

**SUMMARY OF REVIEWER COMMENTS ON TWO REPORTS ANALYZING ORV
USE AT CAPE HATTERAS NATIONAL SEASHORE**

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INTRODUCTION AND BACKGROUND

Five peer reviewers were asked to evaluate two research reports dealing with ORVs and other recreational use at Cape Hatteras National Seashore (CAHA).

The five persons serving on the review panel were:

- Dr. Robert Ditton, Professor Emeritus, Dept of Wildlife and Fisheries Sciences, Texas A&M University.
 - Expertise: marine recreation, human dimensions of fisheries.
- Dr. Steve Lawson, Assistant Professor, Dept. of Forestry, Virginia Tech University.
 - Expertise: onsite visitor survey methods, survey data analysis.
- Dr. Larry Ringer, Professor Emeritus, Dept. of Statistics (Head), Texas A&M University.
 - Expertise: survey sampling design, survey data analysis.
- Dr. Frederick Solop, Professor, Dept. of Political Science and Director, Social Research Laboratory, Northern Arizona University.
 - Expertise: mail survey research methods, survey data analysis.
- Dr. Daniel Stynes, Professor Emeritus, Dept. of Community, Agriculture, Recreation, and Resource Studies, Michigan State University.,
 - Expertise: recreation economic impact assessment, visitation counting, research methods.

The two reports reviewed by the panel were:

- Vogelsong, H. (2003). Cape Hatteras National Seashore visitor use study, (54 pp. + appendix).
- Neal, W. (2005). The Lower Outer Banks of North Carolina: Results of a survey of residents, nonresident property owners, and visitors (39 pp. + appendix).

The Vogelsong report describes findings from a survey of visitors to CAHA conducted in 2001-2002. This survey was sponsored by the NPS. The Neal report describes findings from a survey of various groups, including visitors, conducted in 2002-2003. This survey was sponsored by the Outer Banks Preservation Association.

These two reports, along with other research, are being considered by the NPS during the development of a CAHA Off-Road Vehicle Management Plan and Environmental Impact Statement. The NPS is developing a range of numbers for use in an analysis of the economic

impacts of managing ORVs at CAHA. The alternatives could affect the number of ORVs using the park's beaches, with consequent changes in economic impacts from visitor spending.

REVIEW PROCESS

In accordance with National Park Service interim guidelines for peer reviews, panel members were appointed by the peer review manager based on their expertise in topics discussed in the two reports and on their independence from the Vogel song and Neal surveys.

Reviewers received copies of both the Vogel song and Neal reports in March 2008 and were asked to respond in writing to the 10 questions (A through J) listed below. Following receipt of evaluations from each panel member, the peer review manager drafted a summary of their responses. This summary, along with the original reviews, was then sent to panel members for their comments. During a telephone conference on April 11, the five reviewers discussed the summary and each other's evaluations. Reviewers were then given the opportunity to edit their comments. The peer review manager revised the summary to reflect these edits and re-circulated the document among panel members to ensure that it provided an accurate synopsis of their evaluations. The summary and complete text of each review were transmitted to the project manager on April 30, 2008.

When draft manuscripts are peer-reviewed for scientific publications, authors are provided an opportunity to respond to the reviewers' comments. Because final reports, rather than draft manuscripts, were reviewed in this case, the authors were not asked to respond to the reviews. This is because the review panel's task was to evaluate the application of two finished reports for use in developing the CAHA ORV Management Plan and Environmental Impact Statement. The panel was not tasked with providing input to help authors revise documents that had already been accepted by sponsors as final.

In the summary that follows, the numbered paragraphs are comments extracted from the reviews of the individual panel members, with minor edits for consistency and style. The introductory unnumbered paragraphs are the peer review manager's summary of the panel's responses to each question. The complete text of each review is attached to this summary.

SUMMARY OF PEER REVIEWERS' COMMENTS

A. Do either the Vogel song or Neal surveys provide a sound scientific basis for estimating the total amount of ORV use at CAHA during the study period and the total visitor spending resulting from this activity? In other words, how suitable is the science of the studies for use in the planned role in decision-making?

Based on the analyses described in the two technical reports, four of the five reviewers concluded that neither the Vogel song nor the Neal studies appear to provide a sound scientific basis for estimating ORV use at CAHA or the economic impact of visitor spending associated with ORV use. One panel member stated that the Vogel song study was helpful and the Neal study, in general, provided a sound scientific basis for decision-making; however, this reviewer also concluded that the information provided in both reports was probably insufficient for making a decision regarding limiting or prohibiting the use of ORVs at CAHA. Reviewers were unanimous in their concern about the lack of detail on research methods provided in both reports.

VOGELSONG REPORT

The panel commented that the design of the Vogelsong study served certain purposes well, such as documenting attitudes of park visitors and comparing ORV users with non-ORV users. However, all reviewers felt that there was insufficient detail provided on the sampling methods and analysis in the Vogelsong report for them to reliably determine the extent to which CAHA is used by ORVs:

1. The report includes no estimates of turnover rates throughout the day and no discussion of weekday-weekend or seasonal variations that would be required to arrive at an overall annual estimate of ORV use. A “vehicles-at-one-time” estimate would require turnover rates to estimate daily activity. Thus, even if the data could give a reasonably accurate basis for estimating the number of ORVs in the park *at one time*, it is not clear that they provide a sound scientific basis for estimating *total* daily or annual ORV use.
2. The Vogelsong report contains virtually no information about the methods used to collect the visitor-use data reported in Table 1 of the report; yet these data provide the primary basis for estimating total park visitation and total ORV use at CAHA. Thus, it is difficult to judge the rigor and scientific credibility of the methods used to collect these data. Vogelsong’s annual ORV use estimate seems somewhat arbitrary. In particular, the report states, “Since this number is probably accurate plus or minus 20%, a more accurate but less precise estimate would include a range of 73,526 - 110,288 ORVs or 166,300 - 249,450 ORV users annually using the beach.” There is no quantitative characterization of the precision associated with these estimates or the methods used to generate the ranges.
3. Information is lacking on the number of days ORV sites were observed and the times of the day that observations were made. Were any observations made at night when much fishing activity takes place, or was this particular ORV use overlooked?
4. The high standard deviation (268.8) around the mean ORV count of 251.8 indicates that ORV use is highly variable at CAHA, depending on seasonal differences, site differences, and differences between coastal and sound sides of the island. Given this, extrapolating daily count data to an annual figure based on counts at just 15 locations is problematic.
5. The sampling of sites for ORV counts may not constitute a representative probability sample. The report suggests that selection of data collection sites may have been based on criteria other than random choice. The report states, “not all park users/vehicles/ORVs were accounted for, but it is hoped that these counts are representative of similar areas throughout the park” (p. 8-9). However, no data supporting the representativeness of the sampled sites is provided in the report.

Regarding Vogelsong’s estimates of the economic impact of ORV use at CAHA, reviewers made the following observations:

6. The expenditure data reported on p. 51 apparently are for all visitors to CAHA, not just ORV visitors. It does not appear to be a purpose of the report to estimate total spending associated only with ORV use at CAHA; yet, expenditure patterns for ORV users may differ significantly from other users.
7. The spending averages in the Vogelsong report are generally consistent with averages from similar parks if it’s assumed that the figures apply to overnight visitors staying in

motels, hotels, and other commercial rental housing. Spending averages would be lower for campers, visitors staying with friends, relatives, or in owned seasonal homes. They would also be lower for visitors not staying overnight in the area.

8. The economic impact analysis fell short as the last item in the report. Although it may not have been a purpose of the study, the report failed to tie the economic impact data to overall ORV use at CAHA, and the focus was entirely on direct expenditures. The focus on average daily and average total expenditures in the Outer Banks area failed to address the overall extent of expenditures associated with ORV use in the park.
9. The heading on p. 50 of the report is titled “Economic Impact,” but the investigator does not go beyond estimating direct expenditures. Multiplier effects are not included. It would have been preferable to have included an IMPLAN analysis to better understand the overall economic impacts of ORV use at CAHA.¹
10. The Vogelsong report states that, on average, visitors spend \$511.00 per day (p. 51); however, the expenditure averages in Table 34 sum to \$428.28 per day. The study does not discuss handling of outliers and missing spending data that can significantly influence results. Failure to deal with these issues likely explains the discrepancies in the Vogelsong sums.

NEAL REPORT

None of the reviewers felt that the Neal report provided sufficiently adequate information to serve as a basis for regulating ORV use in the park. Among the concerns expressed by the reviewers were: 1) the Neal survey did not focus on spending by ORV users, but on the extent to which total tourism spending would drop in the Outer Banks area as a result of a ban on ORV use; 2) quality control in the survey sample was lacking, and coverage of relevant populations fell short of that needed to understand the effects of limiting ORV traffic at CAHA; and 3) the mail survey did not follow scientifically recognized protocols for questionnaire design or survey implementation in the field:

11. The information in this report is probably not sufficient for making a decision regarding limiting or prohibiting the use of ORVs at CAHA. The report does not address the differences, if any, between expenditures and experiences of ORV users and non-ORV users. Also, there is a concern as to whether or not the individuals who received questionnaires mailed by the management companies and lodging companies were truly selected following a random selection process.
12. The study surveyed residents and non-resident property owners, but these persons should have been intercepted on the ground when they became visitors to CAHA. This is the preferred way to sample a visitor population because it yields a representative sample of the most recent ORV trip rather than a “typical” trip to the Outer Banks area.
13. There is no connection between the study’s results for the three groups surveyed and the universe of CAHA ORV visitors. The percentage of the three groups who use ORVs at CAHA is reported, but the report fails to link this to any actual use data for the park. This is surprising given that the fourth objective of the study (stated in the research plan) was to “determine the volume of usage of the beaches for a list of typical activities . . .”
14. The study’s findings are based on a data collection method characterized by lack of rigor. While residents appear to have been randomly selected to participate in the mail survey,

¹ Peer review manager’s footnote: The NPS Money Generation Model—version 2 also could be used to estimate economic impacts of visitor spending.

it is not clear that the surveys of visitors and non-resident property owners were conducted with random populations. Instead, the investigator relied on third parties (property management companies, private campgrounds, motels) to distribute the mail surveys. No instructions are included in the report on how these parties were to randomly select people to participate. It is difficult to assure quality of the sampling process when relying on so many untrained entities to select survey participants.

15. Standard mail survey procedures do not appear to have been used to guide administration of the questionnaire. There is no mention of the use of follow-up reminders and replacement questionnaires to enhance survey response rates and minimize the potential for non-response bias.
16. Although sample sizes are sufficient for point estimates of proportions (percentages), the report does not include standard errors of the estimates. If one wants to use these data for examining various scenarios and give confidence intervals or measures of uncertainty for the outcomes, one needs to have measures of the uncertainty (e.g., standard errors) for the values used.

With respect to the analysis of economic impacts in the Neal report, reviewers commented:

17. The manner in which economic data are used to compute the economic impact estimate is somewhat speculative. For example, the study uses survey respondents' "best guesses" at what they would spend if they spent a week visiting CAHA as a key input into the computation of the economic impact of an ORV ban.
18. The calculation of the total spending estimate is based on room tax figures for the area. This is a reliable source of hotel sales, assuming all rental properties are covered by the tax. The approach, however, will not include spending of NPS campers, day visitors, non-resident property owners, or residents, and therefore will underestimate total spending. The procedure used completely misses the spending of these groups.
19. The representativeness of the sample relative to spending is not discussed. Properties sampled and seasonal issues would be important factors in estimating spending. Seasonal variations in spending are likely substantial given that summer rental rates are at least double off-season rates.
20. Apparently, no campers at NPS campgrounds were included in the survey [although CAHA campgrounds reported 91,000 overnight stays in 2007]. Campers would have a different spending pattern than visitors in hotels and rental housing.

In addition to evaluations of the utility of both studies for estimating ORV use and the economic impact of EIS alternatives, the panel was asked to comment on nine other aspects of the Vogelsong and Neal reports.

B. Ability to generalize the results of the data collections to the universe of CAHA visitors and other populations (i.e., residents and other property owners).

This issue addresses the ability of a sample to accurately describe all members of the population it is intended to represent. A sample's generalizability depends on several factors, including variability in the population sampled, sampling methods, and, to a lesser extent, sample size. It also is a function of the precision of estimates of population characteristics, i.e., the "margin of error." Finally, generalizability is affected by sampling error and non-response bias. Sampling error occurs when a sample represents only a portion of a population. Non-response bias is the

extent to which the characteristics and opinions of people failing to return a mail survey or refusing to be interviewed on-site are different from the characteristics and opinions of those who do participate.

VOGELSONG REPORT

All reviewers noted the lack of detail on survey methods in the Vogelsong report, making it difficult to judge how well the sample represented the universe of park visitors:

21. The author does not disclose how many intercept surveys were conducted, how many mailback surveys were received, how visitors were selected to participate in the intercept study, and how many visitors refused to participate. (Combining information on page 12 and page 14 suggests 1,681 people participated in the mail survey; yet, tables appearing later in the report suggest a smaller number of participants.) In addition, the investigator does not identify a margin of error for the data, leaving the reader unable to evaluate the quality of findings and unclear about the extent to which research findings can be generalized to the larger population of visitors.
22. The sampling time frame for interviews was spread throughout the year and weekdays to account for variations in seasonal and day visitations. This should contribute to the study's generalizability.

