

Increasing Creel Survey Efficiency: Early Termination of Survey on Inactive Days

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Abstract: Estimates were made of the percent of sport-boat interviews and retained fish that would be missed by terminating weekend surveys early when no anglers have been seen prior to specified times. Surveys could be terminated at 1200 hours during the summer and not miss more than 2% of the total interviews within any 1 bay system. Fall, winter, and spring surveys could be terminated at 1400 hours and no more than 4% of the total interviews would be missed. The percent of surveys that could be terminated early is highest in winter (37%–67%) and lowest in summer and fall (2%–10%). The percent of fish retained by anglers that would not be seen in interviews due to early termination was never more than 4% within any bay system and season.

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Marine recreational fishing is receiving increased recognition in fisheries research and decision making because the harvest and economic impact can no longer be considered an inconsequential use of fisheries resources (Deuel 1973). The recreational fishery annually lands approximately 3.6 million kilograms of seafood from Texas' coastal waters and is valued at approximately \$1.1 billion at the retail level. More than 1.1 million sport fishermen actively fish Texas' bays and the Gulf of Mexico and the trend in number of people fishing is increasing dramatically (McEachron and Green 1984).

The Texas Parks and Wildlife Department (TPWD) has monitored the weekend sport-boat fishery in the 7 major bay systems of Texas since 1974 using an on-site creel interview method (Heffernan et al. 1976, Breuer et al. 1977, Green et al. 1978, McEachron 1980a, 1980b, McEachron and Green

1981, 1982). The inefficient use of field personnel time is a chief economic concern of on-site surveys (Robson 1960). Methods of reducing the cost of conducting these surveys while minimizing loss of precision are needed.

The TPWD has continually modified its creel survey program to increase the amount of data collected per unit of effort by interviewers. During the 1976–77 study, TPWD changed from a completely random selection of interview sites to weighted site selection using angling pressure data obtained during the 1974–76 surveys, thereby increasing the number of interviews conducted per survey day. Daily interview periods were established based on analysis showing that the majority of sport-boat anglers completed their trips between 1000–1800 hours (Heffernan et al. 1976; McEachron, pers. commun.). McEachron (pers. commun.) also analyzed the mean daily trailer counts during 10 equal time periods (seasons) for each year from September 1975 to August 1978 and determined that a 2-season stratification for estimating fishing pressure was more efficient than the 4 seasons previously used.

These modifications increased creel sampling efficiency, but other factors such as bad weather and surveying boat ramps with little fishing activity have continued to result in survey days with few or no interviews. To reduce the amount of time spent on these surveys, this study was conducted to evaluate if and at what time such surveys could be terminated and how much information would be missed by so doing.

The objectives of this study were to: 1) estimate the percent of sport-boat angler interviews and retained fish that would be missed by terminating creel surveys at 1200, 1400, and 1600 hours on days when no interviews were conducted prior to these times, and 2) estimate the percent of days on which early termination can be expected to occur.

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Methods

Data for this study were collected from September 1976 through August 1978 (Green et al. 1978, McEachron 1980a) in Galveston, Matagorda (including East Matagorda), San Antonio, Aransas, Corpus Christi, upper Laguna Madre and lower Laguna Madre bay systems. Department personnel were stationed at boat ramps from 1000 to 1800 hours on randomly selected week-end days to collect harvest data by interviewing angling parties as they completed a trip. Interviewers recorded species, number, weights, and lengths of fish brought back by fishing parties as well as number of persons in the party, fishing location, gear used, and trip length. Interview sites were selected at random, but were weighted according to relative fishing pressure (Heffernan

et al. 1976, Breuer et al. 1977). This resulted in boat ramps with high fishing pressure being sampled more often than boat ramps with low fishing pressure. Each year was divided into 4 seasons: fall (1 Sep–30 Nov), winter (1 Dec–29 Feb), spring (1 Mar–31 May), and summer (1 Jun–31 Aug). Each bay was sampled 8 weekend days per season except Galveston Bay, where sampling occurred on 16 weekend days per season, and Matagorda Bay, where sampling occurred on 11 weekend days during the spring and summer seasons of 1978.

