American Alligator Distribution, Size, and Hole Occupancy and American Crocodile Juvenile Growth and Survival Volume II

MAP 3.1.3.15 and 3.1.3.16
Cooperative Agreement Number:
1434-05HQRU1544/244

Frank J. Mazzotti[1], Kristen M. Hart [2], Brian M. Jeffery[1], Michael S. Cherkiss[1], Laura A. Brandt[3]
Ikuko Fujisaki[1], Kenneth G. Rice[2]

Principal Investigator:
H. Franklin Percival[4]

Prepared for:
U.S. Army Corps of Engineers

2010

[1] (University of Florida, Fort Lauderdale Research and Education Center)
[2] (USGS, Southeast Ecological Science Center)
[3] (USFWS)
[4] (USGS, Florida Cooperative Fish and Wildlife Research Unit)

Suggested Citation: Mazzotti, Frank J., Kristen M. Hart, Brian M. Jeffery, Michael S. Cherkiss, Laura A. Brandt, Ikuko Fujisaki, and Kenneth G. Rice. 2010. American Alligator Distribution, Size, and Hole Occupancy and American Crocodile Juvenile Growth and Survival Volume II. MAP RECOVER 2004-2009 Final Summary Report, Fort Lauderdale Research and Education Center, University of Florida, Fort Lauderdale, FL.

Appendix 1. Alligator and crocodile protocols for MAP.

This appendix includes the following protocols:

Training (survey and capture training applicable to both alligator and crocodiles, others just alligators)
Alligator Capture and Data Management
Alligator Spotlight Survey Field and Data Management
Alligator Hole Occupancy Survey and Data Management
Crocodile Growth and Survival Survey and Data Management
Crocodile Survey Observation/Capture Data Entry
Crocodile Nesting Survey and Data Management
Crocodile Nesting Survey Data Entry

Training Protocol

This training protocol is associated with collection of data for the alligator relative abundance, body condition, hole occupancy and crocodile growth and survival (monitoring elements (3.1.3.15 and 3.1.3.16) of the 2004 RECOVER Monitoring and Assessment Plan. While the survey and capture training protocols apply to both alligator and crocodile work, we will only refer to alligators in the protocol. These protocols need to be read through entirety to understand the training procedures.

Spotlight Survey Training

Observers will be trained according to the following methods and will not be the primary observer until such time as they have demonstrated acceptable proficiency at night boat operations, survey procedures, and size estimation:

- Trainees will participate on several surveys as recorders.
- Trainees will participate in size estimation. Both trainer and recorder will make estimates for comparison for learning purposes, only the trainers estimate will be retained for survey data.
- Trainees will participate in alligator capture events and record a size estimate as soon as possible when an animal is observed. Comparing the estimate to the actual total length of the animal will allow for analysis of the trainees' estimate accuracy. Estimates must be >85% correct in the aggregate size class.
- The trainees must make estimates throughout a season (spring or fall), estimate a minimum of 30 alligators, and must be >85% correct in the aggregate class size from the primary observer's classification.

- Trainee will complete the Department of Interiors Motorboat Operators Certification Class (MOCC) and Airboat certification which requires a minimum of 40 hours of airboat operation.

- Trainee must demonstrate proficiency in navigation both with and without a GPS.

- Trainee will conduct a mock survey where they are the boat driver and the primary observer. A designated trainer will be present to record both size estimates and to assess the trainee's ability to safely navigate at night and complete the responsibilities of a primary observer.

- Once the trainee has successfully completed the above, the project manager will designate the trainee as a primary observer.

The trainees will continue to participate in catches and surveys until the project manager signs off that they possess sufficient skill/experience to be a primary observer/catcher.
It is the responsibility of the trainee for maintaining the log.
Logs are kept on a secured server on the FLREC office in Davie.

Capture Training

Training will be performed by appropriate personnel. Employees that have never participated in a capture event are ***not*** permitted to capture alligators on their first time out. They are to observe the process of safely securing and measuring a captured alligator. On subsequence trips, the trainee will have the opportunity to capture alligators under the supervision of experienced staff. Training will consist of:

- The trainee will observe all activities on their first time out.

- On subsequent trips, the trainee will observe the snaring technique. After observing experienced catchers, the trainee will have the opportunity to capture alligators with snares with the supervision of an experienced catcher.

- Once the trainee has mastered the snaring technique, they will have an opportunity close the mouth with a mouth snare while an experienced person is observing.

- The trainee will continue to have supervision until the trainer feels that they are capable of safely conducting the necessary procedure on their own.

- The trainee will learn how to hand grab an alligator only after they have mastered snaring.

- Snatch hook and tong capturing techniques are not required to be mastered in order for the training to be completed. If specific projects require these techniques, then they will be incorporated into the training program.

Only when the trainer feels that the trainee has the experience to safely handle alligators, will that person be able to be a designated catcher. A log will be kept by the project manager of how many alligators the trainee has captured and what procedures were done.

Captures

Captures are conducted by 2 to 3 people. The boat driver is designated as the captain. The captain of the boat is in charge of all operations. All personnel will listen to the captain. Only one person will be on the deck of the boat to attempt to capture an animal. While the remainder of the capture techniques and training protocol are for both alligators and crocodiles, we will only be referring to alligators.

Snare Capture

- All snares will be tied to the appropriate part of the boat. Ropes will be at least 15 feet in length to ensure that the alligator will not roll into the boat.
- Alligators are to be snared around the neck. Securing the alligator around the neck allows for control of the animal. In the event where an alligator is snared around its body or tail, a second snare should be place around the neck as soon as possible so as not to lose the animal.
- Alligators should not be brought on board until they are tired. As they tire they will begin to roll more and more slowly until they are barely turning over.
- Once the captain has determined the alligator is tired, the captain will secure the mouth with a mouth snare or other securing device.
- Once the mouth is secured by the snare, the captain will grab the mouth for the catcher to secure closed with tape or rubber bands and tape. No alligator is to be brought onto the boat without its mouth secured.
- After the mouth is secured, the alligator can be brought onto the boat to be measured. Weight must be applied to the alligator at all times, to maintain control over the animal while it is onboard and to prevent it from returning to the water.
- Once the measurements have been recorded, the alligator is ready to be released. The release rope will be tied to the boat. The other end of the release rope will be tied to the tape and rubber bands around the mouth. During the tying process, the head will be secured to ensure that the alligator does not pull the tape off before it is in the water.
- The tape and rubber bands can be removed once the alligator is in the water by pulling on the release rope. Care must be taken to ensure that the tape and rubber bands have been removed.
- Snares will be prepared for the next capture prior to leaving the capture site to look for the next animal.

Hand Captures

- Hand captures are only to be performed by experienced personnel.
- The appropriate size for hand capture is less than 1.25m. Never hand capture an alligator that is too big for you to handle.
- Grab the alligator behind the neck. Never grab an alligator on any other part of its body.
- Keep the alligator at arm's length. Never bring an alligator into your body. If you grab an alligator that is too big to handle, let it go. If you need help bringing in an alligator, keep the animal in the water, and ask for help.
- Secure the mouth and place a snare around its neck.
- Conduct necessary measurements.
- Use normal procedures for removing the tape from the mouth.

Snatch Hook Capture

Using the snatch hook to capture alligators can be useful in areas where alligators submerge before the snare can be used.

- Before casting, make sure that your casting area is clear.
- Try to snatch the alligator on its side. Take care to prevent the alligator from going into vegetation.
- Snare the alligator according to procedures and secure the mouth.
- If possible, try to remove the snatch hook before bringing the alligator on the boat.
- If the snatch hook could not be removed safely before bringing the alligator on the boat, note where the snatch hook is and take care not to get caught on it while bringing the alligator on the boat.
- Remove the snatch hook and perform normal procedures.

Tong Captures

- Tongs can be used for capturing hatchlings that are in difficult locations such as up under vegetation.
- To capture hatchlings try to grab them around the body and gently squeeze the handle.
- Care must be taken to prevent excess pressure from crushing the animal.
- Release the handle to let the hatchling go.
- It is very difficult for one person to capture and handle a hatchling due to the tongs length. The hatchling should be carefully placed into a bucket or handed to another person.

Alligator Hole Occupancy Training

- All passengers on helicopter and fixed wing flights must have successfully completed the Interagency B-3 (Combination Helicopter/Airplane Safety) course. If the required training is not completed, unescorted air operation cannot take place.

- To conduct helicopter operations without an escort (to operate as flight manager), permittees must have successfully completed the Interagency B-3 and the Interagency S-271 (Helicopter Air Crewmember Training) courses. Additionally, a project Helicopter Crew Member (HECM) task book will have been completed and signed off by a qualified aviation management HECM when flight books are give to researchers. However, if the S-271 course was taken prior to 12/4/2008, a task book is not required.

- Additionally, qualified observers are trained in accordance with the Alligator Spotlight Survey methodology and must demonstrate proficiency at size estimation prior to conducting aerial surveys.

***Trainees must*:**

- Estimate alligator sizes while participating as the data recorder during alligator spotlight surveys; both trainer and recorder will estimate size for comparison with only the trainer's estimate being retained as the official survey data.

- Participate in alligator capture events and record size estimates as soon as possible when an animal is observed. Comparing the estimate to the actual total length of the animal will allow for analysis of the trainees' estimate accuracy. Estimates must be >85% correct in the aggregate size class (see capture protocol for size class info).

- Make estimates throughout a season (spring or fall), estimate a minimum of 30 alligators, and be >85% correct in the aggregate class size from the primary observer's classification.

- Continue to participate in catches and surveys until possessing sufficient skill/experience to be a primary observer.

Volunteers

Volunteers are permitted to attend survey and capture events after filling out the proper University of Florida, USGS, and FWS volunteer forms. Volunteers may participate in recording and measuring data on alligator surveys and capture events, but are ***not*** permitted to capture alligators.

Working Conditions

A person will not be allowed to work when they:

- Are using medication that will impair their ability function normally.
- Do not show the proper maturity.
- Sick enough to impair judgment.
- Under a controlled substance.
- Shows unsafe actions.
- Does not follow directions.

Alligator Capture and Data Management Protocols

Alligator body condition is one of the monitoring elements (3.1.3.15) of the 2004 RECOVER Monitoring and Assessment Plan. This protocol describes the methodology used to capture alligators to track body condition and was developed as a training guide for project personnel. This document needs to be read through its entirety to understand the alligator capture and data management procedures. This protocol was updated in September 2010 to reflect current methods.

Capture Areas

- Captures are conducted in areas corresponding to spotlight survey routes which have been established based on hydrological characteristics, accessibility, and orientation in and around habitats. Currently there are 12 capture areas (Figure 1); others may be added if they are determined to be beneficial/necessary.

Conducting Captures

- Only qualified personnel will be boat captains and catchers. Trainees and observers may assist. See Training Protocol.

Capture Timing

- Captures will be conducted once in the spring (dry season) and will not be conducted in marshes where water levels are equal to or less than 15.25 cm (6"). This period is selected to coincide with spotlight surveys. The first surveys will be conducted before April 1st. May 15 will be the last day to complete captures in order to prevent observing changes contributable to the onset of breeding behavior. In the event of dry conditions where areas are inaccessible during the April 1 to May 15 dry season capture event, capture events may begin earlier or later.

- Captures will be conducted once in the fall (wet season) again corresponding to spotlight surveys. Captures will begin in mid-September and will be completed no later than November 31st.

