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# Length of Recall Period and Accuracy of Estimates from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation

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*Abstract.*—Every fifth year since 1955, the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation has provided a data base that is comprehensive and widely used. Questions about the accuracy of the survey's estimates of anglers and hunters, their days of activity, and their expenditures led the U.S. Fish and Wildlife Service to contract a study of how different recall periods may affect its estimates. This paper summarizes key results of that study. Estimates based on survey recall periods of 2 weeks, 1 month, 3 months, 6 months, and 12 months are compared. In general, the size of estimates appears to increase with the length of the recall period. However, there are numerous unexplained variations in the general pattern that suggest important questions for further research.

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (national survey) has been conducted by the U.S. Fish and Wildlife Service (Service) at 5-year intervals since 1955. Results of each of the seven surveys through 1985 relied on respondents' recall of events during the calendar year prior to their interviews. When estimates based on these interviews were questioned because the survey used an annual recall period (e.g., respondents to the 1985 national survey were asked in early 1986 about their participation, days, and expenditures during 1985), the Service contracted with Westat, Inc., to study how different recall periods affect survey results. The study compared the results from a traditional annual recall survey with results from surveys based on recall periods of 2 weeks, 1 month, 3 months, and 6 months. This paper introduces important recall issues in the context of the national survey, summarizes findings from the Westat, Inc., recall study (Chu et al. 1989), and suggests directions for future research.

## Background

The national survey estimates the number of participants in wildlife-related recreation, total days of participation, and the associated expenditures. These variables are estimated nationally and by state for anglers, hunters, and nonconsumptive participants (those who feed, photograph, or observe fish and wildlife). Because the survey's results have a wide range of policy and program uses at national and state levels, they need to be accurate.

It should be noted, however, that the more frequent interviews necessary to introduce shorter, more accurate recall periods would increase survey costs dramatically. This is relevant because interview costs can represent over two-thirds of a survey's total cost. For example, changing a US$10 million survey's recall period from 12 to 6 months could increase total cost to over $16 million. Thus, the improved accuracy gained with shorter recall periods must be weighed against increased costs.

The results of almost all surveys differ to some extent from the true values they estimate. These differences may be from sampling errors or nonsampling errors. Sampling errors arise because samples inexactly replicate the characteristics of the population being studied. Nonsampling errors involve various sources, including inaccurate recall by respondents.

One method to detect the presence of nonsampling errors is to compare a survey's results with other data bases. If a particular survey consistently overestimates or underestimates relative to other credible data sources, then recall errors may exist. Before the recall study by Westat, Inc., no consistent patterns were identified when the national survey results were compared with results from other data bases. Instead, the comparisons showed some relative underestimates, some roughly equal estimates, and some relative overestimates.[1]

Similarly, the literature on recall bias reveals mixed results.[2] The dominant effects, telescoping and memory decay, work in opposite directions. Telescoping brings events into the recall period from other times and tends to produce overestimates. Memory decay, as the name suggests, tends to produce underestimates because respondents forget events that actually happened during the recall period. The literature suggests that memory decay dominates the recall of routine activities, and telescoping dominates the recall of more significant events. Other factors also influence recall, including whether the respondent is asked to itemize events or to summarize a number of events that occurred over time.

In 1985, the U.S. Office of Management and Budget, which must approve each national survey, strongly recommended that the Service conduct a study of the accuracy of estimates based on the traditional annual recall period. Concurrently, the issue of recall period was in the minds of the survey staff because of inquiries from data users about possible over- or underestimates.

### Study Objectives and Working Hypotheses

The major objective of the recall study was to learn whether the length of the recall period imparted a systematic bias to survey results. With a systematic bias, respondents' inaccurate recall would yield inaccurate survey estimates. By comparison, with an unsystematic bias, respondents' inaccuracies cancel one another, resulting in unbiased estimates with an artificially high variability.

