16	209438	4313423
SIUC-R 4324	2003	J. Palis	Grassy Slough Preserve	Johnson	16	328333	4133196
Photographed	2003	J. Palis	Grassy Slough Preserve	Johnson	16	329777	4132919
Capture	2005	A. Readel	Horseshoe Pond	Gallatin	16	402928	4193186
Photographed	2006	S. Ballard	Loon Lake	Massac	16	359157	4107743
Photographed	2006	J.F. Wilson	I mi N Mt. Pleasant Rd.- Hwy. 146	Union	16	316476	4147628
SAM 1909			Grand Chain	White	16	411210	4209473
UMMZ 128176			Grand Chain	White	16	411210	4209473
Published				Jersey	16	209486	4330955
Published			Grand Chain	White	16	411000	4209000
INHS 10367		J. Schneck	Mt. Carmel	Wabash	16	433227	4251836

APPENDIX II
P. concinna Data Collected from 1994 - 2006

Marking	Date	Sex	CL	PL	CW	SH	Mass	Age	Cohort
-----	8/7/2006	Female	105	96	90	39	145	-----	-----
01L	5/18/1994	Male	209	180	153	64	805	-----	-----
01L-02L	5/29/1994	Male	207	183	156	68	800	-----	-----
	8/29/1996	Male	215	191	161	69	957	-----	-----
	7/16/1999	Male	221	197	165	69	1001	-----	-----
01L-02L-01R	9/6/2004	Female	239	208	168	75	1244	-----	-----
01L-02L-01R-02R-03R	5/25/1998	Female	148	134	120	54	402	7	1991
	7/27/1999	Female	177	161	137	61	643	8	1991
01L-02L-01R-08R-12R	5/27/1998	Female	141	129	113	51	346	7	1991
	5/28/1998	Unknown	111	99	93	43	168	4	1994
01L-02L-01R-09R-11R	5/28/1998	Unknown	105	98	90	43	153	3	1995
01L-02L-01R-10R	8/29/1996	Male	189	171	138	62	672	-----	-----
01L-02L-01R-11R	8/29/1996	Male	201	180	153	64	811	-----	-----
	8/23/2004	Male	225	205	167	71	1103	-----	-----
01L-02L-03L-03R	8/3/2002	Female	172	157	130	56	520	6	1996
01L-02L-03L-08R	8/3/2002	Male	174	152	130	55	520	3	1999
	9/1/2004	Male	180	156	133	58	570	5	1999
	7/31/2006	Male	182	157	134	57	594	-----	-----
01L-02L-03R-09R	8/29/1996	Male	221	196	161	-----	1056	-----	-----
01L-02L-03R-10R	8/29/1996	Female	134	128	113	51	322	5	1991
	6/1/1998	Female	136	133	115	52	313	7	1991
	7/11/1999	Female	152	145	124	57	456	8	1991
	8/18/2006	Female	198	189	153	69	905	-----	-----
01L-02L-08R	6/1/1994	Female	299	283	219	93	-----	-----	-----
	8/14/2004	Female	274	256	194	98	2172	-----	-----
01L-02L-09R	6/1/1994	Female	144	134	115	53	345	7	1987
	8/13/1995	Female	164	152	126	59	487	8	1987
	6/29/1999	Female	229	213	165	77	1221	12	1987
	7/17/1999	Female	229	213	165	78	1244	12	1987
	8/23/2006	Female	278	260	199	99	2154	-----	-----
01L-02L-10L-02R	8/6/2002	Female	172	160	134	64	620	5	1997
01L-02L-10R	6/1/1994	Female	145	135	114	51	290	7	1987
	5/15/1995	Female	147	136	115	51	338	8	1987
	7/11/1999	Male	201	182	143	62	702	12	1987
01L-02L-11L-02R-03R	8/7/2002	Female	74	70	69	35	70	2	2000
	8/16/2004	Female	130	122	110	49	259	5	1999
01L-02L-11L-11R	8/8/2002	Female	168	155	129	59	550	6	1996
01L-02L-11R	6/1/1994	Male	110	97	90	40	140	4	1990
01L-02L-11R	8/14/2004	Male	190	171	141	62	684	14	1990
01L-02L-12L-09R	8/8/2002	Male	174	159	131	61	525	5	1997
01L-02L-12L-12R	8/9/2002	Female	134	118	111	46	265	5	1997
	9/1/2004	Female	143	128	116	49	314	7	1997
01L-02R-09R	6/27/1999	Male	207	183	152	62	772	-----	-----
01L-03L-01R-12R	8/30/1996	Unknown	104	101	89	43	172	4	1992
01L-03L-02R-03R	8/30/1996	Female	157	148	123	56	415	-----	-----
01L-03L-03R-08R	8/31/1996	Male	181	164	141	62	658	-----	-----
01L-03L-03R-09R	8/31/1996	Unknown	94	89	82	40	117	3	1993
01L-03L-08L-02R	8/9/2002	Female	142	128	111	51	325	5	1997
01L-03L-08L-12R	8/9/2002	Male	226	200	174	70	1200	-----	-----

APPENDIX II (CONT.)