Captures

- Captures will be conducted by a 2 or 3 person crew. One person will be designated the lead and have final say in all capture procedures (see Capturing and Handling section of Training Protocol).

- A 200,000 candlepower spotlight will be used by the driver to find the animals.

- Once an animal has been spotted those personnel who are primary observers on spotlight surveys or training to be primary observers on spotlight surveys will make an estimate of the length of the alligator. If the animal is successfully captured these estimates are recorded and verification of estimates will be used as training for spotlight surveys.

- Once an animal is captured data are recorded on a separate data sheet (see next three pages).

ALLIGATOR CAPTURE DATA SHEET

Crew

Web Tag#	**Recapture/Tag #**	**Scute Clip #**	**Area**
FWC		(N/A for most)	Canal / Marsh

GPS LOCATION (Map Datum WGS 84)

Capture Date	**Capture Time**	**UTM Easting**	**UTM Northing**

Temperature	**Habitat Type**	**Water Depth**	**Total Depth**
Air _____ **°C** **Water** _____ **°C**		**cm**	**cm**

Head Length	**SV Length**	**Check box**	**Total Length**
cm	**cm**	Dorsal / Ventral	**cm**

Tail Girth	**Weight**	**Sex**	**Capture Method**
cm		**Male Female**	**Snare Hand Tong Hook**

Notes and Deformities	**Condition**
Salinity **(only for ENP-EST)**	**Skinny Fat** **Normal**

Name				
Size Estimate				

Description of Measures and Coding

Crew -- First initial and surname of boat crew (K. Rice, M. Cherkiss).

Recapture/Tag # -- Has this alligator been previously captured and if so what is the tag type and number?

Web Tag # -- Number engraved on toe tag (e.g. GFC 37201). If other than GFC please note. Webtag is to be placed on right hind leg, between the second and third digit.

Scute Clip # -- Animal number derived from scute clipping (used only on LOX).

Area -- Geographical location and determination of marsh/canal (circle or the other) – Everglades Nat Park – Shark Slough (**ENP-SS**), Frog City (**ENP-FC**) Estuarine (**ENP-EST**); Loxahatchee NWR (**LOX**); Water Conservation Area 2A (**WCA2A**), Water Conservation Area 3A North (**WCA3ATower),** Central (Holiday Park-**WCA3AHD)** and South (**WCA3A-N41)**; Water Conservation Area 3B (**WCA3B**); Big Cypress National Preserve (**BICY**).

Capture Date -- Date in 1 Oct 99 format.

Capture Time – All times are in 24 hr (military) format (0215, 1622).

GPS Location -- UTM coordinates of capture site (Easting 0548515, Northing 2891857) . Please check that GPS is set to display in Universal Transverse Mercator with a map datum of WGS 84

Water Temp / Air Temp -- In-situ air and water temp. (~ 6" below surface) recorded in degrees Celsius only.

Habitat Type -- Specific habitat type:

Open water = 1	Mangrove = 10
Airboat trail = 2	Other Dominant Vegetation = 12
Canal = 3	(describe in notes)
Sawgrass = 6	No Emergents = 13
Cattail Marsh = 7	(includes gator holes and submerged/water level vegetation)
Levee Break = 9	Mixed Emergents = 14
	River = 15

Water Depth -- Water depth at capture site in cm. Measured from the water surface to top of substrate. This measurement is not taken in open water, canals, rivers or levee breaks.

Total Depth -- Measure from surface of water to bedrock in cm. If the total depth is greater than the length of device measuring the depth (ie. >183cm) then write 888. This measurement is not taken in open water, canals, rivers or levee breaks.

Muck Depth – This measurement is not taken, but can be calculated by subtracting the water depth from the total depth.

Cap Method -- Capture Method (Snare, Hand, Tongs, Snatch Hook), circle appropriate selection.

Measurements: all measurements must be in centimeters; animal should be as straight and flat as possible.

- **-HL:** (head length) measured dorsally from tip of snout to center of V at posterior end of skull plates.
- **-SVL: (**snout-vent length) measured from tip of snout to immediately posterior of vent. Check box for ventral or dorsal measurement.
- **-TL:** (total length) measured from tip of snout to end of tail.
- **-TG:** (tail girth) measure tail circumference at break in scale row immediately posterior of vent. (Third scute row posterior of rear legs).
- **-WT:** (weight) mass of animal recorded in grams or kilograms.
- **-Sex:** sex of animal recorded as male or female (circle appropriate selection).

Salinity – Recorded in ppt using a refractometer. The measurement is only to be taken in brackish waters such as ENP-EST.

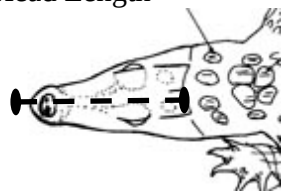
Notes and Deformities – Note any additional relevant information about the animal or capture area (e.g.- found 1 dead 6' gator, animal appeared in poor physical condition). Note any physical deformities or prominent scars (missing LR foot). Upon first observation circle skinny, fat, or normal. If there are no notes or deformities write **None**.

Size Estimates -- Write the size estimate and the name of the person who makes the estimate. The estimate should be made as soon as possible and the number written should be the lower limit of the size class.

General Condition -- To be determined at capture, circle one description that is most appropriate.

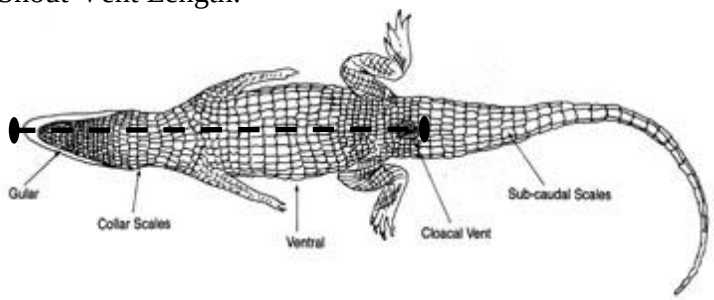
GENERAL PICTORIAL MORPHOMETRIC MEASUREMENT INSTRUCTIONS

Head Length-



Measure dorsally from tip of snout to center of posterior end of skull. Dashed line indicates measurement.
*

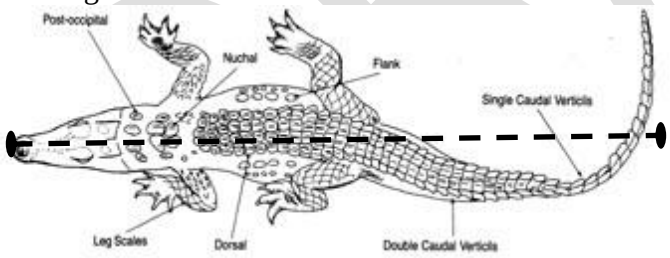
Snout-Vent Length:



Measure ventrally from tip of snout to back of vent or dorsally to the back of the second tail scute row. The zero tail scute is the last short tail scute—the last one from the body that doesn't wrap all the way around the tail.

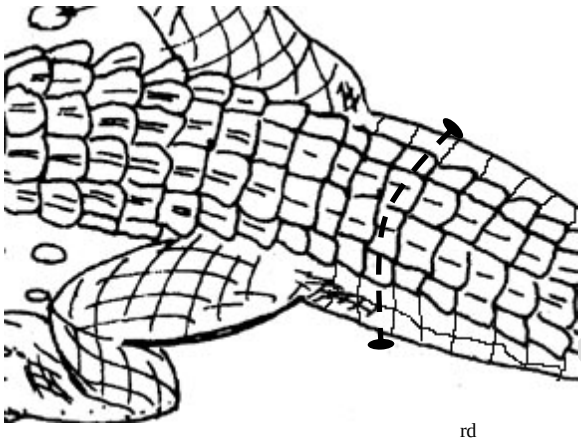
Detail of vent for snout-vent length:
* Modified from King and Brazaitis (1971). 41 42

Total Length:



Measure straight distance dorsally or ventrally from tip of snout to tip of tail. Note if tip of tail is missing. Make sure gator and tail are in a straight line, not like this one.

Tail Girth:



Measure the circumference of tail at 3rd scute row posterior to rear legs.

Data Management

- Immediately upon returning to the lab a copy of the datasheets are made.
- Data are entered by each observer into the alligator capture un-proofed Access file following the procedure outlined below in the Data Entry section.

Data Entry

- Data is to be entered onto a **copy** of the current master database.
- Only after the data have been proofed and all changes have been accepted by the project manager, the database will be converted into the new master database.
- Use the form labeled ASN_Captures in the alligator master database
- To enter a new entry, press the arrow facing to the right with a star next to it at the bottom of the form. This will bring up a blank form to be filled out.
- Any entries that require numerical responses that are not used (i.e. data we do not collect anymore such as chest girth or data not collected on that occasion) will receive a 999.
- Any entries that require text that are not used or filled in will use ND (no data).
- Data will be entered as follows
    - Autonumber- does not require action. The database will fill it in automatically

- TimeStamp- does not require action.
- Capture Date- Date of capture from datasheet- enter as mm/dd/yyyy
- Capture Time- Time of capture from the datasheet- enter in 24hr format hh:mm
- Area- Broad area description of where the alligator was captured. Select from a drop down list:
    - BICY- Big Cypress National Preserve
    - ENP- Everglades National Park (includes areas ENP-SS, ENP-FC, and ENP-EST)
    - LOX- Loxahatchee National Wildlife Refuge (includes areas LOX, LOX L-40)
    - WCA2- Water Conservation Area 2 (includes WCA2A)
    - WCA3AN- Water Conservation Area 3A North (includes WCA3A-TW)
    - WCA3AS- Water Conservation Area 3A South (includes WCA3A-HD and WCA3A-N41)
    - WCA3B- Water Conservation Area 3B
- SubArea- Local area description of where the alligator was captured. Select from a drop down list:
    - BICY- Big Cypress National Preserve
    - ENP-SS- Everglades National Park Shark Slough
    - ENP-FC- Everglades National Park Frog City
    - ENP-EST- Everglades National Park Estuary
    - LOX- Loxahatchee National Wildlife Refuge
    - LOX L-40- Loxahatchee National Wildlife Refuge L-40 Canal
    - WCA2A- Water Conservation Area 2A
    - WCA3A-HD- Water Conservation Area 3A Holiday Park
    - WCA3A-N41- Water Conservation Area 3A North of State Road 41
    - WCA3A-TW- Water Conservation Area 3A Tower Camp
    - WCA3B- Water Conservation Area 3B
- Marsh/Canal/River- Location of capture, use drop down list to select marsh, canal, or river.