A necessary criterion before considering an early termination of a creel survey was that no interviews were conducted from the beginning of the survey (1000 CST) until a specified time. Three equally spaced terminating times between 1000 and 1800 hours (1200, 1400, and 1600 hours) were compared to determine the percent of interviews and retained fish which would be missed by terminating a survey at each time. Interviews conducted on each survey day were divided into 2-hour time periods (1000–1159, 1200–1359, 1400–1559, and 1600–1800 hours) by bay system and season in order to identify those days when no interviews were conducted prior to each termination time. On those days, any interviews conducted after the termination time were assumed missed and the percent of interviews and retained fish missed was calculated by dividing these data by all data collected during the season. The percent of interviews and retained fish missed were tested for significant differences among termination times, bay systems, and seasons using a 3-way analysis of variance (Sokal and Rohlf 1981). A posteriori testing of means was not possible since there was no replicate measures within cells. All analyses of variance were performed using a transformation ($\arcsine \sqrt{p_i}$).

Survey days could be categorized into 4 different types based on the time interviews were conducted with respect to a proposed termination time. Day type A was a day in which all interviews were conducted from 1000 hours to the termination time. Day type B was a day in which all interviews were conducted from the termination time to 1800 hours. Day type C was a day in which interviews were conducted before and after the termination time and day type D was a day in which no interviews were conducted. For each termination time, the number of days in each of 4 day types (A-D) was analyzed for significant differences ($P \leq 0.05$) among bay systems and seasons using a test of independence (Sokal and Rohlf 1981). The percent of days in each day type was calculated by dividing these data by the number of survey days in the season.

Results

A significant interaction between termination time and season prevented a straightforward test of main effects on percent of interviews and fishes missed. Inspection of the data indicated that this interaction was caused by a large decrease in the percent of interviews and fishes missed between 1200 and 1400 hours during the fall and a much smaller decrease between these 2 times

Table 1. Percent of interviews and retained fish that would be missed by terminating a survey at a specified time by seasons.

Seasons	Time:	Interviews missed (%)			Fish missed (%)		
		1200	1400	1600	1200	1400	1600
Fall		7.0	0.4	0.3	9.6	0.2	0.2
Winter		23.7	3.4	0.4	16.6	3.1	<0.1
Spring		11.0	2.5	0.6	6.8	1.5	0.2
Summer		1.4	0.1	<0.1	1.0	0.1	<0.1

in the summer. Removing data from 1200 hours and reanalyzing confirmed this observation. The percent of interviews and retained fish missed varied significantly ($P \leq 0.05$) among termination times and seasons but not among bay systems ($P \geq 0.05$). The largest percent of interviews that would be missed by terminating a survey at 1200 or 1400 hours occurred in the winter (23.7% and 3.4% respectively, Table 1). The smallest percent missed occurred in the summer, 1.4% and 0.1%, respectively). This pattern was paralleled by the number of fish missed (Table 2). For termination at 1400 hours, the number of interviews and retained fish missed each decreased to <3.5% during any season. At 1600 hours, the missed information decreased to <1% during any season.

For each termination time, the proportion of survey days in each day type varied significantly among bay systems and season ($P \leq 0.05$). However, some bay systems and seasons were similar ($P \geq 0.05$) within each termination time. Bay systems which were grouped together were not the same for each termination time (Table 2). The highest percent of survey days that could be terminated early occurred during the winter, while the lowest percent was during the summer or summer/fall for each termination time and bay system. During the winter, the percent of survey days terminated early ranged from 23% to 77% and during the summer or summer/fall ranged from 0% to 16%.

