PHOTO-IDENTIFICATION STUDIES AND GENETIC SAMPLE ACQUISITION AND PROCESSING OF MANATEES IN SOUTHWESTERN FLORIDA

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION CONTRACT 04222
FINAL REPORT

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Title of Project: Photo-identification studies and genetic sample acquisition and processing of manatees in southwestern Florida

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Goals of the Project:

The two goals of this project were (1) to continue the photo-identification efforts in southwestern Florida, particularly in Matlacha Isles, and supplement the photo-identification efforts at and near the FPL Ft. Myers power plant during the winter months and (2) to continue the collaborative efforts of USGS Sirenia Project, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, and Mote Marine Laboratory to fully integrate the statewide photo-identification data into the Manatee Photo-Identification System (MIPS).

Introduction:

Manatee photo-identification (photo-ID) studies have provided information on population structure, life history and reproductive traits, site fidelity, behavior, movement and travel patterns, habitat selection, and estimates of survival rates (Reid et al. 1991; Beck and Reid 1995; O'Shea and Ackerman, 1995; Langtimm et al. 1998; Koelsch 2001; Langtimm et al. 2004). Knowledge of calving intervals/reproductive rates, age at sexual maturity, and estimates of annual adult survival, determined from resightings of individuals, form the basis of the demographic recovery as stated in the most recent Florida Manatee Recovery Plan (U.S. Fish and Wildlife Service 2001). In fact, according to an expert panel at the Manatee Population Ecology

Workshop (Gainesville, FL; April 2002) the adult survival estimates emanating from rigorous photo-identification, followed by mark-recapture analyses, represent the strongest available approach for estimating manatee population trends. Sighting histories of identifiable manatees later recovered as carcasses also provide useful information; previous sightings may indicate behavior and movements prior to animals' deaths and provide insight into mortality factors. Thus, an emphasis has been placed on maintaining and expanding photo-identification efforts statewide, particularly in southwestern Florida.

Prior to 1996/1997, the scar catalog for southwestern Florida south of Sarasota Bay was outdated. Fifty-seven manatees observed in Ft. Myers were incorporated into MIPS during the 1980s (Beck and Reid 1995), but regular surveys had not been conducted for the several years following. During the winter of 1996/1997, Mote Marine Laboratory began regular photo-ID surveys in southwestern Florida (south of Sarasota Bay) to update and expand the scar catalog in this region. Staff at the FWC Fish and Wildlife Research Institute (FWRI) also increased photo-ID efforts in this region to further update the scar catalog and facilitate the calculation of annual adult survival probabilities in southwestern Florida, as this was the only subpopulation for which those analyses had not been done (Langtimm et al. 1998). Although data collected through winter 2001/2002 were recently used by Langtimm et al. (2004) to calculate the first adult survival estimates for the southwestern Florida subpopulation, it is important to continue photo-ID studies in order to annually update the survival estimates (U.S. Fish and Wildlife Service 2001).

Manatee photo-identification surveys were conducted in Charlotte and Lee Counties, including Matlacha Isles, Burnt Store Marina, and 10-Mile Canal, Sarasota County, and near the FPL Ft. Myers power plant to further develop and increase sighting histories of manatees in the

Southwest subpopulation. Data collected during these surveys will update, expand, and improve the collaborative statewide scar catalog (MIPS) by documenting individual manatees at primary and secondary winter refuge sites, as well as non-winter sites, and establish sighting histories for new distinct individuals.

Methods:

Photographic identification surveys were conducted in four areas in southwestern Florida: Matlacha, the Florida Power & Light Ft. Myers power plant, Burnt Store Marina, and 10-mile canal from late fall 2005 to early spring 2006. Photo-ID surveys were conducted regularly at Matlacha Isles and sites at and near the FPL Ft. Myers power plant (Manatee Park and lower Orange River; Figure 1). Additional sites, which include Burnt Store Marina and 10-Mile Canal were surveyed less frequently.

