

## 7. APPENDIX I

### Methods Used to Expand Creel Census Data into Unmeasured Time Periods

The creel census data base for the Fisheries Assessment Project consists of two basic kinds of data records. One is a sample set record, which "initializes" a creel census interview set. The other is an interview record, which contains information specific to a particular fishing party in a specific area of the Bay. The sample set record contains the following relevant information:

1. Kind of day, (KD) - weekday or weekend/holiday;
2. Sampling period (SP);
3. Time of day (TD) - night or day;
4. Type of fishing (TY) - shoreline or boat;
5. (P) - number of interview periods in this particular KD, SP, TD, and access point combination;
6. Access point (AC);
7. Instantaneous count (IC) - for shoreline fishing;
8. Not Interviewed (NI) - number of people crossing a boat ramp who were not interviewed.

An interview data record contains the following relevant information:

1. AC - used to back check on sample card;
2. Interview number (IN);
3. Area fished (AF) - area of Bay where fishing occurred;
4. (NP) - number of people in fishing party;
5. Time fished (TF) - in hours and minutes;
6. (NB) - when interview number = 000, NB stores the number of people interviewed who were not fishing in the Bay;
7. The remainder of the record contains information on type, number, and weight of fish caught.

The two-letter codes used above for specific data items will be used in the body of this report when referring to those items.

All information stored in the data expansion program (DEP) from interview records is stored according to area being fished, not according to access point from which the data from a given interview set were collected. In general, the DEP collects data from one sample record/interview records set at a time. When all the data from a single set has been stored, the data from that set, which represents a single six hour time period, are expanded into all available hours for the KD, SP, TD interval that the data represent. The primary formula for data expansion is presented below:

$$\text{Expanded C} = C \times \frac{(D \times TP)}{(P \times NP)} \quad (1)$$

where: C = unexpanded data (man-hours, count or weight data) for specific sampling area;  
D = total days in SP in same KD;  
TP = total people for sampling area (see note below);  
P = as defined above (#5 sample record);  
NP = sum of all people interviewed who were fishing in sampling area.

The value PT provides an estimate of how total effort crossed an access point during a even six-hour interviewed period, and is calculated differently for shoreline and boat fishing interview sets. For the former, the NP above is compared to the instantaneous count on the sample card. If IC > NP, then PT is set to equal IC. Otherwise, TP = NP.

For boat fishing, the calculation is more complicated. First, the proportion of number of people interviewed who were fishing in the specific area under consideration (NP) to the total number of Bay fishing people interviewed (AP), must be calculated (call it YP). Second, the proportion of people not fishing in the Bay (NB) to the total number of people to cross the access point (AP + NB) is calculated (= PNB). Third, the number of people not interviewed found on the sample card (NI) must be adjusted by multiplying by YP, which creates a value (XN) that represents the N1 for the sampling area being expanded. TP can now be calculated as follows

$$TP = NP + (XN - (XN * PNB)) \tag{2}$$

The basic data expansion is complete at this point. However, the design of the creel sampling program created the need for some additional data expansion in certain situations. This is required because not all possible types of sampling interval were sampled for any given access point. The table below represents a hypothetical sampling schedule for a given sampling periods

Access Point	Weekday				Weekend/Holiday			
	Day		Night		Day		Night	
	AM	PM	N1	N2	AM	PM	N1	N2
41	1 *	2	0	1	1	2	2	1
42	2	2	1	1	1	3	0	0
43	1	1	0	0	1	1	0	0

\* Values are number of times sampled.

The above table presents all possible cases where additional data expansion would be necessary. The first case, AC #41, requires an expansion of data from one time period to a similar time period with same kind of day and within a single access point's data. In this case, the expansion is from weekday night N2 period into weekday night N1. First, the data from the N2 time period would be expanded as described above. Then this expanded number would be divided by a factor representing the average effort (manhours) in the N2 weekday night period as a proportion of the average effort of weekday night N2 and N1 combined. This number will then equal the expanded data value for both time periods.

The second case (AC #42) requires an expansion from one kind of day to a like time period in another kind of day. In this case, the expansion would be from weekday night (both N2 and N1) to weekend night. As above, the initial data expansion is performed on the collected data. It is then necessary to expand the expanded weekday night data into the missing weekend night slots. This expansion uses a previously determined relationship between a weekday time period and a weekend time period. In the above case for boat fishing at night, one weekend night interval = 2.66 weekday intervals. (2.66 shall be referred to as F below.) The formula for the expansion into the weekend slot is:

$$FINAL = ExpC + \frac{ExpC \times F}{D1} \times D2 \tag{3}$$

where: D1 = total days in SP for weekday D in formula 1);  
D2 = total days in SP for weekend/holidays  
ExpC = expanded data

In the opposite case of expanding into weekday from a weekend slot, the formula would be:

$$\text{FINAL} = \text{ExpC} + \frac{\text{ExpC} \times (1/F)}{D2} \times D1 \quad (4)$$

The final case, AC #43 above, requires expansion of data from one ramp to another. In this example, the night-time block was never sampled for access point 43. Because of the differences in type of fish that are caught during the night and day, we made the decision not to expand from one TD block to another; this necessitated expanding from ramp (AC) to ramp in some situations, as above. As data can not be expanded from one TD to another, so it would also be invalid to expand from one ramp to another as the boats leaving that ramp did not typically fish in the same areas of the Bay. Therefore, ramp to ramp expansion must occur only among ramps with similar geographic locations. The relationships in average fishing effort among similar ramps for each time of day/type of day combination were determined through analysis of the creel data base. If one assumes that the three access points in the table above are all similar ramps, the data for access points 41 and 42 would be expanded as it was collected by dividing the ExpC by the sum of the proportion of effort among the three ramps occurring at ramps 41 and 42. For example, if the average weekday night effort at AC #41 was 2 man-hours, at AC #42 was 4 man-hours, and at AC #43 was 6 man-hours, then the proportion of effort among the three ramps would be:

$$0.1666 : 0.3333 : 0.30$$

and all data collected for weekday nights for ramps 41 and 42 would be divided by 0.1666 + 0.3333, or 0.5.