Discussion

Creel surveys conducted during all fishing days and time periods represent the most reliable survey methods for estimating recreational harvest information. However, time spent surveying during periods of low activity is costly and inefficient. Simply reducing the number of creel survey days would be most economical but will result in less precise estimates (Best and Boles 1956). However, the early termination of unproductive survey days could result in lower costs while maintaining approximately the same level of precision.

The advantages of terminating creel survey days early when no inter-

Table 2. Percent of survey days by day types (A = interviews conducted up to termination time only, B = interviews conducted after termination time only, C = days with interviews conducted before and after termination time, and D = days during which no interviews were conducted), termination times, bay system groups and seasons.

Termination time	Group ^a	Season	Day types				Early termination B + D	Total survey days
			A	B	C	D		
1200	1	Winter	6	31	38	25	56	80
		Fall/Spring	1	17	77	5	22	160
		Summer	3	5	92	0	5	80
	2	Winter	4	17	19	60	77	48
		Fall/Spring	2	37	53	8	45	99
		Summer	2	14	82	2	16	51
1400	1	Winter	14	12	49	25	37	80
		Summer/Fall	12	1	86	1	2	160
		Spring	4	8	80	8	16	80
	2	Winter	6	6	27	61	67	48
		Summer/Fall	9	7	81	3	10	99
		Spring	12	17	59	12	29	51
1600	3	Winter	25	0	29	46	46	48
		Fall/Spring	32	6	53	9	15	99
		Summer	37	0	61	2	2	51
	4	Winter	31	2	46	21	23	48
		Fall/Spring	21	1	74	2	3	96
		Summer	19	0	81	0	0	48
	5	Winter	16	9	22	53	62	32
		Fall/Spring	17	6	69	8	14	64
		Summer	19	0	81	0	0	32

^a Bay systems in each group are:

- 1 = San Antonio, Aransas, Corpus Christi, upper Laguna Madre, and lower Laguna Madre,
- 2 = Galveston and Matagorda,
- 3 = Matagorda, Aransas, and Corpus Christi,
- 4 = San Antonio, upper Laguna Madre, and lower Laguna Madre,
- 5 = Galveston.

views are being conducted would be 3-fold: 1) more effective use of personnel time, 2) improved personnel morale, and 3) improved public relations.

More effective use of personnel time would be accomplished by allowing survey personnel to use the remaining workday on other job duties. This, in turn, would often improve personnel morale. Athos and Coffey (1968) reported that most people want interesting, challenging, and varied work. Good morale stimulates employees to work harder, which results in more efficient output (Jucius 1967). Public relations would improve by decreasing the amount of idle time survey personnel are exposed to the public. TPWD survey personnel have received negative comments from the public concerning the apparently inefficient use of state employees' time and monies while sitting idly at boat ramps when there is little fishing activity.

The principal disadvantage of terminating surveys early is missed information caused by missing interviews. McEachron (pers. commun.) demonstrated that sport anglers do not complete their trips uniformly in time within

or among bay systems. However, this study indicated the amount of information missed by terminating unproductive surveys early was uniform among bay systems. The amount of information that was missed by terminating surveys after 1400 hours was minimal (<5% for any bay system). Data indicate that unproductive surveys could be terminated as early as 1200 hours during the summer season in all bay systems assuming the amount of missed information that can be tolerated is $\leq 5\%$. Conducting surveys until 1600 hours would decrease the amount of missed information to <1%.

The percent of surveys that could be terminated early (with the 5% tolerance for missed information) varied from 0% to 77% depending upon the termination time, season, and bay system. For all bay systems combined, an estimated 8% of summer surveys could be terminated at 1200 hours and 17% of fall, winter, and spring surveys combined could be terminated at 1400 hours. Using current TPWD creel procedures, this would allow the early termination of an estimated 124 surveys coastwide and allow survey personnel to spend an estimated 472 man-hours on other duties.

The interviews analyzed in this study only involved weekend sport-boat anglers and consequently the results do not reflect the percent of non-angling or weekday boat interviews that would be missed from surveys terminated early. The analysis of these data sets is recommended for future studies.

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