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CUSPATE SHOREFORMS OF WEST PASSAGE NARRAGANSETT BAY, RHODE ISLAND

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CUSPATE SHOREFORMS OF WEST PASSAGE NARRAGANSETT BAY, RHODE ISLAND

BY

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ABSTRACT

The cuspate shoreforms of the lower West Passage, Narragansett Bay, are similar in configuration. They are triangular in shape, enclose a central lagoon and extend seaward from the mainland into West Passage. Two of these cuspate shoreforms, Greene Point and Casey Point, were selected for field investigation to determine their morphologic and sedimentologic response to the littoral environment.

Greene Point is partially composed of fine sediments ranging from silt to pebble sizes, which are easily set in motion by waves under normal meteorologic conditions. The beach morphology of this shoreform undergoes significant seasonal variations. In addition, this beach has apparently been retreating over lagoonal deposits which are now partially exposed on the foreshore. The cobble and boulder size material forming portions of the lower foreshore of Greene Point are not normally transported by waves and have lagged behind the retreating portion of the beach.

In contrast, the Casey Point beach shows little seasonal change. Shape sorting of the cobble and boulder size material forming the beach indicates, however, that the surficial sediments are at least occasionally reworked by

waves.

The extremely coarse material included in the cuspate shoreforms along West Passage was glacially derived and deposited at or near the location of the present shoreforms during the last glacial age. After post-glacial transgression and establishment of a marine environment along West Passage this material was probably reworked by waves into the present morphology of the shoreforms. The cuspate configuration of the shoreforms is due to shoreline orientation perpendicular to maximum effective fetch in West Passage.

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INTRODUCTION

Four cuspate shoreforms occur along the west shoreline of West Passage of Narragansett Bay, Rhode Island (Fig. 1). Greene Point, the northernmost feature is located just north of the Jamestown Bridge. Plum Beach Point is located just under the western end of the Bridge. Casey Point is situated approximately three-fourths of a mile south of the Bridge. The cuspate feature known as South Ferry is located another mile south of Casey Point.

Included in the field investigation of this study are Greene Point, a cuspate shoreform of sand, gravel, cobbles and boulders, and Casey Point, composed largely of cobbles and boulders. These shoreforms were chosen over other cuspate shoreforms in the area for field study because they are the least altered by construction and artificial fill.

Field studies were designed to measure characteristics of the cuspate shoreforms such as morphology, sediment populations, seasonal changes in beach morphology and transport of surficial material. The objectives of these studies were to define the stability of the present cuspate shoreforms and provide clues to their origin and development.

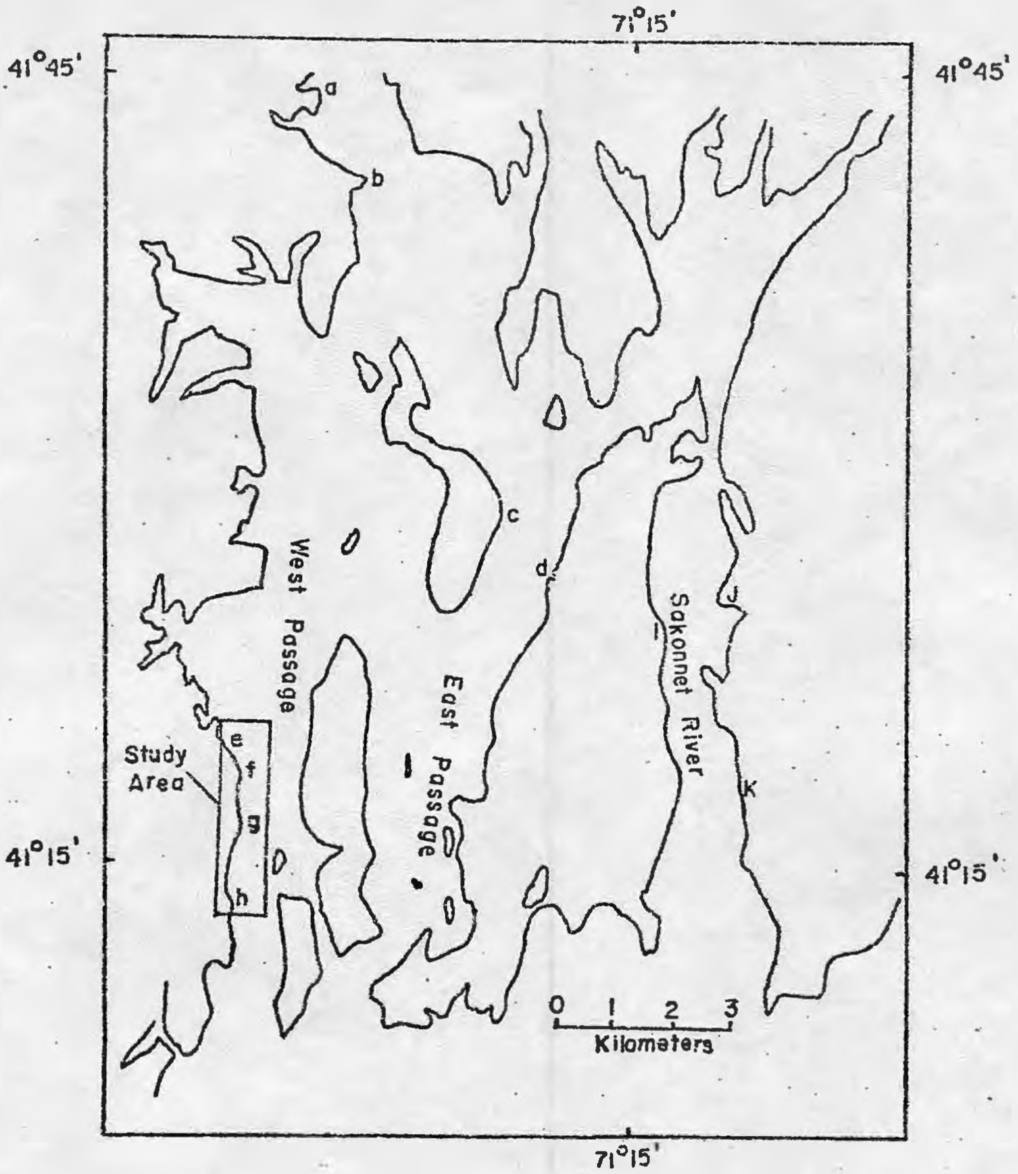


Figure 1. Location of cuspate shoreforms in Narragansett Bay - a. Gaspee Point b. Conimmicut Point c. Sandy Point d. Coggeshall Point e. Greene Point f. Plum Beach Point g. Casey Point h. South Ferry i. McCurry Point j. Sapowet Point k. Brown Point

Previous Studies of Cuspate Shoreforms

Pioneering studies of coastal processes and shoreline development were conducted by D. W. Johnson who cited the cuspate shoreforms of West Passage as typical in the early stages of shoreline development of embayed coasts (Johnson, 1925, p. 360). He attributed the origin of cuspate shoreforms to littoral drifting of beach sediments in opposite directions. Conditions ideal for this type of origin exist in long, narrow water bodies such as West Passage where directions of wave fetch are limited. All examples of cuspate shoreforms cited by Johnson occur in narrow water bodies located in weak-rock, lowland regions typically underlain by Carboniferous sediments. Johnson (1925, p. 441) terms triangular shoreforms enclosing lagoons or marshy areas, such as Greene Point and Casey Point, cuspate bars. Other authors use terms such as cuspate spits, cuspate barriers and cuspate forelands for similar features.

Fisher (1955) studied the numerous cuspate forms occurring in the lagoons of St. Lawrence Island in the Bering Sea, terming them cuspate spits. He concluded these forms were deposited from littoral drift and modified by opposing eddy currents, wave shadow effects, and storm breaching of lagoon barriers.

According to Zenkovich (1967, p. 500-522) cuspate shoreforms may be formed by deposition of material from littoral supply under several conditions. Spits accumulating and growing in opposite directions, merge at their distal ends, forming a cuspate configuration. Cyclic deposition of sediment from an oversaturated littoral supply may result in evenly spaced cuspate shoreforms along long, narrow lagoons. Cuspate-like features originating behind islands, shoals, and shipwrecks which provide shelter from wave attack have also been cited by Zenkovich (1967, p. 520).

Cuspate shoreforms enclosing lagoons are termed double fringing spits by Zenkovich (1967) and forms with no enclosed lagoon are termed cuspate forelands.

King (1972, p. 519) states that cuspate shoreforms originate under two main conditions: (1) Deposition in the wave shelter of an offshore island and (2) Origin in areas where wave approach is restricted.

Cuspate shoreforms are referred to as cuspate barriers by King (1972, p. 519) if they include a lagoonal pond and cuspate forelands if the pond is absent.

Studies in Narragansett Bay

Investigation of shoreline processes in the study area have been limited despite local beaches having serious erosion. Cross et al (1971) studied erosion problems at Plum Point and Plum Beach Point, but did not observe the area long enough to note changes in the Plum Beach Point cuspate shoreform.

Rose *et al* (1971), investigated water mass movements in West Passage during a site evaluation for a nuclear power plant to be located on Rome Point just north of the study area.

Studies of the general coastal and marine geology of the Narragansett area have been carried out by McMaster (1960, 1962), describing sediment size distribution and heavy mineral associations in Narragansett Bay.

Geologic Setting

Major topographic features in the study area predate the Wisconsin (Schafer, 1961). West Passage is assumed to be an erosional valley cut prior to the last glaciation and submerged by post-glacial sea-level rise (Smith, 1955).

The surficial sediment cover (Figure 2) is almost all glacially derived (Schafer, 1961). Ground moraine and end moraine deposits include poorly sorted mixtures of till, gravel and sand. Ice contact deposits include gravel, sand, silt and thin layers of till. Outwash deposits include sorted layers of gravel and sand. Most of the glacial material was probably derived from the Pennsylvanian bedrock of the Rhode Island formation present in the area (Schafer, 1957).

Surficial sediments in the immediate area of Greene Point and Plum Beach Point are ice-contact deposits, while

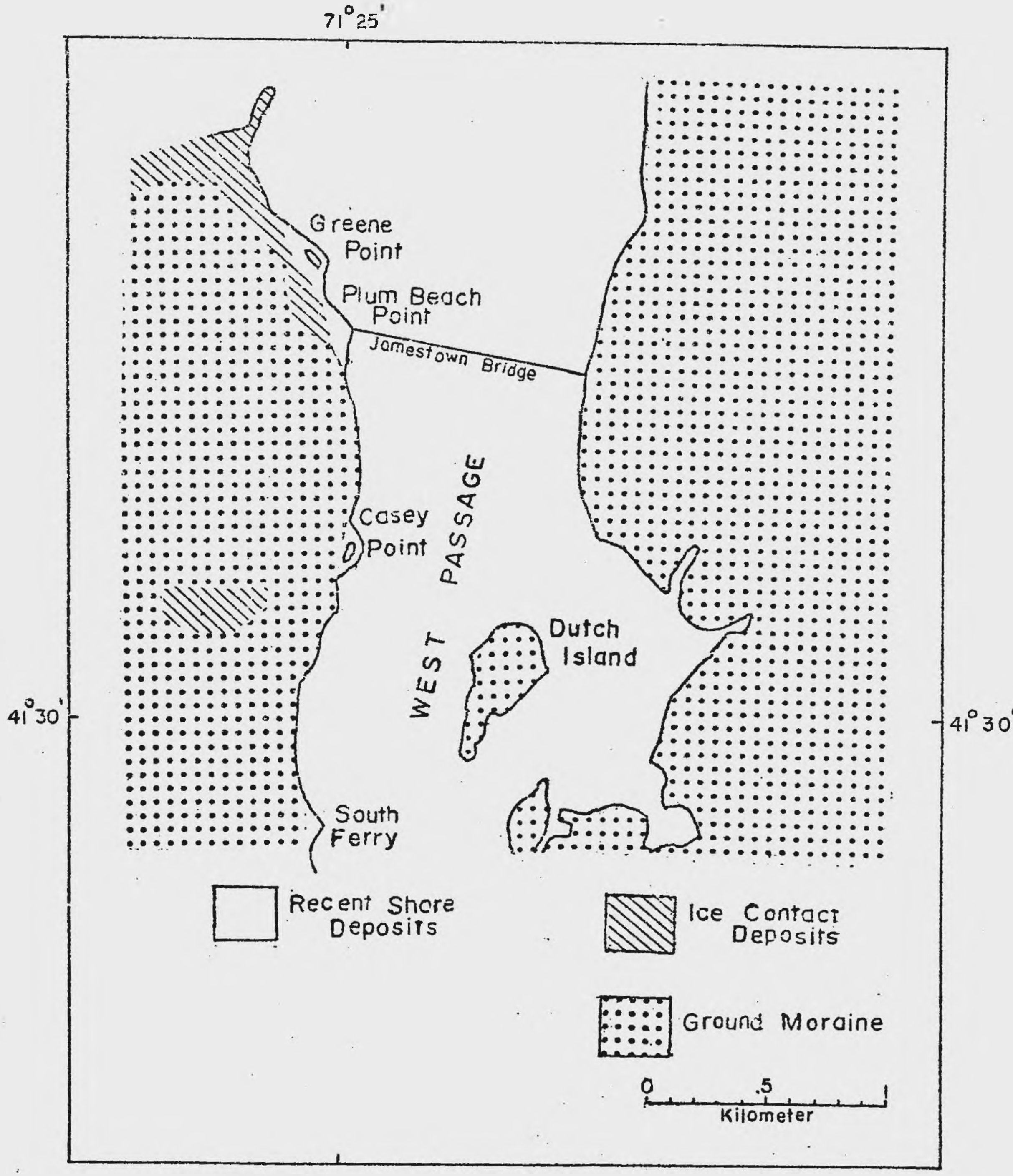


Figure 2. Location of cuspate shoreforms in West Passage and surficial geology (after Schafer, 1961)

deposits near Casey Point and South Ferry are coarser ground moraine materials composed largely of glacial till (Fig. 2).

According to Schafer (1957), shoreline deposits along West Passage have been derived from erosion of glacial sediments by waves and currents. Schafer (1961) notes heavy shoreline erosion during storms such as the August 1954 hurricane, resulting in wave cut cliffs up to 15 feet high.

METHODS OF STUDY

Topographic Survey

Greene Point and Casey Point were mapped using a plane table and alidade between October 20 and November 12, 1971. Four topographic profiles on each cuspate shoreform were measured during the initial mapping period. These profiles were measured again between March 26th and 30th, 1972 to determine any changes over the winter months. During the spring profiling, in-situ reference stakes were placed along each profile and their intersection with the sediment surface marked. The stakes were monitored weekly between April 4th and June 9th, 1972 and changes in elevation recorded. Continued monitoring of the profiles through the late spring to measure any changes in the beaches was based on the winter-erosional and summer-recovery relationship (Bascom, 1964, p. 188). It was also hoped to compare winter-summer changes of two different types of beaches, Casey Point being a cobble beach and Greene Point being more sandy in nature.

Littoral Sediment Movement

Littoral sediment movement along Greene Point and Casey Point was monitored using tracer sediments coated with fluorescent paint. The fluorescent coating is highly visible in both ultraviolet light and daylight, and is available in a variety of colors allowing it to be used in closely spaced studies without confusing results.

Fluorescent tracer studies of cobble and boulder size material on Greene Point and Casey Point were conducted by coating a 3 foot by 3 foot square section of beach at four locations along the foreshore. Each location was monitored weekly for sediment movement between March 18 and June 20, 1972.

Tracer studies of sand size sediments on the upper foreshore of Greene Point required removal of approximately 4 liters of material from the beach, coating it with the fluorescent paint and replacement on the beach. This process was completed within 24 hours to minimize the possibility of significant textural changes at the tracer study locations. The sand tracer studies were conducted at four locations along Greene Point. Each study spanned two tidal cycles, with coated sediments emplaced during low tide and collected at low tide the following day. The collection procedure involved vaseline coated index cards pressed over points on a sampling grid surrounding the original point of emplacement (Ingle, 1966). The cards were then examined under ultraviolet light and the number of recovered fluorescent grains counted.

During each study period the wind velocity was recorded (from the Quonset Point Naval Air Station) and the longshore current velocity approximated by observing a float in the littoral zone.

Sediment Samples: Greene Point

Sediment samples from the Greene Point beach ridge were collected over six traverses of six to nine samples each. Sample spacing along each traverse was such that at least two samples from each zone of the beach were collected (foreshore, backshore and zone of wind transported material if any).

Surficial sediment samples were collected with a sample scoop and shovel. The scoop was used for sand, gravel and finer sediments, while the shovel was used for cobble and boulder sized sediments. The samples were large enough to include at least a few of the largest particles.

Surficial samples were also collected along the breachway channel cutting through Greene Point and from the lagoon behind the beach.

Cores of the Greene Point beach ridge and lagoon were used to obtain samples of subsurface sediments. Three cores of the beach ridge and three cores of the lagoon were collected.

Sediment Samples: Casey Point

The cobble and boulder-sized sediments of Casey Point were measured in-situ at eight positions along the foreshore.

The intermediate diameters of fifty particles were measured in a nine square foot section (3 ft. x 3 ft.) at each sample site. This size section allowed at least a few of the largest particles to be included in the sample (Krumbein and Pettijohn, 1938, p. 31). Four sediment samples were also measured along three traverses across the Casey Point beach to determine any shape sorting trends. The short, intermediate and long axis of each particle was measured. Sampling at Casey Point was designed to measure the range of sizes among the larger particles. No attempt was made to include all sediment sizes by sampling interstitial sand, silt and clay. The finer material composed approximately 5% to 10% of the surficial sediments.

Two sediment cores were obtained from the Casey Point lagoon but the material underlying the beach could not be sampled because of difficult coring and trenching through the coarse surficial material.

Size Analysis

All sediment samples excepting the coarse material measured in-situ, underwent mechanical size analysis. Before size analysis, however, samples were treated with a 30% solution of hydrogen peroxide to remove organic material. Samples containing fractions of silt and clay greater than 5% were wet sieved to separate the fine and coarse material. The silt and clay fractions were measured by pipette analysis and grain sizes from 0.062 mm (4.0 phi) to 32 mm (-5.0 phi) in diameter were mechanically sieved at quarter phi intervals. Particles larger than 32 mm in diameter were measured at quarter phi intervals using a sliding rule apparatus similar to that described by Krumbein Pettijohn (1938, p. 145).

Textural parameters were calculated using a computer program developed by (Robert) Zimmerman at the University of Rhode Island Graduate School of Oceanography. Minor corrections in the program were made by Edmond Fitch of the Geology Department before it was used in this study.

Q-Mode Factor Analysis

Factor analysis was employed as a statistical aid in defining sediment populations on Greene Point. This statistical tool was chosen because of the low energy bay environment in which the study was conducted. Friedman (1967) suggests that techniques employing grain size parameters for differentiating between sediment populations from different depositional environments, tend to be ineffective in low energy situations where sediment supply often exceeds energy available for distribution. Solohub and Klovan (1970) in a study comparing various techniques for identifying depositional environments conclude that factor analysis is sensitive enough to detect subtle differences in grain size distributions in low energy environments.

Factor analysis on Greene Point samples was completed using a computer program supplied by Dr. John Imbrie of Brown University and adapted for use by the computer faculties at the University of Rhode Island by Joseph Lambiase and Edmond Fitch of the University of Rhode Island Geology Department.

The computer program is a Q-Mode factor analysis program which discerns relationships between variables of the sample. Each quarter phi size interval in the size analysis of sediment samples is considered a variable in the computer program and the relationship between variables is expressed by correlation coefficients (Harbaugh and Merriam, 1968, p. 182). These inter-relationships are expressed geometrically by mathematically plotted pairs of vectors which are projected onto factor axes of unit length (-1.0 to +1.0). The sum of the squares of the loadings on the factor axes is a measure of the completeness of the representation of the variables by the factor axes and is known as the communality. The goal of factor analysis is to account for the most variability in grain size with the fewest factors. In order to maximize this accountability, the computer program uses a varimax rotation which rotates the factor axes until the sums of the squares of the factor loadings are maximized. This is a positioning of the factor axes so that they are near the center of gravity of clusters of vectors representing variables.

The raw weights in each size class of all surface and subsurface samples from Greene Point comprised the input to the Q-Mode factor analysis program.

MORPHOLOGIC AND SEDIMENTOLOGIC ANALYSIS

Morphology and Morphologic Changes

The Greene Point cuspate shoreform is 2400 feet long in a north-south direction and extends 800 feet bayward from the steeply slope mainland of West Passage. The most prominent features of Greene Point are a wide beach ridge (250 feet at low water) and the enclosed shallow lagoon. Tidal exchange between the Bay and lagoon takes place through a shallow breachway cutting through the beach. A marshy area at the southern end of the lagoon encloses a smaller pond which abuts against the mainland (Fig. 3).

Casey Point is smaller in its north-south dimension (1400 feet) than Greene Point, but extends more prominently into the Bay (900 feet) from the mainland (Fig. 4). Similar to Greene Point, the Casey Point beach enclosed a lagoon which is connected to the Bay by a shallow breachway. The Casey Point lagoon does not, however, include any marshy areas.

Results of reprofiling of Greene Point in March of 1972 after the winter period show significant differences from the original profiles of November, 1971 (Fig. 5). Profiles 1 and 2, appearing concave where the beach slopes

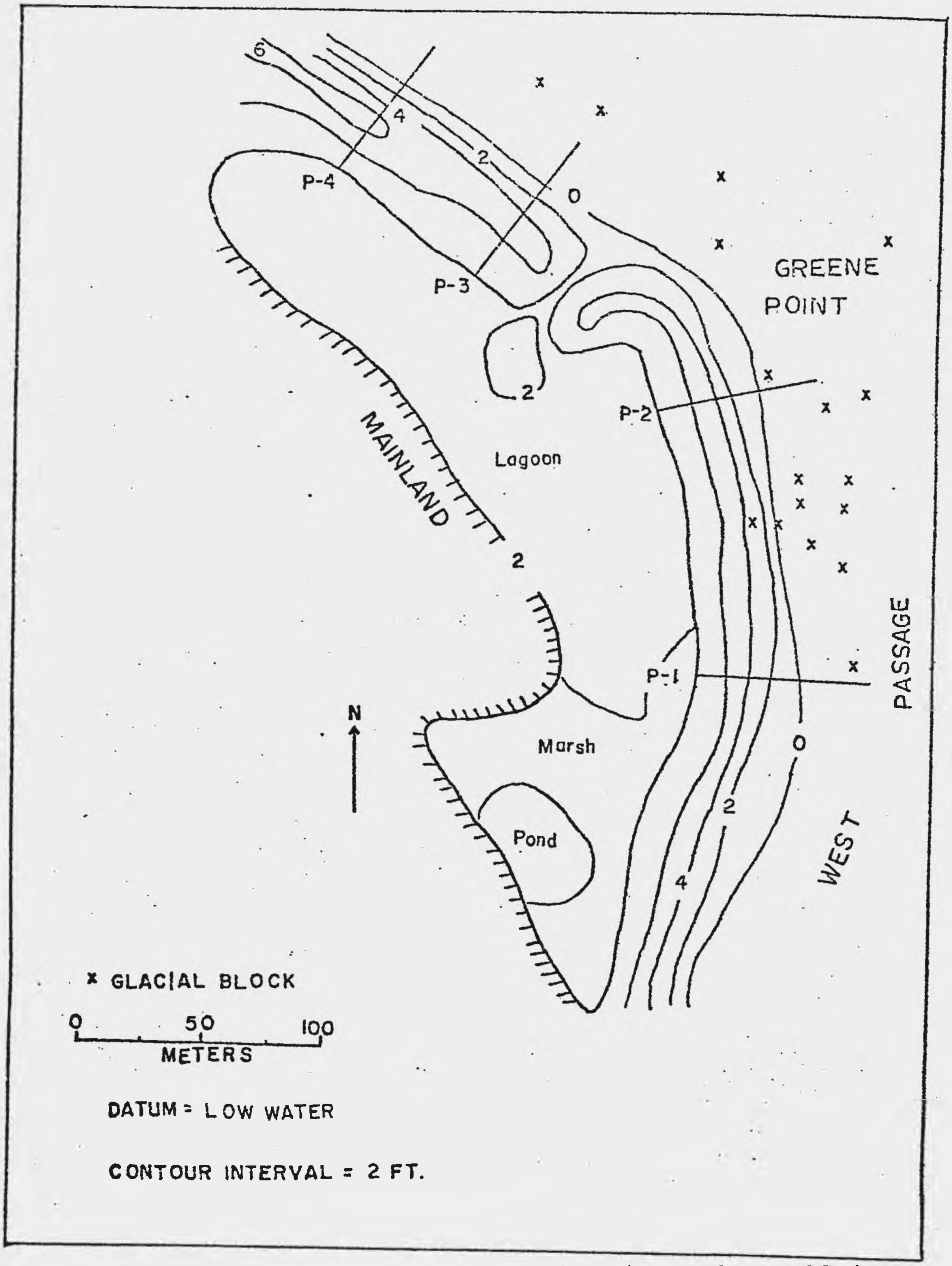


Figure 3. Topography of Greene Point (November,1971) and location of beach profiles

