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RESULTS OF A PRIVATE BOAT ANGLING SURVEY FOR ESTIMATING CATCH AND EFFORT, CONDUCTED AT OCEANSIDE, CALIFORNIA DURING MAY AND JUNE 1974

by

Donald L. Schultze

MARINE RESOURCES

Administrative Report No. 75-11

December 1975

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ABSTRACT

Two survey methods (postcard and interview) for generating marine fish catch and effort estimates for private boats were field tested at Oceanside, California during May and June of 1974. Sampling days were pre-assigned to weekday and weekend strata. The postcard survey was shown to produce biased estimates. Causes of the various biases are discussed. The interview survey provided background data to test for biases in the postcard survey and between marina and launch ramp interview areas.

1/ Marine Resources Administrative Report No. 75-11 December 1975.

2/ Operations Research Branch, 350 Golden Shore, Long Beach, California 90802.

INTRODUCTION

This survey was undertaken as part of a cooperative effort by California Department of Fish and Game and National Marine Fisheries Service personnel to evaluate and expand management efforts associated with the stocks of southern California game fishes and pelagic fish resources. Cooperative meetings between both agencies held in March 1973 identified many of the problems associated with this evaluation and management. One of the problems is the lack of catch and effort information associated with the marine private boat sport fishing segment of the sport fishing industry in southern California waters.

Our objective for this limited study was to evaluate the effectiveness of two possible sampling methods to give relatively unbiased estimates of private boat sportfishing catch and effort. Funding for field work was provided through State-Federal contract No. 03-4-208-160.

California is one of a small number of states which regularly collects catch and effort information for a segment of its sport-fishery. The California commercial partyboat industry is required by law to submit daily fishing logs containing catch and effort information about each day's trips. While this information provides adequate estimates of catch and effort for this segment of the sportfishery, it is desirable when possible to obtain information from other segments of the fishery, particularly when they represent a significant part of the total catch and/or effort. Studies conducted by the California Department of Fish and Game during the years 1964 through 1966 (Pinkas, Oliphant, and Haugen 1968) showed

that an estimated 23% of the total southern California marine sport fishing effort (man hours) and 13% of the estimated total catch of fish (# of fish) in southern California waters was made by private boats. In addition, from 1964 to 1973 the number of registered private boats in southern California increased from 311,687 to 461,295, an increase of 48 over the 1964 value (Worrall, California Dept. Motor Vehicles Vessel Registration, pers. commun.). While only a fraction of this number are used for marine sport fishing, it is reasonable to assume that this sportfishing fraction is increasing in proportion to the increase in the total number of boats. Other factors relating to the importance of collecting private boat fishing information, in addition to partyboat information, are shown by differences in species and size composition of catches between the two boat types.

A Kolmogorov - Smirnov two-sample test (Siegel 1956) was used to compare the size composition of 1974 barracuda, *Sphyraena argentea*, and bonito, *Sarda chiliensis*, samples collected from partyboats and private boats during May and June (Table 1). For bonito, significant differences in the size composition between private and partyboat samples was shown. No such difference could be shown for barracuda, however. Significant chi square values were obtained when we compared the species composition of partyboat catches and private boat catches sampled from the survey area for the months of May and June (Table 2). This indicates that the two fishing groups may utilize different size and species composition of some stocks of game fishes. Pinkas, et al. (1968) observed differences in the species composition of catches made by private boats and partyboats and in the relative importance of each species to the two fishing

TABLE 1. Kolmogorov-Smirnov Two Sample Test - Compares Length Frequencies of Catch by Private and Partyboats.

	Private boat (n_1)	Partyboat (n_2)	$D = 1.36\sqrt{\frac{n_1+n_2}{n_1 n_2}}$	Observed value	Significant
Barracuda	263	165	0.13457	0.0947	NO
Bonito	298	149	0.13646	0.1980	YES

TABLE 2. Chi Square Test for Significance - Comparison of Species Composition - Partyboats Versus Private Boats

Month	Degrees of freedom	Number in sample	x^2 value	Level of * significance
May	8	8404	150.48	< 0.005
June	8	18913	308.75	< 0.005

* Probability of chance deviation between O and E

groups. Also of concern to management efforts is the fact that present sampling by Department personnel indicates that less than 50% of the barracuda caught and landed by private boat anglers were larger than the legal limit of 28 inches (71.1 cm). The total extent of such fishing pressure on younger age groups can only be estimated from private boat samples collected on a regular basis.

