Comparison of Bait Types Used by Saltwater Sport-boat Anglers in Texas

Mike G. Weixelman, *Texas Parks and Wildlife Department, Coastal Fisheries Branch, 2200 Harrison, Palacios, TX 77465*

Peng Chai, *Texas Parks and Wildlife Department, Coastal Fisheries Branch, 4200 Smith School Road, Austin, TX 78744*

Abstract: Using results from on-site creel interviews, the use and fishing success of 16 bait types for 8 game fishes were studied for bay and pass saltwater sport-boat anglers in Texas. The success of catching at least 1 fish was evaluated using percentage of successful fishing parties by fish species, bay system, and bait type. For all fish species, the use of different baits was not proportional to the success of these baits in catching fish; however, we could not determine whether this was caused by ineffectiveness of the investigated bait or anglers not directing this bait toward the investigated fish. A logistic regression model fitting the effects of bay system and bait type for each fish species adequately described the odds of success for fishing parties.

Proc. Annu. Conf. Southeast Assoc. Fish and Wildl. Agencies 45:347–354

According to Royce (1983), the measure of success in fishery science was a satisfied user of the recreational fishery. Royce predicted that the challenge of fishery science in the next decade was to deliver information to its clients (the anglers) in ways that would lead to greater angler satisfaction. According to Stroud et al. (1982), an early assertion of fishing quality was made by Swingle (1950) who indicated that a satisfactory state of fishing was based on the frequency of catching acceptable size fishes.

Making more information available to the angling public on the use and relative effectiveness of bait types may increase angler success in landing acceptable size fishes in coastal bays and passes. The Texas Parks and Wildlife Department (TPWD) has collected data on bait types used by saltwater sport-boat anglers in 7 major bay systems of Texas since 1974 using on-site creel interview methods (Green et al. 1978, Heffernan et al. 1976, Osburn and Ferguson 1987).

Using 16 bait types, this study was conducted to determine if fishing success significantly varied by bay systems and bait types for 8 game fishes for bay and pass saltwater sport-boat anglers. This information may help not only saltwater anglers to increase fishing success, but also, in the absence of adequate fishery independent

data, fishery managers to assess trends in fish populations. Fishery managers need to understand the relationship between fishing success and bait types so that changes in fishing success can be assessed against any changes in bait types used by anglers.

The objectives of this study were to: 1) determine the percentage of bay and pass saltwater sport-boat fishing parties by bait types, 2) determine the percentage of fishes landed by bait types, 3) compare fishing success by bait types, and 4) compare mean total lengths of fishes by bait types.

We would like to thank each member of the TPWD Coastal Fisheries Sport Harvest Program for conscientiously collecting data, Lisa Jaramillo and Rhonda Mokry for preparing the tables, and Maury Osborn, Peter Rubec, Ted Storck, Gene Wilde, and an anonymous reviewer for providing valuable comments. Special thanks to Phil Unger for assistance in data analysis. This study was partially funded by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service under PL 88-309, and the U.S. Department of Interior, Fish and Wildlife Service under D.J. 15.605.

Methods

Data used in this study were collected from 15 May 1983 through 14 May 1987 (Osburn and Ferguson 1987) on randomly selected weekend days and weekdays in Galveston, Matagorda (including East Matagorda), San Antonio, Aransas, Corpus Christi, and upper and lower Laguna Madre bay systems. Methods used to survey sport-boat anglers (including private, party, and tournament) were described in Heffernan et al. (1976), Green et al. (1978), and Osburn and Ferguson (1987). Landings data were collected by interviewing sport-boat anglers as they completed a trip.

Sixteen bait types were compared: 12 single and 4 combination bait types. Whenever a fishing party used 2 bait types, both baits were recorded unless a bait was used during more than 85% of the trip or harvested greater than 85% of the landings. When 2 baits were recorded, they were categorized as natural baits combined, artificial baits combined, or natural and artificial baits combined. Three or more baits combined were given 1 type.

The percentage of bay and pass saltwater sport-boat fishing parties that used each bait type was calculated by dividing those fishing parties by the total number of fishing parties. The percentage of fish landed on each bait type was calculated by dividing the number of those fish by the total number of fish landed by species. The percentage of successful fishing parties in each bait type was calculated by dividing the number of successful fishing parties using a bait by the total number of fishing parties using that bait. For each species, a fishing party was considered successful if they landed at least 1 fish. Mean total length of fish landed was the mean of all measured fish by species and bait type; up to 6 fish were randomly chosen and measured for each fishing party interviewed.