NEAL REPORT

The panel commented on the lack of quality control in the Neal sample due to the apparent lack of oversight by individuals trained in survey research methods. Two reviewers commented on potential sampling error in the Neal survey:

23. There is little information to judge the representativeness and generalizability of the Neal samples to the relevant populations. The resident sample was proportional to residences by Zip code, but possible nonresponse bias is not addressed. Did the proportion of returned questionnaires match the proportion of sampled addresses in each Zip code? The non-resident property owners and overnight visitor samples were selected by cooperating realty and lodging companies. It isn't clear how representative these samples may be. How individual respondents were chosen and potential response biases are not addressed.
24. Although the Neal study examines the potential impact of an ORV ban at CAHA, it does not include those individuals who have not visited CAHA, but may visit if there is a ban on ORVs, or those who may visit CAHA in the future, but will not, if there is a ban on ORVs.² However, it is next to impossible to identify these individuals and the sample of visitors serves as a surrogate for them.

C. Design of the survey instruments and observation protocols.

VOGELSONG REPORT

Three of the five reviewers specifically commented on the design of the survey instrument used in the Vogelsong study. These comments were favorable, and one panel member noted that it had been reviewed (and approved) by the federal Office of Management and Budget.³ However,

² Peer review manager's footnote: These difficult-to-reach populations also were not covered in the Vogelsong study.

³ Peer review manager's footnote: The Vogelsong questionnaire was pre-tested at the park in 2000, the year prior to its full-scale implementation. Pre-testing of draft questionnaires helps evaluate respondents' comprehension, the

regarding the vehicle-observation protocols, reviewers commented that there was not enough information presented in the report to judge the adequacy of these observations:

25. The Vogelsong questionnaires (intercept survey and mailback survey) do a better job than the Neal survey in phrasing questions in a non-biased and balanced manner. Questions initiated with phrases such as “Would you say...” “Would you imagine...” and “How would you rate...” do not have the effect of leading survey participants toward specific responses.
26. The interview schedule was useful for getting descriptive information on the trip party and their *pre-trip* intentions for participation at CAHA. Respondents to the interview also were given the opportunity (if they chose to do so) to provide additional *post-trip* information on a variety of topics best addressed after their trip to CAHA, i.e., amount of money spent by category on their most recent trip to the Outer Banks, activities participated in, and whether or not they had driven an ORV on a beach at CAHA.
27. Vogelsong engaged in an elaborate observation strategy for the purpose of estimating the total number of visitors to CAHA. He combined observations of vehicles and visitors to calculate a people-per-vehicle ratio. He also conducted observations at multiple sites to gauge the number of ORVs on beaches within CAHA. However, he does not provide detailed information about when counts were conducted and how they were conducted to enable independent evaluation of the quality of the observation protocol and data.

NEAL REPORT

Reviewers commented on the potential confusion arising from the Neal survey’s use of a single questionnaire for three different populations. Other comments dealt with the wording of specific items in the questionnaire:

28. Skip patterns and other survey response instructions are somewhat awkward, and could have been eliminated by crafting separate versions of the survey for residents, non-resident property owners, and visitors.
29. The design of the Neal questionnaire did not provide respondents with a detailed understanding of alternatives and trade-offs involved in future decision-making regarding ORVs. Arguments for and against proposals for charging fees (question A5), restricting beach access (question A6), and banning the use of licensed off-road vehicles (question A7) were not presented. Thus, the survey questions provided insufficient framing and likely led to various biases in the data collected. Overall, many of the questions in the Neal survey were poorly stated from a validity and reliability standpoint.
30. Several of the Neal questions asked visitors to provide speculative answers (e.g., to speculate on the impact of an ORV ban on percentage change in personal income and beach erosion), while other questions were leading. For example, the question about the effects of an ORV ban on respondents’ jobs (question A8) assumes that any effect would be negative, and that it is simply a matter of degree.
31. ORV use is not listed as an activity at CAHA on the recreational activity list provided in the Neal survey (question D4). It would have to be written in by the respondent. Also, there was potential for major recall bias and digit bias problems when respondents tried to identify the number of visits and days per visit by 3-month season.

wording of questions, and other factors that could affect the quality of survey data. There is no mention in the Neal report of questionnaire pre-testing.

D. Rigor of the data-collection methods in the field.

VOGELSONG REPORT

Consistent with previous comments, the reviewers observed that there were insufficient methodological details included in the Vogel song report to properly evaluate the rigor of the study's field methods:

32. Vogel song never mentions tracking of people taking mailback surveys. The reader does not know how many mailback surveys were distributed relative to the number returned.⁴
33. The author could have spoken to some of the quality control/quality assurance problems that can occur with a project like this. What worked well; which did not? And what was done to make things work right? For example, how were vehicles /ORVs observed (point in time or a particular time period) and what kind of adjustments were made throughout the project? Were there refusals when people were asked to complete interviews? How many on a percentage basis? Exactly how was the random sample of visitors selected for personal interview purposes? Was more than one person per party selected for interview purposes?
34. Vogel song's estimate of total park visitation was determined by two primary types of data: 1) vehicle counts on Highway 12 and passenger counts on the Cedar Island and Swan Quarter ferries; and 2) people-per-vehicle counts conducted at two locations in the park. Both the vehicle/passenger counts and the people-per-vehicle data are potentially problematic. The vehicle counts on Highway 12 and ferry passenger counts presumably count all traffic, including non-recreational/non-park visitor traffic. It is likely that some proportion of the vehicle traffic counted on Highway 12 includes residential and commercial traffic, rather than park visitor traffic. If this is the case, the counts overestimate park visitation, and it is not apparent that data were collected to adjust traffic counts to account for residential and commercial vehicle traffic.⁵
35. The 23 sites for interviews were distributed throughout the park. The least number of interviews from any one site is 12, and the largest number of interviews at any one site is 162. There is no indication of any problems in selecting individuals to be interviewed or of any attempt by the interviewers to influence responses.

NEAL REPORT

Reviewers were uncomfortable with using local groups not trained in survey methods to send random mailings at particular times or to follow standard mail survey protocols. One reviewer having experience with such groups noted that third parties often indicate a willingness to participate in carrying out surveys, but fail to follow through on important details:

36. The sampling methods used to administer surveys to residents, non-resident property owners, and visitors are, to some extent, by convenience, rather than a systematic or random sampling approach. There also are questions about "quality control" on survey sampling, as this was administered by property management companies, hotel and motel

⁴ Peer review manager's footnote: Tracking response rates is important for assessing the potential for non-response bias in the survey results.

⁵ Peer review manager's footnote: This comment deals with the calculation of total vehicular traffic at CAHA, rather than ORV traffic. However, any computation of ORV traffic that is based on counts of total recreational traffic would be affected by inaccuracies in the latter count.

managers, and campground managers, rather than researchers with training in survey sampling and research methods.

37. The local groups responsible for distributing the survey may not have had a clear understanding of random sampling beyond the colloquial notion of “random” mailings. Doubts about the randomness of these mailings seriously jeopardizes the validity of the survey results.
38. The survey administration literature is in agreement that mail surveys are best conducted in waves, preceded by respondent notification, followed by mailing a survey packet, a reminder letter mailed to non-responders, and sending of a second survey packet. Neal apparently did not follow these established procedures. This failure to properly administer a mail survey leads to a higher-than-necessary rate of non-response. Whether the data for the non-responders would differ from that of respondents is not addressed in the report.

E. Appropriateness of the data analysis, including the characterization of uncertainty (margin of error).

Reviewers expressed concern about the lack of any discussion or presentation of error margins in many of the analyses in both reports. Without margins of error around sample estimates, it is difficult to assess the extent to which the samples adequately represent the populations from which they were drawn. Other aspects of the data analysis in both reports also were questioned by the reviewers:

VOGELSONG REPORT

39. Neither investigator reports the quality of their data as reflected in the margin of error associated with findings. This cripples the independent reviewer from definitively commenting on the appropriateness of the data analysis. If visitors were not randomly selected, and there is no margin of error associated with the visitor data, subsequent analysis is little more than descriptive of (survey) participant attitudes, rather than generalizable to larger populations.
40. Survey data analysis in the Vogelsong report is restricted mostly to univariate frequencies. Subgroup comparisons and cross-tabulations are limited.
41. Almost all the tables in the Vogelsong report fail to show respondent totals, and there did not seem to be a statement of the total number of personal intercept interviews or the number of questionnaires returned.
42. The author reports means for ordinal data (Tables 9-13, 18-21, 27-29) when a mean is not appropriate. Consider Table 22 comparing ORV use levels to visitor expectation. The author reports a mean of 3.21. However, this calculation is a result of assigning the value of 6 to the response “You didn’t have any expectations,” which has a count of 80. Deleting this category changes the mean to 2.97. Assigning a code of 0 to the category gives a mean of 2.73. Assigning a value of 3 (same as “About what you expected”) gives a mean of 2.97. Which of these is correct? And even if you decide the correct value for this category, what does a value of 2.73 or 2.97 or 3.21 mean? None of these is one of the categories. The correct summary statistic is the median, which in this case is the category “About what you expected.”
43. The people-per-vehicle estimate appears to be based on a total of 40 observations collected at just two locations within the park. Further, it is not evident from the report

whether counts were stratified by day of week and/or season of use. Due to the relatively low number of people-per-vehicle observations, it is likely that the Vogelsong estimate of people per vehicle is not precise (though the precision of the estimate is not reported). Furthermore, the sampling does not appear to have been stratified in any manner. Thus, the people per-vehicle-data do not provide a sound scientific basis to account for potentially systematic differences in the number of people per vehicle associated with different modes of access to the park, different types of recreation sites visited, different types of activities/vehicles, season of visit, and day of week.

NEAL REPORT

In addition to the lack of error margins, two reviewers questioned the appropriateness of the Neal report's analysis of the impacts of an ORV ban at CAHA on the region's tourism. One reviewer commented favorably on Neal's economic impact analysis:

44. The Neal study's estimated drop in tourism associated with an ORV ban is based on an arbitrary weighting of responses to a question asking survey respondents if they would continue to visit CAHA if there was a ban on ORVs. Not only is the weighting of these responses seemingly arbitrary, but the response scale provided with the question in the survey is unbalanced, with a greater number of response options associated with visiting less or not at all than with visiting more frequently. The estimated drop in tourism also does not factor in the potential for some people who currently don't visit CAHA because of ORV use to start visiting if ORV use were banned.
45. Responses to a question about how visitors would react to a ban on beach driving are converted into an overall percentage drop in visits by assigning weights to the six possible responses to this question. The weights are somewhat arbitrary and are not related to each visitor's current use. For example, those who responded they would visit only occasionally may not be reducing visits if they currently visit only occasionally. The response categories are not sufficiently precise to reliably estimate the drop in visits.
46. I am impressed that Neal utilizes a wider variety of sources in his [economic] analysis than does Vogelsong. Neal combines self-reported expenditure information for 10 expenses with county-level tax reports, and property management data and implements a complex formula for understanding the true impact of visitor activity. Vogelsong's economic impact analysis relies solely on self-reported expenditures in seven areas.

F. Use of other data sources included in the reports as cross-checks on key estimates of ORV use, including ferry counts and traffic counts.

VOGELSONG REPORT

One reviewer questioned the accuracy of Vogelsong's calculations of total recreational use at CAHA, which were based in part on traffic and ferry passenger counts provided by the North Carolina Department of Transportation. These counts also are used by the park to calculate total recreational use:

47. Vogelsong uses the traffic and ferry count data that the NPS uses to estimate recreation visits. It isn't clear if the NPS counting protocols adequately account for commercial traffic, commuting traffic, and visitors who pass the traffic counter multiple times during their visit.

NEAL REPORT

One reviewer commented on Neal’s use of 2003 Dare County tax receipts for lodging and food in his economic impact analysis:

48. Neal uses Dare County lodging tax receipts to estimate spending. This grounds the spending estimates in actual room sales, which should be more reliable than survey estimates. However, the spending estimate therefore omits spending of visitors who do not stay in paid lodging subject to the tax.

G. Potential for non-response bias in the survey results.

The potential for non-response bias—when people who do not return a survey are systematically different from those who do—increases with lower response rates. Proper survey procedure dictates that researchers should account for non-response bias and subsequently use this assessment to frame results. Without a description of survey non-response, it is impossible to estimate the effect of non-response bias on survey findings.

VOGELSONG REPORT

49. The Vogelsong report contained no discussion of response rates or non-response bias. The investigator should have been able to assess the potential for bias by comparing interview data collected on-site with responses to the same questions in the mail survey. However, an analysis of non-response bias was not reported.
50. There is no indication of the percentage of people who were intercepted during on-site interviews, but who refused to be questioned, or whether these refusals came from a certain group of park users. This is also a potential source of non-response bias and should have been reported.

