TERRAPIN MONITORING AT THE PAUL S. SARBANES ECOSYSTEM RESTORATION PROJECT AT POPLAR ISLAND

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Ohio University researcher Willem Roosenburg processing the first female terrapin hatched from a Poplar Island nest after she returned to nest on Poplar Island in 2012.

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BACKGROUND

The Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (Poplar Island), formerly known as the Poplar Island Environmental Restoration Project (PIERP), is a large-scale project that is using dredged material to restore the once-eroding Poplar Island in the Middle Chesapeake Bay. As recently as 100 years ago, the island was greater than 400 hectares and contained uplands and high and low marshes. During the past 100 years, the island eroded and by 1996 only three small islands (<4 hectares) remained before the restoration project commenced. The Project Sponsors, the United States Army Corps of Engineers (USACE) and the Maryland Port Administration (MPA), are rebuilding and restoring Poplar Island to a size similar to what existed over 100 years ago. A series of stone-covered perimeter dikes were erected to prevent erosion, and dredged material from the Chesapeake Bay Approach Channels to the Port of Baltimore is being used to fill the areas within the dikes. The ultimate goals of the project are: to restore remote island habitat in the mid-Chesapeake Bay using clean dredged material from the Chesapeake Bay Approach Channels to the Port of Baltimore; optimize site capacity for clean dredged material while meeting the environmental restoration purpose of the project; and protect the environment around the restoration site. Ultimately, this restoration will benefit the wildlife that once existed on Poplar Island.

After completion of the perimeter dikes in 2002, diamondback terrapins, *Malaclemys terrapin*, began using the newly formed habitat as a nesting site (Roosenburg and Allman 2003; Roosenburg and Sullivan, 2006; Roosenburg and Trimbath, 2010; Roosenburg et al., 2004; 2005; 2007; 2008; 2010; 2012). The persistent erosion of Poplar and nearby islands had greatly reduced the terrapin nesting and juvenile habitat in the Poplar Island archipelago. Prior to the initiation of the project, terrapin populations in the area likely declined due to emigration of adults and reduced recruitment because of limited high quality nesting habitat. By restoring the island and providing nesting and juvenile habitat, terrapin populations utilizing Poplar Island and the surrounding wetlands could increase and potentially repopulate the archipelago. The newly restored wetlands could provide the resources that would allow terrapin populations to increase by providing high quality juvenile habitat.

Poplar Island provides a unique opportunity to understand how large-scale ecological restoration projects affect terrapin populations and turtle populations in general. In 2002, a long-term terrapin monitoring program was initiated to document terrapin nesting on Poplar Island. By monitoring the terrapin population on Poplar Island, resource managers can learn how creating new terrapin nesting and juvenile habitat affects terrapin populations. This information will contribute to understanding the ecological quality of the restored habitat on Poplar Island, as well as understanding how terrapins respond to large-scale restoration projects. The results of terrapin nesting surveys and hatchling captures from 2004 – 2012 are summarized herein to identify how diamondback terrapins use habitat created by Poplar Island and how terrapin use has changed during that time. Additionally, researchers conducted a vegetation removal experiment in 2012 to evaluate how the succession of vegetation on the nesting areas in the Notch and outside Cell 5 affected the nesting behavior of female terrapins; the results from this experiment also are presented.

The 2009 Poplar Island Framework Monitoring Document (FMD; Maryland Environmental Service, 2009) identifies three reasons for terrapin monitoring:

1) Quantify the use of nesting and juvenile habitat by diamondback terrapins on Poplar Island, including the responses to change in habitat availability as the project progresses
2) Evaluate the suitability of terrapin nesting habitat by monitoring nest and hatchling viability, recruitment rates, and hatchling sex ratios.
3) Determine if the project affects terrapin population dynamics by increasing the available juvenile and nesting habitat on the island.

The terrapin's charismatic nature also makes it an excellent species to use as a tool for environmental outreach and education. Some of the terrapin hatchlings that originate on Poplar Island participate in an environmental education program in Maryland schools through the Arlington Echo Outdoor Education Center (AE), Maryland Environmental Service (MES), and the National Aquarium in Baltimore (NAIB). These programs provide students with a scientifically-based learning experience that also allows Ohio University (OU) researchers to gather more detailed information on the nesting biology of terrapins, in addition to providing an outreach and education opportunity for Poplar Island. As part of the terrapin monitoring program at Poplar Island, OU researchers are collaborating with staff at AE, MES, and NAIB to foster both a classroom and field experience that uses terrapins to teach environmental education and increase awareness for Poplar Island. The students raise the terrapins throughout their first winter, and the terrapins attain a body size that is comparable to 2-5 year old wild individuals, thus "headstarting" their growth. The goals of the terrapin outreach program are:

1) Provide approximately 250 terrapin hatchlings to AE, MES, and NAIB to be raised in classrooms.
2) Obtain sex ratio data from the hatchlings as increased body size allows.
3) Conduct a scientifically-based program to evaluate the effectiveness of head-starting.

METHODS

Specific details of differences in surveys and sampling techniques used during 2002 - 2012 can be found in Roosenburg and Allman (2003), Roosenburg and Trimbath (2010), and Roosenburg et al. (2004; 2005; 2008). Since 2004, survey efforts to find nests have been consistent in the Notch, outside Cell 5, and outside Cell 3 (Figure 1). Construction in Cell 6 has eliminated nesting activity there, and the completion of Cells 4D, 3D, and 1A have resulted in nesting along the perimeter dike of these cells therefore mandating surveys of these recently completed nesting areas. Details of the general survey methods and specific techniques employed during 2012 are described below.

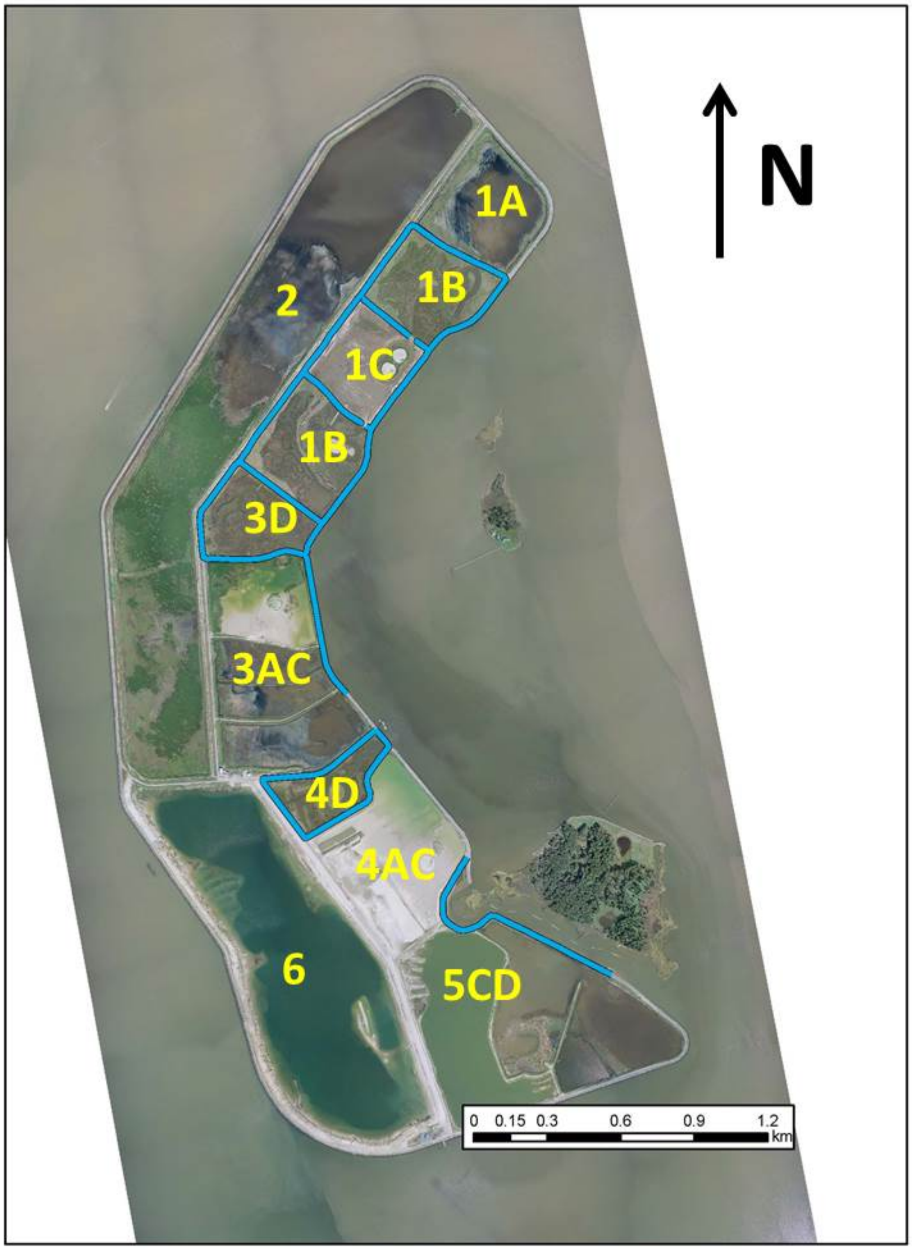

Figure 1. Map of Poplar Island with blue lines indicating areas surveyed daily for terrapin nesting activity by the research team.

Identification of terrapin nests

From 23 May to 30 July 2012 (the last nest to be confirmed as less than 24 hours old was found on 12 July), OU researchers surveyed the following areas on Poplar Island daily: beaches in the Notch area (surrounding the northwestern tip of Coaches Island near Cell 4AB), areas between Coaches Island and Poplar Island (outside of Cell 5AB), the beach outside the dike near Cell 3AC in Poplar Harbor, and interior perimeter dikes of Cells 4D, 3D, 1A, 1B, and 1C (blue lines in Figure 1). A geographic positioning system (GPS) recorded nest positions and survey flags identified the specific nest locations.

Upon discovering a nest, researchers examined the eggs to determine the age of the nest. If the eggs were white and chalky, the nest was greater than 24 hours old and no further excavation was conducted because of increased risk of rupturing the allantoic membrane and killing the embryo. Researchers excavated recent nests (less than 24 hours old; these nests were identified by a pinkish translucent appearance of the eggs) to count the eggs, and from 2004 through 2012 weighed the individual eggs. Researchers marked nests with four 7.5 cm^2 survey flags, and beginning in 2005, laid a 30 cm by 30 cm, 1.25 cm^2 mesh rat wire on the sand over the nest to deter avian nest predators, primarily crows.

Monitoring nesting and hatching success

After 45 to 50 days of egg incubation, researchers placed an aluminum flashing ring around each nest to prevent emerging hatchlings from escaping. Anti-predator (1.25 cm^2) wire also was placed over the ring to prevent predation of emerging hatchlings within the ring. Beginning in late July, the researchers checked ringed nests at least once daily for emerged hatchlings. Researchers brought newly emerged hatchlings to the onsite storage shed where they measured and tagged the hatchlings.

Researchers excavated nests ten days after the last hatchling emerged. For each nest, they recorded the number of live hatchlings, dead hatchlings that remained buried, eggs with dead embryos, and eggs that showed no sign of development. To estimate hatching success, researchers compared the number of surviving hatchlings to the total number of eggs from only the nests that were excavated within 24 hrs of oviposition, which provided an exact count of the number of eggs. Additionally, researchers determined if the nest was still active – with eggs that appeared healthy and had not completed development. The researchers allowed nests containing viable eggs or hatchlings that had not fully absorbed their yolk sac to continue to develop; however, researchers removed fully developed hatchlings from nests, further described in the next section.

Capture of hatchlings

Researchers collected hatchlings from ringed nests and also from nests that were discovered by hatchling emergence (hatchling tacks or emergence hole). The presence of egg shells when excavated confirmed all nests discovered by emerging hatchlings. Additionally, researchers found a small number of hatchlings on the beach and in the drift fences from the vegetation removal experiment (see below), which they collected and processed. Because 50 nests had not produced hatchlings by 1 November 2012, these nests were left to be excavated in the spring of 2013. After 30 March 2013 researchers traveled to Poplar Island weekly to recover emerging hatchlings. All overwintering nests that had not emerged by 21 May 2013 were excavated to determine their fate.

Measuring, tagging, and release of hatchlings

Researchers brought all hatchlings back to the MES shed onsite where they placed hatchlings in plastic containers with water until they were processed (measured, notched, and tagged), usually within 24 hours of capture. Researchers marked hatchlings by notching with a scalpel the 10th right marginal scute and 9th left marginal scute, establishing the cohort ID 10R9L for 2012 fall emerging hatchlings. OU personnel gave spring 2013 emerging hatchlings a different cohort ID of 9R12R (notching the 9th and 12th right marginal scutes) to distinguish fall 2012 from spring 2013 emerging hatchlings upon later recapture. Researchers implanted individually marked Northwest Marine Technologies® coded wire tags (CWTs) in all hatchlings. The CWTs were placed subcutaneously in the right rear limb using a 25-gauge needle. The CWTs should have high retention rates (Roosenburg and Allman, 2003) and in the future researchers will be able to identify terrapins originating from Poplar Island for the lifetime of the turtle by detecting tag presence using a Northwest Marine Technologies® V-Detector.

Researchers measured plastron length, carapace length, width, and height (± 0.1 mm), and mass (± 0.1 g) of all hatchlings. Additionally, they checked for anomalous scute patterns and other developmental irregularities. Following tagging and measuring, researchers released all hatchlings in either Cell 4D, Cell 3D, or Cell 1C (which was completed during the summer of 2011). On several occasions, large numbers (>50) of hatchlings were simultaneously released but dispersed around the cell to minimize avian predation.

Measuring, tagging, and release of juveniles and adults

All juvenile and adult turtles captured on the island were transported to the onsite shed for processing. Researchers recorded plastron length, carapace length, width, and height (±1 mm), and mass (±1 g) of all juveniles and adults. Biomark Inc. Passive Integrated Transponder (PIT) tags were implanted in the right inguinal region; in the loose skin anterior to the hind limb where it meets the plastron. Additionally, a National Band and Tag Company monel tag was placed in the 9th right marginal scute. The number sequence on the tag begins with the letters PI, identifying that this animal originated on Poplar Island.

Terrapin Education and Environmental Outreach Program

During 2012, 235 Poplar Island hatchlings were reared in the terrapin education and environmental outreach programs at AE, the NAIB, and MES. In April 2013, researchers traveled to AE to implant PIT tags in 217 head-started individuals. Researchers also measured and weighed all animals at this time. From late May through July 2013, the head-started terrapins were returned to Poplar Island and released in the Notch.

2012 Vegetation Removal Experiment

Five blocks of paired plots, each plot measuring10m by 4-5m, were established in the nesting areas in the Notch and outside Cell 5AB prior to the onset of the nesting season in 2012. Each block consisted of a control plot and experimental plot from which vegetation was removed using a rototiller and then weeded by hand thereafter. Vegetation coverage was sampled within each plot using a $1m^2$ Daubenmire Frame with point sampling in each $10cm^2$ square for 100 total points prior to vegetation removal. These samples were conducted at three random locations along three randomly selected transects that ran the length of the plot (10m). Vegetation coverage also was sampled with a single point sample at 1m intervals along each of the three transects. The point sampling method used a pin (survey flag) dropped at the location and documented the number and species of all vegetation that contacted the pin. All plots were surveyed daily to document nesting activity and all nests were documented as described above. At the end of the nesting season all plots were enclosed with a 20cm high drift fence to catch all hatchlings emerging from possible undocumented nests. All documented nests were ringed (see method described above). All hatchlings were recorded and processed as described in method above.

Data Analysis and Processing

Researchers summarized and processed all data using Microsoft Excel$^{®}$ and Statistical Analysis System (SAS). Graphs were made using Sigmaplot$^{®}$. Institutional Animal Care and Uses Committee at OU (IACUC) approved animal use protocols (13-L-023) and Maryland Department of Natural Resources (MD DNR) – Wildlife and Heritage issued a Scientific Collecting Permit Number SCO-52238 to Willem M. Roosenburg (WMR).

Results and Discussion

Nest and Hatchling Survivorship

During the 2012 terrapin nesting season (23 May – end of July), the researchers located 200 nests on Poplar Island (Table 1, raw nest data provided in Appendix 1). Of these 200 nests, 138 successfully produced hatchlings and 51 nests were unsuccessful, of which predators destroyed 42 nests completely and another 39 nests were partially depredated some of which produced hatchlings (Table 1). Six nests failed because the eggs did not develop or eggs were thin-shelled which results in nest failure. Four nests were lost due to inundation by the high tide or washed out due to heavy rains because the nest site was in an area of high erosion.

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Nests	68	67	182	282	191	225	218	189	166	211	200
Nests produced hatchlings	38	50	129	176	112	166	180	145	125	180	138
Nests that did not survive	1	7	17	70	69	44	28	34	42	20	51
Depredated (Roots or Animal)*	0	0	12	46	54	18	12	10	9	24/6	81/39
Washed out	1	6	3	11	13	2	6	3	4	3	4
Undeveloped eggs, weak shelled eggs, or dead embryos	0	1	0	12	1	19	10	12	11	5	6
Destroyed by another turtle or nest was in rocks	0	0	2	0	0	3	0	0	2	0	2
Destroyed by Bulldozer	0	0	0	1	0	0	0	0	0	0	0
Dead Hatchlings	0	0	0	0	1	2	0	2	6	3	0
Fate of Nest Unknown	29	10	36	36	10	19	10	10	17	9	7

Table 1 - Summary of the diamondback terrapin nests found on Poplar Island and their fate from 2002 to 2012. *The two values for depredated nests indicates the total number nest that experienced some level of predation and the second number identifies those that were partially depredated.

The number of terrapin nests on Poplar Island has averaged 207 nests per year since 2004 (Table 1); 2012 was an average year which deviated only -7 nests from the mean. The increase in nests in the Notch in 2011 and 2012 is attributed to the increase in availability of open sandy nesting areas. The sand storage in Cell 4AB and the subsequent north westerly wind caused erosion of sand to the perimeter dike in the Notch during 2011 and 2012 created large open sandy areas that were heavily used by nesting females. The nesting habitat in the Notch also has high nest survival (Figures 2 and 3). The increase in open nesting habitat in the Notch may have contributed to reduced nesting on the outside of Cell 5AB, where vegetation has reduced the availability of open areas further, and attracted nesting females to the Notch. Nonetheless, the area between Poplar Island and Coaches Island remains the primary nesting area on Poplar Island. The completion of additional wetland cells has led to the expansion of nesting on other parts of the island (Figures 2 and 3). During 2012, the first nests were discovered on the cross dikes between Cells 1A, 1B, 1C, and 1D (Figure 3) indicating that terrapins are using these wetland cells to access potential nesting sites and that the sparse vegetation on these cross dikes provides the open areas selected by females for nesting. In particular, the cross dikes between Cell 1AB and Cell 1BC attracted nesting females. Areas with dense vegetation typically support fewer terrapin nests in the Chesapeake Bay region (Roosenburg, 1996) and pose a threat to terrapin nests because the roots of grasses can either entrap hatchlings or prey directly on the eggs (Stegmann et al., 1988). The outside of Cell 3AC remains a reliable nesting area used by females as well as the open areas that have become established on the southern side of Cell 4D (Figure 3).

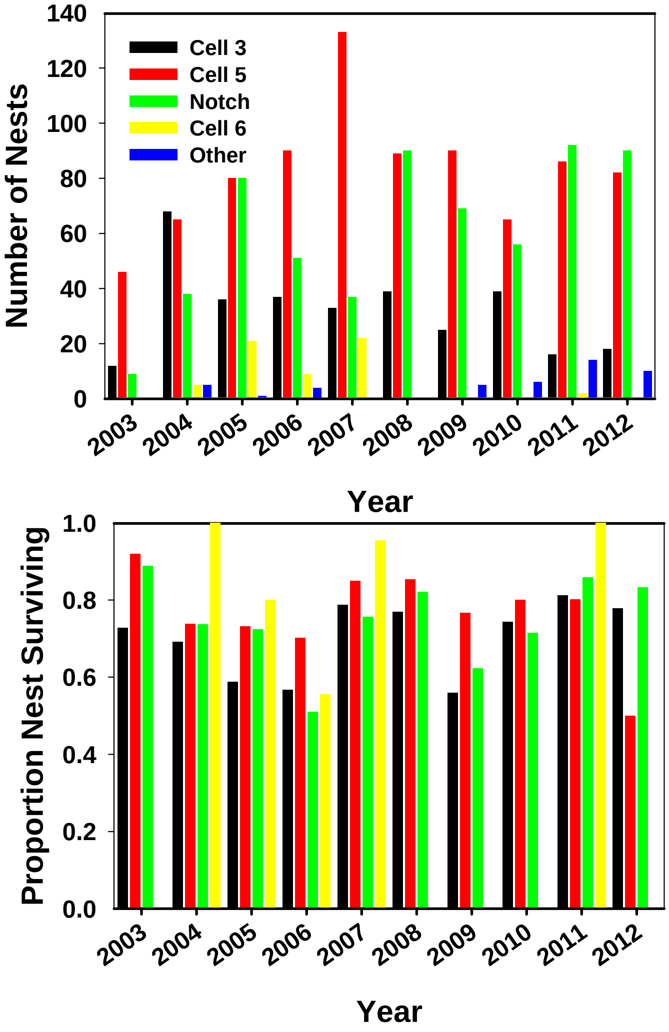

Figure 2 – The number of nests in each of the major nesting areas for each year of the study (top panel) and the proportion of nests surviving (bottom panel).

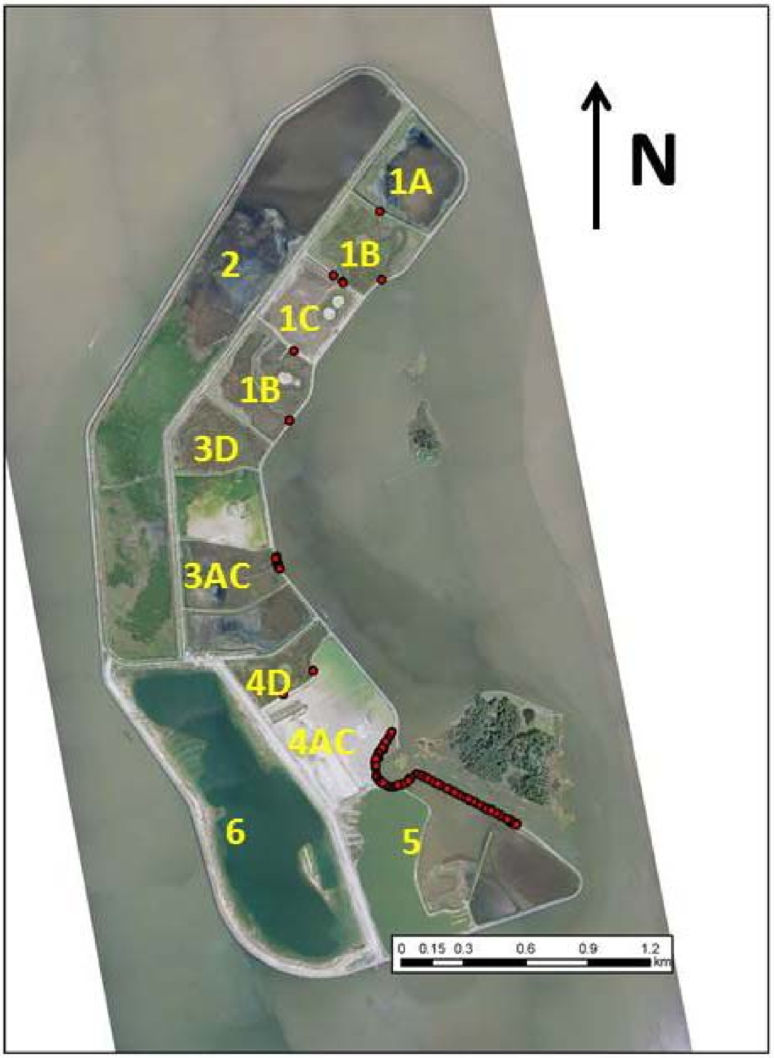

Figure 3 – Terrapin nesting locations on Poplar Island during 2012

Survivorship of nests (the proportion of nests producing hatchlings) decreased from 80.2% in 2011 to 50.0% in 2012 in the area outside of Cell 5AB (Figure 2). Predation by deer mice (*Peromyscus maniculatus*) was the primary cause for the decline in nest survivorship eating eggs throughout incubation. Researchers used small mammal traps to confirm that deer mice were eating terrapin eggs. Nest predation did not increase in the other areas around the island: outside Cell 3AC and the Notch, where vegetation density is considerably less than outside Cell 5AB. Although some predation by small mammals has been noted in the past, 2012 was the first year that a large portion of the nests were eaten. In the past this predation was suspected to have been caused by short-tailed shrew (*Blarina brevicauda*). OU researchers suggest that the increase in vegetation provided habitat and the forage (grass seeds) that resulted in a large population of deer mice on the dike outside Cell 5AB during the summer of 2012. Terrapin nests likely were a secondary prey source for deer mice, but high mouse population levels may have resulted in depleting the natural food sources and resulted in the high predation rates on terrapin nests particularly later in the nesting season (late July/early August). If the population of deer mice on Poplar Island is cyclic, it may be anticipated that in future years terrapin nest predation by deer mice may cycle as well.

Researchers continued to place hardware cloth over the nests to prevent crow predation during 2012. This mechanism was not successful in deterring predation by deer mice and eastern king snakes on terrapin nests (*Lampropeltis getulus*). Five eastern king snakes were captured on Poplar Island; 4 new individuals and one that had been marked in previous years. Researchers suspect that king snakes are coming from Coaches Island and preying on the readily available terrapin nests, in addition to northern water snakes (*Nerodia sipedon*) and deer mice. Five nests were confirmed as depredated by king snakes during 2012 with additional nests suspected, but not confirmed. The number of 2012 confirmed predation events by king snakes is down from 18 in 2011. Despite the high rate of nest predation in Cell 5, the lack of raccoons and foxes combined with researchers protecting nests from crows contributed to the continued high nest survival on Poplar Island.

Mean within nest survivorship (proportion of eggs within nest surviving) was 0.597 during 2012. This is down slightly from 0.624 during 2011 but well above the low observed in 2010 of 0.429. The fluctuation in survivorship is most likely due to the fluctuation of temperature and rainfall among summers in which hotter, dryer summers reduce survivorship within nests, and wetter summers have higher survivorship. The 2010 nesting season was the hottest and driest on record, while 2012 had considerably more rainfall events during the summer. During hot and dry conditions, soil water potential drops and eggs can become desiccated and die as a consequence. In 2012, researchers documented six nests in which eggs had not completed development and died within their nests; desiccation or overheating were the suspected primary cause for this within nest mortality. Possibly contributing to the increase in mortality is the increasing presence of vegetation on the nesting beaches, particularly in the Notch and outside of Cell 5. Vegetation competes with turtle eggs for soil moisture and can tolerate lower soil water potentials than eggs, in addition to the roots ability to encase eggs and draw the moisture out (Stegmann et al., 1988).

Researchers noted three nests with thin-shelled or kidney shaped eggs on Poplar Island. Thin-shelled eggs also have been observed in the Patuxent River terrapin population (Roosenburg, personal observation). In all three clutches only a few of the eggs were thin-shelled or miss-shaped. In previous years, OU researchers have noted nests in which all of the eggs have thin shells; these eggs are frequently broken during oviposition and seldom hatch. The cause of the thin-shelled eggs is unknown at this time, but it is not unique to Poplar Island. Two possible causes that remain to be evaluated include a toxicological effect of a ubiquitous factor in the Chesapeake Bay, or a resource limitation making the females unable to sequester sufficient amounts of calcium to shell the eggs.

Reproductive Output

Clutch size (Analysis of Variance; ANOVA, $F_{6,849} = 1.83, P > 0.05$) and clutch mass (ANOVA, $F_{8,851} = 1.33, P > 0.05$) did not differ among years. Average egg mass (ANOVA, $F_{6,851} = 3.24, P < 0.05$) differed among years (Table 2). The difference in clutch size that resulted at the end of 2011 has disappeared with the inclusion of the 2012 data. Clutch size decreased by almost a 0.5 egg from 2011 to 2012. Average egg mass remained different among years and 2012 saw the largest average egg mass ever reported for Poplar Island while 2011 had the smallest egg mass. Researchers can only speculate what may be driving the variation observed among years in reproductive output but suggest two potential causes. The first potential cause is underlying environmental variation (e.g. temperature or resources) that may result in different allocation strategies that determine the number and size of eggs and the total clutch mass. A study investigating environmental correlates of reproductive characteristics could reveal significant patterns associated with environmental variation. Second, there may be changes in the demographic structure in the Poplar Island terrapin population such that the strong recruitment driven by the creation of new and predator-free nesting habitat has resulted in a greater number of younger females. Younger females may have different reproductive characteristics than the older females that dominated the population in the early years of the project. Additionally, younger females may be more variable in the production of eggs. Identification of known-aged female clutches could address these questions. Continued monitoring of terrapin reproductive biology on Poplar Island will be important in determining the underlying causal factors of variation in reproductive output.

YEAR	CLUTCH SIZE	CLUTCH MASS (g)	EGG MASS (g)
2004	13.68 (0.379)	127.55 (4.372)	9.80 (0.110)
2005	13.62 (0.245)	133.11 (2.541)	9.92 (0.087)
2006	13.48 (0.248)	133.28 (2.570)	9.97 (0.081)
2007	13.11 (0.241)	127.4 (2.502)	9.86 (0.086)
2008	12.90 (0.260)	128.0 (2.890)	10.06 (0.092)
2009	13.85 (0.242)	137.1 (2.335)	10.02 (0.091)
2010	13.33 (0.364)	133.1 (3.850)	10.10 (0.198)
2011	14.08 (0.290)	131.5 (2.688)	9.46 (0.142)
2012	13.67 (0.309)	131.7 (3.697)	10.13 (0.162)

Table 2. Average and standard error of clutch size, clutch mass, and egg mass from 2004-2012 on Poplar Island.

Hatchlings

Researchers captured, tagged, and notched 961 terrapin hatchlings on Poplar Island between 26 July 2012 and 23 May 2013 (Table 3; Appendix 2). Sixty-four hatchlings were caught in the drift fences surrounding the experimental plots and an additional 14 hatchlings were caught by hand on the nesting beaches. All other hatchlings were captured in the rings surrounding the nests. Researchers found 29 nests after 30 July 2012 through 21 May 2013 that were discovered either when the hatchlings emerged or predators had excavated the nests and left egg shells. Hatchling carapace length and mass were similar among all years of the study (Table 3). Since 2002, 12,289 hatchlings have been captured, tagged, and notched on Poplar Island (Table 3, these values include animals that were put into the headstart program).

Year	**Number of Hatchlings**	**Mean Carapace Length (mm)**	**Mean Mass (g)**
2002	565	31.28 (1.61)	7.52 (0.96)
2003	387	31.13 (1.50)	7.50 (0.99)
2004	1,337	31.57 (1.47)	7.61 (0.89)
2005	1,526	30.98 (1.94)	7.45 (1.10)
2006	855	30.95 (1.71)	7.38 (1.01)
2007	1,616	31.26 (1.72)	7.50 (0.91)
2008	1,443	31.03 (1.34)	7.42 (0.14)
2009	1,430	30.99 (1.83)	7.33 (0.99)
2010	785	30.45 (0.06)	7.38 (0.04)
2011	1,382	30.41 (2.02)	7.40 (1.15)
2012	961	30.83 (2.26)	7.37 (1.30)
Total	12,289		

Table 3 - Number of hatchlings, mean and standard error of carapace length, and mean mass of terrapin hatchlings caught on Poplar Island from 2002-2012.

2012 was a year with reduced hatchling recruitment although the number of nests discovered was similar to 2011 (Table 1 and 3). The decrease in the number of hatchlings was mostly due to the high predation rates on Cell 5 nests resulting in only 50% survivorship of nests in this nesting area. Other nesting areas had nest survival rates comparable to previous years (Figure 2). The relationship between average clutch egg mass and average clutch hatchling mass suggests that incubation conditions were normal during 2012. Only in 2008 and 2010, summers when incubation conditions were dryer than normal due to lower rainfall and higher temperatures, did the relationship between egg mass and hatchling differ (ANCOVA; $F_{8, 343} = 4.53$; $P < 0.0001$) resulting in larger eggs producing smaller than normal hatchlings (Figure 4). These findings suggest that hatchling size is affected by both egg size and the environmental conditions experienced during incubation.

Overwintering

There were 40 nests that OU allowed to overwinter during the winter of 2012-2013 and all overwintered successfully (Table 4). In the spring, the accumulation of sand within the rings surrounding the nests resulted in several nests emerging, as indicated by the texture of the egg shells, but the hatchlings escaped as the sand had completely covered the rings.

In 2012, there was an increase in the number of nests that had both fall and spring emerging hatchlings (Table 4). Furthermore, the accumulation of sand in the Notch completely buried some nests, and other nests' rings were either ripped away by wind or washed out by unusually high tides during the winter and never found - accounting for unknown nests (Table 4). Researchers recovered no dead hatchlings from any overwintering nests, suggesting that despite a low number of nests overwintering, overwintering success was high. Many of the overwintering nests contained large numbers of dead eggs indicating that most of the mortality occurred while the eggs were developing and not in the nest post-hatching.

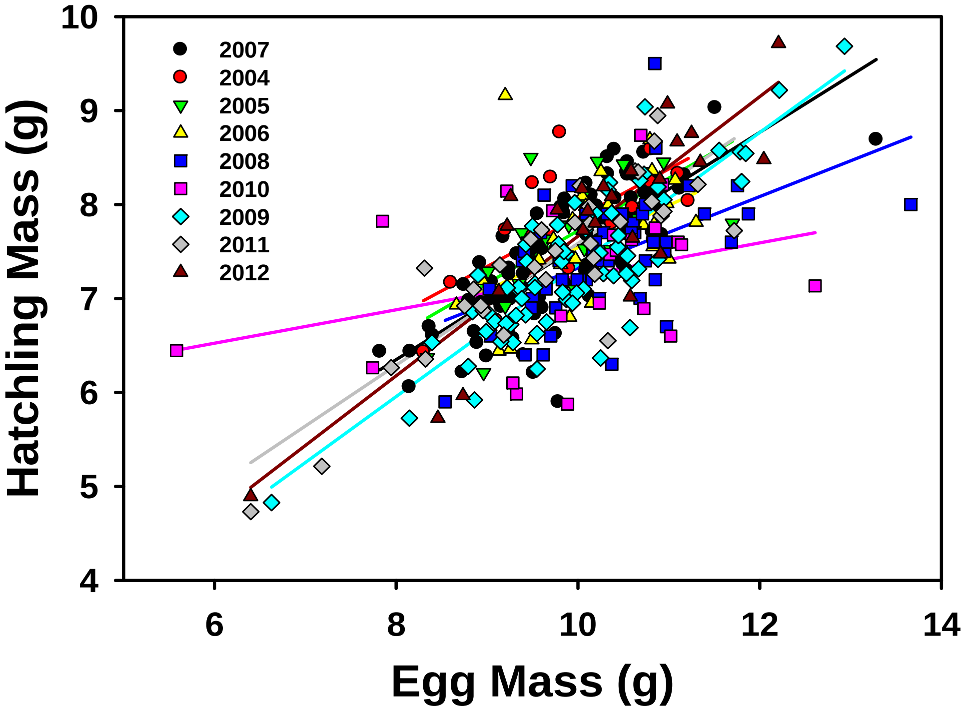

Figure 4. The relationship between average egg mass and average hatchling mass by clutch for 9 years on Poplar Island. The relationship is similar for all years except 2010 when the slope decreased.

	2006	2007	2008	2009	2010	2011	2012
Total Nests - Notch & Outside of Cell 5	146	170	183	159	124	178	172
Depredated Nests and Nests destroyed before fall emergence	47 (32.2%)	18 (10.6 %)	17 (9.3%)	12 (7.5%)	4 (3.2%)	15 (8.4%)	46 (26.7%)
Fall Emerging Nests	49 (33.6%)	92 (54.1%	113 (61.7%)	68 (42.8%)	77 (62.1%)	134 (75.3%)	62 (36.0%)
Nests Over-wintering	44 (30.1%)	60 (35.3%)	44 (24.0%)	74 (46.5%)	21 (16.9%)	22 (12.4%)	40 (23.3%)
Spring Emerging Nests	33 (22.6%)	50 (29.4%)	40 (21.9%)	66 (41.5%)	21 (16.9%)	22 (12.4%)	40 (23.3%)
Over-wintering Nests that did not Emerge	6 13.6%	4 (2.4%)	4 (2.2%)	8 (5.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Unknown Nests	11 (7.5%)	6 (3.5%)	9 (4.9%)	5 (3.1%)	5 (4.0%)	7 (3.9%)	25 (14.5%)
Both Fall & Spring Emerging Nests	1 (0.7%)	0 (0%)	1 (0.5%)	4 (2.5%)	4 (3.2%)	4 (2.2%)	12 (7.0%)

Table 4 – Nest fate and overwintering percentage of the nests during the 2006 – 2012 nesting seasons on Poplar Island.

Researchers also PIT tagged terrapins that were part of the AE, NAIB, and MES head-start programs. Researchers tagged and processed 223 terrapins in April 2013 (Appendix 3). During May, June, and July 2013 head-started hatchlings were transported to Poplar Island and were released for the first inside the wetlands in Cell 1A and Cell 1B in addition to the releases in the Notch, Cell 4D and Cell 3D. Two hatchlings died during the rearing phase of the project.

Vegetation Removal Experiment

Details of the vegetation removal experiment are provided in Appendix 4: Undergraduate Honors Thesis for ElizaBeth Clowes at Ohio University, which was successfully defended in May 2013. Herein is a brief summary of the major findings of the experiment.

More nests were discovered in the vegetation removal plots than in the control plots (Table 5) indicating that terrapins select open sandy areas and use areas with dense vegetation less frequently on Poplar Island. Because the vegetation in Block 1 (North end of the Notch) was distinctly different from the other four blocks (see Appendix 4, Figure 5), data also were analyzed with Block 1 removed. The number of nests in open areas remained greater than control areas (Table 5). This result demonstrates that open areas with no or sparse vegetation are preferred and is a potential explanation for the decrease in nesting that has occurred outside Cell 5 where the vegetation has become both tall and dense (Figure 5).

SCENARIO	NULL PROBABILITY (EQUAL PREFERENCE)	NESTS IN EXPERIMENTAL PLOTS	NESTS IN CONTROL PLOTS	TOTAL COMBINED TRIALS (ALL CONTROL V. ALL EXP)	EXACT P-VALUE CALCULATED
ALL PLOT SETS	0.5	18	4	22	0.004344
BLOCK 1 EXCLUDED	0.5	13	1	14	0.001831

Table 5. Final combined nest counts and calculated P-values (binomial exact test, two-tailed). Given major differences between control and experimental plots in Block 1, its nests were excluded and a second calculation was performed.

Vegetation encountered in the plots was dominated by switchgrass (*Panicum virgatum)* (Table 6), which frequently was greater than 1m in height and occurred in clumps with dense root mats that are impenetrable for a digging female terrapin. Although switchgrass is an excellent perennial species for erosion control in nutrient poor substrates, such as the sandy dikes on Poplar Island, it reduces potential nesting sites for terrapins. Its tall stature also hinders the terrapins in sighting potential nesting areas that may lay beyond the grasses further inland.

COMMON NAME	SCIENTIFIC NAME	% DAUBENMIRE	% TRANSECT
SMOOTH CORDGRASS	*SPARTINA ALTERNIFLORA*	20.0	13.3
SWITCHGRASS	*PANICUM VIRGATUM*	83.3	76.7
SALTMARSH HAY	*SPARTINA PATENS*	53.3	36.7
COMMON LAMBSQUARTER	*CHENOPODIUM ALBUM*	20.0	13.3
BLACK-EYED SUSAN	*RUDBECKIA HIRTA*	16.7	6.7
SEA ROCKET	*CAKILE EDENTULA*	3.3	0.0
BARNYARD GRASS	*ECHINOCHOLOA WALTERI*	30.0	16.7
REDTOP	*AGROSTIS ALBA*	10.0	13.3
FIELD BROMEGRASS	*BROMUS ARVENSUS*	60.0	50.0
LITTLE BLUESTEM	*SCHIZACHYRIUM SCOPARIUM*	23.3	23.3
VIRGINIA PEPPERWEED	*LEPIDIUM VIRGINICUM*	23.3	26.7
TRAILING FUZZY BEAN	*STROPHOSTYLES HELVOLA*	10.0	6.7
HORSEWEED	*CONYZA CANADENSIS*	60.0	50.0
ANNUAL WORMWOOD	*ARTEMISIA ANNUA*	3.3	0.0
WINGED PIGWEED	*CYCLOLOMA ATRIPLICIFOLIUM*	3.3	0.0
SALT MARSH FLEABANE	*PLUCHEA PURPURASCENS*	3.3	0.0
EVENING PRIMROSE	*OENOTHERA BIENNIS*	3.3	0.0
GROUNDSEL TREE	*BACCHARIS HALIMIFOLIA*	3.3	6.7

Table 6. Plant species found on Cell 5 exterior dike at Poplar Island. Percentages of occurrence in modified Daubenmire and transect sampling are displayed.

The results of the vegetation removal experiment suggest that open areas for terrapin nesting should be maintained on Poplar Island to ensure high levels of successful nests. The shift in nesting density from Cell 5, where vegetation has increased both in stature and density, to the north side of the Notch where the 2011 wind erosion of the sand from the Cell 4AB stock piles has maintained open sandy areas reflects natural support for the results reflected in this vegetation removal experiment. Perhaps the most interesting outcome of this experiment is how successful the small experimental plots (10m x 4m) were in attracting nesting females, suggesting that the size of the open areas can be relatively small to successfully attract nesting terrapins.

Highlights of the 2012 Field Season

Two interesting observations occurred during the 2012 field season. First, researchers located the first female terrapin that was marked as a Poplar Island hatchling (2004) returning to nest. The female terrapin was caught by MES personnel in the vicinity of the trailers in the center of the island (Figure 1); she likely emerged from Cell 4D. The female was gravid (carrying eggs) and had come ashore to nest. Her origin from Poplar Island was confirmed by the presence of a CWT and notch code identifying her from the 2004 cohort and thus was an 8-year-old female. The second highlight was the capture of three hatchling eastern mud turtles (*Kinosternon subrubrum*) in the Notch, suggesting that mud turtles are reproducing on the island. Mud turtles have been recovered in the past in the Notch area but never any indication of nesting. These three

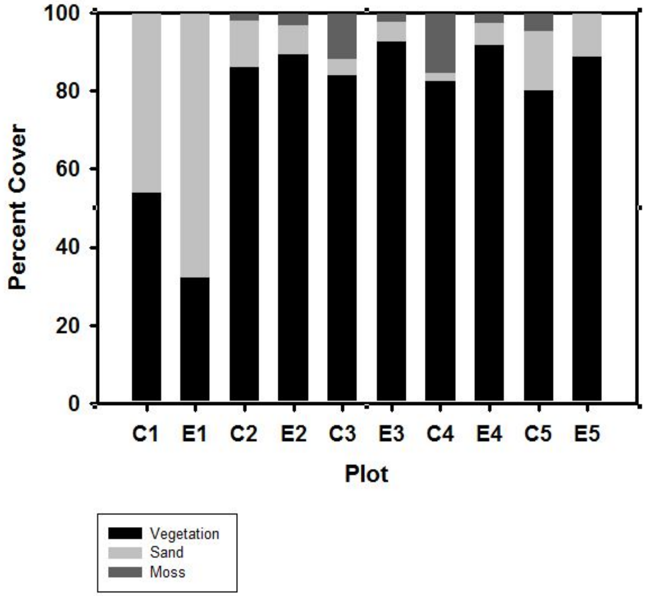

Figure 5. Percent ground cover and open substrate in control and experimental plots prior to vegetation removal based on Daubenmire Frame sampling.

hatchlings were caught in the drift fence surrounding one of the vegetation removal plots, which suggests that they are nesting on Poplar Island.