8. APPENDIX II

Biscayne Bay (creel survey) Interview Sheet

Biscayne Bay Interview Sheet

Interviewer \_\_\_\_\_

Survey Type:  
 1 = daylight, 0 = night \_\_\_\_\_ Kind of day 1 = weekday \_\_\_\_\_ Interview Number \_\_\_\_\_  
 2 = weekend or holiday \_\_\_\_\_ 7 \_\_\_\_\_ 8 \_\_\_\_\_ 20 \_\_\_\_\_ 21 \_\_\_\_\_ 22 \_\_\_\_\_

1 = boat, 0 = shore \_\_\_\_\_ Sample Number \_\_\_\_\_ Number in Party \_\_\_\_\_  
 2 \_\_\_\_\_ 9 \_\_\_\_\_ 10 \_\_\_\_\_ NP \_\_\_\_\_

Area Fished \_\_\_\_\_ Access or Shore Point \_\_\_\_\_ Time Fished \_\_\_\_\_  
 3 \_\_\_\_\_ 4 \_\_\_\_\_ 11 \_\_\_\_\_ 12 \_\_\_\_\_ 13 \_\_\_\_\_ (party hours) \_\_\_\_\_  
 HR \_\_\_\_\_

Period \_\_\_\_\_ Date (month, day, year) \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_  
 5 \_\_\_\_\_ 6 \_\_\_\_\_ 14 \_\_\_\_\_ 15 \_\_\_\_\_ 16 \_\_\_\_\_ 17 \_\_\_\_\_ 18 \_\_\_\_\_ 19 \_\_\_\_\_  
 MIN \_\_\_\_\_

Indicate species fished for by checking one or none

Species	Fished For	Caught & Released	Caught & Kept	Total Weight	Species	Fished For	Caught & Released	Caught & Kept	Total Weight
Grey (mangrove) Snapper <u>Lutjanus griseus</u>	1242	2242	3242	4242	White Grunt <u>Haemulon plumieri</u>	1261	2261	3261	4261
Mutton Snapper <u>L. analis</u>	1241	2241	3241	4241	Bluestriped Grunt <u>H. sciurus</u>	1262	2262	3262	4262
Lane Snapper <u>L. synagris</u>	1243	2243	3243	4243	Tomtate <u>H. aurolineatum</u>	1268	2268	3268	4268
Yocotail Snapper <u>C. chrysurus</u>	1244	2244	3244	4244	Sailors Choice <u>H. parrai</u>	1267	2267	3267	4267
Great Barracuda <u>Sphyrna barracuda</u>	1361	2361	3361	4361	French Grunt <u>H. flavolineatum</u>	1266	2266	3266	4266
Sand Perch <u>Diplectrum formosum</u>	1192	2192	3192	4192	Pigfish <u>Orthopristes chrysopterus</u>	1263	2263	3263	4263
Gag Grouper <u>Mycteroperca microlepis</u>	1191	2191	3191	4191	Porkfish <u>Anisotremus virginicus</u>	1269	2269	3269	4269
Black Grouper <u>M. bonaci</u>	1195	2195	3195	4195	Unident. Grunts Haemulidae	1260	2260	3260	4260
Red Grouper <u>Epinephelus morio</u>	1193	2193	3193	4193	Blue Runner <u>Caranx crysos</u>	1231	2231	3231	4231
Red Hind <u>E. guttatus</u>	1194	2194	3194	4194	Crevalle Jack <u>C. hippos</u>	1232	2232	3232	4232
Nassau Grouper <u>E. striatus</u>	1196	2196	3196	4196	Horseeye Jack <u>C. latus</u>	1234	2234	3234	4234
Sea Bream <u>Archosargus rhomboidalis</u>	1271	2271	3271	4271	Yellow Jack <u>C. bartholomaei</u>	1235	2235	3235	4235
Sheepshead <u>A. probatocephalus</u>	1272	2272	3272	4272	Bar Jack <u>C. ruber</u>	1238	2238	3238	4238
Pinfish <u>Lagodon rhomboides</u>	1273	2273	3273	4273	Lookdown <u>Solene vomer</u>	1237	2237	3237	4237
Head Porgy <u>C. baionado</u>	1274	2274	3274	4274	Skipjack/Leatherjacket <u>Oligoplites saurus</u>	1236	2236	3236	4236
Unident. Porgy <u>Calamus sp.</u>	1275	2275	3275	4275	Pompano <u>Trachinotus carolinus</u>	1233	2233	3233	4233
Sauceraye Porgy <u>Calamus calamus</u>	1276	2276	3276	4276	Unident. Jack Carangidae	1230	2230	3230	4230
Spottail Porv	1277	2277	3277	4277					

