LA Creel/MRIP Red Snapper Private Mode Landings and Discards Calibration Procedure

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Overview

Time-series of fishery removals are critical components of stock assessments as they provide the level of depletion of the resource through time. Beginning in 2014, the Louisiana Department of Wildlife and Fisheries (LDWF) started its own creel survey (LA Creel) to provide recreational catch estimates for Louisiana-specific fishery management and stock assessment purposes. Prior to 2014, recreational catch estimates were taken from the National Marine Fisheries Service's Marine Recreational Intercept Program and the earlier Marine Recreational Fisheries Statistical Survey (NMFS MRIP/MRFSS). The MRIP and LA Creel surveys were conducted simultaneously in 2015 for benchmarking purposes. Methods are now needed to calibrate red snapper landings and discards estimates to provide time series of estimates for SEDAR 74 in common currencies from 1981-2020.

The LA Creel survey uses a complemented survey design, where estimates of catch rates from an on-site access point survey are combined with effort estimates from a telephone/email survey to estimate recreational catches (landings + discards). The catch and effort surveys use probabilistic designs. The on-site catch survey is based on a stratified two-stage design and the telephone/email effort survey uses a stratified random design. The survey has been peer-reviewed and certified (see Appendix 1-3). Full technical details of the survey can be found in Appendix 4.

Calibration Methodology

A ratio estimator approach is described below allowing hindcasting of LA Creel recreational landings and discards estimates to 1981 and the MRIP recreational landings and discards estimates to 2020.

The LA Creel survey provides estimates for four fishing modes: private inshore (PI), private offshore (PO), charter inshore (CI), and charter offshore (CO). The MRIP survey provides estimates for five fishing modes: private boat (PR), shore (SH), PO, CI, and CO. For red snapper calibration purposes, the inshore/offshore fishing modes of each survey are collapsed into overall private and charter fishing modes. To remain consistent with previous SEDAR red snapper stock assessments, estimates of the MRIP SH mode are excluded and not included in the calibration procedure. Because the charter fishing frame used by the LA Creel and MRIP surveys are functionally equivalent, charter fishing estimates of the two surveys are assumed equivalent and are not adjusted or presented.

Landings

Concurrent harvest estimates of the LA Creel and MRIP surveys are only available for the single year (2015) both surveys were conducted simultaneously. The ratio of the annual 2015 landings estimates as numbers of fish can be used to calibrate between surveys by assuming the difference between the point estimates is consistent through time (Table 1).

LA Creel private mode landings estimates as numbers of fish are hindcast to 1981 as the product of the 2015 LA Creel/MRIP landings ratio and the MRIP landings estimates (1981-2013; Table 1 and Figure 1). Variance estimates are not adjusted. MRIP private mode landings estimates as numbers of fish are hindcast to 2020 as the product of the inverse 2015 LA Creel/MRIP landings ratio and the La Creel landings estimates (2014, 2016-2020; Table 1 and Figure 1). Variance estimates are not adjusted. MRIP estimates are taken from the Southeast Fisheries Science Center (SEFSC) GenRec estimates provided by the NMFS on 11/23/21 and are FES/APAIS derived estimates that represent A+B1 catches.

Landings estimates in units of numbers of fish can be converted to weight estimates as the product of the landings-in-numbers estimates and strata-specific mean weight estimates. Annual mean weight estimates will be calculated and applied by the SEFSC using the MRIP APAIS and LDWF Biological Sampling Program data to estimate annual landings of the private fishing mode in units of weight.

Discards

Information related to discards were not collected as part of the LA Creel access point survey until 2016.

To allow calibration of discard estimates between surveys, LA creel discards of red snapper in 2014 and 2015 are estimated as the product of the ratio of discards to harvest in the 2016 LA Creel survey and the 2014 and 2015 LA Creel harvest estimates (Tables 2 and 3). The 2016 LA Creel estimates were chosen to form the ratio of discards to harvest to calculate the 2014 and 2015 LA Creel discards estimates due to the similarity between the 2014-2016 Louisiana red snapper fishing seasons (i.e., similar federal and state season lengths) prior to fishery management changes implemented in 2017.

The ratio of the annual 2015 discard estimates as numbers of fish can be used to calibrate between surveys by assuming the difference between the point estimates is consistent through time (Table 3).

LA Creel private mode discard estimates are hindcast to 1981 as the product of the 2015 LA Creel/MRIP discard ratio and the MRIP discard estimates (1981-2013; Table 3 and Figure 2). Variance estimates are not adjusted. MRIP private mode discard estimates as numbers of fish are hindcast to 2020 as the product of the inverse 2015 LA Creel/MRIP landings ratio and the LA Creel discard estimates (2014, 2016-2020; Table 1 and Figure 1). Variance estimates are not adjusted. MRIP estimates are taken from the SEFSC GenRec estimates provided by the NMFS on 11/23/21 and are FES/APAIS derived estimates that represent B2 catches.

Table 1: Annual private mode landings estimates of the LA Creel and MRIP FES/APAIS surveys in units of numbers of fish and corresponding coefficients of variation. Shaded cells indicate values hindcast from the 2015 LA Creel/ MRIP landings ratio and the corresponding annual landings estimates.

		MRIP		LA Creel		Harvest ratio
Common	Year	Harvest	CV	Harvest	CV	LA Creel /MRIP
RED SNAPPER	1981	2,384,191	0.671	1,319,864	--	--
RED SNAPPER	1982	1,172,112	0.534	648,869	--	--
RED SNAPPER	1983	2,887,834	0.392	1,598,675	--	--
RED SNAPPER	1984	402,517	0.426	222,829	--	--
RED SNAPPER	1985	252,061	0.626	139,538	--	--
RED SNAPPER	1986	338,981	0.379	187,656	--	--
RED SNAPPER	1987	111,294	0.746	61,611	--	--
RED SNAPPER	1988	229,867	0.438	127,252	--	--
RED SNAPPER	1989	279,289	0.437	154,612	--	--
RED SNAPPER	1990	124,223	0.570	68,769	--	--
RED SNAPPER	1991	29,900	0.689	16,552	--	--
RED SNAPPER	1992	251,971	0.292	139,488	--	--
RED SNAPPER	1993	613,996	0.382	339,902	--	--
RED SNAPPER	1994	368,772	0.436	204,149	--	--
RED SNAPPER	1995	550,452	0.531	304,725	--	--
RED SNAPPER	1996	208,256	0.397	115,289	--	--
RED SNAPPER	1997	247,913	0.372	137,242	--	--
RED SNAPPER	1998	416,659	0.514	230,658	--	--
RED SNAPPER	1999	167,370	0.316	92,654	--	--
RED SNAPPER	2000	171,996	0.381	95,215	--	--
RED SNAPPER	2001	81,748	0.404	45,255	--	--
RED SNAPPER	2002	26,308	0.544	14,564	--	--
RED SNAPPER	2003	30,274	0.516	16,760	--	--
RED SNAPPER	2004	18,429	0.485	10,202	--	--
RED SNAPPER	2005	53,987	0.483	29,887	--	--
RED SNAPPER	2006	124,426	0.333	68,881	--	--
RED SNAPPER	2007	150,246	0.282	83,175	--	--
RED SNAPPER	2008	81,408	0.437	45,067	--	--
RED SNAPPER	2009	106,304	0.414	58,849	--	--
RED SNAPPER	2010	12,189	0.772	6,748	--	--
RED SNAPPER	2011	58,951	0.487	32,635	--	--
RED SNAPPER	2012	130,282	0.390	72,123	--	--
RED SNAPPER	2013	98,597	0.365	54,582	--	--
RED SNAPPER	2014	222,963	--	123,430	0.116	--
RED SNAPPER	2015	275,798	0.206	152,679	0.115	0.554
RED SNAPPER	2016	212,860	--	117,837	0.125	--
RED SNAPPER	2017	163,648	--	90,594	0.109	--
RED SNAPPER	2018	154,853	--	85,725	0.115	--
RED SNAPPER	2019	191,261	--	105,880	0.114	--
RED SNAPPER	2020	168,735	--	93,410	0.106	--

Table 2: Annual landings and discard estimates of the 2016 LA Creel survey in units of numbers of fish.

		LA Creel		
Common	Year	Landings	Discards	Discards/Landings ratio
RED SNAPPER	2016	117,837	57,567	0.489

Table 3: Annual private mode discard estimates of the LA Creel and MRIP FES/APAIS surveys in units of numbers of fish and corresponding coefficients of variation. Shaded cells indicate values hindcast from the 2015 LA Creel/ MRIP discard ratio and the corresponding annual discard estimates. The 2014 and 2015 LA Creel discard estimates* are calculated from the discards to landings ratio presented in Table 2 and the 2014 and 2015 LA Creel landings estimates presented in Table 1.