Multiple goodness of fit comparison tests for frequency data (Sokal and Rohlf 1981) were used to compare bait use patterns between bays. The relationship between

bays and bait types on fishing party success was examined for each fish species separately. GLIM (Generalized Linear Interactive Modeling) program was used to fit, by maximum likelihood, the following logistic regression model (McCullagh and Nelder 1989) to the data of fishing party success:

$$\text{Ln}(P_{\text{success}}/P_{\text{not success}}) = \text{Bay}_i + \text{Bait}_j,$$

where Bay_i = effect of 1 of the 7 bay systems, Bait_j = effect of 1 of the 14 bait types, and the logit $\text{Ln}(P_{\text{success}}/P_{\text{not success}})$ = natural logarithm of the odds ratio, i.e., proportion of successful parties in each bay × bait combination divided by the unsuccessful parties. Bait types "sea lice" and "undetermined baits" were excluded for analysis because of insufficient sample sizes.

Results

A total of 28,092 fishing parties were interviewed during the study period. Coastwide, live shrimp ranked first in bait use with 34% of the fishing parties using them (Table 1). Dead shrimp, worm jigs, and spoons ranked second (12%), third (11%), and fourth (8%), respectively. The remaining individual baits were each used by <4% of the fishing parties. Combinations of baits were used by 25% of the fishing parties.

Although there were significant differences in bait use between bays ($P < 0.01$), in each bay system, live shrimp ranked first in bait use except for the lower

Table 1. Percentage of bay and pass saltwater sport-boat fishing parties using different baits by bay system.

	Bay system							
Bait type	Galveston	Matagorda	San Antonio	Aransas	Corpus Christi	Upper Laguna Madre	Lower Laguna Madre	Coastwide
Live shrimp	49.6	36.6	29.5	34.5	31.8	33.9	25.3	33.8
Dead shrimp	16.0	12.8	8.9	9.1	16.7	17.8	4.7	11.8
Live fish	2.6	2.8	3.8	5.5	3.6	1.3	0.5	2.6
Dead fish	1.8	2.5	2.9	5.9	4.6	0.7	6.2	3.6
Crabs	0.5	1.4	0.4	0.5	0.3	0.0	0.1	0.4
Squid	0.3	1.3	1.6	1.1	1.2	<0.1	0.2	0.7
Sea lice	0.0	0.0	<0.1	<0.1	0.1	0.0	<0.1	<0.1
Natural baits combined	13.4	9.1	8.3	8.4	11.1	5.9	4.2	8.3
Spoons	1.6	9.1	12.8	10.9	6.3	10.0	4.5	7.6
Worm jigs	1.0	6.9	7.4	6.6	5.1	9.4	30.6	11.2
Other jigs	1.0	2.1	3.4	0.7	1.0	0.7	0.4	1.2
Plugs, fish shaped	2.3	2.0	2.2	2.5	1.9	2.8	0.4	1.9
Artificial baits combined	1.6	4.7	7.9	3.9	2.8	4.6	10.3	5.5
Nat. and art. baits combined	3.9	5.7	7.4	6.5	7.6	8.7	9.1	7.2
3 or more baits	3.8	3.0	3.1	3.6	5.5	4.2	3.2	3.7
Undetermined baits	0.8	0.2	0.5	0.3	0.4	<0.1	0.3	0.4

Laguna Madre Bay (Table 1). The percentage of fishing parties using live shrimp ranged from 25% in the lower Laguna Madre Bay to 50% in Galveston Bay. Around 90% of fishing parties in Galveston Bay used natural baits, whereas >50% of fishing parties used artificial baits and >30% used worm jigs in lower Laguna Madre Bay. In the remaining bays, from one quarter to one third of the fishing parties used artificial baits, with spoons ranking first.

For all species combined, coastwide, anglers using live shrimp landed the most fish (33%, Table 2). Anglers using live shrimp landed the most spotted seatrout (42%), southern flounder (30%), and sheepshead (71%), whereas anglers using either live shrimp or spoons landed the most red drum (22%). Most black drum (39%), atlantic croaker (38%), and sand seatrout (28%) were landed by anglers using dead shrimp, and most gafftopsail catfish (25%) were landed by anglers using squid for bait (Table 2).

