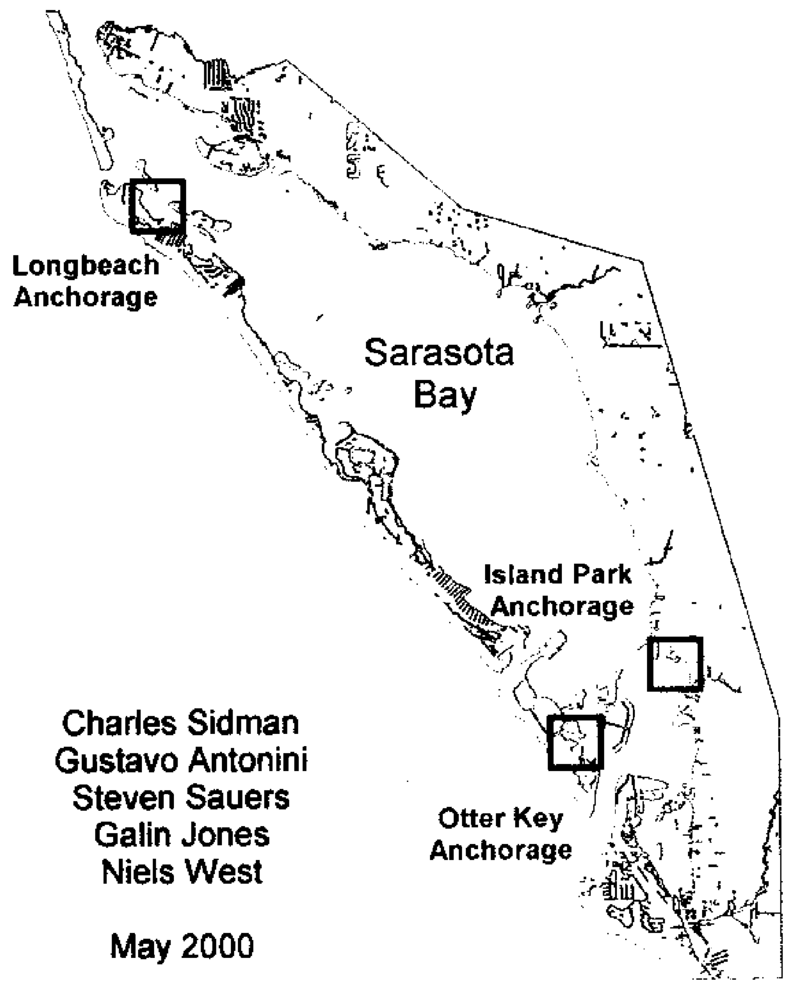
Evaluating Recreational Boating Patterns at Selected Sites in Southwest Florida for Regional Anchorage Management



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Evaluating Recreational Boating Patterns at Selected Sites in Southwest Florida for Regional Anchorage Management

by

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Executive Summary

The monitoring of recreational boating activities was carried out as part of the Five-Year Pilot Anchorage Management Program, undertaken by the Boaters Action and Information League (BAIL), the Department of Environmental Protection (DEP), Florida Sea Grant (FSG), the Southwest Florida Regional Planning Council (SWFRPC), and the West Coast Inland Navigation District (WCIND).

Monitoring complements the program's earlier work that inventoried, at selected anchorages, shoreline, bottom sediments, bathymetry, and seagrass characteristics and surveyed shore resident attitudes towards boating activities. The goal of the monitoring project is to develop a strategy to assess the compatibility of recreational activities with surrounding natural features and shorefront residents. Monitoring was carried out at three popular boat recreation areas in Sarasota Bay: Otter Key, Longbeach, and Island Park. It included identifying and mapping the type, frequency of occurrence, and the geographic extent of recreational boating activities, such as, jet skiing, power boating, dinghying, sailing, fishing, anchoring, living-aboard, and wet (in the water) storage. Monitoring was accomplished using a global positioning system (GPS) and laser range-finder, and was conducted over a one-year period (July 1998 - July 1999).

A geographic information system (GIS) relates bio-physical, social and boat activity information. Water use compatibility zones are mapped for boating activities by combining biophysical and shore resident tolerance information. A multi-overlay composite scoring approach defines areas of low, medium, and high compatibility. On-the-water observations of boat activities are compared with compatibility zones to identify potentially vulnerable areas within each of the three test sites. General mapping results are as follows:

- Temporary-anchoring takes place predominantly in areas of soft-silt mud.
- A strong association exists between fishing and areas that contain seagrass
- No areas at Otter Key achieved a high vulnerability rating.
- Several areas at Longbeach (mainly around the Moore's Stone Crab Restaurant dock) received high vulnerability ratings due, in part, to frequent power-boating.
- Numerous occurrences of living-aboard and dinghying resulted in high vulnerability ratings for several areas at Island Park, near the Bayfront Park shoreline.

- The degree of shore resident tolerance differed depending on the location, the activity, and the distance from the shoreline at which the activity occurred. Shore residents are clearly less tolerant of higher intensity activities, such as power-boating and jet-skiing. Shore residents have the greatest tolerance for sailing, temporary-anchoring and fishing.

A Poisson regression model was used to quantify complex boating activity profiles by simultaneously testing the significance of activity occurrences by site, season, day of the week, and time of day. Regression results indicated that boating activities are not independent of season, day, time, or site. The effects of day and time were only marginal in explaining activity counts. Statistical comparisons of specific activities that occurred among the three sites showed:

- Longbeach experiences significantly more temporary-anchoring, dinghying, jet-skiing, power-boating, and sailing than Island Park or Otter Key

- Otter Key experiences significantly more fishing than Longbeach or Island Park, and more power-boating than Island Park.

- Island Park experiences significantly more temporary-anchoring, dinghying, jet-skiing, and sailing than Otter Key.

Anchorages in southwest Florida are a hub for activities that transcend temporary-anchoring. Anchorages exhibit differing boating types, intensities, and patterns of use, and for this reason require different management approaches.

Boat Activity Monitoring

Introduction

Project Background

The monitoring of recreational boating activities is a component of the Five-Year Pilot Anchorage Management Program being carried out by the Boaters Action and Information League (BAIL), the Department of Environmental Protection (DEP), Florida Sea Grant (FSG), the Southwest Florida Regional Planning Council (SWFRPC), and the West Coast Inland Navigation District (WCIND). The goal of this pilot program is to facilitate anchorage management efforts by improving boater education and awareness through public meetings, the development of an anchorage-related web site, and the dissemination of educational products such as a detailed anchorage guidebook (BAIL, 1999), and large-scale photo-maps that contain historical, environmental and social information about popular recreational anchorages. The boat activity monitoring project complements the program's earlier work that inventoried bio-physical site characteristics (shoreline, bottom sediments, bathymetry, seagrass beds) and surveyed shore resident attitudes towards boating activities at selected anchorages. Identifying recreational boating activities that are common to popular anchorages is an important component of the inventory and description of the anchorage site geography.

Several monitoring approaches were investigated. The original method proposed to use on-the-water volunteers to conduct intercept surveys, but this proved unsatisfactory since individuals were unable to commit blocks of time for data gathering. An alternate method which utilized land-based video recording was rejected by the Regional Harbor Board which felt that the procedure would be too intrusive. The use of periodic aerial surveys to photograph the sites was also considered , but it was determined that the cost associated with this method would limit sampling to a few "snapshots" in time, limiting the ability to determine activity type, travel routes, and the ability to differentiate seasonal, weekly and daily variability in use. The best method for satisfying the project objectives was determined to be land-based monitoring, on randomly selected dates and times, by a paid field observer, trained in data capture using global positioning systems (GPS) and laser-ranging equipment.

Project Goal and Objectives

The goal of the boat activity monitoring project is to develop and test a field-observation methodology that can be used to generate activity-use profiles for near-shore boat recreation areas, which can be related to existing site-specific bio-physical and social information. Supporting objectives include (1) capturing and mapping, with a high level of precision, the location and spatial extent of recreational boating activities, and the frequency at which they occur, (2) demonstrating proof of concept by determining yearly, seasonal, weekly, and daily activity-use profiles for three test sites which represent a range of popular urban baywater boating destinations, and (3) relating boat activity data with bio-physical and social information, within a geographic information system (GIS), to identify zones of potential vulnerability due to frequent boating use.

Rationale

As coastal populations grow, there will be an increasing need for boat activity and traffic monitoring to support efforts to plan for and manage coastal resources. Planning for recreational boating needs and impacts requires the knowledge of where and when specific activities are most likely to occur. An objective assessment of current uses provides baseline data to classify, popular boat recreation areas on the basis of activity profiles, use intensity, and the potential for social and environmental impacts. For instance, to what extent do boating activities compromise sea grass beds? How often do boats actually anchor in areas of less desirable holding? To what degree are personal water-craft a nuisance in these areas? What is the impact of live-aboards and wet-stored vessels on overall site usage? Anecdotal experience suggest that social and environmental conflicts exist (Antonini et al. 1994). However, it is necessary to quantify these occurrences through a scientific process that objectively measures the actual frequency and spatial extent of boating activities within the bio-physical and social context of the recreational setting (Sidman, 1998). Boat activity monitoring offers a way to relate observed boating activities, including measures of densities, and multiple-uses, to potential impacts, and, thus, to provide objective input for assessing anchorage management needs.

Monitoring Methods

Sample Framework, Data Collection, Mapping and Analysis

Introduction

A description of the data collection and analytical techniques is presented in this section. The first sections outline the rationale for selecting the sample sites, and describe the environmental and social characteristics of each site. This is followed by an overview of the methodological components (Figure 1) which include the sampling framework, GPS survey techniques, and the mapping and analysis (Map 8, page 25).

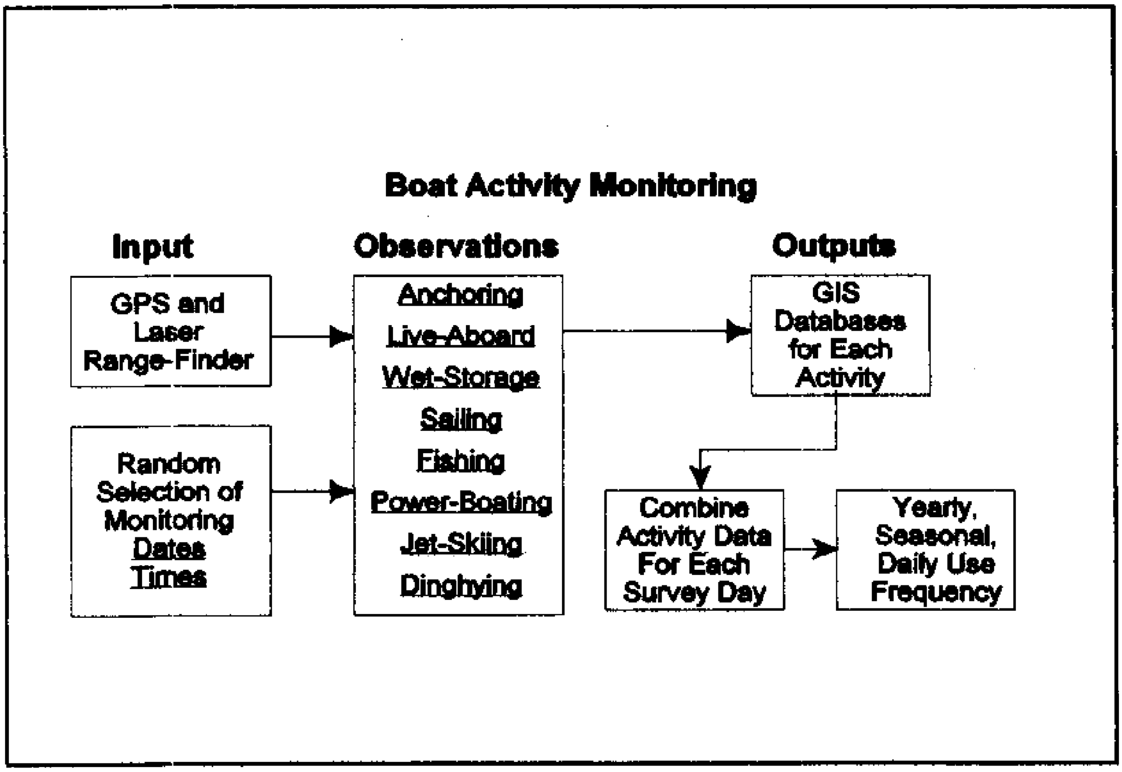

Figure 1. Monitoring Strategy.

Site Selection

Local boating experts who are members of the Boaters Action and Information League (BAIL) identified 47 anchorages in southwest Florida that are commonly used both by residents and transient vacationers for storm refuge, recreation, and as locales for experiencing nature (BAIL, 1999). As such, these anchorages are considered to be popular boat recreational sites and cruising destinations. These anchorage sites offer a variety of environmental conditions and boating facilities which affect the intensity and frequency of their use. Some anchorages have been subjected to increasing user pressure because of their natural attractiveness, sheltered location, proximity to boating facilities or land-side attractions.

A charette was conducted in which a focus group of experts in marine-related fields identified and ranked management issues in order of importance for the 47 popular southwest Florida anchorage sites. Management issues included both habitat and non-habitat descriptors. The focus group used these management issues to develop a general typology (urban, suburban, rural) for southwest Florida anchorages. In addition, management issues were used to rank each site according to its need for pro-active or passive (non-regulatory) management. Three test sites were chosen from locations which were identified as having pro-active management needs (Antonini et al., 1998).

Site Description

Otter Key, Longbeach, and Sarasota Island Park, situated in Sarasota and Manatee Counties, are representative examples of urban and suburban waterfront locations that have sensitive shore resident populations, presence of seagrass, recognized crowding problems, different shoreline land use configurations, and varying amounts of adjacent natural shorefront.

The Otter Key site is roughly 30 acres - four of which contain "lightly scarred" seagrass beds according to Sargent et al. (1995). The anchorage site is located adjacent to an upscale single-family residential neighborhood near St. Armand's Key. A previous survey of shorefront residents suggested that on-site residents are sensitive towards on-the-water activities (Antonini et al., 1994). A large undeveloped island, presence of seagrass, proximity to Big Sarasota Pass, and upscale shopping makes the Otter Key anchorage popular among boaters. This is reflected in Otter Key's management need rank of seventh out of the 47 sites (Antonini et al., 1998).

The Longbeach anchorage, located on Longboat Key approximately nine miles north of Otter Key in Manatee County, offers land use contrasts to the Otter Key site. The Longbeach site is approximately 45 acres in area, and is comprised of a greater variety of shorefront land-uses including residential single-family, commercial (restaurants), and public (boat ramp) use. This site's location adjacent to the Gulf Intracoastal Waterway also makes it accessible to a greater variety and frequency of boating activities. Jewfish Key, a private island with mangrove and Australian pine, borders the site on the east. The anchorage contains 19 of seagrass beds categorized as "non-scarred" by Sargent et al. (1995). This non-scarred status makes Longbeach a good candidate for long-term boat monitoring with the objective of preserving its relatively pristine seagrass beds. Longbeach is ranked sixth by Antonini et al., (1998), out of the 47 sites with respect to management needs.

Island Park is one of the largest, and most active anchorages in southwest Florida. It is ranked fourth by Antonini et al. (1998) with respect to pro-active management needs. Island Park is a prime example of a high intensity water-use site. The site is roughly 100 acres in area, with the northeastern portion consisting of nearly 12 acres of seagrass beds fringing the shoreline and several uninhabited mangrove islands. During the high boating season (January through April) more than 100 boats are moored there, and there is a visible live-aboard population. In addition, personal watercraft (PWC) and boat charter rentals operate from adjacent waterfront locations. A large municipal marina, just north of the site, is an additional source of boating activities and traffic through already congested waters. Other shorefront land uses include a public waterfront park, high-rise residential condominiums, and restaurants, hotels, and banks. Several upscale residential neighborhoods also share the nearby waterfront.

The Island Park anchorage has been the focus of numerous complaints concerning live-aboards, derelict vessels, wet-stored (unattended) boats, boat crowding, and trash (Antonini et al. 1998). Consequently, the Island Park anchorage exhibits many of the traits that identify sites in need of more pro-active management.

Sampling Design

A procedure was developed to sample peak-use periods and to randomly select the dates and times that activity monitoring would occur at the three test locations. The best available information was used to characterize the types of on-the-water activities, their relative importance, and the day and time of peak occurrences. This information was gleaned by observations (Antonini et al., 1994; Antonini and Box, 1996) and informal interviews. The following parameters were considered in the development of the sampling procedure: (1) daily usage pattern, defined by four categories (early and late mornings, and early and late afternoons); (2) weekly usage, defined by two categories (weekend/holiday and weekday) - no distinction was made between Saturday and Sunday, nor was any distinction made concerning which weekday was selected as a sampling day; (3) use intensities.

The three sites were ranked by relative levels of use, in order to give each location its proportion (fair share) of sample hours. For sampling, it was estimated that Island Park represents about 40 percent of all types of activities found at the three sites, Longbeach and Otter Key about 30 percent each.

Based on budgetary considerations, field observations were limited to 342 person-hour days (including drive-time) which were spread over 55 survey days: Seventeen data collection days took place during the week while the balance, 34 days, occurred on weekends. The four "traditional" boating holidays (Easter, Independence Day, Labor Day, and Memorial Day) were sampled in addition to the randomly selected dates.

The sampling period began on July 1, 1998 and extend through June 30, 1999. The year-long sampling period contained a total of 260 weekdays and 105 weekend days. Each weekend and weekday was given a sequential number starting with the first weekday or weekend day of the year and terminating on the last weekday or weekend day of the year. A random number generator selected 17 numbers (from a range of 1 - 260) for weekdays, and 34 numbers (from a range of 1 - 105) for weekends. Thus, for Monday, March 29, one hour was spent sampling in the early morning at Otter Key, followed by a one hour data collection period in the late morning at Longbeach, finishing with two hours monitoring at Island Park in the late afternoon, for a total of four hours of data collection (Appendix A, Table 5). Alternate days were selected in case of inclement weather or equipment failure.

The field observer worked from one to nine hours on each survey day; traveling between each sampling site was calculated to take one to two hours. The length of stay at a site for any given time period was calculated on the basis of (a) the total number of hours allocated (Appendix A, Tables 1 through 4) and (b) the predicted time required to monitor anchored boats at the sites. Daily monitoring time periods also were determined by fitting the hours such that monitoring would occur for a minimum of one hour on weekdays and two hours on weekends, and only once a day at any given site. Occasionally, double-shifts (i.e. two consecutive survey periods) took place to make up for rain delays and equipment malfunction. The monitoring schedule, which included observation and drive time totals for each selected monitoring day, is presented in Appendix A, Table 5.

Activity Descriptions

The activities that were monitored included the range of recreational boating-uses common to southwest Florida. Recent boat surveys of Sarasota Bay conducted by Antonini et al., (1994) and Antonini and Box (1996), identified temporary-anchoring, living-aboard, sailing, power-boating, jet-skiing, and fishing as primary recreational boating activities in the area. Many of the chosen boating activities also were identified by shore residents as being responsible for anchorage site issues, such as noise, wake, floating debris, trespassing and theft. (Antonini et al., 1994). Wet-storing of vessels and dinghying were added to the list due to the presence of these activities at Longbeach and Island Park. Kayaking and canoeing activities were not included but were noted to occur occasionally at Otter Key and Longbeach.

Monitoring focused on the activity, not the boat type. However, a general association is made between the activity and the type of boat. For example, the activity of sailing is associated with a sailboat under sail - not power; fishing was observed to be associated with smaller craft, with an outboard motor, and dinghying (small craft with or without an outboard motor) was always observed in conjunction with an anchored mother-vessel. These associations were monitored accordingly. The following activity descriptions were used by the field observer to distinguish between the various types of boating activities.

Temporary-Anchoring: In-transit, short duration lay-overs, ranging from less than one day to up to two days, usually as evidenced by reliance on the vessel's ground tackle for anchoring. ***Temporary-anchoring and anchoring are used interchangeably in this report.***

Sailing: In-transit under sail.

Dinghying: Act of ferrying boaters between the anchored vessel and shore.

Power-Boating: In-transit, large or small vessel cruising with outboard or inboard motor.

Jet-Skiing (PWC): In-transit, personal watercraft.

Wet-Storage: Lying to a permanent mooring or laid-up in the water with gear and fittings stowed.

Living-Aboard: Moored as opposed to anchored, and showing permanent active ship board use.

Fishing: Stationary, drifting, or slowly trolling. Evidence of fishing gear.

GPS Survey Technique

Recreational boating activities were surveyed from waterfront locations using a Trimble Navigation ProXR DGPS equiped with a TDC-2 data-logger (Map 8, page 25). A laser range-finder was connected to the DGPS unit. The DGPS identified the observers location by tracking the position of satellites. The laser range-finder, when pointed at a vessel, would return an "offset" value based on the boats' relative distance and bearing from the observer. This permitted the observer to collect a series of positions (points) for each boat or jet ski as it traversed a site. The data-logger was programmed with a dictionary which allowed the field observer to input activity "type" and associate a unique ID number with each boat position along its travel route, ensuring that all discrete observations relating to the movement of a single vessel could be uniquely identified. The data dictionary was also programmed to output the time at which each position was collected. The GPS data identifying boat activity positions, for each survey period, were subsequently converted to an Arc/Info GIS format using a Trimble Navigation conversion utility.

Mapping Boat Activity Data

An Arc/Info[1], Arc Macro Language (AML), program (ESRI, 1993) was created to generate separate digital point coverages for each activity occurring on a particular survey date. The AML program "reselected" all points associated with specific activities (i..e. temporary-anchoring, sailing power-boating etc.) and placed them into individual activity data layers for each survey day. Next, the AML program looped through each data layer, sorting the points by ID and time. Once sorted, the program generated continuous boat travel routes (line coverages) by adding an arc between all discrete points in a travel path based on the time that each point was collected. Each arc segment, which identified the travel paths of a specific activity on a particular survey day, was assigned a value of one.

Each data layer comprising boat paths for individual survey days was converted to a grid and combined with the travel path data for other survey days. In this way, the values assigned to each travel path accumulate spatially, over time. The resulting digital layer divides the anchorage site into 50-foot grid cells, each cell containing a composite use-frequency score related to the number of times a boat crossed the cell. Frequently traveled grid cells accumulate higher values permitting the determination of the most heavily utilized areas for specific activities at each of the study sites.

An ArcView Avenue program (ESRI, 1996) was written to automate yearly, seasonal and daily grid analyses. The program calculated a use-frequency composite score for the high season, by selecting and combining grids which correspond to data collected between the months of November through April. Low season scores for each activity were calculated by combining grids with dates of May through October. Composite scores for morning and afternoons were generated by combining grids which correspond to data collected during the morning (between 7:00am and 12:00pm) and afternoon hours (12:00pm - 6:00pm). Yearly composite scores were derived by combining the results of high and low season calculations.

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[1] Arc/Info and ArcView are the registered trademarks for ESRI's (Redlands, California) Arc/Info geographic information systems software.

Characterizing Use Profiles

A descriptive evaluation of the activity counts establishes general use profiles by season, day of the week, and time of day. A Poisson regression model, programmed in the SAS statistical software (Cody and Smith, 1997), is used to quantify complex use profiles by simultaneously testing the significance of activity occurrences by site, season, day of the week, and time of day. Offsets, specified in the model, adjust for relative size differences between sites. A Poisson regression is an appropriate model to describe specific events which occur during units of time, or within units of area (McClave and Dietrich, 1982). Regression objectives are as follows:

1. Quantify overall seasonal, weekly and daily use.

   Measure overall differences in activity occurrences between high and low seasons, between weekends and weekdays, and between morning and afternoon hours.