CONCLUSIONS

2012 was an average year for terrapin nesting, however the higher than normal predation rates of nests outside Cell 5 resulted in decreasing nest survival to 50% and thereby reduced the number of hatchlings recovered. Most of this nest predation was caused by deer mice that were trapped by researchers in the vicinity of the nests. It is possible that the population of deer mice cycles in responses to resources (primarily seeds from grasses and forbs) and that there may have been a peak in the deer mouse population during 2012 that coincided with the terrapin nesting season. Evaluating the level of mouse predation in 2013 may help distinguish between a cyclical or an increasing population level of deer mice on Poplar Island. Nonetheless, Poplar Island continues to provide excellent nesting habitat for terrapins since the completion of the perimeter dike. Nest survivorship remains high on Poplar Island relative to the Patuxent River mainland population (Roosenburg, 1991) mainly because the primary nest predators are absent from the island, and avian predation is reduced by the hardware cloth laid over the nests. Unfortunately the hardware cloth placed over the nests is not an effective deterrent for mice. In those areas on Poplar Island where mouse predation was not a problem, nest survivorship remained high due to the lack of raccoons and foxes that decimate nests on mainland nesting sites.

The sand stockpile in Cell 4AB and its erosion by wind in 2011 created high quality (open sandy) terrapin nesting habitat in the Notch. The large deposit of sand created a large sand dune in the Notch that continued to attract terrapins to nest in 2012. Furthermore, windblown erosion created open sandy areas in Cell 4D and the Notch that were previously overgrown with vegetation. Indeed, Figure 3 illustrates the high density nesting that occurred in these areas of newly formed nesting habitat, including nests on the actual sand pile in Cell 4AB. However, when this sand source is depleted for construction vegetation will likely colonize and deteriorate the quality of the nesting habitat. Targeting of vegetation-free areas by nesting females indicates the need to maintain these types of habitat throughout the island to provide high quality nesting habitat on Poplar Island. This conclusion also was supported by the vegetation removal experiment which demonstrated that terrapins placed more nests in the open cleared areas than in the control areas. Researchers are concerned by the increasing vegetation, particularly outside Cell 5 and in the Notch. The accumulated sand in the northern portion of the Notch and the southern boundary of Cell 4D made available large portions of suitable nesting habitat (with little vegetation) that was used heavily during 2012. The number of nests found annually also indicates that 70-125 adult females are using Poplar Island for nesting. This estimate is based on a maximum reproductive output of three clutches per year per female, as has been observed in the Patuxent River population (Roosenburg and Dunham, 1997).

During 2012, the researchers conducted twice daily surveys of the nesting areas in the Notch, outside Cell 5, and outside Cell 3, in addition to once daily surveys in Cell 4D, Cell 3D, Cell 1A, Cell 1B, and Cell 1C. This was possible because one researcher was dedicated full-time to locating terrapin nests and three other OU researchers assisted her throughout the nesting season. The researchers discovered 29 nests by noting hatchlings emerging after the nesting season had ended, and confirmed the nest with the presence of egg shells. Many of these nests were probably laid during the weekends of the nesting season when researchers could not complete nesting surveys. Furthermore, the extremely dry conditions during July make it more difficult to locate recently laid nests because the disturbances in the sand that identify nests erode quickly in dry soils.

Raccoons, foxes, and otters are known terrapin nest predators and contribute to low nest survivorship in areas where these predators occur, sometimes depredating 95% of the nests (Roosenburg, 1994). The lack of raccoons on Poplar Island minimizes the risk to nesting females (Seigel, 1980; Roosenburg, pers. obs.). Nest predation in 2012 increased because of the high predation rates by mice on the nesting area outside Cell 5. Nonetheless, the absence of efficient nest and adult predators on Poplar Island generated nest and adult survivorship rates that remain higher compared to similar nesting areas with efficient predators. As was similarly observed in 2002 through 2011 (Roosenburg and Allman, 2003; Roosenburg and Sullivan, 2006; Roosenburg and Trimbath, 2010; Roosenburg et al., 2004; 2005; 2007; 2008, 2011), the nest survivorship and hatchling recruitment on Poplar Island continues to be higher relative to mainland populations.

Poplar Island produced 961 hatchlings during the 2012 nesting season. Hatchlings started emerging from the nests on 30 July 2012; the last hatchlings were excavated on 21 May 2013. This was made possible because Willem Roosenburg was on sabbatical during the spring of 2013 and thus was able to visit the island weekly after the 1st of April. Researchers released all of the hatchlings in the wetlands of Cell 4D, Cell 3D, Cell 1A, and Cell 1C, however many of the hatchlings released in September and October 2012 clearly preferred to stay on land as opposed to remaining in the water, because hibernating in water may be physiologically more costly than hibernating on land.

During the winter of 2012-2013, 40 nests overwintered successfully. The recovery of 221 hatchlings from overwintering nests confirms overwintering as a successful strategy used by some terrapin hatchlings. However, excavation of many of these nests in the following spring discovered dead eggs, indicating that these nests never developed successfully during the summer incubation period. Other nests contained empty egg shells from which hatchlings had emerged but had escaped the ring. In these cases it was impossible to confirm whether these nests emerged in the fall or the spring. Continued studies of overwintering and spring emergence will be conducted to better understand the effect of overwintering on the terrapin's fitness, life cycle, and natural history. Poplar Island offers a wonderful opportunity to study terrapin overwintering because of the large number of nests that survive predation.

The educational program conducted in collaboration with AE, NAIB, and MES successfully head-started many terrapins. Students increased the size of the hatchlings they raised to sizes characteristic of 2-5 year old terrapins in the wild. All hatchlings were PIT tagged to determine the fate of these hatchlings in the future through the continued mark-recapture study, which is sponsored by Maryland Department of Natural Resources (MD-DNR). During the summer of 2009-2012 mark-recapture efforts in the Poplar Island Harbor and the area between Poplar and Coaches Island have relocated several headstart and natural release hatchlings. The preliminary results indicate that some terrapins from the island are remaining within the archipelago and surviving. Researchers were rewarded this year with the return of a Poplar Island hatchling as an onsite nesting adult from the 2004 cohort. The presence of CWTs in this individual confirmed its origin from Poplar Island.

The initial success of terrapin nesting on Poplar Island indicates that similar projects also may create suitable terrapin nesting habitat. Although measures are taken on Poplar Island to protect nests, similar habitat creation projects should have high nest success until raccoons or foxes colonize the project. Throughout their range, terrapin populations are threatened by loss of nesting habitat to development and shoreline stabilization (Roosenburg, 1991; Siegel and Gibbons, 1995). Projects such as Poplar Island combine the beneficial use of dredged material with ecological restoration, and can create habitat similar to what has been lost to erosion and human practices. With proper management, areas like Poplar Island may become areas of concentration for species such as terrapins, thus becoming source populations for the recovery of terrapins throughout the Bay.

The Poplar Island FMD identifies three purposes for the terrapin monitoring program. The first purpose is to quantify terrapin use of nesting and juvenile habitat on Poplar Island, including the responses to change in habitat availability throughout the progression of the project. The current monitoring program is detailing widespread use of the island by terrapins, evidenced by a comparable number of nests found relative to mainland sites in the Patuxent River as well as the recovery of several marked individuals in our mark-recapture study. The second purpose is to evaluate the suitability of the habitat for terrapin nesting through determining hatchling viability, recruitment rates, and sex ratios. The high nest success and hatching rates on Poplar Island indicate the island provides high quality terrapin nesting habitat, albeit limited in availability because of the rock perimeter dike around most of the island. The third purpose is to determine if the project is affecting terrapin population dynamics by increasing the amount of juvenile and nesting habitat on the island. During 2012, OU researchers initiated the first intensive trapping in wetland cells (funded by MD-DNR) and recaptured large numbers of both headstart and wild hatchlings that originated from Poplar Island. Furthermore the discovery of nests and nesting females on the dikes around completed wetland cells indicates that terrapins are using and this newly created habitat.

The Poplar Island FMD also identifies three hypotheses for the terrapin monitoring program. Hypothesis one is that there will be no change in the number of terrapin nests or the habitat used from year to year. During 2012 researchers discovered 200 nests, which is not statistically different from the mean of 207 nests per year supporting this hypothesis. Hypothesis two states that nest survivorship, hatchling survivorship, and sex ratio will not differ between Poplar Island and reference sites. This hypothesis is rejected as nest success and hatchling survivorship is much higher on Poplar Island because of the lack of major nest predators, and the sex ratio of hatchlings on Poplar Island is highly female biased. Hypothesis three states that there will be no change in terrapin population size on Poplar Island; particularly within cells from the time the cells are filled, throughout wetland development, and after completion and breach of the retaining dike. The status of this hypothesis remains undetermined as there is not enough data currently to form a conclusion.

RECOMMENDATIONS

Terrapin nesting is expanding on Poplar Island as wetland cell completion creates both access to and availability of nesting habitat. The discovery of nests on the dikes of Cells 3D, 4D, 1A, 1B, and 1C indicate that female terrapins are entering wetlands and using them as access routes to nesting areas. Researchers have frequently noted terrapins inside wetland Cells 4D and 3D. Although the dikes around the new wetland cells, particularly Cell 3D,1A, 1B, and 1C, are sufficiently elevated for terrapin nesting, the amount of nesting activity could potentially increase if open sandy areas were created strategically near inlets and open water within the cells. Particularly, the terminal ends of the cross dikes that lie between Cells 1AB and 1BC could attract terrapin nesting because of their proximity to the channels (Figure 6). OU researchers recommend supplementing sand and maintaining open areas that could attract nesting females to these areas. As the nesting beach outside Cell 3AC continues to decrease in size and the vegetation continues to increase in the Notch and outside Cell 5, the amount of accessible high quality nesting habitat is decreasing. The accumulation of sand in the Notch during 2010-2012 has created open sandy habitat that was heavily used by terrapins during the 2012 nesting season, indicating that the availability of open sandy habitat can enhance terrapin nesting activity on the island. The outcome of this natural experiment and the vegetation removal experiment suggest that short and long-term measures can be taken to improve nesting habitat and thereby increase nesting on the island, particularly as the terrapin population expands.

Figure 6. Aerial photo of the cross dikes between Cells 1A/B and B/C (still under construction) highlighting potential nesting areas that could be expanded and maintained vegetation free with minimal danger of erosion.

The northeast expansion of Poplar Island provides an opportunity and the recommendation to create dedicated terrapin nesting habitat in the sheltered areas of Poplar Harbor between Poplar Island and Jefferson Island. In particular, areas to be built to the northeast of Jefferson Island would be ideal for creating terrapin nesting habitat. The creation of these nesting areas could help offset the natural loss of nesting habitat that has occurred on the outside of Cell 3C in recent years. Although this area of the expansion is proposed to be an upland cell, the creation of offshore bulkheads and backfilling of sand as illustrated in Figure 7 could provide a large amount of terrapin nesting habitat in an area where terrapins have been captured in high concentrations. Building structures such as those illustrated in Figure 7 on the outside of the barrier dike would preclude the need to build additional fencing to prevent turtles from getting into the cells under construction. Furthermore, nesting areas without marsh and beach grasses could be provided for terrapin nesting habitat within the cells under construction. Because terrapins avoid nesting in areas with dense vegetation (Roosenburg 1996), providing open, sandy areas on the seaward side of the dikes should reduce efforts by terrapins to enter cells under construction to find suitable, open areas.

Predator control on the island will be paramount to the continued success of terrapin recruitment and therefore, continuation is recommended. The continued lack of raccoon and fox populations will maintain the high nest survivorship observed in 2002 through 2012. At this time it is uncertain if the nest predation by mice will continue to decrease nest survival in Cell 5. Researchers will continue to monitor nesting and predation in this area and if necessary implement a trapping program to reduce the mouse population in future years. At this time researchers are unaware of a successful non-lethal method to reduce the mouse population. The high nest success due to screens placed over the nests is an effective mechanism to reduce crow predation. A sustained program to eliminate mammalian predators and prevent avian predation will facilitate continued terrapin nesting success on Poplar Island.

Figure 7 – Shoreline stabilization and the creation of terrapin nesting habitat in Calvert County Maryland – Red dots indicate terrapin nests.

Researchers also recommend the continuation of terrapin nesting monitoring on Poplar Island. The area of newly deposited sand in the Notch with little vegetation creates a natural experiment that will allow us to evaluate how the creating new nesting areas may benefit nesting activity on the island. Furthermore, continuation of the experimental removal of vegetation in parts of Cell 5 and the Notch as a mechanism to increase nesting densities where it has declined in recent years is recommended. Additionally, continued monitoring will document the further expansion and use of terrapin habitat on the island (the purpose of this monitoring as listed in the FMD). During 2012, the first nests in Cell 1C and Cell 1B were discovered after these cells were opened to tidal flow, thus allowing access to nesting sites within those cells. OU researchers plan to continue to include additional cells into the nesting surveys as the wetland cells are completed.

Finally, researchers recommend the continuation of the head-start/education program. The terrapin is an excellent ambassador for the island because of its charismatic nature, but also because the project has successfully created habitat for this species. Thus the terrapin education program is an extremely effective mechanism to teach about Poplar Island and its environmental restoration. The message that terrapins provide is not only absorbed by K-12 students, but by all visitors to the island and therefore is an invaluable tool to promote Poplar Island. These five recommendations offered by OU will contribute to continuing and increasing public and scientific understanding of the effect of Poplar Island on terrapin populations and promotes their use as stewards for Poplar Island.

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Nest Number	Date	Latitude	Longitude	Cell #	Predation	Clutch Size	Total Mass	Average Mass	Number Hatch	Comments
1	23-May-12	38.75256	76.37452	Notch	N	13	130.1	11.83	3	Laid by PI 1919; 3 hatch 10-Aug-12; Dug 2-Apr-13 (1 dead egg-empty shells-hatched but not caught-probably sanded over)
2	25-May-12	38.76087	76.38004	3	N				12	Old nest; 12 hatch and 2 dead eggs 27-Jul-12
3	25-May-12	38.75269	76.37442	Notch	N	15	141.3	9.42	·	EXP-1; 11-Apr-13 sand removed from ring; Nest dug completely 30-Apr-13, nothing found
4	29-May-12	38.76067	76.37993	3	N	13	139.8	10.75	4	1 hatch 3-Aug-12; 1 hatch 4-Aug-12; 1 hatch 14-Aug-12; 1 hatch died in shed, 1 dead egg 30-Aug-12
5	29-May-12	38.75628	76.37440	Notch	N	12	129.2	10.77	3	EXP-1; 3 hatch (2 live/1 dead) found 4-Aug-12
6	29-May-12	38.75232	76.37464	Notch	N				13	Old nest; 12 hatch 3-Aug-12; 1 hatch 13-Aug-12
7	29-May-12	38.75217	76.37466	Notch	N	13	141.3	10.87	13	CON-1; 13-Aug-12 Found 4 hatch; 23-Apr-13 Dug, 9 hatch and 3 dead eggs; May have been laid on another nest
8	29-May-12	38.75159	76.37466	Notch	N				2	Eggs too soft to dig up; 2-Apr-13 ring fully filled with sand; 17-May-13--1 hatch; 20-May-13--1 hatch; 23-May-13 nest dug up, no shells/hatch/eggs found
9	29-May-12	38.75120	76.37418	Notch	N	11	132.5	12.05	10	2-Apr-13 small hole, possible emergence hole, nothing near nest- left; 16-Apr-13 found 10 hatch
10	29-May-12	38.75072	76.37009	5	N	12	140.7	11.73	8	EXP-4; 8 hatch 12-Sep-12
11	29-May-12	38.75038	76.36909	5	Y	11	118.0	10.73	0	Partial pred 10 July, full 25 July
12	29-May-12	38.75016	76.36857	5	Y	11	110.2	10.02	0	EXP-5; Partially depredated (date unknown); 23-May-13 nest dug up, 6 dead eggs only
13	29-May-12	38.75016	76.36864	5	N				11	Old nest; 16-Apr-13 Found 10 hatch, nest dug, 1 depredated hatch and 1 dead egg
14	29-May-12	38.75005	76.36828	5	N	15	138.9	9.26	14	14 hatch 27-Aug-13
15	29-May-12	38.74955	76.36712	5	Y				3	Old nest, Partial pred 30 July, 3 hatch discovered
16	29-May-12	38.75518	76.37980	4D	N	16	151.5	9.47	7	Could not get accurate bottom depth
17	30-May-12	38.76098	76.38009	3	Y	14	178.4	12.74	·	Full predation on unknown date- no remaining eggs
18	31-May-12	38.75168	76.37466	Notch	N	19	183.9	9.68	5	No top depth; 2 hatch 5-Aug-12; 1 hatch,2 dead hatch, 9 'bad' eggs 14-Aug-12
19	31-May-12	38.75135	76.37440	Notch	·	17	116.1	6.83	8	2 hatch 24-Aug-12; 5 hatch 27-Aug-12; 1 hatch 4-Sept-12; 10 Sept, at least 5 dead eggs, possible predation
20	31-May-12	38.75164	76.37242	5	Y	17	145.3	8.55	13	Laid by PI 1631, Partial predation 13 Aug; 6 hatch 8-Aug-12; 2 hatch 9-Aug-12; 4 live hatch 13-Aug-12 plus 1 depredated hatch
21	31-May-12	38.75001	76.36829	5	N	14	153.8	10.99	14	14 hatch on 27-Aug-12
22	31-May-12	38.74981	76.36784	5	Y	7	83.2	11.89	3	Predation 26 July, 3 hatchlings found (2 alive, 1 dead)
23	31-May-12	38.74950	76.36712	5	N	10	102.7	10.27	2	Dug up 15-May-13, 3 dead eggs, 2 hatch
24	31-May-12	38.76078	76.38003	3	N	14	129.1	9.22	14	7 hatch 9-Aug-12; 3 hatch 20-Aug-12; 3 hatch 17-Sep-12; 1 hatch 20-Sep-12
25	1-Jun-12	38.75153	76.37461	Notch	N	16	165.2	10.33	0	23-May-13 nest dug up, 14 dead eggs only
26	1-Jun-12	38.74983	76.36783	5	N	14	140.8	10.06	12	12 hatch 21-Aug-12
27	1-Jun-12	38.74944	76.36688	5	N	14	152.6	10.90	·	2-Apr-13 Washed out; fate of nest unknown
28	4-Jun-12	38.75025	76.36879	5	Y				5	Found by king snake eating eggs, old nest; 3 hatch 4-Sep-12; 16-Apr-13 Found 1 live hatch & 1 depredated hatch
29	4-Jun-12	38.75013	76.36862	5	N				·	EXP-5; Old nest; 7-May-13 Emergence hole but nothing found

Nest Number	Date	Latitude	Longitude	Cell #	Predation	Clutch Size	Total Mass	Average Mass	Number Hatch	Comments
30	4-Jun-12	38.76070	76.37990	3	N				0	Old nest; 5 dead eggs when dug up 8-Oct-12
31	4-Jun-12	38.76064	76.37993	3	N				10	Old nest, 19 September nest washed away from very high tide
32	4-Jun-12	38.76711	76.37933	1A	N				·	Old nest; Dug 19-oct-12 shells found only; no hatch captured
33	5-Jun-12	38.76065	76.37990	3	N				12	Old nest; 2 hatch 3-Aug-12; 3 hatch 4-Aug-12; 2 hatch 5-Aug-12; 1 hatch 10-Aug-12; 4 hatch 13-Aug-12
34	7-Jun-12	38.75148	76.37195	5	Y				1	Old nest, Partial predation 26 July and 1 Aug; 1 dead hatch found but too decayed to process; dug 8-Oct-12 nothing found
35	8-Jun-12	38.75107	76.37392	Notch	N				13	Old nest; 16-Apr-13 Nest dug, 13 hatch, 1 dead egg
36	8-Jun-12	38.75123	76.37131	5	Y				9	Old nest, 8 hatch 8-Aug-12; 1 hatch and partial predation 13-Aug-12
37	8-Jun-12	38.74954	76.36704	5	Y				0	Old nest; Full predation date unknown
38	11-Jun-12	38.76066	76.37994	3	N	14	170.9	12.21	14	14 hatch 16-Aug-12
39	11-Jun-12	38.75346	76.37380	Notch	Y	15	151.1	10.07	7	Partial predation 11 June, King snake; 4 hatch 13-Aug-12; 1 hatch 14-Aug-12; 1 hatch 15-Aug-12; 1 hatch 25-Oct-12
40	11-Jun-12	38.75276	76.37427	Notch	N	16	160.7	10.04	16	15 hatch 24-Aug-12; 1 hatch 28-Aug-12
41	11-Jun-12	38.75274	76.37427	Notch	N				1	Old nest; 20-May-13--1 dead hatch; 23-May-13 dug up 1 dead egg
42	11-Jun-12	38.75272	76.37426	Notch	N	17	155.2	9.13	17	17 hatch 17-Aug-12
43	11-Jun-12	38.75238	76.37400	Notch	N	14	157.5	11.25	14	Data sheet had only three digits for long, check with GPS unit; 14 hatch 18-Sep-12
44	11-Jun-12	38.75232	76.37466	Notch	N	13	126.4	10.58	11	5 hatch 14-Aug-12; 5 hatch 15-Aug-12; 1 hatch and 1 dead egg when dug up 25-Oct-12
45	11-Jun-12	38.75209	76.37471	Notch	N				2	Old nest; 4-Sep-12--1 hatch; 16-Apr-13 1 hatch; 23-Apr-13 possible exit hole discovered; sand dug out 30-Apr-1; 7-May-13 sand dug out; 23-May-13 nest dug up, 1 dead egg
46	11-Jun-12	38.74952	76.36706	5	N	14	143.7	10.26	3	4-May-13 found 1 hatch; 7-May-13 Nest dug, 2 hatch, 7 dead eggs
47	11-Jun-12	38.75234	76.37454	Notch	N	11	119.9	10.90	10	10 hatch 27-Aug-12
48	11-Jun-12	38.77013	76.37905	1C/D	Y				0	Found depredated, Herring gull
49	12-Jun-12	38.75161	76.37465	Notch	N	13	147.5	11.35	10	15-Aug-12--9 hatch; 2-Apr-13 Ring partially filled;20-May-13--1 hatch; 23-May-13 nest dug up, 1 dead egg with possible root predation
50	12-Jun-12	38.75045	76.36883	5	N	12	88.4	7.37	·	2-Apr-13 discovered washed out; fate of nest unknown; 1 depredated eggshell
51	6/14/12012	38.75334	76.37390	Notch	N	15	172.4	11.49	1	13-Sep-12--1 hatch; 23-May-13 dug up nest, 3 dead eggs
52	14-Jun-12	38.75015	76.36856	5	N				12	EXP-5; Old nest; 23-Aug-12 4 hatch; 24-Aug-12 2 hatch; 16-Apr-13 5 hatch and 1 dead egg
53	14-Jun-12	38.76709	76.37934	1C	N				14	Old nest; 14 hatch 19-Oct-12
54	14-Jun-12	38.75004	76.36840	5	Y				10	Old nest, Partial predation 20 July; 10 hatch 26-oct-12
55	15-Jun-12	38.75239	76.37461	Notch	N	18	185.7	10.92	4	1 egg popped while digging; 16-Apr-13 ring fill dug out; 30-Apr-13 sand dug out again; 4-May-13 found 2 hatch; 15-May-13 found 1 hatch; 23-May-13 dug up nest, 3 dead eggs
56	15-Jun-12	38.75201	76.37469	Notch	N				10	Old nest; 2-Apr-13 filled 2" above ring; 11-Apr-13 sand dug out again; 23-Apr-13 sand dug out; 30-Apr-13 dug out again; 15-May-13 dug out again, 2 hatch; 16-May-13 found 1 hatch; 20-May-13 found 2 hatch; 21-May-13 found 3 hatch; 23-May-13 nest dug up, 1 hatch, 5 dead eggs

Nest Number	Date	Latitude	Longitude	Cell #	Predation	Clutch Size	Total Mass	Average Mass	Number Hatch	Comments
57	15-Jun-12	38.75012	76.36855	5	N	12	115.5	9.63	8	EXP-5; 16-Apr-13 Discovered 8 hatch, 1 dead egg; 7-May-13 sand dug out
58	18-Jun-12	38.75292	76.37425	Notch	N	16	164.1	10.26	8	2-Apr-13 ring filled to top; 11-Apr-13 sand removed again; 23-Apr-13 sanded over again, dug out, 8 hatch
59	18-Jun-12	38.75018	76.36870	5	Y				0	Old nest, Full predation 16 July
60	18-Jun-12	38.75037	76.36914	5	Y				0	Full depredation upon discovery
61	18-Jun-12	38.74946	76.36688	5	N	13	141.3	10.87	·	2-Apr-13 Washed out; fate of nest unknown
62	19-Jun-12	38.76105	76.38012	3	Y	6	76.1	12.68	0	Open nest, eggs were visible; Full depredation-date unknown
63	20-Jun-12	38.75161	76.37465	Notch	N	17	167.2	9.84	12	5 hatch 22-Aug-12; 1 hatch 23-Aug-12; 6 hatch 24-Aug-12; ~4 dead eggs discovered when dug up
64	20-Jun-12	38.75113	76.37353	Notch	N	15	140.4	9.36	8	EXP-2; 13-Sep-12--8 hatch; 23-May-13 nest dug up, 7 dead eggs
65	21-Jun-12	38.75119	76.37321	Notch	Y				0	Old nest; partial predation on unknown date; dug up 16-Aug-12, 8 dead eggs
66	21-Jun-12	38.76087	76.38010	3	Y	18	154.7	8.59	10	Partial predation 27 July and 13 Aug; 8 hatch and 2 dead hatch 13-Aug-12
67	22-Jun-12	38.75118	76.37118	5	Y				0	Old nest, Partial predation 25 June; full predation on unknown date
68	22-Jun-12	38.75097	76.37068	5	Y				6	Old nest, Partial predation 30 July and 1 Aug; 1 hatch found alive but died 1-Aug-12; 3 dead hatch 2-Aug-12; 1 dead hatch 3-Aug-12; 2 hatch found 18-Sep-12
69	22-Jun-12	38.75091	76.37053	5	Y				0	Found predated outside of the fence, probable mammal
70	22-Jun-12	38.75023	76.36893	5	N	10	84.6	8.46	8	30-Apr-13 Dug up 8 hatch, 1 dead egg
71	22-Jun-12	38.74986	76.36784	5	N	12	108.3	9.03	5	1 hatch 1-Oct-12; Nest was located on a steep slope due to heavy rains, partial erosion took place around the ring on 2 October and hatchlings could have been missed, 4 hatch discovered same day (2 October)
72	25-Jun-12	38.75303	76.37414	Notch	N	13	131.4	10.11	13	12 live and 1 dead hatch 22-Aug-12
73	25-Jun-12	38.75263	76.37442	Notch	N	11	113.1	10.28	10	EXP-1; 3 hatch 4-Sep-12; 6 hatch 5-Sep-12; 1 hatch 6-Sep-12
74	25-Jun-12	38.75255	76.37447	Notch	N	14	153.9	10.99	7	4-Sep-12 found 4 hatch; 20-May-13 nest dug up, 3 hatch, rest likely escaped
75	25-Jun-12	38.75234	76.37466	Notch	N				13	Old nest; 1 hatch 24-Aug-12; 5 hatch 30-Aug-12; 7 hatch 31-Aug-12; 6 dead eggs 25-Oct-12
76	25-Jun-12	38.75191	76.37471	Notch	N	14	151.3	10.81	0	Same ring as 77; 23-Apr-13 dug out sand; 15-May-13 dug out sand; 21-May-13 dug up (with 77)--21 dead eggs
77	25-Jun-12	38.75191	76.37471	Notch	N				0	Found next to nest 76; same ring; dug out sand on 23-Apr-13; dug out 30-Apr-13; 15-May-13 dug out sand; dug up 21-May-13 with nest 76--21 dead eggs
78	25-Jun-12	38.75101	76.37071	5	Y				0	Full predation by probably King snake
79	25-Jun-12	38.75012	76.36856	5	N				14	EXP-5; Old nest; 2 hatch 27-Aug-12; 4-May-13 found 4 hatch; 7-May-13 found 8 hatch
80	25-Jun-12	38.75011	76.36847	5	N	12	133.1	11.09	11	Logger ended on 15 Aug; 9 hatch and 2 dead hatch
81	27-Jun-12	38.74978	76.36778	5	Y				8	Old nest; 7 hatch 24-Aug-12; 1 hatch and 4 dead eggs 25-Oct-12
82	29-Jun-12	38.75282	76.37428	Notch	Y	13	143.1	11.01	4	1 hatch 4-Sep-12; 3 hatch 17-Sep-12; 11-Apr-13 Sand removed from ring; 7-May-13 sand dug out; 23-May-13--dug up 3 dead eggs

Nest Number	Date	Latitude	Longitude	Cell #	Predation	Clutch Size	Total Mass	Average Mass	Number Hatch	Comments
83	2-Jul-12	38.75265	76.37443	Notch	N				3	EXP-1; Old nest; 16-Apr-13 ring fill dug out; 23-Apr-13 dug, 3 hatch
84	2-Jul-12	38.75350	76.37375	Notch	Y				.	Old nest; 2-Apr-13 ring filled, possible hatch escape; 23-May-13--dug up 4 dead eggs, root predation
85	2-Jul-12	38.75294	76.37414	Notch	N				9	Old nest; 2-Apr-13 nest not rung in fall, sand dug out 9 live hatchlings found
86	2-Jul-12	38.75250	76.37458	Notch	N				.	Old nest; Nest dug up 20-May-13, 4 dead eggs, hatch likely escaped
87	2-Jul-12	38.75246	76.37459	Notch	N				2	Old nest; 20-May-13 nest dug up, 2 hatch, 2 dead eggs, rest of hatch likely escaped
88	2-Jul-12	38.75225	76.37468	Notch	N				2	Old nest; 11-Apr-13 sand removed from ring and 1 hatch emerged; 16-Apr-13 1 hatch, nest dug up, empty shells only
89	2-Jul-12	38.75123	76.37323	Notch	Y				0	Old nest, Partial predation 10 July, Full predation 16 July
90	2-Jul-12	38.75096	76.37073	5	Y				0	Found fully predated
91	2-Jul-12	38.75081	76.37027	5	N				.	CON-4; Old nest; 23-May-13 nest dug up, only eggshells found
92	2-Jul-12	38.75070	76.37004	5	Y				0	Old nest, Partial predation 23 July, Full predation 25 July
93	2-Jul-12	38.75068	76.36998	5	N				9	Old nest; 11-Apr-13 Emergence hole, nest dug, 9 hatch found
94	2-Jul-12	38.74952	76.36709	5	Y				5	Old nest, Partial predation 19 Sept, 3 live and 1 dead hatch, 1 too destroyed to keep, 1 dead egg
95	2-Jul-12	38.75016	76.36866	5	N				5	Old nest; 16-Apr-13 Found 4 hatch, 1 depredated hatch, 1 dead egg
96	2-Jul-12	38.75098	76.37065	5	N				12	Old nest; 8 hatch 19-Sep-12; 4 hatch 19-Sep-12 (P.M.); Dug-shells only 25-Oct-12
97	2-Jul-12	38.75160	76.37218	5	N				7	Old nest, 19 September emergence hole seen going under the ring, 3 hatch, possible hatchling escape; 22 hatch 25-Sep-12; 11-Apr-13 nest dug after emergence hole discovered, 2 hatch, 1 dead egg, more empty shells
98	2-Jul-12	38.76084	76.38015	3	N				2	Broke egg upong processing, shells to soft to process further; 1 hatch 6-Sep-12; 1 hatch and 9 dead eggs 2-Oct-12
99	2-Jul-12	38.77321	76.37420	1B	N	13	108.5	9.04	7	One egg was not massed; 7 hatch and 2 dead eggs 19-Oct-12
100	2-Jul-12	38.77317	76.37638	1B/C	N				7	Old Nest; 7 hatch 22-Oct-12; 3 dead eggs 22-Oct-12
101	3-Jul-12	38.75235	76.37464	Notch	N				1	Old Nest; 1 hatch 20-Aug-12
102	3-Jul-12	38.75231	76.37468	Notch	Y				0	Found completely depredated
103	3-Jul-12	38.76060	76.37996	3	Y				1	Old nest; 10 dead eggs 8-Oct-12
104	5-Jul-12	38.75151	76.37459	Notch	Y				9	Old nest, no accurate top depth, unknown predator destroyed at least three eggs; 1 hatch 21-Aug-12; 1 hatch 23-Aug-12; 4 hatch 4-Sep-12; 3 hatch and 2 dead eggs 12-Sep-12
105	5-Jul-12	38.74984	76.36789	5	Y				0	Old nest, no accurate top depth, unknown predator
106	6-Jul-12	38.75317	76.37401	Notch	N				3	Old nest; 9-Aug-12--1 hatch; 20-Aug-12--1 hatch; 21-May-13--1 hatch; 23-May-13 dug up 1 dead egg
107	6-Jul-12	38.75193	76.37468	Notch	N				6	Old nest, eggs not very turgid; ; 2-Apr-13 filled 2" above ring; 11-Apr-13 sand removed again; 23-Apr-13 Dug up 1 hatch, 2 dead eggs, other emerged shells
108	9-Jul-12	38.75219	76.37470	Notch	N	14	139.6	9.97	10	CON-1; 23-Apr-13 Dug 10 hatch, discovered because nest was buried
109	9-Jul-12	38.75211	76.37468	Notch	N	13	137.5	10.58	12	Dug 11-Apr-13; 12 hatch

Nest Number	Date	Latitude	Longitude	Cell #	Predation	Clutch Size	Total Mass	Average Mass	Number Hatch	Comments
110	9-Jul-12	38.75004	76.36744	5	Y	17	114.3	7.14	6	EXP-5; One egg punctured by female turtle; Nest dug up 20-May-13, 2 hatch, 2 dead (dep) hatch, 1 dead (dep) egg, 21-May-13--2 dead (dep) hatch, 3 dead eggs, dug up, rest of hatch likely escaped or eaten; ant predation on dead hatch/eggs
111	9-Jul-12	38.74965	76.36744	5	Y				0	Found fully depredated
112	9-Jul-12	38.74958	76.36725	5	Y				0	Found partially depredated, Full predation 10 July
113	10-Jul-12	38.75347	76.37377	Notch	Y	15	137.3	9.15	·	Partial predation 26 July; 2-Apr-13 ring partially filled with sand--possible hatch escape but probably okay; 23-May-13--dug up 3 dead eggs
114	10-Jul-12	38.75263	76.37445	Notch	N	12	118.3	9.86	3	EXP-1; 16-Apr-13 ring fill dug out; 30-Apr-13 sand dug out again; 15-May-13 found 1 hatch; 21-May-13--1 hatch; 22-May-13--dug up, 1 hatch, 1 dead egg, temp logger
115	10-Jul-12	38.75251	76.37446	Notch	Y	18	130.1	7.23	12	Partial predation 26 July; buried under sand, dug up 16-May-13, 12 hatch, 4 dead eggs
116	10-Jul-12	38.75247	76.37456	Notch	N	15	131.9	8.79	9	9 hatch and 2 dead eggs 19-Oct-12
117	10-Jul-12	38.75228	76.37467	Notch	Y	11	109.1	9.92	4	Partial dep unknown date; 2 hatch 17-Sep-12; 2 hatch 20-Sep-12; dug 8-Oct-12 nothing found
118	10-Jul-12	38.75148	76.37463	Notch	N	15	96.0	6.40	13	13 hatch 17-Sep-12; 1 dead egg 19-Oct-12
119	10-Jul-12	38.75118	76.37414	Notch	N	14	145.2	10.37	14	11-Oct-12 14 hatch
120	10-Jul-12	38.75119	76.37318	Notch	N				0	6 eggs were destroyed from female laying nest 121 on top; 8-Oct-12 dug, 2 dead eggs discovered
121	10-Jul-12	38.75119	76.37318	Notch	Y				0	Partial predation 16 July and July 30; laid atop 120
122	10-Jul-12	38.75158	76.37213	5	N	10	109.1	10.91	8	22-Apr-13 3 hatch; 15-May-13 dug up, 2 dead eggs, 5 hatch
123	10-Jul-12	38.75146	76.37192	5	Y				·	Old nest found by partial depredation
124	10-Jul-12	38.75114	76.37104	5	N	16	168.0	10.50	·	No notes after initial discovery
125	10-Jul-12	38.73980	76.36783	5	Y				·	Old nest found by partial depredation
126	10-Jul-12	38.74944	76.36689	5	N				0	Old nest; 2-Apr-13 possible emergence hole but left alone; 11-Apr-13 hole visible, nest dug, 13 dead eggs, no hatchlings, no shells that appeared to have hatched
127	10-Jul-12	38.76077	76.37999	3	N	15	146.6	9.77	14	14 hatch 17-Sep-12 and 1 dead egg
128	10-Jul-12	38.76101	76.38011	3	N	14	122.3	8.74	12	12 hatch 22-Oct-12
129	10-Jul-12	38.77356	76.37697	1B/C	N				13	Old nest; 13 hatch and 1 dead egg 22-Oct-12
130	10-Jul-12	38.77311	76.37633	1B/C	N				9	Eggs with weak shell, did not dig fully; 9 hatch and 3 dead eggs 22-Oct-12
131	11-Jul-12	38.75138	76.37449	Notch	N	14	134.4	9.60	1	Laid by PI0055, last egg laid while processing, added later to nest (may affect temp logger); 20-May-13 found 1 hatch; 23-May-13 nest dug up, 6 dead eggs
132	11-Jul-12	38.75162	76.37235	5	Y				0	Found completely depredated
133	12-Jul-12	38.75281	76.37425	Notch	N	10	106.0	10.60	9	9 hatch and 1 dead egg 8-Oct-12
134	12-Jul-12	38.75618	76.37812	4D	N				9	Old nest; 9 hatch and 2 dead eggs 19-Oct-12
135	12-Jul-12	38.75130	76.37202	5	Y				0	Old nest, Full predation 7 Aug
136	12-Jul-12	38.75135	76.37293	Notch	Y				1	Old nest found partially depredated; 27-Aug-12--1 hatch; 23-May-13 nest dug up, eggshells only

Nest Number	Date	Latitude	Longitude	Cell #	Predation	Clutch Size	Total Mass	Average Mass	Number Hatch	Comments
137	16-Jul-12	38.75134	76.37292	Notch	Y				0	Old nest found fully depredated
138	16-Jul-12	38.75143	76.37282	Notch	Y				6	Old nest, 13 Aug 6 eaten hatchlings
139	16-Jul-12	38.75087	76.37044	5	Y				0	Old nest found partially depredated; full dep unknown date
140	16-Jul-12	38.75056	76.36968	5	Y				8	Old nest; 23-Apr-13 Discovered 6 eaten hatch in ring, dug up 2 live hatch
141	16-Jul-12	38.74997	76.36826	5	Y				2	Old nest; 23-Apr-13 Discovered 1 eaten hatch, 1 live
142	18-Jul-12	38.75116	76.37110	5	Y				0	Found fully depredated
143	18-Jul-12	38.75000	76.36840	5	Y				·	Found partially depredated; 23-May-13 dug up, eggshells found only
144	18-Jul-12	38.74963	76.36738	5	Y				0	Found fully depredated
145	18-Jul-12	38.74960	76.36725	5	Y				0	Found fully depredated
146	19-Jul-12	38.74963	76.36739	5	Y				0	Found partially depredated, full depredation 23 July
147	19-Jul-12	38.76112	76.38014	3	N				0	Old nest; covered by tide 16-Sep-12; dug up 22-Oct-12 no hatch or eggs
148	19-Jul-12	38.76106	76.38013	3	N				11	Old nest; 14-Aug-12 10 hatch; 1 hatch 15-Aug-12
149	20-Jul-12	38.75119	76.37331	Notch	Y				·	Old nest found partially depredated; 23-May-13 nest dug up, eggshells only
150	20-Jul-12	38.75087	76.37042	5	Y				0	Found fully depredated
151	23-Jul-12	38.75112	76.37371	Notch	Y				0	Found partially depredated, full depredation 7 Aug
152	23-Jul-12	38.75129	76.37319	Notch	Y				·	Found partially depredated; 23-May-13 dug up, eggshells found only
153	23-Jul-12	38.75158	76.37213	5	Y				0	Found partially depredated, full predation 16 Aug
154	23-Jul-12	38.75099	76.37072	5	Y				1	Old nest, 13Sept 1 hatchling died in turtle shed, no surviving hatchlings from predation
155	23-Jul-12	38.74987	76.36773	5	Y				0	Found fully depredated
156	23-Jul-12	38.77619	76.37425	1C/D	Y				0	Found fully depredated
157	26-Jul-12	38.74872	76.36765	5	Y				1	All eggs destroyed but one live hatchling, died in shed
158	26-Jul-12	38.75044	76.36949	5	Y				0	Found fully depredated
159	26-Jul-12	38.75082	76.37034	5	Y				0	Found partially depredated, Full predation 27 July
160	26-Jul-12	38.75117	76.37153	5	Y				0	Found fully depredated
161	26-Jul-12	38.75214	76.37465	Notch	N				2	CON-1; 11-Sep-12 found 1 hatch; 14Sep12 found 1 hatch; 7-May-13 sand dug out; 23-May-13 nest dug up, 6 dead eggs
162	27-Jul-12	38.75012	76.36852	5	Y				4	EXP-5; Found partially depredated, 3 hatch taken from nest-still some eggs; found fully destroyed 30-Jul-12 with 1 dead hatch
163	30-Jul-12	38.74990	76.36799	5	Y				0	Found fully depredated
164	30-Jul-12	38.75044	76.36930	5	Y				0	Old nest, partial predation 31 July, full predation 1 Aug
165	30-Jul-12	38.75059	76.36973	5	Y				0	Found fully depredated
166	30-Jul-12	38.75122	76.37312	Notch	Y				·	Found partially depredated by king snake
167	30-Jul-12	38.75122	76.37315	Notch	Y				2	Found partially depredated by king snake; 20-May-13 found 1 hatch; 23-May-13 dug up, 1 dead hatch and eggshells found
168	30-Jul-12	38.75265	76.37444	Notch	N				1	EXP-1; Nest found by emergence
169	30-Jul-12	38.75317	76.37400	Notch	Y				0	Found by partial predation; full predation 13-Aug-12
170	30-Jul-12	38.75150	76.37193	5	Y				0	Found fully depredated
171	31-Jul-12	38.75123	76.37315	Notch	Y				0	Found fully depredated

Nest Number	Date	Latitude	Longitude	Cell #	Predation	Clutch Size	Total Mass	Average Mass	Number Hatch	Comments
172	1-Aug-12	38.75142	76.37176	5	Y				0	Found fully depredated
173	6-Aug-12	38.75115	76.37355	Notch	N				13	EXP-2; Clutch found in pitfall traps, nest discovered later
174	7-Aug-12	38.75145	76.37277	Notch	Y				0	Found fully depredated
175	8-Aug-12	38.75308	76.37411	Notch	N				·	Found by emergence
176	8-Aug-12	38.75006	76.36839	5	Y				·	Found partially depredated: 23-May-13 nest dug; eggshells found only
177	8-Aug-12	38.75127	76.37139	5	Y				0	Found fully depredated
178	8-Aug-12	38.75136	76.37827	Notch	·				2	Either depredated or hatched out
179	14-Aug-12	38.75055	76.36955	5	Y				0	Found fully depredated
180	15-Aug-12	38.75235	76.37462	Notch	N				1	Found by emergence, 1 dead hatch
181	15-Aug-12	38.75259	76.37447	Notch	N				·	Found by emergence
182	15-Aug-12	38.75010	76.36856	5	N				5	EXP-5; Found by emergence, 5 hatch, 2 dead eggs
183	15-Aug-12	38.75273	76.37427	Notch	N				1	Found by emergence, 1 hatch
184	15-Aug-12	38.75278	76.37429	Notch	N				1	Found by emergence, 1 hatch
185	20-Aug-12	38.75116	76.37347	Notch	N				8	Found by emergence, 8 hatch
186	23-Aug-12	38.75231	76.37467	Notch	N				·	Found by emergence, 1 dead egg
187	23-Aug-12	38.75272	76.37439	Notch	N				·	Found by emergence
188	24-Aug-12	38.75131	76.37441	Notch	N				·	Found by emergence
189	28-Aug-12	38.75130	76.37151	5	N				17	EXP-3; Found by emergence 17 hatch 28-Aug-12 (Captured in pitfalls)
190	12-Sep-12	38.75128	76.37430	Notch	N				·	Found by emergence
191	13-Sep-12	38.75002	76.36829	5	N				·	Found by emergence
192	17-Sep-12	38.78062	76.37992	3	N				8	Found by emergence, 8 hatch and 1 unhatched egg
193	17-Sep-12	38.76062	76.37995	3	N				·	Found by emergence
194	19-Oct-12	38.75280	76.37432	Notch	N				2	Found by emergenge
195	19-Oct-12	38.75122	76.37127	5	N				·	Found by emergence
196	15-May-13	38.75255	76.37447	Notch	N				·	Found when removing sand from fence; eggshells only
197	15-May-13	38.75257	76.37453	Notch	N				·	Found when removing sand from fence; eggshells only
198	20-May-13	38.75241	76.37461	Notch	N				11	Found when removing sand from fence; 11 hatch, 4 dead eggs
199	20-May-13	38.75231	76.37466	Notch	N				·	Found when removing sand from fence; eggshells only
200	21-May-13	38.75201	76.37466	Notch	N				6	Found when removing sand from fence; 6 hatch, 4 dead eggs