Marking	Date	Sex	CL	PL	CW	SH	Mass	Age	Cohort
01L-03L-08R-11R	8/31/1996	Female	150	134	117	54	349	4	1992
	6/4/1998	Female	161	144	123	58	469	6	1992
	7/22/1999	Female	177	157	131	60	601	7	1992
01L-03L-08R-12R	9/1/1996	Female	245	234	188	85	1550	-----	-----
	7/27/1999	Female	292	258	215	95	2500	-----	-----
01L-03L-09R-10R	9/1/1996	Female	278	262	205	96	2005	-----	-----
01L-03L-09R-12R	9/1/2004	Female	117	110	102	43	200	4	2000
01L-03L-11L-09R	8/12/2002	Female	135	124	111	51	310	5	1997
01L-03L-12L-01R	8/12/2002	Female	176	163	138	58	600	7	1995
01L-03L-12L-10R	8/12/2002	Female	123	113	101	43	220	5	1997
	8/26/2004	Female	154	143	123	54	410	7	1997
01L-03L-12R	6/10/1994	Female	125	116	106	57	240	6	1988
	7/19/1999	Male	183	165	139	63	661	11	1988
01L-08L	8/20/2006	Female	105	96	90	48	146	-----	-----
01L-08L-01R-02R	8/9/1997	Unknown	102	96	86	40	143	3	1994
01L-08L-01R-10R	8/14/2002	Female	177	167	136	62	635	-----	-----
01L-08L-01R-10R-11R	8/9/1997	Male	208	186	153	78	851	-----	-----
	8/25/2004	Male	241	212	172	77	1318	9	1995
01L-08L-03R-09R	9/2/2004	Female	194	183	147	68	811	9	1995
01L-08L-09L-02R-03R	8/14/2002	Male	244	214	174	74	1260	-----	-----
01L-08L-09R-12R	9/3/2004	Female	304	284	211	101	2950	-----	-----
01L-08L-10R	6/10/1994	Unknown	110	100	91	43	155	4	1990
01L-08L-11R	6/10/1994	Male	142	133	120	52	340	5	1989
	6/29/1999	Male	186	169	144	62	664	10	1989
	7/14/1999	Male	186	169	141	61	690	10	1989
01L-08L-12L-12R	8/17/2002	Female	152	152	124	42	380	5	1997
01L-08R	5/28/1994	Male	152	147	120	53	425	4	1990
01L-09L	6/28/1999	Unknown	85	80	75	37	88	2	1997
	8/4/2002	Female	154	144	119	50	375	5	1997
01L-09L-01R	6/10/1994	Unknown	115	113	96	43	180	5	1989
01L-09L-01R-08R	8/10/1997	Female	115	110	94	46	200	3	1994
01L-09L-02R	6/10/1994	Male	158	142	126	53	405	-----	-----
01L-09L-03R	6/10/1994	Female	200	185	144	78	1810	-----	1997
01L-09L-03R-09R	9/4/2004	Female	202	187	149	67	855	-----	-----
01L-09L-03R-10R	9/4/2004	Male	235	213	166	72	1183	-----	-----
01L-09L-08R	6/11/1994	Female	181	168	136	62	645	-----	-----
01L-09L-10L-02R	8/11/2004	Female	187	176	142	65	716	9	1995
01L-09L-10R-12R	9/4/2004	Female	260	228	204	81	1810	-----	-----
01L-10L-01R-09R	8/11/1997	Female	121	117	99	46	215	3	1994
	5/28/1998	Unknown	127	123	103	50	264	4	1994
	5/28/1998	Unknown	127	123	103	50	264	4	1994
	8/2/2002	Female	175	170	135	60	621	8	1994
01L-10L-02R-12R	9/5/2004	Female	159	150	122	56	431	8	1996
01L-10L-03R	6/11/1994	Male	148	134	114	55	335	7	1987
01L-10L-03R-08R	9/6/2004	Female	124	118	100	46	-----	4	2000
01L-10L-08R	6/11/1994	Unknown	92	84	81	43	100	5	1989
01L-10L-08R-09R	9/6/2004	Female	174	169	132	62	629	7	1997
01L-11L	7/11/1999	Female	157	148	126	54	445	4	1995
01L-11L-01R-02R	8/24/2006	Female	241	219	176	76	1277	-----	-----
01L-11L-01R-12R	8/12/1997	Female	122	115	101	44	200	3	1994

APPENDIX II (CONT.)

Marking	Date	Sex	CL	PL	CW	SH	Mass	Age	Cohort
	6/3/1998	Female	128	120	106	47	240	4	1994
	6/29/1999	Female	164	152	128	57	456	5	1994
01L-11L-02R	6/14/1994	Female	121	114	98	44	210	4	1990
01L-11L-02R	8/31/2004	Female	221	216	161	94	1141	14	1990
01L-11L-03R	6/14/1994	Female	116	107	97	43	220	5	1989
01L-11L-08R	6/14/1994	Female	218	198	161	78	1070	-----	-----
01L-11L-09R	6/14/1994	Male	-----	-----	-----	-----	460	7	1987
	5/14/1995	Male	179	156	134	57	488	8	1987
01L-11L-10R	6/14/1994	Female	268	253	193	98	2500	-----	-----
	8/29/2004	Female	280	264	203	97	2630	-----	-----
01L-11L-11R	6/14/1994	Male	160	154	131	67	450	9	1985
01L-11L-12R	6/15/1994	Female	149	137	116	51	380	6	1988
	5/15/1995	Female	152	140	119	53	406	7	1988
01L-12L	7/19/1999	Unknown	98	93	-----	-----	142	2	1997
	8/4/2002	Female	150	143	120	53	385	5	1997
01R-02R	8/4/2006	Female	104	98	86	40	152	-----	-----
01R-12R	8/22/2004	Unknown	82	78	71	37	81	2	2002
02L	5/18/1994	Male	109	100	92	42	170	3	1991
	8/13/2004	Male	182	165	138	57	569	13	1991
02L-02R	5/19/1994	Female	166	157	133	63	595	7	1987
02L-03L	6/30/1999	Unknown	88	85	75	37	93	2	1997
02L-03L-02R	6/4/1994	Female	136	124	113	50	265	7	1987
	5/5/1995	Female	141	128	115	53	339	8	1987
02L-03L-02R-08R	6/1/1998	Female	135	125	114	51	298	4	1994
	7/21/1999	Female	148	122	122	53	395	5	1994
02L-03L-02R-09R	6/1/1998	Unknown	111	103	95	45	106	4	1994
	8/1/2002	Female	168	155	134	59	566	8	1994
	9/6/2004	Male	191	173	148	63	741	10	1994
02L-03L-02R-10R	6/1/1998	Female	108	99	89	43	169	3	1995
	7/7/1999	Female	135	125	109	49	324	4	1995
	9/3/2004	Female	209	193	154	69	925	7	1997
	8/23/2006	Female	220	204	161	72	1112	-----	-----
02L-03L-02R-11R	6/1/1998	Unknown	67	63	64	30	50	2	1996
02L-03L-10L-09R	8/15/2004	Female	110	105	95	44	182	5	1999
	8/2/2006	Female	126	121	105	46	261	-----	-----
02L-03L-10L-10R	8/15/2004	Male	231	202	164	73	1135	7	1997
02L-03L-11L-02R	8/16/2004	Male	206	175	157	70	823	7	1997
02L-03L-11L-03R	8/16/2004	Female	225	210	170	72	1205	-----	-----
02L-03L-11L-08R	8/16/2004	Female	147	137	117	53	265	8	1996
02L-03R	5/19/1994	Male	178	161	143	64	680	-----	-----
02L-08L	7/24/1999	Unknown	96	88	84	38	123	2	1997
02L-08L-01R-02R	6/1/1998	Female	130	118	105	49	275	4	1994
02L-08L-01R-10R	6/1/1998	Female	111	104	93	43	175	3	1995
	7/19/1999	Female	145	136	116	50	358	4	1995
	8/20/2004	Female	202	193	150	70	866	9	1995
02L-08L-10L	6/22/1999	Female	111	108	92	43	170	-----	-----
02L-08L-10L-03R	8/17/2004	Female	116	111	97	47	202	5	1999
02L-08L-10L-08R	8/17/2004	Female	163	143	127	50	382	7	1997
02L-08L-11L-12R	8/18/2004	Female	154	141	120	53	425	7	1997
	5/26/1998	Female	236	222	173	81	1221	12	1986

APPENDIX II (CONT.)

