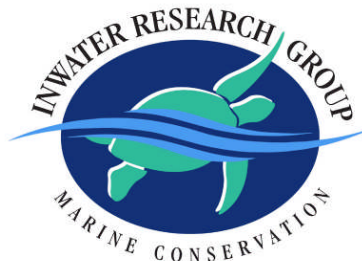


**POPULATION ASSESSMENT OF MARINE TURTLES IN LAKE
WORTH LAGOON, FLORIDA.
Sampling Event 2, June 2005**



**Submitted to : Palm Beach County Department Of
Environmental Resources Management
3323 Belvedere Rd. Building 502
West Palm Beach, FL 33406-1548**

**Submitted by : Inwater Research Group
4160 NE Hyline Dr.
Jensen Beach, FL 34957**



INTRODUCTION

Lake Worth Lagoon (LWL) is a 20 mile long body of water located just west of the Atlantic ocean along the coast of Palm Beach County, Florida. The lagoon was historically a freshwater lake, but has been severely altered by human activities since the late 1800's. Today, LWL is a moderately polluted estuarine waterway that receives ocean water from two man-made inlets. Due to heightened awareness of it's degraded state, Palm Beach County's Department of Environmental Resources Management (PBCDERM) drafted a management plan for LWL in the mid 1990's. The final draft of the Lake Worth Lagoon Management Plan was approved by a steering committee in 1998. One of the goals under the habitat restoration and enhancement program is "to attain and maintain the biological integrity of the ecosystem which supports the diversity of fisheries and wildlife, including endangered and threatened species." This directive specifically includes "research that should be conducted to understand the extent of utilization of the Lake Worth Lagoon habitat by sea turtles".

In March 2005, PBCDERM contracted Inwater Research Group, Inc. (IRG) to conduct a preliminary survey of marine turtles in LWL. Possible study sites in LWL were originally identified by analyzing stranding records and sighting data provided by PBCDERM. An introductory trip with PBCDERM representatives in fall 2004 provided an on-site look at potential study sites within LWL and was followed by a sampling trip on March 7-10, 2005. This initial assessment used a two pronged approach to evaluate the abundance and species composition of marine turtles utilizing LWL. First, visual transects were used to identify potential areas where marine turtles aggregate and second, netting operations were conducted in areas that were identified as potential turtle "hotspots". Results from this sampling trip were detailed in a report titled "Preliminary Population Assessment of Marine Turtles in Lake Worth Lagoon, Florida" submitted to PBCDERM in March 2005.

Based on results obtained during IRG's preliminary study, PBCDERM obtained funding through the Sea Turtle Grants Program for the continuation of this project. This report details sampling effort conducted by IRG personnel on June 13-15, 2005 and provides a cumulative overview of data previously collected. Field operations conducted in June represent the first of four, three day marine turtle sampling trips to be conducted in LWL during 2005/2006.

The primary objectives of this study are to:

- 1) Obtain baseline data on species abundance, size frequencies and sex ratios. These baseline data consist of quantitative measurements that can be used to determine stage-specific abundance, and in the future, determine recoveries or declines in these populations.
- 2) Determine Catch per Unit Effort (CPUE) at specific sites in Lake Worth Lagoon. This measurement will allow direct comparisons over time within Lake Worth Lagoon and with other ongoing research projects throughout the state.

- 3) Document the prevalence of fibropapillomatosis (FP), a potentially deadly disease that occurs at a high frequency among sea turtles in Indian River Lagoon and Florida Bay.
- 4) Obtain blood samples for genetic, sex ratio and disease analysis.
- 5) Determine habitat preference of sea turtles within Lake Worth Lagoon by collecting GPS waypoints for sighting and captures.

METHODS

Quantitative data on the abundance of turtles over wide areas of LWL were collected by a vessel based, visual transect system developed by IRG. The "H.U.N.T." (haphazard, unmarked, nonlinear transect) method consisted of stationing two individuals in an elevated tower of the boat to sight turtles while moving at slow speeds. Start and end points of each transect were recorded by GPS and all turtles sighted were assigned a waypoint relative to their distance from the transect line. This method allows for analysis of marine turtles sighted per kilometer of transect performed.