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
26-Jul-12	02014		8R	Nest	22	26.1	30.1	25.1	15.9	6.8	Wild hatchling; different notch code
26-Jul-12	02015	02016	10R9L	Nest	22	20.6	24.1	20.5	13.8	3.6	
26-Jul-12				Nest	22						Found dead, no accurate measurements
26-Jul-12				Nest	157	23.4	27.2	21.2	13.6	6.0	Died in turtle shed
27-Jul-12	00938	00939	1R	Nest	2	27.0	30.9	28.3	16.2	8.3	Headstart
27-Jul-12	00940		1R	Nest	2	30.1	32.9	29.2	17.1	9.4	Headstart
27-Jul-12	00949	00950	1R	Nest	2	29.3	32.2	29.3	16.5	8.8	Headstart
27-Jul-12	00951	00952	1R	Nest	2	28.1	31.5	29.0	16.8	8.9	Headstart
27-Jul-12	00953		1R	Nest	2	28.1	31.6	29.3	16.3	8.6	Headstart
27-Jul-12	00954	00955	1R	Nest	2	29.7	32.3	29.1	16.3	9.3	Headstart
27-Jul-12	00956		1R	Nest	2	28.1	31.5	27.9	16.1	8.2	Headstart
27-Jul-12	00957	00958	1R	Nest	2	29.1	32.3	28.5	16.3	8.7	Ano plastron; Headstart
27-Jul-12	00961		1R	Nest	2	28.7	30.3	27.9	16.7	8.4	Headstart
27-Jul-12	00962	00963	1R	Nest	2	29.0	32.3	29.2	16.4	8.9	Headstart
27-Jul-12	00964	00965	1R	Nest	2	29.2	31.6	27.8	16.4	8.8	Headstart
27-Jul-12	02012	02013	10R9L	Nest	2	23.4	28.6	24.9	15.5	6.7	
27-Jul-12	00966		2R	Nest	162	26.3	29.3	25.9	14.5	7.0	EXP-5; Headstart
27-Jul-12	00967	00968	2R	Nest	162	28.0	31.5	26.5	15.6	7.9	EXP-5; Headstart
27-Jul-12	00969	00970	2R	Nest	162	26.6	29.6	25.9	15.4	7.0	EXP-5; Headstart
30-Jul-12	00971		3R	Nest	15	22.5	26.2	22.9	14.3	5.2	Headstart
30-Jul-12	00972	00973	3R	Nest	15	23.6	27.9	23.3	14.8	5.9	Headstart
30-Jul-12	00974	00975	3R	Nest	15	22.7	26.1	22.4	14.5	5.2	Headstart
30-Jul-12				Nest	162						EXP-5; Found dead, no accurate measurements
30-Jul-12	00976		10R9L	Nest	168	26.5	29.9	25.8	15.8	7.8	EXP-1; Ano V5
1-Aug-12				Nest	34						Found dead, no accurate measurements
2-Aug-12				Nest	68	23.5	28.5	24.0	13.1		Found dead in depredated nest
2-Aug-12				Nest	68	23.4	26.3	21.7	13.0		Found dead in depredated nest
2-Aug-12				Nest	68	18.8	22.4	18.6	12.8		Found dead in depredated nest
3-Aug-12	00997	00998	9R	Nest	4	26.7	31.1	28.1	17.3	9.0	Headstart
3-Aug-12	0090	00991	8R	Nest	6	27.9	32.3	27.3	16.4	7.0	Headstart
3-Aug-12	00977	00978	8R	Nest	6	28.0	32.8	28.5	15.6	8.0	Headstart
3-Aug-12	00979		8R	Nest	6	28.2	31.1	25.1	16.5	7.0	Indented L carapace; Headstart
3-Aug-12	00980	00981	8R	Nest	6	27.0	31.3	27.2	16.1	8.0	Headstart
3-Aug-12	00982	00983	8R	Nest	6	27.9	31.9	27.1	15.7	8.0	Headstart
3-Aug-12	00984		8R	Nest	6	28.6	31.8	28.1	17.2	8.0	Headstart
3-Aug-12	00985	00986	8R	Nest	6	28.4	32.6	27.8	16.4	8.0	Headstart
3-Aug-12	00987	00988	8R	Nest	6	27.1	31.9	28.7	15.7	7.0	Headstart
3-Aug-12	00989		8R	Nest	6	27.6	32.1	28.7	16.1	8.0	Headstart
3-Aug-12	00992	00993	8R	Nest	6	29.8	33.0	28.0	15.4	8.0	Headstart
3-Aug-12	00994		8R	Nest	6	26.6	31.1	27.8	15.8	8.0	Headstart
3-Aug-12	00995	00996	8R	Nest	6	27.5	31.4	27.2	15.4	8.0	Headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
3-Aug-12	00999		10R	Nest	33	26.6	31.8	28.0	15.8	8.0	Headstart
3-Aug-12	01002		10R	Nest	33	28.9	33.1	29.1	16.4	9.0	Headstart
3-Aug-12				Nest	68	24.6	28.6	23.3	13.7		Found dead in depredated nest
4-Aug-12	01008	01009	10R9L	Nest	4	28.0	32.4	27.9	16.1	7.9	
4-Aug-12	01003	01004	10R9L	Nest	5	25.3	30.3	26.0	16.4	7.8	EXP-1
4-Aug-12	01005	01006	10R9L	Nest	5	26.5	31.2	27.1	17.0	7.9	EXP-1
4-Aug-12				Nest	5						EXP-1; Found dead, no accurate measurements
4-Aug-12	01030		10R	Nest	33	27.5	33.1	29.6	15.8	9.0	Headstart
4-Aug-12	01031	01032	10R	Nest	33	27.2	32.7	29.6	16.2	9.3	Headstart
4-Aug-12	01033		10R	Nest	33	26.5	32.2	28.6	16.2	8.4	Headstart
4-Aug-12	01010	01011	11R	Nest	173	28.7	31.1	28.0	16.0	7.9	EXP-2; Ano R costals; Headstart
4-Aug-12	01012		11R	Nest	173	28.8	31.6	26.9	16.0	7.6	EXP-2; Ano R and L costals; Headstart
4-Aug-12	01013	01014	11R	Nest	173	28.7	32.1	28.8	15.8	7.8	EXP-2; Headstart
4-Aug-12	01015	01016	11R	Nest	173	28.9	32.2	27.8	15.4	7.9	EXP-2; Headstart
4-Aug-12	01017		11R	Nest	173	28.7	32.0	28.2	16.5	8.0	EXP-2; Headstart
4-Aug-12	01018	01019	11R	Nest	173	27.7	31.6	28.1	16.3	8.1	EXP-2; Headstart
4-Aug-12	01020	01021	11R	Nest	173	27.6	31.6	27.9	15.6	7.7	EXP-2; Headstart
4-Aug-12	01022		11R	Nest	173	27.7	31.0	28.6	15.3	7.7	EXP-2; Headstart
4-Aug-12	01023	01024	11R	Nest	173	29.7	32.6	27.7	15.9	7.9	EXP-2; Headstart
4-Aug-12	01025	01026	11R	Nest	173	28.3	31.5	28.5	15.1	7.8	EXP-2; Headstart
4-Aug-12	01027		11R	Nest	173	30.4	32.2	28.6	15.4	8.2	EXP-2; Headstart
4-Aug-12	01028		11R	Nest	173	26.8	29.9	26.9	14.9	7.2	EXP-2; Headstart
4-Aug-12	01007		10R9L	Hand		27.5	31.2	27.0	15.7	7.5	EXP-5
5-Aug-12	01038		12R	Nest	18	25.7	30.0	24.9	18.2	7.5	Indented L carapace; Headstart
5-Aug-12	01039	01040	12R	Nest	18	24.1	28.0	25.3	16.5	7.4	Headstart
5-Aug-12	01034	01035	10R	Nest	33	28.4	33.1	28.8	16.0	8.7	Headstart
5-Aug-12	01036	01037	10R	Nest	33	26.4	31.2	28.6	16.6	7.9	Headstart
5-Aug-12	01041	01042	11R	Nest	173	28.3	30.9	26.7	15.4	6.6	EXP-2; Headstart
8-Aug-12	01043		1L	Nest	20	25.2	29.7	26.5	15.5	7.1	Headstart
8-Aug-12	01044	01045	1L	Nest	20	25.0	29.8	25.6	15.8	7.1	Headstart
8-Aug-12	01046		1L	Nest	20	24.0	26.3	22.3	15.9	6.5	Headstart
8-Aug-12	01047	01048	1L	Nest	20	26.9	29.7	25.6	16.3	7.2	Headstart
8-Aug-12	01049	01050	1L	Nest	20	26.2	30.4	26.6	16.4	7.3	Headstart
8-Aug-12	01051		1L	Nest	20	26.2	30.1	26.6	16.3	7.4	Headstart
8-Aug-12	01069		1L	Nest	20	26.3	30.7	26.6	16.2	7.1	Headstart
8-Aug-12	01070	01071	1L	Nest	20	26.0	29.4	24.8	16.2	6.8	Headstart
8-Aug-12	01052	01053	2L	Nest	36	29.0	32.7	29.1	16.5	8.1	Headstart
8-Aug-12	01054	01055	2L	Nest	36	29.2	33.1	29.2	16.7	8.7	Headstart
8-Aug-12	01056		2L	Nest	36	28.9	33.1	30.4	17.1	8.8	Headstart
8-Aug-12	01057	01058	2L	Nest	36	27.2	31.9	28.3	16.6	8.2	Headstart
8-Aug-12	01059		2L	Nest	36	26.5	29.7	23.7	14.9	5.8	Headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
8-Aug-12	01061		2L	Nest	36	28.8	33.5	28.6	16.7	8.9	Ano V3; Headstart
8-Aug-12	01062	01063	2L	Nest	36	27.6	31.7	27.4	16.7	8.3	Headstart
8-Aug-12	01064		2L	Nest	36	29.1	32.8	28.6	16.2	8.6	Headstart
8-Aug-12	01066		3L	Nest	178	24.8	28.2	25.1	15.0	6.1	Headstart
8-Aug-12	01067	01068	3L	Nest	178	25.4	28.7	25.6	15.3	6.3	Headstart
9-Aug-12	01072	01073	8L	Nest	24	26.9	32.8	28.9	16.4	8.3	Headstart
9-Aug-12	01074		8L	Nest	24	25.6	31.3	28.5	16.1	7.8	Headstart
9-Aug-12	01077	01078	8L	Nest	24	26.8	32.5	28.5	16.4	8.3	Headstart
9-Aug-12	01079		8L	Nest	24	26.5	31.4	28.8	16.3	7.9	Headstart
9-Aug-12	01080	01081	8L	Nest	24	28.3	31.8	28.2	16.4	8.6	Headstart
9-Aug-12	01082	01083	8L	Nest	24	27.1	31.1	27.0	16.1	7.6	Headstart
9-Aug-12	01084		8L	Nest	24	27.6	33.0	28.9	16.3	8.0	Ano V5; Headstart
9-Aug-12	01075	01076	10R9L	Nest	106	28.7	31.6	27.4	17.0	8.4	
10-Aug-12	01102		10L	Nest	1	28.3	32.2	28.4	16.8	8.3	Headstart
10-Aug-12	01103	01104	10L	Nest	1	27.9	33.3	27.9	16.8	8.2	Headstart
10-Aug-12	01105		10L	Nest	1	28.4	32.6	28.8	16.6	8.5	Headstart
10-Aug-12	01085	01086	9L	Nest	31	28.5	32.2	28.1	16.2	8.5	Ano V4; Headstart
10-Aug-12	01087	01088	9L	Nest	31	28.0	32.3	28.7	16.7	8.6	Headstart
10-Aug-12	01089		9L	Nest	31	25.8	30.8	27.8	16.5	8.1	Ano V4; Headstart
10-Aug-12	01090	01091	9L	Nest	31	26.6	30.3	28.3	16.0	8.1	Headstart
10-Aug-12	01092	01093	9L	Nest	31	29.6	33.3	29.0	16.2	9.2	Headstart
10-Aug-12	01094		9L	Nest	31	28.5	33.6	29.6	16.7	9.0	Headstart
10-Aug-12	01095	01096	9L	Nest	31	29.9	34.5	30.6	16.4	8.9	26 marg; Headstart
10-Aug-12	01097	01098	9L	Nest	31	27.2	31.2	28.7	16.6	8.5	26 marg; Headstart
10-Aug-12	01099		9L	Nest	31	28.5	32.1	29.5	16.6	8.6	Headstart
10-Aug-12	01100		9L	Nest	31	27.8	31.7	28.6	16.4	8.5	Headstart
10-Aug-12	01106	01107	10R	Nest	33	27.4	33.8	29.3	16.7	8.9	Headstart
13-Aug-12	01108	01109	8R	Nest	6	28.1	33.4	28.9	16.3	8.2	Headstart
13-Aug-12	01129	01130	1R3R	Nest	7	28.4	32.2	27.7	16.3	8.0	CON-1; Headstart
13-Aug-12	01131	01132	1R3R	Nest	7	27.3	31.9	28.0	16.1	7.9	CON-1; Headstart
13-Aug-12	01133		1R3R	Nest	7	27.9	31.6	28.0	16.4	7.8	CON-1; Headstart
13-Aug-12	01134	01135	1R3R	Nest	7	26.7	31.5	28.5	16.2	7.7	CON-1; Ano LC; Headstart
13-Aug-12	01144	01145	1L	Nest	20	25.2	29.8	26.8	15.3	7.0	Headstart
13-Aug-12	01146		1L	Nest	20	26.6	30.3	25.7	16.1	7.5	Headstart
13-Aug-12	01147	01148	1L	Nest	20	24.2	28.0	24.7	15.9	6.6	Ano V5; Headstart
13-Aug-12	01149	01150	1L	Nest	20	25.2	30.5	26.8	15.6	7.3	Ano V5; Headstart
13-Aug-12				Nest	20						Found dead, no accurate measurements
13-Aug-12	01138		10R	Nest	33	27.9	33.0	29.7	17.5	9.8	Headstart
13-Aug-12	01139	01140	10R	Nest	33	29.4	33.3	29.9	17.3	9.4	Headstart
13-Aug-12	01141		10R	Nest	33	28.0	32.9	29.4	16.9	8.9	Headstart
13-Aug-12	01143		10R	Nest	33	26.8	32.7	28.5	16.8	8.3	Headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
13-Aug-12	01136	01137	2L	Nest	36	29.3	33.5	29.8	16.1	8.6	Headstart
13-Aug-12	01123		12L	Nest	39	26.7	31.3	28.1	15.8	7.7	Headstart
13-Aug-12	01125		12L	Nest	39	25.7	30.4	28.0	17.0	8.0	Headstart
13-Aug-12	01126	00127	12L	Nest	39	24.8	28.9	24.5	16.2	6.9	Headstart
13-Aug-12	01128		12L	Nest	39	26.1	29.3	27.7	16.0	7.3	Ano V5; Headstart
13-Aug-12	01110		11L	Nest	66	24.0	27.8	23.5	15.3	5.6	Headstart
13-Aug-12	01111	01112	11L	Nest	66	24.5	28.1	23.3	15.6	6.3	Headstart
13-Aug-12	01113	01114	11L	Nest	66	25.1	28.7	25.3	15.2	6.3	Headstart
13-Aug-12	01115		11L	Nest	66	22.6	25.8	23.0	14.7	5.4	Ano plastron; Headstart
13-Aug-12	01116	01117	11L	Nest	66	24.6	28.1	23.7	15.8	6.2	Ano plastron; Ano V5; Headstart
13-Aug-12	01118		11L	Nest	66	25.3	27.8	24.2	14.3	5.8	Headstart
13-Aug-12	01120		11L	Nest	66	25.7	29.2	25.2	15.7	6.7	Headstart
13-Aug-12	01121	01122	11L	Nest	66	26.1	29.5	25.3	16.3	7.3	Ano V5; Headstart
13-Aug-12				Nest	66						Found dead, no accurate measurements
13-Aug-12				Nest	66						Found dead, no accurate measurements
13-Aug-12				Nest	138						Found dead, no accurate measurements
13-Aug-12				Nest	138						Found dead, no accurate measurements
13-Aug-12				Nest	138	23.1	28.1	23.6	14.0		Found dead
13-Aug-12				Nest	138						Found dead
13-Aug-12				Nest	138						Found dead
13-Aug-12				Nest	138						Found dead
14-Aug-12	01182	01183	10R9L	Nest	4	26.5	30.5	27.7	15.4	7.7	
14-Aug-12	01179	01180	12R	Nest	18	22.7	27.0	23.4	15.3	6.4	Headstart
14-Aug-12				Nest	18						Found dead, no accurate measurements
14-Aug-12				Nest	18						Found dead, no accurate measurements
14-Aug-12	01181		9R9L	Nest	39	25.0	30.1	27.3	16.5	7.5	Wild hatchling; different notch code
14-Aug-12	01167	01168	2R8R2L	Nest	44	29.1	32.8	29.0	17.1	9.0	Ano plastron; 5 LC; 5 RC; Headstart
14-Aug-12	01171		2R8R2L	Nest	44	28.3	32.3	28.3	16.4	8.5	Ano V1; Headstart
14-Aug-12	01174	01175	2R8R2L	Nest	44	27.4	31.5	27.2	16.1	8.1	Headstart
14-Aug-12	01176		2R8R2L	Nest	44	27.0	32.0	28.1	15.8	8.0	Headstart
14-Aug-12	01177	01178	2R8R2L	Nest	44	28.0	32.4	27.5	17.0	8.8	5 LC; Headstart
14-Aug-12	1151		2R8R	Nest	148	27.9	30.0	27.8	15.3	8.0	Headstart
14-Aug-12	1152	1153	2R8R	Nest	148	28.0	30.8	28.0	16.2	8.4	No nuchal scute; Ano V5; Headstart
14-Aug-12	1154	1155	2R8R	Nest	148	27.4	31.0	27.9	16.6	8.3	No nuchal scute; Ano V4/5, plastron, LC; Headstart
14-Aug-12	1156		2R8R	Nest	148	27.0	30.0	27.9	15.7	8.4	3 LC; 3 RC; Ano V5, plastron, 13 L marg; Headstart
14-Aug-12	01157	01158	2R8R	Nest	148	28.1	29.0	27.9	15.9	8.6	Ano V4/5, plastron; 13 R marg; Headstart
14-Aug-12	01159	01160	2R8R	Nest	148	27.0	30.0	27.1	16.3	8.2	Ano plastron; No nuchal scute; Headstart
14-Aug-12	01161		2R8R	Nest	148	27.2	30.3	28.4	15.7	8.1	Ano V5, plastron; Headstart
14-Aug-12	01162	01163	2R8R	Nest	148	27.5	30.9	28.0	15.8	8.0	Ano V4/5, plastron; Headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
14-Aug-12	01164	01165	2R8R	Nest	148	27.1	30.2	27.1	16.4	8.3	Ano V4/5, plastron; Headstart
14-Aug-12	01166		2R8R	Nest	148	27.7	29.6	28.3	16.6	8.2	Ano plastron; Headstart
15-Aug-12	01197		10R9L	Nest	39	26.3	30.6	27.5	16.9	7.8	
15-Aug-12	01184	01185	2R8R2L	Nest	44	27.9	32.1	27.8	16.7	8.5	Ano plastron; Headstart
15-Aug-12	01186		2R8R2L	Nest	44	28.9	32.6	28.8	16.2	8.3	Headstart
15-Aug-12	01187		2R8R2L	Nest	44	27.8	32.1	29.0	16.3	8.0	Headstart
15-Aug-12	01189		2R8R2L	Nest	44	28.4	32.4	28.1	16.7	8.3	Ano plastron; Headstart
15-Aug-12	01190	01191	2R8R2L	Nest	44	28.5	32.9	28.8	16.9	8.6	Headstart
15-Aug-12	01213	01214	2R10R	Nest	49	28.7	33.7	29.3	16.7	8.6	Headstart
15-Aug-12	01215		2R10R	Nest	49	28.4	33.4	29.8	16.2	8.7	Headstart
15-Aug-12	01216	01217	2R10R	Nest	49	27.7	33.2	29.3	16.5	8.4	Headstart
15-Aug-12	01218	01219	2R10R	Nest	49	28.3	32.8	28.9	16.0	8.8	Headstart
15-Aug-12	01220		2R10R	Nest	49	27.8	32.8	28.8	16.0	8.2	Headstart
15-Aug-12	01221	01222	2R10R	Nest	49	27.1	33.1	29.5	16.9	8.8	Ano V5, headstart
15-Aug-12	01223		2R10R	Nest	49	27.2	33.4	29.9	16.9	8.8	Ano V5; Headstart
15-Aug-12	01225		2R10R	Nest	49	29.1	34.1	29.2	16.4	8.5	Headstart
15-Aug-12	01226	01227	2R10R	Nest	49	27.7	32.5	29.7	16.4	8.3	Ano V5; Headstart
15-Aug-12	01198	01199	2R9R	Nest	80	26.8	30.3	27.4	16.7	8.5	Headstart
15-Aug-12	01200	01201	2R9R	Nest	80	27.1	31.3	28.3	16.4	8.5	Ano plastron; Headstart
15-Aug-12	01202		2R9R	Nest	80	27.5	30.8	27.4	16.7	8.6	Ano V5; Headstart
15-Aug-12	01203	01204	2R9R	Nest	80	27.9	31.4	27.7	17.8	8.9	Ano V4; 5 RC; Headstart
15-Aug-12	01205	01206	2R9R	Nest	80	26.6	30.4	27.8	16.6	8.2	Ano V4; 5 LC; Headstart
15-Aug-12	01207		2R9R	Nest	80	27.8	30.0	26.4	17.5	8.8	Headstart
15-Aug-12	01208	01209	2R9R	Nest	80	27.9	31.7	29.2	16.8	8.8	Ano V5; Headstart
15-Aug-12	01210		2R9R	Nest	80	28.5	31.8	27.4	17.1	9.1	6 LC; 5 RC; Headstart
15-Aug-12	01211	01212	2R9R	Nest	80	28.5	31.9	27.1	17.2	8.6	6 vert; Ano V2/3; 6 RC; Headstart
15-Aug-12				Nest	80						Found dead, no accurate measurements
15-Aug-12				Nest	80						Found dead, no accurate measurements
15-Aug-12	01195	01196	2R8R	Nest	148	24.4	27.2	25.3	15.2	6.8	Ano V3/4; 5 RC; Headstart
15-Aug-12				Nest	180	21.9	22.1	19.9	12.9	5.0	Found dead
15-Aug-12	01228		2R11R	Nest	182	27.4	31.4	28.8	16.2	8.1	EXP-5; Ano Plast, Headstart
15-Aug-12	01229	01230	2R11R	Nest	182	26.8	30.9	27.7	16.0	7.7	EXP-5; Headstart
15-Aug-12	01231	01232	2R11R	Nest	182	27.4	31.4	28.0	15.7	7.8	EXP-5; Headstart
15-Aug-12	01233		2R11R	Nest	182	24.4	29.4	25.8	15.8	6.6	EXP-5; Headstart
15-Aug-12	01234	01235	2R11R	Nest	182	27.4	32.0	28.2	16.4	8.3	EXP-5; Headstart
15-Aug-12	01238		10R9L	Nest	183	26.7	31.4	28.2	16.2	7.6	Ano V5
16-Aug-12	01239	01240	2R12R	Nest	38	30.5	34.5	31.1	17.2	10.4	Ano plastron; Headstart
16-Aug-12	01241	01242	2R12R	Nest	38	30.0	34.4	29.8	17.0	10.4	Headstart
16-Aug-12	01243		2R12R	Nest	38	30.8	34.8	30.9	16.6	10.2	Headstart
16-Aug-12	01244	01245	2R12R	Nest	38	30.7	34.2	30.4	17.2	10.0	Headstart
16-Aug-12	01246	01247	2R12R	Nest	38	29.0	32.9	29.0	16.4	8.9	Ano pllastron; Headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
16-Aug-12	01248		2R12R	Nest	38	29.9	32.7	28.7	16.9	8.9	Ano V1; Headstart
16-Aug-12	01249	01250	2R12R	Nest	38	30.3	34.3	30.3	17.1	10.2	Headstart
16-Aug-12	01251	01252	2R12R	Nest	38	29.0	33.9	30.3	16.9	9.8	Headstart
16-Aug-12	01253		2R12R	Nest	38	29.4	34.1	30.2	17.2	9.9	Headstart
16-Aug-12	01254	01255	2R12R	Nest	38	30.6	34.3	31.2	17.3	10.0	Headstart
16-Aug-12	01258		2R12R	Nest	38	29.5	33.4	29.2	16.8	9.3	Headstart
16-Aug-12	01259	01260	2R12R	Nest	38	29.0	32.1	29.8	15.9	8.6	Headstart
16-Aug-12	01261	01262	2R12R	Nest	38	29.6	33.6	30.3	17.3	10.1	Headstart
16-Aug-12	01263		2R12R	Nest	38	28.2	32.3	29.8	17.1	9.3	Headstart
16-Aug-12	01266		10R9L	Nest	184	25.9	29.8	27.1	15.9	7.0	
16-Aug-12	01264		10R9L	Hand		28.8	32.0	26.3	16.4	8.7	Found on 3A/B road
20-Aug-12	01280	01281	2R3L	Nest	16	26.7	29.7	26.2	15.9	7.1	Ano V5; Headstart
20-Aug-12	01282	01283	2R3L	Nest	16	25.1	29.8	26.7	15.9	6.8	Headstart
20-Aug-12	01292		2R3L	Nest	16	26.9	30.0	27.2	15.8	7.1	Headstart
20-Aug-12	01293	01294	2R3L	Nest	16	27.4	30.8	27.2	15.7	6.7	Headstart
20-Aug-12	01284		2R3L8L	Nest	24	26.6	32.2	28.3	16.2	7.7	Headstart
20-Aug-12	01285	01286	8L	Nest	24	26.7	32.3	28.9	16.6	7.9	13 R marg; Headstart
20-Aug-12	01287		8L	Nest	24	26.5	32.1	28.3	15.9	7.4	Ano V5; Headstart
20-Aug-12	01290	01291	10R9L	Nest	101	27.4	31.9	28.8	16.5	8.0	
20-Aug-12	01289		10R9L	Nest	106	28.7	32.3	27.8	16.7	8.3	
20-Aug-12	01267	01268	2R2L	Nest	185	27.6	30.1	27.7	15.0	7.2	7 vert; Ano V5-7, plastron; 5 LC; Headstart
20-Aug-12	01269		2R2L	Nest	185	28.1	31.5	27.3	15.5	7.4	Ano plastron; Headstart
20-Aug-12	01270	01271	2R2L	Nest	185	27.4	31.2	26.7	15.6	7.7	Ano plastron; Headstart
20-Aug-12	01272	01273	2R2L	Nest	185	28.5	31.1	27.7	16.0	8.0	Ano plastron; 6 LC; 6 RC; Headstart
20-Aug-12	01274		2R2L	Nest	185	28.5	32.3	28.0	16.1	8.0	Ano plastron; Headstart
20-Aug-12	01275	01276	2R2L	Nest	185	26.0	28.0	24.9	15.2	6.0	Ano V5, plastron; 5 LC; raised plast at bridge; Headstart
20-Aug-12	01277	01278	2R2L	Nest	185	27.9	31.5	26.9	16.1	7.7	Ano plastron; Headstart
20-Aug-12	01279		2R2L	Nest	185	28.9	32.2	27.9	16.3	8.6	Ano plastron; Headstart
21-Aug-12	01295	01296	2R8L	Nest	26	29.9	32.1	28.4	16.6	8.0	Headstart ** 3 hatch from nest returned from HS program and released as wild
21-Aug-12	01297		2R8L	Nest	26	29.3	32.6	28.9	16.6	8.2	Headstart ** 3 hatch from nest returned from HS program and released as wild
21-Aug-12	01298	01299	2R8L	Nest	26	28.7	32.0	28.5	15.5	7.6	Headstart ** 3 hatch from nest returned from HS program and released as wild
21-Aug-12	01300	01301	2R8L	Nest	26	27.7	30.6	26.1	14.8	7.0	Ano plastron; Headstart
21-Aug-12	01302		2R8L	Nest	26	28.9	32.3	27.8	16.3	8.3	Headstart
21-Aug-12	01303	01304	2R8L	Nest	26	29.8	32.8	28.3	15.6	8.2	Headstart
21-Aug-12	01305		2R8L	Nest	26	30.0	31.9	27.1	16.0	7.9	Headstart
21-Aug-12	01307		2R8L	Nest	26	29.4	33.4	29.2	15.8	8.4	Headstart
21-Aug-12	01308	01309	2R8L	Nest	26	28.5	32.6	28.2	15.8	7.9	Headstart
21-Aug-12	01310	01311	2R8L	Nest	26	28.9	30.7	25.9	15.2	7.0	Headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
21-Aug-12	01312		2R8L	Nest	26	26.1	30.0	25.6	14.6	6.7	Headstart
21-Aug-12	01313	01314	2R8L	Nest	26	27.1	32.2	27.5	15.3	7.5	Headstart
21-Aug-12	01315		10R9L	Nest	55	27.5	31.6	27.9	17.9	8.5	
21-Aug-12	01316	01317	10R9L	Nest	104	24.5	28.8	25.2	15.9	6.6	
22-Aug-12	01318	01319	2R3L	Nest	16	28.4	31.9	27.7	15.9	7.7	Headstart
22-Aug-12	01320		2R9L	Nest	63	28.5	31.0	27.5	17.6	8.5	Ano V5, headstart
22-Aug-12	01321	01322	2R9L	Nest	63	27.2	30.6	25.6	16.1	7.4	Notched as headstart; returned and released as wild hatchling
22-Aug-12	01323		2R9L	Nest	63	27.6	30.1	26.0	16.2	7.7	Notched as headstart; returned and released as wild hatchling
22-Aug-12	01324	01325	2R9L	Nest	63	27.5	31.2	27.2	16.3	8.0	Notched as headstart; returned and released as wild hatchling
22-Aug-12	01326	01327	2R9L	Nest	63	27.8	30.9	27.5	16.7	8.3	Indented plastron; Headstart
22-Aug-12	01328		2R10L	Nest	72	29.9	31.6	29.5	15.7	8.5	No nuchal scute; Ano V5; Headstart
22-Aug-12	01329	01330	2R10L	Nest	72	26.4	30.1	27.0	15.3	7.8	Headstart
22-Aug-12	01331	01332	2R10L	Nest	72	28.8	32.2	29.1	16.8	8.5	Headstart
22-Aug-12	01333		2R10L	Nest	72	30.2	33.8	30.0	16.9	9.4	Headstart
22-Aug-12	01334	01335	2R10L	Nest	72	27.3	31.4	28.4	16.4	7.9	Headstart
22-Aug-12	01336	01337	2R10L	Nest	72	29.0	32.9	29.5	16.5	9.0	Headstart
22-Aug-12	01338		2R10L	Nest	72	27.0	31.0	28.4	16.4	7.6	11 R marg; Ano V5; Headstart
22-Aug-12	01339	01340	2R10L	Nest	72	26.4	29.8	28.0	16.2	7.2	Ano V5; Headstart
22-Aug-12	01341	01342	2R10L	Nest	72	25.8	29.7	27.0	15.0	6.2	Headstart
22-Aug-12	01343		2R10L	Nest	72	27.8	31.8	28.9	16.3	7.9	Headstart
22-Aug-12	01344	01345	2R10L	Nest	72	28.4	32.4	28.6	13.2	8.2	Headstart
22-Aug-12	01346	01347	2R10L	Nest	72	24.8	29.0	26.8	15.6	6.7	11 R marg; Ano V3-5; Headstart
22-Aug-12			2R10L	Nest	72	26.5	31.5	29.4	15.3	8.2	Found dead
23-Aug-12	01357	01358	2R3L	Nest	16	27.5	30.6	27.7	15.7	7.3	
23-Aug-12	01361		2R3L	Nest	16	24.5	27.5	25.0	14.9	6.2	Indented F.L. carapace; Ano plastron; Headstart
23-Aug-12	01349	01350	2R11L	Nest	52	28.4	32.6	27.5	15.9	7.7	EXP-5; Notched as headstart; returned and released as wild hatchling
23-Aug-12	01351		2R11L	Nest	52	27.7	32.1	26.4	15.5	7.0	EXP-5; Notched as headstart; returned and released as wild hatchling
23-Aug-12	01352	01353	2R11L	Nest	52	28.9	33.1	29.0	16.3	8.6	EXP-5; Headstart
23-Aug-12	01354	01355	2R11L	Nest	52	29.4	33.5	29.9	16.4	9.0	EXP-5; Headstart
23-Aug-12	01356		10R9L	Nest	63	28.9	32.0	28.3	15.6	8.0	
23-Aug-12	01348		10R9L	Nest	104	24.8	29.5	25.4	16.5	7.0	13 R marg, died overnight
24-Aug-12	01359	01360	3R8R	Nest	19	28.1	32.0	27.0	16.3	7.5	Indented mid-R carapace; Headstart
24-Aug-12	01362	01363	3R8R	Nest	19	29.2	34.0	27.7	16.9	8.2	Headstart
24-Aug-12	01382		2R12L	Nest	40	29.3	33.1	29.0	16.4	8.1	Headstart
24-Aug-12	01383	01384	2R12L	Nest	40	30.1	33.4	30.5	15.8	8.6	Headstart
24-Aug-12	01385	01386	2R12L	Nest	40	29.3	32.8	29.2	15.6	8.2	Headstart
24-Aug-12	01387		2R12L	Nest	40	27.9	32.4	28.4	16.0	7.8	11 L marg; Headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
24-Aug-12	01388	01389	2R12L	Nest	40	28.8	32.0	28.0	15.9	8.1	Headstart
24-Aug-12	01390	01391	2R12L	Nest	40	29.0	32.7	29.7	16.4	8.3	Ano V5; Headstart
24-Aug-12	01392		10R9L	Nest	40	27.9	31.6	28.4	15.8	7.7	
24-Aug-12	01393	01394	10R9L	Nest	40	29.3	33.1	30.0	16.6	8.8	5 RC
24-Aug-12	01395	01396	10R9L	Nest	40	27.8	32.8	29.6	15.8	8.4	
24-Aug-12	01397		10R9L	Nest	40	28.9	32.4	29.7	16.2	8.5	
24-Aug-12	01398	01399	10R9L	Nest	40	26.8	32.1	29.2	16.0	7.5	
24-Aug-12	01400	01401	10R9L	Nest	40	29.4	33.4	28.8	16.7	8.7	
24-Aug-12	01402		10R9L	Nest	40	27.4	32.1	29.1	15.7	7.8	
24-Aug-12	01403	01404	10R9L	Nest	40	29.1	32.1	28.4	16.3	8.1	
24-Aug-12	01405	01406	10R9L	Nest	40	29.8	33.4	30.2	15.9	8.3	
24-Aug-12	01366		10R9L	Nest	52	29.2	33.5	28.9	16.6	8.5	EXP-5
24-Aug-12	01367	01368	10R9L	Nest	52	28.4	32.8	28.3	16.2	7.9	EXP-5
24-Aug-12	01369	01370	10R9L	Nest	52	27.9	33.1	29.2	15.7	8.2	EXP-5
24-Aug-12	01371		10R9L	Nest	63	28.9	32.4	28.1	16.2	8.2	
24-Aug-12	01372	01373	10R9L	Nest	63	28.4	31.1	27.4	16.7	7.8	Ano V4
24-Aug-12	01374	01375	10R9L	Nest	63	29.6	32.2	28.2	16.1	8.3	Ano V5
24-Aug-12	01376		10R9L	Nest	63	27.2	30.0	27.2	15.8	7.5	
24-Aug-12	01378	01379	10R9L	Nest	63	29.4	31.1	25.9	16.7	7.7	
24-Aug-12	01380	01381	10R9L	Nest	63	27.7	31.9	27.6	16.1	7.8	
24-Aug-12	01364	01365	10R9L	Nest	75	28.1	32.3	27.3	17.1	8.6	
24-Aug-12	01407		10R9L	Nest	81	27.8	31.4	27.8	15.2	8.0	
24-Aug-12	01408	01409	10R9L	Nest	81	27.3	30.7	27.5	15.7	7.6	
24-Aug-12	01410	01411	10R9L	Nest	81	28.5	31.5	27.1	15.8	7.9	Ano V5
24-Aug-12	01412		10R9L	Nest	81	27.5	30.6	27.8	15.9	8.0	5 LC
24-Aug-12	01413	01414	10R9L	Nest	81	26.6	30.2	27.7	15.1	7.5	Ano V5
24-Aug-12	01415	01416	10R9L	Nest	81	28.4	31.5	28.4	16.1	8.2	Ano plastron
24-Aug-12	01417		10R9L	Nest	81	27.0	30.2	27.5	14.6	7.2	6 vert
27-Aug-12	01500	01501	10R9L	Nest	14	24.5	31.1	29.0	16.5	7.9	Ano V1
27-Aug-12	01502		10R9L	Nest	14	26.8	31.9	28.4	16.1	7.7	
27-Aug-12	01503	01504	10R9L	Nest	14	27.1	32.8	29.1	16.4	8.5	
27-Aug-12	01505		10R9L	Nest	14	27.7	33.3	29.5	16.4	8.6	
27-Aug-12	01506	01507	10R9L	Nest	14	26.5	31.1	27.7	16.8	8.2	26 marg
27-Aug-12	01508	01509	10R9L	Nest	14	26.0	30.8	26.4	15.6	7.0	
27-Aug-12	01510		10R9L	Nest	14	26.0	32.2	28.1	16.4	7.9	
27-Aug-12	01511	01512	10R9L	Nest	14	22.9	30.9	27.8	15.9	7.4	26 marg
27-Aug-12	01513	01514	10R9L	Nest	14	28.4	34.1	29.5	16.2	8.6	6 vert; 6 RC; 26 marg
27-Aug-12	01515		10R9L	Nest	14	27.2	32.4	28.2	16.2	8.0	
27-Aug-12	01516	01517	10R9L	Nest	14	27.5	33.7	28.6	17.0	8.9	5 LC; Ano V5
27-Aug-12	01518	01519	10R9L	Nest	14	28.2	33.6	28.5	16.1	8.7	13 R marg
27-Aug-12	01520		10R9L	Nest	14	25.1	31.3	28.2	15.7	7.7	Ano V3

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
27-Aug-12	01521	01522	10R9L	Nest	14	26.3	32.1	28.5	16.2	8.1	
27-Aug-12	01464	01465	10R9L	Nest	19	22.4	27.1	23.0	14.2	5.1	
27-Aug-12	01466		10R9L	Nest	19	21.9	24.6	21.0	14.9	5.0	
27-Aug-12	01467	01468	10R9L	Nest	19	24.6	28.7	25.0	15.1	5.6	
27-Aug-12	01469		10R9L	Nest	19	24.1	28.3	23.5	15.1	5.6	
27-Aug-12	01470	01471	10R9L	Nest	19	24.6	28.8	24.6	15.1	5.6	
27-Aug-12	01449		10R9L	Nest	21	29.1	33.1	28.5	16.3	8.8	
27-Aug-12	01477	01478	10R9L	Nest	21	29.6	33.8	28.4	16.8	9.0	
27-Aug-12	01479		10R9L	Nest	21	29.9	34.0	29.1	16.8	9.3	
27-Aug-12	01480	01481	10R9L	Nest	21	30.2	34.3	28.5	17.0	9.3	
27-Aug-12	01482	01483	10R9L	Nest	21	29.9	33.5	28.5	16.4	8.6	
27-Aug-12	01484		10R9L	Nest	21	28.3	32.5	27.8	16.5	8.6	Ano V5
27-Aug-12	01485	01486	10R9L	Nest	21	30.5	34.5	29.8	16.9	9.6	
27-Aug-12	01487	01488	10R9L	Nest	21	28.8	34.1	29.3	16.9	9.5	
27-Aug-12	01489		10R9L	Nest	21	28.7	33.3	29.2	16.4	8.8	
27-Aug-12	01490	01491	10R9L	Nest	21	29.4	34.2	28.9	16.9	9.3	
27-Aug-12	01492	01493	10R9L	Nest	21	28.8	33.2	28.6	16.7	9.0	
27-Aug-12	01494		10R9L	Nest	21	28.5	32.8	28.6	16.9	9.0	
27-Aug-12	01494	01496	10R9L	Nest	21	29.9	33.9	28.6	17.1	9.5	
27-Aug-12	01497	01498	10R9L	Nest	21	28.4	32.9	28.8	17.0	8.7	
27-Aug-12	01420		10R9L	Nest	42	25.3	31.1	27.8	16.1	7.5	
27-Aug-12	01421	01422	10R9L	Nest	42	27.2	32.2	28.4	15.9	7.7	
27-Aug-12	01423		10R9L	Nest	42	26.7	31.3	27.6	16.0	7.2	
27-Aug-12	01424	01425	10R9L	Nest	42	26.7	31.2	27.3	15.4	7.3	Ano plastron
27-Aug-12	01426	01427	10R9L	Nest	42	25.5	30.8	28.5	15.5	7.2	
27-Aug-12	01428		10R9L	Nest	42	25.3	30.5	28.0	15.8	7.4	
27-Aug-12	01429	01430	10R9L	Nest	42	26.5	31.2	27.8	16.0	7.0	
27-Aug-12	01431	01432	10R9L	Nest	42	26.3	30.6	28.3	16.0	7.2	
27-Aug-12	01433		10R9L	Nest	42	25.4	30.3	26.4	15.4	6.5	
27-Aug-12	01434	01435	10R9L	Nest	42	26.6	31.3	26.7	15.2	6.7	
27-Aug-12	01436	01437	10R9L	Nest	42	26.4	31.4	28.0	16.0	7.3	
27-Aug-12	01438		10R9L	Nest	42	26.3	29.6	26.6	15.5	6.5	13 L marg
27-Aug-12	01439	01440	10R9L	Nest	42	25.8	30.8	27.5	15.6	6.9	
27-Aug-12	01441	01442	10R9L	Nest	42	26.4	31.6	27.4	16.0	7.2	
27-Aug-12	01443		10R9L	Nest	42	26.2	30.7	28.4	16.2	7.5	Ano V5
27-Aug-12	01444	01445	10R9L	Nest	42	24.8	30.6	26.1	15.7	6.2	
27-Aug-12	01446		10R9L	Nest	42	26.5	31.0	26.9	15.6	7.0	
27-Aug-12	01447	01448	3R10R	Nest	47	27.0	32.6	28.2	16.1	7.8	Headstart
27-Aug-12	01449	01450	3R10R	Nest	47	27.5	31.7	28.2	16.3	7.9	Headstart
27-Aug-12	01451		3R10R	Nest	47	27.0	32.3	29.3	16.8	8.6	Headstart
27-Aug-12	01452	01453	3R10R	Nest	47	29.2	32.9	29.0	16.7	8.9	Ano V5, headstart