		MRIP		LA Creel		Discards ratio
Common	Year	Discards	CV	Discards	CV	LA Creel/MRIP
RED SNAPPER	1981	23,485	0.722	3,299	--	--
RED SNAPPER	1982	4,083	1.00	573	--	--
RED SNAPPER	1983	0	--	0	--	--
RED SNAPPER	1984	0	--	0	--	--
RED SNAPPER	1985	86,825	0.963	12,195	--	--
RED SNAPPER	1986	0	--	0	--	--
RED SNAPPER	1987	25,648	1.00	3,603	--	--
RED SNAPPER	1988	150,992	0.465	21,208	--	--
RED SNAPPER	1989	195,027	0.706	27,394	--	--
RED SNAPPER	1990	132,515	0.655	18,613	--	--
RED SNAPPER	1991	26,082	0.785	3,664	--	--
RED SNAPPER	1992	181,551	0.346	25,501	--	--
RED SNAPPER	1993	311,183	0.360	43,709	--	--
RED SNAPPER	1994	371,160	0.536	52,133	--	--
RED SNAPPER	1995	699,614	0.440	98,268	--	--
RED SNAPPER	1996	80,650	0.412	11,328	--	--
RED SNAPPER	1997	115,544	0.497	16,229	--	--
RED SNAPPER	1998	325,864	0.587	45,771	--	--
RED SNAPPER	1999	518,969	0.370	72,895	--	--
RED SNAPPER	2000	190,253	0.311	26,723	--	--
RED SNAPPER	2001	89,915	0.374	12,629	--	--
RED SNAPPER	2002	48,385	0.557	6,796	--	--
RED SNAPPER	2003	138,823	0.435	19,499	--	--
RED SNAPPER	2004	162,932	0.762	22,886	--	--
RED SNAPPER	2005	195,912	0.408	27,518	--	--
RED SNAPPER	2006	400,202	0.331	56,213	--	--
RED SNAPPER	2007	298,980	0.356	41,995	--	--
RED SNAPPER	2008	313,022	0.362	43,967	--	--
RED SNAPPER	2009	285,535	0.375	40,107	--	--
RED SNAPPER	2010	11,501	0.809	1,615	--	--
RED SNAPPER	2011	207,034	0.453	29,080	--	--
RED SNAPPER	2012	200,325	0.486	28,138	--	--
RED SNAPPER	2013	312,891	0.368	43,949	--	--
RED SNAPPER	2014	429,297	--	60,299*	--	--
RED SNAPPER	2015	531,027	0.314	74,588*	--	0.140
RED SNAPPER	2016	409,844	--	57,567	0.156	--
RED SNAPPER	2017	516,336	--	72,525	0.162	--
RED SNAPPER	2018	484,619	--	68,070	0.213	--
RED SNAPPER	2019	848,002	--	119,111	0.129	--
RED SNAPPER	2020	753,819	--	105,882	0.137	--

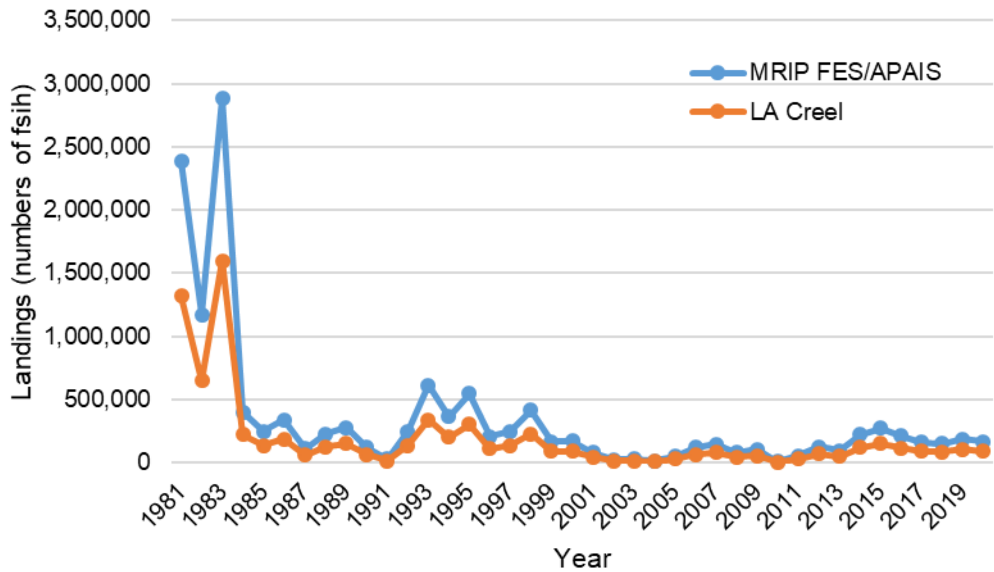

Figure 1: Landings estimates of the LA Creel and MRIP FES/APAIS surveys in units of numbers of fish. The 1981-2013 LA Creel estimates are hindcast as the product of the 2015 LA Creel/ MRIP landings ratio and the corresponding MRIP annual landings estimates. The 2014 and 2016-2020 MRIP estimates are hindcast as the product of the inverse of the 2015 LA Creel/ MRIP landings ratio and the corresponding LA Creel annual landings estimates.

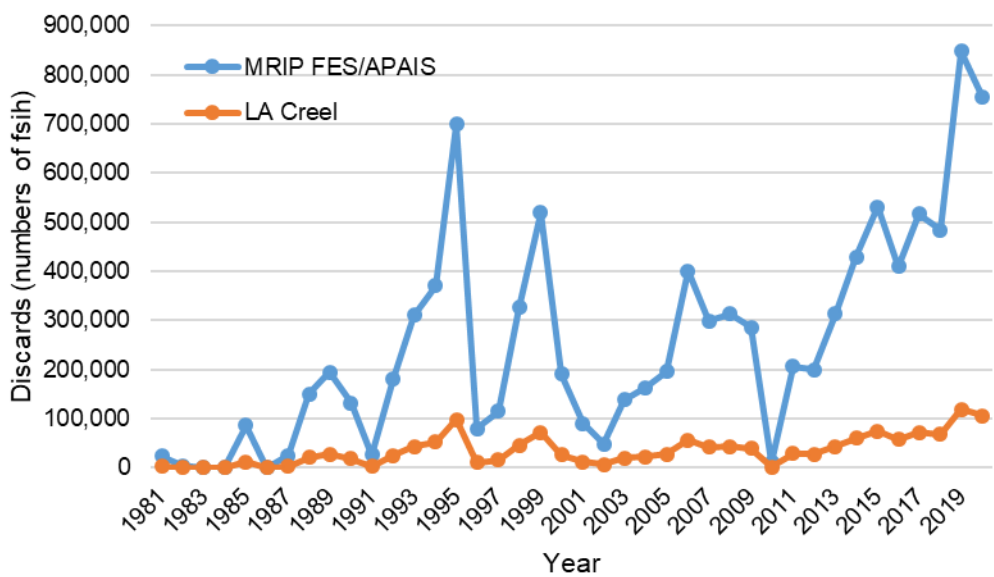

Figure 2: Discard estimates of the LA Creel and MRIP FES/APAIS surveys in units of numbers of fish. The 1981-2013 LA Creel estimates are hindcast as the product of the 2015 LA Creel/ MRIP discards ratio and the corresponding MRIP annual discards estimates. The 2014 and 2016-2020 MRIP estimates are hindcast as the product of the inverse of the 2015 LA Creel/ MRIP landings ratio and the corresponding LA Creel annual discard estimates.

Appendix 1:

Review of LA Creel

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Westat

August 16, 2015

1 Introduction

During the one-and-a-half-day meeting in Baton Rouge, LA, on June 2–3, 2015, we met with Louisiana Department of Wildlife and Fisheries (LDWF) staff to discuss LDWF's recreational fisheries statistics program, LA Creel. Prior to the meeting, we had been provided with a report entitled "RECREATIONAL STATISTICS PROGRAM: LA CREEL LANDING STATISTICS," which provided a thorough overview of the survey design and estimation procedures that comprise LA Creel.

We begin by briefly summarizing our overall reaction to LA Creel: it is a well-designed and executed program. The program has a large and thorough sampling effort, with fine spatial and temporal stratification for on-site work. There is a high-quality license frame for effort measures. LA Creel appears to have careful design in all of its aspects, and rigorous randomization. There is an exceptionally high level of quality assurance/quality control built into the program. For the most part, there is also a clear and clean match between the sampling design and the estimation methods. The methodology is thoroughly documented, with assumptions explicitly listed. The consultants had very favorable reactions to all of these characteristics of LA Creel.

In the remainder of this report, we outline our recommendations for possible extensions or improvements to LA Creel, as well as a few suggestions for further study.

2 On-site survey

2.1 Definition of primary sampling units

In the LA Creel methodology report, the sampling design is considered a three-stage design, with site-day as the primary sampling unit (PSU), shift within the site-day as the secondary sampling unit (SSU) and angler trip within the site-day-shift as the tertiary sampling unit (TSU).

The selection procedure for days and shifts is with replacement among all day-shift combinations in a stratum, with a rejection step if duplicate assignments are obtained. Ignoring the small chance of duplicate assignments within a basin, the design is closely approximated by without-replacement selection of site-day-shifts, followed by selection of anglers within site-day-shifts. Our recommendation, therefore, is to treat the design as a two-stage design, with site-day-shift as the PSU and the angler trip as the SSU.

2.2 Stratification for offshore sampling

Sites are assigned monthly pressures in three "activities" (private in-shore, private off-shore and charter), which is conceptually similar to the "modes" in MRIP, in the sense that it separates the overall recreational fishing activity at a site into categories with different characteristics for the purpose of sampling. Selection of sites (and hence site-days and shifts) is performed through stratified PPS sampling, proportional to the average site pressure across all activities present at the site. This procedure results in oversampling of sites with private off-shore activity, because these sites tend to have fewer activities (1–2) but high off-shore pressure. This oversampling is considered desirable because these sites are smaller in number but are important due to the presence of critical species such as red snapper. During the federal red snapper season, the pressure of the private off-shore activity is increased, to further increase the probability of sampling these sites.

This sampling procedure is statistically valid and we see no major issues with continuing to use it. However, the somewhat indirect manner in which the oversampling is achieved is likely to result in sample sizes that will vary month-to-month, leading to possibly increased variance of the resulting catch estimates. An allocation that oversamples certain types of sites can also be achieved more directly by stratifying the sites (which can also be done using the activity pressures, averaged or otherwise) and selecting the desired number of sample days in each stratum. The stratification could also help with weighting because the inverse of selection probabilities are simple to obtain and can be used as weights. A further advantage of stratification is that it is easy to incorporate additional sampling requirements such as geographic representation (as is already being done), minimum sample sizes in low-pressure categories that might often be missed by pure PPS sampling, etc.