NEAL REPORT

51. There are major non-response bias problems in the residential survey results (enclosure 4 in the Neal report). Maybe a 45% response rate is “excellent” (investigator’s words) in the area of applied marketing studies, but this level of non-response is totally unacceptable in the social sciences.⁶ The response rates presented in enclosure 4 beg the questions as to what the remaining non-respondents were doing in the way of use patterns and thinking on the various topics presented to them in the mail survey. We cannot assume responses of respondents and non-respondents were the same.
52. In any mail survey there is a potential for non-response bias. Because there was no effort to contact non-responders to encourage responses, it is difficult to judge if the data for the non-responders to the Neal survey would differ from those of the responders.

H. Reasonableness of conclusions based on survey data and other evidence.

In their discussion of the reasonableness of the conclusions from the CAHA studies, some reviewers addressed each report separately, while others combined their evaluations of the two reports. These latter comments are presented first, followed by comments on each report separately.

⁶ Peer review manager’s footnote: A 45% response rate is unusually low for an on-site visitor survey, although not for an off-site survey of a general population. However, because the probability of non-response bias increases as response rates go down, studies with response rates as low as 45% should include a non-response bias analysis.

COMMENTS ON BOTH REPORTS

53. Both the Vogel song and Neal studies have serious limitations, although taken together and by factoring these limitations into the analysis, one can draw some general conclusions. It appears that between 30% and 60% of the visitors to CAHA use ORVs to drive on the beach. Visitors generally support existing restrictions on ORV beach access, but the majority are opposed to further restrictions and especially a ban on beach driving. Beach driving is not a primary activity for most visitors, but it is a desired and convenient means to access the beach for fishing, sunbathing, and other activities. The presence of ORVs on the beach is not a major concern for most visitors.
54. Though critical of some aspects of Vogel song's methodology, his data collection efforts and analysis of data are more sound than Neal's. Much of Vogel song's arguments about percentage of people using ORVs come out of his intercept survey instrument. The value of intercept surveys as a method for understanding park visitor attitudes is well-established.

VOGELSONG REPORT

55. The two pages of conclusions in the Vogel song report appear to carefully reflect project findings. However, there was no mention in the conclusions of the estimate of ORV users and extent of related expenditures. The investigator notes that "ORV use in the park while high, did not have any negative impact on visitor experiences"... It is not clear from the estimates of overall ORV use or from data from other seashores why they characterized ORV use at CAHA as "high." There was no evidence presented to support this characterization. It is important that users did not seem to view overall use levels at CAHA or current levels of ORV use as problematic. The fact that most visitors reported they were positive or neutral toward ORV users and their activity would seem to indicate that this activity is accepted and understood as the means by which many shore anglers access their coastal fishing sites.

NEAL REPORT

56. The summary begins with a sensational statement, namely that the economic losses associated with hurricanes in the Outer Banks over the last 100 years would not come close to equaling the damages that would be caused by denying beach access to licensed ORVs at CAHA. This is difficult to believe given all of the remaining activities besides ORV use at CAHA and response differentials to various levels of closure not addressed in the Neal report. What the investigator presents to readers is a worst-case scenario based on what respondents report would happen if ORV use were banned. Many of the questions are leading at best and ask respondents to respond to something they likely hadn't thought of previously, if at all. There are serious validity problems here. When visitors were asked how they would respond to various policy alternatives, the responses were predictably in the negative. Without any details provided, it would be easy to be opposed to "charging fees and banning ORV use." Instead of an outright ban on ORV use, there would likely be various alternatives to be considered. This report does not provide any insights on how visitors would respond to the various policy alternatives likely to be considered, rather than a total ban on ORV activity.
57. Neal's claims of economic losses should ORVs be restricted or banned appear highly exaggerated. Neal's estimate of a 27% drop seems high, given that driving ORVs on the

beach is not a primary activity for most visitors. Beach access appears to be a convenient way to access the beach for fishing, sunbathing, swimming and other activities, rather than a primary activity in its own right.

58. Changes in visitation described in the Neal report would hinge on the extent of inconvenience to visitors of not being able to drive vehicles on the beach. Would residents, non-resident property owners, and visitors stop coming to the park if they could not drive on the beach, but instead had to walk from nearby parking areas? Are there potential substitutes nearby where vehicles can be driven on the beach? If so, closures at CAHA would shift some use. If not, it seems unlikely that use would drop dramatically as long as visitors can still engage in their primary activities.
59. The conclusions drawn from the Neal study, as summarized in the scenario described in the first two pages of the report, go well beyond the bounds of the data. The ripple effects described in the Summary of Findings of an ORV ban on sales tax revenue, unemployment rates, new construction, property values, and the electric and water utilities in the Dare County area are speculative, at best. In summary, the Neal study does not provide a sound scientific basis for estimating total park visitation and ORV use at CAHA, as this was not a purpose of the study. Further, the Neal study does not provide a sound scientific basis for estimating the total visitor spending associated with ORV use at CAHA. This because the study's economic impact estimates are based on hypothetical spending data, arbitrary weighting of data, and questionable survey instrument design and sampling methods.

The review panel was asked to respond to two final questions regarding the need for additional analysis and research.

I. Based on answers to the previous items, would there be value in re-analyzing the Vogelsong or Neal data? Why or why not? If yes, what key points should be examined as part of the re-analysis?

Reviewers were mixed on their responses to this question. Some felt there would be no value in re-analyzing the data because of other limitations in the design of the surveys. This was especially true of the Neal survey. Other reviewers offered suggestions for specific types of re-analysis that might be done using the Vogelsong data.

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60. I would like to see the investigator re-analyze the expenditure data in Table 34 and produce an estimate of overall expenditures associated with ORV use at CAHA. As the table stands now, the expenditures look like they are for overall CAHA visitation. This need to be clarified. All means need to be accompanied by standard errors; most scientific journals would require this at the minimum. Also, I would like to see sample sizes in tables overall and also for items, for example, in Table 33. This would make the report more stand-alone and usable by park staff and reviewers.
61. Since crowding and presence of ORVs on the beach do not appear to be significant concerns to visitors surveyed by Vogelsong, policy changes would likely be based more on environmental considerations than social or economic ones. The percentage of visitors driving on the beach appears to be around 50% based on the two studies. Further precision in this estimate is not likely to alter decisions. The estimates of total spending

are also likely adequate. What is less clear is the possible decline in spending if ORV beach access is further restricted or banned.

62. I do not see value in re-analyzing data at this time. My concerns are more about how both researchers collected data, rather than about how the data were analyzed. Having said this, I strongly recommend that both researchers provide fuller disclosure of their data collection methods and their assessments of the quality of the data, including margins of error and data limitations. This would enable peer reviewers to better understand whether studies can be replicated and the extent to which findings can be generalized to larger populations.
63. Additional measures of correlation or dependency among the responses to the various questions concerned with observed crowding, perceived crowding, and impact of crowding on enjoyment of the park may be valuable when studying the impact of policies banning or limiting ORVs, or limiting the number of visitors. However, other than using the median rather than the mean to define the “typical” response for ordinal data, I do not believe there would be anything to gain from further analysis of the data.
64. If the Vogelsong data are to be used to estimate annual park visitation, ORV use, and the economic impact of park visitation at CAHA, the following is recommended. The economic impact estimates should be refined to provide a range of estimates, based on various demographic and trip characteristics of visitors. Further, a matrix of estimates of total park visitation and ORV use should be presented to reflect the imprecise nature of these estimates as generated from the data collected in the Vogelsong study. Estimates of total park visitation and ORV use should be generated based on various assumptions about people-per-vehicle figures, the number of park visits generated “locally” that are not accounted for by vehicle counts on Rte. 12 and the ferries, the proportions of park visitation and non-park visitation traffic on Rte. 12 and the ferries, and the total number of ORVs in the park per day, rather than at one time. Providing a matrix or range of estimates would provide a basis for identifying upper-bound and lower-bound estimates of the social, environmental, and economic impacts of park visitation and ORV use at CAHA. The imprecise nature of the data, however, is likely to result in a relatively broad range from the upper- to lower-bound estimates.

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65. There are simply so many problems with how these data were collected and the survey focus on various groups, rather than focusing on ORV use by these groups, that any re-analysis will be of no value.
66. I do not see any need to re-analyze the data in the Neal report other than to provide standard deviations and standard errors for the estimates presented.

J. Would conducting additional social science research improve the ability to estimate the amount of ORV use at CAHA and the impact of this use on visitor spending? If so, what type(s) of research would be needed?

Reviewers suggested specific information that should be gathered and reported if additional research were to be performed. (Unlike most previous comments, discussion of the need for more field research was not specific to either the Vogelsong or Neal reports.)

67. There is an extensive literature in the fisheries field for estimating total effort (or use of an area) for recreational fisheries. Methods include access-point creel intercepts, roving

creel intercepts, and a variety of other statistically sound methods for estimating use where activity is dispersed. I would like to see this investigator make use of one or more of these methods for estimating ORV use and related spending at the CAHA.

68. Rather than a precipitous change in policy, the park might experimentally add restrictions in some areas or rotate which sections of the beach are open during which seasons and monitor changes in use patterns as better indicators of behavioral responses by CAHA visitors.
69. It would be advisable to collect additional data to improve the reliability and validity of people-per-vehicle estimates used to estimate total park visitation. At a minimum, sampling of people per vehicle should be stratified by mode of access to the park (Rte. 12, Cedar Island ferry, Swan Quarter ferry), time of year, and potentially day of week and time of day. Additional stratification based on location(s) within the park visited and type of activities/vehicle (e.g., ORV versus non-ORV) should be considered as well, and would require strategic placement of traffic counting equipment to record vehicle counts at a greater degree of spatial precision than measured in the current study. Further, sample sizes for each stratum should be greater than 20 vehicles.
70. The percentage of vehicles driving on the beach could be easily estimated with a well-designed study to count vehicles at beach access points relative to those on the road or in road parking areas. Alternatively, a sample of exiting vehicles could be asked if they had driven on the beach that trip. There are complications from visitors and residents exiting and entering the park multiple times during their visits and the numerous residences that are inside the park entrance. The NPS counting procedures assume 90-94% of vehicles at the entrance gate are recreation visits and persons per vehicle range from 1.7 to 2.7 seasonally. These protocols were last updated in 1993.

COMPLETE TEXT OF PEER REVIEWERS' COMMENTS

The complete text of each reviewer's final comments is presented below. Reviewers were given the opportunity to edit or revise their comments prior to final submission. Following standard practice for peer reviews, the identities of individual reviewers are not associated with their comments, and there is no relationship between the ordering of the reviewers' names as listed at the front of this document and the ordering of the comments that follow.

REVIEWER #1: COMPLETE COMMENTS

Vogelsong, H. (2003). Cape Hatteras National Seashore visitor use study.

The Vogelsong report contains virtually no information about the methods used to collect the visitor use count data reported in Table 1 of the report, yet these data provide the primary basis for estimating total park visitation and total ORV use for CAHA. Thus, it is difficult to judge the rigor and scientific credibility of the methods used to collect these data. Furthermore, the language used in the report does not suggest a strong degree of confidence that the data provide a sound scientific basis for estimating the total amount of ORV use at CAHA during the study period. For example, the report states that "Although not all park users/vehicles/ORVs were accounted for, it is hoped that these counts are representative of similar areas throughout the park." Yet, the authors provide insufficient information to conclude that the visitor use count data are reliable and valid, and that it is reasonable to generalize from the study data to the park as a whole. Given these concerns, and the more specific limitations described below, the Vogelsong data may not provide a sufficient basis for estimating total ORV use in CAHA.

Vogelsong's empirical basis for estimating total ORV use is questionable. The ORV counts appear to have measured the number of ORVs seen at one time in various locations in the park. Thus, the data may give a reasonably accurate basis for estimating the number of ORVs in the park at one time, but it is not clear they provide a sound scientific basis for estimating total daily ORV use. Nonetheless, the Vogelsong ORV count data are treated as being estimates of total daily ORV use in the computation of annual ORV use of the park. The characterization of uncertainty associated with Vogelsong's annual ORV use estimate seems somewhat arbitrary. In particular, the report states "Since this number is probably accurate plus or minus 20%, a more accurate but less precise estimate would include a range of 73,526 - 110,288 ORVs or 166,300 - 249,450 ORV users annually using the beach." There is no quantitative characterization of the precision associated with these estimates or the methods used to generate the ranges. Based on my interpretation of the Vogelsong ORV count data, it appears that additional data collection may be warranted to estimate daily and annual ORV use in a more valid manner. To generate estimates of total daily ORV use, it would be necessary to count ORV arrivals per day, by location, and collect ORV-specific people per vehicle data. Sampling would need to be stratified by location, season, and day of week. An efficient method for collecting these data might involve the use of vehicle counters stationed at key locations, coupled with a subset of sampling days during which direct observation counts are conducted to collect calibration data for the vehicle counter data and people per vehicle data. With these data, it would be valid to compute annual ORV visitation using the computation methods presented in the Vogelsong report.