Survey teams worked from 6-7 meter outboard motorboats with observation towers and propeller guards, shorelines, bridges, or docks. Electric trolling motors were used on all boats to minimize disturbance to the manatees. The primary observer operated a Canon EOS 10D or EOS 20D digital camera with 6.3 and 8.20 respective mega pixel resolution and fitted with either a 28-90 mm or 75-300 mm zoom lens with a polarizing filter. All images were taken in RAW format with embedded jpegs. A field day included one or more sites surveyed on a single day. Whenever possible, multiple sites were surveyed simultaneously by different observers in order to increase effort and efficiency and decrease travel expense. A sighting was defined as all individuals at a geographically distinct location (*i.e.*, canal, bayou, harbor, boat basin) within an approximately 0.1 - 0.2 km^2 area at the same time. For each sighting, we photographed individual manatees and sketched scars and other features on data sheets compatible with those used by the U.S. Geological Survey Sirenia Project and FWRI. We noted the gender of

individuals when either the ventrum or a nursing calf was observed. We also recorded environmental data, such as weather, water and air temperatures, salinity, wind direction and speed, and photo conditions.

Bottom water temperatures in Matlacha Isles, Matlacha Pass, Orange River, and the Caloosahatchee River were collected at one-hour intervals using Optic StowAway® Temp data loggers (Onset Computer Corporation). Water temperature loggers within Matlacha Isles were attached to the ends of residential docks. Water temperature loggers within Matlacha Pass, the Orange River, and the Caloosahatchee River were attached to channel markers. The water temperature loggers were housed in casings made of PVC with multiple holes and covered with antifouling paint. The design of the casings allowed ample water flow to reach the loggers, while protecting them from biofouling. Each logger and casing was cleaned and data from each logger were downloaded approximately once per month.

Data and photographic images are being processed and analyzed using standardized protocols and methods established by Manatee Individual Photo-Identification System (MIPS) partners. All photographic images were taken in raw format (for archiving) with embedded jpegs (for data processing and analyses). Images were downloaded from the cameras onto the computer with Downloader Pro software and embedded jpegs were extracted via BreezeBrowser Pro software. Each photographic image had a raw, jpeg, and thumbnail image that was subsequently burned onto DVDs for archival purposes. IMatch software is being used for labeling, sorting, and matching images to known and unknown individuals within and between seasons.

Distinctive individuals that were photographically documented will have sketches drawn of their scars, mutilations, and/or other features to facilitate making matches between days and

with previously known individuals. All distinctive manatees will be compared to cataloged individuals in MIPS, as well as to distinctive but unknown individuals observed previously in southwestern Florida. Images will also be exchanged with MIPS partners to further search for matches with individuals that they may have documented. Individuals not recognized as being previously identified will be grouped into one of three categories:

- Indistinct - Manatees with no readily identifiable scars or natural markings;
- Distinct Unknown (DU) - Manatees with visible scars or natural markings, but were either not photographed in their entirety or photographs were not of adequate quality to allow for verifiable resightings. These distinct unknowns may represent incomplete photographs of previously sighted animals, but others may be unique individuals;
- Distinct Known- Manatees with readily recognizable, permanent scars or natural markings. These animals have adequate photographic documentation to be considered for inclusion into the MIPS catalog.

Results:

We completed 129 surveys of 15 sites during 35 field days from 1 December 2005 to 4 April 2006 (Table 1). We are continuing photo analyses from winter 2004-2005 and have not yet begun analyses of the current photos, so unfortunately sightings of individual manatees and their movement patterns cannot be reported. We can, however, report numbers of manatees observed during photo-identification surveys in relation to water temperatures in two sections of the study area, Matlacha and near the FPL Ft. Myers power plant.

Total counts of manatees were highest following cold fronts, with the highest estimated counts being at Manatee Park during these periods (highest minimum count: 100 on 22 and 28

December 2006; Table 1). Cold fronts during late December 2005 through mid-February 2006 caused water temperatures in Matlacha Pass to drop below 18°C during five periods, with the lowest daily average water temperature of 13.5°C on 14 February 2006. Most of the manatees sighted during these colder periods were at Manatee Park/Orange River (Table 1), whose waters are heated by the effluent of the FPL Ft. Myers power plant and average >3.7°C higher than those of other sites (Table 2). Water temperatures within the Orange River averaged 25.7°C (Table 2) for the winter and only dropped below 20°C during 2 brief periods in early to mid-December 2005 (Figure 2).

During the periods between cold fronts, counts in Manatee Park/Orange River decreased (Table 1), indicating that many of those manatees may have dispersed. Total counts of manatees in survey sites outside Manatee Park/Orange River increased during these times. The highest total count during photo-identification surveys in Matlacha Isles was 87-105 on 1 February 2006. Water temperatures within Matlacha Isles had daily averages near or above 18°C throughout the winter (Figure 2). The highest total count during photo-identification surveys in the pit on 10-mile canal was 32-40 on 8 February 2006.