The success of anglers coastwide at landing 1 or more fish varied by bait type and fish species (Table 3). Anglers using worm jigs were the most successful at landing a fish of any species (77%), at landing spotted seatrout (66%), and southern flounder (24%). Anglers using spoons had the greatest success catching red drum (50%). Crab was the bait most successful at landing black drum (32%) and sheepshead (21%). Anglers using dead shrimp were most successful at landing atlantic croaker (21%), whereas the greatest success at landing sand seatrout was achieved by anglers using a combination of natural baits (19%), and gafftopsail catfish using squid (31%).

Table 2. Percentage of fish landed by species and bait type.

	Species								
Bait type	Spotted seatrout	Red drum	Black drum	Southern flounder	Sheeps-head	Atlantic croaker	Sand seatrout	Gafftopsail catfish	All species combined
Live shrimp	42.0	21.6	30.5	29.8	71.0	19.2	21.7	16.1	32.7
Dead shrimp	2.2	4.8	39.1	5.0	11.8	37.9	27.7	13.9	13.5
Live fish	2.2	5.3	0.2	3.9	0.3	0.1	0.2	1.9	2.0
Dead fish	0.7	5.9	1.3	5.0	0.3	14.1	13.7	8.6	5.6
Crabs	<0.1	<0.1	2.4	<0.1	2.4	0.0	<0.1	1.2	0.2
Squid	<0.1	<0.1	0.0	0.1	0.1	0.2	3.1	25.2	1.1
Sea lice	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	<0.1
Natural baits combined	3.0	4.9	14.9	9.7	7.2	21.0	23.6	23.8	10.8
Spoons	4.9	22.1	1.1	3.6	0.6	0.4	0.1	0.8	5.0
Worm jigs	21.4	15.0	2.3	21.7	0.6	0.5	1.8	0.4	12.6
Other jigs	1.9	1.2	0.3	1.9	0.1	0.1	0.5	0.1	1.2
Plugs, fish shaped	3.2	1.4	<0.1	0.5	0.1	<0.1	0.1	0.7	1.6
Artificial baits combined	6.8	9.4	0.9	5.6	0.2	0.1	0.8	0.2	4.5
Nat. and art. baits combined	9.6	6.4	3.5	10.2	3.7	2.8	3.3	1.9	6.7
3 or more baits	1.9	1.8	2.2	2.8	1.3	3.6	3.3	2.8	2.5
Undetermined baits	0.1	0.1	1.1	<0.1	0.4	<0.1	0.2	2.5	0.2

Table 3. Percent successful bay and pass saltwater sport-boat fishing parties by species and bait type. Successful fishing parties landed at least 1 fish.

Bait type	Species								
	Spotted seatrout	Red drum	Black drum	Southern flounder	Sheeps-head	Atlantic croaker	Sand seatrout	Gafftopsail catfish	All spec. combined
Live shrimp	47.4	17.0	5.9	15.3	10.8	7.9	8.7	1.7	65.8
Dead shrimp	12.2	10.4	12.7	9.5	4.8	20.6	13.6	2.1	48.1
Live fish	31.7	29.6	0.0	19.5	0.7	1.5	2.0	1.5	60.1
Dead fish	19.1	24.4	3.0	13.7	1.1	13.1	15.0	3.6	60.0
Crabs	0.9	4.5	32.4	2.7	20.7	0.0	1.0	4.5	58.6
Squid	1.5	2.4	0.0	3.4	1.0	4.9	16.0	30.6	49.5
Sea lice	0.0	0.0	20.0	0.0	20.0	0.0	0.0	0.0	40.0
Natural baits combined	20.3	13.4	8.6	15.4	6.7	18.1	19.0	5.2	56.8
Spoons	37.5	50.0	1.2	11.4	0.6	0.7	0.8	0.2	67.8
Worm jigs	65.6	29.3	1.3	24.1	1.0	1.8	3.3	0.1	77.2
Other jigs	52.1	18.5	2.0	21.1	1.1	2.6	5.4	0.6	67.8
Plugs, fish shaped	56.7	21.3	0.2	6.0	0.7	0.6	2.4	0.4	66.7
Artificial baits combined	51.0	33.2	1.4	15.1	0.8	0.8	2.0	0.3	62.0
Nat. and art. baits combined	47.4	21.2	3.6	17.1	4.5	5.7	5.9	0.6	61.6
3 or more baits	27.4	13.2	4.0	13.0	2.8	6.7	8.0	2.8	45.4
Undetermined baits	8.1	5.1	16.2	3.0	8.1	1.0	3.0	4.0	40.4

The logistic regression model fits the linear effects of bay systems and bait types and can describe data adequately. Except for southern flounder, the model accounts for >86% of the observed variation of fishing party success when fishing at different bays and using different bait types (Table 4). This indicates that bait success was consistent across bay systems and bay influences were consistent across bait types. By examining the percentage values in Table 4, one can easily assess the probability of success for a particular bait in a particular bay.