Species	Fished For	Caught & Released	Caught & Kept	Total Weight	Species	Fished For	Caught & Released	Caught & Kept	Total Weight
Tarpon <u>Megalops atlantica</u>	1031	2031	3031	4031	Spotted Seatrout <u>Cynoscion nebulosus</u>	1281	2281	3281	4281
Ladyfish <u>Elops saurus</u>	1032	2032	3032	4032	Unident. Croaker Sciaenidae	1280	2280	3280	4280
Bonefish <u>Albula vipes</u>	1041	2041	3041	4041	King Mackerel <u>Scomberomorus cavalla</u>	1421	2421	3421	4421
Atl. Threadfin Herring <u>Opisthomus oligum</u>	1061	2061	3061	4061	Spanish Mackerel <u>S. maculatus</u>	1422	2422	3422	4422
Spanish Sardines <u>Sardinella aurita</u>	1062	2062	3062	4062	Cero Mackerel <u>S. regalis</u>	1423	2423	3423	4423
Pilchard <u>Harengula jaguana</u>	1063	2063	3063	4063	Snook <u>Centropomus undecimalis</u>	1181	2181	3181	4183
White Mullet <u>Mugil curema</u>	1351	2351	3351	4351	Sea Catfish <u>Arius felis</u>	1291	2291	3291	4291
Striped (Black) Mullet <u>cephalis</u>	1352	2352	3352	4352	Lizardfish <u>Synodus foetens</u>	1081	2081	3081	4081
Ballyhoo <u>Hemiramphus brasiliensis</u>	1111	2111	3111	4111	Houndfish <u>Tylosurus crocodilus</u>	1131	2131	3131	4131
Unident. Wrasse Labridae	1330	2330	3330	4330	Nurse Shark <u>Ginglymostoma cirratum</u>	1013	2013	3013	4013
Hogfish <u>Lachnolaimus maximus</u>	1331	2331	3331	4331	Unident. Shark	1012	2012	3012	4012
Bermuda Chub <u>Kyphosus sectatrix</u>	1301	2301	3301	4301	Unident. Parrotfish Scaridae	1340	2340	3340	4340
Yellowfin Mojarra <u>Gerres cinereus</u>	1251	2251	3251	4251	Southern Stingray <u>Dasyatis americana</u>	1011	2011	3011	4011
Silver Jenny <u>Eucinostomus gula</u>	1252	2252	3252	4252	Unident. Puffer Tetraodontidae	1490	2490	3490	4490
Unident. Mojarra Gerreidae	1250	2250	3250	4250	Sand Tilefish <u>Malacanthus plumieri</u>	1581	2581	3581	4581
Unident. Triggerfish Balistidae	1470	2470	3470	4470					
Queen Triggerfish <u>Balistes vetula</u>	1471	2471	3471	4471					
Grey Triggerfish <u>Balistes capriseus</u>	1472	2472	3472	4472					
Crab	1711	2711	3711	4711					
Lobster	1721	2721	3721	4721					
Shrimp	1731	2731	3731	4731					

## 9. APPENDIX III

### Taxonomic References Used for Identification of Biscayne Bay Fish and Crustaceans

Anderson, W. P., Sr. 1967. Field Guide to the Snappers (Lutjanidae) of the Western Atlantic. DOI, Fish and Wildlife Serv., Bureau of Comm. Fish. Cir. 252.

Anderson, W. W., J. W. Gehringer, and Frederick H. Berry. 1966. Field Guide to the Synodontidae (Lizard fishes) of the Western Atlantic Ocean. DOI, Fish and Wildlife Serv., Bureau of Comm. Fish. Cir. 245.

Anderson, W. P., Sr. 1967. Field Guide to the Snappers (Lutjanidae) of the Western Atlantic. DOI, Fish and Wildlife Serv., Bureau of Comm. Fish. Cir. 252.

Anderson, W. W., J. W. Gehringer, and F. H. Berry. 1966. Field Guide to the Synodont. Nat. Sci. Philadelphia, 120:43-174.

Berry, F. H., and L. E. Vogele. 1961. Filefish (Monacanthidae) of the western north Atlantic. Fishery Bulletin of the Fish and Wildlife Service. Fishery Bull. 191, Volume 61.

Biffar, T. A. 1971. The genus Callinassa (Crustacea, Decapoda, Thalassinidae) in south Florida, with keys to the western Atlantic species. Bull. Mar. Sci., 21(3):637-715.

Bohlke, J. E., and J. E. Randall. 1968. A key to the shallow water west Atlantic cardinal fishes, with descriptions of five new species. Proc. Acad. Nat. Sci. Phil., 120:175-206.

Bortone, S. A., K. A. Armsby, M. B. Bortone (eds.) 1990. An indexed bibliography of snapper (Lutjanidae) and grouper-sea bass (Serranidae) biology. Sea Grant Report No. 30. U.S. Dept. of Com., NOAA, Nat. Mar. Fish. Serv., SEFC.

Chace, F. A., Sr. 1972. The shrimp of the Smithsonian-Bredin Caribbean Expedition with a summary of the west Indian shallow-water species (Crustacea:Decapoda:Nathantia). Smithsonian Contributions to Zoology, Number 98.

Courtenay, W. R., Sr. 1961. Western Atlantic fishes of the genus Haemulon (Pomadouridae): systematic status and Juvenile pigmentation. Bull. of Mar. Sci. Gulf and Caribbean, 11(1):66-149.

Dahlbers, M. D. 1975. Guide to coastal fishes of Georgia and nearby states. University of Georgia Press, Athens, GA.

Daly, R. J. 1966. A systematic study of southern Florida anchovies (Pisces:Engraulidae) thesis, University of Miami.

Dawson, C. E. (in press) Key to the western Atlantic genera of Syngnathidae. Bull. Mar. Sci. [STILL IN PRESS IN 2003]

Eddy, S. 1969. How to Know the Freshwater Fishes. Wm. C. Brown Co. Publishers, Dubuque, Iowa.

Eschmeyers W. N. 1965. Western Atlantic Scorpion fishes of the genus Scorpaena including 4 new species. Bull. Mar. Sci., 15(1):84-164.

