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SURVEY OF OCEANOGRAPHIC AND METEOROLOGICAL PARAMETERS OF IMPORTANCE TO THE SITE SELECTION OF AN OCEAN FOOD AND ENERGY FARM (OFEF) IN THE EASTERN PACIFIC

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Selection candidate Phase 1 OFEF and future farm sites are given after a thorough review of pertinent data and literature. It is determined that within the area studied, the southern California offshore region from approximately $32^{\circ}30'N$ to $34^{\circ}30'N$ is best suited for siting preliminary Ocean Farms. Detailed maps and tables of currents, ocean temperatures, winds, nutrient concentrations and other parameters are presented.

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SUMMARY

OBJECTIVES

The principal objectives of this site selection project are to:

- establish preliminary site selection for an ocean food and energy farm (OFEF) based on the requirements and limitations of OFEF as delineated by the principal investigators;
- compile a digest of oceanographic and meteorological data useful to the selection of the Phase 1 and future farm sites; and
- select candidate Phase 1 sites after a thorough review of pertinent data and literature, and report these sites in order of increasing importance.

RESULTS

Site selection criteria and requirements are developed and are listed. Pertinent oceanographic and meteorological data are given in tables, figures and appendices. By comparing these criteria to the available environmental data, the southern California offshore region from 32°30'N to 34°30'N was chosen as the most suitable preliminary site for OFEF. This area has been selected as the optimal location for Phase 1, and probably for Phase 2 and early 3 as well, for the following reasons.

1. The sites chosen are within the U.S. economic zone (increased to 200 miles in March 1977), thereby avoiding possible international conflict.
2. The region has the most mild and least severe extreme weather conditions of any offshore area within the economic zone of the continental United States or Hawaii. It has a very low occurrence of high velocity winds and high waves. This is because the region is north of the tropical cyclone zone and is located on the southern extreme of the extra-tropical cyclone region.
3. In this nearshore area, nutrients of adequate concentrations are relatively near the surface (15-25 $\mu\text{g-at/liter NO}_3$ at 100 meters).
4. Research and support facilities are available close to the proposed sites.
5. The region is within the natural habitat zone of Macrocystis pyrifera. Temperature and light regions are excellent for Macrocystis growth.
6. Current speeds are mostly within the ranges specified for optimal OFEF operations and kelp growth characteristics.

RECOMMENDATIONS

It is recommended that: (i) siting of Phase 1 and probably future ocean farms be within the southern California offshore region; (ii) further research on M. Pyrifera be performed to define nutrient and temperature requirements and possible synergistic effects for better definition of potential growing sites; (iii) other worldwide geographic locales be investigated for possible future siting of OFEF's; and (iv) that thorough current surveys be conducted at final sites prior to placement of farm. This is necessary for final engineering requirements and farm configuration planning.

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INTRODUCTION

The Ocean Food and Energy Farm (OFEF) concept envisions large areas of open ocean under cultivation utilizing solar energy input and the photosynthetic process to produce high yields of marine algae. The proposed crop plant, the giant brown kelp Macrocystis pyrifera, is expected to yield in excess of 270 wet metric tons (36 dry metric tons) of harvested organic material per acre per year (Refs. 1 and 2). This material would be harvested and processed to produce methane gas, food and feed products, fertilizer, ethanol, and other organic products, many of which are currently produced from nonrenewable petroleum sources (Ref. 3). In addition, a mariculture subsystem would produce high-value finfish and shellfish products for human consumption.

The economic success of any aquaculture system is dependent on the selection of an appropriate site. Factors which must be considered in selecting potential sites include various physical, chemical, biological, economic, and geopolitical parameters.

Proper selection of a farm site requires that the needs and limitations of the total farm system be considered. Particularly important are the biological requirements of the kelp Macrocystis pyrifera and the practical engineering and economic factors which affect design of the farm substrate and artificial upwelling systems.

Biological and chemical parameters of importance to site selection include the availability and concentration of nutrients in both the near-surface mixed layer (directly available to crop) and at intermediate depths (100 to 300 meters of depth and available to the crop after artificial upwelling). Nutrient concentration and availability in combination with light intensity and temperature are among the principal factors which will determine the rate of OFEF primary productivity and therefore, economic return. Nutrient concentrations are highly variable in both location and season with the principal determining factors being the amount of wind-caused mixing, natural upwelling, and biological utilization.

The cost of the substrate system will constitute a large part of the total cost of the OFEF. The substrate therefore "represents a major investment in an ocean structure which may be vulnerable to damage during periods of storm and adverse weather conditions" (Ref. 2). Selection of a farm site which minimizes the chance for environmental damage is consequently of great importance.

The location and intensity of prevailing currents are also important; areas of high-speed currents may have to be avoided whereas weaker currents can act to remove waste materials and replenish nutrient supplies.

Other aspects important to the farm location include the amount of incident solar radiation and degree of light penetration (both vary geographically), the ocean temperature in relation to M. pyrifera tolerance, and the location and concentration of potential sources of pollution.

Economic and geopolitical considerations are briefly addressed. The location of future support and processing facilities in relation to the farm site are important economic factors. Previously claimed or disputed territorial waters will be areas of high risk until international agreements are made. Location of traditional sea lanes must be considered.

The general region of the eastern Pacific was chosen for study because of the proximity of support facilities, the positive geopolitical environment, and the need to limit the area of preliminary consideration to a manageable size.

This report discusses the site selection for one or more Phase 1 prototype farms. The summary of available environmental data presented, however, are also applicable to the selection of future Phase 2 and 3 locations. Site selection is based on criteria as developed by the principal investigators for the OFEF Project and include Dr. W. North of the California Institute of Technology and Dr. H. Wilcox and Mr. D. Murphy of the Naval Ocean Systems Center.

OFEE SITE SELECTION CRITERIA

BIOLOGICAL REQUIREMENTS/LIMITATIONS

Site selection criteria dealing with the biological requirements and limitations are summarized in Table 1.

Nutrients

Surface waters of the open ocean in temperate and tropical areas beyond coastal and upwelling influences are generally nutrient-limited to the degree that the naturally available nutrients will sustain only low levels of productivity. It has been demonstrated that nitrogen is the principal controlling nutrient in the eastern tropical Pacific (Refs. 4 and 5) and is the primary nutrient limiting growth of phytoplankton off southern California (Ref. 6).

Studies of marine macroalgae productivity as a function of nutrient concentration are few. Waite and Mitchell (Ref. 7) have demonstrated that increases in the concentration of ammonia and phosphate significantly increase the rate of carbon fixation (photosynthesis) in Ulva lactuca, a green macroalgae. In the red alga Eucheuma, periods of maximum growth coincide with maximum nutrient concentrations during periods of lowered temperatures and reduced light along the Florida coast (Ref. 8).

Jackson states in his PhD thesis that for natural kelp beds (M. pyrifera) off San Diego "the condition most limiting Macrocystis production was the low concentration of dissolved nutrients, especially nitrogenous substances, near the surface" (Ref. 9). Nitrate concentrations in the San Diego Point Loma kelp bed were generally low, less than 1 $\mu\text{g-at/liter NO}_3 - \text{N}^*$ (Ref. 9), however, during upwelling periods can go as high as 5.8 $\mu\text{g-at}$ in the near-surface (Ref. 10). There is evidence that M. pyrifera compensates for this nitrogen limitation by translocating it from depths where concentrations are significantly higher (Ref. 9). This characteristic is very significant and should be considered when designing the upwelling and distribution systems for the Ocean Farm.

Natural populations of M. pyrifera off southern California experience nitrate concentrations on the surface from near 0 $\mu\text{g-at/liter}$ to as high as 9 $\mu\text{g-at/liter NO}_3\text{-N}$, but generally less than 4 $\mu\text{g-at/liter}$. At 8-10 meters depth the concentrations are usually higher, varying from about 1 $\mu\text{g-at}$ to as high as 16 with a mean range of 2-6 $\mu\text{g-at NO}_3\text{-N}$ (Refs. 9 through 12). Nutrient concentrations are usually highest in the January to June period and lowest in late summer. Growth rates have been observed to be decidedly low when dissolved nitrogen falls below 1.0 $\mu\text{g-at/liter}$ (Ref. 13). Preliminary studies by W. North indicate that K_m for NO_3 (the concentration of nitrate at which the uptake velocity of nitrate is 1/2 maximum) is near 9.4 $\mu\text{g-at/liter}$ (Ref. 13). Optimally, the concentration of nutrients should be above the K_m for maximal productivity. An area having a 10-15 $\mu\text{g-at/liter NO}_3\text{-N}$ should yield a very high growth rate. Above this concentration the uptake rate curve levels off, therefore,

*1 $\mu\text{g-at/liter NO}_3\text{-N}$ = 14 micrograms nitrate nitrogen/liter or 14 parts per billion (ppb).

Table 1. Ocean Energy Farm: summary of site selection criteria.

BIOLOGICAL REQUIREMENTS/LIMITATIONS	
1.	20° maximum mean surface temperature
2.	a. 3–5 µg-at/liter nitrate (minimum) b. 10–15 µg-at/liter nitrate (optimal)
3.	a. 25 cm/sec (0.5 kn) current maximum OFEF ($\geq$ 25 cm/sec sustained current causes plants to approach horizontal at substrate depth) b. Optimal: 10 cm/sec (0.2 kn) c. Minimal: 4 cm/sec (0.08 kn)
ENGINEERING LIMITATIONS/REQUIREMENTS	
1.	a. 0.5-m/sec (1-kn) current at substrate depth (Phase 1 operational current) b. Maximum 1.5-m/sec sustained current design limitation
2.	a. Avoid storm-force winds (greater than 25 m/sec) (locate in area of least storm probability) b. Minimize gale-force winds (greater than 17-m/sec, 5.5-meter waves)
3.	a. Maximum significant wave height 11 meters (35 feet) (design for Phase 1 test module) b. Extreme wave height 19 meters (63 feet) (extreme design wave) c. Minimum mean wave height 1 meter (required for upwelling system) Optimal wave height 2–3 meters (for upwelling system)
ECONOMIC	
1.	Moored substrate – maximum depth 600 meters (Phase 3)
2.	Proximity to research and support facilities Phase 1: 32-kilometers maximum (2-hour transit time)
GEOPOLITICAL	
1.	Avoid traditional sea lanes and submarine transit zones
2.	Locate outside claimed economic and territorial zones (probably 320-kilometer zones will be adopted – needs international clarification)

providing the plants with greater than 15 $\mu\text{g-at-NO}_3\text{-N}$ would probably not be economical (e.g., an increase from 16 to 23 $\mu\text{g-at/liter}$ only causes an increase in uptake rate of 12 percent, Ref. 13). Minimum levels of NO_3 required for the marine farm are estimated to be between 3 and 5 $\mu\text{g-at/liter}$ (an increase in uptake rate of 400 percent is computed when NO_3 levels are increased from 1 to 5 $\mu\text{g-at/liter}$ from W. North data, Ref. 13), since average levels of NO_3 off the southern California coast at depths between 100 and 300 meters vary from 15 to 30 $\mu\text{g-at/liter}$. If the nitrate required by *M. pyrifera* is between 3 and 15 $\mu\text{g-at/liter}$, then the estimated amount of upwelled water to provide this level of nutrient to the plants is between 10 and 50 percent assuming thorough mixing of upwelled with surface waters. A very important parameter discussed by North (Ref. 13), is the percentage of surface area of kelp that is exposed to given levels of NO_3 . This factor should be considered in the design of the distribution system. If exposure area on the *M. pyrifera* can be maximized, then the concentration of NO_3 might be reduced significantly while maintaining adequate growth rates.

Temperature

In most biochemical systems, increases in temperature cause increases in chemical reaction rates to some maximal temperature level beyond which inhibition occurs. Temperature is found to be very important in modifying kelp growth rate. Comparison of elongation growth rates measured at different temperatures yield a Q_{10}^* of approximately 1.7 for *M. pyrifera* (Ref. 14). This indicates that the expected increase in frond elongation for a 10°C rise in temperature is by the factor 1.7. However, *M. pyrifera* off southern California does poorly at temperatures above 20°C , and when above 25°C the symptoms of "temperature damage" (pigment loss, brittleness, sloughing) appear in a week or less (personal communication, W. North).

Clendenning studied the effect of short-term exposures to high temperatures and found that light-saturated photosynthesis was always highest between 20° and 25°C (Ref. 15). At 30°C photosynthesis was completely inactivated within the first hour of exposure in kelp collected from depths of 15 to 20 meters, and it was partially inactivated in one hour in kelp collected from the surface canopy. In longer term experiments at 23.9°C (75°F), *M. pyrifera* showed a decrease in photosynthetic capacity after one day and severe degradation of the plant after two days (Ref. 15). *M. pyrifera* from Bahia Tortugas, Baja California, flourishes in water that reaches approximately 26°C for several weeks during late summer (W. North, personal communication). Clendenning demonstrated that the photosynthetic temperature optimum for the Turtle Bay kelp was between 25° and 30°C . These plants also exhibited a 50-percent-higher photosynthetic capacity per unit area than has been observed in local southern California kelp (Ref. 15).

Studies on the effect of temperature on *M. pyrifera* growth have not generally included nutrient measurements. In the reported cases where there has been a summer die-off of kelp, allegedly caused by higher than normal temperatures, nutrient data are

*Temperature coefficient. The increase in rate of a process (expressed as a multiple of initial rate) produced by raising the temperature 10°C .

sparse or unavailable. Warmer surface water from the south is very low in nutrients, and when there is an intrusion of this water along the southern California coast, it is possible, if not probable that the plants suffer from nutrient deficiency rather than high temperature degradation, or perhaps there is a synergistic effect. An experiment to investigate the combined nutrient and temperature effects on the growth rate of *M. pyrifera* must be completed to better define temperature and nutrient limitations and thus more accurately characterize potential ocean farm geographic ranges.

The initial sustained temperature limitation is therefore tentatively put at 20°C. Temperatures above this value appear to have a degrading effect on the kelp off southern California and this area will probably be the first source of plants for early experimental farms. The 20°C assumed limiting temperature may eventually be increased if southern (Bahia Tortugas) plants are used or if genetic manipulation in the future creates strains of greater temperature tolerance. (Note: Figure 11 shows the approximate ranges of Macrocystis if limited to 20°C and with varying amounts of surface cooling from artificial upwelling.)

Currents

The magnitude of the current field to which the proposed marine farm is exposed is of great importance to its overall success. Currents of high velocities relative to the substrate will entail high cost structures and will tend either to cause the kelp to trail horizontally at or near the depth of the substrate, thus reducing light level and productivity. In extreme conditions such currents might cause the plants to break away. In combination with high waves they could cause damage to the substrate structure itself. Conversely, a low velocity water movement is required to replenish nutrients in the vicinity of the plants and carry off waste products.

Besides major current systems, other forms of water movement are important. These include local wind-derived currents, swell and chop, internal waves, and natural and artificial upwelling. Artificial upwelling may become very important as a water movement factor in a large marine farm where the other forms may be severely diminished by the frictional characteristics of the plants (Ref. 16).

Preliminary experiments at the University of California, Santa Barbara, indicate that for tissue excised from adult Macrocystis, a maximum photosynthetic rate (ml O₂ evolved/cm² blade/hr) is observed with a water velocity of 10 cm/sec or approximately 0.2 knot (W. Wheeler, personal communication). In several as yet unpublished experiments, W. Wheeler utilized a variable flow-through system to measure the O₂ evolution from Macrocystis tissue while keeping nutrients and light levels constant. The rate of photosynthesis with no water movement was measured to be approximately 1/5 that at 10 cm/sec. At a velocity of 4 cm/sec (0.08 knot) the photosynthetic rate was 1/2 maximum. It is apparent from these experiments that some degree of water movement is required to increase nutrient availability, and thus the rate of photosynthesis, above that supported by purely diffusive processes.

The optimum current velocity recommended for the Ocean Farm is 10 cm/sec (0.2 knot). An absolute minimum sustained velocity of 4 cm/sec (0.08 knot) is recommended. These recommendations are for mean water speed past the kelp plants and are tentative until more thorough experiments can be accomplished. The important parameter is relative water speed which can be the combined result of current, swell, internal waves, and upwelling. If factors other than primary current create an adequate water flow, the site could successfully be located in an area where current velocity is reduced below the levels listed above as minimum. Some degree of water movement is necessary, however, to ensure an interchange of nutrient-depleted, high-waste-concentration water with fresh water.

At the other extreme, sustained currents of relatively high velocity can be destructive to the plants or cause them to trail horizontally, thus reducing their photosynthetic capacity by reducing available light. Currents above 25 cm/sec (0.5 knot) tend to cause mature M. pyrifera to trail towards the horizontal, approaching the depth of their substrate (W. North, personal communication). For this reason, the maximum, mean sustained relative current that can be tolerated within the marine farm is taken as 25 cm/sec.

ENGINEERING LIMITATIONS/REQUIREMENTS

The preliminary design criteria for a moored ocean farm grid system for Phase 1 and 2 farms have been delineated (Ref. 17). The wind is the principal driving force behind most environmental parameters of importance to structural integrity. Although the wind itself has a negligible effect on submerged substrates and kelp plants and is not considered in the engineering criteria, it is the driving force for both wave height and localized currents. Because wind is more frequently measured than other parameters it is discussed here and in more detail in the meteorology section. For design purposes, the maximum significant wave height (significant height defined as average height of the 1/3 highest waves) is set at 11 meters (35 feet) (the extreme wave height is set at 19 meters) and the significant period set at 12.6 seconds. The design operational current is an omnidirectional 0.5 m/sec, with a maximal total design current of 1.5 m/sec. Above 1.5 m/sec relative current the kelp plants begin to come apart (W. North, personal communication). These engineering criteria were defined after using a single cable dynamic load model with the worst case defined as the substrate at a 15-meter depth experiencing 11-meter waves with the peak load approximately 2.8 m/sec (effect of 0.5-m/sec current plus action of waves) (Ref. 17). In order to avoid maximum wave heights and currents as delineated above and in Table 1, areas considered for locating the marine farm should be as free as possible of gale-force winds (greater than 17 m/sec) and should be positioned to avoid (minimize probability of occurrence) storm-force winds (25 m/sec or greater).

At present, wave-powered pumps appear to be the most promising means of delivering high-nutrient water to the farms (Ref. 18). First estimates indicated that a minimum mean wave height of 1 meter is required to pump sufficient water to maintain desired nutrient levels. A wave height of 2 to 2.5 meters is preferred to supply enough energy to upwell the deep water needed to fertilize one acre (4000 square meters) of ocean farm with one pump utilizing a 3-meter-diameter float (Ref. 18).

ECONOMIC REQUIREMENTS

It is presently planned to have Phase 1 and 2 farms in the form of moored grids while the feasibility of dynamically positioned farms is being studied. One of the most important economic parameters when considering anchored substrates is the cost of mooring and mooring materials. It is currently not feasible to place multipoint mooring anchors and lines for large OFEF substrates below about 600 meters in depth because of the extreme rise in costs beyond that depth (H. Wilcox, personal communication). This cost factor will limit moored farms to approximately the 700-meter contour. Early experimental farms will require much smaller mooring systems and are governed by different economic pressures, allowing them to be moored at deeper depths.

A second cost factor related to site selection is the proximity of logistic and support facilities. For Phase 1 sites, a distance of approximately 32 kilometers (2-hour transit time) to support facilities is considered maximum due to the significant amount of experimental effort and support required for these early prototype farms. For future Phase 2 farms, the distance to support facilities might be increased to approximately 80 kilometers; however, there is potentially a bottom depth constraint. Phase 3 and future farms may have support facilities incorporated into the farm itself and so it may be economically feasible for the site to be three to several hundred kilometers from the final processing centers on land.

GEOPOLITICAL CONSIDERATIONS

The selection of an appropriate site must take certain geographical and political factors into account. Traditional sea lanes and submarine transit zones should be avoided to prevent navigational hazards. Until international agreements are made, the site will have to remain outside the claimed economic and territorial zones of other nations. It is probable that in the near future most of the countries of the world will claim 322-kilometer (200-mile) economic zones. Many of the countries of South and Central America have already claimed 322-kilometer economic zones; some, including Brazil and Ecuador, have claimed 322-kilometer territorial limits. Mexico has recently (effective July 1976) claimed a 322-kilometer economic zone, restricting significantly the southern areas where marine farms might be placed, at least until agreements can be made with Mexico. Dr. Arvid Pardo of USC, a convener of the Law of the Sea Conference, has strongly recommended that marine systems (such as the Food and Energy Farm) be maintained within the U.S. economic zone, which is currently 19 kilometers (12 miles), but likely will soon (March 1977) be extended to 320 kilometers, unless prior international agreements are made concerning the utilization of open ocean (unclaimed) areas (Dr. B. Anderson, personal communication).

OCEANOGRAPHIC AND METEOROLOGICAL SURVEY

The world oceans, including adjacent seas, encompass over 361 million square kilometers (139 million square miles) of surface area with a tremendous diversity of environmental conditions (Ref. 19). Because of the need in this preliminary study to limit the site survey area to a manageable size, the eastern Pacific Ocean from 50°N to 10°S latitude and from the west coast of the Americas to Hawaii (160°W longitude) was chosen (Fig. 1). This area encompasses approximately 36 million square kilometers ($14 \times 10^6 \text{ mi}^2$) or 10 percent of the world ocean (20 percent of the Pacific Ocean). This area, particularly the northeastern Pacific, is highly appropriate to study for potential ocean farm sites for several reasons, some of which are listed below.

1. Much of the area is within operating range of scientific and support facilities of personnel who have been involved in Macrocystis research and other aspects of the Ocean Farm Project.
2. The northern distribution of the genus Macrocystis, the proposed ocean farm organism, falls within this area (Fig. 2). Therefore, at least in the nearshore environment, the ecological requirements for the growth of Macrocystis are met.
3. The general oceanographic/meteorological climate in much of the survey area appears to be moderate enough to allow large open ocean farms.

The survey area was initially divided into eleven natural oceanic regions, (Ref. 20, Fig. 1, A-K) which are based on the properties of surface waters, their biology, currents, and current boundaries, rather than classical oceanic water masses which are based primarily on deep water characteristics (Ref. 19). Within these natural oceanic regions, 20 geographic areas were picked as representative portions of the whole region. These areas were then analyzed using National Oceanographic Data Center data tapes on the Naval Ocean Systems Center (NOSC) Univac 1110 computer. Temperature, salinity, density, and nutrient profiles for the representative areas were produced.

In addition, these areas were surveyed for meteorological data by the Naval Weather Service Detachment at the Environmental Data Service, National Climatic Center, Asheville, North Carolina. Other environmental parameters and informational sources were utilized to characterize the regions, to eliminate areas which were significantly beyond the defined criteria, and finally to select optimal sites.

OCEANOGRAPHY

Currents

The general current regimes (direction and mean velocities) are given for summer and winter for the north Pacific Ocean in Figs. 3 and 4, respectively. The principal current in the area of the survey is the California Current. This current has a rather poorly defined and variable southerly flow which is easily influenced by prevailing winds. The California Current starts its southerly movement at 45° to 48°N at a position where the North Pacific and Aleutian (Subarctic) Currents impact the coast. The current varies in width from about

400 kilometers (250 mi) off Washington to 720 kilometers (450 mi) off southern California (Fig. 5). The California Current turns westerly between 20° and 25°N and becomes the North Equatorial Current with mean speeds between 15 and 30 cm/sec to the longitude of Hawaii.

Overall, the California Current averages about 15 to 30 cm/sec (Figs. 3 and 4). The southward flow, particularly near the coasts (areas C and D in Fig. 5), predominates from March through September. During the months October to February the weak northward moving Davidson Current predominates near the coast. Even during the summer months, when the current is most stable, it tends to be variable. In region A the current sets directly south 23 percent of the time; all other directions average about 10 percent (Ref. 28). In region B the current becomes more consistent, setting between the southwest and southeast 48 percent of the time with little or no secondary flow. The speeds in sections A and B, as listed in Fig. 5, vary from 0.15 to 1.1 m/sec. The maximum speeds (above 0.6 m/sec) are probably somewhat high because they are mostly based on ship drift measurements on which prevailing winds can have a highly significant effect. In region C the nearshore currents are higher in velocity and more consistent than in region D.

During the winter months (November to February) the prevailing current direction in regions C and D in the California Current region (Fig. 5) shifts northward and is called the Davidson Current (Fig. 6), which can be termed more accurately the Winter Coastal Countercurrent (Ref. 28). It has a rather poorly defined variable flow dependent mainly on the influence of the wind. Figure 6 shows the boundary within which the prevailing northward flow generally occurs.

The table with Fig. 6 indicates the variability of flow by showing monthly percent frequency of observations of speed and direction. The Davidson Current is interrupted by the prevailing southerly flow of the California Current from March through the first half of October. The southern portion of the current (Fig. 6, region B) is more variable than the northern part, with sets occurring in the opposite direction (south) frequently in January and February. There is evidence that there is a permanent northward flow below 200 meters of depth running about 64 kilometers wide at speeds of about 25 cm/sec. It is probable that when northerly winds become weak or negligible in late autumn and winter, a north-setting countercurrent forms at the surface inshore of the main California Current. During this period coastal upwelling lessens (upwelling is strongest in the spring and early summer months), and numerous irregular eddies occur along the coast (Refs. 28 and 29). Nearshore currents may be influenced by coastal tidal currents (which are rotary and thus will set in all directions) and by the local winds, hence will tend to have a highly variable nature. In summary, the Davidson Current begins at about 32°N, is variable and weak in the southern section (10 to 25 cm/sec), but becomes more constant as it moves northward. In the northern section it averages slightly higher speeds (20 to 35 cm/sec) and meets the more swiftly northern-moving Alaska Current (25 to 50 cm/sec) at about 48°N.

Current profile (velocity with depth) measurements are relatively sparse. However, this type of information is extremely important to the planning and development of the ocean farm because of the need to design substrate and mooring systems to withstand current and current shear. Figure 7 gives several current profiles for the northeast Pacific

region. As can be seen in the figure, current measurements are highly diverse and vary from rather high surface speeds, 25 to 120 cm/sec, in the northern portion near the coast (profile 8-11) to the very low speed currents, less than 10 cm/sec, at 35°N (profile 14). The northern area (48° to 52°N) is the terminus of the Aleutian Current and the southeastern portion of the northward-moving Alaska Current. In locations 8 and 9 the current remains near the same velocity or increases with depth; there may be some tidal influence from the inlet north of Vancouver Island. Slightly further south the strong surface currents (greater than 1 m/sec in locations 10 and 11) are reduced to nearly 25 cm/sec by 25-meter depths. It is probable that these rather high maximum surface current speeds were wind-induced (wind velocities are not given). The measurement locations off the continental slope (locations 12, 13, and 14) are relatively low (10 to 20 cm/sec) in current speed and nearly constant with depth. In the southern portion of the California Current region the profiles show slow (5 to 15 cm/sec) surface currents that decrease in speed slowly with depth or remain roughly constant.

The need for further current time histories and depth profiles is apparent. Prior to placement of the prototype marine farm, current velocity profile measurements should be made to estimate better the probable stresses on the substrate and upwelling systems.

In the central portion of the survey area, northeast of Hawaii, a large gyre is formed during the summer from the forces of the weak easterly-moving North Pacific Current, the southerly California Current, and the relatively strong westerly-setting North Equatorial Current (25 to 50 cm/sec, 13° to 18°N). The current flow in the central gyre area is relatively slow, (5 to 15 cm/sec). The gyre tends to disappear in the winter (Fig. 4). Further to the south, the North Equatorial Countercurrent runs steadily towards the east at 25 to 50 cm/sec from about 5° to 7°N. At the point of the northward deflection of the countercurrent as it impinges on the coast of Central America, there is a redistribution of mass that is effected by divergence and crosscurrent flow thus causing an upwelling zone about 400 kilometers across (Refs. 24 and 25). This zone is termed the Costa Rica Dome and is characterized by lower near-surface temperatures and elevated nutrient concentrations (see Fig. 1).

From approximately 4°N to 1°S the high-velocity South Equatorial Current sets in a westerly direction with speeds up to 1 m/sec near the equator. The South Equatorial Current originates principally from the Peru Current, which moves up the coast of South America with a mean velocity of approximately 30 cm/sec in the region of 10°S increasing to about 45 cm/sec in the northern portion where it turns west (regions 9 and 10, Fig. 8) at about 3°S. The surface current velocity is roughly constant both seasonally and over most of its length. Slight seasonal changes are shown in Fig. 8. The current close inshore is under the nearly continuous influence of small-scale upwelling (Ref. 28). The upwelling takes place from about 130 meters from 35°S to 2°S (Ref. 29) and causes lower temperatures and increased nutrient concentrations near the coast.

Temperature

Temperature is important biologically for two principal reasons: (1) it has a stimulatory effect on the growth rate of Macrocystis as the temperature increases from low values,

and (2) it may have an inhibitory effect when the temperature rises above 20°C for northern strains of M. pyrifera (somewhat higher than 20°C for the southern, Baja California, plants). A most important parameter, in terms of selecting an Ocean Food and Energy Farm site, is the maximum temperature reached during the summer months. Figure 9 gives the mean temperature of the north Pacific for September; generally, the warmest water temperatures are observed during this month. The mean 20°C isotherm (68°F) runs eastward from the western Pacific very close to 40°N latitude to approximately 150°W where it bends southward meeting the west coast at about 32°N, just south of San Diego (Fig. 9). This southern bending of the isotherms along the west coast is caused by significantly cooler temperatures resulting from the southerly movement of the cold California Current; during some months, the effect of coastal upwelling intensifies the cooling trend. Figure 10 gives the surface thermal structure for maximum September temperatures. The thermal configuration is basically the same (as Fig. 9) except the warmer isotherms are extended further to the north. The 20°C maximum isotherm runs across the Pacific at 43°N, bends southward at 130°W, and meets the coast at about 39°N.

The selection of the Ocean Farm site, again, is dependent on the surface thermal structure, to the extent that (1) Macrocystis is temperature-limited (needs further research), (2) the degree of optimization of growth rate desired, and (3) the surface water can be cooled with artificial upwelling. Considering point (3) above, Fig. 11 shows the increment-temperature reduction of surface waters, by artificial upwelling, required to lower the mean ambient September temperature to 20°C, the estimated sustained upper temperature limit for M. pyrifera.

Figures 12 and 13 give the mean and minimum temperatures, respectively, for the north Pacific for February.

Nutrients

Most open ocean areas under consideration for the OFEF are nutrient-limited (Refs. 4, 5, and 6), given the selection criteria delineated in Table 1 (3-5 µg-at/liter nitrate minimum, 10-15 µg-at/liter optimum). Even in the nearshore environment where Macrocystis grows, the nitrogen concentration is frequently limiting (Ref. 9). It seems apparent that artificial fertilization (probably by upwelling pumps) will be necessary at most sites (Refs. 3 and 18). The geographic distribution of nutrients (both horizontally and vertically) is a very important parameter that must be considered in the OFEF site selection process. Because there is strong evidence that nitrogen is the principal macro-nutrient that is limiting to Macrocystis and because other nutrients generally occur in constant ratios to nitrogen, NO₃ is the only nutrient surveyed below.

In general, nitrate concentrations at the surface are less than 1 µg-at/liter except for certain near-coastal areas where natural upwelling occurs and two major upwelling areas, the Costa Rica Dome and equatorial upwelling zone shown in Fig. 1.

National Oceanographic Data Center data tapes were surveyed for nitrate profiles; these data are presented in Appendix A. In areas 1 through 9 and 15 (Fig. 1), NODC nutrient data were unavailable. Because nutrient data are strongly correlated with thermal structure, a

review of temperature profiles is given in Appendix B. For those areas where nutrient data are lacking, a qualitative estimate of the depth from which artificial pumping will be necessary can be made by determining the depth of the bottom of the thermocline.

The nutrient profiles in Appendix A are divided into four seasons, winter (Jan-Mar), spring (Apr-Jun), summer (Jul-Sep), and fall (Oct-Dec). Table 2 gives the depth range at which a concentration of 30 $\mu\text{g-at/liter}$ NO_3 can be expected for the survey area given. In the northern sector of the study area (area 12, Fig. 1), surface nutrients are relatively high (1-6 $\mu\text{g-at/liter}$) in the winter, probably caused by heavy wind mixing and low biological utilization. At 100 meters of depth, nitrate concentration varies from about 12 to 25 $\mu\text{g-at/liter}$, and this increases gradually to 20-35 $\mu\text{g-at/liter}$ at 300 meters of depth (Fig. A.3*). During the other seasons, particularly summer, the near-surface nitrate concentrations (upper 50 meters) are consistently low, being generally below 1 $\mu\text{g-at/liter}$. This fact is probably caused by the increased biological productivity found in the mixed surface layer

*In Figures A.3 to A.6 the reduced nitrate values (all from a single research cruise) which form an astatistical profile to the left of the main profile appear to be incorrect data and should be ignored.

Table 2. Depth range at which a concentration of 30 $\mu\text{g-at/liter}$ nitrate can be expected for seasons in the areas surveyed.

AREA ⁺	Depth in meters of 30 $\mu\text{g-at/liter}$			
	WINTER	SPRING	SUMMER	FALL
1-9	200-300	200-300	200-300	200-300
10	N	250-350	N	N
11	N	150-250	N	N
12	100-200	100-250	150-300	100-250
13	*450	N	N	N
14	*325	*500	*475	N
15	N	N	N	N
16	*325-450	*500	*475	N
17	100	N	N	N
18	N	*250-300	N	N
19	100-500	120->500	100->500	>300
20	225-350	200->500	100->500	250-350

* Data sparse

N Data not available

+ Areas defined in Fig. 1.

(Ref. 31). As the mixed layer increases in depth, the maximum concentration of phytoplankton (microalgae) gradually deepens, leaving a zone of nitrate-deficient water between it and the upper pycnocline.* North of 45°N, nitrate remains at relatively high concentrations throughout the year. South of 45°N, nitrate is present at the surface during winter and late fall but becomes depleted in spring and summer. The maintenance of relatively high concentrations of nitrate north of 45°N is attributed to relatively intensive entrainment of deep water into the upper zone coupled with a slow rate of removal of nutrients by primary producers (Ref. 31).

For areas south of 40°N in the eastern Pacific Ocean there have been two major surveys of nutrient and other oceanographic parameters. The California Cooperative Oceanic Fisheries Investigation Program (CALCOFI) has been studying oceanic properties on the California Current region from approximately 40°N to 20°N since 1950 and the Eastern Tropical Pacific (EASTROPAC) cruises were fielded during 1967 and 1968 to survey the tropical and subtropical eastern Pacific from about 25°N to 20°S and from the coast west to 130°W.

Near-surface nutrient concentrations from 40°N to about 35°N tend to be low during spring and summer but with slightly higher concentrations in the winter. Concentrations of 30 $\mu\text{g-at NO}_3\text{-N/liter}$ are generally located between 150 and 300 meters of depth. Figure A.2 shows nitrate levels increasing rapidly from near 0 $\mu\text{g-at/liter}$ at about 50 meters of depth to 20-25 $\mu\text{g-at NO}_3\text{/liter}$ at 200 meters in area 11.

South of 35°N, near-surface NO_3 concentrations tend to be very low, 0.1 $\mu\text{g-at/liter}$ or less. Figures 14-17 (from CALOFI Atlas, Ref. 32) show the nitrate concentrations at 10 meters for the four seasons. Near-shore concentrations can be very high in certain areas along the Baja California and California coasts during the spring and summer upwelling periods. Concentrations as high as 16 $\mu\text{g-at/liter NO}_3\text{-N}$ are observed at Pt. Eugenia, 27° 30'N and Pt. Antonia, 30°N, both in Baja California; and at California's Pt. Conception, 34°30'N (Fig. 15, Ref. 32). Relatively high concentrations are observed off San Francisco in the fall (Fig. 17). South of 35°N, nitrate concentrations at distances greater than 8 kilometers off the coast are consistently low. Figures 18 through 21 show the seasonal concentration of NO_3 at 100 meters of depth.

Seasonal variations are not as apparent as areal trends. Nitrate concentrations at 100 meters of depth decrease from approximately 25 $\mu\text{g-at/liter}$ at 35°N near the coast to about 5 $\mu\text{g-at/liter}$ at 35°N but 240 to 300 kilometers farther west. To the south there is also a trend of generally decreasing nitrate concentrations but with higher values at greater depths. Figure A.1 shows three profiles for spring in area 10 (Fig. 1) taken in the vicinity of 27°N, 117°W. The nitrate concentration is at undetectable concentrations down to about 50 meters of depth, but then the concentration rapidly increases to between 7 and 22 $\mu\text{g-at/liter}$ at 100 meters of depth and 30 $\mu\text{g-at/liter}$ between 250 and 350 meters (Table 2).

*Vertical zone of maximum density gradient; usually corresponds with the thermocline.

Areas further to the west (region 13, in the north Pacific gyral water, Fig. 1) show low surface concentrations which increase to 30 $\mu\text{g-at/liter}$ $\text{NO}_3\text{-N}$ at near 450 meters of depth. From limited data, there appears to be a seasonal near-surface increase of concentration from winter to summer (Figs. A.7 to A.9) to a value of approximately 1 $\mu\text{g-at}$ in the spring and summer.

In Hawaiian offshore waters (area 14, Pacific north equatorial region, Fig. 1), near-surface nitrate concentrations are again low (less than 0.5 $\mu\text{g-at/liter}$) and do not reach 30 $\mu\text{g-at/liter}$ levels until a depth of between 325 and 500 meters is reached (Figs. A.10 to A.12). Average nitrate levels for Hawaiian offshore waters are given in Table 3. There is little upwelling in the Hawaiian area except in some very localized near-shore sites; overall the area can be considered nutrient-limited.

In area 18, the western extreme of California water (Fig. 1), nutrient values are low in the upper 100 meters (less than 0.2 $\mu\text{g-at/liter}$) (Figs. B.54 through B.61). Nitrate levels of 30 $\mu\text{g-at/liter}$ are reached at approximately 300 meters of depth. Further to the south (3°N to 15°N) in the North Equatorial Countercurrent region (region 17, Fig. 1), nutrient concentrations are again low in the upper 50 meters, but rise rapidly to between 15 and 25 $\mu\text{g-at}$ $\text{NO}_3\text{/liter}$ at 100 meters of depth. Below 100 meters, the concentration remains relatively constant, approaching 30 $\mu\text{g-at/liter}$ at 250-300 meters of depth but in some measurements not going above 20 to 25 $\mu\text{g-at/liter}$ at depths of 350 meters (Fig. A.13). In this area, therefore, little would be apparently accomplished by upwelling water artificially from deeper than 150 meters.

