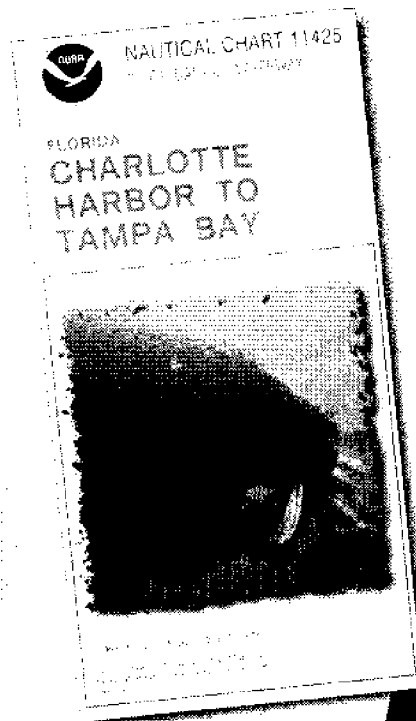


A Recreational Boater-Based Method for Re-designing the NOS Small-Craft Chart

Promoting Safe Navigation and Stewardship of Coastal Resources



by

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Executive Summary

1. Project Background

NOAA's Small-Craft Charts were first developed to serve the needs of recreational boaters, inshore fishers, and other users operating in close proximity to the shore. Since then, few conceptual changes have been made to these charts even though there has been a dramatic increase in the number and types of recreational users. Today, the small-craft chart is being used in ways that could not be envisioned when these charts were first produced: diving, racing, nature-touring, wildlife-viewing are current boating activities, in addition to traditional uses, such as sailing, fishing, anchoring and cruising. The need to promote safe navigation, the primary goal of charting, is being challenged by the numbers and varied types of contemporary recreational users. Furthermore, the conventional small-craft chart does not contain information needed to make current users aware of coastal resources. NOAA and other federal agencies, states and local municipalities, are increasingly concerned about the environmental impacts caused by recreational boating.

This project was designed to determine the chart information needs of boaters which satisfy safe navigation and promote stewardship. Study objectives include: identifying the information needed by today's boater to promote safe navigation and stewardship; developing a prototype small-craft chart, and ancillary map/guide products, which include information identified by recreational boaters, fishers, divers, resource managers and environmentalists, to modernize a new generation chart; evaluating the utility of the additional information provided on the prototype products through a boater survey; and analyzing whether the new information contained on the prototype chart and ancillary products can change boater's environmental perception, attitudes, behavior, and knowledge on-the-water.

2. Prototype Photo-Chart

The prototype chart was produced for study purposes by NOAA's Marine Chart Division in collaboration with the University of Florida Sea Grant Program and NOAA's Coastal Services Center. The design was based on recommendations from boaters and marine industry representatives who attended workshops in southwest Florida in May 1998. The chart covers the southwest Florida coast from lower Tampa Bay to Charlotte Harbor. Each side of the Prototype Photo-Chart is divided into top and bottom half-sections, which are further subdivided into panels.

Navigation chart panels are found on the bottom portion of both sides. Side A uses color symbols to distinguish marsh (green) and spoil (blue) areas from the water. Spot soundings are depicted over a white background and are shown as on the conventional chart. Side B uses several methods to depict bathymetry and habitat: there are panels that render water areas less than 6 ft in a blue color, deeper water is white and sea grass is green, as on the conventional chart; another panel renders water areas in blue-shaded 3 ft increments with spot soundings shown as on a conventional chart.

Environmental and boating map panels are presented on the top portion of both sides and include: anchorage locations, bridges, boat ramps, sea grass, marsh, shellfish harvesting, depth zones, and speed zones. Boating tables and diagrams also are included: anchorage characteristics, navigation rules, flags for vessel maneuverability, and weather pennants.

Background aerial photography and imagery is an important additional feature of the prototype photo-chart. Several types are included: 4-meter resolution, digital infra-red, aerial ortho-photography, converted to natural color, 2-meter resolution, infra-red color photography; and 5-meter resolution, composite satellite imagery color-fused with aerial photography. There are examples of background imagery covering both land and water, as well as color imagery only covering land.