A second component of this project is the continued efforts towards the complete integration of the Manatee Individual Photo-Identification System (MIPS). All three MIPS partners have begun scanning original slides and saving them as high-resolution digital images, through a contracted professional photography company (Boston Photo). To date, MML has transferred nearly 39,000 slides of cataloged and distinct unknown (DU) individuals to digital format. We are also continuing our quality assurance/quality control protocols on all of our photographic slides and their corresponding field datasheets and database records. Additionally, we have begun entering MML's image catalog data for each image into the MIPS transaction

table. To date, over 25,000 of MML's images have the initial metadata entry completed and nearly 2,000 images have final metadata completed.

A third component of this project involved the initiation and further development of a field sampling method that is less invasive and less disruptive than "cookie sections" for obtaining tissue samples for genetic studies. The device that has been developed for obtaining skin scrapings from manatees, as well as the field method and associated behavioral observations of the sampled individuals, are detailed in the molecular biologist post-doctoral position portion of this contract report (see Carney and Reynolds 2006).

Discussion:

Photo-identification surveys of manatees in southwestern Florida documented distinctive manatees in all major areas surveyed. Also, by covering multiple sites, we have documented any movement that may have occurred between sites during the winter and early spring and will be able to correlate those movements with water temperatures. Upon completion of slide analyses, data will be used to update, expand, and improve the collaborative statewide scar catalog (MIPS), establish sighting histories for new distinct individuals, and contribute to population and reproductive models of manatees in southwestern Florida.

Conservation benefits:

The long-term maintenance and expansion of statewide photo-identification efforts of Florida manatees is of considerable importance for estimating population trends. Collaborative efforts of USGS Sirenia Project, FWC Fish and Wildlife Research Institute, Mote Marine Laboratory Manatee Research Program staff, and others have contributed to the adult survival estimates for Florida manatees. Continued efforts are crucial in order to annually update these estimates and other population trends.

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List of Tables:

List of Figures:

Table 1. Summary of photo-identification effort in southwestern Florida, 1 December 2005 - 4 April 2006.

		Obs Time		# Manatees		# Photo'd		Air	Water Temp (°C)		Salinity
Date	Location	Start	End	Min	Max	Min	Max	Temp (°C)	Surface	Bottom	(ppt)
1-Dec-05	Manatee Park	942	1021	4	4	0	0	22.2	22.3	-	3
1-Dec-05	Matlacha Isles, site 1	1141	1328	15	20	12	15	22.0	23.1	-	6
1-Dec-05	Orange River, site 1	1035	1100	1	1	0	0	18.8	21.1	-	3
10-Dec-05	Matlacha Isles, site 1	1400	1441	6	6	1	1	25.9	25.0	-	3
10-Dec-05	Manatee Park	1046	1210	25	37	12	13	25.7	22.5	-	0
10-Dec-05	Orange River, site 1	1237	1254	2	2	2	2	27.4	-	-	-
10-Dec-05	Orange River, site 2	1300	1316	5	6	0	0	27.8	23.3	-	0
12-Dec-05	Manatee Park	1030	1230	30	40	11	12	17.4	17.7	-	0
12-Dec-05	10-Mile Canal, Island Park Woods boat ramp	1310	1325	0	0	0	0	19.6	22.3	-	0
12-Dec-05	Orange River, site 2	1345	1355	3	4	0	0	20.8	22.5	-	0
12-Dec-05	Orange River, site 1	1410	1439	5	6	5	5	20.9	-	-	-
12-Dec-05	Matlacha Isles, site 2	1545	1630	18	25	3	6	21.5	22.6	-	9
15-Dec-05	Matlacha Isles, site 2	1050	1309	25	35	16	20	25.1	21.6	-	10
15-Dec-05	Matlacha Isles, site 1	1335	1358	3	3	1	1	26.8	21.5	-	7
15-Dec-05	Manatee Park	1459	1537	34	47	1	2	27.4	21.8	-	0
15-Dec-05	Orange River, site 1	1546	1558	2	2	0	0	-	-	-	-
22-Dec-05	Manatee Park	1013	1304	100	130	66	76	14.7	24.2	-	0
22-Dec-05	Matlacha Isles, site 1	1358	1409	5	5	0	0	18.3	19.7	19.7	10
22-Dec-05	Matlacha Isles, site 2	1421	1500	10	12	2	2	19.8	19.1	-	9
22-Dec-05	Matlacha Isles, site 6	1509	1524	5	6	0	0	20.4	19.7	-	-
22-Dec-05	Burnt Store Marina, south basin	1543	1558	0	0	0	0	19.9	18.8	19.1	22
22-Dec-05	Burnt Store Marina, north basin	1602	1617	2	2	0	0	19.6	19.1	19.2	25
23-Dec-05	Manatee Park	1145	1412	90	130	48	60	20.4	24.3	-	0
27-Dec-05	Manatee Park	1026	1254	95	110	56	59	16.9	23.7	-	0
28-Dec-05	Manatee Park	1054	1342	100	145	50	60	21.5	23.0	-	0
30-Dec-05	Matlacha Isles, site 1	1231	1300	0	0	0	0	29.4	20.7	20.2	10
30-Dec-05	Matlacha Isles, site 2	1328	1358	15	18	3	5	29.6	22.5	-	-
5-Jan-06	Matlacha Isles, site 1	1052	1125	2	2	0	0	22.5	22.0	-	10
5-Jan-06	Matlacha Isles, site 6	1205	1250	5	5	0	0	23.6	22.3	-	10
5-Jan-06	Matlacha Isles, site 5	1305	1318	0	0	0	0	23.7	22.3	-	10
5-Jan-06	Matlacha Isles, site 4	1320	1330	0	0	0	0	23.2	23.1	-	10
5-Jan-06	Orange River, site 2	1343	1400	10	12	1	1	23.9	24.9	24.0	-
5-Jan-06	Matlacha Isles, site 1	1620	1631	2	10	1	2	23.6	23.5	-	11
5-Jan-06	Matlacha Isles, site 7a	1342	1550	30	36	23	26	24.2	23.8	-	11