It should also be noted that the manner in which sites are labeled and selected for the purpose of sample selection, e.g. sites in an "off-shore stratum" and those in an "in-shore stratum," has no implication on the data that can be collected at those sites, so that replacing a PPS-based sample selection by a stratification-based one is strictly a design issue. Similarly, defining relatively fine sampling strata does not imply that estimates should be created and reported for all the strata.

2.3 Undercoverage and compliance rate adjustments

A key issue in surveys that estimate the average catch and the total effort separately is that the definition of a "trip" needs to be matched across both surveys. It is clear that the LDWF staff are aware of this and have made sure that this is reflected in both surveys, by eliminating the "species targeted" as a factor in determining the catch and the effort. A related issue is frame undercoverage, which can occur on both the catch and the effort side: private sites are an example of frame undercoverage in the former survey, and people fishing without a license are an example in the latter. Because of the complementarity of both surveys, it is possible to compute correction factors for some of these types of frame undercoverage. In LA Creel, the on-site survey is used to estimate the fraction of people fishing without a license, which is then used to correct the estimate of total effort obtained from the license sampling frame.

A similar correction factor is applied to account for anglers without a recreational offshore landing permit (ROLP). The factor is estimated as the (weighted) fraction of trips that land off-shore species for which the angler has an ROLP in the on-site survey. However, it is not appropriate to treat the absence of ROLP as an undercoverage issue, and hence to adjust effort estimates in this manner. The reason for this is that the category of anglers defined as "ROLP holders" is fully captured by the ROLP frame, so there are no missing anglers in the frame and no undercoverage adjustment is needed. In contrast, the category "angler" is not exhaustively covered by the license frame, so an undercoverage adjustment *is* needed. Another way to see the same thing is by considering the correction factor itself: by calculating the fraction of off-shore trips where the angler has an ROLP, we can indeed estimate the fraction of anglers who adhere to a recreational fishery regulation, but this contains no information directly applicable to the estimation of effort of the anglers who hold an ROLP.

The anglers can be divided into three non-overlapping groups: those holding an ROLP (and, we assume, an angling license), those holding an angling license and no ROLP, and those holding neither. These groups should drive the design of the on-site and effort surveys and the manner in which estimates are produced. The effort of the first two groups are separately estimated directly by the telephone survey, while that for the third group cannot be estimated directly. During the on-site survey, the catch of the first group can be estimated directly as long as these anglers are identified, and this needs to be done regardless of whether they are fishing off-shore or in-shore, since effort estimates are calculated across both types of trip (note: this might not be correct, the telephone survey does ask whether a trip is in-shore or off-shore). The average catch of the second and third groups are estimated together for both off-shore and in-shore trips, and the combined effort of both groups is obtained by estimating the total effort of the second group in the telephone survey and applying a correction factor from the on-site survey to account for the third group.

The discussion above assumes that the license and ROLP status of anglers can be exactly determined during the on-site survey. This is of course not exactly true, because anglers might not know whether they are licensed and/or have the permit, or they might say they have it but it is not correct (e.g. license expired, belongs to spouse, outright lies, etc). Hence, it is still useful to supplement questions about license and permit compliance with a validation question for a subset of the intercepted anglers. The estimated validation rate can be used to perform sensitivity analysis for the license undercoverage correction and for the catch estimates for the ROLP group, and also constitutes a useful survey quality metric to track over time. One way to increase the efficiency of the validation sampling and to reduce its respondent burden is to perform the ROLP validation preferentially over the license validation: if an angler selected for validation claims to have a ROLP and a license, only check the ROLP. This also makes sense since the license frame undercoverage correction is only applied to the non-ROLP angler group.

3 Off-site survey

3.1 Burden of response: charter captains

Currently, up to five attempts are used to obtain data on trips (up to three trips each day of the week) from the charter boat captains. Multiple contacts are essential to maximize response rate, but survey research has shown that different types of communication approaches are generally more powerful to maximize response. In order to improve participation of charter boat captains for the surveys, a number of techniques used by survey researchers should be tested. Since most contacts are made by either phone or email, using the postal service to send a letter prior to calling may improve participation. Having a well-respected individual who is supportive of the project sign the letter would be ideal. The letter would describe the objective of the survey and emphasize the importance of participation. An example of a letter with a number of ideas discussed at the June meeting is shown in Appendix A. The letter should be brief—probably not including all of the text provided in the Appendix A example. Confidentiality comments or details on the length/time should be delayed until the questionnaire is given to the boat captain.

With a population of 720 captains and the current level of response rates (30–40%) after mailing everyone each week, we obtain responses from approximately 250 captains. While this might look like a reasonable sample size, the problem is that this includes a significant burden on the target population, and leads to a sample that is possibly not representative, in the sense that the randomization is fully determined by the willingness to respond, and not by type of sampling. A proposal to solve both of these problems is to use the rotating panel design that is discussed in the next section.

3.2 Alternative design with rotating panels

Given the response rates obtained in survey of boat captains, it would be beneficial to design the approach to select charter boat captains recognizing nonresponse as a component of the survey design. A panel survey observes repeated measurements taken on the same sampling units at different time points. Obviously, participants tire of providing high quality data and eventually drop out of surveys. In order to decrease the burden on boat captains to report each month, another approach LDWF may consider is adopting a rotating panel design. In a rotating panel design, new individuals (e.g., charter boat captains) are periodically sampled and asked to provide data for a fixed number of times, and then are removed from the study. The Census Bureau's Current Population Survey uses a rotating panel design for their monthly surveys. Once a household is selected, the household reports for four consecutive months, then rotates out for eight months, and the then returns back to report for an additional four months. At that point the household leaves the sample permanently (`http://www.census.gov/cps/methodology/`). New households rotate in each month to provide continuity but limit the burden on the respondent by rotating them off the panel after a fixed amount of time.

To make this specific for the LA Creel charter captain population, suppose there are 700 captains in all. Rather than asking most to respond to each wave, divide the captains into groups (say five random groups of 140 each). If the wave sample size requirement is about 300 sampled (not 300 responding), then groups 1 and 2 would be included in the first wave, for the next wave group 1 would drop out and groups 2 and 3 would be sampled. The pattern would continue with group 1 joining group 5 in a circular fashion, as shown in the following table.

	Wave						
Group	1	2	3	4	5	6	$\cdots$
1	X				X	X	
2	X	X				X	$\ddots$
3		X	X				$\ddots$
4			X	X			
5				X	X		

With such a rotation scheme, the captains could be told up front that they would only be asked to respond for two consecutive waves and then would be not burdened until four waves later. This is just a rough example and the numbers and rotation could be revised to give the needed sizes and periods of time out of the sample.

3.3 Use of auxiliary information

A comment made during the meeting was that the data collection is so extensive in LA Creel that very short-term temporal effects can be identified from the effort data: federal season for red snapper, weather and tide events, etc.

The ability to identify such relationships from the data suggests that there may be opportunities to include auxiliary information into the estimation procedures, to gain precision at almost no additional cost. Weather, tide and regulation information has some explanatory power for effort, and may be available even when other information is difficult and costly to obtain (e.g., due to nonresponse). For example, if total effort is correlated with the count of "good fishing days", determined from readily-available wind, precipitation and tide data, then these correlated counts can be used to improve the precision of the effort estimates without actually collecting more data. Even if the predictive relationships between auxiliary variables and effort are imperfect, the auxiliary data may be very useful in producing more efficient estimators using "model-assisted estimation." Like direct survey estimates, model-assisted estimators are design-unbiased or nearly so, and allow for consistent variance estimation and proper confidence interval construction (even if the regression model is imperfect). If the regression model has reasonable explanatory power, the model-assisted estimator has smaller variance and narrower confidence intervals than the direct estimator that ignores auxiliary data.

It may be worth establishing predictive relationships now, given the currently extensive LA Creel data collection effort. In the future, if resources are less available for field data collection, the predictive relationships may be very helpful in maintaining precision of the estimates.

4 LA Creel compared to MRIP

We believe it was a useful exercise to go through the on-site MRIP questionnaire items in comparison to the on-site LA Creel questionnaire items, and similarly for the off-site MRIP and LA Creel instruments. This made clear the decision-making that has led to the structure of each program, including the trade-offs. We comment briefly on the comparisons here.

4.1 Incomplete trips

One notable difference between MRIP and LA Creel is with regard to the treatment of incomplete trips. MRIP asks unfinished anglers how long they intend to continue fishing, then uses that information to weight up the observed catch for the observed time fishing to the total angler catch for the total (estimated) time spent fishing. LA Creel, on the other hand, asks unfinished anglers to mail back a card specifying their catch during the unobserved time spent fishing, and replaces incomplete records with complete records if a card is returned. No other incomplete records are included in estimation. Clearly the two methods have their own strengths and weaknesses. One interesting possibility, that would give researchers some insight into the relative merits of the two methods, would be to add the MRIP "how long do you intend to continue fishing" item to the LA Creel survey instrument.

Because the LA Creel approach provides mailed-in responses for a subset of the non-responses, there is the potential to develop a suitable imputation method to fully account for the nonresponse due to incomplete trip reporting. This might be preferable to the current practice of discarding the incomplete records for which no card is returned. A simple version of such an imputation method might be a hierarchical hot-deck approach, in which an incomplete record is randomly matched to one that was returned with similar characteristics (site or region, main activity, weekday/weekend, species caught, etc), which becomes a "donor" record. The values from the donor are used to impute the missing incomplete trip characteristics. Strictly speaking, the hot-deck does not require that the donor be itself an originally incomplete trip, but if there are a sufficient number of potential donors among the returned cards, that might represent a better set of matches in the sense all the trips (donors and "recipients") were originally incomplete.