The prototype photo-chart is 30" x 60" with a triple-fold, one-third larger than the conventional small-craft chart, though both products fold to 5" x 10" size.

8. Ancillary Boater Information Products

Four other information products were developed, distributed and evaluated.

Guide to Anchorages in Southwest Florida, 2nd Edition was produced by the Boaters Action and Information League (BAIL) in association with Florida Sea Grant, the Florida Department of Environmental Protection, the Southwest Florida Regional Planning Council, and the West Coast Inland Navigation District. The guidebook provides information on 47 popular anchorages, such as photographs with superimposed course lines, chart-lets with preferred course and buoys, anchorage descriptions, boating and anchoring tips, a link to the Florida Sea Grant Web Site for Southwest Florida Anchorages, and large-scale photo-maps of selected anchorages.

Sarasota Bay Blueways Pocket Guide was produced by the Sarasota Bay National Estuary Program. The guide's map is designed to help the boater learn more about and enjoy Sarasota Bay by locating main channels, sea grass, artificial reefs, bird-viewing areas, boat ramps and canoe/kayak launches, fishing piers, marinas and dockside restaurants. The guide also includes information on bay habitats, flora and

fauna, boating safety tips, and a resource directory.

Six Anchorage and Waterway Photo-Maps of popular boating locales were prepared as place-mats for waterfront businesses by Florida Sea Grant. The place-mats show depths, bottom sediments, sea grass, selected navigation aids, and boating hazards. In addition, channel center-line routes are marked, for approaching and transiting the anchorages.

The Florida Sea Grant Anchorage Web Site was designed and produced in coordination with the Regional Harbor Board for Southwest Florida and with the cooperation of the West Coast Inland Navigation District. The web site contains a virtual tour of "A Guide to Anchorages in Southwest Florida 2nd Ed," information on the Regional Harbor Board of Southwest Florida, resource information to help boaters select and enjoy many popular anchorages, and information on local restrictions, maps and photos, hot links to weather, tides, and chart updating, and related program information pertaining to anchorage management and monitoring publications.

9. Boater Surveys

Two mail surveys were implemented to profile boaters and to obtain product feedback. The Boater Profile Survey was developed to characterize the boating population of the region covered by the prototype photo-chart and to encourage boaters to use and evaluate the prototype chart and ancillary information products. Another objective of this survey was to determine the extent to which perceptions, attitudes and behavior differ among discrete boating populations. The survey instrument included questions regarding boat type, draft, mooring location, preferred boating activities, manner of use and type of navigational/piloting equipment, as well as a series of attitudinal-type questions which posed hypothetical boating situations.

A Product Evaluation Survey was mailed to 481 volunteers who completed the Boater Profile Survey, and volunteered to use the prototype products during a three-month test period (February - April, 1999). This survey instrument included questions regarding the content, format and usefulness of the prototype information products. The survey objectives were to obtain feedback from boaters regarding the content and cartographic representation of the prototype chart, to determine which information products – prototype chart, pocket guide, place-mats, anchorage guide, anchorage web site – were most or least useful to boaters, and to test if such products can change the environmental perception, attitudes, and behavior of boaters.

The opinion and evaluation surveys were administered using established mail survey and convenience sampling procedures. The Boater Profile Survey questionnaire was mailed to 3000 resident boaters; 828 individuals returned the questionnaire, and 417 volunteered to use and evaluate the prototype chart and other

information products. Another 250 Boater Profile Survey questionnaires were distributed to transient boaters; 87 returned the questionnaire, and 64 volunteered to use and evaluate the prototype products. The number of questionnaires received by boaters was 3018, and the number completed was 915 (828 resident, 87 transient); this represents a 30 percent return rate. Of those boaters who completed this questionnaire, 53 percent (481) volunteered to use and evaluate the prototype products (417 resident, 64 transient). There were 132 volunteers who completed the second survey -- Boater Product Evaluation Survey -- questionnaire; this represents a 27 percent rate of return.