- Farfante, I. P. 1970. Diagnostic characters of juveniles of the shrimps *Penaeus aztecus aztecus*, *P. duorarum duorarum*, and *P. brasiliensis* (Crustacea, Decapoda, Penaeidae). U.S. Fish. Wildl. Serv., Spec. Sci. Fish. No. 599, 26 pp.
- Fischer, W. (ed). 1978. FAO species Identification sheets for fishery purposes. Western central Atlantic (Fishing Area 31) Vols. 1-7. Food and Agriculture Organization of the United States.
- Gilbert, C. R., and J. E. Randall. 1979. Two new western Atlantic species of the Gobiid fish genus *Gobionellus*, with remarks on characteristics of the genus. Northern Gulf Science, 3(1):27-47.
- Ginsburg, I. 1937. Review of the seahorses (*Hippocampus*) found on the coasts of the American continents and at Europe. Proceedings of the National Museum Vol. 83, no. 2997.
- Ginsburg, I. 1950. Review of the western Atlantic Triglidae (fishes). Tex. J. Sci., 2(4):489-527.
- Guthertz, E. J. 1967. Field guide to the flatfishes of the family Bothidae in the western North Atlantic. Bull. Fish and Wildlife, Bureau of Comm. Fishery Circ. 263.
- Hendrix, G. Y. 1971. A systematic study of the genus *Alpheus* (Crustacea: Decapoda: Alpheidae) in South Florida. Ph.D. dissertation, University of Miami.
- Hildebrand, S. F., and W. C. Schroeder. 1972. Fishes of the Chesapeake Bay. Smithsonian Institution, T. F. H. Publications, Inc. Neptune, NJ. 388 pp.
- Hoese, H. D., and R. H. Moore. 1977. Fishes of Gulf of Mexico, Texas, Louisiana and Adjacent Waters. Texas A & M University Press. College Station, TX. 327 pp.
- Holthuis, L. B. 1931. A general revision of the Palaemonidae (Crustacea:Decapoda:Natantia) of the Americas 1. The subfamilies Euryrhynchinae and Pontonlinae. Allan Hancock Foundation Publications of USC Occasional Paper Number 11.
- Lyons, W. G. 1970. Scyllarid lobsters (Crustacea, Decapoda) Memoirs of the Hourglass cruises Vol. I, Part IV, Mar. Research Lab., Fla. Dept. of Nat. Resources.
- Manning, R. B. 1969. Stomatopod crustacea of the western Atlantic Studies in Tropical Oceanography No. 8, Inst. of Mar. Sci., University of Miami.
- Manning, R. B., and L. B. Holthuis. 1991. West African Brachyuran crabs (Crustacean: Decapoda) Smithsonian contributions to Zoology No. 306.
- Manning, R. B. 1968. A revision of the family Squillidae (Crustacea, Stomatopoda), with the description of eight new genera. Bull. Mar. Sci., 18(1):105-142.
- Manning, R. B., and Fenner, A. C. Sr. 1971. Shrimps of the family Processidae from the Northwestern Atlantic Ocean (Crustacea:Decapoda:Caridae) Smithsonian Contributions to Zoology No. 89.
- Norman, J. R. 1934. A systematic monograph of the flatfishes (Heterosomata) Vol. 1. British Museum of Natural History.



- Opresko, L., D. Opresko, R. Thomas, and G. Voss. 1973. Guide to the lobsters and lobster-like animals of Florida the Gulf of Mexico and the Caribbean Area. Sea Grant Field Guide Series 01. Univ. of Miami Sea Grant Program (NOAA Sea Grant No. 04-3-159-27).
- Park, J. R. 1969. A preliminary study of Portunid crabs in Biscayne Bay. Quar. J. Fla. Acad. Sci., 32(1):12-20.
- Randall, J. E. 1968. Caribbean Reef Fishes. TFLT Publications. Inc., Jersey City, NJ. 318 pp.
- Randall, J. E., and D. K. Caldwell. 1966. A review of the sparid fish genus Calanus, with descriptions of four new species. Bull. Los Angeles County Mus. Nat. Ms., Science, No. 2.
- Rathbun, Mary J. 1925. The spider crabs of America. US National Museum Bulletin 129.
- Rathbun, Mary J. 1930. The cancrroid crabs of America of the families Euryalidae, Portunidae, Atelecyclidae, Cancridae and Xanthidae. Smith. Inst. US Nat. Mus. Bull., 152.
- Schultz, L. P. 1959. Review of the Parrotfishes, Family Scaridae. US National Museum Bulletin 214.
- Soloman, C. H., D. M. Allen, and T. J. Costello. 1968. Distribution of three species of shrimp (Genus Penaeus) in waters contiguous to southern Florida. Bull. of Mar. Sci., 18(2):343-350.
- Topp, R. W., and F. H. Hoff, Jr. 1972. Flatfish (Pleuronectiformes). Memoirs of the Hourglass cruises Vol. IV Part II.
- Voss, G. L. 1935. A key to the commercial and potentially commercial shrimp of the family Penaeidae of the western north Atlantic and the Gulf of Mexico. State of Fla. Board of Conservation Technical Series No. 14.
- Voss, G. L., E. M. Bayerg C. R. Robins, M. Gornon, and L T. LaRoe. 1969. A report to the Nat. Park Serv. DOI, on the Mar. Ecology of the Biscayne Nat. Monument, Inst. of Mar. and Atm. Sci., Univ. of Miami.
- Williams, A. B. 1965. Marine decapod crustaceans of the Carolinas. Fishery Bulletin, 65(1):1-298.
- Williams, A. B. 1974. The swimming crabs of the genus Callinectes (Decapoda:Portunidae). Fishery Bull., 72(3):685-798.

10. APPENDIX IV

a) 10.1. Recreational Harvest for All Species Recorded in the Creel Survey

b) 10.2. Catch Per Unit Effort for Fished For Species

**MISSING**

11. APPENDIX V

ANOVA and Multiple Range Tests of Abundance of 16 Fish Species and Four Crustacean Species,  
and of Biomass of All Fish, All Crustaceans, and All faunas

**MISSING**



## 12. APPENDIX VI

### Correction Factors for Creel Survey Catch and Effort Data Derived from Aerial Overflight Counts

Overflights were conducted thrice monthly to account for that portion of the fishing population which would consistently be missed by our survey (i.e. boats launched from private docks, moorings, canals, etc.)

The overflight "correction factor" for boat fishermen was derived as follows:

The mid-point of the scheduled overflight time period was determined and assigned to either the AM or PM time period (according to monthly scheduling). The total number of boat fisher men (BF) counted during an overflight was assumed to represent the total boat-fishermen population for the entire Bay during any instant of that specific time period.