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
27-Aug-12	01454	01455	3R10R	Nest	47	26.7	32.1	28.6	16.8	7.9	Headstart
27-Aug-12	01456		3R10R	Nest	47	27.7	31.8	28.2	16.2	8.0	Headstart
27-Aug-12	01457	01458	10R9L	Nest	47	28.8	32.9	28.6	16.7	8.6	
27-Aug-12	01459	01460	10R9L	Nest	47	27.6	32.8	29.6	16.4	8.5	
27-Aug-12	01461		10R9L	Nest	47	27.4	32.1	29.3	16.8	8.3	
27-Aug-12	01462	01463	10R9L	Nest	47	28.0	32.7	29.4	16.0	8.2	Ano V5
27-Aug-12	01474		10R9L	Nest	79	29.4	33.6	27.8	16.5	9.1	EXP-5
27-Aug-12	01475	01476	10R9L	Nest	79	29.2	32.7	29.5	17.4	9.5	EXP-5
27-Aug-12	01472	01473	10R9L	Nest	136	27.4	29.1	25.4	16.3	7.1	6 vert; Ano V4
27-Aug-12	01418		10R9L	Hand	Cell 4	28.2	33.1	28.2	16.1	7.8	
28-Aug-12	01523	01524	10R9L	Nest	40	27.9	32.3	29.0	15.9	7.8	
28-Aug-12	01525		10R9L	Nest	56	26.5	30.7	25.5	15.9	7.2	
28-Aug-12	01529	01530	10R9L	Nest	189	26.8	30.8	26.1	15.2	6.5	EXP-3
28-Aug-12	01531	01532	10R9L	Nest	189	26.4	31.2	26.0	15.0	6.7	EXP-3
28-Aug-12	01533		10R9L	Nest	189	26.8	30.6	25.5	15.6	7.1	EXP-3
28-Aug-12	01534	01535	10R9L	Nest	189	25.2	29.3	24.9	14.8	5.8	EXP-3
28-Aug-12	01536	01537	10R9L	Nest	189	26.5	31.5	27.9	15.2	7.1	EXP-3; 13 L marg
28-Aug-12	01538		10R9L	Nest	189	27.0	31.9	26.9	15.3	6.9	EXP-3
28-Aug-12	01539	01540	10R9L	Nest	189	26.5	31.9	26.9	15.6	7.1	EXP-3
28-Aug-12	01541	01542	10R9L	Nest	189	27.2	31.8	26.1	15.2	6.9	EXP-3; Ano V5
28-Aug-12	01543		10R9L	Nest	189	25.9	31.0	27.3	15.1	6.6	EXP-3
28-Aug-12	01544	01545	10R9L	Nest	189	27.7	32.4	27.7	16.0	8.0	EXP-3
28-Aug-12	01546	01547	10R9L	Nest	189	26.3	31.3	25.3	15.5	6.8	EXP-3
28-Aug-12	01548		10R9L	Nest	189	25.2	30.0	26.3	14.6	6.2	EXP-3
28-Aug-12	01549	01550	10R9L	Nest	189	25.5	30.1	25.5	15.4	6.4	EXP-3
28-Aug-12	01551		10R9L	Nest	189	24.8	30.2	25.4	14.8	6.2	EXP-3
28-Aug-12	01552	01553	10R9L	Nest	189	26.1	31.0	24.9	15.6	6.9	EXP-3
28-Aug-12	01554	01555	10R9L	Nest	189	27.2	32.4	27.5	15.8	7.7	EXP-3
28-Aug-12	01556		10R9L	Nest	189	26.3	30.8	25.7	15.6	7.0	EXP-3
28-Aug-12	01528		10R9L	Fence		28.5	31.9	28.4	16.2	8.8	EXP-2 pitfall; 6 vert; Ano V3-6; 5 RC
28-Aug-12	01526	01527	10R9L	Fence		28.6	31.8	28.8	15.2	7.9	CON-4 pitfall; Ano V3-5, LC
29-Aug-12				Nest	4	22.1	22.7	21.3	12.1		Died in turtle shed
30-Aug-12	01557	01558	10R9L	Nest	75	25.2	30.2	26.8	16.6	7.5	5 RC
30-Aug-12	01559	01560	10R9L	Nest	75	25.3	28.1	26.8	16.1	7.3	Ano V1, 3, 5, plastron; 5 RC
30-Aug-12	01561		10R9L	Nest	75	27.6	31.8	28.8	17.4	8.6	Ano V4/5
30-Aug-12	01562	01563	10R9L	Nest	75	25.8	30.3	26.8	17.4	7.7	
30-Aug-12	01564	01565	10R9L	Nest	75	25.5	30.3	26.4	16.8	7.7	
31-Aug-12	01566		10R9L	Nest	75	29.2	35.1	30.5	16.8	9.7	
31-Aug-12	01567	01568	10R9L	Nest	75	29.2	33.6	29.9	16.5	9.5	
31-Aug-12	01569	01570	10R9L	Nest	75	27.4	31.4	27.7	16.5	8.3	
31-Aug-12	01571		10R9L	Nest	75	30.1	33.1	29.6	16.1	9.1	

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
31-Aug-12	01572	01573	10R9L	Nest	75	28.6	33.8	30.4	16.6	9.0	
31-Aug-12	01574	01575	10R9L	Nest	75	28.4	33.2	28.9	16.4	9.2	
31-Aug-12	01576		10R9L	Nest	75	28.2	34.5	29.8	17.1	9.7	
4-Sep-12	01598	01599	10R9L	Nest	19	23.8	27.8	24.2	14.6	5.3	
4-Sep-12	01600	01601	10R9L	Nest	28	25.1	30.4	26.9	14.6	6.5	
4-Sep-12	01602		10R9L	Nest	28	24.8	29.8	26.5	14.8	6.5	
4-Sep-12	01603	01604	10R9L	Nest	28	24.8	29.3	27.0	15.0	6.1	
4-Sep-12	01584	01585	10R9L	Nest	45	26.1	30.6	27.6	15.8	7.3	
4-Sep-12	01579	01580	10R9L	Nest	73	30.0	33.6	29.3	16.7	8.9	EXP-1; 5 RC; 5 LC
4-Sep-12	01581		10R9L	Nest	73	28.8	33.4	29.5	16.1	8.2	EXP-1
4-Sep-12	01582	01583	10R9L	Nest	73	28.6	32.6	29.3	16.5	8.3	EXP-1
4-Sep-12	01586		10R9L	Nest	74	28.0	33.5	28.3	16.2	8.8	
4-Sep-12	01587	01588	10R9L	Nest	74	28.0	33.2	29.5	15.7	8.4	Ano V5
4-Sep-12	01589	01590	10R9L	Nest	74	28.8	33.6	30.4	16.4	9.4	Ano V3-5
4-Sep-12	01591		10R9L	Nest	74	28.0	32.5	29.1	15.4	7.8	
4-Sep-12	01577	01578	10R9L	Nest	82	28.3	31.7	29.0	16.0	7.6	
4-Sep-12	01592		10R9L	Nest	104	25.4	29.8	26.7	15.2	6.7	
4-Sep-12	01594		10R9L	Nest	104	26.5	31.3	28.3	16.2	7.7	
4-Sep-12	01595	01596	10R9L	Nest	104	26.1	30.7	27.6	15.6	7.3	
4-Sep-12	01597		10R9L	Nest	104	26.9	31.1	27.2	15.4	7.9	
5-Sep-12	01605	01606	10R9L	Nest	73	27.6	32.0	28.4	16.1	7.7	EXP-1; 5 RC; 5 LC
5-Sep-12	01607		10R9L	Nest	73	28.9	31.7	29.5	16.2	8.0	EXP-1; 5 RC; 26 marg
5-Sep-12	01608	01609	10R9L	Nest	73	28.0	32.0	28.3	15.9	7.9	EXP-1; Ano V5
5-Sep-12	01610	01611	10R9L	Nest	73	28.8	32.5	29.2	16.4	8.3	EXP-1; 5 RC, 5 LC
5-Sep-12	01612		10R9L	Nest	73	28.1	32.0	28.4	16.7	8.3	EXP-1; 6 Vert; 5 RC; 5 LC
5-Sep-12	01613		10R9L	Nest	73	28.6	32.6	28.5	16.5	8.2	EXP-1; Ano V5
6-Sep-12	01614	01615	10R9L	Nest	73	28.3	32.6	29.7	15.9	8.1	EXP-1; Ano plastron
6-Sep-12	01616	01617	10R9L	Nest	98	25.8	30.2	28.5	15.7	7.5	
6-Sep-12	01618		10R9L	Hand		28.6	30.4	28.5	15.5	7.5	EXP-5; Ano plastron, V5
7-Sep-12	01619	01620	10R9L	Nest	107	24.9	28.1	25.2	15.3	6.1	5RC, Ano V4
7-Sep-12	01621	01622	10R9L	Nest	107	26.4	29.0	25.0	15.4	6.3	6RC, Ano V2-V3
7-Sep-12	01623		10R9L	Nest	107	22.2	26.7	23.2	14.1	5.0	Ano V4-V5
7-Sep-12	01624	01625	10R9L	Nest	107	24.3	28.0	23.5	14.4	5.5	
7-Sep-12	01626	01627	10R9L	Nest	107	26.1	30.0	25.1	14.8	6.4	6Vert, Ano V4-V5, 6RC
11-Sep-12	01628		10R9L	Nest	161	23.2	27.8	24.0	15.8	6.5	CON-1; 26 Marg
11-Sep-12				Hand	Ex1						EXP-1; Found dead, no accurate measurements
12-Sep-12	01634	01635	10R9L	Nest	10	29.1	34.4	29.5	17.0	9.2	EXP-4
12-Sep-12	01636	01637	10R9L	Nest	10	29.3	33.1	28.8	16.4	8.6	EXP-4
12-Sep-12	01638		10R9L	Nest	10	30.2	33.9	28.7	16.2	8.7	EXP-4; Marg 1 (R &L) appear to be 2 scutes but no separation
12-Sep-12	01639	01640	10R9L	Nest	10	29.7	33.9	28.9	16.3	8.8	EXP-4

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
12-Sep-12	01641	01642	10R9L	Nest	10	29.7	34.2	28.0	16.9	8.7	EXP-4
12-Sep-12	01643		10R9L	Nest	10	29.6	33.5	29.4	16.0	8.8	EXP-4
12-Sep-12	01644	01645	10R9L	Nest	10	28.8	33.0	29.3	17.2	9.1	EXP-4
12-Sep-12	01646	01647	10R9L	Nest	10	29.6	34.2	28.7	16.8	8.9	EXP-4
12-Sep-12	01629	01630	10R9L	Nest	104	26.3	31.4	28.4	16.4	7.7	Ano LC2
12-Sep-12	01631	01632	10R9L	Nest	104	26.2	31.4	27.8	15.7	7.5	
12-Sep-12	01633		10R9L	Nest	104	27.1	32.0	28.5	16.5	8.1	Ano V4/5; 5 LC; ~7 RC
13-Sep-12	01648		10R9L	Nest	51	27.5	31.3	27.5	16.6	7.9	Ano V5
13-Sep-12	01649	01650	10R9L	Nest	64	27.5	31.8	28.1	15.8	7.3	EXP-2
13-Sep-12	01651	01652	10R9L	Nest	64	27.5	30.2	26.3	15.5	7.0	EXP-2
13-Sep-12	01653		10R9L	Nest	64	26.8	30.4	27.0	15.8	7.1	EXP-2; Ano plastron
13-Sep-12	01654	01655	10R9L	Nest	64	26.4	29.8	26.0	15.5	6.9	EXP-2
13-Sep-12	01656	01657	10R9L	Nest	64	26.5	28.4	26.2	15.8	6.4	EXP-2; Ano plastron, V5; very reduced LC4
13-Sep-12	01658		10R9L	Nest	64	27.1	29.1	26.7	15.5	6.6	EXP-2; Ano plastron, V1, V3-5; Reduced RC4; 13 L marg
13-Sep-12	01659	01660	10R9L	Nest	64	28.6	27.5	25.7	15.6	6.5	EXP-2; Ano plastron, V3-5, Reduced LC4
13-Sep-12	01661	01662	10R9L	Nest	64	27.7	31.3	27.1	15.9	7.4	EXP-2; 5 RC; 13 R marg
13-Sep-12				Nest	154	25.4	28.5	21.8	15.4	7.0	Died in turtle shed; nest heavily predated
14-Sep-12	01663		10R9L	Nest	161	25.9	29.2	23.9	15.3	6.7	CON-1; Ano V2-5; 6 RC; 6 LC
17-Sep-12	01667	01668	10R9L	Nest	24	26.4	31.9	29.1	16.5	7.6	
17-Sep-12	01669		10R9L	Nest	24	25.3	30.7	26.9	16.0	7.3	
17-Sep-12	01671		10R9L	Nest	24	24.7	29.8	27.2	15.5	6.5	
17-Sep-12	01672	01673	10R9L	Nest	82	29.2	33.0	29.7	16.6	8.1	Ano V2-4, 7 RC; 5 LC
17-Sep-12	01674		10R9L	Nest	82	27.5	31.7	28.6	16.7	8.1	26 marg; 6 RC; 6 LC
17-Sep-12	01675	01676	10R9L	Nest	82	25.1	29.9	26.7	15.9	6.6	
17-Sep-12	01664	01665	10R9L	Nest	117	26.2	29.8	26.2	15.1	6.4	
17-Sep-12	01666		10R9L	Nest	117	26.8	30.5	27.1	15.7	7.0	
17-Sep-12	01692		10R9L	Nest	118	21.4	25.6	22.4	13.4	4.2	5 RC; 5 LC
17-Sep-12	01693	01694	10R9L	Nest	118	23.2	27.0	23.4	14.4	5.3	5 RC; 5 LC
17-Sep-12	01695	01696	10R9L	Nest	118	22.9	28.0	24.9	14.8	5.4	
17-Sep-12	01697		10R9L	Nest	118	22.3	27.6	24.3	14.4	5.0	
17-Sep-12	01698	01699	10R9L	Nest	118	23.8	27.9	24.7	14.9	5.7	5 RC; 5 LC
17-Sep-12	01700	01701	10R9L	Nest	118	21.1	25.3	22.1	13.9	3.9	Ano V5
17-Sep-12	01702		10R9L	Nest	118	21.1	24.9	22.1	12.8	4.1	
17-Sep-12	01703	01704	10R9L	Nest	118	22.2	26.9	23.5	13.9	5.2	13 R marg
17-Sep-12	01705	01706	10R9L	Nest	118	21.0	25.3	22.8	13.4	4.4	
17-Sep-12	01707		10R9L	Nest	118	23.1	26.4	23.7	14.4	5.0	
17-Sep-12	01708	01709	10R9L	Nest	118	21.6	25.3	23.0	13.8	4.2	
17-Sep-12	01710	01711	10R9L	Nest	118	21.6	27.0	24.0	14.6	5.2	
17-Sep-12	01712		10R9L	Nest	118	23.0	28.3	25.2	15.2	6.0	
17-Sep-12	01679		10R9L	Nest	192	28.1	32.9	29.5	17.3	9.5	

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
17-Sep-12	01680	01681	10R9L	Nest	192	28.8	32.2	28.4	16.9	9.3	
17-Sep-12	01682	01683	10R9L	Nest	192	26.7	30.9	28.1	15.7	8.1	V5 very reduced
17-Sep-12	01684		10R9L	Nest	192	25.9	30.0	26.0	15.2	7.1	
17-Sep-12	01685	01686	10R9L	Nest	192	27.5	32.0	28.6	16.0	8.7	
17-Sep-12	01687	01688	10R9L	Nest	192	28.2	31.5	27.8	16.3	8.7	
17-Sep-12	01689		10R9L	Nest	192	26.3	30.1	26.5	14.9	7.1	
17-Sep-12	01690	01691	10R9L	Nest	192	29.0	32.8	29.5	17.5	9.6	
17-Sep-12	01677	01678	10R9L	Hand		28.3	32.7	30.2	15.4	8.0	EXP-1; 13 R marg
18-Sep-12	01716		10R9L	Nest	43	28.1	32.7	29.7	16.0	8.4	
18-Sep-12	01718		10R9L	Nest	43	29.1	33.8	30.4	16.1	8.5	
18-Sep-12	01720		10R9L	Nest	43	29.9	34.2	30.3	16.9	9.1	
18-Sep-12	01721	01722	10R9L	Nest	43	29.8	33.5	29.4	16.7	8.5	
18-Sep-12	01723	01724	10R9L	Nest	43	28.2	32.6	30.0	17.1	9.0	
18-Sep-12	01725		10R9L	Nest	43	28.4	33.0	29.9	16.6	8.7	
18-Sep-12	01726	01727	10R9L	Nest	43	27.7	32.8	29.6	16.4	8.3	
18-Sep-12	01728		10R9L	Nest	43	28.4	32.9	29.0	16.3	8.4	
18-Sep-12	01730		10R9L	Nest	43	28.0	33.7	30.5	16.4	9.0	
18-Sep-12	01731	01732	10R9L	Nest	43	28.2	33.7	30.6	16.1	8.9	
18-Sep-12	01733		10R9L	Nest	43	27.5	32.4	29.6	16.8	8.6	
18-Sep-12	01734	01735	10R9L	Nest	43	28.2	33.9	30.6	16.4	8.7	
18-Sep-12	01736	01736	10R9L	Nest	43	28.8	33.8	30.3	17.3	9.4	
18-Sep-12	01738		10R9L	Nest	43	28.8	33.7	29.9	16.9	9.1	Ano V4/5; 5 RC
18-Sep-12	01713	01714	10R9L	Nest	68	27.5	30.2	26.8	16.0	6.6	
18-Sep-12	01715		10R9L	Nest	68	25.6	30.0	26.1	15.5	6.2	
19-Sep-12	01759	01760	10R9L	Nest	94	26.9	30.4	25.6	14.6	6.3	6 Vert; Ano V4-6; 5 RC; 6 LC; 26 marg; indented abdomen
19-Sep-12	01761		10R9L	Nest	94	27.4	31.3	27.8	15.8	7.2	6 Vert; Ano V3-5; 6 RC; 7 LC; 13 R marg; slight abdominal indentation
19-Sep-12	01762	01763	10R9L	Nest	94	26.9	29.2	25.7	15.3	6.6	5 RC
19-Sep-12				Nest	94	25.1	27.5	24.1	14.7	6.8	Found dead; 6 Vert; Ano V2-4; 6 RC; 6 LC
19-Sep-12				Nest	94						Found dead, no accurate measurements
19-Sep-12	01739	01740	10R9L	Nest	96	28.9	31.6	27.8	15.5	7.6	Ano V5
19-Sep-12	01741	01742	10R9L	Nest	96	29.1	33.5	29.6	16.2	8.9	6 vert; Ano V6; 5 RC; 5 LC
19-Sep-12	01743		10R9L	Nest	96	29.8	34.4	30.3	16.8	9.5	13 R marg
19-Sep-12	01744	01745	10R9L	Nest	96	28.0	31.6	28.2	15.1	7.9	26 marg; 5 RC; 5 LC
19-Sep-12	01746		10R9L	Nest	96	28.2	31.7	28.7	16.0	7.9	Ano V5
19-Sep-12	01748		10R9L	Nest	96	29.4	32.8	28.9	15.7	8.8	6 vert; Ano V3/4; 5 RC; 5 LC
19-Sep-12	01751		10R9L	Nest	96	30.1	34.2	30.6	17.4	10.2	5 RC; 5 LC
19-Sep-12	01753		10R9L	Nest	96	30.2	33.4	30.3	16.4	9.1	
19-Sep-12	01764	01765	10R9L	Nest	96	27.5	32.2	28.7	16.4	8.3	5 RC
19-Sep-12	01766		10R9L	Nest	96	26.9	31.6	28.1	15.7	7.7	5 RC; 5 LC

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
19-Sep-12	01767	01768	10R9L	Nest	96	25.7	30.9	27.4	16.1	7.4	6 vert; Ano V4-6; 5 LC
19-Sep-12	01769	01770	10R9L	Nest	96	26.4	31.7	28.3	16.0	7.9	
19-Sep-12	01754	01755	10R9L	Nest	97	28.3	33.0	30.1	16.8	8.2	
19-Sep-12	01756		10R9L	Nest	97	28.6	33.0	29.0	17.3	9.0	
19-Sep-12	01757	01758	10R9L	Nest	97	29.3	33.4	30.4	16.6	8.7	
20-Sep-12	01771		10R9L	Nest	24	26.7	32.4	28.6	16.3	7.9	
20-Sep-12	01772	01773	10R9L	Nest	117	24.3	28.2	24.7	14.5	5.2	
20-Sep-12	01774		10R9L	Nest	117	27.9	30.8	27.5	15.7	7.4	
25-Sep-12	01776		10R9L	Nest	97	29.6	33.7	29.3	16.9	9.1	
25-Sep-12	01777	01778	10R9L	Nest	97	28.2	33.4	28.8	16.2	8.0	
27-Sep-12	01779		10R9L	Nest	127	27.7	31.1	27.2	16.0	7.4	6 Vert; Ano V3-6, 5 RC; 5 LC
27-Sep-12	01780	01781	10R9L	Nest	127	27.8	31.0	27.5	16.1	7.6	
27-Sep-12	01782	01783	10R9L	Nest	127	30.1	33.4	28.8	17.2	9.1	
27-Sep-12	01784		10R9L	Nest	127	26.5	29.7	26.5	15.2	6.2	
27-Sep-12	01785	01786	10R9L	Nest	127	29.6	32.9	28.4	16.3	8.4	
27-Sep-12	01787	01788	10R9L	Nest	127	27.9	33.4	29.9	17.4	9.1	
27-Sep-12	01789		10R9L	Nest	127	28.2	32.4	28.6	15.7	7.4	Ano V4; 5 LC; 26 marg
27-Sep-12	01790	01791	10R9L	Nest	127	28.8	33.1	29.1	16.1	8.2	
27-Sep-12	01792		10R9L	Nest	127	27.8	31.9	26.4	15.9	7.1	
27-Sep-12	01794		10R9L	Nest	127	27.1	31.3	27.4	15.9	7.4	13 R marg
27-Sep-12	01795	01796	10R9L	Nest	127	28.8	33.3	29.7	17.1	8.6	
27-Sep-12	01797		10R9L	Nest	127	30.4	34.2	28.8	17.2	8.9	Ano V5
27-Sep-12	01799		10R9L	Nest	127	29.3	32.8	28.6	16.5	8.3	
27-Sep-12	01800	01801	10R9L	Nest	127	28.4	32.4	27.9	16.1	7.5	Ano V5; 26 marg
1-Oct-12	01802		10R9L	Nest	71	24.4	28.1	23.5	14.8	5.7	
2-Oct-12	01804		10R9L	Nest	71	28.2	31.9	28.1	15.8	7.6	
2-Oct-12	01805	01806	10R9L	Nest	71	28.6	32.3	28.7	15.7	7.7	Ano V5
2-Oct-12	01807		10R9L	Nest	71	28.0	31.6	27.1	16.4	7.4	
2-Oct-12	01808	01809	10R9L	Nest	71	28.6	31.7	27.6	15.5	7.3	Ano V2
2-Oct-12	01810		10R9L	Hand	Con2	26.6	30.3	25.9	14.6	5.8	
3-Oct-12	01812		10R9L	Hand	Ex3	27.2	32.2	27.6	16.1	7.6	
4-Oct-12	01813	01814	10R9L	Hand	Con3	28.8	33.2	29.7	16.9	8.9	Ano V2/3; 5 RC
8-Oct-12	01830		10R9L	Nest	103	26.0	29.7	26.8	16.2	8.1	Ano V1-5; almost no tail
8-Oct-12	01815		10R9L	Nest	133	28.3	31.9	27.8	16.2	7.6	
8-Oct-12	01817		10R9L	Nest	133	29.0	33.5	30.1	16.0	7.9	
8-Oct-12	01818	01819	10R9L	Nest	133	28.4	32.5	29.0	17.0	8.3	
8-Oct-12	01820		10R9L	Nest	133	29.2	33.0	28.8	16.2	7.7	
8-Oct-12	01821	01822	10R9L	Nest	133	27.6	31.7	26.9	16.6	6.6	
8-Oct-12	01823	01824	10R9L	Nest	133	28.4	32.8	30.1	16.7	8.7	
8-Oct-12	01825		10R9L	Nest	133	28.7	32.7	28.8	17.0	8.6	
8-Oct-12	01826	01827	10R9L	Nest	133	26.7	30.7	27.6	15.9	6.5	

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
8-Oct-12	01828	01829	10R9L	Nest	133	27.0	30.8	27.0	16.0	6.9	Ano V5
11-Oct-12	01831	01832	10R9L	Nest	119	26.1	30.0	27.3	15.4	7.0	
11-Oct-12	01833		10R9L	Nest	119	27.8	31.6	28.2	16.0	7.9	
11-Oct-12	01835		10R9L	Nest	119	26.7	31.6	28.4	16.2	7.9	
11-Oct-12	01836	01837	10R9L	Nest	119	26.8	31.0	27.3	15.4	7.1	
11-Oct-12	01838		10R9L	Nest	119	29.1	33.1	29.5	16.8	8.8	
11-Oct-12	01840		10R9L	Nest	119	27.6	31.4	28.1	16.3	8.1	
11-Oct-12	01841	01842	10R9L	Nest	119	28.5	33.4	29.8	16.7	9.0	
11-Oct-12	01843		10R9L	Nest	119	26.2	31.6	27.3	15.8	7.2	
11-Oct-12	01844	01845	10R9L	Nest	119	28.9	33.6	30.0	16.6	9.1	
11-Oct-12	01846	01847	10R9L	Nest	119	27.1	31.5	28.2	15.9	7.7	
11-Oct-12	01848		10R9L	Nest	119	28.6	32.7	29.2	16.8	8.8	5 RC
11-Oct-12	01849	01850	10R9L	Nest	119	27.6	32.1	29.0	16.2	8.4	
11-Oct-12	01851	01852	10R9L	Nest	119	29.8	33.5	29.9	16.4	8.6	
11-Oct-12	01854		10R9L	Nest	119	27.5	32.4	28.3	16.5	7.6	
19-Oct-12	01854		3R11R	Nest	53	29.0	32.7	27.4	15.7	7.8	Headstart
19-Oct-12	01856		3R11R	Nest	53	28.2	32.9	27.6	15.9	7.8	Headstart
19-Oct-12	01858		10R9L	Nest	53	28.6	32.4	27.8	15.8	8.0	
19-Oct-12	01859		10R9L	Nest	53	26.8	31.9	28.4	15.5	7.7	5 LC
19-Oct-12	01861		10R9L	Nest	53	28.7	32.7	27.4	16.3	8.5	Ano V5
19-Oct-12	01862		10R9L	Nest	53	27.7	31.3	27.6	17.0	8.2	
19-Oct-12	01864		10R9L	Nest	53	27.4	31.7	27.2	16.5	7.5	
19-Oct-12	01866		10R9L	Nest	53	27.7	32.2	27.7	16.9	8.0	Ano plastron
19-Oct-12	01867		10R9L	Nest	53	26.8	32.3	26.7	16.7	7.9	
19-Oct-12	01869		10R9L	Nest	53	27.9	32.2	27.7	16.8	7.8	Ano plastron
19-Oct-12	01871		10R9L	Nest	53	27.2	32.2	28.6	16.5	8.1	Ano plastron
19-Oct-12	01872		10R9L	Nest	53	27.8	32.2	28.9	16.0	8.2	
19-Oct-12	01874		10R9L	Nest	53	27.1	30.8	25.9	15.3	6.5	Ano plastron
19-Oct-12	01876		10R9L	Nest	53	28.0	32.2	27.2	16.9	8.2	
19-Oct-12	01894		10R9L	Nest	99	25.3	24.9	27.7	14.2	6.3	Posterior shell compressed; 4 vert; Ano V2-4; 22 marg
19-Oct-12	01895	01896	10R9L	Nest	99	27.2	30.8	26.2	15.1	6.7	Ano plastron, V1&5; 28 marg
19-Oct-12	01897		10R9L	Nest	99	28.0	30.3	26.4	15.0	6.3	Ano plastron (extra segment), Ano V1/2; 5 RC; 5 LC; 26 marg
19-Oct-12	01899		10R9L	Nest	99	26.1	27.9	26.3	14.5	6.6	4 vert; Ano V1-V4; 3 RC; 5 LC; 13 R marg
19-Oct-12	01900	01901	10R9L	Nest	99	27.2	30.1	26.1	15.3	6.3	Ano plastron, V3-5; 5 RC
19-Oct-12	01902		10R9L	Nest	99	28.8	31.0	28.4	16.3	8.3	
19-Oct-12	0882	01883	10R9L	Nest	99	25.6	27.5	24.6	15.1	5.8	Ano plastron (extra segment); Ano V1-3,5; 5 RC; 5 LC; 26 marg
19-Oct-12	01903	01904	10R9L	Nest	116	23.3	27.9	24.9	14.4	5.1	5 RC
19-Oct-12	01905	01906	10R9L	Nest	116	24.8	28.8	25.2	15.1	5.6	26 marg
19-Oct-12	01907		10R9L	Nest	116	23.5	27.9	25.2	15.2	5.6	

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
19-Oct-12	01908	01909	10R9L	Nest	116	24.5	28.8	25.4	14.7	5.5	Ano V5
19-Oct-12	01910	01911	10R9L	Nest	116	25.8	28.5	26.8	15.5	6.6	Ano V5; 11 L marg
19-Oct-12	01912		10R9L	Nest	116	25.6	30.0	26.5	15.8	6.6	
19-Oct-12	01913	01914	10R9L	Nest	116	23.7	26.8	24.4	14.4	5.1	
19-Oct-12	01915	01916	10R9L	Nest	116	28.5	32.8	29.7	16.3	8.0	
19-Oct-12	01917		10R9L	Nest	116	26.9	31.8	28.6	16.0	7.1	
19-Oct-12	01877	01878	10R9L	Nest	134	22.9	25.4	21.8	13.4	4.4	Ano V3/4, 6 LC
19-Oct-12	01879		10R9L	Nest	134	23.2	26.3	21.4	15.5	5.4	6 Vert, Ano V3-5; 5 RC; 6 LC
19-Oct-12	01880	01881	10R9L	Nest	134	22.7	26.0	21.3	14.0	4.6	
19-Oct-12	01884		10R9L	Nest	134	20.1	24.3	21.1	13.4	3.9	Ano V4, 5LC
19-Oct-12	01885	01886	10R9L	Nest	134	24.5	27.6	20.6	14.1	4.7	Body curved; cannot retract FR limb, 6 vert; 5 RC; 5 LC; 26 marg; Ano V1/2
19-Oct-12	01887	01888	10R9L	Nest	134	22.2	26.3	21.4	14.0	4.6	Indented L carapace, Ano V3-V5, 6LC, 26 Marg
19-Oct-12	01889		10R9L	Nest	134	22.1	25.8	22.1	13.9	4.4	
19-Oct-12	01890	01891	10R9L	Nest	134	21.7	23.9	21.1	13.6	4.0	Ano V4-V5, 6LC
19-Oct-12	01892		10R9L	Nest	134	19.8	24.2	20.2	12.8	3.6	
19-Oct-12	01918	01919	10R9L	Nest	194	29.3	33.4	29.9	16.4	8.6	13 R marg
19-Oct-12	01920	01921	10R9L	Nest	194	28.4	31.5	28.8	16.2	8.2	
22-Oct-12	01989	01990	10R9L	Nest	98	20.6	25.0	26.9	17.0	6.4	26 marg; F. carapace indented; Plastron appears wrinkled
22-Oct-12	01977	01978	10R9L	Nest	100	28.3	32.5	28.0	16.2	7.8	Ano V5; 13 R marg
22-Oct-12	01979	01980	10R9L	Nest	100	28.1	32.0	28.7	16.2	8.0	
22-Oct-12	01981		10R9L	Nest	100	24.9	25.9	24.2	13.9	5.2	22 marg
22-Oct-12	01982	01983	10R9L	Nest	100	28.0	32.0	28.8	16.9	8.0	
22-Oct-12	01984	01985	10R9L	Nest	100	26.2	27.2	25.3	15.4	5.8	
22-Oct-12	01986		10R9L	Nest	100	26.4	29.0	26.7	15.9	7.0	Ano V5
22-Oct-12	01987	01988	10R9L	Nest	100	25.8	28.7	25.2	15.1	5.9	
22-Oct-12	01943	01944	10R9L	Nest	128	28.9	31.8	26.8	15.3	6.6	
22-Oct-12	01945		10R9L	Nest	128	24.0	28.4	24.5	13.5	4.7	
22-Oct-12	01946	01947	10R9L	Nest	128	26.7	30.1	25.5	15.3	6.3	Ano plast, V3-5
22-Oct-12	01948		10R9L	Nest	128	27.6	30.8	27.4	15.2	6.9	
22-Oct-12	01950		10R9L	Nest	128	28.4	31.1	27.0	15.5	6.9	Ano V4/5
22-Oct-12	01951	01952	10R9L	Nest	128	24.8	28.2	24.0	14.5	5.2	
22-Oct-12	01953		10R9L	Nest	128	26.6	29.6	25.0	15.1	5.6	Ano V5
22-Oct-12	01954	01955	10R9L	Nest	128	23.2	26.5	23.1	13.4	4.4	
22-Oct-12	01956	01957	10R9L	Nest	128	25.1	29.5	25.6	14.9	5.7	
22-Oct-12	01958		10R9L	Nest	128	26.9	30.2	26.8	15.1	6.1	Ano V4/5, 5 RC
22-Oct-12	01959	01960	10R9L	Nest	128	26.0	29.4	25.1	15.5	5.9	
22-Oct-12	01961	01962	10R9L	Nest	128	28.5	32.6	27.8	16.3	7.3	
22-Oct-12	01922		10R9L	Nest	129	28.4	32.3	28.1	16.4	8.2	6 Vert; Ano V2-5; 5 RC; 26 marg
22-Oct-12	01923	01924	10R9L	Nest	129	27.4	30.3	26.9	15.2	7.0	5 RC, 5 LC (both very small)

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
22-Oct-12	01925		10R9L	Nest	129	29.3	32.7	27.6	17.0	8.5	
22-Oct-12	01927		10R9L	Nest	129	27.1	30.5	27.1	15.7	6.8	
22-Oct-12	01928	01929	10R9L	Nest	129	23.4	26.9	23.1	14.4	4.8	Ano V5; 5RC
22-Oct-12	01930		10R9L	Nest	129	23.8	28.3	23.9	14.0	5.2	Ano V5
22-Oct-12	01931	01932	10R9L	Nest	129	23.9	27.1	24.3	13.7	4.8	5 RC
22-Oct-12	01933	01934	10R9L	Nest	129	28.2	32.1	27.7	16.2	7.6	
22-Oct-12	01935		10R9L	Nest	129	23.3	26.6	22.9	13.6	4.4	Ano V4/5
22-Oct-12	01936	01937	10R9L	Nest	129	26.1	30.3	26.2	14.9	6.5	Ano V5; 26 Marg
22-Oct-12	01938	01939	10R9L	Nest	129	22.3	26.3	22.6	13.1	4.1	Ano V2-5; 5 RC
22-Oct-12	01940		10R9L	Nest	129	26.1	29.2	25.5	15.6	6.2	
22-Oct-12	01941	01942	10R9L	Nest	129	27.5	31.7	27.7	16.2	7.6	Amp V5; 5 LC
22-Oct-12	01963		10R9L	Nest	130	22.3	25.2	22.2	13.6	4.5	Died overnight in turtle shed
22-Oct-12	01964	01965	10R9L	Nest	130	26.6	30.2	27.1	15.6	6.6	
22-Oct-12	01966	01967	10R9L	Nest	130	28.6	32.2	27.6	16.4	7.5	Ano V5
22-Oct-12	01968		10R9L	Nest	130	24.4	28.0	24.7	15.1	5.6	
22-Oct-12	01969	01970	10R9L	Nest	130	27.8	31.7	27.3	15.8	7.2	
22-Oct-12	01971		10R9L	Nest	130	28.8	32.4	28.4	16.2	7.4	5 LC
22-Oct-12	01972	01973	10R9L	Nest	130	28.2	30.9	27.8	16.2	7.1	
22-Oct-12	01974	01975	10R9L	Nest	130	28.0	31.1	27.3	16.2	7.0	
22-Oct-12	01976		10R9L	Nest	130	28.5	32.2	27.8	16.7	7.4	
25-Oct-12	01991		10R9L	Nest	39	27.1	31.1	29.4	16.9	8.0	
25-Oct-12	01992	01993	10R9L	Nest	44	27.4	32.2	28.1	16.9	7.8	
25-Oct-12	01994	01995	10R9L	Nest	81	27.6	30.7	27.4	15.3	7.1	Reduced V5
26-Oct-12	01996		10R9L	Nest	54	23.0	25.1	22.3	14.6	5.3	Died overnight in turtle shed
26-Oct-12	01997	01998	10R9L	Nest	54	26.3	30.6	25.4	16.8	7.0	Ano plastron
26-Oct-12	01999		10R9L	Nest	54	26.5	30.6	26.3	15.7	6.8	Ano plastron, V4/5; 26 marg
26-Oct-12	02000	02001	10R9L	Nest	54	26.6	31.3	25.3	16.3	6.9	Ano plastron, V5
26-Oct-12	02002	02003	10R9L	Nest	54	26.7	30.6	25.4	16.1	6.8	Ano plastron
26-Oct-12	02004		10R9L	Nest	54	26.0	29.9	26.0	15.9	6.5	Ano plastron
26-Oct-12	02005	02006	10R9L	Nest	54	26.9	31.3	25.3	17.0	6.8	Ano plastron
26-Oct-12	02007	02008	10R9L	Nest	54	25.6	30.5	26.6	16.5	6.8	Ano plastron
26-Oct-12	02009		10R9L	Nest	54	23.8	29.1	24.2	16.3	5.9	Ano plastron
26-Oct-12	02010	02011	10R9L	Nest	54	26.8	31.1	26.6	16.3	7.0	Ano plastron, V4; 6 RC
2-Apr-13	02017		9R12R	Nest	85	28.5	32.0	30.0	16.4	8.2	
2-Apr-13	02019		9R12R	Nest	85	24.4	28.3	26.4	14.4	5.8	
2-Apr-13	02020	02021	9R12R	Nest	85	26.1	19.1	26.2	14.4	5.9	
2-Apr-13	02022		9R12R	Nest	85	24.9	28.3	25.5	14.7	5.6	
2-Apr-13	02023	02024	9R12R	Nest	85	24.0	27.4	24.7	14.4	5.1	
2-Apr-13	02025	02026	9R12R	Nest	85	20.0	28.3	24.7	14.9	5.7	
2-Apr-13	02027		9R12R	Nest	85	25.2	29.0	25.6	14.6	5.9	
2-Apr-13	02028	02029	9R12R	Nest	85	25.1	28.0	25.6	15.9	5.9	

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
2-Apr-13	02030	02031	9R12R	Nest	85	25.7	28.2	25.1	14.4	5.6	
2-Apr-13				Fence							CON-5; Found dead in pitfall, no accurate measurements
11-Apr-13	02150	02151	9R12R	Nest	88	29.0	31.7	28.9	15.3	8.1	
11-Apr-13	02042		9R12R	Nest	93	22.7	27.5	25.9	14.7	5.9	Ano V4/5
11-Apr-13	02043	02044	9R12R	Nest	93	27.3	32.3	28.6	14.5	7.5	
11-Apr-13	02045		9R12R	Nest	93	26.4	31.2	27.4	15.3	7.2	
11-Apr-13	02046	02047	9R12R	Nest	93	26.7	31.0	27.1	15.2	7.2	
11-Apr-13	02048	02049	9R12R	Nest	93	25.7	30.6	26.2	14.9	6.8	Ano V5
11-Apr-13	02050		9R12R	Nest	93	25.2	29.6	25.9	14.3	6.2	
11-Apr-13	02051	02052	9R12R	Nest	93	27.0	31.9	28.0	15.1	7.4	
11-Apr-13	02053	02054	9R12R	Nest	93	26.2	30.8	25.9	14.6	6.9	
11-Apr-13	02055		9R12R	Nest	93	23.9	28.2	24.5	13.5	5.1	
11-Apr-13	02035	02036	9R12R	Nest	97	29.1	33.5	30.4	16.4	9.0	
11-Apr-13	02037		9R12R	Nest	97	29.1	32.2	29.0	15.5	8.3	
11-Apr-13	02056	02057	9R12R	Nest	109	30.0	32.8	28.9	16.2	8.7	
11-Apr-13	02058	02059	9R12R	Nest	109	28.3	32.0	28.3	15.3	8.0	
11-Apr-13	02061	02062	9R12R	Nest	109	25.5	27.5	24.4	13.9	5.4	
11-Apr-13	02063		9R12R	Nest	109	23.8	27.8	24.8	13.7	5.3	Ano V1
11-Apr-13	02065		9R12R	Nest	109	26.9	30.7	26.2	15.7	7.2	
11-Apr-13	02066	02067	9R12R	Nest	109	23.8	27.4	24.7	13.4	5.1	
11-Apr-13	02068		9R12R	Nest	109	26.9	31.2	27.7	15.6	7.4	Ano V4/5
11-Apr-13	02069	02070	9R12R	Nest	109	27.0	30.0	25.7	14.5	6.7	Ano V5
11-Apr-13	02071	02072	9R12R	Nest	109	27.5	28.4	28.3	15.5	7.7	
11-Apr-13	02073		9R12R	Nest	109	27.7	30.6	26.2	15.2	7.1	Ano V3, RC
11-Apr-13	02074	02075	9R12R	Nest	109	28.3	30.9	27.2	15.6	7.5	
11-Apr-13	02076	02077	9R12R	Nest	109	29.1	31.9	27.7	15.3	8.1	
11-Apr-13	02038	02039	9R12R	Hand		27.1	30.2	25.5	16.3	6.7	CON-1
11-Apr-13	02040		9R12R	Hand		25.7	30.5	27.1	14.9	6.9	EXP-2
15-Apr-13	02132		9R12R	Nest	9	28.0	32.9	28.9	16.6	8.1	
15-Apr-13	02133	02134	9R12R	Nest	9	30.3	33.7	29.6	17.1	8.5	
15-Apr-13	02135	02136	9R12R	Nest	9	29.2	32.9	29.0	16.4	8.1	
15-Apr-13	02137		9R12R	Nest	9	30.2	34.0	30.1	16.8	9.4	
15-Apr-13	02138	02139	9R12R	Nest	9	29.8	33.1	29.0	15.8	8.5	
15-Apr-13	02140	02141	9R12R	Nest	9	29.8	33.6	30.0	15.8	8.8	
15-Apr-13	02142		9R12R	Nest	9	28.7	32.0	27.2	16.4	7.4	
15-Apr-13	02143	02144	9R12R	Nest	9	29.8	33.5	29.3	16.6	8.7	
15-Apr-13	02145	02146	9R12R	Nest	9	29.4	33.8	29.9	16.1	8.7	
15-Apr-13	02147		9R12R	Nest	9	28.7	33.0	29.2	16.8	8.6	
15-Apr-13	01278		9R12R	Nest	13	28.2	32.0	28.2	16.5	7.4	
15-Apr-13	02109		9R12R	Nest	13	27.7	31.5	28.0	15.5	6.8	

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
15-Apr-13	02110	02111	9R12R	Nest	13	27.6	30.5	27.4	15.5	6.6	
15-Apr-13	02112	02113	9R12R	Nest	13	26.7	30.7	27.4	16.5	7.1	
15-Apr-13	02114		9R12R	Nest	13	27.7	32.0	27.2	15.5	6.6	26 marg
15-Apr-13	02115	02116	9R12R	Nest	13	27.8	31.7	27.9	16.4	7.4	
15-Apr-13	02117	02118	9R12R	Nest	13	27.5	32.1	29.2	16.0	7.6	
15-Apr-13	02119		9R12R	Nest	13	27.2	32.0	28.8	15.4	7.1	
15-Apr-13	02120	02121	9R12R	Nest	13	27.3	32.1	28.8	16.4	7.9	26 marg
15-Apr-13	02122	02123	9R12R	Nest	13	26.5	31.8	27.6	16.2	7.4	
15-Apr-13				Nest	13						Found dead, no accurate measurements
15-Apr-13	02107	02108	9R12R	Nest	28	24.5	29.4	27.0	14.3	5.8	
15-Apr-13				Nest	28						Found dead, no accurate measurements
15-Apr-13	02153	02154	9R12R	Nest	35	26.9	30.0	25.5	15.1	6.4	
15-Apr-13	02155		9R12R	Nest	35	25.2	27.7	23.9	13.8	5.1	
15-Apr-13	02157		9R12R	Nest	35	28.9	31.8	28.6	15.9	7.7	
15-Apr-13	02158	02159	9R12R	Nest	35	24.5	28.4	24.4	14.5	5.2	
15-Apr-13	02160		9R12R	Nest	35	25.9	28.8	25.5	14.8	5.8	
15-Apr-13	02162		9R12R	Nest	35	26.2	28.8	24.8	14.5	5.4	
15-Apr-13	02163	02164	9R12R	Nest	35	26.7	30.0	27.1	14.7	6.1	
15-Apr-13	02165		9R12R	Nest	35	28.3	31.8	28.5	16.4	7.8	
15-Apr-13	02166	02167	9R12R	Nest	35	26.1	29.3	26.6	14.3	6.3	
15-Apr-13	02168	02169	9R12R	Nest	35	25.2	27.3	24.0	14.3	5.5	
15-Apr-13	02170		9R12R	Nest	35	27.0	30.3	27.0	15.1	6.6	
15-Apr-13	02171	02172	9R12R	Nest	35	26.8	29.2	24.9	14.8	6.1	
15-Apr-13	02173		9R12R	Nest	35	24.7	28.0	24.0	14.1	5.5	V5 absent
15-Apr-13	02148	02149	9R12R	Nest	45	25.8	31.1	27.0	15.8	7.4	
15-Apr-13	02091		9R12R	Nest	52	29.2	33.8	29.0	16.4	8.4	EXP-5
15-Apr-13	02092	02093	9R12R	Nest	52	28.8	32.0	28.4	15.5	7.4	EXP-5
15-Apr-13	02094	02095	9R12R	Nest	52	28.2	32.1	28.9	15.7	7.6	EXP-5
15-Apr-13	02096		9R12R	Nest	52	28.7	32.7	29.2	15.9	7.8	EXP-5
15-Apr-13	02097	02098	9R12R	Nest	52	28.2	32.2	28.2	16.1	7.9	EXP-5
15-Apr-13	02078		9R12R	Nest	57	26.9	30.1	28.3	16.2	6.6	EXP-5; Ano V5, RC
15-Apr-13	02079	02080	9R12R	Nest	57	26.1	30.0	28.3	14.9	7.0	EXP-5
15-Apr-13	02081	02082	9R12R	Nest	57	26.2	29.7	27.0	15.0	6.4	EXP-5; Ano V5, RC, plastron
15-Apr-13	02083		9R12R	Nest	57	27.7	29.5	26.9	15.8	6.9	EXP-5; Ano plastron
15-Apr-13	02084	02085	9R12R	Nest	57	26.9	31.2	27.1	15.2	7.0	EXP-5; Ano plastron
15-Apr-13	02086		9R12R	Nest	57	27.7	31.3	26.9	15.8	7.0	EXP-5; Ano plastron
15-Apr-13	02087	02088	9R12R	Nest	57	27.1	30.9	27.3	15.0	6.7	EXP-5; Ano V5
15-Apr-13	02089	02090	9R12R	Nest	57	26.5	29.5	27.6	15.1	6.6	EXP-5; Ano plastron; 13 R marg
15-Apr-13	02152		9R12R	Nest	88	28.4	32.7	29.1	15.8	7.9	
15-Apr-13	02099	02100	9R12R	Nest	95	27.9	32.8	29.0	16.9	8.2	
15-Apr-13	02102	02103	9R12R	Nest	95	28.6	32.5	29.2	16.4	8.3	Ano V5, LC