Further to the east, (area 19 in the southern portion of the west Mexican water), surface concentrations are low to about 30 meters of depth (Figs. A.16 to A.19). There are a few high surface values (between 2 and 7 $\mu\text{g-at}$ $\text{NO}_3\text{/liter}$) during the winter (Fig. A.16), a phenomenon which might be caused by local wind-induced upwelling. Below 30 to 50 meters there is a very rapid increase in concentration which reaches 20-25 $\mu\text{g-at/liter}$ at a depth of 100 meters. A nitrate concentration of 30 $\mu\text{g-at/liter}$ is reached between 100 and 500 meters. Nitrate concentrations are generally directly related to the temperature profile (thermocline). Nutrient concentration increases rapidly near the base of the thermocline.

Table 3. Average nitrate concentration for Hawaiian offshore waters (Ref. 33).

DEPTH (m)	$\text{NO}_3\text{-N}$ ($\mu\text{g-at/liter}$)
0	0.05
100	0.08
200	2.18
300	11.90
400	23.92
500	33.03
600	34.77

For example, during the fall in area 19, the thermocline is between 30 and 90 meters of depth (Fig. B.77) and the nitrate concentration rapidly increases over this range (Fig. A.18).

Area 20 in the Peru-Galapagos water (Fig. 1) is in the equatorial region (2°S to 3°N) west of the Galapagos Islands. This is an area of intense natural upwelling caused by a strong divergence at the equator which acts to bring water of low temperature and high nutrient concentration to the surface (Ref. 29). Figures 22 through 25 show nitrate-nitrogen levels for winter and summer at a depth of 10 and 100 meters for a major portion of the eastern tropical Pacific (Ref. 22). Ten-meter nitrate concentrations are highly elevated, averaging between $8\text{ }\mu\text{g-at NO}_3/\text{liter}$ (winter, Fig. 22) and $10\text{ }\mu\text{g-at/liter}$ (summer, Fig. 23). The equatorial upwelling region extends from the Peruvian and Ecuadorian coasts (from about 12°S to the equator) and in the westerly direction to at least 150°W (Figs. 1, 22, and 23). In region 20, 100-meter nitrate levels average from 15 to $25\text{ }\mu\text{g-at/liter}$ for winter (Fig. 24) and summer (Fig. 25). Concentrations as high as $40\text{ }\mu\text{g-at/liter}$ are observed southeast of the Galapagos ($8^{\circ}\text{N } 86^{\circ}\text{W}$) during the winter months (Fig. 24). Figures A.20 through A.24 give nitrate concentration profiles for area 20 for the four seasons. Surface concentrations are variable but high (maximum of $14\text{ }\mu\text{g-at/liter}$ in summer, Fig. A.21). Because of the upwelling, surface temperatures are significantly depressed (Figs. 9 and 10); during the summer and fall mean temperatures are 6° to 7°C lower in region 20 than in region 19 (Appendices B and C). Reduced temperatures and increased nutrients in the natural upwelling zones would, of course, allow for much reduced artificial upwelling rates and possibly eliminate the need for upwelling completely.

In summary, nutrient concentrations in the surface waters of the eastern Pacific Ocean are highly variable. Concentrations of nitrate-nitrogen are usually higher over the continental shelf because of localized upwelling and increased nutrient input from terrestrial runoff. Generally, nitrate concentration decreases in a westerly direction and the isonutrient depths increase. For example, in regions 1 through 9 the $30\text{ }\mu\text{g-at/liter NO}_3$ depth is between 200 and 300 meters, in region 18 it is 250-300 meters, and near Hawaii (region 14) it is 325-500 meters. The trend is similar from north to south; there are higher surface concentrations seasonally north of 35°N . In more temperate waters (south of 35°N to about 3°N) surface concentrations of nitrate are generally below $1\text{ }\mu\text{g-at/liter}$ and frequently below the level of detection. In the Costa Rica Dome and equatorial upwelling regions, surface nitrate levels run as high as 8 to $10\text{ }\mu\text{g-at/liter}$ and reach levels of 20 to $25\text{ }\mu\text{g-at/liter}$ in the upper 100 meters.

METEOROLOGY

The meteorological parameters of greatest significance to OFEF, probably are wind velocity and duration. Severe storms with high velocity winds cause high waves and increased current speeds, which in turn can create increased stresses on substrate structures and kelp plants. Because wave heights and periods are related to wind speed, wind and storm characteristics are considered in this section. The ocean, as a liquid medium, is greatly influenced by severe storms, and siting of an OFEF in an area of minimal storm activity is more than likely important for its economic success and survival. It is probable that future technology will allow placement of the farm in areas of high-storm frequency but the resulting higher costs may dictate selection of areas of low-storm frequency and severity.

Tropical and Extratropical Cyclones

Tropical cyclones develop in the vicinity of 15° to 20° N and near 20° S latitude. In the northern hemisphere, tropical storms and hurricanes evolve from tropical cyclones which have grown from low level disturbances originating in the intertropical convergence zone (ICZ), an area where northeast and southwest trade winds meet (5° to 10° N). Figure 26 gives the average number of cyclones per 5-degree square per year, and the principal season for storm activity is also given for each region. Large areas off the east coast of the United States and the east coast of Asia, Australia, India, and Madagascar are characterized by relatively frequent tropical cyclones. Off the east coast of the U. S. there is at least one tropical cyclone per year per 5-degree square as far north as 42° (Fig. 26), due in part to the influence of the warm, northerly moving Gulf Stream. In the area of study (eastern Pacific), the region of cyclone frequency greater than or equal to one per year per 5-degree square only extends to 27° N because of the cooler California Current water moving south. The greatest frequency of cyclones, however, is in the eastern tropical Pacific, where it reaches a mean of six per year per 5-degree square in the vicinity of 16° N, 110° W (Fig. 26, Ref. 34). In the eastern Pacific, tropical cyclones generally occur in the period June through October, with the greatest frequency occurring during September.

The various stages of tropical cyclones, as well as other meteorological data, are given in Appendix D. Figure D.1 shows the areal distribution plus frequency and speed statistics for cyclonic winds of 18 m/sec (34 knot) or greater (gale-force winds) for 5-degree squares in the northeastern Pacific. During the 22-year period of record, there was only a single tropical cyclone in the vicinity of San Diego (4 percent probability of occurrence) whereas in the square 15° to 20° N and 105° to 110° W there were 106 such cyclones. The frequency and distribution of tropical storms (with winds of 25-32 m/sec or 48-63 knots) and hurricanes (winds ≥ 33 m/sec) are given in Figs. D.2 and D.3, respectively.

Figure 27 shows the maximum extent and mean tracks of both tropical and extratropical cyclones for the northeastern Pacific. Most tropical cyclones originating southwest of the area of maximal cyclone frequency (indicated by crosshatched line) move west-northwestward and reach as far as 180° . The maximum northerly extent of tropical storms with winds of 18 m/sec or greater is approximately 35° N. Hurricane-force storms (winds ≥ 33 m/sec, in the period of record) have not extended beyond 30° N (322 kilometers south of San Diego) and have reached the southern portion of the Hawaiian Islands (Fig. 27).

During autumn and early winter the cooling of the Asiatic continent and adjacent seas strengthens the surface temperature gradients and the polar front. This cooling trend and an intensification of the jet stream aloft leads to more frequent formation and greater development of extratropical cyclones.

The usual extratropical cyclone track is east to southeast (Fig. 27). The Gulf of Alaska is frequented by more extratropical cyclones than any other region of the north Pacific. Their maximum frequency and intensity is attained during early and middle winter. Off the west coast there are fewer than one extratropical cyclone per 5-degree square (during February) south of approximately 44° N. The intensity of extratropical cyclones

decreases in a southerly direction. The maximum southerly range of extratropical cyclones (with winds of ≥ 18 m/sec) is about 31°N .

Winds

Tropical and extratropical cyclone intensities are reflected in surface-wind velocities. In the northern portion of the survey area maximal surface winds occur in November and December and generally blow from the southwest. Figures D.4 through D.7 give wind data for the northern portion of the survey area and show percent frequency of wind speed and direction for 5-degree squares for four months representative of seasonal wind characteristics; January, April, July, and November, respectively. During November and December in the area between 40° and 50°N the frequency of gale-force winds (≥ 14 m/sec) can be as high as 30 to 35 percent. Figure 28 shows the percent of surface winds of Beaufort force ≤ 3 (5 m/sec) and ≥ 8 (17 m/sec) in the northern portion of the survey area.

For November there is a broad region of maximum frequency of strong winds where greater than 5 percent of the time winds of ≥ 18 m/sec were observed north of approximately 40°N . These frequencies decrease to the south. Conversely, light winds (≤ 5 m/sec) are most frequent nearshore with decreasing percentage frequencies to the north and west. The area of maximum frequency of light winds and minimum frequency of gale-force winds is off southern California and northern Baja California (30° - 35°N), where light winds prevail 50-60 percent of the time (Fig. 28). Light winds also prevail along the coast of Canada throughout most of the year.

Mid- and late-winter bring a gradual reduction in mean surface wind speed and cyclone frequency. By February, average wind speeds are generally lower (9-10 m/sec) in the northern and central portion of Fig. 28. There is a general decline in average speeds toward the annual minimum in July or August. Minimum average speeds in most of the quadrangles vary between 4.9 and 6 m/sec during the summer months, with some increase occurring in the southeast section, south of 40°N . The reversal of climatic trends initiated over the northern part of the area during the latter part of August spreads rapidly and causes a marked increase of wind speeds and frequency of gales to nearly all of the area except the southeast corner.

In the southern portion of the survey area, wind speeds are generally less than those in the northern portion. The trade winds derived from the north and south Pacific subtropical high-pressure centers are the predominant factor in the area 30°N to the equator. Figures D.8 to D.11 give the percent frequency of wind speed and direction for the southern portion of the survey area. The trades are exceptionally steady winds, come from the northeast in all seasons, and overlie the region extending from 30°N to the intertropical convergence zone (ICZ) at approximately 10°N . Mean trade wind speed is nearly 8 m/sec. South of this region, the southeast trade winds predominate, intersecting with the northeast trades at the ICZ. Figure 29 gives the percent frequency of winds Beaufort force ≤ 3 (5 m/sec) and ≥ 8 (18 m/sec) for February and August.

In the coastal areas north of 10°N , intrusions of air from the Caribbean and the Gulf of Mexico are common. The more than 1 percent frequency of gales (Beaufort force 8) off

southern Mexico and Guatemala in February are caused by northerly winds from the Caribbean. There are large regions in the southeastern portion of the area where there is greater than 80 percent frequency of winds equal to or less than 5 m/sec. This and other areas where there are a high percentage of light winds are generally out of the major influence of the trade winds. In the areas where trade winds are strong, light winds usually represent only 10 to 30 percent of the total. Although high velocity winds are not common to most of the area, hurricane-force winds (≥ 33 m/sec) caused by strong tropical cyclones have been reported as far north as 30°N (once in 6 years) and more frequently south of Baja California in the vicinity of 20°N , 115°W (12 times in six years) and to the west towards Hawaii (Figures C.5 through C.8). Wind velocities in these areas in excess of 50 m/sec have been reported (62 m/sec winds were measured in Hurricane Maggie, 480 kilometers south of Baja California in 1974, Ref. 44). Strong local winds are frequent during the winter in the Gulf of Tehuantepec and along the Central American coast (17°N to 8°N). These winds reach gale strength during periods of high pressure over the Caribbean and Gulf of Mexico. Local nearshore gale-force winds associated with violent thunderstorms are relatively common along the west coast of Mexico and Central America during the summer months.

Figure 30 gives a summary of environmental data for the central northeast Pacific, including percent frequency of wind velocity ≥ 17 m/sec for two Ocean Weather Stations (OWS N, 30°N , 140°W , and OWS P, 50°N , 145°W) and four quadrangles in between. The value of the OWS data is that the weather observation ships were continuously manned by professional observers for over twenty years (including periods of severe weather). Other data sources are usually from ships of opportunity and have a fair weather bias because most ships tend to avoid bad weather (Ref. 27). It is apparent from Fig. 30 that there is a marked reduction in frequency of gale-force winds from OWS P south to OWS N. At OWS P gale-force winds occur more than 10 percent of the time during January through March and October through December. The peak months are November and December where gale-force winds blow over 20 percent of the time. At OWS N, winds of greater than 17 m/sec occur near 1 percent of the time in January, February, and December and occur rarely, if ever, between June and September. Areas 1 through 4 show intermediate frequency structures. Figures 31 and 32 are monthly persistence graphs of gale-force winds for OWS N and P. These graphs depict the cumulative percent frequency of hours of duration of the event (winds ≥ 17 m/sec) equal to or less than the number of hours intersected by the solid curve; and also depict days interval between events equal to or less than the number of days intersected by the broken curve.

At OWS N winds of 17 m/sec or greater are of short duration, and there is generally a long period of time between the events. There are very few winds of high velocity during May and October. At OWS P, winds of 17 m/sec or greater are not uncommon during any month; the longest duration of event and shortest period between events occurs January through April and September through December (Fig. 32). Persistence graphs of low-velocity winds (≥ 2.5 m/sec) will give an estimate of total wind energy available if wind powered energy sources are considered for upwelling apparatus. Figures 33 and 34 present persistence graphs for winds ≥ 2.5 m/sec for OWS N and P, respectively.

In summary, the most severe persistent winds are in the northern portion of the survey area and frequently are associated with extratropical storms in the fall and winter.

High-wind velocities are not uncommon north of 35°N but decrease significantly in frequency in southern California waters. The southern region of the area has steady, predominate trade winds averaging 5 to 10 m/sec, blowing from the northeast in latitudes 5° to 25°N and from the southeast 10°S to 5°N. Occasional high-velocity winds associated with local activity or tropical cyclones are observed along the coasts of Central America and Mexico. Other areas, particularly the northern Baja and southern California coast at latitudes 20° to 35°N, have very low-velocity winds (only rarely do they increase above 17 m/sec).

Wind-Generated Ocean Waves

Ocean waves are considered here as part of the meteorological data because nearly all near-surface waves are wind-generated and are directly related to wind velocity and duration. An exception would be the extremely rare tidal waves (tsunamis) generated by seismic disturbances or volcanic eruptions. Quantitative values for wave height (the vertical distance between a wave crest and the preceding trough) and period (length of time between successive crests) have been established as a function of wind speed, fetch (distance which the wind has blown over water), duration of the wind, and decay distance (distance the waves have progressed from the area of generation). Although ocean waves are generated as a direct result of wind action, other variables such as currents, bottom topography, and local winds affect their magnitude and direction.

Wave data are generally observed as either “sea” (waves generated by local winds) or “swell” (waves which travel beyond their source regions). The observed wave height is usually termed the “significant height” and is defined as the average value of the highest one third of all waves observed in a given wave train. “Extreme waves” are quite rare and occur when two or more very high waves come together in constructive phase. Extreme wave heights are discussed in the Extreme Meteorological Data Section and are defined by Thom (Ref. 37):

$$\text{Extreme Wave Height} = 1.8 \times \text{Significant Wave Height.}$$

Figure 35 gives an empirically-derived curve of sustained wind speed versus significant wave height for increasing and decreasing wind regimes. The figure indicates that for decreasing winds the significant wave height will generally be higher because of the longer period of time that the wind has blown. The right side of Fig. 35 thus demonstrates a “fully arisen” sea (the total energy possible from a wind has been translated to wave energy). This figure can be used to derive approximate values of significant wave heights from the wind data given in the previous section.

Wave period is highly important as an engineering consideration because it controls the depths reached by given fractions of the wave motion (amplitude and velocity). Figure 36 shows the attenuation of wave motion with depth given the period of the wave. For example, the motion of a wave with a 6-second period is 50 percent attenuated at about 4.5 meters of depth and becomes insignificant (4 percent of surface wave energy remaining) at 26 meters, while a 12-second wave is 50 percent attenuated at 23 meters and becomes insignificant at 110 meters. (Note: Wave-induced drag forces scale with the square of the wave motion.)

Figures 37 to 40 give percent frequency of wave height, period, and wave direction for winter (Jan-Mar), spring (Apr-Jun), summer (Jul-Sep), and fall (Oct-Dec), respectively, for the northern sector (30° to 45° N) of the survey area. During the winter months the frequency of high seas (≥ 3.7 meters) increases from south to north and from east to west, showing a maximum of 15 percent in the northwest and a minimum of about 2 percent off southern California. The prevailing southwest to west winds, reflecting the steep pressure gradient between the Aleutian low and the north Pacific high, generate high frequencies (>50 percent) of seas 1.5 meters or higher in the west. These decrease substantially towards the east.

During May, seas of 1.5 meters or higher are at a maximum frequency (near 50 percent) at 30° to 35° N and 120° to 130° W. The summer months represent the period of lowest sea state for the entire area. However, the winter trend is reversed; the wave heights tend to increase slightly toward the east with the area of maximum frequency of 1.5 meters or greater seas being located about 35° to 40° N and 125° to 130° W. Waves of 3.7 meters or higher are observed with frequencies of 2 percent or less in all areas. During the fall, the sea state begins to increase toward winter values.

Wave heights of at least 1 meter will probably be necessary for wave-powered pumps of economical size. Figures 41 and 42 give persistence graphs for wave heights of 1 meter or greater at OWS N and P, respectively (see Fig. 30 for map). They give percent frequencies of the duration of events and days interval between events. At both weather stations there is a maximum of approximately 5 days between events (100 percent of the waves ≥ 1 meter were followed by another such condition within 5 days).

The median duration of waves ≥ 1 meter is about 50 hours in the summer and over 200 hours in the winter at OWS N, and 24 hours both summer and winter for OWS P. Figures 43 and 44 give persistence graphs for high seas (≥ 5 meters) for OWS N and P, respectively. At OWS N waves ≥ 5 meters are rare or nonexistent during May through September. The rare occurrence in August is probably due to occasional tropical cyclones. During fall and winter the median duration of high seas is between 6 and 12 hours and the median interval is between 8 and 16 days. For OWS P, high seas are more frequent, with the median duration being similar (6-12 hours), but the median interval is reduced to 1 to 2 days in winter or fall and 40 to 48 days in summer (June, July).

In the southern portion of the survey area sea and swell are caused by the northeast trade winds. During winter and fall these winds blow from 5° to 25° N and during spring and summer they blow from 10° to 30° N. Southeast trades are important in producing sea and swell in the southeast section during spring and summer.

The frequency of seas greater than or equal to 1.5 meters in height is generally greater in the western portion of the survey area because of the long northeast fetch. Figures 45 and 46 give the percent frequency of wave height, period, and direction characteristics for winter and summer for the southern portion of the survey area from 30° N to 0° . During the winter and spring, seas are normally from the northeast. South of 5° N the seas are generally from the southeast to east because of the southeast trades. The seas become calmer as the coast is approached, with the southeast being the calmest portion due to the short

northeast fetch; about 10 percent of the waves are ≥ 1.5 meters as compared to 60 percent in the northwest corner (Fig. 45). High seas, 3.7 meters or greater, occur less frequently in the southwest than throughout most of the northern section. They occur generally less than 2 percent of the time but approach 10 percent in two quadrats (10° to 20° N, 120° to 130° W and 20° to 30° N, 130° to 140° W). Summer gives the most northerly advance of the southeast trades, to 10° N. Frequency of 1.5-meter or greater seas varies from a maximum of about 45 percent in the northwest to a minimum of 15 percent in the southeast. Seas of 3.7 meters are rare in the 20° to 30° N region but are slightly more common in the 10° to 20° N region due to the tropical cyclones (Fig. 46) which occasionally occur in that region.

In summary, sea states are generally higher at points further from the coast (west) and at the higher latitudes (north). Fall and winter show the highest seas, and summer is the calmest season except for occasional tropical cyclones through the southeastern section.

Summary of Meteorological Data

Wind and wave data for the survey area were requested from the Naval Weather Service Detachment, National Climatic Center, Asheville, North Carolina. Table 4 is a summary of these data and presents monthly mean and 99.5 percentile wind speeds and wave heights, the percentile of 18 m/sec winds, and an annual wave period distribution. Events of 99.5 percentile indicate that 0.5 percent of the time (3.5 hours/month), during any given month, the event will occur at or greater than the level indicated. The areas of the meteorological survey are shown in Fig. 47. The areas delineated are equivalent to those oceanographic survey quadrats in Fig. 1 as indicated by the number in the lower right hand corner of each area. Areas 5 and 6 have the lowest mean wind velocities (3 to 5 m/sec in winter and 4 to 6 m/sec in summer) and have maximum wind velocities during summer of 19 and 14 m/sec, respectively. Area 5 is subject to tropical cyclones during late summer and early fall, which explains the elevated summer velocities. Area 4 has the highest mean (6-8 m/sec) and 99.5 percentile (19-26 m/sec) wind velocities. This represents the area north of Point Conception to 45° N. The high winter maximums (23-26 m/sec) represent the southerly extension of extratropical cyclones. Areas 1, 2, and 3 are similar, averaging between 5 and 8 m/sec winds with maximum winds (99.5 percent) varying between 13 and 18 m/sec. These winds are relatively constant because they are in the northeast trade wind zone.

Mean wave heights are rather constant in all the areas surveyed varying between 1 and 1.5 meters. Maximum waves vary significantly; the highest seas are in the north (area 4, varying between 4.5 meters in the summer and 8 meters in January) and in the west (4 to 7.5 meters), due to the long fetch of the northeast trades. All the other areas have lower maximum sea states which vary between 3 and 5 meters at the 99.5-percent level.

Table 4. Summary of mean and 99.5 percentile wind and wave data for the eastern Pacific.
(1 knot $\approx$ 0.5 m/sec)

(Data from the Naval Weather Service, Environmental Detachment, National Climatic Center,
Asheville, NC)

NOTES

1. Values of the mean and 99.5 percentile of wind speed (knots) and wave height (meters) are presented for all months. Wave height is the greater of sea and swell when both are reported. Otherwise it is the reported value of sea or swell. A distribution of the annual percent frequency of wave period (seconds) by specified groups is also provided.

2. Observations in TDF-11 are primarily from ships-in-passage. These ships tend to avoid areas of known "heavy weather" (i.e., strong winds and high seas). Radio communications and optimum track ship routing have produced a "fair weather bias" (i.e., a decrease in the frequency of heavy weather observations) in this data file.

Area 1; 15-20°N, 145-155°W.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
mean wind speed (kts)	13	14	14	13	13	13	14	14	13	12	14	15
99.5 percentile	35	35	31	31	28	27	27	28	26	29	35	35
Wind speeds of 34 knots were in the 99.9 percentile.												
mean wave height (m)	1.5	1.5	1.5	1.5	1.5	1	1	1	1	1	1.5	1.5
99.5 percentile	7.5	6	5.5	4.5	4.5	4	4	3.5	3.5	4.5	5.5	6.5
Wave period distribution (annual): (<6 sec) 42%, (6-7 sec) 30%, (8-9 sec) 15%, (10-11 sec) 6%												

Area 2; 3-13°N, 120-140°W.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
mean wind speed (kts)	12	12	11	12	10	10	10	11	11	10	11	12
99.5 percentile	28	29	30	30	25	24	24	25	26	25	24	27
Wind speeds of 34 knots were in the 99.9 percentile.												
mean wave height (m)	1.5	1.5	1.5	1.5	1	1	1	1.5	1.5	1.5	1	1.5
99.5 percentile	4	5	5	4	4.5	3.5	3.5	4	4	3.5	3.5	4
Wave period distribution (annual): (<6 sec) 47%, (6-7 sec) 25%, (8-9 sec) 10%, (10-11 sec) 5%												

Table 4. (Continued).

Area 3; 23-30°N, 120-130°W.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
mean wind speed (kts)	12	12	12	13	13	12	12	11	11	11	10	12
99.5 percentile	30	30	30	30	27	26	28	28	28	25	30	28
Wind speeds of 34 knots were in the 99.9 percentile.												
mean wave height (m)	1	1	1	1.5	1.5	1.5	1.5	1	1	1	1.5	
99.5 percentile	4	4.5	4.5	5	4.5	4.5	4.5	4.5	4	4	5	
Wave period distribution (annual): (<6 sec) 38%, (6-7 sec) 29%, (8-9) 19%, (10-11 sec) 8%												

Area 4; 35-45°N, 121-132°W.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
mean wind speed (kts)	16	16	15	15	13	13	12	12	12	13	14	15
99.5 percentile	50	45	45	43	40	40	38	36	37	40	44	50
Wind speeds of 34 knots were in the 97 percentile.												
mean wave height (m)	1.5	1.5	1.5	1.5	1.5	1.5	1	1	1	1	1.5	1.5
99.5 percentile	8	7	6.5	6.5	6	5	5	4.5	5	6	6.5	8
Wave period distribution (annual): (<6 sec) 33%, (6-7 sec) 28%, (8-9 sec) 20%, (10-11 sec) 8%												

Area 5, 10-15°N, 100-110°W.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
mean wind speed (kts)	8	8	7	7	7	9	8	8	9	8	7	7
99.5 percentile	24	25	21	21	27	35	33	30	37	30	30	27
Wind speeds of 34 knots were in the 99.7 percentile.												
mean wave height (m)	1	1	1	1	1	1	1	1	1.5	1	1	1
99.5 percentile	3	4	4	3.5	4	4.5	4	4	4.5	4	4	4.5
Wave period distribution (annual): (<6 sec) 52%, (6-7 sec) 18%, (8-9 sec) 8%, (10-11 sec) 4%												

Table 4. (Continued).

Area 6, 2°S to 3°N, 95-110°W.												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
mean wind speed (kts)	8	8	7	7	8	10	11	11	10	9	9	9
99.5 percentile	24	24	24	24	24	25	27	27	25	24	24	24
Wind speeds of 34 knots were in the 99.9 percentile.												
mean wave height (m)	1	1	1	1	1	1.5	1.5	1.5	1.5	1.5	1.5	1
99.5 percentile	3.5	4	4	4	4	5	4.5	4.5	5	4	4	3.5
Wave period distribution (annual):												
(<6 sec) 49%, (6-7 sec) 24%, (8-9 sec) 9%, (10-11 sec) 4%												

Extreme Meteorological Data

Extreme wind and wave data are highly important to the design and siting of the OFEF. These data need to be assessed in relation to engineering and biological requirements and tolerances. Table 5 gives the extreme wind speed, significant wave heights, and extreme wave heights, for specified return periods for west coast, Hawaii, and east coast areas (the latter is included for informational comparison purposes). Figure 48 shows coastal areas where wind and wave recurrence statistics were computed. The table gives mean return period, which is defined as the average number of years between successive occurrence of values greater than, or equal to, the stated value. On the west coast from central California to Washington, areas 25 to 30 have the highest extreme winds; these areas have 25-year wind returns value of 41 to 43 m/sec (Ref. 38). The area off Hawaii has 37- to 40-m/sec 25-year extreme winds. The coastal areas of lowest extreme velocities are southern California (area 22) and northern Baja California (Area 20), showing 31 and 35 m/sec, respectively for 25-year extremes. Off southern California, the five-year return extreme is by far the lowest at 26 m/sec.

Wave-height extremes show a similar trend to the wind values with the highest waves off northern California, Oregon, and Washington. The 25-year significant wave for this area varies between 15 and 16 meters (extreme waves of 27 to 29 meters), whereas off southern California the significant 25-year wave is between 11 and 12 meters (extremes of 19 to 21 meters).

Waves in the Hawaiian waters are estimated at 15 to 16 meters, significant height and 23 to 28 meters for extreme waves for 25-year return periods.

Tables 6 and 7 give high-wind and wave-recurrence statistics for the northwestern portion of the survey area. The highest winds occur in the northern portion at OWS P (50°N) where the 5-year wind is 43 m/sec and the 25-year wind is 51 m/sec. The minimum extreme winds are observed at OWS N (30°N) where the 5- and 25-year winds are 32 and 39 m/sec, respectively. Areas 1 to 4 have intermediate extreme winds.

Table 5. Extreme wind speed, significant wave height and extreme wave heights for specified return periods for the West Coast, Hawaii and the east coast of the U.S. Survey areas are shown in Fig. 48. (1 foot = 0.3 meter)

(Data from NOAA, Ref. 38)

Extreme wind speed for specified return periods.

Area	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	Area	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
1	76	83	92	100	109	27	66	72	80	87	94
2	68	78	93	108	125	28	68	73	82	89	96
3	56	61	70	78	88	29	67	73	82	88	96
4	71	77	86	94	103	30	67	73	81	88	95
5	67	74	83	91	100	31	59	65	72	78	85
6	63	70	78	86	96	32	73	79	88	95	104
7	66	73	83	91	102	33	71	77	86	93	101
8	68	76	90	104	120	34	70	76	85	92	100
9	71	79	92	105	120	35	71	77	86	93	101
10	72	81	96	110	128	36	75	82	91	99	107
11	69	79	94	109	126	37	69	75	84	91	98
12	63	73	88	102	118	38	77	83	93	101	109
13	62	72	88	102	119	39	73	80	89	96	104
14	62	73	89	103	120	40	73	79	88	96	104
15	63	73	88	102	118	41	74	80	89	97	105
16	63	72	86	100	116	42	75	81	91	98	107
17	62	70	84	96	111	43	76	83	92	100	108
18	60	68	79	91	104	44	77	84	93	101	110
19	62	69	79	89	100	45	76	83	92	100	108
20	56	61	69	75	81	46	74	81	90	97	106
21	60	66	73	79	86	47	67	73	81	88	95
22	50	55	61	66	72	48	63	68	76	82	89
23	64	70	78	84	91	49	54	59	65	71	77
24	56	60	67	73	79	50	61	67	75	82	90
25	65	71	79	86	93	51	59	65	72	79	87
26	68	74	83	90	97	52	64	69	78	85	93

--Significant wave height estimates (feet) for specified return periods.

Area	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
1	44	50	59	66	74
2	37	42	49	56	62
3	31	36	42	47	53
4	37	42	50	56	63
5	35	40	47	53	59
6	36	41	48	54	61
7	38	43	50	56	63
8	47	53	63	70	79
9	50	57	67	75	84
10	44	50	59	66	74
11	41	47	55	61	69
12	38	43	50	56	63
13	36	41	48	54	61
14	33	37	43	49	55
15	34	38	45	51	57
16	34	39	46	51	58
17	34	39	45	51	57
18	33	38	44	50	56
19	32	36	43	48	54
20	32	36	43	48	54
21	30	34	39	44	50
22	28	32	38	42	48
23	26	30	35	39	44
24	32	36	42	47	53
25	38	43	50	56	63
26	39	45	52	59	66
27	38	43	50	57	64
28	39	44	52	58	65
29	39	44	52	58	65
30	39	44	51	58	65
31	34	39	45	51	57
32	39	44	51	57	64
33	38	43	51	57	64
34	38	43	50	56	63
35	38	43	51	57	64
36	38	43	51	57	64
37	36	40	47	53	60
38	41	46	54	61	68
39	38	44	51	57	64
40	38	43	51	57	64
41	36	41	48	54	60
42	33	37	43	49	55
43	33	37	43	49	55
44	31	35	41	46	52
45	19	22	26	29	33
46	22	25	29	33	37
47	18	20	24	27	30
48	22	24	29	32	36
49	18	21	24	27	31
50	37	41	49	55	61
51	31	35	41	46	52
52	38	43	51	57	64

--Extreme wave height estimates (feet) for specified return periods.

Area	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
1	80	90	106	119	134
2	67	76	89	100	112
3	56	64	75	84	95
4	67	76	90	101	113
5	64	72	85	95	107
6	65	74	87	97	109
7	68	77	90	102	114
8	85	96	113	127	142
9	91	103	120	135	152
10	80	90	106	119	134
11	74	84	98	111	124
12	68	77	90	101	114
13	65	74	87	98	110
14	59	66	78	87	98
15	61	69	81	91	102
16	62	70	82	92	104
17	62	70	82	92	103
18	60	68	80	90	101
19	58	66	77	86	97
20	58	66	77	86	97
21	53	60	71	80	89
22	51	58	68	76	86
23	47	54	63	71	80
24	57	65	76	85	96
25	68	77	90	101	113
26	71	80	94	106	119
27	68	78	91	102	115
28	70	80	93	105	118
29	70	79	93	104	117
30	70	79	93	104	117
31	61	70	81	92	103
32	70	79	92	104	117
33	69	78	91	103	115
34	68	77	90	101	114
35	69	78	92	103	116
36	69	78	91	103	115
37	64	73	85	96	108
38	73	83	97	109	122
39	69	78	92	103	116
40	69	78	91	103	115
41	65	74	86	97	109
42	59	66	78	87	98
43	59	66	78	87	98
44	56	63	74	84	94
45	35	40	46	53	59
46	37	42	49	55	62
47	32	36	43	48	54
48	39	44	51	58	65
49	33	38	44	49	56
50	66	75	87	98	110
51	56	63	74	83	93
52	69	78	91	102	115

Table 6. Extreme wind velocity recurrence intervals for the north central Pacific.

(1 knot $\approx$ 0.5 m/sec)

(Data from Naval Weather Service, Ref. 27)

AREA 1			AREA 2			AREA 3		
MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SUSTAINED WIND (KNOTS)		MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SUSTAINED WIND (KNOTS)		MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SUSTAINED WIND (KNOTS)	
5	74		5	74		5	73	
10	81		10	81		10	79	
25	90		25	90		25	88	
50	98		50	97		50	95	
100	106		100	105		100	104	
AREA 4			OWS N			OWS P		
MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SUSTAINED WIND (KNOTS)		MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SUSTAINED WIND (KNOTS)		MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SUSTAINED WIND (KNOTS)	
5	70		5	62		5	83	
10	76		10	67		10	90	
25	85		25	75		25	100	
50	92		50	81		50	109	
100	100		100	88		100	118	

LEGEND

HIGH WIND RECURRENCE INTERVALS

On the average the indicated threshold wind speeds will be equalled or exceeded at least once during a mean recurrence interval. Wind speeds are sustained values (i.e., averaged over a period of about a minute) and are estimated to represent a nominal height of about 10 meters above the surface

AREA MAP

Table 7. Maximum significant and extreme wave height recurrence intervals for the north central Pacific.
(1 knot ≈ 0.5 m/sec)

(Data from Naval Weather Service, Ref. 27)

AREA 1					AREA 2					AREA 3				
MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)
5	43	78	5	43	77	5	43	77	5	42	76	5	42	76
10	49	88	10	49	88	10	49	88	10	48	86	10	48	86
25	57	103	25	57	103	25	57	103	25	56	101	25	56	101
50	65	116	50	64	115	50	64	115	50	63	113	50	63	113
100	72	130	100	72	130	100	72	130	100	71	127	100	71	127

AREA 4					OWS N					OWS P				
MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)	MEAN RECURRENCE INTERVAL (YEARS)	MAXIMUM SIGNIFICANT WAVE (FEET)	EXTREME WAVE (FEET)
5	41	73	5	35	64	5	35	64	5	48	87	5	48	87
10	46	83	10	40	72	10	40	72	10	55	98	10	55	98
25	54	97	25	47	85	25	47	85	25	64	115	25	64	115
50	60	109	50	53	95	50	53	95	50	72	130	50	72	130
100	68	122	100	59	107	100	59	107	100	81	146	100	81	146

LEGEND

HIGH WAVE RECURRENCE INTERVALS

On the average the indicated threshold wave heights will be equalled or exceeded at least once during a mean recurrence interval. Maximum significant waves represent the highest one third of the waves (sea or swell). Extreme wave heights are estimated to be 1.8 times the significant wave height.

AREA MAP

Maximum significant and extreme wave heights are given in Table 7. The highest seas are at OWS P where the maximum significant wave heights for 5- and 25-year intervals are 15 and 20 meters and the extreme wave heights for the same periods are 27 and 35 meters. OWS N has the least severe seas in the northwest area with 11- to 14-meter maximum significant wave heights and 20- to 26-meter extreme wave heights for 5- and 25-year intervals. Again, because of the many years of data collected in bad as well as good weather, the Ocean Weather Station extreme data are probably the most accurate available for open ocean areas.

As a note of interest, probably the largest wave ever observed and accurately measured was in the general vicinity of the study area, at 34°N, 167°W. The wave was approximately 34 meters high and was geometrically measured by personnel aboard the USS RAMAPO, 7 February 1933 (Ref. 39).

Extreme current data are also very important to the Ocean Farm. Current measurements in severe weather are extremely rare, and generally only theoretical data exists. A brief discussion of this topic is given in Appendix E. A further discussion of extreme meteorological data is given in Refs. 40 through 44.

Figure 1. Eastern Pacific area chosen for oceanographic and meteorological survey for Phase 1 and future Ocean Farms. Natural Oceanic regions (Ref. 20) as delineated by Laevastu and LaFond, 1970 (Ref. 21) are given. Natural upwelling regions (Eastropac Atlases, Ref. 22; CALCOFI Atlas, Ref. 23, 24, 25) and existing or proposed economic or territorial zones are shown.

Figure 2. Distribution of Macrocytis in North and South America. A. Aerial observations of the coast. B. Detailed diving surveys; points where areas were examined intertidally or by diving are indicated. (From Neushul, 1971, Ref. 26) Note: M. pyrifera occurs as far north as the coast of Alaska but is not dominant north of about 35°N.