MATERIALS AND METHODS

In consideration of the time and money available for this study, we felt it would be best to concentrate our efforts upon an isolated marina or harbor where a small number of individuals could operate more effectively. We then designed the study to evaluate two possible approaches for determining the catch and fishing effort of private boats fishing from Oceanside's small craft harbor (Figure 1). Oceanside harbor was picked because it best fit the conditions we were looking for in a study site. Oceanside marina has moorings for approximately 700 small craft moored within two basins. Vessels entering or leaving the mouth of the harbor can be observed from either basin as well as from the small craft launching ramp and the live bait barge.

The two survey methods decided upon were a postcard survey and an interview survey. Both methods have been used on numerous occasions in the past for surveys dealing with catch or bag success rate, species composition, and effort. The interview survey was conducted by two people on each scheduled weekday and four people on the weekend days. One sampler was stationed at the only launch ramp available for private trailorable boats in Oceanside. Here he interviewed boat owners as they returned from their fishing trip. The other samplers interviewed skippers of returning boats who tied up at permanent marina docks. The marina samplers were in contact with the launch

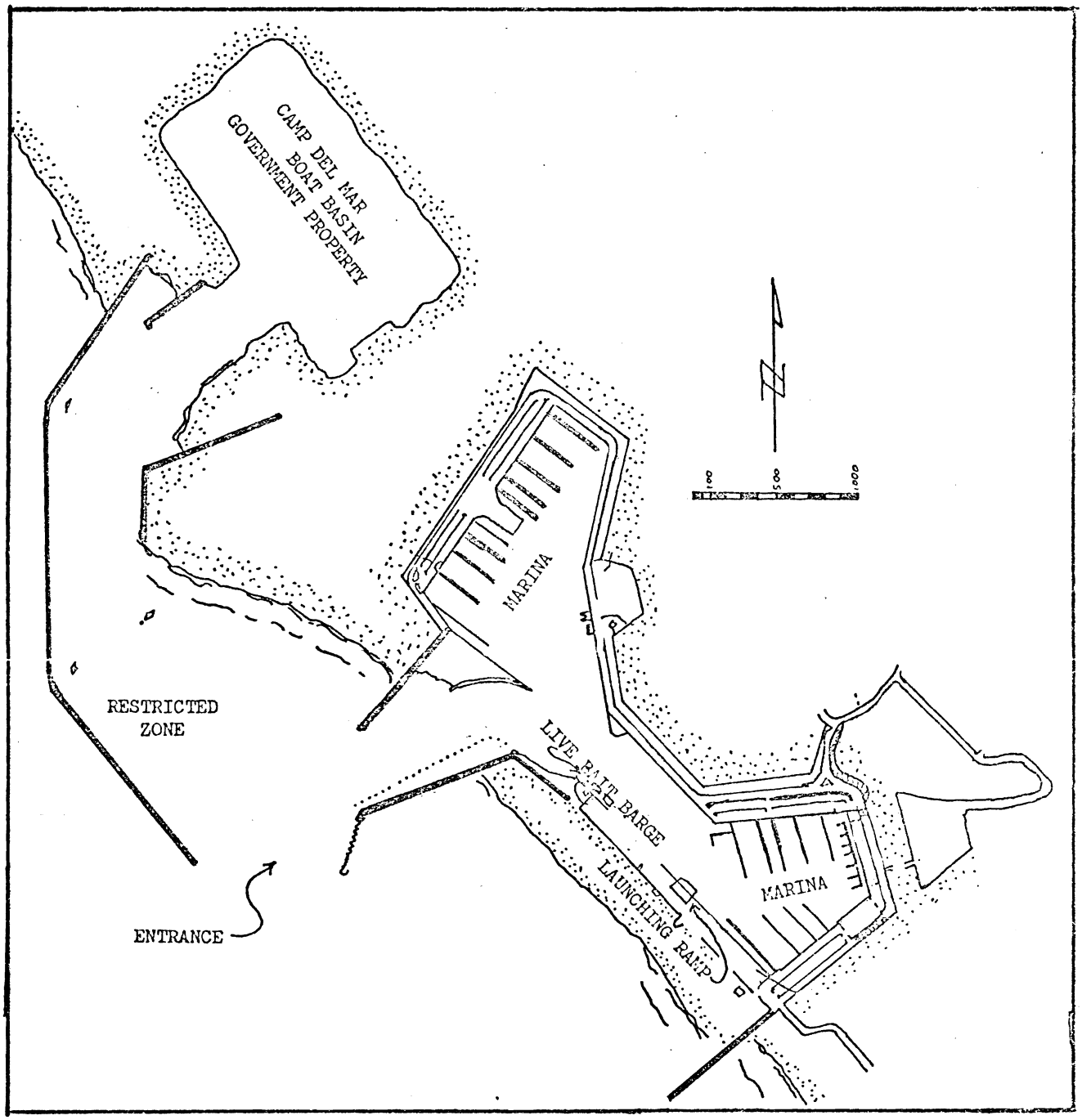

FIGURE 1. Oceanside small craft harbor.

ramp sampler via radio. The location of the launch ramp made it possible for the sampler at this point to help spot returning marina boats and relay their positions and descriptions to the marina samplers. This helped reduce the number of returning boats missed by samplers on interview days to essentially zero.

Our samplers began work at 1100 hours and continued interviewing returning fishermen until 1900 hours. These were the hours we felt would provide the greatest coverage of returning fishermen. Periodic checks and observations made by the postcard sampler at the live-bait barge confirmed that boats generally did not begin to return from fishing until 1100 hoursunless weather conditions forced their early return to the harbor.

The postcard survey consisted of stationing a person on the local live-bait barge to hand out prepaid, self-addressed, postcard questionnaires to the skipper of each boat stopping for bait (Figure 2). The skippers were asked to fill out the questionnaires upon returning from their fishing trip and then return the card to us in the mail. A form letter was also given to each of the skippers at this time explaining the purpose and goals of the survey as well as the need for their cooperation.