Table 1 (continued). Summary of photo-identification effort in southwestern Florida, 1 December 2005 - 4 April 2006.

		Obs Time		# Manatees		# Photo'd		Air	Water Temp (°C)		Salinity
Date	**Location**	**Start**	**End**	**Min**	**Max**	**Min**	**Max**	**Temp (°C)**	**Surface**	**Bottom**	**(ppt)**
9-Jan-06	Manatee Park	1051	1551	50	65	38	47	23.8	25.7	-	0
10-Jan-06	10-Mile Canal, pit	1227	1640	20	30	20	20	25.9	21.0	20.4	5
16-Jan-06	Manatee Park	1049	1248	35	53	26	31	22.2	28.7	-	0
16-Jan-06	Matlacha Isles, site 1	1347	1357	0	0	0	0	21.4	18.4	19.5	15
16-Jan-06	Matlacha Isles, site 2	1406	1442	14	20	2	2	21.4	20.5	-	16
19-Jan-06	Orange River, site 1	1028	1231	34	41	8	8	20.7	-	-	-
19-Jan-06	Manatee Park	1030	1145	20	25	10	10	21.1	29.4	-	0
19-Jan-06	Matlacha Isles, site 1	1317	1337	0	0	0	0	26.1	18.5	19.9	11
19-Jan-06	Matlacha Isles, site 2	1348	1424	15	17	4	4	27.0	19.1	19.2	20
19-Jan-06	Matlacha Isles, site 6	1436	1552	13	15	7	8	26.9	21.4	20.8	-
26-Jan-06	Manatee Park	1016	1102	12	15	4	5	18.2	27.8	-	4
26-Jan-06	10-Mile Canal, Island Park Woods boat ramp	1425	1600	7	10	3	4	22.7	21.8	-	0
27-Jan-06	Matlacha Isles, site 1	1055	1207	10	15	1	1	21.1	19.9	21.0	15.5
27-Jan-06	Matlacha Isles, site 7a	1300	1358	17	20	6	7	21.9	21.2	-	14
27-Jan-06	Matlacha Isles, site 2	1410	1502	22	26	3	4	23.4	21.3	-	16
31-Jan-06	Matlacha Isles, site 1	1110	1208	8	11	6	7	21.7	20.7	20.7	18
31-Jan-06	Matlacha Isles, site 7a	1230	1413	43	48	34	37	22.8	21.8	21.2	21.5
31-Jan-06	Matlacha Isles, site 7b	1420	1433	3	3	2	2	-	-	-	-
31-Jan-06	Matlacha Isles, site 7c	1433	1446	2	2	0	0	-	-	-	-
31-Jan-06	Matlacha Isles, site 2	1446	1607	30	40	15	17	25.2	22.3	-	22
1-Feb-06	Orange River, site 1	1050	1224	34	38	22	23	19.8	27.2	25.1	0
1-Feb-06	Manatee Park	1054	1220	22	25	17	20	22.8	28.3	-	11
1-Feb-06	Matlacha Isles, site 2	1315	1512	70	80	24	29	25.6	22.1	21.8	18
1-Feb-06	Matlacha Isles, site 7a	1329	1347	10	13	0	0	24.7	21.0	21.3	19
1-Feb-06	Matlacha Isles, site 1	1401	1436	7	12	7	7	24.9	20.6	20.6	12
1-Feb-06	Burnt Store Marina, south basin	1529	1544	2	3	0	0	23.9	21.8	20.7	28
1-Feb-06	Burnt Store Marina, north basin	1551	1606	0	0	0	0	22.0	21.9	-	30
6-Feb-06	Orange River, site 1	1016	1214	15	22	8	9	18.8	-	-	-
6-Feb-06	Manatee Park	1019	1204	70	80	46	48	18.8	26.8	-	0
6-Feb-06	Matlacha Isles, site 2	1257	1332	25	30	7	7	23.1	20.7	-	16
6-Feb-06	Matlacha Isles, site 7a	1259	1317	1	2	0	0	22.3	20.3	20.5	10
6-Feb-06	Matlacha Isles, site 1	1323	1350	10	12	1	1	24.4	20.6	20.3	8
6-Feb-06	Matlacha Isles, site 6	1401	1432	17	18	11	11	23.9	21.1	20.3	13
8-Feb-06	Manatee Park	1044	1214	70	80	46	47	17.5	27.5	-	0
8-Feb-06	10-Mile Canal, pit	1341	1539	32	40	22	25	18.9	19.7	22.0	12.7

