CROWD SOURCING ESSENTIAL FISHERY INFORMATION FOR CALIFORNIA HALIBUT

A Final Report for California Fisheries Research West

Project number: R/OPCCFRW-11MG, Grant: 11-027

February 2015

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EXECUTIVE SUMMARY

BACKGROUND:
Until recently, it was common for hundreds of halibut to be entered in the annual Marina Del Rey Halibut Derby hosted by the Marina Del Rey Anglers (MDRA) fishing club. In the last few years as few as two halibut were caught and was a source of concern. This project is a result of the MDRA members' genuine concern for the fishery and interest in bringing it back.

The CDFW is planning to collect data on recreational halibut fishing for a stock assessment over the next few years. Gathering this information is costly, especially when halibut landings are infrequent. But if fishermen who target halibut can collect essential fishery information (EFI) through a citizen-science monitoring program, CDFW can avoid the expense.

GOALS: Develop and test a citizen-science program to collect information about recreationally caught halibut that will:

- Generate reliable, accurate, and consistent EFI on halibut caught by recreational anglers;
- Use methods that rely on the tools that anglers have already;
- Engage anglers in the management of this fishery;
- Create incentives to encourage angler participation; and
- Be adopted elsewhere.

Derby entries in 2006 (LEFT) and 2013 (RIGHT). *Photos courtesy of the Marina Del Rey Anglers.*

VISIT HTTP://MDRA.FISHINGSTATUS.COM TO VIEW THE DATA AND LEARN HOW YOU CAN HELP!

METHODS: In the pilot phase of this project, members of the MDRA fishing club were surveyed about whether and how they weigh and measure their fish and their level of interest in participating in such a program. Based on these results and existing CDFW methods, a description of standardized methods for collecting EFI was written and reviewed by anglers, fishery biologists, and fishery managers. At the same time, a website was built to provide a platform for entering and submitting data, offering incentives for active participants, and managing the data. Then, the methods, the reporting system, and angler accuracy was tested during a series of fishing trips. Angler generated data was compared with scientist generated data to demonstrate the reliability of the data generated by the program and discussions were held with CDFW staff to discuss data usage and sharing. Now, the MDRA are actively working to expand the program's membership by reaching out to other fishing clubs in southern California.

MAIN CONCLUSIONS

Data are comparable: Length measurements made by fishermen are statistically the same as those of scientists (P = 0.30). When fishermen use the same equipment, the differences become even less (P = 0.65). The weight measurements made by fishermen and scientists were significantly different (P = $1.18E^{-8}$). This was most likely because the scientists were using spring-scales that are less sensitive to light weights, while most of the fish caught weighed less than 5 pounds.

ANGLERS ARE WILLING TO CONTRIBUTE DATA

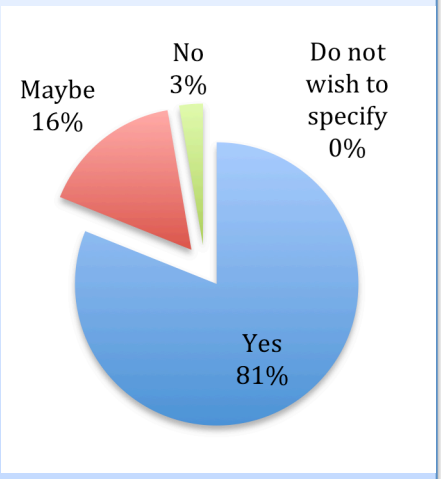


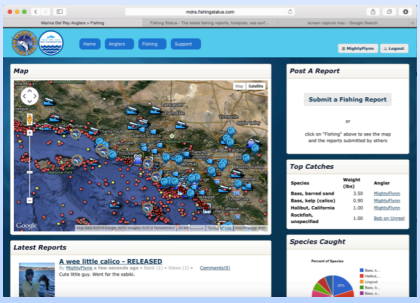
Figure: MDRA members' responses when asked if they were willing to collect halibut EFI and submit it to CDFW through a web-based platform.

Privacy is Important: The website and data system are designed to provide participants with the option of protecting their fishing location information, while still making a generalized location available in the data set.