The sampler began handing out postcards at 0530 hours or when the first fisherman showed up at the live-bait barge to obtain bait. He worked 8 hours with a 1/2-hour break for lunch, finishing work at 1400 hours. Periodic checks showed that very few fishermen departed to go fishing later than 1400 hours.

Published results of postcard surveys in the past have reported large positive response errors in the information provided by respondents. However, we felt that because postcard surveys are

DEPARTMENT OF FISH AND GAME
Ocean Fishing Survey

Please answer the following questions upon returning from your fishing trip.
How many people fished? 4
How long did you fish? 7 hrs.
Where did you fish? 7 miles so. of Oceanside
Did you fish with: live bait x lures x troll ____
How many of the following fishes did you catch?

1	bonito	2	rockfish
____	mackerel	____	white seabass
8	barracuda	____	yellowtail
____	calico bass	____	perch
5	barred sand bass	____	white croaker
____	spotted sand bass		(kingfish)
3	halibut	____	other _____

FIGURE 2. Sample postcard questionnaire given to fishermen from Oceanside live-bait receiver.

relatively inexpensive methods of gathering information and the method could be expanded at a later date to include other coastal areas, it would be worthwhile to explore its usefulness for our purposes. We needed to determine whether or not we could obtain relatively unbiased estimates of catch and effort from the postcard survey. The interview survey was conducted primarily to supply background information with which to check for the presence of sampling and response errors within the postcard survey.

The two survey methods were conducted on separate days to avoid biasing results of one method with contact made during the other survey. No attempt at random sampling was made because of the short term nature of the survey, and because we were more concerned with obtaining samples large enough to identify the presence of biases. Weekdays (Monday through Friday) were considered a separate stratum from weekends (Saturdays, Sundays, and holidays) and within these strata the two survey methods were alternated from day to day. In other words, during the weekday stratum a day would be spent handing out postcards from the live-bait barge and the following day we would interview returning fishermen at the launching ramp and the marina. The sampling portion of the survey began during the second week in May and was concluded on June 29th.

RESULTS

Postcard Survey

The number of postcard questionnaires handed out in June was not recorded by our samplers and, consequently, values for individual days or strata for the June postcard portion of the survey could not be calculated.

In May, a total of 159 postcards was handed to private boat skippers from the live-bait barge. A total of 48 (30%) cards was returned. While this degree of response appears low, it is similar to response rates of 30 to 40% obtained during other postcard surveys. Interviews for this same period of time numbered 178.