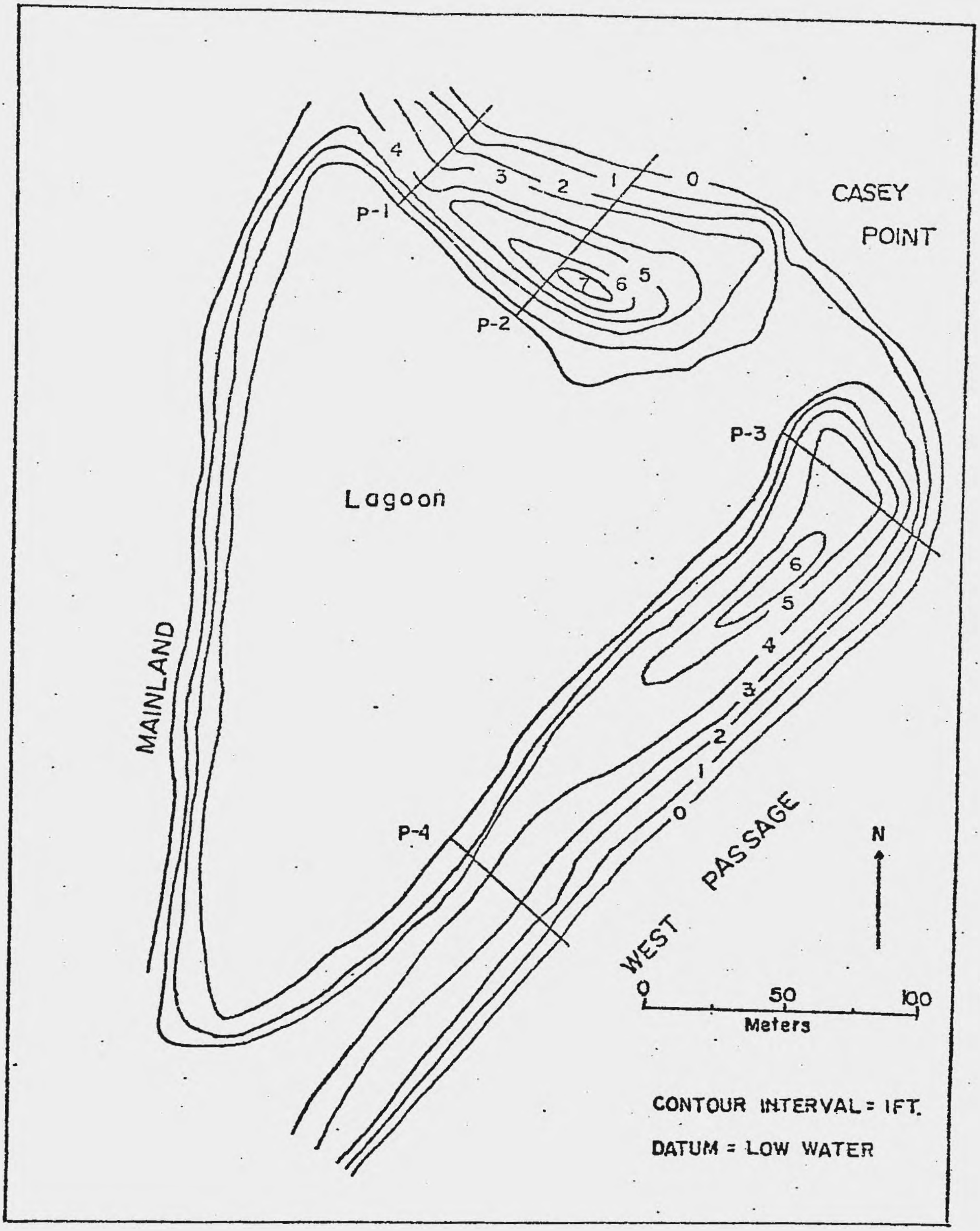


Figure 4. Topography of Casey Point (November,1971) and location of beach profiles

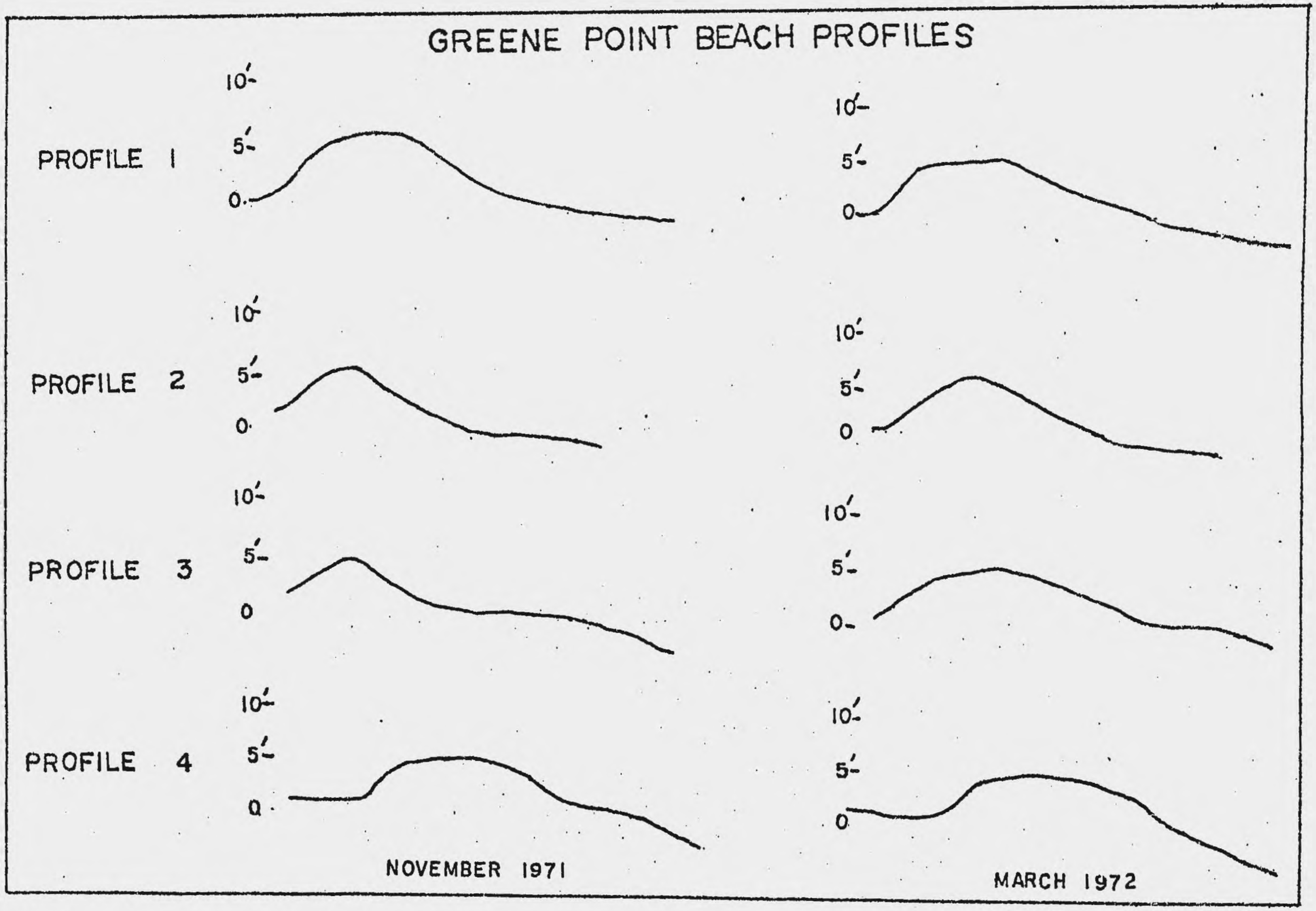


Figure 5. Greene Point beach profiles, November 1971 and March 1972 (datum low water)

up to the crest of the beach ridge in November, 1971, had a less concave, much straighter profile by March, 1972. Greene Point profile 3 appeared concave along the beach zone section nearest the crest of the beach ridge and convex along the foreshore section in November. In the March profile the situation became reversed with the upper section becoming convex and the foreshore becoming concave. Profile 4 underwent changes similar to profiles 1 and 2, changing from slightly concave in November to straight or slightly convex in March.

Profiles 1, 2 and 4 across the Casey Point beach underwent no detectable changes between November 1971 and March 1972 (Fig. 6). Profile 3 located across the most seaward section of the beach showed the accumulation of a berm-like feature on the upper foreshore.

Monitoring of reference stakes along the Greene Point and Casey Point profiles between March and June, 1972, indicated no change on Casey Point and moderate changes along the upper sandy foreshore of Greene Point (Fig. 7). Changes in Greene Point profiles 1, 3 and 4 indicate shoreward movement of sediment between March and June.

Littoral Sediment Movement

Sediment movement on the upper sandy portion of the Greene Point foreshore correlated with average wind direction recorded during each 24 hour tracer study period

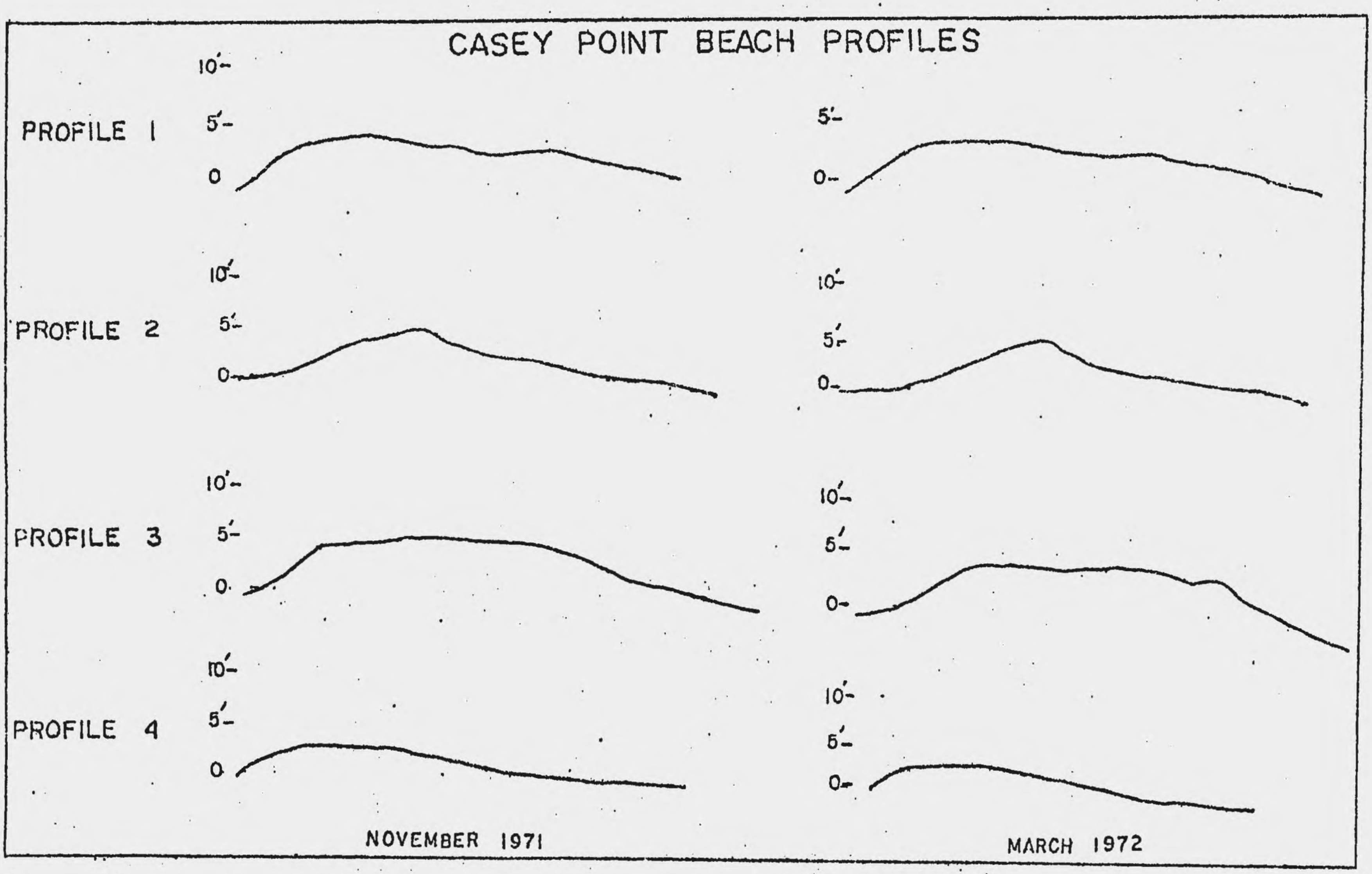


Figure 6. Casey Point beach profiles, November 1971 and March 1972 (datum low water)

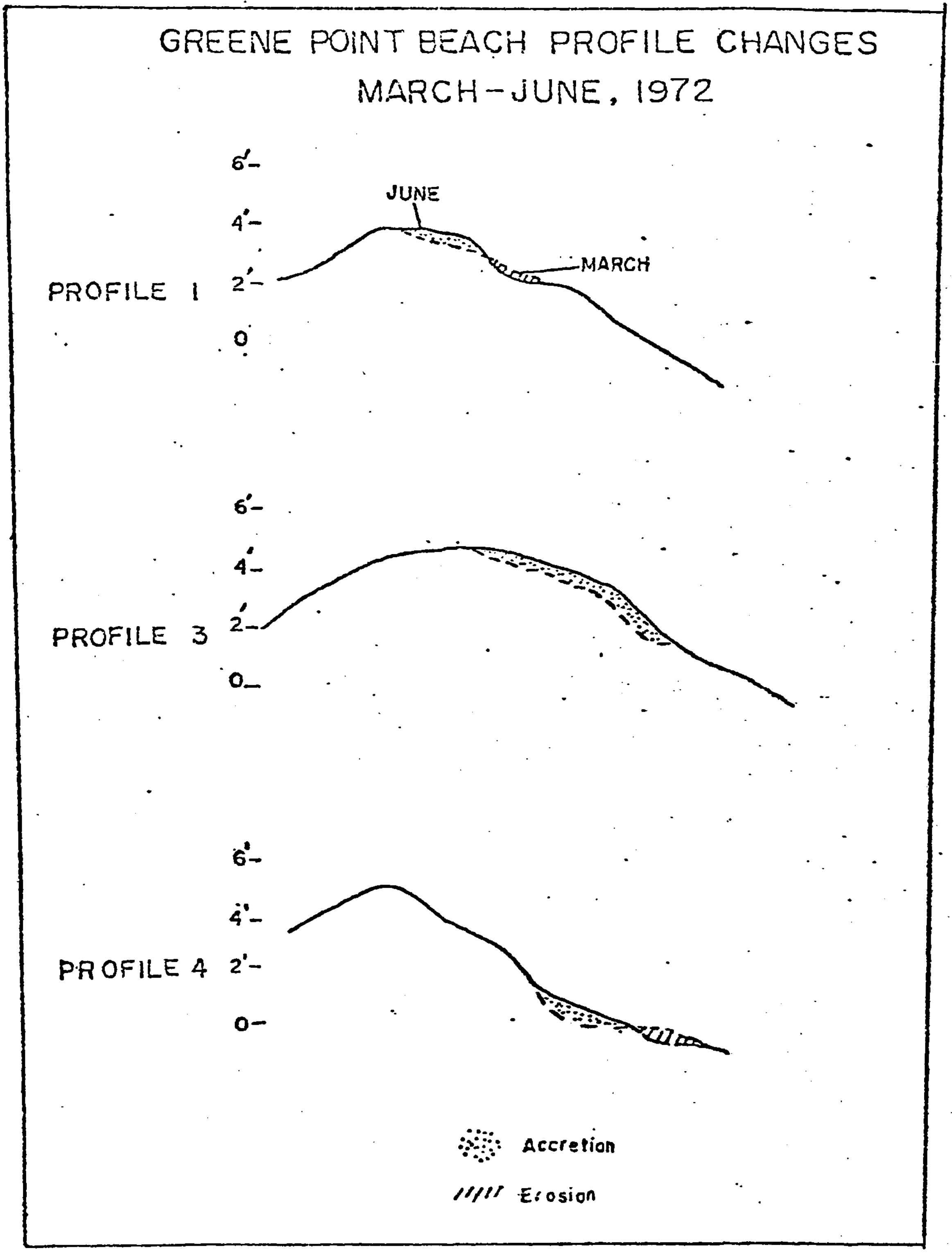


Figure 7. Greene Point beach profile changes between March and June, 1972 (datum low water)

(Table A). When winds were from the southern quadrants during a tracer study, the fluorescently-coated tracer sands moved north along the foreshore. The reverse case was true for winds from the northern quadrants.

In general, the net distance of longshore movement was small and tracer sands were never recovered more than 66 feet alongshore in either direction from the starting point. This is probably due to the limited time of exposure the upper foreshore has to wave action during each tidal cycle.

The distance of transport varied depending on the average wind direction over each 24 hour study period. The greatest longshore movement occurred during winds from the northwest quadrant (northwest and north northwest) and from the southwest quadrant (southwest and south southwest). Net longshore transport was 25 feet or less during winds from the west and northeast.

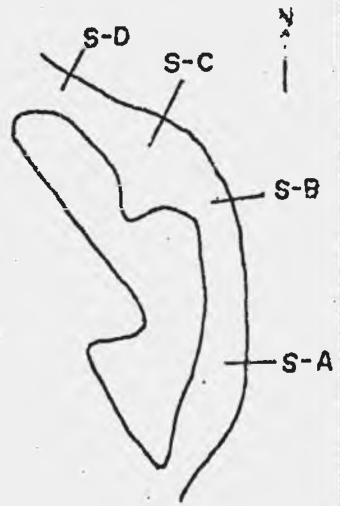
Average wind speeds were low during the studies, varying between 8 and 14 miles per hour, and no correlation could be observed between wind speed and longshore transport. Longshore current measurements should not be considered indicative of average littoral conditions, since they were not taken throughout each study period and averaged as the wind velocity had been. However, the longshore current velocity recorded at the end of each tracer study period was highest, as sediment transport had been, during wind

GREENE POINT FORESHORE TRACER STUDIES

Date	Station	Wind Direction	Wind Speed (M.P.H.)	Tracer Direction*	Tracer Distance (24 Hrs.)	Littoral Current* (ft./sec.)
3/23	S-A	SSW	14	NW(U)	15 ft.	.33(D)
3/29	S-B	NW	12	SSE(D)	40 ft.	.25(D)
3/29	S-A	NW	12	SSW(D)	60 ft.	.35(D)
4/6	S-C	SW	10	NW(U)	66 ft.	.50(U)
4/9	S-B	NNW	12	SSW(D)	45 ft.	.40(D)
4/29	S-B	WSW	14	W	10 ft.	.15(D)
4/29	S-C	WSW	14	WSW(D)	15 ft.	.15(D)
5/24	S-D	SSW	8	NW(U)	45 ft.	.15(U)
5/26	S-A	NE	10	SSW(D)	25 ft.	.50(D)

*U - Upcoast Towards Bayhead
D - Downcoast Towards Baymouth

GREENE POINT



LOCATION of SEDIMENT DYE STATIONS

TABLE A

activity from the northwest and southwest.

Observations between March 18 and June 20, 1972 at sediment dye stations on the shingle material along the lower foreshore of Greene Point revealed only two periods of movement. Observations on May 10 and 16 at a dye station just north of the breachway, indicated shoreward movement of three particles between 5 cm and 10 cm in diameter. Maximum movement was five feet in the landward direction from the starting point at the dye station.

Bi-monthly observations between March 18 and June 20, 1972 at five dye stations along the lower foreshore of Casey Point indicated no movement of large cobble and boulder sized sediments. One instance of movement of smaller cobbles (4 cm to 6 cm in diameter) was recorded on May 18th. Three small cobbles had moved 5 feet landward of the dye station.

Sediment Distribution: Greene Point

Textural analysis of Greene Point surficial samples indicates six areas of similar sediment size and sorting characteristics (Fig. 9). Poorly sorted pebble to cobble size sediments dominate in a zone parallel to the seaward edge of Greene Point. This zone is widest (225 ft.) along the segment of Greene Point south of the tidal breachway and narrows on the north side of the breachway. It forms the flat lower foreshore of Greene Point and slopes bay-

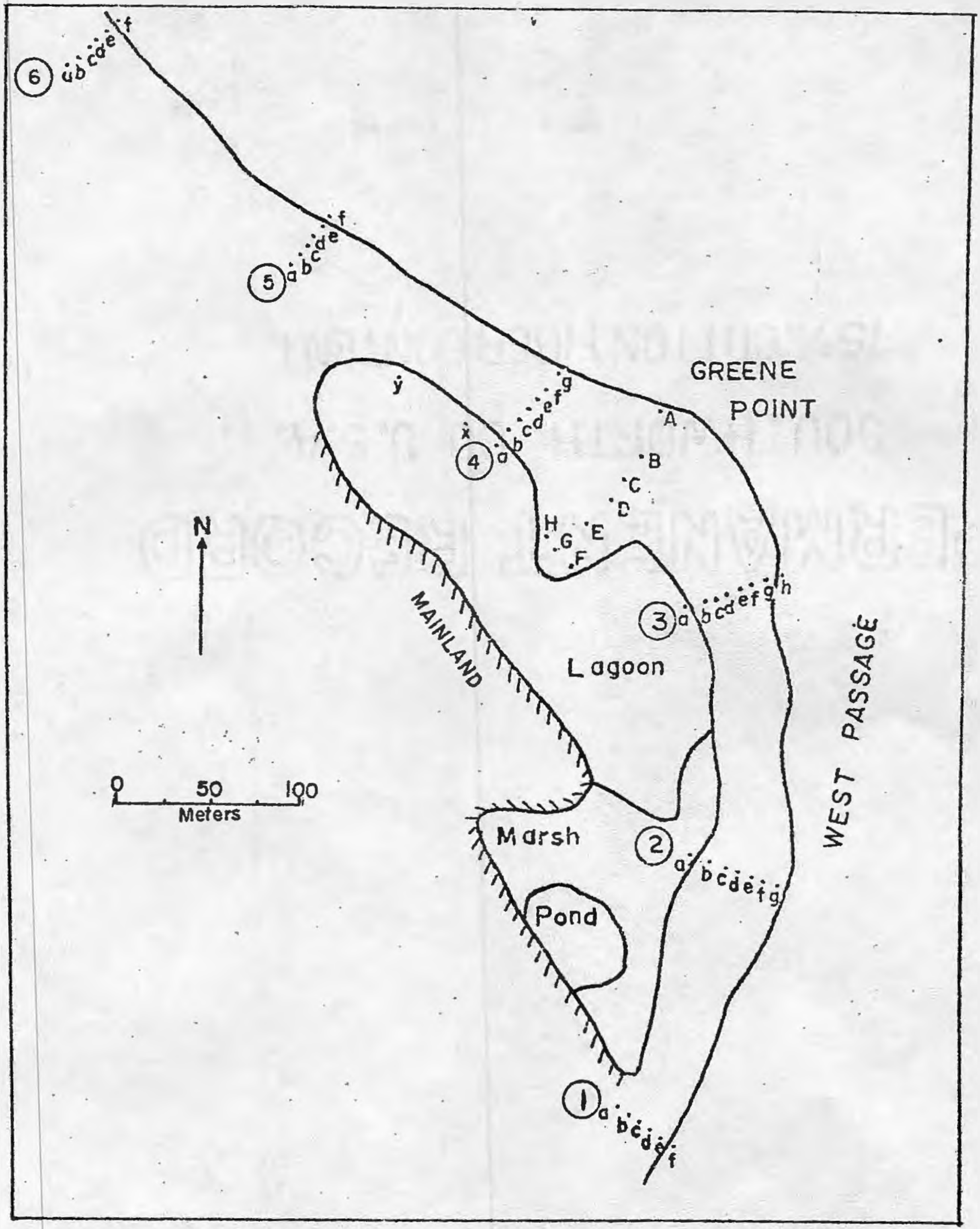


Figure 8. Location of sample traverses on Greene Point
Traverse through breachway indicated by
capital letters

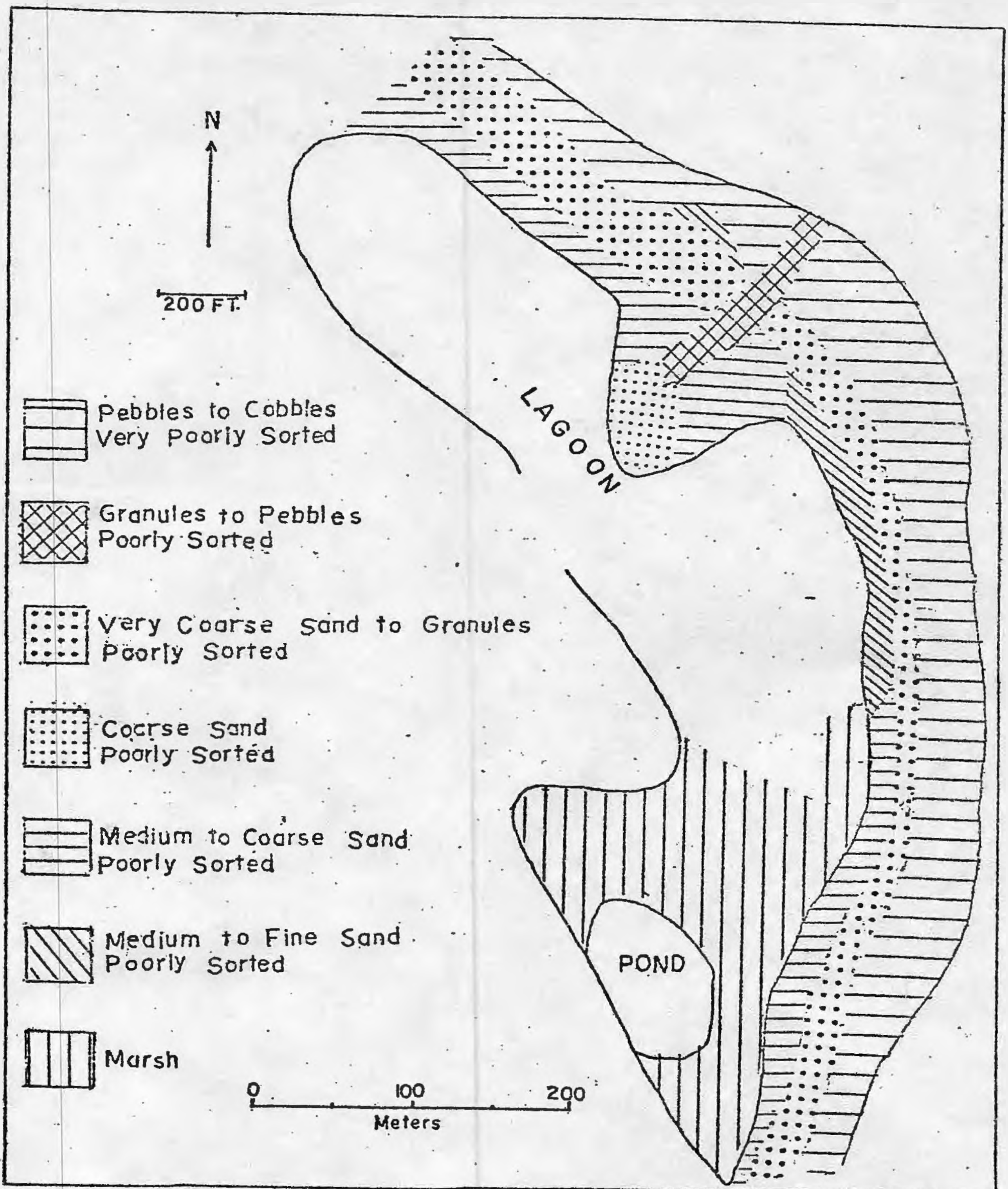


Figure 9. Distribution of surficial sediments on Greene Point (shoreline indicated at low water)

ward at one degree or less. Landward of the lower foreshore is a zone of poorly sorted sediment ranging from granules to very coarse sand. This zone runs the entire length of Greene Point and connects with adjoining sand beaches. The upper foreshore and the shoreward edge of the backshore are included in this zone. The remainder of the backshore area includes a zone of medium to coarse sand, moderately to poorly sorted and a zone of fine to medium, poorly sorted sand. Two sediment zones occur in the area of the breachway. One, in the channel itself, is an area of granule to pebble size, poorly sorted sediments. In the area including the delta-like extension into the lagoon, a zone of coarse, poorly sorted sand occurs.