Marking	Date	Sex	CL	PL	CW	SH	Mass	Age	Cohort
	8/29/2004	Female	282	265	198	94	2106	18	1986
02L-08R	8/31/1996	Male	191	171	150	64	748	-----	-----
	6/3/1998	Male	192	174	152	69	756	-----	-----
	7/8/1999	Male	198	177	153	67	803	-----	-----
02L-09L	7/27/1999	Unknown	80	76	71	35	79	2	1997
02L-09L-01R-11R	6/2/1998	Female	307	270	213	100	3100	-----	-----
02L-09L-01R-12R	6/2/1998	Female	125	121	104	47	242	5	1993
	6/5/1998	Female	126	122	109	46	295	5	1993
	6/30/1999	Female	143	138	115	52	346	6	1993
02L-09L-02R-08R	6/3/1998	Unknown	82	77	71	37	79	4	1994
02L-09L-02R-09R	6/4/1998	Unknown	43	41	42	22	15	1	1997
02L-09L-02R-10R	6/4/1998	Unknown	111	104	87	45	166	3	1995
02L-09L-02R-11R	-----	Unknown	43	40	40	22	14	-----	1998
02L-09L-11L-10R	8/19/2004	Female	115	107	96	45	181	4	2000
02L-09L-12L-01R	8/19/2004	Female	150	138	123	54	379	6	1998
	8/4/2006	Female	152	141	125	55	416	-----	-----
02L-09L-12L-02R	8/19/2004	Female	174	165	139	66	636	9	1995
02L-09L-12L-03R	8/19/2004	Male	272	237	194	84	1736	-----	-----
02L-10L-02R-08R	8/2/2006	Male	124	117	103	48	248	-----	-----
02L-10L-02R-09R	8/2/2006	Male	208	188	155	67	913	-----	-----
02L-10L-11L-01R	8/19/2004	Male	157	143	127	54	410	8	1996
02L-10L-12L	6/22/1999	Female	183	168	138	61	613	-----	-----
02L-10L-12L-11R	8/19/2004	Female	109	104	92	42	161	4	2000
	8/6/2006	Female	117	110	98	45	205	-----	-----
02L-10R-11R	6/28/1999	Female	152	142	117	54	381	5	1994
02L-11L	9/3/2004	Unknown	91	86	79	38	102	3	2001
	8/7/2006	Female	109	102	91	43	163	-----	-----
02L-11L-12L-09R	8/20/2004	Male	230	202	173	69	1063	-----	-----
	8/25/2006	Male	231	202	172	69	1003	-----	-----
02L-11L-12L-11R	8/20/2004	Male	215	189	155	72	969	-----	-----
02L-11L-12L-12R	8/20/2004	Female	247	226	175	79	1533	-----	-----
02L-12L-03R-11R	8/8/2006	Female	165	156	131	57	502	-----	-----
02L-12L-08R-09R	8/9/2006	Female	144	132	111	50	338	-----	-----
02L-12L-08R-11R	8/9/2006	Female	172	160	135	61	562	-----	-----
02R-03R-08R	8/1/2002	Male	180	163	144	60	648	7	1995
02R-09R-10R	8/1/2002	Male	158	143	120	53	406	8	1994
	8/16/2004	Male	186	165	135	60	574	10	1994
03L	5/18/1994	Unknown	108	94	91	43	160	3	1991
03L-02R-09R	6/30/1999	Female	210	198	164	71	943	11	1988
03L-02R-10R	6/30/1999	Female	156	151	124	57	436	6	1993
	7/20/1999	Female	157	151	126	57	480	-----	-----
03L-03R	5/20/1994	Female	189	174	138	67	-----	-----	-----
03L-08L	5/28/1998	Female	190	177	143	65	710	8	1990
03L-08L-02R-03R	8/19/2006	Unknown	103	97	91	38	140	-----	-----
03L-08L-02R-08R	8/15/2006	Male	231	208	164	70	1113	-----	-----
03L-08L-03R	6/4/1994	Male	206	183	157	67	915	7	1987
03L-08L-08R	6/4/1994	Female	160	148	122	58	410	-----	-----
03L-08L-08R-09R	8/19/2006	Male	183	162	138	57	575	-----	-----
03L-08L-09L-10R	8/21/2004	Female	197	184	153	68	830	8	1996
03L-08L-09L-10R-11R	8/21/2004	Female	176	160	134	60	543	6	1998

APPENDIX II (CONT.)