2. Quantify specific activity occurrences among sites.

   Measure differences in activity occurrences between Island Park and Longbeach, Island Park and Otter Key, and between Longbeach and Otter Key.

The regression model included only activities that were observed at all three sites (temporary-anchoring, sailing, fishing, power-boating, jet-skiing, and dinghying). The best fit of the regression model to the data required that wet-stored and live-aboard activities be removed from Island Park counts to reduce the number of missing observations for those activities at Longbeach and Otter Key.

Monitoring Results

Descriptive and Quantitative Analyses

Identifying General Use Profiles

A descriptive evaluation of the activity monitoring data establishes general use profiles by site, season, day of the week, and by the time of day. Seasonal categories include high (November - April), and low (May - October). Weekly categories include week days (Monday - Friday) and weekends (Saturday and Sunday). Daily categories include morning hours (7:00am to 12:00pm) and afternoon hours (12:00pm to 6:00pm).

Sampling and Observation Totals

Boat activity monitoring data are grouped into yearly, seasonal, weekly and daily boating profiles for each of the three test sites. Out of a possible 55 survey days, Otter Key was surveyed on 48 days, Longbeach on 47 days, and Island Park on 43 days (not all sites were surveyed on each day). Observation data for each survey period is provided in Appendix A, Tables 6, 7 and 8. Combined activity totals for the survey period (Table 1) show relative use levels among test sites. The greatest number of activity observations (4146) took place at Island Park. A total of 1366 and 321 activity sightings were logged at Longbeach and Otter Key, respectively. Activity observation totals indicate that Otter Key, with an average of seven occurrences per survey period (activity totals / survey days) has much lower recreational boating use levels than Longbeach (thirty occurrences per survey period) and Island Park (ninety-six occurrences per survey period).

Sample Days							
Site	Morning	Afternoon	Weekend	Weekday	High Season	Low Season	Yearly Totals
Otter Key	24	24	29	18	23	25	48
Longbeach	23	24	31	17	23	24	47
Island Park	10	33	32	11	22	21	43
Boat Activity Observation Totals							
Site	Morning	Afternoon	Weekend	Weekday	High Season	Low Season	Yearly Totals
Otter Key	125	196	251	70	139	182	321
Longbeach	672	694	1048	318	631	735	1366
Island Park	910	3236	3101	1045	2256	1890	4146

Table 1. Sample Days and Activity Observation Totals

Yearly Activity-Use Profiles

Power-boating and fishing (Table 2) account for the greatest proportion of activities observed at Otter Key and Longbeach while live-aboard and wet-storage activities are greatest at

Island Park (Table 2). Power-boating is the major use at Otter Key (66.36%) and Longbeach (45.90%) but represents only 4.56% of Island Park usage. Fishing accounts for 18.69% of the total activity sightings at Otter Key and 24.82% of the observed activities at Longbeach. Temporary-anchoring is one of the top three activities at each of the three test sites: Otter Key (8.10%), Longbeach (24.82%), Island Park (16.23%). Dinghy trips associated with temporary-anchoring account for 0.93% of activity sightings at Otter Key, 11.20% of sightings at Longbeach and 7.98% of sightings at Island Park. Jet-skiing represents a small fraction of the combined usage at the three sites: Otter Key (4.67%), Longbeach (3.00%), Island Park (1.62%). Sailing occurred rarely at the test sites and as such accounts for only 1.25% of Otter Key activities, 1.61% of Longbeach activities, and 0.51% of Island Park activities.

Yearly Boating Percentages			
Activity	Otter Key	Longbeach	Island Park
Power-Boating	66.36	45.90	4.56
Fishing	18.69	24.82	0.17
Temporary-Anchoring	8.10	11.20	16.23
Jet-Skiing	4.67	9.81	1.62
Sailing	1.25	3.66	0.51
Dinghying	0.93	3.00	7.98
Live-Aboard	0	1.61	27.01
Wet-Storage	0	0	14.92

Table 2. Yearly Boating Profiles.

Yearly activity proportions by boat class (Table 3) indicate that temporary-anchoring accounts for the greatest proportion of stationary activities at Otter Key (100%) and Longbeach (71.7%). Wet-stored vessels (49.2%) account for the greatest proportion of stationary activities at Island Park. Power-boating (72%) and fishing (20.3%) are the most common moving activities at Otter Key; Power-boating (70.2%) and dinghying (17.1%) are the most common at Longbeach; Dinghying (53.9%) and power-boating (31.7%) are the most common moving activities at Island Park.

Seasonal Activity-Use Profiles

Seasonal differences are negligible for most activities at Otter Key (Table 4). The most notable exception is fishing, which jumped from a proportion of 12.6% during the low season to 30.5% during the high season. Jet-skiing activities did not occur during the cooler high season months, but captured 9.0 % of site usage for moving vessels at Otter Key during the low season months.

General trends in seasonal activity use at Longbeach (Table 4) indicate marginal differences in use. Percent totals show that power boating (67.4% low vs. 72.4% high) dinghying

(14.7% low vs. 20.3% high), and jet-skiing activities (1.8 % high vs. 6.8 % low) exhibit the greatest proportional seasonal changes.

The greatest differences in seasonal-use at Island Park (Table 4) occurred for wet-storage (55.4% low vs. 43.8% high), temporary anchoring (13% low vs. 24.4% high), dinghying (48.2% low vs. 57.5 high) and jet-skiing (8.5% low vs. 14.7% high). Seasonal differences for live-aboard, fishing, and sailing were negligible.

Yearly Activity Percentages by Class (Moving or Stationary)				
Boat Class	Activity	Otter Key	Longbeach	Island Park
Stationary Vessels	Temporary-Anchoring	100	71.7	19.1
	Live-Aboard	0	0	31.7
	Wet-Storage	0	28.3	49.2
Moving Vessels	Power-Boating	72.2	70.2	30.7
	Fishing	20.3	5.6	1.1
	Jet-Skiing	5.1	4.6	10.9
	Sailing	1.4	2.5	3.4
	Dinghying	1.0	17.1	53.9

Table 3. Relative Proportions of Yearly Activity Observations by Boating Class.

Seasonal Activity Proportion by Class (Moving or Stationary)								
Boat Class	Activity	Otter Key		Longbeach		Island Park	
		High	Low	High	Low	High	Low
Stationary Vessels	Temporary-Anchoring	100	100	71.9	71.4	24.4	13.0
	Live-Aboard	0	0	0	0	31.8	31.6
	Wet-Storage	0	0	28.1	28.6	43.8	55.4
Moving Vessels	Power-Boating	67.2	76.1	67.4	72.4	29.3	33.1
	Fishing	12.6	30.5	6.4	5.0	1.3	0.8
	Jet-Skiing	9.0	0	1.8	6.8	8.5	14.7
	Sailing	0.8	1.8	4.1	1.2	3.5	3.4
	Dinghying	1.6	0.6	20.3	14.7	57.5	48.2

Table 4. Relative Proportions of Seasonal Activity Observations by Boating Class.

Daily Activity-Use Profiles

Daily differences (Table 5) are negligible for most activities at Otter Key (less that 7% difference between morning and afternoon occurrences). The most notable exception is fishing (26.7% morning vs. 16.2% afternoon). A less than 3% proportional difference suggests consistent proportional use throughout the day for all observed activities at Longbeach (Table 5). Power-boating (21.3% morning vs. 32.4% afternoon) and dinghying (69.1% morning vs. 51.1% afternoon) exhibit the greatest differences in proportional daily use at Island Park.

Daily Activity Proportion by Class (Moving or Stationary)							
Boat Class	Activity	Otter Key		Longbeach		Island Park	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Stationary Vessels	Temporary-Anchoring	100	100	71.0	72.3	18.4	19.3
	Live-Aboard	0	0	0	0	30.0	32.2
	Wet-Storage	0	0	29.0	27.7	51.6	48.5
Moving Vessels	Power	68.1	74.9	68.7	71.7	21.3	32.4
	Fish	26.7	16.2	7.0	4.2	2.1	1.0
	Jet-Ski	5.2	5.0	3.6	5.5	7.5	11.5
	Sail	0	2.2	3.4	1.6	0	4.0
	Dinghy	0	1.7	17.2	17.0	69.1	51.1

Table 5. Relative Proportions of Daily Activity Observations by Boating Class

Comparing Boating Densities Among Sites

Boating densities (Table 6) illustrate average boating concentrations by relating the number of observed activities to the size of the site. This allows boating observation totals to be directly compared between sites and to gauge the intensity of use. The density of moving boats (power-boating, fishing, jet-skiing, dinghying and sailing) is greatest at Longbeach (0.422 boats per acre), and lowest at Island Park (0.144 boats per acre). Conversely, Island Park (0.929 boats per acre) experiences the greatest density of stationary boats (temporary-anchoring, live-aboard, and wet-storage).

Densities for moving boats (0.205) are eleven times greater than that of stationary activities (0.018) at Otter Key, and twice (0.422) that of stationary activities (0,224) at Longbeach. The converse is true for Island Park, which experiences almost six times the use-intensity from stationary vessels (0.829) as it does from moving vessels (0.144). Yearly composite densities identify Island Park (0.964) as having the greatest overall per-day boating use-intensity. Longbeach ranks second with 0.646 aggregate boats per acre. Otter Key ranks a distant third, with an aggregate boating density of 0.223 - roughly three times lower than that of

Longbeach and four times lower than Island Park. Island park has almost four times the stationary boating density as Longbeach and over forty-five times that of Otter Key. Longbeach experiences the greatest yearly moving boat densities - roughly two times that of Otter Key and over three times that of Island Park.

Boating Densities (average boats per acre)			
Site	Stationary Boats	Moving Boats	Yearly Totals
Otter Key	0.018	0.205	0.223
Longbeach	0.224	0.422	0.646
Island Park	0.829	0.144	0.974

Table 6. Boating Densities.

Quantifying Complex Use Profiles

Poisson regression results (Appendix C) indicate that activity observations are not independent of season, day, time, or site (alpha = .05; P-values < 0.025). However, the effects of day and time only marginally explained activity counts. In other words, activity levels were consistent across weekends and weekdays, and across mornings and afternoons. The most significant weekly and daily differences (Table 7) were that, on average, five more power-boating occurrences were observed during weekend sampling periods than during week days (9.03 vs 4.30), and roughly three more temporary-anchored vessels were observed during the afternoon hours than during morning hours (8.94 vs 5.57).

Activity Observation Means for Day and Time Variables				
	Weekday	Weekend	Morning	Afternoon
Anchoring	6.09	8.24	5.57	8.94
Dinghying	2.59	4.00	2.43	4.32
Fishing	0.67	0.93	1.10	0.66
Jet-Skiing	0.05	1.07	0.50	1.18
Power-Boating	4.30	9.03	6.93	7.84
Sailing	0.13	0.45	0.26	0.40

Table 7. Activity Observation Means for Day and Time Variables.

Formal comparisons among sites for overall counts of temporary-anchoring, fishing, sailing, jet-skiing, dinghying, and power-boating indicate that Longbeach experiences the greatest boating intensity and Island Park experiences the lowest boating intensity of the three sites. Live-aboard and wet-stored vessels were omitted because those activities did not take place at all three sites. The large numbers of live-aboard and wet-stored vessels at Island Park factored significantly in the density calculations, which show that Island Park experiences the greatest "overall" boating densities (Table 6). Differences in density calculations and regression results demonstrate the tremendous impact that live-aboard and wet-stored vessels have on overall usage at Island Park.

Formal comparisons of specific activities among sites indicate that: (1) Longbeach experiences significantly more temporary-anchoring, dinghying, jet-skiing, power-boating, and sailing than Island Park or Otter Key; (2) Otter Key experiences significantly more fishing than Longbeach or Island Park, and more power-boating than Island Park; and (3) Island Park experiences significantly more temporary-anchoring, dinghying, jet-skiing, and sailing than Otter Key. The relative ranking of sites with respect to specific activity levels, adjusted for area, is presented in Table 8. Wet-storage and live-aboard rankings (Table 8) are based on relative densities and were not derived from the regression analysis.

Site Ranking for Activity Use Adjusted for Area			
Activity	**Otter Key**	**Longbeach**	**Island Park**
Temporary- Anchoring	3	1	2
Dinghying	3	1	2
Fishing	1	2	3
Jet-Skiing	3	1	2
Power-Boating	2	1	3
Sailing	3	1	2
Wet-Storage	None	2	1
Live-Aboard	None	None	1

Table 8. Site Rankings for Activity Use Adjusted for Area.

Mapping Boat Activities

Characterizing Spatial Use Profiles

Multi-Overlay Composite Scores

Boat activity monitoring data are aggregated and mapped as yearly, seasonal, and daily boating profiles for each of the three test sites. The spatial distribution and frequency of observed boating activities are displayed in map form at a 50 foot grid cell resolution[2]. Boat travel paths collected from each survey period are aggregated and displayed as composite frequency scores. Inset maps illustrate the relative contribution of individual activities to the yearly composite score. Cells with lower use frequency totals are displayed in shades of green. Cells with higher use frequency totals are displayed in shades of red. The darker the shade, the higher the use associated with that cell. The shades are identical for each site. However, depending on the site, each shade reflects different cell hit intervals. This is due to the fact that some sites were surveyed on more days than others, and that each site experienced varying amounts of activity use. For example, yearly cell hit aggregates for Otter Key (Map 1) are displayed as five intervals of seven. Yearly cell hit totals for Island Park (Map 5) are displayed as five intervals of 17.

Daily (morning vs. afternoon) and seasonal (high vs. low) use frequency is also mapped. Cell hit intervals are matched to allow for the comparison between morning/afternoon, and high/low season use frequency. An additional analysis shows use frequency for stationary (temporary-anchoring, living-aboard, and wet-storage) and moving (power-boating, jet-skiing, fishing, dinghying, and sailing) activities at Island Park (Map 6). Moving boat activities tend to cluster, following a narrow travel route to and from the O'Leary's Restaurant docks at Island Park. This suggests that O'Leary's is the origin and destination for much of the site's transient activities. Conversely, stationary activities display a more diffuse spatial pattern. One reason for this is that the swing radius of many moored vessels was much greater than the 50 foot mapping resolution. As a result, a stationary 50 foot vessel with a 100 foot scope might potentially be surveyed and mapped over several 50 foot grid cells, diffusing point accumulations over several nearby cells. Thus, at the selected mapping resolution, cells (areas) frequented by moving activities accumulated much higher scores than those for stationary activities. As such, stationary and moving use-frequencies should be viewed independently, not compared directly.

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[2] The 50 foot grid cell resolution is appropriate for most activities especially given the small size of the Otter Key and Longbeach anchorages. The most common boating categories at Island Park consist of long-term moored live-aboard and wet-stored vessels. Under perfect conditions, these activities would accumulate temporally in single grid cells. However, while technically considered to be stationary activities, wind, tides and scope can result in swing radii, over time, exceeding even several 50 foot grid spaces. As a result, fewer cells overlapped temporally for independent stationary activities. For comparative purposes, it was necessary to apply a standard grid resolution to all activity categories at each of the three sites.

Otter Key Anchorage Spatial-Use Profile

Yearly composite scores for all activities (Map 1) show the greatest use (cells with 29 - 34 hits) occurring along the narrowest portion of the center channel. Activity frequency tapers from the center channel area with the lowest use occurring along near-shore areas. The yearly travel composition for individual activities is depicted as inset maps. Power boating activities traverse the entire Otter Key Anchorage, and account for the greatest contribution of cell hits to the yearly composite score. Jet-skiing and fishing activities also extend over most of the anchorage area but take place with much less regularity. The spatial and temporal impact of temporary-anchoring, sailing, and dinghying was negligible. Yearly aggregate scores show a relatively infrequent and diffuse temporary-anchoring pattern.

Seasonal results (Map 2) clearly illustrate that while boating occurs over the entire extent of the site, it does so with less regularity during the colder winter months. Morning use (Map 2) is more concentrated, with the greatest frequency of activities (mainly fishing) occurring near seagrass beds which surround a sunken dredge barge. The results suggest that power-boating and jet-skiing occur more frequently during the warmer low season months, and afternoon hours. The results also illustrate that the majority of boating activities are confined to the dredged center channel. Exceptions are fishing which takes place near residential shorelines and the shoreline of Otter Key and jet-skiing which is evenly distributed throughout the site.

Longbeach Anchorage Spatial-Use Profile

The yearly composite scores for Longbeach (Map 3), which identifies areas as having up to 56 hits, reflects higher use totals than Otter Key. At Longbeach most boating activities are focused around a public boat ramp and several restaurants which have docks to accommodate transient boaters. Yearly composite scores reflect the intense use of waters adjacent to the Moore's Stone Crab and MarVista restaurants.

As is the case with Otter Key, power boating is the dominant activity at Longbeach; illustrated by cells with as many as 44 power boat hits. Aggregate yearly scores for individual activities show an extensive use of anchorage waters. Anchoring activities are clustered with wet-stored vessels in the central basin. Dinghy activities are spatially diffuse with the highest concentrations of activities centered around anchoring vessels.

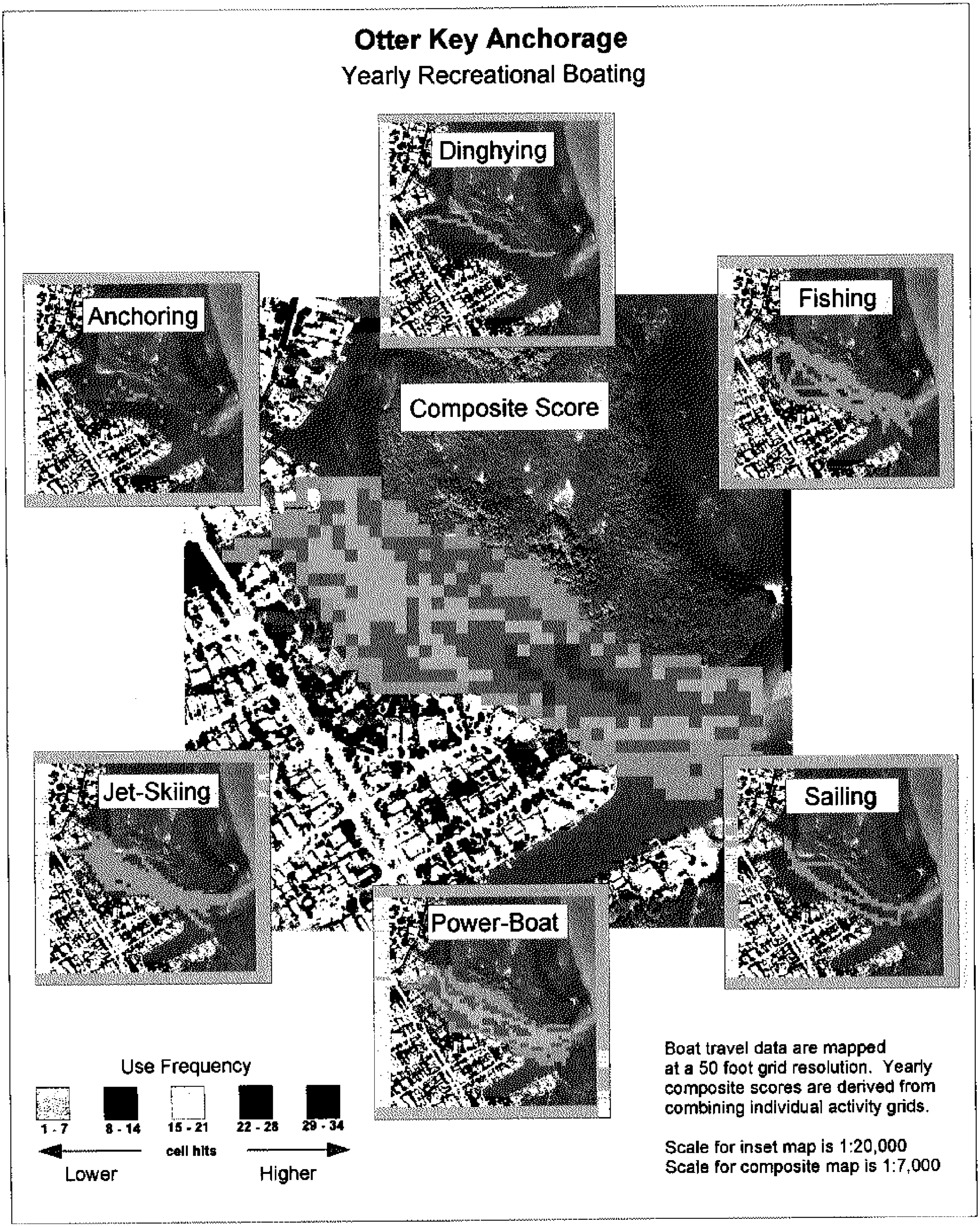
Seasonal and daily results (Map 4) show corroborate descriptive analyses which show a relatively consistent use of the site regardless of the season or time of the day. However, the spatial extent of higher-use areas is greater during the low season and afternoon hours; consistent with, yet not as distinct as the seasonal and daily differences observed at Otter Key.

Island Park Anchorage Spatial-Use Profile

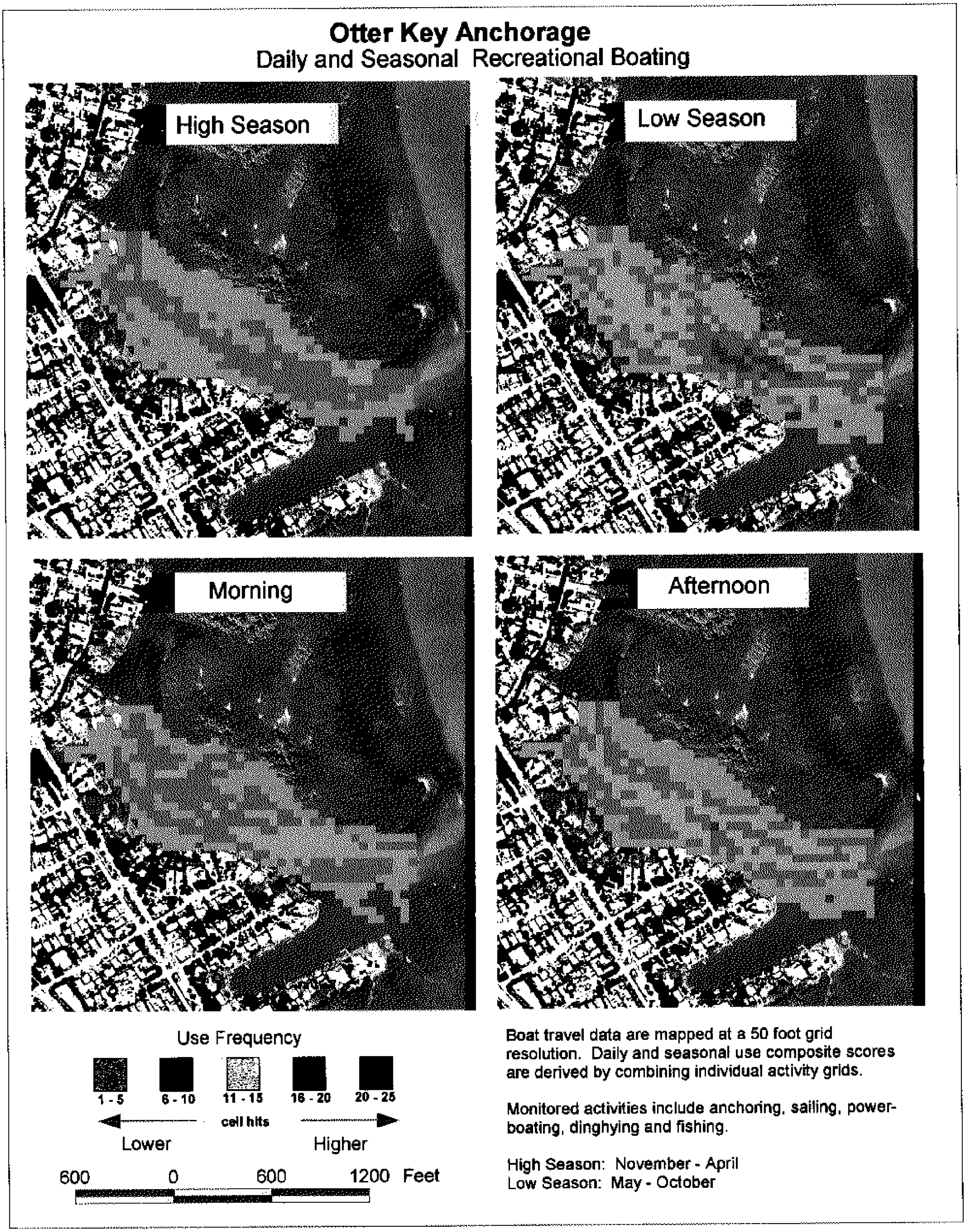
Yearly composite scores for Island Park (Map 5) depict a core area of the highest combined activity near the O'Leary's Restaurant and boat rental docks located at Bayfront Park. Power-boating and dinghying activities cover the greatest area but use frequency is concentrated in the immediate vicinity of the restaurant and boat rental docks, with a travel corridor following the contour of the Bayfront Park peninsula. Fishing is rarely observed. Jet-skiing and sailing, while infrequent, still utilized significant portions of the site. The origin and destination of moving boats is clearly shown by the diffusion of activities from the O'Leary's Restaurant and boat rental docks at Bayfront Park.

