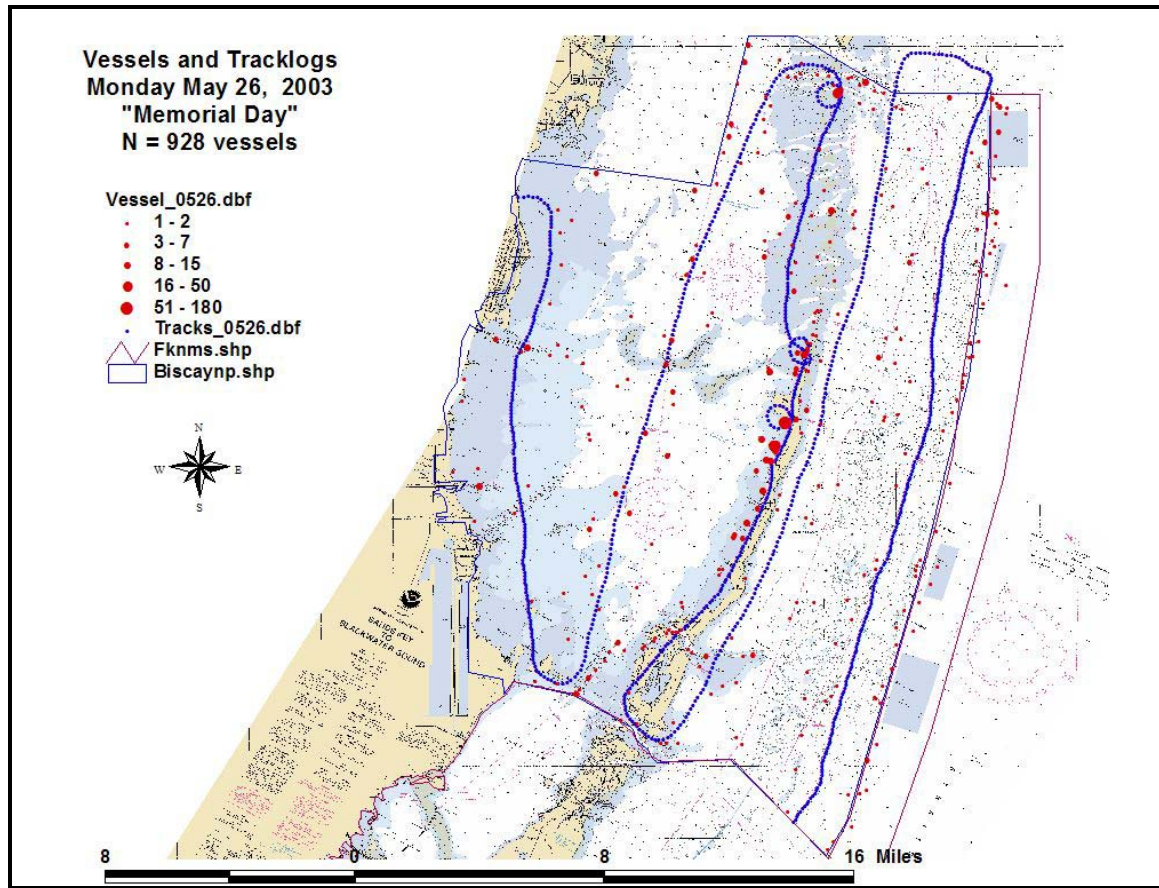


Description of an electronic data logging system designed to geo-reference vessel usage



by

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Introduction

Impacts on marine resources within Biscayne National Park (BNP) by the recreational and commercial fishing, diving, and sailing fleets are intense. Understanding the extent of magnitude and spatial distribution of boater usage is an important consideration for building sustainable resources within BNP. A statistical method was developed in the 1970's to determine the relationship between direct counts of boat trailers at major public boat ramps in close proximity to the BNP and the number of vessels estimated from aerial overflights.

