MEC 1983 SAND CRAB PROJECT
FINAL REPORT

VOLUME 2 APPENDICES

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APPENDIX A

EQUIPMENT CALIBRATION

A.1 Sorting Sieve Calibration

Calibrations were completed for the four sets of sorting sieves that were used to live-sort sand crabs into size categories. Each set, made up of 18 sieves, was color coded black, blue, green or red. The calibration procedure involved measuring animals retained on each sieve of a set and comparing the variability between the sieves. The methods used for this procedure are discussed below.

Animals collected with sleds or with shovels during the three surveys were used for the calibrations. The animals were sorted live in the field through the four sets of color-coded sieves. Animals retained on each of the 18 sieves comprising a sieve set were kept separate, preserved in formalin, and returned to the laboratory. A technician randomly selected five preserved animals from a jar that corresponded to a color-coded sieve size and measured the animals. The longest carapace length was measured to the nearest tenth of a millimeter with calipers (Figure A-1). Animals were then returned to the jar. This procedure was repeated for each sieve size for each of the four sieve sets. The entire procedure was independently performed by five technicians.

The mean length of animals retained on the 18 sieves (numbered from 20 to 3) for each sieve set was calculated (Table A-1). A total of 25 measurements (5 technicians x 5 measurements) were used to compute the mean values. The number of observations were less than 25 in three cases (i.e. blue sieve 16, blue sieve 3, and green sieve 3) because animals of those sizes had been damaged during the calibration procedure, and there were no animals to replace them.

The difference in mean carapace length between adjacent sieves ranged between 0.6 and 1.7 mm with the following exceptions. The

difference in mean size of animals retained on sieves 19 and 20 was greater than 2 mm for the green and red sieves because several extremely large (>23 mm) individuals were captured on sieve 20.

Measurements by each technician for each sieve of the four color-coded sieve sets were examined using a three-way factorial ANOVA (Table A-2). The results indicated a highly significant ($P < 0.0001$) sieve color by sieve size interaction, as well as sieve color by technician interaction, but no sieve size by technician interaction. The significant interaction term containing color and sieve size indicates that estimates of size of sand crabs must take into account the set of sieves used to sort them.

The relationship between animal size and sieve was examined for each sieve set using linear regression (Fig. A-2). The resultant equations for the sieve sets are as follows:

Black sieves, carapace length (mm) = .983 (sieve #) + 1.723;

Blue sieves, carapace length (mm) = 1.036 (sieve #) + 1.379;

Green sieves, carapace length (mm) =1.028 (sieve #) + 1.290; and

Red sieves, carpace length (mm) = 1.068 (sieve #) + 0.988.

Wenner's (1982) equation with an equivalence between his tub (= sieve) numbers (64's of an inch) and MEC's sieve numbers (32's of an inch), is as follows:

Carapace length = .526 (2)(tub#) + 1.05 (see MEC July Quarterly Report).

Wenner's equation is most similar to the MEC equation for red sieves. The variation in size predicted by Wenner's equation and MEC's equation for the red sieve is within three tenths of a millimeter (Table A-3). The other MEC equations predict sizes within 0 to 7 tenths of a millimeter, depending on sieve size, of Wenner's equation.

The measurements of the animals from the sieve calibration procedure rather than values estimated from the regression equations were considered the best estimators of size for animals sorted with the sieve sets. The means of the measured lengths of animals from sieves of a color-coded set were incorporated into the data base establishment program. Raw biological data entered in the data base by sieve color and sieve number were equated to the appropriate length (mm) during the data base establishment.

A.2 Folsom Splitter

The accuracy associated with splitting sand crab samples was investigated for ten samples having eighty of more crabs. Samples were split in half and the number of crabs (N) that were retained in each side of the splitter was recorded. The mean (x), standard deviation (SD), and coefficient of variation (CV = s/x) were calculated (Sokal and Rohlf, 1981). The coefficients of variation in the number of crabs between sides of the splitter ranged from 0 to 16%; the mean coefficient of variation for the ten samples was less than 10% (Table A-4).

Table A-1. Mean length of measured sandcrabs retained on each sieve of the four color-coded sieve sets.