The Island Park anchorage is host to a mix of recreational boating uses. As such, activities are grouped into yearly boating profiles for stationary (moored) and moving activities (Map 6). The shallow basin adjacent to O'Leary's Restaurant experiences the greatest frequency (16 - 26 hit range) of stationary or moored activities which include wet-stored vessels, temporary-anchoring, and living-aboard. Nevertheless, cells accumulating higher hit scores are scattered about the anchorage. These cells probably reflect the presence of the same moored vessel over many survey days. Transient boating trends toward a clustering of greater uses which follows the contour of the Bayfront Park shoreline.

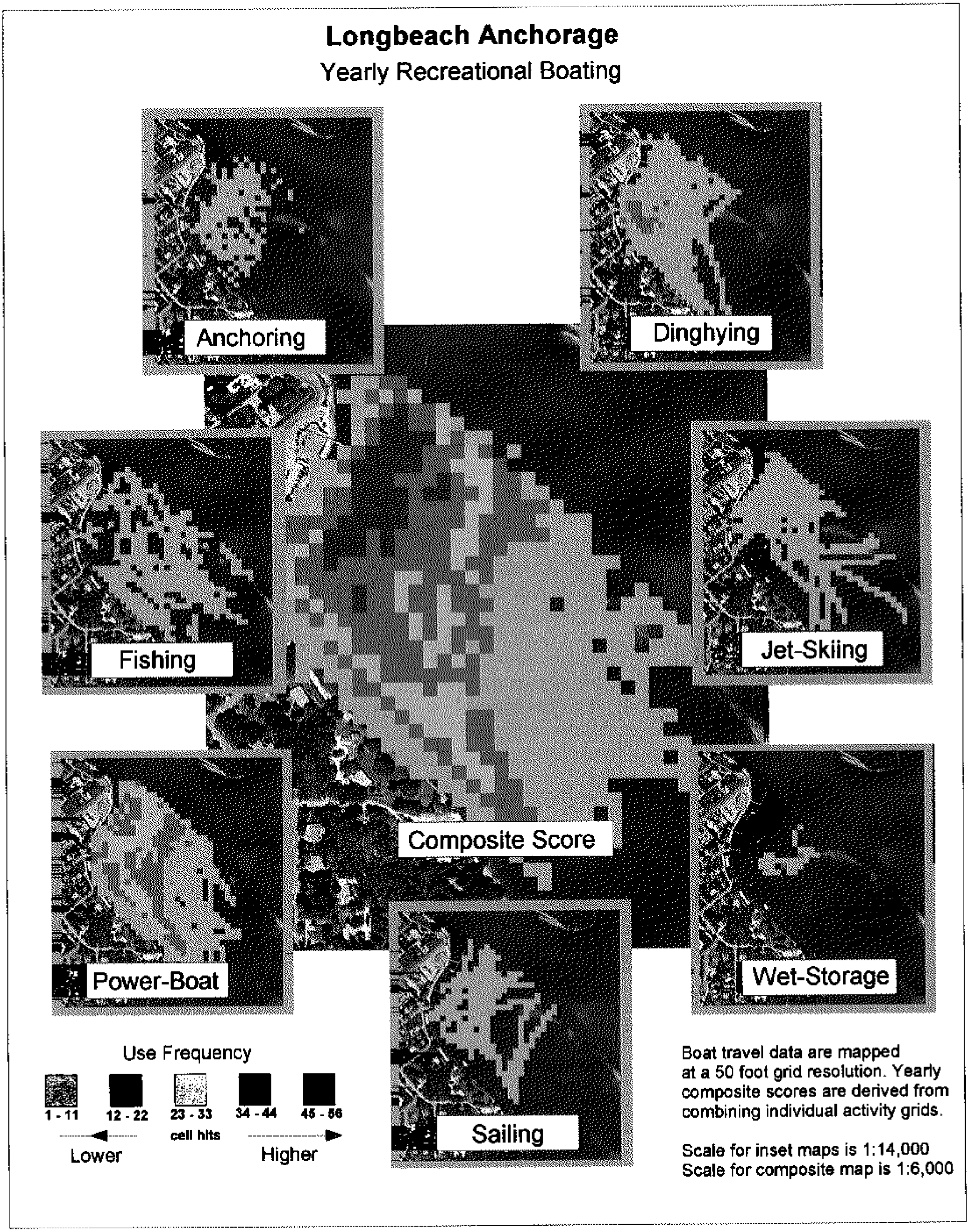
Seasonal and daily results for Island park (Map 7) are consistent with use profiles at Otter Key and Longbeach which show a higher frequency and spatial extent of boating activities during the low season and afternoon hours. Use differences, however, are most noticeable between morning and afternoon. The difference in daily use frequency reflects the propensity of moving boat activities such as power-boating, jet-skiing, and dinghying to take place during the warmer afternoon hours.



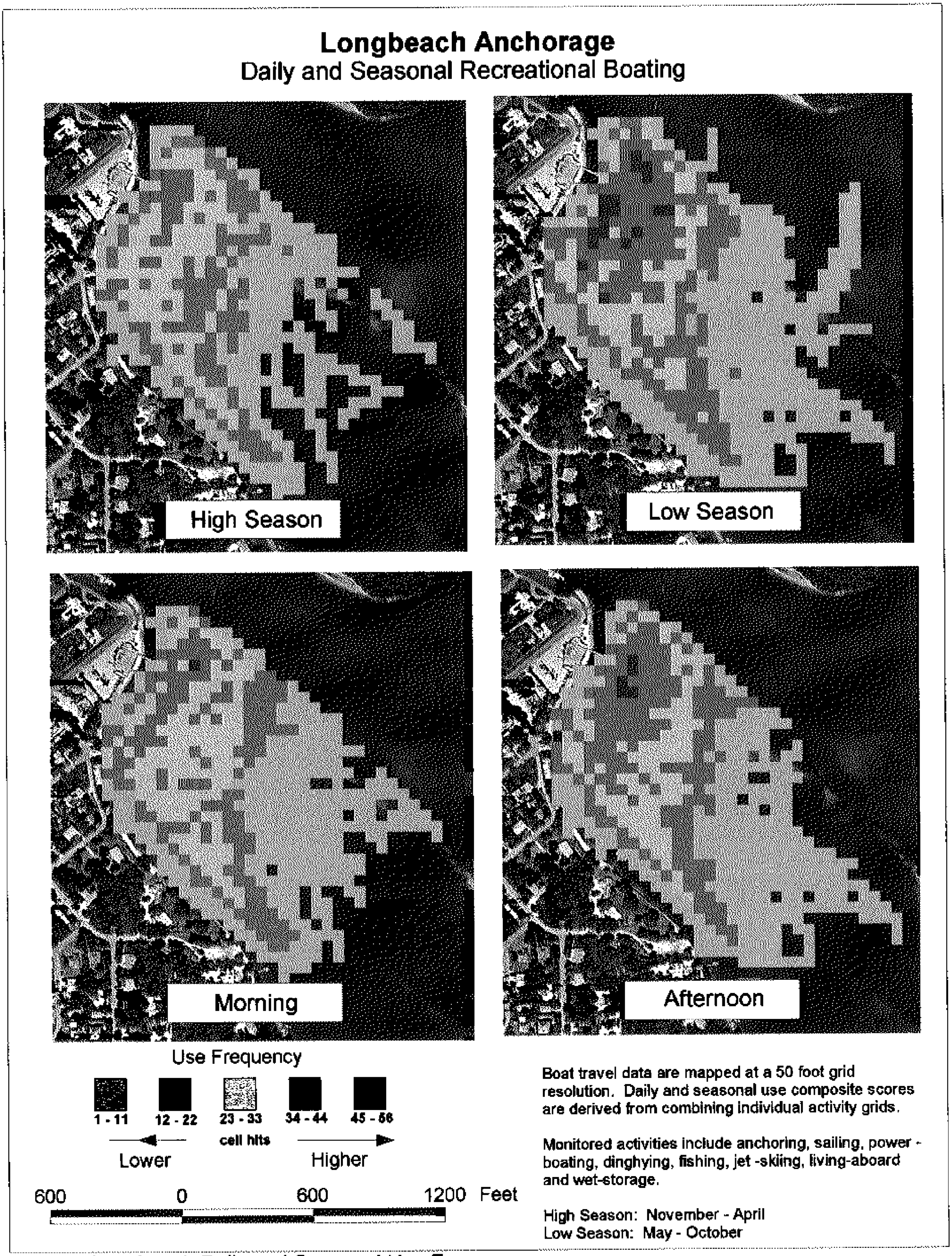
Map 1. Otter Key Yearly Activity-Use Frequency.



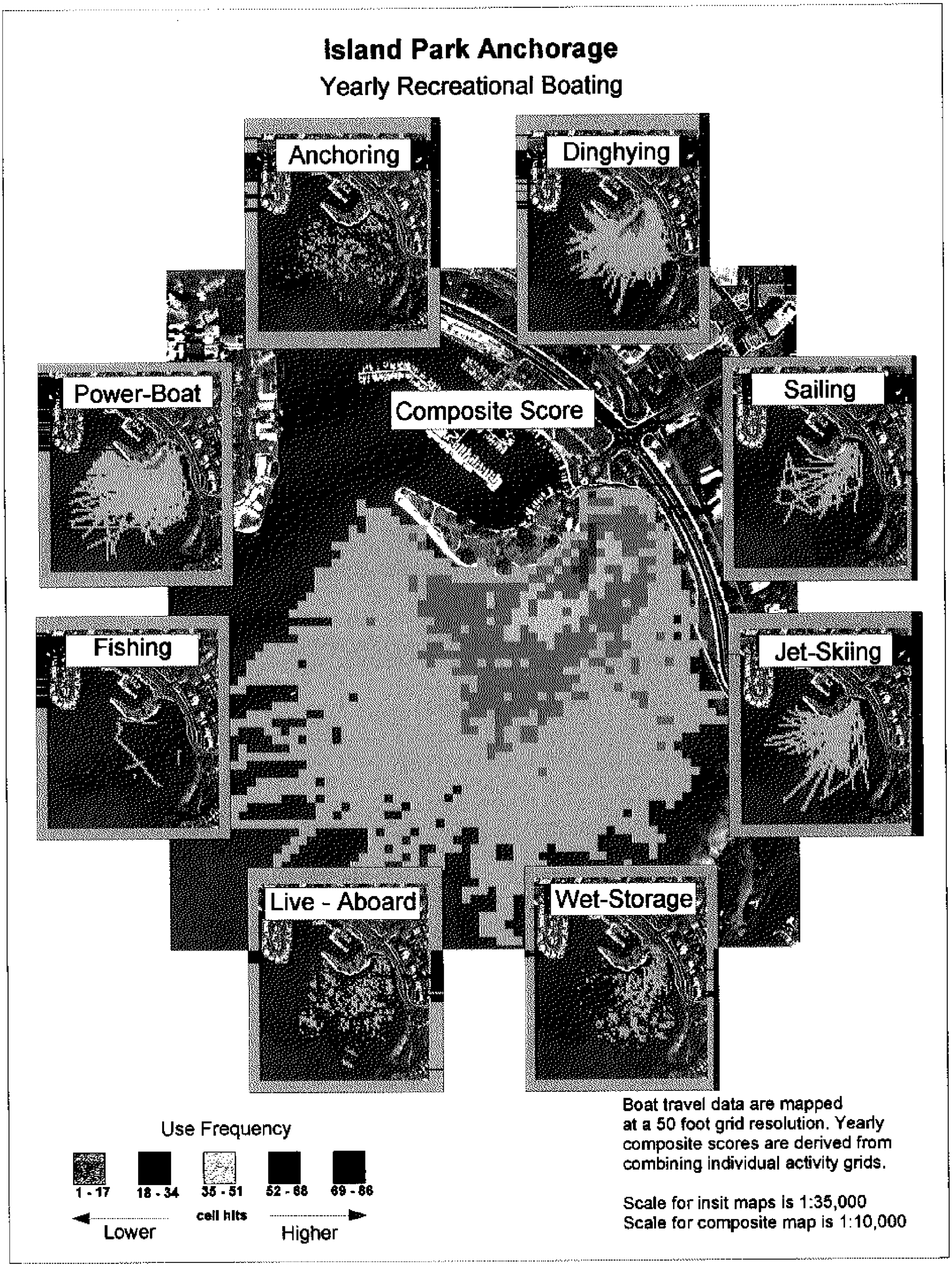
Map 2. Otter Key Daily and Seasonal Use Frequency.



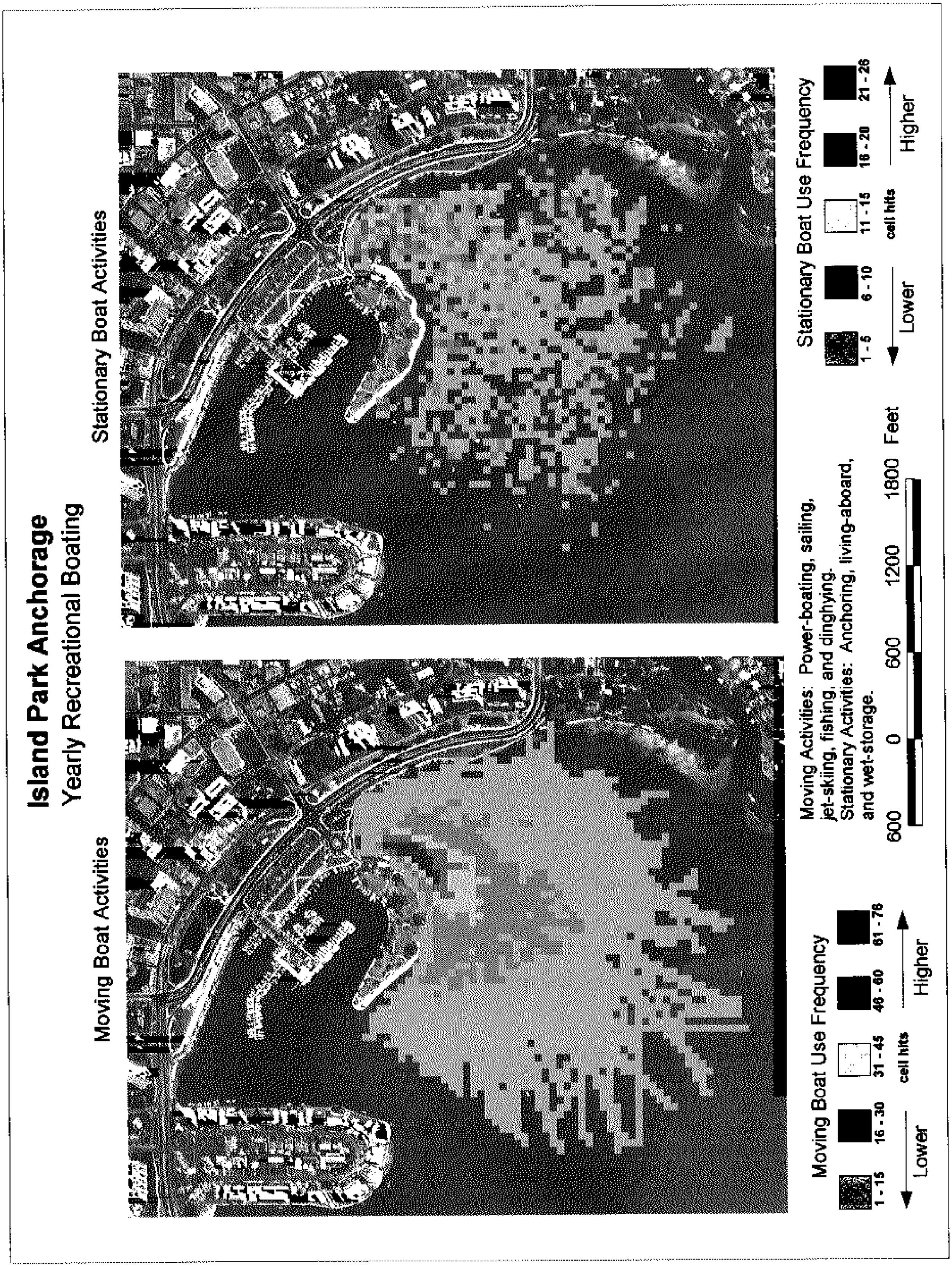
Map 3. Longbeach Yearly Activity-Use Frequency.



Map 4. Longbeach Daily and Seasonal Use Frequency.



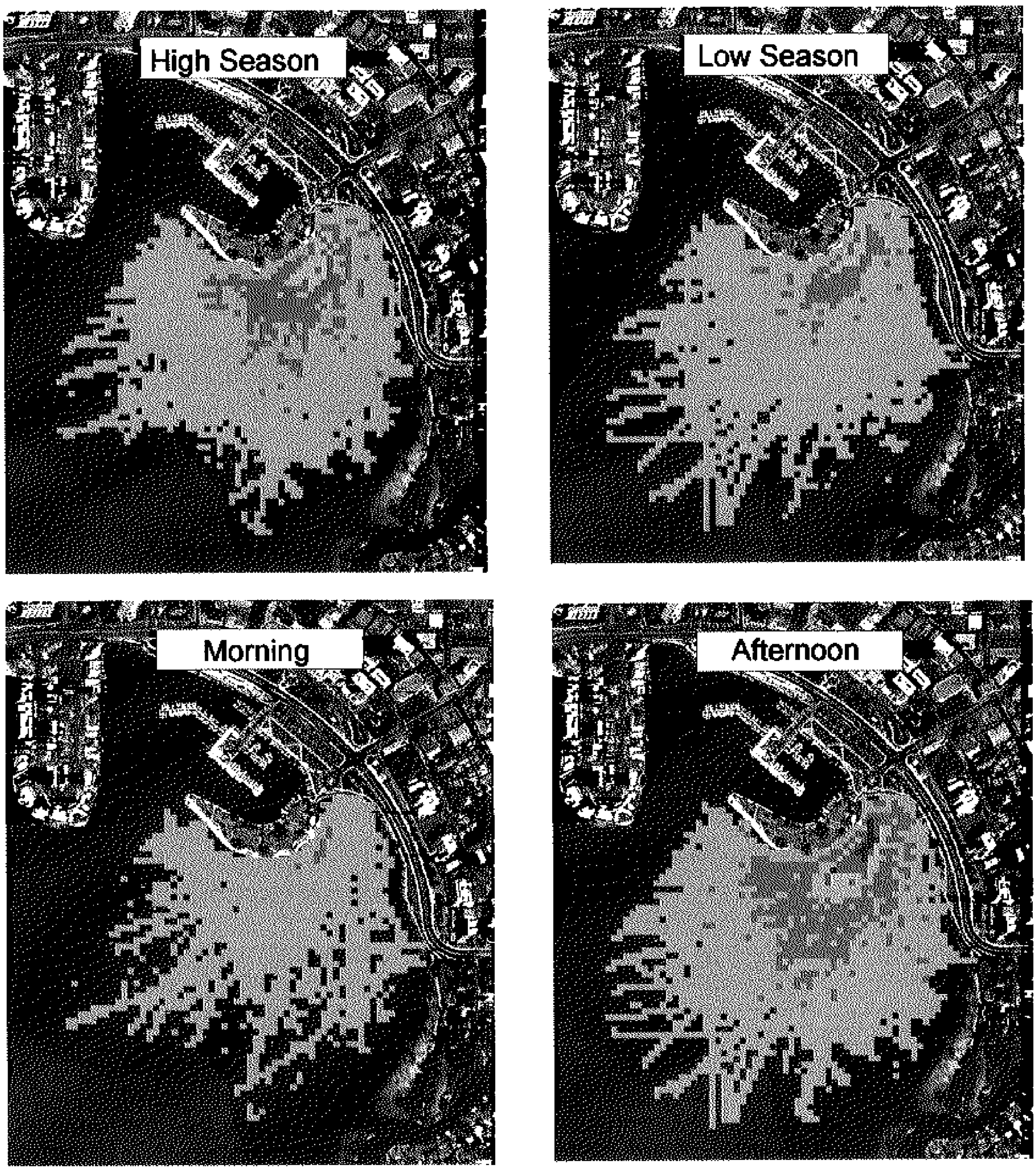
Map 5. Island Park Yearly Activity-Use Frequency.



Map 6. Island Park Yearly Use Frequency for Moving and Stationary Boats.