Daytime boat ramps surveyed on overflight days were used to estimate the boat-fishermen population for all ramps included in our sampling design. The following input data were used to determine the baywide population from a single ramp(s):

TF = Total number of Bay fishermen that crossed a specific ramp(s).

PC = Percent contribution of a specific ramp to the population of ramps included in our sampling design. This figure was derived from 21 months of data.

LT = Like time period. Monthly percentage fishing effort to be applied to ramp/time period under consideration.

ULT = Unlike time period. Monthly percentage fishing effort to be applied to the time period in which the overflight occurred.

UPE = Unadjusted population estimate.

BPE = Baywide population estimate for time period under consideration.

BF = Total number of boat fishermen counted during overflights.

When the ramp survey(s) occurred during the same time period as the overflight, then BPE was calculated as follows:

$$BPE = \frac{TF}{PC}$$

This value should be an underestimate of BF.

If the ramp survey(s) occurred in the opposing time period to the overflight, then TF/PC equals UPE and must be adjusted as follows

$$\frac{UPE}{LT} \times ULT = BPE$$

This adjusted value should also be an underestimate of BF.

Daytime fishing effort was determined on a monthly basis from our creel interviews. The percentage of morning fishing effort (AM) plus the percentage comprising the afternoon effort (PM) equals 100% of the daytime effort. Or:

$$AM\% + PM\% = \text{Total Daylight Fishing Effort (100\%)}$$

These proportions are used to estimate fishing effort for one time of day (TOD) if effort for the other is known. This can be seen in the following example for an overflight in May 1983:

boat ramp #49 AM count (TF)	=		4.000			
boat ramp #46 PM count (TF)	=		18.000			
weekday contribution of #48 (PC)	=		0.196			
weekday contribution of #46 (PC)	=		0.162			
baywide population estimate	=	$\frac{TF}{PC}$	=	$\frac{4}{0.186}$	=	21.5
from #48 AM (BPE)						
unadjusted population estimate	=	$\frac{TF}{PC}$	=	$\frac{18}{0.162}$	=	111.1
from #46 PM (UPE)						

May 1983 recorded weekday fishing effort:

$$AM = 0.1929$$

$$PM = 0.8071$$

Fifty-four boat fishermen were counted on a morning (AM) overflight. The counts for the morning shift at boat ramp #49 and the afternoon (PM) shift at boat ramp #46 are 4 and 18, respectively. The weekday percent contributions of ramps 49 and 46 are, respectively, 0.196 and 0.162. Hence, the population estimate using counts from 48 AM is 21.5. Using counts from 46 PM, a shift done at a different time than the overflight, the population estimate (SPE) is:

$$\frac{UPE}{PM} \times AM = BPE$$

$$\frac{111.1}{0.8071} \times 0.1929 = BPE = 26.6$$

Both estimates (21.5 and 26.6) provide Independent population estimates of boat fishermen in the Bay, and are then compared to the overflight count (BF = 54), which is the assumed total number of fishermen.

All independent ramp population estimates (BPE and adjusted UPE) were summed over the whole survey period, and an overall mean was calculated. The same was done for all 38 overflight counts MO. By dividing the overflight overall mean by the ramp-estimate overall mean, a correction factor was derived which would estimate the percentage of boat-fishermen unaccounted for at the boat ramps during the course of the survey.

### 13. APPENDIX VII

#### References Used for Establishing Spawning Seasons of "Important" Species

- Aiken, K. A. 1976. Jamaica spiny lobster investigations. In: Symposium on progress in marine research in the Caribbean and adjacent regions. Caracas, 12-16 July 1976. FAO Fisheries Report no. 200. pp. 23-30.
- Eldred, B., J. Williams, G. T. Martin, and L. A. Joyce Jr. 1965. Seasonal distribution of Penaeid larvae and post larvae of the Tampa Bay area, Florida. Fla. Bd. Conserv., Tech. Ser. No. 44. 47 pp.
- Erdman, D. S. 1967. Spawning seasons of some game fishes around Puerto Rico. In: Proc. Twelfth Ann. Int. Game Fish Conf., Puerto Rico, Nov. 1967. pp. 11-19.
- Erdman, D. S. 1976. Spawning patterns of fish from the northeastern Caribbean and adjacent regions. In: Symposium on progress in marine research in the Caribbean and adjacent regions. Caracas, 12-16 July 1976. PAO Fisheries Report no. 200. pp. 145-169.
- Fahay, M. P. 1983. Journal of northwest Atlantic fishery science, vol. 4. Northwest Atlantic Fisheries Organization. Dartmouth, Canada. 423 pp.
- Fritzsche, R. A. 1978. Development of fishes of the mid-Atlantic bight, vol. V. U.S. Fish and Wildlife Service. U.S. Dept. of the Interior.
- Hardy, Jr., J. .D. 1979. Development of fishes of the mid-Atlantic bight, vols. II - III. U.S. Fish and Wildlife Service. U.S. Dept. of the Interior.
- Johnson, G. D. 1979. Development of fishes of the mid-Atlantic bight, vol. IV. U.S. Fish and Wildlife Service. U.S. Dept. of the Interior.
- Jones, P. W. 1978. Development of fishes of the mid-Atlantic bight, vol. I. U.S. Fish and Wildlife Service. U.S. Dept. of the Interior.
- Martin, F. D. 1978. Development of fishes of the mid-Atlantic bight, vol. VI. U.S. Fish and Wildlife Service. U.S. Dept. of the Interior.
- Munroe, J. L., Gaut, V. C., Thompson, R., and Reesons P. H. 1972. The spawning seasons of Caribbean reef fishes. J. Fish Biology, 4(4):69-94.
- Noe, C. D. 1967. Contribution to the life history of the stone crab, *Menippe mercenaria* (Say), with emphasis on the reproduction cycle. Thesis, University of Miami, Coral Gables, 53 pp.
- Tagatz, M. E. 1968. Biology of the blue crab, *Callinectes sapidus* (Rathbun), in the St. Johns River, Florida. Fish. Bull., 67(1):17-33.
- Williams, A. B. 1974. The swimming crabs of the genus *Callinectes* (Decapoda: Portunidae). Fish. Bull., 72(3):695-799.