Marking	Date	Sex	CL	PL	CW	SH	Mass	Age	Cohort
03L-08L-09L-12R	8/21/2004	Male	194	176	145	60	681	7	1997
03L-08L-09R	6/4/1994	Female	134	126	112	47	255	5	1989
03L-08L-10R	6/4/1994	Male	130	123	108	47	240	7	1987
03L-08L-11R	6/4/1994	Unknown	103	93	90	39	125	6	1988
03L-09L	8/11/2004	Unknown	93	89	81	40	122	3	2001
	8/7/2006	Female	116	109	95	43	194	-----	-----
03L-09L-01R-03R	8/21/2006	Female	298	270	205	101	2594	-----	-----
	8/25/2006	Male	244	212	178	75	1383	-----	-----
03L-09L-02R-08R	8/23/2006	Female	196	184	154	68	753	-----	-----
03L-09L-03R-11R	8/25/2006	Male	284	244	196	90	2242	-----	-----
03L-09L-08R-09R	8/25/2006	Male	294	254	200	87	2108	-----	-----
03L-09L-10L-08R	8/22/2004	Male	216	190	159	68	953	-----	-----
03L-09L-11L-03R	8/22/2004	Female	114	108	93	45	181	6	1998
03L-09L-12L-01R	8/22/2004	Male	198	180	146	68	817	10	1994
03L-09R-10R	7/7/1999	Male	127	118	104	47	242	7	1992
	9/3/2004	Male	185	170	142	62	645	12	1992
03L-10L-01R-02R	8/9/2006	Female	247	231	174	79	1342	-----	-----
03L-10L-01R-03R	8/22/2006	Male	201	186	152	63	808	-----	-----
03L-10L-12L-01R	8/24/2004	Male	189	177	144	62	686	10	1994
03L-10R	5/20/1994	Unknown	118	109	100	47	230	5	1989
03L-11R-12R	7/7/1999	Female	165	152	127	62	517	8	1991
	8/20/2004	Female	210	193	155	75	990	13	1991
03L-12L-12R	6/17/1994	Female	210	194	162	71	-----	-----	-----
03R-08R	6/28/1999	Unknown	81	77	71	36	81	2	1997
	7/7/1999	Unknown	83	78	72	36	88	2	1997
03R-09R	8/16/2004	Unknown	75	71	66	34	68	2	2002
04L-10L-12L-14R	8/22/2004	Female	163	150	127	59	480	2	2002
08L	5/28/1994	Male	181	166	146	62	590	-----	-----
08L-02R-11R	7/17/1999	Female	131	126	102	47	263	4	1995
	8/3/2002	Female	175	167	129	57	545	7	1995
08L-03R-08R	7/18/1999	Female	207	193	153	69	962	10	1989
08L-03R-09R	7/18/1999	Female	228	219	171	78	1315	11	1988
	8/24/2004	Female	287	275	207	101	2666	16	1988
08L-09L	7/25/1999	Male	181	173	139	59	621	-----	-----
08L-09L-01R	6/17/1994	Female	316	286	216	109	-----	-----	-----
08L-09L-02R	6/17/1994	Female	255	219	219	85	-----	-----	-----
08L-09L-03R	7/13/1999	Female	212	198	156	73	1014	5	1994
	8/20/2004	Female	247	231	178	85	1592	10	1994
08L-09L-10L-12R	8/26/2004	Female	163	154	128	61	496	9	1995
08L-09L-11L-01R	8/26/2004	Female	123	115	106	47	244	5	1999
08L-09L-11L-02R	8/26/2004	Male	237	200	163	174	1111	-----	-----
	8/19/2006	Male	233	198	163	73	1096	-----	-----
08L-09L-11L-12R	8/30/2004	Female	285	264	202	103	2564	-----	-----
08L-09L-11R	7/19/1999	Male	215	194	160	68	918	-----	-----
08L-09L-12L-03R	8/27/2004	Female	313	284	214	96	2708	-----	-----
08L-09L-12L-08R	8/27/2004	Female	336	308	229	119	3766	-----	-----
08L-09L-12R	5/8/1995	Female	121	119	103	47	225	-----	-----
08L-10L-01R	5/10/1995	Female	144	136	115	56	390	6	1989
08L-10L-02R	5/10/1995	Female	129	120	103	49	265	4	1991
08L-10L-03R	5/10/1995	Female	314	292	221	125	3250	-----	-----

APPENDIX II (CONT.)

Marking	Date	Sex	CL	PL	CW	SH	Mass	Age	Cohort
08L-10L-11L	6/23/1999	Female	147	136	123	52	353	-----	-----
08L-10L-11L-02R	8/27/2004	Male	164	153	130	55	476	9	1995
08L-10L-11L-11R	8/28/2004	Female	292	269	207	99	2404	-----	-----
08L-10L-11L-12R	8/28/2004	Male	196	178	145	64	747	-----	-----
08L-10L-12L-01R	8/28/2004	Female	161	157	129	56	476	10	1994
08L-10L-12L-02R	8/28/2004	Male	145	-----	153	139	353	10	1994
08L-11L	8/12/2004	Female	117	111	99	44	204	5	1999
08L-11L-02R	5/12/1995	Female	107	102	94	42	167	3	1992
08L-11L-09R	5/12/1995	Unknown	82	75	72	36	78	3	1992
08L-12L-10R	5/15/1995	Male	220	191	160	67	960	-----	-----
08L-12L-11R	5/15/1995	Unknown	124	118	104	48	262	3	1992
08R	5/27/1994	Female	271	246	191	92	-----	13	1981
08R-09R	8/16/2004	Unknown	88	82	75	27	93	3	2001
08R-09R-11R-12R	8/2/2002	Male	153	142	122	51	400	5	1997
	8/15/2004	Male	176	162	135	56	558	7	1997
08R-10R-12R	8/2/2002	Female	130	120	109	45	255	14	1988
	8/30/2004	Female	155	147	127	53	422	16	1988
	8/8/2006	Female	158	149	128	52	444	-----	-----
08R-11R-12R	8/2/2002	Female	116	106	94	43	175	14	1988
08R-11R-12R	8/24/2004	Female	155	143	119	53	383	16	1988
09L-01R-02R	8/15/1995	Unknown	94	85	82	37	112	4	1991
09L-01R-02R	7/9/1999	Female	143	135	119	51	361	8	1991
09L-02R-10R	7/21/1999	Male	-----	-----	-----	-----	786	10	1989
09L-03R-08R	7/9/1999	Male	210	185	152	64	823	10	1989
09L-08R-09R-12R	5/28/1994	Male	174	156	133	58	510	11	1983
	7/17/1999	Male	192	170	142	63	683	16	1983
09L-09R-10R-13R	8/27/2004	Male	198	165	146	64	710	-----	-----
09L-10L	8/12/2004	Unknown	69	64	61	30	53	1	2003
	8/23/2006	Female	110	103	94	41	166	-----	-----
09L-10L-01R	5/8/1995	Male	196	176	143	62	655	-----	-----
09L-10L-02R	5/8/1995	Female	311	281	227	104	2500	-----	-----
09L-10L-11L-01R	8/29/2004	Female	195	179	144	68	793	-----	-----
09L-10L-11L-12L-01R	8/26/2004	Male	190	176	140	62	690	-----	-----
09L-10L-11L-12L-08R-09R-10R-11R-12R	7/25/1999	Female	-----	164	137	62	592	-----	-----
09L-10L-12L-01R	8/30/2004	Male	265	228	188	81	1648	-----	-----
09L-11L-11R	5/14/1995	Female	322	291	221	112	3100	-----	-----
09L-11L-12R	5/14/1995	Female	292	266	192	110	2250	-----	-----
09L-11R	5/28/1994	Unknown	114	100	96	41	150	4	1990
	8/14/1995	Female	143	126	116	49	333	-----	-----
	6/2/1998	Female	165	148	132	67	476	-----	-----
	6/27/1999	Female	177	157	140	67	550	-----	-----
	7/7/1999	Female	176	158	140	57	575	-----	-----
09L-12L-01R	5/16/1995	Male	199	179	152	77	854	-----	-----
09L-12L-11R	6/20/1995	Female	308	283	212	108	2500	-----	-----
	7/11/1999	Female	310	288	214	104	3500	-----	-----
10L-01R-08R	7/7/1999	Male	273	241	191	95	1976	-----	-----
10L-02R-10R-12R	7/25/1999	Unknown	123	113	100	44	221	5	1994
10L-03R-10R	7/25/1999	Female	209	189	150	72	1001	-----	-----
10L-11L-12L-02R	9/1/2004	Female	171	159	138	61	560	10	1994
11L-02R	5/29/1994	Female	133	130	107	50	280	6	1988

APPENDIX II (CONT.)