	BLACK				BLUE				GREEN				RED			
SIEVE	N	MEAN	SD	CV	N	MEAN	SD	CV	N	MEAN	SD	CV	N	MEAN	SD	CV
20	25	21.1	0.78	3.71	25	22.09	0.71	3.24	25	22.7	1.20	5.29	25	23.7	1.62	6.83
19	25	20.5	1.02	4.95	25	21.2	0.69	3.25	25	20.5	0.81	3.94	25	21.2	1.69	8.29
18	25	19.2	1.04	5.40	25	20.2	0.36	1.80	25	19.4	0.39	2.02	25	20.4	0.69	3.37
17	25	18.6	1.12	6.04	25	18.9	0.53	2.79	25	18.7	0.54	2.89	25	19.3	0.49	2.52
16	25	17.3	0.89	5.15	24	18.4	0.52	2.81	25	17.7	0.28	1.56	25	17.5	0.63	3.58
15	25	16.6	0.70	4.20	25	16.9	0.48	2.82	25	16.3	0.54	3.30	25	16.0	0.43	2.66
14	25	15.3	0.73	4.75	25	15.3	0.49	3.19	25	15.3	0.37	2.42	25	15.3	0.65	4.26
13	25	14.6	0.36	2.48	25	14.5	0.83	5.74	25	14.6	0.37	2.56	25	14.5	0.67	4.62
12	25	13.8	0.60	4.36	25	13.7	0.35	2.57	25	13.8	0.31	2.23	25	13.8	0.43	3.11
11	25	12.7	0.51	4.05	25	12.6	0.66	5.22	25	12.9	0.45	3.48	25	12.9	0.54	4.15
10	25	11.7	0.42	3.60	25	11.8	0.44	3.69	25	11.9	0.40	3.31	25	11.7	0.39	3.33
9	25	11.0	0.28	2.53	25	10.9	0.38	3.50	25	11.0	0.52	4.74	25	10.8	0.55	5.12
8	25	9.8	0.39	3.97	25	9.9	0.53	5.35	25	9.8	0.45	4.56	25	9.5	0.48	5.06
7	25	8.0	0.32	3.93	25	8.6	0.48	5.55	25	8.1	0.46	5.69	25	8.4	0.41	4.92
6	25	7.4	0.60	8.03	25	8.0	0.45	5.67	25	7.4	0.36	4.86	25	7.5	0.40	5.36
5	25	6.6	0.43	6.50	25	6.6	0.53	8.14	25	6.3	0.40	6.32	25	6.7	0.38	5.74
4	25	5.6	0.40	7.27	25	5.3	0.43	8.03	25	5.4	0.45	8.42	25	5.5	0.38	6.82
3	25	4.7	0.55	11.67	24	4.5	0.46	10.34	23	4.2	0.38	9.00	25	4.2	0.42	10.07

Table A-2. Results of a three-way factorial ANOVA of sieve calibration data.

Source of Variation	df	SS	MS	F	P
Color	3	17.25	5.75		
Sieve	17	50783.70	2987.28		
Technician	4	8.29	2.07		
Color x Sieve	51	171.50	3.36	8.89	0.0001*
Color x Technician	12	21.53	1.79	4.74	0.0001*
Sieve x Technician	68	24.18	0.36	0.94	0.6156
Color x Sieve x Technician	204	67.33	0.33	0.87	0.8921
Error	1436	543.03	0.38		

* P < .0001

Table A-3. Comparison of carapace lengths (mm) for each sieve size as predicted by MEC and Wenner (1982) regression equations.

	Mean Carapace Length (mm)				
	MEC Equations for color-coded sieve sets				Wenner's
Sieve	Black	Blue	Green	Red	Equation
20	21.4	22.1	21.8	22.3	22.1
19	20.4	21.1	20.8	21.3	21.0
18	19.4	20.0	19.8	20.2	20.0
17	18.4	19.0	18.8	19.1	18.9
16	17.4	18.0	17.7	18.1	17.9
15	16.5	16.9	16.7	17.0	16.8
14	15.5	15.9	15.7	15.9	15.8
13	14.5	14.8	14.6	14.9	14.7
12	13.5	13.8	13.6	13.7	13.7
11	12.5	12.8	12.6	12.7	12.6
10	11.5	11.7	11.6	11.7	11.6
9	10.6	10.7	10.5	10.6	10.5
8	9.6	9.7	9.5	9.5	9.5
7	8.6	8.6	8.5	8.5	8.4
6	7.6	7.6	7.5	7.4	7.4
5	6.6	6.6	6.4	6.3	6.3
4	5.7	5.5	5.4	5.3	5.3
3	4.7	4.5	4.4	4.2	4.2

Table A-4. The number (N) of animals that resulted from splitting ten sand crab samples in half with a Folsom plankton splitter.