Table 1 (continued). Summary of photo-identification effort in southwestern Florida, 1 December 2005 - 4 April 2006.

		Obs Time		# Manatees		# Photo'd		Air	Water Temp (°C)		Salinity
Date	**Location**	**Start**	**End**	**Min**	**Max**	**Min**	**Max**	**Temp (°C)**	**Surface**	**Bottom**	**(ppt)**
10-Feb-06	Manatee Park	1032	1318	60	80	40	47	18.2	26.9	-	0
10-Feb-06	Matlacha Isles, site 1	1423	1438	0	0	0	0	20.8	20.1	20.5	11
10-Feb-06	Matlacha Isles, site 2	1447	1548	12	20	3	3	20.8	21.4	-	12
10-Feb-06	Matlacha Isles, site 6	1553	1614	12	18	1	1	21.8	20.9	-	-
13-Feb-06	Manatee Park	1038	1347	72	77	42	44	9.3	28.1	-	0
13-Feb-06	Matlacha Isles, site 1	1110	1141	4	6	2	2	11.1	14.7	19.4	14.5
13-Feb-06	Matlacha Isles, site 2	1149	1253	16	24	3	3	12.7	18.4	-	18
13-Feb-06	Matlacha Isles, site 6	1307	1350	18	26	8	9	13	19.9	-	17
15-Feb-06	Manatee Park	1050	1230	43	47	32	33	23.3	25.5	-	0
15-Feb-06	Matlacha Isles, site 6	1120	1202	15	20	8	10	22.3	19.6	20.2	13
15-Feb-06	Matlacha Isles, site 1	1214	1229	0	0	0	0	26.4	16.4	18.5	12
15-Feb-06	Matlacha Isles, site 2	1244	1356	25	36	13	16	24.0	20.2	20.6	18
15-Feb-06	Orange River, site 1	1315	1432	63	65	27	27	26.6	-	-	-
21-Feb-06	Manatee Park	1041	1103	1	2	0	0	26.2	28.8	-	0
21-Feb-06	10-Mile Canal, pit	1251	1454	16	19	11	11	31.0	24.8	22.7	10
23-Feb-06	Matlacha Isles, site 1	1110	1135	6	6	1	1	27.5	24.6	25.3	15
23-Feb-06	Matlacha Isles, site 7a	1144	1233	25	30	13	13	27.5	25.3	-	13
23-Feb-06	Matlacha Isles, site 2	1321	1417	25	30	8	8	29.2	27.2	25.8	16.0
23-Feb-06	Matlacha Isles, site 6	1425	1440	0	0	0	0	31.4	27.6	26.6	15
23-Feb-06	Burnt Store Marina, south basin	1504	1519	1	1	0	0	26.2	24.8	-	26
23-Feb-06	Burnt Store Marina, north basin	1524	1539	0	0	0	0	28.2	24.8	-	26
28-Feb-06	Matlacha Isles, site 1	1125	1234	35	45	20	22	25.6	21.2	24.5	14
28-Feb-06	Matlacha Isles, site 7a	1252	1513	38	56	19	24	23.9	22.8	-	15
2-Mar-06	Matlacha Isles, site 2	1102	1201	10	12	3	3	26.9	24.6	24.6	20
2-Mar-06	Matlacha Isles, site 7a	1213	1515	19	20	12	13	25	24	24.0	20
2-Mar-06	Matlacha Isles, site 1	1542	1630	7	8	4	4	27.6	25.1	23.9	15
7-Mar-06	Matlacha Isles, site 7a	1158	1337	25	31	16	16	22.5	23.7	24.3	15
7-Mar-06	Matlacha Isles, site 1	1344	1420	9	10	4	5	24.3	25.0	24.3	15
7-Mar-06	Matlacha Isles, site 2	1439	1502	6	8	3	3	28.3	24.7	24.3	18
7-Mar-06	Matlacha Isles, site 6	1508	1527	1	2	1	1	23.0	25.2	-	15
8-Mar-06	Manatee Park	1112	1128	0	0	0	0	22.8	30.8	-	0
8-Mar-06	10-Mile Canal, pit	1300	1455	7	8	3	3	25.5	23.3	-	10
14-Mar-06	Matlacha Isles, site 7a	1057	1500	38	45	30	35	27.7	26.1	-	19
14-Mar-06	Matlacha Isles, site 1	1515	1532	0	0	0	0	28.8	27.8	-	20