An alternative approach to estimating total ORV use at CAHA would be to compute ORV use as a proportion of total park visitation, based on the mail-back survey data from the Vogelsong study. However, Vogelsong's estimate of total park visitation is problematic for several reasons. Vogelsong's estimate of total park visitation is determined by two primary types of data: 1) vehicle counts on Highway 12 and passenger counts on the Cedar Island and Swan Quarter ferries; and 2) people per vehicle counts conducted at two locations in the park. Both the vehicle/passenger counts and the people per vehicle data are potentially problematic, as outlined below. The vehicle counts on Highway 12 and ferry passenger counts presumably count all traffic, including non-recreational/non-park visitor traffic. For example, it is likely that some proportion of the vehicle traffic counted on Highway 12 includes residential and commercial traffic, rather than park visitor traffic. If this is the case, the counts overestimate park visitation, and it is not apparent that data were collected to adjust traffic counts to account for residential and commercial vehicle traffic. The same issue applies for ferry passenger counts. It is recommended that, if it has not yet been done, data be collected to adjust for non-park visitation traffic on Highway 12 and the ferries. As stated, Vogelsong's total park visitation estimate also hinges on the validity and reliability of the people per vehicle estimate (mean = 2.26) used in the computation presented in Table 2 of the report. Yet, the people per vehicle estimate appears to be based on a total of 40 observations, collected at just two locations within the park. Further, it is not evident from the report whether counts were stratified by day of week and/or season of use. Due to the relatively low number of people per vehicle observations, it is likely that the Vogelsong estimate of people per vehicle is not precise (though the precision of the estimate is not reported). Furthermore, the Vogelsong people per vehicle sampling does not appear to have been stratified in any manner (i.e., occurred in only two locations, apparently over a short period of time). Thus, the people per vehicle data do not provide a sound scientific basis to account for potentially systematic differences in the number of people per vehicle associated with different modes of access to the park (i.e., Rte. 12, Cedar Island ferry, Swan Quarter ferry), different types of recreation sites visited in the park (e.g., beach sites, lighthouses, etc.), different types of activities/vehicles (e.g., ORV versus non-ORV), season of visit (i.e., summer, fall, winter, spring), and day of week (i.e., weekend vs. weekday). The study results suggest this may be a significant limitation, as the counts conducted at the Marina and Lighthouse resulted in different estimates of the mean number of people per vehicle (2.17 and 2.23, respectively), and these were different than the mean number of people per vehicle estimated by the State Ferry System (2.38 people per vehicle) and from the visitor interview data (3.95 people per vehicle). While the Vogelsong report states that the differences are "negligible", when used to compute annual park visitation, the effects are arguably substantive. For example, estimated annual park visitation is approximately 5% higher than that reported by Vogelsong, when using the State Ferry System data, and 69% higher when using the people per vehicle estimate from the Vogelsong visitor interview data. Furthermore, estimated annual park visitation is approximately 4% lower when using the people per vehicle estimate based on data collected just at the Marina, and about 1% lower when using only the people per vehicle data collected at the Lighthouse. It would be advisable to collect additional data to improve the reliability and validity of people per vehicle estimates used to estimate total park visitation. At a minimum, sampling of people per vehicle should be stratified by mode of access to the park (Rte. 12, Cedar Island ferry, Swan Quarter ferry), time of year, and potentially day of week and time of day. Additional stratification based on location(s) within the park visited and type of activities/vehicle (e.g., ORV versus non-ORV)

should be considered as well, and would require strategic placement of traffic counting equipment to record vehicle counts at a greater degree of spatial precision than measured in the current study. Further, sample sizes for each stratum should be greater than 20 vehicles.

An additional limitation of the Vogel song estimate of total park visitation reported in Table 2 is that it only accounts for vehicles entering the park from Rte. 12 and the two ferries to Ocracoke. To the extent that park visits and ORV trips are generated from the local communities, Vogel song's report provides an invalid estimate of total park visitation. Estimates of the number of local park and ORV trips could be generated from survey data on the proportion of park visitors/users who did not enter the park via Rte. 12 or one of the ferries.

While I am not an expert on economic impact analysis studies, the estimate of economic impact associated with visitors to CAHA seems high. One issue is that the average daily expenditures estimate includes nearly \$150 per day for lodging, which may be appropriate for overnight visitors, but inflates the expenditures of day use visitors. At a minimum, average daily expenditures should be estimated separately for day use and overnight ORV visitors, and the proportion of day use and overnight ORV visitors to the park should be estimated. Furthermore, if the survey data, upon which the economic impact estimates are based, under-represent local residents, the daily economic impact figures likely overestimate the true economic impact per ORV visitor to CAHA. For example, like with day use visitors, the lodging expenditure included in Table 34 of Vogel song's report would overstate daily expenditures of local residents. Similarly, it is reasonable to expect that local residents would spend less money per day on shopping for souvenirs, food and beverage, and possibly "all other expenses". The only demographic data presented in the report are derived from the onsite interview, while the economic impact data were collected via a mail back questionnaire. Thus, it is difficult to judge whether the data under-represent local residents. That being said, 79% of the interview sample, from which the mail back survey sample was based, do not live in North Carolina, and it is reasonable to assume an even larger proportion of the sample do not live locally. Furthermore, the mean travel distance of interview respondents was over 350 miles and the average length of stay was approximately 7 nights. At a minimum, it would be advisable to compute economic impact estimates for subsets of the study sample, segmented by variables that might serve as proxies for local residents versus non-local ORV visitors (e.g., distance traveled, length of stay). Other variables by which economic impact estimates might be segmented include household income, age, and as stated above, day use versus overnight ORV visitors.

In summary, if the Vogel song data are to be used to estimate annual ORV use and the economic impact of ORV use at CAHA, the following is recommended. The economic impact estimates should be refined to account for differences based on various demographic and trip characteristics of ORV visitors. Further, a matrix of estimates of total park visitation and ORV use should be presented to reflect the imprecise nature of these estimates as generated from the data collected in the Vogel song study. Estimates of total park visitation and ORV use should be generated based on various assumptions about people per vehicle figures, the number of park visits generated "locally" that are not accounted for by vehicle counts on Rte. 12 and the ferries, the proportions of park visitation and non-park visitation traffic on Rte. 12 and the ferries, and the total number of ORVs in the park per day, rather than at one time. Providing a matrix or range of estimates would provide a basis for identifying upper-bound and lower-bound estimates

of the social, environmental, and economic impacts of ORV use at CAHA. The imprecise nature of the data, however, are likely to result in a relatively broad range from the upper to lower-bound estimates.

Neal, W. (2005). The Lower Outer Banks of North Carolina: Results of a survey of residents, nonresident property owners, and visitors.

The Neal survey does not provide a scientific basis for estimating the total amount of ORV use at CAHA or total visitor spending resulting from this activity. In fact, these do not appear to be specific purposes of the study. Rather, the study is designed to estimate the extent to which total tourism spending would drop in the CAHA area as a result of a ban on ORV use at CAHA. While the study does generate a numeric estimate of the economic impact of a ban on ORV use, the methods used to generate this estimate rely on a number of assumptions, some of which seem arbitrary and/or speculative. For example, the study's estimated drop in tourism associated with an ORV ban is based on an arbitrary weighting of responses to a question asking survey respondents if they would continue to visit CAHA if there was a ban on ORVs. Not only is the weighting of these responses seemingly arbitrary, but the response scale provided with the question in the survey is unbalanced, with a greater number of response options associated with visiting less or not at all than with visiting more frequently. The estimated drop in tourism also does not factor in the potential for some people who currently don't visit CAHA because of ORV use to start visiting if ORV use were banned. The manner in which economic data are used to compute the economic impact estimate are also somewhat speculative. For example, the study uses survey respondents' "best guesses" at what they would spend if they spent a week visiting CAHA as a key input into the computation of the economic impact of an ORV ban. The visitor survey data are also not representative of the CAHA visitor population, as the sample of visitors was drawn from those visitors who stayed in a hotel, rental property, or campground, excluding day use visitors and those who stayed in other types of accommodations. Thus, survey respondents' estimated expenditures cannot be generalized to the population of all CAHA visitors.

In addition to the concerns noted above, there are other methodological issues associated with the Neal study. The sampling methods used to administer surveys to residents, non-resident property owners (NRPOs), and visitors are, to some extent, by convenience, rather than a systematic or random sampling approach. I also have questions about "quality control" on survey sampling, as this was administered by property management companies, hotel and motel managers, and campground managers, rather than researchers with training in survey sampling and research methods. Furthermore, standard mail survey procedures do not appear to have been used to guide the administration of the survey. In particular, it is standard procedure to use follow-up reminders and replacement versions of the questionnaire to enhance survey response rate and to minimize the potential for non-response bias. The study report does not mention the use of these conventional mail survey methods, thus there is reason to be concerned about the potential for non-response bias associated with the survey data.

In addition to the concerns I have about the sampling methods used in the Neal study, there are also issues with the questions used in the survey. Several of the questions ask visitors to provide speculative answers (e.g., to speculate on the impact of an ORV ban on percentage change in

personal income and beach erosion), while other questions are leading. For example, the question about the effects of an ORV ban on respondents' jobs assumes that any effect will be negative and that it is simply a matter of degree. Skip patterns and other survey response instructions are somewhat awkward, and could have been eliminated by crafting separate versions of the survey for residents, NRPOs, and visitors.

I would suggest that the conclusions drawn from the Neal study, as summarized in the scenario described in the first two pages of the report, go well beyond the bounds of the data. The ripple effects described in the Summary of Findings of an ORV ban on sales tax revenue, unemployment rates, new construction, property values, and the electric and water utilities in the Dare County area are speculative, at best. In summary, the Neal study does not provide a sound scientific basis for estimating ORV use at CAHA, as this was not a purpose of the study. Further, it is my judgment that the Neal study does not provide a sound scientific basis for estimating the total visitor spending associated with ORV use at CAHA. I conclude this because the study's economic impact estimates are based on hypothetical spending data, arbitrary weighting of data, and questionable survey instrument design and sampling methods.

REVIEWER #2: COMPLETE COMMENTS

The National Park Service has requested peer-review of two research studies involving Cape Hatteras National Seashore (CAHA), hereafter known as the Vogel song and Neal studies. The broad concern guiding this review is whether either or both studies provide a scientifically sound basis for estimating off-road recreational vehicle (ORV) use at CAHA and total visitor spending from this activity.

Generalizability of Findings

The two studies differ fundamentally in their respective methodologies for collecting and interpreting data. Vogel song conducted an intercept survey of CAHA users, followed by a survey instrument that visitors completing the interviews were asked to take home, complete and mail in at a later time. Data collection took place between May 2001 and May 2002. The author does not disclose specifics about his methodology, including exactly how many intercept surveys were conducted, how many mail back surveys were received,⁷ how visitors were selected to participate in the intercept study, how many visitors refused to participate. Mail back surveys were apparently received from 1681 visitors (page 12, page 14 demographic information only requested on mail back survey), but the original number of intercept surveys conducted is not disclosed. In addition, Vogel song does not identify a margin of error for the data, leaving the reader unable to evaluate the quality of findings and unclear about the extent to which research findings can be generalized to the larger population of visitors.

Neal pursued a very different strategy for collecting information. This report is based on surveys of CAHA visitors, residents, and nonresident property owners conducted between September 2002 and August 2003, the year following Vogel song's data collection period. Neal clearly states that his research is based on surveys of 466 residents, 546 non-resident property owners, and 438

⁷ Combining information on page 12 and page 14 suggests 1681 people participated in the mail back survey; yet, data tables appearing later in the report suggest a smaller number of participants.

visitors, a broader set of actors than is included in the Vogelsong study. While residents appear to have been randomly selected to participate in this study,⁸ it is not so clear that the visitor and non-resident property owner surveys were conducted with random populations. Neal relied on third parties (property management companies, private camp grounds, motels) to distribute the mail surveys. To be fair, Neal states that businesses were asked to distribute surveys to randomly selected respondents, but he does not include instructions in the report for how these businesses were to randomly select people to participate. In addition, it is difficult to maintain quality control of the sampling process when relying on so many untrained entities to select survey participants. Similar to Vogelsong, Neal does not attach a margin of error to his data findings, leaving the reader unable to say whether findings can be generalized to larger populations.

On balance, I have the most confidence in findings from Neal's study of residents because of the randomization of the participant selection process. Comparing visitor studies, I have more confidence in Vogelsong's work rather than Neal's due to a larger number of participating respondents, representation across 22 data collection sites, and prior validation of intercept survey methodology. I am also familiar with the rigor of the OMB review process. Vogelsong's methodology passed muster with OMB, while Neal's methodology was not peer-reviewed.

Survey Instrument Design and Observation Protocols

Vogelsong and Neal include their data collection instruments with their respective reports. Overall, the Vogelsong instruments (intercept survey and mail back survey) do a better job phrasing questions in a non-biased, balanced manner. Questions initiated with phrases such as "Would you say..." "Would you imagine..." and "How would you rate..." do not have the effect of leading survey participants toward specific responses.

In contrast, Neal's instrument includes questions framed in leading ways. He asks people to react to proposals for "charging fees," "restricting beach access," and "banning the use of licensed off-road vehicles" (bolded and underlined) without presenting arguments for and against each proposal.