An aerial survey of boater use in BNP was initiated in March 2003 to update this statistical relationship (Ault et al. 2003). The database will contain information on the composition of the Park visitor fleet comprised of the sailing, recreational fishing and diving, commercial fishing and lobstering, and charter, yacht, and motorboat (i.e. cruising and "anchor to party") fleets. Future studies on the socioeconomic aspects of BNP visitor usage and effort, as well as spatial distribution of the different fleets could be determined. Temporal and spatial patterns of effort, using GIS software, could determine the number of vessels participating in different activities, believed to vary greatly both seasonally and spatially throughout the Park. To obtain accurate positions of vessels observed during the overflights, a new type of data entry logging system was created.

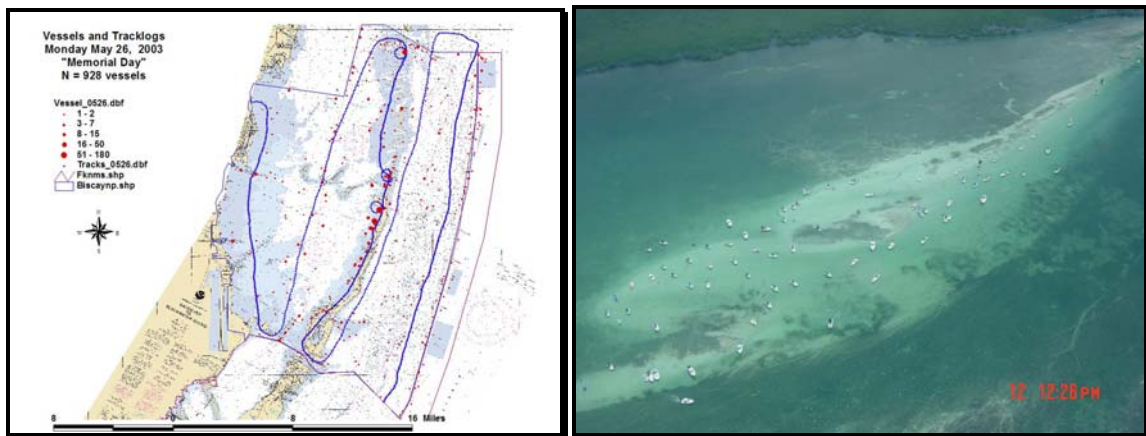
Methods



A small fixed wing aircraft (Cessna 172) was used to survey vessels within BNP, taking approximately two hours to conduct five transects between the hours of 1200 and 1500. Flights were allocated among seasons: spring (March and April), summer (May, June, July, and August), fall (October and November), and winter (January and February). Days were randomly allocated among weekdays (Monday through Friday, excluding holidays) and high use days on weekends (Saturday and Sunday). Holidays such as Memorial Day, Columbus Day regatta, and spiny lobster mini-season were also sampled. All weather days were surveyed to determine this impact on boater usage. Trailer counts were simultaneously taken on these days to predict on-water boater usage.



A mobile GIS recording system, all components mounted on a lap desk, was developed to collect-real time data on vessel usage including position (latitude and longitude), time of sighting, vessel number, and characterization and disposition of the vessels. The main components of the system are an IBM compatible laptop computer, utilizing ESRI ArcView 3.3 and Tracking Analyst packages, interfaced with a global positioning unit (Garmin GPS 176). Time of day between the GPS and laptop are synchronized for later comparisons. Power requirements for the laptop are extended by using two battery packs enabling up to four hours of continuous flight, but a DC to AC power converter could be used on vessels or for longer aircraft surveys. With the creation of a script in Arcview 3.3, a dialog box with information on the type and number of vessels, and comments if desired, is also created. The mouse pointer can be positioned in the exact position for a vessel on the nautical chart, and a point with time and position is created and sent to a text file.