Information about the time path of memory decay in the context of wildlife-related recreation was needed to determine the most appropriate recall period to use for the national survey. Metz (1956) found errors as great as 10% in reported milk expenditures a week after purchase. If survey responses about wildlife-related activities showed comparable errors, then options for accurate surveys at a reasonable cost would be severely limited. Using a shorter recall period would increase the cost of the survey because more frequent interviews would be necessary for annual estimates.

Because the cost of the national survey was a concern, another objective of the recall study was to investigate whether subgroups of the population had different functional relationships between the length of the recall period and their responses to survey questions. For example, if annual recall periods were accurate in the northern part of the country and 6-month periods were accurate in the south, it might be possible to contain costs by using different recall periods in different parts of the country. Similarly, it might be possible to design a more economical survey if the recall of avid participants were found to differ from that of the less avid.

A final objective of the recall study was to determine whether the relationship between accuracy and different recall periods varied with the survey topics. Numerous studies have shown that

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[1]Most of these comparisons involved personal correspondondence, especially with staff of state conservation agencies. A notable exception, and an example of roughly equal estimates, was the comparison between 1980 State of Illinois (Illinois Department of Conservation 1983) and 1980 national survey estimates for Illinois anglers and their days of fishing in Illinois. In this case, the estimates were almost identical. As a second example, the national survey's estimates of anglers and hunters for the nation tended to equal the sum of those reported by individual states. However, national survey estimates for participants in a particular state may be up to 25% higher or lower than the state's estimates of its anglers and hunters. As a final example, the national total for days of saltwater fishing reported in the national survey tended to be larger than the total from the National Marine Fisheries Service's Marine Recreational Fishery Statistics Survey, even though this national trend for days of saltwater fishing may not hold for any particular state.

[2]Some details about this literature appear in subsequent sections. For a thorough review, see Chu et al. (1989).

when telescoping is controlled, underreporting increases as the recall period is increased.[3] This has been found to hold for estimates of expenditures (Neter and Waksberg 1964). Similarly, for the topic of crime, Murphy and Cowan (1976) found that victims surveyed in the National Crime Survey reported fewer crimes as the recall period was lengthened. On the other side, Chase and Harada (1984) demonstrated overreporting of swimming activities associated with a longer recall period, and Ghosh's (1978) results suggested overestimates of fishing with longer recall periods.

One plausible explanation of the above differences is that reporting patterns differ between surveys that require respondents to itemize each event and those that ask for summary information. Another possibility is that memory decay is to be expected for negative experiences (being a crime victim) or neutral experiences (expenditures), whereas unintended overreporting—what we call "recall inflation"—occurs for pleasurable events (swimming and fishing).

It is important to distinguish recall inflation from prestige bias. Prestige bias involves the deliberate overreporting of "good" or prestigious things, such as earnings, and the underreporting of "bad" or unpleasant things, such as experiencing a crime. These kinds of effects were found by Ferber and Birnbaum (1979) and Wyner (1980). Recall inflation results from the unintended embellishment of memories of past pleasures.

Even though both recall inflation and prestige bias may be affected by a survey's subject matter and recall period, eliminating them requires different strategies. Eliminating prestige bias requires overcoming intentional errors of reporting. Improving the design and administration of the questionnaire may be the most effective strategy for eliminating prestige bias. In contrast, eliminating recall inflation requires preventing unintended reporting errors, which may be accomplished with a shorter recall period.

One of the working hypotheses of the recall study was that recall errors are topic-specific. In addition to asking respondents about their fishing and hunting activities, the national survey asks about different types of fishing (in salt water, the Great Lakes, or in other fresh water) and different types of hunting (for big game, small game, migratory birds, or other animals). We assumed that the accuracy of estimates may differ across these categories for a given recall period.

Another hypothesis was that rare but important events are remembered most accurately. For example, we expected big game activities to be reported most accurately over a long recall period. Before the recall study, comparisons of national survey results with state data provided strong support for this notion.[4]

A final hypothesis was that memory aids improve the accuracy of estimates. Recent national surveys asked respondents to view a map and organize their responses around the places where they fished or hunted. Flash cards with lists of items that might have been purchased were used to aid the accuracy of recalled expenditures. The recall study examined the effects of map books, flash cards, and other memory aids.