4.2 Discards, releases, biological samples

In designing its new survey program, LDWF made the decision to exclude discards and releases and not to collect biological samples as part of the on-site interview protocol. These decisions were made partly to streamline the interview process, and in the case of discards/releases, because there were concerns that the self-reported information was not sufficiently reliable. While these concerns are justified in our view, we recommend that LDWF staff develop formal sampling plans to obtain these types of information as well, to ensure that the data and resulting estimates are of the same level of statistical validity as the primary catch and effort surveys.

4.3 Treatment of charter captain catch

This is likely to be a relatively minor point in terms of the effect on the catch estimates, but it seems strange to us that the catch of the charter captain is included as part of the recreational catch for this trip, but the captain is not counted as an angler (presumably because he is not "recreating"). If this catch is a significant part of the total trip catch (we don't know whether it is or not), this might lead to catch/angler estimates that are inflated. To the extent that this is only used to estimate total catch, this is not a problem, but other uses of the data related to e.g. economic analysis of recreational CPUE, might be adversely affected. A possible solution, if that is not yet done, would be to flag such trips in the data file, so that different users can perform the analysis that is appropriate for their purpose.

5 Other comments

In closing, we note that the methodology report contains a few technical errors that should be addressed. Some of these are typographical errors while others reflect misinterpretations of the relevant theory. For example, the statement (bottom of page 11) that "Variance calculation using Proc Surveymeans in SAS only accounts for among cluster variation" is misleading: the standard PSU-only variance approximation does account for both among-PSU and within-PSU variation, but not in an obvious way and not in an unbiased way. The estimator only uses the *empirical* variation among PSUs, but the *theoretical* variation among PSUs and within PSUs is included in this empirical variation. Under mild conditions on the design, the bias of the PSU-only variance estimator is extremely small.

Typographical errors include:

- Extra divisor of $n_h - 1$ in equation [10], page 12.
- Missing overbars in $\mathrm{Cov}(\bar{X}, \bar{Y})$ in equation [18], page 13.
- Incorrect Goodman's formula in equation [22], page 14.

All of the equations need to be checked carefully in the documentation and in any code that relies on the equations, in case the typos have been copied to or from the analysis programs.

Appendix 2:

Review of LA Creel Survey Program Proposed for MRIP Certification

Jay Breidt (Colorado State University), Mike Brick (Westat), Ginny Lesser (Oregon State University), Jean Opsomer (Colorado State University), Lynne Stokes (Southern Methodist University)

September 29, 2017

After reviewing the materials provided to us by NOAA staff, we address each of the terms of reference below.

1. *Does the survey design follow a formal probability sampling protocol with known inclusion probabilities at all stages and/or phases of sampling?*

   The designs of both the catch and effort surveys are probability designs. The catch survey is a stratified two-stage design and the effort surveys have stratified random designs. These designs follow accepted survey methodology and are appropriate for these surveys.

2. *Do the estimation methods appropriately weight the sample data to account for the sampling design and produce design-unbiased point estimates and variance estimates?*

   Both the effort and catch surveys follow unequal-probability sampling designs. The design for the catch survey is a stratified two-stage PPS, with the first stage a stratified selection of site-day-shift assignments with probabilities proportional to the fishing pressure, and the second stage assumed to be an equal-probability selection of anglers at the assigned site. The estimation methods for the average catch/trip and corresponding variance are weighted according to this sampling design, as required for valid design-based inference. However, they cannot be claimed to be exactly design-unbiased, because of standard approximations applied in the derivation of these estimators and the variance estimators. These approximations are commonly used in official surveys, so this is not a concern, but they do introduce a small amount of design bias. The estimation methods appropriately weight the sample data to account for the sample design, producing approximately design-unbiased point estimates and valid variance estimates.

   The effort surveys, both for individual anglers and for charter captains, are stratified simple random sampling designs using list frames. Weights are used in estimation and inference here as well, again producing approximately design-unbiased point estimates and valid variance estimates. The final estimates include adjustments for undercoverage of the license frames, which are definitely warranted here.

   Overall, we view these surveys and associated estimation approaches as statistically valid.

3. *Are appropriate methods in place to measure and/or correct for potential biases due to undercoverage, nonresponse, or response errors?*

   We do not have enough information to fully answer this question about nonresponse. Little information is provided about nonresponse rates in either survey and what is done to account for nonresponse. Response rates are frequently very low in telephone surveys these days, so this has the potential to cause a bias problem. Further, one might expect that the response rates are differential by stratum, which could cause biases since effort is likely to differ by stratum (e.g., out-of-state vs in-state). This issue is worth further investigation. Unfortunately, this issue does not only affect LA Creel but recreational angler telephone surveys nation-wide as well as most telephone surveys.

   One related concern about the effort surveys is the fact that they are set up as quota samples, in the sense that data collection is stopped once a target number of interviews is reached in each stratum. This can lead to "early respondent bias," since it will tend to lead to samples that contain easier-to-reach respondents. This might be difficult or impossible to avoid when rapid turn-around is required for the survey. Nevertheless, it might be worth investigating whether a survey that spends more effort converting recalcitrant respondents leads to different results than the current approach.

   The undercoverage issue is addressed more fully than the nonresponse issue. Specifically, the issue of undercoverage of the license frame is addressed, and a reasonable method for adjusting for this undercoverage is described. In the report on p. 11, there is a comment that these adjustments can be made separately by species, type of fishing activity, and fishing area. A possible concern is that the sample sizes for the compliance rate estimates for these small domains might be very small, resulting in a variance in equation [19] that is dominated by the adjustment variance. Hence, implementation of these adjustments at the species, activity or area level should be monitored to make sure they are not too large, causing instability in the estimates.

   There is also an issue with undercoverage in the catch survey for private access and after-sunset anglers. The report mentions that the effort survey collects information to allow assessment of how large this undercoverage is, but no description of that data is provided. There is no adjustment possible for that undercoverage since no information on catch is available for the private and after-sunset anglers. However, the size of the undercoverage might help to judge the effect of the implicit assumption that catch is the same for all. The private access undercoverage problem is no different than what is present in MRIP, but the after-sunset issue is different, so this might lead to differences between both surveys. The size of this difference is likely small but should be investigated.

   The quality control system in place for supervision of interviewers and for preventing data entry and editing errors seems very thorough.

The incomplete fishing day method seems reasonable, but it would be useful to know the response rate on the postcard method. The reliability of these self-reported data and how they compare with observed catch should be investigated.

Overall, the survey addresses the main types of potential biases to a level that is comparable to MRIP.

4. *How sensitive is the accuracy of the survey to assumptions made about segments of the target population that are not covered by the survey frame? What can be done to reduce or limit that sensitivity?*

The biggest frame issue is the unlicensed anglers, which as noted above is addressed by a separate adjustment. This adjustment is based on data collected in the access point survey. The information about whether or not each angler possesses a license is self-reported by the anglers, with no validation. Previous research by MRIP in an all mail survey of anglers showed that they both over-report (reporting that they have a license when they do not) and under-report (stating that they do not have a license when they do) their license ownership. These misreporting rates were non-negligible in both directions, but were higher for over-reporting than under-reporting. It is likely that this will also be true in a face-to-face interview. Therefore, we recommend that at a minimum, they periodically (e.g., every three years) perform a validation study on the license ownership question. This should take the form of a randomized experiment embedded into the access point data collection process, where some anglers are asked to produce their license (or otherwise prove they own one) and others self-report. If these discrepancies are non-negligible, a calibrated license ownership rate should be used in the license adjustment factor.

Another frame issue is bad contact information, which makes license holders ineligible. That issue is not addressed except to the extent of encouraging people to update their information. It would be useful to find out what fraction of license frame holders are eliminated because of bad addresses and investigate whether they have different angling behavior from the remaining license holders. Finally, the private access site issue can also be considered frame-related, but that problem is not specific to LA Creel.

5. *How sensitive is the accuracy of the survey to other potential sources of nonsampling error? What can be done to reduce or limit that sensitivity?*

One of the main sources of nonsampling error is nonresponse error. While using a frame of license holders will somewhat mitigate this source of error, the nonresponse rate is likely to be quite large and is expected to continue to grow in the future. At the same time, the use of quota-based sampling will make the problem worse, since it will tend to result in a larger

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Overall, the survey addresses the main types of potential biases to a level that is comparable to MRIP.

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The overall structure of the design (with complementary surveys for catch and effort) is very similar to the MRIP design. The major positive difference now is in the sample sizes, which are larger for the new design and which therefore are expected to produce more precise estimates, especially for red snapper. As noted above, however, one possibly negative difference is that the effort survey is by telephone, which now have notoriously bad response rates, and which will represent a mode discrepancy with the FES. Investigating the size of resulting differences and possibly developing a calibration method is warranted.

The standard error estimates reported seem mostly to be smaller than comparable MRIP ones in the benchmarking data. However, in some cases, the estimates are quite different, with confidence intervals not at all close (e.g., PR +SH fishing effort comparison; MRIP value always higher). Is there an understanding of why that is the case?

We do have a comment about efficiency of the effort survey design. While we understand that equal stratum sample size is simple to explain and implement, it can lead to inefficient estimators with strata that vary fifteen-fold in size (from 15K to 226K per Table 2). Especially since these strata do not represent estimation domains of interest, it would seem to be more efficient to have sample sizes more nearly proportional to either the stratum size or the stratum angler activity.   This should represent a relatively minor adjustment in implementation, since neither the sampling nor the estimation procedures would change materially, and it might result in non-trivial improvement in estimator efficiency.

Some differences with the previous survey are the fact that sample sizes are increased during red snapper season, and that quota-based sampling is used in the effort survey. Both are driven by the need for in-season monitoring. The former is perfectly acceptable, as long as the estimates are weighted appropriately to reflect the increased sampling. The latter is a drawback, as already noted, but likely unavoidable.