In addition to surficial beach sediments ranging up to boulder size a number of blocks ranging from four feet to eight feet in diameter occur along the lower foreshore and in the littoral zone (Fig. 3). The total number of observable blocks is in excess of twenty. Some may be undetectable because they are not exposed at low tide. Most of the blocks are fractured and many have been broken into smaller fragments by frost action. These large blocks were probably glacially emplaced, but evidence such as striations and grooves are absent and may have been removed by wave action.

The beach cores (cores 1, 2 and 3, Fig. 10) indicate the Greene Point beach is underlain by coarse, moderately

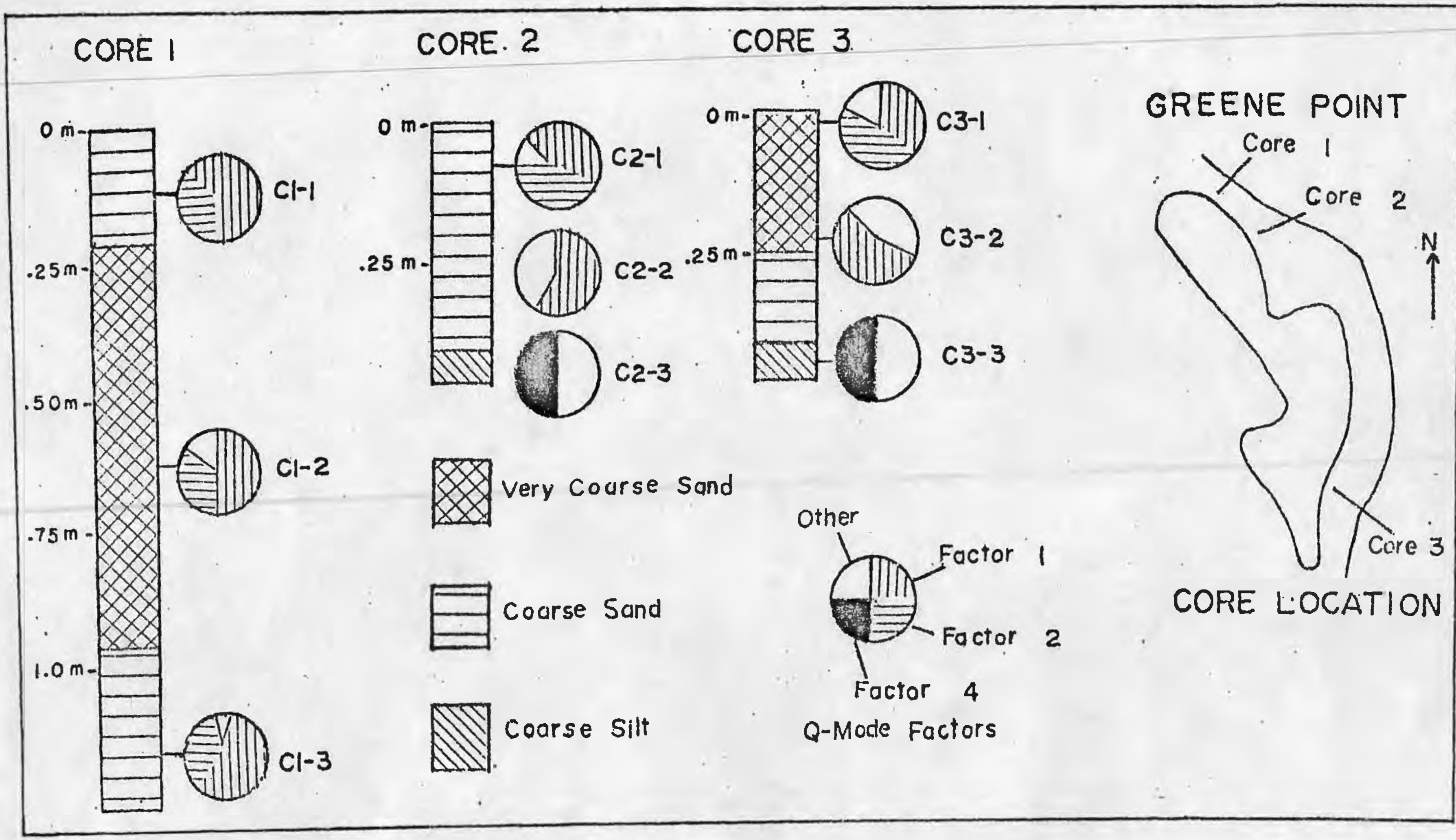


Figure 10. Distribution of sediments and Q-Mode factors in cores from Greene Point beach.

sorted sand. Cores 2 and 3 were taken in low backshore areas of Greene Point and terminated in a coarse, dark, organic appearing silt layer similar to sediments found in the near lagoon.

Analysis of core samples from the lagoon indicate it is underlain by layers of coarse silt interbedded with layers of medium to coarse, moderately sorted sand (Fig. 11). Some of the coarse lagoonal layers included particles, ranging up to pebble size.

Interpretation of Q-Mode Factors

Q-Modefactor analysis was used by Solohub and Klovan (1970) to differentiate between sediment populations in the relatively low energy Great Lakes area. It was found that the factor analysis helped to define the various sediment populations related to different environments of deposition (beach, dune and river) much more clearly than frequently used bivariate plots of textural parameters (Friedman 1967).

While factor analysis is a valuable tool for detecting subtle differences in sediment populations from grain size distributions, it is only a mathematical tool. The relation between Q-Mode factor and sedimentologic process is ultimately a subjective interpretation. The interpretation of Q-Mode factors resulting from analysis of Greene Point samples is based on the positioning of the samples on the beach (foreshore, backshore and lagoon) and a knowledge

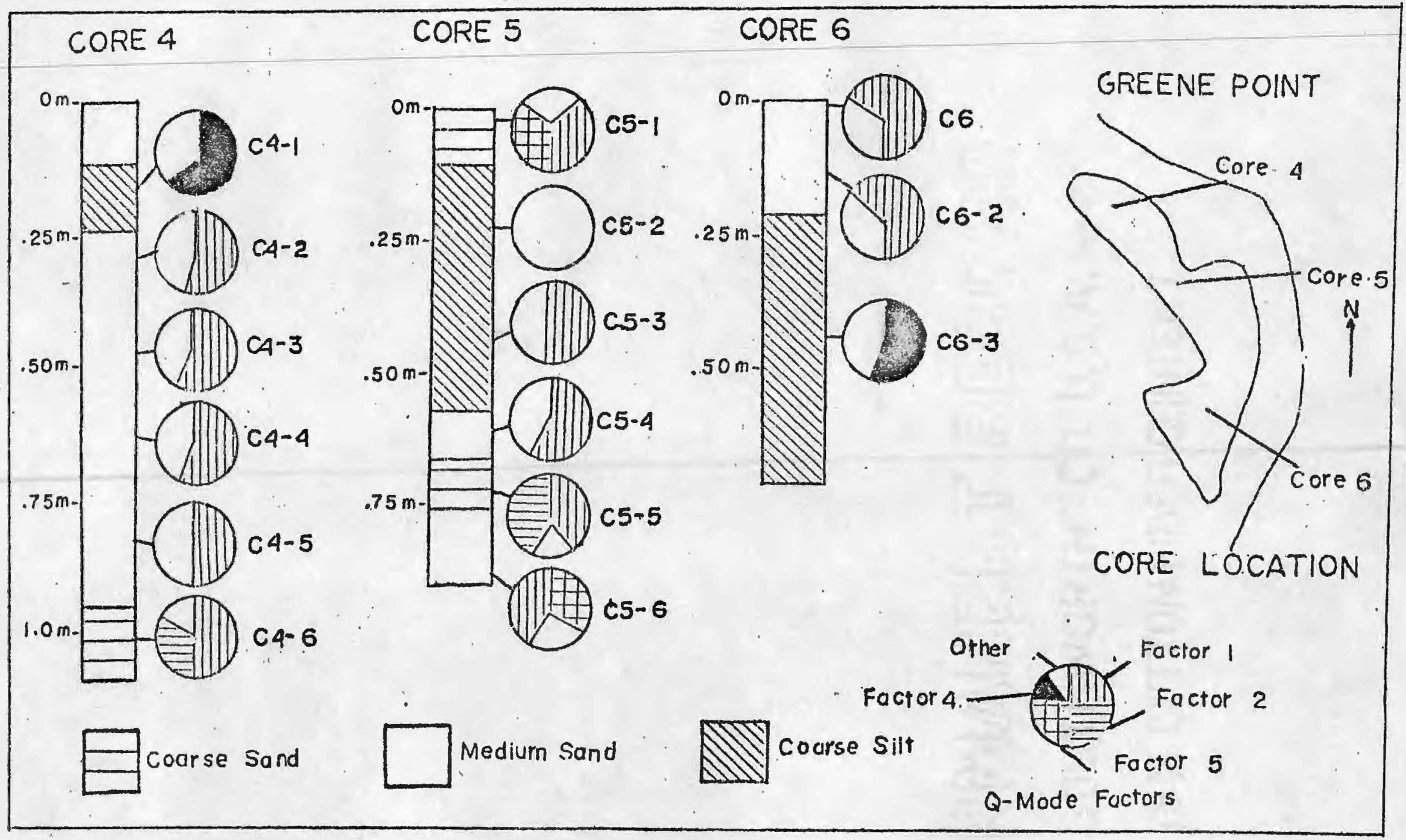


Figure 11. Distribution of sediments and Q-Mode factors in cores from Greene Point lagoon.

of processes that operate in these zones (wave, wind, and tidal).

Q-Mode factor analysis of 81 Greene Point beach and lagoon samples resulted in five mathematical factors accounting for 86.5% of the variability among samples. Q-Mode factor 1, accounting for 33% of the total variability, is significant in varimax matrix scores (Table 2, Appendix) of samples taken along the upper foreshore of Greene Point (Fig. 12). The medium to coarse sand in this zone was readily transported alongshore during tracer studies (see analysis of littoral sediment movement) by swash and backwash. Factor 1 therefore probably indicates the influence of wave run-up and backwash on the size distribution of beach sediments.

Q-Mode factor 2 accounts for 24% of variability among Greene Point samples and is significant in the varimax matrix scores of samples from the section of foreshore between mid-tide elevation and the low water line. The mean grain size of material in this zone is in the pebble range (19 mm to 76 mm). The transporting mechanism for this coarse material must be of a higher energy level than swash and backwash motion which is competent enough to move finer material higher up on the foreshore. Q-Mode factor 2, therefore, is probably related to the breaking wave process which supplies enough energy through turbulence to account for coarser size distributions. This lower section of foreshore is

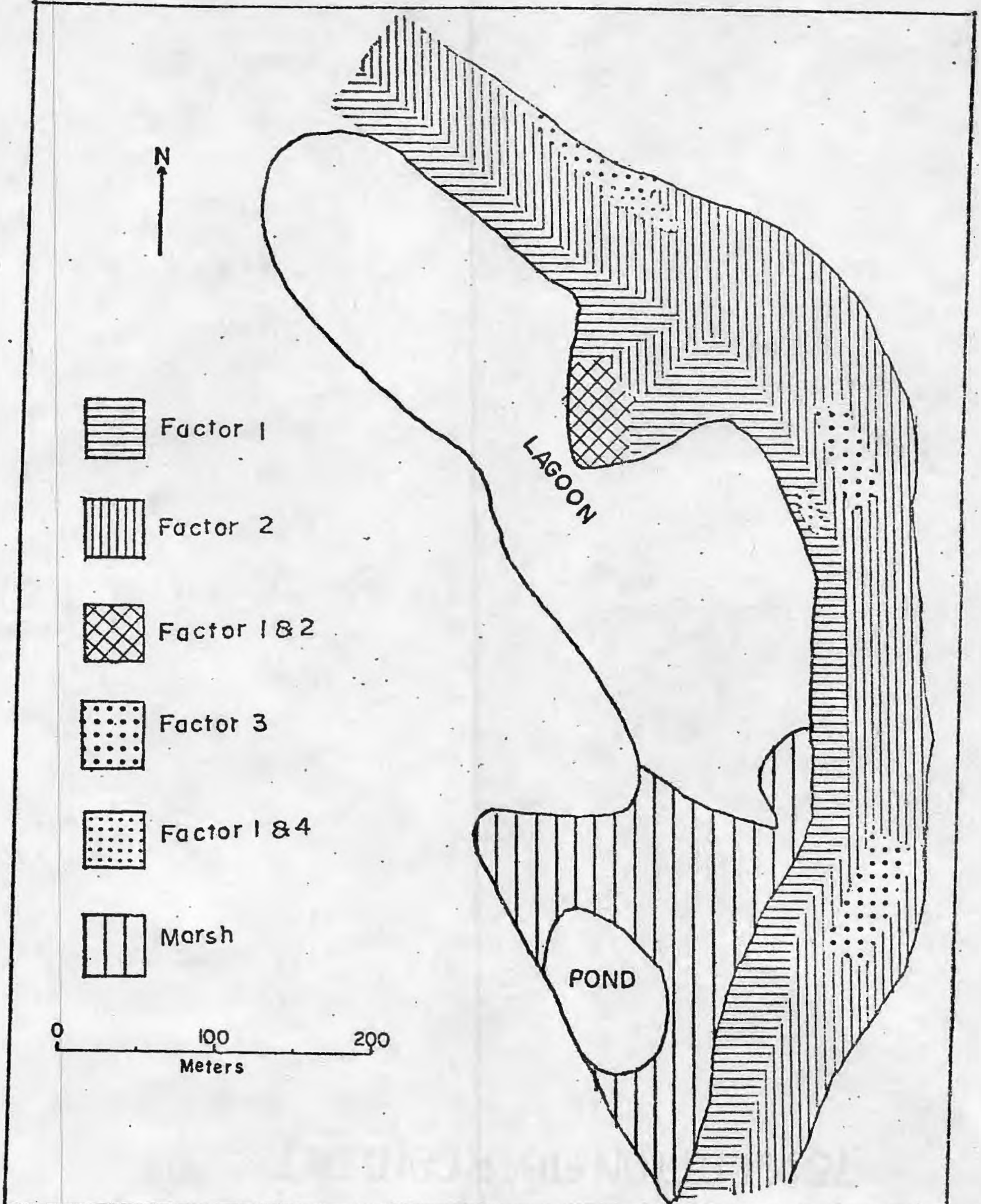


Figure 12. Distribution of Q-Mode factors in Greene Point surficial sediments

wide, flat (less than 2° seaward slope) and completely submerged at high tide. Waves normally shoal and break in this section for a few hours before and after high tide. Miller and Zeigler (1964) reported that sediments within the breaker zone commonly have coarser size distributions than sediments landward or seaward of this zone.

Q-Mode factor 2 is also significant in all samples (samples A through H) taken from the breachway of Greene Point. This indicates that the material in the breachway has been subject to similar energy conditions as the lower foreshore of Greene Point, but not necessarily attributed to the same transport process which influences the lower foreshore. Wave motion was not observed in the narrow section of the breachway where it cuts the highest portion of the beach ridge, while waves were observed to break where the breachway widens on the foreshore. Both oscillatory wave motion and unidirectional tidal flow are probably responsible for sediment size distribution in the breachway.

Q-Mode factor 3 is significant in 12 of 29 samples with a mean grain size greater than -2.00 phi taken on the middle to lower foreshore. All these samples included particles up to boulders (greater than 76 mm) in size. The extreme size of these deposits suggests they may be lag deposits. Littoral movement tracer studies of this coarse material on the foreshore of Greene Point indicated slight shifting of only the smaller cobble sizes. These studies, however, were conducted under moderate energy conditions during the Spring of 1972.

Q-Mode factor 4 accounts for 8.3% of total variability among samples. Samples in which this factor is significant contains 25% or more silt. Sample 3b from the backshore of Greene Point, sample C from the breachway and sample K on the foreshore adjacent to the breachway, all have a significant factor 4 in their varimax matrix scores (Table 2). Factor 4 is also significant in samples 2a and 3a, which are samples of the lagoon bottom (Fig. 8).

The source of the fine material may be offshore from the bay bottom. Finer sediments in the lagoon samples may be transported through the breachway or over the Greene Point beach. The significance of factor 4 in sample 3b from the backshore beyond the normal range of wave activity, suggests wind transport may account for the distribution of some finer sediments.

Greene Point beach core samples C2-3 and C3-3 (Fig. 10) and lagoon core samples C4-1 and C6-3 (Fig. 11) have a significant factor 4. All three samples are dark with a large organic content and have a mean grain size in the coarse silt range. The occurrence of factor 4 in beach cores as well as in foreshore and breachway samples suggests that the beach has retreated over former lagoonal deposits.

Q-Mode factor 5, accounting for 11% of total variability, is significant in a third of the samples from the lower foreshore of Greene Point (Fig. 12) and in five subsurface samples from the lagoon. This factor occurs significantly in samples of platykurtic size distribution. Such a distribution may result from addition of fine material to the tail of a coarser distribution (Mason and Folk, 1958). Following this interpretation, the significance of factor 5 may indicate infilling of finer sediments around the coarser material on the lower foreshore. All samples from this zone range in grain size from boulders to fine silt.

Sediment Distribution: Casey Point

Surficial beach sediments of Casey Point are coarser than those of Greene Point and include sizes from pebbles to boulders. Finer interstitial material ranges from fine sand to coarse silt and makes up less than 10% of the total surficial material.

The mean size of samples of the coarse surficial beach material increases from 6.26 cm on the north end of Casey Point to 12.06 cm on the south end (Fig. 13, Appendix, Table 3). Samples taken in transects across Casey Point beach, from landward to seaward, also increase in mean grain size.

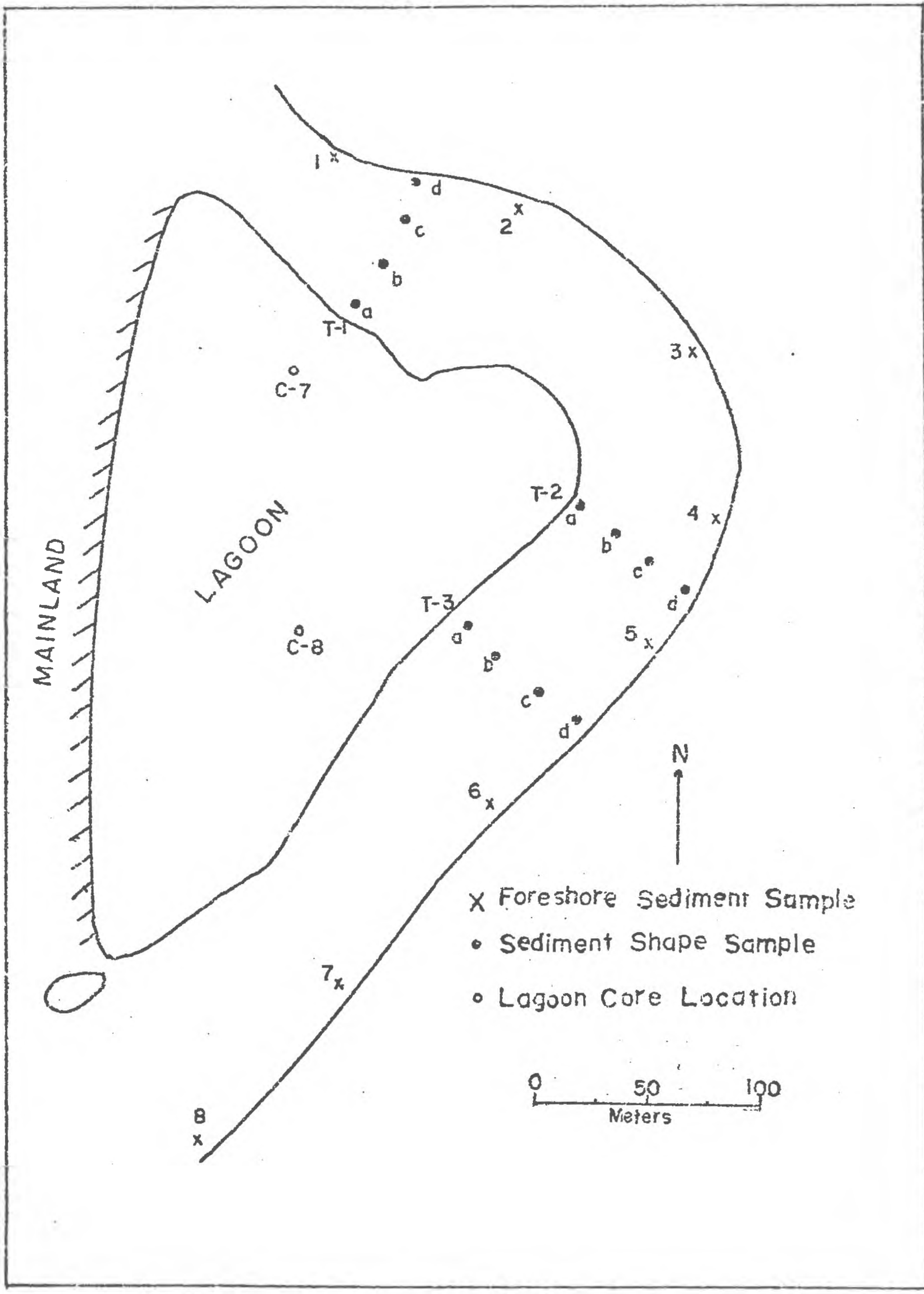


Figure 13. Location of sediment samples and cores from Casey Point

In contrast, cores from the lagoon were composed of fine and medium sand. All samples of the cores (Appendix, Table 1, p. 99), except sample C7-1, have a mean grain size in the medium to fine sand range, are moderately sorted, and have either a positive or nearly normal skewness. Sample C7-1 from the top of core 1 is coarse silt and more poorly sorted than the other samples. Layers of coarse material such as found in the Greene Point lagoon are not found in the Casey Point lagoon at least to a depth of 3 feet below the sediment surface.

Sediment Shape Analysis of Casey Point Shingle

Shape analysis indicates the distribution of sphere, blade, rod and disc shaped particles in a landward to seaward sequence across Casey Point (Fig. 14). In general, there is a seaward increase in the percentage of spherical particles, with the percentage of blade and rod-shaped particles variable among the samples. Plots of particular size in phi units against percentage of shapes, show the greatest percentage of disc-shaped particles occur in the modal size class.