Turtles were captured using a large mesh tangle net, 150 meters long by five meters deep with 40 cm stretch (knot to knot) multi-filament mesh. The mesh is suspended from a foam core braided polyethylene top line with fixed buoys spaced 3.5 meters apart. The bottom line consists of a small diameter lead core line. Anchors attached to both ends of the net keep it in position and prevent it from drifting. GPS waypoints were recorded at each end of the net and when possible, habitat type was identified and recorded. Every effort was made to avoid damaging sea grass beds and netting was not conducted in areas containing listed sea grass species. The net was deployed by boat and carefully monitored by pulling the net hand over hand every 30 minutes. When turtles encountered the net and became entangled, they were quickly removed and placed on the deck of the boat for work up.

Morphometric data were collected for each turtle captured using forestry calipers and a flexible tape. Measurements included straight standard carapace length (SCL), straight minimum carapace length, straight maximum carapace width, straight midline plastron length, curved standard carapace length, curved maximum carapace width and head width. Inconel # 681 tags were applied to the trailing edge of each front flipper and a passive integrated transponder (PIT) tag was applied subcutaneously to the right front flipper. Only one Inconel tag was applied to green turtles under 40 cm SCL or turtles with flipper anomalies. Before insertion of any tags all flippers were scanned for the presence of any pre-existing PIT tags. All turtles were inspected carefully and when present, tumors associated with fibropapillomatosis (FP) were measured and recorded on a standardized tumor score sheet. The total tumor score was used to assign turtles a severity category as described by Work and Balazs (1999) . Turtles were weighed and photographed before being released near the capture area.

To determine the relative abundance of marine turtles within LWL, catch per unit effort (CPUE) was calculated. In the formula described in Ehrhart et al. (1996) effort is expressed in net kilometer (km) hours (one kilometer of net fished for one hour). CPUE is then calculated using the formula $C/(L*T)$. Where C = the number of turtles captured, L = the length of net fished, and T = the amount of time the net was fished. The CPUE data collected at sites within LWL will be used to determine seasonal and annual fluctuations in marine turtle abundance.

Blood samples from most turtles captured were taken for genetic analysis, sex ratios and disease. We drew blood from the cervical sinus using a sterile vacutainer with no additive (Owens and Ruiz, 1980). The area was thoroughly sterilized with betadine before needle insertion. A 22 gauge 1" needle was used on small juveniles, while a 1 ½" was used on larger subadults. We collected approximately 4 ml from each turtle and added a few drops to a lysis buffer (100 mM Tris-HCL, pH 8; 100 mM EDTA, pH 8, 10 mM NaCl; 1.0% SDS) in a 1:10 ratio, gently shook the mixture and stored it in a cool dark place. This blood will be used for later mtDNA haplotype analysis to determine the turtles origin (Encalada et al. 1996). The remaining blood was placed in a sterile vacutainer with lithium heparin and spun for ten minutes in a Adams Physician centrifuge. Plasma was then pipetted into a 1.8 ml vial and held for future testosterone radioimmunoassays to determine sex.

Dietary samples were carefully extracted from captured green turtles using a technique called "lavage". The lavage process flushes food items from the esophagus and mouth areas. During this procedure turtles were held on their back with their posterior end slightly elevated. A soft plastic veterinarian's stomach tube was lubricated with vegetable oil and cautiously inserted into the mouth and throat area. Seawater was then pumped through the tube using a veterinarian's double action pump. The tube was gently moved back and forth along the length of the esophagus and prey items were collected in a bucket positioned under the turtle's head.

The extracted diet sample was then strained through a fine mesh net (mesh ~1mm) and placed into a collection jar. A 4% formalin-seawater solution was used to preserve the sample for future analysis. Date, location and tag numbers of the turtles were recorded on the collection jar.