Hans Vogelsong engaged in an elaborate observation strategy for the purpose of estimating the total number of visitors to CAHA. He combined observations of vehicles and visitors to calculate a people per vehicle ratio. He also conducted observations at multiple sites to gauge the number of ORVs on beaches within CAHA. Vogelsong reports his belief that counts of ORVs on the beach are likely more accurate than counts of people and parked vehicles (page 12). However, Vogelsong does not provide detailed information about when counts were conducted and how they were conducted to enable independent evaluation of the quality of the data. Counts of people and vehicles were not within the scope of Neal's research.

Rigor of Data Collection Methods

I favor Vogelsong's strategy of conducting an intercept with visitors and asking visitors to complete a follow-up mail back survey, rather than Neal's one time mailing from a variety of entities. The survey administration literature is in agreement that mail surveys are best conducted in waves (The Dillman Method), preceded by respondent notification, followed by mailing of a

⁸ 1000 addresses were randomly selected from among the universe of 4012 properties. Surveys were mailed to these addresses.

survey packet, a reminder letter mailed to non-responders, and sending of a second survey packet. Neal apparently did not follow these established procedures. This failure to properly administer a mail survey leads to a higher than necessary rate of non-response. Similarly, Vogelsong never mentions tracking of people taking mail-back surveys. The reader does not know how many mail-back surveys were distributed relative to the number returned.

Neal and Vogelsong take different paths to conducting an economic impact analysis. Admittedly, this is not my forte; however, I am impressed that Neal utilizes a wider variety of sources in his analysis than does Vogelsong. Neal combines self-reported expenditure information for 10 expenses with county-level tax reports, and property management data and implements a complex formula for understanding the true impact of visitor activity. Vogelsong's economic impact analysis relies solely on self-reported expenditures in seven areas.

Interestingly, Vogelsong and Neal come to similar conclusions about visitor expenditures. Vogelsong says average trip expenditures are \$1,868. This compares favorably to Neal's calculation of to \$1,963. Beyond this, as mentioned, Neal's economic analysis is more ambitious and more significant. His conclusion that the net value of tourism to the region over 10 years is \$1.5 billion sounds reasonable, though he does not provide enough information to allow for independent verification.

Finally, Vogelsong provides a more in-depth portrait of visitor demographics than does Neal. Demographic questions are valuable for they enable the researcher to look at underlying patterns of activity. Because of this, Vogelsong is later able to identify a conflict in attitudes toward ORV access to beaches held by ORV owners and non-owners. Vogelsong does a better job than Neal in employing demographic characteristics of respondent populations as independent variables in their analyses.

Appropriateness of Data Analysis, Including Characterization of Uncertainty

The Vogelsong and Neal reports employ a variety of statistical tools in their analyses. While Neal appears to conduct a more appropriate analysis of the economic impact of tourism, Vogelsong does a better job estimating park usage. Vogelsong takes a more sophisticated approach to the utilization of statistics, appropriately including standard deviations, f statistics, and levels of significance. Both authors could go further employing multivariate analyses in their work.

As already mentioned, neither researcher reports the quality of their data as reflected in the margin of error associated with findings. This cripples the independent reviewer from definitively commenting on the appropriateness of data analysis. If, in the final moment, visitors were not randomly selected and there is no margin of error associated with the visitor data, subsequent analysis is little more than descriptive of participant attitudes rather than generalizable to larger populations.

Use of Other Data Sources

Vogelsong's research includes counts of seashore visitors, parked vehicles, and off-road vehicles, all data that he collects for the purpose of assessing park carrying capacity. Neal utilizes a variety of data sources in his economic analysis, including county tax rates and rental

home values. Each researcher is properly seeking additional information to inform their research questions. This is not to say, however, that other data sources would not prove informative to their respective analyses.

Potential for Non-Response Bias

The potential for non-response bias in both studies is huge. Generally speaking, non-response associated with mail surveys will be higher than non-response associated with short intercept surveys. However, non-response on the Vogelsong mail-back survey can be just as high as Neal experienced with his mail survey.

Proper survey procedure suggests that the researchers should attempt to account for non-response bias, and subsequently use this assessment to properly frame data findings. Without proper accounting of survey non-response, it is impossible to account for impact of non-response on the quality of findings.

Reasonableness of Conclusions

Given differences in data collection methods and analytical rigor, it is not surprising that Vogelsong and Neal generate different portraits of the average visitor. For Neal, visitors prefer beachcombing, walking/jogging, swimming, sunbathing, and beach fishing, in that order. Vogelsong concludes that visitors prefer, in order, fishing, sunbathing, and swimming.

More significant to study findings, Vogelsong and Neal differ in assessing the value of ORV use. In Vogelsong's study, 76.4 percent of visitors own an ORV, with 90 percent of owners (68% of all visitors) driving their ORV on the beach. Neal says that just about half of ORV users (52%) use an ORV for beach access. If I have to choose between the two figures, I have more confidence in Vogelsong's assessment. His figures are drawn from the intercept survey instrument, while Neal's numbers are derived from his mail survey of visitors of which I have already expressed serious reservations. Having said this, I am a bit troubled by Vogelsong's suggestion of selecting data collection sites from other than random choice:

Consequently, by sampling at areas known to be frequented by ORV users, the sampling strategy and intercept points were set up to include high numbers of both ORV users and non-users. (p. 15)

Vogelsong says that attitudinal differences between ORV users and nonusers are significant. Therefore, it is not surprising, given differing assessments of the frequency of use, that Vogelsong and Neal derive different conclusions about ORV use in their studies. Vogelsong says, overall, that visitors are supportive of ORV use at CAHA beach areas. Visitors rely on ORVs to engage in certain activities, such as fishing, and a ban on ORVs at beach areas would lead to a decline in rates of visitation. Vogelsong goes further and identifies 'social value conflict' between ORV users and nonusers. Nonusers are more likely to react neutrally to a ban on ORV use at beaches.

Neal makes more exaggerated claims about the effects of banning ORV use at beach areas. He predicts a ban on ORV use would lead to an economic tsunami with a 28 percent drop in tourism and a loss of over \$400,000 within a 10-year period. Similarly, Vogelsong says a ban on ORV

use at beaches would lead to 29 percent of visitors no longer coming to the beach area (Table 20). However, Vogel song also says that visitorship declines coming from a total ban would be partially offset by 9 percent of visitors who would visit the beaches more frequently. Vogel song does not predict economic collapse would result from a total ban on ORV use.

Interestingly, though Neal makes more exaggerated claims about the impact of a ban on ORV use at beaches, he also claims that people support NPS bans on vehicular access to beaches, with non-resident property owners and residents being more supportive than visitors:

Basically, it appears that current NPS bans on vehicular beach access...during the main tourist season is broadly supported and should be continued in-season when the majority of visitors are there.

Which perspective is more correct. I am more sympathetic to Vogel song's analysis. Though critical of some aspects of his methodology, I believe his data collection efforts and analysis of data is more sound than Neal's. Much of Vogel song's arguments about percentage of people using ORVs and carrying capacity from a visitor's perspective come out of his intercept survey instrument. The value of intercept surveys as a method for understanding park visitor attitudes is well established. Finally, I appreciate that Vogel song approaches these questions from an academic perspective. He is a member of the Department of Recreation and Leisure Studies at East Carolina University. As such, he has the proper background to engage in this type of analysis.

Neal's visitor data comes out of a data collection method marred by uncertainty and lack of rigor. I am concerned that Neal does not have the academic training to properly engage in the level of analysis required for this project. I am also concerned that the Office of Management and Budget did not review his methodology.

Value in Re-Analyzing Data

I do not see value in re-analyzing data at this time. My concerns are more about how both researchers collected data rather than about how the data was analyzed. Having said this, I strongly recommend that both researchers provide fuller disclosure of their data collection methods and their assessments of the quality of the data, including margins of error and data limitations. This would enable peer reviewers to better understand whether studies can be replicated and the extent to which findings can be generalized to larger populations.

Improvement of Analysis Through More Research

Asking a researcher if more research should be conducted is like asking an alcoholic if they prefer having another drink. The answer is 'of course.' If more research was conducted, I would like to see respondents selected through a truly random process, data collected more systematically, and an accounting of non-response bias. The value of contracting for additional research, however, need be weighed against availability of other sources information, and the availability of adequate resources.

REVIEWER #3: COMPLETE COMMENTS**1. Is there a sound scientific basis for estimating the total amount of ORV use at CAHA during the study period and total visitor spending from this activity?****Vogelsong**

Overall, the investigator implemented a workable methodology based on established protocols of the state DOT agency, for example, for estimating ORV use (counts) at selected sites on both the ocean and sound sides of the island. The investigator failed to tell us how often counts were made, how they were made in some detail and how many were made by study quarter. They selected 15 sites for counting ORVs. Of these, they concluded that four sites accounted for over one-half of the “average ORV count of 252 ORVs using the park at one time.” Of the 15 sites, two had the highest single counts of any site. Likewise, they concluded that sites on the sound side had little ORV use overall during the study period.

Although they focused on understanding where ORV use did and did not occur and were able to have sufficient sample sizes of ORV users for follow-up questions on crowding norms and satisfaction among various other topics, the investigator failed to provide a scientific basis for estimating “the total amount of ORV use at CAHA during the study period.” In the final analysis, they extrapolated daily count data for the number of ORVs to an annual figure. I had trouble with a simple extrapolation of average number of ORVs at one time from only 15 ORV sites to overall ORV use for 365 days per year. Likewise, the study failed to provide a sound scientific basis for estimating “total visitor spending resulting from this activity (ORV)?”

As noted on page 8 of the report: “Both the counting methodology and the survey instruments were pilot tested and determined valid and reliable in a separate project at the seashore conducted September through November, 2000.” I would need to see more details on the counting procedures before I was willing to buy into the estimate of daily and annual ORV use provided in this report. Seasonal differences, site differences, differences between coastal and sound sides of the island all help explain the high S.D. for the total use figure for overall ORV use in Table 1. What about the use of all of the sites not included in the data for ORV use in Table 1? Ultimately, the investigator proposes a range in the number of ORVs on a daily or annual basis (line 7, page 12) based on use of error brackets of plus or minus 20% of their estimate. What is the basis for the plus or minus 20%? No effort is made to cross-validate these estimates with others.

Finally, it is not clear from the table heading for Table 34 on page 51 whether the table includes direct expenditures made by all CAHA visitors or only ORV users. There would be a major difference since “the range of ORV use supposedly represents 7.3% to 11% of all CAHA visitors.” No effort was made to provide estimates of total spending associated with ORV use in the CAHA. Several questions arise. Are the expenditures in Table 34 all made in the CAHA or Outer Banks area (assuming that respondents know where this is), or were some made on the way to the CAHA? The per-visitor figures in Table 34 seem high to me based on previous projects we have seen at other destinations. This makes me wonder whether the focus on

expenses (for you and for others in your group) in the questionnaire was understood clearly. Or were they instead acting as a party leader and giving total group expenditures whether paid by them or not. The heading in the report is “Economic Impact,” but the investigator did not go beyond direct expenditure. While it is unclear the number of individuals who were contacted for expenditure data (1,681 people were interviewed but the final number of follow-up questionnaires returned is unknown), I would have preferred to have seen an IMPLAN analysis to better understand the overall economic impacts of ORV use in the CAHA.

Neal

This report is not helpful in identifying the extent of ORV use at Cape Hatteras and the total visitor spending associated with this activity. From the start, the “study design” makes an effort to be inclusive by representing a variety of groups with an interest and expenditures in the study area but without a focus on ORV activity in the CAHA. The study focus was supposed to be on visitors but this investigator also included residents and non-resident property owners who would have/ should have been intercepted when they became visitors to the CAHA. With a desired study focus on visitors using ORVs at the CAHA, some sort of intercept study would have been necessary to be able to gather data from actual ORV users in the study area. The NPS is interested in better understanding the extent of ORV use on their lands while the local communities and the people who live there and benefit to some extent from doing so will seek to make use of the data collected in this report to make and sustain their arguments against restrictions, charges, etc. At that point, this study design and data will come under a microscope; the mail survey conducted with the various groups leaves much to be desired, is likely to produce seriously biased data, and is likely to be problematic in support of follow-up policy making. I will identify a number of these weaknesses in the following paragraphs.

2. Can we generalize the results of the data collection to the universe of CAHA visitors and other populations (i.e., residents and property owners)?

Vogelsong

To the extent that the investigator made use of probability sampling in his study of visitors to the CAHA, results would be generalizable to the universe of CAHA visitors. There were numerous times during my review when I wished the investigator had included a much more detailed methods section in the report so I could have a better idea of how data collection was actually accomplished. For example, there was a mailback survey for collecting expenditure data from their most recent trip. How many surveys were sent and how many were returned with the data requested? Interviews were conducted at a wide variety of sites regarding visitor attitudes and management preferences. The study had good coverage across the seasons. Overall, results would be generalizable to all visitors to the CAHA, rather than any one particular user group, even though the sample is driven mainly by people participating in recreational fishing, sunbathing and swimming. By disproportionately sampling sites known to be frequented by ORV users, this was a good strategy for finding and collecting data from ORV users. While this was an effective strategy for better understanding ORV users at CAHA and what they are thinking about appropriate use levels, etc., it does not help the NPS to better understand the extent to which the CAHA is used for ORV use. This is an entirely different matter.