SAMPLE	N(SIDE 1)	N(SIDE 2)	MEAN	SD	CV (%)
1	209	246	227.5	26.1630	11.5002
2	70	81	75.5	7.77882	10.3022
3	84	79	81.5	3.5355	4.3381
4	172	170	171.0	1.4142	0.8270
5	45	36	40.5	6.3640	15.7135
6	38	42	40.0	2.8284	7.0711
7	53	43	48.0	7.0711	14.7314
8	53	51	52.0	1.4142	2.7196
9	60	60	60.0	0.0000	0.0000
10	63	57	60.0	4.2426	7.0711

mean CV = 7.4274

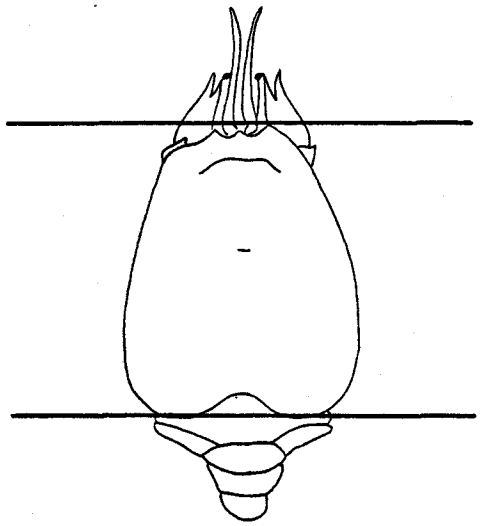

Figure A-1. Dorsal aspect of the thoracic carapace of the sand crab, Emerita analoga. Horizontal lines indicate the portion that was measured to determine the carapace length.