RESULTS AND DISCUSSION

In June 2005 Inwater Research Group conducted sea turtle sampling efforts in LWL. During this period, five visual transects were conducted using the H.U.N.T. technique and 25.99 kilometers of LWL were covered. A total of 12 green turtles (*Chelonia mydas*) were sighted during transect effort, generating a sighting rate of 0.46 green turtles per kilometer of transect (Table 1). To date, 13 green turtles have been sighted over 85 kilometers of transects conducted in LWL. Locations of all turtles sighted on transect are presented in Table 2. In addition to sea turtles sighted on transect, 22 green turtles and one loggerhead

(*Caretta caretta*) were sighted off transect. These turtles were generally sighted during netting efforts and locations were recorded by GPS (Table 3, Figure 1, 2, 3).

In June, tangle nets were set in LWL seven times for a total of 1.96 km net hours. Netting activity was conducted in the vicinity of Little Munyon Island north of Lake Worth Inlet and all net beginning and end point locations were recorded (Table 4, Figure 1, 2, 3). During June, netting effort in LWL produced one loggerhead and seven green turtle captures for a CPUE of 4.08 turtles per km/net hour. This translates to a CPUE of 3.57 green turtles per km/net hour and a CPUE of 0.51 loggerheads per km/net hour. CPUE for LWL, including past sampling, was calculated at 2.67 turtles per km/net hour.

Green turtles captured in June ranged in size from 29.8 – 54.9 cm SCL with a mean SCL of 42.3 cm (n=7). Overall, green turtles captured in LWL ranged in size from 29.8 – 54.9 cm SCL with a mean of 43.3 cm (n=9, Table 5). Fibropapillomas were visually identified on three of seven green turtles (42.9%) captured in LWL in June. Two of these turtles were categorized as lightly afflicted and one was considered severely afflicted based on the number and size of the tumors present. Cumulatively, the FP rate among green turtles captured in LWL is 33.3%.

During this sampling trip one loggerhead was captured in LWL with a SCL of 72.0 cm. This turtle had healing injuries to the carapace consistent with a boat strike and was remanded to Miami Seaquarium for rehabilitation after consulting Florida Fish and Wildlife Research Institute personnel. This marks the first loggerhead sighted or captured since the project's inception.

In addition to collecting morphometric data on all turtles captured in June, seven DNA samples and seven lavage samples were collected for future analysis. These samples will be stored by IRG until funding becomes available for processing.

The June sampling trip represented the second by IRG into LWL and produced remarkable new information. During this three day period we were able to verify, by visual sightings and captures, that the area around Little Munyon Island (LMI) is important habitat for green turtles. The CPUE found at the LMI site is similar to our sampling site in the Indian River Lagoon where CPUE for green turtles ranged from 1.56 – 4.71 turtles per km/net hour between 1998 and 2004 (IRG, 2004). However, it is premature to make any comparison between sites until more seasonal data is acquired. In the future we will conduct visual transects throughout the lagoon to identify other potentially important sites where sea turtles aggregate, but we will continue to devote a portion of effort each sampling trip to the LMI site.

The detection of FP among green turtles captured in LWL is troublesome, but not unexpected. FP is at epizootic levels among green turtles in similar degraded, eutrophic, low flow environments like the Indian River Lagoon and Florida Bay. This study is still in its preliminary stages and as more sampling is conducted, we will better understand the effects FP has on green turtles in LWL.

Marine turtles in LWL may be more negatively impacted by the high rate of boat related injuries we have observed. To date, two out of ten turtles (20%)

captured in the lagoon had boat related damage to the carapace. Both turtles had to be sent to rehabilitation facilities for treatment due to the severity of the injuries. Comparisons to other sites are premature, but it is interesting to note that boat hit injuries have been observed on just 4.4% of turtles found at our Indian River Lagoon study site (n=251) and on 8.6% of turtles at our site in the Key West National Wildlife Refuge (n=151) (IRG, 2004, 2005). These are preliminary observations, but with over one million boaters using LWL annually this could be a significant problem.

As more data are collected and a greater area of the LWL is surveyed we will develop a better understanding of the demographic composition of sea turtles utilizing habitat in the lagoon. However, based on data collected to date, it is evident that LWL could be an important developmental habitat for at least two species of marine turtles.