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
15-Apr-13	02104	02105	9R12R	Nest	95	29.1	31.7	29.1	17.0	8.5	
15-Apr-13	02104	02105	9R12R	Nest	95	23.1	24.7	23.6	13.0	4.1	
15-Apr-13				Nest	95						Found dead, no accurate measurements
15-Apr-13				Fence							EXP-3; Found dead, no accurate measurements
15-Apr-13	02106		9R12R	Fence		27.0	31.5	27.5	15.8	7.3	EXP-3
15-Apr-13	02124		9R12R	Fence		26.1	30.1	27.2	14.9	6.2	EXP-2
15-Apr-13	02125	02126	9R12R	Fence		30.1	32.0	28.9	15.6	8.7	EXP-2
15-Apr-13	02127		9R12R	Fence		24.2	27.9	24.6	13.7	4.8	CON-3
15-Apr-13	02129		9R12R	Fence		25.8	28.8	26.0	14.7	5.3	CON-3
15-Apr-13				Fence							CON-3; Found dead, no accurate measurements
15-Apr-13				Fence							CON-3; Found dead, no accurate measurements
15-Apr-13	02130	02131	9R12R	Fence		26.5	29.7	26.2	15.3	7.0	CON-1
15-Apr-13	02175		9R12R	Fence		23.7	27.4	23.4	13.5	4.7	EXP-1
15-Apr-13	02176	02177	9R12R	Fence		24.7	29.3	25.4	15.3		EXP-1
22-Apr-13	02179	02180	9R12R	Nest	122	27.9	32.8	28.7	16.0	8.2	
22-Apr-13	02181	02182	9R12R	Nest	122	28.4	32.0	28.1	16.1	7.8	
22-Apr-13	02183		9R12R	Nest	122	28.6	31.3	28.0	15.8	7.6	
22-Apr-13	02184	02185	9R12R	Nest	141	24.7	29.1	25.2	14.1	5.7	
23-Apr-13	02191	02192	9R12R	Nest	7	26.0	28.9	26.3	15.2	6.4	CON-1
23-Apr-13	02193		9R12R	Nest	7	26.5	29.3	27.7	15.4	6.5	CON-1
23-Apr-13	02194	02195	9R12R	Nest	7	25.3	29.4	24.1	14.8	5.8	CON-1
23-Apr-13	02196		9R12R	Nest	7	28.6	32.6	28.0	16.1	7.6	CON-1
23-Apr-13	02197	02198	9R12R	Nest	7	25.6	29.4	26.9	15.9	6.7	CON-1
23-Apr-13	02199	02200	9R12R	Nest	7	27.8	31.2	28.6	15.7	7.2	CON-1
23-Apr-13	02201		9R12R	Nest	7	27.8	31.4	28.4	15.6	7.1	CON-1
23-Apr-13	02202	02203	9R12R	Nest	7	27.5	30.9	28.6	15.8	7.1	CON-1
23-Apr-13	02204	02205	9R12R	Nest	7	28.0	31.0	28.4	15.6	7.4	CON-1
23-Apr-13	02229		9R12R	Nest	58	29.1	31.1	27.8	16.1	7.1	
23-Apr-13	02230	02231	9R12R	Nest	58	27.9	31.9	28.5	15.6	7.7	
23-Apr-13	02232	02233	9R12R	Nest	58	28.0	31.5	28.5	16.2	7.8	
23-Apr-13	02234		9R12R	Nest	58	25.9	30.2	25.3	14.7	6.3	
23-Apr-13	02235	02236	9R12R	Nest	58	29.5	32.1	29.1	16.7	8.0	
23-Apr-13	02237	02238	9R12R	Nest	58	27.5	31.5	27.4	15.2	7.2	
23-Apr-13	02239		9R12R	Nest	58	24.7	29.0	25.3	14.1	5.8	
23-Apr-13	02240	02241	9R12R	Nest	58	26.5	30.5	27.4	16.3	7.1	
23-Apr-13	02242		9R12R	Nest	83	30.0	33.7	30.0	16.6	8.6	EXP-1
23-Apr-13	02243	02244	9R12R	Nest	83	29.5	32.5	28.5	15.7	7.6	EXP-1
23-Apr-13	02245	02246	9R12R	Nest	83	27.9	31.2	28.2	15.5	7.6	EXP-1; Ano V5
23-Apr-13	02227	02228	9R12R	Nest	107	23.2	25.7	23.6	14.0	4.8	
23-Apr-13	02209	02210	9R12R	Nest	108	26.7	31.1	30.1	16.4	7.8	CON-1
23-Apr-13	02211		9R12R	Nest	108	25.8	29.2	27.1	15.0	6.2	CON-1

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
23-Apr-13	02212	02213	9R12R	Nest	108	24.9	30.5	28.7	15.2	6.9	CON-1
23-Apr-13	02214	02215	9R12R	Nest	108	26.1	29.1	26.8	15.7	6.8	CON-1
23-Apr-13	02216		9R12R	Nest	108	25.5	29.6	27.9	15.5	6.8	CON-1
23-Apr-13	02217	02218	9R12R	Nest	108	26.6	30.0	27.9	15.0	6.7	CON-1; Ano V5
23-Apr-13	02219		9R12R	Nest	108	27.9	29.8	27.4	15.8	6.3	CON-1
23-Apr-13	02220	02221	9R12R	Nest	108	26.4	31.0	28.8	16.0	7.6	CON-1; 26 marg
23-Apr-13	02222	02223	9R12R	Nest	108	25.1	29.3	26.7	15.4	6.4	CON-1; Ano V5; 13 R marg
23-Apr-13	02224		9R12R	Nest	108	23.0	27.2	26.1	15.1	6.1	CON-1; Ano V5; 26 marg
23-Apr-13	02188		9R12R	Nest	140	28.6	32.2	29.0	14.3	7.4	
23-Apr-13	02189	02190	9R12R	Nest	140	28.1	25.5	27.8	18.7	8.2	Kyphotic shell; 18 marg; 4 vert; 3 L cost
23-Apr-13				Nest	140						Found dead, no accurate measurements
23-Apr-13				Nest	140						Found dead, no accurate measurements
23-Apr-13				Nest	140						Found dead, no accurate measurements
23-Apr-13				Nest	140						Found dead, no accurate measurements
23-Apr-13				Nest	140						Found dead, no accurate measurements
23-Apr-13				Nest	140						Found dead, no accurate measurements
23-Apr-13	02186	02187	9R12R	Nest	141	24.4	29.3	25.5	14.4	5.9	
23-Apr-13				Nest	141						Found dead, no accurate measurements
23-Apr-13	02206		9R12R	Fence		28.1	32.6	29.0	16.4	7.4	EXP-2
23-Apr-13	02207	02208	9R12R	Fence		27.3	31.6	27.2	16.4	7.5	EXP-2
23-Apr-13	02225	02226	9R12R	Fence		25.3	29.9	26.2	15.9	6.3	CON-1
23-Apr-13				Fence							EXP-3; Found dead, no accurate measurements
23-Apr-13				Fence							CON-3; Found dead, no accurate measurements
23-Apr-13				Fence							CON-4; Found dead, no accurate measurements
23-Apr-13				Fence							CON-5; Found dead, no accurate measurements
23-Apr-13				Fence							CON-5; Found dead, no accurate measurements
23-Apr-13	02247		9R12R	Fence		25.8	30.3	27.7	15.3	7.2	EXP-1
23-Apr-13	02248	02249	9R12R	Fence		28.5	33.4	29.5	16.4	8.5	EXP-1
23-Apr-13	02250	02251	9R12R	Fence		26.9	31.4	28.4	15.2	7.2	EXP-1
23-Apr-13	02252		9R12R	Fence		27.6	32.0	28.2	15.6	8.1	EXP-1; Ano V5; 26 marg
23-Apr-13	02253	02254	9R12R	Fence		27.6	31.8	29.6	14.9	7.6	EXP-1; Ano V5; 26 marg
23-Apr-13	02255	02256	9R12R	Fence		26.7	30.3	27.1	15.9	6.3	EXP-1
23-Apr-13	02257		9R12R	Fence		25.5	30.5	27.2	14.2	6.5	EXP-2
30-Apr-13	02258	02259	9R12R	Nest	70	27.0	29.4	26.3	14.0	6.3	Ano V5
30-Apr-13	02260		9R12R	Nest	70	24.4	25.7	23.2	14.0	5.1	
30-Apr-13	02262		9R12R	Nest	70	25.4	27.8	25.5	14.5	5.7	
30-Apr-13	02263	02264	9R12R	Nest	70	25.0	28.1	25.0	14.4	5.6	Ano V5
30-Apr-13	02265		9R12R	Nest	70	25.1	28.2	24.6	14.3	5.3	
30-Apr-13	02267		9R12R	Nest	70	25.8	27.8	24.3	14.0	5.6	Ano V5, plastron
30-Apr-13	02268	02269	9R12R	Nest	70	26.6	29.0	25.9	14.5	6.3	
30-Apr-13	02270		9R12R	Nest	70	26.5	28.4	24.6	14.9	5.9	Ano V3-5

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
30-Apr-13	02271	02272	9R12R	Fence		23.6	27.2	24.1	14.0	4.9	CON-1
30-Apr-13	02275		9R12R	Fence		24.2	27.5	24.2	14.6	5.1	CON-1
30-Apr-13	02276	02277	9R12R	Fence		23.1	26.3	23.9	14.4	4.8	CON-1
30-Apr-13	02278	02279	9R12R	Fence		22.2	25.6	23.2	13.3	4.3	CON-1
30-Apr-13	02280		9R12R	Fence		23.0	26.9	23.5	14.3	4.7	CON-1
30-Apr-13	02281	02282	9R12R	Fence		25.0	27.8	24.4	14.0	5.2	CON-1
30-Apr-13	02283	02290	9R12R	Fence		21.0	24.7	21.4	13.2	4.0	CON-1
30-Apr-13	02285		9R12R	Fence		21.6	25.5	22.2	13.3	4.0	CON-1
30-Apr-13	02286	02287	9R12R	Fence		29.8	32.5	29.4	15.7	7.6	EXP-1
30-Apr-13	02288		9R12R	Fence		24.2	28.7	26.4	13.9	5.5	CON-1
30-Apr-13				Fence							CON-3; Found dead, no accurate measurements
30-Apr-13				Fence							CON-4; Found dead, no accurate measurements
4-May-13	02294	02295	9R12R	Nest	46	25.3	30.4	25.2	15.3	6.7	
4-May-13	02291	02292	9R12R	Nest	55	26.2	29.3	26.6	15.7	6.0	
4-May-13	02293		9R12R	Nest	55	28.2	31.9	29.7	16.1	7.7	
4-May-13	02296	02297	9R12R	Nest	79	29.1	32.5	28.5	16.6	8.6	EXP-5
4-May-13	02298		9R12R	Nest	79	29.0	31.9	28.4	15.6	7.6	EXP-5
4-May-13	02299	02300	9R12R	Nest	79	30.8	33.1	29.8	14.5	8.0	EXP-5
4-May-13	02301	02302	9R12R	Nest	79	30.0	33.2	29.7	16.6	8.6	EXP-5
7-May-13	02331		9R12R	Nest	46	24.2	27.9	24.9	14.5	6.2	
7-May-13	02332	02333	9R12R	Nest	46	25.5	30.3	27.9	15.0	6.9	
7-May-13	02303		9R12R	Nest	79	28.6	31.1	28.7	14.3	7.4	EXP-5
7-May-13	02304	02305	9R12R	Nest	79	29.7	31.7	28.1	14.7	7.1	EXP-5
7-May-13	02306	02307	9R12R	Nest	79	28.1	31.7	29.0	15.2	7.1	EXP-5; Ano V5
7-May-13	02308		9R12R	Nest	79	29.9	33.3	28.5	15.3	7.0	EXP-5; Ano V5
7-May-13	02309	02310	9R12R	Nest	79	28.5	31.0	27.2	15.1	6.4	EXP-5; Ano V5
7-May-13	02311		9R12R	Nest	79	28.2	31.1	28.1	14.5	6.6	EXP-5
7-May-13	02313		9R12R	Nest	79	27.5	29.3	26.0	15.4	6.0	EXP-5
7-May-13	02314	02315	9R12R	Nest	79	28.4	30.8	27.9	15.4	6.7	EXP-5
7-May-13	02316		9R12R	Fence		26.8	30.6	27.6	15.4	6.8	EXP-2
7-May-13	02317	02318	9R12R	Fence		26.8	31.9	29.3	15.5	7.1	EXP-2
7-May-13	02319	02320	9R12R	Fence		20.9	23.8	21.6	13.3	3.3	CON-2
7-May-13	02334		9R12R	Fence		27.2	30.5	27.6	15.6	6.6	CON-1
7-May-13	02335	02336	9R12R	Fence		23.9	27.0	23.9	13.5	4.2	EXP-1
7-May-13	02321		9R12R	Fence		23.2	26.2	23.3	13.3	4.1	CON-2
7-May-13	02322	02323	9R12R	Fence		23.0	26.8	24.9	15.2	4.6	CON-2
7-May-13	02324	02325	9R12R	Fence		21.3	24.7	23.4	13.2	3.8	CON-2
7-May-13	02326		9R12R	Fence		21.6	24.4	21.6	12.6	3.3	CON-2
7-May-13	02327	02328	9R12R	Fence		21.8	25.4	23.8	13.4	4.1	CON-2
7-May-13	02329	02330	9R12R	Fence		24.5	27.4	24.9	14.1	4.8	CON-3
7-May-13				Fence							EXP-3; Found dead, no accurate measurements

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
7-May-13				Fence							CON-4; Found dead, no accurate measurements
7-May-13				Fence							EXP-5; Found dead, no accurate measurements
7-May-13				Fence							EXP-5; Found dead, no accurate measurements
9-May-13	02337	02338	9R12R	Fence		31.6	33.3	30.1	16.3	8.3	CON-5
9-May-13	02339		9R12R	Fence		28.4	30.9	29.9	15.9	7.6	EXP-5
9-May-13	02340	02341	9R12R	Fence		28.8	32.1	29.2	16.0	7.8	CON-2
10-May-13	02342	02343	9R12R	Fence		29.8	34.6	30.4	15.7	8.6	EXP-1
10-May-13	02344		9R12R	Fence		23.0	26.2	24.3	13.2	4.5	EXP-1
10-May-13	02345	02346	9R12R	Fence		23.7	28.3	25.2	14.6	5.2	CON-1
10-May-13	02347	02348	9R12R	Fence		24.1	28.0	23.4	13.6	4.7	CON-1
14-May-13	02349		9R12R	Nest	56	26.1	28.8	26.0	14.0	5.5	
14-May-13	02350	02351	9R12R	Fence		28.5	32.9	31.2	16.9	9.1	EXP-1; Ano V5
14-May-13	02352		9R12R	Fence		25.7	30.3	27.1	14.8	6.2	EXP-1
14-May-13	02354		9R12R	Fence		27.2	31.8	29.1	15.7	7.5	EXP-1
15-May-13	02367		9R12R	Nest	23	28.6	30.8	26.4	15.7	6.9	
15-May-13	02368	02369	9R12R	Nest	23	28.6	32.7	27.8	15.4	7.8	
15-May-13	02370	02371	9R12R	Nest	55	26.4	31.3	27.9	16.0	7.0	
15-May-13	02372		9R12R	Nest	56	26.9	31.7	30.3	15.9	7.4	
15-May-13	02373		9R12R	Nest	56	27.0	31.1	28.5	15.5	6.8	
15-May-13	02363	02364	8R11R	Nest	114	29.2	30.0	27.9	15.1	6.4	EXP-1; 22 marg
15-May-13	02355	02356	9R129	Nest	122	29.1	33.6	29.6	15.4	8.2	
15-May-13	02357		9R12R	Nest	122	28.1	32.3	27.7	15.0	7.3	
15-May-13	02358	02359	9R12R	Nest	122	27.4	30.9	28.8	14.2	7.0	
15-May-13	02360	02361	9R12R	Nest	122	26.6	31.6	28.5	15.4	8.1	
15-May-13	02362		9R12R	Nest	122	24.8	28.5	25.6	13.8	5.6	Ano V5
15-May-13	02365	02366	9R12R	Fence		24.1	28.5	24.9	12.6	5.7	CON-2
15-May-13				Fence							CON-5; Found dead, no accurate measurements
15-May-13				Fence							EXP-5; Found dead, no accurate measurements
16-May-13	02378	02379	9R12R	Nest	56	31.0	36.0	31.8	16.7	10.5	
16-May-13	02380	02381	9R12R	Nest	115	18.0	21.3	19.9	11.7	2.7	
16-May-13	02382		9R12R	Nest	115	27.9	32.1	28.7	15.9	7.7	
16-May-13	02383	02384	9R12R	Nest	115	27.8	29.4	28.3	15.5	7.6	
16-May-13	02385		9R12R	Nest	115	29.1	30.1	28.1	15.3	7.5	
16-May-13	02386	02387	9R12R	Nest	115	27.9	31.5	27.6	15.5	7.2	
16-May-13	02388	02389	9R12R	Nest	115	27.2	30.5	28.2	15.4	7.4	
16-May-13	02390		9R12R	Nest	115	27.8	29.2	28.3	15.1	7.5	
16-May-13	02391	02392	9R12R	Nest	115	28.9	32.7	28.4	14.6	7.6	
16-May-13	02393	02394	9R12R	Nest	115	26.4	29.4	27.4	14.2	6.8	13 R marg
16-May-13	02395		9R12R	Nest	115	29.6	31.1	27.3	15.0	7.2	
16-May-13	02396	02397	9R12R	Nest	115	27.4	30.1	27.4	15.4	7.2	
16-May-13	02398	02399	9R12R	Nest	115	25.8	29.2	27.7	15.2	6.8	

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
16-May-13	02377		9R12R	Fence		26.7	31.4	28.9	15.3	7.3	EXP-1; Ano V5; 26 marg
16-May-13	02375	02376	9R12R	Hand		26.3	31.1	25.2	15.5	7.0	
16-May-13				Fence							CON-3; Found dead, no accurate measurements
17-May-13	02400		9R12R	Nest	8	27.3	30.7	28.9	14.8	7.5	
20-May-13	02406	02407	9R12R	Nest	8	28.1	30.0	27.7	15.2	7.6	
20-May-13				Nest	41						Found dead, no accurate measurements
20-May-13	02449	02450	9R12R	Nest	49	27.7	31.7	28.6	15.7	7.4	
20-May-13	02428		9R12R	Nest	56	25.1	27.9	26.7	14.1	6.1	
20-May-13	02429	02430	9R12R	Nest	56	24.6	28.3	24.7	14.9	6.4	
20-May-13	02439	02440	9R12R	Nest	74	24.7	28.3	29.7	15.6	7.8	
20-May-13	02441	02442	9R12R	Nest	74	26.0	30.3	29.5	15.5	8.3	
20-May-13	02443		9R12R	Nest	74	27.8	29.6	28.9	15.2	7.4	
20-May-13	02444	02445	9R12R	Nest	87	24.5	28.6	27.2	15.9	6.4	
20-May-13	02446		8R11R	Nest	87	21.4	25.6	23.9	13.4	5.2	11 R marg
20-May-13	02436	02437	9R12R	Nest	110	23.6	26.1	22.1	13.1	4.7	EXP-5
20-May-13	02438		9R12R	Nest	110	21.3	24.1	22.1	12.7	3.9	EXP-5
20-May-13				Nest	110						EXP-5; Found depredated by ants; no accurate measurements
20-May-13				Nest	110						EXP-5; Found depredated by ants; no accurate measurements
20-May-13	02448		9R12R	Nest	131	29.1	32.8	29.6	16.6	7.8	Ano RC & LC; 13 R marg
20-May-13	02433		9R12R	Nest	167	26.4	28.9	26.1	14.3	6.3	
20-May-13	02408	02409	9R12R	Nest	198	27.7	31.6	28.7	14.6	8.0	Ano V1
20-May-13	02410		9R12R	Nest	198	24.0	29.3	25.7	14.2	6.4	
20-May-13	02411	02412	9R12R	Nest	198	25.9	30.4	27.4	13.7	7.1	
20-May-13	02413	02414	9R12R	Nest	198	27.0	30.2	27.2	14.6	7.1	
20-May-13	02415		9R12R	Nest	198	25.0	28.9	27.0	13.4	6.6	
20-May-13	02416	02417	9R12R	Nest	198	24.9	27.8	26.9	13.9	6.3	
20-May-13	02418		9R12R	Nest	198	24.8	28.3	25.7	13.2	12.9	
20-May-13	02420		9R12R	Nest	198	24.4	28.5	28.3	13.5	7.1	
20-May-13	02421	02422	9R12R	Nest	198	23.4	26.2	26.6	13.5	5.5	
20-May-13	02423		9R12R	Nest	198	25.1	27.7	23.4	15.4	6.6	
20-May-13	02424	02425	9R12R	Nest	198	23.4	29.3	25.9	13.4	5.8	
20-May-13	02403	02404	9R12R	Unk		26.6	33.2	28.9	16.3	9.6	
20-May-13	02405		9R12R	Unk		24.6	28.7	26.1	14.7	6.0	
20-May-13	02408	02409	9R12R	Unk		26.6	30.6	27.4	14.9	7.1	
21-May-13	02467	02468	9R12R	Nest	56	27.2	30.2	28.0	15.6	6.8	
21-May-13	02469	02470	9R12R	Nest	56	26.4	31.6	29.0	16.2	8.1	Spot on R anal scute
21-May-13	02471		9R12R	Nest	56	30.4	33.9	31.6	16.4	9.3	
21-May-13	02466		9R12R	Nest	106	24.9	26.4	23.7	13.7	4.6	
21-May-13				Nest	110						EXP-5; Found depredated by ants; no accurate measurements

Date	ID1	ID2	Notch ID	MOC	Nest #	Plastron Length	Carapace Length	Shell Width	Shell Height	Mass	Comments
21-May-13				Nest	110						EXP-5; Found depredated by ants; no accurate measurements
21-May-13	02464	02465	9R12R	Nest	114	29.7	33.8	30.7	18.2	9.7	EXP-1; Possibly blind L eye
21-May-13	02451		9R12R	Nest	200	26.1	30.7	25.6	15.8	7.7	Indented L carapace
21-May-13	02452	02453	9R12R	Nest	200	24.9	27.0	25.1	15.0	6.6	
21-May-13	02454	02455	9R12R	Nest	200	25.3	28.6	26.2	15.2	6.2	Ano V5
21-May-13	02456		9R12R	Nest	200	25.3	28.8	23.7	16.1	5.6	Ano V5; Indented carapace
21-May-13	02458		9R12R	Nest	200	27.3	29.4	26.9	15.2	5.9	Ano V5
21-May-13	02459		9R12R	Nest	200	25.4	29.1	23.9	15.2	5.3	Ano V5
21-May-13	02461		9R12R	Hand		26.6	30.2	27.4	15.4	6.2	Notch
21-May-13	02462	02463	9R12R	Fence		30.3	32.9	29.1	16.3	8.5	CON-2
21-May-13	02472	02473	9R12R	Fence		27.3	29.5	27.6	15.5	7.0	CON-3
22-May-13	02475	02476	9R12R	Nest	114	28.8	32.5	29.2	17.0	8.3	EXP-1
22-May-13				Fence							CON-3; Found dead, no accurate measurements
23-May-13	02474		9R12R	Nest	56	26.7	30.3	28.7	15.9	6.9	Ano V5
23-May-13				Nest	167						Found dead, no accurate measurements

Date	PIT ID	Notch ID	Sex	Plastron Length	Carapace Length	Width	Height	Weight	DOB	Comments
8-Apr-13	0A140A5430	11R	F	95	113	90	47	250	2012	Fairview
8-Apr-13	0A140A540D	11R	J	79	90	73	37	123	2012	Conococheague
8-Apr-13	0A140A5414	11R	F	104	116	96	48	254	2012	St. John's; Ano V1
8-Apr-13	0A140A5412	1R	J	67	81	64	34	86	2012	Ken School
8-Apr-13	0A140A5415	3R	F	77	91	74	42	134	2012	School of Incarnation
8-Apr-13	0A140A540A	2R	J	74	86	68	36	111	2012	Montgomery Blair
8-Apr-13	0A140A5374	11R	F	88	102	73	43	139	2012	Northern HS, kyophotic
8-Apr-13	0A140A5447	1R	F	105	120	99	49	293	2012	Huntinstown; Ano V5
8-Apr-13	0A140A5435	1R	J	49	59	47	27	40	2012	Sudbrook
8-Apr-13	0A140A5378	11R	F	88	98	83	38	156	2012	Chesapeake Acad; Soft shell; Ano V5
8-Apr-13	0A140A537D	1R	J	71	82	71	35	99	2012	Lime Kimln
8-Apr-13	0A140A5445	12R	F	103	118	97	47	277	2012	Bushy Park
8-Apr-13	0A140A5423	11R	F	103	116	92	46	240	2012	Glenelg HS
8-Apr-13	0A140A5443	1R	J	72	82	66	37	101	2012	Kent County
8-Apr-13	0A140A5375	3R	J	51	62	49	27	42	2012	Pointers Run
8-Apr-13	0A140A5407	11R	J	64	74	60	32	74	2012	Pine Grove
8-Apr-13	0A140A537A	1R	J	79	94	78	41	143	2012	Franklin MS
8-Apr-13	0A140A5427	3R	J	60	72	55	30	57	2012	City Neighbors
8-Apr-13	0A140A54AC	11R	F	94	107	89	43	206	2012	Broadneck
8-Apr-13	0A140A541F	11R	J	82	95	76	39	138	2012	Perry Hall
8-Apr-13	0A140A5439	1R	F	103	117	97	49	273	2012	Naval Academy
8-Apr-13	0A140A544E	12R	J	79	91	76	39	154	2012	Wilde Lake
8-Apr-13	0A140A536F	11R	J	55	65	52	28	50	2012	Washington Middle
8-Apr-13	0A140A5376	1R	J	85	96	77	40	142	2012	McDonogh; Ano plastron
8-Apr-13	0A140A5448	11R	F	106	123	102	53	316	2012	Calvert High
8-Apr-13	0A140A5377	2R	F	86	99	77	40	155	2012	St. Andrews
8-Apr-13	0A140A5348	1R	F	85	100	80	42	166	2012	Paint Branch
8-Apr-13	0A140A543A	11R	J	73	89	77	42	141	2012	MRHS; kyophotic shell
8-Apr-13	0A140A537C	2R	F	118	139	110	55	403	2012	Sandy Spring
8-Apr-13	0A140A542B	1R	J	75	88	72	39	121	2012	MCMS; Ano V5
8-Apr-13	0A140A1E15	11L	J	76	87	71	39	127	2012	Old Mill Mid N (Greenlee)
8-Apr-13	0A140A1E4B	2R2L	J	66	75	67	33	95	2012	Voll Glen Burnie; Ano plastron, LC, V5
8-Apr-13	0A140A1E1D	2R11R	J	67	81	66	35	66	2012	Voll Glen Burnie
8-Apr-13	0A140A1E18	2R9R	F	84	97	82	44	181	2012	Shipley's Choice Webb
8-Apr-13	0A140A1E43	2R8R2L	F	89	102	88	47	214	2012	Old Mill Mid N (Greenlee)
8-Apr-13	0A140A4F45	1L	F	87	100	88	44	191	2012	Ship Choice (Webb)
8-Apr-13	0A140A501F	2R9R	F	76	88	71	36	119	2012	SPHS Hannahs; Ano V5
8-Apr-13	0A140A1E13	1L	J	49	56	48	26	41	2012	Hannahs SPHS
8-Apr-13	0A140A5027	8R	J	71	85	65	35	104	2012	Freetown Haney
8-Apr-13	0A140A1E35	10R	J	67	82	69	34	100	2012	Meade Middle-Shellmen
8-Apr-13	0A140A1E29	1L	J	72	82	70	38	107	2012	Southern MS-Dress Ano V5

Date	PIT ID	Notch ID	Sex	Plastron Length	Carapace Length	Width	Height	Weight	DOB	Comments
8-Apr-13	0A140A1D7F	12L	J	71	82	67	38	108	2012	North County HS
8-Apr-13	0A140A4F71	2R8R	J	63	73	66	34	86	2012	Cat North; Ano V4/5, RC
8-Apr-13	0A140A1E01	9L	J	72	84	69	35	102	2012	Terr Conn AE
8-Apr-13	0A140A1E39	10R	J	63	76	62	31	73	2012	Terr Conn AE
8-Apr-13	0A140A1E00	8R	J	56	67	53	30	52	2012	Tracey's Elem Mcderias
8-Apr-13	0A140A5034	2R2L	J	58	64	59	28	58	2012	Tracey's Elem Mcderias; Ano V3, LC
8-Apr-13	0A140A1E2D	2R12R	J	72	83	69	36	122	2012	Freetown Haney
8-Apr-13	0A140A500E	10L	J	78	95	78	41	144	2012	Ann HS-Skinner
8-Apr-13	0A140A1E57	2R11R	F	82	97	82	41	160	2012	Ann HS-Skinner
8-Apr-13	0A140A1E4A	2R3L	F	78	89	76	38	144	2012	Martin-Van Bohlen
8-Apr-13	0A140A1E2A	1L	J	73	88	75	37	128	2012	Martin-Van Bohlen
8-Apr-13	0A140A1E3E	8R	F	91	106	83	43	190	2012	Southshore Elem
8-Apr-13	0A140A5026	2R12R	F	93	104	88	46	211	2012	Southshore Elem
8-Apr-13	0A140A5021	9L	J	76	87	75	38	123	2012	Central Special Geier
8-Apr-13	0A140A4F4E	1L	J	67	77	64	34	93	2012	Central Special Geier
8-Apr-13	0A140A4F50	2R2L	J	60	71	57	31	71	2012	CBM-Wheeler
8-Apr-13	0A140A4F76	2R12R	J	63	72	61	33	79	2012	CBM-Wheeler
8-Apr-13	0A140A4F7A	9L	F	99	116	93	49	265	2012	CBM-Maxwell; 26 marg
8-Apr-13	0A140A5001	10R	F	95	114	92	46	251	2012	CBM-Maxwell
8-Apr-13	0A140A1E33	2R8R2L	F	97	110	89	47	239	2012	NEHS-Imwold
8-Apr-13	0A140A1E05	12L	F	86	99	81	44	188	2012	NEHS-Imwold
8-Apr-13	0A140A501B	8L	J	70	86	70	35	106	2012	CBME-Werre
8-Apr-13	0A140A5008	9R	J	67	82	62	34	84	2012	CBME-Werre
8-Apr-13	0A140A5031	10R	J	62	77	61	33	73	2012	MacArthur Mid-Klinedinst
8-Apr-13	0A140A4F7E	3L	J	68	78	64	34	91	2012	MacArthur Mid-Klinedinst
8-Apr-13	0A140A1D7A	2R10R	J	62	74	59	32	72	2012	Old Mill HS- Helms
8-Apr-13	0A140A5033	12L	J	58	69	54	31	64	2012	Old Mill HS- Helms
8-Apr-13	0A140A500D	2L	J	96	110	92	48	230	2012	RuthEason-Angle
8-Apr-13	0A140A1E16	8R	J	89	105	81	43	173	2012	RuthEason-Angle
8-Apr-13	0A140A1E07	2R9R	F	74	84	72	37	121	2012	Rivera Beach- Flohr
8-Apr-13	0A140A1E26	11L	F	69	80	67	38	98	2012	Rivera Beach- Flohr
8-Apr-13	0A140A5018	2R10R	J	83	98	79	42	155	2012	Edgewater-Jessie
8-Apr-13	0A140A1D7C	10R	J	84	101	79	41	160	2012	Edgewater-Jessie
8-Apr-13	0A140A4F42	8L	J	86	98	84	41	172	2012	Belvedere-Sabat
8-Apr-13	0A140A1E3A	2R8R	J	77	85	72	38	125	2012	Belvedere-Sabat
8-Apr-13	0A140A5011	1L	J	64	76	63	34	84	2012	Bates Mid-Smith
8-Apr-13	0A140A1E4D	2R8R2L	J	60	71	59	31	71	2012	Bates Mid-Smith
8-Apr-13	0A140A1E45	2L	F	106	125	99	52	333	2012	Hilltop-Day
8-Apr-13	0A140A1E1C	2R12R	F	106	119	99	51	322	2012	Hilltop-Day
8-Apr-13	0A140A5023	2L	F	81	97	80	42	167	2012	Rolling Knolls-Gallagher
8-Apr-13	0A140A1E54	2R9R	F	76	87	73	38	135	2012	Rolling Knolls-Gallagher

Date	PIT ID	Notch ID	Sex	Plastron Length	Carapace Length	Width	Height	Weight	DOB	Comments
8-Apr-13	0A140A501E	2R12R	J	65	73	60	33	80	2012	CMS-Hanson
8-Apr-13	0A140A4F77	8R	J	60	72	56	31	62	2012	CMS-Hanson
8-Apr-13	0A140A4F7F	2R12R	J	57	64	53	27	55	2012	Marley Middle Maynard
8-Apr-13	0A140A 4F43	9L	J	54	62	50	28	49	2012	Marley Middle Maynard
8-Apr-13	0A140A503C	1L	J	62	75	62	81	62	2012	Oak Hill Lawton
8-Apr-13	0A140A5022	10R	J	58	72	58	30	65	2012	Oak Hill Lawton
8-Apr-13	0A140A1E17	2R8R2L	J	56	67	56	30	58	2012	Davidsonville-Moff
8-Apr-13	0A140A1E47	8L	J	68	82	68	33	100	2012	Davidsonville-Moff
8-Apr-13	0A140A5044	10R	J	70	84	70	37	106	2012	Davidsonville-Perett
8-Apr-13	0A140A4F7D	2R10R	J	79	92	76	41	142	2012	Davidsonville-Perett
9-Apr-13	0A140A500C	8R	J	77	91	70	38	117	2012	Southern MS-Dress
9-Apr-13	0A140A1E0C	1L	J	66	79	65	36	92	2012	South River Martin; damaged tail
9-Apr-13	0A140A4F78	2R8R	F	80	87	77	40	142	2012	South River Martin
9-Apr-13	0A140A1E56	2R3L	J	87	103	85	43	192	2012	Bodkin-Rush
9-Apr-13	0A140A1E30	10R	J	76	89	73	37	119	2012	West Annapolis Burrows
9-Apr-13	0A140A5040	8L	F	87	102	86	41	185	2012	Bodkin Duffy-Captain
9-Apr-13	0A140A5036	2R9R	F	83	95	81	42	173	2012	Bodkin Duffy-Treasure
9-Apr-13	0A140A4F4D	2R2L	J	64	70	62	33	80	2012	West Annapolis Burrows; Ano V1
9-Apr-13	0A140A4F54	1L	F	91	104	89	46	199	2012	Bodkin-Rush
9-Apr-13	0A140A1E11	2R10R	J	74	88	72	38	117	2012	C. Rowland
9-Apr-13	0A140A4F74	9L	J	69	80	66	36	92	2012	C. Rowland
9-Apr-13	0A140A5017	3R2L	J	76	87	75	39	135	2012	Hudson-SRMS
9-Apr-13	0A140A5012	2L	F	74	89	76	39	131	2012	Hudson-SRMS
9-Apr-13	0A140A1E41	8L	J	63	76	64	33	88	2012	Benfield-Mullin
9-Apr-13	0A140A5005	2R8R	J	61	68	58	32	69	2012	Benfield-Mullin
9-Apr-13	0A140A502D	1R3R	M	103	122	96	47	280	2012	Greenlee-SRMS
9-Apr-13	0A140A503D	9L	F	82	96	78	42	168	2012	Greenlee-SRMS
9-Apr-13	0A140A502B	9R	F	87	102	85	41	194	2012	SPES-Leavitt-Liberto
9-Apr-13	0A140A4F4C	9R13R	F	70	78	71	34	97	2012	SPES-Leavitt-Gomer; 13 R marg; Ano V5
9-Apr-13	0A140A4F72	2R8L	J	69	79	66	34	94	2012	Kent Island-Ritz Sadowski
9-Apr-13	0A140A1E27	2R11L	J	74	85	73	38	124	2012	Hurlock
9-Apr-13	0A140A501D	2R8L	J	58	67	56	29	62	2012	Hurlock
9-Apr-13	0A140A4F79	10R	J	81	94	79	42	148	2012	Clarksville
9-Apr-13	0A140A4F4F	2R12L	J	61	70	57	33	65	2012	Clarksville
9-Apr-13	0A140A1E21	2R10L	J	81	93	81	41	162	2012	Hurlock
9-Apr-13	0A140A1E5B	2R9L	J	63	73	62	33	76	2012	Hurlock
9-Apr-13	0A140A4F48	2R11L	J	69	83	68	37	102	2012	HQ
9-Apr-13	0A140A1E37	2R 911	J	65	76	64	35	88	2012	HQ
9-Apr-13	0A140A5006	3R10R	J	71	86	70	37	111	2012	HQ
9-Apr-13	0A140A1E19	2R3L	J	60	70	60	31	67	2012	HQ
9-Apr-13	0A140A500B	2R8L	J	68	80	66	33	89	2012	HQ

Date	PIT ID	Notch ID	Sex	Plastron Length	Carapace Length	Width	Height	Weight	DOB	Comments
9-Apr-13	0A140A1E52	3R8R	J	52	66	54	29	50	2012	HQ
9-Apr-13	0A140A5002	2R12L	J	56	68	55	31	56	2012	HQ
9-Apr-13	0A140A1E4C	2R10L	J	53	64	53	29	48	2012	HQ
9-Apr-13	0A140A5004	2R10L	J	70	81	71	34	93	2012	Deitrich
9-Apr-13	0A140A5038	3R10R	J	60	73	57	30	63	2012	Deitrich
9-Apr-13	0A140A5003	2R10L	F	85	98	88	45	175	2012	Kent Island-Ritz Sadowski
9-Apr-13	0A140A4F7B	2R10L	J	78	88	80	39	134	2012	Ward Metapeake Middle
9-Apr-13	0A140A1E06	2R8L	J	69	82	65	36	96	2012	Ward Metapeake Middle
9-Apr-13	0A140A5024	3R10R	F	83	94	78	43	141	2012	St. Michales MS
9-Apr-13	0A140A5007	2R11L	J	67	78	63	36	96	2012	St. Michales MS
9-Apr-13	0A140A1E0D	2R12L	J	70	82	69	34	94	2012	Chapel District
9-Apr-13	0A140A5043	3R10R	J	62	75	61	32	72	2012	Chapel District
9-Apr-13	0A140A500A	2R9L	J	44	50	43	25	28	2012	Overington; missing plastron scutes
9-Apr-13	0A140A1E55	2R8L	J	80	81	76	38	129	2012	Overington
9-Apr-13	0A140A5028	2R8L	J	61	72	56	31	62	2012	Johnson Kim
9-Apr-13	0A140A502F	2R12L	J	76	90	74	40	116	2012	Johnson Kim
9-Apr-13	0A140A4F47	2R8L	J	51	59	49	27	40	2012	Tilghman
9-Apr-13	0A140A4F7C	2R12L	J	50	60	48	27	40	2012	Tilghman
9-Apr-13	0A140A5041	3R8R	F	81	97	76	44	145	2012	Poplar
9-Apr-13	0A140A4F4A	2R10L	F	85	96	84	44	171	2012	Poplar
9-Apr-13	0A140A502C	2R3L	F	75	85	74	40	125	2012	Poplar
9-Apr-13	0A140A4F46	3R10R	F	78	90	75	42	134	2012	Poplar
9-Apr-13	0A140A5030	1R	F	99	111	91	49	252	2012	William Schmidt Outdoor Education Center NAIB
9-Apr-13	0A140A5032	2R10R	F	80	96	78	39	137	2012	SPES Woolpper Rocky
9-Apr-13	0A140A5029	11L	J	66	77	67	34	94	2012	SPES Lightning
9-Apr-13	0A140A5042	1R3R	J	78	94	79	38	140	2012	SPES Jacobs Bobblehead
9-Apr-13	0A140A5037	8L	F	83	101	80	40	171	2012	Solley Mr Carpenter
9-Apr-13	0A140A5015	2R9R	J	83	97	79	40	164	2012	Solley; Ano V4-V5
9-Apr-13	0A140A1E3D	1R3R	J	65	78	63	33	82	2012	George Fox Ben Thompson
9-Apr-13	0A140A1E2C	2L	J	67	80	64	33	92	2012	Geroge Fox Thompson
9-Apr-13	0A140A4F55	2R9R	F	87	98	81	42	185	2012	Severna Park Bubba
9-Apr-13	0A140A503F	2L	F	69	81	66	35	103	2012	Severna Park Bubbles
9-Apr-13	0A140A5019	9L	J	67	77	66	36	86	2012	Arundel Mid Jones
9-Apr-13	0A140A4F73	2R10R	J	67	79	63	36	80	2012	Arundel Mid Jones
9-Apr-13	0A140A502A	10L	J	72	86	70	36	112	2012	Cotton Elem Fritz
9-Apr-13	0A140A501A	10R	J	63	77	64	33	79	2012	Cotton Elem Fritz
9-Apr-13	0A140A500F	2R8L	F	94	110	87	45	237	2012	Arnold Elem Pebbles
9-Apr-13	0A140A5020	2R12R	J	66	77	64	34	88	2012	Jessup Anderson
9-Apr-13	0A140A501C	10R	J	61	76	59	31	70	2012	Jessup Anderson
9-Apr-13	0A140A4F53	9L	F	96	110	93	46	222	2012	Arnold Hartman; 26 marg
9-Apr-13	0A140A5013	8R	J	79	66	64	34	83	2012	Nolan Hebron Harmon