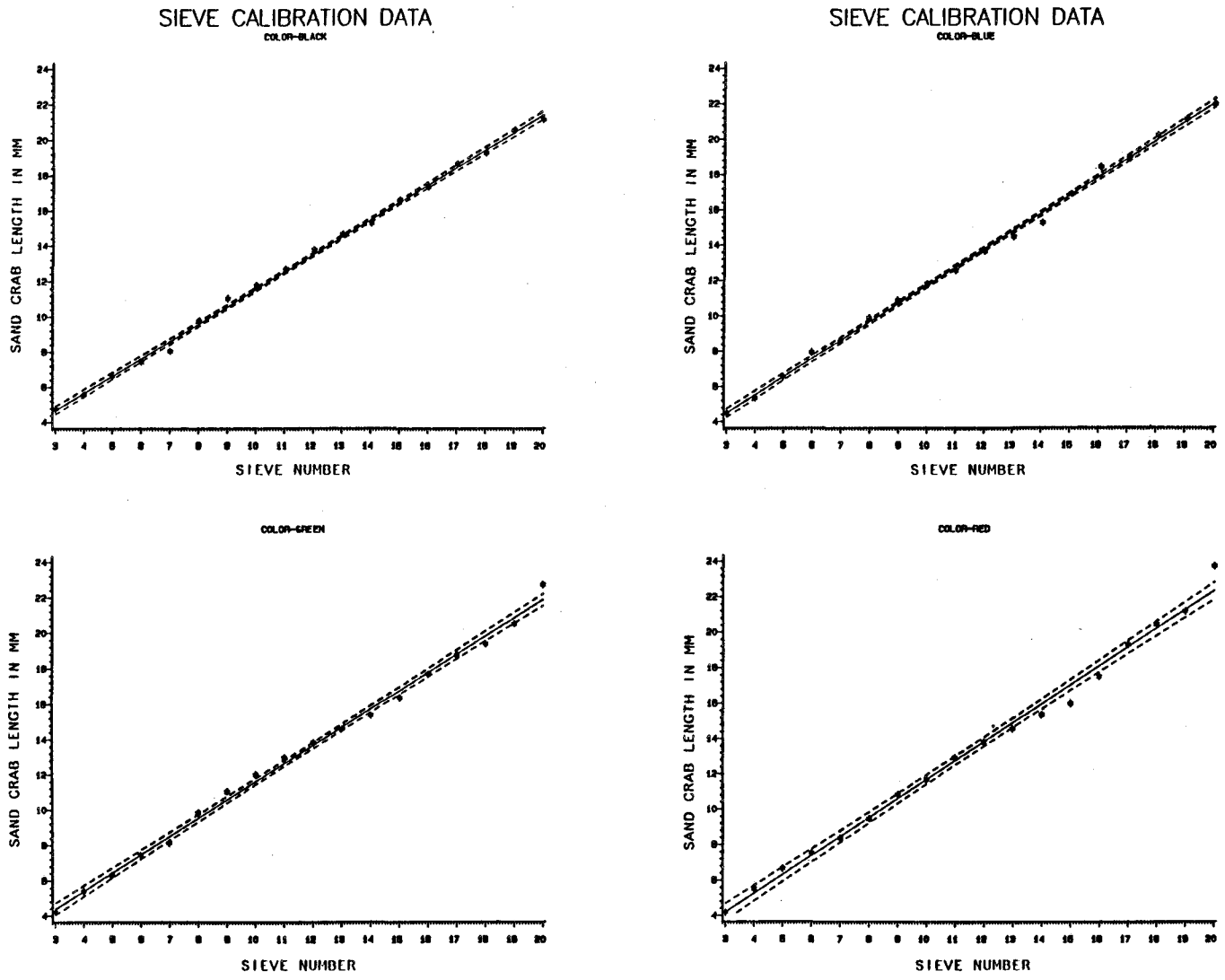

Figure A-2. Plots of the linear regressions between sand crab size (mm) and sieve size for the four color-coded sieve sets.

APPENDIX B

FIELD PROTOCOLS

B.1 Sand Crab Survey 1 (11-15 June 1983)

1) Note beach characteristics on field sheet. Make a note of your beginning/ending study site landmarks on the first survey.
Beach length and wave height are estimated; wave frequency is timed. Wave height is based on the trough to crest height when the waves break.

The start and end points of the sampling area should be 30-100 meters away from any obstacle (pier, creek etc.) and 100 m away from the source of any bright lights.

2) WAIT UNTIL THE SUN HAS SET AND THE TIDE IS EBBING - The earliest possible sampling time will be estimated at the lab and provided on your field sheet. The field leader will wait for the sand crab patch width to contract to less than 6 meters or until 1.5 hours have elapsed since the earliest possible sampling time.

(Note: If your have lots of time between your arrival and the Beach walk described in Step 3, you should place the sample location stakes at the positions liste on the Randomly Selected Sites: Positioning sheet. See below for techniques.)

3) BEACH WALK - Walk the length of the study area, one person above the patch area, the other below it, recording the locations and sizes of patches of sand crabs and rock/pebble patches on graph paper. Try to keep to the scale provided but don't attempt excessive detailing which might consume time.

NOTE: You are taking meter-long strides to keep track of where you are on the beach.

RANDOMLY SELECTED SITES: POSITIONING
Carry your site stakes while you are walking. On your way back to the starting point place these stakes at the 9 preselected sampling sites as noted on your field sheets. Use the "Paces from 500" column to get the number of paces to count off from the end position.
If one of the sites falls on a cobble stretch, replace it with the first number from the list of additional sites. All unacceptable sites are replaced as they occur. The new site numbers are listed in the "New Site" column of the "Positioning" sheet.
When your have 9 acceptable sampling sites, reorder them, serially from zero on the Positioning sheet and transfer this list to the "Randomly Selected Sites: Description" sheet.

4) SAMPLE SITE- Go to sample site and describe it for sand crab patch length, width and portion of patch sampled - edge, middle, between patch, giving distances from the patch edges. If the sand crabs form a continuous band, state so and describe the band for 5 meters on either side of the tow.

5) START SAMPLING ANIMALS
Start 1/2 meter below the low edge of patch or in area exposed by a withdrawn wave if there is no patch or if there is no lower edge to the patch. Note: if animals sporatically occur down to wave edge, try to define the point where 90% of the animals are higher on the beach and use that boundary as your lower edge.

Tow towards the berm for the length of the net.

Pull the sled as quickly as you can without pulling the sled out of the sand. The sand will clog the mouth of the sampler when the tow is complete.

If the band is wider than the bag length, a second tow must be taken. This tow will start at the position where the first tow ended (plant your sled in the sand to mark the spot after the first tow) at least 2 meters up or down the beach from that tow line. Measure and record the distance of the second tow.

Never walk on the area you are about to sample and minimize the amount of light shone on this area.

Rinse sand out of the bag and take bage with you.
Leave stake at sampling site.