ACKNOWLEDGEMENTS

We would like to thank personnel from PBCDERM for their help and support with this project, specifically Carly De Maye and Paul Davis. Also we would like to thank personnel from Florida Fish and Wildlife Research Institute and Chris Johnson and Niki Dejardin from the Marine Life Center for their field support.

This project was funded in part by a grant awarded from the Sea Turtle Grants Program. The Sea Turtle Grants Program is funded from proceeds for the sale of Florida Sea Turtle License Plates. Learn more at : www.helpingseaturtles.org.



LITERATURE CITED

- Ehrhart, L.M., W.E. Redfoot and D.A. Bagley. 1996. A study of the population ecology of inwater marine turtle populations on the east-central coast of Florida. Comprehensive final report to NOAA, National Marine Fisheries Service. 164 pp.
- Enclada, S.E., P.N. Lahanas, K.A. Bjorndal, A.B. Bolten, M.M. Miyamoto and B.W. Bowen. 1996. Phylogeography and population structure of the Atlantic and Mediterranean green turtle (*Chelonia mydas*): a mitochondrial DNA control region sequence assessment. *Molecular Ecology* 1996(5):473-483.

Inwater Research Group Inc. 2005. Final Report on Sea Turtle Sampling in the Key West National Wildlife Refuge, Florida. Technical report submitted to Florida Fish and Wildlife Research Institute.

Inwater Research Group Inc. 2004. Assessment of marine turtles in the southern Indian River Lagoon System, Florida. Annual report to NMFS, National Sea Turtle Coordinator.

Owens, D.W. and G.W. Ruiz. 1980. New methods of obtaining blood and cerebrospinal fluid from turtles. *Herpetologica* 36(1):17-20.

Work, T.M. and G.H. Balazs. 1999. Relating Tumor Score to Hematology in Green Turtles with Fibropapillomatosis in Hawaii. *Journal of Wildlife Diseases*, 35(4) pp 804-807.

FIGURES



Figure 1. Net set locations, captures and non-transect sightings on June 13, 2005. Green dots = *Chelonia mydas*, Red dot = *Caretta caretta*, yellow line = net.



Figure 2. Net set locations, captures and non-transect sightings on June 14, 2005. Green dots = *Chelonia mydas*, yellow line = net.



Figure 3. Net set locations, captures and non-transect sightings on June 15, 2005. Green dots = *Chelonia mydas*, yellow line = net.

TABLES

DATE	TRANSECT NUMBER	AREA COVERED	START LOCATION (LAT/LONG)	END LOCATION (LAT/LONG)	TRANSECT LENGTH (km)	Cm sighted	Cc sighted	Cm per km/transect	Cc per km/transect
3/7/2005	1	North end of lagoon to north of Blue Heron Bridge.	N26.83840 W80.05656	N26.79415 W80.04418	13.10	0	0	0.00	0.00
3/7/2005	2	North of Peanut Island to north of Flagler Bridge.	N26.77839 W80.04360	N26.71975 W80.04711	11.61	1	0	0.09	0.00
3/7/2005	3	Boynton Inlet area and north.	N26.54797 W80.04767	N26.54709 W80.04770	10.10	0	0	0.00	0.00
3/7/005	4	North of Flagler bridge to Sailfish Marina.	N26.72535 W80.04577	N26.77689 W80.04130	11.80	0	0	0.00	0.00
3/10/2005	5	Lake Worth Inlet to south of Rybovich Marine	N26.77241 W80.03999	N26.74685 W80.04556	4.31	0	0	0.00	0.00
3/10/2005	6	SE Little Munyon Island to north of Munyon Island	N26.80429 W80.04321	N26.82423 W80.04785	5.60	0	0	0.00	0.00
3/10/2005	7	East of Little Munyon Island to south of Little Munyon Island	N26.80626 W80.04241	N26.80021 W80.04344	2.54	0	0	0.00	0.00
6/13/2005	8	SE Little Munyon Island	N26.80101 W80.04001	N26.80335 W80.03676	1.14	1	0	0.88	0.00
6/13/2005	9	South of Little Munyon to north of Peanut Island	N26.79931 W80.04217	N26.77949 W80.04447	5.35	0	0	0.00	0.00
6/14/2005	10	South of Port of Palm Beach to north of Ibis Isle	N26.76413 W80.04957	N26.64413 W80.04278	14.10	0	0	0.00	0.00
6/15/2005	11	South of Little Munyon Island to SE of Little Munyon Island	N26.80053 W80.04468	N26.80216 W80.03757	2.78	9	0	3.24	0.00
6/15/2005	12	SE Little Munyon Island	N26.80103 W80.03735	N26.80516 W80.04350	2.62	2	0	0.76	0.00