Marking	Date	Sex	CL	PL	CW	SH	Mass	Age	Cohort
11L-02R-10R	7/28/1999	Female	206	194	153	70	879	8	1991
11L-08R	5/29/1994	Female	121	115	101	46	230	4	1990
	9/1/2004	Female	222	209	165	79	1187	14	1990
11L-08R-10R	7/28/2002	Female	141	133	117	55	377	6	1996
	8/14/2004	Female	165	156	134	61	561	8	1996
11L-09R	5/29/1994	Male	111	101	93	43	160	5	1989
	6/11/1994	Unknown	111	102	94	42	160	3	1991
12L-02R-11R	7/29/2002	Female	139	123	110	46	294	5	1997
	8/22/2004	Female	157	142	121	55	389	7	1997
	8/7/2006	Female	165	148	126	56	463	-----	-----
12L-03R	5/29/1994	Female	140	125	112	58	280	8	1986
	5/16/1995	Female	159	133	118	52	353	9	1986
12L-03R-09R	8/4/1996	Female	269	244	195	94	2500	-----	-----
	9/3/2004	Female	273	249	201	94	2144	-----	-----
12L-08R	5/31/1994	Female	127	120	103	49	263	7	1987
12L-09R-11R	7/30/2002	Unknown	58	55	55	34	35	2	2000
12L-10R-12R	8/5/1996	Unknown	-----	-----	-----	-----	192	5	1991
12L-11R-12R	8/5/1996	Male	155	144	124	55	427	6	1990
	7/21/1999	Male	197	180	149	69	857	-----	-----
COH1L	5/24/1998	Unknown	37	35	36	19	9	-----	1998
COH1L	5/24/1998	Unknown	36	35	35	20	10	-----	1998

APPENDIX III
P. concinna Within-Year Recaptures

Marking	**Date**	**Sex**	**Recap1**	**Recap2**	**Recap3**	**Recap4**
03L-10R	5/20/1994	Unknown	6/10/1994			
09L-11R	5/28/1994	Unknown	6/4/1994			
12L-03R	5/29/1994	Female	6/11/1994	6/14/1995		
01L-02L-09R	6/1/1994	Female	6/14/1994			
01L-02L-10R	6/1/1994	Female	6/1/1994			
01L-08L-11R	6/10/1994	Male	6/14/1994			
08L-11L-09R	5/12/1995	Unknown	5/16/1995			
03R-08R	6/28/1999	Unknown	7/7/1999			
01L-08L-11R	6/29/1999	Male	7/14/1999			
09L-11R	7/7/1999	Female	7/21/1999			
10L-01R-08R	7/7/1999	Male	7/14/1999			
02L-08R	7/8/1999	Male	7/25/1999			
09L-03R-08R	7/9/1999	Male	7/18/1999			
01L-02L-09R	7/17/1999	Female	7/20/1999	7/22/1999		
08L-03R-08R	7/18/1999	Female	7/22/1999			
02L-03L-02R-08R	7/21/1999	Female	7/28/1999			
12L-11R-12R	7/21/1999	Male	7/25/1999			
12L-02R-11R	7/29/2002	Female	7/31/2002			
02R-03R-08R	8/1/2002	Male	8/7/2002			
01L-02L-11L-02R-03R	8/7/2002	Female	8/8/2002			
03L-09L	8/11/2004	Unknown	8/18/2004	8/20/2004	8/30/2004	9/2/2004
08L-11L	8/12/2004	Female	8/22/2004	9/1/2004		
09L-10L	8/12/2004	Unknown	9/4/2004			
02L	8/13/2004	Male	8/30/2004			
02L-03L-10L-09R	8/15/2004	Female	9/6/2004			
08R-09R-11R-12R	8/15/2004	Male	9/1/2004			
01L-02L-11L-02R-03R	8/16/2004	Female	8/28/2004			
02L-03L-11L-02R	8/16/2004	Male	8/26/2004			
03R-09R	8/16/2004	Unknown	8/27/2004	8/28/2004		
08R-09R	8/16/2004	Unknown	8/18/2004	9/1/2004		
02L-08L-10L-03R	8/17/2004	Female	8/23/2004			
02L-08L-10L-08R	8/17/2004	Female	8/19/2004			
02L-09L-12L-01R	8/19/2004	Female	9/2/2004	9/4/2004		
02L-10L-12L-11R	8/19/2004	Female	8/29/2004			
02L-08L-01R-10R	8/20/2004	Female	9/5/2004			
03L-09L-11L-03R	8/22/2004	Female	9/6/2004			
08R-11R-12R	8/24/2004	Female	9/4/2004			
02L-03L-10L-09R	8/2/2006	Female	8/8/2006			
01R-02R	8/4/2006	Female	8/8/2006			
02L-11L	8/7/2006	Female	8/9/2006			
08R-10R-12R	8/8/2006	Female	8/9/2006			