6) TAKE CHEMISTRY SAMPLES THREE PREDETERMINED TOW SITES ONLY
These sites will be noted on your "Sampling" field sheets. (The nine tow sites have been divided into three groups of three - three "triads". There is one chemistry site in each of these triads.)

A) Sand samples- taken from mid-tow area, one meter away from tow line.
Use specimen cups to take FOUR sand samples (as cores).
Cap and label outside of cups and caps with:
Beach name
Date
Site letter
Sample type
place sample in ice chest

Use glass bottle for ONE sand sample. Label as above.
These samples will not be taken on the first survey.

B) Wave-wash samples - these samples will be taken after you have processed the animal samples. Directions will be given in this protocol.

7) Describe each sample site area for 1) beach width (estimated) 2) beach slope (measured with level line) - if beach has two distinct slopes measure both of them 3) cobble on the wet sand, in the wave break and in knee-deep water (outgoing wave) and 4) temperature of water in knee-deep water (outgoing wave).

8) Proceed to animal processing area. Get sieves and jars from truck - while you are at the truck put on dry ice those chemistry samples which require freezing.

PROCESS ANIMALS THROUGH SIEVES 20 - 3
Each site is processed separately.
There are no buckets 1 and 2.
Stack buckets sequentially, #20 (largest holes) on the top.
Sieve animals.
Fill in zero counts on Sand Crab Tally Sheet - preserved
Fill in counts for buckets 11-20.

Animals from all buckets will be preserved separately by bucket in glass jars and returned to the laboratory. Use labels prepared in lab. Prepare the 10% Formalin solution at your processing area by pouring half of the Formalin (in the one gallon carboy) into the 5 gallon carboy then filling the 5 gallon carboy with sea water.

Using the "Sand crab tally sheet" keep track of the number of individuals preserved from buckets 11-20. We want to end up with at least 300 of these individuals preserved from the entire beach; at least one hundred from each of the three-site triads.
If not enough animals were sampled, return to site areas (i.e., triad) that provide low numbers and dig for more animals. Screen these animals through buck #11 and preserve each triad area separately from the towed samples.

LIVE ANIMALS
From each three-site triad area we want 30 females (approximately ten per tow site) with bright orange eggs from buckets 11-15 brought back alive. Go to the first area, find a patch of large animals, gently shovel them out, screen the shovelful through buckets 16 (top) and 11 (bottom). Select for smaller individuals.

When you have 30 undamaged females with orange eggs, place them in a wet laundry bag and fill out the red I.D. tag with Beach, Triad Area and Sample Time. Gently stow this bag in one of the "Live" containers provided for this useage and this useage only. Proceed to next triad area and find thrity more females as above.
Do same for third triad area.

10) TAKE WAVE WASH SAMPLES AND PROCESS THEM

Seston sample taking:

1) Fill the large, rectangular opaque bottle with ocean water from slack waer that is approx. one foot deep.

2) Allow sand in large bottle to settle for 30 seconds before carefully decanting water into smaller "triad bottle". Fill to overflowing.

3) Rinse large bottle and repeat procedure for each of next tow triads.

4) Fill large bottle from anywhere along the study beach.

5) Smaller bottles will be filtered in the field. Large bottle will be chilled and not filtered.

Chlorophyll sample taking:

1) Fill two scintillation vials marked "Sampl 1 (A, F or H)" and "Samp 2 (A, F or H)" to the top from slack water approx. one foot in depth. Cap the vials.

2) Both samples from each triad will be combined to be filtered as one.

3) The chlorophyll/phaeophytin sample will be filtered after the seston sample.

SESTON Filtering in the Field:

1) Use a preweighed GFC Filter in a numbered petri dish for the seston filtering.

2) Remove the top piece of the filter holder.

3) Wet the glass frit with distilled water.

4) Note the number on the petri dish in the log and remove the GFC filter to the wetted frit with the flat bladed Millipore forceps. Do not touch the filter with your hands!

5) Be careful to center the filter, apply vacuum and clamp or screw on the top part of the filter holder.

6) Filter the contents of bottle #1 with vacuum less than 15 inces Hg. Bottle #1 holds 200 ml. and the filtering apparatus does not. BE CAREFUL when pouring the sample into the filter holder. Swirl the contents prior to pouring the last of the sample water into the filter holder.

7) Turn pump off and break the vacuum. Reestablish setup.

8) Add 2.5-5.0 ml. distilled water to rinse the filter, briefly apply suction to remove excess water. Repeat.