Island Park Anchorage

Daily and Seasonal Recreational Boating



Use Frequency

1 - 14 | 15 - 28 | 29 - 42 | 43 - 56 | 57 - 71

cell hits

Lower ... Higher

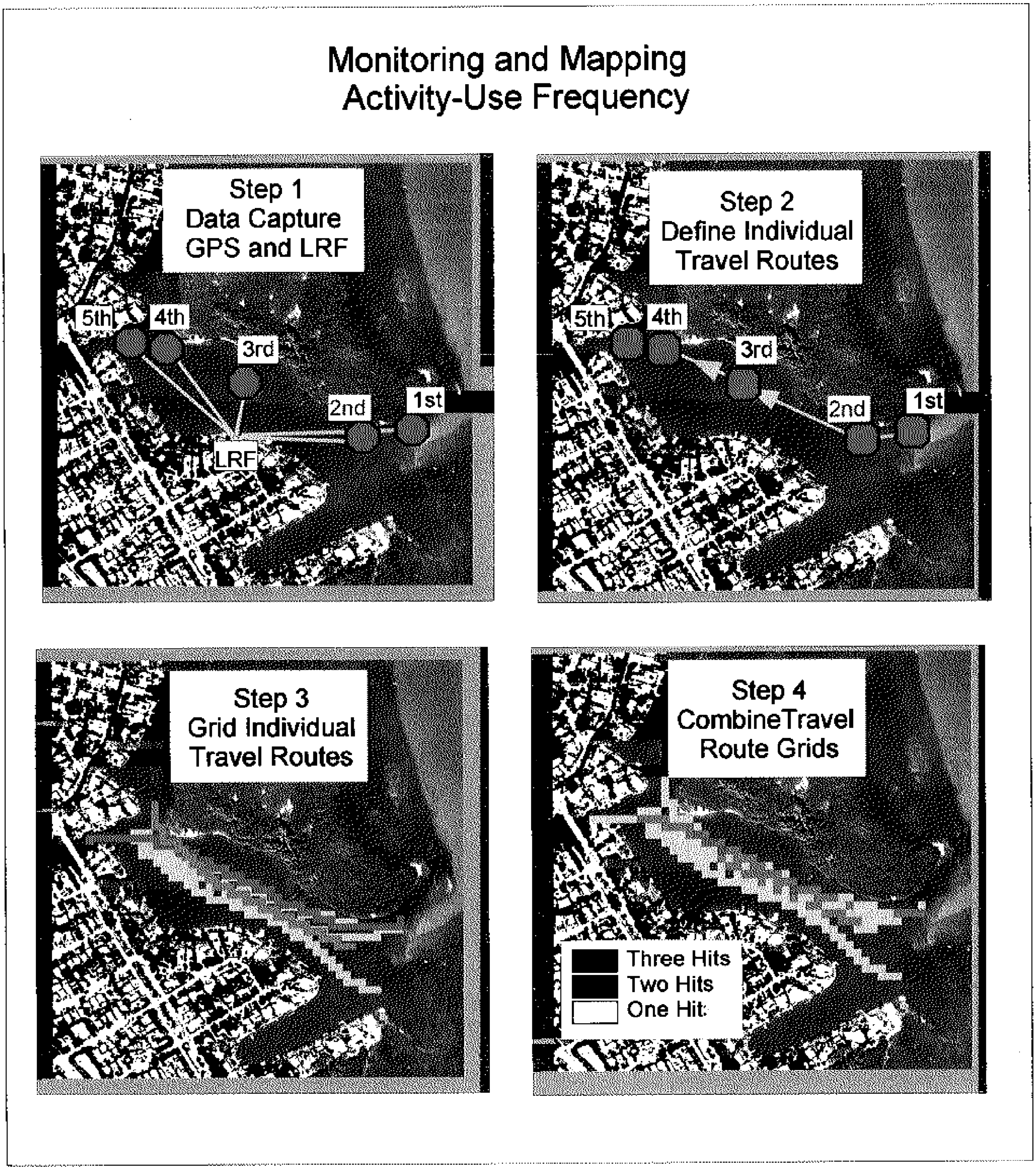
600 0 600 1200 Feet

Boat travel data are mapped at a 50 foot grid resolution. Daily and seasonal use composite scores are derived from combining individual activity grids.

Monitored activities include anchoring, sailing, power-boating, dinghying, fishing, jet-skiing, living- aboard and wet-storage.

High Season: November - April
Low Season: May - October

Map 7. Island Park Daily and Seasonal Use Frequency.



Map 8. Methods of Data Capture and Use-Frequency Analysis.

Mapping Impact Potential

Identifying Areas of Potential Vulnerability

Integrating Spatial Data

Monitoring recreational boating activities provides important baseline information concerning the frequency and spatial extent of boating activities. However, anchorage management recommendations also should consider the interrelationships between water-dependent uses and other important social and bio-physical factors that characterize an anchorage. This section presents the findings of GIS analyses that integrate activity monitoring data with bio-physical and shore resident information. Specific analyses include relating the locations of temporary-anchored and moored vessels to bottom type (Map 9) and associating activities with sea grass (Map 10). In addition, a method is presented that integrates boat activity frequencies with sea grass, bottom sediments, water depth, and shore resident tolerance, as the basis for mapping areas of potential vulnerability (Figure 2). Potentially vulnerable areas

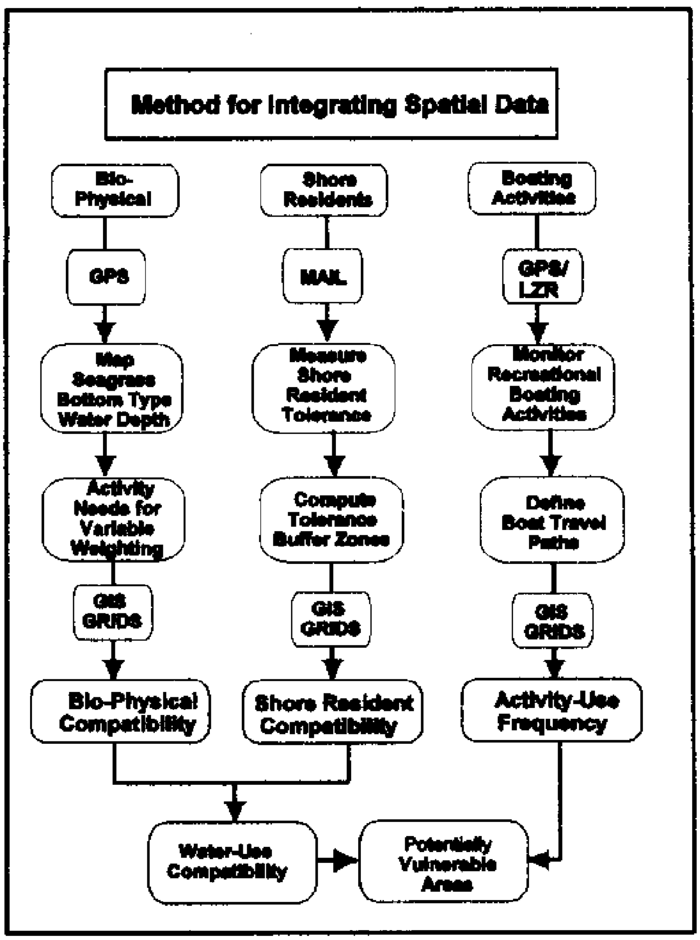


Figure 2. Method for Integrating Spatial Data.

are identified by weighting and combining bio-physical and shore resident information to identify water-use zones of high, medium, and low activity compatibility, and by subsequently comparing water-use zones with boat activity frequencies.

Developing Bio-Physical and Shore Resident Compatibility Surfaces

Bio-physical site descriptors, including seagrass, bottom sediments, and water depth, were field mapped using a GPS and a depth sounder (Antonini et al. 1994). Water depth was recorded every few feet along each specified transect (a lead line was used in shallow areas). Bottom characteristics, including soft and hard silt mud, sand, rock, shell, and coral, were recorded with the help of a biologist /diver who relayed bottom information "topside" via a special electronic headset. Seagrass areas were mapped in a similar fashion with divers relaying the presence or absence of seagrass at specific locations along transects. Once a rough boundary was identified, the divers concentrated their efforts along the edge, in order to define the seagrass area more precisely (see Maps 11, 12, and 13 for bio-physical compatibility surfaces).

An opinion survey elicited the attitudes of shore residents (waterfront property owners at each of the three sites) toward boating activities. Each questionnaire included an aerial photograph specific to each of the three test sites. Distances of 200, 400, 600, and 800 feet from the shoreline were plotted on the aerial photographs. Shore residents were asked to evaluate the degree to which specific boating activities occurring at specified distances pleased or annoyed them. Responses ranged from +3 (pleased) to -3 (annoyed). A multi-way analysis of variance (ANOVA) model generated least square mean estimates of shore resident pleasure or annoyance by analyzing the interaction of survey responses for activity and distance variables. Least square means generated from the interaction of activity and distance variables are used in a regression model to identify distance breakpoints at which specific activities become tolerable to shore residents. Thus, for the regression line

$$Y = a+bX,$$

$Y = 0$ at the distance (X) at which attitudes towards an activity become indifferent. Hence,

$$X = -a/b$$

The distance at which emotional responses towards a specific activity become indifferent is estimated by dividing the intercept (a) by the slope (b). For more on the methods and results of the shore resident survey see Sidman (1998). A spatial index of shore resident tolerance is generated by buffering the shoreline, within the GIS, using tolerance distances estimated by the regression model (see maps 14, 15, and 16 for shore resident tolerance surfaces).

Variable Weighting

A scoring system was developed to weight bio-physical features with respect to meeting or falling below boating activity requirements, such as, avoiding seagrass beds, adequate depth, and acceptable bottom type for anchor holding. Areas meeting activity requirements are assigned lower values for higher compatibility, and areas failing to meet requirements are assigned larger values for lower compatibility (Table 9). Certain activities (temporary-anchoring, sailing, living-aboard) are associated with boats that require greater depth than others (power-boating, fishing, jet skiing). The minimum water depth was determined to be five feet for activities involving sail boats, and three feet for activities which typically utilize power boats (Antonini et al., 1994).

Scoring Scheme for Site Features		
Variable	Yes	No
depth < 5 feet (sail-type boats) depth < 3 feet (power-type boats)	2	1
sea grass present	3	1
favorable holding	1	2
within shore resident tolerance zone	3	1

Table 9. Variable Weights.

Shore resident tolerance zones were weighted as follows: Areas failing to meet shore resident tolerance requirements are assigned a weight of "three" and areas meeting social tolerance standards are assigned a weight of "one". Variable weighting is consistent with the outcome of a focus group interview of marine experts who ranked environmental and social concerns as the most important criteria in determining anchorage management needs (Antonini et al., 1998). Upon combining bio-physical and shore resident databases, variable weights accumulate spatially as a water-use compatibility surface (See Table 10; Maps 17, 18, and 19 for water-use compatibility surfaces). The degree to which an activity is bio-physically and socially compatible at any given location is determined by point accumulations: Greater values reflect lower compatibility ratings. Acreage calculations for low, medium and highly compatible areas (Appendix B) provide an estimate of the net useable space contained within a site for specific boating activities. Percent area totals (Appendix B) may be used to identify those activities that are most suitable to a specific anchorage.

Point Accumulations for Water-Use Compatibility			
Boat Type	Highest Compatibility	Medium Compatibility	Lowest Compatibility
stationary	4 or 5 points	6 or 7 points	8, 9 or 10 points
moving	3 or 4 points	5or 6 points	7or 8 points

Table 10. Point Accumulations for Water-Use Compatibility.

Identifying Potentially Vulnerable Areas

Potentially vulnerable areas are identified by reclassifying and integrating activity frequency and water-use compatibility ranges within the GIS (Table 11). For example, for stationary boats, cells accumulating four or five points are reclassified to one; six or seven are reclassified to two; and values of eight through ten are reclassified to three. The same procedure is applied to activity frequency grids which are reclassified based on the number of survey days that a grid cell was traversed. For the Longbeach site, 1 - 15 days is reclassified to one; 16 - 32 days is reclassified to two; 33 - 47 days is reclassified to three. Composite vulnerability scores (Table 12; Maps 20, 21, and 22) identify areas that may be more sensitive to boating activities.

GIS Reclass for Activity Occurrence and Water-Use Zones			
Ranges	Activity Frequency of Occurrence	Water-Use Compatibility	
		stationary boats	moving boats
Lowest Longbeach Otter Key Island Park	1 - 15 days = 1 1 - 15 days = 1 1 - 13 days = 1	4 or 5 = 1	3 or 4 = 1
Medium Longbeach Otter Key Island Park	16 - 32 days = 2 16 - 32 days = 2 14 - 29 days = 2	6 or 7 = 2	5 or 6 = 2
Highest Longbeach Otter Key Island Park	33 - 47 days = 3 33 - 48 days = 3 30 - 43 days = 3	8, 9 or 10 = 3	7or 8 = 3

Table 11. Grid Cell Reclassification.

Composite Vulnerability Scores		
Vulnerability	Points	Vulnerability Combinations
Lowest	2 or 3	low frequency - low stress low frequency - medium stress medium frequency - low stress
Medium	4	low frequency - high stress medium frequency - medium stress high frequency - low stress
Highest	5 or 6	medium frequency - high stress high frequency - medium stress high frequency - high stress

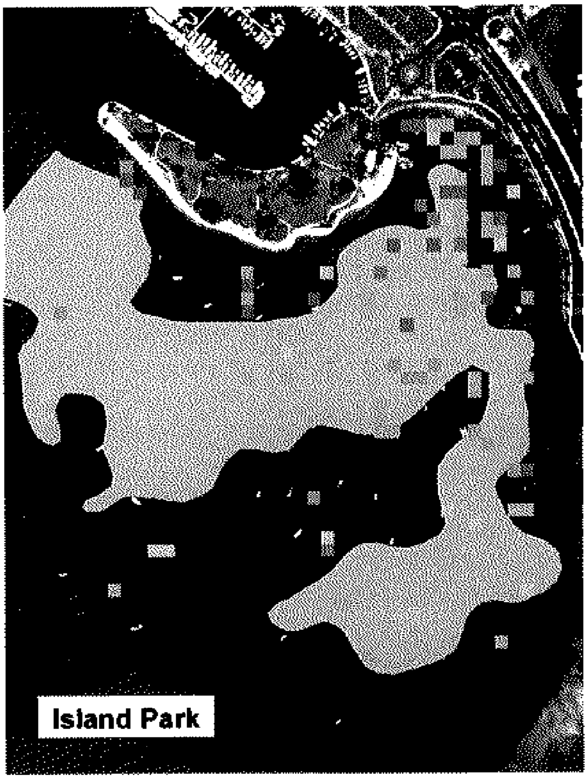
Table 12. Point Accumulations for Potential Vulnerability Ratings.

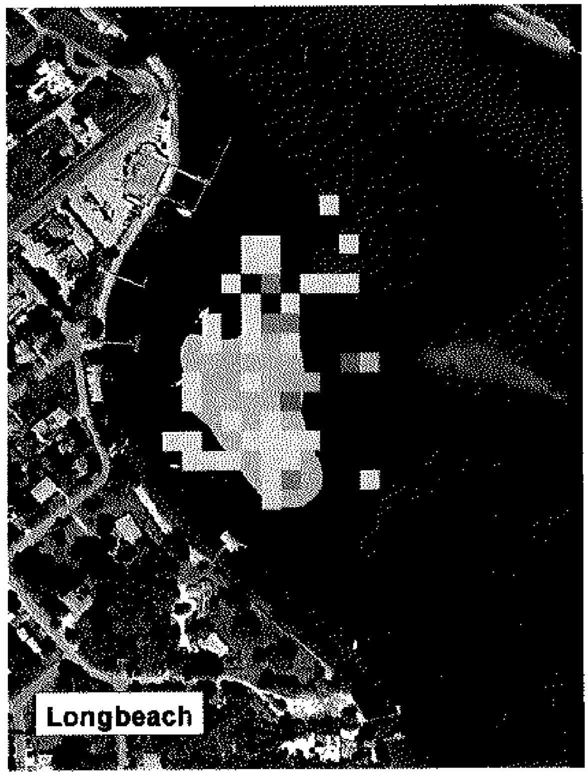
Summary of GIS Impact Analysis

Yearly composite scores show that the majority of boating is confined to the deeper dredged center channel at Otter Key. An exception is fishing, which takes place in shallower waters along the residential shoreline and over sea grass beds which fringe the island of Otter Key. At Longbeach, most seasonal and daily boating is focused around a public boat ramp and restaurant docks. Fishing, was rarely observed in the high traffic areas around the ramp and restaurant docks, favoring the shallow-water sea grass beds along the residential shoreline in the southern portion of the Longbeach anchorage. The core area of highest use at Island Park centers around the docks adjacent to O'Leary's Restaurant. Most transient activities travel to and from O'Leary's along a tight corridor which follows the contour of the Bayfront Park peninsula. Temporary-anchoring and live-aboards tend to anchor farther from the shorefront[3]. This is due, in part, to the high concentration of wet-stored vessels that are found in the more protected waters, closest to the Bayfront Park shoreline.

[3]The distance from the shoreline of each temporarily-anchored, wet-stored, and live-aboard vessel was calculated in the GIS. A statistical analysis (t-tests; alpha .01, p-values < .0001) of relative distances showed that wet-stored vessels moored significantly closer to the shoreline than did live-aboards or temporarily-anchored vessels. Wet-stored vessels were moored an average of 800 feet from the shoreline, while live-aboards and temporarily-anchored vessels were moored an average of 1080 feet from the shoreline.

Stationary Uses and Bottom Holding





Use Frequency and Bottom Type

Cell Hit Ranges	Live-Aboard medium	Live-Aboard highest	Anchoring medium	Anchoring highest	Wet-Storage medium	Wet-Storage highest
Otter Key			1 - 3			
Longbeach			3 - 5	6 - 7	6 - 10	11 - 16
Island Park	9 - 16	17 - 24	6 - 9	10 - 13	8 - 14	15 - 22

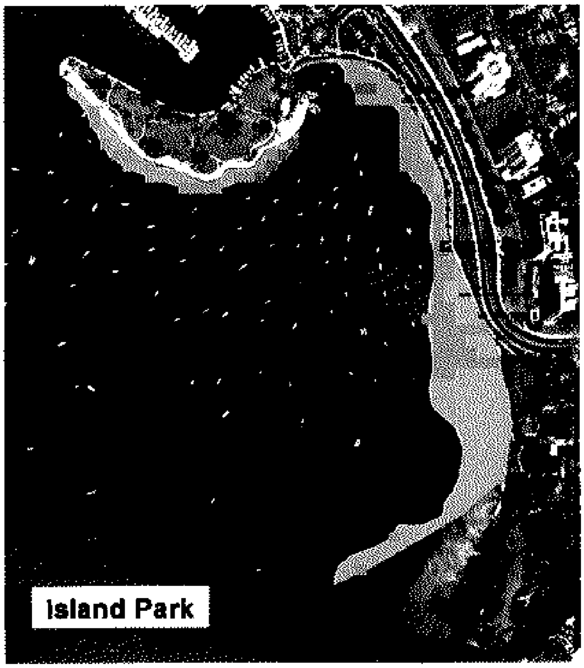
Soft -Silt Mud

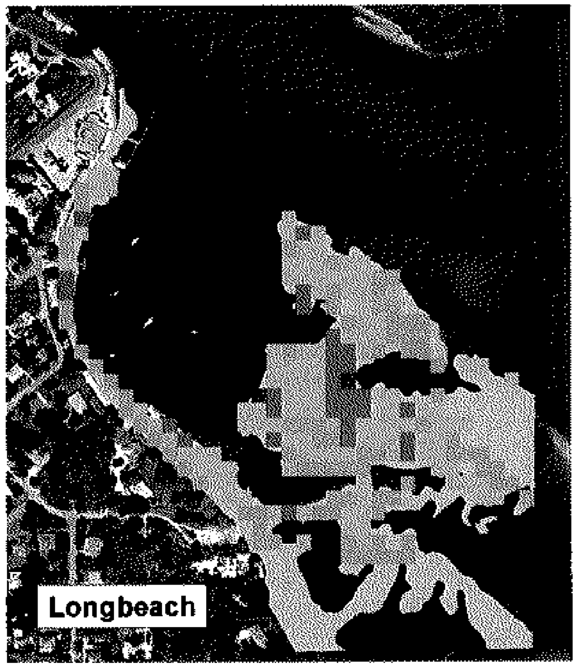
Grid cells are 50 feet square. Grid cells appear to be different sizes due to the variation in scale between sites, as shown. Cell hit ranges reflect relative differences in use between sites.

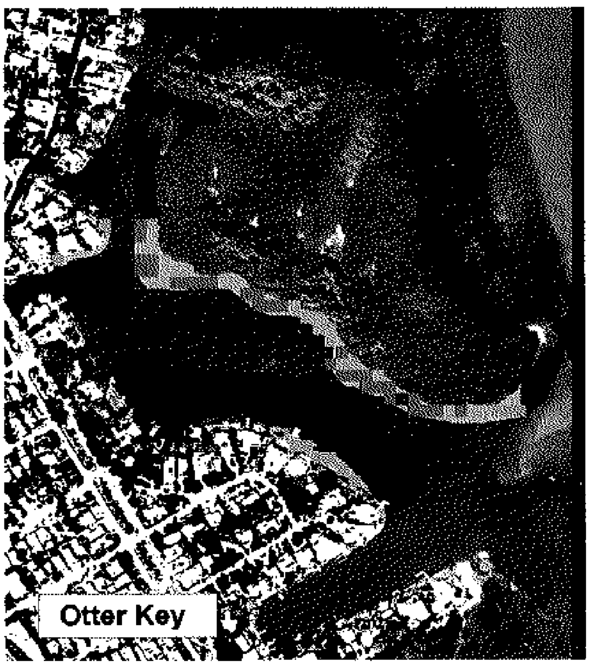
Island Park and Longbeach had multiple-use occurrences and achieved higher use levels. Thus, to reduce theme overlap only cells achieving hit frequencies in the medium and high ranges are depicted. Otter Key experienced low use levels requiring that all anchoring incidents be depicted in the medium range.

Map 9. Association of Anchored and Moored Vessels With Bottom Sediments.

Boating Activities and Seagrass Beds







Use Frequency over Sea Grass Beds

	All Activities			Fishing		
	lowest	medium	highest	lowest	medium	highest
Otter Key	1 - 11	12 - 24	25 - 34	1 - 3	4 - 7	7 - 10
Longbeach	1 - 18	19 - 36	37 - 56	1 - 2	3 - 4	5 - 7
Island Park	1 - 29	30 - 58	59 - 86	1 - 2	Cell Hit Ranges	

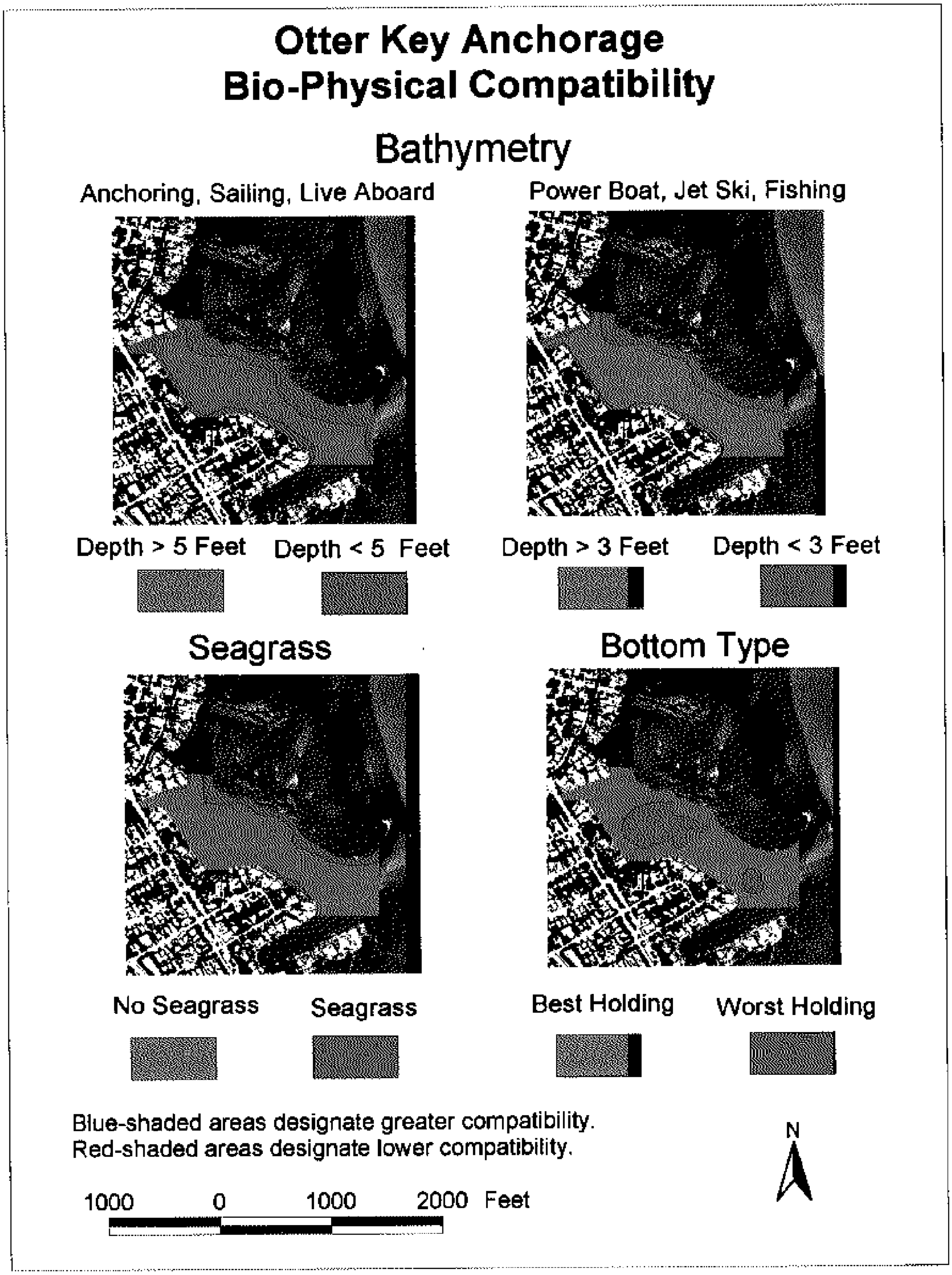
Sea Grass

Grid cells are 50 feet square. Grid cells appear to be different sizes due to the variation in scale between sites, as shown. Cell hit ranges reflect differences in site use.