### Study Design

The recall study's two-phase design included (1) small laboratory and focus groups, and (2) a survey. In phase 1, laboratory and focus groups verified many working hypotheses. For example, memory aids improved the accuracy of reporting because they helped respondents itemize events. In addition, results from the laboratory and focus groups suggested that references to key events, such as Memorial Day and other chronological milestones, are likely to improve recall. They further indicated that the use of a technique known as bounding may improve the accuracy of survey responses. For example, an interviewer might begin a second-quarter interview by reminding the respondent of the last item reported during the first-quarter interview. This provides a time reference, or bound, to discourage the respondent from telescoping first-quarter events into the second quarter. Bounding, however, is unlikely to correct errors due to prestige bias or recall inflation. Removing them is a challenge for sampling and questionnaire design.

Phase 2 of the recall study involved a survey with comparative panels. Following Neter and Waksberg (1964), the recall study relied on chronology for bounding—respondents were asked to

[3]For a thorough review of this theme, see Chu et al. (1989), Chapter 2.

[4]Service staff compared unpublished estimates of bag and catch from the 1980 national survey with states' bag and catch estimates. Except for big game species, national survey and state estimates diverge. The states' estimates were published by the U.S. Fish and Wildlife Service (USFWS 1983, section C).

identify the date or time of the event being reported as a means of minimizing telescoping. Chronology also was used to compare the seasonal patterns of activities reported by different panels and to see whether the accuracy of estimates improved when respondents were asked to associate their experiences with a given time period.

*Questionnaire Design*

Wording of the recall study's questionnaires was similar to the national survey's questionnaires for purposes of comparability, although the former had fewer questions. For example, only 5 of the national survey's 28 questions about fishing equipment items appeared in the recall study, which did not ask about big ticket items (boat purchases) or where respondents spent money for their trips.

Also for the sake of comparability, recall study questionnaires retained the national survey's organization of activities around places where fishing and hunting occurred. Finally, the recall study investigated activities comparable with the national survey's, including saltwater fishing, freshwater fishing, and hunting for big game, small game, and migratory birds. Not included in the recall study were the national survey's activities of fishing in the Great Lakes and hunting for other animals.

*Sampling Design*

Samples were drawn from two geographically distinct areas, eastern Texas and eastern Wisconsin. After households were screened, individual respondents from each area who fished or hunted in 1987 were placed randomly into one of six panels (Table 1) for interviews about their fishing and hunting in 1988.

Members of the two annual recall period panels (A and B) were to be asked in early 1989 about their activities and expenditures during all of 1988. Panel A was designed to be directly comparable with the national survey. In contrast to panel B, it did not use a key event approach.[5]

TABLE 1.—Key characteristics of recall study panels.[a]

| Panel[b] | Interview method | Number of respondents | Recall period and description |
|---|---|---|---|
| A | In person | 576 | Annual (no key events used) |
| B | In person | 558 | Annual (key events used) |
| C | In person | 637 | 6-month |
| D | In person | 814 | 3-month |
| E | Telephone | 411 | 1-month (1st to end of month) |
| F | Telephone | 392 | 1-month (16th of month to 15th of next month) |

[a]Sources: Chu et al. (1989: Tables 1-1 and 4-5) and A. Chu (Westat, Inc., personal communication).

[b]Members of panels A, B, C, and D were contacted by telephone before the in-person interviews. Panel members who indicated they did not participate during the relevant period (e.g., any particular quarter for members of panel D) were not interviewed in person, because they had no activity to report for the period. Members of the monthly panels were contacted by telephone each month. About half of the respondents resided in Texas and half in Wisconsin.

Other panels were established for 6-month (panel C) and quarterly (panel D) recall periods. Except for their different state origins, no panels had subpanels. All members of panels A, B, C, and D were interviewed in person at designated intervals during 1988 and 1989.