## 14. APPENDIX VIII

### A Bibliography and Index of the Biscayne Bay Ecosystem



## 15. APPENDIX IX

### Species preserved for DERM Reference Collection

#### Fishes

##### Fam. Dasyatidae (stingrays)

*Dasyatis sabina* (Atlantic stingray)  
*Gymnura micrura* (smooth butterfly ray)  
*Urolophus jamaicensis* (yellow stingray)

##### Fam. Rajidae (skates)

*Raja texana* (roundel skate)

##### Fam. Torpedinidae (electric rays)

*Narcine brasiliensis* (less electric ray)

##### Fam. Ophidiidae (cusk-eels)

*Ophidion holbrooki* (Bank cusk-eel)

##### Fam. Elopidae (tarpons)

*Elops saurus* (ladyfish)

##### Fam. Albulidae (bonefishes)

*Albula vulpes* (bonefish)

##### Fam. Muraenidae (morays)

*Gymnothorax nigromarginatus* (blackedge moray eel)  
*Lycodontis funebris* (moray eel)

##### Fam. Ophichthidae (snake eels)

*Ahlia egmontis* (key worm eel)  
*Myrichthys acuminatus* (sharptail eel)  
*Ophichthus gomesi* (shrimp eel)

##### Fam. Clupeidae (herrings)

*Harengula humeralis* (redeal sardine)  
*Harengula jaguana* (scaled sardine)  
*Jenkinsia lamprotaenia* (dwarf herring)  
*Sardinella aurita* (Spanish sardine)

Fam. Engraulidae (anchovies)

*Anchoa mitchilli* (bay anchovy)

Fam. Synodontidae (lizardfishes)

*Synodus foetens* (inshore lizardfish)

*Synodus synodus* (red lizardfish)

Fam. Batrachodidae (toadfish)

*Opsanus beta* (Gulf toadfish)

Fam. Antennariidae (frog fishes)

*Antennarius scaber* (splitlure frogfish)

*Histrio histrio* (sargassum fish)

Fam. Ogcocephalidae (bat fishes)

*Ogcocephalus radiatus* (Polka-dot batfish)

Fam. Exocoetidae (flying fishes)

*Chriodorus atherinoides* (hardhead halfbeak)

*Hemirhamphus brasiliensis* (ballyhoo)

*Hyporhamphus unifasciatus* (halfbeak)

Fam. Belonidae (needlefish)

*Strongylura notata* (redfin needlefish)

*Strongylura timucu* (timucu)

*Tylosurus crocodilus* (houndfish)

Fam. Cyprinodontidae (killifishes)

*Cyprinodon variegatus* (Sheepshead minnow)

*Lucania parva* (rainwater killifish)

Fam. Atherinidae (sliversides)

*Atherinomorus stipes* (hardhead silverside)

*Hypoatherina harringtonensis* (reef sliverside)

Fam. Holocentridae (squirrel fishes)

*Holocentrus rufus* (longspine squirrelfish)

Fam. Syngnathidae (pipefishes)

*Cosmocampus albirostris* (whitenose pipefish)  
*Hippocampus erectus* (lined seahorse)  
*Hippocampus reidi* (longsnout seahorse)  
*Hippocampus zosterae* (dwarf seahorse)  
*Micrognathus criniger* (fringed pipefish)  
*Syngnathus floridae* (dusky pipefish)  
*Syngnathus louisianae* (chain pipefish)  
*Syngnathus scovelli* (Gulf pipefish)

Fam. Serranidae (sea basses)

*Diplectrum bivittatum* (dwarf sand perch)  
*Diplectrum formosum* (sand perch)  
*Epinephelus morio* (red grouper)  
*Epinephelus striatus* (Nassau grouper)  
*Hypoplectrus unicolor* (butter hamlet)  
*Mycteroperca interstitialis* (yellowmouth grouper)  
*Mycteroperca microlepis* (gag grouper)  
*Serranus baldwini* (lantern bass)

Fam. Apogonidae (cardinal fishes)

*Apogon aurolineatus* (bridle cardinalfish)  
*Apogon binotatus* (barred cardinalfish)  
*Apogon quadrisquamatus* (sawcheek cardinalfish)  
*Astrapogon alutus* (bronze cardinalfish)  
*Astrapogon stellatus* (conchtish)  
*Phaeoptyx pigmentaria* (dusky cardinalfish)

Fam. Carangidae (jacks)

*Caranx batholomaei* (yellow jack)  
*Caranx crysos* (blue runner)  
*Caranx ruber* (barjack)  
*Oligoplites saurus* (leatherjacket)  
*Selene setapinnis* (Atlantic moonfish)  
*Selene vomer* (lookdown)  
*Trachinotus carolinus* (Florida pompano)

Fam. Lutjanidae (snappers)

*Lutjanus analis* (mutton snapper)  
*Lutjanus apodus* (schoolmaster snapper)  
*Lutjanus griseus* (Gray snapper)  
*Lutjanus synagris* (lane snapper)  
*Ocyurus chrysurus* (yellowtail snapper)

Fam. Gerreidae (mojarra)

*Eucinostomus jonesi* (slender mojarra)  
*Eucinostomus lefroyi* (mottled mojarra)  
*Gerres cinereus* (yellowlin mojarra)

Fam. Haemulidae (grunts)

*Anisotremus virginicus* (porkfish)  
*Haemulon aurolineatum* (tomtate)  
*Haemulon flavolineatum* (French grunt)  
*Haemulon melanurum* (cottonwick)  
*Haemulon parrai* (sailor's choice)  
*Haemulon plumieri* (white grunt)  
*Haemulon sciurus* (bluestriped grunt)  
*Orthopristis chrysoptera* (pigfish)