Disc-shaped particles are the most frequently occurring of the four shape classifications, composing up to 50% of the most landward samples. The second most frequent shape is the blade, composing 35% of some samples and usually frequenting the lower size classes. Spherical shapes

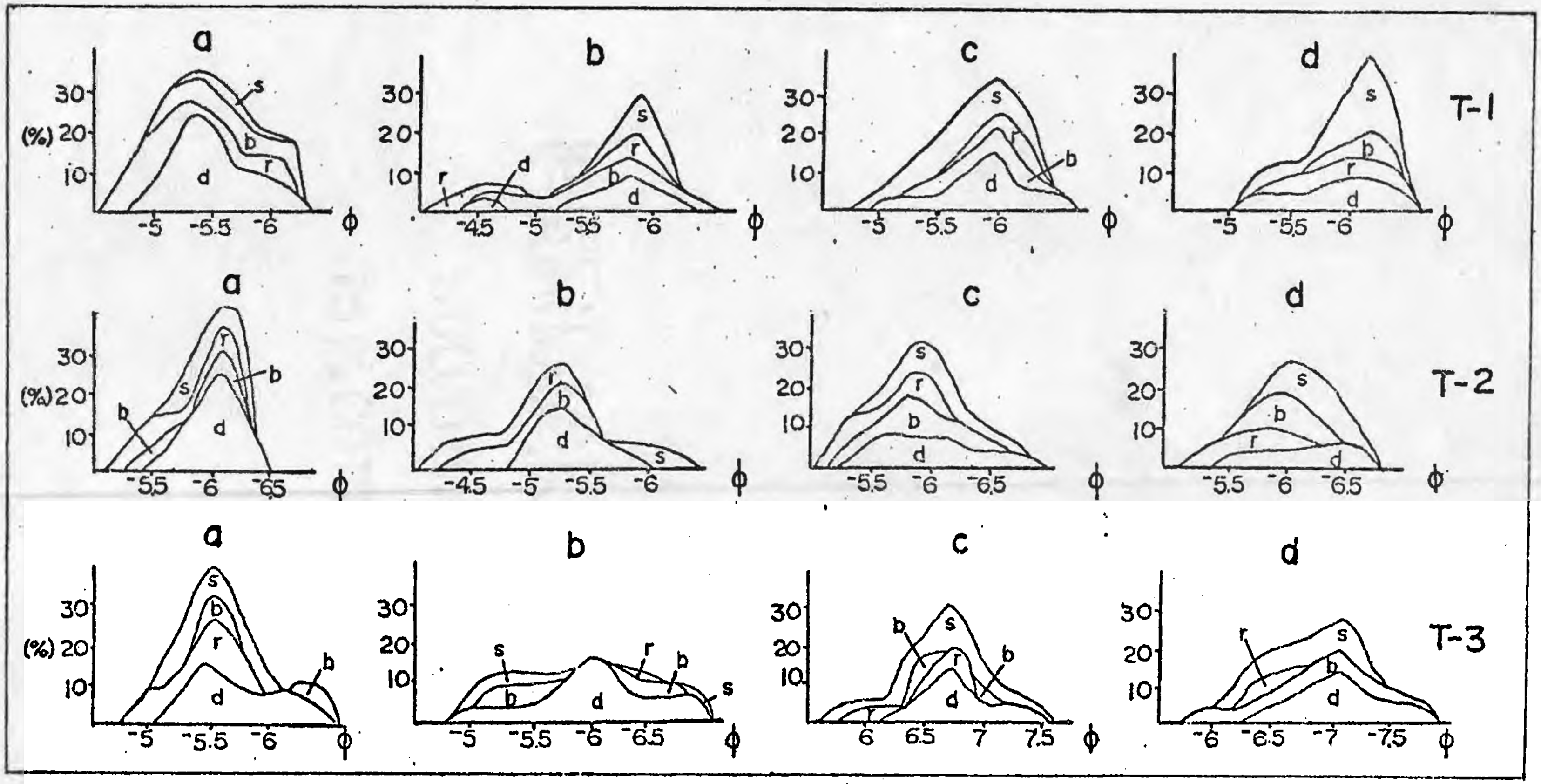


Figure 14. Frequency plots of Casey Point shape samples s = sphere, b = blade, r = rod, d = disc. Samples a through d in each transect are in landward to seaward sequence. (see figure 13 for transect location)

are third in abundance, forming up to 30% of some seaward samples. Spheres are scattered through all size classes, but are most frequently in modal or near modal size classes. Rod-shaped particles occur most infrequently of any shape and are confined to the smaller size classes.

Bluck (1967) found that samples from beach shingle reworked to maturity by waves, had the greatest percentage of discs in the modal size class and a seaward increase in the percentage of spherical particles. Distribution of particle shapes on Casey Point is very similar to Bluck's results and indicates the Casey Point shingle has, at least surfically, been reworked.

Comparison of Greene Point and Casey Point - Morphology and Sedimentology

Greene Point and Casey Point are similar in their general morphology. Both are cuspate shoreforms composed of a beach ridge enclosing a shallow lagoon. Elevation of each beach ridge at the crest is between 5 and 7 feet above low water. Tidal exchange between the lagoons and the bay is through shallow breachways cutting the beach ridge at the apex of the cuspate form. Tidal exchange occurs only at high tide since the elevation of the breachway channels at their highest point is 2 feet above low water.

Major morphologic differences between Greene Point and Casey Point are size and shape. Although Greene Point is approximately 1000 feet longer than Casey Point, it does not extend as far seaward as Casey Point, and is less cuspate in form than Casey Point.

In detailed morphology, the two shoreforms differ greatly in profile. Greene Point has a sandy upper foreshore which dips seaward at 6° to 8° and a very wide lower foreshore (100 feet at low water) which dips gently seaward at 2°. Casey Point, however, slopes continuously seaward at 8° to 12° from the crest of the beach ridge and has no wide, flat lower foreshore.

Another major difference between Greene Point and Casey Point is in sediment size distribution. Casey Point's surficial material is primarily cobbles and boulders with some interstitial finer material. Greene Point has a zone of surficial cobbles and boulders along the lower foreshore, but also has an upper foreshore composed of medium to coarse sand. This sandy zone of Greene Point changes seasonally, eroding in the winter months and accumulating material in the spring and summer months. Eroded beach sand is apparently stored offshore during the winter months as indicated by linear ridges of sand which were observed to migrate landward across the lower foreshore in the spring. Tracer studies along the foreshore of Greene Point indicate the sands are continuously reworked and transported alongshore by waves. Q-Mode factor analysis of sand samples further supports reworking. The sands are sorted in the breaker zone and the finer sizes are distributed over the upper foreshore by wave swash and backwash. The poorly sorted nature of the sands indicates, however, the energy available for transport and reworking is low in the bay in comparison to oceanic shorelines.

Casey Point does not undergo seasonal erosion or deposition. Shape sorting of cobbles and boulders and the accumulation of a small berm indicate Casey Point is reworked slightly by waves. Movement of material up to 10 cm in diameter during the winter months is apparent from the fore mentioned berm, but the reworking processes is not continuous. Movement of material larger than 6 cm in diameter was not recorded during tracer studies. The berm that accumulated during the winter of 1971-72 remained unchanged for at least 6 months after it was first observed in March, 1972.

Sediments in the lagoons behind Greene Point and Casey Point are also markedly different. Sizes range from silt through coarse sand in the Greene Point lagoon with included particles ranging up to pebble size. Sediments in the Casey Point lagoon range from medium sand to coarse silt with no included large particles. Greene Point lagoonal sediments may have originated as former foreshore deposits is suggested by Q-Mode factors 1 & 2, which are significant in both lagoon and foreshore samples. Overwashing of sand from the present beach may have also contributed some lagoonal material. However, evidence of the retreat of the Greene Point beach over lagoonal sediments is indicated by the exposure of dark gray sand on the foreshore and in the breachway. These samples contained decomposing organic matter similar to dark layers of sand found in the lagoon.

There is no evidence that Casey Point has retreated landward over lagoonal deposits. Lack of coarse material in the lagoon indicates that overwashing has not taken place. There is no exposure of lagoonal sediments on the Casey Point foreshore. It is not known, however, whether the present Casey Point beach is resting on former lagoonal sediments since the coarse surficial material could not be penetrated.

ORIGIN OF CUSPATE SHOREFORMS

As pointed out earlier (p. 3) Johnson (1925, p. 360) first recognized the significance of limited wave attack in the development of cuspate shoreforms. Johnson suggested that wave attack limited to two opposing directions results in littoral drifting of sediment in opposing directions toward inequalities in the shore, shoals or protected areas in the lee of islands, or points projecting from an opposing shore. Numerous examples are given of wave built cuspate shoreforms in elongate narrow water bodies. Among these are St. Andrews Channel, West Arm of Sydney Harbor and St. Anns Harbor, all adjacent to St. Anns Bay near Bras d'Or Lakes, Cape Breton, Canada. These water bodies resemble West Passage, Narragansett Bay. All are found in weak rock lowlands and numerous cuspate shoreforms have developed along the shorelines of each.

Zenkovich (1967) discussed several possible origins of cuspate shoreforms. Some cuspate features may originate as a double feature formed by two spits accumulating from opposing directions. Cuspate shoreforms originating in this manner form in narrow bays where littoral material may be derived from the directions of both the baymouth and bayhead.

Cuspate shoreforms also develop in long narrow, sandy lagoons and tend to be evenly spaced cyclic shoreforms (Zenkovich, 1967). Waves move along the axis of the narrow water body in both directions, depending on fetch length (distance from the opposite end), and their energy becomes constant or decreases at some point due to refraction. At this point the littoral drift system becomes saturated with material and sediment tends to accumulate. After the load of littoral material is decreased by deposition, the cycle will repeat. The cuspate configuration of the accumulation form depends on the strength of littoral flow from each opposing direction. More symmetrical forms tend to accumulate near the center of the lagoon where opposing currents are equal.

Cuspate features also develop by erosion of more complex shoreforms and islands according to Zenkovich. An interesting example of this is cited from Nichols (1948) in which a cuspate feature developed from the destruction of Snake Island, a drumlin island in Boston Harbor. The development of a winged flying bar from material eroded from the drumlin gave rise to a cuspate configuration. The apex or front of the form is protected from direct wave attack by a boulder pavement, the remnants of the eroded drumlin. Nichols (1948) noted several peat deposits on the seaward side of the flying bars. He concluded the bars must have migrated over these deposits which formed in the sheltered area behind the bars. This cuspate feature is similar in some respects to Greene Point which also has retreated over sheltered lagoonal deposits and is bordered on its seaward side by glacial blocks and boulders. Greene Point, however, is tied to the mainland and the Boston Harbor feature is not. Since Nichols' study in 1948, the Boston Harbor feature has apparently migrated far enough away from the protection of the island remnants to be vigorously attacked by waves and tidal currents. Snake Island now exists as a curving almost circular spit according to the latest edition of U. S. Coast and Geodetic Survey Chart 236.

King (1972, p. 521) states that cuspate shoreforms originate under two general conditions: (1) in the shelter of offshore islands and (2) in areas of restricted wave approach due to intricate shoreline configuration.

Moila Point in the Solomon Islands is cited by King (1972), as a cuspate feature which formed in the lee of an offshore island. The apex of the cuspate form points directly toward the island. Each side of the feature is formed by a system of parallel ridges. These ridges were apparently formed by deposition of material from littoral drift in opposing directions. The two systems of ridges met forming the apex of the cuspate form.

The well-known cuspate foreland at Dungeness on the southern coast of England near the Straits of Dover is an example of a form resulting from wave approach restricted by coastal configuration. Wave approach is restricted to the southeast by the proximity of France and the apex of the form points southeast. The southwest shoreline of the Dungeness form faces the open expanse of the English Channel and the northeast shoreline faces the Straits of Dover. These shorelines are apparently oriented perpendicular to the direction of maximum possible wave fetch.

Although King (1972, p. 521) suggests two conditions for the development of cuspate shoreforms, the difference in her two examples (Moila Point and Dungeness) is only one of scale. The sheltering effect of an offshore island is just one of many ways wave approach can be restricted. The sheltering effect of a small offshore island is much more limited than a proximal land area across the expanse of a major water body and the corresponding shoreforms are different in size.

Shoreline Orientation

The basic reason for the development of cuspate shoreforms in all the analyses presented here is the restriction of wave approach. In quantitative and qualitative estimates of alongshore wave energy and volume of littoral drift, the angle between the shoreline and the wave crest or wave rays of approaching waves is always taken into account (Johnson and Eagleson, 1966). The more acute the angle between the wave ray and the shoreline (the larger the angle between the wavecrest and the shoreline), the greater the component of alongshore wave energy. If waves approach a beach from one direction only, and assuming the approach direction is at an angle to the shoreline, even after refraction in the shoaling littoral zone, the beach would eventually reorient to a trend more perpendicular to the wave rays (parallel to wave crests). In this configuration, littoral transport is at a minimum and the beach is stable. This is an ideal case, however, since waves generally approach a shoreline from many directions.

Lewis (1938) stresses the importance of dominant waves, which he considers to be storm waves, in determining the orientation of beaches composed of coarse material. According to Lewis, shorelines tend to orient normal to the direction of maximum wave fetch from which dominant waves approach.

Schou (1945) considers the effects of direction of maximum wave fetch and wind resultant. If maximum fetch and wind resultant direction coincide, or the fetch is equal in all directions, the shoreline will tend to become oriented normal to the wind resultant. If maximum fetch and wind resultant do not coincide, the shoreline will become oriented along a line between the two directions.

The work of Lewis and Schou applies to beaches composed of coarse material ranging up to cobble and boulder size in areas of limited fetch. Waves affecting these beaches, are storm waves generated by local winds and have smaller wavelengths, greater relative steepness and are less refracted than waves approaching open ocean beaches. Davis (1960) considers the orientation of sand beaches. He considers the refraction of longer waves generated under non-storm conditions as a significant factor in determining beach orientation. Sandy beaches will be most stable if they are oriented normal to the direction of refracted waves. Littoral zone bathymetry will therefore be important in determining beach orientation.

Orientation of the West Passage Cuspate Shoreforms

From the previous discussion it can be easily understood what effects an elongate body of water such as West Passage can have on shoreforms developing along its shorelines. Limited wave fetch probably has a significant effect on both dominant wave direction and prevalent wave direction (waves occurring with the greatest frequency within the Passage).

Possible relationships between the orientation of Greene Point, Casey Point, the other two cuspate shoreforms (Plum Beach Point and South Ferry), and the configuration of West Passage were tested by calculating maximum fetch. Maximum fetch was determined relative to the north and south sides of all four cuspate shoreforms.

Wave fetch is restricted by the configuration of West Passage and therefore it is necessary to calculate the _effective_ fetch which accounts for the limiting effect of surrounding shorelines. Calculation consists of measuring the lengths of fifteen radials extended from a wave station (Greene Point and Casey Point in this case) until they intersect the shoreline (U.S. Army Corps of Engineers 1966, p. 24). The radials are constructed at 6 degree intervals out to 45 degrees on either side of the direction for which effective fetch is to be calculated. Each radial measurement is multiplied by the cosine of the angle between the central fetch direction and that radial. The resulting values are summed and divided by the sum of the cosines of all angles. This operation can be expressed by:

$$\frac{\Sigma X_1 \text{ Cos } \theta}{\Sigma \text{ Cos } \theta}$$ where X_1 is the length of each radial

and θ is the angle between each radial and the wind direction. This multiple radial method is based on the following assumptions: (a) wind moving over the water surface transfers energy to the water in the wind direction and over 45 degrees on either side of the wind direction, (b) the wind transfers a unit amount of energy to the water surface along the radial in the direction of the wind and transfers energy in the direction of any other radial in an amount proportional to the cosine of the angle between the radial and wind direction, and (c) waves are completely absorbed at the shoreline.

Effective fetch was calculated for both Greene Point and Casey Point in eight compass directions, 45 degrees apart. The two largest fetch directions were selected from the northern and southern quadrants and additional fetch distances were calculated within a few degrees of these two directions, to be certain that the maximum possible fetch was correctly located.

Relative to the northern side of Casey Point the maximum effective fetch is 3.17 nautical miles, trending N22°E. On the south side of Casey Point maximum effective fetch is 1.80 nautical miles, trending S23°E (Fig. 15). Plotting these fetch directions relative to Casey Point on a map, it can be seen that the fetch direction from the north is nearly perpendicular to the north side of Casey Point. The southern maximum fetch direction is not quite normal to the southern side, varying from the normal by approximately 10° to 20°.

Maximum fetch relative to the north side of Greene Point is 4.89 nautical miles trending N10°E. On the

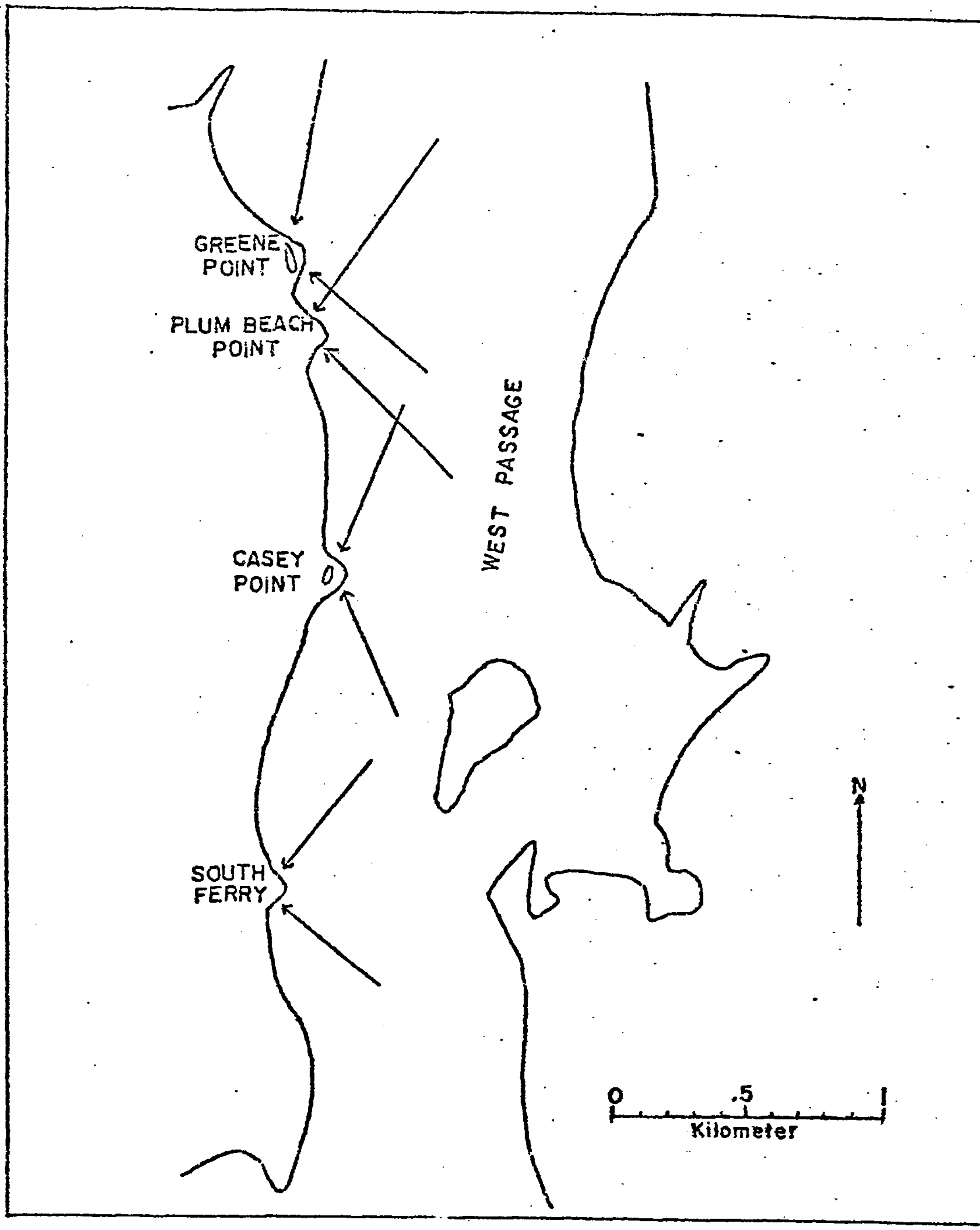


Figure 15. Orientation of maximum fetch relative to the cuspate shoreforms in West Passage

southern side of Greene Point maximum fetch is 1.57 nautical miles trending S50° E (Fig. 15). The relation of these fetch directions to the Greene Point shoreline is difficult to assess since this shoreline is much more curvilinear in outline than Casey Point. However, taking the perpendicular at various points along the Greene Point shoreline, as established from the plane table and alidade survey, and measuring the angle between the normal and the fetch direction, a range of values can be obtained. The northern fetch direction varies between 17° and 35° from the normal to the shoreline at various points along the northeast facing beach of Greene Point. The southeast fetch direction varies between 12° and 20° from the normal.

Maximum effective fetch directions calculated relative to Plum Beach Point and South Ferry are approximately normal to the general trend of their shorelines (Fig. 15). The configuration of Plum Beach Point and South Ferry was taken from U.S. Coast and Geodetic Survey Chart No. 236. Therefore a range of angles between wave fetch and shoreline could not be established as with Greene Point and Casey Point for which a detailed plane table survey was made.

In general, the orientation of all four cuspate shoreforms along the west bank of West Passage are clearly related to the maximum available wave fetch. These shoreforms are apparently oriented in approximate equilibrium with the most dominant waves generated in West Passage. Deviation from this norm of shoreline orientation relative to maximum fetch is probably due to wave refraction effects. Since these deviations are relatively small, the shallow submarine slope offshore from the shoreforms has probably been somewhat reworked and reoriented relative to dominant wave direction.

The shoreline of Greene Point is curvilinear and markedly different from the other West Passage cuspate shoreforms which are sharply angular in map view. The dispersion of wave energy due to refraction, reflection and diffraction of waves around the numerous glacial blocks bordering Greene Point is probably the major cause of its curvilinear configuration.

Prevalent Waves and Initiation of Sediment Transport

Prevalent waves or waves occurring with the greatest frequency, are related to average wind direction in West Passage. In order to estimate the prevalent wave direction and possible effect on shoreline orientation, wind resultants for West Passage were calculated.

The calculation method used is based on a formula for wave energy, $E = W^4HF$ (Bruun, 1955), where E equals total wave energy from a given direction, W is the wind force according to the Beaufort scale, H is the wind frequency from a given direction and F is the fetch length. Calculation consists of determining a vector for eight or more compass directions whose length is proportional to E in the above formula. These vectors are added graphically and the resultant is the straight line joining the first and last vectors (Schou, 1945).

Wind data for resultant calculation was obtained from the Quonset Point Naval Air Station for the period between August, 1970 and June, 1972. The data were recorded hourly and consist of both speed and direction. Monthly summaries of the data are given in table 5 in the Appendix (p. 134).

The effect of the configuration of West Passage on wind velocity is that the highest wind speeds and frequencies occur subparallel to the long axis of West Passage.

In calculating the wind resultant for West Passage, average wind velocity in eight compass directions was used along with the fetch in those directions. Because effective fetch was used, the resultant was calculated at two positions along West Passage, Greene Point and South Ferry. This was done to include the effect of fetch variation at different locations.

The wave energy formula used in this case was modified somewhat from Bruun's original formula because of the low average wind speed in West Passage. If the Beaufort scale was used, all the wind speeds would fall into the force 3 category or lower. In previous wind resultant calculations (Guilcher, 1958) all winds below Beaufort force 4 have been eliminated as ineffective. In West Passage, however, the frequency of winds greater than Beaufort force 4 (18 M.P.H.) is very low and all winds of lower force must be included in the analysis. Therefore the actual wind speed was used in the resultant calculation to insure that differences in wind speed were adequately represented.

The wind resultants are shown in Figure 16 at Greene Point and South Ferry along with the vectors calculated for each wind direction. The Greene Point resultant trends N 27° E and the South Ferry resultant N 25° E. Both resultants are close to the maximum fetch calculated for the northeast facing shorelines of the two shoreforms.

The wind resultant suggests a southerly longshore drift direction for sediments transported under energy conditions, indicated by average wind velocity. This is supported by the constant piling up of sand on the north side of the small rock groins built along the beach between Greene Point and Plum Beach Point.

Maximum average wind speed for any month between August 1970 and June 1972 was no greater than 16 M.P.H. Using this figure as the maximum average condition and applying it to wave hindcasting curve (U.S. Army Corps

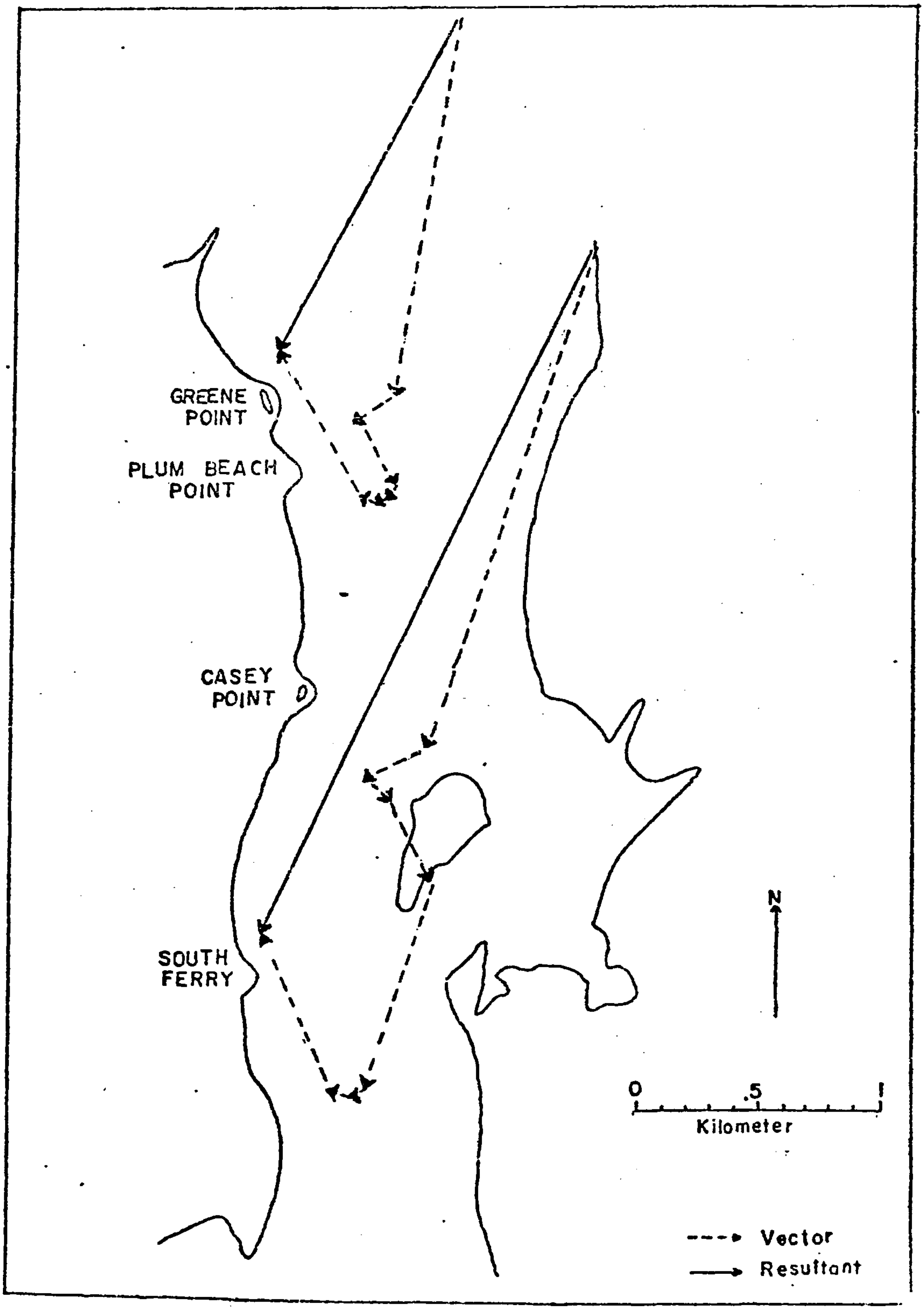


Figure 16. Wind resultant in West Passage, Greene Point and South Ferry

of Engineers, 1966, p. 59), the hindcasted wave over the maximum available fetch (5 nautical miles) would have a significant height of 1 foot, a period of 5 seconds and a length of 80 feet. Sediment tracer studies on Greene Point indicate that sediments up to coarse pebble size (76 mm) are readily transported when wind speed averages no more than 14 M.P.H. (Table A). It is therefore concluded that waves normally generated within West Passage are competent in transporting sand in the littoral zone along with some coarser material ranging up to pebble size.