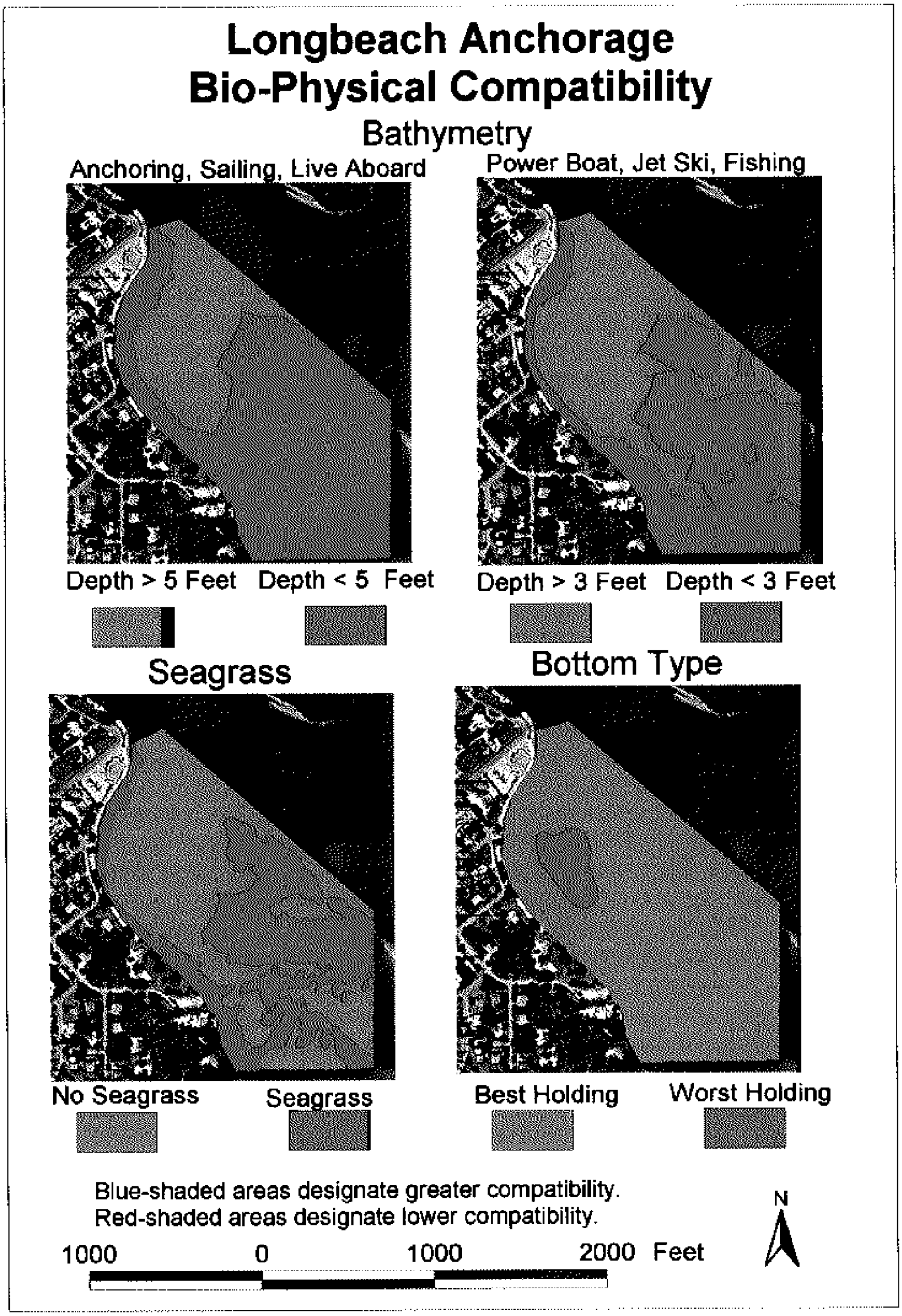
Cells containing sea grass beds did not achieve hit frequencies adequate to reach the "highest" hit range of "all activities".

Activity and fishing themes are mutually exclusive. Therefore, some thematic overlap is present as the result of plotting fishing activities over "all activity" themes. The intent is to illustrate the contribution of fishing to activities occurring over sea grass beds.

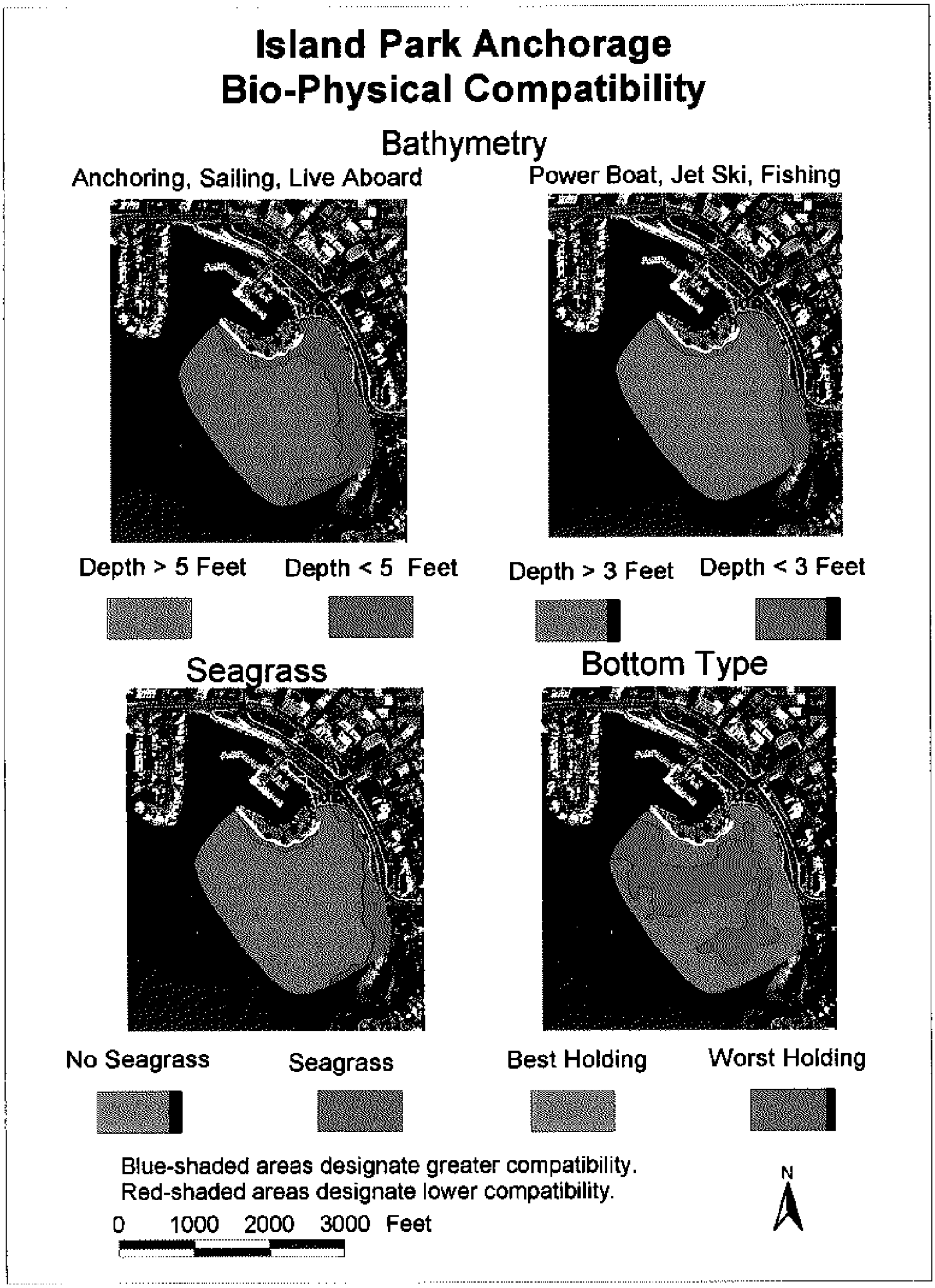
Map 10. Association of Recreational Boating with Seagrass Beds.



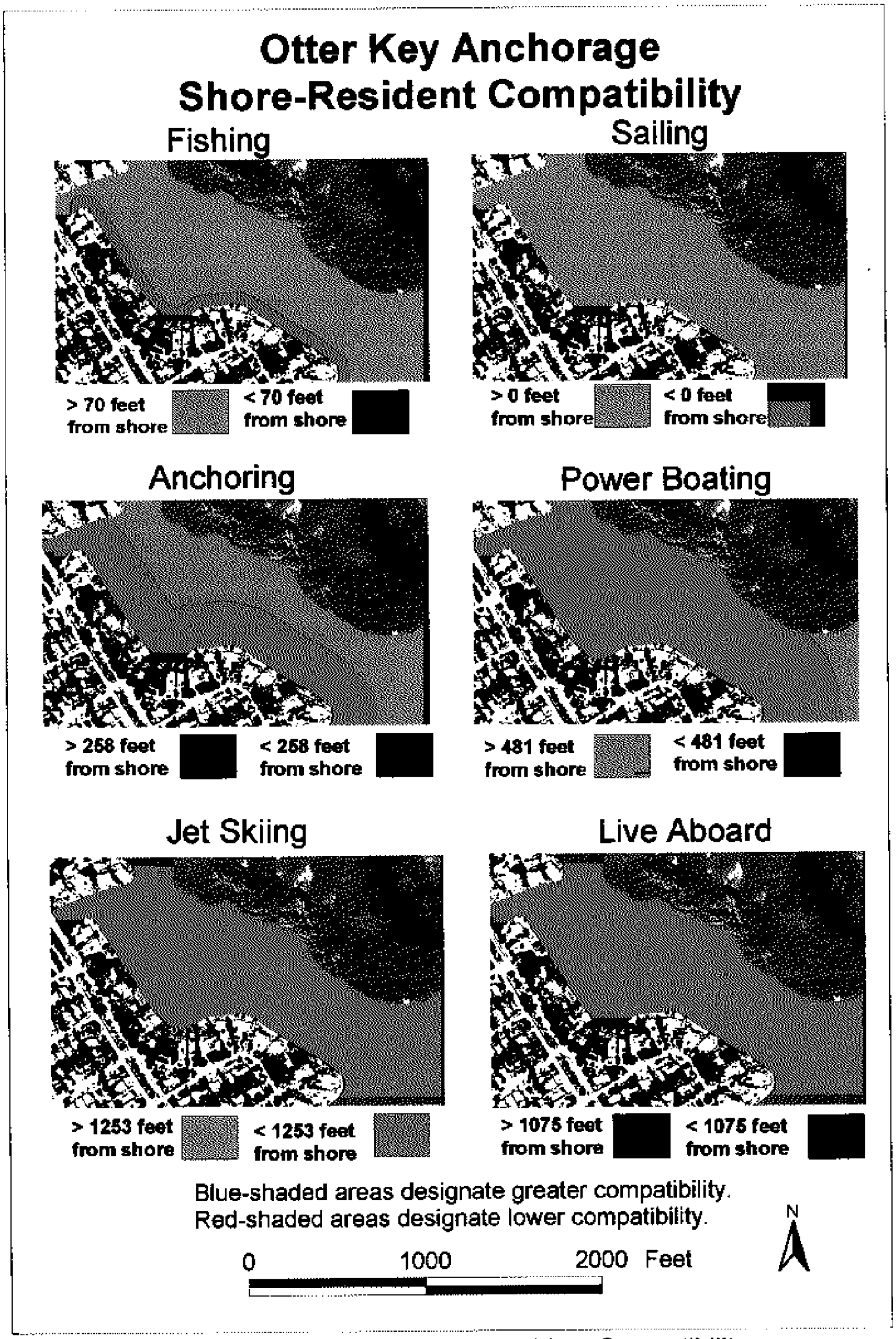
Map 11. Otter Key: Activity and Bio-Physical Compatibility.



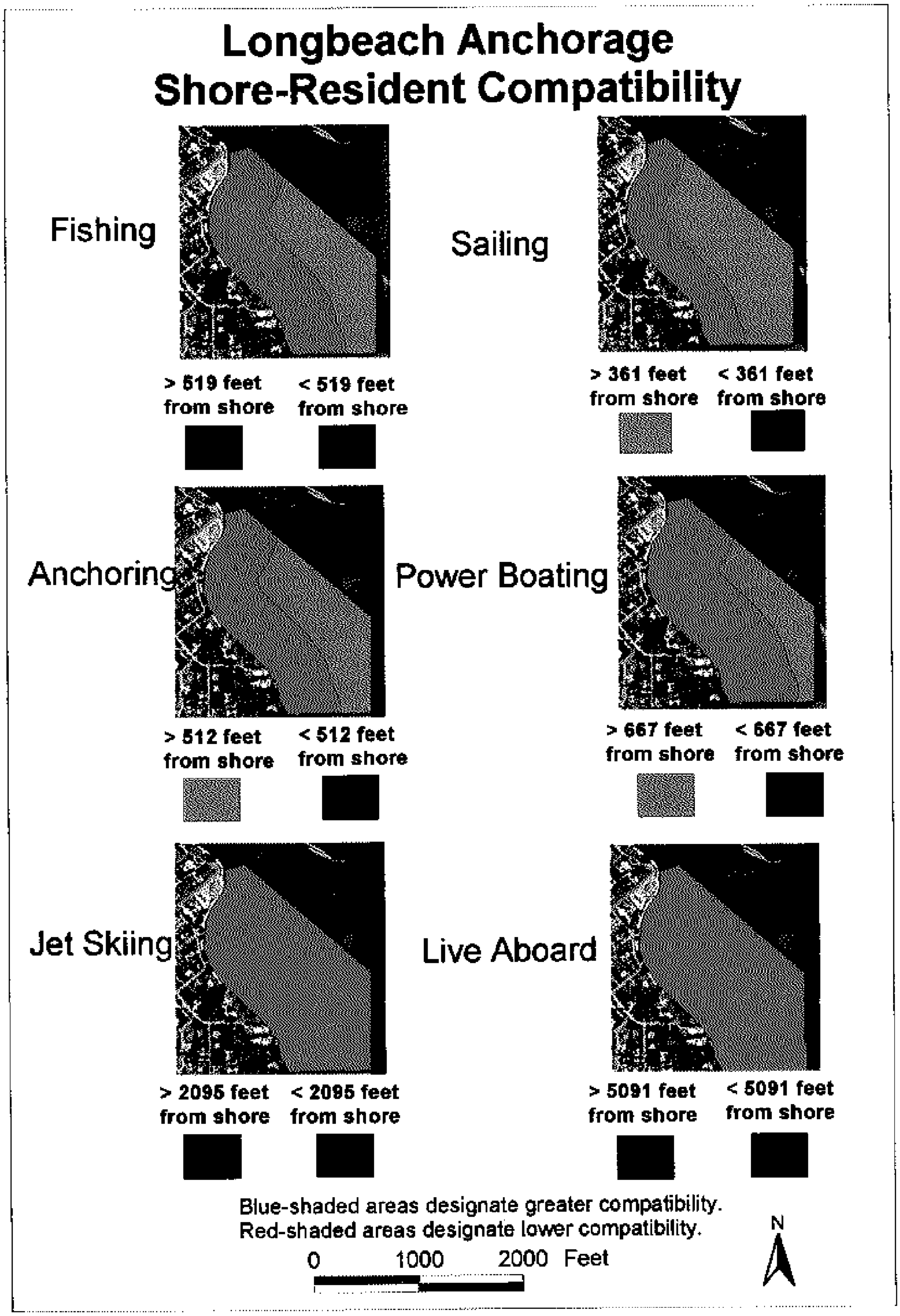
Map 12. Longbeach: Activity and Bio-Physical Compatibility.



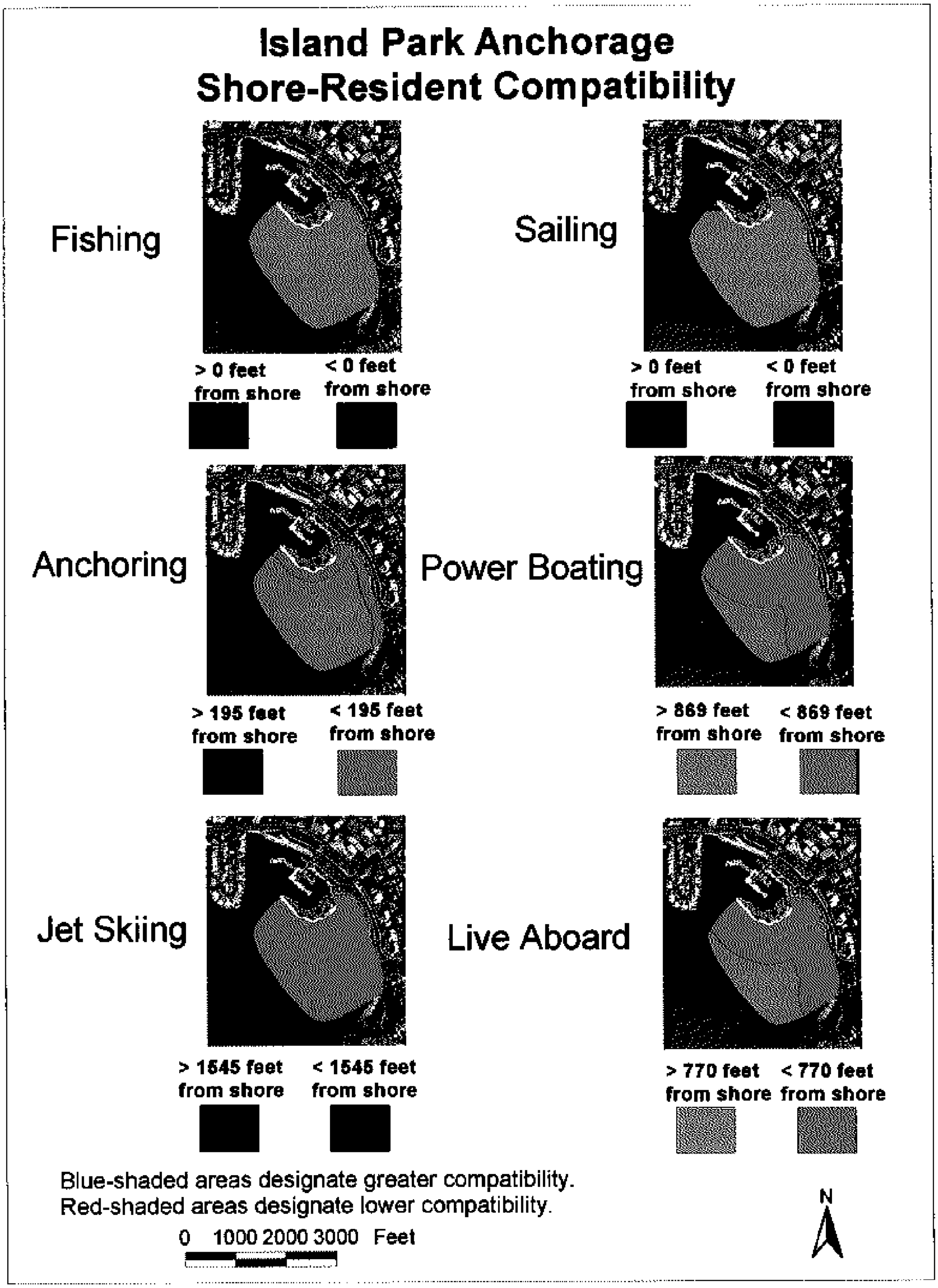
Map 13. Island Park: Activity and Bio-Physical Compatibility.



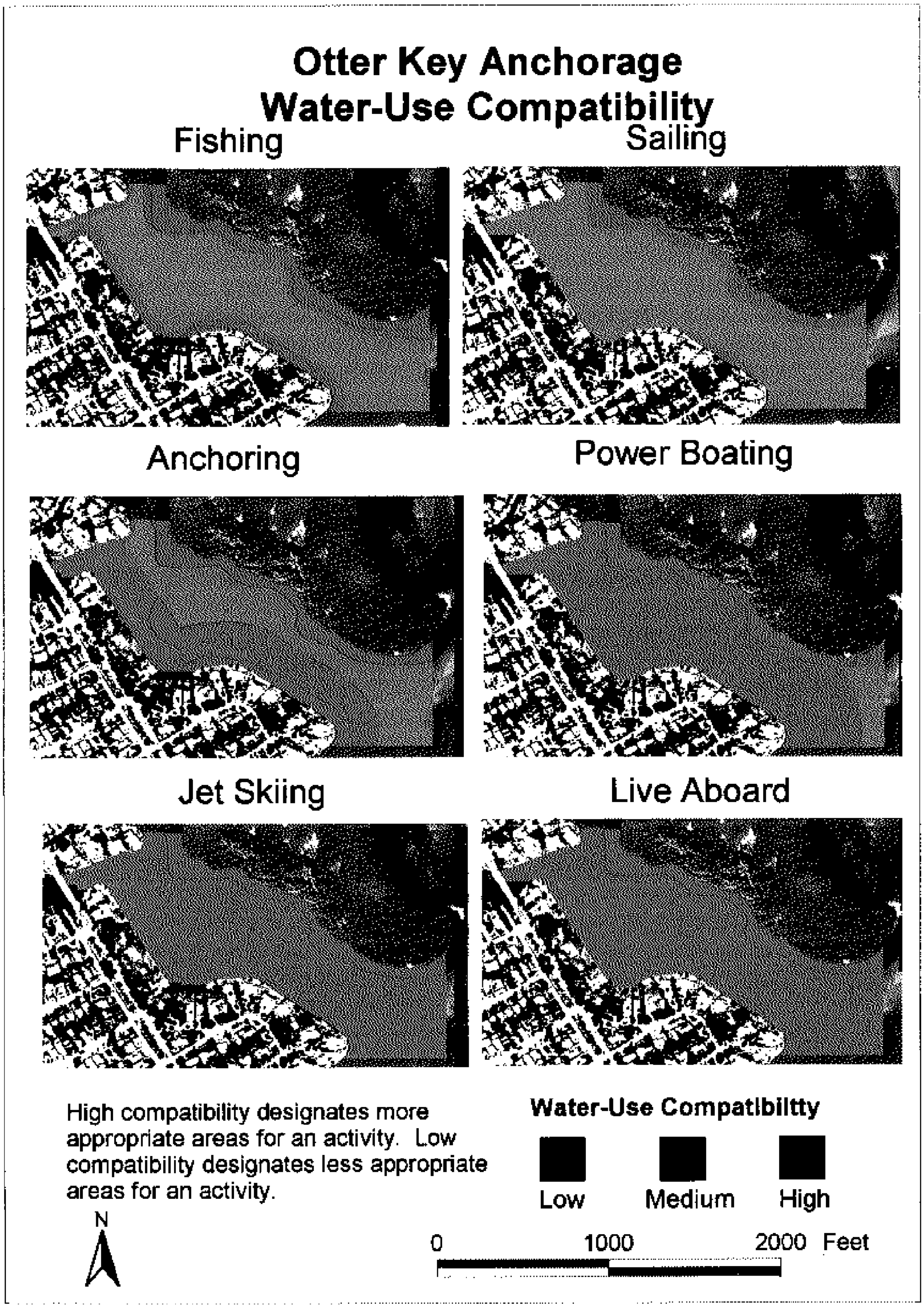
Map 14. Otter Key: Activity and Shore-Resident Compatibility.