8. *How does the survey design compare with other survey designs previously certified by MRIP for estimating fishing effort and/or catch for the same fishing mode(s)? Is it more statistically sound and efficient, or is it at least comparable in its statistical validity and efficiency? What design features are most important in supporting this assessment?*

   As noted, the overall survey program approach follows the standard MRIP model of complementary effort and catch surveys, and is implemented as randomized sampling and design-weighted estimators. The interview instruments are simplified compared to the MRIP ones, but essentially comparable in terms of key questions. The biggest difference is expected to be the mail vs. telephone mode for the effort survey, so that should be evaluated further. Overall, this survey program is similar to the other recreational angler survey programs currently certified by MRIP.

9. *Is the survey collecting data and producing information products that will meet the needs of the primary customers (stock assessment scientists and fishery managers)?* [To be addressed by NMFS staff.]

Appendix 3:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

December 21, 2017

MEMORANDUM FOR: The Record

FROM: Cisco Werner, Ph.D., Director, Scientific Programs and Chief Science Advisor, National Marine Fisheries Service

SUBJECT: Certification of Marine Recreational Information Program (MRIP) Fishing Survey Method for LA Creel

This memorandum certifies the LA Creel survey design described herein as an approved method for derivation of estimates of recreational fishing catch and effort. The MRIP certification process is described at https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/making-improvement. For LA Creel, specific Terms of Reference were also adopted (see attached).

BACKGROUND

Prior to 2008, the Marine Recreational Fisheries Statistics Survey (MRFSS), initiated in 1979, was the primary source for national recreational fishery statistics in the United States. In response to a growing demand for an improved recreational fishing data collection program, NMFS commissioned the National Research Council (NRC) of the National Academies of Science to conduct a high-level scientific review of the existing survey methods used by NMFS and its partners to monitor catch, effort, and participation in marine recreational fisheries throughout the U.S.

The NRC's Ocean Studies Board formed a 10-member committee of experts in sampling design and statistics to conduct the requested review independent of NMFS. A final report of their findings (*Review of Recreational Fisheries Survey Methods*) was published in April 2006. The committee identified a number of potential problems with the MRFSS sampling and estimation designs, and questioned the adequacy of existing surveys in providing the statistics needed to support stock assessments and the kinds of fishery management decisions required by current law and practice. The report included recommendations to redesign current surveys to improve: their effectiveness, the appropriateness of their sampling procedures, their applicability to various kinds of management decisions, and their usefulness for social and economic analyses.

Section 401(g) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), which was added via the 2006 Magnuson-Stevens Reauthorization Act (MSRA), P.L. 109-479 (Jan. 12, 2007), includes new requirements for improving recreational fisheries data collection:

- "Within 24 months after the date of enactment of the [MSRA], the Secretary, in consultation with representatives of the recreational fishing industry and experts in statistics, technology, and other appropriate fields, shall establish a program to improve the quality and accuracy of information generated by the Marine Recreational Fishery Statistics Survey, with a goal of achieving acceptable accuracy and utility for each individual fishery." 16 U.S.C. § 1881(g)(3)(A).

- "The program shall take into consideration and, to the extent feasible, implement the recommendations of the National Research Council in its report *Review of Recreational Fishing Survey Methods* (2006), including...redesigning the survey to improve the effectiveness of sampling and estimation procedures, its applicability to various kinds of management decisions, and its usefulness for social and economic analyses..." *Id.* § 1881(g)(3)(B).
- "Unless the Secretary determines that alternative methods will achieve this goal more efficiently and effectively, the program shall, to the extent possible, include...use of surveys that target anglers registered or licensed at the State or Federal level to collect participation and effort data...collection and analysis of vessel trip report data from charter fishing vessels." *Id.* § 1881(g)(3)(C)(ii)-(iii).

NMFS initiated the Marine Recreational Information Program (MRIP) in 2006 to address the findings and recommendations of the NRC report and to carry out the above requirements. MRIP was formally established upon adoption of an Implementation Plan in October, 2008. It is a collaborative effort among NOAA Fisheries, regional fisheries managers and stock assessment scientists, and the recreational fishing community to develop and implement an improved recreational fisheries statistics program. The new program consists of a system of regional surveys that provides the best scientific information available (BSIA) for use in the assessment and management of the Nation's marine fisheries. *See id.* § 1851(a)(2) (requiring, under MSA National Standard 2, that conservation and management measures be based on BSIA). Decisions to implement new data collection methods are informed by a technically-sound scientific process that includes testing of new or enhanced survey methods, peer reviews of survey methods and project results, reviews by stakeholder groups, and development and execution of transition plans that assure an orderly and scientifically sound process for incorporating the catch and effort estimates derived from new methods into catch history databases as necessary for fisheries stock assessments and management.

In response to the NRC findings and recommendations, and as directed and authorized by § 401(g) of the MSA, MRIP has undertaken a series of actions to establish more suitable sample frames and to develop and test survey methods which will result in more accurate estimates of fishing effort. In addition to the BSIA standard under MSA's National Standard 2, MRIP follows the requirements of the Information Quality Act (P.L. 106-554 § 515), which ensures the quality, objectivity, utility, and integrity of disseminated information.

Many regional partners have also initiated development of alternative and supplemental survey designs that are intended to provide catch estimates that directly address partner needs that are not fully met by the general MRIP surveys. In order for the data generated by these surveys to be utilized by NMFS, NMFS developed a certification process under which survey designs are pilot tested, the design and pilot results peer reviewed, and NMFS certifies whether the survey and estimation methods are scientifically sound.

In 2014, the Louisiana Department of Wildlife and Fisheries (LDWF) developed an alternative general survey design designated as LA Creel. LA Creel was designed to provide catch estimates for state drainage basins, particularly for offshore fisheries, that are more precise than the MRIP general survey estimates, and also to provide preliminary estimates weekly during the fishing season. To achieve improved precision at finer temporal and spatial scales, LDWF increased LA Creel sampling effort substantively from the levels previously provided by the MRIP general surveys, at a cost that is three to four times higher. At the time of certification, LDWF is providing funds to cover all costs above the original MRIP funding allocated for Louisiana.

LA Creel was pilot tested in 2014-2015, and the design was adjusted in response to pilot testing. At LDWF's request, NMFS conducted a peer review of LA Creel in June, 2015. LDWF has responded to the peer review comments and there have been subsequent rounds of review and response, as documented in the attachments.

DESCRIPTION OF THE CERTIFIED METHOD

The LA Creel survey is based on a complemented survey design, where an on-site access point survey is combined with off-site telephone surveys in order to calculate total landings estimates for fish species across different recreational fishing activities. The access point survey is primarily used to estimate landing rates (landing per angler trip or landing per charter trip), and two different telephone surveys—one for private anglers and one for charter boats--are primarily used to estimate total effort (total number of angler or charter trips). Total landings estimates for a certain period of time are simply the product of the landing rate and total effort values. There are three primary survey components of LA Creel:

- The Access Point Survey for Landings Rate Estimation is conducted at fishing access points, stratified by river basin and day type. A probability sampling design based on site pressure is utilized. Estimates of catch rates are produced weekly. Sites with offshore fishing activity are sampled at higher rates during the federal red snapper season.

- The Private Angler Effort Survey is a telephone survey of Louisiana saltwater fishing license holders with telephone numbers on file. The telephone survey is stratified into three geographic regions of the state plus non-residents, plus holders of Recreational Offshore Landing Permits (ROLP). The survey produces weekly estimates of the number of trips at shore, public (boat) and private (boat) access sites. Sampling rates for ROLP holders are increased during the federal red snapper fishing season.

- The Charter Effort Survey is a weekly survey of holders of Louisiana Charter Boat Guide licenses. The survey is stratified by holders and non-holders of ROLP's. Weekly estimates of charter-based fishing trips are produced by basin.

The complete documentation of the LA Creel survey methods, survey instruments, and estimation is provided in the attachments hereto.

CERTIFICATION

The LA Creel survey design described in the attached file titled *LA Creel Survey Documentation 12012017-1* is certified as a design that has been appropriately developed and peer-reviewed and that is considered scientifically valid. The practical effect of this certification is that NMFS may fund use of this design in surveys and fund and/or provide technical support for other similar efforts proposed or used by partner organizations. It should be noted that any modifications of the documented survey design are not automatically deemed certified, but will require review for consistency with this determination and potential further modification for the survey to remain certified.

This certification does not mean that estimates from LA Creel are, at this time, the best scientific information available for purposes of MSA National Standard 2, 16 U.S.C. § 1851(a)(2). Catch statistics produced using LA Creel cannot be reliably used for fishery stock assessments and management actions until scientifically valid methods have been developed, peer reviewed, and implemented that allow for integration of the LA Creel catch estimates into the history of MRIP-derived estimates in a common currency for comparison. In order to integrate the LA Creel estimates, NMFS and LDWF need to develop a calibration method to adjust the historic estimates to be comparable to LA Creel, have the new calibration method peer reviewed, and then apply it to catch history time series in updated stock assessments. Once these measures have been completed, through execution of a Transition Plan pursuant to NMFS Policy Directive 04-114, the LA Creel estimates can be fully utilized by NMFS in fishery stock assessments and management decision-making.

Attachments:
LA Creel Survey Documentation 12012017-1
LA Creel Review 09292017and Response-1
LA_Creel_Review_v4
LA_Creel_Review_TOR9
LA Creel Review - Final Response 15Dec15
LA Creel OT Review_12152017
ESC Review of LA Creel_1221201

Appendix 4:

Saltwater Finfish Landing Statistics

Purpose
To provide recreational fishery information to aid in the management of Louisiana's valuable fishery resources. The saltwater component of the recreational fishery encompasses state waters including marsh habitat, bays, beaches and nearshore areas as well as the offshore federally managed waters of the EEZ. These are open systems where the only boundary to the species is its habitat requirements.