Figure 4. Winter North Pacific current regime showing prevailing direction and mean speed range in knots. (From Naval Weather Service, Ref. 27) (1 knot $\approx$ 0.5 m/sec)

Figure 5. Boundaries, directions and speeds of the California Current.
(From Naval Oceanographic Office, Ref. 28) (1 knot $\approx$ 0.5 m/sec)

Figure 6. Boundaries, directions and speeds of the Davidson Current.
(From Naval Oceanographic Office, Ref. 28) (1 knot $\approx$ 0.5 m/sec)

Figure 7. Current speed profiles for the northeastern Pacific area. (1 knot $\approx$ 0.5 m/sec) (From U.S. Navy sources)

Figure 8. Boundary, direction and velocity of the northern portion of the Peru Current. (From Naval Oceanographic Office, Ref. 28) (1 knot $\approx$ 0.5 m/sec)

Figure 9. Mean surface temperature for September for the north Pacific. Isotherms in degrees Fahrenheit. (From Naval Oceanographic Office, Ref. 30)

Figure 10. Maximum surface temperatures for September in the north Pacific. Isotherms in degrees Fahrenheit. (From Naval Oceanographic Office, Ref. 30)

Figure 11. The amount of cooling of surface waters required to lower the mean ambient September temperature to 20°C. Heavy line indicates the northern extent of the 20°C isotherm (i.e., no cooling required). (Temperature data from Naval Oceanographic Office, Ref. 30)

Figure 12. Mean surface temperature for the north Pacific for February. In degrees Fahrenheit. (From Naval Oceanographic Office, Ref. 30)

Figure 13. Minimum surface temperature for the north Pacific for February. In degrees Fahrenheit. (From Naval Oceanographic Office, Ref. 30)

Figure 14. Nitrate nitrogen concentration, at 10 meters, for the southern California Current region - winter. (Duplicated from CALCOFI Atlas, Ref. 32)

Figure 15. Nitrate nitrogen concentration at 10 meters for the southern California Current region - spring. (Duplicated from CALCOFI Atlas, Ref. 32)

Figure 16. Nitrate nitrogen concentration at 10 meters for the southern California Current region - summer. (Duplicated from CALCOFI Atlas, Ref. 32)

Figure 17. Nitrate nitrogen concentration at 10 meters for the southern California Current region - fall. (Duplicated from CALCOFI Atlas, Ref. 32)

Figure 18. Nitrate nitrogen concentration at 100 meters for the southern California Current region - winter. (Duplicated from CALCOFI Atlas - Ref. 32)

Figure 19. Nitrate nitrogen concentration at 100 meters for the southern California Current region - spring. (Duplicated from CALCOFI Atlas, Ref. 32)

Figure 20. Nitrate nitrogen concentration at 100 meters for the southern California Current region - summer. (Duplicated from CALCOFI Atlas - Ref. 32)

Figure 21. Nitrate nitrogen concentration at 100 meters for the southern California Current region - fall. (Duplicated from CALCOFI Atlas, Ref. 32)

Figure 22. Nitrate-nitrogen ($\mu\text{g-at/liter}$) concentration at 10 meters; Feb-Mar 1967, for the eastern tropical Pacific. (Reproduced from EASTROPAC Atlas Vol. 2, Ref. 22).

Figure 23. Nitrate-nitrogen ($\mu\text{g-at/liter}$) concentration at 10 meters; Aug-Sep 1967, for the eastern tropical Pacific. (Reproduced from EASTROPAC Atlas Vol. 6, Ref. 22).

Figure 24. Nitrate-nitrogen ($\mu\text{g-at/liter}$) at 100 meters Feb-Mar 1967 for the eastern tropical Pacific. (Reproduced from EASTROPAC Atlas, Vol. 2, Ref. 22)

Figure 25. Nitrate-nitrogen ($\mu\text{g-at/liter}$) at 100 meters Aug-Sep 1967 for the eastern tropical Pacific. (Reproduced from EASTROPAC Atlas, Vol. 6, Ref. 22).

Figure 26. Average numbers of tropical cyclones per 5-degree square per year. Principal season for cyclonic activity is given. (Reproduced from Naval Weather Service, Ref. 34)

Figure 27. Maximum extent and mean tracks of tropical and extratropical cyclones for the northeastern Pacific. Maximum limits of tropical storms and hurricanes are also given. (1 kt $\approx$ 0.5 m/sec). (Data sources: Naval Weather Service, Ref. 34, NOAA (Weather Bureau), Ref. 35, 36).

Figure 29. Percent frequency of surface winds of $\leq$ Beaufort force 3 (10 kn) and $\geq$ 8 (34 kn) for Feb and Aug for the eastern Pacific south of 30°N. (1 knot $\approx$ 0.5 m/sec.) (U. S. Navy sources).

CENTRAL NE PACIFIC ENVIRONMENT

Figure 30. Environmental data for the central northeast Pacific showing monthly percent frequency of wave height ≥ 5 and ≥ 12 ft, wind speed ≥ 34 kn and median sea surface temperature. Area map gives location of Ocean Weather Station N and P and sample regions 1-4. (1 knot ≈ 0.5 m/sec; 1 ft ≈ 0.3 meters) (Data from Naval Weather Service, Ref. 27).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

Figure 31. Wind speed persistence graph for the central northeast Pacific for Ocean Weather Station N giving percent frequency of duration and interval between 17 m/sec or greater winds. (1 knot $\approx$ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 27).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

Figure 32. Wind speed persistence graph for the central northeast Pacific for Ocean Weather Station P giving percent frequency of duration of and interval between 17 m/sec or greater winds. (1 knot ≈ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 27).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

Figure 33. Wind speed persistence graph for the central northeast Pacific for Ocean Weather Station N giving percent frequency of duration of and interval between 2.5 m/sec or greater winds. (1 knot $\approx$ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 27).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

JANUARY

FEBRUARY

MARCH

APRIL

MAY

JUNE

JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER

Figure 34. Wind speed persistence graph for the central northeast Pacific for Ocean Weather Station P giving percent frequency of duration of and interval between 25 m/sec or greater winds. (1 knot ≈ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 27).

Figure 35. An empirically derived curve of sustained wind speed versus significant wave height for increasing and decreasing wind regimes. $\bar{H}_{1/3}$ is the average of the highest one third waves (significant wave). (1 knot ≈ 0.5 m/sec) (From U.S. Navy sources).

Figure 36. The percent attenuation of wave motion with depth given the period (T) in seconds. (1 foot $\approx$ 0.3 meter) (Data from U.S. Navy sources).

Figure 37. Percent frequency of wave height, period and direction for January through March for the northeastern Pacific 30°N to 45°N. (1 foot $\approx$ 0.3 meter) (From U.S. Navy sources).

Figure 39. Percent frequency of wave height, period and direction for July through September for the northeastern Pacific 30° to 45°N. (1 foot $\approx$ 0.3 meter) (From U.S. Navy sources).

Figure 40. Percent frequency of wave height, period and direction for October through December for the northeastern Pacific 30°N to 45°N. (1 foot $\approx$ 0.3 meter) (From U.S. Navy sources).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

Figure 41. Monthly persistence graphs giving the cumulative percent frequency of hours of duration of a ≥ 1 -meter wave event and of days interval between events for OWS N. (Reproduced from Naval Weather Service, Ref. 27).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

Figure 42. Monthly persistence graphs giving the cumulative percent frequency of hours of duration of a ≥ 1 -meter wave event and of days interval between events for OWS P. (Reproduced from Naval Weather Service, Ref. 27).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

JANUARY

FEBRUARY

MARCH

APRIL

MAY

INSUFFICIENT
DATA

JUNE

INSUFFICIENT
DATA

JULY

INSUFFICIENT
DATA

AUGUST

SEPTEMBER

INSUFFICIENT
DATA

OCTOBER

NOVEMBER

DECEMBER

Figure 43. Monthly persistence graphs giving the cumulative percent frequency of hours of duration of a ≥ 5 -meter wave event and of days interval between events for OWS N. (Reproduced from Naval Weather Service, Ref. 27).

Durations of events meeting the above criterion are depicted by SOLID lines and refer to the TOP SCALE of each graph.

Intervals between events are depicted by DASHED lines and refer to the BOTTOM SCALE of each graph.

JANUARY

FEBRUARY

MARCH

APRIL

MAY

JUNE

JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER

Figure 44. Monthly persistence graphs giving the cumulative percent frequency of hours of duration of a ≥ 5 -meter wave event and of days interval between events for OWS P. (Reproduced from Naval Weather Service, Ref. 27).

Figure 45. Percent frequency of wave height, period and direction for February for southern portion of survey area south of 30°N. (1 foot $\approx$ 0.3 meter) (From U.S. Navy sources).

Figure 47. Geographic areas surveyed for the meteorological summary in Table 4. Numbers in the bottom right hand corner of each quadrant represent the survey areas in Fig. 1. (From Naval Weather Service Detachment, National Climatic Center, Asheville, NC).

Figure 48. Maps showing coastal areas for which wind and wave recurrence statistics (Table 5) were computed. (Reproduced from NOAA, Ref. 38).

PRELIMINARY OFEF SITE SELECTION

Before specific site selections are made, certain areas can be omitted because their environmental characteristics are completely outside the preliminary selection criteria. The following discussion will tentatively support or reject certain areas as potential farm sites for Phase 1; additionally, some discussion of site potentials for future phases will be given.

BIOLOGICAL CRITERIA

Temperature

Utilizing 20°C as the temperature maximum for Macrocystis tolerance and Fig. 11 as a guide, it is apparent that south of about 31°N, cooling by upwelling will be required. The further south the site is located, the greater is the upwelling required to lower the ambient temperature to 20°C, except for the equatorial upwelling region where ambient surface temperatures are lower, thus reducing the requirement for upwelled water. From Figs. 1 and 11 plus Appendices B and C, it is apparent that areas 11 and 12 require no cooling from upwelling (the need for nutrients in these areas may, of course, impose requirements for upwelling). Areas 1-9 are marginal and may require slight cooling during the late summer. Areas 10, 15, and 18 would require some cooling during the summer months. Area 13 would require 2 to 3 degrees cooling during summer and fall. Assuming that the upwelled water was from 200 meters (13°C) and completely mixed, then approximately 33 percent upwelled water would be required in the surface layer to lower its ambient temperature to 20°C. Off Hawaii (areas 14 and 16), approximately 50 percent of the surface water would have to be upwelled from 200 meters to meet the temperature requirement. Also, in areas 17 and 19 in the tropical eastern Pacific north of the equator, the surface waters would have to be mixed with approximately 50-percent upwelled water from 200 meters to lower ambient temperatures to 20°C. In area 20, the winter and spring seasons are the warmest (25°C), thus requiring approximately 40-percent upwelled water mixed with ambient surface water to lower the temperature to 20°C.

The 20°C temperature limitation has not been conclusively demonstrated, and the actual limiting temperature may be significantly higher, thus possibly requiring less upwelling for cooling purposes. If, however, 20°C is assumed to be limiting, then north of 30°N there appears to be little or no problem from upper temperature limitations whereas south to about 25°N some cooling will be required. Off Hawaii and between 25°N and the equator, surface temperatures may be limiting unless enough deep water (200-meter) can be brought to the surface to produce a 50 percent deep/50 percent surface water mixture.

Nutrients

Macrocystis nitrate requirements are tentatively placed at 3 to 5 µg-at/liter minimum, and 10-15 µg-at/liter optimal. The only areas where the required nitrate concentrations are observed at the surface are the near-coastal zones during the upwelling seasons and in the

equatorial and Costa Rica Dome upwelling regions (Fig. 1). At all other offshore areas, artificial upwelling will be required. To provide adequate nutrients to the plants, using a reasonable upwelling volume, the upwelled water may need to contain some 20 to 30 $\mu\text{g-at}$ NO_3/liter . In general, nutrient concentrations in the 20 to 30 $\mu\text{g-at}/\text{liter}$ range are found at deeper depths as one moves west from the coast and from north to south. The depth of the 30 $\mu\text{g-at}/\text{liter}$ NO_3 level increases from 100-200 meters at 40-45°N to 250-350 meters at 25-30°N along the west coast, and is at 350-500 meters off Hawaii. Other things being equal, the greater the depth from which water must be pumped, the greater the costs involved. The proposed pumping depth of 100 meters (Ref. 2) for a Phase 3 farm might necessitate locating the farm above 40°N or very close to west coast upwelling areas within a few kilometers from shore, or else pumping rates could possibly be increased somewhat beyond the proposed five acre feet (six cubic kilometers) per day (Ref. 2). Upwelling pipes might have to be 200-300 meters long off southern California in open ocean areas, and even longer to the south or west to provide adequate concentrations of nutrients to the surface. In the equatorial upwelling and Costa Rica Dome regions, it is possible that no artificial upwelling would be needed because of the continual high concentration of nutrients at the surface. Other factors, however, place these upwelling regions in doubt as potential farm locations for the near term because of the relatively high current speed, temperature regime, and remoteness from potential processing facilities. If, however, the OFEF concept of a dynamically-positioned farm capable of movement with propulsors (Refs. 2 and 3) is tenable, and at-sea processing and long-distance transportation become economically feasible, then large floating farms in the equatorial region become a strong possibility. The farms could float to the east with the Equatorial Countercurrent, move south a few hundred kilometers and move west with the South Equatorial Current, and then propulse north to the Equatorial Countercurrent again, thus remaining in a limited area of the central eastern Pacific and within high-nutrient waters.

The requirement for nutrients at a given concentration may be a significant economic factor because the costs increase with the depth of the required upwelling and the depth of derived nutrient levels varies with area. Therefore, location of the OFEF with regard to nutrients is more a question of economics than of Macrocystis requirements. Probably the most cost effective farm locations from the nutrient (near surface) availability standpoint would be as follows:

1. Equatorial Upwelling Zone (area 20), Costa Rica Dome, and Peruvian upwelling regions;
2. Areas north of 40°N and coastal regions to 35°N (area 12);
3. Coastal regions south of 35°N to 25°N (areas 11 and 1-9);
4. Areas 10 and 18; and the
5. Central eastern Pacific areas 13, 14, 15, 16, 17 and 19.

Practically, for Phase 1 and 2 farms and early Phase 3 farms, the areas included under 2 and 3 above are the most feasible from a nutrient viewpoint.

Currents

Phase 1 and 2 farms will probably be moored and therefore the surface currents could be a major contributor to the water movement around the plants. Current speeds greater than the minimum (4 cm/sec) requirements are observed almost continually throughout the eastern Pacific survey area. Current speeds less than the optimal (10 cm/sec) can occur in the north Pacific gyral area, 25° to 45°N and 130° to 160°W, and in the southern extreme of the California Current, 20° to 25°N. Because of the tendency of the plants to deflect toward the horizontal in currents of greater than 25 cm/sec, sustained currents of greater than this speed may have to be avoided, at least for the relatively small Phase 1 and 2 moored systems.* Areas where currents greater than 25 cm/sec are observed for significant periods of time, include the northern Davidson Current during the winter and the Alaska Current to the north. Also, the North Equatorial Current, the Equatorial Countercurrent, and the South Equatorial Currents exhibit speeds greater than 25 cm/sec much of the time between 5°S and 15°N from the coast to the western edge of the survey area.

Areas which meet the optimal current ranges (10 to 25 cm/sec) include the westward-moving North Pacific and Subarctic Currents, 35° to 42°N; most of the California Current region south of 40°N; the northern portion of the North Equatorial Current region from the coast westward between 15° and 20°N; and the South and Central American coastal areas from the equator to central Mexico (20°N).

With the advent of floating OFEF's, current velocities above 25 cm/sec may become less restrictive because the farms can float with the currents, thus reducing the relative water motion. In floating farms, the importance of wind mixing, internal waves, and upwelling velocity is increased while the importance of surface current velocity is decreased in relation to nutrient uptake rates. However, the energy requirements and engineering limitations for station-keeping must be considered as well.

ENGINEERING CRITERIA

Currents

Although current engineering limitations are not yet well defined, design requirements which meet certain minimal environmental forces will have to be met. A 50-cm/sec operational current is assumed for developmental design of the substrate structure (Ref. 17). A 1.5-m/sec sustained current is the initial engineering design limitation value. Both the operational and design currents are above the biological sustained current limitation of 25 cm/sec. In terms of engineering current limitations, the only areas which have sustained currents above 50 cm/sec are the South Equatorial Current and the northeastern portion of the survey area near Vancouver Island (Fig. 7). Currents of 100 cm/sec are observed in the California and Davidson Currents under extreme conditions (Figs. 5 and 6, these measurements are from ship drift and may be somewhat elevated). Storm-generated currents may, however, become highly important in terms of plant and structural survival (see Appendix E).

*Ambient currents will probably not penetrate far into large OFEF's, see Ref. 16.

Storms/Wind

It will be best for the early OFEF's to avoid areas of strong storms because of the high waves and surface currents generated by them. If possible, areas of storm-force winds (≥ 25 m/sec) and hurricane-force winds (≥ 33 m/sec) should be avoided, and encounters with gale-force winds (≥ 17 m/sec) should be minimized. In the north, extratropical cyclones are generated in the Gulf of Alaska, and these frequently move toward the south with diminishing intensity and frequency to a maximum southern limit of about 30°N . Subtropical cyclones move from an area of generation near 15°N to the west and northwest with diminishing intensity to about 35°N (maximum northern limit of tropical storms). North of about 35°N , and particularly to the northwest, storms and high-wind velocities are common. In the south, between 10°N and 30°N , and to the west to 160°W the probability of strong subtropical storms and hurricanes is high, and these areas should initially be avoided. Areas of low-velocity winds with low probability of intense storms (the most desirable for OFEF location) are given below in order of preference.

1. Southern California and northern Baja California between 35°N and 30°N within 97 kilometers of the coast, (areas 1 through 9 and the northern portion of 10). This area has the lowest probability of extreme winds of any coastal area in the United States (approximately 1 storm ≥ 25 m/sec in a 5-year period).
2. 25°N to 32°N , 120°W to 140°W (areas 15 and 18).
3. Leeward side of Hawaiian Islands (area 51, Fig. 48).
4. Trade wind regions south of tropical cyclone areas, 10°N to 10°S from the coast, west to 160°W . (Relatively constant winds of 5-10 m/sec.)

Waves

Wind-generated waves are relatively constant throughout the survey area. The mean wave height is between 1 and 1.5 meters in all areas (Table 4); however, 99.5 percentile and extreme waves are highly variable. North of 35°N , both along the coast and to the west, 5-year significant and extreme waves are higher than the proposed engineering limitations for preliminary farms (11 and 19 meters, respectively). Areas to the south, particularly the coastal regions from 34°N to 27°N and west to 125°W (areas 1 through 10 and the eastern half of 18, Fig. 1) and regions 20 to 23 (Table 5), show very low wave heights and 10-year extremes within the designated criteria. South of this area, to about 10°N , tropical cyclones can cause very high waves which in conjunction with high currents might cause structural or plant damage to an OFEF located in this area. Wave heights increase in a westerly direction. OWS N (30°N , 140°W) is marginal, with an estimated 5-year significant wave height of 11 meters (Table 6). North of OWS N waves become significantly higher, making this region less desirable as an OFEF site. In Hawaiian waters, extreme wave heights on the windward side of the islands are estimated to be significantly higher than on the leeward side (area 51, Table 5). The leeward side is within the engineering wave height limitations for 10-year waves, while the windward (north and east) side is not.

The southern California/northern Baja region is the area of least severe wind-generated waves.

ECONOMIC AND GEOPOLITICAL CONSIDERATIONS

Economic considerations are discussed in detail in Ref. 2 and are certainly of major importance in OFEF site selection. For Phase 1 experimental farms, the factors of production and transport costs are not a consideration. However, because these early prototype farms will have limited budgets and will be designed essentially to prove the OFEF concept, it is important that they be located in reasonable proximity to scientific and logistic support. Approximately 30 kilometers maximum (2-hour transit) is considered an appropriate distance for adequate scientific support and study of Phase 1 farms. This distance will limit the site initially to a near-shore (coast or island) location in the vicinity of a marine laboratory or facility. For large moored OFEF systems, the depth of the bottom is an important factor. For depths greater than 610 meters the mooring costs become excessive. This depth limitation is not highly significant for Phase 1 and 2 farms because of their small size (610-meter water is available) and relaxed economic requirements. For Phase 3 and the future, however, it is not likely that large farms can economically be anchored; they will probably be dynamically positioned and so will not be geographically limited by bottom contour.

OFEF should presently remain outside claimed territorial and economic zones of other countries until mutual international agreements are made. Currently most South and Central American countries and Mexico have claimed 200-mile (322-kilometer) economic or territorial zones, and it now appears certain that the U.S. will do the same by March 1977. Figure 1 gives the approximate 322-kilometer economic zone boundaries. With economic zone exclusion of the 322 kilometers around Guadalupe Island, the islands south of Baja California, and the Galapagos Islands, much of the open ocean areas as well as all the coastal regions south of $32^{\circ}30'N$ are removed from OFEF site availability at the present time.

PHASE 1 SITE SELECTION

SOUTHERN CALIFORNIA OFEF SITE SELECTION

It is apparent that the first requirement for the Phase 1 OFEF prototype is that it should be located in the nearshore area to allow adequate access by scientific and support personnel. Secondly, it should be located in an area with mild oceanographic and meteorological characteristics and be within the criteria delineated in Table 1. The region best suited within the guidelines of the proposed and established criteria is the southern California offshore area from Pt. Conception, 34° 30'N, to the Mexican economic zone, 32° 30'N. This area is presented in Fig. 49, which also shows submarine transit lanes, shipping lanes, the 322-kilometer Mexican economic zone boundary and the proposed locations of selected OFEF Phase 1 sites listed in priority order.

The southern California offshore area has been selected as the optimal location for Phase 1, and will more than likely be selected for Phase 2 and early 3 as well, for the following reasons.

1. The sites chosen are within the U.S. economic zone which will be increased to 200 miles (322 kilometers) by March 1977, thereby avoiding possible international conflict.
2. The region has the most mild and least severe extreme weather conditions of any offshore area within the economic zone of the continental United States or Hawaii. It has a very low occurrence of high-velocity winds and high waves. This is because the region is north of the tropical cyclone zone and is located on the southern extreme of the extratropical cyclone region.
3. In this nearshore area, nutrients of adequate concentrations are relatively near the surface (15-25 $\mu\text{g-at/liter NO}_3$ at 100 meters).
4. Research and support facilities are available close to the proposed sites.
5. The region is within the natural habitat zone of Macrocystis pyrifera. Temperature and light regions are excellent for Macrocystis growth.
6. Current speeds are mostly within the ranges specified for optimal OFEF operations and kelp growth characteristics.

SOUTHERN CALIFORNIA OFFSHORE CHARACTERISTICS

Figures 50 through 71 (from the Naval Weather Service, Ref. 45) give detailed oceanographic and meteorologic data of the southern California offshore area. These data, along with the criteria below, were used to select specific sites. Table 8 gives nutrient concentrations for various depths off southern California and northern Baja California.

Winter (February) and summer (August) wave heights > 2 and > 6 feet (> 0.6 and 1.8 meters) are given in Figs. 50 and 51, and > 9 and > 12 feet (> 2.7 and 3.7 meters) in Figs. 52 and 53. Percent frequency of the wave heights given increase to the west showing a

minimal value of 20 percent for > 2-foot (0.6-meter) waves in August nearshore (Fig. 51) to a maximum of 70 percent for > 2-foot (0.6-meter) waves in the northern Channel Islands (34°N). High waves (> 3.7 meters) occur rarely in August (2.5 percent at about 121°W, 32°30'N) and are slightly more common in winter (Figs. 52 and 53).

Table 8. Nitrate concentration versus depth off southern California and northern Baja California.

Depth (m)	Ocean Locations										
	1	2	3	4	5	6	7	8	9	10	11
	Nitrate concentration ($\mu\text{g-at NO}_3\text{-N/liter}$)										
0	1	1	2	0.5	0.5	0.5	0	—	—	—	—
10	1	2	2	0.5	0.5	0.5	0	—	—	—	—
50	2	7	2	18.0	7.0	16.0	12	—	16	13	—
100	15	—	9	22.0	20.0	22.0	21	—	—	—	—
200	24	20	19	30.0	28.0	26.0	28	—	—	—	—
300	30	30	—	32.0	33.0	28.0	33	30	—	—	23-33

Ocean Locations

Data Sources

1. San Diego Trough — September 72	unpublished data
2. Off Baja California — July 72	unpublished 30°N, 120°W
3. Off Baja California — August 72	unpublished 30°N, 120°W
4. San Diego Trough — April 71	unpublished 32° 30'N, 117° 30'W
5. San Diego Trough — October 70	unpublished 32° 30'N, 117° 30'W
6. San Diego Trough — April 70	unpublished 32° 30'N, 117° 30'W
7. Santa Catalina Basin — May 65	33° 18.5'N, 118° 40'W (Ref. 46)
8. San Diego Trough — April 75	Supplied to W. North for upwelling experiments.
9. Catalina Island — September 75	W. North, Personal Comm.
10. Catalina Island — November 75	W. North, Personal Comm.
11. Range of values from 300 meters — ICC experiment, from W. North (Ref. 12)	

Wind speeds are relatively low off southern California. Speeds of 6-11 m/sec during the summer (Fig. 57) occur between 10 and 20 percent of the time in the nearshore area and up to 40 percent of the time west of San Clemente Island. In winter, the frequencies of nearshore winds of 6-10 m/sec increase to 20 percent while those of offshore winds remain nearly the same. Winds of ≥ 18 m/sec are increasingly frequent in winter, occurring about 1 to 3 percent of the time off the Channel Islands and less than 0.5 percent in the nearshore areas (Fig. 54). Winds of ≤ 3 m/sec occur about 30 percent of the time in winter and summer in the Channel Island areas and about 50 to 60 percent of the time in the nearshore environment (33° - 34° N).

The mixed layer* depth, given in Figs. 58 and 59, are relatively shallow in the nearshore areas and increase in a westerly direction. During summer the mixed depth is very shallow (about 6 meters) in the inshore areas; in winter this depth increases to 18 meters inshore, to about 24 meters off San Clemente Island, and to about 60 meters to the southwest (30° N, 120° W).

Figures 60 through 71 give monthly prevailing current direction and mean current speed. Currents south of 32° $30'$ N are generally south at 20 to 25 cm/sec. North of this, the currents are more variable in speed and direction. The prevailing nearshore currents are also 20 to 25 cm/sec. Currents in the Channel Island areas are more variable in direction including some westerly and northerly currents varying between 20 and 36 cm/sec on average. During fall and early winter the prevailing currents change to predominately a north to northwest direction (Davidson Current) with speed averaging 20 to 25 cm/sec. A high northwesterly current approximating 50 cm/sec off Santa Catalina is observed in December (Fig. 71). In January, near coastal currents are variable and in the spring the prevailing direction is south to southeast with speeds averaging from 20 to 30 cm/sec. Other current studies of the southern California area include CALCOFI, Ref. 47; Scripps Institute of Oceanography, Ref. 48; and the Oceanographic Survey of the Santa Barbara Channel Oil Spill, Ref. 49.

Specific Phase 1 site selections in the southern California area were made using the following criteria.

1. Locate within the 500-fathom (915-meter) contour to make mooring costs as economical as possible and still test the deep water OFEF concept.
2. Remain outside shipping and submarine transit lanes and common pleasure-boating areas.
3. Be within 32 kilometers (2-hour transit) of scientific and logistic support due to the frequent observation and measurement requirements of the Phase 1 farms.

*The layer in which wind-mixing occurs and below which the thermocline begins. The mixed layer is usually at a very low nutrient concentration due to phytoplanktonic utilization in this zone.

PRIORITIZED PHASE I OFEF SITE SELECTION

The selected sites as shown in Fig. 49 were prioritized as stated below.

1. Site 1 is located in the inshore area south of Corona del Mar ($33^{\circ} 30'N$, $117^{\circ} 55'W$). It was chosen as the first priority site because it is within 8 to 16 kilometers of the Cal Tech marine laboratory, thus allowing easy access to the early prototype experiments. The depth range is approximately 100-200 fathoms (180-360 meters) and the site is between the pleasure and commercial routes from Los Angeles to San Diego and points south. In addition, the inshore area has somewhat milder conditions than the offshore sites. Wave heights and wind velocities are reduced below those of the offshore islands (see Figs. 50-59). Also, the thermocline (bottom of the mixed layer) is frequently shallower at site 1 than at 2 and 3, making high-nutrient concentrations nearer to the surface (Fig. 54).

2. Site 2 is located 8 to 24 kilometers northwest of San Clemente Island ($33^{\circ} 05'N$, $118^{\circ} 45'W$). This site was chosen because it is close to the Naval Undersea Center facility on the northern portion of San Clemente Island. An airstrip and small boats are available for farm support. This site would be an excellent location to test the deep water (away from coastal influence) concept of OFEF. In addition, this site would probably be less molested by private boats than the other two selections. A discussion of the near-surface nutrient regime is found in Ref. 10.

3. Site 3 is 5 to 15 kilometers northwest of Santa Catalina Island ($33^{\circ} 35'N$, $118^{\circ} 35'W$). It is within 8 to 19 kilometers of the University of Southern California marine laboratory, shown in Fig. 49, which could function as a support facility for the farm project. The currents in this region can be somewhat higher than in other parts of the southern California area in winter (Fig. 69). A few nutrient measurements are given in Table 8. Site 3 is located just south of the shipping lane from Los Angeles to Hawaii and west of the major pleasure-boat traffic to Avalon Bay in the southern portion of Santa Catalina.

Figure 49. Phase 1 prioritized site selection, southern California area. Dashed lines give major commercial and pleasure craft shipping lanes, solid lines show submarine transit (ST) areas and dotted lines show approximate location of claimed Mexican 200 mile economic zone. Numbered quadrangles give selected locations for Phase 1 and possible Phase 2 farm sites in priority order. Star in area 1 was location of initial upwelling experiments (ICC) during January 1976. (200 miles $\approx$ 322 kilometers)

Figure 50. Percent frequency of wave height greater than 2 and 6 feet for the southern California area for February. (1 foot $\approx$ 0.3 meter) (Reproduced from Naval Weather Service, Ref. 45)

Figure 51. Percent frequency of wave height greater than 2 and 6 feet for the southern California area for August. (1 foot $\approx$ 0.3 meter) (Reproduced from Naval Weather Service, Ref. 45)

Figure 52. Percent frequency of wave height greater than 9 and 12 feet for the southern California area for February. (1 foot $\approx$ 0.3 meter) (Reproduced from Naval Weather Service, Ref. 45)

Figure 53. Percent frequency of wave height greater than 9 and 12 feet for the southern California area for August. (1 foot $\approx$ 0.3 meter) (Reproduced from Naval Weather Service, Ref. 45)

Figure 54. Percent frequency of wind speed less than or equal to 6 and greater than or equal to 34 knots for the southern California area for February. (1 knot $\approx$ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 45)

Figure 55. Percent frequency of wind speed less than or equal to 6 and greater than or equal to 34 knots for the southern California area for August. (1 knot ≈ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 45)

Figure 56. Percent frequency of wind speed 11-21 knots for the southern California area for February. (1 knot $\approx$ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 45)

Figure 57. Percent frequency of wind speed 11-21 knots for the southern California area for August. (1 knot $\approx$ 0.5 m/sec) (Reproduced from Naval Weather Service, Ref. 45)

Figure 58. Depth of mean mixed layer off southern California for February.
(1 foot $\approx$ 0.3 meter) (Reproduced from Naval Weather Service, Ref. 45)

Figure 59. Depth of mean mixed layer off southern California for August. (1 foot $\approx$ 0.3 meter)
(Reproduced from Naval Weather Service, Ref. 45)

Figures 60-71. Prevailing current direction and mean current speed for the southern California area. Secondary currents are indicated with dashed lines and variable currents with a V. Monthly data, January through December are given. (1 knot $\approx$ 0.5 m/sec) (Data reproduced from Naval Weather Service, Ref. 45)

Figure 60. January

Figure 61. February

Figure 62. March

Figure 63. April

Figure 64. May

Figure 65, June

Figure 66. July

Figure 67. August

Figure 68, September

Figure 69. October

Figure 70. November

Figure 71. December

RECOMMENDATIONS FOR FUTURE OFEF SITING

It is recommended that one or more of the Phase 2 and Phase 3 farms be located in the southern California offshore region from $32^{\circ} 30'N$ to $34^{\circ}N$ and from $117^{\circ} 30'W$ to $120^{\circ}W$. If dynamically-positioned farms have not been completely engineered by the time large-scale OFEF's are ready to be tested, a number of possible locations exist in water shallow enough to allow for mooring. One possible offshore region is the zone from Cortes Bank at $32^{\circ} 30'N$, $119^{\circ}W$ northwest past San Nicolas Island to Santa Rosa Island at $34^{\circ}N$, $120^{\circ}W$ (Fig. 49). This region is called the Santa Rosa-Cortes Ridge and is a relatively shallow region, 100 to 500 fathoms (180 to 900 meters), 24 to 40 kilometers across and covering approximately 5000 square kilometers (1,280,000 acres). Other possible regions include the area south of site 1 between commercial and pleasure traffic zones covering about 1300 square kilometers of nearshore sites and the area northwest of San Clemente and Catalina Islands, $33^{\circ} 15'N$ to $34^{\circ}N$ and $118^{\circ} 20'W$ to $119^{\circ} 20'W$, encompassing about 2600 square kilometers (not including shipping lanes). These areas could conceivably support some 22 Phase-I (405 square kilometer) farms, all within 120 kilometers of potential support and processing centers. As dynamically-positioned farms are engineered and built, and as international agreements are made, the farms could spread further west and south, thus opening up millions of square kilometers to potential OFEF farming.

**SURVEY OF OCEANOGRAPHIC AND METEOROLOGICAL PARAMETERS
OF IMPORTANCE TO THE SITE SELECTION OF AN OCEAN FOOD
AND ENERGY FARM (OFEF) IN THE EASTERN PACIFIC.**

APPENDICES A-E

APPENDIX A
SEASONAL NITRATE PROFILES FOR THE EASTERN PACIFIC
OCEAN AREAS AS DEFINED IN FIGURE 1

Data for nitrate profiles were obtained from the National Oceanographic Data Center and summarized using the Naval Undersea Center UNIVAC 1110 computer and developed software.

Nitrate is given in micrograms-atoms/liter on a log scale and are shown to a maximum depth of 500 meters.

Figure A.1.

AREA ELEVEN - SPRING

Figure A.2.

AREA TWELVE - WINTER

Figure A.3.

AREA TWELVE - SPRING

Figure A.4.

AREA TWELVE - SUMMER

Figure A.5.

AREA TWELVE - FALL

Figure A.6.

AREA THIRTEEN - WINTER

Figure A.7.

AREA THIRTEEN - SPRING

Figure A.8.

AREA THIRTEEN - SUMMER

Figure A.9.

AREA FOURTEEN - WINTER

Figure A.10.

AREA FOURTEEN - SPRING

Figure A.11.

Figure A.12.

AREA SEVENTEEN - WINTER

Figure A.13.

Figure A.14.

AREA EIGHTEEN - FALL

Figure A.15.

AREA NINETEEN - WINTER

Figure A.16.

AREA NINETEEN - SPRING

Figure A.17.

Figure A.18.

AREA NINETEEN - FALL

Figure A.19.

Figure A.20.

Figure A.21.

AREA TWENTY - SUMMER

Figure A.22.

AREA TWENTY - FALL

Figure A.23.

APPENDIX B

Seasonal temperature profiles for survey areas shown in Figure 1. Temperature data is from the National Oceanographic Data Center and represents all hydrocasts of record for the season and area depicted.

Temperature envelopes give an approximation of minimum and maximum temperatures at various depths and the range of depths at which the thermocline is located.

Figure B.1 shows the geographic location of survey areas 1-9.

Figure B.1. Geographic location of survey areas 1-9, southern California area.

Figure B.2.

Figure B.3.

Figure B.4.

Figure B.5.

Figure B.6.

Figure B.7.

Figure B.8.

Figure B.9.

Figure B.10.

AREA THREE - SPRING

Figure B.11.

Figure B.12.

Figure B.13.

AREA FOUR - WINTER

Figure B.14.

AREA FOUR - SPRING

Figure B.15.

Figure B.16.

Figure B.17.

AREA FIVE - WINTER

Figure B.18.

Figure B.19.

AREA FIVE - SUMMER

Figure B.20.

AREA FIVE - FALL

Figure B.21.

AREA SIX - WINTER

Figure B.22.

AREA SIX - SPRING

Figure B.23.

Figure B.24.

AREA SIX - FALL

Figure B.25.

Figure B.26.

AREA SEVEN - SPRING

Figure B.27.

Figure B.28.

AREA SEVEN - FALL

Figure B.29.

Figure B.30.

AREA EIGHT - SPRING

Figure B.31.

AREA EIGHT - SUMMER

Figure B.32.

AREA EIGHT - FALL

Figure B.33.

AREA NINE - WINTER

Figure B.34.

AREA NINE - SPRING

Figure B.35.

AREA NINE - SUMMER

Figure B.36.

AREA NINE - FALL

Figure B.37.

AREA TEN - WINTER

Figure B.38.

AREA TEN - SPRING

Figure B.39.

AREA TEN - SUMMER

Figure B.40.

Figure B.41.

Figure B.42.

AREA ELEVEN - SPRING

Figure B.43.

Figure B.44.

AREA ELEVEN - FALL

Figure B.45.

Figure B.46.

Figure B.47.

Figure B.48.

Figure B.49.

AREA THIRTEEN - WINTER

Figure B.50.

AREA THIRTEEN - SPRING

Figure B.51.

AREA THIRTEEN - SUMMER

Figure B.52.

AREA THIRTEEN - FALL

Figure B.53.

Figure B.54.

AREA FOURTEEN - SPRING

Figure B.55.

Figure B.56.

AREA FOURTEEN - FALL

Figure B.57.

AREA FIFTEEN - WINTER

Figure B.58.

AREA FIFTEEN - SPRING

Figure B.59.

Figure B.60.

Figure B.61.

AREA SIXTEEN - WINTER

Figure B.62.

AREA SIXTEEN - SPRING

Figure B.63.

AREA SIXTEEN - SUMMER

Figure B.64.

AREA SIXTEEN - FALL

Figure B.65.

AREA SEVENTEEN - WINTER

Figure B.66.

AREA SEVENTEEN - SPRING

Figure B.67.

Figure B.68.

AREA SEVENTEEN - FALL

Figure B.69.

AREA EIGHTEEN - WINTER

Figure B.70.

AREA EIGHTEEN - SPRING

Figure B.71.

AREA EIGHTEEN - SUMMER

Figure B.72.

Figure B.73.

AREA NINETEEN - WINTER

Figure B.74.

Figure B.75.

Figure B.76.

Figure B.77.

Figure B.78.

AREA TWENTY - SPRING

Figure B.79.

AREA TWENTY - SUMMER

Figure B.80.

AREA TWENTY - FALL

Figure B.81.

APPENDIX C
STATISTICAL SUMMARY OF PHYSICAL OCEANOGRAPHIC
DATA BY SEASON AND AREA

Data from the National Oceanographic Data Center was analyzed on the Naval Undersea Center UNIVAC 1110 computer to obtain maximum, mean, minimum and standard deviation of temperature ($^{\circ}\text{C}$), salinity (parts per thousand), and sigma-t (density). The number of hydrocasts analyzed is given. Areas are shown in Figure 1 and B.1.

Data can be utilized for future modeling programs for OFEF, such as growth simulation, sinking rate and structural and total farm buoyancy models.