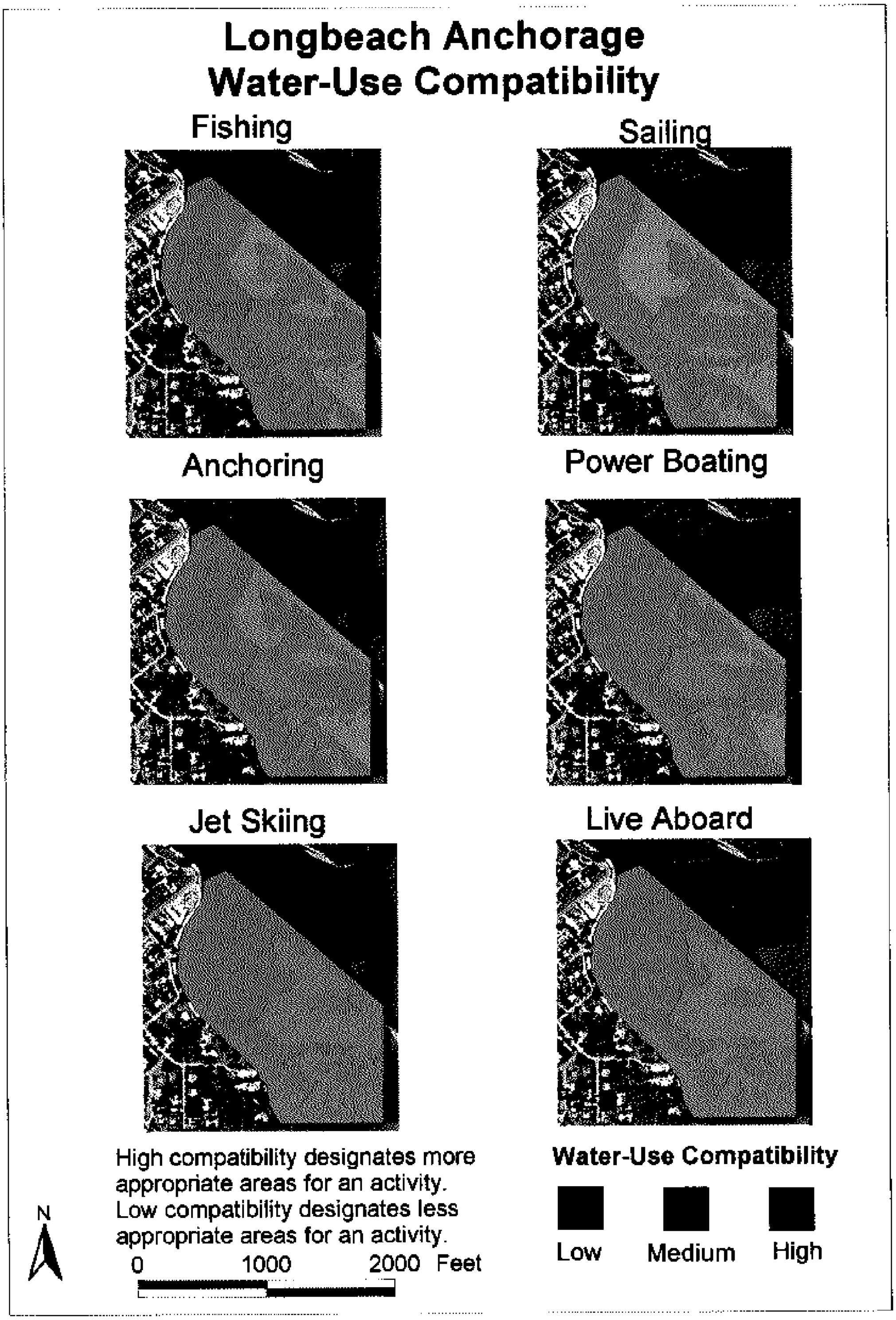
Map 15. Longbeach: Activity and Shore Resident Compatibility.



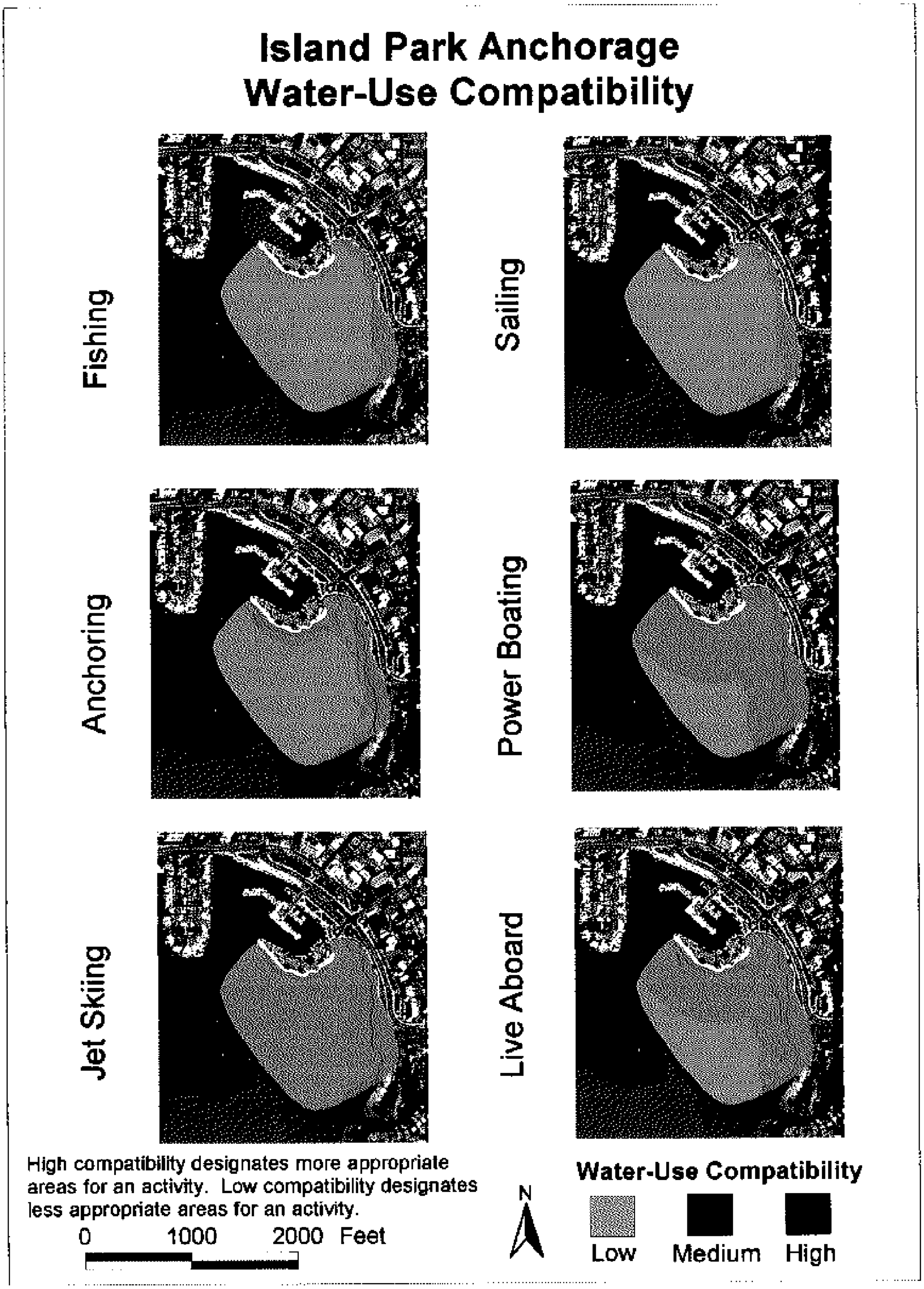
Map 16. Island Park: Activity and Shore-Resident Compatibility.



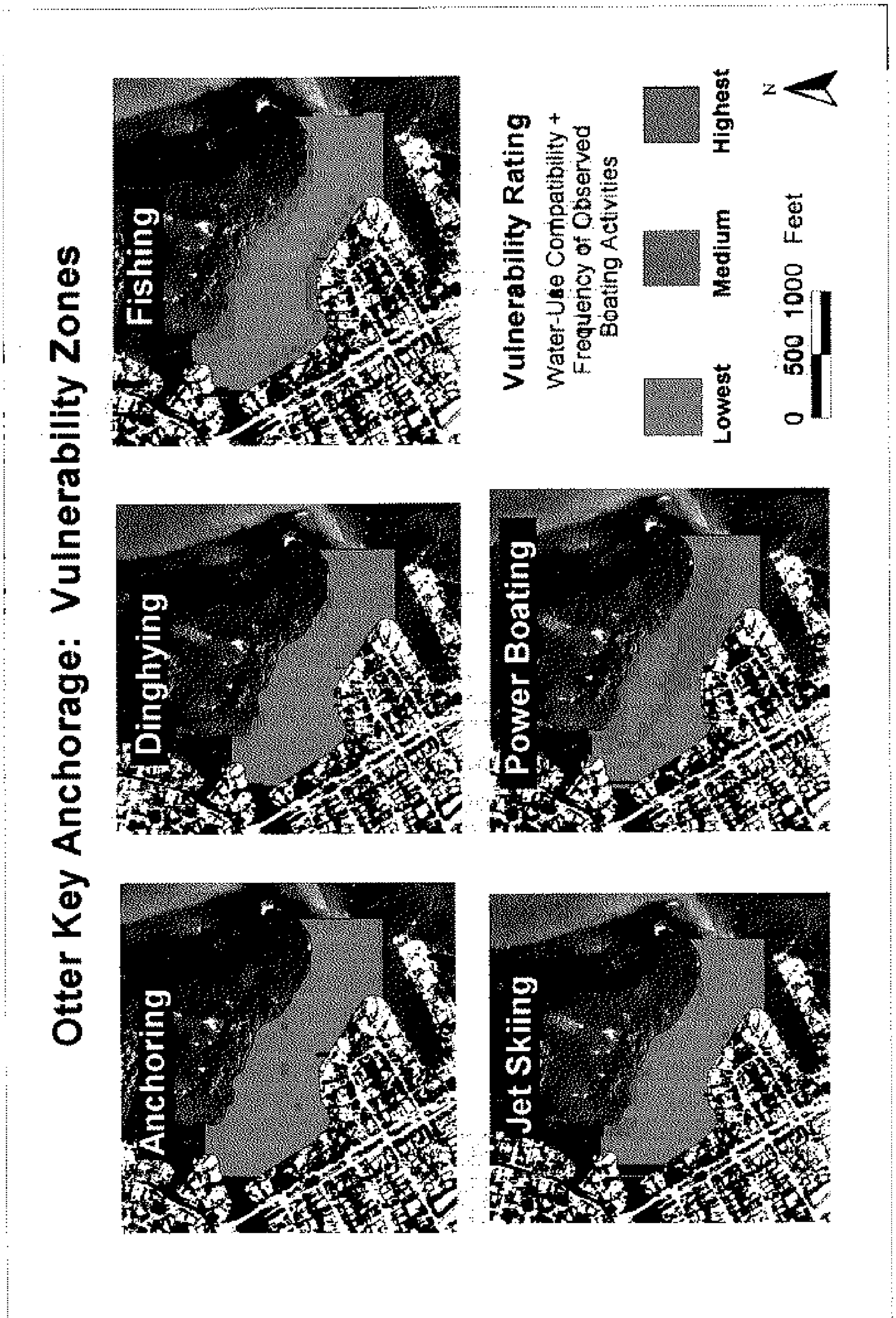
Map 17. Otter Key: Water-Use Compatibility.



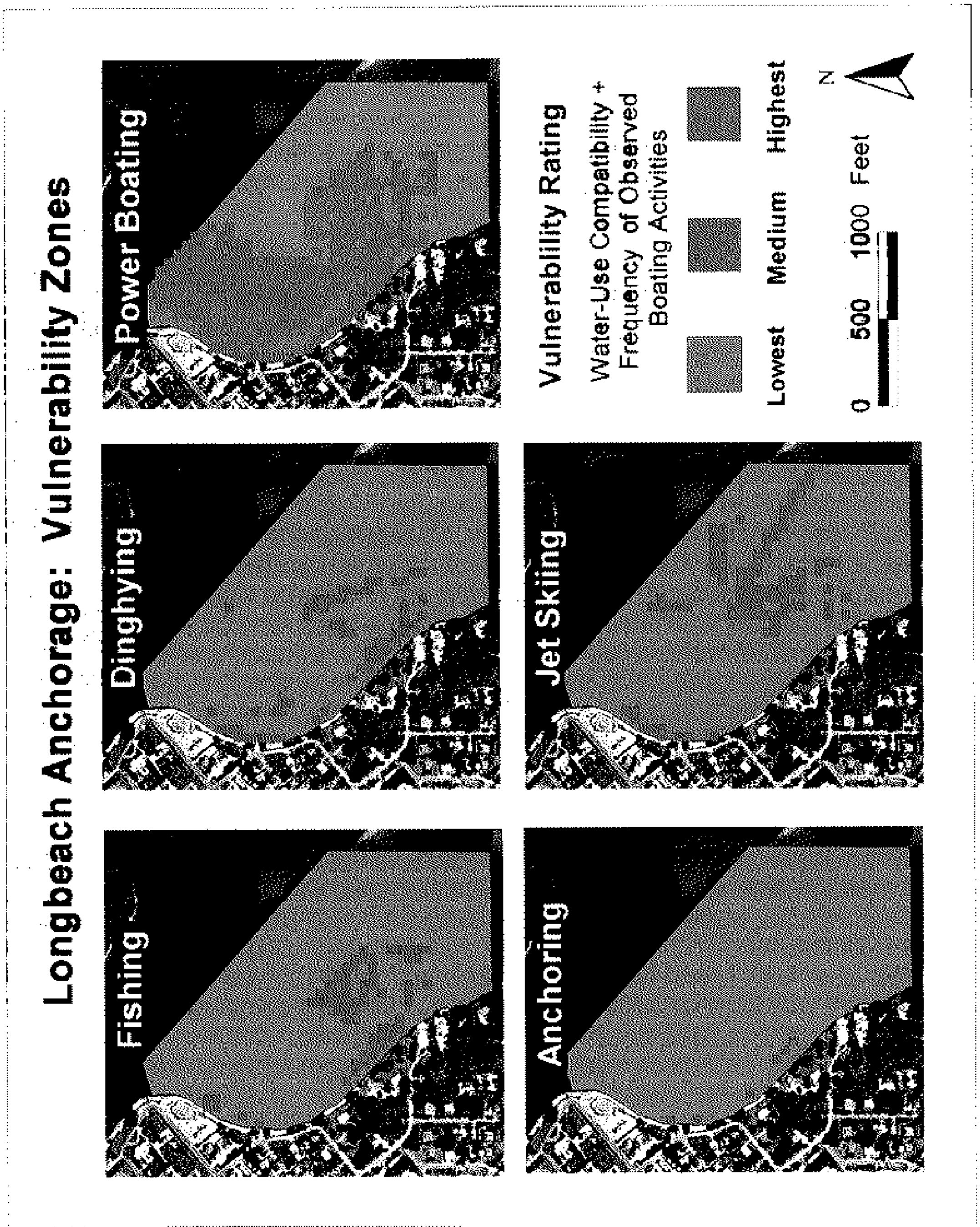
Map 18. Longbeach: Water-Use Compatibility.



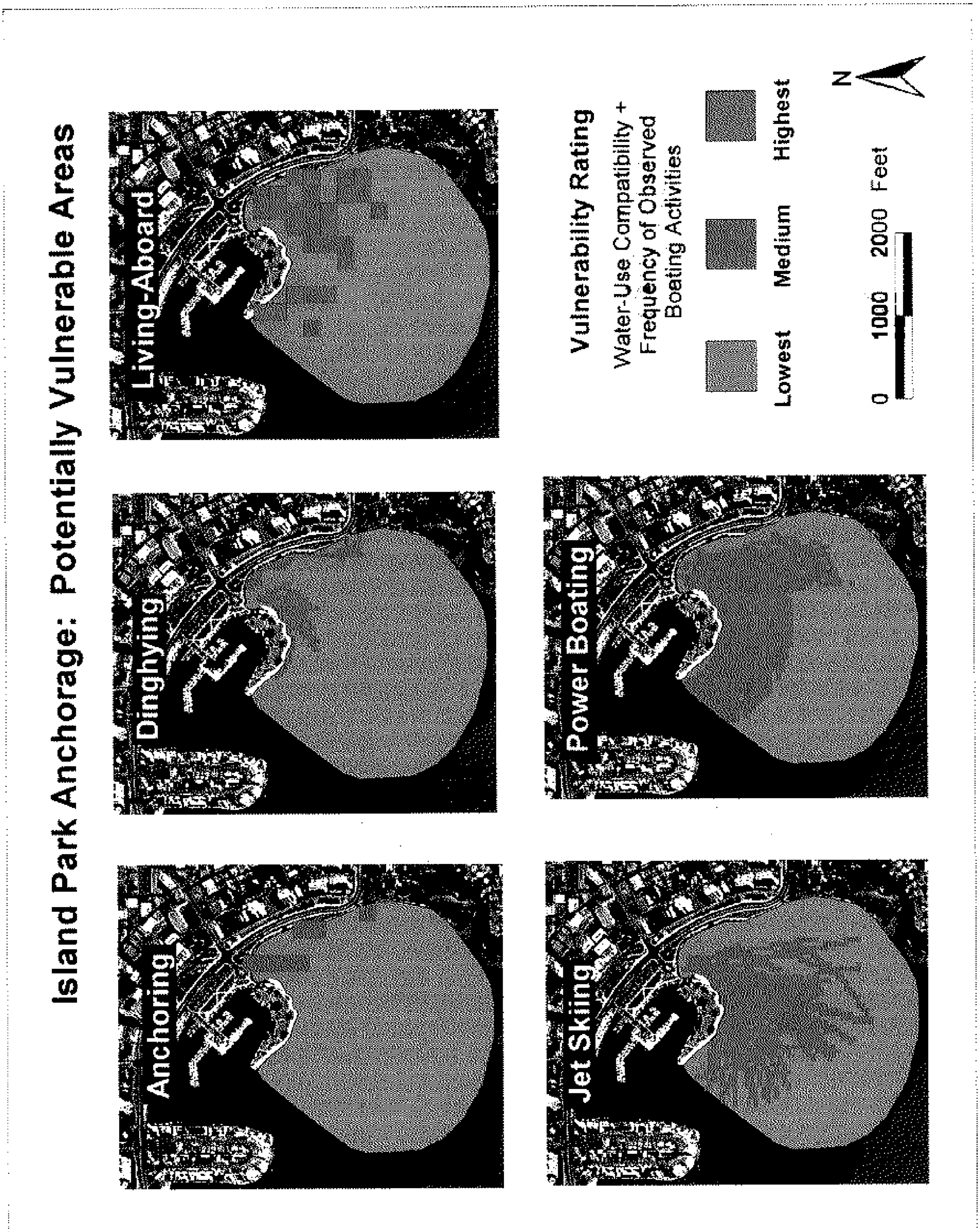
Map 19. Island Park: Water-Use Compatibility.



Map 20. Otter Key: Vulnerability Ratings



Map 21. Longbeach: Vulnerability Ratings.



Map 22. Island Park: Vulnerability Ratings.

Research Findings

Conclusions and Management Considerations

General Findings from the Mapping Analyses

- Temporary-anchoring takes place predominantly in areas of soft-silt mud (Map 9).
- A strong association exists between fishing and areas that contain sea grass beds (Map 10).
- No areas at Otter Key achieved a high vulnerability rating (Map 20).
- Several areas at Longbeach (mainly around the Moore's Stone Crab Restaurant dock) received high vulnerability ratings due, in part, to frequent power-boating (Map 21).
- Numerous occurrences of living-aboard and dinghying resulted in high vulnerability ratings for several areas at Island Park, near the Bayfront Park shoreline (Map 22).
- The degree of shore resident tolerance differed depending on the location, the activity, and the distance from the shoreline at which the activity occurred. Shore residents are clearly less tolerant of higher intensity activities such as power boating and jet skiing. Shore residents have the greatest tolerance for sailing, temporary-anchoring and fishing activities.

General Findings From Descriptive and Statistical Analysis

- Power-boating and temporary-anchoring are the most common activities shared among sites; jet-skiing and sailing are the least common.
- The greatest aggregate boating density is observed at Island Park - four times that of Otter Key and one-and-a-half times that of Longbeach. Aggregate densities include live-aboard and wet-stored vessels.
- Island Park experiences the greatest amounts of wet-storage and live-aboard activities, and the lowest levels of fishing and power-boating, per unit area.
- Longbeach experiences the most temporary-anchoring, dinghying, jet-skiing, power-boating, and sailing, per unit area.

- Otter Key receives the greatest amounts of fishing and the lowest levels of temporary-anchoring, dinghying, and jet-skiing, per unit area.

- Season and location are significant factors in explaining activity levels. Activity levels are consistent across days of the week and times of the day.

Otter Key Findings

Activity Associations with Sea Grass and Bottom Type (Maps 9 and 10)

- Low levels of use occur over virtually the entire extent of sea grass beds that fringe the residential shorefront and the Otter Key shoreline (Map 9).

- Fishing activities account for the greatest occurrence over sea grass beds that fringe the Otter Key shoreline (Map 9).

- Temporary-anchoring occurs in the deeper central channel and is clustered in an area of dredged bottom consisting of mud and soft silt, that offers tenuous holding (Map 10).

Shore Resident Tolerance Distances (Map 14)

- Sailing (0 feet from the shoreline), fishing (70 feet from the shoreline) and temporary-anchoring (258 feet from the shoreline) activities are the most tolerated.

- Power-boating (481 feet from the shoreline) is "moderately" tolerable.

- Jet-skiing (1253 feet from the shoreline) and living-aboard (1075 feet from the shoreline) are tolerated least.

Water-Use Compatibility[4] (Appendix B, Map17)

- Significant amounts of highly compatible area exist for sailing (83 percent of the site; 24 acres), temporary-anchoring (41 percent of the site; 12 acres), and fishing (66 percent of the site; 19 acres) activities.

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[4]Activity compatibility is not simply a function of acreage and percent totals (Appendix B) Other important factors, such as activity space requirements and other concurrent uses (wet-stored vessels etc.), must also be considered. Eighty percent of 30 acres may still not be enough area for some activities to take place safely. However, given enough area, a site possessing large amounts of highly compatible acreage is generally best suited for that type of activity.

- Significant amounts of moderately compatible areas exist for power-boating and jet-skiing (roughly 80 percent; 23 acres).

Potentially Vulnerable Areas[5] (Map 20)

- Power-boating and fishing occurrences generate moderate impacts. This is due mainly to frequent power-boating within shore resident tolerance zones and fishing in shallow waters over sea grass beds.

- Overall, power-boating and fishing activities represent the greatest environmental and social impact at Otter Key.

Longbeach Findings

Activity Associations with Sea Grass and Bottom Type (Maps 9 and 10)

- Fishing rarely occurred in the high-traffic areas adjacent to restaurant docks, but did take place over sea grass beds and along the residential shoreline.

- Temporary-anchoring and wet-stored vessels are clustered in a cove that mainly consists of soft-silt and mud bottom sediments.