Methodology
The LA Creel survey is based on a complemented survey design, where an on-site access-point survey is combined with off-site telephone surveys in order to calculate total landings estimates for fish species across different recreational fishing activities. The access point survey is primarily used to estimate landing rates (landing per angler trip or landing per charter trip) and the telephone survey is primarily used to estimate total effort (total number of angler or charter trips). Total landings estimates for a certain period of time are simply the product of the landing rate and total effort values.

Access Point Survey for Landing Rate Estimation

Site Sample Frame
Access points included in the survey are public sites (i.e., boat launches, marinas, piers, road side, beaches) in coastal Louisiana that are utilized by saltwater anglers. Each site is evaluated monthly on the intensity of fishing pressure (estimated average number of trips per day) for each fishing activity (Private Inshore, Private Offshore, Charter Inshore, Charter Offshore) and for each day type (weekday/weekend). Weekdays are Monday – Thursday and weekend days are Friday – Sunday. Each site initially has 8 pressure values for a sample week (4 fishing activities x 2 day types). For each fishing activity within a basin and day type, proportional probabilities are derived from pressure values for each site, and then averaged across fishing activities. The end result is 2 weighting factors (average proportional probabilities) per site per month, one for each day type. These weighting factors are used during assignment selection (described below). The Barataria Basin has a disproportionate amount of offshore effort located in the area's southern half. In order to prevent this offshore effort from dominating the probability calculations for site selection, the basin was divided into two distinct selection strata, an upper and lower portion of the basin.

Sample Design
The Access Point Survey follows a stratified two-stage design. For site selection, the site sample frame is divided and stratified into the following categories:

BASIN	DAY TYPE
Lake Pontchartrain Upper Barataria-Mississippi River Lower Barataria-Mississippi River Terrebonne-Timbalier Vermillion-Teche-Mermentau Sabine-Calcasieu	Weekday (Monday-Thursday) Weekend (Friday-Sunday)*

*Veteran's Day is treated as a weekend day.

The primary sampling unit (cluster) is a specific site, day, and shift when an interviewer will be present to survey anglers. Shifts are 8am – 2pm and 2pm – sunset. The secondary sampling unit is the angler trip. From here on, the specific site/day/shift clusters are referred to as “assignments.” See “Louisiana Recreational Statistics Program: Sampling Protocol” for detailed interview procedures. One person from each fishing party will be interviewed.
Information collected during dockside survey:

1. Fishing activity (Private Inshore, Private Offshore, Charter Inshore, Charter Offshore)
2. Number of anglers in party
3. Total number of fish landed for each species (trip totals for entire party)
4. Total number of fish thrown back or used as bait by species for the following species
    - i. Black Drum
    - ii. Gray Snapper
    - iii. Gray Triggerfish
    - iv. Greater Amberjack
    - v. King Mackerel
    - vi. Red Drum
    - vii. Red Snapper
    - viii. Sheepshead
    - ix. Southern Flounder
    - x. Spanish Mackerel
    - xi. Spotted Seatrout
    - xii. Largemouth Bass
5. Number of anglers with a valid Louisiana saltwater fishing license
6. Number of anglers with a valid Recreational Offshore Landing Permit (ROLP)
7. Area where majority of fish were harvested or, if no harvest, area of majority of fishing effort.
    - a. Area reported at sub-basin level for state waters.
    - b. Area reported by grid number for EEZ waters.
8. Charter captain name if applicable
9. Whether or not trip was participating in a tournament
10. Trip status (complete/incomplete)
11. Interview status (complete, incomplete, refusal)
12. Target species (primary and secondary, at the request of NMFS)
13. Number of missed parties (counted for each assignment)
14. Time of interview

Discarded fish are recorded as: under the legal size limit, used for bait, or other (for any reason not covered by the first two options).

Incomplete trips are allowed to be surveyed to accommodate shore sites due to the length and layout of the site, which may span more than a mile. Interviewers are encouraged to conduct incomplete trip surveys only during the last on-site hour. Incomplete trip parties are issued a postage paid, uniquely numbered card on which they can record their landings and mail the card to LDWF. Incomplete trip data are recorded as reported but, are not used for statistical purposes until the card is received.

Missed parties are those parties who were believed to be eligible for the survey, but were not approached due to the interviewer surveying other parties at the time.

Biological data is recorded if time allows, but biological data collection is not a part of the dockside survey. (See “Biological Sampling Program” document for details).

Assignment Selection

The number of assignments per basin per month was determined based on the diversity of fishing activities within each basin as well as the number of sites that experience fishing pressure. Since greater fishing activity occurs on the weekends, assignments for each basin are divided so that weekends are drawn more often than weekdays with the exception of the Vermilion basin which has limited recreational activity compared to other basins (Table 1).

BASIN	**WEEKLY ASSIGNMENT DISTRIBUTION**	
	Weekdays	**Weekends**
Lake Pontchartrain	2	4
Upper Barataria-Mississippi River	2	2
Lower Barataria-Mississippi River	2	4
Terrebonne-Timbalier	2	3
Vermillion-Teche-Mermentau	2	2
Sabine-Calcasieu	2	4

Table 1. Dockside assignment distribution.

Next, specific sites, dates, and shift times are selected. For each sub-week, sites are randomly selected using a probability proportional to size (PPS) methodology with replacement; using average proportional probabilities for each site as the weighting factor. Dates and shift times are randomly selected with replacement for each sub-week using equal weights. This process is repeated for each basin. In the event that duplicate assignments occur within a basin, the selection process is repeated until no duplication occurs. Creel schedules with interview assignments are distributed to field offices monthly.

Federal Red Snapper Season

Given the drastic increase in offshore angling activity during the shortened federal red snapper private angler season, sampling at sites with offshore angling pressures is increased by moving assignments from the Upper Barataria – Mississippi River Basin with little or no offshore activity to the Lower Barataria – Mississippi River basin with the highest offshore activity in the state. In 2016, one weekday and one weekend day were moved for the month of June. The number of assignments does not change, but survey effort at sites with offshore pressure is increased in order to improve the precision offshore landing rate estimates. The above is just one example of how La Creel offers LDWF the flexibility to review its sampling protocol and adjust assignment selection as necessary to make sure adequate coverage is provided for species of concern or in response to environmental issues.

Additional information is collected during red snapper season:

1. EFP trip number (or ROLP trip number)

2. Vessel number
3. Fishing location
4. Depth fished
5. Lease location

These questions are asked if an angler was targeting or caught red snapper.

Considerations

Interviewing anglers in-person immediately after they finish their trip is preferred because trained field staff can observe and confirm catch. This removes numerous response issues common in off-site survey designs (recall bias) and assumptions associated with incomplete trip (roving) surveys. Typical access point surveys can have a high cost given the relatively low number of interviews obtained, but the data obtained are high quality (Pollack et al., 1994). Given that only one angler per fishing party is required to report for the trip, the question list is short, and that anglers from all fishing activities will be interviewed during an assignment, this survey increases the possible number of trips interviewed and reduces potential angler skill level bias compared to other access point surveys. The short interview time should also appeal to anglers and increase participation (reduce refusal rate). In addition, mail-in cards that are given to anglers who have not yet completed their trip can be submitted upon trip completion further increasing angler participation. This is primarily to help better quantify shore-based trips where observing complete trips is less common.

Site selection is optimized through the inclusion of site pressures that are evaluated monthly by fishing activity and day-type; where assignment dates are distributed evenly throughout the month and/or season. This helps to minimize manpower requirements on a given day and data lost to weather cancellations or poor fishing conditions (resulting in no interviews). By weighting the random selection process, the likelihood that observed landing rates are representative of Louisiana anglers over time is greatly increased. As LA Creel data are analyzed, weighting AM/PM shifts may be added if data suggests doing so would further increase efficiency. In addition, modifying the monthly number of assignments for each basin and fishing activity from a fixed number to one that changes throughout the year may prove to be beneficial. The access point survey portion of LA Creel does not currently sample nighttime anglers or anglers with private fishing access and as such, landing rates will not include these angler groups. It is not known if landing rates of nighttime anglers and private access anglers substantially differ from daytime landing rates at public access sites. This will be determined through separate LDWF programs. If total landings estimates from private access sites are calculated, landing rates from public sites will be used in combination with private effort to determine total private landings. The telephone surveys will account for public vs. private and daytime vs. nighttime differences in effort.

Although catch and release data collected from surveys are not verifiable, they are subject to prestige bias (exaggeration), and could be intentionally falsified if it is perceived by anglers that their response can influence management decisions. LA Creel began collecting such data in May 2016 at the request of NMFS. In addition, discard mortality rates are variable. Using spotted seatrout as an example, discard mortality rates depend largely on bait/hook type, hooking location, angler skill level, fish size, and water quality (LDWF 1995, Murphy et al. 1995, Stunz and McKee 2006, James et al. 2007).

For the purpose of producing estimates, this survey does not utilize a question on which fish species are being targeted by anglers. Omitting a targeting question removes a source of prestige bias (anglers stating that only fish harvested were targeted), but since this is a multispecies survey, the issue is raised of when to apply zeroes if a species is not harvested.

Zeroes will only appear in the survey data when a party landed no fish. This survey assumes that all anglers interviewed had the potential to catch all species observed during the time period of interest, essentially assigning zeroes to parties that did not land a species that was landed by another party.

At the request of NMFS specific species targeting questions were added for the purpose of providing this data to NMFS. La Creel does not currently utilize species targeted in its analysis protocol.

Effort Surveys

There are two separate effort surveys being conducted, one for private recreational saltwater anglers (Private Angler Effort Survey) and one for the Charter Boat Captains (Charter Effort Survey).