- Web Tag#- Numerical field for a unique number on a monel tag that is applied to the alligator.
- Tag Type- Prefix to the webtag number. Select from drop down list. All of our tags come through the Florida Fish and Wildlife Conservation Commission. There are older tags in Everglades National Park that do not have prefixes.
    - FWC- Fish and Wildlife Commission
    - GFC- Game and Fish Commission
    - Fla Game and Fish- Florida Game and Fish
    - FGFC – Fla Game and Fish Commision
    - Other- It is a webtag, but does not have a prefix
- Recapture- Check box if there is a yes and a webtag or scute clip number in the recapture box
- Recapture Tag- This is used for recaptures only. It is the webtag or scute clip number that is written in the Recapture Box. Be sure to include tag type prefix if available in the notes.
- Tail Scute Clip- Numerical field for a unique number given to an alligator based on the cuts of scutes on the alligators tail (LOX animals). If animal is a recapture, then enter scute clip number in the recapture box as well.
- Area Scute Clip- Numerical field for a unique cut of the scutes based on the area (no longer used enter 999)
- Crew- Text field for the names of people on the capture event (full name)
- UTM_Easting- Numerical field for UTM Easting from the alligators location in WGS 1984 datum
- UTM_Northing- Numerical field for UTM Northing from the alligators location in WGS 1984 datum
- Air Temp- Numerical field for air temperature in degrees Celsius where the alligator was captured
- Water Temp- Numerical field for water temperature in degrees Celsius where the alligator was captured.
- Location and Habitat- Text field used to describe the general area and habitat where the alligator was captured (no longer used, ND should be typed in)
- Habitat Type- Drop down list of habitats. Habitat codes are recorded on the datasheet, refer to the back of data sheet for appropriate definition

        - Open Water = 1
        - Airboat Trail = 2
        - Canal = 3
        - Sawgrass = 6
        - Cattail Marsh = 7
        - Levee Break = 9
        - Mangrove = 10
        - Other dominate vegetation = 12
        - No emergent = 13
        - Mixed emergents = 14
        - River = 15
    - Water Depth- Numerical field for water depth measured at alligator capture location in centimeters.
    - Muck Depth- Numerical field for muck depth in centimeters. This number is obtained by subtracting Total Depth from Water Depth.
    - Total Depth- Numerical field for water and muck depth measured at alligator capture location in centimeters. If the total depth is greater than the pole used for measurement, enter 888 for muck and total depth, then in the notes section write that the total depth is greater than whatever the poles length is (i.e. Total depth > 183cm.)
    - Capture Method- Drop down list for the way the alligator was captured
        - Snare
        - Dart
        - Hand
        - Snatch Hook
        - Other
    - Capture Status- Text field used to describe the actions of the alligator upon capture (no longer used, enter ND)
    - Head Length- Numerical field for the head length measurement in centimeters
    - SV Length- Numerical field for the snout to vent length measurement in centimeters

- SVL Measured- Drop down list for the way snout to vent was measured. Dorsal or Ventral
- Total Length- Numerical field for the total length measurement in centimeters
- Hind Foot Length- Numerical field for the right hind foot measurement in centimeters (no longer used, enter 999)
- Tail Girth- Numerical field for the tail girth measurement in centimeters
- Neck Girth- Numerical field for the neck girth measurement in centimeters (no longer used, enter 999)
- Chest Girth- Numerical field for the chest girth measurement in centimeters (no longer used, enter 999)
- Weight- Numerical field for the weight measurement in kilograms
- Sex- Drop down list for the sex of the alligator
    - M- Male
    - F-Female
    - J-Juvenile too small to sex
    - H- Hatchling
    - U- Unknown (if written on datasheet)
    - ND- No data (enter this if it was left blank on the data sheet)
- Deformities- Text field for any observed deformities in the notes (if left blank enter ND)
- Release status- Text field for the status of the alligator after release (not used anymore, enter ND)
- General Condition- Drop down list that describes the overall general condition of the alligator
    - Skinny
    - Normal
    - Fat
- Notes- Text field for any general notes about the capture of the alligator. Separate statements with (;) do not hit the enter key. (if left blank enter ND)
- Salinity- Numerical field for salinity in ppt recorded at the alligator location. Generally used in ENP-EST subarea (enter ND in all other locations)

- SVLVentralF- Numerical field for snout to vent length measured to the front of the cloaca in centimeters (not used anymore, enter 999)
- SVLVentralB- Numerical field for snout to vent length measured to the back of the cloaca in centimeters (not used anymore, enter 999)
- Observer 1- Text field for the name of the observer who made the size estimate (in the format…….Use the same format for Observer 2, Observer 3, and Observer 4). (These can be left blank if not filled in)
- Size Estimate 1- Numerical field for the size estimate in meters of Observer 1 (use same format for Size Estimate 2, Size Estimate 3, and Size Estimate 4). (These can be left blank if not filled in)

QA/QC

- After data has been entered, the data must be proofed by another individual other than the person that entered the data.
- The data are printed out and the information from the data sheets is compared to the printout.
- Any errors are noted on the printed data and corrections made to the un-proofed Access file by the technician in charge of the database.
- Once the data have been proofed and all corrections made the data are added to the master database.
- A copy of the master database will be saved on to the server after every catch season.

Alligator Spotlight Survey Field and Data Management Protocols

Alligator relative abundance is one of the monitoring elements (3.1.3.15) of the 2004 RECOVER Monitoring and Assessment Plan. This protocol describes the methodology used to conduct surveys to track abundance and was developed as a training guide for project personnel. This document needs to be read through its entirety to understand the alligator spotlight survey and data management procedures. This protocol was updated in September 2010 to reflect current methods. All data collected needs to be turned in to the project manager within two weeks of completion.

Alligator Spotlight Survey

Survey Routes

- Survey routes have been established based on hydrological characteristics, accessibility, and orientation in and around habitats based on previous surveys and in consultation with the Florida Fish and Wildlife Conservation Commission. Routes are currently located in 9 marsh, 1 estuary and 8 canal areas (Figure 2). Subsequent routes may be added if they are determined to be beneficial/necessary. Marsh and estuary routes are used for the performance measure.

- Marsh surveys routes consist of two 10 km transects plus 1 km between transects except in Water Conservation Area 3A-Tower where spring water conditions confine transects to one 6.75km and one 7 km transect.

- Canal routes consist of one 10 km transect except in A.R.M. Loxahatchee National Wildlife Refuge where two transects are surveyed and in Everglades National Park L-67 where the canal survey was shortened to 8.75 km when the canal was back filled.

Conducting Surveys

- Only qualified observers will be used as the primary observer for all surveys (see Training Protocol).

- Four surveys a year are conducted in marshes and estuaries to allow for detection of trends over a five year period.

- Surveys will be conducted twice in the spring (dry season) and will not be conducted in marshes where water levels are less than or equal to 15.25 cm (6 inches). This period is selected to record maximum concentrations of alligators. The first surveys will be conducted before April 1st or at such time as to allow the second surveys to be completed before water levels drop below the 15.25 cm (6 inch) minimum. Surveys will be completed by May 15 in order to prevent observing changes contributable to the onset of breeding behavior. If surveys cannot be completed before May 15th because of low water

levels, surveys will be conducted when water levels return to the minimum depth requirement.

- Surveys will be conducted twice in the fall (wet season) in marsh and will help to assess pods and provide an index of reproduction. Surveys will begin in mid-September and the second round will be completed no later than October 31st. Canal surveys will only be conducted in the spring.

- Surveys will be conducted at least 14 days apart and no more than 30 days apart in order to insure independence of counts.

- Surveys will be conducted by skiff or airboat at a speed that allows the craft to be on minimum plane (minimum speed which is required to keep the vessel on plane). Due the differences in hull design, propellers, engines, and vegetative communities, there is no established speed but it is generally approximately (32-48 kmph) (20-30 mph).

- Crews must be at the survey start point prior to sunset or wait 30 minutes before beginning survey. Paired canal/marsh surveys for each area must be consistently done in the same order during the survey period and from year to year. Order is not important between geographical study areas.

Environmental Constraints

- Surveys will not be conducted during a full moon (a full moon is defined as one day before, the day of, and the night after the full moon), heavy rain, wind greater than 15 mph, (21kmph) or begun while in-situ water temperature is below 18 degrees Celsius.

Animal Observations

- A 200,000 candlepower spotlight will be used by the driver/primary observer. Once animals have been spotted, headlamps may be used to reestablish close proximity eyeshines or to count hatchlings.

- Only animals observed by the primary observer will be recorded.

- Only animals within 50 m of the designated route will be recorded. Every effort should be made to return to the survey route at the same point and by the same path after deviating from course to approach an eyeshine. Animals observed within 50 m of the primary route will be recorded even when observed while going to and from an eyeshine.

- Tracks and waypoints of the route will be recorded using map datum WGS 84.

Data to be recorded during surveys

Data will be recorded in a personal data assistant (PDA) set up with the appropriate forms (see below) or in a waterproof field book.

Survey Data

Data recorded at beginning of survey:

Route Name
Date (mm/dd/yyyy)
Boat Driver
Data Recorder
GPS User
Wind (mph) - wind speed is taken using Kestrel 2000 averaged over 1 minute
Cloud Cover (%) - estimated to the nearest 5%
Visible Moon (¼, ½, ¾, none {covered by clouds})
Boat Name
Start Time

Data recorded at end of survey:

End Time
Survey Comments
General Observations

- When a volunteer is used for the Data Recorder or GPS User it should always be entered/written as "volunteer" with the name written out in the notes.

Data recorded at both the start and end of the survey:

Air temperature (C°)
Water (C°)
Salinity (ppt)
Marsh water depth (cm)
Total depth to bedrock (cm)
Muck depth (cm) {Total depth to bedrock – marsh water depth = muck depth}
Comments

- Environmental data are taken at the start and end of route and indicated as such
- If other than start or end of each route take a GPS waypoint (numerical only) and record waypoint number with associated environmental data
- Total depth to bedrock is taken by inserting a pole through the muck until it hits the bedrock. Mark the spot with your finger and measure the distance.
  *For any field where data is not recorded because it cannot be measured (ex: water depth in a canal or muck depth in the marsh) "ND should be entered if that field requires text. If the field requires a numeric response then "999" should be entered.

Data when an alligator is observed

Waypoint for each alligator(s)
Size code: see codes
Identical individuals (number of individuals of that size code for that waypoint)
Habitat code: see codes
Vegetation Density: see categories
Vegetation Height (only if vegetation density is listed as Dense): Short or Tall
Comments

- Waypoints that correspond to UTM's for the location of each individual animal will be recorded (WGS 84) for each observed animal. Animals within 10 m of each other do not require separate waypoints. Habitat type will be recorded for each animal

- Size estimates will be in 0.25 m increments with the estimate indicating the lower bound of the size class. Size class estimates which cannot be accurately made should be classified as follows:
  - 9 = Hatchlings = < 0.5 m
  - 10 = Small = < 1.25 m
  - 11 = Medium = ≥ 1.25 - < 1.75m
  - 12 = Large = ≥ 1.75m
  - 13 = Unknown* = (U) No size estimate could be made using the available information

  *Every effort should be made to place an animal into one of the more descript size classes. Only use Unknown if no inference to the size class can be made.

- The habitat type recorded is the dominant habitat in the immediate proximity of the observed eyeshine.

- Habitat type/dominant vegetation should be noted for each observed animal and placed into the most appropriate category from the following:

  1 = Open Water/River
  2 = Airboat Trail
  3 = Canal
  6 = Sawgrass
  7 = Cattail
  9 = Levee Break
  10= Mangrove
  12 = Other Dominant Vegetation
  13 = No Emergents (includes alligator holes and submerged/water level vegetation)
  14 = Mixed Emergents

- Vegetation category: subdivided to describe the percent cover Sparse (<26%), Medium (26-75%), and Dense (>75%). If percent cover is dense, describe the height of vegetation as Tall (greater than shoulder height of the observer), or Short (less than shoulder height of the observer).

- For any field where data is not recorded because it cannot be measured (ex: water depth in a canal or muck depth in the marsh) "ND should be entered if that field requires text. If the field requires a numeric response then "999" should be entered.