Neal

As best I can see it, there is no connection between Neal’s results for the various groups studied and the universe of CAHA ORV visitors. They know what percents of their various groups use ORVs in the CAHA but fail to make to link to any actual use data for the park. This is surprising since one of their study objectives in their research plan (4) was “to determine the volume of usage of the beaches for a list of typical activities and determine how these activities would be impacted by a possible ban on driving personal vehicles on the beaches of Cape Hatteras National Seashore.” From the report, it doesn’t look like they set out estimate ORV use at the CAHA and their respective visitor spending.

Much of the data collected in the mail survey looks interesting and should be of application to the various businesses in the various towns in the Outer Banks. But the investigator made no apparent effort to estimate the extent of ORV use in the CAHA and related expenditure. They chose the mail survey to give them the data they wanted rather than using on-site observation techniques or an intercept approach followed by a mail survey which would allow them to focus on their most recent ORV trip rather than a “typical” trip to the Outer Banks area.

3. What about the design of the survey instruments and observation protocols?**Vogelsong**

The interview schedule and follow-up mail survey used were well designed. This is not surprising since the survey instruments was reviewed by the National Park Service Social Science Program as well as the Office of Management and Budget prior to implementation in addition to a review by an on-campus Human Subjects Committee at East Carolina University. The interview schedule was useful for getting descriptive information on the trip party and their *pre- trip* intentions for participation at CAHA. The interview provided a means for determining the number of visitors who owned or have ever rented an ORV, and most importantly whether they have ever driven it on this beach at CAHA.. Respondents to the interview were given the opportunity (if they chose to do so) to provide additional post-trip information on a variety of topics best addressed after their trip to CAHA, i.e., amount of money spent by category on their most recent trip to the Outer Banks, activities participated in and whether or not they have driven an ORV on a beach at the CAHA. Overall, the investigator made good use of observation techniques to acquire traffic count data, conducted interviews with randomly selected individuals at pre-established sites and collected additional information *post-trip* from these same individuals.

Neal

One wave of questionnaires (I don’t believe there were any follow-ups sent to non-respondents) was sent to members of three different groups (visitors, non-resident property owners, and residents) with instructions to go to the sections in the questionnaire with questions for your respective group. This made the questionnaire seem especially unwieldy and awkward and likely played a role in the low response rates achieved. The survey asked visitors about their last trip but it was not clear for analysis purposes exactly when this last trip may have occurred. The questionnaire asked respondents how often they “normally visit” the Outer Banks area. This is followed by other questions that inquire about their “typical trip” to the CAHA. The survey questions provide insufficient framing and likely lead to various biases in the data collected.

There is no effort made to group similar questions in the questionnaire and likewise no effort made to help inform the policy questions with more detailed explanations of policy changes actually being proposed by the NPS. The way the questionnaire is designed regarding policy issues is only likely to exacerbate the fears of respondents without providing respondents with a detailed understanding of alternatives and trade-offs involved in future decision making. Overall, many of the questions in the Neal survey were poorly stated from a validity and reliability standpoint. Also, the questionnaire was not designed to be user friendly and did not seem to follow any design protocol with which I am familiar.

4. What about the rigor of the data collection instruments in the field?

Vogelsong

I have mentioned this previously but there are simply too many methodological details left out of this report, making it difficult to evaluate it. I would encourage the author to include a methods chapter/ section in his next report and to incorporate as much of the important methodological detail as possible in an Appendix. For example, I would like to know the number of days ORV sites were observed and the times of the day that observations were made. Were any observations made at night when much fishing activity takes place or was this particular ORV use overlooked? When were observations made? The investigator mentions a sampling schedule for interviews with attention to weekday and weekend coverage. I would like to know more about the distribution of interviews. We were told there were about 1,681 interviews made; how many of these individuals elected to complete the follow-up mail survey and what was the response rate for this group? Having sample sizes clearly noted in the tables throughout the report would have made it much more readable and useful.

With a methodology section, the author could have also spoken to some of the quality control/ quality assurance problems that can occur with a project like this. What worked well; which did not? and what was done to make things work right? For example, how were vehicles /ORVs observed (point in time or a particular time period) and what kinds of adjustments were made throughout the project? Were there refusals when people were asked to complete interviews? How many on a percentage basis? Exactly how was the random sample of visitors selected for personal interview purposes? Was more than one person per party selected for interview purposes? Did all people selected for the interview also have an opportunity to receive and complete a mail survey? What were the quarterly numbers of returned questionnaires? I was unable to get the answers to these and other such similar questions from the report so it is difficult to address the extent of rigor in this particular project.

Neal

The mail survey used seemed lengthy and user-unfriendly because of the three groups covered and the instructions to skip various sections. In section D, visitors and non-resident rental property owners were asked a number of questions about their visitation to CAHA: first trip, times per year they visit CAHA, visits, days, number per party by seasonal quarter and activities in which they participated. Interestingly, ORV use, the activity that the NPS is most interested in according to the overarching questions guiding this review, is not even listed as an activity on the list provided (Question D4). It would have to be written in by the respondent. Also, there are a number of activities listed that could be done with an ORV but they would have to be identified

separately instead of ORV. Also, there was the potential for major recall bias and digit bias problems when respondents tried to identify the number of visits, days/visit, and days/visit by 3-month season.

I am quite uncomfortable with using local groups and organizations to send “random mailings” at particular times. From my experience, these groups always indicate a willingness to participate in carrying out surveys like this one but often fail to follow through in carrying out important survey details. I am concerned that they did not have a clear understanding of random sampling beyond the colloquial notion of “random” mailings. If five or ten mailings need to go out that month, five or ten of the most recent customers and likely their worst customers rather than best customers would receive the mailing. These mailings are not random in a statistical sense and this seriously jeopardizes survey results in several ways. It is not clear to me that this investigator was 100% in charge of the data collection process as he should have been.

5. What about the appropriateness of the data analysis, including the characterization of uncertainty?

Vogelsong

While the ORV counts for selected sites were interesting, they did not produce a credible estimate of total ORV use at the CAHA and total visitor spending resulting from the overall extent of this activity. Tables 7 - 33 were presented as in previous studies of social carrying capacity, crowding, satisfaction, attitudes, etc. The tables were clean and descriptive but could have been improved with more attention to sample sizes throughout. The economic impact analysis fell short as the last item in the report. The investigator failed to tie it to overall ORV use in the CAHA and the economic impact focus was entirely on direct expenditure. The focus on average daily and average total expenditures in the Outer Banks area failed to address the overall extent of expenditure associated with ORV use in the CAHA.

Neal

There really is not much in the way of data analysis. It is mostly descriptive with simple distributions provided. No standard errors were provided for any of the means presented. Some detailed analysis of economic impact was completed but it was apparently for island tourism overall by visitors (not CAHA in particular or ORV visitors at CAHA). They used tax revenues for various tourism-related categories to get at overall expenditures (direct economic impact). I would have liked to see them focus more on the group of policy interest at the moment, i.e., ORV users at the CAHA, and look at their direct expenditures along with an IMPLAN analysis to better understand the total economic impact of ORV use at the CAHA. They didn't do this and chose instead to focus on the economic impact of **all** tourism that was Outer Banks-related.

6. What about the use of other data sources as cross checks on key estimates of ORV use, including ferry and traffic counts.

Vogelsong

The investigator used traffic counter data and ferry counts together with their persons-per-vehicle counts to estimate overall park use. No connection was made to the extent of estimated ORV use at the CAHA nor was any effort made to compare their estimate with any others available. ORV

use of the CAHA was estimated using extrapolation of visitation data from 15 sites at the seashore. Finally, I would have liked to see some cross-checking of expenditure data with those from other national seashores.

Neal

No effort was made to use other data sources to cross-validate the information provided in the Neal effort.

7. Is there a potential for non-response bias in the survey results?

Vogelsong

There is a potential for non-response bias with the follow-up questionnaires if they are not returned soon after the respondent initially agreed to do so. I could find no response rate data in this report to help me understand whether response was a problem or not. I would have expected a good response rate after they were intercepted at the CAHA and their support solicited in support of management decision making. If there was substantial non-response (and I don't expect this was the case), the investigator would be able to assess the extent of bias involved, if necessary, by making comparisons with the interview data provided earlier by respondents.

Neal

There are major non-response bias problems in the residential survey results (enclosure 4). Maybe a 45% response rate is "excellent" (investigator's words) in the area of applied marketing studies but this level of non-response is totally unacceptable in the social sciences. The response rates presented in enclosure 4 beg the questions as to what the remaining non-respondents were doing in the way of use patterns and thinking on the various topics presented to them in the mail survey. We cannot assume responses of respondents and non-respondents were the same.

For the most part, we can expect that various residents in the Outer Banks towns were receiving questionnaires which dealt with topics that were just not that salient to them. Surveys were sent to visitors and non-resident property owners as well. I found no information on the extent of their response rates. Low response rates constitute a fatal flaw in my view which means the study cannot be repaired but instead must be repeated with steps taken to deal effectively with this design issue.

8. Are the conclusions reasonable and based on survey data and other evidence?

Vogelsong

The two pages of conclusions in the report appear to carefully reflect project findings. There was no mention of their estimate of ORV users and extent of related expenditures in the conclusions section. The investigator notes that "ORV use in the park while high, did not have a negative impact on visitor experiences. . ." It is not clear from their estimates of overall ORV use or from data from other seashores why ORV use at the CAHA why they characterized ORV use here as "high." There was no evidence presented to support this characterization. It is important that users did not seem to view overall use levels at the CAHA or current levels of ORV use as problematic. The fact that most visitors reported they were positive or neutral toward ORV users

and their activity would seem to indicate that this activity is accepted and understood as the means by which many shore anglers access their coastal fishing sites.

Neal

This report did not provide any conclusions, only an overview and summary of findings. The summary begins with a sensational statement, namely that the economic losses associated with hurricanes in the Outer Banks over the last 100 years would not come close to equaling the damages that would be caused by denying beach access to licensed ORVs at the CAHA. This is difficult to believe given all of the remaining activities besides ORV use at the CAHA and response differentials to various levels of closure not addressed in the Neal report. What the investigator presents to readers is a worst case scenario based on what respondents report would happen if ORV use was banned. Many of the questions are leading at best and ask respondents to respond to something they likely hadn't thought of previously if at all. There are serious validity problems here. When visitors were asked how they would respond to various policy alternatives, the responses were predictably in the negative. Without any details provided; it would be easy to be opposed to "charging fees and banning ORV use." Instead of an outright ban on ORV use, there would likely be various alternatives to be considered. This report does not provide any insights to how visitors would respond to the various policy alternatives likely to be considered rather than a total ban on ORV activity.

9. Based on the preceding responses, would there be any additional value to be gained from re-analyzing the data collected?

Vogelsong

I would like to see the investigator re-analyze the expenditure data in Table 34 and produce an estimate of overall expenditure associated with ORV use at the CAHA. As the table stands now, the expenditures look like they are for overall CAHA visitation. This need to be clarified because it was one of the "overarching questions guiding this review." All means need to be accompanied by standard errors; most scientific journals would require this at the minimum. Also, I would like to see sample sizes in tables overall and also for items, for example, in Table 33. This would make the report more stand-alone and usable by park staff and reviewers.

Neal

There are simply so many problems with how these data was collected and the survey focus on various groups rather than focusing on ORV use by these groups that any re-analysis will be of no value.

10. Would conducting any additional social science research improve the ability to estimate the amount of ORV use at CAHA and related visitor spending and economic impact?

Vogelsong

This research project appears to have been designed too broadly from the start. As is often the case, funding agencies typically want to know everything about too many topics in one project. The investigator has done a credible job with an extensive number of various topics in this project and final report. But in the final analysis, "the over arching question guiding the review is: Do either the Vogelsong or Neal surveys provide a sound scientific basis for estimating the

total amount of ORV use at CAHA during the study period and the total visitor spending resulting from this activity?" The investigator has looked at per day visitor ORV counts (Table 1) at a limited number of sites and extrapolated this partial total by 365 days/year to estimate overall ORV use at the CAHA. Much of the rest of the work based on interviews and a mailback questionnaire is first rate and consistent with how this work has been done elsewhere. There is an extensive literature in the fisheries field for estimating total effort (or use of an area) for recreational fisheries. (See, for example, K. H. Pollock, C. M. Jones, and T. L. Brown. 1994. Angler Survey Methods and Their Applications in Fisheries Management. American Fisheries Society, 371 pp, Item# x51024xm, \$101.00.) Methods include access point creel intercepts, roving creel intercepts, and a variety of other statistically sound methods for estimating use where activity is dispersed. I would like to see this investigator make use of one or more of these methods for estimating ORV use and related spending at the CAHA.

I would like to see some effort made to estimate the extent of direct expenditure in the study area made by ORV users. Using the expenditure data collected in the mailback survey, it looks like the investigator has the ability to provide an estimate of total expenditures made by ORV users tied to the annual estimate of ORVs and ORV use at the CAHA and that "ORV use represents 7.3% to 11% of all CAHA visitors."