10. Results

Boating Profile

About half of the boats are small outboard vessels and another quarter are large trawlers and cabin-cruisers; 17 percent are sailboats, and the remaining 8 percent are personal water-craft, kayaks, canoes and rowboats. These are shallow-water vessels: over half draw less than 2 ft, 30 percent have 2-3 ft drafts, and 16 percent have drafts between 3 and 4 ft. Over 60 percent of the boats are moored at private docks.

Eighty-five percent of the boaters have 10 or more years of experience, and spent, on average, about 51 hours on-the-water during the March - May boating season. Over two-thirds have taken some formal boater education courses, such as introductory boating safety and seamanship as well as intermediate or advanced courses in piloting and navigation. Overall, 90 percent have no perceived difficulties in carrying out navigation and piloting operations.

The average boater is 58 years of age, white, male, and college educated. Fifty-nine percent are partially or fully retired. Over 60 percent have household incomes of \geq \$50,000, and 13 percent have \geq \$150,000 incomes. Those with the lowest incomes ($<$ \$20,000 which is 3 percent of the boaters) spend 131 hours on-the-water during the high boating season, compared with 154 hours of boating time by the majority with higher incomes. Most boating time by the employed occurs on the weekend (68.7 percent) in contrast to fully retired individuals who spent 50.8 percent of their boating time on weekdays.

Stand-out reasons why people boat are for fishing and cruising. During the March - May season, the average boater spent 46.70 hours on-the-water, engaged in activities ranging from a high for inshore fishing (60.75 hours/boater) and cruising (55.78 hours/boater) to a low of 17.22 hours/boater for ocean racing. About 50 percent of boating time is spent in pursuit of fishing, while cruising accounts of 29 percent of the boating time. The top three reasons for boating in one area over another are its scenic beauty, clean waters and fishing opportunities. Main reasons for selecting an anchorage locale are its bottom-holding, storm protection, fishing opportunities, and

calm waters. Results of the boating pressure model show that on a hours/acre basis, the greatest pressure is exerted by sailboats (93.81 hours/acre), followed by speed-boat type (58.17 hours/acre), personal water-craft (24.75 hours/acre), cabin-cruisers (18.82 hours/acre), and row-boat type (8.01 hours/acre). It should be noted that not all boat types have the same impact, per hour/acre, on the resource.

Prototype Chart and Other Information Products

The most readable navigation panels on the prototype chart showed composite color-fused imagery only over land areas, with spot soundings and conventional supplemental contours over water areas. The most useful navigation information was depths in general and soundings by color-shading, land photo images, shore features and the shoreline. The principal problems with the navigation panels related to background colors of the imagery and their cluttered appearance. The most readable and useful environmental and boating information panels on the prototype chart showed sea grass and mangrove coverages and symbols for anchorage, ramp and bridge features. Three-quarters of the boaters concurred that the supplemental boating information tables and diagrams (bridge, anchorage, facilities, aids to navigation, etc.) should be included on the prototype chart. About two-thirds of the boaters found the triple-fold chart size acceptable. About two-thirds of those who considered the chart size unsatisfactory, said that a 'track ticket' format would be more suitable.

The four other information products – Pocket Guide, Place-mats, Anchorage Guide, Web Site – were evaluated for their usefulness and relevance. The Anchorage Guide had the highest scores: top rated features were photographs with superimposed course lines and chart-lets with preferred courses and buoys. Only half of the boaters have access to a home computer which may explain the low score for the Web Site product.