Sampling Bias

To determine if the two different survey methods were contacting equivalent numbers of boats from both the bait barge and the marina-launch ramp areas, a t-test comparison of the mean number of boats per day was made (Table 3). The number of boats per day within a stratum should be relatively constant for consecutive days. Significant differences in this value would indicate that sampling error is present, and that one survey method would be contacting a greater or lesser number of boats than the other method. No significant difference at the 95% level of confidence could be shown to exist for May data. Incomplete postcard data prevented us from testing this for June. Because of the survey's design, we could test only for the presence or absence of sampling error and not its magnitude.

The t-test comparison indicated no significant sampling error to be present in the number of boats sampled each day. However, it was noted that while all boats sampled during the postcard survey days carried live bait, those boats sampled at the marina-launch ramp areas on alternate days did not always carry live bait. During May, 37.6% of the total boats interviewed at marina-launch ramp sites did not fish with live bait. During June, 20.4% of those interviewed at marina-launch ramp sites fished without live bait. This means that when we limited our sampling to the handing out of postcards from the live-bait barge we missed a substantial number of boats fishing with a

different type of bait (lures, frozen bait). Those vessels not fishing with live bait were not sampled by the postcard survey because they did not stop at the live-bait barge when leaving the harbor.

If future postcard sampling from a bait barge could be expected to provide representative and unbiased data for the entire private boat fishery, it is necessary to show that no significant differences in catch rate or species composition exist between those using live bait (generally considered more effective in catching fish) and fishermen not using live bait. Chi square comparisons were made of the number of fish caught per angler hour fished by interviewed fishermen using live bait and those interviewed and not using live bait. This tested the null hypothesis that there was no difference between the success rate (# fish/angler hour) of fishermen using live bait and those not using live bait (Table 4). Because of the small sample size for the weekday interview strata, chi square tests were restricted to weekend strata and total number of anglers for May and total number of anglers for June. Chi square values for the monthly totals indicate that live-bait fishermen are more successful than those fishing without the use of live bait. The chi square values for the weekend strata are less conclusive than we would expect from looking at the chi square values for monthly totals. The figure for the weekend strata in May however is very close to being significant at the 0.90% confidence level. The lack of significance for the June weekend strata is difficult to explain. If fishing is generally good and many species of fish are in abundance, then the live-bait factor may weigh less heavily on the success of a fishing trip. Fishing conditions (weather and fish availability) were much improved in June from those

TABLE 3. t-Test for Significance - Compares the Number of Private Fishing Boats Per Day Contacted at the Live-Bait Receiver and at the Marina and Launch Ramp Sites.

Month	Degrees of freedom	Number in sample	Value	Level of * significance
May	6	75	1.596	<0.10

* Probability of obtaining chance deviation as large or larger than observed value

TABLE 4. Chi Square Test for Significance - Compares the Number of Fish/Angler Hour Caught by Interviewed Fishermen Using Live Bait and Those Not Using Live Bait.

Month	Strata	Degrees of freedom	Number in sample	x^2 value	Level of * significance
May	Weekend	2	122	4.600	<0.25
May	Total	2	167	14.929	<0.005
June	Weekend	2	180	1.480	>0.25
June	Total	2	213	7.543	<0.025

* Probability of chance deviation between O and E

in May. While these chi square values do not ensure certainty, a good probability exists that postcard sampling from a bait barge introduces a positive bias into the estimates of angler success. This should be considered a factor when designing future sampling programs which may involve sampling from any restricted facility or area.

To eliminate postcard sampling bias caused by fishing with live bait it would be necessary to hand out the postcards randomly from the marina and launch ramp areas to ensure that boats not using live bait would have the same opportunity of receiving a postcard as those vessels using live bait.

The chi square values comparing the success of fishermen using live bait and those not using live bait were derived using interview data only. This was done because the data were collected on the same days and because the catch figures from the postcard returns contains an additional form of bias.

Response Bias

When the number of fish caught per angler hour by interviewed fishermen using live bait is compared with that caught by the postcard respondents (who also used only live bait), any differences reflected as chi square values should be due to response bias present in the information from postcard respondents (Table 5). Response bias generally exists in the form of exaggerated catch or effort figures when postcard responses are compared with some known background figure determined through an interview or other method. However, little or no response bias should exist within the interview survey data. Because of the small number of postcards returned each month, 48 in

May and 29 in June, it was necessary for chi square tests to include all respondents and interviewed fishermen using live bait within a month, without regard to weekend or weekday strata. The chi square value for May is significant and indicates that response bias is present in the catch figures returned by postcard respondents. The chi square figure for June does not show this same degree of significance but is high enough to be suspicious. Hjersman (1951), Atwood (1956), Abramson and Berude (1969), and Calhoun (1950) all analyzed postal card survey data and came to the conclusion that postcard respondents tend to overestimate catch statistics by varying amounts. The main reasons for the exaggeration in their cases is memory failure with a tendency to overestimate their own success due to the relatively long time which had elapsed between the actual fishing or hunting and the request for the catch or bag information.