Date	PIT ID	Notch ID	Sex	Plastron Length	Carapace Length	Width	Height	Weight	DOB	Comments
9-Apr-13	0A140A5009	2R12	J	68	78	66	34	88	2012	Nolan Hebron Harmon
9-Apr-13	0A140A5045	2R8R2L	F	87	98	84	43	177	2012	Overlook McGowan
9-Apr-13	0A140A5010	1L	J	83	94	84	39	156	2012	Solley Elem. Flannagan
9-Apr-13	0A140A5016	2R9R	F	106	120	98	45	291	2012	Solley Elem; Ano V3-5
9-Apr-13	0A140A4F49	11L	F	70	81	67	35	91	2012	Overlook Finn, Schmiedt
9-Apr-13	0A140A4F52	2R11R	J	46	55	47	25	33	2012	Annaplois Middle
9-Apr-13	0A140A4F44	10R	J	60	74	58	30	66	2012	Lindale Middle Mauro
9-Apr-13	0A140A502E	2L	J	71	83	72	36	112	2012	McGowan Overlook
9-Apr-13	0A140A1E59	2R8R2L	J	75	88	72	37	123	2012	Overlook, Schmidt
9-Apr-13	0A140A1E1A	2R9R	F	94	106	86	46	235	2012	Greenlee Severn River
9-Apr-13	0A140A503B	3R11R	F	82	94	78	39	151	2012	Calvert Co
9-Apr-13	0A140A4F51	3R11R	F	86	97	81	41	162	2012	Calvert Co
9-Apr-13	0A140A503A	3L	F	76	89	73	37	127	2012	Solley Sicfert
9-Apr-13	0A140A503E	2R10R	F	85	97	78	40	152	2012	Solley Sicfert
9-Apr-13	0A140A5035	1R3R	J	77	90	77	40	129	2012	Hannah Moore Riahin
9-Apr-13	4A730E6767	8R	J	77	91	73	37	124	2012	Southern High -West
9-Apr-13	0A13091419	2R12R	J	72	87	74	38	126	2012	Southern High -West
9-Apr-13	0A1309136B	10L	J	73	89	75	37	127	2012	Annaplois Middle Henry
9-Apr-13	0A13091365	2L	J	66	77	62	34	82	2012	Richard Henry Lee Senchak
9-Apr-13	0A1309141C	11L	J	61	73	61	33	76	2012	Richard Henry Lee Senchak
9-Apr-13	0A13091371	2R10R	J	83	97	77	41	148	2012	Jones ES Montague
9-Apr-13	0A1309140E	2R12R	J	84	97	79	71	165	2012	Jones ES Montague
9-Apr-13	0A13091416	2R3L	J	49	56	47	26	37	2012	Arundel HS Hanson
9-Apr-13	4B04330233	8R	J	69	84	64	33	89	2012	Maryland City ES Nichols
9-Apr-13	0A13091408	2R12R	J	68	77	65	34	92	2012	Maryland City ES Nichols
9-Apr-13	0A13091358	11L	J	68	80	65	35	96	2012	CAT-N Chow; Ano RC
9-Apr-13	0A13091427	2R12R	J	71	82	68	36	110	2012	Meade HS Gioia
9-Apr-13	0A1309141A	8R	J	66	79	62	34	85	2012	Meade HS Gioia
9-Apr-13	0A1309137E	8L	F	80	97	80	40	160	2012	Quarterfield Favris
9-Apr-13	4B02707503	2R8R	F	75	86	74	40	135	2012	Quarterfield Favris
9-Apr-13	0A13091429	8R3L	F	73	84	68	37	112	2012	Cape St. Clair Velozo
9-Apr-13	0A13091403	1L	J	67	80	68	37	100	2012	Cape St. Clair Velozo
9-Apr-13	4B05335C38	9R	J	85	100	85	43	194	2012	Woodside Kirendall
9-Apr-13	0A1309142A	2R2L	F	77	88	77	40	155	2012	Woodside Kirendall
9-Apr-13	0A13091417	2R8R	F	79	87	78	40	138	2012	Woodside Cronin
9-Apr-13	4A72287F47	8L	J	63	75	62	33	75	2012	Woodeside Cronin
10-Apr-13	0A1309135A	12L	J	67	77	63	33	83	2012	Odenton Morris
10-Apr-13	0A1309136E	2R8R2L	J	61	72	60	32	68	2012	Odenton Morris
10-Apr-13	0A13091377	9L	F	91	109	89	46	223	2012	Crofton Woods Powers
10-Apr-13	0A13091363	2R10R	F	104	117	95	49	289	2012	Crofton Woods Powers; Ano V5
10-Apr-13	0A13091411	2R12R	J	68	78	68	35	100	2012	Folger McKinset Rodger

Date	PIT ID	Notch ID	Sex	Plastron Length	Carapace Length	Width	Height	Weight	DOB	Comments
10-Apr-13	0A1309141B	8R	J	82	95	78	40	147	2012	Folger McKinset Rodger
10-Apr-13	0A1309135F	2R3L	J	82	94	76	39	155	2012	BPMS Prestridce
10-Apr-13	0A13091410	8L	J	85	199	80	40	169	2012	BPMS Prestridce; Ano V5
10-Apr-13	0A13091413	2R9R	J	64	72	62	32	83	2012	Piney Orchard Beall; Ano V5
10-Apr-13	0A13091424	11L	J	58	68	57	30	63	2012	Piney Orchard Beall; Ano V5
10-Apr-13	4B042D421A	2R8L2L	J	70	84	74	37	111	2012	Oakwood ES Brandon
10-Apr-13	0A13091354	2R11LR	F	101	116	99	48	297	2012	Green School Clokey
10-Apr-13	0A13091415	11L	J	69	79	68	36	100	2012	Oakwood Brado
10-Apr-13	0A13091421	8R	J	64	77	60	32	77	2012	Hillsmere Ferrer Nussley
10-Apr-13	0A13091353	2R12R	J	65	76	63	31	77	2012	Hillsmere Feerer Flipper
10-Apr-13	0A13091369	2R8R2L	J	81	95	79	42	156	2012	North County Clardy
10-Apr-13	0A13091423	2R2L	F	97	110	92	48	241	2012	Green School Clokey
10-Apr-13	0A13091376	2R8R	J	66	75	63	35	86	2012	Lindale Rob Mauro
10-Apr-13	0A13091414	2R28R2L	J	67	79	68	34	95	2012	Ridgeway Scoggins
10-Apr-13	4B04386754	2L	J	92	104	81	41	153	2012	Ridgeway Scoggins
10-Apr-13	4A0E01241F	9L	J	103	123	97	56	313	2012	Chesapeake HS Wohlgemuth
10-Apr-13	0A13091372	2R3L8L	J	103	120	96	53	309	2012	Chesapeake HS Wohlgemuth

Influences of vegetation on Northern Diamondback Terrapin (*Malaclemys terrapin terrapin)* nest site selection

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A Thesis Presented
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by

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May 2013

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Abstract

The diamondback terrapin *(Malaclemys terrapin)* is an estuarine turtle native to tidal marshes, lagoons, and swamps along the East and Gulf coasts of the United States. In the early 1900s, terrapins were harvested for human consumption almost to extinction, but populations recovered as the demand for terrapin flesh passed (Coker, 1920). Since then, terrapin populations have suffered from other anthropogenic influences including habitat loss, crab pot bycatch and pollution (Butler et al., 2006a). Shoreline development accounts for the majority of diamondback terrapin nesting habitat destruction along the coast. Many waterfront property owners have armored their land against erosion using artificial structures that block female access to nesting habitat. Planting marsh grasses and other estuarine vegetation is an ecological alternative to those methods of shoreline stabilization. This study examines the influence of vegetation on female nest site preference in a Chesapeake Bay population of the Northern Diamondback terrapin (*Malaclemys terrapin terrapin)*. I used vegetation removal in shoreline plots on a man-made island, the Poplar Island Ecosystem Restoration Project (PIERP), to experimentally determine if female terrapins prefer nest areas covered by vegetation or those with vegetation removed. High nesting activity in manipulated plots compared with little nesting in vegetated control plots suggests that female terrapins prefer to oviposit in open areas. Based on these results, vegetation removal should be considered as a means of maintaining quality terrapin nesting habitat where vegetation is used for shoreline stabilization.

Introduction

I. General Introduction

The diamondback terrapin (*Malaclemys terrapin)* is a medium-sized estuarine turtle with rich history in conservation biology and American culture (Hart and Lee, 2006). Its habitat distinguishes it from all chelonians (turtles) and most reptiles, since few species in this family prefer to live in brackish water (Carr, 1952). Formerly the diamondback terrapin was abundant along the East and Gulf coasts of the United States. Populations are drastically smaller today, caused directly by human consumption and indirectly by other anthropogenic influences (Coker, 1920; Butler et al., 2006a). Over three centuries, the diamondback terrapin progressed from an inexpensive, widely available food item to a rare gourmet delicacy. The switch to epicurean menus relates directly to the shrinking of terrapin populations and greater efforts required to obtain them. Precipitous declines a century ago were followed by slight rebounds, yet terrapin numbers do not compare to those before human harvest.

Terrapins are generalist consumers of mollusks, vegetation, and crabs, so they play an important role in trophic regulation of tidal habitats (Davenport et al., 1992). Extirpation of any terrapin population may bear great influence on local estuarine communities and thus their conservation may be essential for the maintenance of healthy ecosystem function. Overharvesting for human consumption, nesting habitat loss, and the pet trade have been just a few of the numerous threats to their success. Long-term studies on the diamondback terrapin have deepened our understanding of habitat use during multiple life stages, especially nesting and egg development. The focus of this study is female nest site choice in a Chesapeake Bay population of the Northern diamondback terrapin (*Malaclemys terrapin terrapin)* on Poplar Island. By refining our knowledge of terrapin nesting preferences, we wish to improve conservation strategies for the protection and expansion of optimal diamondback terrapin nesting habitat.

II. Distribution and Habitat

The diamondback terrapin (*M. terrapin)* is an estuarine emydid turtle found along the East Coast of the United States from Cape Cod, Massachusetts to the Gulf Coast of Texas (Figure 1). Terrapins inhabit various brackish environments including tidal creeks, estuaries, lagoons, and coastal salt marshes (Butler et al., 2006b). Despite the extensiveness and ecological variability along the Atlantic and Gulf shorelines, terrapins currently occupy a relatively small total geographic area due to habitat loss and population declines (Hart and Lee, 2006).

Figure 1. Distribution of the seven subspecies of *Malaclemys terrapin*. (From Pfau and Roosenburg, 2010). Colors indicate the approximate ranges of each subspecies. In order from north to south and around the panhandle of Florida: *M. t. terrapin* (brown), *M. t. centrata* (blue), *M. t. tequesta* (orange), *M. t. rhizophorarum* (red), *M. t. macrospilata* (green), *M. t. pileata* (violet), and *M. t. littoralis* (yellow).

Emydid turtles are typically freshwater species and can only withstand minimal exposure to high salinity, making the estuary-dwelling diamondback terrapin unique within its family (Carr, 1952). While many reptiles inhabit either freshwater or marine habitats, the terrapin is distinctive also in its class because it inhabits brackish habitats exclusively. Terrapins are well adapted to variable salinity in estuaries, lagoons, and marshes. Heavy rainfalls and fluctuating tides constantly alter the composition of seawater, yet terrapins maintain relatively constant ionic concentrations in their bodily fluids (Robinson and Dunson, 1976).

III. Morphology

Malaclemys terrapin is easily distinguished from other turtles because of its coloration on both the shell and soft tissues (Butler et al., 2006b). Terrapins have an oblong carapace, the shell's upper half has a mid-dorsal keel. Characteristic diamond-shaped scutes cover the carapace and are responsible for the terrapin's name. Young individuals, or hatchlings, often look similar to each other and have distinct concentric growth rings in their scutes. Coloration may vary substantially between adult terrapins, even within a population. Skin patterns can range from bold black stripes and dots surrounded by white skin to tiny spots overlaying dark gray skin (Pfau and Roosenburg, 2010). Shell coloration is equally variable, as some terrapins have a bright yellow orange plastron, the shell's flat underside, and bold rings on each scute while others have darkly colored shells without any distinct color patterns (Figure 2).

Figure 2. Juvenile female terrapin with a prominent mid-dorsal keel, bold rings on plastron scutes, and dark stripes and spots contrasting with white skin.

Malaclemys terrapin individuals are sexually dimorphic in size. Males may reach 16 cm in carapace length, while females can grow to a maximum length of 32 cm. Males can be distinguished from females by their longer and thicker tail (Pfau and Roosenburg, 2010). In northern populations, female terrapins may reach sexual maturity by their eighth year, and have a potential life span of more than 40 years. Males mature between 4-5 years of age. Few long-term studies are available to confirm the terrapin's life span in the wild. Willem Roosenburg's ongoing mark-recapture study of a Chesapeake Bay population may offer more insight about terrapin longevity in the future.

Seven subspecies of *M. terrapin* live along the East and Gulf coasts, which are distinguished by differing carapace morphology, color patterns and soft tissue markings (Carr 1952). Ranges of *M. terrapin* subspecies are continuous with each other along the coasts (Figure 1). From Cape Cod to the Gulf Coast, subspecies are in geographic order: the Northern Diamondback terrapin (*M. t. terrapin)*, Carolina Diamondback terrapin (*M. t. centrata)*, Florida East Coast terrapin (*M. t. tequesta),* Mangrove terrapin (*M. t. rhizophorarum)*, Ornate Diamondback terrapin (*M. t. macrospilata)*, Mississippi Diamondback terrapin (*M. t. pileata),* and the Texas Diamondback terrapin (*M. t. littoralis)* (Pfau and Roosenburg, 2010). In some areas subspecies are poorly defined by morphology, which may be the result of hybridization from over a century ago. When terrapin farms failed in the early 1900s, captive individuals were released into the wild without regard for subspecies ranges (Hildebrand, 1933).

Allman et al. (2012) summarized trends in body size, egg size, and nesting season along the latitudinal gradient of *M. terrapin*'s range. Adults reach larger body size with increasing latitude, while average egg size decreases. Nesting seasons are longer in southern coastal states and females consistently lay three clutches per season, the maximum frequency of clutches for diamondback terrapins. This study concerns the Northern Diamondback terrapin (*Malaclemys terrapin terrapin),* found throughout the northeastern Atlantic coast from Cape Hatteras, North Carolina to Cape Cod, Massachusetts (Butler et al., 2006b).

IV. Feeding

Terrapins are primarily molluscivores but their diets include a wide variety of prey items, thus they are important macroconsumers within salt marsh systems (Tucker et. al 1995). Although their morphology permits them to feed upon small crustaceans, gastropods, and mollusks, terrapins occasionally consume plant matter, fish, and insects (Ehret and Werner, 2004).

Juvenile terrapins inhabit and forage within the intertidal high marsh zone. They typically feed on small prey items including amphipods (*Orchestia sp.*) and green crabs *(Carcinus maenas)* but will also consume marsh snails, grass shrimp, and various insect larvae (King, 2007). Smaller terrapins do not attempt to consume large crabs or clams because they are limited by gape and jaw strength. During development the terrapin diet becomes more specialized, as their jaws grow large enough to consume snails and some crabs (Tucker et al., 1995). Sexual dimorphism is especially important for mature females, which have enlarged heads capable of easily crushing bivalves (Davenport et al., 1992).

Large female terrapins are able to attack blue crabs, a potentially dangerous food item. Crabs have strong chelipeds, or claws, with which they can grasp terrapin limbs. To prevent injury, terrapins exhibit a “cropping” behavior in which they consume only the walking legs of larger crabs but do not attempt to eat the whole crab (Davenport et al., 1992). Terrapins also perform this behavior because they have difficulty grasping a large crab’s smooth cephalothorax with their beak. While there is a nutritional tradeoff associated with only eating crab legs, terrapins do not hesitate to consume the prey item. Experiments in captivity show that all terrapins may try to consume crabs, however juvenile females and male terrapins are less likely to attack large crabs. Bels (1995) discovered another behavior in which terrapins distend their throats considerably while feeding on prey items. This likely prevents them from shifting prey or alerting prey with water pressure waves as they gape and grasp for them.

A terrapin's range also contributes to its diet. In extensive salt marshes along the coast, diamondback terrapins feast on the high densities of gastropod mollusks. In southern coastal states, terrapins are beneficial where the salt marsh snail called Marsh Periwinkle (*Littorina irrorata)* is present (Tucker and Fitzsimmons, 1992). The abundant salt marsh periwinkle eats bacteria that live on *Spartina alterniflora*, a salt marsh cordgrass important for shoreline stabilization. Grazing activity damages the essential vegetation, so terrapin consumption of these snails is beneficial because it preserves the integrity of shoreline vegetation (Pfau and Roosenburg, 2010). Meanwhile terrapins living the tributaries of the Chesapeake Bay are more likely to rely on the abundant bivalves such as razor clams (*Tagelus* sp.), ribbed mussels (*Geukensia demissa)*, and soft-shelled clams (*Mya arenaria*) (Roosenburg, 1994).

V. Reproduction

Diamondback terrapins are sexually dimorphic. At sexual maturity, females are considerably larger than males. Thus they take several years longer to reach maturity

(Roosenburg and Kelley, 1996). Female diamondback terrapins generally mature after seven years of growth while males can mature in four years (Hildebrand, 1932; Burger and Montevecchi, 1975).

Mating and courtship behavior is largely unknown for *M. terrapin*. Hay (1904) noted that mating takes place at night or in early morning, and occurs in water. Partial mating observations were made later for *M. t. tequesta*, a subspecies that inhabits the east coast of Florida (Seigel 1980). Terrapins form large aggregations, potentially to increase the chance of finding a mate. Males approach floating females, which they nudge with their snout and immediately mount if the female remains motionless. In cases that the female swims away, a male may pursue them for up to 10 minutes. Copulation is very brief and lasts only 1-2 minutes.

Like other turtle species, the diamondback terrapin exhibits Temperature-Dependent Sex Determination (TSD). As eggs develop in a nest, the soil temperature surrounding them influences gender. Jeyasuria et al. (1994) found that with constant incubation temperatures, sex determination occurs in the middle third portion of development. Nests laid in cooler areas tend to promote male development, while nests buried in warmer sand and soil contribute to female development. Within a range of 3° C around 28.9° C, nests may produce mixed sex ratios (Jeyasuria et al., 1994). Females often lay nests with larger eggs in warmer environments and small eggs in cooler environments. Warmer environments are favorable for faster development of females, which may reach sexual maturity sooner because large eggs grow faster than small eggs. Males are unaffected by egg size and speed of development, so laying large eggs in cool environments is not additionally beneficial (Roosenburg and Kelley, 1996). TSD causes skewed sex ratios during some nesting seasons, so incubation temperature and subsequent offspring phenotype may influence an individual's success within a population. Skewed sex ratios may be the result of beach aspect, or compass direction, because south facing beaches tend to be warmer (Roosenburg and Place, 1995; Burger 1976a).

VI. Nesting and Predation

Females often exhibit site fidelity and return each season to the same nesting beach to lay between one and several nests per season (Roosenburg, 1994). Nest seasons vary in time and duration along the coast. Nesting seasons generally occur between April and July. For southerly populations of *M. terrapin*, nest seasons begin sooner and last the longest (Burger 1977, Ernst et al., 1994).

Females generally nest during daylight hours and choose oviposition sites above the mean high tide line. Nesting has been observed most often on sand dune and open beach areas. Although females prefer to nest on warm, sunny days, they have been observed nesting at night, during rain, and after rain (Burger and Montevecchi, 1975; Roosenburg, 1994). In areas with large tidal amplitude, females nest during the incoming high tide, minimizing the time spent exposed to predators as well as keeping the nest above mean high water (Burger and Montevecchi, 1975). When choosing a precise nesting location, females experience tradeoffs with nest stability and ease of digging. Sandy, open areas take less effort to dig a nest, but are prone to wind and water erosion. Nests laid in vegetated areas are more stable but frequently require females to dig through roots.

Nest predators frequently destroy most or all of the nests on an entire nesting beach. Of the primary nesting months, June and July, eggs laid in July experience the highest predation (Burger, 1977). Predators include raccoons, foxes and otters as well as various avian predators (Butler et al., 2006a; Pfau and Roosenburg, 2010). Birds that consume *M. terrapin* eggs include fish gulls and crows (Burger, 1977). Marsh grass roots of the dunegrass *Ammophila* have also been documented in the destruction of eggs (Lazell and Auger, 1981). Quickly growing roots are able to penetrate fragile terrapin eggs and utilize nutrients from the embryo (Lazell and Auger, 1981; Stegmann et al., 1988). Burger (1977) found that nest predation varies between habitats with different levels of vegetation cover. Mammalian predation occurred most frequently in areas with very dense vegetation, while avian predators posed the greatest threat to nests in open, sandy areas.

Nests oviposited on the same date do not necessarily develop and hatch at similar rates. Temperature variation plays an important role in egg development and may cause eggs in cooler nests to lag behind others during development (Burger 1976a). Temperature variation includes diel variation during the day, monthly variation throughout the season, and slight temperature differences between nests that face different directions (Roosenburg and Place, 1994). Burger (1976a) found that generally warmer nests have more quickly developing eggs than cooler nests.

VII. History

Diamondback terrapins became a food item in the United States long before the country's independence. In colonial years, terrapin flesh was the chief sustenance for slaves on many plantations (Coker, 1920). During the American Revolution, soldiers in the Continental Army subsisted on terrapins (Hart and Lee, 2006). The beginnings of commercial harvest were prosperous owing to the turtle's overwhelming abundance. Inhabitants along the East coast regularly observed scores of terrapins basking during warm days along the beaches and marshes. Catching terrapins by hand or dip net was a common pastime, and some North Carolina residents even trained their dogs for the purpose of hunting terrapins (Brooks, 1983). In some cases terrapins were so plentiful that they became a nuisance. Fishermen in the Carolinas occasionally trapped more terrapins in nets than the desired catch, deeming their fish hauls worthless (Coker, 1920).

Although the transition remains unclear, the diamondback terrapin rose to the status of delicacy by the mid-1800s. Chefs around the country used terrapin flesh, cooked with liberal amounts of sherry, for unique soups and stews. Those able to afford the delicacy claimed that terrapin flesh was unmatched in flavor by other freshwater turtles (Coker, 1920). Increased demand for terrapin flesh resulted in drastic expansion of the fishery by the 1890s. In southern states, watermen hauled 500 ft. long, 20 ft. wide nets along channel bottoms to catch numerous diamondback terrapins at once (Brooks, 1893). Harvesting techniques of this kind were particularly successful during winter because terrapins have an inactive brumation period, comparable to mammalian hibernation (Hart and Lee, 2006). As watermen raked the estuary floor with massive mesh nets weighted by a heavy iron bar, terrapins were unearthed from their muddy hiding places. Trailing nets immediately collected the slow moving terrapins, leaving them little opportunity for escape.

Regulation of the terrapin fishery was virtually nonexistent until the early twentieth century. For example, in 1906 the state of North Carolina imposed only two regulations on terrapin harvest. A non-citizen with fewer than two years of residence in the state could not use a drag net for terrapin fishing, and no terrapins under 5 inches in length could be harvested between April 15 and August 15. Both types of misdemeanors were largely ignored by watermen and entirely unenforced by the North Carolina government (Coker, 1920).

By the early 1900s, demand for terrapin flesh peaked. "Chesapeakes," or the Northern diamondback terrapin (what we now know as *Malaclemys terrapin terrapin)* was believed to have the highest quality terrapin flesh. More abundant terrapins from the Carolinas were supposedly inferior and sold for less than those in the Chesapeake Bay. Terrapins from the Gulf coast were considered even lesser in quality than those from the Carolinas (Coker, 1906). Unregulated harvest in Atlantic coast states depleted populations, especially from northern states. By 1920 wholesale values reached $125 for a dozen fully grown female Chesapeake terrapins (Coker, 1920).

Dwindling terrapin populations prompted breeding experiments to restock wild populations (Coker, 1906). The experiments persisted only briefly due to difficulty and high expense. Fortunately, artificial propagation served to do more than restock waters for harvest. Investigators took careful notes on hatchling success, fertility, growth, diet, and necessary captive living conditions (Barney, 1922). The unorganized notes of breeders and terrapin farmers served as the foundation for diamondback terrapin research.

With the implementation of prohibition, public interest in terrapin consumption evaporated (Hart and Lee, 2006). Without the availability of sherry, the essential ingredient for terrapin soup, the delicacy lost its appeal. Diminishing demand was beneficial for diamondback terrapin populations, which may have otherwise disappeared. Terrapin populations rebounded as the terrapin soup fad diminished, yet they are still not safe from population decline (Butler et al., 2006a).

Commercial harvest persists only in the state of Louisiana, where it is prohibited between April 15 and June 15 (LA Dept. of Wildlife and Fisheries). Some individuals illegally trap terrapins along the coast for the pet trade and export them to China for high profits. Chinese buyers may also purchase terrapins through one Maryland terrapin farmer, although the sustainability and welfare of turtles at the farm is questionable considering terrapins' specific environmental requirements (Pfau and Roosenburg, 2010; Pelton, 2006).

VIII. Conservation Concerns

Even though commercial harvest for human consumption does not pose the danger it formerly did, anthropogenic impacts on diamondback terrapin populations are prominent. The blue crab (*Callinectes sapidus)* industry accounts for deaths of numerous terrapins that drown in baited crab pots (Bishop, 1983; Roosenburg, 2004). Most estuaries along the coast are found near urban metropolises and areas of high agricultural activity, so pollution from industry, heavy metals, and urban runoff are constant threats to estuarine habitat integrity and terrapin health (Pfau and Roosenburg, 2010). Boating accidents commonly result in lost limbs and deaths of terrapins that are swimming or foraging, while vehicles on land frequently kill females searching for upland nesting habitat (Cecala et. al, 2008). Finally, shoreline development along the coast is responsible for devastating estuarine habitat loss, which is detrimental for terrapin populations as well as whole animal and plant communities in marshes. Development additionally exacerbates the problem of vehicular injuries, as gravid females are forced by habitat destruction to search expansive areas for proper nesting habitat.

Commercial crab bycatch- The blue crab's range overlaps with the diamondback terrapin in most Atlantic and Gulf coast states, so recreational and commercial crab fishing has a widespread impact on terrapin populations. Rates of capture, especially by juveniles and males, increase when pots are set in shallow near-shore areas (Grant, 1997; Roosenburg et al., 1999). As of 2006, crab pot mortalities accounted for the greatest threat to terrapins in a survey of the 16 coastal states in the diamondback terrapin's range (Butler et al., 2006a). Crab pot-induced mortality remains the leading threat to terrapin populations.

Crab pots are fashioned from wire mesh into a cube shape with a 60 cm edge (Roosenburg, 2004). Bait is enclosed in the center and funnels are situated on the sides to allow crab entry. Bait, already trapped crabs, or even empty pots attract terrapins, which crawl into the funnels and cannot escape. If the pots go unchecked for several hours, terrapins drown. Drowning occurs more quickly in summer months, since oxygen solubility decreases with increasing temperature (Roosenburg et al., 1997). Incidental terrapin captures in crab pots are dominated by male terrapins and juvenile females. Because of sexual dimorphism, males do not reach a size that excludes them from crab pots, as is the case with larger sexually mature females (Roosenburg, 2004). Terrapins may be able to detect each other underwater, so the presence of one trapped terrapin could attract others and result in their death (Bishop 1983). Another serious problem for terrapins are "ghost" crab pots and eel pots (Bishop, 1983; Roosenburg, 1991). Ghost pots, which have been abandoned or lost, may be carried by the current and waves to shallow tidal areas where they continuously trap terrapins. Ghost pots may sit indefinitely without discovery. Two noteworthy observations of ghost pot devastation include one found with 28 dead terrapins (Bishop, 1983) and one with 49 dead terrapins (Roosenburg, 1991).

Many terrapin populations have a skewed sex ratio with far more females than males, so the incidental capture and death of sexually mature males and juveniles may cause dramatic population declines. Given these circumstances, crab pot mortalities have the potential to remove 15-78% of a population in a single year (Roosenburg et al., 1997). Fortunately, rectangular bycatch reduction devices (BRDs) developed by Wood (1997) may be installed to allow turtles to escape without impacting crab yield. Use of BRDs for recreational crab fishing has been implemented in New Jersey, Delaware, and Maryland (Roosenburg, 2004).

Pollution and runoff- Terrapins are keystone predators in many brackish environments, so they hold a critical position at the top of the food chain. Terrapins can accumulate heavy metals and toxic organic chemicals in their tissue, referred to as bioaccumulation. One example of such is PCB exposure, which increases stress hormone levels, reduces bone density, and retards growth in terrapins (Ford 2005).

Vehicular injuries- Watercraft and on land vehicles account for the injury and death of many terrapins. In a 24-year study of a terrapin population near Kiwah Island, South Carolina, Cecala et al. (2008) discovered that 10.8% of the population suffered injuries from boats and other watercraft. Larger turtles had the highest rates of injury, which may indicate that sexually mature, potentially gravid females have the greatest chance of sustaining injuries in areas of watercraft use. As is expected, terrapins with lost limbs experienced drastically reduced survivorship.

Road accidents are more likely than watercraft accidents to cause mortalities. In areas where females must cross roads to find proper nesting habitat, high traffic is correlated with high numbers of fatalities. For a New Jersey population of *M. t.*

terrapin, 8.83% of all recorded females in the nest season were killed in traffic, most often at night or in the early morning (Szerlag and McRobert 2006.)

Nesting habitat loss from development- Shoreline development destroys prime terrapin nesting habitat, especially where waterfront property owners have installed riprap or bulkheads to armor their land from erosion. These barriers block access for gravid females to nesting areas above the mean high tide line, a requirement for nest success. As nesting habitat disappears, females have begun to nest in marginal habitats. Female terrapins often exhibit nest site fidelity, so they return to the same nesting grounds annually to lay eggs. In changing habitats invaded by developers, some females returning to their usual nesting grounds have begun to nest in habitats less suitable for egg incubation (Roosenburg, 1994).

IX. Shoreline Stabilization

Erosion is a naturally occurring process along coastlines and is responsible for the loss of some land each year. In the Chesapeake Bay, wave action removes up to 20-40 cm of coastline per year (Subramanian et al., 2008). Estimates for shoreline erosion in North Carolina are even higher, ranging from 25-88 cm per year (Currin et al., 2010). Urban and industrial development exacerbates shoreline erosion. As vegetated marshes, lagoons, and estuaries are destroyed to make way for waterfront property, natural stabilization is replaced with bare and unprotected beaches. Because

51% of the U.S. population inhabits coastal areas, the impacts of development on shoreline stability and habitat loss are profound (Subramanian et al. 2008).

In order to prevent land loss from erosion, property owners and industries based in coastal areas have installed massive barriers to armor their land. These stabilization methods frequently involve structures made of concrete, wood, vinyl, metal, and rock (riprap) (Currin et al., 2010). Introduction of stabilizing structures typically depreciates or eliminates natural coastal habitats through fragmentation. Biodiversity of tidal habitats subsequently plummets.

Alternatives methods of shoreline stabilization exist that attempt to reduce negative ecological impacts, namely living shorelines. The concept of living shorelines incorporates the use of vegetation, especially sea grasses like *Spartina*, which are naturally found in salt marshes and are excellent for stabilization because they grow deep roots. Because vegetation is a natural form of shoreline stabilization, it promotes habitat growth and higher biodiversity. While vegetation may not be as permanent or hardy as bulkheading and riprap, it is a more sustainable alternative to mitigate erosion problems (Bulleri and Chapman, 2010). Regrettably the concept of living shorelines is not new, yet it remains uncommon. Widespread transformation of coastal shorelines from artificial barriers to living, vegetated shorelines may restore marshland habitat necessary for estuarine plant and animal species to thrive. Therefore, the benefits of living shorelines and the use of vegetation for coastal stabilization must be highlighted so that waterfront property owners are aware of their benefits. When wood and concrete barriers break down, vegetation should be promoted as a replacement. Understanding the ecological potential for living shorelines is necessary for its advancement, so I hope to refine our understanding of its impacts, specifically on diamondback terrapin nesting behavior.

X. Study Site

The study site, Poplar Island, is located in the middle of Chesapeake Bay in Talbot County, MD. It has a rich geological and cultural history; it was once a 400-hectare island initially used as a trading post in the 1630s (U.S.A.C.E. Website). After years of erosion from wave action, Poplar Island and the two nearby islands, Coaches and Jefferson Island, were drastically reduced from their original size of over 400 hectares. In 1998, the Paul S. Sarbanes Poplar Island Ecosystem Restoration Project (PIERP) run by the Army Corps of Engineers (U.S.A.C.E), Maryland Port Authority and Maryland Environmental Service (MES) began to rebuild the Poplar landmass using dredge material from Chesapeake Bay's Port of Baltimore shipping channels (Figure 3). It is now over 460 acres and has estuarine wetland and eastern deciduous forest habitat types. Even though it remains under construction, wildlife is already abundant in the completed wetland cells.

Figure 3. Poplar Island. Areas of high nesting activity are highlighted by red. Nests have been found in areas highlighted by green. Study area is indicated by the white box.

To prevent the island from eroding again, a containment dike composed of large rocks was built around the majority of Poplar's perimeter. The dike prevents terrapin movement and nesting. However, the containment dike is constructed of sand in the area where the nearby Coaches Island shields the Poplar Island shoreline. The sandy and relatively open area extends through the Notch, which curves around a small peninsula from Coaches Island, and down the outside edge of Poplar's Cell 5.

Diamondback terrapins are a target restoration species on Poplar Island. Because Poplar Island is free of the mainland predators, raccoons and foxes, nesting is more successful on Poplar than on mainland beaches (Roosenburg et al., 2003).

Terrapin nesting usually takes place in open shoreline areas above the mean high tide line that run along the Notch and Cell 5. These sloping beaches are not covered with rocks so females can easily access the sandy and vegetated beaches. Terrapin nests are often found along a fence constructed to prevent terrapins from gaining access into Cell 5, which poses a threat to females and nests because it is still under construction.

Since initial wetland construction on Poplar Island, the shoreline landscape has slowly transformed. Almost ten years ago, the Notch and Cell 5 shorelines had considerably less vegetation. Now tall cordgrasses (*Spartina)* and other wetland plants densely cover much of the areas. Considering the progression of this vegetation growth, I am curious if nesting behavior has changed, and whether or not vegetation has affected hatchling success.

XI. Research Question and Objectives

Planting vegetation for shoreline stabilization is an ecological alternative to rip-rap and bulkheading on the East and Gulf coasts of the United States. However, vegetated areas may require maintenance to optimize their ecological potential over time. In the case of terrapins, vegetation is necessary for sheltering hatchlings and other animals that provide sustenance for terrapins. Yet, overgrown vegetation has the potential to reduce nesting habitat quality because terrapins are most often found nesting on open, sandy upland areas. Using the northern diamondback terrapin population that inhabits marsh areas of Poplar Island as a model, I wish to discern how the presence or absence of vegetation in upland shoreline areas influences *M. terrapin* female nest site choices. The primary goal of this study is to determine if removing some vegetation in heavily covered areas encourages gravid terrapins to nest. Female preference for sites devoid of vegetation would suggest the need for shoreline upkeep to preserve both the shoreline's stabilization features and biological assets. Confirming female preference for nest habitat is critical in the conservation of this species. Greater understating of terrapin female preference may thus contribute to better conservation strategies for diamondback terrapins during reproduction and early life stages.

Methods

I. Study Site

The Paul S. Sarbanes Poplar Island Ecosystem Restoration Project (PIERP) is located in the middle Chesapeake Bay in Talbot County, MD. Poplar Island is a man-made island composed of upland cells designated for forested and scrub/shrub habitat and lowland wetland cells. During reconstruction a variety of trees, shrubs, and grasses were planted on the dikes that surround the cells and along shorelines. Upland habitat is comprised of trees and shrubs planted in 2002 including *Acer rubrum, Pinus strobes, Chamaecyparis thyoides, Viburnum dentatum, Iva frutescens,* and *Baccharis halimifolia*. Sandy beach areas are thickly covered with grasses including *Panicum virgatum, Schizachyrium scoparium,* and *Festuca arundinacea*. Prominent wetland and edge species bordering the water are *Spartina patens, Spartina alterniflora,* and *Juncus roemerianus*. Vegetation diversity and density vary along the open shoreline in the Notch and Cell 5, where we conducted this study.

II. Experimental and Control Plots

We conducted our study in ten 3-5 m x 10 m plots along Poplar Island's Notch and exterior dike of Cell 5 (Figure 4). We established 5 paired control and experimental plots along the nesting beach with highest terrapin nesting activity. Prior to nesting season, we cleared vegetation from experimental plots using a Mantis rototiller. The five control plots remained unmanipulated. We separated adjacent control and experimental plots by at least five meters to prevent edge effects. We spaced the sets of plots widely along the Notch and Cell 5 and did not clear vegetation to the shoreline to minimize habitat impacts. Terrapins typically nest above the mean high tide line, so removal of vegetation from low-lying areas of shoreline was not necessary.

Figure 4. View of the Notch (curved shoreline) and Cell 5. Blocks, or plot sets, 1-5 are shown from left to right. Red rectangles indicated control plots; green rectangles indicate experimental plots with vegetation removed.

III. Slope, Aspect, and GPS Location

We recorded plot location using a handheld GPS in the four corners of each rectangular plot. Distance from the plots' upper boundaries (permanent drift fence) to the lower boundaries (water's edge) varied between plots due to shoreline irregularity. Experimental and control plots in block 1, located on the wide southeast facing slope of the Notch, were 5 m x 10 m. Block 2 plots were 4 m x 10 m and Blocks 3, 4, and 5 were 3 m x 10 m due to the short distance between the permanent drift fence and the water's edge.

We quantified slope in each plot using a level fastened to a horizontal 1.5 m stake, a tape measure, and a large vertical stake. We measured slope at the 1,3,5,7, and 9 meter marks along the 10 m wide plots. For each "run" measurement, we recorded distance between the bottom of the permanent drift fence and the vertical stake while the level and tape measure were held flat. We aligned the leveling stake parallel to the plot's sides and extended the tape measure directly across the plot for each measurement. We recorded perpendicular "rise" measurements along the vertical stake between the horizontal "run" marking and the bottom of the stake. For comparisons between plots, we calculated a mean slope from each set of 5 measurements. To reduce variation in slope between experimental and control plots, we designated sets of experimental and control plots in adjacent patches of land with visually similar slopes.

Aspect refers to the compass direction of an incline. Compass direction of shorelines may influence sun exposure and nest and sand temperature, which influences sex ratio of hatchlings as well as nest success (Roosenburg and Place, 1995; Burger 1976a). Inclines faced different directions along the shoreline. Plots located in the Notch faced southeast (Block 1) and northwest (Block 2), and plots along Cell 5 (Blocks 3-5) faced northeast. Using the GPS data points, we calculated aspect for each plot.

IV. Vegetation

Prior to vegetation removal, we identified and quantified vegetation using transect sampling and modified Daubenmire sampling. Transect samples were suitable to determine the general composition of plot vegetation, while modified Daubenmire samples were necessary for more detailed observations. We measured plant variation in each plot using the point-intercept approach with both sampling methods (Roman et al. 2001, Roman et al. 2002). For the point-intercept technique, the observer drops a pin at the sample location and records every species encountered from the top of the pin down to the substrate. When we encountered unknown species, we preserved one plant specimen and identified it later using Brown and Brown's Herbaceous Plants of Maryland (1984).

Transects- Using a random number generator, we selected three whole numbers between 0 and 3-5 (depending on plot size) to determine three longitudinal transects parallel to the water's edge. After stretching a measuring tape along each transect, we dropped a 12" flag as a pin for each meter mark from 0 – 10 m and recorded all vegetation encountered.

Daubenmire samples- The Daubenmire sampling technique is a widely used, efficient, and standardized method for vegetational analysis, canopy cover in particular (Daubenmire, 1959). It combines both quantitative and qualitative sampling, which is critical for characterizing grass-dominated habitats where a simple list of species does not provide sufficient habitat information (Greenfield et. al., 2002). Grasses and small flowering plants dominate Poplar Island's Notch and Cell 5 shoreline, so the Daubenmire method was an appropriate sampling technique. Typically the method uses a 20 cm by 50 cm frame placed atop multiple randomly selected areas in a survey region to determine coverage. Since we wanted to detect the presence of potentially rare species on Poplar Island (that may go undetected in transect samples), we increased the sample size to 1 m x 1 m and split it into 100 quadrats.

We took three modified Daubenmire frame samples per plot. Holding the frame level in the air, we placed it overtop the vegetation and recorded a sample from each quadrat. To maintain sampling consistency, we always sampled across horizontal sections labeled 1-10 and then down vertical sections labeled A-J. In some cases, thickly matted *Spartina patens* and *Panicum virgatum* could not be counted accurately without disturbing the vegetation. We recorded these observations as vegetation mats, and we gently moved each section of matted vegetation to record the underlying substrate.

Analysis- Vegetation comparisons were used to determine how closely each experimental plot represented its adjacent control plot. We looked at percent ground cover and species profiles for transects and modified Daubenmire samples. To determine which species and substrate combinations were most responsible for differences between experimental and control plots as well as distinctions along the entire shoreline, we created ordinations using Nonmetric Multidimensional Scaling (NMDS).

NMDS is a useful analysis tool for assessing intricate relationships between sample units, in this case control and experimental plots. Ordinations created by NMDS minimize the number of variables necessary to summarize the complex relationships and present them in a simple visual manner (Howey and Dinkelacker, 2009). Sample units with least dissimilarity are located closely together in ordinations, while sample units with greatest dissimilarity are pulled apart from each other on one or all axes. For this analysis, we wished to determine if our designated control plots were similar to their adjacent experimental plots before vegetation removal so that comparisons between final nest frequencies would be appropriate. We performed multiple runs of NMDS using Bray-Curtis dissimilarity since it is commonly used for ecological analyses of community abundance data. To determine which species were responsible for the greatest variation in vegetation between and within plots, we grouped or removed rare species and substrates in a variety of combinations for both transect and Daubenmire samples.

V. Nest Processing

We inspected both control and experimental plots daily during the nesting season (excluding weekends and holidays) for freshly oviposited eggs. Upon discovery of each new nest, we excavated it and inspected the top eggs. If the nest was fresh, less than 24 hours old (determined by the appearance and chalking of the eggs), we removed the eggs. After measuring the depth to the top of the nest, we cleaned loose sand from eggs and weighed them. We measured the depth to the bottom of the nest, replaced the eggs, rebuilt the nests, marked it with flags, and protected it with a 20 cm x 20 cm ½" hardwire mesh cloth. Nests were observed twice daily for predation. Nests older than 24 hrs were marked, protected, and monitored, but not excavated to minimize damaging the developing embryo.

Forty-five days after discovery, we replaced the protective hardwire mesh covering the nests with a ring of 6-8" metal flashing, and covered it with hardwire mesh to prevent avian predation of hatchlings. We checked nests twice daily for hatchling emergence, and over weekends we shaded each ring with plywood sheets.

VI. Drift Fences

Rain and wind affect visibility of recently laid nests by erasing recent female tracks and nest patterns, so numerous nests potentially go undiscovered by the end of the nesting season. Furthermore, nests in vegetated areas are more difficult to find than those in open sandy areas. Despite the limited window of time for optimal discovery, nests can still be found by the emergence hole or following recently emerged hatchling tracks. As hatchlings dig their way out of nests, they leave a star-like pattern of tracks that extend from the nest (Burger, 1976b). The presence of nests is confirmed by excavating the nests and locating eggshells of recently hatched terrapins.

To control for additional nests we may have missed in the plots during nesting season, we constructed drift fences around each plot's perimeter with 10" metal flashing and wooden stakes after the end of the nesting season (Figure 5). We also installed small 1 L pitfall buckets at the bottom corners, the sides and bottom middle of each fence to catch stray hatchlings. We used plywood boards to shade buckets to prevent sunlight from desiccating any hatchlings. Pitfall buckets were checked twice daily along with nest rings for emergent hatchlings.

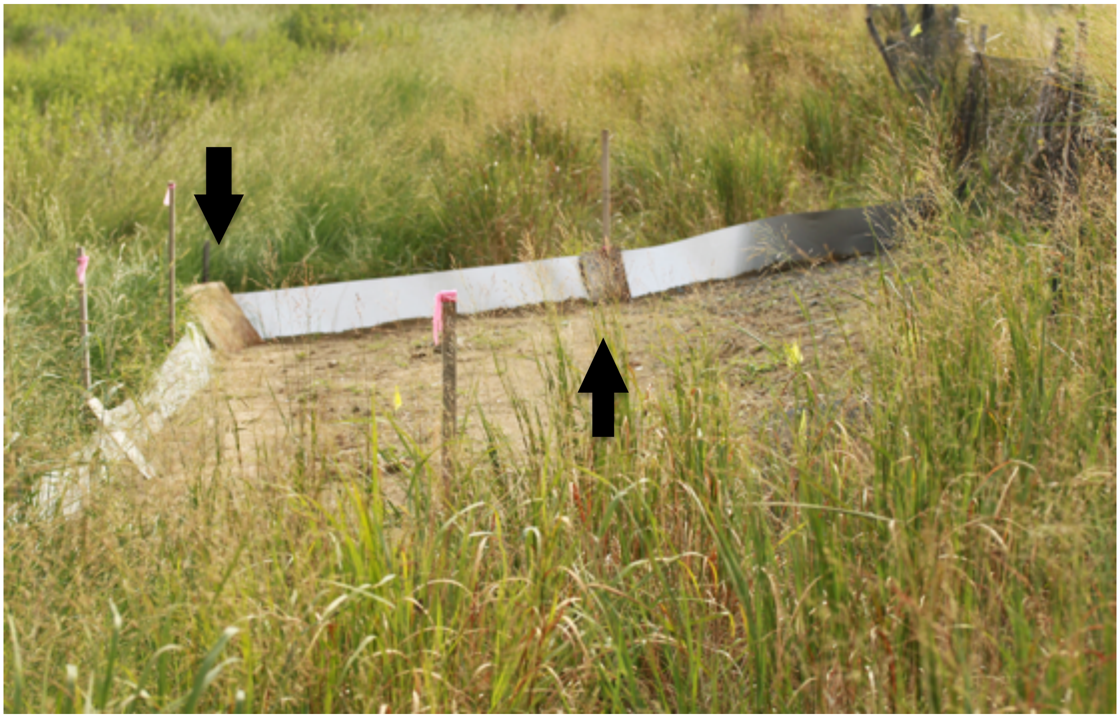

Figure 5. Drift fence constructed around Experimental Plot 2. Pitfall buckets are shown covered with protective plywood squares (indicated by arrows).