Tracking Analyst is an extension for mapping objects that move or change status over time, such as the position of an airplane, enabling tracklog creation in real time. The track of the airplane is seen on the digitized nautical chart, viewed as a theme in ArcView, enabling real time location. Tracklogs of each survey were downloaded after each flight using MapSource, a complete waypoint and tracklog management software

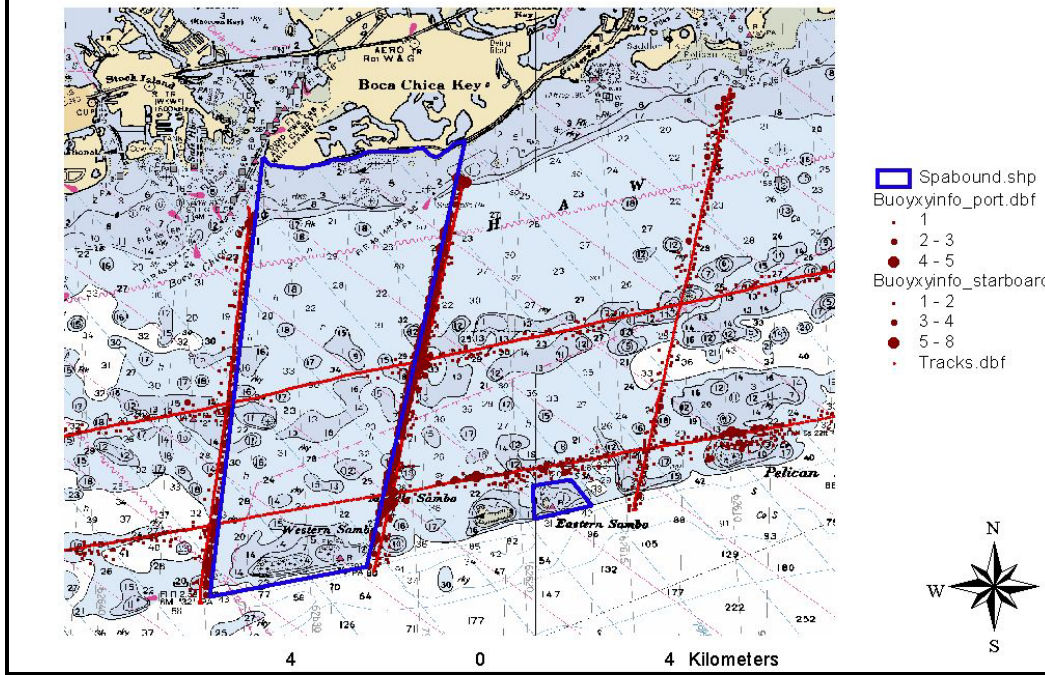
package supplied by Garmin, Inc. The exported text file was transformed into a dbase file using Microsoft Excel. Information included the exact position (latitude and longitude (converted into GIS coordinates) of the plane in 3 second intervals, time of position, altitude, speed over water, distance, and course. This dbase was later used to create individual shapefiles of each survey track, using ArcView 3.3 software. Total effort (distance of survey) can be computed using a script to add distances between points on the tracklog. A movement analysis program could be used since the tracklog created by the Garmin also has distance already computed. Future versions of this system might enable the tracklog to be sent directly to the laptop as a text file, eliminating this step. At present, the vessel information files created takes precedent, only one file able to be created at a time. A more powerful computer which could run two GIS programs at once might also enable two files to be created.