This conclusion was compared with published empirical and theoretical methods of predicting initiation of sediment motion. Sternberg (1972) conducted field tests on initiation of sediment motion and found that the curves relating mean velocity, shear velocity and Shields entrainment function to grain size agree closely with field data. These curves can be used to predict, in general, what grains sizes will be initiated into motion by instantaneous water velocities under shoaling waves. This assumes that instantaneous orbital velocities are analogous to the same velocities in unidirectional flow. Komar and Miller (1973), however, point out that accelerating orbital motion will exert a greater stress than a constant flow of the same velocity at a given instant. The analysis presented here will therefore result in a minimum diameter of particles eroded under a given set of wave conditions.

Taking the hindcasted significant 1 foot wave, generated over maximum available fetch in West Passage, shallow water transformations can be approximated using the transformation relationships presented by Eagleson and Dean (1966). The transformed wave in five feet of water would be 2 feet in height, have a wavelength of 20 feet and a celerity of 15 feet per second. Using these parameters in the equation for maximum horizontal particle velocity in a solitary wave (Dean and Eagleson, 1966):

$$U_{max} = \frac{CN}{1 + \cos\left(\frac{Mz+h}{h}\right)}$$

, where C = wave celerity, N and M are functions of wave height and water depth and z = distance above the bottom, a particle velocity of 3 feet per second is obtained. A very small z is taken to obtain velocity near the sediment surface. According to published competency curves (Inman, 1963), this velocity is sufficient to initiate motion in sediments up to sizes of 10 mm in diameter (pebbles).

Prevalent waves in West Passage, which are generated according to the wave resultant in a fetch direction from the northeast, will generally have a significant wave height of up to 1 foot under normal conditions. While such waves are adequate to transport material up to pebble size in the littoral zone and on the foreshore, tracer studies indicate transport of cobble and boulder size material is very limited. Certainly there is no longshore transport of cobbles and boulders by waves of 1 foot or less. Therefore, the effect of relatively low energy waves generated in the study area on the orientation of the West Passage cuspate shoreforms, which have significant fractions of very coarse material, is considered minimal.

This coarser material is, however, at times locally reworked by waves as indicated by the cobble berm built on Casey Point and the landward shifting of a few cobbles on the foreshore of Casey Point and Greene Point. Transport of this material may take place under higher than average energy conditions when wind speeds and tidal elevations are higher than normal. This is supported by the fact that the berm built on Casey Point during the 1971-1972 winter was located above the usual high water mark.

Origin of West Passage Cuspate Shoreforms

Apparently there is no littoral budget of the cobbles and boulders forming the lower foreshore of Greene Point and all of the Casey Point beach. Shape sorting of the Casey Point shingle, however, is strong evidence that the beach has been totally reworked by waves. Schafer (1961) suggests the West Passage shoreforms have developed from pre-existing shoreline and bathymetric irregularities. These irregularities probably existed as salients of ground moraine material projected towards the center of the West

Passage Channel. After sea-level rose to its present position, the coarse glacial deposits could then be reworked and reoriented by dominant waves generated over the largest fetch areas in West Passage. The finer material, consisting of sand, silt, and gravel, now present in the beach deposits of Greene Point and Plum Beach Point has probably infilled around pre-existing coarser deposits. These shoreforms are adjacent to ice contact deposits (Figure 2), which are characteristically stratified, include a wide range of grain sizes and are deformed. These properties indicate the role of stagnating glacial ice and meltwater in the depositional process (Flint, 1971, p. 184). Collapse of these deposits after final melting of the ice probably exposed significant amounts of fine material to erosion and resulted in a supply of silt, sand and gravel to the adjacent shoreline. Casey Point, however, is bordered on its landward side by ground moraine and is isolated from immediate sources of finer material available in ice-contact deposits. The source materials for Casey Point, therefore, are the cobbles and boulders predominant in glacial till of the adjacent ground moraine deposits.

SUMMARY AND CONCLUSIONS

Greene Point and Casey Point can be classified in general terms as cuspate shoreforms. Both shoreforms consist of a northeast and southeast facing shoreline enclosing a shallow lagoon. The beaches, which enclose these lagoons, are 5 to 7 feet above low water and are cut by breachways through which tidal exchange takes place with West Passage.

Topographic and sedimentologic surveys indicate Greene Point and Casey Point differ greatly in detail. Greene Point is more elongated than Casey Point but does not extend as far seaward, nor is it as cuspate in form. The Casey Point beach consists of shape sorted cobbles and boulders dipping sharply seaward and landward from the beach ridge crest at angles of 8° to 12°. Greene Point has a surficial cover of sandy and pebbly, poorly sorted, sediments over its upper foreshore and backshore areas. Along the flat, lower foreshore, Greene Point has a zone of cobbles and boulders mixed with poorly sorted sediment ranging in size from silt to pebbles.

The Greene Point lagoon contains layers of medium to coarse sand, interbedded with coarse silt layers, with a high organic content. Particles up to pebble size have been found in this lagoon. Casey Point lagoon sediments are finer and range from medium sand to coarse silt in size.

Seasonal changes on Greene Point include erosion of sandy material during the winter months from the upper foreshore and infilling of this zone during the spring and summer months. Littoral transport of these sandy sediments readily takes place under normal, lower wave energy climatic conditions. Exposure of lagoonal deposits on the foreshore indicates Greene Point has retreated landward.

Cobble and boulder material forming the Casey Point beach and the lower foreshore of Greene Point is not transported in an alongshore direction, but some of the smaller cobbles are shifted landward under normal high wave energy climatic conditions. Significant shape sorting of the Casey Point shingle and the building of a berm-like mound near the apex of Casey Point indicates that the surficial material is at least occasionally reworked by waves. There is no indication, however, that Casey Point is retreating landward over lagoonal deposits.

The configuration of Greene Point, Casey Point and the other two prominent cuspate shoreforms in West Passage (Plum Beach Point and South Ferry) is related to maximum available fetch. The shorelines of these cuspate features are oriented nearly perpendicular to maximum effective fetch in the northern and southern quadrants.

Waves generated under normal wind conditions in West Passage are generally small, having a significant wave height of 1 foot or less. Instantaneous water particle velocities under these waves as they move into shallow water, however, are capable of initiating motion in sediments up to 10 cm. in diameter. Larger particles may be set in motion in the turbulent breaker zone.

Prevalent waves, as indicated by the wind resultant, probably approach from the northeast. This is supported by a dominant southerly littoral drift.

It is concluded that the cuspate shoreforms of West Passage originated as localized coarse glacial deposits which were later reoriented by waves generated over maximum available fetch. Waves capable of reworking large boulders and cobbles are likely to be dominant storm generated waves.

The sedimentology of the cuspate shoreforms is directly related to local source areas. The coarser sediments of Greene Point have been infilled by finer material available in ice-contact deposits immediately adjacent to the landward and north side (updrift) of this shoreform. Casey Point, further to the south however, is isolated from any large source of fine material in the immediate area and is composed of coarse size lag deposits from ground moraine material.

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APPENDIX

Table 1

Sediment size frequency and textural parameters

Size (phi)	1A	1B	1C	1D
-6.50	14.83	0.0	0.0	0.0
-6.25	0.0	0.0	0.0	0.0
-6.00	0.0	0.0	0.0	0.0
-5.75	0.0	0.0	0.0	0.0
-5.50	2.47	0.0	0.0	0.0
-5.25	5.05	6.32	0.0	0.0
-5.00	0.0	4.63	0.0	0.0
-4.75	2.85	0.52	4.42	0.0
-4.50	2.85	0.52	5.06	0.0
-4.25	3.94	1.97	0.92	0.0
-4.00	3.94	1.97	0.92	0.0
-3.75	2.11	1.91	1.06	0.56
-3.50	2.11	1.91	1.06	0.56
-3.25	1.48	2.75	1.92	0.95
-3.00	1.42	2.75	1.92	0.95
-2.75	1.30	2.96	1.63	0.77
-2.50	0.91	2.18	1.61	1.02
-2.25	0.94	2.28	1.67	0.59
-2.00	1.08	3.17	2.23	1.00
-1.75	0.71	1.85	1.34	0.75
-1.50	1.17	2.76	1.49	1.10
-1.25	1.04	2.39	1.22	1.09
-1.00	1.33	2.85	1.22	0.80
-0.75	1.74	4.50	1.54	1.09
-0.50	2.08	4.83	1.39	1.06
-0.25	2.95	4.61	1.50	0.89
0.0	4.76	5.37	1.76	1.22
0.25	5.96	5.82	1.79	1.14
0.50	6.93	6.24	1.79	1.35
0.75	6.96	4.42	1.98	1.34
1.00	6.42	2.57	2.34	3.72
1.25	4.58	2.54	3.56	5.07
1.50	2.86	2.86	6.30	5.91
1.75	1.71	3.93	10.48	11.95
2.00	0.86	3.28	9.97	14.40
2.25	0.25	1.44	8.09	10.84
2.50	0.12	0.63	6.71	8.97
2.75	0.06	0.49	4.25	6.66
3.00	0.04	0.19	3.15	5.64
3.25	0.04	0.31	1.71	2.75
3.50	0.04	0.11	1.20	2.19
3.75	0.02	0.16	0.48	0.82

Table 1

Size (phi)	Sample % 1A	1B	1C	1D
4.00	0.01	0.0	0.15	0.33
4.25	0.04	0.0	0.14	0.42
4.50	0.04	0.0	0.0	0.42
4.75	0.0	0.0	0.0	0.21
5.00	0.0	0.0	0.0	0.21
5.25	0.0	0.0	0.0	0.63
5.50	0.0	0.0	0.0	0.63
Mean (phi)	-2.187	-1.261	0.164	1.490
Standard Deviation	2.886	2.243	2.503	1.636
Skewness	-0.264	-0.362	-0.796	-1.259
Kurtosis	1.543	2.097	2.247	4.946

Table 1

Sample %

Size (phi)	1E	1F	2A	2C
-6.50	0.0	0.0	0.0	0.0
-6.25	10.57	0.0	0.0	0.0
-6.00	8.65	0.0	0.0	0.0
-5.75	0.0	7.20	0.0	0.0
-5.50	0.0	4.09	0.0	0.0
-5.25	0.0	1.18	0.0	0.0
-5.00	0.0	3.85	0.0	0.0
-4.75	2,23	6.35	0.0	1.42
-4.50	2.23	6.35	0.0	1.42
-4.25	1.98	2.89	0.0	0.53
-4.00	1.98	2.89	0.0	0.53
-3.75	1.99	2.28	0.0	2.02
-3.50	1.99	2.28	0.0	2.02
-3.25	2.40	2.32	0.0	2.27
-3.00	2.40	2.32	0.0	2.27
-2.75	2.23	2.09	0.0	0.99
-2.50	1.90	2.42	0.0	1.52
-2.25	1.86	2.27	0.0	1.35
-2.00	2.29	3.00	0.0	1.71
-1.75	1.56	1.75	0.0	1.67
-1.50	1.98	2.46	0.0	1.98
-1.25	1.53	1.77	0.0	2.37
-1.00	1.67	1.64	0.0	3.31
-0.75	1.59	2.25	0.73	5.82
-0.50	1.92	1.79	0.73	7.52
-0.25	1.68	1.95	0.49	8.94
0.0	1.85	2.15	0.24	10.41
0.25	1.84	1.93	0.24	7.86
0.50	1.69	1.15	0.49	6.06
0.75	1.20	1.79	0.73	4.63
1.00	1.51	1.58	0.98	4.40
1.25	2.00	1.82	1.22	4.55
1.50	2.81	2.61	1.46	4.28
1.75	5.98	4.47	0.98	3.21
2.00	7.88	4.14	0.49	2.03
2.25	4.93	2.84	0.49	1.19
2.50	4.16	2.55	0.49	0.74
2.75	2.64	1.73	0.49	0.41
3.00	1.77	1.00	0.49	0.23
3.25	0.88	0.36	0.49	0.13
3.50	0.67	0.19	0.98	0.09
3.75	0.27	0.06	1.22	0.12
4.00	0.15	0.02	1.22	0.0
4.25	0.19	0.08	12.20	0.0
4.50	0.19	0.08	12.20	0.0
4.75	0.0	0.08	6.10	0.0
5.00	0.0	0.08	6.10	0.0

Table 1

Size (phi)	Sample % 1E	1F	2A	2C
5.25	0.19	0.40	0.0	0.0
5.50	0.19	0.40	0.0	0.0
5.75	0.10	0.40	6.10	0.0
6.00	0.10	0.40	6.10	0.0
6.25	0.10	0.16	6.10	0.0
6.50	0.10	0.16	6.10	0.0
6.75	0.0	0.0	12.20	0.0
7.00	0.0	0.0	12.20	0.0
Mean (phi)	-1.448	-1.906	4.975	-0.522
Standard Deviation	3.285	2.987	1.749	1.666
Skewness	-0.150	0.406	-1.226	-0.724
Kurtosis	1.687	2.086	4.386	3.157

Table 1

Size (phi)	Sample % 2D	2E	2F	2G
-6.50	0.0	0.0	25.30	0.0
-6.25	8.27	0.0	14.20	3.84
-6.00	3.16	2.94	7.30	0.0
-5.75	2.25	8.13	2.52	4.71
-5.50	4.55	1.34	5.25	1.27
-5.25	3.16	4.40	2.49	5.53
-5.00	1.60	0.98	0.0	5.84
-4.75	4.44	3.14	2.83	2.56
-4.50	4.44	3.14	2.83	2.56
-4.25	4.28	3.39	1.55	2.69
-4.00	4.28	3.39	1.55	2.69
-3.75	4.08	3.06	2.02	2.02
-3.50	4.08	3.06	2.02	2.02
-3.25	3.25	2.80	1.68	1.99
-3.00	3.25	2.80	1.68	1.99
-2.75	2.75	2.76	1.47	1.78
-2.50	2.16	2.41	1.37	1.59
-2.25	2.24	1.97	1.29	1.45
-2.00	2.29	2.86	1.47	2.12
-1.75	1.42	1.82	0.90	1.49
-1.50	1.79	3.03	1.26	2.21
-1.25	1.42	2.81	0.98	1.93
-1.00	1.49	3.38	0.97	2.11
-0.75	1.78	4.14	1.25	2.70
-0.50	1.75	4.23	1.04	2.94
-0.25	1.78	3.74	1.06	2.94
0.0	2.35	3.51	1.18	3.28
0.25	2.58	2.59	1.07	3.05
0.50	2.64	1.92	1.04	2.69
0.75	2.22	1.43	1.07	2.57
1.00	1.99	1.20	1.10	2.60
1.25	2.44	1.69	1.20	2.59
1.50	2.42	1.96	1.35	2.45
1.75	2.20	2.17	1.35	2.50
2.00	1.00	1.97	1.16	4.77
2.25	0.97	1.56	0.76	2.35
2.50	1.03	1.34	0.82	2.32
2.75	0.66	0.97	0.58	1.69
3.00	0.35	0.65	0.35	0.98
3.25	0.10	0.33	0.16	0.37
3.50	0.07	0.24	0.12	0.25
3.75	0.08	0.09	0.04	0.09
4.00	0.06	0.09	0.03	0.04
4.25	0.05	0.07	0.03	0.20
4.50	0.05	0.07	0.03	0.20
4.75	0.10	0.0	0.03	0.20

Table 1
Sample %

Size (phi)	2D	2E	2F	2G
5.00	0.10	0.0	0.03	0.20
5.25	0.14	0.14	0.08	0.20
5.50	0.14	0.14	0.08	0.20
5.75	0.05	0.07	0.03	0.20
6.00	0.05	0.07	0.03	0.20
6.25	0.05	0.0	0.0	0.20
6.50	0.05	0.0	0.0	0.20
6.75	0.05	0.0	0.0	0.20
7.00	0.05	0.0	0.0	0.20
Mean (phi)	-2.740	-2.199	-4.304	-1.703
Standard Deviation	2.723	2.599	2.823	3.034
Skewness	0.593	0.243	1.136	0.196
Kurtosis	2.386	2.152	3.088	2.093

Table 1

Sample %

Size (phi)	3A	3B	3C	3D
-6.50	0.0	0.0	7.28	18.11
-6.25	0.0	0.0	0.0	0.0
-6.00	0.0	0.0	0.0	18.88
-5.75	0.0	0.0	0.0	11.64
-5.50	0.0	0.0	3.80	4.13
-5.25	0.0	0.0	1.48	3.41
-5.00	0.0	0.0	2.52	0.45
-4.75	0.0	0.0	1.44	2.74
-4.50	0.0	0.0	1.44	2.74
-4.25	0.0	0.0	1.19	2.47
-4.00	0.0	0.0	1.19	2.47
-3.75	0.0	0.0	1.50	2.08
-3.50	0.0	0.0	1.50	2.08
-3.25	0.0	0.0	1.50	1.33
-3.00	0.0	0.0	1.50	1.33
-2.75	0.0	0.0	2.05	1.00
-2.50	0.0	0.0	3.68	1.00
-2.25	0.0	0.0	2.80	1.05
-2.00	0.0	0.0	2.80	1.15
-1.75	0.0	0.0	2.11	0.68
-1.50	0.0	0.0	3.62	1.03
-1.25	0.0	0.0	3.39	0.78
-1.00	0.0	0.0	3.90	0.91
-0.75	0.85	0.0	3.79	1.32
-0.50	0.85	1.55	3.45	1.21
-0.25	0.75	2.09	3.09	1.14
0.0	1.88	3.01	3.12	1.32
0.25	2.07	3.55	2.79	1.20
0.50	1.60	4.19	2.89	1.20
0.75	2.25	4.10	2.93	1.26
1.00	2.25	5.56	3.29	1.24
1.25	2.44	6.38	3.32	1.16
1.50	2.63	6.19	3.29	1.19
1.75	2.72	6.28	3.14	1.23
2.00	2.16	5.10	2.62	1.08
2.25	2.44	5.10	1.90	0.81
2.50	2.25	5.46	1.76	0.71
2.75	2.25	5.28	1.43	0.51
3.00	1.97	5.56	1.50	0.39
3.25	2.35	3.73	1.04	0.24
3.50	2.63	4.28	1.01	0.21
3.75	0.85	2.64	0.55	0.00
4.00	1.78	1.73	0.41	0.09
4.25	9.39	2.28	0.33	0.13
4.50	9.39	2.28	0.33	0.13
4.75	9.39	0.0	0.08	0.13

Table 1

Size (phi)	Sample % 3A	3B	3C	3D
5.00	9.39	0.0	0.08	0.13
5.25	2.35	0.0	0.17	0.0
5.50	2.35	0.0	0.17	0.0
5.75	7.04	6.83	0.41	0.17
6.00	7.04	6.83	0.41	0.17
6.25	2.35	0.0	0.0	0.0
6.50	2.35	0.0	0.0	0.0
Mean (phi)	3.696	2.367	-1.283	-4.148
Standard Deviation	1.870	1.782	2.881	2.865
Skewness	-0.699	0.554	0.164	1.240
Kurtosis	2.407	2.465	2.361	3.474

Table 1

Sample %

Size (phi)	3E	3F	3G	3H
-6.50	0.0	0.0	0.0	0.0
-6.25	17.70	0.0	0.0	6.17
-6.00	18.21	3.94	3.96	0.0
-5.75	0.0	0.0	7.51	6.89
-5.50	3.20	5.37	2.36	8.61
-5.25	0.85	6.65	4.57	7.56
-5.00	0.0	1.38	0.0	0.80
-4.75	2.18	1.89	1.63	4.92
-4.50	2.18	1.89	1.63	4.92
-4.25	3.02	1.74	1.38	3.36
-4.00	3.02	1.74	1.38	3.36
-3.75	1.63	2.47	2.62	1.71
-3.50	1.63	2.47	2.62	1.71
-3.25	1.79	2.72	2.45	1.59
-3.00	1.79	2.72	2.45	1.59
-2.75	1.59	2.01	2.32	1.61
-2.50	1.45	2.25	2.23	1.52
-2.25	1.24	2.40	1.81	1.19
-2.00	1.57	3.32	2.85	1.33
-1.75	1.05	3.54	1.78	0.65
-1.50	1.39	3.16	2.73	0.86
-1.25	1.18	2.44	2.40	0.62
-1.00	1.23	2.74	2.74	0.58
-0.75	1.16	2.61	3.09	0.55
-0.50	1.29	2.69	3.10	0.48
-0.25	1.29	2.52	2.99	0.37
0.0	1.58	2.82	3.28	0.53
0.25	1.75	2.38	2.63	0.46
0.50	2.06	2.34	2.16	0.47
0.75	2.07	1.86	1.89	0.54
1.00	2.65	1.95	2.02	0.69
1.25	2.71	2.82	2.72	1.35
1.50	2.31	2.44	2.81	2.38
1.75	2.18	2.55	3.10	4.59
2.00	2.40	3.24	3.41	7.23
2.25	1.62	3.24	3.28	5.93
2.50	1.63	2.89	3.04	5.41
2.75	1.15	1.99	2.14	3.07
3.00	0.79	1.71	1.36	1.76
3.25	0.43	0.69	0.59	0.68
3.50	0.44	0.48	0.46	0.44
3.75	0.27	0.20	0.17	0.14
4.00	0.15	0.13	0.16	0.12
4.25	0.10	0.13	0.20	0.13
4.50	0.10	0.13	0.20	0.13
4.75	0.39	0.27	0.39	0.26

Table 1

Size (phi)	Sample % 3E	3F	3G	3H
5.00	0.39	0.27	0.39	0.26
5.25	0.20	0.40	0.29	0.0
5.50	0.20	0.40	0.29	0.0
5.75	0.39	0.0	0.10	0.13
6.00	0.39	0.0	0.10	0.13
6.25	0.0	0.0	0.0	0.0
6.50	0.0	0.0	0.0	0.0
Mean (phi)	-2.946	-1.564	-1.505	-2.137
Standard Deviation	3.363	2.852	2.969	3.467
Skewness	0.581	0.102	0.042	0.351
Kurtosis	2.032	1.984	2.017	1.518

Table 1

Sample %

Size (phi)	3I	3J	4A	4B
-6.50	11.26	0.0	0.0	0.0
-6.25	8.18	0.0	0.0	0.0
-6.00	0.0	0.0	0.0	0.0
-5.75	7.26	0.0	0.0	0.0
-5.50	0.0	14.59	0.0	0.0
-5.25	0.0	2.87	0.0	0.0
-5.00	0.10	2.37	0.0	0.0
-4.75	1.38	2.91	0.0	6.97
-4.50	1.38	2.91	0.0	3.02
-4.25	1.01	2.82	0.0	1.79
-4.00	1.01	2.82	0.0	0.0
-3.75	0.98	1.90	1.01	0.0
-3.50	0.98	1.90	1.01	0.0
-3.25	0.43	1.07	3.74	0.22
-3.00	0.43	1.07	3.74	0.22
-2.75	0.59	1.10	4.88	0.15
-2.50	0.51	0.90	2.87	0.19
-2.25	0.54	0.66	2.87	0.06
-2.00	0.77	0.65	2.80	0.12
-1.75	0.43	0.42	2.54	0.05
-1.50	0.68	0.66	3.72	0.12
-1.25	0.55	0.46	2.18	0.15
-1.00	0.59	0.49	2.49	0.23
-0.75	0.66	0.67	2.70	0.35
-0.50	0.65	0.84	3.27	0.58
-0.25	0.63	0.97	3.44	0.74
0.0	0.69	0.83	4.55	1.32
0.25	0.64	1.01	4.83	2.19
0.50	0.63	1.11	4.91	3.32
0.75	0.61	1.23	5.57	4.79
1.00	0.98	1.94	5.20	8.10
1.25	2.17	2.53	5.45	11.69
1.50	3.77	3.76	5.59	14.25
1.75	6.70	6.46	6.50	15.97
2.00	9.68	9.15	5.39	13.21
2.25	7.67	6.71	3.02	7.05
2.50	8.25	6.48	1.82	2.39
2.75	5.65	3.98	0.78	0.50
3.00	3.59	2.53	0.41	0.13
3.25	1.21	1.17	0.11	0.13
3.50	1.24	0.52	0.14	0.0
3.75	0.46	0.41	0.12	0.0
4.00	0.33	0.29	0.08	0.0
4.25	0.15	0.48	0.16	0.0

