A Rapid Bioassessment Program for Estero Bay Tributaries

FINAL REPORT

Principal Investigators
Edwin M. Everham III
John R. Cassani
S. Gregory Tolley
Dave W. Ceilley

April 4, 2000

Table of Contents

Project Goal

The goal of this project is to develop a rapid bioassessment protocol that will support the development of an estuarine stream index (ESI) utilizing fish and possibly benthic macroinvertebrate faunas and designed specifically for use in estuaries including the tidal portions of associated tributaries. This involves integration and modification of existing protocols for freshwater and marine systems, and the development of new standards appropriate for estuarine systems. The development and validation of an ESI will provide a tool to resource managers for confirming that fish populations in similar estuarine streams of southwest Florida will respond to similar anthropogenic stress with a predictable pattern. This project is intended to accomplish the initial survey of possible methods for data collection and analysis and preliminary field testing of the resulting protocol. It is not intended to accomplish validation of that protocol.

Project Description

This project was organized into four phases: 1) Planning Phase, 2) Preliminary Sampling Phase, 3) Intensive Sampling Phase, and 4) Analysis and Reporting Phase.

Phase I involved a review of literature on sampling protocols and alternative measures to include in the bioassessment. During this phase we developed initial protocols for the field procedures and a Quality Assurance Plan.

In Phase II we conducted preliminary sampling of gear to determine the most appropriate and practical method of sampling in Estero Bay tributaries. The use of block-net seining and various fish traps were evaluated. Preliminary data on physical water quality parameters were examined to attempt to identify habitat types of estuarine streams of Estero Bay and ultimately provide a basis for comparing similar habitat types in other estuarine streams of southwest Florida. During this phase of the project we sampled all four tributaries to the bay. We also developed an Estuary Tributary Habitat Data form (see Appendix A).

After gear determination and habitat type identification resulting from Phase II activities was completed, we focused our efforts on three sites in the Estero River and intensively sampled using seining and Breder traps. This Phase III of the project occurred from August 1999 to January 2000, overlapping the end of the rainy season and the beginning of the dry season. We did not continue with macroinvertebrate sampling as taxonomic identification proved too labor intensive. Our initial experiments with plankton nets in the river were also unproductive. Shallow water and obstructions made it difficult to pull the net. All data collected were transferred to an Excel spreadsheet (see Appendix D).

In the final phase of the project we compared the two fish sampling techniques using a variety of metrics for summarizing date, including: total count of fish, species count, Shannon Diversity Index, Simpson Diversity Index and Pielou Eveness Index. The biodiversity indices chosen represented a balance of emphasis on richness (species count), eveness (Pielou), and incorporation of both (Shannon and Simpson).

Figure 1 - Water Temperature

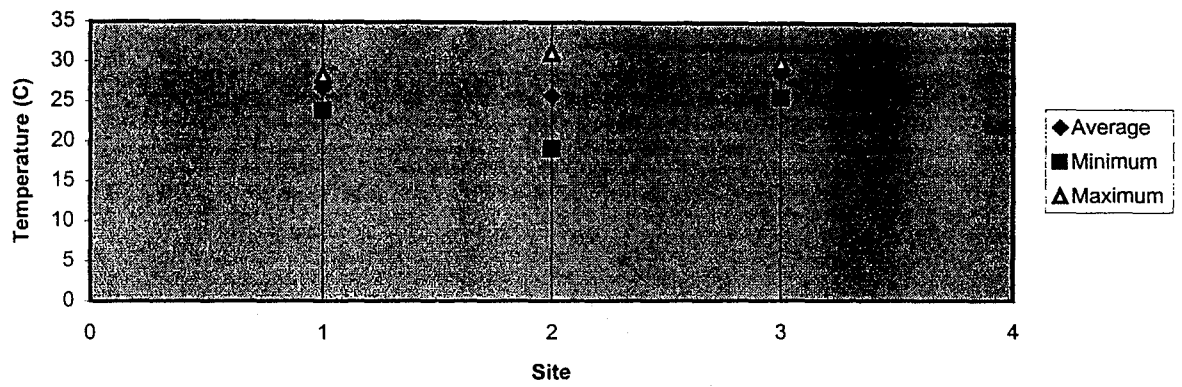


Figure 2 - Salinity

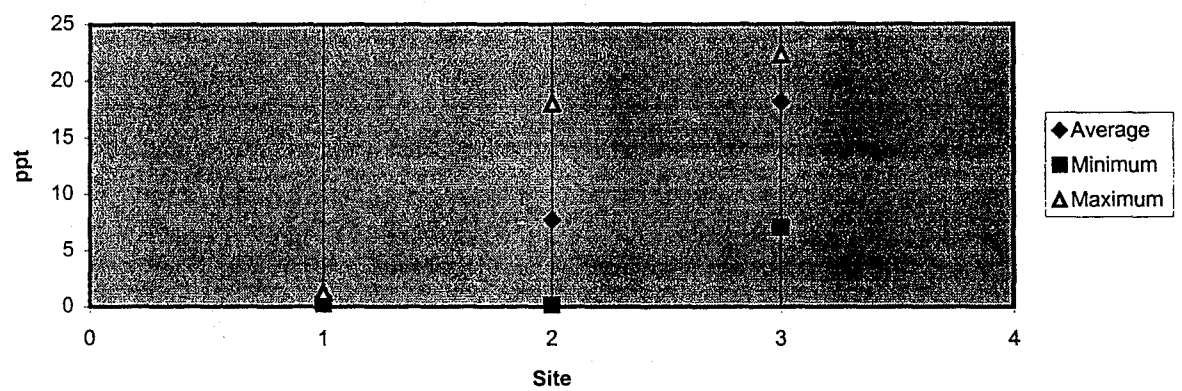
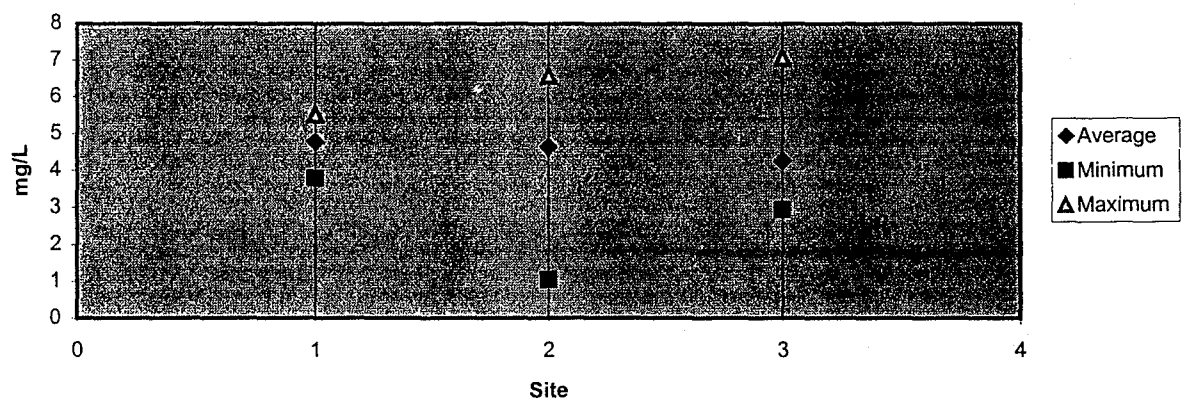


Figure 3 - Dissolved Oxygen



During intensive sampling of our threes sites on the Estero River we collected specimens of 45 species of native fish, and at least two species of exotic fish (Table 2). The number of species of exotic fish is probably an underestimate as we could not identify specimens beyond the level of genus. Exotic fish were almost exclusively found at Site 1, the upstream site. One individual was netted at Site 2. Percent composition of exotic fish in a given sample varied from 0 - 25% in Breder traps (mean=8.3%, sd=22.2) and 0 - 83.9% (mean=25.3, sd=30.1) in seining. Total counts of fish varied from 0 - 24 in a single Breder trap (mean=3.18, sd=4.3) and from 0 - 177 from a single seine (mean=36.8, sd=43.5). Species richness, as measured by number of species, varied from 0 - 5 (mean=1.0,sd=0.85) in Breder traps and varied from 0 - 9 (mean=3.42, sd=1.87). The most common species are shown in Table 3.