This is not felt to be the main reason for the differences in our figures. Our postcards were handed out at the very start of a fishing trip. The period of time elapsing between the actual fishing activity and the completion of the card and return to us was, by comparison with other surveys, very short. Of the 48 postcards returned in May, 42 were postmarked the same day that they were handed out. It appears that if the postcard is not filled out and mailed shortly after it is handed out, then it stands little chance of being returned. What then caused the postcard respondents to report a significantly higher catch rate? Reexamination of the postcard returns showed that some fishermen reported not only those fish caught and kept but those fish caught and released back into the water, probably accounting for the major portion of the response

bias. While some fishermen stated on the cards that those fish reported had been returned to the water, many more fishermen may have reported fish returned to the water without stating this on the postcard. This problem occurred because of our failure to specify on the postal card that we wished the skippers to record only those fish caught and kept. This could be corrected in the future by more careful attention to wording of the questionnaire.

Non-response Bias

The third form of bias which we were concerned about in this study was that of non-response error. "Non-response error", in the words of Norman Abramson (1963), "occurs when the tendency to respond is correlated with the value being estimated." If those fishermen who caught fish tend to respond more than those fishermen who did not catch any fish, "then non-response errors occur since the respondents do not represent the population." To test for the presence of non-response error, we compared the number of postcard respondents and those anglers interviewed who caught no fish on their fishing trip (Table 6). Chi square values for May were significant at the 99.5% level while the chi square figure for June was significant at between the 75 and 90% level of confidence. These values, while suggesting the presence of non-response bias, are suspect for the reason stated above that many of the postcard returns reported fish which were caught and not kept. This would probably reduce the number of postcard respondents reporting zero catches and makes it impossible to say whether the significant chi square figures were due to non-response or to reporting of fish caught but not kept by postcard respondents. To correct for

TABLE 5. Chi Square Test for Significance - Compares the Number of Fish/Angler Hour Caught by Those Private and Partyboat Fishermen Using Only Live Bait.

Month	Strata	Degrees of freedom	Number in sample	x^2 value	Level of * significance
May	Total	3	147	7.866	<0.05
June	Total	3	201	4.953	<0.25

* Probability of chance deviation between O and E

TABLE 6. Chi Square Test for Significance - Compares the Number of Zero Catches Reported by Interviewed Fishermen and Postcard Respondents.

Month	Degrees of freedom	Number in sample	x^2 value	Level of * significance
May	1	226	13.518	<0.005
June	1	245	2.471	<0.25

* Probability of chance deviation between O and E

non-response bias when it is shown to be present, it is necessary to either mail follow up questionnaires to those people who don't respond during the initial survey request, or to have a field survey of non-respondents. We had neither the means nor manpower to initiate either of these methods.

Launch Ramp and Marina Interview Survey

In May we interviewed a total of 178 boats, 92 at the launch ramp and 86 at the marina docks (Table 7). In June the figures were 216 total, 155 launch ramp boats and 61 marina based boats. Improved weather and fishing conditions in June seem to have attracted more trailorable boat owners, while fishing activity from marina based boats actually declined. No explanation has been found for this decline in marina fishing effort.

About 74% of all boats interviewed in May were interviewed on weekends. In May 77% of those boats interviewed at the launch ramp were interviewed on weekends, while 70% of all those boats interviewed at the marina dock in May were interviewed on weekends. In June about 84% of all boats interviewed were fishing on weekends, with 88% of the June sampled launch ramp boats fishing weekends and 74% of the interviewed marina boats fishing on weekends. As expected, fishing activity by both marina and launch ramp boats is concentrated on the weekends. Our sampling also indicates that with an increase in total fishing effort in June and improved weather conditions the proportion of those people fishing on weekends increased.

In June the launching ramp boats provided the majority of the private boat fishing effort. Because of this it is of interest to determine whether there are significant differences in the success

TABLE 7. Catch, Effort, and Catch per Unit of Effort Values Obtained From Private Boat Sampling.