Table 1 (continued). Summary of photo-identification effort in southwestern Florida, 1 December 2005 - 4 April 2006.

		Obs Time		# Manatees		# Photo'd		Air	Water Temp (°C)		Salinity
Date	**Location**	**Start**	**End**	**Min**	**Max**	**Min**	**Max**	**Temp (°C)**	**Surface**	**Bottom**	**(ppt)**
16-Mar-06	Burnt Store Marina, south basin	1032	1111	8	9	2	2	25.5	24.2	-	30
16-Mar-06	Burnt Store Marina, north basin	1118	1139	2	3	0	0	27.7	24.2	-	30
16-Mar-06	Matlacha Isles, site 6	1203	1218	0	0	0	0	28.0	24.0	-	17.5
16-Mar-06	Matlacha Isles, site 2	1222	1319	9	13	3	3	29.4	25.4	25.3	20
16-Mar-06	Matlacha Isles, site 1	1327	1356	5	7	1	1	27.5	25.2	25.4	16
16-Mar-06	Matlacha Isles, site 7a	1404	1433	6	9	3	3	25.6	25.3	25.2	18
21-Mar-06	Burnt Store Marina, north basin	1026	1044	2	3	0	0	28.7	25.2	-	28
21-Mar-06	Burnt Store Marina, south basin	1050	1105	10	12	0	0	30.5	25.0	-	30
21-Mar-06	Matlacha Isles, site 6	1134	1149	0	0	0	0	31.5	26.8	27.1	20
21-Mar-06	Matlacha Isles, site 7a	1157	1333	20	30	10	11	30.0	26.3	26.4	21
21-Mar-06	Matlacha Isles, site 1	1350	1414	2	3	1	1	29.0	27.9	26.5	19
21-Mar-06	Matlacha Isles, site 2	1420	1536	18	25	10	14	31.3	28.8	-	20
27-Mar-06	Burnt Store Marina, south basin	1012	1055	11	15	4	4	20.1	20.3	-	30
27-Mar-06	Burnt Store Marina, north basin	1110	1152	13	15	4	5	21.9	20.3	-	31
27-Mar-06	Matlacha Isles, site 1	1226	1241	5	5	3	3	25.4	20.8	20.7	14
27-Mar-06	Matlacha Isles, site 7a	1248	1336	15	20	7	7	23.1	21.4	21.6	20
27-Mar-06	Matlacha Isles, site 6	1343	1423	12	18	5	6	25.4	21.8	22.0	20
29-Mar-06	Burnt Store Marina, north basin	1029	1058	5	5	0	0	27.1	21.2	-	29
29-Mar-06	Burnt Store Marina, south basin	1104	1122	9	9	0	0	24.8	21.6	-	30
29-Mar-06	Matlacha Isles, site 1	1148	1207	5	5	3	3	28.5	22.9	22.0	20
29-Mar-06	Matlacha Isles, site 7a	1214	1304	16	20	11	11	26.3	23.5	23.3	20
29-Mar-06	Matlacha Isles, site 2	1318	1417	30	35	15	15	26.4	24.4	23.2	21
4-Apr-06	Manatee Park	1037	1047	0	0	0	0	24.6	31.4	-	0
4-Apr-06	Matlacha Isles, site 1	1220	1259	7	8	3	3	28.7	25.9	25.1	18
4-Apr-06	Matlacha Isles, site 2	1151	1206	0	0	0	0	26.3	25.9	25.5	23
4-Apr-06	Matlacha Isles, site 7a	1320	1622	20	25	15	16	26.4	27.5	26.0	18