Data Management

Data can be recorded in a PDA or field book. PDA is the preferred method of data entry, but in cases where volunteers are used, field books can be used. If a field book is used, data will be entered into the PDA after the survey.

Use of Palm in Alligator Surveys

Print this document and bring it with you into the field.

There are four main concepts to keep in mind while using the palm for data collection. These are the relationships between forms, subforms, records and fields. The most basic unit of data is called a field, such as "Air Temp" or "Size Class." A group of fields make up a record. Thinking of a spreadsheet a field would be an individual cell and a record would be an entire row. Forms are the main access to data input. For our uses, the main form is titled "Alligator Survey Data." From the main form you can enter data as well as access subforms. Essentially a subform is a form to enter data in a way that it is automatically associated, and therefore linked, to the data in the main form. In our setup, the subforms are named "AS Single Alligators," "AS Multiple Alligators," "AS Environmentals," and "AS Staff Gauges."

Collecting Data

1. Turn the palm on and access Pendragon Forms from the Program list. If Pendragon Forms is not displayed, tap the "home" button on the palm to scroll through the program groupings until it is.
2. When Pendragon Forms is selected, the screen should display "Pendragon Forms" at the top, and a box with a list of forms below. This is the main Pendragon page. If opening the program does not immediately display the main page, this means that the last time Pendragon was closed a record was not completed (discussed in troubleshooting below).
3. From the list of forms in the main page you should see the 5 forms listed above. You will notice that the icon to the left of "Alligator Survey Data" is different from the other 4 forms. This is because the other forms are displayed as subforms, meaning that they can only be entered through another form. If the subform were entered directly from the forms list, we would end up with data about alligators with no data to link them to a survey. The subforms are shown only to review and/or delete individual records that were created from the main form.
4. Select the form "Alligator Survey Data" and click the "New" button at the bottom of the screen. This will create a new record in the "Alligator Survey Data" form.
5. Go through the form page by page, entering data using the lookup menus or number keypads where required.

6. Immediately after the "Start Time" field in the main form, you will come to a field labeled "Alligators and Environmentals." This is where you access the subforms and are able to link data collected about individual alligators to which survey they were a part of (Pendragon does this automatically, so don't worry). Clicking the "Select One" button on this field will display a list of the 4 subforms available.
7. All four subforms operate in the same way. Clicking one subform will automatically jump to a list of records created in that subform. At the top of the screen will be the name of the route you are on, below which is a ¬ symbol and the name of the subform you are in. The bulk of the screen is a list of the records already created in that subform (if you haven't created any records yet the box will be blank).
8. Clicking the "Add" button at the bottom of the screen will create a record in the subform. Fill in the data fields in the subform in the same way as in the main form. When a record is completed you will return to the list of records, with the record you just created now visible. (Note: The form for entering alligators is set to repeat itself without returning to the record list. When you are finished entering alligators, push the end button at the bottom of the page. You will see a message asking if you want to delete the current record. Click "Yes" and you will be returned to the list of records.
9. Specifically for "Single Alligator" and "Multiple Alligator" subforms, the last field is the comments field. It will already be filled in with the words "trainee estimate". There is a look up list that must be tapped to access. Choose a trainee name. Then tap the "123" icon on the palm and enter in the length of the alligator estimated by the trainee. If there are other comments use the "abc" icon to write in comments.
10. If you wish to create another record in the same subform, click "add" again and the process will repeat itself. When you are done entering records in that subform, click "Done" and you will return to the list of subforms.
11. You can now access another subform, or move to the next field on the main form to complete the record (the fields for end time, moon phase, etc.)
12. If any of the data recorders, GPS users or boat driver are volunteers "Volunteer (Named in notes) should be recorded in the appropriate field and then in the "Survey Comments" field, the person's name should be written.

Example- Data Collection

You're collecting data on alligators and need to put in environmentals. You first close the alligator subform you are working in by clicking done on the record that Pendragon attempted to create for your next alligator. A message opens asking if you'd like to delete the current record. You select "Yes." You now see the record list for the "AS Single Alligator" subform. Since you don't want to put in more alligators, click "Done." You're returned to the main form at the "Alligators and Environmentals" field from which you had originally entered the alligator subform. You click on "AS Environmentals" and you are redirected to the record list for that subform. You click the "Add" button and the environmental subform opens. You fill in the required environmental data and, after the last data field, are returned to the record list. You're now done with the survey, so you click "Done" and are returned to the main form at the "Alligators and Environmentals" field again. You page through the rest of the form, filling in data for Moon Phase, End Time, etc. When you've finished the form, you're returned to the

opening screen of Pendragon. You back up the palm, and then select the "Alligator Survey Data" form to begin collecting data on your second route.

Reviewing/Deleting Data

Records in all forms can be reviewed or deleted from the Pendragon opening page, the list of forms and subforms. Simply highlight the form which contains the record you wish to work with, and click either the "Review" or "Delete" button at the bottom of the screen. Each record is shown by its display key, or in other words, the field in that record that most uniquely identifies the record. For example, in the Survey Data form, the Route name is the display key, and if you were looking to review the record from a certain route you would select the record with that route listed. This may be a little tricky with the individual alligators. The display key for individual alligators is the waypoint number, and since multiple alligators can have the same waypoint, it's possible to have several records with the same display key. For deleting a specific alligator record your best bet is to first review the record, change the waypoint number to something unique, such as 999, and then delete the now easily recognizable record.

Keep in mind also that if you want to add records to a subform, you cannot do this directly from the main forms list. This is because if you were to create a record it would not be linked to any survey information. You must instead re-enter the main record and access the subform in order to create meaningful data.

Example- Reviewing

You just finished your survey and closed your main record, then realized that you forgot to take environmental data at the end of the survey. You're on the list of forms and subforms, and when you try to access the "AS Environmentals" form you get a message saying "You cannot directly create new subform records." Instead, you highlight the "Alligator Survey Data" form and click review. You see a list of the two routes you just finished surveying, and you select the one for the canal route. You're taken to fields that are already filled in, but you page through until you get to the "Alligators and Environmentals" field. From here you select "AS Environmentals" and see the list of environmental records already taken, noting the lack of a record titled "End." You click "Add" and create the final environmental record, click "Done" after you're taken back to the record list, and click "Done" again in the main form and are returned to the forms list.

Troubleshooting

The most common cause of confusion will most likely be looking down at the palm and not knowing what to do next. This could occur if an untrained volunteer hands you the palm after getting overwhelmed, or if you start Pendragon and are do not immediately see the opening page. The only solution is to know where you are in the process of data entry. Once you have an understanding of the way different screens and forms look this should not be a problem.

The three main screens you will see will be the Pendragon opening screen, the subform records screen, and the individual fields of data within the forms and subform. Each one is easily recognizable and from each you should be able to tell exactly what you need to do.

From the opening screen in Pendragon you can begin a record in the main form (Alligator Survey Data) or review/delete records in any of the forms or subforms. When you're at the opening screen it usually means that you've either just started or have completed any records you were working on.

From the screen asking for direct data input, your main task is to figure out what form or subform you are currently in. Familiarity with the forms is the only way to accomplish this. However, it should be fairly self explanatory that when the palm is asking for observer names, you are in the main survey data form, and when it is asking for water temperatures, you are in the environmentals subform. If you have no idea where you are, page backwards through the record using the arrow keys until you see a field that is obviously associated with a particular form. Also, if you aren't sure the record was completed; page forward to make sure all the data fields are filled in for that record. When you exit the record, you will end up either at the subform records list or at the Pendragon opening page, depending on which form you were in.

From the subform record list, you will be able to add a new subform record or return to the list of subforms in the main form. Either click the "Add" or "Done" button.

Example- You're lost

You just stuck the backup card into the palm and backed up the data. Putting the backup card in turns off Pendragon, and when you run Pendragon again you don't see the familiar opening screen with the list of forms. Instead you're on a field asking you for a waypoint number. You page forward and find yourself at the "Size Class" field. A light bulb goes off and you realize that you're in one of the individual alligator subforms. Whenever you exit Pendragon, it returns you to wherever you were when you left. In this case, you were entering alligators; Pendragon began a record for your next alligator, and then was shut off to open the backup program. You now have started a record that you don't need (just like every other time when you finish entering alligators) and so you click "End," and when prompted you delete the current record. You're returned to the familiar subform record list; you click "Done" and are returned to the "Alligators and Environmentals" field in the main form. You complete the "Alligator Survey Data" record and are returned to the Pendragon opening page.

Note- Some confusion may also arise while scrolling backwards through a record. This is because there are scripts written to skip certain unnecessary fields. These scripts do not skip the fields when the record is scrolled through in the opposite direction, and so the fields are shown when they shouldn't be. For example, there is a field for "Number of Hatchlings in Pod" that is skipped when the size class is "Hatchling." If you were to put in a size class of 2.0, move forward to the habitat type, and then decide to change the size class to 2.25, scrolling backwards would display the "Number of Hatchlings in Pod" field. There are several other occasions where something like this may occur, and the best solution is just to continue scrolling backwards until you reach the field you were looking for, ignoring the others. When you scroll forward again, the scripts will run as planned and the superfluous fields will be skipped.

Transferring Data to Master Database

1. All users should have the following available in the office
    a. Pendragon Forms 5.1 with the Alligator Survey forms and lookup lists installed
    b. HotSync/Recharging cradle for each Palm in use
    c. Replica of the Microsoft Access database "Alligator Surveys"
        i. IMPORTANT NOTE- Due to the linkage between Pendragon Forms and Microsoft Access, you cannot move or rename the replica of the "Alligator Surveys" database. Doing so will prevent Pendragon from knowing where to "point" to send the data. If the file absolutely must be moved or renamed, we can work around this, but it is much more of a hassle than it is worth.
2. All users should have the following when heading into the field:
    a. Palm OS PDA with a backup card slot
    b. Otter Box Protective case or other waterproof case
    c. Secure File PDA backup card
3. Data will be collected in the field using the Pendragon forms on the PDA or in a field book and then transferred to the PDA.
4. The Secure File PDA backup card should be used to backup data in the field after each survey. The backup card should be kept in a dry place other than the inside of the Otter Box protective case, and brought out only when needed. If a palm is corrupted or destroyed in the field, the backup card can be used to restore any data that had been saved.
5. As soon after returning from the field as possible, the project manager should perform a HotSync of the PDA using the cradle connected to their desktop
    a. If no error message appears, the Hotsync was successful and nothing further needs be done. You can open your replica of the Access database and see that live data has been updated.
    b. If an error message appears (a box will open displaying "HotSync generated one or more messages") DON'T PANIC.
        i. All data that has successfully been downloaded from the Palm has also been removed from the Palm. Therefore, on your Palm you can re-open Pendragon Forms, hit review, and know that any records that still exist on the Palm have some problem that must be corrected.
        ii. The most common form of error we will encounter is primary key violations, meaning that data which is needed in a parent table does not exist, or, that data in a record does not match the data in the parent table.
        iii. If it is found that the size class was entered incorrectly and is the reason for the primary key violation (i.e. a size class was entered that is not one of our selected size classes), the size class of that record should be changed to Unknown).
    c. If the error message cannot be understood, or the cause of the message can not be diagnosed, save the text of the error log (viewed by opening the HotSync manager from the toolbar). Do not HotSync again. Call the project manager (Brian at (954) 577-6384) as soon as possible to diagnose and fix the problem.
6. After HotSync of all data is complete, live data is updated in the replica of the Access Database. Open the database to see that new records have been created.