9) With the suction on, remove the filter funnel and rinse the edge of the filter with a few drops of distilled water. Suck off excess water.

10) Break the vacuum and remove the filter with the flat bladed Millipore forceps. Put filter in numbered petri dish it came from.

11) Petri dish goes into a Ziploc bag and onto dry ice.

NOTE: You have only one spare preweighed filter.

IMPORTANT: The vacuum system does not have a water trap to protect the vacuum pumps. Empty the flasks after each filtering. Save the last flask - it will be used for the chlorophyll filter rinse.

CHLOROPHYLL/PHAEOPHYTIN FILTERING IN THE FIELD

1) Each ch. sample consists of 2 scintillation vials of sea water (approx. 50 ml.) labelled "Sampl 1 (A, H or F)" and "Samp 2 (A, H or F)".

2) Remove the filter funnel and wet the glass frit (distilled water).

3) MILLIPORE AA membrane filters will be used for the chl. samples. Each filter is between two blue wax papers. Remove the white membrane filter and center it on the wetted glass frit. The blue wax paper will curl up as it is wetted and can be removed. Be sure that there is no blue waxed paper when you are trying to filter.

4) While applying suction, replace and clamp the filtering funnel.

5) Filter water from both scintillation bottles (1 & 2) from the chemistry triad using a vacuum less than 15 inches of Hg.

6) Rinse the funnel with 2-5 ml. of the FILTERED SEA WATER FROM THE SESTON PROCEDURE or do not rinse at all. DO NOT use distilled water.

7) Suction off excess water. Remove the filter funnel and break the vacuum.

8) Remove the filter to the appropriate prelabelled scintillation vial which contains 10 ml. of acetone. Secure the cap, shake the vial and place the vial in the dry ice cooler.

IMPORTANT: As much as is practical, keep the sample in reduced light throughout its handling.

11) Return to truck with the samples first.

Fill a "live" carboy with seawater to be brought back to lab.

Rinse the gear to at least remove excess sand. If there is fresh water available, use it.

Stow the rest of the gear and come home.

KEEP THE LIVE ANIMALS AS FAR AWAY FROM THE PRESERVED SAMPLES AND THE PRESERVATIVE AS POSSIBLE.

B.2 Sand Crab Survey 2 (30 June-3 July 1983)

1) Note departure time under "Survey Duration".
Note beach characteristics on field sheet. Use the beginning/ending study site landmarks as defined on the first survey.
Wave height is estimated; wave frequency is timed. Wave height is based on the trough to crest height when the waves break.

(The start and end points of the sampling area should be 30-100 meters away from any obstacle (pier, creek etc.) and 100 m away from the source of any bright lights.)

2) WAIT UNTIL THE SUN HAS SET - the earliest possible sampling time will be estimated at the lab and provided on your field sheet. The field leader can wait for the sand crab patch width to contract to less than 6 meters or until 1.5 hours have elapsed since the earliest possible sampling time.

3) BEACH WALK - Walk the length of the study area, one person above the patch area, the other below it, recording the locations and sizes of patches of sand crabs and rock/pebble patches.

NOTE: You are taking meter-long strides to keep track of where you are on the beach.)

Each new patch begins a new line on the BEACHWALK sheet.

RANDOMLY SELECTED SITES: POSITIONING
Carry your site stakes while you are walking. Mark the patches as you encounter them on your beachwalk if there are only a few patches on your beach.
When you are through with your beachwalk tally up the number of patches and interpatches in your study area.
If there are five or more patches on the beach, use your random number table to select four patches out of the total available and then two non-cobble interpatches out of the total available for sampling.
If there are four patches, sample all four and randomly select two interpatch areas for sampling.
If there are less than four patches, refer to the Contingency Flow Diagram for what to do.
To use the random number table: make a blind stab at the table to select your first number-the digits at the right end of the block are the ones you are interested in. Work your way down the column, keeping the numbers that fall between one and the maximum allowable (as defined either by the number of patches or the number of interpatches.) For example: there are 25 patches on the beach, your finger ends up on "47448", 48 is too large, the next number is "92717", and 17 is acceptable, next is "92312", and 12 is acceptable, as is 05 from "63105" and 11 from "66711".