Table 3 - Most Common Fish Species by Sampling Technique

Species	Common name	Count in Breder Traps	Count from Seining	Total Count
Eucinostomus argenteus	Spotfin Mojarra	4	520	524
Gambusia holbrookii	Mosquitofish	57	41	98
Poecilia latipinna	Sailfin Molly	33	36	69
Membras martinica	Rough Silverside	-	53	53

Analysis

Selection of a sampling technique must, in part, be based on the ability to generate precise data. The technique that minimizes variance over the time of sampling should provide more precise data. In Table 4 we compare the variance generated from our two sampling techniques quantified using five metrics. Since the means vary so greatly (e.g. 3.18 for count of fish using Breder traps, but 36.8 for seining), we standardize the variance of each metric as a proportion of the mean. This analyze indicates that seining (average standard deviation to mean ration of 0.623) minimizes the variance of our sampling relative to use of Breder traps (average standard deviation to mean ratio of 0.907).

Table 4 - Comparison of Breder Traps and Seining for Different Metrics

Technique	Breder Trap			Seining		
Metric	Mean	SD	SD/Mean	Mean	SD	SD/Mean
Count of Fish	31.8	4.3	1.35	36.8	43.5	1.18
Species Richness	1.0	0.85	0.85	3.42	1.87	0.547
Shannon Index	0.249	0.287	1.15	0.738	0.394	0.534
Simpson Index	0.871	0.242	0.278	0.592	0.219	0.370
Pielou Index	n/a	n/a	n/a	2.45	1.19	0.486

The data must also be a valid measure of the health of the system. Without a clearly undisturbed site as a reference for comparison, we relied on assessing the validity of our sampling by examining the temporal pattern of the metrics. Over the relatively short (six months) period of intensive sampling, we assumed little change in the health of the system. Therefore, the most robust metric should have a consistent value over the sampling period, indicated by a slope of , or near, zero. In Figures 4 - 27, the temporal pattern of each metric for each sampling technique,