Boater Environmental Perception, Attitudes and Behavior

The test of boater responses, to a series of natural resource and pollution-related incidents while underway or at anchor, showed that an overwhelming proportion know how to boat in an environmentally appropriate manner. Responses to hypothetical environmental situations showed a high proportion of 'appropriate' responses with answers ranging from 75.6 percent (disturbing sea grass) to a high of 99.6 (encountering manatees). The answers to questions on 'wakes' and 'vessel grounding' were also very high. More than 97 percent indicated an 'environmentally appropriate' response. Responses to hypothetical pollution situations also showed appropriate responses ranging from 47.1 percent in the case of head-discharging to 98.6 percent for encountering a floating plastic bag. These responses to hypothetical situations, however, may or may not reflect the actual behavior of boaters if and when confronted with such situations on-the-water.

The prototype products did influence boating practices and the quality of boating

experiences. The prototype chart had the greatest impact of all test products in affecting decisions to avoid adverse impact on the environment. The Anchorage Guidebook had the highest impact, followed closely by the prototype chart, in enhancing awareness of boating safety, reducing potential conflicts, and increasing on-the-water enjoyment.

11. Conclusions

The conclusions are summarized with respect to each of the study's goals.

Determine the chart information needs of boaters which satisfy safe navigation and promote stewardship.

Findings

1. Shallow water areas (less than three feet) should be highlighted on charts. The analysis indicates that the most frequented boating zones are shallow water areas. The current NOS charts highlight deeper water; shallow water areas are understated.
2. Land is best depicted by composite color-fused imagery. However, boaters felt that the resolution might be improved. The majority of boaters surveyed thought that spot soundings and other information was difficult to read and interpret when displayed over digital imagery. The overall impression was that the prototype photo-chart was "cluttered".
3. Bathymetry is best depicted by spot soundings and conventional supplemental contours, or as color-coded depth ranges with supplemental spot soundings. An equal numbers of boaters favored one or the other combination.
4. The use of red ink should be minimized, and the text increased in size. Many recreational boats are equipped with a red light for nighttime navigation which makes it difficult to see shades of red on charts.
5. The most readable and useful environmental and boating information panels on the prototype chart showed sea grass and mangrove coverages and symbols for anchorage, ramp and bridge features. Three-quarters of the boaters concurred that the supplemental boating information tables and diagrams (bridge, anchorage, facilities, aids to navigation, etc.) should be included on the prototype chart. About two-thirds of the boaters found the triple-fold chart size acceptable. About

two-thirds of those who considered the chart size unsatisfactory, said that a 'track ticket' format would be more suitable.

6. Four ancillary information products -- Pocket Guide, Place-mats, Anchorage Guide, Web Site -- were evaluated for their usefulness and relevance. The Anchorage Guide had the highest scores: top rated features were photographs with superimposed course lines and chart-lets with preferred courses and buoys. Only half of the boaters have access to a home computer which may explain the low score for the Web Site product.

Determine if chart information needs vary with boater education and with boat type.

Findings

1. Results from the statistical analysis strongly suggest that a respondent's type of boat and education had no appreciable impact on the boater's chart information needs. This finding is surprising since the general perception by most boaters is that boating knowledge, behavior and overall use of the environment vary with respect to the respondent's boat type and education. A number of factors may have influenced the responses:
 - a. The boating population tested may be unique to southwest Florida or to the State of Florida.
 - b. The respondents' age is decidedly older than the average for the U.S. population.
 - c. Many boaters go through 'stages', the first is usually a small run-about, succeeded, over the years, by larger and larger boats. As a boater approaches middle age, and then retirement, (s)he continues to boat, usually moving from sail to power vessels where the operation requires less physical energy on behalf of the crew. This means, of course, that most individuals have had not only extensive experience with boating but also in operating different types of vessels. Since questions that might query the respondents in this manner were not included, this hypothesis could not be validated by this study.

Determine if the incorporation of data derived from GIS, GPS and remote-sensing is an effective way to modernize the NOS chart.