AREA ONE - WINTER

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				NUM
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	
0 **	17.22	15.27	13.11	1.6795 **	33.71	33.46	33.00	1.677 **	25.20	24.806	23.90	1.2595	56 **
10 **	17.27	14.87	13.01	1.097 **	33.71	33.48	32.98	1.760 **	25.37	24.642	23.91	1.2579	18 **
20 **	16.77	14.50	11.77	1.202 **	33.71	33.48	33.02	1.679 **	25.37	24.918	24.07	1.2876	38 **
30 **	16.93	14.02	11.22	1.310 **	33.71	33.49	33.18	1.626 **	25.55	25.035	24.44	1.2812	37 **
35 **	15.76	12.81	10.43	1.392 **	33.73	33.51	33.23	1.187 **	25.48	23.880	24.77	1.2873	17 **
40 **	13.20	11.34	9.65	1.043 **	33.68	33.62	33.36	0.996 **	26.14	25.654	25.23	1.2376	33 **
50 **	11.83	10.57	9.41	1.7372 **	34.01	33.75	33.55	0.997 **	26.23	25.692	25.87	1.1744	25 **
125 **	11.37	10.06	9.19	1.6014 **	34.01	33.85	33.61	0.857 **	26.32	26.064	26.73	1.1477	22 **
150 **	10.64	9.65	8.83	1.4844 **	34.09	33.96	33.76	0.710 **	26.37	26.216	26.96	1.1179	22 **
200 **	10.10	9.22	8.54	1.4061 **	34.25	34.11	33.94	0.766 **	26.55	26.404	26.29	1.0774	18 **
250 **	9.25	8.74	8.22	1.2955 **	34.25	34.19	34.03	0.536 **	26.63	26.541	26.45	1.0577	17 **
300 **	8.66	8.23	7.75	1.2239 **	34.29	34.22	34.06	0.550 **	26.73	26.643	26.54	1.0551	16 **
400 **	7.58	7.36	7.11	1.1719 **	34.30	34.25	34.16	0.566 **	26.95	26.794	26.71	1.0415	11 **
500 **	6.57	6.45	6.20	1.1190 **	34.31	34.28	34.25	0.275 **	26.96	26.890	26.91	1.0294	4 **
600 **	5.87	5.81	5.75	1.0849 **	34.34	34.34	34.33	0.071 **	27.07	27.070	27.07	0.0000	2 **

AREA ONE - SUMMER

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				NUM
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	
0 **	22.98	19.85	15.01	1.7645 **	33.73	33.54	33.20	1.845 **	24.42	23.492	22.96	1.1960	29 **
10 **	21.87	16.91	10.11	2.7154 **	33.73	33.48	33.20	1.604 **	25.83	24.357	23.51	1.6120	29 **
20 **	18.57	14.38	9.87	2.3010 **	33.71	33.48	33.19	1.596 **	25.91	24.926	23.79	1.5375	27 **
30 **	16.26	12.70	9.69	1.7837 **	33.68	33.47	33.14	1.747 **	26.00	25.278	24.41	1.4404	27 **
40 **	14.60	11.38	9.47	1.8407 **	33.62	33.57	33.18	1.748 **	26.12	25.571	24.95	1.3513	24 **
75 **	13.02	10.40	9.57	1.6491 **	33.93	33.66	33.45	1.433 **	26.20	25.820	25.28	1.2404	22 **
100 **	12.14	10.28	9.62	1.6531 **	33.95	33.75	33.52	1.399 **	26.19	25.943	25.48	1.2044	21 **
125 **	11.04	10.00	9.25	1.5049 **	34.04	33.85	33.59	1.438 **	26.31	26.037	25.79	1.1844	19 **
150 **	10.44	9.83	9.02	1.5011 **	34.07	33.90	33.73	1.176 **	26.36	26.119	25.96	1.1390	17 **
200 **	10.35	9.47	9.07	1.3182 **	34.27	34.08	33.91	0.984 **	26.51	26.337	26.14	1.0976	16 **
250 **	9.11	9.08	8.69	1.2618 **	34.31	34.19	34.04	0.807 **	26.56	26.492	26.42	1.0460	13 **
300 **	9.20	8.57	7.67	1.4504 **	34.31	34.24	34.14	0.690 **	26.66	26.606	26.52	1.0439	11 **
400 **	8.12	7.61	7.21	1.3413 **	34.36	34.29	34.25	0.457 **	26.82	26.789	26.75	1.0234	7 **
500 **	6.64	6.46	6.37	1.1370 **	34.32	34.28	34.23	0.087 **	26.95	26.942	26.92	0.0050	4 **

AREA ONE - SPRING

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				NUM
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	
0 **	22.37	17.05	11.80	1.6111 **	33.81	33.52	33.25	1.2354 **	25.08	24.367	23.20	1.4760	41 **
10 **	19.28	14.59	12.22	1.7229 **	33.80	33.52	33.21	1.651 **	25.33	24.705	23.92	1.4002	41 **
20 **	15.90	11.26	10.81	1.4219 **	33.77	33.54	33.27	1.155 **	25.73	25.216	24.51	1.2997	41 **
30 **	14.57	12.03	9.85	1.1517 **	33.75	33.56	33.30	0.980 **	25.94	25.490	24.98	1.2492	41 **
40 **	13.55	10.67	9.34	1.7937 **	33.92	33.67	33.43	1.104 **	26.19	25.815	25.21	1.2036	38 **
50 **	11.31	9.95	9.16	1.4848 **	34.07	33.85	33.57	1.077 **	26.35	26.047	25.62	1.1503	37 **
75 **	10.66	9.67	8.91	1.3676 **	34.09	33.91	33.67	1.077 **	26.43	26.174	25.82	1.1224	27 **
100 **	10.27	9.42	8.71	1.3097 **	34.15	34.00	33.40	1.032 **	26.46	26.269	26.06	1.1023	24 **
125 **	9.57	9.30	8.64	1.3111 **	34.25	34.27	33.22	1.135 **	26.48	26.300	26.13	1.0991	21 **
150 **	9.50	8.95	8.11	1.4008 **	34.31	34.17	34.00	0.747 **	26.61	26.497	26.36	1.0658	18 **
200 **	9.19	8.64	7.80	1.3744 **	34.35	34.24	34.06	0.645 **	26.61	26.596	26.51	1.0500	16 **
250 **	8.78	8.31	7.57	1.3665 **	34.43	34.29	34.19	0.904 **	26.77	26.694	26.62	1.0460	16 **
300 **	7.72	7.22	6.01	1.1911 **	34.34	34.26	34.25	0.269 **	26.90	26.839	26.79	1.0371	15 **
400 **	6.61	6.42	6.22	1.1331 **	34.35	34.31	34.27	0.275 **	27.03	26.967	26.91	1.0362	7 **
500 **	5.73	5.73	5.72	1.0571 **	34.34	34.34	34.33	0.071 **	27.06	27.066	27.06	0.0000	2 **

AREA ONE - FALL

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				NUM
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	
0 **	22.54	18.07	14.00	2.0130 **	33.81	33.54	33.25	1.432 **	25.07	24.141	22.95	1.4623	28 **
10 **	20.66	17.42	14.08	1.8597 **	33.80	33.52	33.23	1.410 **	25.07	24.284	23.46	1.4094	26 **
20 **	18.41	15.40	13.21	1.5204 **	33.66	33.48	33.15	1.132 **	25.20	24.626	24.01	1.3092	24 **
30 **	17.35	14.34	11.81	1.4390 **	33.60	33.44	33.16	1.047 **	25.44	24.913	24.32	1.3124	26 **
40 **	15.14	12.59	10.81	1.2682 **	33.67	33.47	33.16	1.104 **	25.68	25.298	24.77	1.2579	25 **
50 **	13.40	11.41	9.72	1.9357 **	33.75	33.57	33.32	0.985 **	25.94	25.604	25.23	1.1933	24 **
75 **	12.31	10.88	9.69	1.6032 **	33.64	33.69	33.42	0.916 **	26.02	25.799	25.48	1.1552	19 **
100 **	11.53	10.15	9.24	1.5566 **	33.92	33.80	33.58	0.929 **	26.23	25.977	25.49	1.1369	19 **
125 **	11.15	9.86	8.89	1.5222 **	34.02	33.91	33.66	0.899 **	26.35	26.121	25.87	1.1224	18 **
200 **	9.67	9.25	8.26	1.4570 **	34.14	34.05	33.90	0.717 **	26.50	26.345	26.17	1.0872	15 **
250 **	9.41	8.81	8.09	1.4044 **	34.25	34.16	34.09	0.579 **	26.64	26.506	26.37	1.0751	15 **
300 **	9.01	8.32	7.69	1.3570 **	34.26	34.20	34.16	0.340 **	26.76	26.615	26.50	1.0642	10 **
400 **	7.67	7.34	7.07	1.2126 **	34.27	34.24	34.21	0.195 **	26.84	26.794	26.73	0.0399	7 **

Figure C.1.

*** STATISTICAL SUMMARY ***

AREA TWO - SIMULR

*** STATISTICAL SUMMARY ***

AREA TWO - SPRING

*** STATISTICAL SUMMARY ***

AREA TWO - FALL

*** STATISTICAL SUMMARY ***

DEPTH (CM)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				
	PAR	PLAN	MIN	ST DLW	PAR	PLAN	MIN	ST DLW	PAR	PLAN	MIN	ST DLW	NUM
0	18.1	18.0	18.0	18.1	34.7	34.7	34.7	34.6	24.9	24.116	23.25	24.00	32
1	17.9	17.9	17.9	17.9	34.7	34.7	34.7	34.6	24.9	24.144	23.76	23.92	12
2	18.1	18.1	18.1	18.1	34.6	34.6	34.6	34.6	25.0	24.375	23.71	23.60	10
3	18.1	18.1	18.1	18.1	34.6	34.6	34.6	34.6	25.2	24.597	23.64	23.54	10
4	18.0	18.0	18.0	18.0	34.5	34.5	34.5	34.5	25.4	25.121	23.55	23.44	29
5	17.9	17.9	17.9	17.9	34.5	34.5	34.5	34.5	25.6	25.445	23.07	23.06	19
6	17.9	17.9	17.9	17.9	34.4	34.4	34.4	34.4	26.1	25.762	22.76	23.02	24
7.5	17.7	17.7	17.7	17.7	34.4	34.4	34.4	34.3	26.25	25.944	22.63	23.77	29
10	17.4	17.4	17.4	17.4	34.3	34.3	34.3	34.2	26.35	26.110	22.63	24.21	29
12	17.1	17.1	17.1	17.1	34.2	34.2	34.2	34.1	26.4	26.241	22.50	23.93	78
14	16.7	16.7	16.7	16.7	34.1	34.1	34.1	34.0	26.75	26.516	22.38	23.78	28
16	16.3	16.3	16.3	16.3	34.0	34.0	34.0	33.9	26.79	26.682	22.35	23.62	78
18	15.9	15.9	15.9	15.9	33.9	33.9	33.9	33.8	26.8	26.802	22.32	23.47	78
20	15.5	15.5	15.5	15.5	33.8	33.8	33.8	33.7	27.05	26.975	22.01	23.64	27
22	15.1	15.1	15.1	15.1	33.7	33.7	33.7	33.6	27.12	27.097	22.01	23.69	77

Figure C.2.

ALFA THREE - WINTER															
*** STATISTICAL SUMMARY ***															
DEPTH (M)	TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T				
	MAX	PLAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV	NUM
2	16.28	14.77	13.14	1.472	**	31.71	32.62	31.40	1.14	**	25.37	24.881	24.23	1.928	32 **
10	16.27	14.49	13.17	1.449	**	31.69	32.47	31.30	1.147	**	25.18	24.669	24.23	1.924	32 **
20	16.21	14.22	13.10	1.430	**	31.67	32.47	31.30	1.147	**	25.25	24.913	24.43	1.991	32 **
30	16.23	14.25	13.11	1.431	**	31.67	32.47	31.30	1.150	**	25.54	25.164	24.62	2.276	32 **
40	16.47	15.75	14.71	1.431	**	31.68	32.45	31.29	1.14	**	27.58	25.493	24.90	2.393	32 **
50	16.27	15.27	14.87	1.274	**	31.64	32.43	31.42	1.048	**	26.29	24.729	25.46	1.322	31 **
60	11.67	9.51	8.1	1.573	**	31.67	32.77	31.54	1.043	**	26.39	26.172	25.63	1.448	32 **
70	10.64	9.44	8.02	1.681	**	31.67	32.99	31.59	1.056	**	26.19	26.106	25.66	1.193	31 **
80	9.54	8.16	7.1	1.574	**	31.67	32.76	31.56	1.017	**	26.58	26.436	26.26	1.074	31 **
90	2.97	3.44	2.75	1.477	**	31.63	34.17	34.28	1.049	**	26.67	26.585	26.52	1.676	31 **
100	1.57	2.74	2.47	1.487	**	31.57	34.71	34.78	1.049	**	27.77	26.689	26.43	2.427	32 **
120	2.24	2.94	2.87	1.107	**	31.54	34.71	34.74	1.042	**	26.94	26.657	26.73	1.428	32 **
140	4.67	5.27	5.1	1.1474	**	31.57	34.71	34.71	1.054	**	27.06	26.999	26.95	1.297	32 **
160	5.69	5.81	5.69	1.1	**	31.44	34.79	34.76	1.059	**	27.23	27.169	27.10	1.411	31 **
180	5.12	4.76	4.42	1.151	**	31.45	34.43	34.40	1.054	**	27.30	27.173	27.20	1.357	31 **
200	4.67	4.35	4.27	1.151	**	31.45	34.45	34.41	1.057	**	27.35	27.150	27.20	1.027	31 **
220	4.10	4.24	4.07	1.135	**	31.50	34.67	34.43	1.057	**	27.43	27.174	27.32	1.020	31 **
240	4.11	3.75	3.67	1.1469	**	31.52	34.49	34.47	1.059	**	27.46	27.419	27.35	1.351	31 **
260	3.46	3.13	3.04	1.059	**	31.57	34.49	34.49	1.061	**	27.50	27.451	27.36	1.556	31 **
280	3.07	2.75	2.61	1.064	**	31.55	34.54	34.57	1.061	**	27.48	27.515	27.45	1.030	31 **
300	3.10	2.99	2.90	1.060	**	31.56	34.55	34.55	1.059	**	27.50	27.537	27.53	1.035	31 **
320	2.63	2.63	2.63	1.059	**	31.55	34.57	34.59	1.059	**	27.43	27.616	27.61	1.000	31 **
340	2.59	2.59	2.59	1.059	**	31.60	34.43	34.45	1.059	**	27.64	27.620	27.62	1.000	31 **
ALFA THREE - SUMMER															
2	21.67	20.14	18.46	1.424	**	31.61	32.46	31.4	1.061	**	24.21	23.852	23.31	2.631	25 **
10	21.67	20.14	18.46	1.424	**	31.61	32.46	31.4	1.061	**	24.24	24.144	23.44	1.411	25 **
20	20.46	18.93	17.14	1.416	**	31.75	32.46	32.4	1.061	**	24.49	24.377	23.50	1.386	24 **
30	21.19	19.47	17.51	1.424	**	31.67	32.46	32.4	1.061	**	25.21	24.773	23.49	1.480	24 **
40	18.46	18.37	16.10	1.1502	**	31.66	32.46	32.4	1.059	**	25.44	25.191	24.55	1.042	24 **
50	17.67	17.16	15.1	1.151	**	31.77	32.49	32.10	1.071	**	25.49	25.495	24.93	1.033	24 **
60	11.47	10.10	8.47	1.424	**	31.67	32.46	32.4	1.070	**	26.15	25.292	25.20	1.346	24 **
70	11.1	9.44	7.67	1.424	**	31.67	32.46	32.4	1.070	**	26.15	25.157	25.10	1.468	24 **
80	7.12	5.10	4.07	1.424	**	31.67	32.46	32.4	1.070	**	26.40	26.265	26.10	1.006	24 **
90	9.57	8.49	7.11	1.424	**	31.67	32.46	32.4	1.070	**	26.56	26.465	26.43	1.064	24 **
100	9.11	8.07	6.71	1.424	**	31.67	32.46	32.4	1.070	**	26.67	26.586	26.56	1.437	24 **
110	8.77	7.51	6.11	1.424	**	31.67	32.46	32.4	1.070	**	26.75	26.678	26.67	1.030	24 **
120	7.57	6.47	5.11	1.424	**	31.67	32.46	32.4	1.070	**	26.76	26.683	26.77	1.039	24 **
130	7.2	6.1	4.71	1.424	**	31.67	32.46	32.4	1.070	**	27.05	26.696	26.90	1.075	24 **
140	6.47	5.71	4.07	1.424	**	31.67	32.46	32.4	1.070	**	27.16	27.102	27.07	1.027	24 **
150	5.71	5.1	3.67	1.424	**	31.67	32.46	32.4	1.070	**	27.35	27.190	27.16	1.065	24 **
160	4.67	4.07	2.67	1.424	**	31.67	32.46	32.4	1.070	**	27.27	27.227	27.25	1.315	24 **
170	4.67	4.67	4.67	1.424	**	31.67	32.46	32.4	1.070	**	27.35	27.311	27.30	1.032	24 **
180	3.47	3.47	3.47	1.424	**	31.67	32.46	32.4	1.070	**	27.30	27.358	27.31	1.054	24 **
190	2.64	2.64	2.64	1.424	**	31.67	32.46	32.4	1.070	**	27.43	27.400	27.47	1.074	24 **
ALFA THREE - SPRING															
2	17.75	15.42	13.67	1.424	**	31.77	32.45	31.4	1.047	**	25.11	24.677	24.02	1.730	25 **
10	17.75	15.42	13.67	1.424	**	31.77	32.45	31.4	1.047	**	25.11	24.729	24.06	1.099	25 **
20	16.41	14.40	12.67	1.424	**	31.69	32.46	32.4	1.069	**	25.25	24.921	24.29	1.216	25 **
30	16.41	14.40	12.67	1.424	**	31.69	32.46	32.4	1.070	**	25.46	25.171	24.47	1.092	25 **
40	16.41	14.40	12.67	1.424	**	31.77	32.45	32.4	1.074	**	26.70	25.520	24.95	1.544	24 **
50	16.41	14.40	12.67	1.424	**	31.77	32.45	32.4	1.074	**	27.15	25.443	24.38	1.103	24 **
60	11.47	9.12	7.67	1.424	**	31.67	32.46	32.4	1.070	**	26.22	26.264	26.71	1.596	24 **
70	11.47	9.12	7.67	1.424	**	31.67	32.46	32.4	1.070	**	26.39	26.176	26.46	1.012	23 **
80	7.47	5.74	4.47	1.424	**	31.67	32.46	32.4	1.070	**	26.85	26.373	26.16	1.035	23 **
90	6.47	4.64	3.47	1.424	**	31.67	32.46	32.4	1.070	**	26.76	26.656	26.15	1.071	23 **
100	4.67	3.47	2.67	1.424	**	31.67	32.46	32.4	1.070	**	26.76	26.747	26.67	1.472	23 **
110	3.47	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.02	26.926	26.42	1.042	23 **
120	4.67	3.47	2.67	1.424	**	31.67	32.46	32.4	1.070	**	27.17	27.015	26.90	1.443	23 **
130	3.77	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.45	27.107	27.07	1.035	8 **
140	3.17	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.19	27.168	27.15	1.071	4 **
150	4.67	3.47	2.67	1.424	**	31.67	32.46	32.4	1.070	**	27.29	27.244	27.20	1.077	6 **
160	4.67	3.47	2.67	1.424	**	31.67	32.46	32.4	1.070	**	27.16	27.351	27.25	1.051	3 **
170	3.47	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.43	27.378	27.43	1.009	3 **
180	3.47	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.46	27.425	27.49	1.045	2 **
190	3.47	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.56	27.465	27.45	1.049	3 **
200	3.47	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.57	27.574	27.43	1.000	3 **
210	3.47	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.56	27.567	27.56	1.000	3 **
220	2.67	2.67	2.67	1.424	**	31.67	32.46	32.4	1.070	**	27.56	27.580	27.56	1.000	3 **
ALFA THREE - FALL															
2	17.75	15.42	13.67	1.424	**	31.77	32.45	31.4	1.047	**	25.11	24.677	24.02	1.730	25 **
10	17.75	15.42	13.67	1.424	**	31.77	32.45	31.4	1.047	**	25.11	24.729	24.06	1.099	25 **
20	16.41	14.40	12.67	1.424	**	31.69	32.46	32.4	1.069	**	25.25	24.921	24.29	1.216	25 **
30	16.41	14.40	12.67	1.424	**	31.69	32.46	32.4	1.070	**	25.46	25.171	24.47	1.092	25 **
40	16.41	14.40	12.67	1.424	**	31.77	32.45	32.4	1.074	**	26.70	25.520	24.95	1.544	24 **
50	16.41	14.40	12.67	1.424	**	31.77	32.45	32.4	1.074	**	27.15	25.443	24.38	1.103	24 **
60	11.47	9.12	7.67	1.424	**	31.67	32.46	32.4	1.070	**	26.22	26.264	26.71	1.596	24 **
70	11.47	9.12	7.67	1.424	**	31.67	32.46	32.4	1.070	**	26.39	26.176	26.46	1.012	23 **
80	7.47	5.74	4.47	1.424	**	31.67	32.46	32.4	1.070	**	26.85	26.373	26.16	1.035	23 **
90	6.47	4.64	3.47	1.424	**	31.67	32.46	32.4	1.070	**	26.76	26.656	26.15	1.071	23 **
100	4.67	3.47	2.67	1.424	**	31.67	32.46	32.4	1.070	**	26.76	26.747	26.67	1.472	23 **
110	3.47	2.67	1.47	1.424	**	31.67	32.46	32.4	1.070	**	27.02	26.926	26.42	1.042	23 **
120	4.67	3.47	2.67	1.424	**	31.67	32.46	32.4	1.070	**	27.17	27.015	26.90	1.443	23 **
130	3.77	2.67	1.47	1.424											

••• STATISTICAL SUMMARY •••

PAGE FOUR - SIMMER

AFCA FOUR - SPRINGDATA FOUR - FALL228

DATA FIVE - WINTER														
*** STATISTICAL SUMMARY ***														
DEPTH (M)	TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T			
	MAX	MEAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV
5	16.27	14.15	12.20	1.6463		35.36	35.46	35.10	0.5992		25.25	24.93	24.33	0.4225
10	15.74	14.01	12.17	1.6911		35.24	35.39	35.10	0.4997		25.25	24.955	24.34	0.2711
15	15.69	13.27	12.25	1.6151		35.63	35.76	35.2	0.5732		25.25	24.977	24.37	0.2332
20	15.55	13.41	11.7	1.5954		35.58	35.78	35.2	0.561		25.43	25.026	24.36	0.2374
25	15.38	12.69	10.22	1.7012		35.28	35.39	35.18	0.584		25.72	25.274	24.42	0.2723
30	15.58	11.08	9.44	1.6777		35.39	35.46	35.25	0.5334		26.04	25.573	24.72	0.2846
35	15.38	10.38	9.45	1.6676		35.37	35.42	35.21	0.5026		26.23	25.639	24.62	0.2815
40	15.49	9.46	6.79	1.4654		35.59	35.75	35.44	0.3811		26.41	26.047	24.91	0.3274
45	15.16	9.12	8.45	1.5971		34.55	35.57	35.04	0.9802		26.43	26.236	26.01	0.0235
50	16.29	8.51	7.69	1.5337		34.11	34.74	34.64	0.4034		27.12	26.466	26.25	0.0426
55	16.60	8.32	7.65	1.4777		34.10	34.72	34.61	0.4827		26.67	26.655	26.44	0.0415
60	16.21	7.59	7.11	1.5955		34.28	34.78	34.7	0.3731		26.77	26.712	26.63	0.0225
65	16.26	6.56	5.84	1.4222		34.30	34.78	34.31	0.5322		26.23	26.626	26.79	0.4425
70	16.44	6.26	5.77	1.1851		34.33	34.75	34.27	0.3477		27.03	26.997	26.95	0.0376
75	16.76	5.63	5.27	1.4442		34.29	34.75	34.21	0.2802		27.17	27.094	27.21	0.0352
80	15.19	4.15	3.4	1.264		34.22	34.70	34.34	0.2531		27.23	27.185	27.15	0.0174
85	16.65	4.71	4.62	0.777		34.51	34.64	34.29	0.4395		27.14	27.325	27.20	0.0645
90	16.33	4.01	3.92	0.322		34.48	34.74	34.62	0.3413		27.29	27.255	27.27	0.0143
100	15.57	3.92	3.97	0.077		34.67	34.86	34.67	0.077		27.46	27.465	27.46	0.0001
DATA FIVE - SUMMER														
5	16.97	17.24	16.88	1.4721		35.41	35.74	35.14	0.6231		24.52	24.56	24.66	0.3748
10	16.18	17.31	16.77	1.6797		35.64	35.74	35.14	0.7842		24.44	24.576	24.79	0.4712
15	15.91	15.79	15.69	0.0925		35.60	35.76	35.66	0.5669		25.46	24.637	24.86	0.4275
20	16.47	16.10	16.12	0.0051		35.62	35.73	35.34	0.1951		25.09	25.072	25.06	0.0025
25	16.29	15.51	15.11	1.1842		35.62	35.64	35.54	0.022		26.22	25.594	25.6	0.2626
30	15.65	15.01	14.67	0.771		34.33	35.67	35.37	0.7227		26.62	25.921	25.48	0.4481
35	16.66	9.33	8.24	1.5474		34.79	35.73	35.46	0.4611		26.46	26.155	25.72	0.3724
40	16.47	8.61	7.61	1.1647		34.77	35.75	35.47	0.2675		26.53	26.379	26.37	0.0001
45	16.45	8.64	8.02	0.628		34.10	34.22	33.87	0.2619		26.49	26.425	26.27	0.2996
50	16.74	7.63	7.67	0.066		34.25	34.71	33.94	0.6939		26.75	26.266	26.46	0.2477
55	16.43	7.44	7.44	0.000		34.46	34.64	34.62	0.0207		26.76	26.76	26.76	0.0000
60	16.41	7.47	6.67	0.800		34.32	34.73	34.7	0.4007		26.67	26.776	26.65	0.0211
65	16.13	6.25	5.62	0.633		34.30	34.72	34.62	0.0827		26.80	26.477	26.65	0.4676
70	16.4	6.11	5.61	0.500		34.27	34.77	34.75	0.0227		26.77	26.905	26.8	0.1278
75	16.92	5.75	5.62	0.1274		34.25	34.74	34.23	0.0127		27.11	27.079	27.02	0.021
80	16.99	5.24	5.11	0.131		34.47	34.75	34.25	0.3027		27.23	27.174	27.15	0.0247
85	16.89	4.77	4.62	0.152		34.42	34.62	34.62	0.0000		27.32	27.262	27.25	0.0675
90	16.51	4.42	4.25	0.171		34.25	34.64	34.36	0.3934		27.47	27.334	27.27	0.1471
95	16.41	4.41	4.62	0.213		34.42	34.64	34.64	0.0000		27.46	27.367	27.33	0.0829
100	16.45	3.92	3.86	0.057		34.44	34.66	34.67	0.007		27.43	27.435	27.43	0.0000
DATA FIVE - SPRING														
5	16.69	16.75	16.36	0.4071		35.73	35.86	35.32	0.4711		25.36	24.659	24.86	0.9227
10	16.11	16.31	16.23	0.0894		35.73	35.82	35.61	0.1207		25.46	24.610	24.92	0.4447
15	16.65	15.42	15.44	0.1257		35.72	35.43	35.29	0.2802		25.50	24.511	24.626	0.5071
20	15.64	15.15	15.17	0.0177		35.77	35.44	35.34	0.307		25.84	25.166	24.79	0.5566
25	16.44	15.79	15.65	0.1352		35.62	35.49	35.36	0.1490		26.16	25.663	24.70	0.5674
30	16.34	16.42	16.42	0.000		35.67	35.47	35.21	0.2827		26.20	25.776	24.79	0.6692
35	15.91	9.33	8.24	1.5474		35.61	35.76	35.61	0.1544		26.23	25.594	25.6	0.1746
40	16.96	9.33	8.24	1.5474		35.61	35.76	35.71	0.057		26.46	26.155	25.72	0.3724
45	16.47	8.61	7.61	1.1647		34.77	35.75	35.47	0.2675		26.53	26.379	26.37	0.0001
50	16.45	8.64	8.02	0.628		34.10	34.22	33.87	0.2619		26.49	26.425	26.27	0.2996
55	16.74	7.63	7.67	0.066		34.25	34.71	33.94	0.6939		26.75	26.266	26.46	0.2477
60	16.43	7.44	7.44	0.000		34.46	34.64	34.62	0.0207		26.76	26.76	26.76	0.0000
65	16.41	7.47	6.67	0.800		34.32	34.73	34.7	0.4007		26.67	26.776	26.65	0.0211
70	16.13	6.25	5.62	0.633		34.30	34.72	34.62	0.0827		26.80	26.477	26.65	0.4676
75	16.4	6.11	5.61	0.500		34.27	34.77	34.75	0.0227		26.77	26.905	26.8	0.1278
80	16.92	5.75	5.62	0.1274		34.25	34.74	34.23	0.0127		27.11	27.079	27.02	0.021
85	16.99	5.24	5.11	0.131		34.47	34.75	34.25	0.3027		27.23	27.174	27.15	0.0247
90	16.89	4.77	4.62	0.152		34.42	34.62	34.62	0.0000		27.32	27.262	27.25	0.0675
95	16.51	4.42	4.29	0.169		34.25	34.64	34.48	0.207		27.47	27.344	27.34	0.0000
100	16.42	4.02	4.02	0.000		34.63	34.66	34.67	0.007		27.33	27.335	27.33	0.0000
DATA FIVE - FALL														
5	16.66	16.66	16.67	0.0000		35.71	35.59	35.61	0.0214		25.54	24.656	24.86	0.5569
10	16.44	16.41	16.21	0.1170		35.77	35.70	35.61	0.074		25.44	24.675	24.79	0.2374
15	16.65	16.11	16.62	0.0377		35.67	35.46	35.63	0.2197		25.55	24.263	24.86	0.3274
20	16.77	15.67	16.67	0.000		35.54	35.46	35.63	0.087		26.64	24.775	24.62	0.3696
25	16.67	15.96	16.67	0.000		35.77	35.41	35.32	0.3538		25.51	25.177	24.50	0.5573
30	17.14	15.44	15.7	0.6767		35.77	35.44	35.34	0.307		25.84	25.166	24.79	0.5566
35	16.11	15.02	14.9	0.1034		35.72	35.49	35.62	0.2277		26.22	25.911	25.36	0.2626
40	16.11	9.42	8.45	0.9707		34.60	34.74	34.64	0.1274		26.72	26.146	24.91	0.4734
45	16.47	8.11	7.61	0.500		34.77	35.75	35.47	0.2675		26.53	26.379	26.37	0.0001
50	16.45	8.64	8.02	0.628		34.10	34.22	33.87	0.2619		26.49	26.425	26.27	0.2996
55	16.74	7.63	7.67	0.066		34.25	34.71	33.94	0.6939		26.75	26.266	26.46	0.2477
60	16.43	7.44	7.44	0.000		34.46	34.64	34.62	0.0207		26.76	26.76	26.76	0.0000
65	16.41	7.47	6.67	0.800		34.32	34.73	34.7	0.4007		26.67	26.776	26.65	0.0211
70	16.13	6.25	5.62	0.633		34.30	34.72	34.62	0.0827		26.80	26.477	26.65	0.4676
75	16.4	6.11	5.61	0.500		34.27	34.77	34.75	0.0227		26.77	26.905	26.8	0.1278
80	16.92	5.75	5.62	0.1274		34.25	34.74	34.23	0.0127		27.11	27.079	27.02	0.021
85	16.99	5.24	5.11	0.131		34.47	34.75	34.25	0.3027		27.23	27.174	27.15	0.0247
90	16.89	4.77	4.67	0.103		34.42	34.62	34.62	0.000		27.32	27.262	27.26	0.000
95	16.51	4.26	4.26	0.000		34.25	34.67	34.37	0.207		27.49	27.375	27.16	0.2076
100	16.46	4.02	4.02	0.000		34.63	34.64	34.64	0.000		27.46	27.46	27.46	0.000
105	16.42	4.02	4.02	0.000		34.63	34.65	34.65	0.000		27.34	27.344	27.34	0.000

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T				
	MAX	MEAN	P10	ST DEV	NUR	MAX	MEAN	MIN	ST DEV	NUR	MAX	MEAN	P10	ST DEV	NUR
0 **	16.40	16.33	16.29	0.17	29	34.72	34.62	34.56	0.17	34	25.38	24.623	24.63	0.556	41 44
1 **	17.29	17.22	17.17	0.17	29	34.72	34.62	34.56	0.17	34	25.43	24.63	24.66	0.221	41 44
2 **	16.87	16.82	16.77	0.16	31	34.613	34.52	34.44	0.159	34	25.51	24.933	24.87	0.247	41 44
3 **	16.82	16.79	16.74	0.16	31	34.613	34.52	34.44	0.159	34	25.46	25.046	24.95	0.243	41 44
4 **	17.02	17.02	16.97	0.16	31	34.613	34.52	34.44	0.159	34	25.46	25.046	24.95	0.243	41 44
5 **	17.24	17.20	17.15	0.17	29	34.613	34.56	34.50	0.169	34	26.10	25.629	25.41	0.251	56 60
6 **	17.22	17.18	17.13	0.17	29	34.613	34.56	34.50	0.169	34	26.23	25.686	25.41	0.253	35 38
7 **	17.15	17.12	17.07	0.17	29	34.613	34.56	34.50	0.169	34	26.23	25.686	25.41	0.253	35 38
10 **	17.07	17.02	16.97	0.16	31	34.609	34.55	34.47	0.164	34	26.43	26.225	25.95	0.266	1176 36
20 **	16.88	16.81	16.76	0.16	31	34.627	34.52	34.45	0.164	34	26.55	26.444	26.23	0.271	133 13
30 **	16.90	16.84	16.78	0.16	31	34.627	34.52	34.45	0.164	34	26.55	26.444	26.23	0.271	133 13
40 **	16.90	16.84	16.78	0.16	31	34.627	34.52	34.45	0.164	34	26.55	26.444	26.23	0.271	133 13
50 **	16.90	16.84	16.78	0.16	31	34.627	34.52	34.45	0.164	34	26.55	26.444	26.23	0.271	133 13
60 **	16.85	16.82	16.77	0.16	31	34.626	34.52	34.45	0.162	34	26.62	26.421	26.23	0.272	133 13
70 **	16.85	16.82	16.77	0.16	31	34.626	34.52	34.45	0.162	34	26.70	26.421	26.23	0.272	133 13
80 **	16.82	16.79	16.74	0.16	31	34.625	34.52	34.45	0.162	34	27.11	27.007	27.06	0.245	4 4

*** STATISTICAL SUMMARY ***

DEPTH (F)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				WSP
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	
1	33.91	32.21	34.21	1.7722	35.38	33.54	35.1	1.4877	26.48	26.771	26.22	0.7627	42
2	31.65	31.1	32.64	0.572	33.87	32.42	33.2	0.732	25.16	25.282	25.21	0.263	42
3	27.22	15.25	11.94	7.4722	32.76	33.48	33.15	1.412	25.59	25.97	25.9	0.4191	38
20	27.15	17.31	10.1	5.6539	35.60	33.45	33.10	1.618	25.91	25.170	24.34	0.769	38
25	15.70	11.25	9.1	1.2776	33.23	32.43	32.7	1.694	26.01	25.555	24.63	0.706	37
35	14.24	16.47	9.6	0.707	29.00	33.43	33.16	1.674	26.18	25.702	24.6	0.672	36
50	14.2	15.97	9.1	0.7432	33.72	34.71	35.7	1.358	25.28	26.563	26.33	0.7074	34
75	11.60	14.2	9.1	0.7432	33.72	34.71	35.7	1.358	25.27	26.104	25.62	0.672	34
100	10.28	14.67	6.70	0.7432	34.13	35.02	35.5	1.117	26.37	26.104	25.62	0.672	34
125	11.24	14.1	6.7	0.7271	34.20	34.77	33.91	0.732	26.5	26.359	26.14	0.2826	28
150	9.1	14.1	6.7	0.7271	34.20	34.77	33.91	0.732	26.53	26.359	26.29	0.7726	27
200	7.47	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
250	7.47	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
300	7.47	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
350	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
400	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
450	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
500	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
550	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
600	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
650	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
700	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
750	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
800	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
850	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27
900	6.7	14.5	7.4	0.7432	34.71	34.71	34.12	0.7432	26.53	26.359	26.29	0.7726	27

016T KEMP, SGT

*** STATISTICAL SUMMARY ***

DEPTH (F)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				DUR
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	
1	17.1	16.32	15.7	1.0262	35.75	35.70	35.67	0.0744	25.10	24.396	23.25	0.5505	48
2	17.1	16.32	15.7	1.0262	35.75	35.70	35.67	0.0744	25.10	24.396	23.25	0.5505	61
3	16.6	16.26	15.81	1.0426	35.72	35.67	35.65	0.0752	25.07	24.387	23.27	0.5616	76
4	16.1	16.11	15.71	1.1010	35.70	35.63	35.62	0.0767	25.06	24.377	23.26	0.5601	90
5	15.7	16.05	15.65	1.0914	35.68	35.64	35.63	0.0762	25.04	24.371	23.26	0.5593	50
6	15.3	15.95	15.62	1.0462	35.67	35.65	35.63	0.0759	25.03	24.367	23.26	0.5585	51
7	14.7	15.7	15.27	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
8	14.2	15.6	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
9	13.7	15.5	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
10	13.2	15.4	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
11	12.7	15.3	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
12	12.2	15.2	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
13	11.7	15.1	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
14	11.2	15.0	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
15	10.7	14.9	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
16	10.2	14.8	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
17	9.7	14.7	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
18	9.2	14.6	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
19	8.7	14.5	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
20	8.2	14.4	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
21	7.7	14.3	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
22	7.2	14.2	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
23	6.7	14.1	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
24	6.2	14.0	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
25	5.7	13.9	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
26	5.2	13.8	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
27	4.7	13.7	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
28	4.2	13.6	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
29	3.7	13.5	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
30	3.2	13.4	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
31	2.7	13.3	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
32	2.2	13.2	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
33	1.7	13.1	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
34	1.2	13.0	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
35	0.7	12.9	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48
36	0.2	12.8	15.2	1.0775	35.66	35.62	35.62	0.0771	25.02	24.374	23.26	0.5573	48

*** STATISTICAL SUMMARY ***

TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T				
DATE	TIME	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	WUR
11	00:42	17.6	14.4	14.2	1.5	35.2	35.3	35.16	0.14	25.36	26.226	25.66	0.222	41.8
11	01:27	17.5	14.3	14.2	1.5	35.2	35.3	35.16	0.14	25.37	26.246	25.64	0.214	41.8
11	02:15	14.9	12.2	12.1	1.6	35.6	35.7	35.47	0.15	25.38	26.273	25.63	0.216	41.8
11	03:05	14.8	11.7	11.6	1.6	35.7	35.8	35.47	0.17	25.43	26.292	25.62	0.217	40.8
11	03:55	14.4	10.2	10.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	04:45	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	05:35	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	06:25	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	07:15	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	08:05	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	08:55	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	09:45	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	10:35	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	11:25	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	12:15	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	13:05	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	13:55	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	14:45	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	15:35	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	16:25	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	17:15	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	18:05	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	18:55	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	19:45	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8
11	20:35	14.2	9.2	9.1	1.7	35.7	35.8	35.47	0.18	25.47	26.313	25.61	0.218	40.8

SECRET REFERENCE

Figure C.6.