Discussion

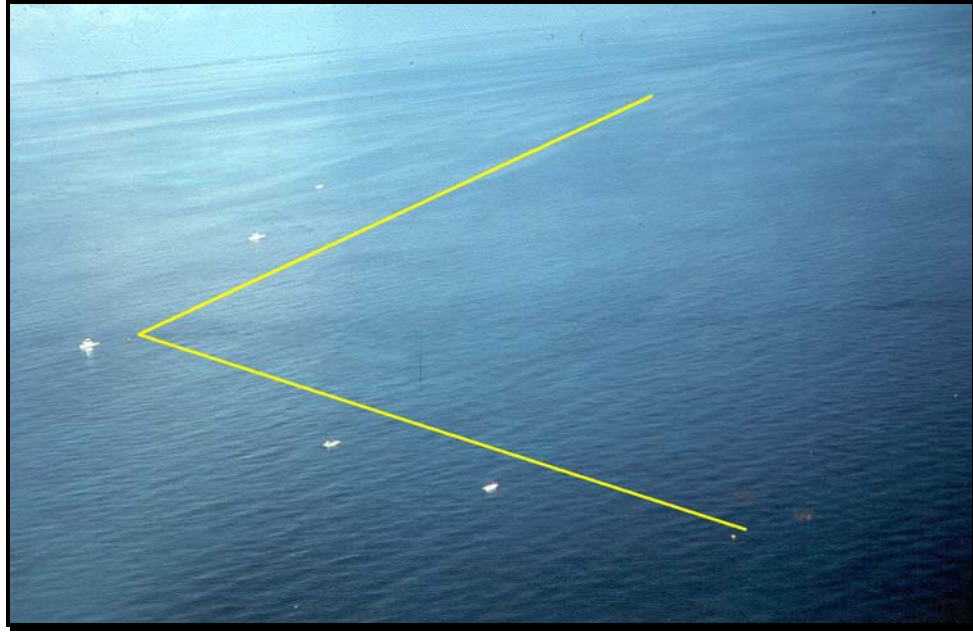
11,516 vessels were recorded from 30 surveys in the spring and summer of 2003 (Ault et al. 2003). To obtain a better temporal picture of vessel usage in the BNP, 24 additional flights in the fall of 2003 and winter of 2004 flights are scheduled. Preliminary analysis of the database indicates an r-square value of 0.93 between trailer counts and number of vessels, enabling future management decisions by managers. McClellan (1996) found an r-square value of 0.73 for five boat/trailer counts in the BNP. A wind speed of about 15-20 knots was found to be a determining factor whether smaller recreational vessels used the waters of BNP and the Florida Keys National Marine Sanctuary (FKNMS). Vessel usage in BNP (zone 9) was also estimated from these surveys, seasonality and weather conditions major factors in determining where and when different activities were conducted.

Future analysis of these survey data will show the effects of different variables such as weather, day of week and season, spatially determined usage pattern of the BNP between seasons and activities, calibration of creel censuses and fleet composition, socio-economical and biological impacts of the different fleets, and information for spatial zone management policies. Usage maps for different activities, i.e. flats fishing in the bay, diving and fishing on the inner and outer reefs, commercial spiny lobster, blue crab, and stone crab fishing, partying by recreational vessels anchored at Sand Key and Stiltsville sandbars, sailing on windy days and the Columbus Day regatta, and recreational mini-season lobster diving, could be created.

August 6, 2003
Lobster Buoy Survey
N= 1,102



The system was used to create fishing effort maps by the commercial spiny lobster fleet around Sambos Ecological Reserve (D. Harper pers. comm.) by adaptation of the script and dialog box. Three tracklines were plotted on a GPS (Garmin 2010C), based on known spiny lobster fishing activities across the Reserve, extending for ~5 miles on either side in a north-south direction. Two tracklines parallel to the east-west boundary on either side of the Reserve were also plotted. These five tracklines were cruised at a speed of ~10 knots. Two observers, each with the data entry system on either side of the boat, positioned lobster pot buoys. An accurate georeferenced map (for “fishing the line”) of commercial lobster fishing effort adjacent to the Reserve was created.



“Fishing the line” effects of marine protected areas in FKNMS and effort during the spiny lobster mini-season in BNP are in progress (D. McClellan per. comm.). This system, with adaptation of the script and dialog box, could be used to geo-position the exact locations of marine animals, such as turtles, dolphins and whales from aerial surveys.

Acknowledgements

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Literature cited

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