		INTERVIEWS							POSTCARDS		
		LAUNCH RAMP			MARINA			Grand	LIVE-BAIT BARGE		
	Month	Week-ends	Week-days	Total or avg.	Week-ends	Week-days	Total or avg.	Total or avg.	Week-ends	Week-days	Total
Number of days sampled	May	3	8	11	3	8	11	11	4	7	11
	June	5	8	13	5	8	13	13	4	7	11
Number of boats	May	71	21	92	60	26	86	178	128	31	159
	June	136	19	155	45	16	61	216	37	11	48
Number of anglers	May	124	54	178	109	64	173	351	122	32	154
	June	388	52	440	155	41	196	636	*	*	102
Number of angler hours	May	981	315	1296	738	292	1030	2326	638	172	810
	June	1840	267	2107	720	182	902	3009	*	*	717
Avg. trip length (hr.)	May	4.8	5.2	4.9	3.5	4.3	3.8	4.4	5.162	5.455	5.2
	June	4.7	4.6	4.7	4.4	4.0	4.3	4.6	*	*	7.1
Number of fish	May	292	94	386	182	83	265	651	341	174	515
	June	722	87	809	356	50	406	1215	*	*	544
Number of anglers per trip	May	1.75	2.57	1.93	1.82	2.46	2.01	1.97			
	June	2.85	2.74	2.84	3.44	2.56	3.21	2.94			

* Figures not available

rates and or species composition of catches made by the fishermen using different facilities. Boats permanently moored at marina docks are generally larger, (20 plus feet), than launch ramp boats and can potentially carry more people. They may also carry more sophisticated fish finding equipment and may have greater live bait capacity. Boats using the launching ramp facilities seldom exceed 20 to 25 feet in length, and are generally open boats, often with canvas shelters. Chi square tests were made of the species compositions and the number of fish caught per angler hour fished for launch ramp and marina boats. Chi square figures obtained from the comparison of the number of fish per angler hour caught by marina boat fishermen and launch ramp fishermen were not significant for May or June, indicating that there is no appreciable difference in the success rate of launch ramp fishermen and marina boat fishermen (Table 8). Chi square comparisons of the relative number of marina and launch ramp boats using live bait indicates no significant difference in the use of live bait by launch ramp and marina boats (Table 9). A comparison of the species composition of catches sampled from marina boats and launch ramp boats showed significant differences for both months (Table 10). It is questionable whether the species composition results indicate a real difference in the type of fishing activity by the two groups of fishermen or whether the natural variations in catch account for the significant difference. The lack of significance for the number of fish per angler hour between launch ramp and marina boats suggest the latter, as different success rates would probably be obtained if the two groups were pursuing different species of fish.

TABLE 8. Chi Square Test for Significance - Compares the Number of Fish/Angler Hour Caught by Marina Boats and Launch Ramp Boats.

Month	Degrees of freedom	Number in sample	x^2 value	Level of * significance
May	3	164	3.070	>0.25
June	3	213	3.693	>0.25

* Probability of chance deviation between O and E

TABLE 9. Chi Square Test for Significance - Compares the Number of Marina and Launch Ramp Fishermen Using Live Bait.

Month	Degrees of freedom	Number in sample	x^2 value	Level of * significance
May	1	167	0.745	>0.25
June	1	214	0.299	>0.25

* Probability of chance deviation between O and E

TABLE 10. Chi Square Test for Significance - Compares the Species Composition of Catches Made by Launch Ramp and Marina Boats.

Month	Degrees of freedom	Number in sample	x^2 value	Level of * significance
May	8	659	30.22	< 0.005
June	9	1165	43.27	< 0.005

* Probability of chance deviation between O and E

Estimates of Total Catch and Effort

In May an average of 1.9 anglers per trip fished an average of 4.1 hours per trip. In June an average 2.9 anglers per trip fished an average of 4.6 hours per trip. Launch ramp boats carried fewer passengers per trip than did marina based boats. However, they averaged longer fishing trips than did marina based boats. The generally smaller size of the launch ramp boats probably accounts for the reduced passenger loads. The effort that is required to launch a boat at the launch ramp is generally greater than the effort required for getting under way from a marina slip. This greater effort at the launch ramp may result in longer fishing trips on the average to compensate for the added effort of launching the boat.