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				DUP		
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV			
**	36.267	36.555	36.243	1.00794	**	33.724	33.643	33.740	**	35.466	35.403	35.411	0.206	47 **	
1	**	36.247	36.444	**	1.01794	**	33.721	33.643	33.741	**	35.577	35.491	35.418	0.298	47 **
2	**	36.445	36.572	36.318	1.00794	**	33.716	33.643	33.741	**	35.757	35.707	35.415	0.47	47 **
3	**	36.310	36.371	36.509	1.01293	**	33.725	33.643	33.741	**	35.476	35.546	35.439	0.211	47 **
20	**	35.902	36.274	36.067	1.04476	**	33.682	33.549	33.815	**	35.776	35.529	35.471	0.836	47 **
25	**	35.111	**	36.047	1.05864	**	33.628	**	33.710	**	35.616	35.516	35.474	0.2297	47 **
1	**	35.127	35.742	36.042	1.2131	**	34.343	33.649	**	**	35.724	35.724	35.474	0.278	47 **
163	**	35.763	36.982	3.887	1.56747	**	34.709	35.291	33.584	**	36.836	36.269	35.499	1.359	48 **
164	**	36.222	36.462	36.467	0.8161	**	34.688	35.479	33.667	**	36.846	36.231	35.482	1.213	45 **
165	**	36.457	36.457	36.457	0.00000	**	34.688	35.479	33.667	**	36.846	36.231	35.482	1.213	45 **
235	**	36.049	3.837	7.872	1.3742	**	34.625	34.716	34.544	**	36.844	36.588	35.482	0.508	42 **
742	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
743	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
744	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
745	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
746	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
747	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
 
787	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
788	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
789	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
790	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
791	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
792	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
793	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
794	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
795	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
796	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
797	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
798	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
799	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **
800	**	36.049	7.839	7.872	1.3742	**	34.627	34.716	34.544	**	36.876	36.686	35.482	0.647	43 **

ARFA SEVEN - SUMMER

[illegible]

AREA SEVEN - SPRING

[illegible]

AREA SEVEN - FALL

[illegible]

Figure C 7

*** STATISTICAL SUMMARY ***

DEPTH [M]	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				NUM
	PAX	P1AN	MIL	ST DEV	PAX	P1AN	M1N	ST DEV	PAX	PCAN	M1N	ST DEV	
1	13.69	13.67	13.67	0.000	35.61	35.62	35.67	0.000	27.59	27.60	27.61	0.000	16
2	13.71	13.71	13.71	0.000	35.62	35.62	35.67	0.000	27.60	27.60	27.61	0.000	16
3	13.71	13.62	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.65	27.61	0.000	16
4	13.69	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
5	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
6	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
7	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
8	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
9	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
10	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
11	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
12	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
13	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
14	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
15	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
16	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
17	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
18	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
19	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
20	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
21	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
22	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
 
71	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
72	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
73	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
74	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
75	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
76	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
77	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
78	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
79	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
80	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
81	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
82	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
83	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
84	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
85	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
86	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
87	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
88	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66	27.66	27.61	0.000	17
89	13.67	13.61	13.61	0.000	35.67	35.67	35.61	0.000	27.66				

A&FA LIGHT - SUPPLY

[illegible]
$$\ln \frac{A}{A_0} = -\lambda t \quad \text{or} \quad \lambda = \frac{1}{t} \ln \frac{A_0}{A}$$
[illegible]

ANFA - TGMT - FALL

[illegible]

Figure C.8.

AREA NINE - WINTER

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T			
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV
1	12.46	12.42	12.43	1.0000	35.03	35.43	35.42	1.0280	24.82	24.492	23.96	1.0744
2	12.45	12.45	12.45	1.0431	35.02	35.43	35.42	1.0417	24.84	24.491	24.11	1.0909
3	12.44	12.42	12.42	1.0704	35.02	35.43	35.44	1.0721	24.90	24.723	24.27	1.1163
4	12.45	12.42	12.41	1.1745	35.07	35.45	35.42	1.1767	25.03	24.697	24.71	1.1626
5	12.42	12.45	12.45	1.0587	35.01	35.41	35.41	1.0571	25.44	25.353	25.25	1.1202
7.5	12.44	12.41	12.41	1.0901	35.00	35.46	35.43	1.0914	25.71	25.626	25.43	1.1275
10	12.43	12.42	12.42	1.1372	35.00	35.44	35.40	1.1377	26.03	25.935	25.54	1.1444
12.5	12.41	12.44	12.44	1.1407	35.00	35.45	35.41	1.1405	26.14	26.075	25.71	1.1319
15	9.27	9.23	9.47	1.1920	35.05	35.03	35.01	1.1923	26.25	26.105	25.96	1.0826
20	9.09	9.01	9.24	1.1775	34.97	34.99	34.99	1.1771	26.44	26.442	26.42	1.0283
25	8.49	8.44	8.45	1.1811	34.90	34.95	34.97	1.1811	26.46	26.455	26.37	1.0218
30	8.25	7.49	7.77	1.1966	34.83	34.93	34.92	1.1962	26.74	26.695	26.69	1.0071
40	7.26	7.16	7.46	1.2767	34.77	34.77	34.77	1.1411	26.87	26.835	26.80	1.0475
50	6.55	6.47	6.47	1.2754	34.70	34.70	34.70	1.0722	27.01	26.970	26.93	1.0588

AREA NINE - SUMMER

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T			
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV
1	21.49	21.42	21.42	1.0000	35.02	35.43	35.40	1.0280	23.52	23.425	23.48	1.0636
2	21.45	21.45	21.45	1.0431	35.02	35.43	35.42	1.0417	24.77	24.705	24.64	1.0909
3	21.44	21.42	21.42	1.1704	35.02	35.43	35.44	1.1721	24.95	24.913	24.85	1.1163
4	21.45	21.42	21.41	1.1745	35.07	35.45	35.42	1.1767	25.03	25.215	24.71	1.1626
5	21.42	21.45	21.45	1.0587	35.01	35.41	35.41	1.0571	25.44	25.696	25.49	1.1202
7.5	21.44	21.41	21.41	1.0901	35.00	35.46	35.43	1.0914	25.71	25.670	25.43	1.1275
10	21.43	21.42	21.42	1.1372	35.00	35.44	35.40	1.1377	26.03	26.075	25.71	1.1444
12.5	21.41	21.44	21.44	1.1407	35.00	35.45	35.41	1.1405	26.14	26.105	25.96	1.0826
15	9.49	9.49	9.49	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
20	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
25	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
30	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
40	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
50	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283

AREA NINE - SPRING

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T			
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV
1	17.41	17.41	17.41	1.0000	35.02	35.43	35.40	1.0280	24.83	24.432	23.84	1.0744
2	17.41	17.41	17.41	1.0431	35.02	35.43	35.42	1.0417	24.84	24.491	24.11	1.0909
3	17.41	17.41	17.41	1.0704	35.02	35.43	35.44	1.0721	24.90	24.723	24.27	1.1163
4	17.41	17.41	17.41	1.1745	35.07	35.45	35.42	1.1767	25.03	25.697	24.71	1.1626
5	17.42	17.41	17.41	1.0587	35.01	35.41	35.41	1.0571	25.44	25.656	25.44	1.1202
7.5	17.44	17.41	17.41	1.0901	35.00	35.46	35.43	1.0914	25.71	25.670	25.43	1.1275
10	17.43	17.42	17.42	1.1372	35.00	35.44	35.40	1.1377	26.03	26.075	25.71	1.1444
12.5	17.41	17.44	17.44	1.1407	35.00	35.45	35.41	1.1405	26.14	26.105	25.96	1.0826
15	9.49	9.49	9.49	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
20	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
25	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
30	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
40	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
50	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283

AREA NINE - FALL

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T			
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV
1	17.41	17.41	17.41	1.0000	35.02	35.43	35.40	1.0280	24.83	24.432	23.84	1.0744
2	17.41	17.41	17.41	1.0431	35.02	35.43	35.42	1.0417	24.84	24.491	24.11	1.0909
3	17.41	17.41	17.41	1.0704	35.02	35.43	35.44	1.0721	24.90	24.723	24.27	1.1163
4	17.41	17.41	17.41	1.1745	35.07	35.45	35.42	1.1767	25.03	25.697	24.71	1.1626
5	17.42	17.41	17.41	1.0587	35.01	35.41	35.41	1.0571	25.44	25.656	25.44	1.1202
7.5	17.44	17.41	17.41	1.0901	35.00	35.46	35.43	1.0914	25.71	25.670	25.43	1.1275
10	17.43	17.42	17.42	1.1372	35.00	35.44	35.40	1.1377	26.03	26.075	25.71	1.1444
12.5	17.41	17.44	17.44	1.1407	35.00	35.45	35.41	1.1405	26.14	26.105	25.96	1.0826
15	9.49	9.49	9.49	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
20	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
25	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
30	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
40	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283
50	9.41	9.41	9.41	1.1811	34.92	34.92	34.92	1.1811	26.45	26.450	26.45	1.0283

*** XBT KALB-1001 ***

Figure C.9.

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T				NUM
	RAX	MEAN	MIN	ST DEV	RAX	MEAN	MIN	ST DEV	RAX	MEAN	MIN	ST DEV	
0	21.07	16.04	12.33	1.4458	34.59	33.63	33.09	2.667	25.29	24.694	24.05	1.646	447 **
10	21.08	15.99	12.37	1.4246	34.60	33.63	33.12	2.654	25.29	24.701	24.02	1.653	447 **
20	21.07	15.94	12.57	1.4524	34.59	33.63	33.05	2.684	25.33	24.716	24.03	1.687	453 **
30	21.05	15.84	11.91	1.5072	34.59	33.63	33.11	2.705	25.33	24.737	24.03	1.705	453 **
50	21.03	15.43	10.52	1.1776	34.60	33.62	33.04	2.707	25.75	24.815	24.02	2.394	432 **
75	19.51	14.50	9.44	2.0375	34.48	33.57	33.05	2.643	25.66	25.077	24.31	3.140	427 **
100	17.40	12.20	6.98	1.5892	34.57	33.54	33.07	2.618	26.18	25.454	24.52	2.425	432 **
125	15.33	11.00	8.89	1.0937	34.53	33.72	33.14	1.843	26.26	25.788	24.81	2.254	424 **
150	13.62	10.24	8.50	0.8370	34.55	33.77	33.23	1.865	26.41	26.041	25.33	1.740	422 **
175	12.07	9.44	7.78	0.7453	34.63	34.11	33.41	1.668	26.56	26.359	25.67	1.436	413 **
200	11.22	8.59	7.11	0.7547	34.67	34.23	33.94	1.478	26.69	26.543	26.21	1.006	410 **
250	10.44	7.39	6.70	0.6970	34.62	34.28	34.02	1.250	26.82	26.664	26.37	0.516	402 **
300	8.97	7.37	6.17	0.5445	34.55	34.34	34.04	0.892	27.00	26.804	26.41	0.342	391 **
400	7.78	6.52	5.58	0.3701	34.56	34.33	34.05	0.656	27.11	26.987	26.75	0.000	374 **
500	6.64	5.79	5.07	0.2656	34.48	34.37	34.15	0.551	27.20	27.009	26.94	0.066	221 **
600	5.59	5.23	4.73	0.2132	34.57	34.35	34.21	0.392	27.29	27.169	27.13	0.000	199 **
800	5.04	4.77	4.47	0.1335	34.52	34.43	34.28	0.430	27.35	27.265	27.15	0.040	126 **
1000	4.60	4.36	4.17	0.1066	34.55	34.46	34.32	0.415	27.41	27.330	27.23	0.039	122 **
1200	4.23	4.04	3.85	0.0896	34.56	34.43	34.31	0.409	27.48	27.343	27.25	0.038	109 **
1400	3.93	3.75	3.58	0.0740	34.59	34.50	34.31	0.397	27.51	27.433	27.27	0.038	96 **
1600	3.66	3.51	3.39	0.0664	34.58	34.52	34.30	0.449	27.53	27.476	27.29	0.039	36 **
1800	3.34	3.27	3.16	0.0495	34.55	34.54	34.33	0.048	27.53	27.513	27.50	0.004	10 **
1900	3.09	3.04	2.94	0.0518	34.57	34.55	34.35	0.078	27.56	27.547	27.54	0.009	6 **
2000	2.90	2.84	2.71	0.0506	34.58	34.57	34.56	0.099	27.59	27.577	27.57	0.005	7 **
2100	2.46	2.41	2.30	0.0432	34.61	34.60	34.59	0.079	27.65	27.647	27.63	0.005	32 **
2200	2.13	2.10	2.06	0.0736	34.63	34.62	34.61	0.069	27.69	27.683	27.67	0.009	7 **
2500	1.81	1.79	1.76	0.0192	34.63	34.63	34.63	0.000	27.73	27.730	27.73	0.000	5 **
3000	1.63	1.62	1.61	0.0000	34.66	34.66	34.66	0.000	27.75	27.750	27.75	0.000	3 **

AREA TEN - SUMMER

0	25.31	19.48	13.62	1.6886	34.44	33.61	33.17	1.866	25.16	23.841	22.56	3.957	386 **
10	25.33	19.22	13.34	1.8954	34.46	33.61	33.15	1.869	25.26	23.841	22.60	3.948	386 **
20	25.23	19.17	12.62	1.6475	34.30	33.59	33.16	1.901	25.40	24.112	22.98	3.755	370 **
30	22.64	17.13	11.32	2.0072	34.23	33.55	33.12	1.911	25.73	24.367	23.11	3.968	369 **
40	19.95	14.91	9.75	1.1240	34.32	33.57	33.17	1.937	26.04	24.651	23.48	3.969	369 **
75	16.42	13.03	8.93	2.0078	34.11	33.52	32.94	1.885	26.25	24.240	24.42	4.073	366 **
100	16.06	11.60	8.71	1.6151	34.30	33.62	33.14	1.917	26.36	25.599	24.75	3.555	364 **
125	13.67	10.18	8.24	1.0606	34.31	33.71	33.20	1.921	26.50	25.806	24.82	3.555	364 **
150	12.14	10.01	8.36	0.8415	34.71	33.93	33.48	2.015	26.56	26.127	25.60	1.945	363 **
175	12.01	9.41	7.68	0.8334	34.71	34.16	33.63	1.707	26.71	26.406	26.10	1.038	360 **
200	11.15	8.45	7.14	0.8001	34.57	34.22	33.92	1.670	26.83	26.563	26.50	0.000	359 **
300	10.79	8.43	6.83	0.8561	34.71	34.31	34.01	1.366	26.88	26.678	26.50	0.010	352 **
400	9.62	7.43	6.20	0.6690	34.64	34.33	34.10	0.951	27.05	26.645	26.67	0.036	345 **
500	8.29	6.57	5.41	0.4633	34.51	34.23	34.01	0.551	27.21	26.983	26.97	0.000	327 **
600	7.03	5.89	5.07	0.3359	34.58	34.38	34.25	0.527	27.27	27.097	26.95	0.078	335 **
700	6.15	5.35	4.69	0.2609	34.58	34.42	34.33	0.526	27.37	27.196	27.07	0.045	91 **
800	5.43	4.85	4.34	0.2164	34.57	34.44	34.34	0.517	27.44	27.271	27.15	0.045	91 **
900	4.88	4.45	4.02	0.1760	34.60	34.47	34.36	0.481	27.44	27.355	27.25	0.078	81 **
1000	4.42	4.11	3.71	0.1325	34.63	34.50	34.36	0.475	27.50	27.392	27.28	0.030	81 **
1100	4.00	3.82	3.51	0.1047	34.63	34.52	34.43	0.472	27.56	27.443	27.33	0.087	68 **
1200	3.78	3.59	3.37	0.1051	34.69	34.55	34.48	0.447	27.59	27.489	27.41	0.072	36 **
1300	3.56	3.34	3.19	0.1350	34.58	34.55	34.50	0.282	27.54	27.514	27.44	0.078	7 **
1400	3.20	3.13	3.01	0.1601	34.57	34.56	34.55	0.282	27.57	27.557	27.51	0.000	4 **
1500	3.01	2.92	2.82	0.0785	34.61	34.56	34.53	0.275	27.60	27.580	27.55	0.024	5 **
1600	2.51	2.46	2.37	0.0640	34.63	34.61	34.58	0.238	27.66	27.637	27.62	0.006	4 **
2000	2.19	2.16	2.12	0.0162	34.65	34.64	34.60	0.073	27.68	27.687	27.66	0.011	3 **
2500	1.84	1.83	1.83	0.0071	34.64	34.63	34.63	0.000	27.71	27.700	27.71	0.000	1 **
3000	1.75	1.75	1.75	0.0000	34.63	34.63	34.63	0.000	27.71	27.710	27.71	0.000	1 **

AREA TEN - SPRING

0	**	19.62	16.20	12.46	1.0444	**	34.54	33.55	33.07	2.033	**	25.48	24.580	23.92	1.972	609
10	**	19.67	16.20	12.14	1.0642	**	34.51	33.54	33.07	2.012	**	25.54	24.594	24.05	1.960	609
20	**	19.66	16.03	11.40	1.1677	**	34.51	33.55	33.07	2.034	**	25.62	24.642	24.07	2.205	593
30	**	19.65	15.95	10.71	1.4069	**	34.56	33.54	33.05	2.066	**	25.78	24.704	24.45	2.225	593
50	**	19.19	14.66	9.67	1.6666	**	34.48	33.52	33.01	2.134	**	26.15	24.901	24.26	2.348	590
75	**	16.81	11.16	9.24	1.0247	**	34.59	33.51	33.03	2.047	**	26.31	25.203	24.37	3.901	586
100	**	17.57	11.72	8.92	1.6522	**	34.26	33.58	33.08	1.989	**	26.51	25.462	24.54	3.901	586
125	**	14.65	10.63	8.55	1.1217	**	34.57	33.73	33.18	2.041	**	26.46	25.862	24.88	2.750	585
150	**	13.12	9.97	8.17	0.8375	**	34.57	33.73	33.37	1.909	**	26.53	26.103	25.43	2.027	550
175	**	12.18	9.31	7.86	0.7806	**	34.67	34.13	33.70	1.607	**	26.83	26.403	26.33	0.000	549
200	**	11.29	8.80	7.25	0.7861	**	34.66	34.24	33.94	1.430	**	26.75	26.569	26.25	0.075	557
300	**	10.38	8.29	6.45	0.7601	**	34.67	34.29	34.00	1.268	**	26.84	26.696	26.48	0.091	549
400	**	9.08	7.30	6.02	0.5657	**	34.62	34.23	34.04	0.893	**	27.00	26.841	26.68	0.048	537
500	**	7.86	6.46	5.03	0.3925	**	34.55	34.15	34.12	0.641	**	27.13	27.002	26.83	0.041	512
600	**	6.47	5.81	5.19	0.2678	**	34.63	34.19	34.19	0.538	**	27.29	27.111	26.96	0.049	291
700	**	5.69	5.25	4.75	0.2114	**	34.65	34.42	34.28	0.468	**	27.36	27.205	27.09	0.071	159
800	**	5.10	4.78	4.28	0.1548	**	34.62	34.44	34.33	0.434	**	27.40	27.279	27.20	0.027	140
900	**	4.65	4.39	3.94	0.1215	**	34.58	34.41	34.36	0.367	**	27.48	27.390	27.32	0.024	133
1000	**	4.27	4.05	3.71	0.1011	**	34.57	34.40	34.36	0.508	**	27.41	27.339	27.25	0.020	140
1100	**	3.95	3.77	3.60	0.2084	**	34.59	34.50	34.42	0.348	**	27.51	27.433	27.36	0.025	98
1200	**	3.66	3.53	3.38	0.0749	**	34.63	34.56	34.44	0.374	**	27.55	27.475	27.40	0.014	47
1300	**	3.41	3.31	3.11	0.0727	**	34.59	34.55	34.51	0.194	**	27.56	27.537	27.48	0.013	16
1400	**	3.17	3.10	2.96	0.0660	**	34.59	34.56	34.55	0.124	**	27.56	27.547	27.53	0.005	13
1500	**	2.97	2.94	2.78	0.0641	**	34.61	34.57	34.55	0.145	**	27.60	27.574	27.55	0.019	13
1750	**	2.58	2.47	2.34	0.0671	**	34.64	34.60	34.57	0.155	**	27.66	27.632	27.61	0.014	13
2000	**	2.23	2.14	2.03	0.0619	**	34.63	34.62	34.59	0.116	**	27.69	27.675	27.65	0.014	11
2500	**	1.65	1.60	1.58	0.0078	**	34.65	34.64	34.63	0.165	**	27.73	27.718	27.69	0.013	6
3000	**	1.66	1.64	1.61	0.0192	**	34.67	34.66	34.66	0.055	**	27.75	27.750	27.75	0.000	5

AREA ELEVEN - WINTER

*** STATISTICAL SUMMARY ***

DEPTH (MI)	TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T			
	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV
0	14.73	11.03	7.29	1.9777	33.59	31.16	19.22	3.7695	25.66	23.769	15.19	2.6609
10	14.71	11.18	7.30	1.6871	33.61	32.07	27.36	1.6788	25.66	24.461	21.34	1.2321
20	14.73	11.17	7.29	1.6579	33.60	32.25	28.46	1.6779	25.65	24.607	22.27	1.0574
30	14.73	11.16	7.30	1.6496	33.59	32.23	29.24	1.6717	25.69	24.671	22.62	1.0392
40	14.71	11.06	7.25	1.6303	33.61	32.43	29.54	1.2287	25.69	24.923	22.87	1.0215
50	14.04	10.32	6.14	1.0874	33.77	32.62	29.77	1.1778	24.21	26.208	22.48	1.0248
75	10.12	9.63	7.05	0.855	33.86	33.01	30.05	1.1777	24.36	25.498	23.16	1.0610
100	10.12	9.63	7.05	0.855	33.86	33.01	30.05	1.1777	24.36	25.498	23.16	1.0610
125	10.47	9.17	7.66	0.5517	33.76	33.35	30.23	1.8708	24.42	25.908	23.26	1.7163
150	10.20	8.72	7.50	0.914	34.01	33.68	30.49	1.6755	24.50	26.144	23.92	1.6272
200	9.00	8.03	6.83	0.193	34.09	33.94	33.63	0.0640	24.63	26.473	26.17	0.0796
250	6.56	7.45	6.02	0.3339	34.17	34.02	33.86	0.0539	24.73	26.600	26.92	0.0612
300	6.02	6.91	5.59	0.1823	34.24	34.26	34.03	0.0555	24.82	26.618	26.92	0.0648
400	6.76	6.06	5.48	0.3584	34.25	34.11	33.94	0.0576	24.98	26.662	26.73	0.0611
500	6.26	5.56	4.93	0.2558	34.28	34.18	34.00	0.0539	24.78	26.190	26.83	0.0607
600	5.45	4.95	4.50	0.1716	34.34	34.30	34.13	0.0533	24.75	27.095	26.92	0.0648
700	4.85	4.56	4.21	0.1523	34.33	34.30	34.10	0.0507	24.72	27.193	27.02	0.0355
800	4.93	4.23	3.60	0.1260	34.34	34.26	34.14	0.0480	24.73	27.249	27.07	0.0378
900	4.16	3.95	3.50	0.1216	34.34	34.40	34.13	0.0533	24.79	27.332	27.11	0.0427
1000	3.88	3.70	3.45	0.1294	34.36	34.43	34.10	0.0464	24.73	27.384	27.12	0.0505
1100	3.69	3.49	3.25	0.1174	34.50	34.45	34.07	0.0785	24.76	27.423	27.12	0.0413
1200	3.27	3.23	3.04	0.1059	34.51	34.38	34.70	0.0707	24.50	27.470	27.42	0.0375
1300	3.13	3.07	2.91	0.0814	34.52	34.50	34.49	0.0103	24.52	27.507	27.49	0.0211
1400	2.95	2.86	2.75	0.0780	34.52	34.52	34.51	0.0075	24.55	27.535	27.52	0.0105
1500	2.78	2.71	2.68	0.0746	34.55	34.54	34.53	0.0088	24.58	27.568	27.55	0.0114
1750	2.36	2.31	2.30	0.0622	34.57	34.57	34.57	0.0000	24.63	27.622	27.62	0.0005
2000	2.07	2.02	1.98	0.0662	34.60	34.60	34.59	0.0045	24.68	27.670	27.68	0.0071
2500	1.78	1.77	1.77	0.0000	34.64	34.63	34.63	0.0058	24.73	27.722	27.71	0.0009
3000	1.64	1.65	1.62	0.0116	34.68	34.65	34.66	0.0068	24.75	27.797	27.75	0.0058

AREA ELEVEN - SUMMER

0	23.85	13.62	7.49	2.0396	35.51	32.00	22.17	2.8376	24.85	23.747	15.92	2.3271
10	23.77	13.67	7.49	2.1767	35.50	32.46	22.48	1.3711	24.85	24.372	21.62	1.179
20	23.85	13.62	7.33	2.5377	35.49	32.61	29.25	1.3008	24.98	24.955	22.55	1.8316
30	23.74	13.52	7.23	2.4851	35.49	32.61	29.38	1.2447	24.96	24.941	22.70	1.8474
40	21.14	12.57	6.41	1.0543	35.49	32.61	29.43	1.0163	24.81	25.008	22.82	1.0459
75	19.76	9.73	7.75	1.0409	35.49	33.02	29.68	1.0271	24.39	25.424	22.94	1.0175
100	19.03	9.25	7.73	1.1662	35.03	33.25	29.80	1.9337	24.50	25.717	23.04	1.794
125	18.67	8.79	7.57	1.0737	34.84	33.71	29.86	1.7388	24.55	26.011	23.07	1.646
150	17.80	8.44	7.28	0.9377	34.84	33.71	29.86	1.6577	24.58	26.210	23.11	1.501
200	14.20	7.85	6.83	0.8889	34.34	33.97	33.59	0.0742	24.66	26.508	25.65	1.1251
250	12.27	7.11	6.50	0.562	34.35	34.07	33.66	0.0652	24.65	26.684	25.94	0.9613
300	10.68	6.83	6.07	0.620	34.30	34.07	33.92	0.0622	24.69	26.724	26.17	0.7778
400	8.12	6.04	5.43	0.394	34.31	34.13	34.00	0.0579	24.70	26.874	26.50	0.5950
500	6.42	5.62	5.07	0.357	34.31	34.16	34.09	0.0588	24.70	26.998	26.73	0.5114
600	5.67	4.96	4.47	0.298	34.31	34.26	34.09	0.0588	24.72	27.112	26.94	0.517
700	5.30	4.58	4.11	0.202	34.36	34.32	34.15	0.0567	24.71	27.204	27.07	0.4994
800	4.70	4.25	3.92	0.167	34.35	34.36	34.23	0.0717	24.73	27.273	27.17	0.4378
900	4.29	3.98	3.77	0.134	34.38	34.30	34.32	0.0410	24.70	27.329	27.26	0.0298
1000	4.01	3.73	3.53	0.120	34.52	34.43	34.36	0.0387	24.75	27.363	27.32	0.0300
1100	3.67	3.77	3.32	0.157	34.57	34.36	34.37	0.0387	24.50	27.435	27.40	0.0374
1200	3.40	3.68	3.10	0.091	34.57	34.49	34.42	0.072	24.53	27.472	27.42	0.0362
1300	3.12	3.05	2.96	0.086	34.60	34.63	34.66	0.0551	24.57	27.527	27.48	0.0503
1500	2.97	2.85	2.80	0.076	34.61	34.56	34.58	0.0494	24.60	27.562	27.48	0.0403
1750	2.82	2.70	2.62	0.083	34.64	34.68	34.55	0.024	24.63	27.595	27.58	0.0238
2000	2.38	2.31	2.25	0.059	34.65	34.61	34.58	0.0311	24.68	27.660	27.66	0.0183
2500	2.09	2.03	1.98	0.045	34.67	34.64	34.62	0.0461	24.73	27.703	27.67	0.0304
3000	1.78	1.76	1.76	0.0000	34.73	34.71	34.69	0.0283	24.79	27.760	27.76	0.0212
3600	1.63	1.63	1.63	0.0000	34.73	34.73	34.73	0.0000	24.80	27.800	27.80	0.0000

AREA ELEVEN - SPRING

0	16.85	12.65	7.45	1.3544	33.66	31.90	20.29	2.9465	24.60	24.067	15.20	2.2684
10	15.25	12.13	6.53	1.3339	33.66	32.47	24.88	1.4774	24.64	24.611	19.02	1.0222
20	14.95	11.41	6.31	1.6471	33.72	32.85	28.86	1.1907	24.66	24.752	22.38	1.0722
30	14.67	11.56	6.41	1.8490	33.68	32.66	29.36	1.1241	24.62	24.845	22.78	1.0722
50	14.17	10.46	6.25	1.4772	33.76	32.85	29.51	1.9653	24.17	25.119	22.87	1.770
75	13.84	10.10	6.02	1.2977	33.77	32.85	29.67	1.7647	24.32	25.373	22.98	1.646
100	13.10	9.35	5.95	0.849	33.96	33.19	29.86	1.6657	24.44	25.464	23.06	1.7206
125	11.30	8.84	7.56	0.923	34.06	33.55	29.96	1.6707	24.57	26.023	23.12	1.522
150	10.76	8.49	7.35	0.930	34.08	33.72	30.05	1.6707	24.63	26.208	23.13	1.522
200	7.30	6.39	5.39	0.386	34.21	34.07	33.67	0.0859	24.73	26.497	26.18	1.018
250	6.51	5.31	4.44	0.390	34.26	34.07	33.66	0.0677	24.79	26.623	26.37	0.719
300	7.72	6.80	6.00	0.358	34.31	34.08	33.76	0.0677	24.86	26.728	26.55	0.719
400	6.79	6.06	5.28	0.376	34.33	34.13	33.96	0.0680	24.70	26.877	26.70	0.466
500	6.44	5.44	4.94	0.260	34.39	34.20	34.05	0.0580	24.72	27.008	26.90	0.332
600	5.32	4.97	4.66	0.173	34.48	34.28	34.13	0.0588	24.73	27.112	27.01	0.0386
700	4.86	4.56	4.00	0.160	34.48	34.28	34.17	0.0518	24.73	27.204	27.09	0.0386
800	4.46	4.21	3.65	0.136	34.48	34.37	34.25	0.0488	24.77	27.281	27.19	0.0313
900	4.15	3.96	3.70	0.171	34.48	34.41	34.32	0.0385	24.70	27.362	27.27	0.0279
1000	3.87	3.69	3.49	0.157	34.52	34.43	34.37	0.0367	24.76	27.391	27.33	0.0277
1100	3.62	3.45	3.21	0.0778	34.54	34.46	34.40	0.0345	24.70	27.433	27.38	0.0269
1200	3.38	3.27	3.12	0.0736	34.53	34.48	34.43	0.0345	24.70	27.468	27.33	0.0269
1300	3.11	3.14	3.08	0.0736	34.54	34.52	34.51	0.0141	24.63	27.612	27.50	0.0126
1400	2.92	2.90	2.88	0.0204	34.54	34.55	34.53	0.0141	24.66	27.592	27.53	0.0126
1500	2.74	2.70	2.67	0.0387	34.54	34.55	34.55	0.0003	24.68	27.672	27.57	0.0126
1750	2.31	2.26	2.26	0.0000	34.59	34.58	34.57	0.0100	24.64	27.630	27.62	0.0100
2000	2.07	2.05	2.03	0.0204	34.61	34.60	34.59	0.0173	24.68	27.667	27.65	0.0153
2500	1.79	1.78	1.78	0.0153	34.65	34.63	34.62	0.0153	24.73	27.720	27.70	0.0173
3000	1.69	1.69	1.69	0.0153	34.66	34.65	34.66	0.0058	24.75	27.750	27.75	0.0050

AREA ELEVEN - FALL

0	18.45	13.61	7.41	2.7597	33.67	31.10	19.00	3.9565	24.66	23.230	14.73	2.8812	114 **
10	18.31	13.61	7.32	2.5365	33.67	32.35	28.68	1.4900	24.64	24.204	19.75	1.7998	114 **
20	18.30	13.61	7.29	1.753	33.67	32.35	28.68	1.4900	24.64	24.2			108 **
30	18.16	12.78	6.96	2.3221	33.67	32.50	30.00	1.2088	25.01	24.992	23.19	1.7260	108 **
40	18.11	11.91	6.03	1.9878	33.78	32.70	30.25	1.0895	25.68	24.995	23.27	1.7800	97 **
50	18.11	11.91	6.03	1.9878	33.78	32.70	30.25	1.0895	25.68	24.995	23.27	1.7800	97 **
60	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
70	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
80	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
90	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
100	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
110	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
120	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
130	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
140	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
150	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
160	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
170	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
180	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
190	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
200	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
210	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
220	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
230	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
240	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
250	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
260	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
270	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
280	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
290	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
300	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
310	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
320	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
330	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
340	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
350	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
360	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
370	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
380	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
390	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
400	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
410	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
420	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
430	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
440	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
450	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
460	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
470	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
480	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
490	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
500	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
510	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
520	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
530	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
540	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
550	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
560	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
570	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
580	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
590	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
600	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
610	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
620	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
630	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
640	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
650	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
660	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
670	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
680	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
690	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
700	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
710	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
720	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
730	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
740	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
750	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
760	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
770	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
780	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
790	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
800	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
810	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
820	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
830	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
840	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
850	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
860	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.9529	97 **
870	18.00	12.26	6.92	1.76	33.97	33.00	30.35	1.1575	26.36	25.563	23.34	1.95	