Private Angler Effort Survey

Angler Sample Frame

All persons possessing a Louisiana saltwater fishing license with valid phone numbers on file are included in the private angler effort survey sample frame. The frame includes the angler's name, Louisiana recreational saltwater fishing license number, and phone number. Email addresses are included in the frame if the license holder opts to enter it at the time of license purchase.

Anglers are encouraged to keep their contact information up-to-date through the LDWF website. The frame is being continually screened to remove unusable numbers. The number of saltwater license holders continually changes throughout the year. The most notable sample frame change during the year is immediately after June 30th when annual recreational licenses expire, where a rapid decrease and subsequent increase in frame size occurs as anglers purchase new licenses.

Sample Design

The angler effort survey sample frame is stratified into 5 regions based on geographic area, license densities, and/or license type (Table 2)

REGION	SALTWATER LICENSED ANGLER POPULATION*
North Louisiana	73,010
Southeast Louisiana	193,817
Southwest Louisiana	99,613
Non-Resident	19,255
ROLP (includes saltwater license holders)	17,162

*Numbers are approximations

Table 2. .2019 average private angler license frame by region.

The Recreational Offshore Landing Permit (ROLP), which is a free permit required to possess certain offshore species. The purpose of this stratification is to increase the likelihood that angler effort estimates are possible at fine spatial resolutions. Each week, 1,600 license holders are contacted for interviews, distributed uniformly across the five regions (400 contacts for the ROLP region and 300 contacts per remaining region). For sampling to be considered complete for the week, a total of 800 license holders must complete a survey. Calling efforts continue until the quota of 800 is met.

Information collected during the private angler effort survey:

1. Dates angler went saltwater fishing
2. The basin from which the majority of harvest was taken.
   - If no fish were landed, the area that most of the fishing activity took place.
3. Whether or not activity was from shore
4. Whether trip ended at a publicly accessible site or a private site
5. Time trip ended and returned to dock
6. Whether they possess an ROLP (non-ROLP strata only for database correction)

Call List Selection

The weekly call list of 1,600 anglers is randomly selected from the sample frame without replacement. Anglers do not appear on the call list two weeks in a row. The list is purposely randomized using random number sorting before calling begins. Calls are made by going through the list until the 800 quota is met. This randomization ensures there is no sorting bias that would otherwise occur with this method. By uniformly allocating the weekly call list, the necessary weighting needed to account for disproportional license distribution can be achieved.

Federal Red Snapper Season

Given the drastic increase in offshore angling activity during the shortened federal red snapper season, the number of anglers contacted weekly in the ROLP strata is increased from 400 to 800 in order to improve the precision of private angler ROLP effort estimates. By increasing the number of anglers contacted weekly, private angler ROLP effort estimates has been within a +/- 5 % margin of error (MOE).

Considerations

A telephone survey using an angler license sample frame is recognized as an efficient method to produce precise effort estimates (Pollack et al. 1994). By conducting this survey weekly, recall bias is substantially reduced when compared to other telephone surveys. The question list is short, which minimizes costs and appeals to anglers, and is able to provide effort data by drainage basin and public/private access status. Stratifying the call list sample frame ensures that regional differences in avidity are accounted for. Past research has shown saltwater avidity differs in Louisiana primarily by region, however, additional avidity differences exist between license types and angler age (LDWF 2008).

A common problem with call list sample frames is inaccurate contact information resulting in a high number of calls with no successful interviews. While the frame is screened to remove obviously unusable phone numbers, it is not possible to identify all bad numbers *a priori*. This frame is continually adjusted; removing any unusable number encountered. In addition, a tool on the LDWF website has been developed to enable license holders to update their contact information. Unlicensed anglers are not contacted during the telephone survey, meaning observed total angler trips only includes licensed anglers and is an underestimate of effort.

This is accounted for by expanding observed effort estimates by LA recreational saltwater license requirement and compliance levels determined from the access point survey.

The license turnover that occurs after the annual license expiration date of June 30th may result in a disproportionately high number of lifetime license holders being contacted; however, it is expected that the annual license purchase rate will be high given the popularity of summer fishing, reducing the amount of time this bias occurs. Past research shows that lifetime license holders are slightly less avid than annual license holders (LDWF 2008), which could result in slightly depressed effort estimates in the weeks following June 30th. This particular aspect of the effort survey is being investigated thoroughly by LDWF and may result in design modifications in the near future.

The absence of a fish species targeting question in this telephone survey will require the same total effort data from a period to be applied to each species caught in that period. An assumption with coupled multispecies creel survey designs is that the two populations surveyed are landing the same distribution of fish species. For example, within a single period, the access point survey resulted in two species being caught, and the phone survey resulted in a single effort multiplier. If the landing rate for one species was low, then the total landings estimate will be low for that species; if the landing rate for another species was high, than the total landings estimate will be high for that species.

For effort that is reported by anglers drawn from the ROLP region, the total number of offshore trips will not come from the license frame, but from the ROLP frame. However, the effort estimate generated by ROLP region data is ultimately combined with offshore effort from all other regions to produce one weekly offshore effort for private anglers. Catch rates calculated from dockside data does not distinguish between ROLP and non-ROLP anglers and is applied to the entire weekly offshore effort. ROLP species specific catch rates are no longer applied to just the ROLP effort but to the combined offshore effort of all private offshore trips.

Charter Effort Survey

Charter Sample Frame

All persons possessing a Louisiana charter boat fishing guide license are included in the charter sample frame. The expiration date for guide licenses is December 31st, meaning the size of this sample frame will continually increase throughout the year.

Sample Design

The charter sample frame is stratified into 2 groups: those possessing an ROLP, and those that do not. The purpose of this stratification is to increase the likelihood that offshore charter efforts will be obtained from the survey. Initially each week, 5% of the ROLP captains and 5% of the non-ROLP captains were contacted. Starting on January 1, 2016, 30% of the ROLP captains and 10% of the non-ROLP captains are contacted weekly to improve the precision of charter ROLP effort estimates. See “Louisiana Recreational Statistics Program (LA Creel): Sampling Protocol” for detailed interview procedures.

Information collected during the charter effort survey:
1. Date charter fishing trip took place
2. Number of anglers on each trip
3. The basin in which the majority of harvest was taken

        - If no harvest, then the basin in which the majority of fishing effort took place
4. Whether trip ended at a privately or publicly accessible site

Call List Selection

The weekly charter call list is randomly selected from the sample frame without replacement. Captains do not appear on the call list two weeks in a row.

Federal Red Snapper Season

Given the drastic increase in offshore angling activity during the shortened federal red snapper season, all ROLP captains (100% of the ROLP sample frame strata) are contacted in order to maximize the precision of charter ROLP effort estimates.

Considerations

Most of the considerations for the angler effort survey apply to the charter effort survey. Contact information in the charter sample frame is more accurate than in the angler frame. The size of the weekly call list was chosen due to the small size of the charter call list sample frame. The charter frame is a list of charter captains and not a list of charter vessels, which is the case with other survey designs. This should increase the likelihood that data will be collected from captains with multiple vessels and captains who need to borrow a vessel (if their primary vessel is under repair).

Given the December 31st guide license expiration date, this frame will expand throughout the year, but will likely not consist of more than 1,000 individuals before years end. While sampling the entire frame weekly would be preferred due its small size, past experience has shown that contacting more than 20% of charter captains weekly decreases participation. The ROLP/non-ROLP holder strata were chosen since this is expected to be the primary source of avidity differences within the charter call list sample frame; however stratification may be modified once more data become available

Calculations

The calculations described below determine weekly estimates for landing rate, effort, and total landings for any given species in any particular fishing activity. These estimates can be expanded for any period of interest (month, season, or year). All of the calculations are completed in SAS Enterprise Guide 7.1.

Within the period of interest, total landings for a species can be estimated for each of the following fishing activities within the following basins (equivalent to CSAs), or combined to form statewide total landings estimates (Table 3).

BASIN	FISHING ACTIVITY
Lake Pontchartrain Barataria-Mississippi River Terrebonne-Timbalier Vermillion-Teche-Mermentau Sabine-Calcasieu	Private Inshore Private Offshore Charter Inshore Charter Offshore

Table 3. Basins and activities.

Landing Rate Estimation
The equations and estimates for effort were obtained from the Proc Surveymeans section of SAS Institute Inc. 2009.

For a stratified cluster sample design with sampling weights, the sample can be represented as $n\ x\ (P+1)$ matrix that looks like the following:

$$(\boldsymbol{w},\boldsymbol{Y}) = \left(w_{hij},\boldsymbol{y}_{hij}\right) = (\,w_{hij}, y_{hij}^{(1)},\, y_{hij}^{(2)}, \dots,\, y_{hij}^{(P)})$$

Definitions and Notation for Landing Rate

h=1,2,…,H is the stratum index (day-type)

i=1,2,…n_h is the cluster index (site-day-shift) within stratum h

j=1,2,…m_{hi} is the unit index (interview) within cluster I of stratum h

n= $\sum_{h=1}^{H}\sum_{i=1}^{n_h} m_{hi}$ is the total number of observations (interviews) in the sample

n_h: is the number of clusters (site-days-shifts) per strata

$\boldsymbol{y}_{hij} = (y_{hij}^{(1)}, y_{hij}^{(2)}, \dots, y_{hij}^{(P)})$ are the observed values of analysis variables (number of fish and anglers) for unit *j* in cluster *i* of stratum *h*

w_{hij} = are the assignment weights within cluster *i* of stratum *h*.

x_{hij} = are the values for the variable of interest (i.e. total number of anglers)

f_h : is the sampling rate for stratum h, which is the fraction of clusters (site-days-shifts) selected for the sample

For private and charter anglers, species landing rates are derived from equation [1]:

$$Mean\ Angler\ Harvest\ Rate\ = \frac{Total\ \#\ of\ Fish\ Harvested\ by\ Party}{Total\ \#\ of\ Anglers\ in\ Party} \qquad [1]$$