7. Waypoint Data must be downloaded from the GPS on Garmin's Mapsource software. It must then be imported into the "Waypoints" table in the Database.
    a. If you wish to import the data yourself follow the guidelines in "Procedures for Importing Waypoint Data into Alligator Surveys Database".
    b. If you do not understand the process described above, save your waypoints as a Mapsource file and email to the project manager (Brian bjeffe01@ufl.edu) for manipulation.
8. Data Security- Data is stored on the IFAS-sharedrive which is backed up regularly. In addition, a copy is kept on the project managers C:Drive and a hard copy is made after all data is entered.

Importing Waypoint Data into Alligator Surveys Database Procedures

Downloading and Saving in Mapsource

1. Download waypoint data from GPS using Mapsource.
2. Make sure your Mapsource preferences are set to UTM and WGS84 by selecting *Edit/Preferences/Position* for "Grid" select UTM, for "Datum" select WGS84
3. Look at the tabs *Tracks* and *Routes.* If there are any tracks or routes, delete these from the Mapsource file.
4. Save file as a Text (Tab Delimited) file by selecting *File/Save as*. Make sure to remember the name and location of your export.
    a. File naming convention
        i. Route Name mm-dd-yy
        ii. Ex: WCA3B 09-24-05

Copy Data in Excel Spreadsheet

1. Open Microsoft Excel.
2. Open the text file in Excel by selecting *File/Open.* You will not see the file list until under "Files of Type" you select *Text files.* Then double click on the file name to open it.
3. A wizard will open. Select "Delimited" and click "Next."
4. Select "Space" as the delimiter and make sure that "Treat Consecutive Delimiters as One" is not selected.
5. Click Finish. You should now have a typical Excel file with your waypoint data. Depending on the GPS unit the file may have different formats. You do not need all of this data, only the waypoint number and the easting and northing positions. The waypoint number should be in the second column and the easting and northing in the 9^{th} and 10^{th} columns respectively. If this does not seem correct, the easting will the number right after the two columns of "17" and "R". The northing then will be the column to the right of the easting.
6. Open the Excel file named "Waypoints Import." This is saved in a folder called Ímporting Waypoints". Do a "Save As" and give this file another name. Use the same naming convention as with the Text (Tab Delimited) file. This will prevent you from overwriting the blank "Waypoints Import" file.

7. Highlight the waypoint data in your original file. Copy this data and paste it into the Waypoint Import file, starting in the first cell in the column named "Waypoint Number" (see Table 1 for example).
8. Fill in the date that the survey data was taken, and copy it down the column until all the rows with waypoint data also have a date. If your file included more than one night's worth of waypoints, be sure to change the date at the appropriate waypoint number. Do not rely on the date from the Mapsource file since that is the date the GPS maybe not be correct.
9. Select the workbook "BOAT DRIVER NAME" and copy and paste the name of the Boat Driver from the survey into the column "Boat Driver." Copy it down the column until all rows with waypoint data also have a Boat Driver. PLEASE COPY AND PASTE A NAME RATHER THAN WRITING ONE IN. ACCESS WILL NOT RECOGNIZE THE NAME IF IT IS OFF BY EVEN ONE CHARACTER.
10. The next two columns are "UTM_Easting" and "UTM_Northing" cut and paste the easting and northings from the text file you obtained from Mapsource. Be careful that the proper waypoints and coordinates match up.
11. Save the File. Again be sure you are not overwriting "Waypoint Import."
12. Transect information is filled out by the surveyor by examining the waypoints on Mapsource with the start/end points of each transect.

Table 1. Example of waypoint file to be imported in the access database.

Date	Boat Driver	Waypoint Number	Transect	UTM_Easting	UTM_Northing
12/12/2012	J.Smith	325	1	556724	2901797
12/12/2012	J.Smith	326	2	557819	2901991
12/12/2012	J.Smith	327	2	560245	2902702
12/12/2012	J.Smith	328	0	560694	2902668

Importing Data into Access Database

1. Open your replica of the Alligator Surveys database.
2. Select *File/Get External Data/Import*… and point to your saved Excel file (you'll need to change "files of type" to "Microsoft Excel".
3. A wizard will open. Page one, select "Show Worksheets" and make sure the worksheet "Waypoint Info" is highlighted.
4. Second page, make sure "First Row Contains Column Headings" is selected.
5. Third page, select "In an existing table" and highlight the table "Waypoints" from the dropdown list.
6. Press Finish, and you're done. You should then open the Access "Waypoints" table and make sure the information was transferred correctly.

Alligator Hole Occupancy Survey and Data Management Protocol

Alligator hole occupancy is one of the monitoring elements (3.1.3.15) of the 2004 RECOVER Monitoring and Assessment Plan. This protocol describes the methodology used to track alligator hole occupancy and was developed as a training guide for project personnel. This document needs to be read through its entirety to understand the sampling and data management procedures for alligator hole occupancy. This protocol was updated in September 2010 to reflect current methods.

Survey Routes

Occupancy of alligator holes is determined by flying transects in three areas within Everglades National Park:

- Northeast Shark Slough (NESS): 9.0 km per transect; 18 transects
- Rocky Glades (RG): 7.0 km per transect; 19 transects
- Shark Slough (SS): 7.0 km per transect; 15 transects

Conducting Surveys

Only qualified observers will be used for all surveys (see Training Protocol).

Surveys are conducted by two observers in the spring (dry season) during May and June. All flights are conducted via helicopter between 8 am and 12 pm EST.

Surveys will not be conducted if safety is a concern. In-progress flights are to be aborted if any crew member feels unsafe with operations. Flight hazards may include lightning, heavy rain, excessive wind, and other unforeseen events.

The primary observer is seated in the helicopter cockpit and is the lead observer with final say on hole identification. In addition, the primary observer has the following responsibilities during each mission: monitor and communicate potential safety hazards to the crew, ensure transects are surveyed in sequential order, assist pilot in staying on the designated transect alerting the pilot when flight path deviates >50 m from the transect line, pilot goes no further north or south than 250 meters than each transect line to identify an alligator hole, locate alligator holes in front of and along the right side of the transect, count and make size estimates of alligators, mark waypoints of alligator holes into a GPS and record all observations into a field notebook.

The secondary observer is stationed behind the pilot has the following responsibilities during the flight: monitor and communicate potential safety hazards to the crew, locate alligator holes along the left side of the transect, count and make size estimates of alligators, count and make size estimates of alligators, and record all observations into a field notebook.

The initial survey for each region begins in the northeast at transect 1 and proceeds east-west, then west-east along transect 2, east-west along transect 3 and so on until all transects are complete. It may take several days to complete each region as the annual variation of water levels may impact the detectability of alligator holes and the amount of data collected.

Surveys are conducted using a modified Standard Reconnaissance Flight Protocol with transects 500 m apart. The pilot navigates each transect at an average height of 150 feet (46m) above ground. Observers search the area below and out approximately 250m from the center of the transect, hovering to 50 feet above each hole for detailed observation and data collection. When an alligator hole is detected, a waypoint is recorded (see below) and observers perform alligator counts and size class estimation independently. There is no established speed for surveys.

The following criteria are used to determine whether or not an alligator hole exists at a particular location: the presence of a circular or oval depression in the muck or limestone relative to the surrounding marsh (occasionally alligator holes are of an amorphous shape not corresponding to a circle or an oval), a change in vegetation surrounding the depression, and/or visible alligator activity around the hole.

Animal Observations

- Once an alligator hole has been confirmed, observers will independently count alligators, estimate size classes, and record observations into their own respective field books (see below).

- Alligators observed within 10 meters of an alligator hole are recorded as utilizing the hole.

- Every effort should be made to return to the survey transect at the same point and by the same path at which it was initially deviated from.

- Tracks and waypoints of the route will be recorded using map datum WGS 84.

Data recorded during surveys

The primary and secondary surveyors will have their own field books. New field books are to be used each year.

Survey Data (recorded at the airport)

Survey Area (NESS, RG, SS)
Date (day-month-year); example 20-May-2010
Helicopter Name
Pilot
Observer 1
Observer 2
Start Time (helicopter start-up)

End Time (helicopter shut-off)
Flight Hours
Survey Comments
General Observations

Environmental Data

Comments i.e. general weather conditions, cloud cover (%), general water levels

Transect Data (recorded at the start/end of each transect)

Transects Number (i.e. 1)
Transect Start Time
Transect End Time
Absence of alligator holes on a particular transect
Comments

Alligator Data (recorded over each alligator hole)

GPS waypoint for each alligator hole
Alligators observed per hole
Alligator size code: (see codes)
Alligator behavior code (see codes)
Habitat code: (see codes)
Presence or absence of water at hole
Comments (general ecological observation, unique landscape events such as burning)

Waypoints that correspond to UTM's (WGS 84) for the location of each hole.

Codes

- Behavior codes for each observed alligator:

  B = Basking next to hole
  BW = Basking in water
  H = Head out only
  CB = Helicopter chased into water
  CW = Helicopter caused gator to move in water
  M = only saw movement
  UW = underwater

- Size estimates will be in 0.25 m increments with the estimate indicating the lower bound of the size class. Size class estimates which cannot be accurately made should be classed as follows:

  Small (S) = < 1.25 m

Medium (M) = ≥ 1.25 - < 1.75m
Large (L) = ≥ 1.75m
Unknown* = (U) No size estimate could be made using the available information. *Every effort should be made to place an animal into one of the more descript size classes. Only use Unknown if no inference to the size class can be made.

- Habitat type/dominant vegetation should be noted for each alligator hole into the most appropriate category from the following:

  CAT = Cattail
  ME = Mixed Emergents
  SG = Sawgrass
  WH = Willowhead

- Location Codes:
  B = Basking next to hole
  BW = Basking in water
  H = Head only
  CB = Helicopter chased in water
  CW = Helicopter caused alligator to move in water
  M = Movement only
  UW = Underwater

The habitat type recorded is the dominant habitat in the immediate proximity of the observed alligator hole.

Data Management

- Immediately upon returning to the lab a copy of both field books is made.
- Data are entered by each observer into the alligator hole occupancy un-proofed Access file
- After data has been entered, the data must be proofed by another individual other than the person that entered the data.
- The data are printed out and the information from the field books is compared to the printout.
- Any errors are noted on the printed data and corrections made to the Access file by the technician in charge of flights
- A copy of the master database is saved on to the server after every survey season.

Data Entry

- Data is to be entered onto a **copy** of the current master database.
- Only after the data have been proofed and all changes have been accepted by the project manager, the database will be converted into the new master database.
- Any entries that require numerical responses that are not used will receive a 999.
- Any entries that require text that are not used or filled in will use ND (no data).
- Data will be entered as follows:
    - Date- Date of capture from datasheet- enter as mm/dd/yyyy
    - Waypoint- Number of waypoint for alligator hole
    - Area- Area description of where the alligator hole was observed:
        - RG- Rocky Glades
        - NESS- Northeast Shark Slough
        - SS- Shark Slough
        - TS- Taylor Slough
    - UTM Northing- Number field of northing in WGS 1984
    - UTM Easting- Number field of easting in WGS 1984
    - Obs1Gator- Number of observed alligators by primary observer
    - Obs1Size- Size estimate of alligator by primary observer (See survey protocol for size categories)
    - Obs1Location- The location/behavior of each observed alligator by the primary observer (See codes section)
    - Obs2Gator- Number of observed alligators by secondary observer
    - Obs2Size- Size estimate of alligator by secondary observer (See survey protocol for size categories)
    - Obs2Location- The location/behavior of each observed alligator by the secondary observer (See codes section)
    - Water- The general water levels of the alligator hole (normal, drying up, dry)
    - Water Presence- Presence/absence of water in alligator hole.