Shore Resident Tolerance Distances Map (15)

- Longbeach shore residents must endure much higher boating levels than Otter Key and Island Park. This may explain the reason why Longbeach residents exhibit much lower tolerance for recreational boating activities, in general.

- Sailing (at 361 feet from the shoreline) is the most tolerated activity.

- Fishing and temporary-anchoring (at 512 and 519 feet from the shoreline, respectively) are tolerated less.

- Jet-skiing and living-aboard (at 2095, and 5091 feet from the shoreline) are tolerated least.

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[5]Low vulnerability does not necessarily mean that environmentally and socially sensitive areas do not exist - it simply means that activities are not frequenting those areas deemed to be less suited for them.

Water-Use Compatibility (Appendix B, Map 18)

- Approximately twenty-four percent of the anchorage (7 acres) is highly compatible for sailing, temporary-anchoring, and fishing. Only eleven percent is highly compatible for power-boating.
- Roughly sixty percent of the anchorage (27 acres) is moderately compatible for all activities.
- Forty-three percent of the anchorage (20 acres) is designated as having a low compatibility for jet-skiing.

Potentially Vulnerable Areas (Map 21)

- Power-boating generates potentially high impacts, mainly near the restaurant docks. The frequency and spatial extent of power-boating contributes to the designation of large areas of moderate vulnerability.
- Overall, power-boating activities represent the greatest social and environmental impact at Longbeach.

Island Park Findings

Activity Associations with Sea Grass and Bottom Type (Maps 9 and 10)

- Temporary-anchoring, live-aboard and wet-stored vessels congregate in the protected basin consisting of soft silt mud and firmer bottom sediments that are sparsely vegetated with sea grass.
- Fishing rarely takes place from boats - the only instance of fishing over sea grass was recorded near Bayfront Park.
- Boating activities traversed much of the sea grass extent, albeit infrequently. Some temporary-anchoring and mooring was recorded in shallow water sea grass beds near the shoreline.

Shore Resident Tolerance Distances (Map 16)

- Fishing and sailing (0 feet from the shoreline), and temporary-anchoring (195 feet from the shoreline) are tolerated most. Tolerances for living aboard and power-boating were 770 and 869 feet from the shoreline, respectively.
- Jet-skiing (1545 feet from the shoreline) was tolerated least.

Water-Use Compatibility (Appendix B, Map 19)

- Roughly eighty percent of the anchorage (80 acres) is highly compatible for sailing, temporary-anchoring, and fishing.
- Approximately thirty-three percent of the anchorage (33 acres) is highly compatible for power-boating and live-aboard activities.
- A majority of the anchorage area is moderately compatible for jet-skiing, living-aboard, power-boating, and temporary-anchoring.

Potentially Vulnerable Areas (Map 22)

- Jet-skiing, and dinghying (associated with transient anchoring) occurred with enough frequency to generate potentially high impacts in areas near Bayfront Park and the O'Leary's Restaurant dock.
- Several areas of high vulnerability are associated with the frequent observance of live-aboard activities. High vulnerability ratings reflect frequent occurrences of live-aboards that impact areas which contain shallow water, sea grass, soft silt mud, and that consistently violate shore resident tolerance zones.
- Living-aboard activities represent the greatest environmental and social threat at Island Park due to their continuous presence in areas shown to be less suitable for them.

Management Considerations

This study successfully monitored anchorage activity for a broad spectrum of anchorage locations. In addition, a methodology was developed which integrates boat monitoring data with other bio-physical and social characteristics in order to map potentially vulnerable areas. The data suggest that many of the forty-seven traditional anchorage locations in southwest Florida are a hub for activities that are not exclusive to temporary-anchoring. In addition, anchorages exhibit different temporal use patterns and activity profiles - anchorage management may vary accordingly. For example, educational materials and management may be required to address activities that do not involve temporary-anchoring. Length of stay restrictions applied generically to temporary-anchoring, at all anchorages, will do little to reduce potential environmental and social impacts from power-boating and fishing activities which account for large proportions of the usage at Longbeach and Otter Key. Management considerations specific to the test anchorages follow:

Live-aboard and temporary-anchoring activities are taking place in channels which are frequently traversed by boats underway creating a potential conflict and potentially dangerous safety situations. Furthermore, an analysis of anchoring and mooring distances from the shoreline revealed that temporary-anchoring and live-aboards tend to anchor about 275 feet farther from the shorefront than wet-stored vessels. This may be due, in part, to the high concentration of wet-stored vessels that are aggregated in the more protected waters, closest to the Bayfront Park shoreline.

Recommendations:

- Designate areas for the permanent mooring of wet-stored vessels at greater distances from the shorefront and in areas where bottom sediments are less desirable for temporary-anchor holding. This would free up space for temporary anchoring and live-aboards, thereby, reducing the tendency to drop anchor in highly traveled corridors, and near seagrass beds. Furthermore, a permanent mooring field for wet-stored vessels would provide temporary-anchorers with greater access to better bottom holding, sheltered locations, and shorefront docks.

- Designate a buffer distance from the shoreline within which anchoring should not occur. This will eliminate anchoring in shallow water seagrass beds and within the popular travel corridor that follows the contour of the Bayfront Park peninsula.

- Remove dilapidated and abandoned vessels to improve shoreline access.

Otter Key and Longbeach

Jet-skiing (less than 5 percent of observation totals) contributed very little to overall anchorage boating use. This suggests that either shore residents - especially at Longbeach - are highly sensitive to even infrequent jet skiing incursions, or that the negative perception of jet-skiing transcends actual site usage. Power-boating and fishing represent the greatest impact potential.

Recommendation:

- Educational materials should focus on the observance of speed and no-wake zones, emphasize environmentally friendly anchoring and trolling techniques to preserve the seagrass beds, and stress that fishing and power-boating near shore resident docks should be avoided.

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Appendix A. Monitoring Schedule

Table 1. Total Time Allocation by Site

	Island Park	Otter Key	Longbeach
Percent Allocation by Site	40	30	30
Total Sampling Effort by Site (MAN HOURS)	13.2 days 92 hours	10.4 days 72 hours	10.4 days 72 hours

Table 2. Island Park Weekly and Sampling Day Allocation

	Weekly Allocation		
allocation	Weekday = 20 % 18 hours	Week-end = 80 % 74 hours	TOTAL 92 hours

Sampling totals	Morning		Afternoon	
	Early = 10%	Late = 10 %	Early = 35 %	Late = 45 %
Weekday 18 hours	2	2	6	8
Week-end 73 hours	8	8	26	32

Table 3. Longbeach Weekly and Sampling Day Allocation

	Weekly Allocation		
allocation	Weekday = 20 % 16 hours	Week-end = 80 % 56 hours	TOTAL 72 hours

Sampling totals	Morning		Afternoon	
	Early = 25%	Late = 25 %	Early = 25 %	Late = 25 %
Weekday 28 hours	4	4	4	4
Week-end 36 hours	14	14	14	14

Table 4. Otter Key Weekly and Sampling Day Allocation

	Weekly Allocation		
allocation	Weekday = 20 % 16 hours	Week-end = 80 % 56 hours	TOTAL 72 hours

Sampling totals	Morning		Afternoon	
	Early = 25%	Late = 25 %	Early = 25 %	Late = 25 %
Weekday 28 hours	4	4	4	4
Week-end 36 hours	14	14	14	14

TABLE 5 Monitoring Schedule

DATE (17 DAYS)	DAY OF WEEK	WEKDAY SURVEY TIMES												DAILY HOUR TOTALS	DAILY DRIVE TOTALS	TOTAL DAILY TOTALS
		Otter Key				Longbeach				Island Park						
		Morning		Afternoon		Morning		Afternoon		Morning		Afternoon				
		early	late	early	late	early	late	early	late	early	late	early	late			
July 6	monday				1			1			2			4	2	6
September 11	friday	1					1							2	1	3
October 21	wednesday			1		1							2	4	2	6
November 5	thursday		1					1						2	1	3
November 12	thursday	1							1			2		4	2	6
December 4	friday				1		1							2	1	3
December 17	thursday			1					1					2	1	3
December 29	tuesday					1							2	3	1	4
January 13	wednesday				1									1	0	1
January 29	friday		1					1						2	1	3
February26	friday			1					1	2				4	2	6
March 29	monday	1					1						2	4	2	6
April 5	monday		1						1			2		4	2	6
April 28	wednesday		1			1								2	1	3
May 19	wednesday			1			1							2	1	3
May 24	tuesday	1						1					2	4	2	6
June 25	friday				1	1						2		4	2	6
TIME PERIOD TOTALS		4	4	4	4	4	4	4	4	2	2	6	8	TOTAL 50	TOTAL 24	TOTAL 74
Holidays																
September 7	Labor Day		2					2					2	6	2	8
May 31	Memorial Day			2			2						2	6	2	8

TOTAL FOR WEEKDAY AND HOLIDAYS **90 HOURS**

DATE (34 days)	DAY OF WEEK	WEEKEND SURVEY TIMES												DAILY HOUR TOTALS	DAILY DRIVE TOTALS	TOTAL DAILY TOTALS
		Otter Key				Longbeach				Island Park						
		Morning		Afternoon		Morning		Afternoon		Morning		Afternoon				
		early	late	early	late	early	late	early	late	early	late	early	late			
July 11	Saturday		2					2		2				6	2	8
July 19	Sunday	2					2					2		6	2	8
August 8	Saturday		2					2					2	6	2	8
August 23	Sunday			2		2							2	6	2	8
September 5	Saturday				2						2			4	1	5
September 6	Sunday	2					2					2	2	8	2	10
September 12	Saturday			2		2							2	6	2	8
September 19	Saturday		2					2					2	6	2	8
September 20	Sunday	2							2		2			6	2	8
October 4	Sunday				2		2					2		6	2	8
October 10	Saturday					2							2	4	1	5
October 11	Sunday			2					2	2				6	2	8
October 31	Sunday				2			2						4	1	5
November 14	Saturday	2							2			2		6	2	8
November 15	Sunday						2						2	4	1	5
December 5	Saturday		2						2	2				6	2	8
December 19	Saturday					2						2		4	1	5
December 20	Sunday			2			2						2	6	2	8
January 3	Sunday				2	2						2		6	2	8
January 16	Saturday		2					2					2	6	2	8
January 30	Saturday					2					2			4	1	5
February 6	Saturday	2										2	2	6	1	7
February 21	Sunday				2		2					2		6	2	8
February 27	Saturday	2							2			2		6	2	8
March 14	Sunday			2									2	4	1	5
March 20	Saturday		2					2					2	6	2	8
April 10	Saturday			2									2	4	1	5
April 24	Saturday		2			2						2	2	8	2	10
May 9	Sunday						2					2	2	6	1	7
May 22	Saturday				2							2		4	1	5
June 5	Saturday			2					2	2				6	2	8
June 12	Saturday	2											2	4	1	5
June 20	Sunday				2			2			2			6	2	8
TIME PERIOD TOTALS		14	14	14	14	14	14	14	12	8	8	24	32	TOTAL 182	TOTAL 54	TOTAL 236
Holidays																
July 4	Independence		2					2					2	6	2	8
April 4	Easter			2			2						2	6	2	8

TOTAL FOR WEEKENDS AND HOLIDAYS **252 HOURS**

Pre daylight savings time hours
early morning 7:00 to 9:00am
late morning 10:00 to 12:00am
early afternoon 1:00 to 3:00pm
late afternoon 4:00 to 6:00pm

Post daylight savings time
early morning 8:00 to 10:00am
late morning 11:00 to 1:00pm
early afternoon 2:00 to 4:00pm
late afternoon 5:00 to 7:00pm

GRAND HOURLY TOTAL **342 HOURS**

Table 6. Otter Key Activity Observations.

Otter Key				anchor	dinghy	sail	fish	power	jetski
Season	Month	Day	Time	OK_A	OK_D	OK_S	OK_F	OK_P	OK_JS
1	1	1	2	1	0	0	1	2	0
1	1	2	2	0	0	0	5	5	0
1	1	1	4	0	0	0	4	1	0
1	1	2	4	1	1	0	1	0	0
1	2	2	1	0	0	0	3	0	0
1	2	2	4	1	0	0	4	4	0
1	2	1	3	0	0	1	0	2	0
1	2	2	1	0	0	0	2	1	0
1	2	2	2	1	0	0	4	4	0
1	3	2	3	0	0	0	0	0	0
1	3	2	2	1	0	0	2	9	0
1	3	1	1	0	0	0	0	0	0
1	4	2	2	1	0	0	1	3	0
1	4	1	2	0	0	0	0	1	0
1	4	2	3	1	0	0	2	11	0
1	4	1	2	1	0	0	0	0	0
1	4	1	3	2	1	0	5	27	0
2	5	1	3	0	0	0	0	1	0
2	5	1	1	0	0	0	0	0	0
2	5	2	3	4	1	0	1	10	2
2	5	2	4	1	0	1	0	7	1
2	6	2	1	0	0	0	1	4	0
2	6	1	4	0	0	0	0	2	0
2	6	2	4	0	0	1	0	5	0
2	6	2	4	0	0	0	0	2	1
2	7	1	4	1	0	0	0	3	1
2	7	2	1	0	0	0	2	5	0
2	7	2	2	2	0	0	0	9	2
2	7	2	2	1	0	0	1	5	0
2	8	2	2	1	0	0	1	9	3
2	8	2	3	0	0	1	1	5	1
2	9	2	1	0	0	0	0	0	0
2	9	2	1	0	0	0	4	7	1
2	9	2	3	0	0	0	0	7	1
2	9	2	2	0	0	0	2	13	0
2	9	1	1	0	0	0	1	1	0
2	9	2	2	0	0	0	0	0	0
2	9	2	4	1	0	0	1	3	0
2	10	2	3	1	0	0	1	13	1
2	10	2	4	0	0	0	3	7	1
2	10	1	3	1	0	0	1	3	0
2	10	2	4	2	0	0	1	6	0
1	11	1	2	0	0	0	0	0	0
1	11	2	1	0	0	0	1	0	0
1	11	1	1	0	0	0	0	1	0
1	12	1	3	0	0	0	1	2	0
1	12	1	4	0	0	0	0	2	0
1	12	2	3	1	0	0	3	11	0

Season 1 = High; 2 = Low

Month 1 = Jan; 2 = Feb; 3 = March etc.

Day 1 = Weekday; 2 = Weekend

Time 1 = Early Morning; 2 = Late Morning; 3 = Early Afternoon; 4 = Late Afternoon

Table 7. Island Park Activity Observations

Island Park				anchor	dinghy	sail	fish	power	jetski	wetstore	liveaboard
Season	Month	Day	Time	IP_A	IP_D	IP_S	IP_F	IP_P	IP_JS	IP_WS	IP_LA
1	1	1	2	24	8	0	0	1	0	38	25
1	1	2	4	23	7	0	0	3	1	42	25
1	1	2	2	21	9	0	0	3	1	40	25
1	1	2	3	18	8	0	0	1	0	37	31
1	2	1	1	24	10	0	0	2	0	36	21
1	2	2	3	25	10	2	0	10	6	34	19
1	2	2	1	24	2	0	0	1	0	36	25
1	2	2	3	26	21	1	1	4	0	37	20
1	2	2	4	29	18	4	1	21	3	36	25
1	3	2	4	28	6	2	0	9	0	38	20
1	3	1	4	23	12	0	0	4	0	42	23
1	3	2	4	24	7	0	0	2	0	36	26
1	4	2	3	24	16	1	1	13	10	41	25
1	4	2	4	21	11	0	1	2	0	42	21
1	4	2	4	26	7	2	0	11	4	37	21
1	4	1	3	22	7	0	0	6	4	42	21
2	5	1	4	24	7	0	0	6	4	38	20
2	5	2	3	24	8	1	0	13	0	35	24
2	5	2	3	22	6	2	0	6	10	40	22
2	5	1	4	26	10	2	0	3	0	35	21
2	6	2	2	18	10	0	0	6	3	38	21
2	6	2	1	22	10	0	1	2	0	38	19
2	6	1	3	18	4	1	0	4	4	40	22
2	7	2	1	4	3	0	0	0	0	47	28
2	7	2	3	1	1	0	0	4	3	51	25
2	7	2	4	4	1	0	0	3	0	24	17
2	8	2	4	2	5	0	0	4	2	54	22
2	8	2	4	10	3	1	0	2	2	37	31
2	9	2	4	3	7	0	0	4	0	56	25
2	9	2	3	2	4	0	0	2	0	50	25
2	9	2	2	2	4	0	0	3	1	49	26
2	9	1	4	0	4	0	0	3	0	54	24
2	9	2	2	4	3	0	0	1	2	52	25
2	10	2	4	8	10	1	0	4	1	42	31
2	10	1	4	4	6	0	0	2	1	46	33
2	10	2	3	9	3	0	0	6	2	42	31
2	10	2	1	7	6	0	1	1	0	47	30
1	11	2	4	13	26	0	0	3	0	35	36
1	11	2	3	6	3	0	0	6	1	37	38
1	11	1	3	9	8	1	1	1	0	37	38
1	12	1	4	14	6	0	0	1	1	34	33
1	12	2	4	16	9	0	0	1	1	36	37
1	12	2	3	19	5	0	0	5	0	30	43

Season 1 = High; 2 = Low

Month 1 = Jan; 2 = Feb; 3 = March etc.

Day 1 = Weekday; 2 = Weekend

Time 1 = Early Morning; 2 = Late Morning; 3 = Early Afternoon; 4 = Late Afternoon

Table 8. Longbeach Activity Observations

Longbeach				anchor	dinghy	sail	fish	power	jetski	wetstore
Season	Month	Day	Time	LB_A	LB_D	LB_S	LB_F	LB_P	LB_JS	LB_WS
1	1	2	3	10	6	1	1	19	1	3
1	1	2	1	7	6	0	1	9	0	3
1	1	1	3	4	1	0	2	6	0	3
1	1	2	1	6	2	0	1	5	0	3
1	2	2	4	10	3	0	1	27	0	3
1	2	2	2	2	3	0	2	10	0	3
1	2	1	4	7	3	0	0	11	0	3
1	2	2	4	0	0	0	0	0	0	3
1	3	1	2	5	4	0	3	3	0	3
1	3	2	3	18	10	1	2	36	1	3
1	4	1	4	8	7	1	0	6	0	3
1	4	2	2	17	6	0	0	33	2	3
1	4	1	1	2	1	0	0	3	0	3
1	4	2	1	20	0	13	5	20	0	3
2	5	2	2	9	6	1	3	45	0	3
2	5	1	2	2	0	0	0	6	1	3
2	5	1	3	4	0	0	0	3	0	3
2	5	1	2	7	4	0	3	23	3	3
2	6	2	3	2	0	3	2	27	1	3
2	6	1	1	3	0	0	1	4	0	3
2	6	2	4	14	0	0	0	4	0	3
2	7	1	3	3	0	0	0	9	4	3
2	7	2	2	5	2	0	1	18	4	3
2	7	2	3	2	6	1	1	25	1	3
2	7	2	3	16	6	0	1	13	12	0
2	8	2	1	3	2	1	1	4	0	3
2	8	2	3	5	1	0	0	23	4	3
2	9	2	1	3	0	0	1	4	0	3
2	9	1	2	2	0	0	0	2	0	3
2	9	2	4	1	2	0	1	10	0	4
2	9	2	2	21	12	0	0	21	3	3
2	9	1	3	10	6	0	2	25	0	3
2	9	2	3	7	0	0	2	11	0	3
2	10	2	3	18	9	0	1	28	0	3
2	10	1	1	5	4	0	1	2	0	3
2	10	2	4	5	3	0	0	15	0	3
2	10	2	2	9	5	0	3	34	1	2
2	10	2	1	9	6	0	1	9	0	0
1	11	2	2	7	6	0	1	21	2	3
1	11	1	3	4	1	0	0	0	0	3
1	11	1	4	7	2	0	2	9	0	3
1	11	2	4	17	10	0	0	14	1	3
1	12	2	2	3	5	0	0	17	0	3
1	12	1	1	8	1	0	0	0	0	2
1	12	2	1	7	0	0	1	8	0	3
1	12	1	4	3	1	0	1	3	0	3
1	12	1	2	2	1	0	2	2	0	3

Season 1 = High; 2 = Low

Month 1 = Jan; 2 = Feb; 3 = March etc.

Day 1 = Weekday; 2 = Weekend

Time 1 = Early Morning; 2 = Late Morning; 3 = Early Afternoon; 4 = Late Afternoon

Appendix B. Water-Use Compatibility Acreage

Activity	Site	Acreage				Percent Total			
		High	Med	Low	Total	High	Med	Low	Total
Sailing	IP	0	12	87	99	0	12	88	100
	LB	7	26	13	46	15	57	28	100
	OK	0	5	24	29	0	17	83	100
Temporary-Anchoring	IP	9	13	77	99	9	13	78	100
	LB	9	28	9	46	20	61	20	100
	OK	10	7	12	29	34	24	41	100
Fishing	IP	0	11	88	99	0	11	89	100
	LB	9	28	9	46	20	61	20	100
	OK	6	4	19	29	21	14	66	100
Power-Boat	IP	11	58	30	99	11	59	30	100
	LB	13	28	5	46	28	61	11	100
	OK	4	23	2	29	14	79	7	100
Jet-Skiing	IP	11	88	0	99	11	89	0	100
	LB	20	26	0	46	43	57	0	100
	OK	5	24	0	29	17	83	0	100
Live-Aboard	IP	16	48	35	99	16	48	35	100
	LB	20	26	0	46	43	57	0	100
	OK	5	24	0	29	17	83	0	100

Acreage Counts by Site for High, Medium, and Low Compatibility Water-Use Areas.
IP = Island Park; LB = Longbeach; OK = Otter Key.