Mean total lengths of fishes varied by bait types (Table 5). Coastwide, mean total lengths of spotted seatrout and red drum were generally the greatest for anglers using live or dead fish as baits. (For red drum, mean total lengths were actually greatest for anglers using squid or crab for bait; however, only 15 red drum were landed using these 2 baits.) For black drum, mean total length was greatest when anglers used crab as baits, whereas for southern flounder, mean total length was greatest for anglers using artificial baits.

Discussion

This study indicates that anglers used a wide variety of baits, and bait use patterns varied significantly between bays (the very large number of interviews made goodness of fit tests prone to give significant results). The use of different baits was not proportional to the success of bait use in catching a particular fish species. The

Table 4. Odds ratio relationships (in percentage) between fishing party success and effects caused by different bait types and bay systems. Relationships were fitted by logistic regression model.

Species	Odds ratio: Live shrimp, Galveston	Other bait type: Dead shrimp	Live fish	Dead fish	Crabs	Squid	Nat. baits	Spoons	Worm jigs	Other jigs	Plugs	Art. baits	Nat. and art. baits	3 or more baits	Other bay system: Mat.	SA	Ara.	CC	ULM	LLM	% Variation accounted for by the model
Spot. seatrout	63	15	59	22	1	2	29	63	149	129	154	93	87	39	115	132	104	119	230	275	92
Red drum	13	59	212	135	24	12	78	465	154	110	139	203	119	72	163	163	164	146	152	253	86
Black drum	10	239	16	55	655	0	144	22	26	31	3	26	67	70	93	58	40	59	31	51	89
South. flounder	25	57	147	91	16	23	101	82	179	179	37	107	119	83	65	39	61	77	73	78	73
Sheepshead	15	44	5	9	184	7	57	5	9	8	6	6	41	25	89	118	90	58	30	72	86
Atlantic croaker	19	303	21	245	0	98	270	11	30	44	7	14	85	89	25	9	28	37	60	30	90
Sand seatrout	20	168	23	222	10	243	240	11	49	71	27	28	79	96	32	29	31	52	29	33	88
Gaff. catfish	1	129	69	246	173	1743	299	12	9	22	20	17	43	180	286	272	155	128	15	16	91

[a]The effects of bays and baits are fitted with respect to odds ratio (successful parties/unsuccessful parties) of fishing in Galveston Bay using live shrimp as bait. By multiplying the percents under other bait types and other bay systems with odds ratio of Galveston Bay and live shrimp, the odds ratio of fishing success at any bait and bay combination can be calculated. For example, for spotted seatrout, the fitted odds ratio of fishing success of live shrimp and Galveston combination is 63% which is 39% success rate [probability of success = odds ratio/(1+odds ratio)]. Using the same bait type at Matagorda Bay, the odds ratio of success is increased to 72% (63% × 115%; 42% success rate). If the bait type is changed to dead shrimp, the odds ratio of success is then reduced to 11% (63% × 115% × 15%; 10% success rate). Parameter estimates and standard errors are available from the authors upon request.

Table 5. Number and mean total length of fishes (mm) ± 1 SE landed by species and bait types. Blank = no fish measured. No standard error = only 1 fish measured.

	Species							
	Spotted seatrout		Red drum		Black drum		Southern flounder	
Bait type	*N* fish	Mean total length ± 1 SE	*N* fish	Mean total length ± SE	*N* fish	Mean total length ± 1 SE	*N* fish	Mean total length ± 1 SE
Live shrimp	14944	398 ± 1	3253	519 ± 2	1018	384 ± 4	2507	351 ± 1
Dead shrimp	984	384 ± 2	730	505 ± 3	1045	374 ± 5	408	342 ± 3
Live fish	738	441 ± 3	704	578 ± 4	8	404 ± 20	337	356 ± 4
Dead fish	393	455 ± 5	778	576 ± 4	50	396 ± 14	306	344 ± 4
Crabs	5	342 ± 22	9	624 ± 36	75	853 ± 14	3	375 ± 31
Squid	9	410 ± 15	6	656 ± 40			8	356 ± 19
Sea lice					6	964 ± 38		
Natural baits combined	1216	408 ± 3	683	540 ± 4	23	466 ± 11	687	352 ± 3
Spoons	2162	417 ± 2	3064	531 ± 2	44	408 ± 18	344	393 ± 3
Worm jigs	7283	416 ± 1	2087	552 ± 2	65	428 ± 16	1622	384 ± 2
Other jigs	611	407 ± 3	172	552 ± 7	11	416 ± 22	142	373 ± 5
Plugs, fish shaped	1108	438 ± 3	231	552 ± 5	2	414 ± 12	41	359 ± 10
Artificial baits combined	2557	420 ± 2	1340	531 ± 2	31	490 ± 28	425	383 ± 3
Nat. and art. baits combined	3363	401 ± 2	909	519 ± 3	114	349 ± 9	754	367 ± 3
3 or more baits	830	393 ± 3	279	536 ± 5	71	434 ± 24	235	358 ± 4
Undetermined baits	23	408 ± 19	14	553 ± 24	34	815 ± 43	3	310 ± 46