Figure 7 - Seining Species Count for Site 1

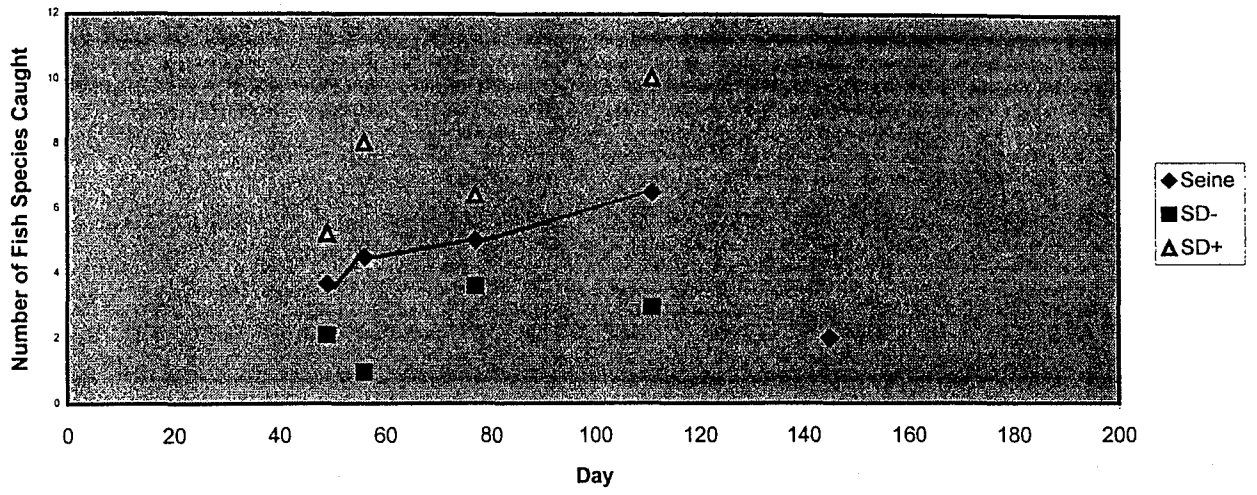


Figure 8 - Seining Species Count for Site 2

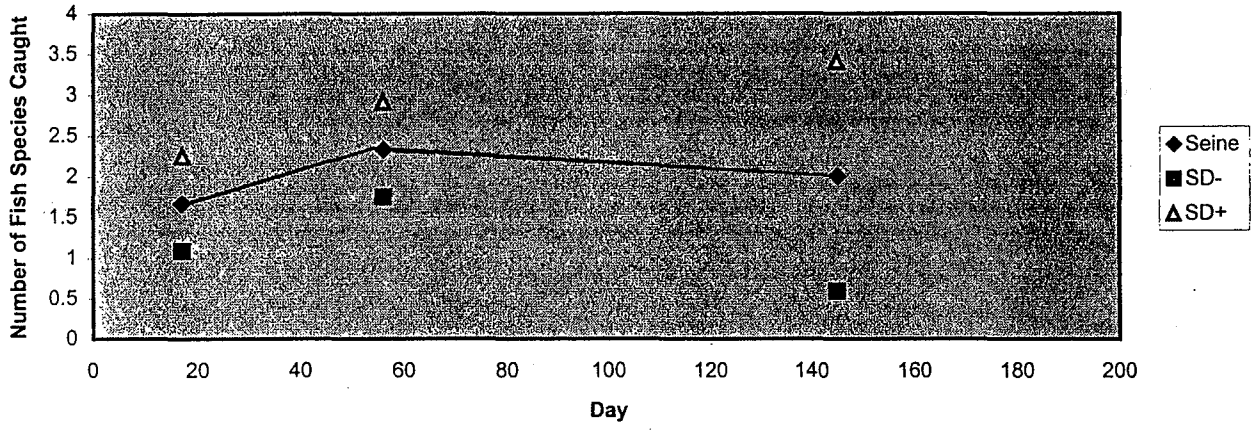


Figure 9 - Seining Species Count for Site 3

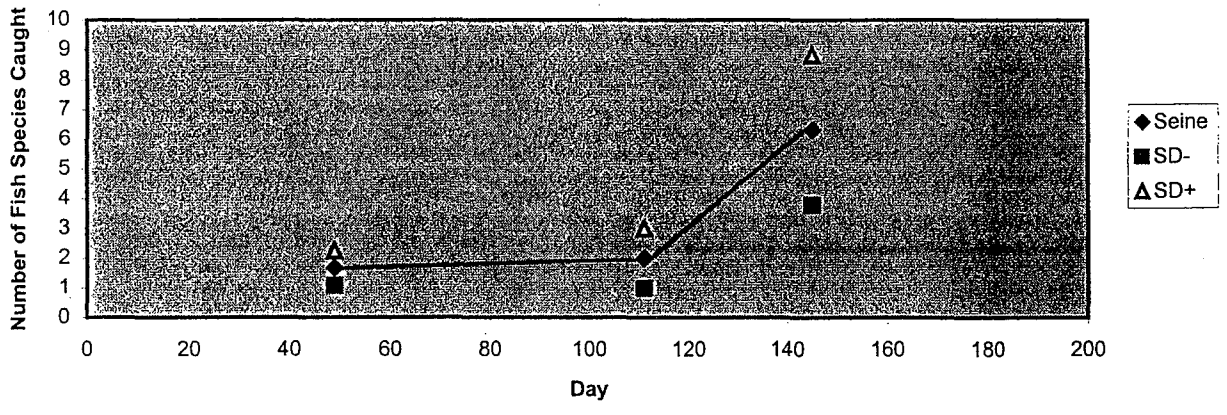


Figure 10 - Breder Trap Shannon Index for Site 1

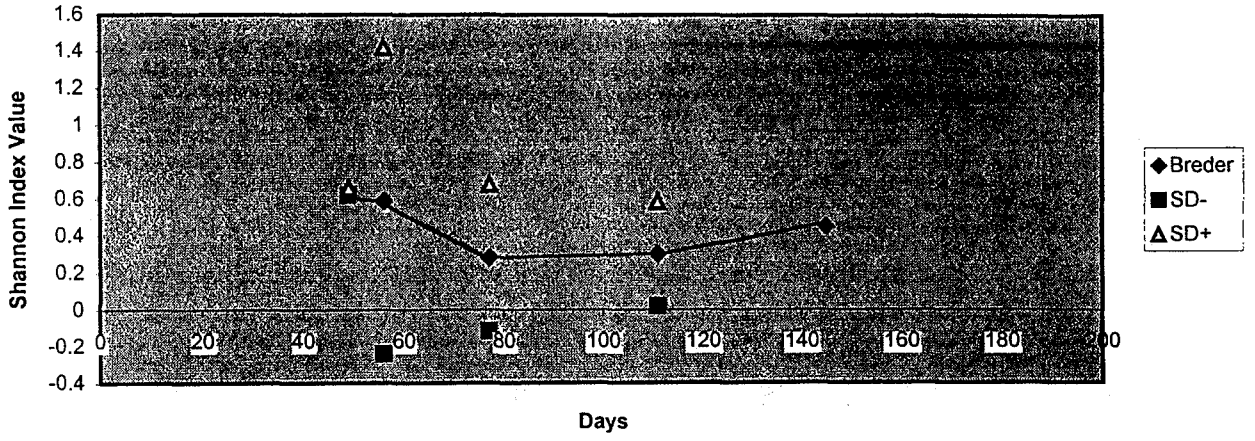


Figure 11 - Breder Trap Shannon Index for Site 2

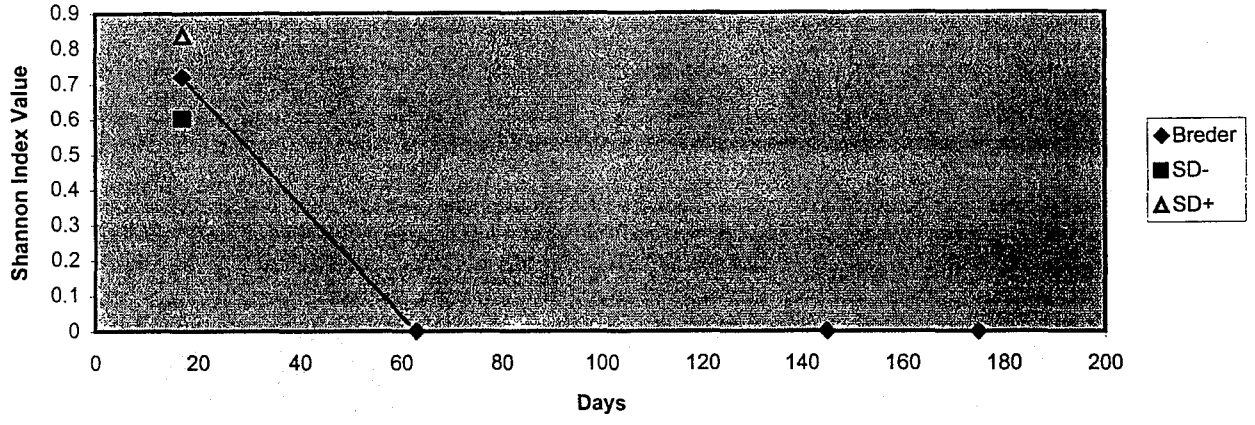


Figure 12 - Breder Trap Shannon Index for Site 3

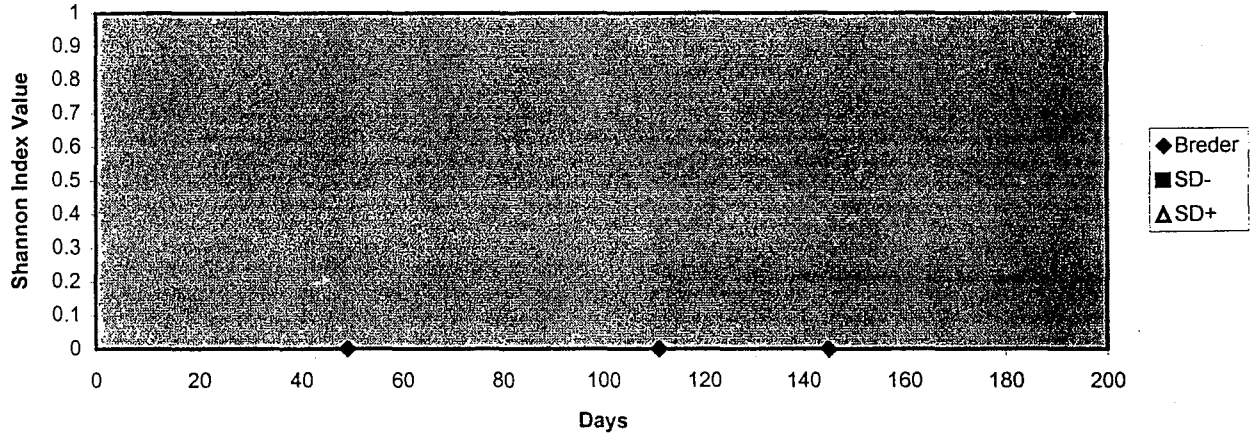


Figure 16 - Seining Simpson Index for Site 1

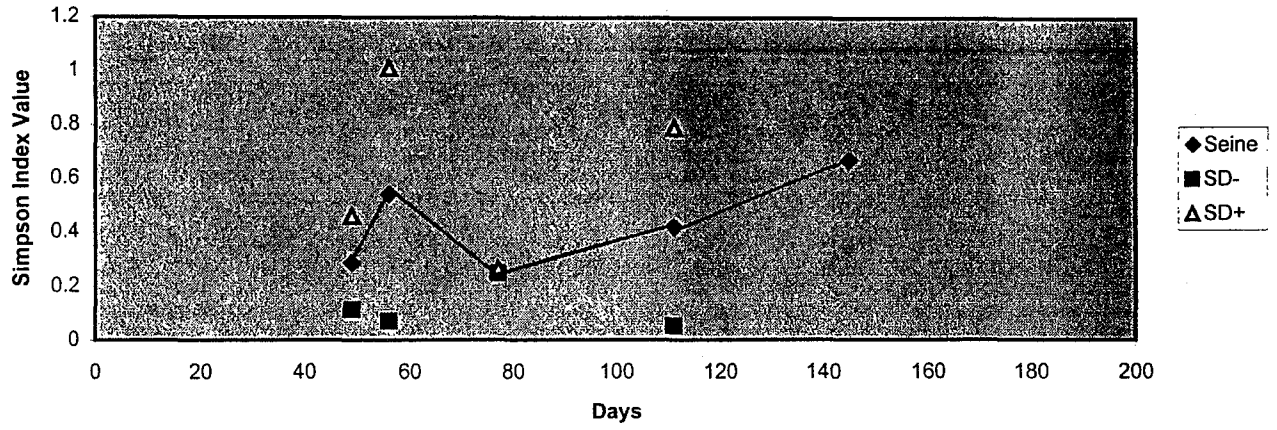


Figure 17 - Seining Simpson Index for Site 2

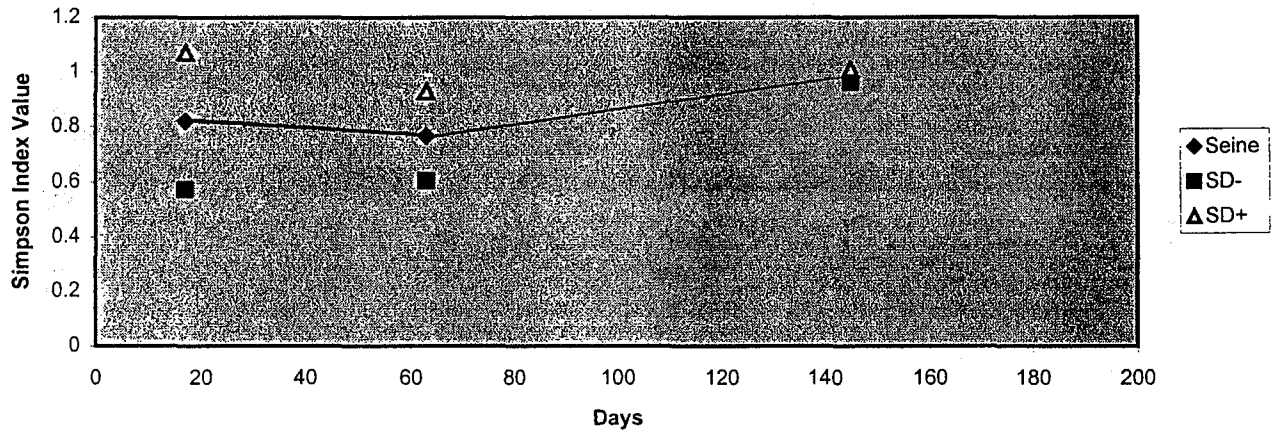


Figure 18 - Seining Simpson Index for Site 3

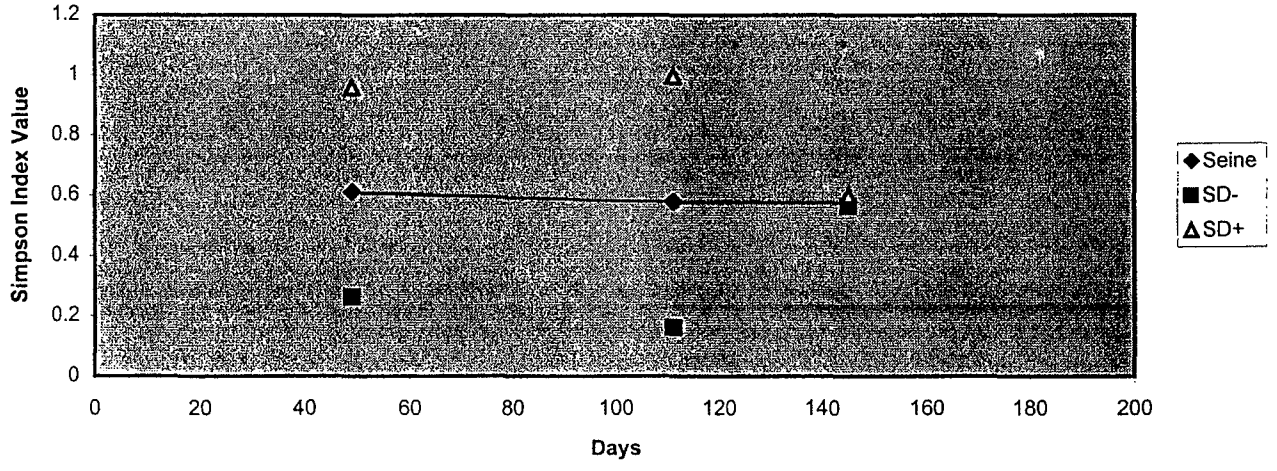


Figure 22 - Breder Trap Fish Count for Site 1

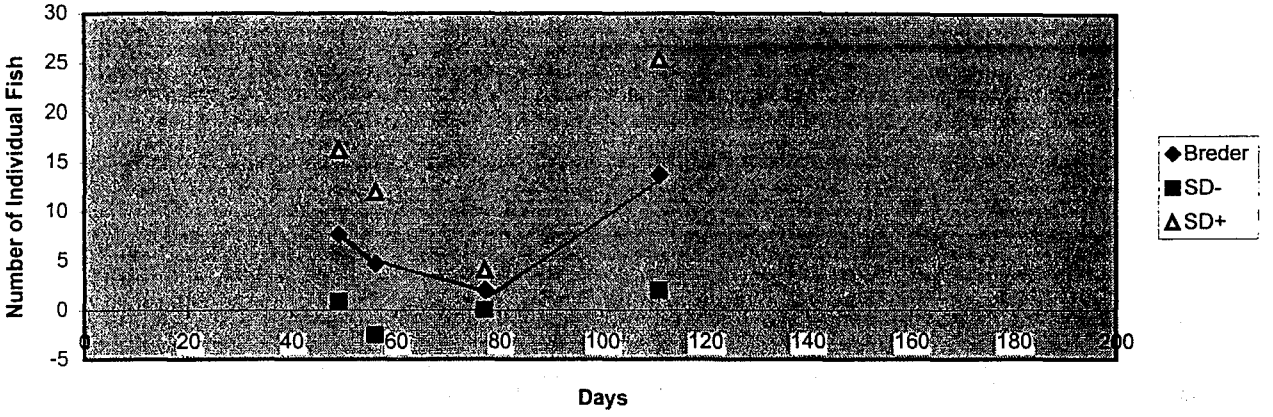


Figure 23 - Breder Trap Fish Count for Site 2

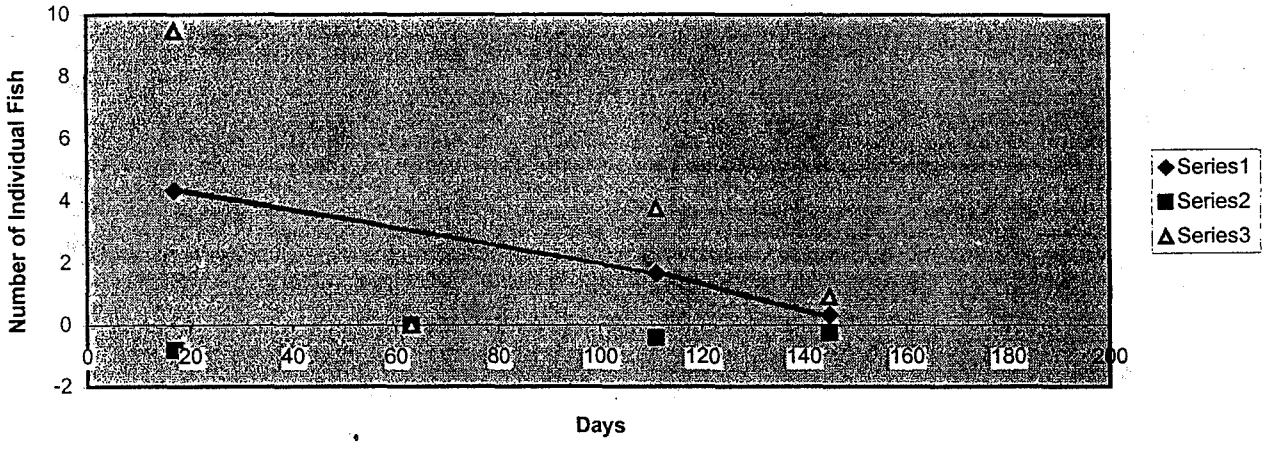


Figure 24 - Breder Trap Fish Count for Site 3

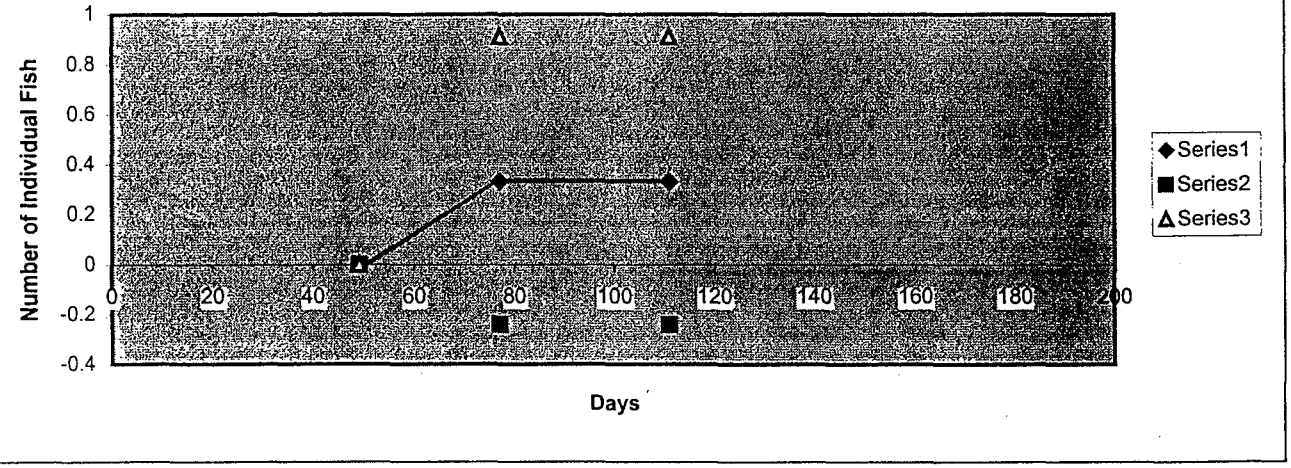


Table 6 - Trend in Metrics by Sampling Technique

Metric	Statistic	Breder Trap	Seine	Combined
Count Of Fish	Correlation (R^2)	0.118	0.367	0.189
	Slope Average	0.0512	0.595	0.323
	Slope Average (absolute values)	0.512	0.595	0.323
Number Of Species	Correlation (R^2)	0.0729	0.169	0.121
	Slope Average	-0.00128	0.0141	0.0064
	Slope Average (absolute values)	0.00375	0.0163	0.010
Shannon Index	Correlation (R^2)	0.318	0.133	0.226
	Slope Average	0.00086	0.00145	0.0012
	Slope Average (absolute values)	0.0046	0.00145	0.0012
Simpson Index	Correlation (R^2)	0.207	0.577	0.392
	Slope Average	0.0039	0.00194	0.00292
	Slope Average (absolute values)	0.00194	0.00194	0.00194
Pielou Index	Correlation (R^2)	0.579	0.389	0.484
	Slope Average	-0.0097	-0.197	0.103
	Slope Average (absolute values)	0.0097	0.203	0.106

Recommendations

The results of this preliminary project has identified several possible directions for future work. To fully develop, and valid, a rapid bioassessment metric will require further testing over a longer time period and at additional sites.