Fam. Sparidae (porgies)

*Archosargus probatocephalus* (sheepshead)  
*Archosargus rhomboidalis* (sea bream)  
*Calamus arctifrons* (grass porgy)  
*Calamus penna* (sheepshead porgy)  
*Calamus proridens* (littlehead porgy)  
*Lagodon rhomboides* (pinfish)

Fam. Sciaenidae (drums)

*Bairdiella chrysoura* (silver perch)  
*Cynoscion nebulosus* (spotted seatrout)  
*Equetus acuminatus* (high-hat)  
*Equetus lanceolatus* (jack-knife fish)

Fam. Ariidae (sea catfishes)

*Arius felis* (hardhead catfish)

Fam. Kyphosidae (sea chubs)

*Kyphosus sectatrix* (Bermuda chub)

Fam. Chaetodontidae (butterflyfishes)

*Chaetodon capistratus* (roureya butterflyfish)  
*Chaetodon sedentarius* (reef butterflyfish)  
*Chaetodon striatus* (banded butterflyfish)

Fam. Pomacanthidae (angelfishes)

*Pomacanthus arcuatus* (gray angelfish)  
*Pomacanthus paru* (French angelfish)

Fam. Pomacentridae (damsel-fishes)

*Pomacentrus fuscus* (dusky damselfish)

Fam. Labridae (wrasses)

*Doratonotus megalepis* (dwarf wrasse)

*Lachnolaimus maximus* (hogfish)

Fam. Scaridae (parrotfishes)

*Nicholsina usta* (emerald parrotfish)

*Scarus coeruleus* (blue parrotfish)

*Scarus croicensis* (striped parrotfish)

*Scarus taeniopterus* (princess parrotfish)

*Scarus vetula* (queen parrotfish)

*Sparisoma chrysopteron* (Redtail parrotfish)

*Sparisoma radians* (Bucktooth parrotfish)

*Sparisoma rubripinne* (Redfin parrotfish)

*Sparisoma viride* (Stoplight parrotfish)

Fam. Mugilidae (mulletts)

*Mugil cephalus* (striped mullet)

*Mugil trichodon* (fantail mullet)

Fam. Sphyraenidae (barracudas)

*Sphyraena barracuda* (great barracuda)

*Sphyraena borealis* (northern sennet)

Fam. Clinidae (clinids)

*Paraclinus fasciatus* (banded blenny)

*Paraclinus marmoratus* (marbled blenny)

Fam. Blenniidae (combtooth blennies)

*Chasmodes saburrae* (Florida blenny)

Fam. Callionymidae (dragonets)

*Callionymus pauciradiatus* (spotted dragonet)

Fam. Gobiidae (gobies)

*Bathypobius curacao* (notchtongue goby)  
*Bathypobius soporator* (frillfin goby)  
*Bollmania* sp. (goby)  
*Coryphopterus eidolon* (pallid goby)  
*Coryphopterus glaucofraenum* (bridled goby)  
*Gobionellus bojeosoma* (darter goby)  
*Gobionellus fasciatus* (slashcheek goby)  
*Gobionellus saepepallens* (dash goby)  
*Gobionellus smaragdus* (emerald goby)  
*Gobionellus stigmaticus* (marked goby)  
*Gobionellus stigmaturus* (spottall goby)  
*Gobiosoma robustum* (code goby)  
*Lophogobius cyprinoides* (crested goby)  
*Microgobius gulosus* (clown goby)  
*Microgobius microlepis* (banner goby)

Fam. Acanthuridae (surgeonfishes)

*Acanthurus chirurgus* (doctorfish)

Fam. Scorpaenidae (scorpionfishes)

*Scorpaena brasiliensis* (barbfish)  
*Scorpaena calcarata* (smoothhead scorpionfish)  
*Scorpaena grandicornis* (plumed scorpionfish)  
*Scorpaena inermis* (mushroom scorpionfish)  
*Scorpaena isthmensis* (smoothcheek scorpionfish)  
*Scorpaena plumieri* (spotted scorpionfish)

Fam. Soleidae (soles)

*Achirus lineatus* (lined sole)  
*Trinectes inscriptus* (scrawled sole)

Fam. Bothidae (lefteye flounders)

*Bothus ocellatus* (eyed flounder)  
*Bothus robinsi* (spot flounder)  
*Citharichthys macrops* (spotted whiff)  
*Citharichthys spilopterus* (bay whiff)  
*Paralichthys albigutta* (Gulf flounder)  
*Syacium gunteri* (shoal flounder)  
*Syacium papillosum* (dusky flounder)

Fam. Cynoglossidae (tonguefishes)

*Symphurus diomedianus* (spottedfin tonguefish)  
*Symphurus pagliusa* (blackcheek tonguefish)



Fam. Balistidae (leatherjackets)

*Aluterus schoepfi* (orange filefish)  
*Aluterus scriptus* (scrawled filefish)  
*Balistes capriscus* (gray triggerfish)  
*Monacanthus ciliatus* (fringed filefish)  
*Monacanthus hispidus* (planehead filefish)  
*Monacanthus setifer* (pygmy filefish)

Fam. Ostraciidae (boxfishes)

*Lactophrys quadricornis* (scrawled cowfish)  
*Lactophrys trigonus* (trunkfish)

Fam. Tetraodontidae (Puffers)

*Canthigaster rostrata* (sharpnose puffer)  
*Sphoeroides nephelus* (southern puffer)  
*Sphoeroides spengleri* (bandtail puffer)  
*Sphoeroides testudineus* (checkered puffer)

Fam. Diodontidae (porcupinefishes)

*Chilomycterus antennatus* (bridled burrfish)  
*Chilomycterus schoepfi* (striped burrfish)  
*Diodon holocanthus* (balloonfish)