Table 1 . Visual transect results from haphazard unmarked non-linear transects, Lake Worth Lagoon, Palm Beach County, 2005. Cm = *Chelonia mydas*, Cc = *Caretta caretta*.

DATE	SPECIES	LOCATION (LAT/LONG)	TRANSECT NUMBER
3/7/2005	<i>Chelonia mydas</i>	N26.75181 W80.04921	2
6/13/2005	<i>Chelonia mydas</i>	N26.80217 W80.03721	8
6/15/2005	<i>Chelonia mydas</i>	N26.79903 W80.04250	11
6/15/2005	<i>Chelonia mydas</i>	N26.79850 W80.04001	11
6/15/2005	<i>Chelonia mydas</i>	N26.80018 W80.03957	11
6/15/2005	<i>Chelonia mydas</i>	N26.80141 W80.03852	11
6/15/2005	<i>Chelonia mydas</i>	N26.80149 W80.03702	11
6/15/2005	<i>Chelonia mydas</i>	N26.80134 W80.03688	11
6/15/2005	<i>Chelonia mydas</i>	N26.80131 W80.03687	11
6/15/2005	<i>Chelonia mydas</i>	N26.80162 W80.03720	11
6/15/2005	<i>Chelonia mydas</i>	N26.80202 W80.03746	11
6/15/2005	<i>Chelonia mydas</i>	N26.79928 W80.03683	12
6/15/2005	<i>Chelonia mydas</i>	N26.80116 W80.03590	12

Table 2. Location of sea turtles sighted on transect in Lake Worth Lagoon, Palm Beach County, 2005.

DATE	SPECIES	LOCATION (LAT/LONG)	Captured?
3/8/2005	<i>Chelonia mydas</i>	N26.79904 W80.05063	YES
3/9/2005	<i>Chelonia mydas</i>	N26.80294 W80.04350	YES
3/10/2005	<i>Chelonia mydas</i>	N26.80533 W80.04321	NO
3/10/2005	<i>Chelonia mydas</i>	N26.80236 W80.04294	NO
3/10/2005	<i>Chelonia mydas</i>	N26.80209 W80.04299	NO
3/10/2005	<i>Chelonia mydas</i>	N26.80198 W80.04263	NO
6/13/2005	<i>Caretta caretta</i>	N26.80427 W80.03947	YES
6/13/2005	<i>Chelonia mydas</i>	N26.80453 W80.03842	NO
6/13/2005	<i>Chelonia mydas</i>	N26.80089 W80.03872	NO
6/13/2005	<i>Chelonia mydas</i>	NET SET #8	YES
6/13/2005	<i>Chelonia mydas</i>	NET SET #8	YES
6/13/2005	<i>Chelonia mydas</i>	NET SET #8	YES
6/14/2005	<i>Chelonia mydas</i>	N26.80456 W80.03714	NO
6/14/2005	<i>Chelonia mydas</i>	N26.80525 W80.04095	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80232 W80.03724	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80243 W80.03703	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80166 W80.03700	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80195 W80.03756	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80219 W80.03750	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80132 W80.03745	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80236 W80.03738	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80130 W80.03675	NO
6/15/2005	<i>Chelonia mydas</i>	NET SET #11	YES
6/15/2005	<i>Chelonia mydas</i>	N26.80242 W80.03737	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80160 W80.03734	NO
6/15/2005	<i>Chelonia mydas</i>	N26.80212 W80.03765	NO
6/15/2005	<i>Chelonia mydas</i>	NET SET #12	YES
6/15/2005	<i>Chelonia mydas</i>	NET SET #12	YES
6/15/2005	<i>Chelonia mydas</i>	NET SET #12	YES

Table 3. Non-transect sightings and locations of sea turtles in Lake Worth Lagoon, Palm Beach County, 2005.