Our results indicate that seining fish holds the most promise for a technique that will give consistent results over time. However, future project may continue to test the use of fish traps, in place for longer periods. Fish traps are easily to train students to use effectively and can be placed by a single volunteer, rather than the team required for seining.

Our results also indicate that either Shannon's Index or Simpson's Index could be utilized as a metric for detecting change in the tributaries. These two metrics had minimum variation and were consistent during the sampling period. However, we now need to determine how these metrics vary when compared to a reference site and how they respond to increasing stress on the system. This requires continued sampling at additional sites and over a longer time period. Although in the Estero River the occurrence of exotics is limited to the upstream reaches, this may change through time and this metric may serve as a measure of change in the health of the system.

Finally, our experience with training students to identify local fish species illuminated a need for reference materials. Building from this project we intend to develop a photographic field identification booklet that can be utilized by volunteer monitors.

ESTERO BAY RAPID BIOASSESSMENT
Estuary Tributary Habitat Data

Date _____ Time _____ Recorder _____

Tributary _____ Site _____

INSTREAM FEATURES

Stream Width (m)_____

Evidence of Point Source Pollution _____

Clarity Clear _____ Slightly Turbid _____ Turbid_____ Opaque _____

Color Brown _____ Green _____ Blue _____ Other _____

Artificial Channelization

None_____ Recovered_____ Some Recovery_____ Channeled_____

Comments:

Substrates: presence of snags, logs, roots, emergent vegetation

>40% _____ 20-40%_____ 5-20%_____ >5%_____

Comments:

Sediments:

Gravel/rock_____ Sand _____ Muck_____ other_____ n/a _____

Comments:

RIPARIAN ZONE

Canopy Cover

Open_____ Light (11-45%)_____ Moderate (46-80%)_____ Heavy (>80%) _____

_____ Bank _____ Bank

Predominant Landuse (%)	Predominant Landuse (%)
Forest_____ Field_____ Altered_____	Forest_____ Field_____ Altered_____
Native____ | Agricultural_____	Native____ | Agricultural_____
Exotic____ | Residential _____	Exotic____ | Residential _____
Type _____ | Commercial_____	Type _____ | Commercial_____
_____ | Industrial _____	_____ | Industrial _____
Comments:	Comments:
Riparian Zone Width (%)	Riparian Zone Width (%)
Native _____ Exotic _____	Native _____ Exotic _____
> 20___ 10-20___ 5-10___ 0-5___ 0___	> 20___ 10-20___ 5-10___ 0-5___ 0___
Vegetation Overhang (%)	Vegetation Overhang (%)
Native _____ Exotic _____	Native _____ Exotic _____
> 3___ 1-3___ 0-1___ 0___	> 3___ 1-3___ 0-1___ 0___
Littoral Alterations	Littoral Alterations
None___ Landscape___ Riprap___ Seawall___	None___ Landscape___ Riprap___ Seawall___
Erosion Potential	Erosion Potential
None ___ Slight___ Moderate___ High___	None ___ Slight___ Moderate___ High___

COMMENTS

Seining Protocol

Net Description: 12.2 m, center-bag seine with 3.2 mm mesh.

Net Deployment:

1. Stretch seine out perpendicular to and with the bag facing into the current.

2. In order to maintain a constant net width through the water, attach a 9.1 m line to the tops of the seine poles and stretch the poles until the line is taught. Angle seine poles so that the lead line is slightly ahead of the float line and begin seining into the current.

3. In order to standardize the area sampled, pull the seine through a horizontal distance of 9.1 meters (gauged using a 9.1 m line).

4. Record water depth as that at which the bag of the seine is deployed.

5. At the end of the 9.1 m line, the two seiners begin to walk toward one another as rapidly as possible.

6. Plant a third pole–the pivot pole–at the point where the two seiners meet. (Note: It is important that the person responsible for carrying both the 9.1 m line and the pivot pole walk beside the seine as it is deployed so as not to disturb any fish out ahead of the seine)

7. Orient the mouth of the bag into the current to keep the bag open and ensure the movement of fish into the bag. If algae is encountered, push it into the bag while retrieving.

8. The first seiner takes both seine poles and pulls the seine around the stationary pivot pole at an angle sufficient to avoid gaps between the pole and the netting (~ 90°).

9. The second seiner helps the pivot person hold the stationary pole and guide the seine around the pole, keeping the lead line on the bottom at all
times. The second seiner and the pivot person also push the seine wings firmly against each other, and the pole, to prevent fish from escaping.

10. When the two sides of the bag meet the stationary pole, stop pulling the seine. The seiner pulling the wings grabs the lead lines and pulls about four more feet of lead line past the pivot pole.

11. The pivot person digs under the net using the pivot pole at the point where the net bends around the pivot pole and pulls the net to the surface using the pole.

12. Using dip nets, transfer the fish to a bucket for recording.

13. Repeat this process two more times, moving upstream for each new,

Fish Trapping Protocol

Trap Description: Modified Breder Trap, constructed of plexiglas with dimensions 15 cm by 15 cm by 30 cm and a 1 cm slot for entry..

Trap Deployment:

1. use three traps for each site.

2. Place traps on the bottom, with the top near the water's surface and orienting the trap so the opening is parallel to the shoreline.

3. Leave traps in place for 30 minutes.

4. Remove traps and transfer fish to a bucket for recording.

Data Collection:

1. Identify each individual fish as to species.

2. Measure the total length of fish < 5 cm.

3. Archive samples of unknown fish and representatives of known species for verification.

4. Record all information on the Breder Data Sheet, including indicating which specimens are archived.

ESTERO BAY RAPID BIOASSESSMENT
Estuary Tributary Bioassessment Data

Date _____ Time _____
Recorders :

Sampling Site

Tributary _____ Site _____

Weather Conditions

Tide stage :

Physical Water Quality

Secchi dish Depth ____

Clarity Clear ___ Slightly turbid ___ turbid ___ Opaque ___

Color Brown ___ Green ___ Blue ___ Other _____

Odors None ___ Sulfides ___ Sewage ___ Petroleum ___ Chemical ___ Other _____

Surface Oils None ___ Sheen ___ Globs ___ Slick ___
Comments:

Water Depth ____ YSI # _____

Depth	Temperature	PH	DO	Conductivity
Top				
Middle				
Bottom				

COMMENTS

ESTERO BAY RAPID BIOASSESSMENT

Estuary Tributary Bioassessment Data

Breder Trapping

Date _____ Time _____

Recorder:

Sampling Site

Tributary _____ Site _____

Trap 1	Depth-			**Trap 2**	Depth-			**Trap 3**	Depth-		
Time in-	Time out-			Time in-	Time out-			Time in-	Time out-		
Count	Species	Size	A	Count	Species	Size	A	Count	Species	Size	A
Comments				comments				comments			

A - indicates an archived sample

COMMENTS:

Fish Species Codes:

Estero Bay Rapid Bioassessment Database

Sheet 1	Summary	6 pages
Sheet 2	Physcial Water Data	2 pages
Sheet 3	Breder Trap Data	2 pages
Sheet 4	Seining Data	3 pages
Sheet 5	Archived Specimens	4 pages
Sheet 6	Species List	1 page
Sheet 7	Biodiversity Data	6 pages