Members of panels E and F, the monthly panels, were interviewed once each month by telephone. Panel E members were contacted soon after the first of each month, and panel F members were contacted soon after the 15th of each month. Respondents in panels E and F were asked to report separately their activities from the first versus the second half of the month. In this way, changes in recall over a 2-week period could be identified by comparing reported activities for the first or last 2 weeks of a month. Further, results from 2-week and 1-month recall periods could be compared.

Scheduling precluded panels E and F from being contacted each of 12 consecutive months. Instead, the members of these panels were contacted for each of 9 consecutive months. Thus, whereas monthly panels E and F can be compared directly with panels C and D, monthly panels E and F cannot be compared directly with annual panels A and B.

A significant feature of the recall study was that the truth of reported activities would remain unknown. Diary panels were rejected as a way of gathering completely accurate data because they are expensive, response rates deteriorate over time, and keeping diaries may affect respondents' behavior. To establish a reference base, it was

[5]Improved recall accuracy was sought by using important dates as key events to define time frames. Panel B participants were asked to organize their responses according to activities that took place after the first of the year and before Easter, from Easter until Memorial Day, from Memorial Day until Labor Day, and from Labor Day until the end of the year.

bag limits
to catch per angler



assumed that the results of the monthly panels were true.

### Recall Study Results

Nonresponse bias should not be a factor in the recall study.[6] Over 87% of households selected for screening provided interviews, and the response rate for individuals selected for detailed interviews was 86%. However, it should be noted that the response rate for the monthly panels fell from an initial 99 to 79% for the last month's interview. This attrition was expected, because both refusals and those who cannot be contacted increase with the frequency of contact. Response rates for the quarterly, 6-month, and annual panels were 86, 88, and 92%, respectively. Usable responses were relatively evenly distributed between respondents from Texas and Wisconsin. The numbers of usable responses for each panel are shown in Table 1.

At the 99% level of confidence used in the recall study, there were no statistically significant differences between panel A and panel B estimates of the number of trips, days, or trip-related expenditures. Therefore, it was concluded that the use of key events did not make a difference between these two annual recall period groups. It appears that shortcomings of the national survey cannot be overcome simply by including key events.

Similarly, there were no apparent differences between panels E and F, the monthly panels. Therefore, it was assumed that the time paths of memory decay or recall inflation did not significantly change between 2 weeks and 1 month. For ease of reporting, results from panels A and B are reported together, as are panels E and F.

Interesting comparisons can be made between the 9 months covered by monthly and corresponding quarterly panels (Table 2) and the annual results of quarterly, 6 month, and annual panels (Table 3). For example, Table 3 shows that 62% of the respondents in the quarterly panel (D) said they fished at least once during the year, compared with 75% of those in the annual panels (A and B). In general (but with some notable exceptions), longer recall periods are associated with larger estimates.

Results in Tables 2 and 3 must be qualified. Whether results from telephone interviews can be compared with results from in-person interviews is a valid question as yet unanswered. Accordingly, it was assumed that a comparison between the monthly (telephone) interview results and the quarterly (in-person) interview results was valid (i.e., no vehicle bias existed).[7] As a second note, extrapolated totals were for sample respondents from areas in Texas and Wisconsin only, rather than from a national group. Estimates of expenditures were for trip-related items on the recall study's questionnaire. Although they allowed comparisons between panels, they did not represent all the expenditures of anglers and hunters.

TABLE 2.—Fishing and hunting estimates for the 9-month period covered by study panels D, E, and F.[a]

| Measure | Recall period: 1-month, panels E and F | Recall period: Quarterly, panel D |
|---|---|---|
| Fishing | | |
| Proportion who fished[b] | 0.67 | 0.60 |
| | (0.02) | (0.02) |
| Average number of fishing trips | 8.89 | 13.52 |
| | (0.54) | (0.84) |
| Average number of fishing days | 11.60 | 16.74 |
| | (0.60) | (0.89) |
| Average trip-related fishing expenditures (US$) | 184.86 | 258.46 |
| | (11.40) | (19.21) |
| Hunting | | |
| Proportion who hunted[c] | 0.40 | 0.39 |
| | (0.01) | (0.01) |
| Average number of hunting trips | 10.34 | 12.09 |
| | (0.66) | (0.81) |
| Average number of hunting days | 14.46 | 16.08 |
| | (0.70) | (0.88) |
| Average trip-related hunting expenditures (US$) | 192.26 | 203.54 |
| | (12.92) | (15.91) |

[a]Source: Chu et al. (1989: Tables 5-10 and 5-11). Entries in parentheses are standard errors of the estimates. Panels E and F were combined for reporting purposes.