- Notes- General notes such as the vegetation surrounding a hole, ecological observations and other miscellaneous notes (WH = Willowhead, TI = Tree Island)
- Transect- Transect number of a survey area
- Time- Time of survey (AM or PM)

QA/QC

- After data has been entered, the data must be proofed by another individual other than the person that entered the data.
- The data are printed out and the information from the data sheets is compared to the printout.
- Any errors are noted on the printed data and corrections made to the un-proofed Access file by the technician in charge of the database.
- Once the data have been proofed and all corrections made the data are added to the master database.
- A copy of the master database will be saved on to the server after every catch season.

Crocodile Growth and Survival Survey and

Data Management Protocol

Crocodile juvenile growth and survival are monitoring elements (3.1.3.16) of the 2004 RECOVER Monitoring and Assessment Plan. This protocol describes methodology used to conduct surveys to track growth and survival and was developed as a training guide for project personnel. This document needs to be read through its entirety to understand the crocodile growth and survival survey and data management procedures. This protocol was updated in September 2010 to reflect current methods.

Spotlight Survey Routes

Survey routes were established based on accessibility, and orientation in and around coastal habitats. Twenty-nine surveys routes of varying length (6 km to 74 km) are set from Biscayne Bay west along the coastline to Cape Sable were surveyed (Figure 1). A reduction/addition in routes may be made in the future if it is determined to be beneficial/necessary.

Conducting Surveys

- Only qualified observers will be used as the primary observer for all surveys (see Alligator Training Protocol)

- Surveys were conducted quarterly, but will be conducted three times a year in the future. This frequency is selected to record seasonal variation. Surveys are not performed at low tide (in tidal areas) due to accessibility and safety concerns.

- Surveys are conducted by skiff, johnboat or kayak. Those conducted by skiff maintain a speed that allows the craft to be on minimum plane (minimum speed which is required to keep the vessel on plane). Due the differences in hull design, propellers, engines, and water depth, there is no established speed but it is approximately 28 kmph (15-20 mph).

Environmental Constraints

- Surveys are not conducted during a full moon (a full moon is defined as one day before, the day of, and the night after the full moon), heavy rain, or wind greater than 21 kmph (15 mph).

Animal Observations

- A 200,000 candlepower spotlight will be used by the driver/primary observer. Once animals have been spotted, headlamps may be used to reestablish close proximity eyeshines.

- Only animals observed by the primary observer will be recorded.

- Tracks of the route and waypoints of the animal locations will be recorded with a global positioning system using map datum WGS 84.

Data recorded during surveys

- Data will be recorded in a waterproof field book.

Survey Data

Data recorded at beginning of survey

Route Name
Date (mm/dd/yyyy)
Personnel Present
Air Temperature, degrees Celsius
Water Temperature, degrees Celsius
Salinity, parts per thousand (PPT)

Data recorded at middle and end of survey

Air Temperature, degrees Celsius
Water Temperature, degrees Celsius
Salinity, parts per thousand (PPT)

Data recorded when a crocodile, alligator or eyeshine is observed

Indentify observation as a crocodile, alligator or eyeshine (if species cannot be determined)
Waypoint for each observation
Size estimate when the individual is not captured: see codes
Air temperature measured in degrees Celsius
Water temperature measured in degrees Celsius
Salinity measured in parts per thousand (PPT) with a hand refractometer
Comments

- Waypoints that correspond to UTM's for the location of each individual animal will be recorded (WGS 84) for each observed animal. Animals within 10 m of each other do not require separate waypoints.

- Size estimates will be in 0.25 m increments with the estimate indicating the lower limit of the size class.
  Unknown* = No size estimate could be made using the available information
  *Every effort should be made to place an animal into one of the more descriptive size classes. Only use Unknown if no inference to the size class can be made.

Captures

- Captures will be conducted by a 2 or 3 person crew. One person will be designated the lead and have final say in all capture procedures (see Capturing and Handling section of Training Protocol).

Data recorded when a crocodile is captured

Waypoint for each animal captured
Morphometric measurements (see below)
Note individual marking (scute clip [S-DL-DR] or pit tag #) if a recapture, otherwise mark new captures (see Figure 3)
Air temperature measured in degrees Celsius
Water temperature measured in degrees Celsius
Salinity measured in parts per thousand (PPT) with a hand refractometer
Comments

- Waypoints that correspond to UTM's for the location of each individual animal will be recorded (WGS 84) for each observed animal. Animals within 10 m of each other do not require separate waypoints.

- **Measurements:** all measurements must be in centimeters; animal should be as straight and flat as possible.

    - **HL:** (head length) measured dorsally from tip of snout to center of V at posterior end of skull plates.
    - **SVL: (**snout-vent length) measured from tip of snout to immediately posterior of vent. Note whether measured ventral or dorsal.

    - **TL:** (total length) measured from tip of snout to end of tail.

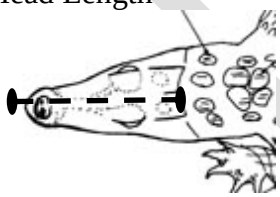
    - **TG:** (tail girth) measure tail circumference at break in scale row immediately posterior of vent (third scute row posterior to rear legs).

    - **WT:** (weight) mass of animal recorded in grams or kilograms.

    - **Sex:** sex of animal recorded as male, female or unknown.

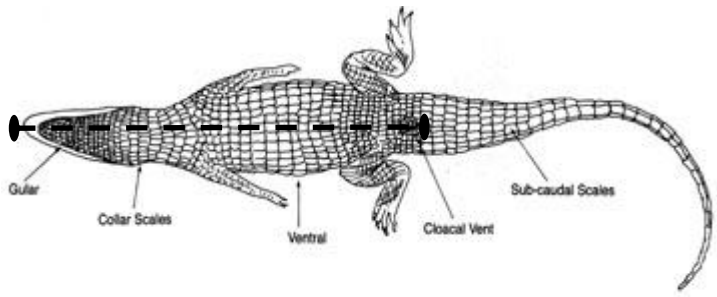
GENERAL PICTORIAL MORPHOMETRIC MEASUREMENT INSTRUCTIONS

Head Length-



Measure dorsally from tip of snout to center of posterior end of skull. Dashed line indicates measurement.
*
Modified from King and Brazaitis (1971)

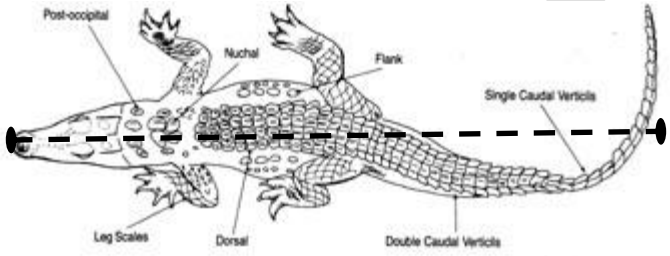
Snout-Vent Length:



Measure ventrally from tip of snout to back of vent or dorsally to the back of the second tail scute row. The zero tail scute row is the last row located directly posterior to the rear legs and does not wrap completely around the tail.

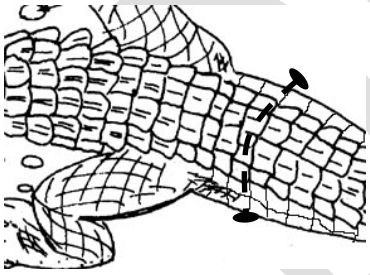
Detail of vent for snout-vent length:
* Modified from King and Brazaitis (1971)

Total Length:



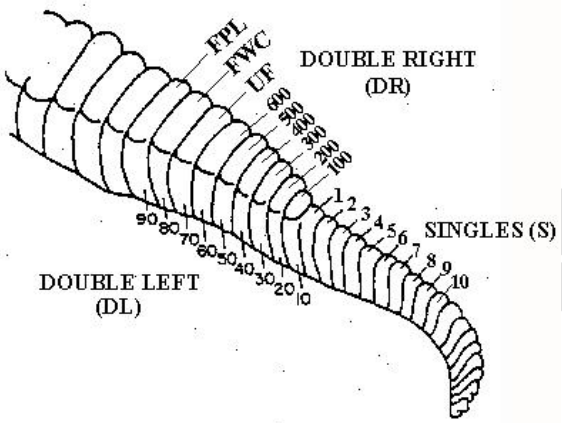
Measure straight distance dorsally or ventrally from tip of snout to tip of tail. Note if tip of tail is missing. Make sure crocodile and tail are in a straight line, not like this one.

Tail Girth:



Measure the circumference of tail at 3rd scute row posterior to rear legs.

Marking methods: Marking method currently in use by University of Florida. We recommend that all sites use this method. Further, we recommend that the following maxims also be followed; “count twice, cut once” when marking the animal and “count twice and then again” when recording the mark on the data sheet.



Crocodile Survey Observation/Capture Data Entry Protocol

Read this entire protocol prior to entering data in to Microsoft Access database.

This data entry protocol is for crocodile data associated with the juvenile growth and survival monitoring element (3.1.3.16) of the 2004 RECOVER Monitoring and Assessment Plan. This protocol needs to be read through its entirety to understand the data entry and QA/QC procedures associated with crocodile survey data.

Data Entry

- Data is to be entered from the field book into a blank table with the same formatting as the current master database.
- Only after the data have been proofed and all changes have been accepted, will the data from this file be added into the master database.
- Any entries that require numerical responses that are not used (i.e. data not collected anymore or data not collected on that occasion) will receive a 999.
- Any entries that require text that are not used or filled in will use ND (no data).
- Data will be entered as follows
    - ID- An autonumber and does not require action -- the database will fill it in automatically
    - Date- Date of capture from field book - enter as dd/mm/yyyy
    - Observation- Observation of a crocodile, alligator, or eyeshine (when species cannot be determined)
    - Clip #- Field for a unique number given to each crocodile based on the scute markings or pit tag that corresponds to the crocodile. If no number can be deciphered but the crocodile was previously marked by Florida Fish and Wildlife Conservation Commission (FWC) or Florida Power and Light Turkey Point Power Plant site (FPL) their abbreviation is entered
    - Capture Status- Listed as an eyeshine-0, first time capture-1 or recapture-2
    - Location- Abbreviation for the location of where the observation was made. A list of location abbreviation descriptions can be found in the abbreviation table within the database

- Total Length (TL)- Numerical field for the total length measurement in centimeters
- Snout-Vent Length (SVL)- Numerical field for the snout to vent length measurement in centimeters
- Head Length (HL)- Numerical field for the head length measurement in centimeters
- Tail Girth- Tail Girth measured at the whorl behind the cloaca.
- Mass- Numerical field for the weight measurement in grams
- Sex- M-Male, F-Female or ND-sex could not be determined or was not recorded
- Air Temp- Numerical field for air temperature in degrees Celsius recorded at the observation location
- Water Temp- Numerical field for water temperature in degrees Celsius recorded at the observation location
- Salinity- Numerical field for salinity in ppt recorded at the observation location
- UTM_Easting- Numerical field for UTM Easting from the observation location in WGS 1984 datum
- UTM_Northing- Numerical field for UTM Northing from the observation location in WGS 1984 datum
- S/DL/DR-Specific scutes clipped on the crocodile making up the scute clip, S-Single row, DL-Double left and DR-Double right
- Comments- Text field for any general notes about the capture of the crocodile or related to the observation made

QA/QC

- After data has been entered, the data must be proofed by another individual other than the person that entered the data.
- The entered data are compared to the field notes.
- Any errors are noted on the electronic file and then corrections are made to the un-proofed Access file by the person designated responsible.