Estimated monthly totals for number of fish caught, number of angler hours fished and number of fish caught per angler hour fished were calculated for weekday, weekend-holiday strata and for marina and launch ramp area under each strata (Table 11). The ratio estimate technique described by Cochran (1963) was used to make the estimates. Our sampling plan was neither stratified random sampling nor stratified systematic sampling and therefore the available variance formulae could not be applied to our ratio estimates. Calculation of estimated totals was not a priority of this study but was performed so that we could make a rough comparison with the reported Oceanside partyboat catch for May and June. Our estimates of catch and effort are minimal estimates as we assumed 100% coverage for sample days, when in reality we did miss a few boats on certain days. The overall private boat catch per angler hour calculated for May and June was 0.362 fish. This compares closely to the 0.306

TABLE 11. Estimated Private Boat Totals for Month.

Month	Strata	Area	Number of fish	Number of angler hours	Number of fish angler hours
May	weekends	launch ramp	897.03	2979	.301
	weekends	marina	540	2156.25	.250
	weekdays	launch ramp	255.75	866.25	.295
	weekdays	marina	280.5	809.6	.346
	Total		1973.28	6811.1	.290
June	weekends	launch ramp	1552	3652	.425
	weekends	marina	690	1440	.479
	weekdays	launch ramp	217.5	667.6	.321
	weekdays	marina	125	458.7	.272
	Total		2584.5	6218.3	.416
May & June	weekends	launch ramp	2553.22	6695.2	.381
	weekends	marina	1246.97	3417.04	.365
	weekdays	launch ramp	472.5	1527.96	.309
	weekdays	marina	399	1254.75	.318
	Total		4671.7	12894.95	.362

fish per angler hour calculated by Pinkas et al. (1968) for the total southern California private boat fishery of 1964. Partyboat catch per angler hour figures for May and June are not yet available for comparison with our private boat estimates. Catch (# of fish) figures are, however, available from partyboats fishing out of Oceanside during May and June (Table 12). The total estimated number of fish caught by private boats from Oceanside (4,671 fish) accounts for about 14% of the estimated total party and private boat catch (32,277 fish) for May and June.

The total estimated catch for each species listed on our sampling form was not calculated; however, an idea of the relative importance of each can be gained from the interview data (Table 13). For both partyboats and private boats fishing out of Oceanside, four categories of fish, the basses (kelp, *Paralabrax clathratus*; barred sand, *P. nebulifer*; and spotted sand, *P. maculatofasciatus*); white croaker, *Genyonemus lineatus*, rockfishes, *Sebastes* spp., and California barracuda accounted for about 80 to 85% of the total catch during May and June. Private boat catches of sculpin, *Scorpaena guttata*, ranked 5th in partyboat catches, were recorded under other fish during our private boat survey. Sculpin were not expected to be as numerous as we found them to be during the survey, otherwise we would have created a separate place for them on our survey sheet. Halibut, *Paralichthys californicus*, and yellowtail, *Seriola dorsalis*, were available to fishermen during May and June off Oceanside and considerable effort was made to pursue these species by both private and partyboats. Bonito were relatively scarce in the Oceanside area during the survey. During the 1964 private boat survey of Pinkas et al. (1968) the bonito

TABLE 12. Partyboats - Number of Fish Reported Caught by Oceanside Partyboats During May and June 1974.

Rank	Species Common name	Scientific name	May	% Comp.	June	% Comp.	Total	% Comp.
1	kelp Bass barred sand spotted sand	*Paralabrax clathratus* *P. nebulifer* *P. maculatofasciatus*	3376	37.51	9342	50.21	12718	46.07
2	White croaker	*Genyonemus lineatus*	2445	27.17	5001	26.88	7446	26.97
3	California barracuda	*Sphyraena argentea*	687	7.63	1301	6.99	1988	7.20
4	Rockfishes	*Sebastes* spp.	616	6.84	855	4.59	1471	5.33
5	Sculpin	*Scorpaena guttata*	697	7.74	588	3.16	1285	4.66
6	Bonito	*Sarda chiliensis*	167	1.86	582	3.13	749	2.71
7	Yellowtail	*Seriola dorsalis*	407	4.52	221	1.19	628	2.28
8	California halibut	*Paralichthys californicus*	93	1.03	176	0.95	269	0.97
9	Mackerel Pacific jack	*Scomber japonicus* *Trachurus symmetricus*	33	0.37	217	1.17	250	0.91
10	Ocean whitefish	*Caulolatilus princeps*	63	0.70	100	0.54	163	0.59
11	Other		417	4.63	222	1.19	639	2.31
	Total		9001	100.00	18605	100.00	27606	100.00

TABLE 13. Private Boats - Number of Fish Sampled During Interview.