percentage of anglers using different baits reveals that coastwide, almost 3 times as many anglers used live shrimp as any other bait. However, for each species, anglers were more successful at landing fish using baits other than live shrimp. Many anglers presumably overrated the effectiveness of live shrimp or they used other criteria. It is likely that bait choice for many anglers is based on personal preferences and not bait effectiveness, e.g., a preference for artificial lures may exist simply because the use of natural baits is not considered as sporting, or there may be a preference for natural baits because artificial lures require too much casting. Bait choice for other anglers might be based on bait availability, e.g., using dead shrimp because live shrimp were not available. Nevertheless, bait use has changed since 1979–80 (McEachron and Green 1981). In general, there has been a dramatic coastwide decrease in the use of dead shrimp, whereas the use of live shrimp and artificial lures has increased.

The percentage of fishes landed by species and bait type is more indicative of bait use than of bait effectiveness, whereas angler success by bait type is more indicative of bait effectiveness. However, evaluating bait effectiveness using percentage of angler success was biased by the degree that anglers using a particular bait actually directed their effort to a particular fish species. For example, the high success rate of landing red drum by anglers using spoons was probably biased by the large percentage of spoon anglers targeting red drum. Likewise, the low success

rate at landing red drum by anglers using live shrimp was probably biased by the large percentage of live shrimp anglers targeting other species. To alleviate this bias, current TPWD sport creel procedures include the determination of target species for each fishing party interviewed so that bait type and targeted species can be better correlated.

Literature Cited

Green, A.W., T.L. Heffernan, and J.P. Breuer. 1978. Recreational and commercial finfish catch statistics for Texas bay systems September 1974–August 1977. Proj. Rep. 2-293-R, Texas Parks and Wildl. Dep. Coastal Fish. Branch, Austin. 81pp.

Heffernan, T.L., A.W. Green, L.W. McEachron, M.G. Weixelman, P.C. Hammerschmidt, and R.A. Harrington. 1976. Survey of finfish harvest in selected Texas bays. Proj. Rep. 2-231-R-1, Texas Parks and Wildl. Dep. Coastal Fish. Branch, Austin. 116pp.

McCullagh, P. and J.A. Nelder. 1989. Generalized linear models, 2nd ed. Chapman and Hall, London. 511pp.

McEachron, L.W. and A.W. Green. 1981. Recreational finfish catch statistics for Texas bay systems, September 1979–August 1980. Manage. Data Ser. 25, Texas Parks and Wildl. Dep. Coastal Fish. Branch, Austin. 64pp.

Osburn, H.A. and M.O. Ferguson. 1987. Trends in finfish landings by sportboat fishermen in Texas marine water; May 1974–May 1986. Manage. Data Ser. 119, Texas Parks and Wildl. Dep. Coastal Fish. Branch, Austin. 464pp.

Royce, W.F. 1983. Trends in fishery science. Fisheries 8:10–13.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry, 2nd ed. W.H. Freeman and Co., New York, N.Y. 859pp.

Stroud, R.H., G.C. Radonski, and R.G. Martin. 1982. Evolving efforts at best-use allocations of fishery resources. Pages 418–431 *in* J.H. Grover, ed. Allocations of fishery resources. Food and Agric. Org. (FAO-United Nations) and Am. Fish. Soc. Bethesda, Md.

Swingle, H.S. 1950. Relationships and dynamics of balanced and unbalanced fish populations. Ala. Agric. Exp. Sta. Bul. 274. Ala. Polytech. Inst., Auburn Univ. 74pp.