AREA TWELVE - WINTER												
*** STATISTICAL SUMMARY ***												
TEMPERATURE (C)					SALINITY (PPT)				SIGMA-T			
DEPTH (M)	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV
0	11.69	9.77	7.40	1.7174	32.76	32.56	32.26	1.2577	25.51	25.100	24.87	1.0184
10	11.69	9.75	7.40	1.7225	32.76	32.56	32.27	1.266	25.51	25.105	24.87	1.0184
20	11.88	9.72	7.44	1.7217	32.76	32.56	32.27	1.276	25.52	25.111	24.87	1.138
30	11.87	9.69	7.40	1.7316	32.06	32.57	32.26	1.333	25.53	25.123	24.87	1.137
40	11.80	9.63	7.40	1.7125	32.23	32.41	32.27	1.283	25.53	25.147	24.88	1.01
50	10.72	9.12	7.63	1.6334	32.94	32.94	32.43	1.2847	26.19	26.506	25.04	2.204
75	9.91	8.52	7.66	1.8015	33.81	33.38	32.50	1.2342	26.37	26.796	25.21	1.052
125	9.78	8.35	7.40	1.7402	33.45	33.45	32.97	1.2641	26.49	26.820	25.71	1.132
140	9.76	7.89	7.13	1.3799	33.76	33.00	33.30	0.9026	26.51	26.370	26.02	0.984
200	9.60	7.31	8.67	1.2616	33.05	33.93	33.68	0.455	26.68	26.551	26.23	0.599
250	8.52	6.75	8.81	1.8013	33.06	33.97	33.89	0.638	26.76	26.658	26.35	0.633
300	8.00	6.24	8.63	1.4472	33.07	33.00	33.92	0.107	26.85	26.737	26.88	0.918
400	8.55	6.56	8.70	1.2172	33.14	33.06	33.94	0.313	26.89	26.862	26.73	0.395
500	8.57	6.45	8.68	1.2112	33.12	33.06	33.92	0.312	27.08	26.999	27.00	0.419
600	8.59	6.66	8.13	1.1993	33.25	33.20	33.08	0.289	27.15	27.098	26.90	0.336
700	8.90	6.35	8.03	1.1000	33.32	33.27	33.13	0.295	27.23	27.185	27.06	0.276
800	8.39	6.35	7.63	1.0340	33.37	33.32	33.20	0.283	27.30	27.262	27.16	0.27
900	8.13	3.79	3.51	1.0108	33.43	33.37	33.33	0.200	27.37	27.328	27.27	0.239
1000	3.61	3.53	3.37	0.0828	33.48	33.41	33.37	0.083	27.45	27.386	27.35	0.078
1100	3.58	3.27	3.13	0.271	33.50	33.44	33.42	0.158	27.49	27.433	27.38	0.176
1200	3.40	3.07	2.96	0.622	33.52	33.47	33.44	0.182	27.52	27.475	27.45	0.156
1300	2.98	2.87	2.72	0.0913	33.51	33.49	33.48	0.009	27.53	27.511	27.50	0.097
1400	2.81	2.68	2.55	0.0836	33.53	33.51	33.49	0.038	27.56	27.555	27.53	0.015
1500	2.59	2.50	2.41	0.0551	33.54	33.53	33.51	0.093	27.59	27.574	27.56	0.105
1600	2.40	2.41	2.09	0.407	33.59	33.58	33.56	0.097	27.66	27.600	27.62	0.129
2000	1.95	1.88	1.80	0.219	33.64	33.63	33.61	0.085	27.70	27.686	27.67	0.077
2500	1.78	1.75	1.74	0.118	33.65	33.64	33.63	0.067	27.73	27.722	27.71	0.079
AREA TWELVE - SUMMER												
0	20.26	18.25	9.90	1.4187	33.48	31.50	28.49	0.0276	25.73	23.014	14.96	0.954
10	19.03	15.93	9.91	1.5531	33.59	31.73	28.96	0.7887	25.96	23.245	20.94	0.7821
20	18.57	14.53	8.71	1.8781	33.70	32.20	30.81	0.930	26.16	23.919	22.62	1.01
30	18.42	14.76	7.92	1.7252	33.75	32.49	31.43	0.294	26.16	24.966	22.41	0.520
40	19.35	10.20	7.36	1.2755	33.93	32.66	32.19	0.2561	26.15	25.101	24.19	0.319
75	11.95	8.99	7.19	1.8084	33.96	32.68	32.92	1.081	26.58	25.460	24.97	0.61
100	10.39	8.93	7.04	1.7024	33.93	33.23	32.65	0.907	26.50	25.835	25.18	0.291
125	9.75	8.12	7.05	1.4114	33.95	33.53	32.77	0.2170	26.66	26.124	25.39	0.211
150	9.36	7.89	6.98	1.031	33.98	33.74	33.15	0.448	26.62	26.225	25.71	0.457
200	8.51	6.25	6.63	1.2812	33.97	33.91	33.82	0.058	26.71	26.581	26.57	0.162
250	7.88	6.01	6.08	0.3325	33.68	33.96	33.67	0.078	26.79	26.654	26.59	0.232
300	7.28	6.29	5.55	0.3156	33.13	33.99	33.86	0.330	26.85	26.745	26.58	0.563
400	6.55	6.23	5.68	0.226	33.68	33.99	33.94	0.026	26.86	26.865	26.84	0.035
500	5.83	5.03	5.48	0.2222	33.25	33.13	33.01	0.378	27.08	27.003	26.86	0.334
600	5.43	4.69	4.20	0.1830	33.32	33.20	33.06	0.361	27.20	27.102	26.94	0.333
700	4.89	4.33	3.98	0.1823	33.68	33.27	33.19	0.269	27.50	27.190	27.19	0.137
800	4.47	4.05	3.72	0.2004	33.71	33.33	33.25	0.384	27.57	27.465	27.17	0.231
900	4.16	3.80	3.54	0.1084	33.53	33.37	33.29	0.261	27.45	27.327	27.28	0.226
1000	3.84	3.56	3.27	0.089	33.55	33.41	33.31	0.269	27.45	27.382	27.32	0.076
1100	3.40	3.33	3.15	0.0702	33.55	33.44	33.36	0.293	27.50	27.29	27.36	0.252
1200	3.23	3.10	2.96	0.086	33.57	33.47	33.36	0.105	27.55	27.469	27.37	0.289
1300	3.01	2.92	2.75	0.052	33.55	33.45	33.36	0.198	27.55	27.509	27.46	0.176
1400	2.79	2.72	2.61	0.0524	33.54	33.51	33.48	0.158	27.56	27.536	27.51	0.157
1500	2.62	2.53	2.45	0.0733	33.55	33.53	33.48	0.202	27.59	27.570	27.54	0.163
1750	2.20	2.15	2.08	0.0127	33.55	33.57	33.54	0.019	27.65	27.633	27.64	0.012
2000	1.95	1.92	1.68	0.2233	33.65	33.60	33.57	0.212	27.73	27.692	27.66	0.193
2500	1.77	1.75	1.71	0.0730	33.65	33.64	33.62	0.127	27.73	27.723	27.71	0.095
AREA TWELVE - SPRING												
0	18.36	12.35	8.39	1.9804	32.91	32.05	26.93	0.961	25.30	24.242	19.90	1.0321
10	18.15	12.16	8.50	1.8785	32.96	32.22	27.02	0.431	25.33	24.708	21.40	0.793
20	18.34	11.71	8.34	1.8888	33.08	32.41	30.79	1.380	25.51	24.644	22.69	0.780
30	19.39	11.08	8.19	1.8292	33.10	32.62	31.55	0.949	25.62	24.983	23.32	0.917
40	19.47	9.98	7.69	1.8729	33.32	33.41	32.04	1.498	25.87	25.104	24.42	1.141
75	11.54	9.17	7.19	1.7826	33.57	32.87	32.43	1.202	26.11	25.819	24.92	1.089
100	10.57	8.55	7.38	1.8087	33.59	33.26	32.65	1.055	26.15	25.858	25.45	0.365
125	10.18	8.44	7.39	1.5544	33.94	33.56	32.76	0.901	26.45	26.132	25.59	1.629
150	9.57	7.91	7.17	1.3923	33.76	33.75	33.17	1.239	26.52	26.324	25.81	1.213
200	8.44	7.41	6.50	1.0505	33.59	33.55	33.55	0.049	26.59	26.534	26.49	0.19
250	7.92	6.72	6.82	0.263	33.11	33.95	33.73	0.642	26.78	26.651	26.44	0.533
300	7.35	6.73	5.16	0.357	33.17	33.99	33.67	0.458	26.86	26.744	26.58	0.336
400	6.27	5.98	4.40	0.7096	33.21	33.60	33.65	0.300	27.00	26.884	26.76	0.189
500	6.49	4.77	3.16	0.7876	33.23	33.12	33.00	0.382	27.09	27.003	26.90	0.322
600	5.03	4.59	3.22	1.621	33.21	33.20	33.10	0.313	27.17	27.100	27.02	0.277
700	4.87	4.49	3.96	1.209	33.39	33.27	33.17	0.217	27.27	27.192	27.11	0.230
800	4.36	4.02	3.75	1.006	33.42	33.33	33.19	0.254	27.33	27.248	27.19	0.226
900	4.05	3.76	3.53	0.0731	33.48	33.37	33.25	0.247	27.40	27.331	27.28	0.207
1000	3.77	3.51	3.25	0.093	33.40	33.41	33.33	0.022	27.46	27.487	27.33	0.200
1100	3.50	3.29	3.11	0.0830	33.54	33.45	33.39	0.021	27.51	27.496	27.39	0.191
1200	3.26	3.08	2.91	0.0785	33.51	33.47	33.45	0.114	27.50	27.479	27.46	0.130
1300	2.98	2.89	2.82	0.0567	33.51	33.45	33.45	0.061	27.52	27.513	27.48	0.06
1400	2.77	2.70	2.64	0.0607	33.53	33.62	33.50	0.083	27.56	27.566	27.54	0.072
1500	2.69	2.52	2.46	0.0846	33.55	33.44	33.53	0.065	27.59	27.588	27.56	0.074
1750	2.23	2.14	2.08	0.0493	33.56	33.57	33.57	0.003	27.65	27.647	27.64	0.004
2000	1.93	1.91	1.69	0.151	33.62	33.61	33.60	0.074	27.69	27.685	27.66	0.053
2500	1.78	1.76	1.74	0.117	33.65	33.64	33.63	0.053	27.74	27.725	27.72	0.076
AREA TWELVE - FALL												
0	17.82	13.38	9.96	1.7233	32.98	32.37	31.55	0.2221	24.99	24.489	22.69	0.461
10	17.77	13.34	9.96	1.7177	33.02	32.37	31.51	0.2224	25.12	24.898	22.49	0.426
20	17.73	13.33	9.96	1.7249	33.02	32.37	31.55	0.224	25.15	24.353	22.96	0.426
30	16.93	12.66	7.23	1.6497	33.26	32.66	31.99	0.2357	25.73	24.905	23.39	0.808
40	17.42	10.56	7.95	1.8275	33.56	32.71	32.26	0.777	26.02	25.075	24.16	1.3076
75	13.44	9.96	7.40	1.7338	33.06	33.06	32.43	1.2813	26.27	26.628	26.09	0.727
100	10.58	8.94	7.11	1.								

AREA THIRTEEN - WINTER

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T					NUM
	MAX	MEAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV		
0	19.97	17.99	14.08	1.9833	+	35.25	34.82	33.46	1.0308	+	25.93	25.147	24.60	1.1197	189	+
10	19.97	17.98	14.01	1.9724	+	35.26	34.82	33.66	1.0291	+	25.94	25.152	24.60	1.1197	189	+
20	20.00	17.97	13.82	1.9705	+	35.26	34.83	33.66	1.0291	+	25.94	25.157	24.60	1.1197	188	+
30	20.02	17.96	13.66	1.9705	+	35.25	34.83	33.66	1.0298	+	25.94	25.161	24.60	1.1193	188	+
40	20.00	17.98	13.86	1.9761	+	35.25	34.83	33.66	1.0216	+	25.96	25.165	24.61	1.1197	188	+
50	20.05	17.93	13.66	1.9753	+	35.25	34.83	33.66	1.0216	+	25.96	25.172	24.61	1.1217	188	+
100	19.40	17.81	13.07	1.9100	+	35.22	34.82	33.65	1.0217	+	25.95	25.190	24.64	1.1192	188	+
125	18.97	17.07	12.86	1.9220	+	35.19	34.70	33.67	1.0204	+	25.97	25.279	24.60	1.1211	183	+
150	18.71	16.71	12.60	1.9257	+	35.13	34.67	33.71	1.0250	+	25.96	25.309	24.61	1.1203	184	+
200	18.92	13.27	10.12	1.2558	+	35.22	34.27	33.73	1.0599	+	26.15	26.741	25.27	1.0677	181	+
250	13.37	11.41	9.31	1.6674	+	35.28	34.11	33.85	0.9799	+	26.30	26.025	25.66	1.0683	181	+
300	11.02	10.00	8.00	1.5802	+	35.41	34.07	33.93	0.9398	+	26.41	26.218	25.93	1.0683	181	+
400	8.89	7.92	6.89	1.3574	+	35.12	34.01	33.92	0.9278	+	26.67	26.574	26.38	0.9271	179	+
500	7.94	6.18	5.12	1.2756	+	35.15	34.00	33.81	0.9338	+	26.88	26.757	26.58	0.9476	167	+
600	6.71	5.16	4.08	1.2324	+	35.14	34.00	33.68	0.9378	+	27.01	26.935	26.70	0.9383	152	+
700	6.09	4.65	3.41	1.1764	+	35.24	34.17	33.98	0.9435	+	27.14	27.073	26.95	0.9344	118	+
800	4.55	4.26	3.08	1.1597	+	35.33	34.26	34.05	0.9227	+	27.26	27.174	27.05	0.9318	110	+
900	4.15	3.95	3.67	1.2400	+	35.34	34.16	34.16	0.9374	+	27.34	27.289	27.16	0.9288	99	+
1000	3.87	3.66	3.23	1.1904	+	35.45	34.40	34.33	0.9322	+	27.41	27.365	27.30	0.9235	39	+
1100	3.62	3.45	3.10	1.1933	+	35.49	34.40	34.37	0.9354	+	27.46	27.421	27.36	0.9233	25	+
1200	3.74	3.26	2.90	1.1547	+	35.52	34.48	34.38	0.9388	+	27.50	27.468	27.39	0.9287	17	+
1300	3.21	3.12	2.89	1.0873	+	35.54	34.51	34.42	0.9382	+	27.53	27.501	27.42	0.9291	14	+
1400	3.08	2.95	2.60	1.1176	+	35.55	34.52	34.44	0.9367	+	27.56	27.529	27.45	0.9276	14	+
1500	2.90	2.77	2.35	1.1362	+	35.58	34.53	34.45	0.9383	+	27.59	27.560	27.48	0.9290	14	+
1750	2.45	2.31	2.11	1.281	+	35.58	34.56	34.52	0.9219	+	27.64	27.620	27.58	0.9235	5	+
2000	2.15	2.02	1.93	1.0817	+	35.61	34.60	34.56	0.9219	+	27.68	27.668	27.64	0.9184	5	+
2500	1.78	1.73	1.70	1.0527	+	35.65	34.62	34.58	0.9240	+	27.73	27.710	27.69	0.9143	1	+
3000	1.64	1.57	1.53	0.9586	+	35.66	34.64	34.60	0.9221	+	27.75	27.733	27.71	0.9208	3	+

AREA THIRTEEN - SUMMER

0	26.39	22.25	14.58	1.7136	+	35.54	34.93	32.71	1.3897	+	25.11	24.076	22.40	1.3283	265	+
10	26.31	22.20	12.19	1.5318	+	35.53	34.93	32.75	1.3882	+	25.27	24.120	22.42	1.3284	264	+
20	25.76	21.92	11.71	1.6216	+	35.53	34.96	32.77	1.3799	+	25.44	24.213	22.45	1.3279	264	+
30	25.50	21.55	11.11	1.7633	+	35.52	34.96	32.80	1.3789	+	25.62	24.317	23.17	1.3007	264	+
40	23.25	19.72	9.74	1.2774	+	35.53	34.93	32.83	1.2774	+	25.64	24.723	24.93	1.0683	264	+
50	21.71	18.29	9.20	1.3535	+	35.49	34.77	32.20	1.2796	+	26.12	25.033	24.96	1.1732	611	+
100	19.68	17.63	8.89	1.3399	+	35.25	34.74	33.49	1.2535	+	26.25	25.175	24.92	1.1555	260	+
125	19.09	17.01	8.79	1.2853	+	35.13	34.68	33.71	1.2480	+	26.22	25.271	24.94	1.1555	259	+
150	18.32	16.17	8.00	1.2515	+	35.05	34.57	33.75	1.2489	+	26.35	25.393	25.11	1.1555	259	+
200	14.56	13.46	7.77	1.2494	+	35.68	34.75	33.75	1.0647	+	26.85	26.025	25.33	1.0757	1098	+
250	13.26	11.52	8.99	1.2277	+	35.72	34.74	33.61	0.9838	+	26.85	26.025	25.79	1.0686	25	+
300	11.19	10.43	8.99	1.0542	+	35.35	34.75	34.84	0.9833	+	27.59	27.560	27.40	0.9377	254	+
400	9.07	7.92	5.98	1.0254	+	35.24	34.01	33.84	0.9338	+	26.88	26.530	26.35	0.901	246	+
500	6.90	6.19	5.39	1.2584	+	35.22	34.01	33.64	0.9357	+	27.01	26.764	26.67	0.914	233	+
600	5.95	5.17	4.71	1.0544	+	35.25	34.01	33.64	0.9349	+	27.12	26.896	26.82	0.914	222	+
700	5.29	4.88	4.22	1.1937	+	35.33	34.18	34.05	0.9355	+	27.20	27.078	26.95	0.915	154	+
800	4.73	4.28	3.89	1.0426	+	35.38	34.27	34.16	0.9315	+	27.29	27.197	27.08	0.9217	154	+
900	4.29	3.94	3.29	1.0355	+	35.43	34.29	34.25	0.9335	+	27.36	27.292	27.21	0.912	127	+
1000	3.90	3.66	3.50	1.1170	+	35.76	34.41	34.27	0.9245	+	27.41	27.369	27.27	0.9230	97	+
1100	3.56	3.42	3.20	1.1584	+	35.76	34.41	34.41	0.9175	+	27.49	27.415	27.39	0.9187	6	+
1200	3.33	3.42	3.08	1.0247	+	35.77	34.47	34.47	0.9335	+	27.51	27.470	27.46	0.9187	6	+
1300	4.11	3.00	4.08	0.8864	+	35.53	35.50	34.44	0.9256	+	27.54	27.505	27.48	0.9235	6	+
1400	2.92	2.97	2.64	1.1222	+	35.54	35.52	35.50	0.9182	+	27.56	27.534	27.51	0.9187	6	+
1500	2.75	2.62	2.61	1.0542	+	35.57	35.54	35.51	0.9189	+	27.57	27.546	27.54	0.9230	5	+
1750	2.42	2.29	2.17	1.0327	+	35.61	35.58	35.54	0.9329	+	27.67	27.628	27.60	0.9342	5	+
2000	2.07	2.01	1.99	0.9881	+	35.67	35.60	35.56	0.9362	+	27.73	27.670	27.64	0.9349	5	+
2500	1.48	1.48	1.48	0.9586	+	35.65	35.62	35.59	0.9300	+	27.75	27.717	27.69	0.9348	1	+
3000	1.54	1.53	1.52	0.9100	+	35.66	35.64	35.61	0.9252	+	27.75	27.743	27.73	0.9115	3	+
4000	1.96	1.94	1.94	0.9000	+	35.66	35.66	35.66	0.9000	+	27.76	27.760	27.76	0.9000	1	+
5000	1.54	1.54	1.54	0.9000	+	35.66	35.66	35.66	0.9000	+	27.76	27.760	27.76	0.9000	1	+

AREA THIRTEEN - SPRING

0	23.33	19.26	14.81	1.6083	+	35.50	34.89	33.84	1.2636	+	25.36	24.873	23.43	1.3324	191	+
10	23.11	19.18	14.80	1.5972	+	35.50	34.89	33.80	1.2622	+	25.36	24.879	23.91	1.3152	190	+
20	22.85	19.16	14.77	1.5811	+	35.50	34.89	33.87	1.2786	+	25.36	24.960	23.92	1.3000	190	+
30	22.63	18.74	14.27	1.2057	+	35.50	34.90	33.85	1.2749	+	25.36	25.012	23.98	1.2129	190	+
40	21.98	18.38	13.87	1.2573	+	35.53	34.87	33.88	1.2573	+	25.45	25.103	24.01	1.326	190	+
50	20.72	18.08	13.02	1.9122	+	35.38	34.88	33.86	1.2292	+	25.46	25.173	24.99	1.1001	196	+
60	20.00	17.73	13.18	1.6700	+	35.32	34.84	33.84	1.2119	+	25.55	25.229	24.60	0.9786	196	+
75	19.30	17.40	12.60	1.6502	+	35.25	34.73	33.81	1.2102	+	25.56	25.310	24.60	1.0786	196	+
100	18.75	16.11	12.03	1.1778	+	35.15	34.59	33.80	1.2327	+	25.88	25.618	24.94	1.175	169	+
150	14.08	13.59	10.40	1.3553	+	35.68	34.28	33.75	1.1710	+	26.12	26.244	25.11	1.1563	169	+
200	17.35	11.75	9.47	1.2504	+	35.74	34.31	33.84	0.9677	+	26.28	26.000	25.65	1.0781	197	+
300	14.55	10.42	8.86	1.591	+	35.69	34.11	33.97	0.9430	+	26.42	26.218	26.00	0.933	185	+
400	14.73	8.13	6.89	1.6190	+	35.58	34.03	33.96	0.9492	+	26.67	26.507	26.37	0.9750	175	+
500	12.30	12.20	5.54	1.2624	+	35.76	34.01	33.81	0.9496	+	26.86	26.747	26.63	0.9781	185	+
600	9.50	9.00	4.71	1.3072	+	35.28	34.04	33.98	0.9386	+	27.03	26.910	26.49	0.964	181	+
700	7.50	4.70	4.38	1.2492	+	35.27	34.17	34.07	0.9371	+	27.16	27.073	26.75	0.9626	100	+
800	6.81	3.97	3.89	1.0321	+	35.37	34.11	34.07	0.9321	+	27.26	27.196	26.99	0.973	97	+
900	6.01	3.47	3.47	1.1278	+	35.42	34.35	34.21	0.9207	+	27.38	27.449	27.09	0.9313	88	+
1000	5.91	3.40	3.38	1.1476	+	35.48	34.31	34.24	0.9338	+	27.46	27.530	27.12	0.9250	13	+
1200	5.40	3.20	3.20	1.1600	+	35.50	34.31	34.24	0.9331	+	27.50	27.530	27.12	0.9250	13	+
1300	5.38	3.13	3.15	1.0808	+	35.52	34.50	34.08	0.9124	+	27.50	27.481	27.46	0.9124	14	+
1400	5.22	3.13	3.08	0.9773	+	35.54	34.52	34.51	0.9087	+	27.53	27.515	27.50	0.9000	11	+
1500	5.10	2.90	2.90	1.0800	+	35.56	34.52	34.51	0.9101	+	27.56	27.515	27.50	0.9000	11	+
1600	5.05	2.74	2.74	1.0335	+	35.58	34.55	34.54	0.9087	+	27.58	27.508	27.55	0.9087	11	+
1750	5.00	2.40	2.40	0.9000	+	35.59	34.57	34.59	0.9000	+	27.63	27.430	27.63	0.0000	1	+
2000	5.00	2.10	2.10	0.9000	+	35.62	34.58	34.62	0.9000	+	27.63	27.430	27.63	0.0000	1	+
2500	5.00	1.80	1.80	0.9000	+	35.65	34.65	34.65	0.9000	+	27.73	27.331	27.73	0.0000	1	+
3000	5.00	1.58	1.58	0.9000	+	35.68	34.68	34.68	0.9000	+	27.77	27.375	27.75	0.0000	1	+

[illegible]

	 

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AREA FIFTEEN - WINTER

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T					NCH
	MAX	MEAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV		MAX	MEAN	MIN	ST DEV		
0 **	20.20	18.66	17.05	1.0089 **		35.09	34.61	33.86	0.3400 **		25.03	24.822	24.66	0.0973	23	**
10 **	20.19	18.66	17.05	1.0034 **		35.09	34.61	33.86	0.3424 **		25.03	24.821	24.63	0.0940	23	**
20 **	20.22	18.67	17.06	1.0088 **		35.09	34.62	33.88	0.3384 **		25.02	24.826	24.63	0.0973	23	**
30 **	20.23	18.68	17.06	0.9920 **		35.09	34.63	33.85	0.3304 **		25.00	24.831	24.63	0.0934	23	**
40 **	20.22	18.72	17.07	0.9804 **		35.08	34.66	33.86	0.3296 **		25.00	24.843	24.64	0.0926	23	**
50 **	20.27	18.76	17.11	0.9808 **		35.12	34.67	33.86	0.3320 **		25.00	24.840	24.64	0.0938	23	**
100 **	20.25	18.99	18.33	1.1013 **		35.12	34.67	33.92	0.3178 **		25.14	24.909	24.79	0.0936	23	**
125 **	19.62	17.79	15.50	1.1934 **		35.08	34.61	34.09	0.2706 **		25.29	25.036	24.84	0.1130	23	**
150 **	18.62	17.25	15.17	1.2256 **		34.87	34.50	34.00	0.2516 **		25.58	25.198	24.96	0.1236	23	**
200 **	15.58	13.64	11.30	1.4098 **		34.48	34.15	33.80	0.2218 **		26.91	25.611	25.38	0.1351	23	**
250 **	12.90	11.10	9.40	1.0036 **		35.18	34.03	33.86	0.0988 **		26.26	26.019	25.76	0.1209	23	**
300 **	10.91	9.43	8.28	0.7100 **		35.15	34.01	33.81	0.0891 **		26.51	26.289	26.10	0.1138	23	**
400 **	7.99	7.28	6.59	0.3372 **		35.09	34.01	33.82	0.0527 **		26.77	26.620	26.45	0.0733	23	**
500 **	6.44	5.94	5.51	0.2596 **		35.23	34.09	33.76	0.0412 **		26.96	26.681	26.75	0.0538	21	**
600 **	5.76	5.26	4.90	0.2636 **		34.97	34.20	34.04	0.0778 **		27.19	27.032	26.80	0.0609	16	**
700 **	5.17	4.81	4.61	0.2037 **		35.39	34.30	34.20	0.0589 **		27.23	27.158	27.08	0.086	12	**
800 **	4.65	4.43	4.19	0.1620 **		35.45	34.38	34.32	0.0709 **		27.30	27.267	27.23	0.0261	12	**
900 **	4.28	4.08	3.92	0.1394 **		35.51	34.44	34.43	0.0335 **		27.38	27.384	27.31	0.0226	8	**
1000 **	3.75	3.75	3.75	0.0000 **		34.50	34.50	34.50	0.0000 **		27.43	27.430	27.43	0.0000	1	**
1100 **	3.57	3.57	3.57	0.0000 **		34.53	34.53	34.53	0.0000 **		27.48	27.480	27.48	0.0000	1	**

AREA FIFTEEN - SUMMER

0 **	23.52	21.05	19.29	1.1598 **		35.09	34.62	33.96	0.2997 **		24.65	24.203	23.68	0.2620	47	**
10 **	23.11	20.69	19.27	1.1178 **		35.10	34.62	33.98	0.3041 **		24.65	24.243	23.62	0.2316	47	**
20 **	22.95	20.77	19.33	1.0317 **		35.10	34.63	33.96	0.2897 **		24.66	24.285	23.67	0.2028	47	**
30 **	22.96	20.59	18.92	0.9734 **		35.11	34.64	33.95	0.2745 **		24.68	24.345	23.96	0.1811	47	**
40 **	22.37	19.68	16.86	1.0751 **		35.15	34.63	33.83	0.2865 **		24.84	24.530	23.91	0.1683	46	**
50 **	20.75	18.76	16.96	0.9791 **		35.08	34.60	33.96	0.2972 **		25.08	24.785	24.37	0.1537	46	**
100 **	19.77	18.15	16.84	0.7427 **		35.08	34.62	34.05	0.2221 **		25.18	24.958	24.75	0.0939	46	**
125 **	18.99	17.68	16.10	0.7597 **		35.01	34.60	34.14	0.1981 **		25.20	25.058	24.93	0.0738	46	**
150 **	18.69	18.61	18.58	0.0791 **		34.97	34.61	33.96	0.2211 **		25.37	25.197	25.00	0.0892	23	**
200 **	16.35	13.39	10.77	1.2523 **		34.94	34.09	33.75	0.1911 **		25.88	25.619	25.38	0.1349	44	**
250 **	13.17	10.86	9.29	0.8800 **		35.24	34.00	33.81	0.0879 **		26.27	26.030	25.79	0.1195	44	**
300 **	10.75	9.15	8.18	0.5828 **		35.08	34.00	33.89	0.0582 **		26.45	26.325	26.08	0.0937	38	**
400 **	8.05	7.17	6.41	0.3633 **		35.28	34.05	33.97	0.0422 **		26.78	26.659	26.49	0.0558	41	**
500 **	6.72	5.76	5.55	0.3022 **		35.41	34.12	34.00	0.0770 **		27.05	26.899	26.96	0.0516	39	**
600 **	5.83	5.49	5.00	0.2102 **		35.46	34.23	34.09	0.0721 **		27.20	27.048	26.98	0.0537	38	**
700 **	5.35	4.85	4.53	0.2495 **		35.50	34.32	34.21	0.0400 **		27.30	27.172	27.12	0.0205	25	**
800 **	4.92	4.68	4.20	0.2070 **		35.50	34.39	34.28	0.0550 **		27.36	27.267	27.21	0.0344	25	**
900 **	4.53	4.16	3.82	0.1824 **		35.50	34.44	34.36	0.0336 **		27.40	27.391	27.28	0.0292	23	**
1000 **	4.10	3.66	3.49	0.1591 **		35.51	34.44	34.45	0.0185 **		27.46	27.408	27.37	0.0215	13	**
1100 **	3.83	3.63	3.21	0.1581 **		35.55	34.51	34.50	0.0144 **		27.52	27.456	27.43	0.0254	11	**
1200 **	3.58	3.55	3.37	0.1581 **		35.59	34.53	34.51	0.0188 **		27.55	27.493	27.46	0.0246	11	**
1300 **	3.37	3.25	3.18	0.0915 **		35.58	34.54	34.55	0.0158 **		27.54	27.514	27.50	0.0152	5	**
1400 **	3.18	3.03	2.97	0.0862 **		35.58	34.57	34.55	0.0129 **		27.57	27.555	27.55	0.0129	4	**
1500 **	2.95	2.85	2.78	0.0829 **		35.60	34.59	34.57	0.0128 **		27.57	27.587	27.57	0.0157	4	**
1750 **	2.40	2.45	2.43	0.0242 **		35.62	34.61	34.58	0.0173 **		27.65	27.640	27.62	0.0141	4	**
2000 **	2.14	2.12	2.09	0.0216 **		35.63	34.62	34.61	0.0115 **		27.68	27.675	27.67	0.0056	4	**
2500 **	1.73	1.73	1.73	0.0000 **		35.64	34.64	34.64	0.0000 **		27.73	27.730	27.73	0.0000	1	**
3000 **	1.53	1.53	1.53	0.0000 **		35.66	34.66	34.66	0.0000 **		27.75	27.750	27.75	0.0000	1	**
4000 **	1.50	1.50	1.50	0.0000 **		35.68	34.68	34.68	0.0000 **		27.77	27.770	27.77	0.0000	1	**

AREA FIFTEEN - SPRING

0	**	22.48	19.90	17.93	1.5741	**	35.00	34.73	33.75	0.2945	**	25.04	24.508	24.00	0.3081	22	**
10	**	22.50	19.79	16.97	1.5616	**	35.00	34.73	33.72	0.3009	**	25.10	24.615	24.00	0.2965	22	**
20	**	22.08	19.67	16.95	1.4651	**	35.00	34.73	33.73	0.3028	**	25.16	24.649	24.10	0.2677	22	**
30	**	21.87	18.60	16.97	1.3716	**	35.03	34.73	33.76	0.3032	**	25.16	24.659	24.24	0.2317	22	**
50	**	20.90	16.99	16.75	1.1506	**	35.03	34.70	33.72	0.3037	**	25.13	24.688	24.46	0.1763	22	**
75	**	21.15	16.81	16.71	0.6662	**	35.08	34.75	33.76	0.2949	**	25.25	24.689	24.66	0.1529	22	**
100	**	19.64	16.57	16.75	0.7754	**	35.06	34.76	33.81	0.1873	**	25.19	24.700	24.77	0.1861	22	**
125	**	19.14	17.09	16.25	0.7934	**	35.09	34.68	34.39	0.1969	**	25.28	25.005	24.85	0.1100	22	**
150	**	18.28	16.91	16.62	0.7103	**	34.77	34.55	34.13	0.1683	**	25.44	25.191	24.96	0.1231	22	**
400	**	14.22	13.63	11.61	1.3366	**	34.57	34.17	33.67	0.0735	**	26.60	26.592	26.38	0.1292	22	**
250	**	12.84	11.27	9.27	0.9126	**	35.28	34.07	33.80	0.1134	**	26.16	26.000	25.83	0.0956	20	**
300	**	10.69	9.58	8.36	0.6344	**	35.17	34.03	33.91	0.0553	**	26.39	26.293	26.17	0.0886	20	**
400	**	9.88	7.93	6.78	0.6189	**	35.26	34.07	33.98	0.0579	**	26.66	26.662	26.41	0.0607	20	**
500	**	7.26	6.11	5.67	0.3987	**	35.23	34.12	34.01	0.0577	**	26.91	26.855	26.76	0.0201	18	**
600	**	5.82	5.34	4.63	0.2662	**	35.20	34.21	34.05	0.0403	**	27.07	27.025	26.96	0.0360	20	**
700	**	5.37	4.91	4.62	0.2169	**	35.16	34.31	34.27	0.0242	**	27.18	27.159	27.12	0.0153	18	**
800	**	4.96	4.55	4.30	0.1697	**	35.41	34.38	34.34	0.0183	**	27.27	27.259	27.21	0.0159	16	**
900	**	4.59	4.25	4.05	0.1366	**	35.45	34.43	34.41	0.0132	**	27.35	27.331	27.29	0.0141	14	**
1000	**	4.03	3.91	3.79	0.0941	**	35.50	34.47	34.45	0.0180	**	27.40	27.391	27.37	0.0121	7	**
1100	**	3.81	3.67	3.54	0.0976	**	35.50	34.50	34.50	0.0000	**	27.44	27.444	27.44	0.0000	2	**
1200	**	3.41	3.31	3.31	0.0000	**	35.51	34.51	34.51	0.0000	**	27.48	27.480	27.48	0.0000	1	**
1300	**	3.13	3.13	3.13	0.0000	**	35.53	34.53	34.53	0.0000	**	27.52	27.520	27.52	0.0000	1	**
1400	**	2.85	2.85	2.85	0.0000	**	35.54	34.54	34.54	0.0000	**	27.54	27.540	27.54	0.0000	1	**
1500	**	2.79	2.79	2.79	0.0000	**	35.56	34.56	34.56	0.0000	**	27.57	27.570	27.57	0.0000	1	**
1750	**	2.44	2.44	2.44	0.0000	**	35.59	34.59	34.59	0.0000	**	27.64	27.636	27.63	0.0000	1	**
2000	**	2.15	2.15	2.15	0.0000	**	35.61	34.61	34.61	0.0000	**	27.67	27.670	27.67	0.0000	1	**
2500	**	1.76	1.76	1.76	0.0000	**	35.64	34.64	34.64	0.0000	**	27.73	27.730	27.73	0.0000	1	**
3000	**	1.46	1.46	1.46	0.0000	**	35.66	34.66	34.66	0.0000	**	27.75	27.750	27.75	0.0000	1	**
4000	**	1.50	1.50	1.50	0.0000	**	35.69	34.69	34.69	0.0000	**	27.76	27.760	27.76	0.0000	1	**

		TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T				
DEPTH (M)		HAR	MEAN	MIN	ST DEV		HAR	MEAN	MIN	ST DEV		HAR	MEAN	MIN	ST DEV	NUN
0 **	25.14	23.26	21.07	68.95		35.32	34.67	33.84	13521		24.73	23.423	22.47	48.11	134 **	
10 **	25.14	23.24	21.03	68.84		35.32	34.67	33.83	13512		24.73	23.420	22.47	47.76	136 **	
20 **	25.14	23.20	21.06	68.88		35.33	34.70	33.84	13510		24.73	23.422	22.47	47.71	136 **	
30 **	25.14	23.17	21.03	68.73		35.33	34.73	33.84	13510		24.73	23.424	22.47	47.705	136 **	
40 **	25.14	23.20	21.03	68.95		35.33	34.73	33.84	13510		24.73	23.424	22.47	47.705	136 **	
50 **	26.04	22.89	20.72	68.00		35.37	34.92	34.00	13497		24.76	23.420	22.73	47.379	136 **	
100 **	23.71	21.05	19.02	64.41		35.40	34.10	33.10	13432		24.70	23.108	23.32	47.136	136 **	
125 **	23.17	20.95	19.10	64.00		35.34	34.05	33.43	13433		24.70	23.458	23.44	45.551	134 **	
150 **	22.92	21.65	19.23	63.55		35.29	34.99	34.34	13454		24.645	24.400	24.05	45.727	134 **	
200 **	20.23	19.50	11.21	21.17		35.17	34.67	34.14	13421		24.408	25.174	24.78	45.171	134 **	
250 **	17.71	13.31	8.92	14.98		34.86	34.34	34.11	13445		24.478	25.185	25.23	42.954	134 **	
300 **	15.00	10.97	8.27	12.70		34.67	34.24	34.04	13436		24.647	26.177	25.64	42.503	136 **	
400 **	10.19	8.81	6.21	10.50		34.51	34.21	34.00	13440		24.648	26.400	26.23	42.474	136 **	
500 **	8.80	6.84	4.61	5.57		34.58	34.22	34.01	13445		24.704	26.454	26.41	41.072	134 **	
600 **	7.54	6.70	4.99	4.11		34.59	34.30	34.06	13431		24.719	27.032	26.87	40.706	133 **	
700 **	6.40	5.51	4.02	3.52		34.52	34.34	34.14	13414		24.74	27.143	27.05	40.95	138 **	
800 **	6.77	4.95	4.28	3.97		34.53	34.44	34.29	13429		24.733	27.243	27.18	40.314	128 **	
900 **	6.25	4.17	4.08	3.78		34.53	34.44	34.36	13434		24.737	27.334	27.27	40.266	127 **	
1000 **	4.74	3.17	3.17	3.17		34.53	34.55	34.50	13441		24.743	27.392	27.33	40.177	134 **	
1100 **	4.41	3.86	3.52	3.18		34.56	34.52	34.50	13454		24.748	27.441	27.39	40.218	119 **	
1200 **	4.07	3.55	3.18	3.18		34.55	34.54	34.51	13451		24.762	27.495	27.44	40.188	118 **	
1300 **	3.75	3.54	3.14	3.14		34.55	34.55	34.51	13451		24.755	27.514	27.48	40.184	107 **	
1400 **	3.44	3.12	2.83	2.83		34.61	34.57	34.54	13457		24.759	27.549	27.51	40.148	99 **	
1500 **	3.19	2.91	2.66	2.66		34.61	34.58	34.56	13452		24.761	27.627	27.53	40.180	94 **	
1750 **	2.87	2.87	2.87	2.87		34.61	34.58	34.59	13459		24.66	27.640	27.62	40.07	8	
2000 **	2.20	2.14	2.03	2.03		34.64	34.63	34.62	13462		24.770	27.648	27.68	40.074	8 **	
2500 **	1.84	1.74	1.72	1.72		34.64	34.64	34.65	13465		24.775	27.738	27.73	40.110	5 **	
3000 **	1.48	1.48	1.48	1.48		34.67	34.67	34.67	13467		24.774	27.740	27.74	40.122	4 **	
4000 **	1.44	1.44	1.44	1.44		34.70	34.68	34.64	13471		24.779	27.780	27.75	40.200	4 **	

AREA SIXTEEN - SUMMER

0 **	26.38	26.13	22.83	7.305		35.28	34.84	34.09	12289		24.70	23.210	22.25	43.10	89 **
10 **	26.38	26.10	22.63	7.280		35.28	34.87	34.08	12280		24.70	23.229	22.25	43.36	89 **
20 **	26.13	24.99	22.55	7.20		35.49	34.80	34.20	12315		24.19	23.270	22.81	43.13	89 **
30 **	26.09	24.85	22.62	7.407		35.31	34.90	34.30	12313		24.23	23.223	22.66	43.01	89 **
40 **	26.00	24.39	22.16	7.773		35.38	34.93	34.33	12362		24.36	23.187	22.65	43.883	89 **
74 **	26.51	24.21	21.25	7.551		35.70	34.59	34.51	12505		24.48	23.478	23.03	45.105	89 **
100 **	25.01	22.04	20.09	7.87		35.38	35.04	34.54	11988		24.44	24.245	23.32	43.78	89 **
125 **	22.93	21.02	18.72	8.010		35.32	35.00	34.52	11844		25.00	24.640	24.11	42.236	89 **
150 **	21.67	20.17	18.03	8.29		35.27	35.09	34.32	11840		24.90	24.617	24.33	42.13	89 **
200 **	20.48	19.17	17.00	8.70		35.23	35.73	34.12	12248		24.28	25.310	24.77	45.08	89 **
280 **	16.25	13.57	10.07	14.51		34.91	34.39	34.11	11515		24.56	26.803	26.13	42.23	89 **
300 **	13.92	11.73	8.50	13.12		34.63	34.32	34.03	11671		24.71	26.145	25.77	42.13	89 **
400 **	10.10	8.47	7.14	4.00		34.43	34.17	34.03	11784		24.90	24.567	24.28	41.504	86 **
500 **	8.55	6.81	5.46	4.83		34.59	34.19	33.76	1121		24.702	26.425	26.58	40.78	83 **
600 **	7.34	5.81	4.55	4.05		34.55	34.27	34.05	1123		24.713	27.015	26.48	40.78	83 **
700 **	6.55	6.24	4.64	4.26		34.55	34.35	34.17	10944		24.724	27.111	27.03	40.82	73 **
800 **	5.63	4.81	4.23	3.68		34.55	34.42	34.28	10652		24.732	27.254	27.17	40.310	73 **
900 **	5.18	4.58	3.91	3.51		34.55	34.37	34.32	10742		24.738	27.327	27.23	40.310	73 **
1000 **	4.64	4.12	3.44	3.04		34.55	34.39	34.32	10231		24.744	27.387	27.31	40.27	64 **
1100 **	4.27	3.84	3.05	3.05		34.55	34.51	34.44	10205		24.748	27.437	27.37	40.240	60 **
1200 **	4.00	3.64	3.23	3.13		34.64	34.53	34.53	10211		24.752	27.478	27.46	40.193	55 **
1300 **	3.73	3.32	3.09	3.09		34.68	34.68	34.62	10153		24.754	27.513	27.48	40.171	47 **
1400 **	3.62	3.08	3.00	3.24		34.61	34.56	34.54	10134		24.760	27.547	27.50	40.195	43 **
1500 **	3.07	2.94	2.72	3.11		34.64	34.64	34.54	10204		24.743	27.677	27.61	40.193	43 **
2000 **	2.50	2.50	2.50	2.50		34.64	34.64	34.64	10240		24.767	27.627	27.64	40.198	8 **
3000 **	1.83	1.74	1.69	1.57		34.67	34.65	34.62	10180		24.778	27.730	27.70	40.155	7 **
4000 **	1.78	1.40	1.82	1.82		34.68	34.64	34.64	10197		24.778	27.750	27.71	40.232	4 **
5000 **	1.88	1.97	1.93	1.93		34.68	34.67	34.68	10130		24.778	27.772	27.78	40.120	5 **
8000 **	1.45	1.44	1.43	1.43		34.67	34.67	34.66	10212		24.778	27.770	27.76	40.141	2 **

AREA SIXTEEN - SPRING

0 **	24.10	23.87	21.25	67.88		36.24	34.70	33.08	12644		24.61	23.462	22.59	49.001	184 **
10 **	24.10	23.87	21.29	67.88		36.24	34.71	33.08	12640		24.60	23.477	22.64	49.001	184 **
20 **	24.01	23.72	21.29	68.30		36.28	34.73	33.10	12539		24.60	23.538	22.68	49.74	184 **
30 **	24.02	23.88	21.28	68.62		36.32	34.74	33.18	12575		24.61	23.587	22.73	49.01	184 **
40 **	24.03	23.93	21.29	68.62		36.32	34.74	33.18	12573		24.61	23.587	22.73	49.01	184 **
74 **	26.05	24.48	20.97	7.95		36.33	34.92	34.12	12540		24.91	23.788	22.65	45.551	144 **
100 **	24.51	21.84	19.70	7.98		35.30	35.02	34.26	11927		24.600	24.254	23.12	48.32	184 **
125 **	22.37	21.01	17.70	10.18		35.30	35.04	34.53	11905		24.614	24.258	23.44	48.32	184 **
150 **	22.39	18.50	15.29	10.52		35.30	35.01	34.27	11594		24.614	24.253	23.10	48.32	184 **
200 **	20.40	18.72	11.11	11.71		35.16	34.69	34.17	12388		24.612	25.237	24.62	47.744	183 **
280 **	17.01	13.29	9.34	12.73		34.74	34.64	34.64	12082		24.614	26.177	25.68	42.22	184 **
300 **	14.35	11.07	8.59	11.07		34.57	34.23	34.06	12082		24.614	26.177	25.68	42.22	184 **
400 **	10.00	8.53	7.14	5.84		34.61	34.19	34.13	11511		24.700	24.674	24.28	41.544	161 **
500 **	8.97	8.46	6.78	5.81		34.55	34.21	34.70	11511		24.700	24.674	24.28	41.544	161 **
600 **	7.21	6.49	4.98	4.74		34.55	34.28	34.04	11378		24.718	27.016	26.86	40.725	141 **
700 **	6.53	5.33	4.93	4.10		34.53	34.37	34.19	10818		24.725	27.152	27.01	40.446	154 **
800 **	6.43	4.84	4.16	3.97		34.52	34.34	34.21	10818		24.734	27.255	27.08	40.344	151 **
900 **	5.42	4.95	4.25	3.82		34.53	34.47	34.24	10236		24.				