Physical Water Quality

Site 1 n=10	Temperature	Conductivity	Salinity	DO%	DO	pH
average	26.77	0.53	0.64	51.5	4.77	7.6
minimum	23.82	0.41	0.26	48.1	3.79	7.3
maximum	28.23	0.6	1.21	67.7	5.51	7.9

Site 2 n=15	Temperature	Conductivity	Salinity	DO%	DO	pH
average	25.69	10.88	7.74	56.39	4.64	7.67
minimum	19.12	0.301	0.14	12	1.05	7.2
maximum	31.1	36.55	18	80.1	6.58	8.3

Site 3 n=12	Temperature	Conductivity	Salinity	DO%	DO	pH
average	28.56	31.31	18.13	60.8	4.26	7.73
minimum	25.55	13.17	7.05	43.4	2.95	7.5
maximum	29.95	38.42	22.3	97	7.07	8

Species R **SITE 1**

Date	day	1 breder	2 breder	3 breder		1 seine	2 seine	3 seine
8/17/1999	17							
9/9/1999	49	3	2	1		4	5	2
9/16/1999	56	1	0	5		2	7	
9/23/1999	63							
10/7/1999	77	2	0	1		6	4	
11/11/1999	111	2	1	3		9	4	
12/15/1999	145					2		
1/25/2000	175							
		r^2= 0.000841		m= -0.0016		r^2= 0.0026		m= -0.0034

Count **SITE 1**

Date	day	1 breder	2 breder	3 breder		1 seine	2 seine	3 seine
8/17/1999	17							
9/9/1999	49	10	13	0		34	7	7
9/16/1999	56	1	0	13		16	23	
9/23/1999	63					21		
10/7/1999	77	4	0	2		122	8	
11/11/1999	111	16	1	24		6	23	
12/15/1999	145							
1/25/2000	175							
		r^2= 0.226		m= 0.149		r^2= 0.0036		m= 0.0864

Species R **SITE 3**

Date	day	1 breder	2 breder	3 breder		1 seine	2 seine	3 seine
8/17/1999	17							
9/9/1999	49	0	0	0		2	1	2
9/16/1999	56							
9/23/1999	63							
10/7/1999	77							
11/11/1999	111	0	1	0		3	1	2
12/15/1999	145	1	0	0		9	6	4
1/25/2000	175							
		r^2= 0.125		m= 0.0037		r^2= 0.477		m= 0.0433

Count **SITE 3**

Date	day	1 breder	2 breder	3 breder		1 seine	2 seine	3 seine
8/17/1999	17							
9/9/1999	49	0	0	0		4	3	3
9/16/1999	56							
9/23/1999	63							
10/7/1999	77							
11/11/1999	111	0	1	0		4	1	8
12/15/1999	145	1	0	0		160	35	14
1/25/2000	175							
		r^2= 0.125		m= 0.0037		r^2= 0.249		m= 0.609

H' SITE 2

Date	day	1 breder	2 breder	3 breder		1 seine	2 seine	3 seine
8/17/1999	17					0	0.617	0.168
9/9/1999	49	0.637	0.802					
9/16/1999	56							
9/23/1999	63	0	0	0		0.679	0.206	0.318
10/7/1999	77							
11/11/1999	111							
12/15/1999	145	0	0	0		0	0.97	
1/25/2000	175	0						
		r^2= 0.496		m= -0.00374		r^2= 0.067		m= 0.00172

D SITE 2

Date	day	1 breder	2 breder	3 breder		1 seine	2 seine	3 seine
8/17/1999	17	0.333	0.489			1	0.538	0.92
9/9/1999	49							
9/16/1999	56							
9/23/1999	63	1	1	1		0.584	0.895	0.819
10/7/1999	77							
11/11/1999	111							
12/15/1999	145	1	1	1		1	0.966	
1/25/2000	175	1						
		r^2= 0.494		m= 0.00306		r^2= 0.067		m= 0.00172

E1 SITE 2

Date	day	1 breder	2 breder	3 breder		1 seine	2 seine	3 seine
8/17/1999	17	1.89	2.23			1	1.85	1.18
9/9/1999	49					1.97	1.23	1.37
9/16/1999	56							
9/23/1999	63							
10/7/1999	77							
11/11/1999	111							
12/15/1999	145	0						
1/25/2000	175							
		r^2= 0.98		m= -0.0161		r^2= 0.195		m= -0.599

Physical Water Quality

Stations	1 ER outfitters	
	2 Below US 41 Bridge	becomes sampling Site 1
	3 Boat ramp	
	4 Footbridge	
	5 Powerline	
	6 Halfway Creek	becomes sampling Site 2
	7 River broadens	
	8 River turns	
	9 Tidal creek shoal	downstream from sampling Site 3
	10 Mouth of the river	

Tributary	Site	Date	Time	Depth (m)	Tempe (C)	Condu uS/cm	Salinit ppt	DO%	DO mg/L	pH	Secchi D (m)	Notes
Estero	1	10/15/1998	2:00 PM	0	26	0.52	0.24	61	4.9	7.8		
Estero	1	10/15/1998	2:00 PM	0.33	25.9	0.51	0.24	56	4.75	7.68		
Estero	2	10/15/1998	2:05 PM	0	26.35	0.56	0.26	59	4.68	7.59		
Estero	2	10/15/1998	2:05 PM	0.5	26.26	0.56	0.26	54.2	4.35	7.53		
Estero	3	10/15/1998	2:10 PM	0	26.75	0.56	0.26	66	5.22	7.59		
Estero	3	10/15/1998	2:10 PM	0.5	26.7	0.56	0.26	62.9	5.02	7.57		
Estero	4	10/15/1998	2:15 PM	0	27.18	1.14	0.54	62	4.9	7.58		
Estero	4	10/15/1998	2:15 PM	0.5	28.4	14.03	8.2	37.6	2.86	7.33		
Estero	5	10/15/1998	2:20 PM	0	27.96	3.58	1.7	63.4	4.72	7.6		
Estero	5	10/15/1998	2:20 PM	0.75	28.87	29	16.45	45	3.22	7.52		
Estero	6	10/15/1998	2:25 PM	0	27.9	5.56	2.65	59.5	4.51	7.65		
Estero	6	10/15/1998	2:25 PM	0.75	29	36.35	17.96	37	2.52	7.53		
Estero	7	10/15/1998	2:30 PM	0	28.2	9.93	5.1	60.9	4.39	7.65		
Estero	7	10/15/1998	2:30 PM	0.5	27.7	36	21.4	58.3	4.07	7.72		
Estero	8	10/15/1998	2:40 PM	0	28.44	13.17	7.05	70	4.98	7.73		
Estero	8	10/15/1998	2:40 PM	0.75	28	31.73	18.7	58.1	4.11	7.69		
Estero	9	10/15/1998	2:50 PM	0	28.41	21.24	11.83	66.4	4.71	7.72		
Estero	9	10/15/1998	2:50 PM	0.5	28.4	22.28	12.48	59.8	4.33	7.7		
Estero	10	10/15/1998	3:00 PM	0	28.56	28.9	16.6	66	4.52	7.74		
Estero	10	10/15/1998	3:00 PM	0.5	28.83	40.68	24.03	78.2	5.36	8.07		
Estero	1	7/23/1999	11:45 AM	0	27.86	0.661	0.31	74.5	5.94	7.97		
Estero	1	7/23/1999	11:45 AM	0.75	27.22	0.67	0.31	71	5.62	7.61		
Estero	1	7/23/1999	11:45 AM	1.5	27.24	0.692	0.32	70.2	5.59	7.69		
Estero	2	7/23/1999	11:45 AM	0	28.23	0.41	0.9	67.7	5.36	7.85		
Estero	2	7/23/1999	11:45 AM	0.9	27.96	0.44	0.93	59.3	4.72	7.65		
Estero	2	7/23/1999	11:45 AM	1.8	27.25	0.57	1.207	59.8	4.89	7.54		
Estero	6	7/23/1999	11:05 AM	0	29.29	1.92	4.08	80.1	6.22	7.84		
Estero	6	7/23/1999	11:05 AM	0.35	29.2	2.45	4.98	61.6	4.17	7.79		
Estero	6	7/23/1999	11:05 AM	0.75	29.32	6.95	12.08	47.8	3.68	7.35		
Estero	8	7/23/1999	10:45 AM	0	29.95	36.45	20.91	47.3	3.22	7.76		
Estero	8	7/23/1999	10:45 AM	0.8	29.27	36.67	21.13	43.4	2.95	7.7		
Estero	8	7/23/1999	10:45 AM	1.75	29.35	36.74	21.21	44.5	3.07	7.7		
Estero	9	7/23/1999	10:33 AM	0	29.73	36.55	19.87	85	5.76	7.72		
Estero	9	7/23/1999	10:33 AM	0.75	29.25	36.35	22.32	47.5	3.19	7.76		