APPENDIX IV
Hoop Trap Effort From 1998 - 2006

Trap #	Date Set	Date Pulled	Trap Hours	Trap Days	*P. concinna*	Hours/Turtle	Days/Turtle
1998-1	5/24/1998 16:45	5/28/1998 7:50	87.1	3.6	0	-----	-----
1998-2	5/24/1998 16:37	5/28/1998 7:59	87.4	3.6	0	-----	-----
1998-3	5/24/1998 17:00	5/28/1998 7:45	86.7	3.6	0	-----	-----
1998-4	5/24/1998 17:11	5/28/1998 7:36	86.4	3.6	0	-----	-----
1998-5	5/24/1998 17:30	5/28/1998 7:35	86.1	3.6	0	-----	-----
1998-6	5/24/1998 16:04	5/28/1998 8:13	88.2	3.7	0	-----	-----
1998-7	5/24/1998 15:58	5/25/1998 18:36	26.6	1.1	0	-----	-----
1998-8	5/24/1998 16:15	5/28/1998 8:04	87.8	3.7	0	-----	-----
1998-9	5/24/1998 15:43	5/25/1998 18:40	27.0	1.1	0	-----	-----
1998-10	5/24/1998 16:08	5/28/1998 8:10	88.0	3.7	0	-----	-----
1998-11	6/1/1998 16:50	6/5/1998 9:10	88.3	3.7	0	-----	-----
1998-12	6/1/1998 11:50	6/5/1998 9:20	93.5	3.9	0	-----	-----
1998-13	6/1/1998 17:22	6/5/1998 9:15	87.9	3.7	0	-----	-----
1998-14	6/1/1998 17:30	6/5/1998 9:20	87.8	3.7	0	-----	-----
1998-15	6/1/1998 17:40	6/5/1998 9:25	87.8	3.7	1	87.8	3.7
1998-16	6/1/1998 17:45	6/5/1998 9:30	87.8	3.7	1	87.8	3.7
1998-17	6/1/1998 17:53	6/5/1998 9:35	87.7	3.7	0	-----	-----
1998-18	6/1/1998 18:00	6/5/1998 9:35	87.6	3.6	2	43.8	1.8
1998-19	6/1/1998 16:05	6/5/1998 9:40	89.6	3.7	0	-----	-----
1998-20	6/1/1998 18:10	6/5/1998 9:45	87.6	3.6	0	-----	-----
1999-1	7/25/1999 17:35	7/28/1999 9:21	63.8	2.7	0	-----	-----
1999-2	7/25/1999 17:40	7/28/1999 9:19	63.7	2.7	0	-----	-----
1999-3	7/25/1999 17:43	7/28/1999 9:15	63.5	2.6	0	-----	-----
1999-4	7/25/1999 17:47	7/28/1999 9:12	63.4	2.6	0	-----	-----
1999-5	7/25/1999 17:55	7/28/1999 9:09	63.2	2.6	0	-----	-----
1999-6	7/25/1999 17:58	7/28/1999 9:04	63.1	2.6	0	-----	-----
1999-7	7/25/1999 18:08	7/28/1999 8:59	62.8	2.6	0	-----	-----
1999-8	7/25/1999 18:15	7/28/1999 8:03	61.8	2.6	0	-----	-----
1999-9	7/25/1999 17:30	7/28/1999 9:24	63.9	2.7	1	63.9	2.7
2002-1	7/28/2002 15:00	8/1/2002 14:00	95.0	4.0	0	-----	-----
2002-2	7/28/2002 15:00	8/1/2002 14:00	95.0	4.0	0	-----	-----
2002-3	7/28/2002 15:00	8/1/2002 14:00	95.0	4.0	1	95.0	4.0
2002-4	7/28/2002 15:00	8/1/2002 14:00	95.0	4.0	0	-----	-----
2002-5	7/28/2002 15:30	8/1/2002 14:00	94.5	3.9	0	-----	-----
2002-6	7/28/2002 15:30	8/1/2002 14:00	94.5	3.9	0	-----	-----
2002-7	7/28/2002 15:30	8/1/2002 14:00	94.5	3.9	0	-----	-----
2002-8	7/28/2002 15:30	8/1/2002 19:00	99.5	4.1	0	-----	-----
2002-9	7/28/2002 16:00	8/1/2002 14:00	94.0	3.9	0	-----	-----
2002-10	7/28/2002 16:00	8/1/2002 14:00	94.0	3.9	0	-----	-----
2002-11	7/28/2002 16:00	8/1/2002 14:00	94.0	3.9	0	-----	-----
2002-12	7/28/2002 16:00	8/1/2002 14:00	94.0	3.9	0	-----	-----
2002-13	8/6/2002 15:00	8/9/2002 13:15	70.3	2.9	0	-----	-----
2002-14	8/6/2002 15:00	8/9/2002 13:15	70.3	2.9	0	-----	-----
2002-15	8/6/2002 15:00	8/9/2002 13:15	70.3	2.9	0	-----	-----
2002-16	8/6/2002 15:00	8/9/2002 13:15	70.3	2.9	0	-----	-----
2002-17	8/6/2002 15:00	8/9/2002 13:20	70.3	2.9	0	-----	-----
2002-18	8/6/2002 16:00	8/9/2002 13:20	69.3	2.9	2	34.7	1.4
2002-19	8/6/2002 16:00	8/9/2002 13:20	69.3	2.9	0	-----	-----
2002-20	8/6/2002 15:00	8/9/2002 13:20	70.3	2.9	0	-----	-----

APPENDIX IV (CONT.)

Trap #	Date Set	Date Pulled	Trap Hours	Trap Days	*P. concinna*	Hours/Turtle	Days/Turtle
2002-21	8/6/2002 15:00	8/9/2002 13:30	70.5	2.9	0	-----	-----
2002-22	8/6/2002 15:00	8/9/2002 13:30	70.5	2.9	0	-----	-----
2002-23	8/6/2002 15:00	8/9/2002 13:40	70.7	2.9	0	-----	-----
2002-24	8/6/2002 15:00	8/9/2002 13:40	70.7	2.9	0	-----	-----
2002-25	8/6/2002 15:00	8/9/2002 15:40	72.7	3.0	0	-----	-----
2002-26	8/13/2002 15:45	8/15/2002 15:20	47.6	2.0	0	-----	-----
2002-27	8/13/2002 15:45	8/16/2002 12:45	69.0	2.9	0	-----	-----
2002-28	8/13/2002 15:45	8/16/2002 12:45	69.0	2.9	0	-----	-----
2002-29	8/13/2002 15:45	8/16/2002 12:30	68.8	2.9	0	-----	-----
2002-30	8/13/2002 15:30	8/16/2002 12:45	69.2	2.9	0	-----	-----
2002-31	8/13/2002 15:30	8/16/2002 12:45	69.2	2.9	0	-----	-----
2002-32	8/13/2002 15:30	8/16/2002 12:40	69.2	2.9	0	-----	-----
2002-33	8/13/2002 15:20	8/16/2002 12:45	69.4	2.9	0	-----	-----
2002-34	8/13/2002 15:15	8/16/2002 12:50	69.6	2.9	0	-----	-----
2002-35	8/13/2002 15:15	8/16/2002 12:50	69.6	2.9	0	-----	-----
2002-36	8/13/2002 15:00	8/16/2002 12:30	69.5	2.9	0	-----	-----
2004-1	8/10/2004 17:42	9/3/2004 13:00	571.3	23.8	1	571.3	23.8
2004-2	8/10/2004 17:36	9/5/2004 14:20	620.7	25.9	1	620.7	25.9
2004-3	8/10/2004 17:47	9/5/2004 14:27	620.7	25.9	0	-----	-----
2004-5	8/10/2004 17:15	9/5/2004 14:05	620.8	25.9	0	-----	-----
2004-6	8/10/2004 18:12	9/5/2004 14:45	620.6	25.9	0	-----	-----
2004-7	8/10/2004 17:53	9/5/2004 14:29	620.6	25.9	0	-----	-----
2004-8	8/10/2004 17:10	9/5/2004 13:59	620.8	25.9	4	155.2	6.5
2004-9	8/10/2004 17:05	9/5/2004 17:05	624.0	26.0	1	624.0	26.0
2004-10	8/10/2004 16:50	9/5/2004 13:33	620.7	25.9	3	206.9	8.6
2004-11	8/10/2004 17:20	9/5/2004 14:11	620.9	25.9	1	620.9	25.9
2004-12	8/10/2004 17:58	9/5/2004 14:34	620.6	25.9	1	620.6	25.9
2004-13	8/10/2004 18:24	9/5/2004 15:00	620.6	25.9	1	620.6	25.9
2004-15	8/10/2004 18:39	9/5/2004 15:15	620.6	25.9	1	620.6	25.9
2004-16	8/10/2004 18:34	9/5/2004 15:11	620.6	25.9	1	620.6	25.9
2004-17	8/10/2004 18:42	9/5/2004 15:19	620.6	25.9	0	-----	-----
2004-18	8/10/2004 18:04	9/5/2004 14:38	620.6	25.9	0	-----	-----
2004-19	8/10/2004 18:08	9/5/2004 14:42	620.6	25.9	1	620.6	25.9
2004-20	8/10/2004 18:15	9/5/2004 14:53	620.6	25.9	0	-----	-----
2004-21	8/10/2004 18:45	9/5/2004 15:23	620.6	25.9	0	-----	-----
2004-22	8/10/2004 18:20	9/5/2004 14:54	620.6	25.9	0	-----	-----
2004-23	8/10/2004 16:58	9/5/2004 13:39	620.7	25.9	0	-----	-----
2004-24	8/10/2004 17:05	9/5/2004 13:47	620.7	25.9	0	-----	-----
2004-25	8/10/2004 18:29	9/5/2004 15:06	620.6	25.9	0	-----	-----
2004-26	8/10/2004 17:31	9/5/2004 14:17	620.8	25.9	0	-----	-----
2004-27	8/10/2004 17:25	9/5/2004 14:14	620.8	25.9	0	-----	-----
2006-1	7/30/2006 10:43	8/5/2006 10:43	144.0	6.0	0	-----	-----
2006-2	7/30/2006 10:47	8/5/2006 10:49	144.0	6.0	0	-----	-----
2006-3	7/30/2006 10:50	8/5/2006 10:52	144.0	6.0	0	-----	-----
2006-4	7/30/2006 10:57	8/5/2006 10:57	144.0	6.0	0	-----	-----
2006-5	7/30/2006 10:59	8/5/2006 11:00	144.0	6.0	0	-----	-----
2006-6	7/30/2006 11:01	8/5/2006 11:05	144.1	6.0	0	-----	-----
2006-7	7/30/2006 11:14	8/5/2006 10:43	143.5	6.0	0	-----	-----
2006-8	7/30/2006 11:17	8/6/2006 10:33	167.3	7.0	0	-----	-----
2006-9	7/30/2006 11:20	8/6/2006 10:39	167.3	7.0	0	-----	-----
2006-10	7/30/2006 16:24	8/6/2006 10:44	162.3	6.8	0	-----	-----