Table 2. Mean bottom water temperatures (°C) in Matlacha and near the FPL Ft. Myers power plant, 1 December 2005 – 31 March 2006.

Location	Mean	SD	Range
Caloosahatchee River	22.0	2.6	17.1 - 31.0
Orange River	25.7	3.5	19.1 - 34.6
Matlacha Isles	21.2	2.1	17.3 - 25.8
Matlacha Pass	20.0	2.8	12.4 - 26.3
Orange River - Matlacha Isles	4.5	2.9	-2.7 - 10.4
Matlacha Isles - Matlacha Pass	1.2	1.7	-3.1 - 6.5
Orange River - Caloosahatchee River	3.7	2.0	-1.4 - 8.0
Orange River - Matlacha Pass	5.7	3.1	-2.5 - 12.3

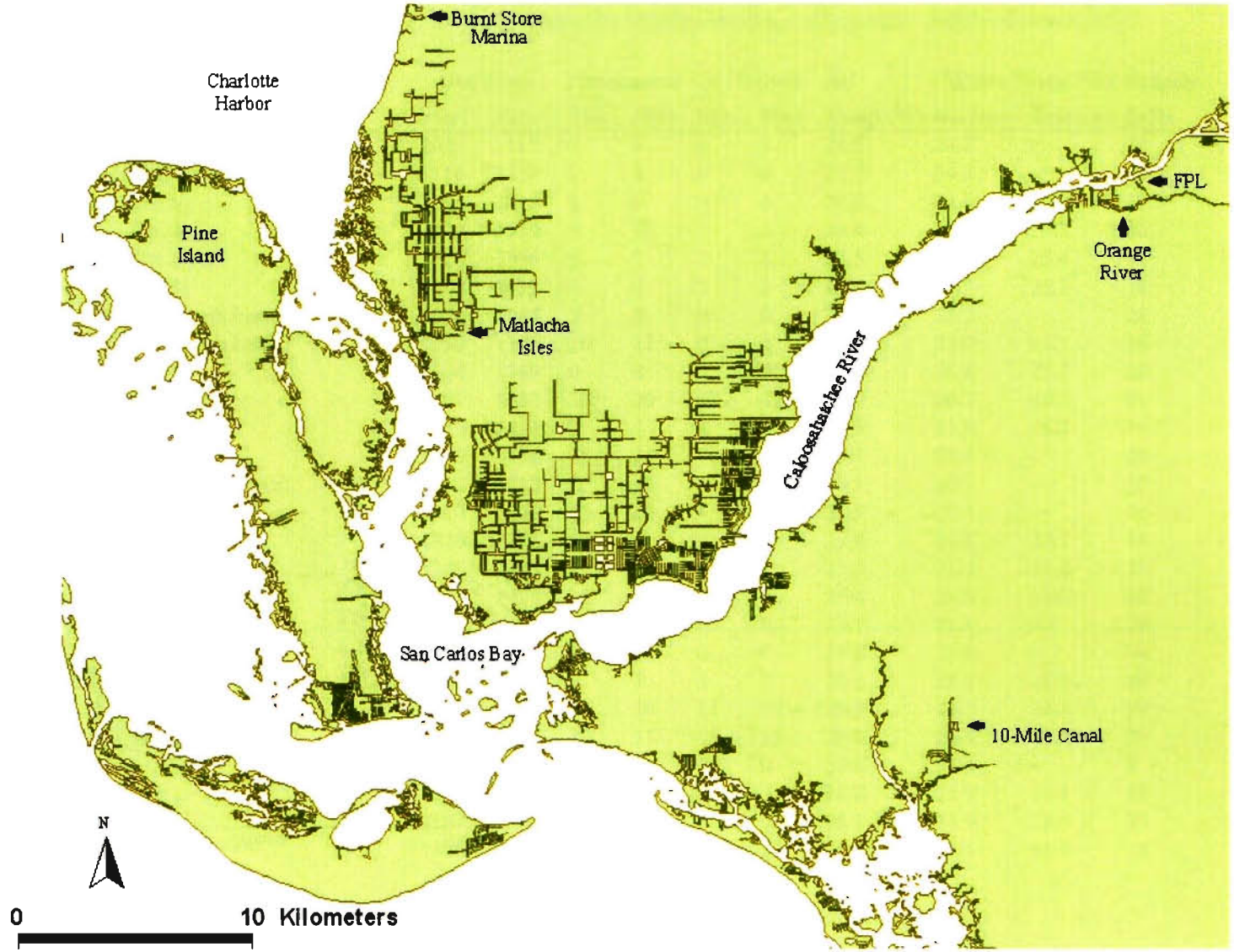

Figure 1. Locations of photographic identification surveys conducted in southwestern Florida, 1 December 2005 – 4 April 2006.

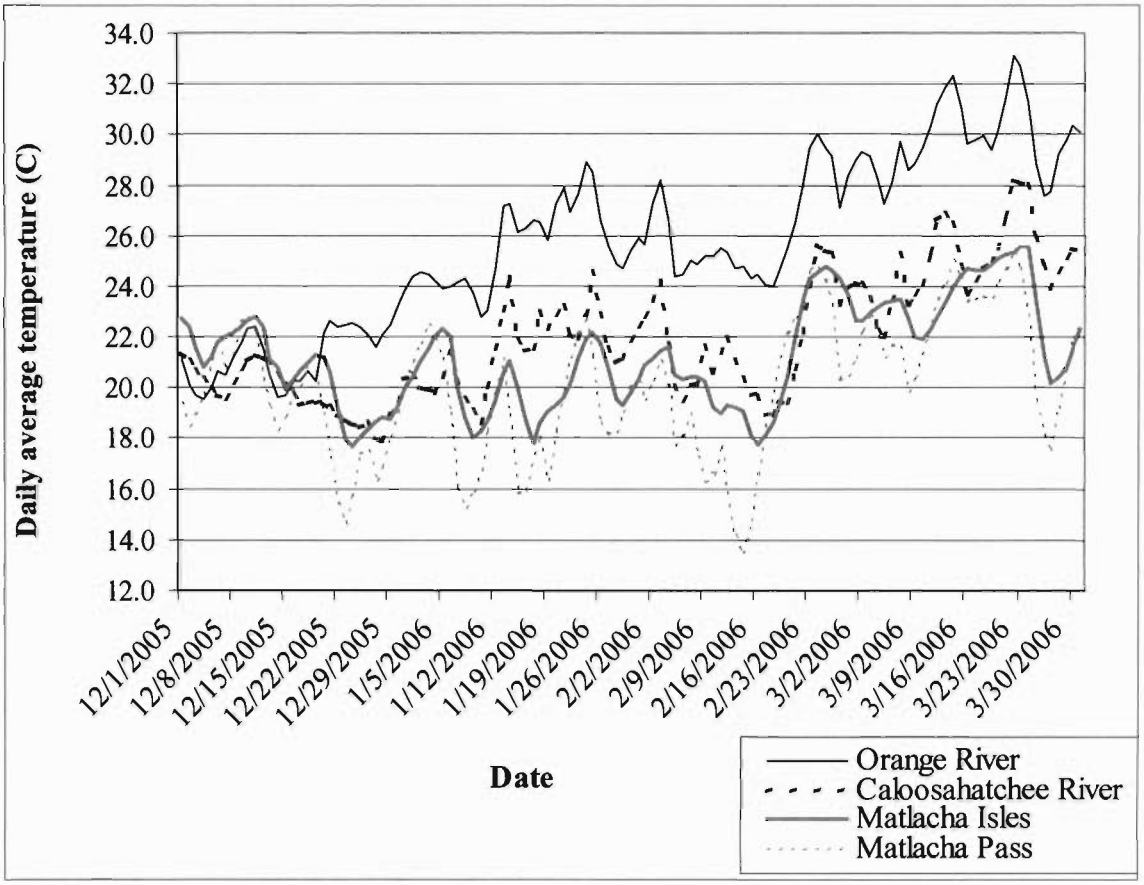

Figure 2. Daily average bottom water temperatures (°C) for sites in Matlacha and near the FPL Ft. Myers power plant, winter and early spring 2005/2006.