Neal

No, I don't think so. This investigator was more interested in estimating overall CAHA visitation by the three groups of interest and their expenditures and devoted little to no attention to ORV visitation and related expenditure. The report was more interested in establishing the extent to which overall visitation and economic impacts would be impacted by rulemaking that restricted ORV use to any extent rather than producing a more informed understanding of ORV use in the CAHA.

REVIEWER #4: COMPLETE COMMENTS

Review of Neal and Vogelsong studies of ORV beach use at Cape Hatteras National Seashore.

Summary

Both the Vogelsong and Neal studies have serious limitations, although taken together and by factoring these limitations into the analysis one can draw some general conclusions. It appears that between 30 and 60% of the visitors to CAHA use ORVs to drive on the beach. Visitors generally support existing restrictions on ORV beach access, but the majority are opposed to further restrictions and especially a ban on beach driving. Beach driving is not a primary activity for most visitors but it is a desired and convenient means to access the beach for fishing, sunbathing, and other activities. The presence of ORVs on the beach is not a major concern for most visitors.

Overnight visitors staying in hotels, condos and other commercial lodging spend around \$300 per day and total spending by visitors in 2003 exceeds \$150 million. Less clear is what changes in visits or spending might occur if beach access were restricted or banned. The Neal estimate of

a 28% drop in spending if ORV beach access should be banned does not seem credible. The calculations for estimating this drop are flawed and there likely is a significant strategic bias in survey responses. Survey respondents may be over-stating their reaction to a policy change that they oppose. The tone of the Neal study and methods employed raise questions about the objectivity of the study. A better way to gauge reactions to beach restrictions would be to experimentally increase restrictions in some areas and measure actual changes in behavior.

More specific methodological concerns may be raised relative to the two primary questions: (1) What percentage of visitors access the beach using ORVs, and (2) How much do visitors spend?

ORV beach access

Both studies have potentially serious flaws for estimating the percentage of visitors driving ORVs on the beach. The Vogelsong estimate of 10% of visitors engaged in beach driving is based on a comparison of vehicle counts relative to the park's overall visit estimate. The estimate appears to be well below the percentages of visitors in both surveys claiming to drive ORVs on the beach.

Vogelsong estimates ORV use from counts of vehicles parked at selected locations. The sampling plan (particularly over time) is not provided and the error estimate of 20% does not appear to be based on statistical variations in the sample. We don't know when or how often the counts of parked vehicles were made or how moving vehicles may have been accounted for. There are no estimates of turnover rates throughout the day and no discussion of weekday-weekend or seasonal variations that would be required to arrive at an overall annual estimate. It is therefore unclear what the per-day vehicle count estimates are representing. A "vehicles-at-one-time" estimate would require turnover rates to estimate daily activity.

The per-day ORV counts are multiplied by 365 to estimate annual use. Even if this figure were an accurate estimate of total vehicles, the figure probably cannot be compared with the annual park visit count, as that figure measures entries to the park, primarily at the park entrance. The park visit figure likely does not fully account for park re-entries and other factors that will inflate the visit estimate.

If the sampling protocols for counts of on-road parked vehicles is comparable to those for vehicles parked on the beach, an alternative estimate might be the ratio of the two counts ($252/320 = 79\%$). This ratio is higher than the Neal estimates based on surveys of visitors and NRPOs.

The distinction between visits (entries to the park) and visitors (persons making one or more visits during their stay or in a 12-month period) is not clearly made in either study. Comments in the studies suggest that many anglers accessing the beach by ORV are regular visitors, many fishing every day when in the area. These visitors would therefore be a much larger percentage of visits than visitors. They may constitute a fairly high percentage of the Neal samples. Vogelsong samples visits on site while Neal samples park visitors by mail. As most visitors appear to be staying overnight in the area and the average length of stay is around 7 days, there is a potentially significant length-of-stay bias in the Vogelsong sample, if interpreted as a sample of visitors. Visitors staying several nights will have a much higher chance of being sampled, as will

those spending more hours in the park. The unit of analysis in the Neal study is the visitor party or household, not individual visits.

The Neal study independently samples from three different visitor subgroups: (1) visitors staying overnight in area hotels, campgrounds, and other rentals, (2) local residents, and (3) non-resident property owners. The relative proportions of these groups in the park visitor or visit populations are not addressed.

Neal estimates that 52% of the overnight visitor group use ORVs to access the beach during their stay, 37% at least 3 times per week. The percentage is higher for NRPOs (78%). I can't find the estimate for residents.

The evidence suggests about 50% of visitors in vehicles use them on the beach.

Spending

Both studies report visitor spending averages on a per-day basis. The Neal survey of visitors staying in hotels and rental housing estimates about \$280 per day based on visitor reports of what they would expect to spend on a 7-day visit. The NRPO spending estimate is about \$205 per day. Both are presumably on a per-travel-party basis. There is no discussion of seasonal variations in spending, which are likely substantial given that summer rental rates are at least double off-season rates. This may partially account for the lower NRPO spending, as many of these trips may be off-season. (It isn't clear why NRPOs pay \$542 per week on lodging if they own the property.)

The Vogelsong average is \$511 per day; however, the individual items do not add up to this total (sum is \$429 per day). Per-day averages for lodging, food and beverages, and shopping are only slightly above the Neal visitor averages, but Vogelsong includes an additional \$92 on "all other expenses" and \$23 on recreation and entertainment. Using the sum of items and omitting the \$92 yields an average of \$336, closer to the \$280 per day of Neal.

Neither study discusses handling of outliers and missing spending data that can significantly influence the results. Failure to deal with these issues likely explains the discrepancies in the Vogelsong sums.

The spending averages are generally consistent with averages from similar parks, if we assume the figures primarily apply to overnight visitors staying in motels, hotels, and other commercial rental housing. Spending averages would be lower for campers, visitors staying with friends, relatives or owned seasonal homes and visitors not staying overnight in the area.

The percentage of campers is not reported. One campground in the Neal study "said they would participate," but it isn't clear if they did or what percentage of the sample was generated by this campgrounds. Forty-six of the visitor surveys in the Vogelsong study were at the Ocracoke campground, and some campers may have been sampled at other locations. No campers at NPS campgrounds were apparently included in the Neal study. NPS campgrounds reported 91,000 overnight stays in 2007, which would be 31,000 visitors if an average stay is 3 nights and 10,000 visitor parties/vehicles if average party size is 3.1. Campers would have a different spending

pattern than visitors in hotels and rental housing. It isn't clear if they would differ from the overall study results relative to driving vehicles on the beach.

Vogelsong does not attempt to expand the spending averages to a total visitor spending estimate. Neal's approach is based on room tax figures for the area. This will be a reliable source of hotel sales, assuming all rental properties are covered by the tax. Vogelsong then estimates total spending in other categories based on their proportions in the visitor survey averages. This would be a sound approach if all visitors stayed in facilities that pay the tax and only such visitors were included in the visitor survey. The latter appears to generally be the case. The approach, however, will not include spending of campers, day visitors, NRPOs, or residents, and therefore will underestimate total spending. The proportion of spending for lodging will be sensitive to the mix of lodging properties included in the sample. Representativeness of the sample relative to spending is not discussed. Properties sampled and seasonal issues would be important factors in estimating spending.

The total spending estimate of \$148 million in 2003 will be biased downward due to the omission of campers, day users, those visiting local residents, NRPOs, and any other visitors who do not pay any lodging tax. The procedure completely misses the spending of these groups.

To address the central question, one must estimate the loss in spending due to the beach closures. The approach taken by Neal is to estimate the likely reduction in visits to CAHA and assume a similar percentage reduction in total spending. This assumes spending patterns of ORV beach drivers are the same as other visitors and that any reduction in spending would be directly proportional to the drop in visits. These may be reasonable assumptions, although local residents and NRPOs are likely a higher proportion of ORV beach drivers than visitors, and these two groups may spend less than other visitors.

The percentage drop in visits is estimated via a somewhat ad hoc procedure. Responses to a question about how visitors would react to a ban on beach driving are converted into an overall percentage drop in visits by assigning weights to the six possible responses to this question. The weights are somewhat arbitrary and are not related to each visitor's current use. For example, those who responded they would visit only occasionally may not be reducing visits if they currently visit only occasionally. The response categories are not sufficiently precise to reliably estimate the drop in visits.

Short responses to other methods issues:

2. Generalizability: There is little information to judge the representativeness and generalizability of the Neal samples to the relevant populations. The resident sample was proportional to residences by Zip code, but possible nonresponse bias is not addressed. The NRPO and overnight visitor samples were selected by cooperating realty and lodging companies. It isn't clear how representative these samples may be. How individual respondents were chosen and potential response biases are not addressed.

3. Design of survey instruments is fine. Observation protocols are not explained sufficiently to judge.

4. Field data collection procedures are not described in sufficient detail to evaluate them.

5. Data analysis: Analysis of car counts is not adequately explained. Survey data analysis is restricted mostly to univariate frequencies. Subgroup comparisons and cross-tabulations are limited. It would have been useful to compare those using ORVs on the beach with those who do not. Vogel song suggests the car counts are subject to errors of 20%. This estimate appears to be based on judgment rather than sampling variability. Vogel song reports some statistical tests of attitudes, but does not address error relative to the spending data.

6. Other data sources: Neal uses Dare County lodging tax receipts to estimate spending. This grounds the spending estimates in actual room sales, which should be more reliable than survey estimates. However, the spending estimate therefore omits spending of visitors who do not stay in paid lodging subject to the tax. Vogel song uses the traffic and ferry count data that the NPS uses to estimate recreation visits. It isn't clear if the NPS counting protocols adequately account for commercial traffic, commuting traffic, and visitors who pass the traffic counter multiple times during their visit.

7. Potential non-response bias: Non-response bias is a potential concern in both studies. Neal's response rate is about 50% to the resident survey. Response rates to NRPO and visitor surveys are not reported. It looks like about 1,000 mail responses out of 1,680 on-site interviews in the Vogel song study. There is no indication of refusals or analysis of mail non-respondents.

8. Conclusions: Both Vogel song and Neal studies support the conclusion that presence of ORVs on the beach does not significantly detract from visitor experiences. The tone of the Neal study suggests a clear opposition of the author to ORV restrictions. It isn't clear whether or how this bias may have influenced survey responses. Neal's claims of economic losses should ORVs be restricted or banned appear highly exaggerated.

9. Re-analysis: Since crowding and presence of ORVs on the beach do not appear to be significant concerns to visitors, policy changes would likely be based more on environmental considerations than social or economic ones. The percentage of visitors driving on the beach appears to be around 50%, based on the two studies. Further precision in this estimate is not likely to alter decisions. The estimates of total spending are also likely adequate. What is less clear is the possible decline in spending if ORV beach access is further restricted or banned. Neal's estimate of a 27% drop seems high, given that driving ORVs on the beach is not a primary activity for most visitors. Beach access appears to be a convenient way to access the beach for fishing, sunbathing, swimming and other activities rather than a primary activity in its own right.

Changes in visitation would hinge on the extent of inconvenience to visitors of not being able to drive vehicles on the beach. Would residents, NRPOs and visitors stop coming to the park if they could not drive on the beach, but instead had to walk from nearby parking areas? Are there potential substitutes nearby where vehicles can be driven on the beach? If so, closures at CAHA would shift some use. If not, it seems unlikely that use would drop dramatically as long as visitors can still engage in their primary activities.

10. Other research: It is difficult to measure changes in behaviors under hypothetical policy changes, particularly when there is a strategic incentive to overstate reactions and the investigator has a particular point to prove. A better approach is to experimentally impose restrictions and measure the associated behavioral changes. Rather than a precipitous change in policy, the park might experimentally add restrictions in some areas or rotate which sections of the beach are open during which seasons and monitor changes in use patterns as better indicators of behavioral responses.

The percentage of vehicles driving on the beach could be easily estimated with a well-designed study to count vehicles at beach access points relative to those on the road or in road parking areas. Alternatively, a sample of exiting vehicles could be asked if they had driven on the beach that trip. There are complications from visitors and residents exiting and entering the park multiple times during their visits and the numerous residences that are inside the park entrance. The NPS counting procedures assume 90-94% of vehicles at the entrance gate are recreation visits and persons per vehicle range from 1.7 to 2.7 seasonally. These protocols were last updated in 1993.

REVIEWER #5: COMPLETE COMMENTS

General Overview:

Both papers provide data from samples related to the activities by visitors to CAHA and provide estimates of the money spent by visitors. Both reports present results of collecting data on the money spent by visitors and attitudes toward crowding. Neal includes information collected from samples of non-resident property owners and local residents in addition to that collected from visitors. Vogelsong has observational counts including counts of ORVs and information based on the collection of perceptions of crowding from the subjects in the sample. Both reports provide summary statistics in the form of proportions and means. Neal does not provide measures of variation with his estimates, whereas Vogelsong does. However, many of the results presented by Vogelsong involve an ordinal scale for the responses which he has coded by providing numerical values for the categories and calculating means and standard deviations. These measures are not appropriate for ordinal scale data! The appropriate measures for ordinal scale data are counts and/or proportions in each category and the median as a “typical” response.