4) SAMPLE SITE- Go to sample site and if the patch has changed dimensions noticeably since the mapping, pace the length of the patch (or interpatch). Using the random number table and the length (number of paces as your maximum number), select the position in the patch (or interpatch) to be towed. You must be at least one pace away from the edge of your patch (or interpatch). Describe the patch (or interpatch) for length, width and portion of patch (or interpatch) sampled - in paces from the edge. If the sand crabs form a continuous band, state so and describe the band for 5 meters on either side of the tow.

5) START SAMPLING ANIMALS
Start 1/2 meter below the low edge of patch or in area exposed by a withdrawn wave if there is no patch or if there is no lower edge to the patch. Note: if animals sporatically occur down to wave edge, try to define the point where 90% of the animals are higher on the beach and use that boundary as your lower edge.

Tow towards the berm for the length of the net.

Pull the sled as quickly as you can without pulling the sled out of the sand and without jerking the sled. The sand will clog the mouth of the sampler when the tow is complete. Pace off the length of the tow and record it to the nearest 1/2 meter.

If the band is wider than the bag length, a second tow must be taken. This tow will start at the position where the first tow ended (plant your sled in the sand to mark the spot after the first tow) at least 2 meters up or down the beach from that tow line. Measure and record the distance of the second tow.

Tie off the open end of the sand crab net and stake it high on the beach, where it won't get washed away.

Never walk on the area you are about to sample and minimize the amount of light shone on this area.

Take the sand chemistry samples

A) Sand samples- taken from mid-tow area, 1/2 meter away from tow line.
Use specimen cups to take FOUR sand samples (as cores). The sample containers should be prelabelled for you, if not:
Cap and label outside of cups and caps with:
Beach code number
Date
Site letter
Sample type
place sample in ice chest

Use glass scintillation bottle for ONE sand sample. Label as above.

B) Wave-wash samples - these samples will be taken after you have processed the animal samples. Directions will be given later in this protocol.

6) IF YOU ARE SAMPLING A PATCH: Fill two laundry bags with sand from the patch you just sampled-you are after more animals. Shovel equal amounts of sand from low, mid and high areas of the patch.
Rinse the bag and check. If there are approximately 200 sand crabs (including at least 40 larger animals) from both bags combined, you're okay. If you need more animals, shovel more sand. Keep a record of the number of sand bags you filled to get the extra animals.

GO ON TO NEXT SAMPLE SITE AND TAKE YOUR NEXT TOW and extra crabs and sand samples. Time is of the essence--we would like all six tows taken as close in time as is possible.

7) After you have sampled all six sites for animals and sand, return to each to describe each sample site area for 1) beach width (estimated) 2) beach slope (measured with level line) - if beach has two distinct slopes measure both of them 3) cobble on the wet sand, in the wave break and in knee-deep water (outgoing wave) and 4) temperature of water in knee-deep water (outgoing wave).

Take the wave-wash samples at each site.
Fill one brown plastic bottle and two scintillation vials with water from a "settling" container. The settling container is a graduated cylinder. Fill the cylinder during slack water - after the wave has come in and before it goes out. Count to 30 seconds for settling before pouring contents into seston and chlorophyll containers. Be careful to avoid getting any sand in the receptacles. The plastic bottle is for "seston", the two vials are for chlorophyll. Label the containers appropriately (if the containers haven't been prelabelled).

Clean the sand out of the sand crab net bag. If the sand is too coarse to go through the netting, the sample contents should be sieved through Sieve # 5 (and therefore eliminate Sieves # 3 and 4).

8) Proceed to animal processing area with your animals, chemistry samples and sampling gear.
Get sieves and jars from truck - while you are at the truck put on dry ice those chemistry samples which require freezing.

PROCESS ANIMALS THROUGH SIEVES 20 - 3
Each site is processed separately.
There are no buckets 1 and 2.
Stack buckets sequentially, #20 (largest holes) on the top.
Sieve animals.
Fill in "p" for present and "0" for zero counts on Sand Crab Tally Sheet - Preserved for all size categories.
Keep approximate track of the total number in each patch sample.
Remember: if you had to use Sieve # 5 to clean the sand out of the sample, you are not going to have crab samples from Sieves # 3 and 4.

Animals from all buckets will be preserved separately by bucket in glass jars and returned to the laboratory. Use labels prepared in lab. Return unused labels to the lab. Prepare the 10% Formalin solution at your processing area by pouring half of the Formalin (in the one gallon carboy) into the 5 gallon carboy then filling the 5 gallon carboy with sea water.

Using the "Sand crab tally sheet" keep track of the number of individuals preserved. We want to end up with at least 200 of these individuals preserved from each patch sampled.