- Once the data have been proofed and all corrections made the data are added to the master database.
- A copy of the master database will be saved on to the server after every update.
- Field books are photocopied and copies are placed into binders and housed in a different location than the original books.

Crocodile Nesting Survey and Data Management Protocol

Nesting Survey Routes

Survey routes have been established based on historical locations of crocodile nesting activity and areas of suitable nesting habitat. Surveys are performed from Biscayne Bay west along the coastline (and areas immediately inland) to Highlands Beach. An increase in routes may be made in the future if it is determined to be beneficial/necessary.

Conducting Nesting Surveys

- Surveys will be conducted annually, with initial nesting activity identified during April and May, first by helicopter and then confirmed on the ground by skiff where accessible.

- During the hatching period (July/August) surveys are performed 3-5 times weekly by boat to monitor hatching, until hatching is completed.

- A final survey by helicopter is performed towards the end of the hatching period to identify any additional sites not previously known.

Data recorded during nesting surveys

Data will be recorded in a in a waterproof field book.
Date (mm/dd/yyyy)
Personnel Present
Indentify observation as a tail drag, digging or a completed nest (if the nest appears completed).
Waypoints for each observation in UTM WGS 84.
If an adult crocodile is present it is noted.

Crocodile Nesting Survey Data Entry Protocol

This section is for crocodile nesting data associated with the juvenile growth and survival monitoring element (3.1.3.16) of the 2004 RECOVER Monitoring and Assessment Plan. Data from initial surveys and from monitoring surveys during the hatching period are recorded in the field book until the end of the nesting season, at which time the data is entered.

Data Entry

- Data is to be entered from the field book into a blank table with the same formatting as the current master database.
- Only after the data have been proofed and all changes have been accepted, will the data from this file be added into the master database.
- Any entries that require numerical responses that are not used (i.e. data not collected anymore or data not collected on that occasion) will receive a 999.
- Any entries that require text that are not used or filled in will use ND (no data).
- Data will be entered as follows
    - ID- An autonumber and does not require action -- the database will fill it in automatically
    - Year- Year the nest was observed during.
    - Location- Abbreviation for the location of where the observation was made. A list of location abbreviation descriptions can be found in the abbreviation table within the database.
    - Fate- This is the final fate of the nest, Successful or Failed.
    - UTM_Easting- Numerical field for UTM Easting from the nesting location in WGS 1984 datum.
    - UTM_Northing- Numerical field for UTM Northing from the nesting location in WGS 1984 datum.

QA/QC

- After data has been entered, the data must be proofed by another individual other than the person that entered the data.
- The entered data are compared to the field notes.

- Any errors are noted on the electronic file and then corrections are made to the un-proofed Access file by the person designated responsible.
- Once the data have been proofed and all corrections made the data are added to the master database.
- A copy of the master database will be saved on to the server after every update.
- Field books are photocopied and copies are placed into binders and housed in a different location than the original books.

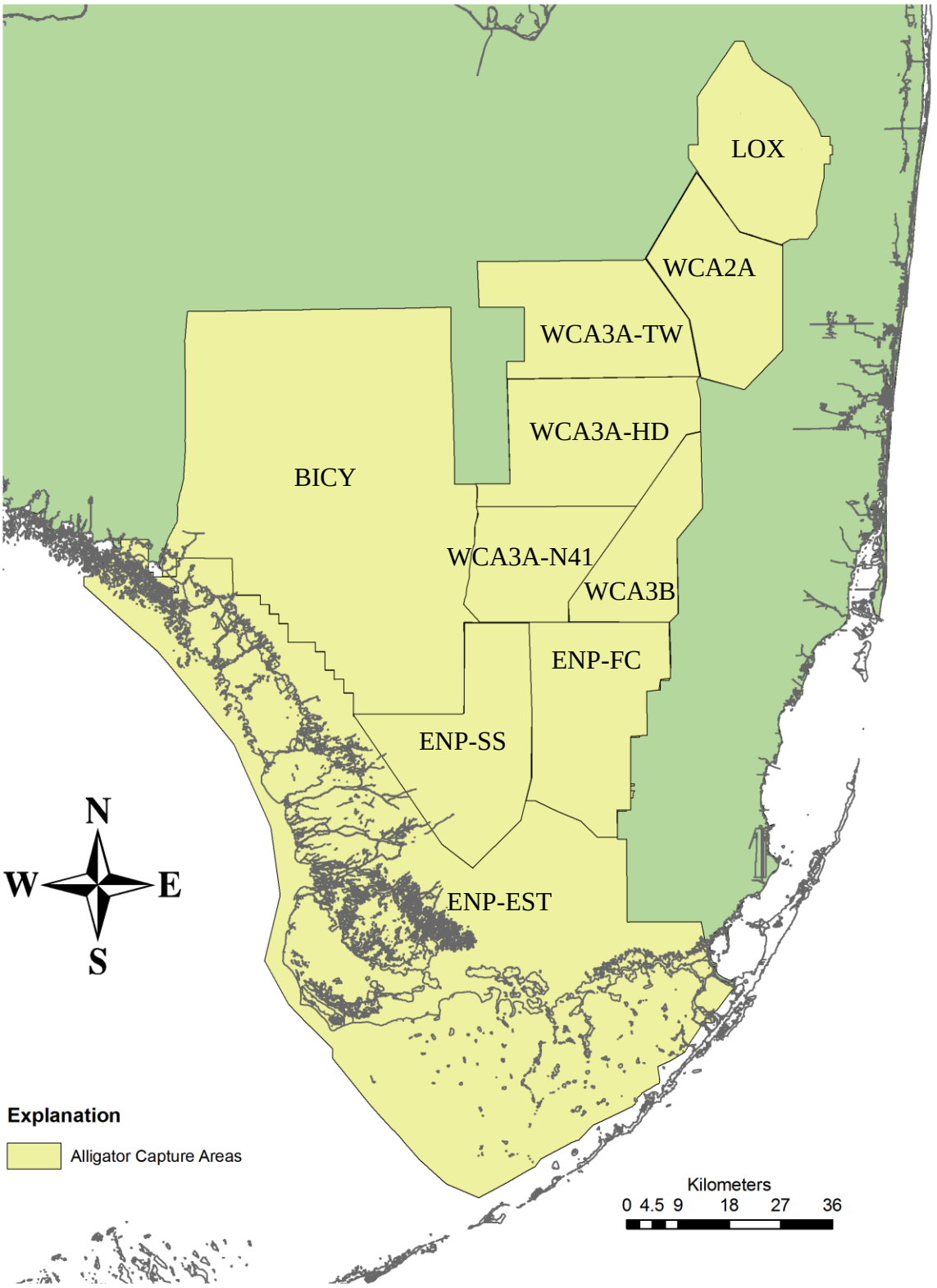


Figure 1. Current alligator capture locations in South Florida from A.R.M. Loxahatchee National Wildlife Refuge to southwest Everglades National Park.

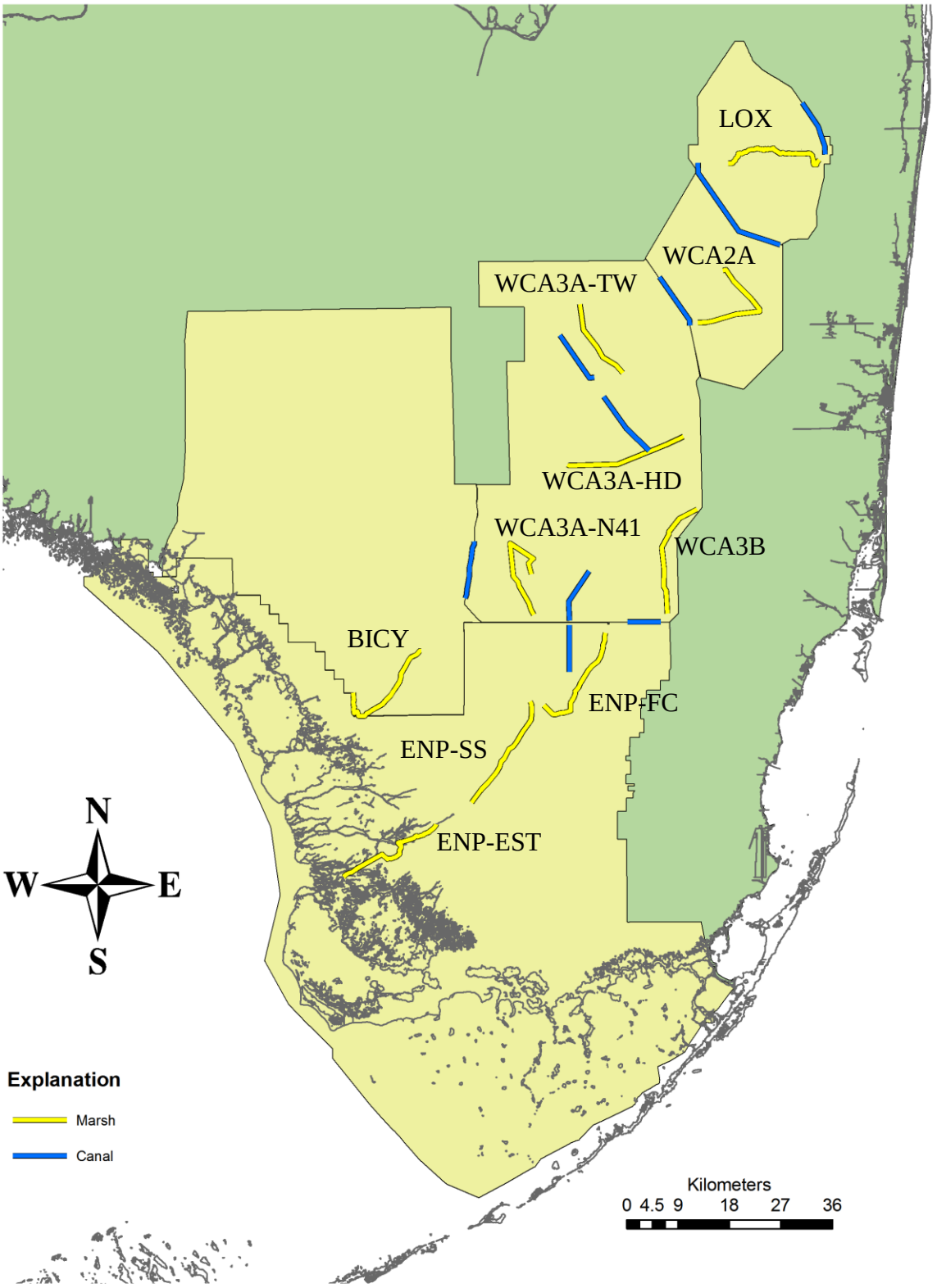


Figure 2. Locations of routes where alligator surveys were conducted from 2004-2009 routes.