VI. Hatchling Processing

Upon emergence, we processed the hatchlings from ringed nests and pitfall buckets. With a Mitoyoto® digital caliper, we measured carapace length, plastron length, shell width, and shell height at the 3rd vertebral scute to the nearest tenth of a millimeter. After weighing to the tenth of a gram with a portable digital balance, we made marginal notches on the carapace and inserted a small coded wire tag (Northwest Marine Technologies) into each hatchling's leg for future identification. We released hatchlings in completed wetland cells of Poplar Island after processing.

Results

I. Nest Choice Analysis

We observed nesting activity during May-July 2012. Final nest counts were established after hatchling emergence concluded for the season (late October) to ensure that we had not excluded undiscovered nests. We combined nest numbers from all study blocks, or paired plot sets, for each treatment. A total of 4 nests in control plots and 18 nests in experimental plots were found (Table 1).

Table 1. Total nest counts per plot.

	Block 1	**Block 2**	**Block 3**	**Block 4**	**Block 5**	**Total**
Experimental	5	2	1	1	9	18
Control	3	0	0	1	0	4

Terrapin nests were laid in every experimental plot along the Notch and Cell 5 (Table 1). All nests received complete sun exposure; we found no nests along plot edges where neighboring vegetation may have provided shade. Three nests located in Experimental Plot 5 were partially depredated upon discovery, one of which was fully depredated later. We discovered nests from May through August, however the final five nests (two in July and three in August) were not detected immediately after laying. Of those five old nests, one was discovered partially depredated in Experimental Plot 5, while the remaining four were partially or fully hatched out.

Hatched out nests were apparent when we found hatchlings in pitfall buckets along the lower edge of drift fences. We traced hatchling tracks from the pitfall buckets up to the emergence hole to determine nest locations.

Nests in control plots were limited to only Control Plot 1 and Control Plot 4 during the months of May (one nest) and July (three nests). Three of the four nests were concentrated in Control Plot 1, which was the least vegetated of all plots (Figure 6). All four nests received complete sun exposure, although two were located close to vegetation. No nest in control plots experienced predation and no hatchlings emerged prior to our discovery of each nest.

For our initial nest choice analysis, an exact binomial test showed that females preferred to nest in open areas with vegetation removed ($P<0.01$) (Table 2). When we later completed vegetational analysis we found that plant species presence and abundance in the plots of Block 1 varied significantly from each other (Figures 6-8). Since an initial difference in vegetation composition existed before manipulation, nesting females may have been biased toward one or the other plot, making them unsuitable for comparison. We chose to exclude the nests found in Experimental Plot 1 and Control Plot 1 for a second analysis. Despite the decrease in sample size, female preference remained significantly higher for open experimental plots than vegetated control plots ($P<0.01$).

Table 2. Final combined nest counts and calculated P-values (binomial exact test, two-tailed). Given major differences between control and experimental plots in Block 1, we excluded its nests and performed a second calculation.

Scenario	Null Probability (equal preference)	Nests in Experimental plots	Nests in Control plots	Total Combined Trials (All Control v. All Exp)	Exact P-value calculated
All plot sets	0.5	18	4	22	0.004344
Block 1 excluded	0.5	13	1	14	0.001831

II. Egg and Hatchling Observations

Of the nests laid in experimental plots, we discovered nine of them early enough to process eggs. Average depth to the top of nests was 11.3 ± 0.7 cm and average depth to the bottom of nests was 17 ± 1.0 cm. The mean clutch size was 12.9 ± 2.2 eggs, with a mean egg mass of 9.7 ± 1.3 g. By the conclusion of nesting season and fall emergence in late October, 78 hatchlings had emerged from all experimental plots. Ten of the 18 nests appear to contain overwintered hatchlings, so hatchling count will rise after nest excavation and hatching processing this spring.

Similar to the experimental plots, we discovered only half of the nests in control plots early enough to process eggs. Average depth to the top of nests was 12.5 ± 0.7 cm and average depth to the bottom was 17 cm (only one measurement recorded). Mean clutch size was 13.5 ± 0.7 eggs and mean egg mass was 10.4 ± 0.6 g.

At the conclusion of the field season, a combined total of 6 hatchlings emerged from two nests in Control Plot 1. Eggs remained in all four nests into the fall, suggesting that each nest contains overwintered hatchlings.

Because of limited egg and hatchling data, especially for nests in control plots, we were unable to perform reasonable statistical analyses of the current data set regarding relationships between hatchling success and vegetation, temperature, and predation. Therefore our data has been provided for descriptive purposes only. Multiple years of data will be required to perform a more robust analysis, especially if sample sizes remain comparable to the past year.

III. Vegetation Analysis

Species occurrence- Modified Daubenmire and transect sampling confirmed the presence of 18 species in control and experimental plots (before vegetation removal, Table 3). Only one species, *Strophostyles helvola*, had previously been unobserved on Poplar Island. Marsh grasses including Saltmarsh Hay (*Spartina patens)* and Switchgrass *(Panicum virgatum)* were abundant in every plot. *Spartina patens* was the dominant species close to the water's edge, while *P. virgatum* dominated areas above mean high tide. We came across several species (*C. edentula, A. annua, C. atriplicifolium, P. purapurascens, O. biennis, B. halmifolia)* only once in our plots, in either one modified Daubenmire sample or one transect sample. The same species were abundant elsewhere on Poplar Island, typically upland of control and experimental plots or much closer to the water's edge.

Table 3. Summary of species found on the PIERP. Percentages of occurrence in modified Daubenmire and transect sampling are displayed. NMDS codes refer to shortened species names used in ordinations.

Common Name	Scientific Name	NMDS Code	Number Code	% Daubenmire	% Transect
Smooth Cordgrass	*Spartina alterniflora*	Spal	4	20.0	13.3
Switchgrass	*Panicum virgatum*	Pavi	5	83.3	76.7
Saltmarsh Hay	*Spartina patens*	Sppa	6	53.3	36.7
Common Lambsquarter	*Chenopodium album*	Chal	7	20.0	13.3
Black-eyed Susan	*Rudbeckia hirta*	Ruhi	8	16.7	6.7
Sea Rocket	*Cakile edentula*	Caed	9	3.3	0.0
Barnyard grass	*Echinocholoa walteri*	Ecwa	10	30.0	16.7
Redtop	*Agrostis alba*	Agal	11	10.0	13.3
Field Bromegrass	*Bromus arvensus*	Brar	12	60.0	50.0
Little Bluestem	*Schizachyrium scoparium*	Scsc	13	23.3	23.3
Virginia Pepperweed	*Lepidium virginicum*	Levi	14	23.3	26.7
Trailing Fuzzy Bean	*Strophostyles helvola*	Sthe	15	10.0	6.7
Horseweed	*Conyza canadensis*	Coca	16	60.0	50.0
Annual Wormwood	*Artemisia annua*	Aran	17	3.3	0.0
Winged Pigweed	*Cycloloma atriplicifolium*	Cyat	18	3.3	0.0
Salt Marsh Fleabane	*Pluchea purpurascens*	Plpu	19	3.3	0.0
Evening Primrose	*Oenothera biennis*	Oebi	20	3.3	0.0
Groundsel Tree	*Baccharis halimifolia*	Baha	21	3.3	6.7

Ground cover- Degrees of ground cover varied little among Blocks 2-5 as well as between control and experimental plots (Table 4). Vegetative cover ranged from 80% to 100% in these plots using both Daubenmire and transect data. Block 1 was considerably more open and sandy than the rest of the shoreline (Figure 6). Experimental Plot 1 had only 32.0% vegetative cover in Daubenmire samples and

33.3% cover in transect samples, while Control Plot 1 exhibited 54.0% cover in Daubenmire samples and 48.5% cover in transect samples.

Table 4. Percent vegetative ground cover for each plot, based on Daubenmire and transect sampling before plot manipulation.

		Block 1	**Block 2**	**Block 3**	**Block 4**	**Block 5**
Daubenmire	**Control**	54.0	86.0	84.0	82.7	80.0
	Experimental	32.0	88.7	92.7	91.7	88.7
Transect	**Control**	48.5	97.0	93.9	78.8	69.7
	Experimental	33.3	87.9	100.0	81.8	90.9

Substrate consisted primarily of sand and mossy soil. Discounting areas of vegetation, bare sand covered 68% of the experimental plot and 46% of the control plot in Block 1. It was the most prevalent substrate in all other plots as well (Figure 6). Mossy soil occurred most frequently in Block 3 (12% in Con and 3% in Exp) and Block 4 (15% in Con and 2.3% in Exp). We recorded only two occurrences of rocky substrate in Control Plot 2.

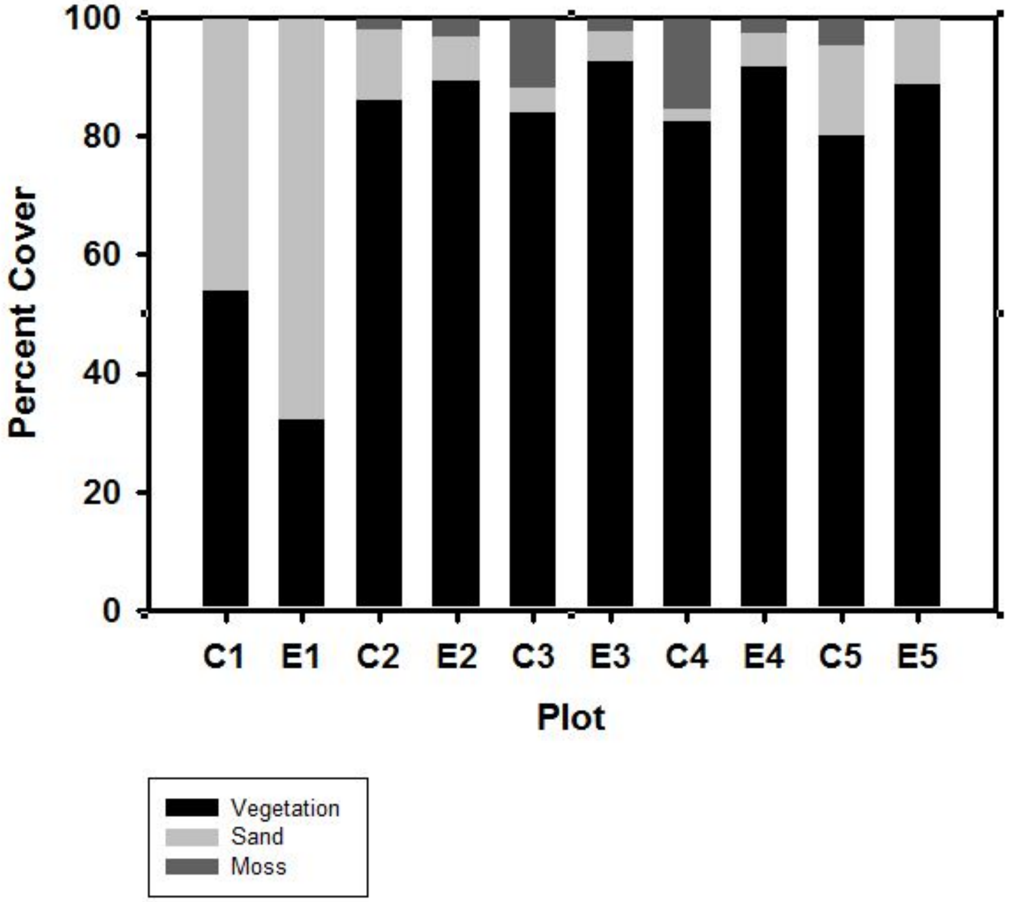

Figure 6. Percent ground cover based on Daubenmire samples, with bare substrate composition included.

Nonmetric Multidimensional Scaling- NMDS ordinations grouped together samples with the least dissimilarity based on species variation and abundance within plots (Figures 7 and 8). Polygons representative of each plot set are situated more closely when they share more vegetation and substrate characteristics. Larger polygons with points that extend far from other data sets exhibit greater variation, driven by nearby species points in the ordination.

An ADONIS (analysis of variance test for distance matrices) on Daubenmire samples including all uncommon species and substrates showed significant differences between blocks (P = 0.0002) as well as among treatments before vegetation removal (P = 0.0005). Transect ordinations with the same criteria also displayed significant differences between blocks (P = 0.0002) and within treatments (P = 0.0012). Ordinations indicated that Block 1 was primarily responsible for the variation (Figures 7 and 8). Smooth Cordgrass (*Spartina alterniflora)* in the experimental plot of Block 1 and Common lambsquarter (*Chenopodium album)* in the control plot of Block 1 were the prominent species driving differences between plots. Less common species including Sea Rocket (*Cakile edentula*) and Trailing Fuzzy Bean (*Strophostyles helvola*) also appeared to drive variation between control and experimental plots in Block 1 as well as with other plot sets along the shoreline. Species composition and abundance profiles also clearly demonstrate this variability in Block 1 plots only (Figures S4-S8).

We reran NMDS ordinations with Block 1 plots excluded. Daubenmire samples including all species continued to show differences, though much reduced, between Blocks (P = 0.016) and among control and experimental plots (P= 0.016) (Figure S2). Transect samples however showed vegetative/substrate differences between blocks (P = 0.0208), but not between control and experimental plots (P = 0.07558) (Figure S3).

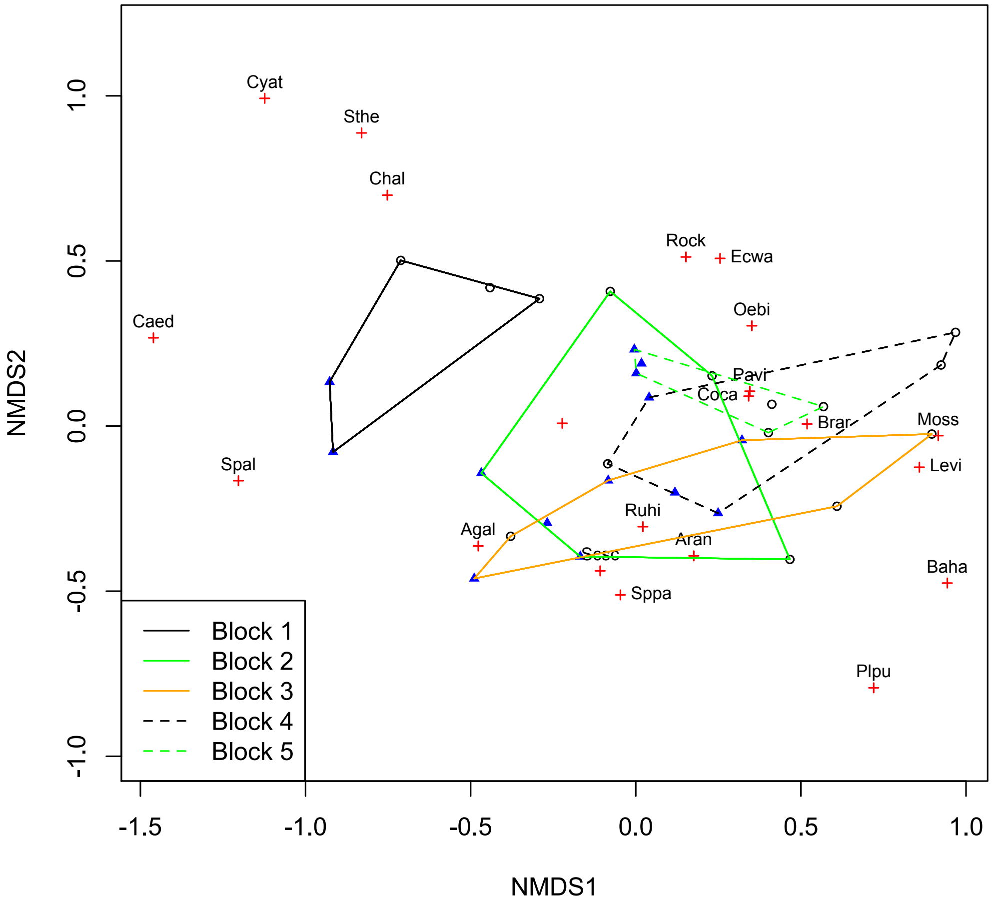

Figure 7. NMDS ordination using modified Daubenmire frame data. Species are indicated by four letter codes and blocks (plot sets) are grouped together. Blue triangles indicate Daubenmire samples from experimental plots; black circles show control plots.

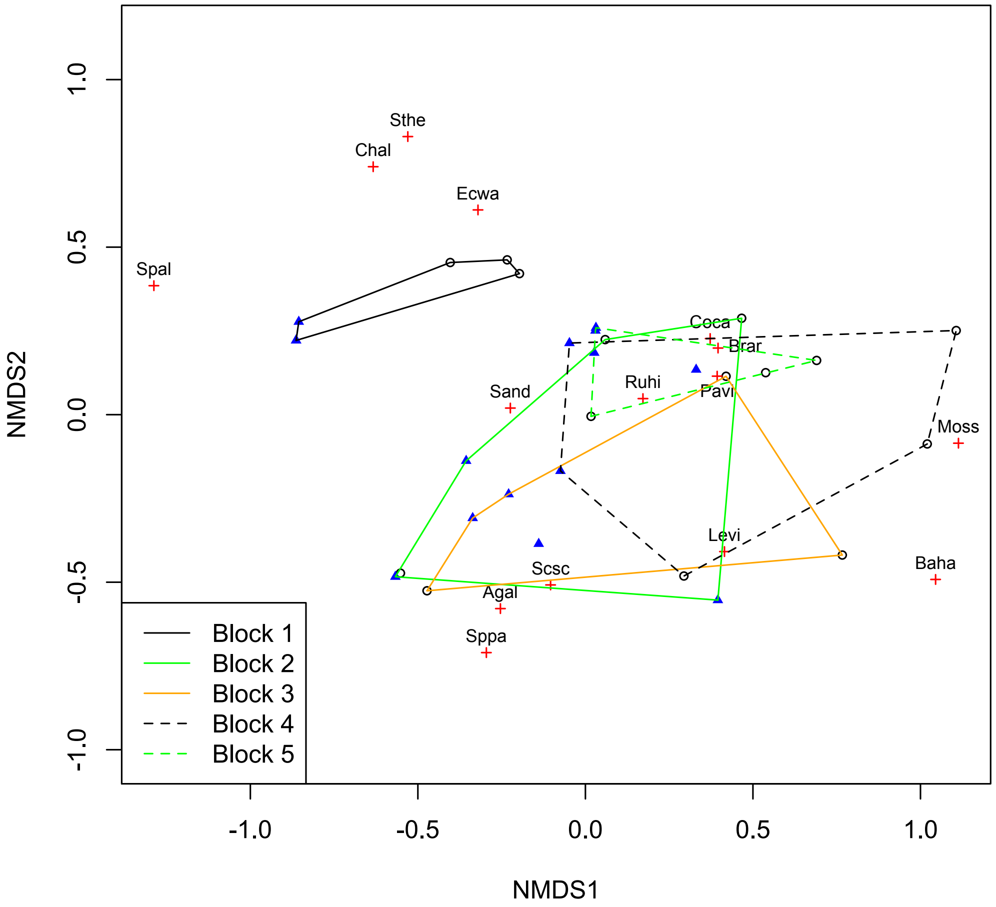

Figure 8. NMDS Ordination of transect sample data. Like Figure 7, species are indicated by four letter codes and blocks (plot sets) are grouped together. Blue triangles indicate transect data from experimental plots; black circles show control plots.

IV. Slope and Aspect

Average slope measurements showed similarity between control and experimental plots for Blocks 1-4 (Table 5; Figure S1). Block 5 exhibited the most variation, as Experimental Plot 5 was 44% less steep than its adjacent control plot, which was a comparable incline to many other plots along the shoreline. Experimental Plot 5 also varied the most within its five measurements, ranging from 0.026 to 0.155.

Table 5. Mean slope calculated from five measurements per plot.

Block	Experimental	Control	%Difference
1	0.166	0.159	4.8
2	0.183	0.175	4.2
3	0.126	0.116	8.5
4	0.168	0.151	10.7
5	0.096	0.150	44.0

Aspect of each incline, or compass direction, was calculated using GPS points from the four corners of each plot. Control and experimental plots in Block 1 faced 123° southeast. Control plot 2, located on the curved area of the Notch faced very slightly more north (349°) than its adjacent experimental plot, which was 335° northwest. All plots in Blocks 3-5 had an identical compass direction of 26° northeast. Despite differences in compass direction, plots received similar exposure to sunlight during the day due to the openness of the shoreline.

V. Temperature Profiles

Temperature loggers were buried in plots from July 2- September 19. We used depths of 2 cm, 8 cm, and 16 cm to create a temperature profile that reflected surface temperatures, the top of a normal nest, and the bottom of a typical terrapin nest. For analysis we compared the mean daily temperatures between all control plots and all experimental plots.

Temperature gradients for both sets of plots revealed similar daily trends from July-August (July temperatures in Figures 9 and 10; August and September temperatures in Figures S9-S12). Surface loggers (2 cm depth) exhibited the greatest daily variation: they displayed maximum temperatures between 1:00-2:00 pm and minimums between 4:00-5:00 am and displayed a wider range of temperatures than both 8 cm and 16 cm loggers. The bottom depth loggers (16 cm) fluctuated least of the three depths. They reached both maximum and minimum temperatures four hours after surface loggers reached their extremes. Additionally, the deepest loggers showed the smallest range of overall temperatures among all logger depths. Loggers buried 8 cm deep showed intermediate daily trends between the surface loggers and bottom depth loggers with regard to the range of temperatures reached as well as time of day they were recorded.

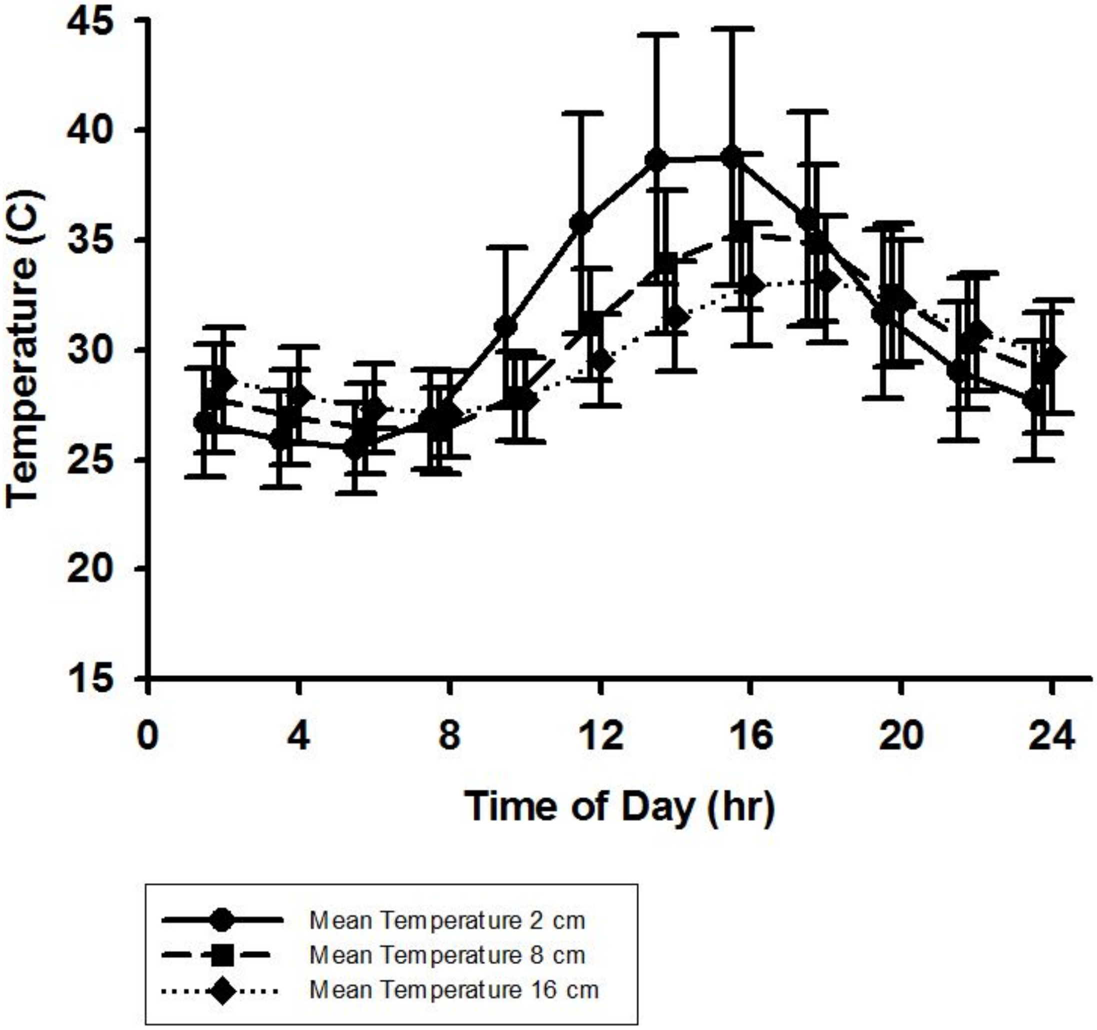

Figure 9. Mean daily temperatures for all experimental plot loggers during July. Solid lines indicate temperatures for 2 cm loggers, dashed lines show 8 cm logger temperatures, and dotted lines show 16 cm logger temperatures.

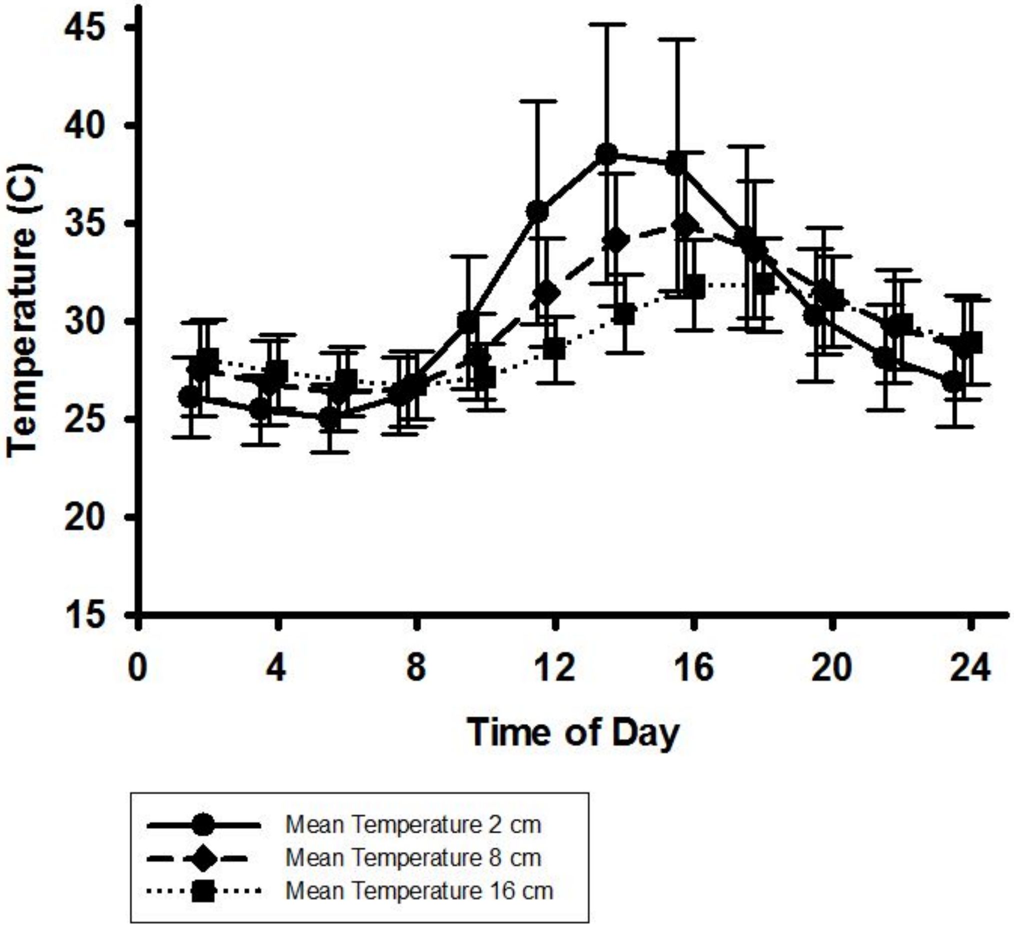

Figure 10. Mean daily temperatures for all control plot loggers during July. Solid lines indicate temperatures for 2 cm loggers, dashed lines show 8 cm logger temperatures, and dotted lines show 16 cm logger temperatures.

Mean daily temperature comparisons showed higher temperatures in open experimental plots than vegetated control plots (Figure 11). Loggers in experimental plots reached maximum temperatures at the same time as control plot loggers, and they remained several degrees warmer for the remainder of the day. Loggers from both plots were approximately the same temperature each morning (~4:00-10:00am).

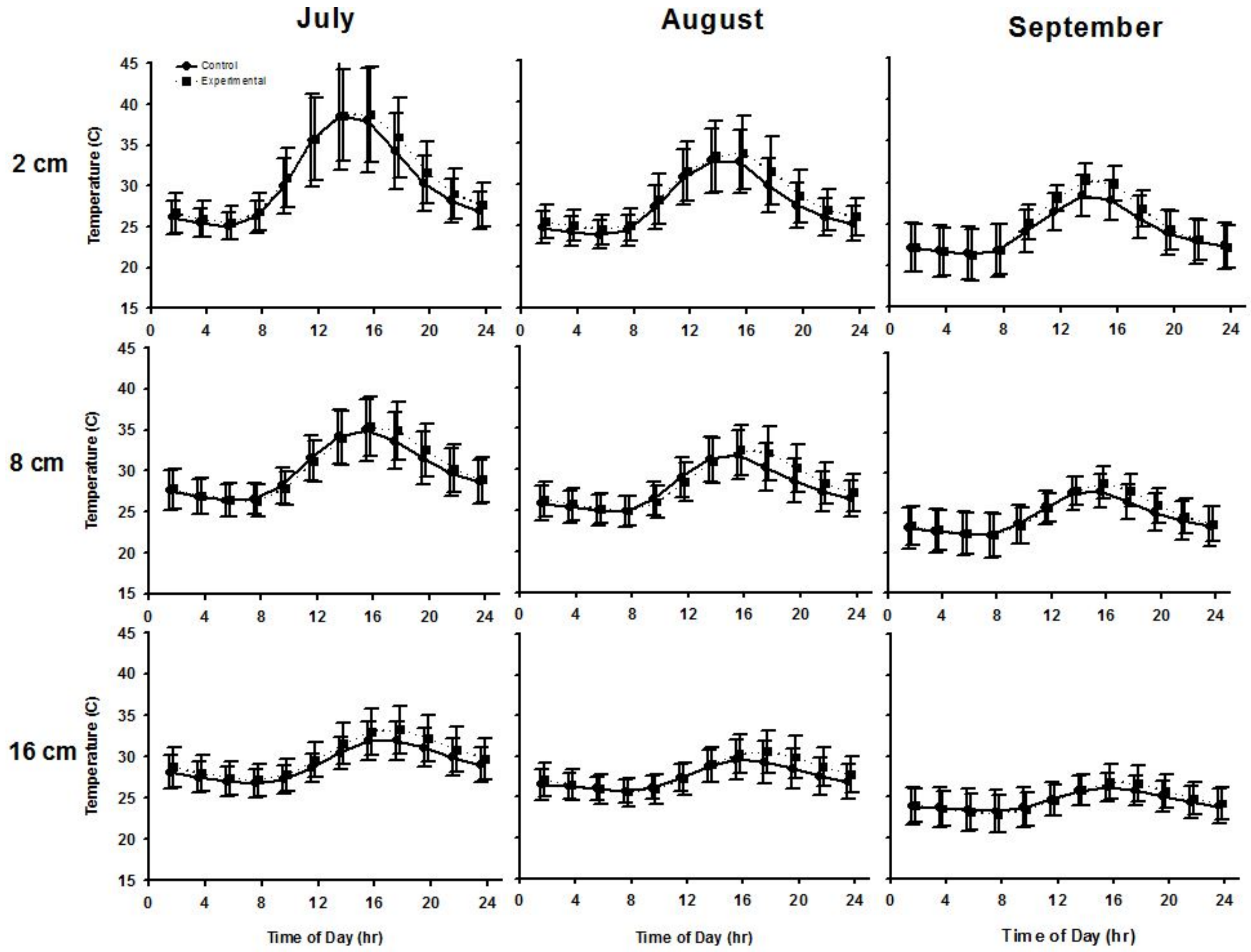

Figure 11. Mean temperature comparisons between loggers in control and experimental plots. Experimental plots are shown by dotted lines; solid lines show control plots.

Discussion

I examined the impact of vegetation on female nest site choice in an experimental manipulation that compared nesting activity in open (manipulated) and vegetated (control) areas along a nesting beach. My results provide evidence that female diamondback terrapins in Maryland preferred to nest in open areas, free of vegetation. Mine is the first experimental manipulation of vegetation in a paired plot design used to experimentally demonstrate a preference for open sandy areas by terrapins. Observational data regarding terrapin nest site selection indicates that females typically nest in sandy, open dunes in coastal areas (Burger, 1977). Roosenburg (1996) evaluated nest site choice in terrapins by comparing nesting habitat used for oviposition with habitat randomly available, also supporting the use of open sandy habitat. In a study on the common snapping turtle (*Chelydra serpentina)*, vegetation had a similar influence on female nest site selection. Females tended to oviposit in areas with short ground vegetation and more open sand (Kolbe and Janzen, 2002). Despite common knowledge of these tendencies, turtle studies that experimentally test female nesting preference for vegetation are uncommon. Spencer and Thompson (2003) found that experimentally reducing vegetative cover revealed female nest site preference for less vegetation in an Australian turtle (*Emydura macquarii*). Similarly, my study confirms female diamondback terrapin preference for open, sandy areas when given a choice between adjacent vegetated and cleared shoreline. Understanding the influences of vegetation on nest site choice provides insight for ecological improvement of nesting habitat along the coast.

While designing this study, I aimed to analyze hatchling success based on relationships among vegetation density, predation, and temperature, but was unable to do so because of the low number of nests in control areas and the high number of overwintering nests that do not emerge until spring of the following nesting season. Kolbe and Janzen (2001) determined that hatchling success in the common snapping turtle increases with decreasing vegetation and decreasing slope. Hatchlings in areas with little ground vegetation disperse farther from their nest after emergence and are more likely to reach water. After data collection from the 2012 nesting season is completed, I wanted to determine how hatchling diamondback terrapin behavior compares to hatchling snapping turtle behavior. A second year of this experiment would benefit the examination of these relationships in juvenile diamondback terrapins.

Nest success is highly dependent on evading predation. Because the incubation environment chosen by gravid females confines hatchlings for the entirety of egg development, careful nest selection is imperative. On Poplar Island, typical mainland predators like raccoons and foxes are absent, yet birds, other small mammals, and snakes still threaten diamondback terrapins and their eggs. During the past field season, nests laid in densely vegetated areas experienced high rates of mammalian predation in which several eggs were removed from the nest and partially eaten. For many partly depredated nests, the mammalian predator revisited the nests and killed any remaining eggs at later dates. The small mammalian predator was not identified during the past field season, but may be a deer mouse of the genus *Peromyscus*. Eastern king snakes (*Lampropeltis getula)* preyed on nests in both open and densely vegetated areas around the island. King snake predation was easily identified by the disappearance of whole eggs accompanied by curved patterns in the sand surrounding depredated nests. Avian predation by fish crows (*Corvus ossifragus)*, herring gulls (*Larus smithsonianus)*, and occasionally willets (*Tringa semipalmata)* has been recorded on Poplar Island. These avian predators pick at eggs in shallow nests and leave behind pieces of eggshells. Our use of protective hardwire mesh atop nests helped reduce the impact of these avian predators.

Temperature plays an important role in hatchling success and sex determination. South facing slopes are warmer than north facing slopes, and may elevate mean nest temperatures ~1° during entire nest seasons (Roosenburg and Place, 1995). Decreasing nest depth correlates with higher temperatures; consistently high temperature in shallow nests can impede or terminate egg development (Burger, 1976a). In a study of western painted turtles *(Chrysemys picta bellii),* Janzen (1994) suggested that female use vegetational cover to evaluate thermal environments, thereby influencing the sex ratio of their offspring. Terrapins may also utilize this mechanism.

Using temperature logger gradients that represented surface depths, top nest depths, and bottom nest depths, we showed that open spaces are consistently warmer than vegetated areas because the absence of ground cover causes complete sun exposure of the substrate. Temperature logger gradients in our plots revealed that during the warmest time of the day, mean temperatures in all vegetated control plots were consistently ~1-3° C lower than open experimental plots. Temperature differences varied over the course of the season, and variation decreased at the start of fall. Based on observations from this field season, vegetation may indirectly impact hatchling success. Hatchling analysis from fall and spring emergence will enable us to look at possible correlations.

To determine if our selection of plots was appropriate for comparison, we analyzed the original plant species composition (from before manipulation). We used nonmetric multidimensional scaling (NMDS) to establish plant species presence and abundance, and performed an analysis of variance for distance matrices to determine if significant variation ($P<0.01$) existed between the plant species composition in control plots and experimental plots before manipulation.

Although we selected visually similar adjacent shoreline plots for our experimental design, vegetation analysis showed that plots in Block 1 (located in the Notch) were more dissimilar than we anticipated before vegetation removal. The control plot and experimental plot within the set had distinct compositions of vegetation and ground cover despite similarities between slope and aspect, or compass direction of the incline (Figures 6, 7, and 8). Differences were driven by the presence of *Spartina alterniflora* in the experimental plot and by *Strophostyles helvola* and *Cakile edentula* in control. Because of their distinct vegetative profiles, females may not have had an initially equal probability of nest choice (i.e. had we not removed vegetation) so we concluded that the first plot set was unsuitable for comparison. Removing nests in Block 1 fortunately did not decrease the significance of our nest choice analysis. New combined nest counts, 14 and 1 for experimental and control plots respectively, had a P-value of 0.001831, showing clear preference for nesting in open, de-vegetated areas.

Dissimilarity in Block 1 may have resulted from temporal variation in vegetation growth. Vegetation data collection was very time consuming, especially for Daubenmire sampling. As a result, experimental plots that required vegetation removal before the nesting season were sampled in mid May, while control plots were sampled 4-5 weeks later. During that interval, the vine legume *S. helvola* as well as *C. album* grew rapidly along the sandy areas of the Notch and Cell 5. These two species were both present in Control Plot 1 but not Experimental Plot 1. Species differences and ground cover notwithstanding, Block 1 posed other problems for the study. Both plots in Block 1 were almost entirely sandy substrate and had sparse initial vegetation, so wind erosion was prominent. Nests were continuously buried by moving sand, and drift fences were uprooted for short periods of time. Excluding Block 1 for final analysis of this study was necessary to remove any bias toward the first experimental plot in Block 1, even though it reduced the total number of study plots.

Poplar Island provided a unique setting to experimentally test terrapin nest site selection. It is not yet a well established wildlife refuge because construction and maintenance are ongoing. In the past decade, vegetation planted to create marsh habitat (specifically *S. patens* and *P. virgatum*) and to stabilize the shoreline has grown densely on the terrapin nesting beaches of Poplar Island. In the past few years, studies from the Roosenburg lab (mark-recapture, nest monitoring, etc.) have shown simultaneous decreases in total nesting activity along the shoreline areas where vegetation grew thicker (Roosenburg et al., 2010). Considering these trends, we wanted to determine if vegetative growth was responsible for fewer nest counts. Our results indicate a possible relationship between the decrease of nesting activity and increase in vegetation density.

Size and quantity of plots for this study were limited since the nesting beach area of Poplar Island is small compared to the rest of the island's armored perimeter. Additionally, we wished only to remove enough vegetation to test our hypothesis so that habitat disturbance was minimal. Plot size constraints combined with unpredictability of nesting are partially responsible for our small overall sample size, however our results suggest that this experimental design may provide a foundation for future nest site studies involving vegetation.

Conclusions

The diamondback terrapin inhabits estuaries and utilizes sandy upland substrate to lay eggs during the nesting season. High quality nesting habitat is essential for the success of the terrapin. Developing eggs require appropriate temperatures, moisture, and ground stability throughout the incubation period, so nest location bears great influence on juvenile success (Burger, 1977). Shoreline armoring and urban development throughout the diamondback terrapin's range have unfortunately caused vast habitat loss since colonization of the United States. In some developed shoreline areas along the East and Gulf coasts, gravid females have begun to nest in unsafe, marginal environments because preferred microhabitats for oviposition have vanished (Roosenburg et al., 1994). Improper nest areas provide poor incubation conditions for developing eggs, which may profoundly decrease nest success and exacerbate population decline. Since terrapins exhibit temperature dependent sex determination (TSD), inadequate nest placement due to habitat constraints may also result in skewed sex ratios (Roosenburg and Place, 1995). Availability of optimal nest sites is critical for the persistence of diamondback terrapin populations. Therefore determining strategies to expand and improve the quality of available nesting habitat is critical for conservation.

Significance

My work on female nest choice integrates two major goals for diamondback terrapin conservation. First we wished to expand our understanding of female nesting preferences in order to encourage the expansion of optimal nesting habitat. Our results clearly demonstrated female preference in this Maryland terrapin population for open areas of sandy beach, which suggests that clearing upland portions of densely vegetated shoreline is feasible method to improve the quality of nesting beaches.

Depending on the outcome of our hatchling data, expanding optimal nesting habitat using vegetation removal may also facilitate juvenile success. Enhanced survivorship of young terrapins could offset population declines caused by other anthropogenic sources (e.g. crab pot bycatch, watercraft accidents, pollution).

Second, in our effort to emphasize the benefits of vegetation for shoreline stabilization as an alternative to other artificial methods, we wished to highlight its constraints. Some plant species including the marsh grasses planted on Poplar Island's shoreline can cause complete ground cover, which we discovered during vegetational analysis. Therefore plant overgrowth is an important consideration when vegetation is employed for shoreline stabilization. We suggest that property owners that use vegetated or living shorelines continually maintain vegetation to preserve the quality of terrapin nesting habitat and to enhance nesting activity. Techniques for upkeep could involve occasionally removing or trimming areas of very dense vegetation. Data from additional nesting seasons is required to refine our suggestions for shoreline management. Our study, though only in its initial stages, has broad applications. It is relevant for terrapin populations along the East and Gulf coasts as well as other turtles with similar nesting ecology. Continuation and expansion of this study should provide further insight about terrapin nest preferences so that we may improve management strategies for conservation.

Future Directions

Nest Preference- Female preference for nesting in areas devoid of vegetation prompts several questions we plan to investigate during the upcoming field season: 1) Do females avoid or prefer to oviposit near particular plant species? 2) Are females unable to see open upland patches if vegetation near the shoreline is tall and visually obstructive? If so, are females more likely to walk upland toward open patches if vegetation is cut to make those areas visible? 3) Lastly, are females more likely to nest in completely open areas or those with a variety of vegetation removal patterns?

To investigate our first question, we will take random samples of vegetation adjacent to each nest processed on Poplar Island using the point-intercept technique. This method, which involves dropping a pin onto the desired sample site and recording all vegetation that touches the pin, was valuable for both transect and Daubenmire sampling in this study. Using it to collect plant data near nests in the future would maintain consistency in our sampling methods. Throughout the next field season we will sample near all nests laid on the island for our observations, including those located outside of control and experimental patches.