APPENDIX IV (CONT.)

Trap #	Date Set	Date Pulled	Trap Hours	Trap Days	*P. concinna*	Hours/Turtle	Days/Turtle
2006-11	7/30/2006 16:28	8/6/2006 10:49	162.3	6.8	0	-----	-----
2006-12	7/30/2006 16:32	8/6/2006 10:53	162.4	6.8	0	-----	-----
2006-13	7/30/2006 11:43	8/6/2006 10:57	167.2	7.0	0	-----	-----
2006-14	7/30/2006 16:41	8/6/2006 11:01	162.3	6.8	0	-----	-----
2006-15	7/30/2006 16:54	8/7/2006 12:45	187.8	7.8	0	-----	-----
2006-16	7/30/2006 16:56	8/7/2006 12:45	187.8	7.8	0	-----	-----
2006-17	7/30/2006 16:59	8/7/2006 12:49	187.8	7.8	0	-----	-----
2006-18	8/3/2006 12:12	8/7/2006 12:54	96.7	4.0	0	-----	-----
2006-19	8/3/2006 12:11	8/7/2006 12:58	96.8	4.0	0	-----	-----
2006-20	8/3/2006 12:11	8/7/2006 13:00	96.8	4.0	0	-----	-----
2006-21	8/3/2006 12:10	8/8/2006 10:54	118.7	4.9	0	-----	-----
2006-22	8/3/2006 12:00	8/8/2006 10:50	118.8	5.0	0	-----	-----
2006-23	8/3/2006 12:05	8/8/2006 10:45	118.7	4.9	0	-----	-----
2006-24	8/3/2006 12:02	8/8/2006 10:41	118.7	4.9	0	-----	-----
2006-25	8/3/2006 12:00	8/8/2006 10:37	118.6	4.9	0	-----	-----
2006-26	8/3/2006 11:54	8/8/2006 10:32	118.6	4.9	0	-----	-----
2006-27	8/15/2006 14:08	8/22/2006 10:40	164.5	6.9	0	-----	-----
2006-28	8/15/2006 14:10	8/22/2006 10:47	164.6	6.9	0	-----	-----
2006-29	8/15/2006 14:13	8/22/2006 10:53	164.7	6.9	0	-----	-----
2006-30	8/15/2006 14:16	8/22/2006 10:58	164.7	6.9	0	-----	-----
2006-31	8/15/2006 14:16	8/22/2006 11:03	164.8	6.9	0	-----	-----
2006-32	8/15/2006 14:23	8/22/2006 11:08	164.7	6.9	0	-----	-----
2006-33	8/15/2006 14:24	8/22/2006 11:11	164.8	6.9	0	-----	-----
2006-34	8/15/2006 14:27	8/23/2006 11:42	189.3	7.9	0	-----	-----
2006-35	8/15/2006 14:29	8/23/2006 11:47	189.3	7.9	1	189.3	7.9
2006-36	8/15/2006 14:32	8/23/2006 11:52	189.3	7.9	0	-----	-----
2006-37	8/15/2006 14:34	8/23/2006 11:56	189.4	7.9	0	-----	-----
2006-38	8/16/2006 11:43	8/23/2006 12:00	168.3	7.0	0	-----	-----
2006-39	8/16/2006 11:45	8/23/2006 12:04	168.3	7.0	0	-----	-----
2006-40	8/16/2006 11:48	8/23/2006 12:09	168.3	7.0	0	-----	-----
2006-41	8/16/2006 11:52	8/23/2006 12:14	168.4	7.0	0	-----	-----
2006-42	8/16/2006 12:03	8/23/2006 12:24	168.4	7.0	0	-----	-----
2006-43	8/16/2006 12:03	8/23/2006 12:29	168.4	7.0	0	-----	-----
2006-44	8/16/2006 12:06	8/23/2006 12:32	168.4	7.0	0	-----	-----
2006-45	8/16/2006 12:08	8/23/2006 12:36	168.5	7.0	0	-----	-----
2006-46	8/17/2006 11:09	8/23/2006 12:40	145.5	6.1	0	-----	-----
2006-47	8/17/2006 11:21	8/24/2006 10:58	167.6	7.0	0	-----	-----
2006-48	8/17/2006 11:25	8/24/2006 11:01	167.6	7.0	0	-----	-----
2006-49	8/17/2006 11:29	8/24/2006 11:03	167.6	7.0	2	83.8	3.5
2006-50	8/17/2006 11:37	8/24/2006 11:04	167.4	7.0	0	-----	-----
2006-51	8/17/2006 11:39	8/24/2006 11:06	167.4	7.0	0	-----	-----
2006-52	8/17/2006 11:45	8/24/2006 11:08	167.4	7.0	0	-----	-----
2006-53	8/16/2006 9:30	8/21/2006 11:35	122.1	5.1	0	-----	-----
2006-54	8/16/2006 9:20	8/21/2006 11:39	122.3	5.1	0	-----	-----
2006-55	8/16/2006 9:25	8/21/2006 11:42	122.3	5.1	0	-----	-----
2006-56	8/16/2006 9:30	8/21/2006 11:45	122.3	5.1	0	-----	-----