Table 1

	Sample %			
Size (phi)	3I	3J	4A	4B
4.50	0.15	0.48	0.16	0.0
4.75	1.17	0.24	0.49	0.0
5.00	1.17	0.24	0.49	0.0
5.25	0.44	0.24	0.16	0.0
5.50	0.44	0.24	0.16	0.0
5.75	0.15	0.49	0.16	0.0
6.00	0.15	0.49	0.16	0.0
6.25	0.44	0.49	0.16	0.0
6.50	0.44	0.49	0.16	0.0
Mean	-0.779	-0.742	-0.170	0.547
Standard Deviation	3.940	3.534	1.955	2.077
Skewness	-0.418	-0.123	0.076	-1.912
Kurtosis	1.583	1.639	2.741	5.234

Table 1

Sample %

Size (phi)	4C	4D	4E	4F
-6.50	0.0	0.0	0.0	15.64
-6.25	0.0	0.0	0.0	9.09
-6.00	0.0	0.0	0.0	2.25
-5.75	0.0	0.0	0.0	5.84
-5.50	0.0	0.0	0.0	2.96
-5.25	0.0	0.0	9.99	2.04
-5.00	0.0	0.0	0.0	2.48
-4.75	1.98	0.0	2.53	2.48
-4.50	1.98	0.0	2.53	2.48
-4.25	3.48	0.0	6.31	4.02
-4.00	3.48	0.0	6.31	4.02
-3.75	2.26	1.00	3.47	2.62
-3.50	2.26	1.00	3.47	2.62
-3.25	2.19	2.45	3.11	1.80
-3.00	2.19	2.45	3.11	1.80
-2.75	1.57	1.95	2.17	1.03
-2.50	1.90	2.63	1.77	1.03
-2.25	2.18	3.22	2.28	1.59
-2.00	3.07	4.33	2.85	1.86
-1.75	2.50	4.12	1.94	1.13
-1.50	3.87	6.51	3.10	1.52
-1.25	3.44	5.89	2.97	1.09
-1.00	3.74	6.59	4.61	1.03
-0.75	4.98	7.37	5.65	1.15
-0.50	4.64	5.64	7.48	1.09
-0.25	3.90	5.57	8.13	1.01
0.0	4.61	6.05	7.85	1.19
0.25	5.49	5.05	3.54	1.08
0.50	5.13	3.83	1.42	1.03
0.75	5.89	2.69	0.51	0.93
1.00	5.89	2.47	0.24	0.74
1.25	4.81	2.16	0.22	1.63
1.50	4.89	2.52	0.31	1.60
1.75	4.17	3.63	0.52	2.35
2.00	2.32	4.69	0.83	3.16
2.25	0.86	3.03	0.80	3.11
2.50	0.18	2.32	0.53	2.93
2.75	0.08	0.72	0.24	1.83
3.00	0.06	0.12	0.07	0.96
3.25	0.0	0.0	0.03	0.33
3.50	0.0	0.0	0.03	0.22
3.75	0.0	0.0	0.04	0.08
4.00	0.0	0.0	0.0	0.06
4.25	0.0	0.0	0.0	0.09

Table 1

Sample %

Size (phi)	4C	4D	4E	4F
4.50	0.0	0.0	0.0	0.09
4.75	0.0	0.0	0.0	0.09
5.00	0.0	0.0	0.0	0.09
5.25	0.0	0.0	0.0	0.18
5.50	0.0	0.0	0.0	0.18
5.75	0.0	0.0	0.0	0.18
6.00	0.0	0.0	0.0	0.18
6.25	0.0	0.0	0.0	0.0
6.50	0.0	0.0	0.0	0.0
Mean (phi)	-0.926	-0.587	-2.217	-3.175
Standard Deviation	1.940	1.572	2.021	3.283
Skewness	-0.461	0.130	0.008	0.670
Kurtosis	2.099	2.297	1.948	2.111

Table 1

Sample %

Size (phi)	4G	4H	5A	5B
-6.50	0.0	15.62	0.0	0.0
-6.25	5.51	10.34	0.0	0.0
-6.00	7.43	0.0	0.0	0.0
-5.75	7.69	6.76	0.0	0.0
-5.50	1.86	8.08	0.0	0.0
-5.25	4.18	3.54	0.0	0.0
-5.00	3.53	1.86	0.0	0.0
-4.75	2.25	3.33	0.0	0.0
-4.50	2.25	3.34	0.0	0.0
-4.25	3.45	1.21	0.0	0.0
-4.00	3.45	1.21	0.0	0.0
-3.75	2.97	1.64	0.0	0.0
-3.50	2.97	1.64	0.0	0.0
-3.25	2.43	1.89	0.0	0.0
-3.00	2.43	1.89	0.0	0.0
-2.75	2.00	1.64	0.0	0.0
-2.50	1.68	1.26	0.0	0.0
-2.25	1.32	1.15	0.0	0.0
-2.00	1.71	1.42	0.0	0.0
-1.75	1.07	0.84	0.0	0.0
-1.50	1.30	1.14	0.0	0.0
-1.25	0.97	0.87	0.0	0.0
-1.00	0.88	0.75	0.0	0.0
-0.75	1.06	0.75	0.09	0.13
-0.50	0.90	0.78	0.10	0.19
-0.25	0.86	0.77	0.19	0.40
0.0	0.95	0.81	0.43	0.87
0.25	0.79	0.75	0.91	1.76
0.50	0.65	0.72	2.08	3.29
0.75	0.64	0.67	4.64	5.23
1.00	0.71	0.83	10.24	9.73
1.25	1.25	1.42	16.36	16.36
1.50	1.95	2.10	20.63	20.32
1.75	3.43	3.15	20.23	19.99
2.00	5.20	4.42	14.32	13.47
2.25	4.81	3.51	5.86	5.41
2.50	5.51	3.40	2.90	2.12
2.75	3.66	1.97	0.74	0.55
3.00	1.97	1.07	0.14	0.13
3.25	0.66	0.32	0.15	0.02
3.50	0.33	0.18	0.0	0.0
3.75	0.10	0.06	0.0	0.0
4.00	0.06	0.04	0.0	0.0
4.25	0.07	0.09	0.0	0.0

Table 1

Sample %

Size (phi)	4G	4H	5A	5B
4.50	0.07	0.09	0.0	0.0
4.75	0.15	0.18	0.0	0.0
5.00	0.15	0.18	0.0	0.0
5.25	0.07	0.18	0.0	0.0
5.50	0.07	0.18	0.0	0.0
5.75	0.15	0.0	0.0	0.0
6.00	0.15	0.0	0.0	0.0
6.25	0.15	0.0	0.0	0.0
6.50	0.15	0.0	0.0	0.0
Mean (phi)	-2.215	-3.210	1.411	1.354
Standard Deviation	3.377	3.401	0.499	0.530
Skewness	0.367	0.666	-0.330	-0.559
Kurtosis	1.657	1.915	3.920	3.397

Table 1

Sample %

Size (phi)	5C	5D	5E	5F
-6.50	0.0	0.0	15.08	0.0
-6.25	0.0	0.0	28.68	0.0
-6.00	0.0	0.0	10.58	0.0
-5.75	0.0	0.0	6.87	0.0
-5.50	0.0	0.0	5.97	0.0
-5.25	8.37	0.0	0.0	0.0
-5.00	4.69	5.43	0.0	0.0
-4.75	3.84	0.0	1.62	0.0
-4.50	3.84	1.00	1.62	3.07
-4.25	4.27	1.69	0.79	3.58
-4.00	4.27	1.69	0.79	1.34
-3.75	3.18	2.70	1.08	0.40
-3.50	3.18	2.70	1.08	0.40
-3.25	2.29	3.24	1.05	0.29
-3.00	2.29	3.24	1.05	0.29
-2.75	1.31	4.58	1.21	0.28
-2.50	0.66	5.06	0.93	0.11
-2.25	0.77	4.12	0.85	0.20
-2.00	0.67	2.99	0.86	0.12
-1.75	0.32	7.26	0.83	0.13
-1.50	0.32	10.83	0.80	0.10
-1.25	0.21	7.11	0.80	0.10
-1.00	0.26	4.84	0.79	0.11
-0.75	0.42	3.86	0.92	0.06
-0.50	0.67	2.79	0.83	0.23
-0.25	1.05	2.50	0.76	0.27
0.0	1.83	3.46	0.84	0.49
0.25	3.21	3.46	0.77	1.11
0.50	5.74	3.44	0.82	0.94
0.75	7.15	2.60	0.81	5.06
1.00	7.44	2.18	1.22	10.45
1.25	8.71	1.84	1.61	17.50
1.50	6.94	1.54	1.52	19.97
1.75	5.63	1.44	1.61	18.16
2.00	3.64	1.18	1.58	5.47
2.25	1.75	0.71	1.06	5.84
2.50	0.67	0.34	0.92	2.31
2.75	0.27	0.14	0.67	0.76
3.00	0.11	0.06	0.24	0.33
3.25	0.00	0.02	0.07	0.11
3.50	0.00	0.01	0.04	0.09
3.75	0.00	0.01	0.01	0.04
4.00	0.0	0.0	0.01	0.06

Table 1

Sample %

Size (phi)	5C	5D	5E	5F
4.75	0.0	0.0	0.04	0.0
5.00	0.0	0.0	0.04	0.0
5.25	0.0	0.0	0.0	0.0
Mean (phi)	-1.372	-1.666	-4.543	0.792
Standard Deviation	2.729	1.740	2.860	1.758
Skewness	-0.261	0.018	1.371	-2.253
Kurtosis	1.340	2.602	3.489	7.008

Table 1

Sample %

Size (phi)	6B	6C	6D	6E
-5.25	0.0	0.0	6.21	0.0
-5.00	0.0	0.0	2.74	0.0
-4.75	0.0	2.12	0.93	5.36
-4.50	0.0	2.12	0.93	5.36
-4.25	0.0	5.43	2.62	1.27
-4.00	0.0	5.43	2.62	1.27
-3.75	0.0	3.59	3.39	4.39
-3.50	0.0	3.59	3.39	4.39
-3.25	0.0	2.09	3.14	3.22
-3.00	0.0	2.09	3.14	3.22
-2.75	0.0	1.20	2.77	3.59
-2.50	0.0	1.05	2.08	2.56
-2.25	0.0	0.48	1.81	2.25
-2.00	0.0	0.79	1.95	3.05
-1.75	0.0	0.53	1.05	2.16
-1.50	0.0	0.71	1.66	3.08
-1.25	0.0	0.71	1.39	2.52
-1.00	0.0	0.87	1.44	2.94
-0.75	0.0	1.47	1.98	4.25
-0.50	0.0	1.87	2.07	3.92
-0.25	0.0	2.02	2.25	4.02
0.0	0.0	2.61	3.46	5.10
0.25	0.07	3.47	4.50	4.96
0.50	0.21	4.87	6.29	5.23
0.75	0.72	6.44	8.18	4.73
1.00	1.96	8.95	9.23	5.21
1.25	4.19	11.62	7.96	5.21
1.50	8.13	9.57	5.07	3.02
1.75	13.68	7.03	2.89	1.97
2.00	20.97	4.25	1.52	0.99
2.25	22.77	1.86	0.68	0.50
2.50	15.77	0.82	0.33	0.16
2.75	7.65	0.28	0.14	0.06
3.00	3.12	0.06	0.07	0.02
3.25	0.66	0.0	0.03	0.01
3.50	0.14	0.0	0.02	0.01
3.75	0.0	0.0	0.05	0.01
4.00	0.0	0.0	0.0	0.01
Mean (phi)	1.971	-0.570	-1.161	-1.451
Standard Deviation	0.472	2.299	2.321	2.036

Table 1

Sample %

Skewness	-0.334	-0.678	-0.460	-0.209
Kurtosis	3.306	1.837	1.775	1.770

Table 1

Sample %

Size (phi)	6F	A	B	C
-6.50	0.0	0.0	0.0	0.0
-6.25	0.0	0.0	0.0	0.0
-6.00	0.0	0.0	0.0	0.0
-5.75	0.0	0.0	0.0	0.0
-5.50	0.0	0.0	0.0	0.0
-5.25	0.0	0.0	0.0	0.0
-5.00	0.0	0.0	0.0	0.0
-4.75	1.55	0.0	7.98	0.0
-4.50	1.55	0.0	7.98	0.0
-4.25	3.55	0.0	4.33	0.0
-4.00	3.55	0.79	4.33	0.0
-3.75	3.14	1.11	4.48	0.0
-3.50	3.14	1.11	4.48	0.0
-3.25	3.64	1.47	5.44	0.0
-3.00	3.64	1.47	5.35	0.0
-2.75	2.86	3.90	5.02	0.0
-2.50	2.66	3.82	4.30	0.0
-2.25	1.87	4.60	2.65	0.0
-2.00	2.35	6.61	4.53	0.0
-1.75	1.54	5.21	2.25	0.0
-1.50	2.26	8.39	3.19	0.0
-1.25	2.06	7.81	2.51	0.0
-1.00	2.23	7.76	2.52	5.02
-0.75	2.96	10.98	3.24	5.02
-0.50	3.25	8.70	3.13	4.02
-0.25	3.42	7.37	2.93	5.00
0.0	4.49	6.95	3.61	6.17
0.25	4.81	4.91	3.37	6.65
0.50	5.45	3.19	2.74	6.34
0.75	6.48	1.41	2.04	6.08
1.00	7.39	1.08	3.14	5.13
1.25	7.89	0.54	1.02	5.97
1.50	5.52	0.27	0.66	3.97
1.75	3.42	0.17	0.54	3.15
2.00	1.86	0.15	0.54	2.61
2.25	0.87	0.12	0.41	2.41
2.50	0.35	0.07	0.28	2.00
2.75	0.15	0.03	0.12	1.52
3.00	0.05	0.02	0.06	1.24
3.25	0.01	0.0	0.02	0.78
3.50	0.01	0.0	0.78	1.32
3.75	0.01	0.0	0.02	0.82
4.00	0.0	0.0	0.0	0.70
4.25	0.0	0.0	0.0	3.24
4.50	0.0	0.0	0.0	3.24

Table 1

Sample %

Size (phi)	6F	A	B	C
4.75	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0
5.25	0.0	0.0	0.0	2.78
5.50	0.0	0.0	0.0	2.78
5.75	0.0	0.0	0.0	2.78
6.00	0.0	0.0	0.0	2.78
6.25	0.0	0.0	0.0	2.32
6.50	0.0	0.0	0.0	2.32
Mean (phi)	-0.931	-1.231	-2.308	1.786
Standard Deviation	2.038	1.104	1.958	2.324
Skewness	-0.400	-0.209	0.523	0.722
Kurtosis	1.792	2.497	2.367	2.220

Table 1

Sample %

Size (phi)	D	E	F	G
-4.75	7.36	0.0	0.0	0.0
-4.50	3.48	1.86	0.0	0.0
-4.25	2.46	4.15	0.0	0.0
-4.00	2.46	4.15	0.0	0.0
-3.75	1.85	5.61	0.0	1.55
-3.50	1.85	5.61	0.61	1.31
-3.25	1.22	5.90	2.21	1.03
-3.00	1.22	5.90	2.21	1.03
-2.75	1.63	5.04	1.47	1.47
-2.50	0.97	4.85	1.80	1.43
-2.25	1.03	4.17	1.96	1.22
-2.00	1.60	4.75	1.40	1.93
-1.75	1.40	2.79	1.75	1.37
-1.50	2.58	3.54	3.10	2.28
-1.25	2.45	2.61	2.80	2.17
-1.00	3.37	2.36	2.82	2.57
-0.75	6.38	3.13	3.56	3.61
-0.50	7.24	2.60	4.73	4.31
-0.25	7.24	2.60	5.03	3.84
0.0	10.40	3.49	6.55	5.16
0.25	9.77	3.72	6.67	5.89
0.50	8.51	3.95	6.88	6.59
0.75	5.40	4.05	6.71	7.15
1.00	3.25	3.53	6.45	7.78
1.25	1.75	3.23	6.64	8.33
1.50	0.87	2.05	5.77	7.63
1.75	0.55	1.73	5.83	7.38
2.00	0.43	1.16	5.44	6.05
2.25	0.27	0.71	3.68	3.20
2.50	0.21	0.40	1.87	1.62
2.75	0.14	0.18	0.63	0.54
3.00	0.08	0.07	0.27	0.17
3.25	0.09	0.04	0.04	0.04
3.50	0.0	0.02	0.05	0.02
3.75	0.0	0.02	0.06	0.02
4.00	0.0	0.01	0.02	0.0
Mean (phi)	-1.186	-2.721	0.042	0.125
Standard Deviation	1.887	1.890	1.510	1.597
Skewness	-0.772	0.332	-0.552	-0.941
Kurtosis	2.396	1.901	2.587	3.198

Table 1

Sample %

Size (phi)	H	I	J	K
4.50	0.0	0.0	0.86	2.51
4.75	0.0	0.0	2.59	1.26
5.00	0.0	0.0	2.59	1.26
5.25	0.0	0.22	3.46	0.42
5.50	0.0	0.22	3.46	0.42
5.75	0.0	0.0	0.86	0.84
6.00	0.0	0.0	0.86	0.84
6.25	0.0	0.45	0.0	0.84
6.50	0.0	0.45	0.0	0.84
Mean (phi)	-0.322	1.410	2.098	1.950
Standard Deviation	1.775	0.838	1.462	1.614
Skewness	-0.535	2.012	1.004	0.935
Kurtosis	2.500	3.322	3.348	3.897

Table 1

Sample %

Size (phi)	C1-1	C1-2	C1-3	C2-1
-3.75	0.0	0.0	3.67	
-3.50	2.89	0.0	1.60	0.0
-3.25	0.82	0.0	1.60	1.94
-3.00	0.82	0.28	1.66	2.16
-2.75	1.55	0.63	2.90	2.59
-2.50	1.33	0.08	1.62	0.47
-2.25	2.23	0.23	3.93	0.63
-2.00	4.81	0.78	2.27	0.81
-1.75	3.41	0.83	3.52	1.22
-1.50	4.43	1.94	4.31	1.17
-1.25	4.55	2.30	5.42	1.58
-1.00	5.76	4.13	5.02	2.28
-0.75	5.35	5.58	5.87	2.93
-0.50	6.46	7.03	6.20	5.00
-0.25	6.26	8.71	6.87	6.85
0.0	7.52	11.38	7.04	7.73
0.25	7.29	10.88	6.65	10.19
0.50	6.46	8.72	6.16	10.82
0.75	5.69	7.41	5.37	10.41
1.00	5.15	6.83	5.42	9.67
1.25	4.59	5.89	3.69	9.15
1.50	3.67	4.62	2.83	7.10
1.75	3.12	3.68	2.08	3.02
2.00	2.48	2.60	1.20	1.40
2.25	1.56	1.58	0.78	0.45
2.50	1.11	1.08	0.48	0.20
2.75	0.41	0.40	0.29	0.07
3.00	0.16	0.25	0.15	0.07
3.25	0.05	0.09	0.14	0.05
3.50	0.05	0.16	0.05	0.05
3.75	0.01	0.06	0.08	0.0
4.00	0.02	0.07	0.29	0.0
4.25	0.0	0.18	0.29	0.0
4.50	0.0	0.18	0.0	0.0
4.75	0.0	0.35	0.0	0.0
5.00	0.0	0.35	0.0	0.0
5.25	0.0	0.18	0.0	0.0
5.50	0.0	0.18	0.29	0.0
Mean (phi)	-0.384	0.256	-0.362	0.566
Standard Deviation	1.414	1.217	1.599	1.222
Skewness	-0.233	1.105	0.126	-1.119
Kurtosis	2.594	7.314	3.657	4.027

Table 1

Sample %

Size (phi)	C2-2	C2-3	C3-1	C3-2
-3.50	0.0	0.0	0.0	0.0
-3.25	0.0	0.0	0.0	0.0
-3.00	0.0	0.0	0.0	0.0
-2.75	0.0	0.0	1.03	0.56
-2.50	0.0	0.0	0.0	0.0
-2.25	1.94	0.0	0.0	0.0
-2.00	2.16	0.0	0.0	0.0
-1.75	2.59	0.0	0.0	0.22
-1.50	0.47	0.0	0.21	0.31
-1.25	0.63	0.0	0.05	0.79
-1.00	0.81	0.0	0.23	2.87
-0.75	1.22	0.0	0.63	3.46
-0.50	1.17	0.90	1.27	5.71
-0.25	1.58	1.17	2.19	6.75
0.0	2.28	2.51	4.19	7.73
0.25	2.93	1.26	6.01	7.59
0.50	5.00	5.02	7.67	8.46
0.75	6.85	2.24	9.99	8.60
1.00	7.73	2.42	12.26	7.84
1.25	10.19	2.78	14.55	6.44
1.50	10.82	3.77	13.15	4.33
1.75	10.41	3.68	10.57	2.00
2.00	9.67	3.86	6.23	1.63
2.25	9.15	4.13	3.35	1.21
2.50	7.10	4.57	1.68	1.12
2.75	3.02	3.05	2.50	0.73
3.00	1.40	2.51	0.66	1.10
3.25	0.45	1.79	0.31	0.11
3.50	0.20	2.51	0.26	0.76
3.75	0.07	1.52	0.13	1.41
4.00	0.07	2.96	0.10	1.41
4.25	0.05	0.90	0.40	2.81
4.50	0.05	1.61	0.40	2.81
4.75	0.0	2.24	0.0	2.11
5.00	0.0	2.24	0.0	2.11
5.25	0.0	8.97	0.0	3.51
5.50	0.0	8.97	0.0	3.51
5.75	0.0	2.24	0.0	0.0
6.00	0.0	2.24	0.0	0.0
6.25	0.0	8.97	0.0	0.0
6.50	0.0	8.97	0.0	0.0

Table 1

Sample %

Size (phi)	C2-2	C2-3	C3-1	C3-2
Mean (phi)	0.566	3.058	1.032	1.735
Standard Deviation	1.222	2.145	0.909	1.920
Skewness	-1.119	-0.232	-0.424	0.873
Kurtosis	4.027	1.660	6.564	2.688

Table 1

Sample %

Size (phi)	C3-3	C4-1	C4-2	C4-3
-3.50	0.0	0.0	0.0	0.0
-3.25	0.0	0.0	0.0	0.0
-3.00	0.0	0.0	0.0	0.0
-2.75	0.0	0.0	1.16	0.0
-2.50	0.0	0.0	0.14	0.52
-2.25	0.0	0.0	0.55	0.63
-2.00	0.0	0.0	0.52	0.85
-1.75	0.0	0.0	0.59	0.77
-1.50	0.0	0.0	1.41	1.48
-1.25	0.0	0.0	1.33	1.25
-1.00	0.0	0.0	1.98	1.34
-0.75	5.62	0.44	1.76	1.81
-0.50	4.14	0.28	2.72	2.48
-0.25	2.81	0.11	3.04	2.87
0.0	5.62	0.39	4.03	4.20
0.25	3.99	0.55	4.34	4.58
0.50	4.44	0.72	4.54	4.99
0.75	4.44	1.39	4.92	5.17
1.00	4.44	1.94	5.57	5.92
1.25	4.14	1.88	6.45	7.25
1.50	3.85	1.77	7.21	8.24
1.75	3.40	1.61	8.71	9.17
2.00	2.51	2.44	9.66	10.93
2.25	1.48	3.33	7.99	9.28
2.50	1.33	4.71	5.97	6.70
2.75	1.33	5.82	3.83	3.74
3.00	2.66	7.15	2.65	2.37
3.25	1.48	4.43	1.57	0.75
3.50	2.96	6.04	0.94	0.82
3.75	1.48	4.05	0.60	0.32
4.00	0.89	1.05	0.06	0.22
4.25	3.70	1.39	0.86	0.22
4.50	3.70	1.39	0.86	0.22
4.75	3.70	11.09	0.86	0.0
5.00	3.70	11.09	0.86	0.0
5.25	0.0	2.77	0.0	0.0
5.50	0.0	2.77	0.0	0.0
5.75	11.09	4.16	0.86	0.45
6.00	11.09	4.16	0.86	0.45
6.25	0.0	4.16	0.29	0.0
6.50	0.0	4.16	0.29	0.0

Table 1

Sample %

	C3-3	C4-1	C4-2	C4-3
Mean (phi)	2.448	3.858	1.296	1.157
Standard Deviation	2.355	1.687	1.582	1.313
Skewness	0.110	-0.305	0.193	-0.258
Kurtosis	1.511	2.382	3.979	4.030

Table 1

Sample %

Size (phi)	C4-4	C4-5	C4-6	C5-1
-3.00	0.0	0.0	0.0	4.80
-2.75	0.0	0.0	0.0	2.84
-2.50	0.0	0.70	0.0	0.79
-2.25	0.0	0.0	0.77	0.45
-2.00	0.0	0.45	0.46	1.81
-1.75	0.54	0.64	0,86	2.07
-1.50	0.32	0.97	2.07	1.94
-1.25	0.41	0.94	1.55	1.19
-1.00	0.71	1.56	2.93	1.79
-0.75	1.66	2.09	4.12	1.34
-0.50	2.07	2.74	5.19	1.62
-0.25	2.26	3.39	5.58	1.57
0.0	3.92	4.87	7.60	2.31
0.25	4.65	5.54	7.46	2.68
0.50	4.91	5.81	7.12	3.13
0.75	4.89	6.56	7.36	3.50
1.00	6.42	7.67	7.20	4.66
1.25	7.19	8.49	7.77	5.57
1.50	8.05	8.72	7.44	6.80
1.75	8.91	9.79	8.01	9.30
2.00	9.22	9.48	4.96	10.72
2.25	7.36	6.77	5.57	8.41
2.50	5.32	3.89	2.64	7.90
2.75	4.05	2.07	1.04	4.29
3.00	3.75	1.38	0.47	2.10
3.25	1.51	0.79	0.15	0.74
3.50	1.87	0.59	0.14	0.62
3.75	0.95	0.25	0.06	0.29
4.00	0.45	0.20	0.07	0.12
4.25	1.61	0.68	0.24	0.39
4.50	1.61	0.68	0.24	0.39
4.75	2.15	0.91	0.0	0.77
5.00	2.15	0.91	0.0	0.77
5.25	0.0	0.0	0.0	0.39
5.50	0.0	0.0	0.0	0.39
5.75	0.54	0.0	0.47	0.77
6.00	0.54	0.0	0.47	0.77
6.25	0.0	0.0	0.0	0.0
6.50	0.0	0.0	0.0	0.0