DATE	NET SET NUMBER	LOCATION	START LOCATION (LAT/LONG)	END LOCATION (LAT/LONG)
3/8/2005	1	East of Kelsey Park	N26.79975 W80.05065	N26.79822 W80.05081
3/9/2005	2	SE of Little Munyon Island	N26.80585 W80.03754	N26.80470 W80.03677
3/9/2005	3	SE of Little Munyon Island	N26.80182 W80.04260	N26.80297 W80.04361
3/10/2005	4	SE of Little Munyon Island	N26.80571 W80.04374	N26.80420 W80.04353
3/10/2005	5	SE of Little Munyon Island	N26.80334 W80.04325	N26.80198 W80.04263
3/10/2005	6	East of Little Munyon Island	N26.80726 W80.04403	N26.80599 W80.04421
6/13/2005	7	SE of Little Munyon Island	N26.80476 W80.03948	N26.80351 W80.04017
6/13/2005	8	SE of Little Munyon Island	N26.80125 W80.03861	N26.79989 W80.03873
6/14/2005	9	SE of Little Munyon Island	N26.80338 W80.03707	N26.80438 W80.03809
6/14/2005	10	SE of Little Munyon Island	N26.80493 W80.03817	N26.80456 W80.03663
6/15/2005	11	SE of Little Munyon Island	N26.80178 W80.03711	N26.80111 W80.03689
6/15/2005	12	SE of Little Munyon Island	N26.80225 W80.03770	N26.80118 W80.03684

Table 4. Tangle net set locations for sea turtle sampling, Lake Worth Lagoon, Palm Beach County, 2005.

Species	Date	Tag Number	SSCL (cm)	CSCL (cm)	SMCW (cm)	CMCW (cm)	Weight (kg)	Lavaged?	Blood Taken?	FP	Comments
<i>Chelonia mydas</i>	3/8/05		40.5	43.5	31.1	37.0	8.0	No	No	No	S shaped deep gouge in carapace, apparent boat propeller wound. Sent to Marinelife Center in Juno Beach for rehabilitation.
<i>Chelonia mydas</i>	3/9/05	XXQ561/XXQ562	52.8	57.7	45.9	53.3	22.3	No	Yes	No	Leeches present in inguinal area.
<i>Chelonia mydas</i>	6/13/05	XXY522/XXY523	46.7	50.5	35.4	42.2	15.0	Yes	No	Yes	Biopsy taken for DNA.
<i>Caretta caretta</i>	6/13/05		72.0	77.6	60.7	72.0	38.0	No	No	No	Large, healing propeller wound to carapace. Sent to Miami Seaquarium for rehabilitation.
<i>Chelonia mydas</i>	6/13/05	XXY521	29.8	31.8	21.5	25.7	3.6	Yes	No	No	Biopsy taken for DNA.
<i>Chelonia mydas</i>	6/13/05	XXY524/XXY525	45.4	48.7	37.1	43.4	13.2	Yes	Yes	No	
<i>Chelonia mydas</i>	6/15/05	XXY516	53.7	57.1	44.0	51.0	21.4	Yes	Yes	Yes	Leeches and leech cocoons present.
<i>Chelonia mydas</i>	6/15/05	XXY518	54.9	58.8	44.3	52.8	27.4	Yes	Yes	Yes	Leeches on inguinal area. Tail missing distal tip and pigals appear truncated. 1 cm round scar at nape of neck.
<i>Chelonia mydas</i>	6/15/05	XXY519	35.0	37.7	28.0	32.7	6.0	Yes	Yes	No	Barnacle on tomium.
<i>Chelonia mydas</i>	6/15/05	XXY520	30.9	32.8	25.1	29.0	3.9	Yes	Yes	No	Fat. Very white plastron.

Table 5. Morphometric data collected on sea turtles captured in Lake Worth Lagoon, Palm Beach County, 2005.