There may be some slight difference in the responses to questions about off-road vehicles due to the definitions used in the survey instruments. Vogelsong, in his survey instrument, defines off-road vehicles to include “any 4 wheel drive vehicles suitable for beach driving,” while Neal uses the term to describe “privately owned, state-inspected vehicles that are licensed for regular on-road operation but are capable of off-road operation.” He excludes all-terrain vehicles and other vehicles that are only suitable for off-road operations.

In judging the adequacy of the sample sizes, it should be remembered that in general terms it is the sample size that determines the variation of the estimates, not the ratio of the sample size to the population size. The sample sizes in these sampling plans are sufficient to give estimates with reasonably acceptable standard errors.

It is my judgment the statistical aspects of the surveys and analyses discussed in these two reports provide some information suitable for use in making decisions regarding the banning or limiting of ORV at CAHA. However, there is not sufficient detail of the sampling procedures in either report to judge the suitability of the procedures. Although both authors imply random samples, there are not sufficient details to verify appropriate random selections were followed. Also, neither study appears to separate financial information for ORV users from that for non-ORV users.

Comments on Report of William D. Neal

1. Does the Neal survey provide a sound scientific basis for estimating the total amount of ORV use at CAHA during the study period and the total visitor spending resulting from this activity?

In general, yes. There were separate samples of visitors, non-resident property owners, and residents. It appears that random samples from each group were selected to respond to a set of questions regarding various aspects of their activities at CAHA and their opinions regarding limiting off-road vehicles. The sample sizes for each of the three groups are sufficient for point estimates of proportions (percentages) within 0.05 (5%) of the true population values with a probability of 95% in the worst case (when the population value is 0.50). For situations where the population values (and/or estimates) are either less than 0.50 or greater than 0.50 the margin of error is less. However, I did not see any mention in the report of the standard errors for the estimates presented. Rather, only summary statistics (proportions and percentages, averages) are provided.

The information obtained included activities participated in by individuals, amount of money spent in various categories, opinions regarding limiting and/or banning ORVs, and perceived financial impacts of limiting and/or banning ORVs.

The data collected include amounts visitors spend for lodging, restaurants, and other services. It also includes estimates of the proportion of visitors who would decrease the number of their annual visits if ORV access was banned. Similar data was collected for non-resident property owners along with additional information on the individuals' perceptions of the impact on limiting ORV access on their property values and rental income. Similar information on the financial impact of limiting ORV access was collected from residents, including the impact of their jobs and income.

2. Ability to generalize the results of the data collection.

Because the data includes samples from visitors, non-resident property owners, and residents the three major groups are represented in the data. The only groups that are not represented are those individuals who have not visited CAHA but may visit if there is a ban on ORVs, or those who may visit CAHA in the future but will not if there is a ban on ORVs. However, it is next to impossible to identify these individuals and the sample of visitors serves as a surrogate for them.

3. The design of the survey instruments and observation protocols.

The survey design included representatives from the three important groups to be considered. The sample of visitor appeared to be spread throughout the year with apparently an attempt to have the sample proportionally allocated to the number of visitors in each month. The sampling was conducted by a mailing to visitors by cooperating rental companies, hotels/motels, and campgrounds as well as by property management companies. The cooperating organizations were instructed to select the individuals to be contacted randomly, but there was no indication how this randomization was done. The response appears to be 438, but there is no indication of how many questionnaires were sent.

The non-resident property owners were also sent mail questionnaires by their property management companies. The questionnaires were allocated to the property management companies proportional to the number of properties managed. They were to select the non-resident property owners to be contacted randomly, but again there is no indication of how the randomization was done. The response appears to be 546, but there is no indication of how many questionnaires were sent.

The resident sample was allocated proportionately to the number of known residential addresses in each of the Zip code areas. A sample of 1000 was mailed to residents, of which it appears 466 useful responses were received. There is no indication of how these 466 responses were distributed over the eight Zip codes.

4. The rigor of the data-collection methods in the field.

As with any mail survey, there is a problem of non-response. I found no mention of any attempt to follow-up with non-responders to encourage them to respond. Because the questionnaires were sent by entities other than the group responsible for the survey, I would guess there was no attempt to get responses from the non-responders. Whether the data for the non-responders would differ from that for the responders is a question that is not answered.

5. The appropriateness of the data analysis, including the characterization of uncertainty.

The results presented in the report are simple point estimates, i.e., percentages or averages. While it is a fairly simple calculation to get standard errors for the percentages, if the number of responses is known, that is not true for averages. If one wants to use these data for examining various scenarios and give confidence intervals or measures of uncertainty for the outcomes, one needs to have measures of the uncertainty (e.g., standard errors) for the values used. These measures may be available from the author of the report. If not, they could be obtained by analyses using the data file.

6. The use of other data sources in the report as cross-checks on key estimates.

I saw no mention of the use of other data sources to support or refute the data from the surveys. The author did use tax receipt data to determine the net present value of the tourism trade in the six villages in the study area.

7. The potential for non-response bias in the survey results.

In any mail survey there is a potential for non-response bias. Because apparently there was no effort to contact non-responders to encourage responses, it is difficult to judge if the data for the non-responders would differ from those of the responders.

8. The reasonableness of conclusions based on survey data and other evidence.

Because the report contains only summary data, it is difficult to judge the reasonableness of the conclusions. I assume the information contained in the report accurately summarizes the results of the data analyses. The only result presented in the report that is not a direct summary of the survey data is the calculation of the economic impact, and I have no way of judging the reasonableness of this result.

9. Would there be value in re-analyzing the data?

I do not see any need to re-analyze the data other than to provide standard deviations and standard errors for the estimates presented in the report.

10. Would conducting additional social science research improve the ability to estimate the amount of ORV use at CAHA and the impact on visitor spending?

I believe this report provides some information regarding activities and expenditures of visitors to CAHA. However, the information in this report is probably not sufficient for making a decision regarding limiting or prohibiting the use of ORVs at CAHA. The report does not address the differences, if any, between expenditures and experiences of ORV users and non-ORV users. Also, I have a concern as to whether or not the individuals who received questionnaires mailed by the management companies and lodging companies were truly selected following a random selection process.

Comments on Report of Hans Vogelsong**Overview:**

This report is based on the results of observational counts and a sample of visitors to CAHA. The data collected involved information collected by counts of vehicles and visitors, personal interviews and mail questionnaires returned by visitors. Information collected included data on expenditures by visitors, activities of the visitors, and perceptions and attitudes of crowding.

In judging the adequacy of the sample sizes, it should be remembered that in general terms it is the sample size that determines the variation of the estimates, not the ratio of the sample size to the population size. The sample sizes reported in this paper are adequate to provide estimates of proportions or percentages with reasonable standard errors. However, there are instances in which means and standard deviations are reported for what is categorical data. Considering the categories as numerical values and reporting mean and standard deviation is not appropriate. The appropriate summary statistics for these data, in which the categories have a natural order, include proportions and the median category.

It is my judgment that this report provides some information that may be used to make decisions regarding the banning or limiting of ORV at CAHA.

1. Does the Vogelsong Survey provide a sound scientific basis for estimating the total amount of ORV use at CAHA during the study period and the total visitor spending resulting from this activity?

The information in the report includes counts for visitors, vehicles, and off-road vehicles for various locations within the CAHA. There are also summaries of the responses of visitors related to size of crowds they observed, and what they would perceive to be overcrowding. In addition, there are summaries of the visitors' attitudes to the use of ORVs and banning or limiting the use of ORVs. This information should be helpful.

The information in this report also provides information related to the perceptions and attitudes of crowding for visitors to CAHA. I believe these data will be useful when examining the relationship of visitors' definitions of crowding and the number of vehicles and ORVs present during the visits.

2. Ability to generalize the results of the data collection.

Because the results are from a supposedly random sample of visitors and counts for randomly selected dates, it should be possible to generalize the results.

3. The design of the survey instruments and observation protocols.

The survey used personal observations, personal interviews and questionnaires returned by visitors. The sampling time frame for interviews was spread throughout the year and weekdays to account for variations in seasonal and day visitations.

There is limited information regarding the selection of the observation sites and visitors to be interviewed. Based on what is available in the report, I would judge the sampling procedures are appropriate to provide representative data.

4. The rigor of the data-collection methods in the field.

The data collection consisted of counts made at various locations and responses from surveys of visitors. The visitor data was obtained from personal interviews and from mail questionnaires. The report indicates the interviews were conducted throughout the year, with the number of interviews apparently roughly apportioned in ratio to the number of visitor in each season. The author states that visitors are adequately represented throughout the 12 months of the study period. Also, the 23 sites for interviews were distributed throughout the park. The least number of interviews from any one site is 12 and the largest number of interviews at any one site is 162.

There is no indication of any problems in selecting individuals to be interviewed or of any attempt by the interviewers to influence responses.

5. The appropriateness of the data analysis, including the characterization of uncertainty.

Although the author indicates a total sample size of 1,681 visitors (Table 3), almost all the tables fail to show totals, and there did not seem to be a statement of the total number of personal interviews or the number of questionnaires returned. The total number of observations for the tables varies greatly. For example, the nine different tables of Visitor Sample Profile (Table 3,

page 14) have total number of observations that range from 957 for Income to 1,686 for State of Residence.

Much of the data reported by the author is categorical with either a nominal or ordinal measurement scale. Nominal scale involves categories with no ordering. Ordinal scale involves categories with ordering, but differences and/or ratios of values are not meaningful. Assigning values of 1, 2, 3, etc. to the categories, as the author does in most of his data displays, does not change the measurement scale. For example, consider the data in Table 13 Crowd size compared to Visitor Expectations. If this were an interval scale that the difference between a 1 and a 2 is the same as between 2 and 3, between 3 and 4, etc. Also the difference between a 2 and a 4 is twice the amount of a difference between a 3 and a 4. This is not true! The numbers are only substitutes for the names of the classes or categories of outcomes. And is the category “You didn’t have any expectations” which is assigned a value of 6 really greater than “A lot more than you expected,” which is assigned a value of 6? This is what the author assumes in calculating the mean. The mean and standard deviations are not appropriate descriptive measures for categorical data.

Because of this coding of numerical values for the categories, the author reports means for ordinal data (Tables 9-13, 18-21, 27-29) when a mean is not appropriate. The appropriate measure of central tendency for ordinal data is the median. To illustrate the inappropriateness of the mean in these situations, consider Table 22 comparing ORV Use Levels compared to Visitor Expectation. The author reports a mean of 3.21. However this calculation is a result of assigning the value of 6 to the response “You didn’t have any expectations,” which has a count of 80. Deleting this category changes the mean to 2.97. Assigning a code number of 0 to the category gives a mean of 2.73. Assigning a value of 3 (same as “About what you expected”) gives a mean of 2.97. Which of these is correct? What is the appropriate value for the “You didn’t have any expectations” category? And even if you decide the correct value for this category, what does a value of 2.73 or 2.97 or 3.21 mean? None of these is one of the categories. The correct summary statistic is the median, which in this case is the category “About what you expected.” This same comment regarding coding the categories and the improper use of the mean is true for Table 13.

A similar statement applies to the inappropriateness of Analysis of Variance (F-tests) in Tables 14-16 and 23-25 and comparisons of “means” (t-tests) in Table 26. These statistical procedures assume at least an interval or ratio measurement scale for the data. This does not invalidate the data, but one should not put too much reliance in the results of the statistical tests.

In Table 13, the author reports N values of 9.6, 15.9, etc. I suspect these should be 96, 159, etc.

6. The use of other data sources in the report as cross-checks on key estimates.

The author used ferry system counts of individuals per vehicle as a check for his survey result. He also used NCDOT traffic and ferry counts to estimate total park visitation.

7. The potential for non-response bias in the survey results.

Obviously, there could be some bias as individuals may refuse to take part in the survey. There is no indication of how many individuals refused to take part in the survey or if the refusals came from a certain group of park users.

8. The reasonableness of conclusions based on survey data and other evidence.

The report is, for the most part, a summary of the information obtained from interviews, observational counts, and mail questionnaires. The conclusions given in the report are reasonable representations of the results of the data analyses.

9. Would there be value in re-analyzing the data?

Measures of correlation or dependency among the responses to the various questions concerned with observed crowding, perceived crowding, and impact of crowding on enjoyment of the park may be valuable when studying the impact of policies banning or limiting ORVs, or limiting the number of visitors.

Other than using the median rather than the mean to define the “typical” response for ordinal data, I do not believe there would be anything to gain from further analysis of the data. However, rather than relying on means and standard deviations, one should consider median responses and the distribution of responses among the categories.

Summaries of observations and attitudes towards crowds and crowding as reported in the paper should be useful without further analysis.

10. Would conducting additional social science research improve the ability to estimate the amount of ORV use at CAHA and the impact on visitor spending?

I believe this report provides some information regarding activities, expenditures, and attitudes of visitors to CAHA. However, the information in this report is probably not sufficient for making a decision regarding limiting or prohibiting the use of ORVs at CAHA. There is no indication if the users interviewed were ORV users or not, and, if both groups are represented, the data is not separated for the two groups.