Table 1

Sample %

	C4-4	C4-5	C4-6	C5-1
Mean (phi)	1.613	1.116	0.637	0.981
Standard Deviation	1.425	1.324	1.244	1.916
Skewness	0.463	0.374	0.480	-0.431
Kurtosis	3.347	4.778	4.725	3.205

Table 1

Sample %

Size (phi)	C5-2	C5-3	C5-4	C5-5
-3.00	0.0	0.0	0.0	0.79
-2.75	0.0	0.0	0.0	1.09
-2.50	0.0	0.0	0.0	1.09
-2.25	0.0	0.0	0.0	0.74
-2.00	0.0	0.0	0.35	0.93
-1.75	0.0	0.61	0.12	1.26
-1.50	0.0	0.05	0.42	2.19
-1.25	0.44	0.16	0.39	1.78
-1.00	0.88	0.64	0.82	3.35
-0.75	2.65	0.68	1.24	4.44
-0.50	0.88	1.29	2.29	4.39
-0.25	0.0	1.43	2.55	5.16
0.0	0.44	2.72	4.36	7.36
0.25	1.11	3.72	5.73	8.16
0.50	1.33	4.63	6.74	7.87
0.75	1.77	5.67	7.85	8.14
1.00	1.77	7.42	8.91	7.65
1.25	2.43	8.19	10.13	7.97
1.50	3.32	8.10	8.65	5.71
1.75	3.98	7.60	7.38	4.44
2.00	3.76	6.49	6.12	3.21
2.25	1.77	6.65	5.70	2.24
2.50	1.55	6.01	4.97	2.24
2.75	1.33	5.51	4.26	1.61
3.00	1.11	4.74	2.96	1.22
3.25	0.66	1.57	1.34	0.44
3.50	0.66	1.63	0.82	0.36
3.75	0.88	0.50	0.57	0.16
4.00	0.88	0.39	0.20	0.10
4.25	0.0	0.57	0.28	0.73
4.50	0.0	0.57	0.28	0.73
4.75	0.0	0.0	0.85	0.73
5.00	0.0	0.0	0.85	0.73
5.25	0.0	1.70	0.28	0.0
5.50	0.0	1.70	0.28	0.0
5.75	22.12	2.84	0.57	0.49
6.00	22.12	2.84	0.57	0.49
6.25	0.0	0.57	0.57	0.0
6.50	0.0	0.57	0.57	0.0
6.75	11.06	1.13	0.0	0.0
7.00	11.06	1.13	0.0	0.0

Table 1

Sample %

	C5-2	C5-3	C5-4	C5-5
Mean (phi)	4.481	2.006	1.361	0.521
Standard Deviation	2.398	1.779	1.378	1.521
Skewness	-0.897	0.970	1.003	0.525
Kurtosis	2.343	3.627	5.105	4.391

Table 1

Sample %

Size (phi)	C5-6	C6-1	C6-2	C6-3
-2.25	0.21	0.0	0.0	0.0
-2.00	0.38	0.0	0.0	0.0
-1.75	0.18	0.0	0.0	0.0
-1.50	0.18	0.0	0.0	0.0
-1.25	0.45	0.0	0.0	0.0
-1.00	0.66	0.0	0.0	0.0
-0.75	0.69	0.13	0.34	0.0
-0.50	0.89	1.02	0.30	0.48
-0.25	1.00	0.89	0.42	0.31
0.0	1.86	2.67	1.11	0.12
0.25	2.48	3.69	0.34	0.42
0.50	3.31	6.74	4.25	0.57
0.75	4.77	9.03	6.68	1.32
1.00	6.42	11.83	11.35	1.39
1.25	7.09	9.80	13.81	1.82
1.50	7.30	9.16	15.13	1.75
1.75	7.83	8.52	13.68	2.55
2.00	8.58	6.49	9.10	3.68
2.25	9.18	3.05	4.61	4.53
2.50	11.09	1.78	1.95	5.90
2.75	10.03	1.15	0.91	6.12
3.00	7.92	1.02	0.54	7.18
3.25	2.62	0.89	0.22	10.88
3.50	0.81	1.27	0.20	9.05
3.75	0.32	1.27	0.10	8.56
4.00	0.12	0.51	0.06	11.18
4.25	0.20	0.0	0.50	12.30
4.50	0.20	0.0	0.50	6.10
4.75	1.41	0.0	5.96	4.60
5.00	1.41	0.0	5.96	1.48
5.25	0.0	9.54	0.0	1.03
5.50	0.0	9.54	0.0	3.70
5.75	0.0	0.0	0.99	3.25
6.00	0.0	0.0	0.99	3.25
6.25	0.0	0.0	0.0	0.0
6.50	0.0	0.0	0.0	0.0
Mean (phi)	1.773	1.977	1.832	3.565
Standard Deviation	1.183	1.767	1.389	2.455
Skewness	-0.010	0.964	1.375	0.311
Kurtosis	4.824	2.571	3.999	2.492

Table 1

Sample %

Size (phi)	C7-1	C7-2	C8-1	C8-2
-2.25	0.0	0.0	0.0	0.0
-2.00	0.0	0.0	0.37	0.0
-1.75	0.0	0.0	0.26	0.0
-1.50	0.0	0.0	0.28	0.0
-1.25	0.0	0.0	0.25	0.0
-1.00	0.0	0.0	0.37	0.0
-0.75	0.0	0.0	0.20	0.16
-0.50	0.0	0.12	0.66	0.10
-0.25	0.0	0.12	0.59	0.17
-0.0	0.32	0.14	1.10	0.20
0.25	0.14	0.24	1.69	0.35
0.50	0.14	0.36	2.61	0.71
0.75	0.23	0.45	4.07	1.33
1.00	0.41	0.95	5.45	2.80
1.25	0.68	1.80	9.15	5.06
1.50	1.14	3.83	9.57	8.44
1.75	2.19	8.59	11.82	13.02
2.00	5.34	15.46	13.30	16.83
2.25	8.22	17.82	11.70	14.15
2.50	9.95	14.91	8.28	9.84
2.75	5.80	8.90	4.03	5.87
3.00	2.83	5.09	2.55	3.59
3.25	1.37	2.75	1.23	1.62
3.50	3.70	2.75	1.50	1.91
3.75	2.46	0.76	0.64	0.68
4.00	2.60	0.78	0.70	0.84
4.25	4.56	1.18	1.76	1.45
4.50	4.56	1.18	1.76	1.45
4.75	2.28	2.37	0.59	1.45
5.00	2.28	2.37	0.59	1.45
5.25	7.99	2.37	0.59	0.36
5.50	7.99	2.37	0.59	0.36
5.75	4.56	0.59	0.59	2.17
6.00	4.56	0.59	0.59	2.17
6.25	3.42	0.59	0.29	0.72
6.50	3.42	0.59	0.29	0.72
6.75	3.42	0.0	0.0	0.0
7.00	3.42	0.0	0.0	0.0
Mean	4.025	2.579	1.861	2.337
Standard Deviation	1.678	1.166	1.235	1.264
Skewness	-0.018	1.265	0.700	1.418
Kurtosis	1.763	4.332	5.295	4.877

Table 1

Sample %

Size (phi)	C8-3
-2.00	0.0
-1.75	0.0
-1.50	0.0
-1.25	0.0
-1.00	0.0
-0.75	0.67
-0.50	0.40
-0.25	0.63
0.0	1.19
0.25	2.42
0.50	4.27
0.75	7.59
1.00	11.93
1.25	15.10
1.50	15.54
1.75	14.96
2.00	12.03
2.25	6.60
2.50	3.31
2.75	1.41
3.00	0.98
3.25	0.28
3.50	0.35
3.75	0.18
4.00	0.08
4.25	0.08
4.50	0.0
4.75	0.0
5.00	0.0
5.25	0.0
5.50	0.0
5.75	0.0
6.00	0.0
6.25	0.0
6.50	0.0
Mean (phi)	1.328
Standard Deviation	0.673
Skewness	-0.090
Kurtosis	4.041

Table 2

Q-MODE VARIMAX FACTOR MATRIX

Sample Name	Comm.	1	2	3	4	5
1A	0.748	0.379	0.506	0.548	0.105	0.195
1B	0.874	0.320	0.850	0.146	0.083	-0.146
1C	0.924	0.556	0.309	0.166	0.092	-0.696
1D	0.963	0.599	0.120	0.086	0.175	-0.743
1E	0.722	0.299	0.332	0.528	0.071	-0.488
1F	0.753	0.179	0.577	0.401	-0.003	-0.476
2A	0.531	0.002	-0.008	0.039	0.727	0.008
2C	0.898	0.391	0.845	0.040	0.173	0.011
2D	0.814	0.122	0.599	0.636	-0.036	-0.189
2E	0.843	0.051	0.773	0.388	0.007	-0.304
2F	0.853	0.035	0.083	0.915	0.046	0.075
2G	0.831	0.248	0.667	0.426	0.075	-0.371
3A	0.810	0.190	0.062	0.055	0.868	-0.113
3B	0.850	0.615	0.200	0.078	0.564	-0.328
3C	0.798	0.319	0.683	0.418	0.147	-0.181
3D	0.633	0.006	0.151	0.780	0.033	-0.001
3E	0.514	0.121	0.208	0.666	0.047	-0.100
3F	0.821	0.197	0.696	0.345	0.058	-0.419
3G	0.838	0.218	0.673	0.385	0.089	-0.426
3H	0.797	0.155	0.249	0.558	0.007	-0.632
3I	0.833	0.337	0.028	0.616	0.190	-0.551
3J	0.668	0.329	0.214	0.316	0.095	-0.637
4A	0.913	0.606	0.689	0.092	0.116	-0.221
4B	0.905	0.858	0.161	0.149	0.019	-0.348
4C	0.959	0.484	0.837	0.136	0.073	-0.036
4D	0.859	0.239	0.851	0.015	0.112	-0.257
4E	0.756	-0.091	0.832	0.182	0.024	-0.146
4F	0.888	0.090	0.210	0.897	0.052	-0.171
4G	0.837	0.115	0.330	0.610	0.032	-0.585
5A	0.927	0.911	0.065	0.103	0.015	-0.285
5B	0.931	0.921	0.089	0.102	0.020	-0.254
5C	0.728	0.642	0.479	0.282	-0.009	-0.087
5D	0.707	0.054	0.820	0.090	-0.020	-0.151
5F	0.785	0.031	0.014	0.884	0.036	0.019
6A	0.866	0.894	0.113	0.137	0.005	-0.188
6B	0.929	0.510	-0.030	0.066	0.112	-0.807
6C	0.869	0.778	0.466	0.207	0.022	-0.057
6D	0.841	0.590	0.668	0.204	0.045	0.055
6E	0.883	0.341	0.857	0.178	0.040	-0.011
6F	0.929	0.582	0.747	0.170	0.054	0.019

Table 2

Q-MODE VARIMAX FACTOR MATRIX

Sample Name	Comm.	1	2	3	4	5
A	0.814	-0.062	0.894	-0.022	0.085	-0.061
B	0.716	0.003	0.795	-0.057	0.251	-0.135
C	0.872	0.535	0.872	0.020	0.506	-0.002
D	0.831	0.183	0.574	0.076	0.158	0.082
E	0.767	0.786	0.826	0.193	-0.030	-0.099
F	0.961	0.190	0.700	0.051	0.154	-0.126
G	0.986	0.655	0.607	0.081	0.129	-0.114
H	0.962	0.763	0.755	0.083	0.118	-0.179
I	0.985	0.582	0.140	0.100	0.073	-0.276
J	0.956	0.814	0.088	0.097	0.228	-0.473
K	0.909	0.535	0.300	0.063	0.724	-0.074
C1-1	0.919	0.404	0.854	0.015	0.157	-0.021
C1-2	0.871	0.509	0.739	-0.008	0.240	0.087
C1-3	0.941	0.433	0.851	0.031	0.171	0.014
C2-1	0.935	0.634	0.707	0.060	0.155	0.066
C2-2	0.972	0.864	0.448	0.076	0.125	-0.047
C2-3	0.834	0.351	0.178	0.059	0.806	-0.160
C3-1	0.986	0.930	0.309	0.087	0.128	-0.037
C3-2	0.967	0.779	0.411	0.067	0.432	0.016
C3-3	0.835	0.349	0.342	0.038	0.771	-0.003
C4-1	0.970	0.741	0.351	0.069	0.270	-0.469
C4-2	0.721	0.139	-0.018	0.058	0.778	-0.305
C4-3	0.964	0.762	0.327	0.069	0.201	-0.480
C4-4	0.972	0.782	0.283	0.076	0.319	-0.415
C4-5	0.975	0.833	0.380	0.069	0.205	-0.300
C4-6	0.934	0.733	0.579	0.034	0.214	-0.122
C5-1	0.940	0.666	0.302	0.092	0.191	-0.601
C5-2	0.418	0.110	0.035	0.044	0.632	-0.056
C5-3	0.945	0.784	0.235	0.087	0.366	-0.365
C5-4	0.959	0.843	0.356	0.076	0.264	-0.214
C5-5	0.949	0.663	0.662	0.034	0.265	0.009
C5-6	0.871	0.654	0.144	0.081	0.275	-0.583
C6-1	0.769	0.814	0.232	0.080	0.203	-0.067
C6-2	0.904	0.900	0.113	0.107	0.200	-0.172
C6-3	0.862	0.153	0.015	0.033	0.589	-0.021
Variance		33.404	24.214	9.308	8.323	11.216
Cun. Var.		33.404	57.618	66.927	75.249	86.465

Table 3

Casey Point Foreshore Samples-Intermediate Diameters

Sample 1	Sample 2	Sample 3	Sample 4
9.3cm	6.6cm	10.5cm	6.6cm
5.1	9.2	6.4	9.8
5.5	5.9	10.6	8.9
7.0	6.3	7.1	12.0
7.2	7.1	9.3	14.0
7.0	5.6	11.2	11.0
5.0	9.0	5.0	7.9
11.0	6.6	10.6	8.2
7.1	5.3	8.1	11.0
6.1	7.0	6.3	7.0
9.3	4.5	11.4	11.3
6.5	9.5	10.1	10.0
11.0	7.5	10.9	8.6
8.1	6.5	14.8	12.6
8.7	6.1	8.0	10.5
10.0	5.6	14.9	6.0
10.4	10.6	10.0	11.8
6.5	6.3	8.9	7.7
9.0	9.2	9.8	8.1
6.0	7.4	11.8	23.0
5.5	7.2	4.5	7.2
7.5	9.0	10.0	21.0
5.5	7.0	6.9	9.5
5.0	6.2	11.5	7.5
5.5	11.0	5.3	9.4
4.4	9.1	6.5	6.1
6.3	4.9	4.3	11.9
6.0	12.0	13.0	11.8
6.3	6.0	10.3	9.1
3.8	8.6	9.6	11.0
3.6	8.0	8.8	8.0
3.9	5.6	6.3	9.7
4.5	7.2	5.1	7.0
5.5	8.0	5.2	17.0
5.0	6.0	11.5	10.5
6.3	7.0	5.1	8.0
6.3	3.1	8.0	9.0
9.3	4.5	4.5	6.1
7.1	3.6	4.7	14.5
2.8	9.5	4.3	13.5
4.8	3.7	5.6	8.8
5.0	4.1	10.6	9.4
12.0	5.0	7.0	8.7
3.8	5.1	10.0	11.2
4.6	6.7	6.5	9.3

Table 3

Casey Point Foreshore Samples-Intermediate Diameters

Sample 1	Sample 2	Sample 3	Sample 4	
4.7	3.4	10.6	8.0	
4.1	7.8	11.8	9.0	
3.4	4.0	4.5	8.8	
3.3	4.6	3.4	10.0	
2.9	3.8	6.6	9.1	
6.3cm	6.7cm	8.4cm	9.7cm	Mean

Table 3

Casey Point Foreshore Samples-Intermediate Diameters

Sample 5	Sample 6	Sample 7	Sample 8
29.0cm	10.1cm	28.9cm	28.9cm
28.0	9.5	27.5	27.5
9.0	11.6	33.4	33.4
12.0	12.0	18.5	18.4
11.0	11.8	15.5	15.5
11.3	18.0	12.5	12.5
20.8	9.8	11.8	11.8
9.2	19.0	14.8	14.8
14.5	9.0	9.7	9.7
10.5	9.5	8.0	8.0
11.9	13.0	20.2	20.2
9.9	7.2	12.0	12.0
9.0	8.5	8.2	8.2
10.0	13.2	8.6	8.6
7.9	13.0	16.5	16.5
9.1	12.6	6.5	6.5
9.7	6.8	11.2	11.2
7.2	7.6	10.9	10.9
15.6	14.2	13.0	13.0
13.3	7.4	11.4	11.4
16.5	7.3	10.3	10.3
13.9	13.0	7.0	7.0
11.5	8.6	4.9	4.9
7.6	10.2	13.2	13.2
7.4	14.6	7.9	7.9
12.1	8.2	14.5	14.5
11.3	6.3	8.5	8.5
11.2	12.9	10.6	10.6
9.5	12.5	12.8	12.8
6.6	5.0	13.1	13.1
5.3	7.5	23.2	23.2
11.0	6.5	9.4	9.4
27.0	6.3	8.1	8.1
10.0	6.6	7.2	7.2
15.7	27.0	6.8	6.8
9.0	5.5	8.0	8.0
13.0	7.2	8.9	8.9
12.0	17.5	10.9	10.9
9.3	6.4	9.8	9.8
8.8	14.0	13.4	13.4
7.2	7.8	9.6	9.6
5.1	10.5	11.9	11.9
7.0	13.5	12.5	12.5
5.9	5.5	7.7	7.7
10.0	10.0	14.5	14.5

Table 3

Casey Point Foreshore Samples-Intermediate Diameters

Sample 5	Sample 6	Sample 7	Sample 8	
14.0	8.5	7.8	7.8	
5.2	19.0	10.1	10.1	
5.0	10.7	6.4	6.4	
4.0	6.9	6.4	6.4	
4.9	14.3	7.6	7.6	
10.1cm	10.7cm	11.4cm	12.1cm	Mean

Table 4

Sample T1-A

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
9.0	8.0	2.6	.49	.63
15.0	7.4	4.0	.62	.76
11.0	6.8	5.5	.73	.80
9.5	7.0	5.0	.58	.66
10.0	5.8	3.8	.58	.66
12.0	7.0	2.6	.58	.47
9.0	5.5	3.1	.61	.55
10.0	5.2	2.6	.52	.85
12.0	5.2	4.0	.83	.56
6.3	3.5	3.0	.41	.66
5.5	7.0	3.0	.78	.64
9.0	5.0	2.8	.63	.50
8.0	5.0	3.8	.73	.60
6.8	5.0	4.0	.63	.52
8.0	5.0	1.3	.63	.60
9.0	6.6	3.3	.73	.51
6.8	5.5	4.2	.81	.51
9.8	5.2	1.5	.53	.62
7.5	5.3	3.1	.76	.58
6.0	6.0	5.0	1.0	.50
6.0	4.0	2.2	.66	.70
12.8	7.4	3.0	.58	.63
7.3	6.0	4.6	.63	.40
6.3	5.0	6.3	.79	.51
9.0	4.1	2.5	.66	.50
6.5	6.0	2.3	.83	.42
5.0	6.0	2.6	.80	.80
5.2	4.2	5.2	.68	.47
7.1	4.8	4.0	.74	.48
7.0	5.2	4.8	.73	.75
9.3	6.8	4.3	1.0	.56
5.0	5.0	3.2	.76	.54
5.0	3.8	4.2	.80	.55
6.5	4.0	2.9	.65	.42
5.0	4.2	1.6	.88	.47
5.5	4.4	4.0	.84	.40
5.4	4.6	5.6	1.0	.56
5.5	5.4	7.8	.78	.54
6.4	4.3	2.6	.81	.35
8.0	5.2	1.6	.37	.55
5.3	3.0	1.5	.71	.87
5.8	3.8	2.1	.70	.53
6.0	4.1	1.8	.50	.51
4.8	3.0	2.3	.83	.70

Table 4

Sample T1-A

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
6.5	4.0	3.5	.72	.50
5.0	4.7	4.6	.80	.76
10.0	4.0	2.9	.40	.73
5.0	4.0	2.4	.72	1.0
3.5	3.8	2.6	1.0	.47

Table 4

Sample T1-B

Long Diameter	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
12.5	9.5	2.6	.76	.27
10.5	6.2	4.0	.59	.65
12.2	7.2	5.5	.59	.76
10.6	8.5	5.0	.80	.58
10.5	6.5	3.8	.61	.58
14.0	9.0	4.6	.64	.51
8.0	5.6	3.8	.70	.67
8.2	6.8	2.6	.82	.38
8.0	5.6	3.1	.70	.55
8.2	7.2	2.6	.87	.36
7.6	5.6	4.0	.73	.71
7.5	5.0	2.9	.71	.58
7.0	6.6	2.4	.94	.36
7.0	5.0	4.0	.71	.68
7.8	6.0	3.0	.77	.50
8.0	5.5	3.0	.69	.54
9.0	5.0	2.8	.44	.56
7.7	7.0	3.8	.90	.54
7.5	6.8	4.0	.90	.66
3.5	3.0	1.3	.85	.43
6.5	5.0	3.3	.83	.66
10.9	6.7	4.2	.61	.63
6.0	2.8	1.5	.47	.50
6.3	5.8	3.1	.92	.53
9.1	8.2	5.0	.90	.61
5.8	5.5	2.2	.94	.40
15.5	6.3	3.0	.41	.47
8.8	6.9	4.6	.78	.66
11.4	8.8	6.3	.70	.78
6.1	3.8	2.5	.49	.66
8.5	4.0	2.3	.47	.57
10.0	5.0	2.6	.50	.52
18.0	8.4	5.2	.47	.64
8.8	6.0	4.0	.68	.66
8.0	7.0	4.8	.87	.69
9.0	5.4	4.3	.60	.79
9.0	5.0	3.2	.55	.64
8.6	8.0	4.2	.93	.53
6.2	4.5	2.9	.73	.64
5.0	4.3	1.6	.86	.37
8.0	5.4	4.0	.67	.74
9.6	5.5	5.6	.58	1.0
7.8	3.0	7.8	.38	.66
8.2	4.1	2.6	.50	.63

Table 4

Sample T1-C

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
13.0	10.0	6.1	.76	.61
11.5	7.6	5.0	.66	.65
10.0	6.3	3.8	.63	.60
9.1	6.4	5.7	.70	.89
8.4	6.3	4.8	.75	.76
9.5	8.0	5.0	.84	.62
8.7	5.3	5.0	.57	.70
9.0	7.0	5.9	.77	.84
9.0	4.0	2.8	.44	.70
7.0	6.0	4.3	.87	.55
8.6	7.5	4.1	.87	.55
8.6	5.5	5.0	.64	.90
8.5	6.0	4.0	.70	.80
14.8	8.0	4.5	.57	.56
11.5	8.6	9.0	.78	.94
9.0	6.6	2.7	.73	.56
9.4	5.6	3.9	.59	.94
9.0	7.5	2.9	.83	.56
11.8	8.0	7.7	.72	.70
12.0	11.0	4.0	.92	.44
7.6	7.2	6.0	.80	.98
12.8	6.0	5.0	.47	.83
7.8	5.0	4.0	.64	.80
12.0	6.8	3.7	.57	.54
6.1	6.3	5.0	.96	.83
17.6	11.0	5.5	.63	.50
8.5	7.2	3.5	.84	.48
8.0	7.0	4.5	.87	.64
8.0	7.8	5.5	.97	.79
17.7	6.6	3.6	.37	.40
7.2	5.8	4.5	.80	.77
6.5	5.2	5.5	.80	.73
6.7	6.8	2.7	.98	.60
5.0	4.1	4.0	.68	.99
6.0	5.0	4.0	.83	.80
7.3	5.7	5.5	.78	.96
7.8	7.0	4.0	.89	.57
7.5	6.5	4.5	.87	.69
8.3	6.0	3.8	.68	.63
6.7	4.4	3.1	.66	.70
10.0	8.8	5.0	.88	.57
12.0	10.5	6.8	.87	.65
14.6	8.0	7.0	.65	.87
12.0	8.2	7.2	.68	.88

Table 4

Sample T1-C

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
5.0	3.1	3.0	.63	.96
17.4	6.0	6.2	.34	.64
15.1	8.6	3.6	.56	.73
7.5	5.0	3.6	.66	.72
5.5	4.6	2.5	.83	.54
5.5	4.4	2.6	.83	.55