Rank	Species: Common name	Scientific name	May	% Comp.	June	% Comp.	Total	% Comp.
1	White croaker	*Genyonemus lineatus*	222	34.10	494	40.66	716	38.37
2	kelp Bass barred sand / spotted sand	*Paralabrax clathratus* / *P. nebulifer* / *P. maculatofasciatus*	137	21.04	383	31.53	520	27.87
3	Rockfishes	*Sebastes* spp.	91	13.98	78	6.42	169	9.05
4	California barracuda	*Sphyraena argentea*	67	10.29	40	3.29	107	5.73
5	California halibut	*Paralichthys californicus*	25	3.84	44	3.62	69	3.70
6	Yellowtail	*Seriola dorsalis*	21	3.23	39	3.21	60	3.22
7	Bonito	*Sarda chiliensis*	6	0.92	32	2.63	38	2.04
8	Surfperch	Embiotocidae	32	4.92	1	0.08	33	1.77
9	Mackerel Pacific / jack	*Scomber japonicus* / *Trachurus symmetricus*	0	0.00	11	0.91	11	0.59
10	White seabass	*Cynoscion nobilis*	0	0.00	5	0.41	5	0.27
11	Other		50	7.68	88	7.24	138	7.39
	Total		651	100.00	1215	100.00	1866	100.00

ranked one and two for private boats and partyboats respectively. There is general agreement between the ranking of the seven or eight most commonly caught fishes in May and June for both private and partyboats.

CONCLUSIONS

Postcard sampling from a live bait receiver does not appear to be the most practical method of surveying private boat catch and effort because of biases introduced into the estimates. Due to differences in catch success rates of live-bait users and those not using live bait, sampling bias could be introduced into future survey results if limiting sampling to a live-bait facility. Response bias was shown to be present in the information supplied by postcard respondents. The exact cause of this response bias could not be identified but it is felt to be due in most part to postcard respondents reporting not only those fish caught and kept but also those fish caught and released back into the water. This occurred because of our failure to specify on the postcards our desire for information about only those fish caught and kept. Tests indicating the presence of non-response bias were felt to be suspect due to the reporting of fish caught and returned to the water by postcard respondents. This would result in a decrease in the number of postcard respondents reporting zero fish for a fishing trip.

The elimination of these three forms of bias in future postcard sampling schemes could be accomplished to varying degrees. The sampling bias could be eliminated only by handing out cards from locations (marina and/or launch ramp) where live-bait users and those not using live bait stand an equal opportunity of receiving

a postcard. Response bias is difficult to eliminate or measure in a mail survey as the response bias may vary for each characteristic measured and between different areas sampled. Non-response bias can be detected and can be corrected by field surveys or mailing follow up questionnaires to those people not responding, but involves additional costs.

The advantage of one sampler being able to contact many boats from the live-bait facility is offset by the sampling biases introduced into the data. Handing out postcards at the launch ramp or the marina would reduce the sampling bias; however, differences in the number of passengers per boat at these two facilities would introduce new errors into estimates made from the data. Also, response and non-response errors would not be reduced by switching the postcard distribution from bait facility to the launch or docking facility.

An interview survey has advantages over a postcard survey which make it much more attractive for estimating catch, effort and catch per unit of effort values. Sampling bias can be avoided by careful design. Response and non-response bias are reduced or eliminated through personal contact with each fisherman. More detailed information about length of trip, location, type of fishing and fish caught can be obtained. Catches can be examined for proper species identification, counts, and the length frequencies of each species may be obtained. The survey design of Pinkas et al. (1968) is a practical approach to private boat interview sampling. It has the necessary flexibility to operate and adjust itself to a wide range of funding. Variance estimates can be calculated for any

level of sampling intensity.

Sampling of California's marine private boat sport-fishermen will undoubtedly be initiated sometime in the future at some presently undetermined level of intensity. After reviewing past and present surveys, I feel a direct contact approach to sampling, i.e. interviewing returning fishermen, will produce more valid estimates of catch and effort as well as size and species composition which could not be obtained as accurately by mail. The greater information derived from an interview survey is felt to justify the need for more personnel to conduct this type of survey.

I would like to acknowledge the cooperation of the Oceanside Harbor Police who provided us access to the launch ramp and marina areas.

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