AREA SEVENTEEN - WINTER

*** STATISTICAL SUMMARY ***

DEPTH (M)	TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T				
	HAS	MEAN	MIN	ST DEV		HAS	MEAN	MIN	ST DEV		HAS	MEAN	MIN	ST DEV	HUM
0	27.60	24.17	24.23	0.000		35.89	34.40	34.30	0.013		23.43	22.489	22.26	0.2799	17 **
10	26.98	24.01	24.27	0.012		35.89	34.38	34.46	0.016		23.42	22.498	22.69	0.2270	6 **
20	26.94	23.60	24.03	0.003		35.88	34.37	34.44	0.014		23.42	22.498	22.69	0.2270	6 **
30	26.92	24.07	24.26	0.007		35.88	34.37	34.44	0.014		23.42	22.498	22.69	0.2270	6 **
40	26.91	23.90	23.63	0.244		35.84	34.37	34.42	0.019		23.38	22.510	22.57	0.2786	6 **
75	26.94	23.60	24.03	0.003		35.88	34.37	34.44	0.014		23.42	22.498	22.69	0.2270	6 **
100	26.93	24.27	24.26	0.000		35.84	34.38	34.40	0.016		23.42	22.498	22.69	0.2270	6 **
125	19.60	14.02	12.17	2.189		34.44	34.08	34.41	0.014		23.31	22.779	22.51	0.6226	6 **
140	17.00	12.00	10.00	2.018		34.44	34.08	34.41	0.014		23.31	22.779	22.51	0.6226	6 **
200	13.50	11.55	10.09	1.476		34.44	34.08	34.41	0.014		23.31	22.779	22.51	0.6226	6 **
280	12.81	10.68	9.57	1.119		34.30	34.08	34.48	0.021		23.31	22.779	22.51	0.6226	6 **
300	11.68	9.30	8.00	1.300		34.14	34.40	34.47	0.022		23.01	22.607	23.03	0.1649	6 **
400	9.60	8.27	6.39	1.400		34.67	34.71	34.61	0.077		22.12	22.443	24.78	0.1227	6 **
500	7.76	7.87	7.14	0.824		34.79	34.67	34.66	0.055		22.17	22.104	27.03	0.6777	6 **
600	6.28	6.38	6.32	0.000		34.64	34.44	34.44	0.000		22.25	22.250	27.25	0.0000	21 **
700	5.67	5.67	5.67	0.000		34.85	34.48	34.48	0.000		27.31	27.310	27.31	0.0000	1 **
800	5.40	5.40	5.40	0.000		34.69	34.69	34.69	0.000		27.40	27.400	27.40	0.0000	6 **
900	5.00	5.00	5.00	0.000		34.71	34.71	34.71	0.000		27.48	27.480	27.48	0.0000	6 **
1000	4.78	4.78	4.78	0.000		34.73	34.73	34.73	0.000		27.46	27.460	27.46	0.0000	6 **
1100	4.98	4.98	4.98	0.000		34.78	34.78	34.78	0.000		27.50	27.500	27.50	0.0000	1 **

AREA SEVENTEEN - SUMMER

DEPTH (M)	TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T				
	HAS	MEAN	MIN	ST DEV		HAS	MEAN	MIN	ST DEV		HAS	MEAN	MIN	ST DEV	HUM
0	27.68	27.19	28.11	0.280		35.90	34.04	32.86	0.428		23.32	21.746	20.78	0.6097	21 **
10	27.60	27.18	28.01	0.381		35.90	34.04	32.86	0.413		23.34	21.747	20.78	0.6119	71 **
20	27.60	27.18	28.01	0.381		35.90	34.04	32.86	0.413		23.34	21.747	20.78	0.6119	71 **
30	27.60	27.18	28.01	0.381		35.90	34.04	32.86	0.413		23.34	21.747	20.78	0.6119	71 **
40	27.67	26.43	24.03	1.002		34.96	34.19	33.21	0.523		23.38	22.242	21.30	0.9524	21 **
50	27.67	26.43	24.03	1.002		34.96	34.19	33.21	0.523		23.38	22.242	21.30	0.9524	21 **
75	27.68	26.43	24.03	1.002		34.96	34.19	33.21	0.523		23.38	22.242	21.30	0.9524	21 **
100	26.20	17.87	11.71	3.247		35.08	34.74	34.48	0.184		24.68	25.001	22.93	1.2785	21 **
125	26.18	16.81	11.19	3.289		35.08	34.74	34.48	0.184		24.68	25.001	22.93	1.2785	21 **
140	26.18	16.81	11.19	3.289		35.08	34.74	34.48	0.184		24.68	25.001	22.93	1.2785	21 **
200	13.58	11.27	10.34	0.721		34.89	34.74	34.61	0.073		24.54	25.161	24.00	0.1491	20 **
280	10.49	10.48	9.92	0.244		34.83	34.74	34.61	0.056		24.78	26.684	24.64	0.5800	21 **
300	10.40	9.98	9.00	0.802		34.82	34.74	34.61	0.058		24.78	26.684	24.64	0.5800	21 **
400	9.41	9.07	8.50	0.880		34.77	34.68	34.61	0.072		24.94	26.870	24.61	0.2488	19 **
500	8.47	7.97	7.87	0.722		34.89	34.62	34.64	0.082		27.07	26.193	24.90	0.5020	20 **
600	7.84	7.18	6.82	0.443		34.82	34.18	34.18	0.247		27.11	27.110	27.00	0.2543	17 **
700	6.41	6.07	5.83	0.281		34.41	34.87	34.81	0.030		27.28	27.217	27.12	0.0492	17 **
800	6.83	6.41	6.14	0.181		34.41	34.87	34.81	0.031		27.34	27.304	27.23	0.0249	16 **
900	6.18	6.48	6.44	0.178		34.41	34.87	34.81	0.028		27.42	27.348	27.30	0.0429	16 **
1000	6.47	6.46	6.22	0.108		34.42	34.87	34.81	0.028		27.48	27.419	27.34	0.0430	16 **
1100	6.34	6.09	5.85	0.181		34.43	34.87	34.81	0.028		27.53	27.444	27.40	0.0430	16 **
1200	6.01	6.18	6.02	0.171		34.44	34.87	34.81	0.027		27.57	27.504	27.44	0.0430	16 **
1300	5.70	5.48	5.24	0.141		34.44	34.87	34.81	0.028		27.59	27.491	27.48	0.0430	16 **
1400	5.61	5.23	5.04	0.141		34.44	34.87	34.81	0.028		27.59	27.491	27.48	0.0430	16 **
1500	5.20	5.01	4.85	0.142		34.44	34.87	34.81	0.028		27.59	27.491	27.48	0.0430	16 **
1780	2.70	2.54	2.52	0.000		34.67	34.67	34.67	0.000		27.70	27.700	27.60	0.0323	12 **
2000	2.30	2.19	2.11	0.054		34.68	34.68	34.68	0.000		27.73	27.703	27.68	0.0430	12 **
1800	1.82	1.88	1.82	0.000		34.68	34.68	34.68	0.000		27.73	27.703	27.68	0.0430	12 **
1900	1.72	1.72	1.72	0.000		34.68	34.68	34.68	0.000		27.73	27.703	27.68	0.0430	12 **
2000	1.38	1.38	1.38	0.000		34.64	34.64	34.64	0.000		27.78	27.780	27.78	0.0000	1 **

AREA SEVENTEEN - SPRING

0	**	26.38	27.64	26.86	0.094	**	34.76	34.34	33.02	0.102	**	22.48	22.094	21.10	1.3442	26	**
10	**	26.24	27.14	26.86	0.258	**	34.76	34.34	33.02	0.102	**	22.47	22.088	21.14	1.3442	26	**
20	**	26.24	27.14	26.86	0.258	**	34.76	34.34	33.02	0.102	**	22.47	22.088	21.14	1.3442	26	**
30	**	26.23	27.17	24.21	0.776	**	35.01	34.46	33.76	0.264	**	22.20	22.294	21.46	0.9757	26	**
40	**	27.68	26.43	24.03	1.002	**	34.96	34.19	33.21	0.523	**	23.38	22.242	21.30	0.9524	21	**
50	**	27.68	26.43	24.03	1.002	**	34.96	34.19	33.21	0.523	**	23.38	22.242	21.30	0.9524	21	**
75	**	27.51	20.93	12.82	4.856	**	35.04	34.72	33.84	1.237	**	24.21	24.218	21.90	2.6555	26	**
100	**	23.21	16.11	11.89	3.604	**	34.76	34.74	34.61	0.116	**	24.68	25.001	22.93	1.2785	26	**
125	**	18.11	11.40	10.68	0.684	**	34.68	34.74	34.61	0.058	**	24.68	25.001	22.93	1.2785	26	**
140	**	16.23	12.21	10.79	1.074	**	34.74	34.73	34.62	0.089	**	24.62	24.353	24.81	0.2248	26	**
200	**	13.24	10.87	10.04	0.726	**	34.70	34.73	34.62	0.078	**	24.74	24.604	24.44	0.0986	23	**
300	**	11.28	10.18	9.44	0.748	**	34.63	34.74	34.61	0.108	**	24.63	24.714	24.60	0.0430	18	**
400	**	10.70	9.77	9.23	0.543	**	34.77	34.70	34.61	0.084	**	24.84	24.776	24.67	0.0524	16	**
500	**	9.81	8.41	8.81	0.285	**	34.68	34.68	34.61	0.082	**	24.94	24.640	24.74	0.0430	16	**
600	**	8.71	8.44	8.97	0.194	**	34.64	34.60	34.68	0.027	**	27.02	26.944	26.91	0.0423	8	**
700	**	8.00	7.22	7.00	0.445	**	34.58	34.67	34.64	0.094	**	27.14	27.004	27.07	0.0223	7	**
800	**	8.28	8.11	8.68	0.183	**	34.56	34.54	34.62	0.077	**	27.23	27.194	27.17	0.0215	7	**
900	**	8.43	8.46	8.18	0.286	**	34.55	34.54	34.63	0.090	**	27.30	27.274	27.25	0.0180	7	**
1000	**	8.08	8.46	8.41	0.080	**	34.58	34.58	34.62	0.096	**	27.37	27.339	27.32	0.0195	7	**
1100	**	8.68	8.46	8.41	0.080	**	34.58	34.58	34.60	0.021	**	27.43	27.347	27.33	0.0315	7	**
1200	**	8.34	8.34	8.21	0.080	**	34.58	34.58	34.62	0.090	**	27.45	27.433	27.41	0.0143	6	**
1300	**	8.69	8.88	8.57	0.774	**	34.50	34.57	34.66	0.140	**	27.53	27.410	27.40	0.0124	6	**
1400	**	8.47	8.13	8.24	0.085	**	34.60	34.68	34.61	0.047	**	27.54	27.538	27.54	0.0000	6	**
1500	**	8.28	8.11	8.03	0.078	**	34.61	34.68	34.67	0.047	**	27.58	27.547	27.54	0.0178	6	**
1750	**	2.61	2.60	2.68	0.013	**	34.62	34.61	34.61	0.056	**	27.63	27.620	27.63	0.0000	3	**
1800	**	2.28	2.24	2.17	0.008	**	34.64	34.63	34.62	0.040	**	27.67	27.640	27.67	0.0100	3	**
1900	**	1.71	1.61	1.61	0.000	**	34.64	34.64	34.64	0.040	**	27.74	27.748	27.74	0.0000	3	**
2000	**	1.20	1.19	1.49	0.071	**	34.60	34.67	34.66	0.014	**	27.76	27.686	27.75	0.0071	2	**

TEMPERATURE (C)					SALINITY (PPT)					SIGMA-T				
DEPTH (M)	NAS	NAM	MIN	ST DEV	NAS	NAM	MIN	ST DEV	NAS	NAM	MIN	ST DEV	MUN	
0	20.43	16.78	12.69	1.3118	35.79	33.79	33.20	1.2563	24.98	24.446	24.18	1.705	123	
10	20.49	16.77	14.00	1.3049	35.84	33.78	33.20	1.2574	25.06	24.443	24.18	1.718	122	
20	20.43	16.78	13.66	1.3118	35.84	33.78	33.20	1.2574	25.06	24.443	24.18	1.718	122	
30	20.43	16.73	13.66	1.3173	35.83	33.80	33.18	1.2587	25.03	24.444	24.18	1.730	120	
40	20.45	16.67	13.80	1.3387	35.82	33.69	33.18	1.2626	25.06	24.445	24.20	1.762	120	
50	20.43	16.70	13.66	1.3118	35.83	33.78	33.20	1.2574	25.06	24.443	24.18	1.718	122	
100	20.43	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
140	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
180	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
200	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
220	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
240	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
260	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
280	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
300	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
320	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
340	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
360	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
380	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
400	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
420	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
440	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
460	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
480	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
500	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
520	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
540	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
560	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
580	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
600	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
620	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
640	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
660	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
680	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
700	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
720	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
740	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
760	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
780	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
800	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
820	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
840	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
860	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
880	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
900	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
920	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
940	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
960	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
980	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	
1000	19.14	16.66	13.62	1.2946	35.78	33.77	33.04	1.2475	24.96	24.444	24.20	1.690	120	

AREA EIGHTEEN - SUMMER																
0	**	28.00	1.71	14.44	1.4929	**	3.78	23.83	33.18	1.3165	**	2.92	23.96	21.02	2.931	18.9
10	**	27.96	1.70	14.44	1.3743	**	3.76	23.62	33.18	1.3163	**	2.93	23.97	21.02	2.970	15.8
20	**	27.92	1.69	14.44	1.2557	**	3.74	23.41	33.18	1.3161	**	2.94	23.97	21.02	2.978	12.6
30	**	27.88	1.67	14.44	1.1370	**	3.75	23.20	33.18	1.3159	**	2.95	23.97	21.02	2.978	15.8
40	**	27.84	1.66	14.44	1.0184	**	3.76	23.00	33.20	1.3222	**	2.96	24.08	22.31	2.998	19.1
50	**	27.80	1.65	14.44	0.8997	**	3.77	22.80	33.20	1.3285	**	2.97	24.19	23.60	3.018	22.4
60	**	28.80	1.64	12.13	1.7079	**	3.79	23.68	32.20	1.2772	**	2.98	24.36	22.02	3.021	15.8
70	**	28.76	1.63	10.82	1.5893	**	3.77	23.53	32.26	1.3355	**	2.99	25.02	23.65	3.024	15.8
80	**	28.72	1.62	9.51	1.4707	**	3.78	23.32	32.30	1.3428	**	2.99	25.02	23.65	3.024	15.8
90	**	28.68	1.61	8.20	1.3521	**	3.79	23.11	32.34	1.3501	**	2.99	25.02	23.65	3.024	15.8
100	**	28.64	1.60	6.89	1.2335	**	3.80	22.90	32.38	1.3574	**	2.99	25.02	23.65	3.024	15.8
110	**	28.60	1.59	5.58	1.1149	**	3.81	22.69	32.42	1.3647	**	2.99	25.02	23.65	3.024	15.8
120	**	28.56	1.58	4.27	1.0000	**	3.82	22.48	32.46	1.3720	**	2.99	25.02	23.65	3.024	15.8
130	**	28.52	1.57	2.96	0.8814	**	3.83	22.27	32.50	1.3793	**	2.99	25.02	23.65	3.024	15.8
140	**	28.48	1.56	1.65	0.7628	**	3.84	22.06	32.54	1.3866	**	2.99	25.02	23.65	3.024	15.8
150	**	28.44	1.55	0.34	0.6442	**	3.85	21.85	32.58	1.3939	**	2.99	25.02	23.65	3.024	15.8
160	**	28.40	1.54	0.03	0.5256	**	3.86	21.64	32.62	1.4012	**	2.99	25.02	23.65	3.024	15.8
170	**	28.36	1.53	0.00	0.4070	**	3.87	21.43	32.66	1.4085	**	2.99	25.02	23.65	3.024	15.8
180	**	28.32	1.52	0.00	0.2884	**	3.88	21.22	32.70	1.4158	**	2.99	25.02	23.65	3.024	15.8
190	**	28.28	1.51	0.00	0.1698	**	3.89	21.01	32.74	1.4231	**	2.99	25.02	23.65	3.024	15.8
200	**	28.24	1.50	0.00	0.0512	**	3.90	20.80	32.78	1.4304	**	2.99	25.02	23.65	3.024	15.8
210	**	28.20	1.49	0.00	0.0000	**	3.91	20.59	32.82	1.4377	**	2.99	25.02	23.65	3.024	15.8
220	**	28.16	1.48	0.00	0.0000	**	3.92	20.38	32.86	1.4450	**	2.99	25.02	23.65	3.024	15.8
230	**	28.12	1.47	0.00	0.0000	**	3.93	20.17	32.90	1.4523	**	2.99	25.02	23.65	3.024	15.8
240	**	28.08	1.46	0.00	0.0000	**	3.94	19.96	32.94	1.4596	**	2.99	25.02	23.65	3.024	15.8
250	**	28.04	1.45	0.00	0.0000	**	3.95	19.75	32.98	1.4669	**	2.99	25.02	23.65	3.024	15.8
260	**	28.00	1.44	0.00	0.0000	**	3.96	19.54	33.02	1.4742	**	2.99	25.02	23.65	3.024	15.8
270	**	27.96	1.43	0.00	0.0000	**	3.97	19.33	33.06	1.4815	**	2.99	25.02	23.65	3.024	15.8
280	**	27.92	1.42	0.00	0.0000	**	3.98	19.12	33.10	1.4888	**	2.99	25.02	23.65	3.024	15.8
290	**	27.88	1.41	0.00	0.0000	**	3.99	18.91	33.14	1.4961	**	2.99	25.02	23.65	3.024	15.8
300	**	27.84	1.40	0.00	0.0000	**	4.00	18.70	33.18	1.5034	**	2.99	25.02	23.65	3.024	15.8
310	**	27.80	1.39	0.00	0.0000	**	4.01	18.49	33.22	1.5107	**	2.99	25.02	23.65	3.024	15.8
320	**	27.76	1.38	0.00	0.0000	**	4.02	18.28	33.26	1.5180	**	2.99	25.02	23.65	3.024	15.8
330	**	27.72	1.37	0.00	0.0000	**	4.03	18.07	33.30	1.5253	**	2.99	25.02	23.65	3.024	15.8
340	**	27.68	1.36	0.00	0.0000	**	4.04	17.86	33.34	1.5326	**	2.99	25.02	23.65	3.024	15.8
350	**	27.64	1.35	0.00	0.0000	**	4.05	17.65	33.38	1.5399	**	2.99	25.02	23.65	3.024	15.8
360	**	27.60	1.34	0.00	0.0000	**	4.06	17.44	33.42	1.5472	**	2.99	25.02	23.65	3.024	15.8
370	**	27.56	1.33	0.00	0.0000	**	4.07	17.23	33.46	1.5545	**	2.99	25.02	23.65	3.024	15.8
380	**	27.52	1.32	0.00	0.0000	**	4.08	17.02	33.50	1.5618	**	2.99	25.02	23.65	3.024	15.8
390	**	27.48	1.31	0.00	0.0000	**	4.09	16.81	33.54	1.5691	**	2.99	25.02	23.65	3.024	15.8
400	**	27.44	1.30	0.00	0.0000	**	4.10	16.60	33.58	1.5764	**	2.99	25.02	23.65	3.024	15.8
410	**	27.40	1.29	0.00	0.0000	**	4.11	16.39	33.62	1.5837	**	2.99	25.02	23.65	3.024	15.8
420	**	27.36	1.28	0.00	0.0000	**	4.12	16.18	33.66	1.5910	**	2.99	25.02	23.65	3.024	15.8
430	**	27.32	1.27	0.00	0.0000	**	4.13	15.97	33.70	1.5983	**	2.99	25.02	23.65	3.024	15.8
440	**	27.28	1.26	0.00	0.0000	**	4.14	15.76	33.74	1.6056	**	2.99	25.02	23.65	3.024	15.8
450	**	27.24	1.25	0.00	0.0000	**	4.15	15.55	33.78	1.6129	**	2.99	25.02	23.65	3.024	15.8
460	**	27.20	1.24	0.00	0.0000	**	4.16	15.34	33.82	1.6202	**	2.99	25.02	23.65	3.024	15.8
470	**	27.16	1.23	0.00	0.0000	**	4.17	15.13	33.86	1.6275	**	2.99	25.02	23.65	3.024	15.8
480	**	27.12	1.22	0.00	0.0000	**	4.18	14.92	33.90	1.6348	**	2.99	25.02	23.65	3.024	15.8
490	**	27.08	1.21	0.00	0.0000	**	4.19	14.71	33.94	1.6421	**	2.99	25.02	23.65	3.024	15.8
500	**	27.04	1.20	0.00	0.0000	**	4.20	14.50	33.98	1.6494	**	2.99	25.02	23.65	3.024	15.8
510	**	27.00	1.19	0.00	0.0000	**	4.21	14.29	34.02	1.6567	**	2.99	25.02	23.65	3.024	15.8
520	**	26.96	1.18	0.00	0.0000	**	4.22	14.08	34.06	1.6640	**	2.99	25.02	23.65	3.024	15.8
530	**	26.92	1.17	0.00	0.0000	**	4.23	13.87	34.10	1.6713	**	2.99	25.02	23.65	3.024	15.8
540	**	26.88	1.16	0.00	0.0000	**	4.24	13.66	34.14	1.6786	**	2.99	25.02	23.65	3.024	15.8
550	**	26.84	1.15	0.00	0.0000	**	4.25	13.45	34.18	1.6859	**	2.99	25.02	23.65	3.024	15.8
560	**	26.80	1.14	0.00	0.0000	**	4.26	13.24	34.22	1.6932	**	2.99	25.02	23.65	3.024	15.8
570	**	26.76	1.13	0.00	0.0000	**	4.27	13.03	34.26	1.7005	**	2.99	25.02	23.65	3.024	15.8
580	**	26.72	1.12	0.00	0.0000	**	4.28	12.82	34.30	1.7078	**	2.99	25.02	23.65	3.024	15.8
590	**	26.68	1.11	0.00	0.0000	**	4.29	12.61	34.34	1.7151	**	2.99	25.02	23.65	3.024	15.8
600	**	26.64	1.10	0.00	0.0000	**	4.30	12.40	34.38	1.7224	**	2.99	25.02	23.65	3.024	15.8
610	**	26.60	1.09	0.00	0.0000	**	4.31	12.19	34.42	1.7297	**	2.99	25.02	23.65	3.024	15.8
620	**	26.56	1.08	0.00	0.0000	**	4.32	11.98	34.46	1.7370	**	2.99	25.02	23.65	3.024	15.8
630	**	26.52	1.07	0.00	0.0000	**	4.33	11.77	34.50	1.7443	**	2.99	25.02	23.65	3.024	15.8
640	**	26.48	1.06	0.00	0.0000	**	4.34	11.56	34.54	1.7516	**	2.99	25.02	23.65	3.024	15.8
650	**	26.44	1.05	0.00	0.0000	**	4.35	11.35	34.58	1.7589	**	2.99	25.02	23.65	3.024	15.8
660	**	26.40	1.04	0.00	0.0000	**	4.36	11.14	34.62	1.7662	**	2.99	25.02	23.65	3.024	15.8
670	**	26.36	1.03	0.00	0.0000	**	4.37	10.93	34.66	1.7735	**	2.99	25.02	23.65	3.024	15.8
680	**	26.32	1.02	0.00	0.0000	**	4.38	10.72	34.70	1.7808	**	2.99	25.02	23.65	3.024	15.8
690	**	26.28	1.01	0.00	0.0000	**	4.39	10.51	34.74	1.7881	**	2.99	25.02	23.65	3.024	15.8
700	**	26.24	1.00	0.00	0.0000	**	4.40	10.30	34.78	1.7954	**	2.99	25.02	23.65	3.024	15.8
710	**	26.20	0.99	0.00	0.0000	**	4.41	10.09	34.82	1.8027	**	2.99	25.02	23.65	3.024	15.8
720	**	26.16	0.98	0.00	0.0000	**	4.42	9.88	34.86	1.8100	**	2.99	25.02	23.65	3.024	15.8
730	**	26.12	0.97	0.00	0.0000	**	4.43	9.67	34.90	1.8173	**	2.99	25.02	23.65	3.024	15.8
740	**	26.08	0.96	0.00	0.0000	**	4.44	9.46	34.94	1.8246	**	2.99	25.02	23.65	3.024	15.8
750	**	26.04	0.95	0.00	0.0000	**	4.45	9.25	34.98	1.8319	**	2.99	25.02	23.65	3.024	15.8
760	**	26.00	0.94	0.00	0.0000	**	4.46	9.04	35.02	1.8392	**	2.99	25.02	23.65	3.024	15.8
770	**	25.96	0.93	0.00	0.0000	**	4.47	8.83	35.06	1.8465	**	2.99	25.02	23.65	3.024	15.8
780	**	25.92	0.92	0.00	0.0000	**	4.48	8.62	35.10	1.8538	**	2.99	25.02	23.65	3.024	15.8
790	**	25.88	0.91	0.00	0.0000	**	4.49	8.41	35.14	1.8611	**	2.99	25.02	23.65	3.024	15.8
800	**	25.84	0.90	0.00	0.0000</											

AREA EIGHTEEN - SPRING

0	**	1.56	1.44	1.43	1.05	**	34.41	33.75	33.71	2.79	**	25.03	24.83	24.00	**132	185
10	**	1.48	1.47	1.41	1.07	**	34.61	33.75	33.17	2.79	**	25.02	24.83	24.00	**137	185
20	**	1.43	1.40	1.41	1.06	**	34.81	33.75	33.12	2.78	**	25.01	24.81	24.20	**140	182
30	**	1.40	1.38	1.39	1.05	**	35.01	33.75	33.10	2.78	**	25.00	24.80	24.20	**142	180
40	**	1.38	1.39	1.32	1.31	**	35.21	33.74	33.06	2.78	**	25.00	24.81	24.20	**145	178
50	**	1.36	1.38	1.30	1.28	**	35.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**148	176
60	**	1.34	1.36	1.28	1.25	**	35.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**151	174
70	**	1.32	1.34	1.26	1.23	**	35.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**154	172
80	**	1.30	1.32	1.24	1.21	**	36.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**157	170
90	**	1.28	1.30	1.22	1.19	**	36.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**160	168
100	**	1.26	1.28	1.20	1.17	**	36.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**163	166
110	**	1.24	1.26	1.18	1.15	**	36.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**166	164
120	**	1.22	1.24	1.16	1.13	**	36.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**169	162
130	**	1.20	1.22	1.14	1.11	**	37.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**172	160
140	**	1.18	1.20	1.12	1.09	**	37.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**175	158
150	**	1.16	1.18	1.10	1.07	**	37.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**178	156
160	**	1.14	1.16	1.08	1.05	**	37.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**181	154
170	**	1.12	1.14	1.06	1.03	**	37.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**184	152
180	**	1.10	1.12	1.04	1.01	**	38.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**187	150
190	**	1.08	1.10	1.02	0.99	**	38.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**190	148
200	**	1.06	1.08	1.00	0.97	**	38.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**193	146
210	**	1.04	1.06	0.98	0.95	**	38.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**196	144
220	**	1.02	1.04	0.96	0.93	**	38.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**199	142
230	**	1.00	1.02	0.94	0.91	**	39.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**202	140
240	**	0.98	1.00	0.92	0.89	**	39.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**205	138
250	**	0.96	0.98	0.90	0.87	**	39.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**208	136
260	**	0.94	0.96	0.88	0.85	**	39.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**211	134
270	**	0.92	0.94	0.86	0.83	**	39.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**214	132
280	**	0.90	0.92	0.84	0.81	**	40.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**217	130
290	**	0.88	0.90	0.82	0.79	**	40.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**220	128
300	**	0.86	0.88	0.80	0.77	**	40.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**223	126
310	**	0.84	0.86	0.78	0.75	**	40.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**226	124
320	**	0.82	0.84	0.76	0.73	**	40.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**229	122
330	**	0.80	0.82	0.74	0.71	**	41.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**232	120
340	**	0.78	0.80	0.72	0.69	**	41.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**235	118
350	**	0.76	0.78	0.70	0.67	**	41.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**238	116
360	**	0.74	0.76	0.68	0.65	**	41.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**241	114
370	**	0.72	0.74	0.66	0.63	**	41.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**244	112
380	**	0.70	0.72	0.64	0.61	**	42.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**247	110
390	**	0.68	0.70	0.62	0.59	**	42.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**250	108
400	**	0.66	0.68	0.60	0.57	**	42.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**253	106
410	**	0.64	0.66	0.58	0.55	**	42.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**256	104
420	**	0.62	0.64	0.56	0.53	**	42.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**259	102
430	**	0.60	0.62	0.54	0.51	**	43.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**262	100
440	**	0.58	0.60	0.52	0.49	**	43.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**265	98
450	**	0.56	0.58	0.50	0.47	**	43.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**268	96
460	**	0.54	0.56	0.48	0.45	**	43.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**271	94
470	**	0.52	0.54	0.46	0.43	**	43.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**274	92
480	**	0.50	0.52	0.44	0.41	**	44.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**277	90
490	**	0.48	0.50	0.42	0.39	**	44.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**280	88
500	**	0.46	0.48	0.40	0.37	**	44.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**283	86
510	**	0.44	0.46	0.38	0.35	**	44.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**286	84
520	**	0.42	0.44	0.36	0.33	**	44.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**289	82
530	**	0.40	0.42	0.34	0.31	**	45.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**292	80
540	**	0.38	0.40	0.32	0.29	**	45.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**295	78
550	**	0.36	0.38	0.30	0.27	**	45.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**298	76
560	**	0.34	0.36	0.28	0.25	**	45.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**301	74
570	**	0.32	0.34	0.26	0.23	**	45.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**304	72
580	**	0.30	0.32	0.24	0.21	**	46.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**307	70
590	**	0.28	0.30	0.22	0.19	**	46.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**310	68
600	**	0.26	0.28	0.20	0.17	**	46.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**313	66
610	**	0.24	0.26	0.18	0.15	**	46.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**316	64
620	**	0.22	0.24	0.16	0.13	**	46.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**319	62
630	**	0.20	0.22	0.14	0.11	**	47.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**322	60
640	**	0.18	0.20	0.12	0.09	**	47.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**325	58
650	**	0.16	0.18	0.10	0.07	**	47.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**328	56
660	**	0.14	0.16	0.08	0.05	**	47.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**331	54
670	**	0.12	0.14	0.06	0.03	**	47.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**334	52
680	**	0.10	0.12	0.04	0.01	**	48.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**337	50
690	**	0.08	0.10	0.02	0.00	**	48.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**340	48
700	**	0.06	0.08	0.00	0.00	**	48.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**343	46
710	**	0.04	0.06	0.00	0.00	**	48.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**346	44
720	**	0.02	0.04	0.00	0.00	**	48.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**349	42
730	**	0.00	0.02	0.00	0.00	**	49.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**352	40
740	**	0.00	0.00	0.00	0.00	**	49.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**355	38
750	**	0.00	0.00	0.00	0.00	**	49.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**358	36
760	**	0.00	0.00	0.00	0.00	**	49.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**361	34
770	**	0.00	0.00	0.00	0.00	**	49.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**364	32
780	**	0.00	0.00	0.00	0.00	**	50.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**367	30
790	**	0.00	0.00	0.00	0.00	**	50.21	33.75	33.03	2.78	**	25.00	24.80	24.20	**370	28
800	**	0.00	0.00	0.00	0.00	**	50.41	33.75	33.03	2.78	**	25.00	24.80	24.20	**373	26
810	**	0.00	0.00	0.00	0.00	**	50.61	33.75	33.03	2.78	**	25.00	24.80	24.20	**376	24
820	**	0.00	0.00	0.00	0.00	**	50.81	33.75	33.03	2.78	**	25.00	24.80	24.20	**379	22
830	**	0.00	0.00	0.00	0.00	**	51.01	33.75	33.03	2.78	**	25.00	24.80	24.20	**382	20

6064 ÉJENYÉN - PÁLL

10	**	23.06	19.93	14.07	2272	**	35.56	33.81	33.12	*3731	**	24.77	24.00	23.48	*2547	135	**
20	**	22.07	19.37	14.09	12156	**	34.58	33.80	33.12	*3717	**	24.87	24.015	23.52	*2711	114	**
30	**	21.08	18.37	14.10	10156	**	33.59	33.81	33.12	*3703	**	24.93	24.028	23.52	*2684	114	**
40	**	22.10	19.25	13.83	12281	**	34.55	33.81	33.12	*3711	**	24.89	24.038	23.52	*2684	114	**
50	**	21.06	18.37	14.26	14813	**	34.79	33.79	33.12	*3733	**	24.83	24.240	23.46	*2376	114	**
60	**	21.06	18.37	14.26	14813	**	34.79	33.79	33.12	*3733	**	24.83	24.240	23.46	*2376	114	**
70	**	16.96	11.17	6.66	17904	**	34.76	33.73	33.05	*3712	**	24.76	24.488	24.13	*2268	114	**
80	**	16.96	11.17	6.66	17904	**	34.76	33.73	33.05	*3712	**	24.76	24.488	24.13	*2268	114	**
128	**	18.37	13.73	9.89	18974	**	34.70	33.74	33.07	*3154	**	24.06	25.277	24.89	*2453	114	**
160	**	11.27	12.40	8.64	17581	**	34.57	33.74	33.28	*2436	**	24.27	25.648	25.03	*2576	114	**
200	**	12.63	12.40	8.64	17581	**	34.57	33.74	33.28	*2436	**	24.27	25.648	25.03	*2576	114	**
250	**	11.24	8.70	7.84	*748	**	34.39	33.48	33.76	1200	**	24.61	24.354	25.96	*1408	114	**
300	**	7.46	8.11	7.02	*631	**	34.38	34.07	33.86	*1185	**	24.73	24.567	26.27	*1000	114	**
400	**	7.46	8.11	7.02	*631	**	34.38	34.07	33.86	*1185	**	24.73	24.567	26.27	*1000	114	**
500	**	7.46	8.07	6.73	*422	**	34.34	34.24	34.05	*658	**	27.11	26.895	24.79	*0524	111	**
600	**	8.70	8.60	*820	18370	**	34.34	34.31	34.17	*0743	**	27.21	27.000	26.97	*0445	78	**
700	**	8.70	8.60	*820	18370	**	34.34	34.31	34.17	*0743	**	27.21	27.000	26.97	*0445	78	**
800	**	8.70	8.44	*820	12154	**	34.31	34.31	34.32	*073	**	27.36	24.64	27.18	*0363	51	**
900	**	8.88	8.29	*02	*164	**	34.65	34.68	34.33	*0240	**	27.73	27.338	27.23	*0364	47	**
1000	**	8.88	8.29	*02	*164	**	34.65	34.68	34.33	*0240	**	27.73	27.338	27.23	*0364	47	**
1100	**	3.33	3.72	1.88	*153	**	34.60	34.50	34.00	*0355	**	27.50	27.323	27.45	*0380	38	**
1200	**	3.33	3.72	1.88	*153	**	34.60	34.50	34.00	*0355	**	27.50	27.323	27.45	*0380	38	**
1300	**	2.63	3.18	2.28	*108	**	34.55	34.52	34.76	*0226	**	27.51	27.477	27.41	*0285	21	**
1400	**	2.63	3.18	2.28	*108	**	34.55	34.52	34.76	*0226	**	27.51	27.477	27.41	*0285	21	**
1500	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
1600	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
1700	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
1800	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
1900	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2000	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2100	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2200	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2300	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2400	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2500	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2600	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2700	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2800	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
2900	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3000	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3100	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3200	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3300	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3400	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3500	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3600	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3700	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3800	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
3900	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**
4000	**	2.13	3.02	2.72	*078	**	34.58	34.58	34.68	*0266	**	27.63	27.607	27.43	*0260	11	**