Table 4

Sample T1-D

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
12.0	7.8	6.8	.65	.87
11.0	7.0	6.0	.64	.84
9.0	7.0	4.6	.78	.66
12.8	6.0	4.5	.46	.75
12.0	7.5	4.5	.63	.60
7.9	6.6	5.0	.83	.75
11.0	6.0	3.9	.55	.65
11.0	8.7	4.7	.79	.54
10.0	6.3	3.8	.62	.61
9.0	7.0	3.9	.77	.56
12.6	7.0	3.3	.56	.47
10.0	6.0	3.8	.60	.63
6.2	5.3	4.2	.83	.81
8.0	7.8	3.8	.97	.49
12.4	7.7	4.6	.63	.60
11.6	8.6	5.4	.97	.63
10.5	8.4	5.8	.63	.70
6.1	6.0	3.8	.78	.63
10.2	8.0	5.0	.78	.70
8.5	4.6	4.3	.53	.63
6.5	4.0	2.5	.62	.63
7.2	6.0	5.0	.83	.95
6.1	6.0	4.1	.98	.65
9.5	4.5	3.8	.47	.92
9.0	7.1	3.8	.79	.68
8.2	5.9	2.8	.72	.84
9.0	6.4	5.3	.71	.54
6.5	5.3	3.0	.66	.70
10.5	7.0	3.5	.70	.50
9.5	7.5	4.0	.80	.53
8.4	6.5	5.4	.77	.69
9.8	7.4	4.2	.74	.58
4.3	3.0	2.0	.75	.67
7.5	5.0	4.0	.67	.80
6.6	5.0	3.0	.83	.60
9.5	7.0	5.0	.73	.71
7.5	5.7	1.8	.76	.31
4.5	4.4	2.6	.97	.59
5.4	3.5	2.5	.64	.71
5.5	4.2	2.3	.76	.55
7.5	4.5	2.8	.60	.62
7.5	5.4	3.2	.72	.58
11.4	9.8	4.3	.86	.43
5.7	3.8	2.8	.67	.72

Table 4

Sample T1-D

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
12.5	6.7	5.8	.53	.86
8.6	7.5	5.2	.88	.69
9.5	7.5	5.2	.78	.71
10.3	8.2	3.0	.80	.36
8.0	5.4	4.0	.68	.74
11.0	6.5	3.0	.59	.46

Table 4

Sample T2-A

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
14.0 (cm)	7.0 (cm)	4.0 (cm)	.50	.57
10.8	8.0	5.4	.74	.62
13.7	6.8	3.1	.48	.39
8.0	6.0	2.5	.75	.42
11.0	6.5	4.0	.59	.62
7.5	5.5	3.5	.73	.63
5.5	4.5	3.0	.82	.67
11.0	7.0	7.0	.63	1.0
9.0	7.0	4.5	.70	.43
13.0	7.4	5.0	.54	.71
8.8	4.5	2.5	.56	.56
8.0	5.5	3.5	.63	.78
7.3	6.7	2.5	.92	.37
8.5	8.6	3.4	1.0	.35
10.0	6.9	3.7	.68	.54
11.0	7.0	5.1	.64	.71
7.0	6.5	4.2	.78	.71
7.0	6.5	4.5	.92	.68
9.5	8.0	3.6	.84	.43
8.0	5.5	3.8	.68	.69
9.0	6.7	4.6	.74	.33
10.0	6.0	4.4	.94	.75
9.5	9.0	7.1	.74	.77
9.0	6.7	3.5	.83	.50
6.6	5.5	2.0	.40	.35
8.7	3.5	2.1	.83	.62
9.0	7.5	3.6	.72	.46
11.0	8.2	4.5	.60	.75
7.5	4.5	4.0	.66	.75
6.0	4.1	3.3	.40	.66
11.0	4.5	3.0	.77	.71
6.0	7.0	5.0	.76	.81
8.0	5.5	4.5	.80	.54
7.5	5.0	3.5	.66	.60
6.5	4.0	3.1	.61	.95
12.0	7.3	3.8	.58	.73
10.0	7.4	5.5	.75	.66
7.5	4.0	5.0	.53	.75
10.5	7.5	3.0	.71	.53
8.0	5.0	4.1	.61	.60
6.0	4.5	3.2	.75	.66
8.5	6.5	3.2	.75	.61
7.0	4.5	4.0	.52	.88
8.0	5.5	4.0	.78	.72

Table 4

Sample T2-A

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
11.0	4.7	2.3	.58	.49
11.0	8.5	5.0	.77	.58
8.0	6.0	3.0	.75	.50
10.0	7.5	6.0	.72	.80

Table 4

Sample T2-B

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
6.0 (cm)	4.0 (cm)	2.0 (cm)	.66	.50
7.5	5.5	4.0	.73	.72
6.0	5.0	2.0	.83	.40
6.3	3.0	1.6	.33	.80
7.0	4.5	2.2	.60	.49
5.0	3.7	1.5	.74	.40
8.0	4.2	2.5	.52	.59
5.3	3.5	1.0	.70	.29
7.0	3.4	1.7	.48	.50
8.0	5.5	1.8	.68	.32
7.6	4.9	2.5	.53	.62
8.0	6.0	2.0	.75	.33
7.5	3.3	2.5	.44	.75
9.5	6.7	5.0	.70	.74
5.2	4.5	2.0	.86	.44
7.0	5.0	2.0	.71	.40
7.0	6.5	2.5	.92	.38
5.0	7.7	1.8	.54	.67
4.5	3.5	2.0	.77	.57
6.0	4.0	3.0	.66	.75
5.5	3.0	1.5	.55	.50
4.0	3.5	1.4	.87	.44
5.0	4.5	2.0	.77	.57
4.5	3.5	2.5	.80	.62
5.0	5.0	1.7	.44	.77
5.0	2.2	5.5	.72	.78
9.5	7.0	2.5	.80	.63
5.1	4.0	1.6	.60	.52
5.0	3.0	2.0	.78	.52
4.5	3.5	2.0	.54	.92
5.0	2.7	2.5	.45	.80
11.0	5.0	4.0	.57	.80
7.0	4.0	1.6	.90	.38
5.0	4.5	2.5	.66	.49
6.0	4.0	2.0	.86	.50
7.0	6.0	3.0	.50	.50
10.0	5.0	3.5	.69	.70
6.5	4.5	1.5	.80	.33
5.0	4.0	1.5	.70	.33
5.0	3.5	2.0	.64	.57
5.5	3.5	1.8	.60	.51
4.0	2.0	1.5	.63	.75
8.0	5.0	3.0	.55	.60
4.3	2.4	1.6	.60	.67

Table 4

Sample T2-B

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
4.5	2.7	2.0	.54	.73
4.6	2.6	1.0	.61	.40
6.5	4.0	2.0	.60	.50
5.0	3.0	2.5	.80	.83
5.0	4.5	3.0	.90	.66
4.1	3.6	1.3	.50	.36

Table 4

Sample T2-C

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
14.0 (cm)	9.0 (cm)	4.0 (cm)	.64	.44
9.0	8.7	3.0	.96	.34
10.5	6.5	4.0	.61	.61
12.0	10.5	4.0	.87	.38
13.0	11.0	2.0	.84	.18
6.5	3.5	2.4	.55	.86
9.0	5.0	4.3	.64	.70
8.0	5.8	4.2	.72	.72
12.0	8.5	6.5	.76	.76
11.0	7.0	5.5	.63	.78
7.0	6.5	4.0	.92	.51
6.5	6.0	2.0	.92	.33
7.5	4.0	2.8	.53	.96
8.0	7.5	2.0	.93	.26
11.0	7.5	5.5	.68	.73
8.0	6.0	3.0	.75	.50
9.5	5.5	3.0	.57	.54
12.0	6.0	2.0	.50	.33
5.5	5.0	2.0	.72	.50
10.0	4.5	4.0	.60	.66
11.0	8.0	2.2	.50	.40
7.5	7.0	2.5	.53	.62
7.2	6.5	4.0	.63	.89
11.0	6.0	4.8	.72	.60
8.0	5.5	3.6	.88	.51
14.0	6.5	2.8	.40	.43
8.5	6.0	2.6	.70	.43
11.0	5.5	3.0	.50	.54
9.0	4.5	2.7	.50	.60
8.5	5.8	2.6	.68	.44
12.5	6.0	3.1	.50	.50
10.5	8.5	4.5	.80	.52
10.5	4.5	2.5	.42	.55
7.0	5.6	3.2	.80	.57
7.0	5.0	2.5	.71	.50
8.0	5.0	2.5	.62	.50
12.5	8.5	4.0	.68	.47
9.5	7.0	5.0	.73	.71
13.0	9.0	7.0	.69	.77
17.0	5.8	4.0	.32	.68
15.0	9.0	2.8	.60	.31
13.5	8.0	5.0	.59	.63
9.0	7.0	5.0	.78	.71
7.0	4.5	2.8	.64	.62

Table 4

Sample T2-C

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
7.6	6.0	4.6	.85	.76
5.0	5.0	4.5	1.0	.90
11.0	7.0	5.5	.64	.78
9.0	7.1	3.0	.77	.42
5.5	4.0	2.6	.50	.65
10.0	6.0	4.5	.60	.70

Table 4

Sample T2-D

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
9.5 (cm)	9.0 (cm)	4.5 (cm)	.95	.50
13.0	11.0	7.5	.84	.68
10.0	8.0	6.5	.80	.81
13.0	9.0	5.0	.69	.56
14.5	7.5	4.2	.58	.49
11.0	8.0	8.0	.81	.88
10.5	6.8	6.0	.64	.88
14.0	10.5	8.0	.76	.76
11.0	8.0	5.3	.72	.66
11.6	8.0	7.0	.69	.87
12.0	10.0	6.2	.83	.62
15.0	8.5	4.0	.56	.47
13.0	7.0	4.0	.53	.67
17.7	9.0	6.0	.50	.66
11.0	7.5	6.0	.68	.67
9.0	8.5	5.0	.94	.58
9.0	6.0	5.0	.66	.83
10.7	6.0	3.8	.56	.63
11.0	8.9	6.1	.81	.68
11.0	6.0	4.6	.54	.78
17.3	7.3	4.6	.42	.61
11.0	8.3	6.2	.75	.74
26.0	13.0	6.0	.50	.48
10.6	6.8	3.8	.64	.56
11.9	6.8	3.0	.57	.43
11.6	9.6	5.0	.84	.52
8.5	6.4	4.4	.74	.69
10.6	6.0	3.0	.57	.50
10.0	6.8	5.1	.68	.75
8.5	7.2	2.9	.85	.40
8.5	5.6	4.6	.65	.71
6.0	5.4	2.6	.90	.48
6.6	6.1	3.3	.92	.54
19.9	11.7	4.3	.78	.36
10.7	7.4	4.7	.68	.63
7.0	4.6	3.3	.65	.71
9.0	4.5	3.8	.50	.84
8.5	5.4	4.2	.63	.77
9.5	5.1	3.5	.53	.68
12.0	6.3	2.8	.52	.46
11.4	4.7	3.2	.41	.68
8.5	4.3	3.0	.50	.69
8.3	5.0	4.0	.60	.80
10.6	8.5	3.0	.80	.35

Table 4

Sample T2-D

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
7.0	3.8	3.0	.54	.78
7.0	4.8	2.8	.68	.58
6.1	4.7	3.9	.93	.68
7.9	5.9	3.6	.72	.63
12.2	7.5	5.9	.60	.78
6.6	4.9	2.6	.74	.53

Table 4

Sample T3-A

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
8.0 (cm)	5.0 (cm)	1.4 (cm)	.62	.28
9.0	7.0	3.8	.78	.54
1.05	10.0	3.6	.95	.36
12.0	10.0	3.5	.83	.35
10.0	5.5	1.6	.57	.29
11.5	7.8	2.5	.67	.32
7.2	7.0	4.5	.97	.64
7.6	6.1	2.8	.80	.48
13.5	5.5	2.8	.42	.51
18.3	5.7	2.0	.31	.35
9.0	6.2	2.7	.69	.46
15.0	10.0	4.4	.66	.44
21.0	11.7	3.2	.56	.66
9.0	6.0	3.1	.67	.52
12.0	5.7	2.9	.48	.41
15.0	14.5	9.8	.97	.68
6.1	5.0	2.6	.81	.52
6.2	5.3	3.8	.85	.72
7.6	5.5	2.1	.72	.38
8.8	5.4	3.1	.61	.56
6.3	5.2	2.0	.83	.38
6.8	3.8	1.5	.56	.39
6.8	4.5	2.5	.66	.56
6.0	4.4	3.1	.72	.70
7.0	5.5	3.0	.79	.54
17.8	14.0	11.5	.79	.82
6.0	4.6	2.4	.77	.52
6.6	4.1	1.2	.62	.29
10.6	7.8	2.5	.74	.32
7.5	5.2	2.2	.69	.30
6.5	5.2	3.8	.82	.72
13.8	9.2	3.5	.67	.38
5.2	4.5	2.4	.87	.53
6.0	5.1	1.5	.85	.31
7.0	5.3	2.1	.75	.40
10.5	9.0	3.1	.72	.34
7.0	4.8	2.0	.69	.42
5.1	3.2	2.0	.63	.62
11.2	7.8	4.0	.70	.51
7.8	4.1	1.9	.63	.37
13.8	10.2	4.6	.74	.45
9.0	7.0	5.0	.78	.71
6.0	5.8	3.8	.97	.66
9.8	4.9	2.1	.50	.43

Table 4

Sample T3-A

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
4.2	3.8	1.5	.90	.39
8.4	5.0	4.0	.60	.80
5.5	4.5	2.2	.82	.49
6.8	5.5	1.9	.80	.36
6.0	3.5	1.5	.58	.43
6.9	6.0	4.8	.86	.80

Table 4

Sample T3-B

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
14.0 (cm)	12.0 (cm)	5.6 (cm)	.86	.47
8.0	6.5	3.0	.81	.46
14.8	10.0	5.1	.68	.57
8.7	7.5	3.7	.86	.49
15.5	7.7	2.3	.50	.29
14.5	10.6	3.8	.73	.36
8.4	6.8	5.7	.80	.83
16.8	12.0	3.8	.71	.32
17.7	8.2	3.1	.46	.37
11.3	8.7	3.5	.76	.40
13.4	6.0	3.0	.44	.50
45.0	10.3	6.5	.22	.62
14.0	12.6	6.9	.85	.54
15.5	9.0	5.2	.58	.58
10.0	7.5	4.0	.75	.53
10.0	6.8	3.2	.68	.47
16.5	11.0	4.5	.67	.41
9.5	5.0	2.1	.53	.42
8.6	6.8	3.8	.76	.56
10.4	7.5	5.8	.72	.77
7.5	5.8	2.6	.77	.45
8.6	6.4	2.0	.74	.47
8.8	7.0	3.1	.79	.44
9.1	3.8	1.9	.41	.50
8.8	7.2	2.4	.82	.33
9.5	5.1	1.8	.54	.35
14.0	9.0	3.4	.64	.37
9.6	7.0	2.5	.72	.35
8.0	4.6	1.9	.57	.41
6.5	4.5	1.8	.80	.40
7.0	3.8	1.5	.54	.38
6.0	4.5	3.5	.75	.78
13.6	8.7	7.5	.64	.86
6.0	4.6	1.6	.77	.34
14.0	7.6	5.0	.54	.66
14.2	9.1	7.9	.64	.87
8.5	3.8	1.3	.45	.34
7.1	4.1	1.0	.57	.21
5.5	4.1	2.9	.74	.71
8.0	6.0	1.5	.75	.24
9.5	5.2	2.2	.56	.42
9.6	8.3	2.3	.86	.28
8.8	7.6	3.4	.86	.44
6.5	5.2	1.6	.80	.31

Table 4

Sample T3-B

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
11.6	10.0	5.8	.86	.58
7.1	4.1	2.8	.58	.68
13.0	10.8	8.0	.83	.74
8.5	3.6	1.9	.42	.52
11.0	9.5	5.0	.86	.52
15.1	10.0	4.2	.72	.54

Table 4

Sample T3-D

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
17.1 (cm)	15.8 (cm)	7.8 (cm)	.90	.49
16.5	12.0	6.0	.72	.50
13.5	10.5	6.9	.77	.65
22.2	16.5	9.6	.74	.58
17.6	12.8	8.8	.78	.64
23.6	10.5	7.8	.44	.74
33.6	14.0	9.0	.42	.64
25.5	17.0	7.0	.57	.41
23.0	12.5	11.0	.54	.88
25.0	12.0	7.8	.50	.65
22.0	14.5	6.1	.66	.42
21.0	13.7	7.5	.62	.58
18.8	13.0	4.6	.69	.35
13.2	11.0	6.6	.83	.60
18.0	16.0	7.0	.89	.44
18.8	17.8	14.0	.96	.79
12.4	12.2	7.4	.98	.61
40.0	20.0	9.0	.50	.45
43.0	31.0	22.0	.72	.71
28.0	24.0	13.0	.86	.54
37.5	22.0	7.0	.58	.32
29.0	22.0	10.0	.76	.45
17.0	12.8	4.1	.74	.32
17.8	11.5	4.6	.65	.40
28.0	16.5	11.5	.59	.70
23.0	19.0	7.0	.83	.37
22.0	10.3	6.8	.47	.66
20.6	16.5	12.5	.78	.78
24.0	18.0	15.5	.75	.86
19.0	19.0	7.0	1.0	.36
23.0	19.6	8.0	.85	.40
19.5	14.5	8.3	.74	.57
31.5	15.5	6.0	.86	.51
17.5	15.0	7.6	.48	.39
22.5	11.6	5.8	.52	.55
17.2	9.8	3.8	.57	.59
11.7	9.5	7.0	.81	.74
19.0	13.0	7.0	.68	.54
13.8	9.8	7.6	.71	.76
17.0	13.2	5.9	.78	.45
15.3	14.2	5.2	.92	.36
20.5	10.4	9.1	.51	.85
13.6	13.0	2.5	.96	.19
13.8	10.7	8.0	.76	.75

Table 4

Sample T3-D

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
10.5	9.4	6.0	.87	.64
14.8	10.5	6.7	.72	.63
20.6	10.0	7.6	.49	.76
18.2	12.5	4.6	.69	.36
13.1	10.0	4.5	.76	.45
15.8	7.3	3.6	.46	.49

Table 4

Sample T3-C

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
19.0 (cm)	14.7 (cm)	3.0 (cm)	.77	.20
15.0	11.0	5.0	.73	.45
20.0	13.5	11.0	.68	.81
14.8	12.0	7.6	.81	.63
17.0	14.5	7.6	.85	.54
15.0	12.2	6.5	.81	.53
20.5	12.5	12.0	.61	.96
17.5	12.5	8.4	.71	.67
17.7	9.7	8.0	.55	.82
34.5	24.7	12.5	.72	.51
13.8	12.2	7.6	.88	.62
21.0	13.3	8.3	.63	.62
14.8	9.0	5.2	.61	.58
14.5	10.2	6.5	.70	.64
14.6	9.5	6.0	.65	.63
21.5	1.60	9.0	.74	.56
14.5	10.5	4.5	.73	.43
18.5	12.0	11.0	.65	.92
21.5	14.7	8.7	.69	.47
13.7	12.0	7.5	.88	.63
13.3	11.6	6.3	.87	.47
16.5	12.5	8.2	.76	.66
13.5	12.3	4.4	.91	.38
13.3	11.0	8.9	.83	.81
35.0	21.0	8.0	.60	.43
25.0	18.0	12.0	.72	.67
19.0	17.0	12.5	.89	.74
16.0	14.0	8.5	.87	.61
17.0	16.0	9.4	.94	.59
15.0	13.5	5.7	.90	.42
13.8	11.5	6.5	.83	.57
28.6	13.0	6.0	.45	.46
16.5	9.2	7.2	.56	.67
10.3	8.4	5.0	.82	.60
10.3	7.8	7.3	.76	.94
13.3	11.8	5.6	.89	.42
11.8	11.0	5.5	.93	.50
10.8	9.0	5.5	.83	.61
10.5	12.0	8.9	.97	.75
14.0	13.5	4.2	.98	.31
15.8	9.5	4.0	.60	.42
21.0	10.5	8.0	.50	.76
19.5	9.6	6.3	.49	.66
15.8	10.8	4.6	.68	.42

Table 4

Sample T3-C

Long Diameter (a)	Intermediate Diameter (b)	Short Diameter (c)	b/a	c/b
15.5	11.6	6.0	.76	.51
15.0	5.5	4.7	.43	.72
14.8	10.5	4.6	.71	.44
9.6	7.5	5.5	.78	.73
10.3	10.0	4.0	.97	.40
15.0	10.5	4.0	.70	.38

Table 5

Wind Velocity Data
August 1970 through July 1972

August 1970

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	4.7	10.9
46-90	4.8	6.8
91-135	3.5	4.7
136-180	14.8	9.1
181-225	18.0	8.6
226-270	14.8	6.4
271-315	15.7	5.9
316-360	11.0	6.4

September 1970

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	8.3	7.4
46-90	4.4	8.0
136-180	1.5	3.8
181-225	20.7	8.9
226-270	16.1	7.3
271-315	18.5	6.4
316-360	14.3	7.1

October 1970

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	13.0	11.8
46-90	8.5	9.1
91-135	4.0	7.8
136-180	11.6	10.1
181-225	14.2	7.5
226-270	11.6	5.5
271-315	11.6	6.1
316-360	14.7	8.3

Table 5

November 1970

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	12.6	10.7
46-90	17.5	7.6
91-135	6.1	6.9
136-180	8.2	7.3
181-225	6.3	11.4
226-270	8.6	5.9
271-315	15.6	6.4
316-360	16.7	7.5

December 1970

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	14.9	9.5
46-90	6.0	11.7
91-135	1.2	10.4
136-180	0.9	7.6
181-225	3.2	11.6
226-270	16.4	7.7
271-315	25.0	10.8
316-360	25.5	10.8

January 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	5.9	9.3
46-90	1.9	6.7
91-135	1.2	7.1
136-180	3.2	7.5
181-225	6.0	8.5
226-270	26.7	9.0
271-315	23.2	9.6
316-360	20.8	8.7

Table 5

February 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	10.0	9.8
46-90	5.1	9.2
91-135	5.7	7.6
136-180	8.1	9.7
181-225	13.1	9.2
226-270	19.2	9.3
271-315	22.9	8.7
316-360	9.7	7.5

March 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	7.0	14.1
46-90	5.6	10.1
91-135	3.2	9.6
136-180	6.7	7.4
181-225	13.7	10.3
226-270	12.9	10.9
271-315	21.9	10.9
316-360	15.2	9.6

April 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	11.2	11.0
46-90	8.9	10.1
91-135	1.9	6.0
136-180	6.9	9.6
181-225	14.4	9.0
226-270	8.2	7.7
271-315	17.9	10.7
316-360	20.0	10.1

Table 5

May 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	15.4	10.6
46-90	5.8	7.0
91-135	2.1	7.0
136-180	11.5	9.1
181-225	20.3	9.4
226-270	18.6	9.8
271-315	6.3	8.9
316-360	13.2	8.6

June 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	6.3	7.2
46-90	13.9	8.1
91-135	2.1	4.5
136-180	11.0	8.5
181-225	17.2	9.1
226-270	24.9	8.0
271-315	7.1	5.7
316-360	7.6	6.1

July 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	3.6	8.7
46-90	2.5	7.4
91-135	1.3	5.0
136-180	11.2	8.9
181-225	18.8	9.0
226-270	20.7	9.1
271-315	8.2	6.3
316-360	6.9	7.0

Table 5

August 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	6.1	8.7
46-90	5.2	7.3
91-135	1.6	5.0
136-180	7.0	8.9
181-225	14.5	9.0
226-270	24.9	9.1
271-315	15.0	6.2
316-360	9.5	7.0

September 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	12.1	7.4
46-90	7.2	6.3
91-135	5.7	5.7
136-180	13.9	6.4
181-225	15.1	8.1
226-270	21.7	6.9
271-315	14.1	4.4
316-360	9.7	5.5

October 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	11.9	9.1
46-90	13.6	8.4
91-135	1.6	6.0
136-180	12.5	8.1
181-225	13.6	7.0
226-270	18.7	5.7
271-315	8.6	5.7
316-360	4.6	5.0

Table 5

November 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	11.2	10.2
46-90	7.1	8.5
91-135	6.3	7.0
136-180	9.0	5.2
181-225	12.3	11.1
226-270	11.9	6.3
271-315	14.8	7.0
316-360	16.2	7.8

December 1971

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	8.7	9.4
46-90	5.8	6.2
91-135	2.7	6.9
136-180	3.8	6.3
181-225	7.5	11.5
226-270	18.1	8.1
271-315	16.3	10.3
316-360	25.1	9.1

January 1972

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	7.1	6.4
46-90	1.6	7.0
91-135	0.8	5.3
136-180	3.6	10.3
181-225	8.4	9.9
226-270	21.8	8.0
271-315	18.8	8.5
316-360	20.7	8.8

Table 5

February 1972

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	11.9	8.0
46-90	10.8	13.5
91-135	2.2	15.5
136-180	3.3	9.7
181-225	7.6	9.6
226-270	16.4	9.4
171-315	19.7	10.6
316-360	18.5	10.3

March 1972

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	13.6	10.8
46-90	10.9	8.4
91-135	2.1	10.7
136-180	9.1	10.3
181-225	15.1	12.7
226-270	9.8	9.6
271-315	14.7	11.0
316-360	20.2	9.7

April 1972

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	13.3	8.9
46-90	5.3	5.8
91-135	3.8	4.4
136-180	10.3	7.3
181-225	9.6	8.3
226-270	11.7	6.5
271-315	15.9	7.6
316-360	18.0	8.0

Table 5

May 1972

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	16.9	11.2
46-90	9.0	10.4
91-135	2.2	3.7
136-180	17.4	8.6
181-225	21.4	9.1
226-270	9.5	9.1
271-315	5.1	5.4
316-360	5.6	7.9

June 1972

Direction (degrees)	Occurrence (%)	Average Speed (M.P.H.)
1-45	5.3	7.4
46-90	7.1	7.9
91-135	4.3	11.2
136-180	20.8	9.9
181-225	30.4	10.3
226-270	17.4	8.2
271-315	4.7	6.7
316-360	5.0	11.4