Fam. Triglidae (sea robins)

*Prionotus scitulus* (leopard searobin)  
*Prionotus tribulus* (bighead searobin)

Fam. Gobiesocidae (clingfishes)

*Gobiesox* sp. (clingfish)

Fam. Opistognathidae (jawfishes)

*Opistognathus* sp. (spotfin jawfish)

Fam. Mullidae (goatfishes)

*Mulloidichthys martinicus* (yellow goatfish)  
*Pseudupeneus maculatus* (spotted goatfish)  
*Upeneus parvus* (dwarf goatfish)

Fam. Dactyloscopidae (sand stargazers)

*Dactyloscopus tridigitatus* (sand stargazer)

Fam. Priacanthidae (bigeyes)

*Pseudopriacanthus* sp. (Bigeye)

Fam. Fistularidae (cornetfishes)

*Fistularia tabacaria* (bluespotted comefish)

Crustaceans

Fam. Penaeidae (Penaeid shrimp)

*Metapenaeopsis goodei* (shrimp)

*Penaeus brasiliensis* (spotted shrimp)

*Penaeus duorarum* (pink shrimp)

*Sicyona brevirostris* (rock shrimp)

*Sicyona dorsalis* (rock shrimp)

*Sicyona laevigata* (rock shrimp)

*Sicyona parri* (rock shrimp)

*Sicyona typica* (rock shrimp)

*Trachipenaeus constrictus* (roughneck shrimp)

Fam. Palaemonidae (Palaemonid shrimps)

*Leander tenuicornis* (shrimp)

*Palaemonetes intermedius* (shore shrimp)

*Palaemonetes pugio* (shore shrimp)

*Periclimenes americanus* (shrimp)

*Periclimenes longicaudatus* (shrimp)

*Periclimenes pedersoni* (Pederson's cleaning shrimp)

*Periclimenes yucatanicus* (spotted cleaning shrimp)

Fam. Alpheidae (snapping shrimps)

*Alpheus armillatus* (banded snapping shrimp)

*Alpheus floridanus* (snapping shrimp)

*Alpheus heterochaelis* (big-clawed snapping shrimp)

*Alpheus normanni* (green snapping shrimp)

*Synalpheus minus* (snapping shrimp)

*Synalpheus townsendi* (small snapping shrimp)

Fam. Hippolytidae (cock shrimps)

*Hippolysmata wurdemanni* (veined shrimp)

*Hippolyte pleuracantha* (graaa shrimp)

*Latreutes fucorum* (aulfweed shrimp)

*Thor floridanus* (grass shrimp)

*Tozuema carolinensis* (arrow shrimp)

Fam. Processidae (Processid shrimp)

*Nikoides schmitti* (shrimp)

*Processa bermudiensis* (shrimp)

Fam. Gonodactylidae (mantis shrimp)

*Gonodactylus oerstedii* (swollen-claw squilla)

*Pseudosquilla ciliata* (ciliated false squilla)

Fam. Lysiosquillidae (mantis shrimp)

*Lysiosquilla scabricauda* (scaly-tailed squilla)

Fam. Squillidae (mantis shrimp)

*Alima hyalina* (mantis shrimp)

*Meiosquilla schmitti* (mantis shrimp)

Fam. Palinuridae (spiny lobsters)

*Panulirus argus* (Caribbean spiny lobster)

Fam. Scyllaridae (slipper lobsters)

*Scyllarides nodifer* (ridged slipper lobster)

*Scyllarus americanus* (slipper lobster)

*Scyllarus chasei* (slipper lobster)

Fam. Porcellanidae (Porcellanid crabs)

*Polynox gibbesi* (crab)

Fam. Dromiidae (Dromid crabs)

*Dromidia antillensis* (lesser sponge crab)

Fam. Leucosiidae (Laucosid crabs)

*Persephons punctata* (purse crabs)

Fam. Calappidae (box crabs)

*Calappa flammes* (flamed box crab)

*Calappa gallus* (yellow box crab)

*Calappa ocellata* (box crab)

*Hepatus ephiliticus* (calico crab)

*Hepatus pudibundus* (box crab)

Fam. Portunidae (swimming crabs)

*Arenaeus cribarius* (Speckled swimming crab)  
*Callinectes bocourti* (blunt tooth swimming crab)  
*Callinectes exasperatus* (masked swimming crab)  
*Callinectes ornatus* (Shellig's ornate crab)  
*Callinectes sapidus* (blue crab)  
*Portunus depressifrons* (flat-browed crab)  
*Portunus gibbesi* (swimming crab)  
*Portunus ordwayi* (swimming crab)  
*Portunus sayi* (sargassum crab)  
*Portunus spinimanus* (spiny-handed portunus)

Fam. Xanthidae (mud crabs)

*Hexapanopeus caribbaeus* (mud crab)  
*Lobopilumnus agassizii* (mud crab)  
*Menippe mercenaria* (stone crab)  
*Panopeus occidentalis* (mud crab)  
*Pilumnus dasypodus* (mud crab)  
*Pilumnus lacteus* (mud crab)

Fam. Goneplacidae (Goneplacis crabs)

*Euryplax nitida* (crab)

Fam. Parthenopidae (Parthenopid crabs)

*Parthenope serrata* (serrate crab)

Fam. Majidae (spider crab)

*Chorinus heros* (spider crab)  
*Libinia dubia* (spider crab)  
*Macrocoeloma camptocerum* (decorator crab)  
*Macrocoeloma trispinosum* (decorator crab)  
*Mithrax hispidus* (coral crab)  
*Mithrax pleuracanthus* (spider crab)  
*Mithrax spinosissimus* (granulated spider crab)  
*Pitho aculeata* (spider crab)  
*Pitho anisodon* (spider crab)  
*Pitho laevigata* (spider crab)  
*Podochela riisei* (spider crab)  
*Podochela sidneyi* (spider crab)  
*Stenorynchus seticornis* (arrow crab)