[b]Includes all those who took at least one trip to fish during the study period.

[c]Includes all those who took at least one trip to hunt during the study period.

[6]The recall study's high response rate did not prove an absence of nonresponse bias. However, except if the nonrespondents were dramatically different from the respondents, the study's qualitative results were unaffected by nonresponse bias. For additional information about the study's nonresponse, see Chu et al. (1989), sections 4.3.2 and 6.3.2.

[7]The recall study did not produce evidence that could be used to evaluate its vehicle bias. In general, according to Chu et al. (1989, pages 6-7 and 6-8), a review of the literature suggested a growing similarity in the results of telephone and in-person interviews. It should be noted as well that most of the recall study's conclusions can be derived from comparisons of only those panels (A–B, C, and D) that used in-person interviewing.

TABLE 3.—Fishing and hunting estimates for the 12-month period covered by study panels A, B, C, and D.[a]

| Measure | Recall period: Quarterly, panel D | 6-month, panel C | Annual, panels A and B |
|---|---|---|---|
| Fishing | | | |
| Proportion who fished[b] | 0.62 (0.02) | 0.69 (0.02) | 0.75 (0.01) |
| Average number of fishing trips | 16.58 (1.00) | 17.97 (1.29) | 21.08 (1.05) |
| Average number of fishing days | 20.05 (1.06) | 21.30 (1.34) | 26.80 (1.17) |
| Average trip-related fishing expenditures (US$) | 343.79 (23.29) | 416.74 (30.21) | 488.42 (36.50) |
| Hunting | | | |
| Proportion who hunted[c] | 0.41 (0.01) | 0.40 (0.02) | 0.50 (0.01) |
| Average number of hunting trips | 13.17 (0.85) | 12.53 (0.93) | 15.45 (0.98) |
| Average number of hunting days | 17.29 (0.92) | 16.75 (1.02) | 20.16 (1.01) |
| Average trip-related hunting expenditures (US$) | 236.70 (20.33) | 267.06 (30.58) | 255.44 (16.32) |

[a]Source: Chu et al. (1989: Tables 5-10 and 5-11). Entries in parentheses are standard errors of the estimates. Panels A and B combined for reporting purposes.

[b]Includes all those who took at least one trip to fish during the study period.

[c]Includes all those who took at least one trip to hunt during the study period.

Finally, both areas (in Texas and Wisconsin) produced similar results, so they were merged for simplicity of reporting in Tables 2 and 3.

Estimates from the quarterly recall period for the number of anglers (shown in Table 2 as the proportion of the sample who fished) tended to be lower than those from the monthly panels. Estimates of average days, trips, and expenditures tended to be higher for the quarterly than for the monthly panels. These differences are statistically significant at fairly high levels of confidence. The point estimates for hunting followed a similar pattern, but the statistical evidence for a hunting trend is considerably weaker.

All estimates, even those for the number of participants, tended to increase with the length of the recall period (Table 3). Especially dramatic was the increase in the number of fishing and hunting trips and days reported for longer recall periods. However, except for estimates of participants, estimate increases associated with the annual recall of hunters were smaller than those of anglers. In addition, the percentage increases between the quarterly and annual panels differed for the three key measures: participants, days, and expenditures.

It is clear that recall effects do not cancel out. However, it is not clear that they are systematic in the sense that correction factors could be applied to annual survey results to produce estimates equivalent to those from a survey with a short recall period. Although it would be ideal if recall study results could be used to correct previously published national survey results, we recommend against attempting this because (1) the universe for the recall study comprised portions of two states rather than the nation, (2) the recall study excluded expenditures for most of the equipment items listed in the national survey, and, (3) the recall study excluded two activities (Great Lakes fishing and hunting for other animals) considered in the national survey.