Breder Trap Data

Site Locatio	1	Koreshan State Historic Site
	2	Halfway Creek
	3	Shallow bay before river divides

Tributar	Site	Date	Trap	Dept (cm)	Time In	Time Out	Species	Count	Size cm	Notes
Estero	2	8/17/1999	1	50	10:13 AM	10:33 AM	EUCARG	2	<5	A
							MICGLU	1	<5	A
Estero	2	8/17/1999	2	50	10:13 AM	10:33 AM	none			
Estero	2	8/17/1999	3	50	10:13 AM	10:33 AM	none			
Estero	2	8/17/1999	4	0	10:38 AM	10:55 AM	none			
Estero	2	8/17/1999	5	0	10:38 AM	10:55 AM	POELAT	7	<5	A
							TILspp	1	<5	A
							GAMHOL	2	<5	A
Estero	2	8/17/1999	6	25	10:38 AM	10:55 AM	none			
Estero	1	9/9/1999	1	0	8:30 AM	8:55 AM	POELAT	8	<5	
							GAMHOL	1	<5	
							LOPCYP	1	<5	
Estero	1	9/9/1999	2	0	8:30 AM	8:55 AM	GAMHOL	8	<5	
							POELAT	5	<5	
Estero	1	9/9/1999	3	0	8:30 AM	8:55 AM	none			
Estero	3	9/9/1999	1	0	10:10 AM	10:20 AM	none			
Estero	3	9/9/1999	2	0	10:10 AM	10:20 AM	none			
Estero	3	9/9/1999	3	0	10:10 AM	10:20 AM	none			
Estero	1	9/16/1999	1	0	9:50 AM	10:03 AM	GAMHOL	1	<5	
Estero	1	9/16/1999	2	0	9:50 AM	10:03 AM	none			
Estero	1	9/16/1999	3	0	9:50 AM	10:03 AM	CICspp	2	<5	
							POELAT	8	<5	
							LEPGUL	1	<5	
							LEPMAC	1	<5	
							LEPMIC	1	<5	
Estero	2	9/23/1999	1	25	9:29 AM	9:41 AM	none			
Estero	2	9/23/1999	2	25	9:29 AM	9:41 AM	none			
Estero	2	9/23/1999	3	25	9:29 AM	9:41 AM	none			
Estero	1	10/7/1999	1	10	10:05 AM	10:20 AM	GAMHOL	3	<5	
							CICspp	1	<5	
Estero	1	10/7/1999	2	10	10:05 AM	10:20 AM	none			
Estero	1	10/7/1999	3	3	10:05 AM	10:20 AM	GAMHOL	2	<5	
Estero	1	11/11/1999	1	0	2:42	3:10	GAMHOL	12	<5	
							POELAT	4	<5	
Estero	1	11/11/1999	2	5	2:42	3:10	GAMHOL	1	<5	
Estero	1	11/11/1999	3	0	2:42	3:10	GAMHOL	22	<5	
							NOTMAC	1	<5	
							LUCGOO	1	<5	A
Estero	3	11/11/1999	1	0	5:05 PM	5:35 PM	none			
Estero	3	11/11/1999	2	0	5:05 PM	5:35 PM	EUCARG	1	<5	
Estero	3	11/11/1999	3	0	5:05 PM	5:35 PM	none			
Estero	3	12/15/1999	1	5	3:04 PM	3:30 PM	POELAT	1	<5	4 shrimp

Seining Data

Site Locations
1 Koreshan State Historic Site
2 Halfway Creek
3 Shallow bay before river divides

Tributary	Site	Date	Time	Seine Type	Species	Count	Size (cm)	Notes
Estero	2	8/17/1999	10:15 AM	1 40 ft 1/8"	EUCARG	3	<5	A
					EUCARG	1	21.5	
					EUCARG	1	8.5	
					EUCARG	1	7.8	
					EUCARG	1	6.5	
					EUCARG	1	6.7	
					EUCARG	1	6.9	
Estero	2	8/17/1999	10:30 AM	2 40 ft 1/8"	EUCARG	1	7.2	2 shrimp
					EUCARG	8	<5	
					MEMMAR	4	<5	A
Estero	2	8/17/1999	10:52 AM	3 40 ft 1/8"	EUCARG	1	<5	
					MENBAR	24	<5	
Estero	1	9/9/1999	8:35 AM	1 40 ft 1/4"	TILspp	12	<5	
					EUCARG	15	<5	A
					POELAT	6	<5	
					LEPPLA	1	37	
Estero	1	9/9/1999	8:50 AM	2 40 ft 1/4"	EUGPLU	1	<5	A
					POELAT	2	<5	
					LOPCYP	2	<5	A
					TRIMAC	1	7.5	
					LEPMIC	1	<5	
Estero	1	9/9/1999	9:07 AM	3 40 ft 1/4"	TILspp	3	<5	
					EUCARG	1	22.5	
					EUCARG	1	15	
					EUCARG	2	<5	A
Estero	3	9/9/1999	10:10 AM	1 40 ft 1/4"	EUCARG	3	<5	
					LOPCYP	1	<5	A
Estero	3	9/9/1999	10:23 AM	2 40 ft 1/4"	EUCARG	3	<5	
Estero	3	9/9/1999	10:42 AM	3 40 ft 1/4"	EUCARG	2	<5	A
					ANCMIT	1	<5	A
Estero	1	9/16/1999		1 50 ft 1/4"	CENUND	1	8.1	
					EUCARG	15	<5	
Estero	1	9/16/1999		2 50 ft 1/4"	CENUND	1	30.1	
					GAMHOL	5	<5	
					LOPCYP	2	<5	A
					LEPMIC	1	<5	
					EUCARG	9	<5	
					CICspp	1	<5	
					POELAT	4	<5	
Estero	2	9/23/1999	9:40 AM	1 50 ft 1/4"	EUCARG	20	<5	
					MENBER	6	<5	
					MICGUL	1	<5	
Estero	2	9/23/1999	9:55 AM	2 50 ft 1/4"	EUCARG	18	<5	
					LOPCYP	1	<5	

Estero	3	12/15/1999	2:50 PM	1	30 ft 1/8	LAGRHO	2	<5 A
						ANCMIT	2	<5 A
						TRIMAC	1	<5 A
						MENBER	25	<5 A
						ACHLIN	1	<5 A
						EUCspp	118	<5 A
						PRITRI	1	<5 A
						MICGUL	6	<5 A
						SCIOCE	4	<5 A
Estero	3	12/15/1999	3:10 AM	2	30 ft 1/8	MICGUL	5	<5 A
						GOBSHU	1	<5 A
						EUCARG	26	<5 A
						SCIOCE	1	<5 A
						LAGRHO	1	<5 A
						PRITRI	1	<5 A
Estero	3	12/15/1999	3:30 PM	3	30 ft 1/8	ANCMIT	1	<5 A
						PRITRI	1	<5
						LAGRHO	1	7.4
						EUCARG	11	<5 A