APPENDIX V
Fyke Trap Effort From 1994 - 2006

Trap #	Date Set	Date Pulled	Trap Hours	Trap Days	*P. concinna*	Hours/Turtle	Days/Turtle
1994-1	5/18/1994 17:00	5/20/1994 12:00	43.0	1.8	4	10.7	0.4
1994-2	5/25/1994 8:00	6/1/1994 10:20	170.3	7.1	15	11.4	0.5
1994-3	6/8/1994 12:00	6/14/1994 18:00	150.0	6.3	9	16.7	0.7
1994-4	6/8/1994 12:10	6/17/1994 11:00	214.8	9.0	2	107.4	4.5
1994-5	6/8/1994 11:45	6/17/1994 20:00	224.3	9.3	13	17.3	0.7
1995-1	5/6/1995 14:00	5/17/1995 8:00	258.0	10.8	11	23.5	1.0
1995-2	5/8/1995 17:30	5/17/1995 8:00	206.5	8.6	0	-----	-----
1995-3	5/8/1995 17:30	5/17/1995 8:00	206.5	8.6	4	51.6	2.2
1995-4	5/10/1995 12:05	5/17/1995 8:00	163.9	6.8	3	54.6	2.3
1995-5	5/11/1995 20:10	5/17/1995 8:00	131.8	5.5	0	-----	-----
1995-6	5/16/1995 15:00	5/17/1995 8:00	17.0	0.7	0	-----	-----
1995-7	6/26/1995 20:10	6/28/1995 16:00	43.8	1.8	0	-----	-----
1995-8	6/26/1995 20:10	6/28/1995 20:00	47.8	2.0	1	47.8	2.0
1995-9	8/12/1995 15:00	8/15/1995 14:00	71.0	3.0	3	23.7	1.0
1995-10	8/12/1995 17:00	8/15/1995 14:00	69.0	2.9	0	-----	-----
1996-1	8/3/1996 10:00	8/5/1996 17:00	55.0	2.3	1	55.0	2.3
1996-2	8/3/1996 17:00	8/5/1996 17:00	48.0	2.0	2	24.0	1.0
1996-3	8/27/1996 18:30	9/1/1996 14:00	115.5	4.8	5	23.1	1.0
1996-4	8/27/1996 18:30	9/1/1996 13:30	115.0	4.8	3	38.3	1.6
1996-5	8/28/1996 12:00	9/1/1996 14:00	98.0	4.1	4	24.5	1.0
1997-1	8/8/1997 11:30	8/13/1997 11:00	119.5	5.0	10	12.0	0.5
1998-1	5/24/1998 20:00	5/28/1998 9:15	85.2	3.6	3	28.4	1.2
1998-2	5/24/1998 19:30	5/28/1998 9:40	86.2	3.6	2	43.1	1.8
1998-3	5/24/1998 19:00	5/28/1998 9:50	86.8	3.6	1	86.8	3.6
1998-4	5/30/1998 16:00	6/5/1998 8:00	136.0	5.7	3	45.3	1.9
1998-5	5/30/1998 16:30	6/5/1998 8:30	136.0	5.7	11	12.4	0.5
1998-6	5/30/1998 17:00	6/5/1998 8:45	135.8	5.7	1	135.8	5.7
1999-1	6/19/1999 14:00	6/30/1999 13:30	263.5	11.0	6	43.9	1.8
1999-2	6/19/1999 11:00	6/30/1999 13:30	266.5	11.1	7	38.1	1.6
1999-3	7/6/1999 16:30	7/28/1999 10:50	522.3	21.8	6	87.1	3.6
1999-4	7/6/1999 18:30	7/28/1999 9:30	519.0	21.6	19	27.3	1.1
1999-5	7/6/1999 17:00	7/28/1999 9:50	520.8	21.7	7	74.4	3.1
1999-6	7/7/1999 9:40	7/28/1999 10:10	504.5	21.0	17	29.7	1.2
2002-1	7/27/2002 15:00	8/17/2002 9:00	498.0	20.8	6	83.0	3.5
2002-2	7/27/2002 19:00	8/17/2002 8:45	493.8	20.6	10	49.4	2.1
2002-3	7/28/2002 18:40	8/7/2002 8:30	229.8	9.6	12	19.2	0.8
2002-4	8/7/2002 19:30	8/17/2002 8:15	228.8	9.5	0	-----	-----
2004-1	8/10/2004 13:00	9/6/2004 11:20	646.3	26.9	10	64.6	2.7
2004-2	8/10/2004 12:30	9/6/2004 10:20	645.8	26.9	36	17.9	0.7
2004-3	8/10/2004 10:09	9/6/2004 10:50	648.7	27.0	20	32.4	1.4
2004-4	8/10/2004 10:48	9/6/2004 9:52	647.1	27.0	15	43.1	1.8
2004-5	8/17/2004 11:48	9/6/2004 9:40	477.9	19.9	7	68.3	2.8
2006-1	7/29/2006 15:00	8/7/2006 12:21	213.3	8.9	1	213.3	8.9
2006-2	7/29/2006 15:30	8/9/2006 10:09	258.7	10.8	9	28.7	1.2
2006-3	7/29/2006 16:00	8/9/2006 9:57	258.0	10.7	5	51.6	2.1
2006-4	8/2/2006 19:45	8/9/2006 9:36	157.9	6.6	4	39.5	1.6
2006-5	8/15/2006 11:00	8/25/2006 11:25	240.4	10.0	2	120.2	5.0
2006-6	8/15/2006 11:30	8/25/2006 11:20	239.8	10.0	7	34.3	1.4
2006-7	8/15/2006 12:00	8/25/2006 12:02	240.0	10.0	1	240.0	10.0
2006-8	8/15/2006 12:45	8/24/2006 11:10	214.4	8.9	4	53.6	2.2