The next national survey will feature a 4-month recall period and will include a separate annual recall panel. This design might permit estimation of correction factors for use with data from previous surveys. Also, forthcoming information on recall errors from that annual recall panel will be weighed against the higher costs of using shorter recall periods, thereby allowing the Service to design future surveys whose recall periods represent the best possible compromises between cost and accuracy.

The recall study found that avid[8] and less avid respondents reported differently, even though each group followed the general pattern of higher estimates associated with longer recall periods. Estimates for avid participants, especially anglers, grew slightly faster with longer recall periods than those for the less avid. As noted previously, no strong regional differences were observed.

Within the types of fishing and hunting, there appeared to be topic-specific differences. Recall changes with length of recall period were most pronounced for freshwater fishing and less pronounced for big game and migratory bird hunting. This might confirm the notion that respondents report their infrequent or important events more accurately than their routine or relatively unimportant events. However, some of these differences could be due to the timing of hunting seasons near the year's end, thus the effective length of the hunting recall period for the 6-month

[8]The recall study based avidity upon 11 days; that is, avid anglers fished 11 or more days in 1987, and avid hunters hunted 11 or more days in 1987. However, the general pattern holds when avidity is defined as more activity (e.g., 21, 41, or 61 days).

bag limits
catch per angler



and annual recall panels was less than the nominal recall period.

The key findings of the recall study are summarized above, but this paper does not address all of the comparisons that emerged from the recall study. Other findings and analyses are detailed in Chu et al. (1989).

## Topics for Future Research

Effective use of chronology and other memory aids is not well understood. Gems et al. (1982) determined that respondents began to report incorrect dates for saltwater fishing trips soon after taking them, although a calendar reference can improve response accuracy. Can the effective use of calendars stretch the optimal recall period? Can other memory aids, such as those used in the national survey, help to eliminate inaccuracies when longer recall periods are used? Results suggest yeses for each of these questions, but they have not been thoroughly evaluated.

A second topic is the relationship (if any) between recall inflation, the unintended overreporting of pleasurable events, and prestige bias, the deliberate overreporting of these events. Do they differ, or are they facets of a single phenomenon? If they differ, what causes recall inflation, and what changes in questionnaires or recall periods will minimize its effects on survey results?

Another topic for research is the relationship between recall inflation and memory decay. One hypothesis holds that recall inflation and memory decay are caused by the same cognitive processes. Under this hypothesis, the same factors that cause underreporting of unpleasant events for longer recall periods will cause overreporting of pleasant ones. It would be very useful to know if recall inflation is related to memory decay, because knowledge about such a relationship would help in the design of better surveys for all kinds of topics.

The finding that respondents often exaggerated days and expenditures as the recall period lengthened was consistent with some intuitive ideas and portions of the literature. However, the really unexpected finding was that estimates of the number of participants tended to be lower for the quarterly and 6-month panels than for the annual panel. Because this pattern held at high levels of statistical significance, further research should determine whether this is an idiosyncracy of the recall study or whether it is typical. If it is typical, further research should address why and how it occurs.

Finally, recall bias has been revealed as a complex concept. Even for a relatively topic-specific survey such as the national survey, no simple proportional relationships were found between the recall period and the accuracy of the survey's estimates. Simple comparisons of estimates for the number of anglers and days of fishing, or between fishing and hunting, show that recall accuracy differs for the topics covered by the national survey. Additional research is necessary to see whether there might be general rules to use for (1) optimal recall periods or (2) correction factors that convert longer recall period results into something that closely approximates results from surveys with shorter recall periods.

The issues that emerged from the recall study are important for any survey. Researchers should consider the need to identify and quantify the various separate impacts that longer (or shorter) recall periods have on survey responses. Information about how individuals remember events will enhance our understanding of the problems associated with recall and increase our abilities to solve them. This will lead to more accurate data, which serves everyone's interest.

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