For our second question, we will examine potential visual obstruction by tall, dense edge species. Although we did not measure vegetation density outside of plots for this study, we did notice that some areas along the water were bordered more thickly by cordgrasses than other areas. Barrier-like plant growth might influence how females survey the shore before nesting, so we intend to experimentally test our question by trimming vegetation between our open experimental plots and the water's edge. Keeping the majority of marsh grass roots intact should make open upland plots more visible from a ground-level perspective without comprising shoreline stabilization provided by vegetation.

The final question regarding patterns of vegetation removal will require further observations of nest site choice before it can be experimentally tested. Our current experimental design does not make it possible to conclude whether or not females choose to nest completely open areas or areas with an array of open spaces and vegetated spaces. Therefore a potential experimental treatment may involve removing vegetation in different patterns (e.g. in small blocks or parallel rows within an experimental plot). Before manipulating more shoreline areas, we will use descriptive nest microhabitat data to help design an appropriate experimental treatment.

Hatchling success- Because of time constraints, we were unable to determine impacts of nest location on hatchling success. Although 78 hatchlings emerged by late fall, most nests located in control and experimental plots appeared to have overwintering hatchlings. After hatchling data is complete for the past nesting season, we will be able to compare hatchling success between areas with and without vegetation, however the strength of comparisons from the past season may be inadequate because of such small sample sizes in vegetated plots. We plan to incorporate vegetation density, predation, nest temperature, and other shoreline features (e.g. slope and aspect) into our analysis of juvenile success. Multiple years of data are necessary for robust analysis.

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Appendix

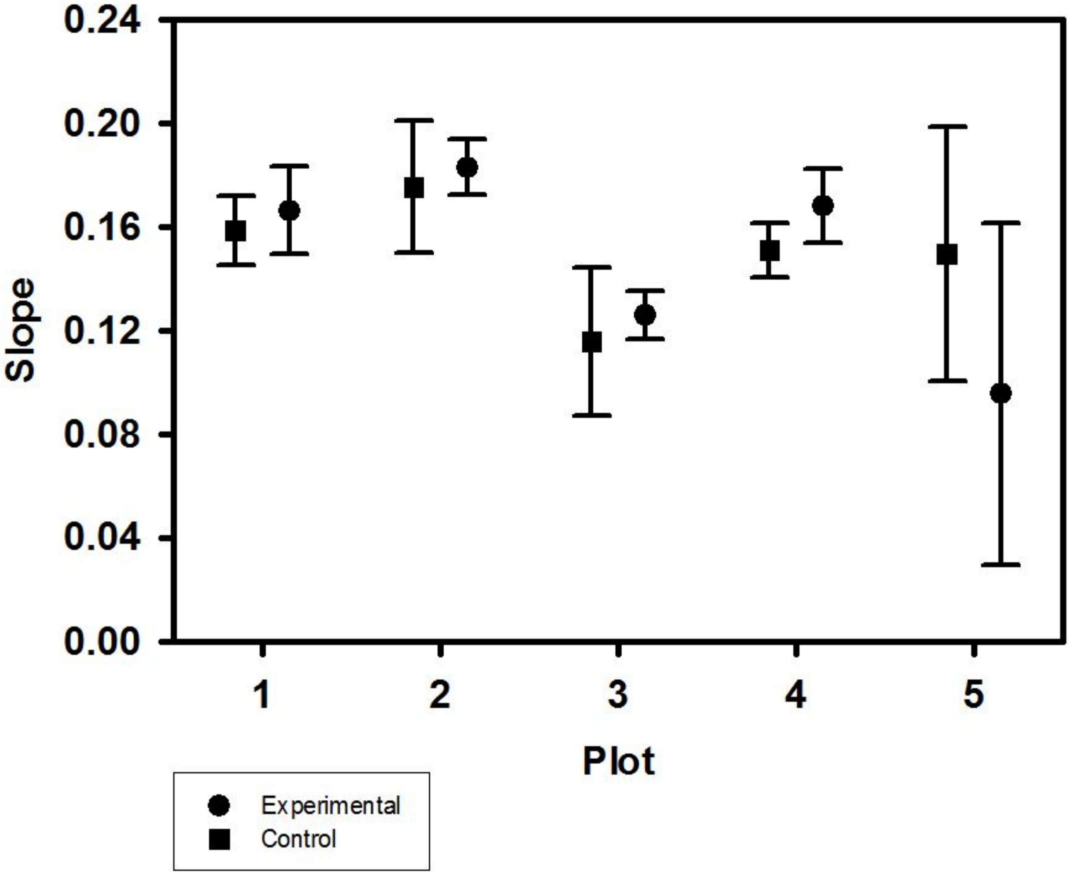

Figure S1. Mean slope (Five measurements per plot).

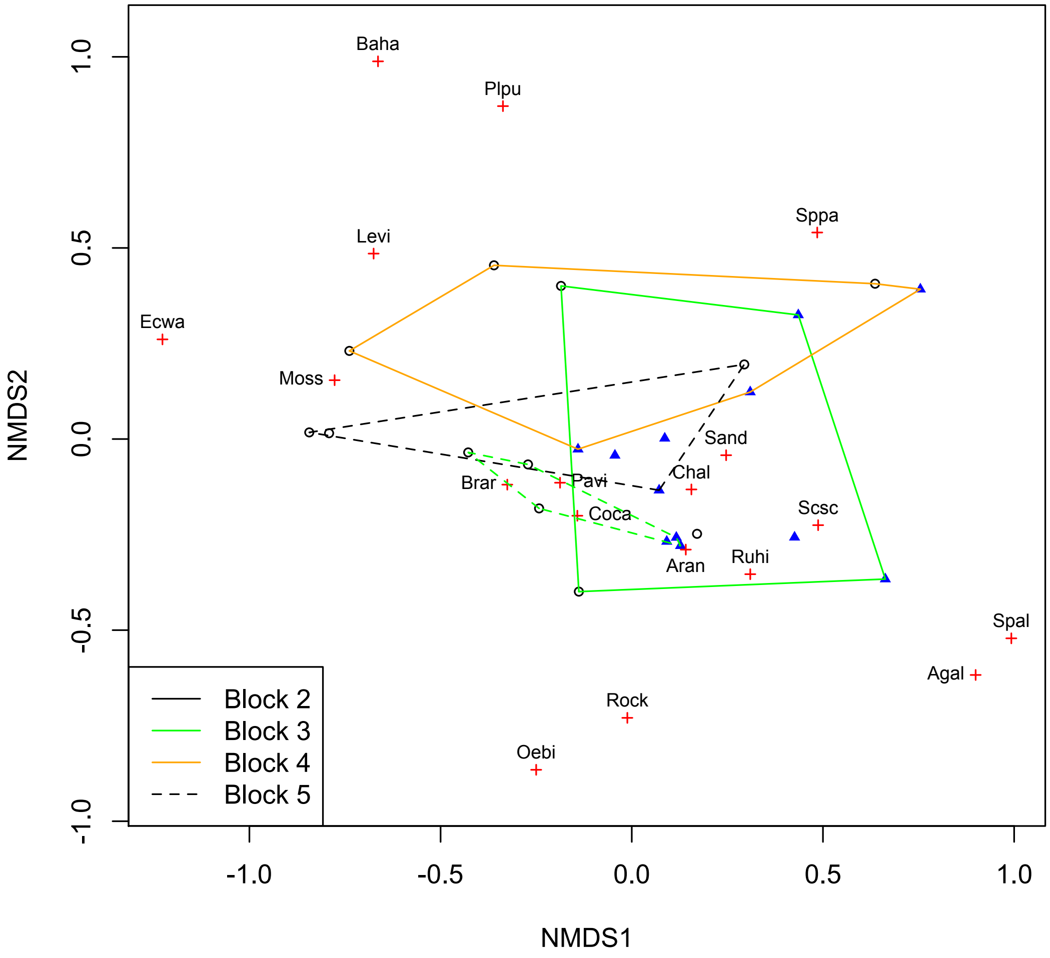

Figure S2. NMDS ordination constructed from Daubenmire samples without Block 1 vegetation. Species are indicated by four letter codes and blocks (plot sets) are grouped together. Blue triangles indicate Daubenmire samples from experimental plots; black circles show control plots.

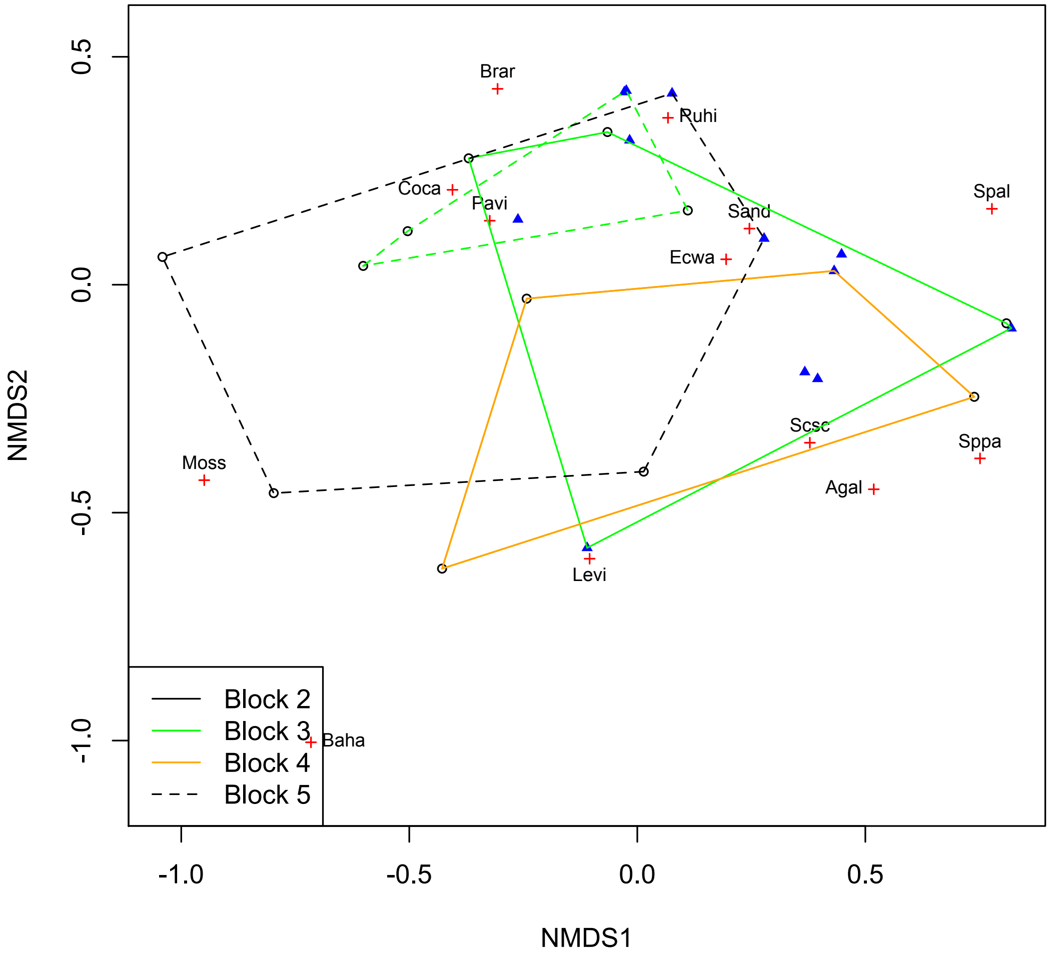

Figure S3. NMDS ordination constructed from transect samples without Block 1 vegetation. Species are indicated by four letter codes and blocks (plot sets) are grouped together. Blue triangles indicate transect samples from experimental plots; black circles show control plots.

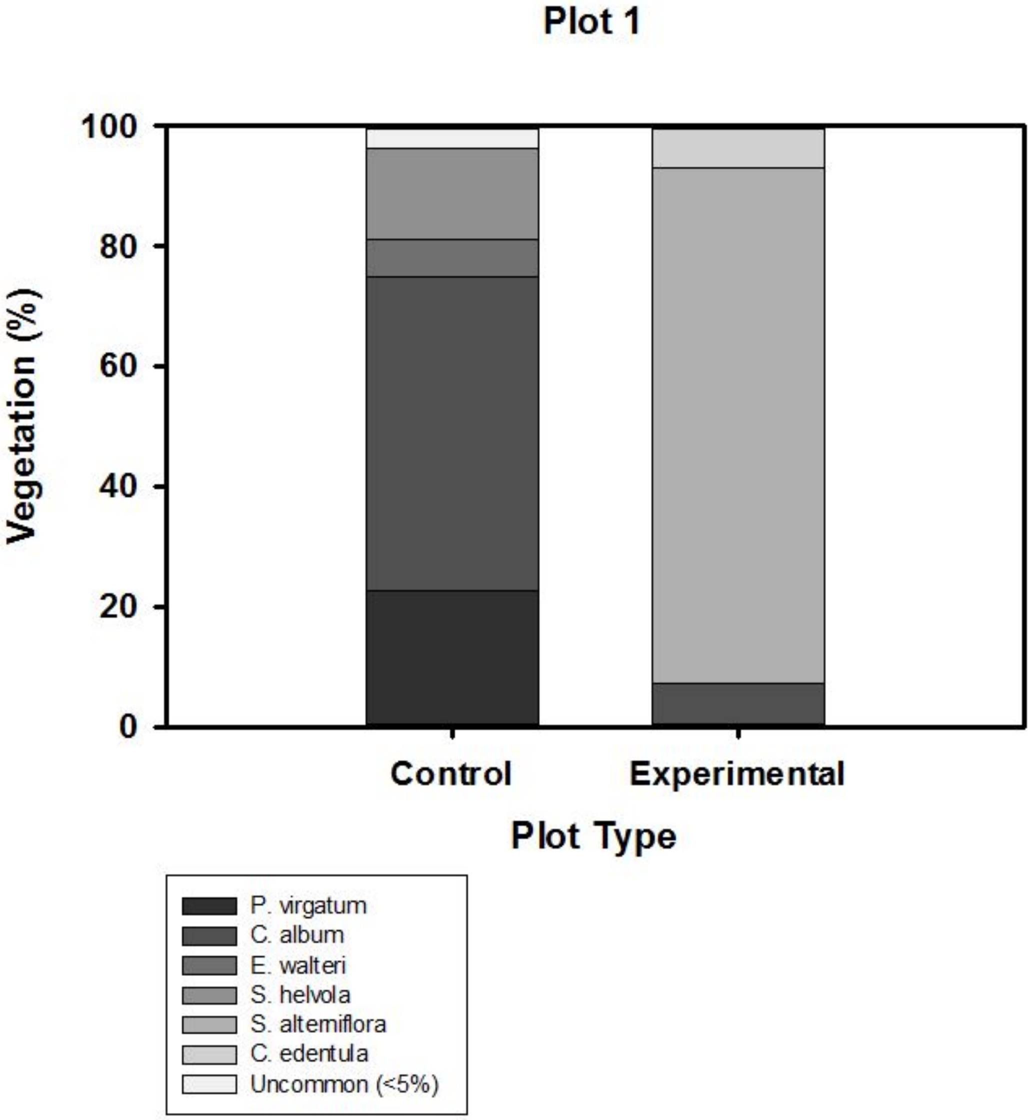

Figure S4. Vegetation profile for Block 1. Uncommon species refer only to species found in < 5% of samples taken in the two plots.

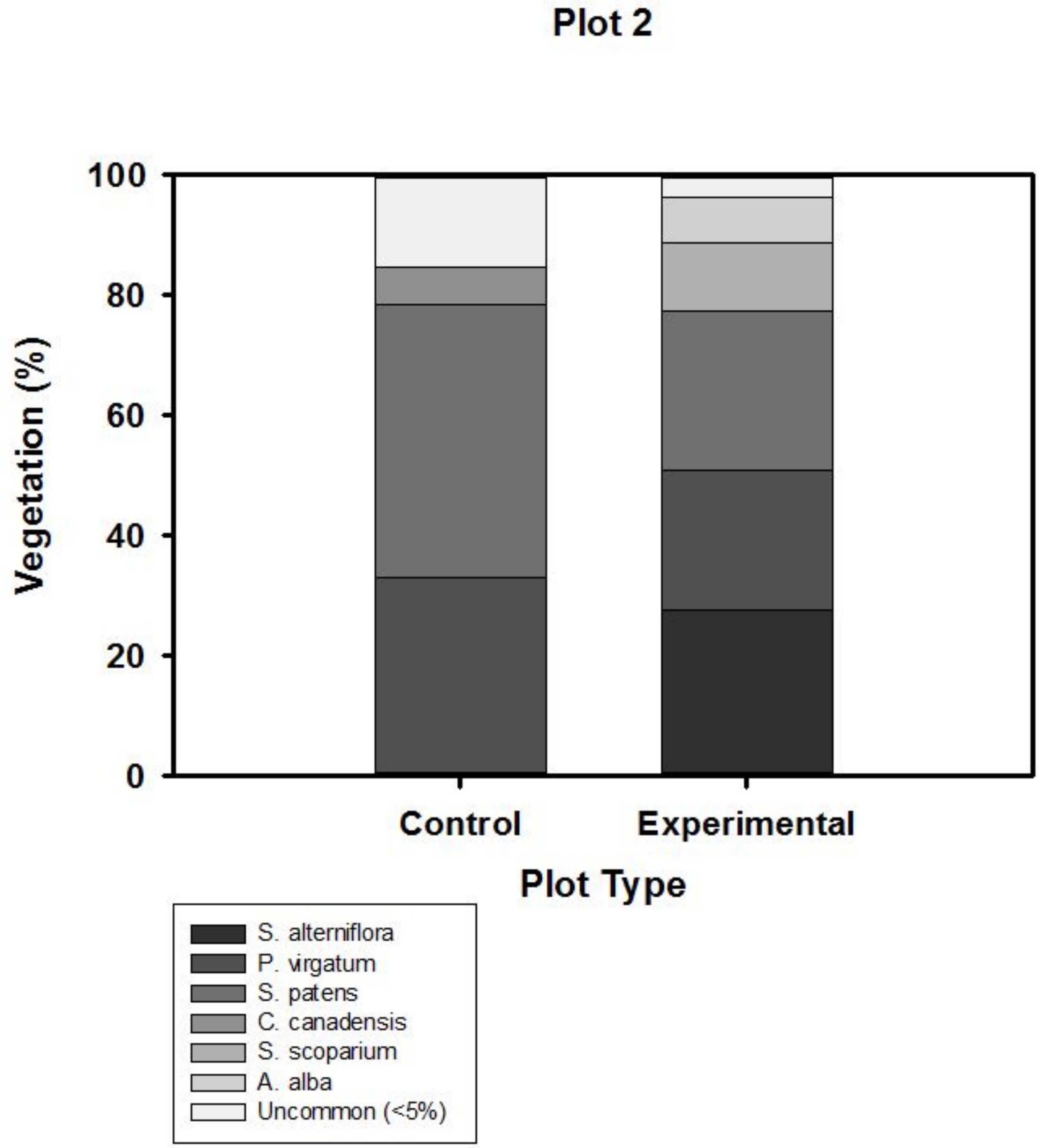

Figure S5. Vegetation profile for Block 2. Uncommon species refer only to species found in < 5% of samples taken in the two plots.

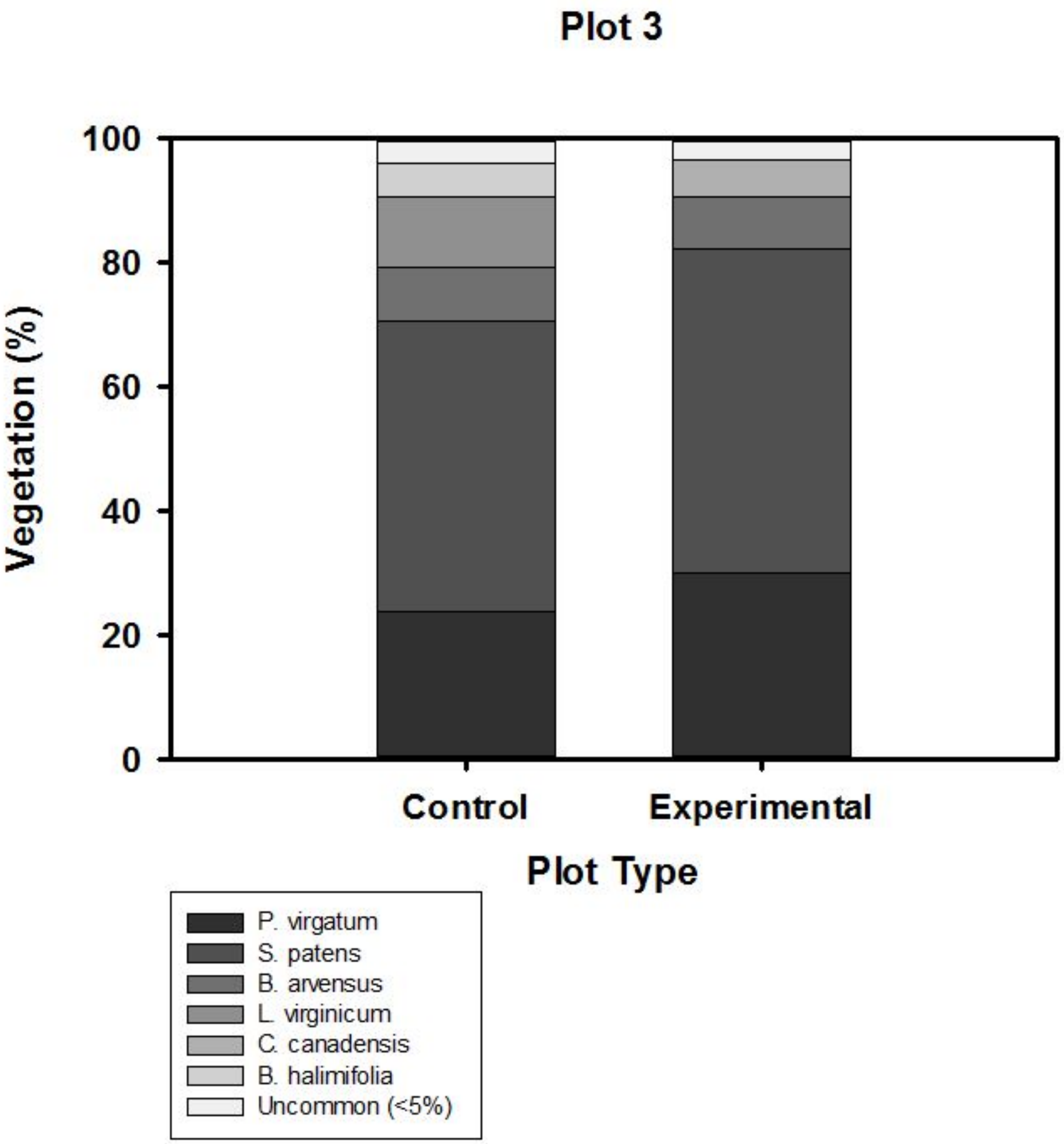

Figure S6. Vegetation profile for Block 3. Uncommon species refer only to species found in < 5% of samples taken in the two plots.

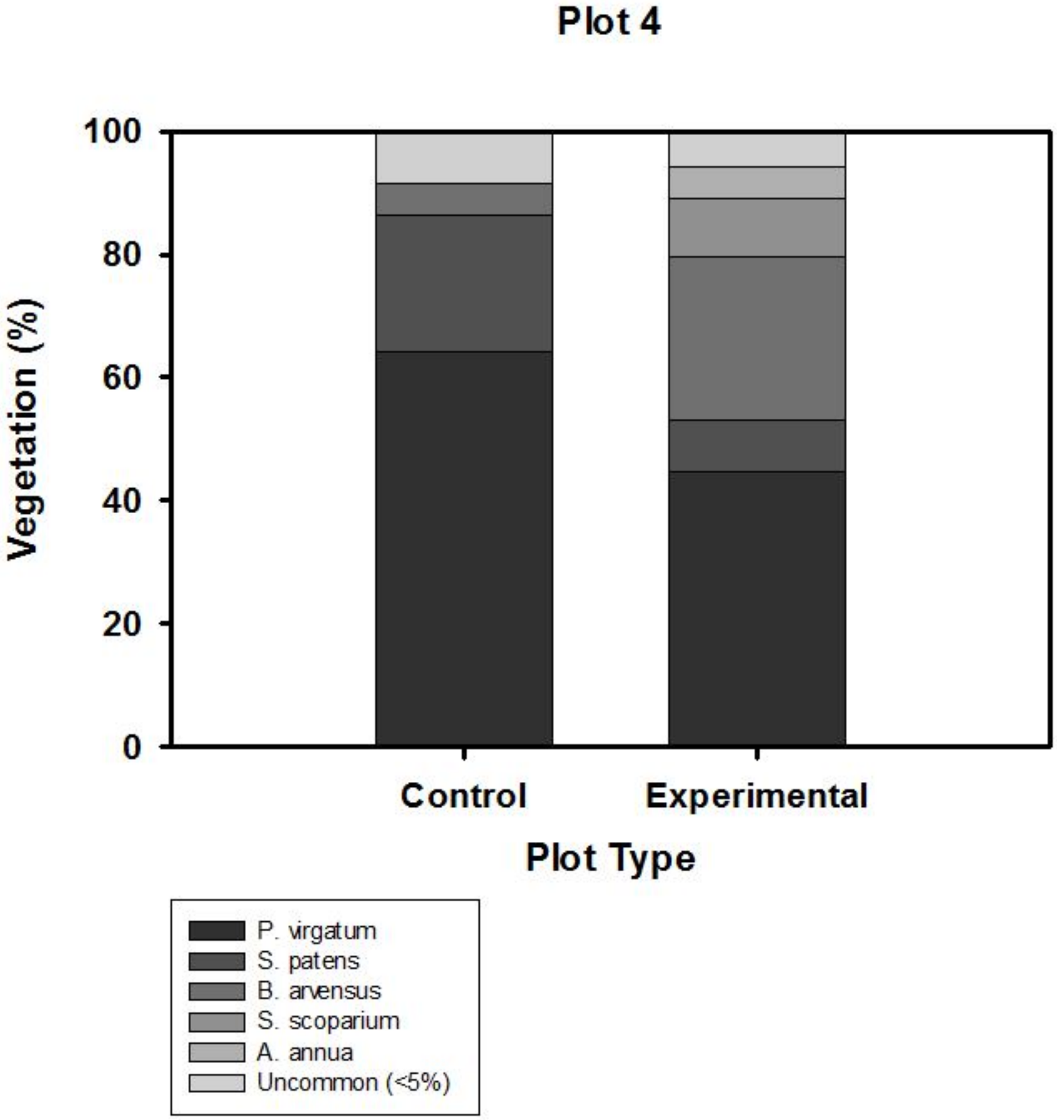

Figure S7. Vegetation profile for Block 4. Uncommon species refer only to species found in < 5% of samples taken in the two plots.

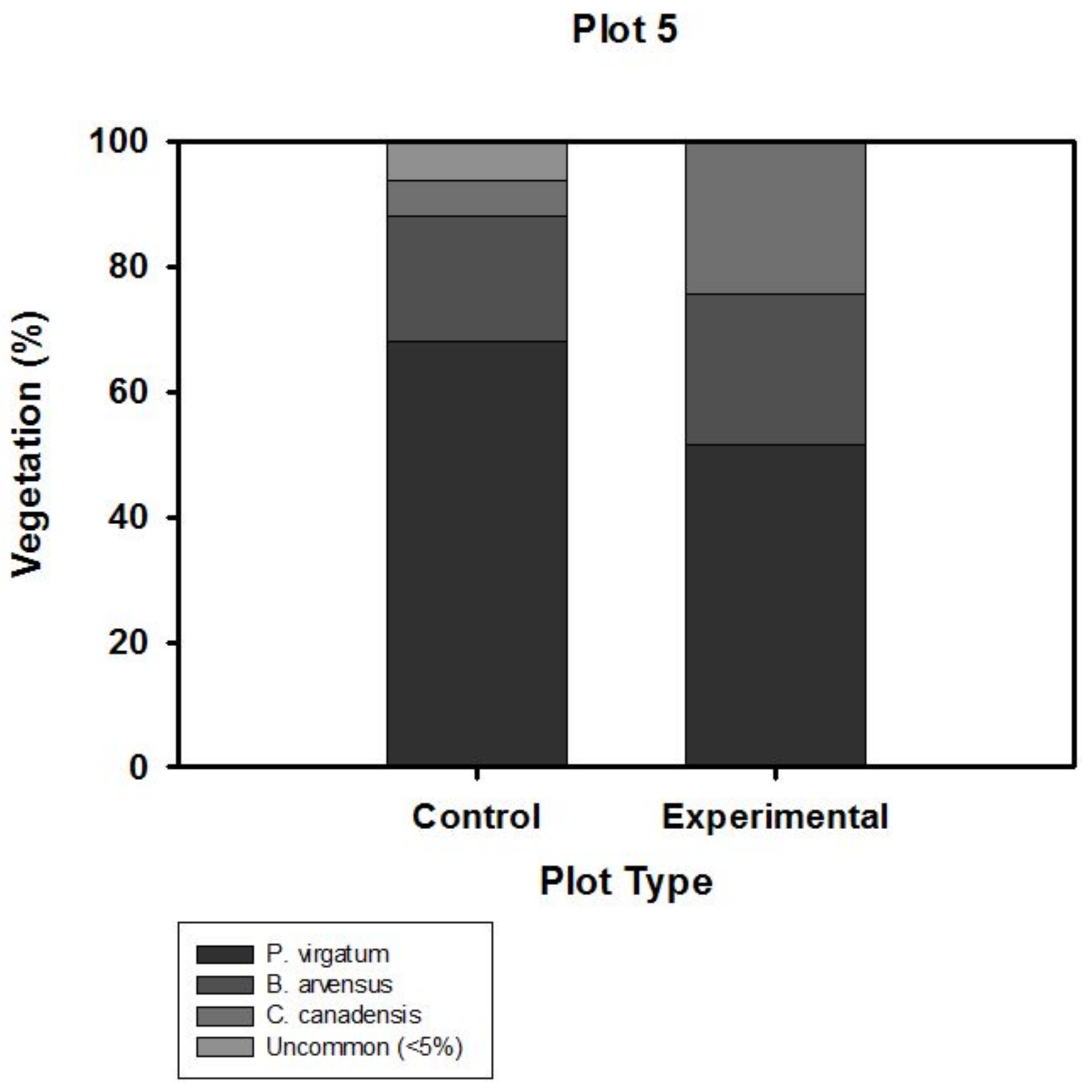

Figure S8. Vegetation profile for Block 5. Uncommon species refer only to species found in < 5% of samples taken in the two plots.

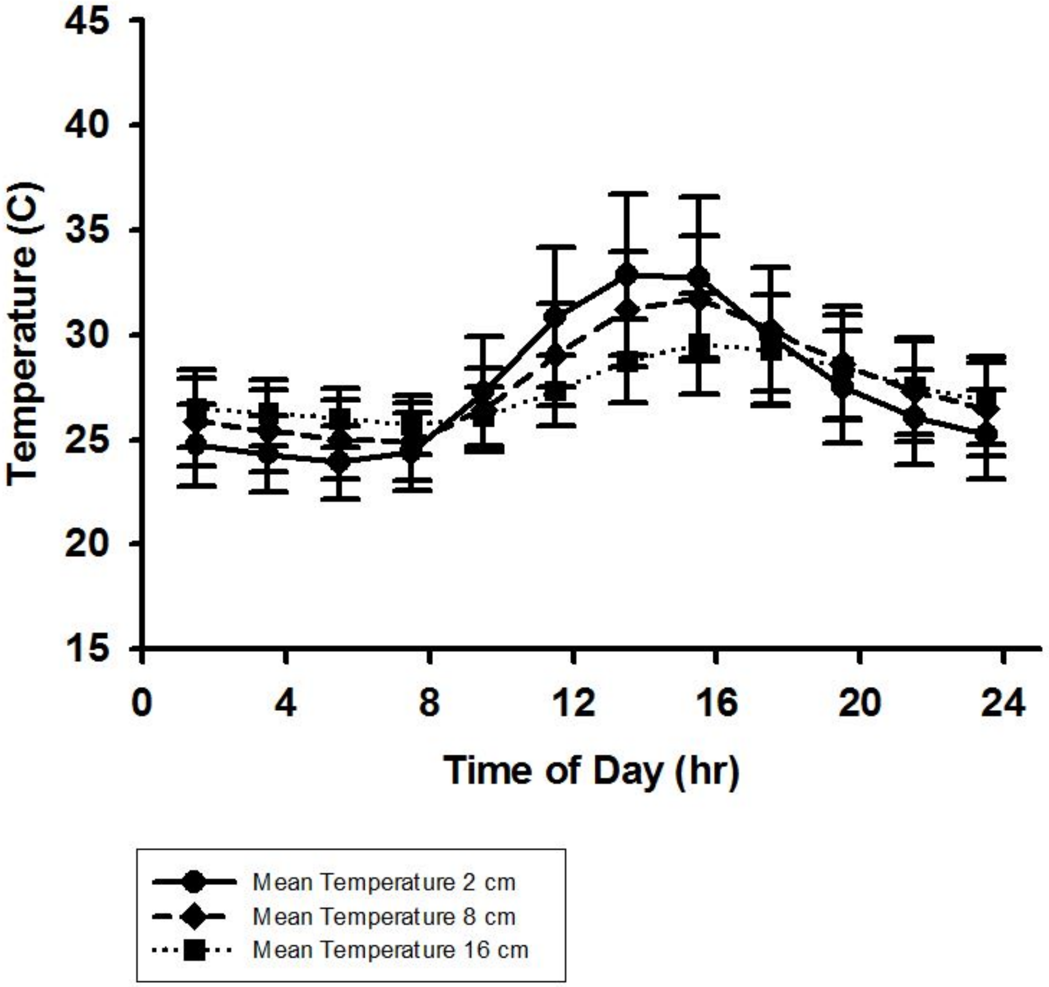

Figure S9. Mean daily temperatures for all control plot loggers during August.

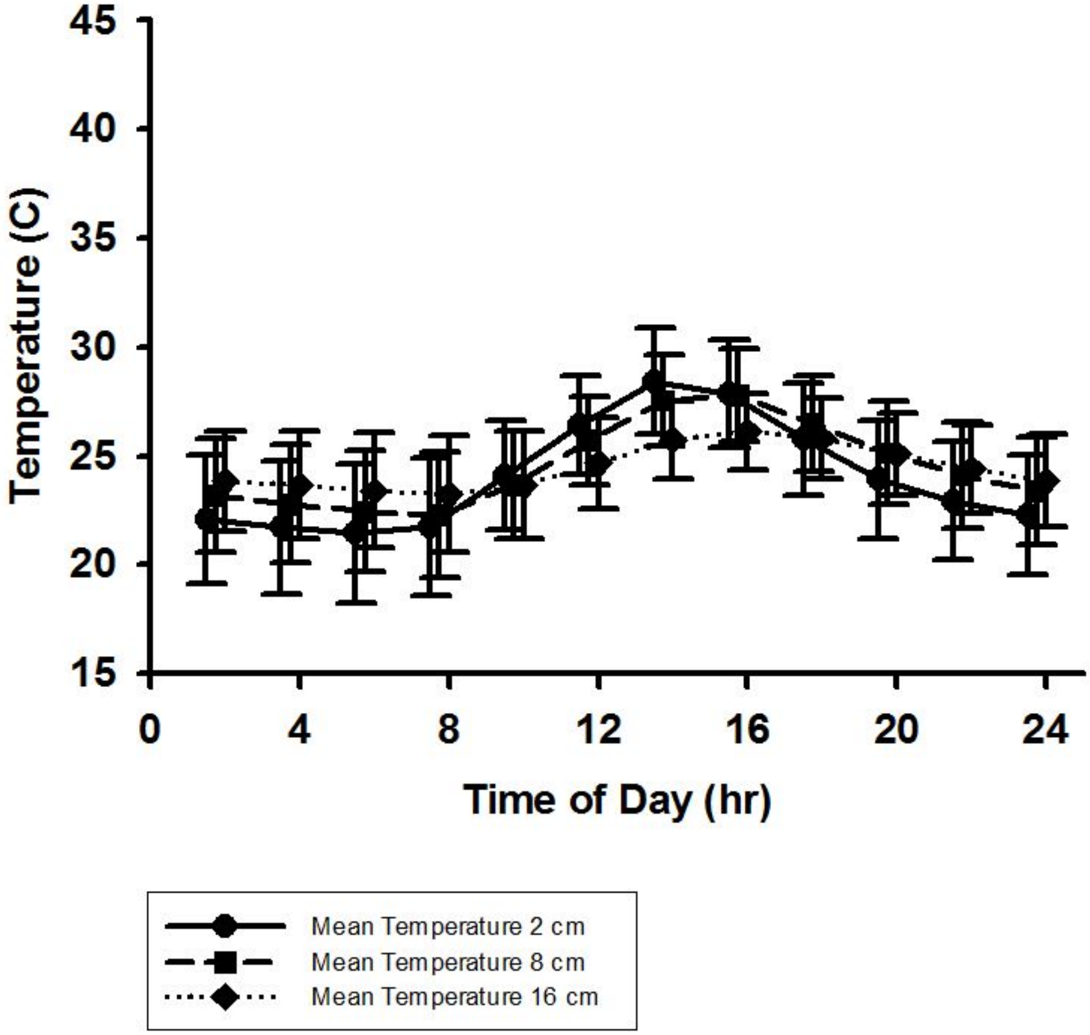

Figure S10. Mean daily temperatures for all control plot loggers during September.

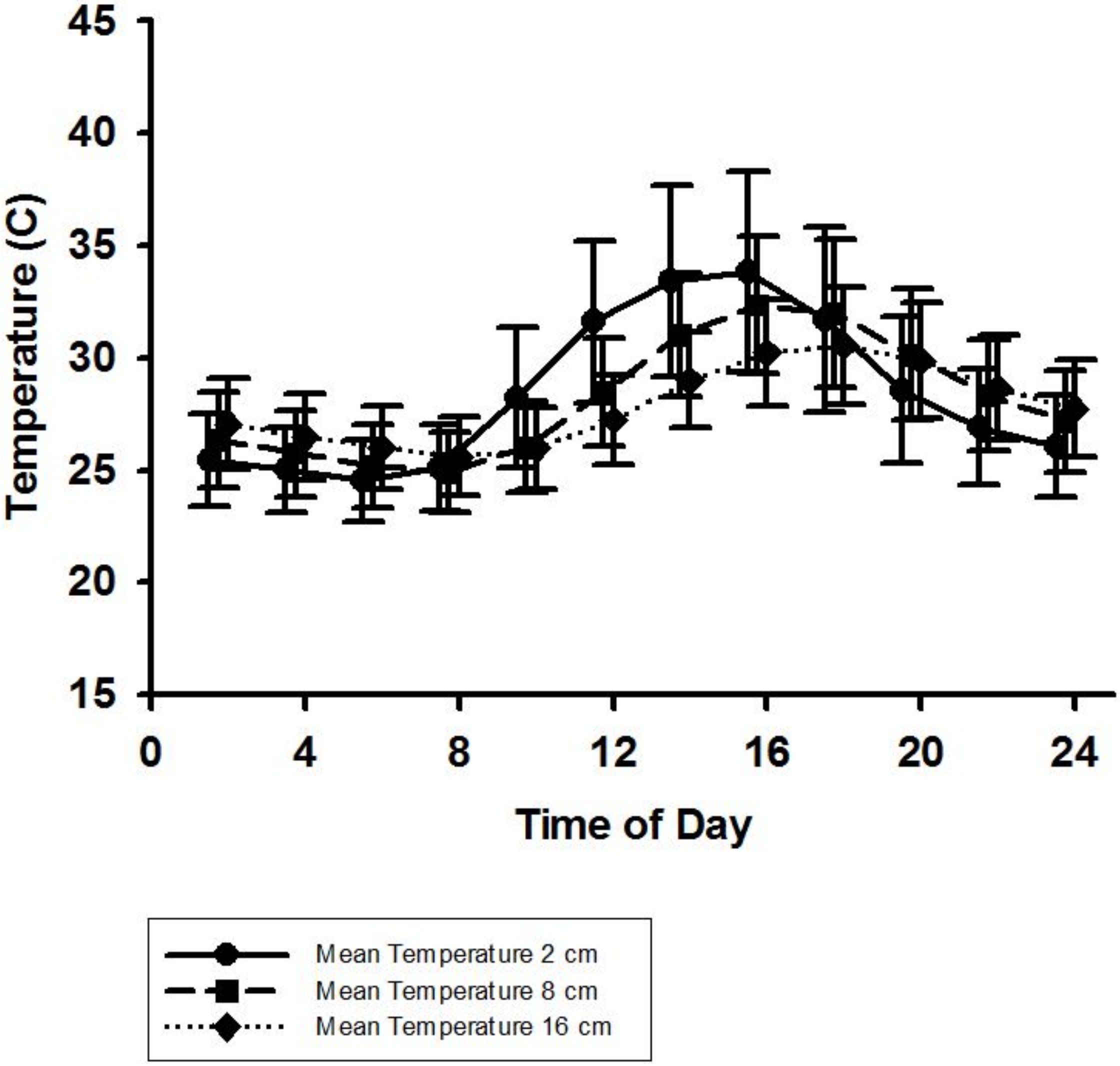

Figure S11. Mean daily temperatures for all experimental plot loggers during August.

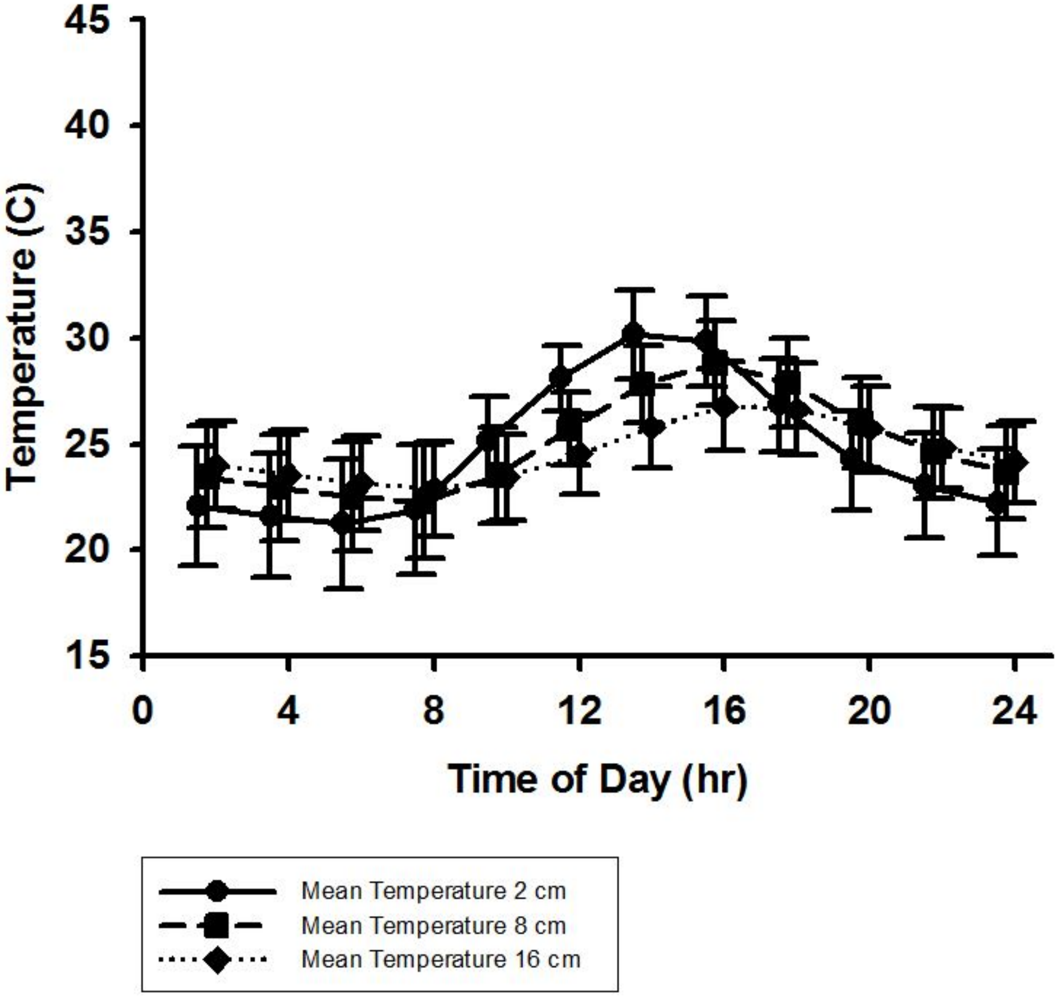

Figure S12. Mean daily temperatures for all experimental plot loggers during September.