9) Return to truck with the samples first.
Fill a "live" carboy with seawater to be brought back to lab.
Rinse the gear to at least remove excess sand. If there is fresh water available, use it.
Stow the rest of the gear and come home.

KEEP THE LIVE ANIMALS AS FAR AWAY FROM THE PRESERVED SAMPLES AND THE PRESERVATIVE AS POSSIBLE.

10) Record the time you return to MEC on Page 1 of the field sheet under "Survey duration".

B.3 Sand Crab Survey 3 (2-5 August 1983)

1) Note departure time under "Survey Duration".
Note beach characteristics on field sheet. Use the beginning/ending study site landmarks as defined on the first survey.
Wave height is estimated; wave frequency is timed. Wave height is based on the trough to crest height when the wave first breaks.

(The start and end points of the sampling area should be 30-100 meters away from any obstacle (pier, creek etc.) and 100 m away from the source of any bright lights.)

2) WAIT UNTIL THE SUN HAS SET - the earliest possible sampling time will be estimated at the lab and provided on your field sheet. The field leader can wait for the sand crab patch width to contract to less than 6 meters or until 1.5 hours have elapsed since the earliest possible sampling time.

3) BEACH WALK - Walk the length of the study area, one person above the patch area, the other below it, recording the locations and sizes of patches of sand crabs and rock/pebble patches.

NOTE: You are taking meter-long strides to keep track of where you are on the beach.)

Each new patch begins a new line on the BEACHWALK sheet.

RANDOMLY SELECTED SITES: POSITIONING
Carry your site stakes while you are walking. Mark the patches as you encounter them on your beachwalk if there are only a few patches on your beach.
When you are through with your beachwalk tally up the number of patches and interpatches in your study area.
If there are five or more patches on the beach, use your random number table to select four patches out of the total available and then two non-cobble interpatches out of the total available for sampling.
If there are four patches, sample all four and randomly select two interpatch areas for sampling.
If there are less than four patches, refer to the Contingency Flow Diagram for what to do.
To use the random number table: make a blind stab at the table to select your first number-the digits at the right end of the block are the ones you are interested in. Work your way down the column, keeping the numbers that fall between one and the maximum allowable (as defined either by the number of patches or the number of interpatches.) For example: there are 25 patches on the beach, your finger ends up on "47448", 48 is too large, the next number is "92717", and 17 is acceptable, next is "92312", and 12 is acceptable, as is 05 from "63105" and 11 from "66711".

4) SAMPLE SITE- Go to sample site and if the patch has changed dimensions noticeably since the mapping, pace the length of the patch (or interpatch). Using the random number table and the length (number of paces as your maximum number), select the position in the patch (or interpatch) to be towed. You must be at least one pace away from the edge of your patch (or interpatch). Describe the patch (or interpatch) for length, width and portion of patch (or interpatch) sampled - in paces from the edge. If the sand crabs form a continuous band, state so and describe the band for 5 meters on either side of the tow.

5) START SAMPLING ANIMALS

You will be taking animals three different ways:

1) in a sled tow
2) shovelled into a small mesh laundry bag
3) shovelled into a large mesh laundry bag

CATEORY 1 SLED TOWS

Start 1/2 meter below the low edge of patch or in area exposed by a withdrawn wave if there is no patch or if there is no lower edge to the patch. Note: if animals sporatically occur down to wave edge, try to define the point where 90% of the animals are higher on the beach and use that boundary as your lower edge.

Tow towards the berm for the length of the net.

Pull the sled as quickly as you can without pulling the sled out of the sand and without jerking the sled. The sand will clog the mouth of the sampler when the tow is complete. Pace off the length of the tow and record it to the nearest 1/2 meter.

If the patch is <u>much</u> wider than the bag length, a second tow must be taken. This tow will start at the position where the first tow ended (plant your sled in the sand to mark the spot after the first tow) at least 2 meters up or down the beach from that tow line. Measure and record the distance of the second tow.

If you missed only a small portion of the patch with your tow, you can use your wider shovel to collect the portion that a second tow would take to complete the patch sample. <u>Be careful</u> to scoop out the same width, depth and length that the sled would have taken. Measure and record this distance.

Tie off the open end of the sand crab net and stake it high on the beach, where it won't get washed away.

<u>Never</u> walk on the area you are about to sample and minimize the amount of light shone on this area.

Take the sand chemistry samples