Stage	No.	Min	Max	Ecology
juv	1	36	36	freshwater
juv	1	68	68	estuarine dependent
adult	1	24	24	freshwater-estuarine
adult	1	60	60	estuarine
juv	1	25	25	estuarine
adult	3	36	43	freshwater
adult	1	38	38	estuarine
adult	1	34	34	estuarine
juv	2	27	32	exotic
juv	1	36	36	estuarine
	2	34	50	
rside	2	32	32	estuarine
juv	1	28	28	estuarine
rra	1	48	48	estuarine
adult	1	34	34	freshwater-estuarine
adult	1	38	38	freshwater
juv	1	25	25	exotic
	1	12	12	
larva	1	57	57	
adult	1	37	37	estuarine
juv	4	22	38	exotic
adult	1	22	22	freshwater
juv	2	16	17	estuarine
adult	1	18	18	estuarine
juv	2	28	32	freshwater
juv	1	34	34	freshwater
adult	1	30	30	estuarine
juv	1	28	28	exotic
juv	1	29	29	exotic
postlarvae	3	12	12	estuarine
juv	5	23	44	exotic
juv	1	26	26	freshwater
adult	10	40	75	estuarine
juv	7	15	20	estuarine
p	3	20	24	
	7	6	9	
p	4	23	32	
	1	5	5	
	1	9	9	
adult	5	31	43	estuarine
juv	1	20	20	freshwater-estuarine
adult	1	54	54	estuarine
juv	25	11	25	estuarine
juv	1	13	13	estuarine dependent
juv	1	11	11	estuarine dependent

juv	1	12	12	estuarine dependent
	1	5	5	
	18	7	10	
	9	2.5	27	
rimp	5	13	56	
juv	2	12	13	estuarine dependent
adult	1	30	30	estuarine dependent
rimp	5	14	60	
juv	1	14.5	14.5	estuarine dependent
juv	1	15	15	estuarine dependent
juv	3	13	15	estuarine
juv	1	22	22	estuarine dependent
	77	7	9	
	1	4	4	
rab	1	23	23	
adult	22	41	55	estuarine
juv	112	11	29	estuarine
juv	1	15	15	estuarine dependent
juv-adult	6	15	34	estuarine
adult	2	40	56	estuarine
juv	4	13	19	estuarine dependent
	1	49	49	estuarine
	1	45	45	estuarine
	1	55	55	freshwater
	2	36	38	estuarine
y	1	32	32	estuarine
y	1	33	33	estuarine
juv	1	18	18	estuarine
juv	1	17	17	estuarine dependent

Species Totals - biodiversity calculations

Column are used to count species for a given trap/site. They are not consistant species down the column.
All diversity index values are reported to 3 significant digits. References are from Ludwig and Reynolds, 198
Statistical Ecology *Some of the values are unreported because of traps that were empty or equations that can not be solved*

Site 1

Date	Trap Type	Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Spp 6	Spp 7	Spp 8	Spp 9	Shannon H'	Simpson D
9/9/1999	Breder 1	8	1	1							0.639	0.622
	Breder 2	8	5								0.666	0.487
	Breder 3	0										
										AVE	**0.653**	**0.555**
										SD	**0.0191**	**0.095**
	Seine 1	12	15	6	1						1.14	0.337
	Seine 2	1	2	2	1	1					1.55	0.095
	Seine 3	3	4								0.683	0.429
										AVE	**1.12**	**0.287**
										SD	**0.434**	**0.173**
9/16/1999	Breder 1	1									0	
	Breder 2	0										
	Breder 3	2	8	1	1	1					1.18	0.312
										AVE	**0.59**	**0.312**
										SD	**0.83**	
	Seine 1	1	15								0.234	0.875
	Seine 2	1	5	2	1	9	1	4			1.62	0.209
										AVE	**0.927**	**0.542**
										SD	**0.98**	**0.471**
10/7/1999	Breder 1	3	1								0.562	0.5
	Breder 2	0										
	Breder 3	2									0	1
										AVE	**0.281**	**0.75**
										SD	**0.397**	**0.354**
	Seine 1	2	4	1	10	1	3				1.46	0.261
	Seine 2	2	1	4	1						1.21	0.25
										AVE	**1.36**	**0.256**
										SD	**0.177**	**0.008**
11/11/1999	Breder 1	12	4								0.562	0.6
	Breder 2	1									0	
	Breder 3	22	1	1							0.345	0.837
										AVE	**0.302**	**0.719**
										SD	**0.283**	**0.168**
	Seine 1	31	29	8	7	4	14	15	8	5	1.97	0.16
	Seine 2	2	19	1	1						0.643	0.68
										AVE	**1.31**	**0.42**
										SD	**0.938**	**0.368**
12/15/1999	Seine 1	5	1								0.451	0.667
										AVE	**0.451**	**0.667**

Site 2

Date	Trap Type	Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Spp 6	Spp 7	Spp 8	Spp 9	H'	D
8/17/1999	Breder 1	2	1								0.637	0.333
	Breder 2	7	1	2							0.802	0.489
	Breder 3	0										
										AVE	**0.72**	**0.411**
										SD	**0.117**	**0.11**
	Seine 1	7									0	1
	Seine 2	9	4								0.617	0.538
	Seine 3	1	24								0.168	0.92
										AVE	**0.262**	**0.819**
										SD	**0.319**	**0.247**
9/23/1999	Breder 1	0										
	Breder 2	0										
	Breder 3	0										
										AVE	**0**	**1**
										SD		
	Seine 1	20	6	1							0.679	0.584
	Seine 2	18	1								0.206	0.895
	Seine 3	28	3								0.318	0.819
										AVE	**0.401**	**0.766**
										SD	**0.247**	**0.162**
12/15/1999	Breder 1	1									0	1
	Breder 2	1									0	1
	Breder 3	0									0	1
										AVE	**0**	**1**
										SD	**0**	**0**
	Seine 1	123									0	1
	Seine 2	174	1	2							0.97	0.966
										AVE	**0.485**	**0.983**
										SD	**0.686**	**0.024**
1/25/2000	Breder 1	0										
	Breder 2	1									0	1
	Breder 3	0										
										AVE	**0**	**1**

Site 3

Date	Trap Type	Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Spp 6	Spp 7	Spp 8	Spp 9	H'	D
9/9/1999	Breder 1	0									0	1
	Breder 2	0									0	1
	Breder 3	0									0	1
										AVE	**0**	**1**
										SD	**0**	**0**
	Seine 1	3	1								0.562	0.5
	Seine 2	3									0	1
	Seine 3	2	1								0.637	0.333
										AVE	**0.4**	**0.611**
										SD	**0.348**	**0.347**
11/11/1999	Breder 1	0										
	Breder 2	1									0	
	Breder 3	0										
										AVE	**0**	**1**
										SD	**0**	**0**
	Seine 1	1	2	1							1.04	0.167
	Seine 2	1									0	
	Seine 3	6	2								0.562	0.571
										AVE	**0.534**	**0.579**
										SD	**0.521**	**0.417**
12/15/1999	Breder 1	1									0	1
	Breder 2	0										
	Breder 3	0										
										AVE	**0**	**1**
										SD	**0**	**0**
	Seine 1	2	2	1	25	1	118	1	6	4	0.934	0.568
	Seine 2	5	1	26	1	1	1				0.905	0.563
	Seine 3	1	1	1	11						0.755	0.604
										AVE	**0.865**	**0.578**
										SD	**0.096**	**0.022**

Appendix E

Final Budget Report

ACCOUNT MANAGER: EDWIN EVERHAM
ORGANIZATION (L2-L5): 95 40 01 205 TITLE: RAPID BIOASSESSMENT PROGRAM
LEVEL 3 NUMBER: 40 TITLE: COLLEGE OF ARTS AND SCIENCES
FUND ID: 2-655011 TITLE: SPONSORED RESEARCH DEVELOPMENT TF FGCU

C & G: RAPBI DATES: 08/30/1999 06/30/2099

OBJ-GL CODE	DATE	DOCUMENT NO.	ENCUMB. NO.	DESCRIPTION	BUDGET	REVENUE	ENCUMBRANCES	DISBURSEMENTS / OTHER	BUDGET BALANCE
	*TOTAL	EXPENSES		*	1841.30			1521.05	320.25
93100	02/29/00	BAL FWD		ALLOTMENTS	5000.00				
512036	02/29/00	BAL FWD		SCIENTIFIC EQUIP				5168.70	
	*TOTAL	OPERATING CAPITAL OUTLAY		*	5000.00			5168.70	168.70-
93100	02/29/00	BAL FWD		ALLOTMENTS	1680.25				
810060	02/29/00	BAL FWD		INTRA-FUND TRSF				1680.25	
	*TOTAL	TRANSFERS		*	1680.25			1680.25	0.00

427802686 4995004278026861 JACK CROCKER