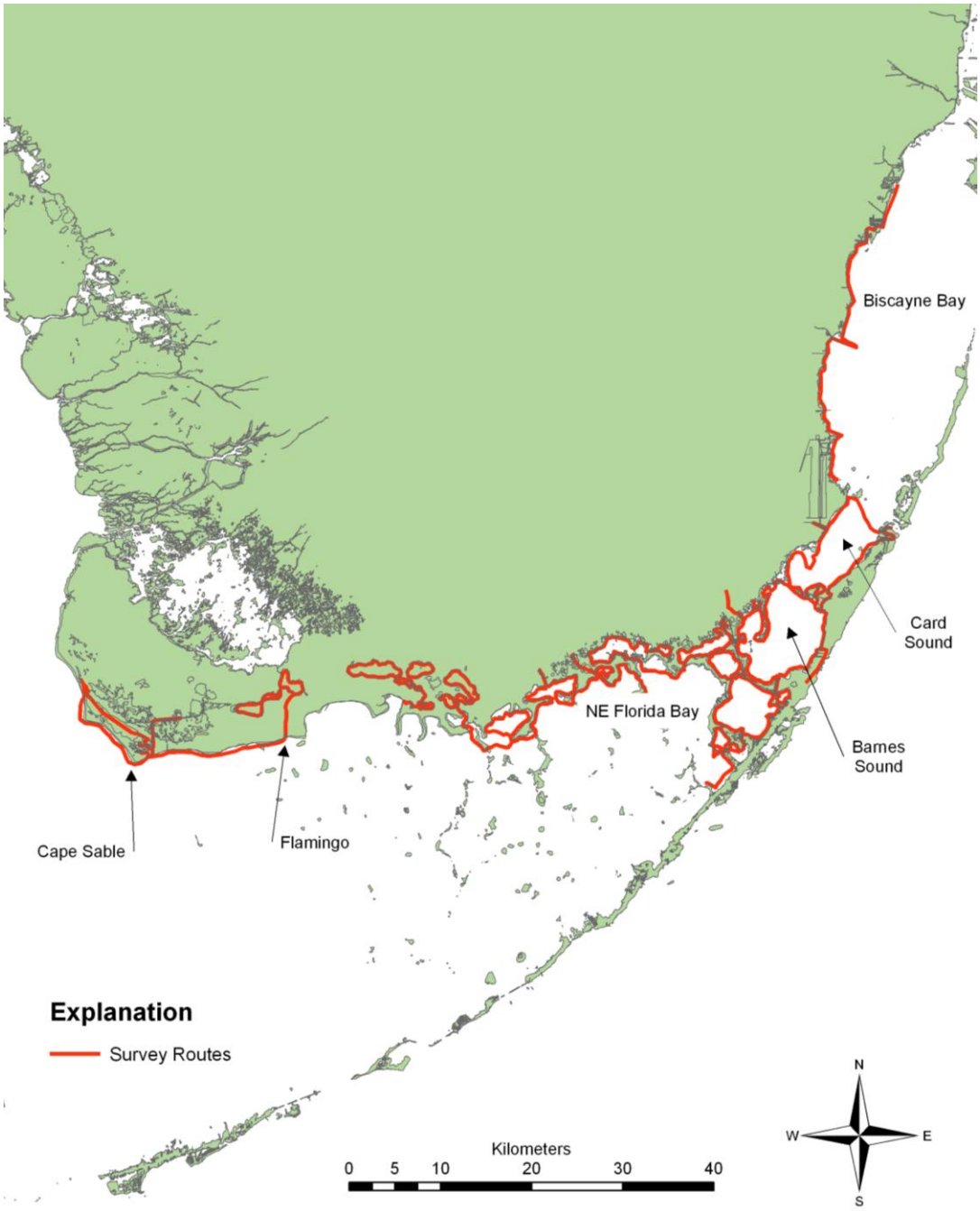


Figure 3. Locations of surveys routes for the American Crocodile for 2004-2009.

Appendix 2. List of reports, publications, and theses supported by Cooperative Agreement 1434-05HQRU1544/244.

Publications and Final Reports done in the last 5 years:

Beauchamp, J.S., M.S. Cherkiss, M.R. Rochford and F.J. Mazzotti. 2009. A recent capture of a large American crocodile (Crocodylus acutus) in Florida. Florida Field Naturalist. 37(4):149-150.*

Brandt, L.A. 2005. Relative density of alligator nests in the Arthur R. Marshall Loxahatchee National Wildlife Refuge 2000-2004. USFWS, Arthur R. Marshall Loxatachee National Wildlife Refuge, Boynton Beach, FL.*

Brandt, L. A., M. R. Campbell and F. J. Mazzotti. 2010. Spatial distribution of alligator holes in the Central Everglades. Southeastern Naturalist. 9(3):487-496.*

Brien, M. L., M. S. Cherkiss and F. J. and Mazzotti. 2008. American crocodile, *Crocodylus acutus*, mortalities in southern Florida. Florida Field Naturalist 36:55-82.*

Bugbee, C.D. 2008. Emergence dynamics of American alligators (*Alligator mississippiensis*) in Arthur R. Marshall Loxahatchee National Wildlilfe Refuge: life history and application to statewide alligator surveys. Thesis, University of Florida, Gainesville, FL.*

Carter, C. 2010. The effects of habitat type and structure on detectability during night light surveys. Master of Science Thesis, University of Florida, Gainesville, FL.*

Campbell, M.R. and F.J. Mazzotti. 2004. Characterization of Natural and Artificial Alligator Holes. Southeastern Naturalist. 3(4):583-594.*

Cherkiss, M. S., F.J. Mazzotti, and K.G. Rice. 2006. Effects of shoreline vegetation on visibility of crocodiles during spotlight surveys. Herpetological Review. 37(1):37-40.*

Cherkiss, M.S., M. Parry, and F.J. Mazzotti. 2007. *Crocodylus acutus* (American Crocodile). Migration. Herpetological Review. 38(1):72-73.*

Cherkiss, M.S., O.S. Bass, and F.J. Mazzotti. 2006. *Crocodylus acutus*: Geographic Distribution. Herpetological Review. 37(4): 491.*

Cherkiss, M.S., S.R. Romanach, and F.J. Mazzotti. The American Crocodile, *Crocodylus acutus*, in Biscyane Bay. Estuaries and Coasts. *Submitted*.

Doren, R.F., Trexler, J.C., Harwell, M., and Best, G.R., Eds, 2008. System-wide Indicators for Everglades Restoration 2008 Assessment. Unpublished Technical Report. 30-31. *

Fujisaki, I., F.J. Mazzotti, R.M. Dorazoi, K.G. Rice, M. Cherkiss, B. Jeffery. Estimating trends in alligator populations from nightlight surveys. Wetlands. *In review.*

Fujisaki, I., K. G. Rice, L. G. Pearlstine and F. J. Mazzotti. 2009. Relationship between body condition of American alligators and water depth in the Everglades, FL. Hydrobiologia 639:329-338.*

Graham, J.A. 2004. Establishing a method to assess detectability of American alligator nests in the Arthur R. Marshall Loxahatchee National Wildlife Refuge Final Report. University of Florida, Fort Lauderdale Research and Education Center, Fort Lauderdale, FL.*

Lui, Z, L.A. Brandt, F.J. Mazzotti, and D.E. Ogurcak. Morphometric and hydrologic characteristics of alligator holes in Everglades National Park, Florida from 1994 to 2007. *In Prep.*

Mazzotti, F.J. and M.S. Cherkiss. 2007. Status and Trends of the American Crocodile (*Crocodylus acutus*) in Everglades National Park. University of Florida Fort Lauderdale Research and Education Center. Fort Lauderdale, FL.*

Mazzotti, F.J., G.R. Best, L.A. Brandt, M.S. Cherkiss, B.M. Jeffery, and K.G. Rice. 2009. Alligators and crocodiles as indicators for restoration of Everglades ecosystems. Ecological Indicators. 9(6) Supplement 1 Indicators for Everglades Restoration: S137-S149.*

Mazzotti, F.J., L.A. Brandt, P. Moler, and M.S. Cherkiss. 2007. The American Crocodile (*Crocodylus acutus*) in Florida: Recommendations for Endangered Species Recovery and Ecosystem Restoration. Journal of Herpetology. 41(1):122-132.*

Mazzotti, F.J., M.S. Cherkiss, and J.S. Beauchamp. 2010. A monitoring program for the American crocodile in Northeastern Florida Bay, Everglades National Park. University of Florida, Fort Lauderdale Research and Education Center. Fort Lauderdale, FL.*

Mazzotti, F.J., M.S. Cherkiss, M.W. Parry, and K.G. Rice. 2007. Recent Nesting of the American Crocodile (*Crocodylus acutus*) in Everglades National Park, Florida USA. Herpetological Review. 38(3):285-289.*

Mazzotti, F.J., M.W. Parry, and M.S. Cherkiss. The 2004-2005 Monitoring program for the endangered American crocodile in south Florida. University of Florida Fort Lauderdale Research and Education Center, Fort Lauderdale, FL.*

Rice, K.G. and F.J. Mazzotti. 2006. Annual Assessment Report American Alligator Distribution, Size, and Hole Occupancy and American Crocodile Juvenile Growth and Survival. University of Florida Fort Lauderdale Research and Education Center. Fort Lauderdale, FL.*

Rice, K.G. and F.J. Mazzotti. 2007. Annual Assessment Report American Alligator Distribution, Size, and Hole Occupancy and American Crocodile Juvenile Growth and

Survival. University of Florida Fort Lauderdale Research and Education Center. Fort Lauderdale, FL.*

Rice, K.G. and F.J. Mazzotti. 2008. Annual Assessment Report American Alligator Distribution, Size, and Hole Occupancy and American Crocodile Juvenile Growth and Survival. University of Florida Fort Lauderdale Research and Education Center. Fort Lauderdale, FL.*

Rice, K.G., F.J. Mazzotti, and L.A. Brandt. 2005. Status of the American alligator (*Alligator mississippiensis*) in southern Florida and its role in measuring restoration success in the Everglades. Pp. 145-153 *In*: Status and Conservation of Florida Amphibians and Reptiles. W.E. Meshaka and K.J. Babbitt (eds.) Krieger Publishers, Melbourne, FL.*

Rice, K.G., K.M. Hart and F.J. Mazzotti. 2009. Annual Assessment Report American Alligator Distribution, Size, and Hole Occupancy and American Crocodile Juvenile Growth and Survival. University of Florida Fort Lauderdale Research and Education Center. Fort Lauderdale, FL.*

Smithem, J.L. and F.J. Mazzotti. 2008. Risk Perception and Acceptance of the American Crocodile (*Crocodylus acutus*) in South Florida. Florida Scientist. 71(1): 9-22.*

Thorbjarnason, J., F. Mazzotti, E. Sanderson, F. Buitrago, M. Lazcano, K. Minkowski, M. Muniz, P. Ponce, L. Sigler, R. Soberon, A. Trelancia, and A. Velasco. 2006. Regional habitat conservation priorities for the American crocodile. Biological Conservation. 128(1).*

Zweig, C.L., F.J. Mazzotti, K.G. Rice, L.A. Brandt, and C.L. Abercrombie. 2004. Evaluation of filed measurements of the American alligator for use in morphometric studies. Herpetological Review. 35(1):43-44.*