Appendix C. Regression Model and Output

SAS Program

```
options nodate;
title 'Boat Monitor Results';
data otter;
 input Season Day Time A D S F P JS;
 site='OK';
 area=30;
 datalines;
2    1    1    0    0    0    0    0    0
2    2    1    0    0    0    1    4    0
1    1    1    0    0    0    0    1    0
1    2    1    0    0    0    1    0    0
1    2    1    0    0    0    3    0    0
2    2    1    0    0    0    2    5    0
2    2    1    0    0    0    0    0    0
1    2    1    0    0    0    2    1    0
1    1    1    0    0    0    0    0    0
2    1    1    0    0    0    1    1    0
2    2    1    0    0    0    4    7    1
1    1    1    0    0    0    0    0    0
1    2    1    1    0    0    1    3    0
1    1    1    0    0    0    0    1    0
1    2    1    0    0    0    5    5    0
1    2    1    1    0    0    2    9    0
1    1    1    1    0    0    1    2    0
1    2    1    1    0    0    4    4    0
2    2    1    0    0    0    2    13    0
2    2    1    1    0    0    1    5    0
2    2    1    0    0    0    0    0    0
1    1    1    1    0    0    0    0    0
2    2    1    1    0    0    1    9    3
2    2    1    2    0    0    0    9    2
1    1    2    2    1    0    5    27    0
2    2    2    4    1    0    1    10    2
1    2    2    0    0    0    0    0    0
2    1    2    0    0    0    0    1    0
1    2    2    1    0    0    3    11    0
1    2    2    1    0    0    2    11    0
2    2    2    0    0    1    1    5    1
1    1    2    0    0    1    0    2    0
2    2    2    1    0    0    1    13    1
2    2    2    0    0    0    0    7    1
1    1    2    0    0    0    1    2    0
2    1    2    1    0    0    1    3    0
2    2    2    0    0    0    0    2    1
2    2    2    1    0    0    1    3    0
2    1    2    1    0    0    0    3    1
```

```
2   2   2   1   0   1   0   7   1
2   2   2   0   0   0   3   7   1
2   2   2   2   0   0   1   6   0
1   2   2   1   0   0   4   4   0
1   2   2   1   1   0   1   0   0
1   1   2   0   0   0   4   1   0
2   1   2   0   0   0   0   2   0
1   1   2   0   0   0   0   2   0
2   2   2   0   0   1   0   5   0
;
data ottera;
 set otter;
 activity='a';
 resp=a;
 drop a d s f p js;
run;
data otterd;
 set otter;
 activity='d';
 resp=d;
 drop a d s f p js;
run;
data otters;
 set otter;
 activity='s';
 resp=s;
 drop a d s f p js;
run;
data otterf;
 set otter;
 activity='f';
 resp=f;
 drop a d s f p js;
run;
data otterp;
 set otter;
 activity='p';
 resp=p;
 drop a d s f p js;
run;
data otterjs;
 set otter;
 activity='js';
 resp=js;
 drop a d s f p js;
run;
data otterall;
 set ottera otterd otters otterf otterp otterjs;
run;
data ip;
 input Season Day Time A D S F P JS Ws LA;
 site='IP';
 area=99;
```

```
datalines;
2   2   1   22   10   0   1   2   0   38   19
2   2   1   7    6    0   1   1   0   47   30
2   2   1   4    3    0   0   0   0   47   28
1   1   1   24   10   0   0   2   0   36   21
1   2   1   24   2    0   0   1   0   36   25
1   2   1   21   9    0   0   3   1   40   25
1   1   1   24   8    0   0   1   0   38   25
2   2   1   2    4    0   0   3   1   49   26
2   2   1   4    3    0   0   1   2   52   25
2   2   1   18   10   0   0   6   3   38   21
1   2   2   26   21   1   1   4   0   37   20
2   2   2   1    1    0   0   4   3   51   25
1   2   2   24   16   1   1   13  10  41   25
1   2   2   25   10   2   0   10  6   34   19
1   2   2   19   5    0   0   5   0   30   43
1   1   2   22   7    0   0   6   4   42   21
2   2   2   2    4    0   0   2   0   50   25
2   2   2   24   8    1   0   13  0   35   24
2   2   2   22   6    2   0   6   10  40   22
2   1   2   18   4    1   0   4   4   40   22
1   2   2   18   8    0   0   1   0   37   31
1   1   2   9    8    1   1   1   0   37   38
1   2   2   6    3    0   0   6   1   37   38
2   2   2   9    3    0   0   6   2   42   31
2   1   2   26   10   2   0   3   0   35   21
2   1   2   24   7    0   0   6   4   38   20
1   2   2   26   7    2   0   11  4   37   21
1   2   2   24   7    0   0   2   0   36   26
2   2   2   3    7    0   0   4   0   56   25
1   2   2   21   11   0   1   2   0   42   21
1   2   2   28   6    2   0   9   0   38   20
2   1   2   0    4    0   0   3   0   54   24
1   2   2   29   18   4   1   21  3   36   25
2   2   2   8    10   1   0   4   1   42   31
2   1   2   4    6    0   0   2   1   46   33
1   1   2   23   12   0   0   4   0   42   23
1   2   2   23   7    0   0   3   1   42   25
1   2   2   13   26   0   0   3   0   35   36
2   2   2   4    1    0   0   3   0   24   17
2   2   2   2    5    0   0   4   2   54   22
1   1   2   14   6    0   0   1   1   34   33
1   2   2   16   9    0   0   1   1   36   37
2   2   2   10   3    1   0   2   2   37   31
;
data ipa;
 set ip;
 activity='a';
 resp=a;
 drop a d s f p js ws la;
run;
data ipd;
 set ip;
```

```
 activity='d';
 resp=d;
 drop a d s f p js ws la;
run;
data ips;
 set ip;
 activity='s';
 resp=s;
 drop a d s f p js ws la;
run;
data ipf;
 set ip;
 activity='f';
 resp=f;
 drop a d s f p js ws la;
run;
data ipp;
 set ip;
 activity='p';
 resp=p;
 drop a d s f p js ws la;
run;
data ipjs;
 set ip;
 activity='js';
 resp=js;
 drop a d s f p js ws la;
run;
data ipws;
 set ip;
 activity='ws';
 resp=ws;
 drop a d s f p js ws la;
run;
data ipla;
 set ip;
 activity='la';
 resp=la;
 drop a d s f p js ws la;
run;
data ipall;
 set ipa ipd ips ipf ipp ipjs ipws ipla;
run;
data lb;
 input Season Day Time A D S F P JS Ws;
 site='LB';
 area=45;
 datalines;
2    1    1    5    4    0    1    2    0    3
1    2    1    7    6    0    1    9    0    3
2    2    1    3    0    0    1    4    0    3
1    2    1    6    2    0    1    5    0    3
2    1    1    3    0    0    1    4    0    3
```

```
2	2	1	3	2	1	1	4	0	3
1	2	1	7	0	0	1	8	0	3
1	1	1	8	1	0	0	0	0	2
2	2	1	9	6	0	1	9	0	0
1	1	1	2	1	0	0	3	0	3
1	2	1	20	0	13	5	20	0	3
1	2	1	2	3	0	2	10	0	3
1	1	1	2	1	0	2	2	0	3
1	2	1	17	6	0	0	33	2	3
2	2	1	9	6	1	3	45	0	3
2	1	1	2	0	0	0	6	1	3
1	2	1	3	5	0	0	17	0	3
1	1	1	5	4	0	3	3	0	3
2	2	1	9	5	0	3	34	1	2
2	1	1	7	4	0	3	23	3	3
1	2	1	7	6	0	1	21	2	3
2	2	1	5	2	0	1	18	4	3
2	2	1	21	12	0	0	21	3	3
2	1	1	2	0	0	0	2	0	3
2	1	2	3	0	0	0	9	4	3
1	2	2	18	10	1	2	36	1	3
2	2	2	2	0	3	2	27	1	3
1	1	2	4	1	0	2	6	0	3
2	2	2	16	6	0	1	13	12	0
2	1	2	4	0	0	0	3	0	3
2	2	2	5	1	0	0	23	4	3
2	1	2	10	6	0	2	25	0	3
2	2	2	7	0	0	2	11	0	3
2	2	2	18	9	0	1	28	0	3
1	2	2	10	6	1	1	19	1	3
2	2	2	2	6	1	1	25	1	3
1	1	2	4	1	0	0	0	0	3
2	2	2	1	2	0	1	10	0	4
2	2	2	14	0	0	0	4	0	3
2	2	2	5	3	0	0	15	0	3
1	1	2	7	2	0	2	9	0	3
1	2	2	17	10	0	0	14	1	3
1	1	2	8	7	1	0	6	0	3
1	2	2	0	0	0	0	0	0	3
1	1	2	7	3	0	0	11	0	3
1	1	2	3	1	0	1	3	0	3
1	2	2	10	3	0	1	27	0	3
;
data lba;
 set lb;
 activity='a';
 resp=a;
 drop a d s f p js ws;
run;
data lbd;
 set lb;
 activity='d';
 resp=d;
```

```
 drop a d s f p js ws;
run;
data lbs;
 set lb;
 activity='s';
 resp=s;
 drop a d s f p js ws;
run;
data lbf;
 set lb;
 activity='f';
 resp=f;
 drop a d s f p js ws;
run;
data lbp;
 set lb;
 activity='p';
 resp=p;
 drop a d s f p js ws;
run;
data lbjs;
 set lb;
 activity='js';
 resp=js;
 drop a d s f p js ws;
run;
data lbws;
 set lb;
 activity='ws';
 resp=ws;
 drop a d s f p js ws;
run;
data lbla;
 set lb;
 activity='la';
 resp=la;
 drop a d s f p js ws;
run;
data lball;
 set lba lbd lbs lbf lbp lbjs lbws;
run;
data all;
 set otterall ipall lball;
 larea=log(area);
 if activity='l' then delete;
run;
proc genmod data=all;
 class season day time site activity;
 model resp = season day time site activity season*activity site*activity
          dist=poisson link=log offset=larea type1 type3;

 estimate 'ip vs ok, overall' site 1 0 -1 / exp;
 estimate 'lb vs ok, overall' site 0 1 -1 / exp;
```

```
estimate 'ip vs lb, overall' site 1 -1 0 / exp;
estimate 'ip vs lb, anchor' site 1 -1 0 site*activity 1 0 0 0 0 0 0   -1 0 0 0 0 0 0;
estimate 'ip vs lb, dinghy' site 1 -1 0 site*activity 0 1 0 0 0 0 0   0 -1 0 0 0 0 0;
estimate 'ip vs lb, fish' site 1 -1 0 site*activity   0 0 1 0 0 0 0   0 0 -1 0 0 0 0;
estimate 'ip vs lb, jetski' site 1 -1 0 site*activity   0 0 0 1 0 0 0   0 0 0 -1 0 0 0;
estimate 'ip vs lb, power' site 1 -1 0 site*activity   0 0 0 0 1 0 0   0 0 0 0 -1 0 0;
estimate 'ip vs lb, sail' site 1 -1 0 site*activity   0 0 0 0 0 1 0   0 0 0 0 0 -1 0;
estimate 'ip vs ok, anchor' site 1 0 -1 site*activity 1 0 0 0 0 0 0   -1 0 0 0 0 0 0;
estimate 'ip vs ok, dinghy' site 1 0 -1 site*activity 0 1 0 0 0 0 0   0 -1 0 0 0 0 0;
estimate 'ip vs ok, fish' site 1 0 -1 site*activity   0 0 1 0 0 0 0   0 0 -1 0 0 0 0;
estimate 'ip vs ok, jetski' site 1 0 -1 site*activity   0 0 0 1 0 0 0   0 0 0 -1 0 0 0;
estimate 'ip vs ok, power' site 1 0 -1 site*activity   0 0 0 0 1 0 0   0 0 0 0 -1 0 0;
estimate 'ip vs ok, sail' site 1 0 -1 site*activity   0 0 0 0 0 1 0   0 0 0 0 0 -1 0;
estimate 'lb vs ok, anchor' site 0 1 -1 site*activity 1 0 0 0 0 0 0   -1 0 0 0 0 0 0;
estimate 'lb vs ok, dinghy' site 0 1 -1 site*activity 0 1 0 0 0 0 0   0 -1 0 0 0 0 0;
estimate 'lb vs ok, fish' site 0 1 -1 site*activity   0 0 1 0 0 0 0   0 0 -1 0 0 0 0;
estimate 'lb vs 0k, jetski' site 0 1 -1 site*activity   0 0 0 1 0 0 0   0 0 0 -1 0 0 0;
estimate 'lb vs ok, power' site 0 1 -1 site*activity   0 0 0 0 1 0 0   0 0 0 0 -1 0 0;
estimate 'lb vs ok, sail' site 0 1 -1 site*activity   0 0 0 0 0 1 0   0 0 0 0 0 -1 0;
```

SAS Output

Boat Monitor Results

The GENMOD Procedure

Model Information

Data Set	WORK.ALL
Distribution	Poisson
Link Function	Log
Dependent Variable	resp
Offset Variable	larea
Observations Used	918

Class Level Information

Class	Levels	Values
Season	2	1 2
Day	2	1 2
Time	2	1 2
site	3	IP LB OK
activity	7	a d f j p s w

Parameter Information

Parameter	Effect	Season	Day	Time	site	activity
Prm1	Intercept					
Prm2	Season	1				
Prm3	Season	2				
Prm4	Day		1			
Prm5	Day		2			
Prm6	Time			1		
Prm7	Time			2		

Prm8	site		IP	
Prm9	site		LB	
Prm10	site		OK	
Prm11	activity			a
Prm12	activity			d
Prm13	activity			f
Prm14	activity			j
Prm15	activity			p
Prm16	activity			s
Prm17	activity			w
Prm18	Season*activity	1		a
Prm19	Season*activity	1		d
Prm20	Season*activity	1		f
Prm21	Season*activity	1		j
Prm22	Season*activity	1		p
Prm23	Season*activity	1		s
Prm24	Season*activity	1		w
Prm25	Season*activity	2		a
Prm26	Season*activity	2		d
Prm27	Season*activity	2		f
Prm28	Season*activity	2		j
Prm29	Season*activity	2		p
Prm30	Season*activity	2		s
Prm31	Season*activity	2		w
Prm32	site*activity		IP	a
Prm33	site*activity		IP	d
Prm34	site*activity		IP	f
Prm35	site*activity		IP	j
Prm36	site*activity		IP	p
Prm37	site*activity		IP	s
Prm38	site*activity		IP	w
Prm39	site*activity		LB	a
Prm40	site*activity		LB	d
Prm41	site*activity		LB	f
Prm42	site*activity		LB	j
Prm43	site*activity		LB	p
Prm44	site*activity		LB	s
Prm45	site*activity		LB	w
Prm46	site*activity		OK	a
Prm47	site*activity		OK	d
Prm48	site*activity		OK	f
Prm49	site*activity		OK	j
Prm50	site*activity		OK	p
Prm51	site*activity		OK	s

Criteria For Assessing Goodness Of Fit

Criterion	DF	Value	Value/DF
Deviance	889	2110.4714	2.3740
Scaled Deviance	889	2110.4714	2.3740
Pearson Chi-Square	889	2502.6994	2.8152
Scaled Pearson X2	889	2502.6994	2.8152
Log Likelihood		7504.2971	

Algorithm converged.

The GENMOD Procedure

Analysis Of Parameter Estimates

Parameter			DF	Estimate	Standard Error	Wald 95% Confidence Limits Lower	Upper	Chi-Square	Pr > ChiSq
Intercept			1	-3.8515	0.5512	-4.9318	-2.7712	48.83	<.0001
Season	1		1	-0.1391	0.0464	-0.2301	-0.0481	8.97	0.0027
Season	2		0	0.0000	0.0000	0.0000	0.0000	.	.
Day	1		1	-0.2930	0.0343	-0.3602	-0.2257	73.00	<.0001
Day	2		0	0.0000	0.0000	0.0000	0.0000	.	.
Time	1		1	-0.1153	0.0330	-0.1799	-0.0507	12.23	0.0005
Time	2		0	0.0000	0.0000	0.0000	0.0000	.	.
site	IP		1	3.1178	0.5510	2.0378	4.1978	32.02	<.0001
site	LB		1	1.3166	0.5436	0.2512	2.3821	5.87	0.0154
site	OK		0	0.0000	0.0000	0.0000	0.0000	.	.
activity	a		1	-0.2655	0.5859	-1.4138	0.8827	0.21	0.6504
activity	d		1	-2.3961	0.7997	-3.9634	-0.8287	8.98	0.0027
activity	f		1	0.5767	0.5761	-0.5524	1.7057	1.00	0.3168
activity	j		1	-0.2846	0.6108	-1.4818	0.9127	0.22	0.6413
activity	p		1	2.1569	0.5557	1.0677	3.2460	15.07	0.0001
activity	s		1	-2.2015	0.2993	-2.7881	-1.6148	54.09	<.0001
activity	w		0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	1	a	1	0.6264	0.0790	0.4715	0.7812	62.86	<.0001
Season*activity	1	d	1	0.5759	0.1038	0.3724	0.7795	30.76	<.0001
Season*activity	1	f	1	0.6161	0.1938	0.2362	0.9959	10.10	0.0015
Season*activity	1	j	1	-0.6121	0.1994	-1.0029	-0.2214	9.43	0.0021
Season*activity	1	p	1	-0.0106	0.0782	-0.1638	0.1427	0.02	0.8925
Season*activity	1	s	1	0.7344	0.3073	0.1321	1.3367	5.71	0.0168
Season*activity	1	w	0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	2	a	0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	2	d	0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	2	f	0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	2	j	0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	2	p	0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	2	s	0	0.0000	0.0000	0.0000	0.0000	.	.
Season*activity	2	w	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	IP	a	1	-1.0314	0.5861	-2.1801	0.1173	3.10	0.0785
site*activity	IP	d	1	0.4211	0.7999	-1.1468	1.9890	0.28	0.5986
site*activity	IP	f	1	-6.4329	0.6806	-7.7668	-5.0990	89.35	<.0001
site*activity	IP	j	1	-2.7241	0.6207	-3.9406	-1.5077	19.26	<.0001
site*activity	IP	p	1	-4.3706	0.5599	-5.4680	-3.2731	60.93	<.0001
site*activity	IP	s	1	-2.6323	0.3181	-3.2558	-2.0088	68.47	<.0001
site*activity	IP	w	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	LB	a	1	0.8654	0.5804	-0.2722	2.0030	2.22	0.1360
site*activity	LB	d	1	2.2304	0.7971	0.6681	3.7927	7.83	0.0051
site*activity	LB	f	1	-1.8846	0.5763	-3.0142	-0.7550	10.69	0.0011
site*activity	LB	j	1	-0.6712	0.6217	-1.8898	0.5474	1.17	0.2804
site*activity	LB	p	1	-0.6091	0.5494	-1.6858	0.4676	1.23	0.2676
site*activity	LB	s	0	0.0000	0.0000	0.0000	0.0000	.	.

The GENMOD Procedure

Analysis Of Parameter Estimates

Wald 95% Confidence

Parameter			DF	Estimate	Standard Error	Limits Lower	Upper	Chi-Square	Pr > ChiSq
site*activity	LB	w	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	OK	a	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	OK	d	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	OK	f	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	OK	j	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	OK	p	0	0.0000	0.0000	0.0000	0.0000	.	.
site*activity	OK	s	0	0.0000	0.0000	0.0000	0.0000	.	.
Scale			0	1.0000	0.0000	1.0000	1.0000		

NOTE: The scale parameter was held fixed.

LR Statistics For Type 1 Analysis

Source	Deviance	DF	Chi-Square	Pr > ChiSq
Intercept	9005.9367			
Season	9001.6934	1	4.24	0.0394
Day	8906.5653	1	95.13	<.0001
Time	8868.2519	1	38.31	<.0001
site	8529.6277	2	338.62	<.0001
activity	4081.5037	6	4448.12	<.0001
Season*activity	3957.2465	6	124.26	<.0001
site*activity	2110.4714	11	1846.78	<.0001

LR Statistics For Type 3 Analysis

Source	DF	Chi-Square	Pr > ChiSq
Season	1	5.03	0.0249
Day	1	76.41	<.0001
Time	1	12.38	0.0004
site	2	104.62	<.0001
activity	6	1700.65	<.0001
Season*activity	6	119.46	<.0001
site*activity	11	1846.78	<.0001

The GENMOD Procedure
ESTIMATE Statement Results

Label	Estimate	Standard Error	Alpha	Lower	Upper	Chi-Square	Pr > ChiSq
ip vs ok, overall	-3.6101	0.0685	0.05	-3.7443	-3.4759	2778.6	<.0001
lb vs ok, overall	-3.0254	0.0482	0.05	-3.1198	-2.9310	3944.1	<.0001
ip vs lb, overall	-0.5847	0.0820	0.05	-0.7454	-0.4241	50.89	<.0001
ip vs lb, anchor	-0.0956	0.0675	0.05	-0.2278	0.0366	2.01	0.1564

ip vs lb, dinghy	-0.0081	0.0984	0.05	-0.2009	0.1846	0.01	0.9342
ip vs lb, fish	-2.7471	0.4037	0.05	-3.5385	-1.9558	46.30	<.0001
ip vs lb, jetski	-0.2518	0.1985	0.05	-0.6409	0.1373	1.61	0.2047
ip vs lb, power	-1.9603	0.0836	0.05	-2.1241	-1.7966	550.43	<.0001
ip vs lb, sail	-0.8311	0.3054	0.05	-1.4297	-0.2325	7.41	0.0065
ip vs ok, anchor	2.0865	0.2002	0.05	1.6941	2.4788	108.66	<.0001
ip vs ok, dinghy	3.5389	0.5801	0.05	2.4020	4.6758	37.22	<.0001
ip vs ok, fish	-3.3151	0.3997	0.05	-4.0984	-2.5318	68.80	<.0001
ip vs ok, jetski	0.3937	0.2859	0.05	-0.1666	0.9540	1.90	0.1685
ip vs ok, power	-1.2528	0.1004	0.05	-1.4495	-1.0560	155.76	<.0001
ip vs ok, sail	0.4855	0.5459	0.05	-0.5843	1.5554	0.79	0.3737
lb vs ok, anchor	2.1821	0.2035	0.05	1.7832	2.5809	114.97	<.0001
lb vs ok, dinghy	3.5470	0.5830	0.05	2.4044	4.6897	37.02	<.0001
lb vs ok, fish	-0.5680	0.1915	0.05	-0.9433	-0.1926	8.79	0.0030
lb vs 0k, jetski	0.6455	0.3018	0.05	0.0540	1.2370	4.57	0.0324
lb vs ok, power	0.7076	0.0793	0.05	0.5521	0.8630	79.56	<.0001
lb vs ok, sail	1.3166	0.5436	0.05	0.2512	2.3821	5.87	0.0154
high vs low, anchor	0.4873	0.0640	0.05	0.3617	0.6128	57.88	<.0001
high vs low, dinghy	0.4368	0.0930	0.05	0.2546	0.6191	22.07	<.0001
high vs low, fish	0.4770	0.1881	0.05	0.1082	0.8457	6.43	0.0112
high vs low, jetski	-0.7512	0.1939	0.05	-1.1313	-0.3712	15.01	0.0001
high vs low, power	-0.1497	0.0629	0.05	-0.2729	-0.0264	5.66	0.0173
high vs low, sail	0.5953	0.3038	0.05	-0.0001	1.1907	3.84	0.0500

The MEANS Procedure

N	Mean	Std Dev	Minimum	Maximum
Day=1 activity=a				
46	6.0869565	7.9633217	0	26.0000000
Day=1 activity=d				
46	2.5869565	3.3965740	0	12.0000000
Day=1 activity=f				
46	0.6739130	1.1748163	0	5.0000000
Day=1 activity=j				
46	0.5000000	1.2064641	0	4.0000000
Day=1 activity=p				
46	4.3043478	6.0768031	0	27.0000000
Day=1 activity=s				
46	0.1304348	0.4004828	0	2.0000000
Day=1 activity=w				
29	17.0689655	18.7100642	2.0000000	54.0000000
Day=2 activity=a				
92	8.2391304	8.9065596	0	29.0000000
Day=2 activity=d				
92	4.0000000	5.0076864	0	26.0000000
Day=2 activity=f				
92	0.9347826	1.1934284	0	5.0000000
Day=2 activity=j				
92	1.0869565	2.1363015	0	12.0000000
Day=2 activity=p				
92	9.0326087	9.1824619	0	45.0000000
Day=2 activity=s				
92	0.4456522	1.4999204	0	13.0000000
Day=2 activity=w				
61	22.5737705	19.6710100	0	56.0000000
Time=1 activity=a				
58	5.5689655	7.3439606	0	24.0000000
Time=1 activity=d				
58	2.4310345	3.3039693	0	12.0000000

Time=1 activity=f				
58	1.1034483	1.3204153	0	5.0000000
Time=1 activity=j				
58	0.5000000	1.0130725	0	4.0000000
Time=1 activity=p				
58	6.9310345	9.3880515	0	45.0000000
Time=1 activity=s				
58	0.2586207	1.7122914	0	13.0000000
Time=1 activity=w				
34	14.3529412	18.4553226	0	52.0000000
Time=2 activity=a				
80	8.9375000	9.2494868	0	29.0000000
Time=2 activity=d				
80	4.3250000	5.1797439	0	26.0000000
Time=2 activity=f				
80	0.6625000	1.0547512	0	5.0000000
Time=2 activity=j				
80	1.1750000	2.2990091	0	12.0000000
Time=2 activity=p				
80	7.8375000	7.9307824	0	36.0000000
Time=2 activity=s				
80	0.4000000	0.7729608	0	4.0000000
Time=2 activity=w				
56	24.7142857	19.1184958	0	56.0000000

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