Findings

1. Digital imagery, as a backdrop for land areas, was well received by the boaters. The background imagery enhanced navigation by providing boaters with a heightened sense of location with respect to the coastline and urban features.
2. Bathymetric mapping with a GPS allowed for the inclusion of detailed depth-range contours for near-shore areas.
3. The use of GPS is proven to be an efficient and accurate method for collecting and updating chart information (signage, anchorages, boat ramps, marinas, spot soundings).
4. The prototype charting effort was greatly enhanced by the ability to utilize and incorporate GIS databases (bathymetry, mangrove, sea grass, shellfish harvest areas, speed zones, etc.), available from state and local agencies.

Determine if the incorporation of environmental history and boating geography information onto chart products could instill stewardship.

Findings

1. An analysis of boater responses to how they would react when confronted with hypothetical boating situations indicated that boaters have a keen awareness of the appropriate action that should be taken to minimize environmental impacts. Results showed that an overwhelming proportion know how to boat in an environmentally appropriate manner. However, responses to hypothetical situations may not reflect the actual behavior of boaters if and when confronted with such situations on-the-water.
 - a. Responses to hypothetical situations which could impact the environment showed a high proportion of 'appropriate' responses with answers ranging from 75.6 percent (disturbing sea grass) to a high of 99.6 (encountering manatees).
 - b. The answers to questions on 'wakes' and 'vessel grounding' were also very high. More than 97 percent indicated an 'environmentally

appropriate' response.

- c. Responses to hypothetical situations which could pollute the environment also showed appropriate responses ranging from 47.1 percent in the case of head-discharge, to 98.6 percent for encountering a floating plastic bag.
2. The prototype products did influence boating practices and the quality of boating experiences. The prototype chart had the greatest impact of all test products in affecting decisions to avoid adverse impacts on the environment. The Anchorage Guidebook had the greatest effect, followed closely by the prototype chart, in enhancing awareness of boating safety, reducing potential conflicts, and increasing on-the-water enjoyment.

The study findings suggest that we have taken an important first step in developing a universally acceptable chart for recreational boaters. This southwest Florida test of the prototype chart does affirm the overall objective that boater attitudes and practices are positively affected by these new kinds of chart information. But, is southwest Florida representative of the range of boater activities, experience and practices found throughout the U.S.? Our study findings show a somewhat older boating population, a large number of smaller power boats, a year-round boating season, and a diversity of boat types and operators, all of which may contribute to a unique set of conditions compared to other boating regions in the country. Given the substantial commitment in manpower and costs that will be required should NOAA's Marine Chart Division adopt our recommendations, we strongly suggest that the study findings be tested in other boating regions of the U.S.

7. Recommendations

1. Redesign the small-craft chart #11425, the focus of this study, incorporating volunteer boater recommendations, and publish it for general distribution and use. Boaters preferred the new, prototype chart format and additional information contained within it. This improved information will promote safer navigation and environmental stewardship in southwest Florida.
2. Conduct multi-regional surveys (East Coast, Gulf Coast, West Coast, Great Lakes) of NOS/recreational boater chart users, to determine their chart information needs to satisfy safe navigation and promote stewardship. The southwest Florida boater survey found a decidedly older boating population than the national population average. Age may have contributed to the fact that many survey respondents felt that the map was "too cluttered" and that spot soundings and other information were "difficult to read and interpret". Boater characteristics, such as education, type of boat and demography may differ significantly from the general boating

population, thereby contributing to special information needs and cartographic presentation.

3. Produce prototype photo-charts for other boating areas, using the methodology developed in this pilot study and relying on results from multi-regional survey (Recommendation 2 above). Representative regional test locations could include Rhode Island, Washington, and Michigan. Sea Grant could oversee and implementation of these boater surveys. The NOAA Coastal Service Center could collaborate in meeting this objective.
4. Refine the Boating Pressure Model developed in this study and improve data applied to the model. This model should be expanded to characterize boating pressure over the calendar year - the current model utilizes only seasonal data. Suggested refinements also should include more precise definitions of water depth (1 ft resolution) and an examination of the relation of habitat (e.g., sea grass, marsh, mangrove) to boating pressure zones. Such an analysis would further quantify how boating activities potentially impact resources and how information needs within these boating pressure zones relate to safe navigation and stewardship.

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