Figure C.18

AREA NINETEEN - WINTER

*** STATISTICAL SUMMARY ***

TEMPERATURE (C)										SALINITY (PPT)					SIGMA-T				
DEPTH (M)	H4X	MEAN	MIN	ST DEV	H4X	MEAN	MIN	ST DEV	H4X	MEAN	MIN	ST DEV	MUN						
0	**	29.58	24.90	23.83	1.446	**	34.04	34.32	33.02	1.8187	**	24.80	22.250	31.09	1.0223	47			
10	**	29.44	24.78	23.58	1.481	**	34.04	34.31	33.02	1.8180	**	24.81	22.218	31.10	1.0223	33			
20	**	28.28	24.72	24.01	1.237	**	35.96	34.34	33.02	1.8736	**	24.81	22.336	31.25	1.0073	33			
30	**	28.00	24.67	23.80	1.276	**	36.97	34.37	33.02	1.8756	**	24.87	22.388	31.31	1.0178	33			
50	**	27.44	24.74	24.30	1.000	**	36.70	34.30	33.04	1.7738	**	24.86	22.592	31.45	1.0192	33			
76	**	24.44	22.18	17.07	2.6240	**	36.90	34.30	33.70	1.5005	**	24.83	23.584	32.23	1.1730	23			
100	**	23.57	18.34	14.19	2.918	**	35.81	34.55	32.84	1.9229	**	24.84	24.427	33.29	1.7816	23			
126	**	21.50	18.93	13.02	3.459	**	36.70	34.48	34.48	1.5513	**	24.13	25.808	34.77	2.5803	23			
150	**	20.09	18.26	12.55	2.255	**	35.59	34.74	34.34	1.2845	**	24.33	25.518	34.61	1.9788	23			
176	**	14.74	17.68	11.98	1.126	**	35.24	34.80	34.71	1.1114	**	24.68	26.310	35.29	1.746	23			
250	**	13.69	17.74	11.27	1.500	**	35.94	34.75	34.68	1.0561	**	24.67	26.167	34.23	1.0823	23			
300	**	11.50	10.98	10.46	1.704	**	35.79	34.71	34.66	0.9333	**	24.64	26.700	34.46	0.9517	23			
400	**	10.27	9.54	8.60	1.550	**	35.81	34.62	34.63	0.9579	**	24.60	26.763	34.63	0.9744	23			
500	**	7.02	8.07	7.12	1.370	**	34.63	34.56	34.50	0.9484	**	24.04	26.710	34.74	0.7850	21			
600	**	7.78	6.93	6.42	1.287	**	35.40	34.50	34.54	0.9377	**	24.15	27.082	34.93	0.9593	15			
700	**	6.66	6.10	5.72	1.043	**	35.56	34.52	34.54	0.9361	**	24.13	27.181	34.98	0.9480	16			
800	**	6.84	6.17	5.29	1.148	**	35.58	34.52	34.58	0.9340	**	24.13	27.188	34.98	0.9480	16			
900	**	6.02	6.16	5.29	1.148	**	35.58	34.52	34.58	0.9340	**	24.13	27.188	34.98	0.9480	16			
1000	**	4.87	5.55	4.03	1.277	**	35.86	34.53	34.54	0.9356	**	24.11	27.349	34.99	0.9399	11			
1100	**	4.28	4.18	4.07	1.076	**	35.55	34.55	34.55	0.9162	**	24.44	27.430	34.92	0.9116	14			
1200	**	3.92	3.81	3.72	0.930	**	35.56	34.55	34.52	0.9200	**	24.40	27.567	34.95	0.9180	4			
1300	**	3.62	3.81	3.30	0.872	**	35.57	34.68	34.52	0.9250	**	24.51	27.602	34.97	0.9096	4			
1400	**	3.34	3.25	3.15	0.818	**	35.58	34.57	34.55	0.9250	**	24.58	27.627	34.92	0.9126	4			
1500	**	3.08	3.00	2.95	0.840	**	35.40	34.88	34.98	0.9222	**	24.58	27.670	34.95	0.9143	4			
1760	**	2.67	2.81	2.17	0.951	**	35.41	34.60	34.88	0.9180	**	24.49	27.628	34.91	0.9126	4			
2500	**	2.80	2.80	2.80	0.000	**	35.40	34.62	34.62	0.9000	**	24.47	27.670	34.91	0.9000	2			
3000	**	1.89	1.87	1.88	0.000	**	35.46	34.68	34.68	0.9071	**	24.72	27.720	34.91	0.9191	2			
3500	**	1.86	1.84	1.82	0.000	**	35.46	34.68	34.68	0.9071	**	24.73	27.730	34.91	0.9000	2			

AREA NINETEEN - SUMMER

0	**	29.07	28.91	27.68	1.874	**	34.20	33.78	33.27	1.3248	**	21.83	21.389	20.87	1.2632	27	**
10	**	29.50	28.24	27.22	1.801	**	34.20	33.65	33.00	1.2764	**	21.74	21.134	20.97	1.2000	27	**
20	**	28.80	27.88	23.80	1.1886	**	34.20	33.65	33.00	1.2764	**	22.73	21.500	21.01	1.2492	16	**
30	**	28.32	27.21	20.79	1.800	**	34.20	33.65	33.00	1.2764	**	22.73	21.500	21.01	1.2492	16	**
50	**	28.09	28.09	28.09	0.000	**	34.20	33.65	33.00	1.2764	**	22.73	22.747	21.97	1.0395	16	**
76	**	26.04	19.93	19.11	3.1818	**	34.20	33.65	33.00	1.2764	**	26.98	24.324	22.30	1.1273	16	**
100	**	20.60	18.00	13.16	2.236	**	35.29	34.62	34.38	1.7278	**	24.16	26.167	34.23	1.7816	23	**
126	**	18.54	18.54	18.54	0.000	**	35.29	34.62	34.38	1.7278	**	24.16	26.167	34.23	1.7816	23	**
150	**	14.11	13.11	12.84	1.132	**	35.48	34.77	34.68	0.9034	**	24.36	26.211	34.01	0.9896	15	**
200	**	12.88	12.16	11.28	1.704	**	35.48	34.78	34.68	0.9034	**	24.36	26.211	34.01	0.9896	15	**
250	**	12.19	12.19	12.19	0.000	**	35.48	34.78	34.68	0.9034	**	24.36	26.211	34.01	0.9896	15	**
300	**	11.32	10.80	10.80	0.000	**	35.48	34.77	34.74	0.0185	**	24.68	26.216	26.65	0.0304	12	**
400	**	9.99	9.29	8.77	1.200	**	35.48	34.78	34.65	0.0171	**	24.68	26.815	26.77	0.0340	12	**
500	**	9.99	9.29	8.77	1.200	**	35.48	34.78	34.65	0.0171	**	24.68	26.815	26.77	0.0340	12	**
600	**	4.99	4.80	4.40	1.340	**	35.48	34.88	34.80	0.0874	**	27.16	27.117	27.07	0.0333	6	**
700	**	4.99	4.80	4.40	1.340	**	35.48	34.87	34.84	0.0187	**	27.24	27.222	27.20	0.0217	6	**
800	**	4.99	4.80	4.40	1.340	**	35.48	34.87	34.83	0.0187	**	27.24	27.222	27.20	0.0217	6	**
900	**	4.99	4.80	4.40	1.340	**	35.48	34.87	34.84	0.0187	**	27.24	27.222	27.20	0.0217	6	**
1000	**	4.99	4.80	4.40	1.340	**	35.48	34.87	34.84	0.0187	**	27.24	27.222	27.20	0.0217	6	**
1100	**	4.99	4.80	4.40	1.340	**	35.48	34.87	34.84	0.0187	**	27.24	27.222	27.20	0.0217	6	**

AREA NINETEEN - SPRING

0	**	30.44	29.28	27.78	1.610	**	34.34	33.89	33.22	1.3661	**	21.92	21.144	20.44	1.2857	34	**
10	**	30.46	29.12	27.51	1.618	**	34.26	33.76	33.22	1.3580	**	21.95	21.106	20.44	1.2802	34	**
20	**	30.42	28.67	26.18	1.0078	**	34.61	33.80	33.26	1.3518	**	22.62	21.287	20.70	1.2882	23	**
30	**	30.19	28.61	26.18	1.434	**	34.58	33.84	33.42	1.3264	**	23.81	21.880	20.74	1.2593	23	**
50	**	28.85	26.81	21.19	2.380	**	34.62	33.80	33.70	1.0201	**	24.02	22.492	21.23	1.2498	23	**
76	**	25.56	20.23	14.83	2.620	**	34.44	34.37	34.05	1.7074	**	25.26	24.104	22.86	1.6185	23	**
100	**	19.82	16.40	14.29	1.838	**	35.40	34.68	34.72	1.1814	**	26.95	26.339	24.38	1.5126	23	**
126	**	15.94	14.23	12.87	1.071	**	35.48	34.77	34.68	0.9034	**	24.36	26.254	34.01	0.9896	15	**
150	**	13.62	12.94	12.19	1.031	**	35.48	34.80	34.80	0.9413	**	24.36	26.256	26.03	1.0212	23	**
200	**	13.70	11.99	11.98	0.000	**	35.81	34.78	34.72	0.9267	**	24.61	26.334	34.33	0.9468	23	**
250	**	11.97	11.97	11.97	0.000	**	35.79	34.78	34.72	0.9198	**	24.62	26.334	34.33	0.9468	23	**
300	**	11.10	10.72	10.20	1.189	**	35.76	34.72	34.70	0.9198	**	24.68	26.423	34.58	0.9444	19	**
400	**	9.88	9.49	8.98	1.271	**	35.48	34.68	34.68	0.9223	**	24.68	26.788	34.73	0.9313	18	**
500	**	8.68	8.10	7.14	1.372	**	35.41	34.58	34.58	0.9142	**	24.03	26.918	34.85	0.9841	17	**
600	**	7.70	6.98	6.82	1.190	**	35.57	34.58	34.51	0.9187	**	24.14	27.082	34.73	0.9327	17	**
700	**	6.84	6.18	5.78	1.773	**	35.57	34.58	34.81	0.9183	**	24.23	27.184	34.71	0.9301	16	**
800	**	6.70	6.51	6.08	1.484	**	35.57	34.58	34.80	0.9188	**	24.31	27.285	34.72	0.9285	15	**
900	**	6.21	6.09	5.61	1.092	**	35.56	34.60	34.50	0.9184	**	24.36	27.327	34.77	0.9231	15	**
1000	**	4.84	4.84	4.84	0.000	**	35.57	34.58	34.51	0.9184	**	24.36	27.327	34.77	0.9231	15	**
1100	**	4.84	4.84	4.84	0.000	**	35.57	34.58	34.51	0.9184	**	24.36	27.327	34.77	0.9231	15	**
1200	**	3.88	3.78	3.63	1.129	**	35.59	34.57	34.85	0.9136	**	24.51	27.989	34.98	0.9125	8	**
1300	**	3.80	3.47	3.24	1.133	**	35.59	34.58	34.58	0.9107	**	24.58	27.823	34.91	0.9111	7	**
1400	**	3.33	3.21	3.02	0.605	**	35.59	34.58	34.58	0.9111	**	24.57	27.840	34.91	0.9111	7	**
1500	**	3.09	3.04	3.00	0.021	**	35.61	34.60	34.89	0.9118	**	24.59	27.983	34.98	0.9080	3	**
1760	**	2.60	2.58	2.58	0.008	**	35.43	34.62	34.62	0.9058	**	24.65	27.940	34.93	0.9100	3	**
2000	**	2.19	2.09	2.01	1.022	**	35.48	34.64	34.64	0.9141	**	24.73	27.705	34.93	0.9043	2	**
2500	**	1.86	1.84	1.84	0.000	**	35.47	34.64	34.65	0.9141	**	24.73	27.730	34.93	0.9000	2	**
3000	**	1.86	1.84	1.86	0.000	**	35.47	34.67	34.67	0.9000	**	24.76	27.750	34.96	0.9000	1	**

AREA NINETEEN - FALL

0	**	29.49	27.92	26.80	1.8197	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.01	1.2489	19	**
10	**	29.28	27.92	26.80	1.8197	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.01	1.2489	19	**
20	**	28.37	26.90	25.33	1.2713	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.01	1.2489	19	**
30	**	28.28	26.90	25.21	1.2672	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
40	**	25.68	19.96	17.96	1.2761	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
50	**	25.68	19.96	17.96	1.2761	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
60	**	25.68	19.96	17.96	1.2761	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
70	**	25.68	19.96	17.96	1.2761	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
80	**	18.31	13.82	12.87	1.6272	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
90	**	14.14	12.88	12.87	1.6272	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
100	**	14.14	12.88	12.87	1.6272	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
110	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
120	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
130	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
140	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
150	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
160	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
170	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
180	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
190	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
200	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
210	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
220	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
230	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
240	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
250	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
260	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
270	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
280	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
290	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
300	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
310	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
320	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
330	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
340	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
350	**	12.98	11.74	11.22	1.6312	**	33.96	33.87	33.20	1.2178	**	21.93	21.266	21.02	1.2505	19	**
 																	

AREA TWENTY - WINTER

*** STATISTICAL SUMMARY ***

		TEMPERATURE (C)				SALINITY (PPT)				SIGMA-T						
DEPTH		MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	MAX	MEAN	MIN	ST DEV	NUM		
(M)																
0	**	27.83	25.31	24.12	1.0022	**	34.92	34.12	32.50	**	25.93	22.566	20.46	1.9897	44	
10	**	27.46	24.62	18.34	1.8277	**	35.01	34.26	32.68	**	25.01	22.599	21.03	1.8888	35	
20	**	27.22	22.26	16.57	2.2497	**	35.14	34.60	33.82	**	25.65	23.836	22.12	1.8854	35	
30	**	25.25	20.20	14.93	2.5780	**	35.03	34.77	34.15	**	26.03	24.510	23.84	1.8788	26	
50	**	24.00	18.74	12.87	2.1634	**	35.26	34.90	34.44	**	26.23	25.008	24.03	1.923	26	
75	**	17.73	14.57	13.27	1.1900	**	35.20	34.96	34.80	**	26.31	26.492	25.57	1.2137	25	
100	**	15.54	13.59	12.91	0.7731	**	35.07	34.92	34.82	**	26.36	26.227	26.04	0.0708	25	
125	**	13.68	13.07	12.82	0.1964	**	35.05	34.92	34.87	**	26.37	26.301	26.18	0.0522	25	
150	**	14.43	13.00	12.73	1.1955	**	35.01	34.91	34.88	**	26.42	26.337	26.27	0.035	25	
200	**	12.97	12.77	12.68	0.1137	**	35.03	34.94	34.89	**	26.40	26.378	26.34	0.0178	25	
250	**	12.75	12.36	11.80	0.2711	**	34.89	34.87	34.83	**	26.51	26.433	26.37	0.035	25	
300	**	12.14	11.30	10.56	0.4555	**	34.87	34.81	34.73	**	26.67	26.585	26.46	0.0645	26	
400	**	9.75	9.16	8.67	0.2761	**	34.73	34.64	34.60	**	26.82	26.858	26.77	0.0176	17	
500	**	7.28	7.40	6.92	0.1132	**	34.84	34.81	34.58	**	27.03	27.14	27.019	26.95	0.032	14
600	**	7.38	6.79	6.31	0.3960	**	34.62	34.57	34.54	**	27.19	27.23	27.128	27.05	0.0521	5
700	**	6.23	5.97	5.71	0.2533	**	34.54	34.53	34.53	**	27.08	27.23	27.213	27.18	0.0289	3
800	**	5.68	5.47	5.09	0.3071	**	34.53	34.53	34.52	**	27.31	27.272	27.25	0.021	3	
900	**	5.33	5.15	4.90	0.2219	**	34.53	34.53	34.53	**	27.33	27.300	27.28	0.0245	3	
1000	**	4.88	4.79	4.67	0.1097	**	34.54	34.54	34.53	**	27.37	27.350	27.34	0.0173	3	

AREA TWENTY - SUMMER

0	**	25.87	21.63	16.92	2.4177	**	35.16	34.62	33.71	**	3270	**	25.53	24.025	22.25	1.5457	46
10	**	25.86	21.37	16.43	2.4955	**	35.16	34.64	33.73	**	3367	**	25.43	24.026	22.26	1.0105	27
20	**	25.84	20.61	16.55	3.6161	**	35.17	34.68	33.76	**	3368	**	26.05	24.320	22.28	1.1587	26
30	**	25.04	19.79	14.18	3.6280	**	35.15	34.75	33.73	**	3370	**	26.15	24.588	22.54	1.1234	26
50	**	25.44	17.76	14.45	3.7356	**	35.13	34.86	33.82	**	3392	**	26.26	25.193	22.69	1.0775	26
75	**	24.53	15.35	13.45	2.1444	**	35.18	34.96	34.80	**	3401	**	26.29	25.557	23.94	1.5446	26
100	**	16.29	12.97	13.28	0.3600	**	35.03	34.95	34.76	**	3402	**	26.32	26.172	26.05	1.3800	26
125	**	14.75	13.51	13.45	0.2860	**	35.00	34.94	34.88	**	3430	**	26.38	26.259	26.17	0.017	26
150	**	13.68	13.24	12.74	0.2670	**	34.97	34.93	34.86	**	3431	**	26.40	26.300	26.25	0.045	26
200	**	12.29	12.07	12.31	0.2552	**	34.78	34.91	34.84	**	3436	**	26.43	26.368	26.32	0.070	26
250	**	12.77	12.51	12.51	0.1137	**	34.92	34.87	34.51	**	3437	**	26.72	26.452	26.18	0.0289	26
300	**	14.52	11.27	10.47	0.0559	**	34.89	34.82	34.75	**	3493	**	26.68	26.547	26.39	0.0709	26
400	**	10.03	9.25	8.39	0.3760	**	34.75	34.68	34.53	**	3494	**	26.96	26.887	26.70	0.579	26
500	**	7.31	7.68	7.40	0.2158	**	34.65	34.61	34.67	**	3497	**	27.07	27.007	26.94	0.0356	22
600	**	7.19	6.95	6.55	0.2101	**	34.60	34.58	34.52	**	3493	**	27.15	27.115	27.05	0.0431	13
700	**	6.42	6.67	5.73	0.2040	**	34.58	34.56	34.52	**	3498	**	27.25	27.215	27.15	0.0248	12
800	**	6.73	6.29	5.27	0.5555	**	34.57	34.55	34.53	**	3499	**	27.31	27.489	27.25	0.0176	11
900	**	5.14	4.94	4.72	0.1344	**	34.57	34.55	34.53	**	3517	**	27.38	27.347	27.32	0.0205	11
1000	**	4.42	4.67	4.30	0.1152	**	34.57	34.56	34.54	**	3511	**	27.43	27.403	27.38	0.0180	7
1100	**	4.15	4.15	3.55	0.5555	**	34.56	34.56	34.56	**	3500	**	27.49	27.440	27.40	0.000	1
1200	**	4.63	3.63	3.63	0.0000	**	34.56	34.56	34.56	**	3500	**	27.48	27.440	27.48	0.000	1
1300	**	3.55	3.55	3.55	0.0000	**	34.57	34.57	34.57	**	3500	**	27.51	27.510	27.51	0.000	1
1400	**	3.49	3.49	3.49	0.0000	**	34.57	34.57	34.57	**	3500	**	27.58	27.580	27.58	0.000	1
1500	**	3.06	3.06	3.06	0.0000	**	34.58	34.58	34.58	**	3500	**	27.56	27.560	27.56	0.000	1
1600	**	2.40	2.40	2.40	0.0000	**	34.60	34.60	34.60	**	3500	**	27.62	27.620	27.62	0.000	1
2000	**	2.31	2.31	2.31	0.0000	**	34.63	34.63	34.63	**	3500	**	27.60	27.600	27.60	0.000	1
2500	**	1.95	1.95	1.95	0.0000	**	34.66	34.66	34.66	**	3500	**	27.73	27.730	27.73	0.000	1
3000	**	1.76	1.76	1.76	0.0000	**	34.66	34.66	34.66	**	3500	**	27.75	27.750	27.75	0.000	1

AREA TWENTY - SPRING

0	**	27.17	25.10	23.43	1.084	**	35.23	34.74	32.76	**	24.13	23.121	21.04	1.7381	26
10	**	26.41	23.66	20.90	2.0878	**	35.17	34.44	32.70	**	24.25	23.312	21.12	1.6416	10
20	**	25.13	21.88	19.00	1.8585	**	35.11	34.27	32.70	**	25.18	24.112	22.11	1.503	26
30	**	23.95	19.97	18.05	2.149	**	35.25	34.65	34.00	**	25.75	24.649	23.74	1.4022	10
50	**	21.50	16.47	15.88	1.854	**	35.23	34.95	34.82	**	26.01	25.526	24.66	1.019	10
75	**	18.77	14.95	14.84	1.082	**	35.09	34.96	34.85	**	26.25	25.950	25.88	0.000	10
100	**	16.35	13.44	12.05	0.7779	**	35.06	34.94	34.87	**	26.31	26.155	25.73	1.842	10
125	**	14.97	13.44	12.94	1.3944	**	35.03	34.93	34.86	**	26.31	26.261	26.12	0.631	10
150	**	13.75	13.14	12.91	0.2823	**	35.00	34.92	34.89	**	26.37	26.307	26.25	0.083	10
200	**	13.04	12.82	12.61	0.1215	**	34.93	34.90	34.88	**	26.39	26.351	26.33	0.013	10
250	**	12.95	12.53	11.75	0.7777	**	34.91	34.86	34.81	**	26.50	26.403	26.35	0.040	10
300	**	12.45	11.64	11.04	0.5202	**	34.88	34.82	34.76	**	26.63	26.533	26.42	0.034	10
400	**	9.93	9.43	8.87	0.7672	**	34.73	34.70	34.65	**	26.88	26.826	26.77	0.291	10
500	**	8.51	8.36	8.05	0.2947	**	34.84	34.83	34.82	**	27.00	26.940	26.93	0.036	1
600	**	7.59	7.46	7.01	0.3344	**	34.60	34.64	34.58	**	27.10	27.060	27.04	0.034	1
700	**	6.61	6.46	6.18	0.2588	**	34.58	34.55	34.55	**	27.19	27.170	27.16	0.0174	3
800	**	5.63	5.63	5.63	0.0000	**	34.55	34.55	34.55	**	27.28	27.280	27.28	0.000	2
900	**	5.09	5.09	5.09	0.0000	**	34.54	34.54	34.54	**	27.32	27.320	27.32	0.000	2
1000	**	4.65	4.65	4.65	0.0000	**	34.55	34.55	34.55	**	27.38	27.380	27.38	0.000	2
1100	**	4.23	4.23	4.23	0.0000	**	34.56	34.56	34.56	**	27.43	27.430	27.43	0.000	2
1200	**	3.88	3.88	3.88	0.0000	**	34.56	34.56	34.56	**	27.48	27.480	27.48	0.000	2
1300	**	3.67	3.67	3.67	0.0000	**	34.57	34.57	34.57	**	27.50	27.500	27.50	0.000	2
1400	**	3.44	3.44	3.44	0.0000	**	34.58	34.58	34.58	**	27.52	27.520	27.52	0.000	2
1500	**	3.22	3.22	3.22	0.0000	**	34.59	34.59	34.59	**	27.56	27.560	27.56	0.000	2
1750	**	2.48	2.48	2.48	0.0000	**	34.62	34.62	34.62	**	27.63	27.630	27.63	0.000	2
2000	**	2.28	2.28	2.28	0.0000	**	34.63	34.63	34.63	**	27.67	27.670	27.67	0.000	2

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0	**	25.29	21.64	18.37	2.0872	**	34.87	34.36	33.61	**	24.93	23.824	22.26	1.9221	38	
10	**	25.08	20.79	18.71	2.1326	**	34.87	34.32	33.61	**	24.94	25.00	24.108	22.29	1.9149	22
20	**	24.87	20.79	17.61	2.5131	**	34.93	34.51	33.61	**	24.90	25.26	24.935	22.20	1.9121	22
30	**	24.66	20.79	16.51	2.4034	**	34.93	34.51	33.61	**	24.90	25.26	24.935	22.20	1.9121	22
40	**	22.75	14.19	13.42	2.2713	**	35.07	34.84	34.00	**	25.77	24.20	25.573	23.30	1.7170	22
50	**	18.86	14.37	13.15	1.0852	**	35.08	34.92	34.78	**	25.82	26.32	26.050	25.22	1.5231	22
60	**	14.31	14.37	14.31	0.506	**	35.08	34.92	34.78	**	25.82	26.32	26.050	25.22	1.5231	22
75	**	12.17	12.38	12.44	0.576	**	34.98	34.90	34.78	**	25.88	26.40	26.276	24.11	0.9733	22
100	**	14.08	12.47	12.31	1.3646	**	34.94	34.69	34.78	**	25.99	26.35	26.14	0.8462	22	
120	**	14.08	12.47	12.31	1.3646	**	34.94	34.69	34.78	**	25.99	26.35	26.14	0.8462	22	
150	**	12.75	12.42	11.80	2.715	**	34.91	34.86	34.78	**	26.38	26.30	26.27	0.975	19	
300	**	12.37	11.46	11.49	1.305	**	34.87	34.82	34.70	**	26.00	26.33	26.246	24.93	0.536	19
400	**	9.60	9.28	9.28	1.3012	**	34.76	34.70	34.60	**	24.93	26.65	26.782	26.71	0.391	18
500	**	9.60	9.28	9.28	1.3012	**	34.76	34.70	34.60	**	24.93	26.65	26.782	26.71	0.391	18
600	**	7.53	7.21	6.70	2.581	**	34.61	34.57	34.46	**	24.84	25.11	27.068	24.98	0.45	17
800	**	6.59	6.30	5.98	1.695	**	34.58	34.55	34.46	**	24.92	27.23	27.211	27.07	0.186	18
1000	**	5.83	5.80	5.29	1.555	**	34.57	34.55	34.46	**	24.92	27.23	27.211	27.07	0.186	18
1200	**	5.37	5.08	4.82	1.913	**	34.57	34.53	34.42	**	24.94	27.36	27.310	27.23	0.28	13
1400	**	4.87	4.62	3.34	1.556	**	34.57	34.43	34.41	**	24.93	27.32	27.363	27.27	0.272	18
1600	**	4.34	4.34	4.06	1.111	**	34.57	34.43	34.41	**	24.93	27.32	27.363	27.27	0.272	18
1800	**	3.68	3.68	3.73	0.876	**	34.58	34.57	34.57	**	24.99	27.50	27.480	27.66	0.115	7
2000	**	3.67	3.59	4.46	0.808	**	34.60	34.58	34.58	**	24.98	27.53	27.515	27.60	0.105	6
2200	**	3.41	3.41	3.47	0.717	**	34.61	34.60	34.60	**	24.99	27.53	27.515	27.60	0.105	6
2400	**	2.69	3.08	4.00	0.808	**	34.62	34.60	34.59	**	24.99	27.55	27.575	27.64	0.105	6
1500	**	3.19	3.56	2.98	0.907	**	34.62	34.62	34.61	**	24.92	27.66	27.638	27.63	0.041	6
1700	**	2.52	2.42	2.20	0.717	**	34.62	34.62	34.61	**	24.92	27.66	27.638	27.63	0.041	6
2500	**	1.97	1.97	1.82	0.741	**	34.64	34.65	34.64	**	24.95	27.73	27.727	27.71	0.082	6
3600	**	1.77	1.77	1.69	0.734	**	34.67	34.66	34.66	**	24.98	27.75	27.760	27.75	0.080	6

APPENDIX D

METEOROLOGICAL DATA FOR EASTERN PACIFIC SURVEY AREA

Data showing various tropical cyclone stages and wind roses for eastern Pacific areas are given.

Data from U. S. Naval Weather Service sources.

Note: 1 knot $\approx$ 0.5 m/sec for the figures in this appendix.

Figure D-1. Tropical cyclone (≥ 34 knot) stage statistics for 5-degree squares in the eastern Pacific, data from 1949-1971. (Reproduced from Naval Weather Service, Ref. 34).

Figure D.2. Tropical storm stage (48-63 knot) statistics for 5-degree squares in the eastern Pacific; data from 1965-1971. (Reproduced from Naval Weather Service, Ref. 34).

Figure D.3. Hurricane stage (> 64 knots) statistics for 5-degree squares in the eastern Pacific; data from 1965-1971. (Reproduced from Naval Weather Service, Ref. 34)

Figure D.4. Wind roses giving percent frequency of speed and direction for the northeastern Pacific north of 30°N for January. (U. S. Navy sources).

Figure D.5. Wind roses giving percent frequency of speed and direction for the northeastern Pacific north of 30° for April. (U. S. Navy sources).

Figure D.6. Wind roses giving percent frequency of speed and direction for the northeastern Pacific north of 30°N for July. (U. S. Navy sources).

Figure D.7. Wind roses giving percent frequency of speed and direction for the northeastern Pacific north of 30° for October. (U. S. Navy sources).

Figure D-8. Wind roses giving percent frequency of speed and direction for the northeastern Pacific south of 30°N for January. (U. S. Navy sources).

Figure D.9. Wind roses giving percent frequency of speed and direction for the northeastern Pacific south of 30° for April. (U. S. Navy sources).

APPENDIX E

DISCUSSION OF STORM-GENERATED CURRENTS

Severe storms and hurricanes can generate intense temporary current fields in the vicinity of the storm. The potential magnitude of these currents is of concern to OFEF for engineering design and overall survivability of the farm structure and kelp plants. Actual measurements of currents during severe storms are rare, principally due to the difficulty of making them under extremely adverse conditions. Nearly all literature references on storm-driven currents deal with theoretical computation of currents associated with storm surge (Ref. 50). Until very recently, these computational methods employed highly simplified equations that could at best only produce rough estimates of current conditions.

The response of the ocean surface-to-wind stresses is realized in several ways. The most apparent responses, and the most important in terms of OFEF structural dynamics, are surface waves and horizontal water transport. The total flow field to which a structure is subjected during storm-induced periods consists of wave-associated particle velocities plus the more slowly varying current component. Two papers which consider the effect of currents and waves on moored systems, and are applicable to Phase 1, 2, and possibly early Phase 3 OFEF's are Refs. 51 and 52.

The only actual current measurement ever made during a severe cyclonic storm of hurricane intensity was taken from NOAA Buoy EB-10 during Hurricane Eloise, September 1975 (Ref. 53). This hurricane reached the coast of Florida with 110-knot (57-m/sec) winds at 1200, 23 September 1975. The wind magnitude, current speed, and wave height chronology are given in Figure E.1. The eye of the hurricane passed within 10 miles (16 kilometers) of buoy EB-10 at 0200, 23 September, approximately 150 miles (240 kilometers) south of Mississippi (Position (a) on Fig. E.1). The maximum measured wind speed by aircraft was 95 knots (49 m/sec), the wind speed at the buoy was 68 knots (35 m/sec) and occurred at 0100, 23 September, just prior to the passage of the eye. Wave response parallels wind speed precisely showing a maximum height of 8.8 meters during the same hour as the maximum wind speed. Currents at 50 meters, however, showed a delay of nearly 24 hours between the build up of the wind and the increase in current speed. Average current speed prior to the storm passage was 0.6 knot (0.3 m/sec) increasing to 1.8 knots (0.9 m/sec) over a 12-hour period (about the same length of time as the increase in wind speed to maximum magnitude). Shortly after the storm, oscillations (26- to 27-hour periods) in current speed with decreasing magnitude and direction were observed; these were detectable for two weeks after passage of the hurricane. Although the data for Figure E.1 were taken in the Gulf of Mexico, the general relationships probably are similar for cyclonic storms in the eastern Pacific. Surface currents were not measured from EB-10 and would be extremely difficult to measure in a storm due to wave and surface chop action.

Surface currents can be measured indirectly by measuring ship drift. One such measurement was made shortly after the passage of a typhoon in the northwest Pacific. A Japanese research vessel showed an anticyclonic drift pattern, 48 hours after the passage of a

Figure E-1. Wind and current speed, and wave height measured from a NOAA buoy in the Gulf of Mexico during Hurricane Eloise, Sept., 1974. Position (a) denotes passing of the hurricane eye. (Data from the Data Buoy Office, NOAA, Ref. 53).

typhoon, approximating a 6-knot (3 m/sec) maximum drift (Ref. 54). Prior to the passage of the typhoon, the current drift was relatively straight to the northwest at 2 to 3 knots (1 to 1.5 m/sec). This demonstrates the dramatic change in both speed (2-3 to 6 knots) and direction (northwest to northeast) that can occur for a significant period of time after a hurricane.

Besides limited ship drift data and the single current measurement in the Gulf of Mexico reported above, no other data giving current measurements in severe storms could be located. Theoretical predictions of the effect of high winds on currents do exist, however; some of the available literature are given in Refs. 55 to 59. A recent paper by Forristall gives a detailed discussion of the three-dimensional structure of storm-generated currents (Ref. 60), where a theoretical model for three-dimensional wind-driven currents is also provided. The driving force comes from the boundary condition of wind shear at the surface. The model solution comes from two major steps: first, a two-dimensional finite difference scheme is used to solve for current transports and storm surge; second, the current profiles at selected points are calculated from convolution integrals, which may be evaluated given a wind stress and sea surface slope at those points.

Some of the important conclusions follow. Wind-driven waves generally produce the dominant forces on offshore structures; however, since the hydrodynamic force is proportional to the square of the water particle velocity, a current of a few feet per second can increase the total force by 50 percent over that caused by waves alone (Refs. 50 and 60).

Solutions for a hurricane in the Gulf of Mexico were derived. An example solution was conducted using given data from Hurricane Camile (August 1969). Surface currents as high as 15.5 knots (8 m/sec) were predicted; current speeds at other depths were as follows: 8.75 knots (4.5 m/sec) at 10 meters, 4.5 knots (2.3 m/sec) at 20 meters, 2.1 knots (1.1 m/sec) at 30 meters, and 1 knot (0.5 m/sec) at 50 meters. A current speed versus depth curve from these data are given in Fig. E.2. These velocities were predicted for a station a few miles east of the hurricane in 100 meters of water, based on a maximum wind velocity of approximately 122 knots (63 m/sec) and a maximum wave height of 22 meters (Ref. 61). The effect of sloping bathymetry was strong, producing primarily longshore currents, which for deep water OFEF's will not be a consideration; thus, open ocean surface currents may be somewhat less. The model demonstrates that a tight circular wind can spin the water column to velocities much higher than those generated by a linear wind, and that the outward flow at the surface is balanced by an inward flow near the bottom. P. Black (personnel communication) has estimated that there is an approximate 10:1 wind velocity to surface current speed ratio in severe cyclonic storms. The predicted current in Forristall's model above (Ref. 60) approximates this estimated ratio (122-knot winds to 15.5-knot surface current).

Because of the lack of measured data, models such as the one described above will have to be used to estimate the current field in the event of a storm in the vicinity of an OFEF. A program to obtain storm-generated current data has been started by the Shell Development Company, Ref. 50, and as data are reported they should be incorporated into OFEF engineering design. Table E.1 gives a list of personnel working in the wind-generated ocean current field for future contact as needed.

Figure E.2. Predicted current profile in the vicinity of Hurricane Camile with a maximum of 122-knot winds. (a) Ratio of current speed at given depth-to-surface current speed. (b) Depth of predicted current in meters. (Computed data from Forristall, Ref. 60).

Table E.1. Personnel working in the field of wind-generated ocean current measurement and theory.

NAME	AFFILIATION	STUDY AREA	PHONE
Vincent Cardone	New York University Inst. of Oceanography 675 W. 252 Street Bronx, NY 10471	Forecasting wave & current data.	212-796-8300
J. H. Hinchman	General Dynamics Electronics Division Ocean Systems, Engineer San Diego, CA	Current measurement & buoy development.	714-279-7301
Peter Black	NOAA National Hurricane Center Hurricane Environmental Meterological Laboratory Miami, Florida	Response of watermass to hurricanes.	305-350-4150

Table E.1. (Continued).

NAME	AFFILIATION	STUDY AREA	PHONE
Duncan Ross	Sea Air Interaction Lab. Miami, Florida		305-361-3361
George Forristall	Shell Development Co.	Storm-generated	713-667-5661
J. Michael Hall	Houston, TX	current modeling.	
Greg Wither	NOAA	Current data from	601-688-2211
Roy Clem	National Data Buoy Office Bay St. Louis, Mississippi	buoys.	
Meritt Stevenson	NOAA National Marine Fisheries Service S.W. Fisheries Center La Jolla, CA	Current measurement and modeling.	714-453-2820

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