Let y_{hij} represent the value of the variable for total number of fish landed by the j^{th} party in cluster *i* in the h^{th} stratum. Let x_{hij} represent the value of the variable for total number of anglers in the *j*[th] party in cluster *i* in the *h*[th] stratum. w_{hij} is the sampling weight for cluster i of stratum *h*. Then equation [3] calculates the landing rate (HR) for a single species in a period (week):

$$\widehat{HR} = \frac{\sum_{h=1}^{H}\sum_{i=1}^{n_h}\sum_{j=1}^{m_{hi}} w_{hij}\, y_{hij}}{\sum_{h=1}^{H}\sum_{i=1}^{n_h}\sum_{j=1}^{m_{hi}} w_{hij}\, x_{hij}} \qquad [2]$$

The variances of this ratio estimate were calculated using a Taylor series expansion method. This method obtains a linear approximation for the estimator and then uses the variance estimate for this approximation to estimate the variance of the estimate itself. The variance calculation of this landing rate ratio is as follows:

$$\hat{V}\left(\widehat{HR}\right) = \sum_{h=1}^{H} \hat{V}_h\,(\widehat{HR}) \qquad [3]$$

For n_h>1:

$$\hat{V}_h\left(\widehat{HR}\right) = \frac{n_h\,(1-f_h)}{n_h-1}\sum_{i=1}^{n_h}(g_{hi} - \overline{g}_h)^2 \quad [4]$$

where:

$$g_{hi} = \frac{\sum_{j=1}^{m_{hi}} w_{hij}\,(y_{hij} - x_{hij}\widehat{HR})}{\sum_{h=1}^{H}\sum_{i=1}^{n_h}\sum_{j=1}^{m_{hi}} w_{hij}\, x_{hij}} \qquad [5]$$

and:

$$\overline{g}_h = \frac{\sum_{i=1}^{n_h} g_{hi}}{n_h} \qquad [6]$$

Considerations

The standard PSU-only variance approximation does account for both among-PSU and within-PSU variation, but not in an obvious way and not in an unbiased way. The estimator only uses the empirical variation among PSUs, but the theoretical variation among PSUs and within PSUs is included in this empirical variation. Under mild conditions on the design, the bias of the PSU-only variance estimator is extremely small.

Effort Estimation

The equations and estimates for effort were obtained from Cadima et al. 2005. Effort estimates are calculated both statewide and for each basin.

Definitions and Notation for Effort:

N: is the total population of licensed anglers statewide

N_h: is the population total of licensed anglers found within each stratum (Region)

n_h: is the total number of anglers interviewed within each stratum (Region)

$\hat{E}$: is the estimated effort (number of angler trips) statewide

$\hat{E}_h$: is the estimated effort (number of angler trips) within each stratum (Region)

e_h: is the estimated mean effort (number of angler trips) per angler

e_{hi}: is the estimated effort (number of angler trips) for a specific angler

The effort survey is a stratified random sampling design within each period (analysis). Thus the following calculations are used to calculate the observed number of angler trips for each stratum (i.e. Region), and the total observed number of angler trips for the total population:

$$\hat{E}_h = N_h * \frac{e_h}{n_h} \qquad [7]$$

$$\hat{E} = N * \sum_{h=1}^{H} \frac{N_h}{N} * \frac{e_h}{n_h} \qquad [8]$$

To calculate variance for the total number of angler trips, you first calculate the estimated variance of each stratum, and then sum the variances for each stratum to get the estimated total variance for the population:

$$\hat{V}_h(\hat{E}_h) = N_h{}^2 \left(1 - \frac{n_h}{N_h}\right) \frac{s_h{}^2}{n_h} \qquad [9]$$

$$\hat{V}(\hat{E}) = \sum_{h=1}^{H} N_h{}^2 \left(1 - \frac{n_h}{N_h}\right) \frac{s_h{}^2}{n_h}, where \ldots s_h{}^2 = \frac{\sum_{i=1}^{n_h} (e_{hi} - \bar{e}_h)^2}{n_h - 1} \qquad [10]$$

To account for unlicensed angler effort, the license compliance rate is calculated using data collected during the access point survey:

$$Private\ Angler\ License\ Compliance\ Rate = \frac{Total\ \#\ of\ Anglers\ in\ Party\ with\ a\ License}{Total\ \#\ of\ Anglers\ in\ Party} \qquad [11]$$

$$Charter\ Guide\ License\ Compliance\ Rate = \frac{Total\ \#\ of\ Captains\ with\ a\ License}{Total\ \#\ of\ Captains\ Interviewed} \qquad [12]$$

$$ROLP\ License\ Compliance\ Rate = \frac{Total\ \#\ of\ Captains\ or\ Anglers\ with\ a\ ROLP}{Total\ \#\ of\ Captains\ or\ Anglers\ Interviewed} \qquad [13]$$

The variance calculation of this ratio are the same as written above in the landing rate estimation section, with the exception being that x_{hij} now represents the value for total number of anglers in the party with a license (or number of captains) for the *j*th member in cluster *i* in the *h*th stratum.

Using the license compliance rates, the observed total number of angler trips is expanded into a new total number of angler trips:

$$Expanded\ Total\ \#\ of\ \ Angler\ Trips = \frac{Observed\ Total\ \#\ of\ Angler\ Trips}{License\ Compliance\ Rate} \qquad [14]$$

The calculation of this ratio and its variance is made using a first-order Taylor series approximation of random variables X (total number of angler or charter trips) and Y (license compliance rate). Suppose one wants to estimate:

$$g(\mu_x, \mu_y) = \frac{\mu_x}{\mu_y} \; where \; E(\bar{X}) = \mu_x \; and \; E(\bar{Y}) = \mu_y \qquad [15]$$

Then the first-order Taylor approximation gives:

$$\hat{g} = \frac{\bar{X}}{\bar{Y}} \qquad [16]$$

$$E(\hat{g}) \approx \frac{\mu_x}{\mu_y} \qquad [17]$$

$$V(\hat{g}) = \left(\frac{\mu_x}{\mu_y}\right)^2 \left[\frac{V(\bar{X})}{\mu^2{}_x} + \frac{V(\bar{Y})}{\mu^2{}_y} - 2\,\frac{Cov(\bar{X},\bar{Y})}{\mu_x \mu_y}\right] \qquad [18]$$

Since X and Y are independent random variables, the covariance $Cov(X, Y)$ is equal to zero, thus equation [18] simplifies to:

$$V(\hat{g}) = \left(\frac{\mu_x}{\mu_y}\right)^2 \left[\frac{V(\bar{X})}{\mu^2{}_x} + \frac{V(\bar{Y})}{\mu^2{}_y}\right] \qquad [19]$$

Since the license compliance rate is calculated from the on-site access survey, they can be analyzed separately by species of interest, fishing activity (private, charter, shore) and fishing area (inshore, offshore). With the expanded total number of angler trips being a function of the license compliance rate, this also means that the expanded total number of angler trips can be calculated separate for each species, fishing activity, and fishing area.

Considerations

When calculating basin specific effort estimates, the issue is raised as how to determine the total population (N) of anglers for each basin, and for the mean number of trips per angler (e_h), which basin to apply the respondents who did not fish. For this survey, it is assumed that Louisiana anglers have the potential to fish in any basin; therefore: 1) N is equal for both statewide and basin specific effort calculations, and 2) for basin effort estimates e_h includes all respondents who did not fish in addition to those who did fish in that basin.

Total Landings Estimation

The equations and calculations for estimating total landings were obtained from Pollack et al. 1994.

The estimate of total landings is the product of the estimated effort and the estimated landing rate. Equation [19] can be used to calculate observed or expanded total landings estimates, using observed or expanded effort estimates, respectively:

$$Total\ Landing = Effort\ * Harvest\ Rate$$

$$\text{or:} \quad \hat{H} = \hat{E} * \widehat{HR} \qquad [20]$$

The estimated variance of the estimated total landing is calculated using a modified version Goodman's Exact Variance of Products (Goodman 1960, Walter and Ortiz 2012):

$$\hat{V}(\hat{H}) = \hat{E}^2\hat{V}(\widehat{HR}) + \widehat{HR}^2\hat{V}(\hat{E}) - \hat{V}(\hat{E})\hat{V}(\widehat{HR}) \quad [21]$$

Quality Control/Quality Assurance

All interviewers will be biologists trained in fish identification, who have passed a training course in LA Creel field procedures. Unannounced visits are made by a trained observer to view the interviewer performing his/her assignment. Interviewers are expected to meet the following minimum criteria:

- ✓ Interviewers must follow protocols as outlined in the LA Creel Sampling Protocol
- ✓ Be at the assigned site at the assigned starting time
- ✓ Clothing must include a shirt with LDWF logo
- ✓ If caps are worn, they must have LDWF logo
- ✓ Shoes must be closed-toe (Crocs© are not acceptable)
- ✓ Have a time piece (watch, cell phone, etc.)
- ✓ Have appropriate fish identification book(s)
- ✓ Conduct must be professional and courteous
- ✓ Field fish identifications must be correct

Field forms are reviewed by an independent biologist, and both the original data on the field form, and the data entered into electronic databases will be validated. Two options for electronic data entry are available; a web entry data management system and an iPad application. Data entered through the iPad application are delivered to a server where a data management biologist downloads and imports the data into the LA Creel database.

Once field forms are received by data management, quality control checks are performed by comparing intercept responses on the field form with the intercept data that was entered electronically. Responses to each question are compared to ensure that each intercept interview data was entered consistently. Data management attempts to correct any transposition errors and/or inconsistencies prior to running estimate calculations. If discrepancies in data arise, the interviewer is contacted for further explanation, the validity of the data discussed, and if necessary, the interviewer is corrected.

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