Data usage: Given that a limited number of fishermen actively target halibut, this program is likely to generate information that is representative of the method of fishing (i.e. gear selectivity), but not of the recreational fishery as a whole (i.e. fishing mortality, catch per unit effort, catch by area).

SUMMARY DATA ARE VIEWABLE ON THE WEBSITE

http://mdra.fishingstatus.com



NARRATIVE

Introduction

Background: California halibut (*Paralichthys californicus*, halibut hereafter) are a long-lived species of flatfish that support high-value commercial and avid recreational fisheries. The annual Marina Del Rey Halibut Derby, which started in 1975 and is hosted by the Marina Del Rey Anglers fishing club (MDRA), is the longest running fishing competition on the West Coast. This tournament attracts fishermen from all over southern California and until recently, it was common for hundreds of halibut to be entered. Since 2005, the numbers of halibut caught during the contest has declined precipitously (Figure 1), raising concerns among anglers about the health of the local population.

Figure 1. Number of fish weighed (BLUE) at annual Marina Del Rey halibut derby from 2005-2011 Vs. the effort during the tournament in Angler-Days per Fish (RED).

The fishery is also one of the State of California's highest priorities for developing a fishery management plan (California Department of Fish and Game 2001). A 2011 stock assessment liberally[1] estimated the southern population to be depleted to about 14% of unfished biomass (MacCall et al. 2011). However, because the assessment was "at the weak end of acceptability" (MacCall et al. 2011), the California Department of Fish and Wildlife (CDFW) plans to collect more data over the next two to three years to address data gaps and deficiencies identified by the stock assessment peer review panel before pursuing a fishery management plan.

One key deficiency is sex-specific age and length frequencies from all modes of the recreational fishery (MacCall et al. 2011; Maunder et al. 2011). At the time of the stock assessment, the available recreational landings data were limited to recreational fishery surveys (stratified sampling across different fishing modes), Commercial Passenger Fishing Vessel (CPFV) logbooks, and observers on CPFV trips. Of these, the CPFV logbooks was the

[1] Assumptions made in the model tend to overestimate abundance (MacCall et al 2011)

only dataset robust enough to use. However, this dataset only includes the number and species of fish caught and discarded. It does not include other essential fishery information (EFI) such as length, weight, and sex.

Natural resource managers in California and beyond are increasingly looking to citizen scientists as an affordable means of filling such data gaps and collecting environmental monitoring data (California Collaborative Fisheries Research Program 2014; Sheppard & Terveen 2011; Fairclough et al. 2014). However, the credibility of data collected by non-scientists has often been questioned (Gillett et al. 2012; Sheppard & Terveen 2011; Alabri & Hunter 2010; Prentice & Parks 1993). A primary cause of unreliable data in citizen science programs is non-standardized protocols (Alabri & Hunter 2010; Sheppard & Terveen 2011).

Project Justification: A robust and credible citizen science program that collects sex-specific length and weight data from halibut caught by recreational anglers would improve estimates of gear selectivity, discard rates, and fishing mortality. These data could then be used to improve the 2011 stock assessment, which "is urgently in need of updating" and allow managers to more accurately model the stock's response to different exploitation rates (MacCall et al. 2011). An ongoing program that continues collecting data is also vital for future stock assessments (MacCall et al. 2011).

Brief Overview of Project Objectives, Components, and Activities: Here, just such a citizen science program is developed and tested in collaboration with recreational fishermen and CDFW. Objectives of this program are to 1) generate reliable, accurate, and consistent EFI on halibut caught by recreational anglers; 2) develop data collection methods that can be used with the tools anglers typically have on hand; 3) engage anglers in the management of this fishery; 4) create incentives to encourage angler participation in the program and 5) enable this program to be adopted elsewhere in southern California.

In this project, a citizen science program is developed and then tested with members of the MDRA fishing club in a pilot phase. At the end of the project, the program is expanded to recreational halibut fishermen across Southern California. First, the current knowledge, capacity, and tools of recreational anglers are assessed. The results of this assessment are used to guide the development of standardized methods, the web-based data submission tool, and incentive programs. The methods are then adapted to the tools and capabilities of the anglers and summarized. Next, field-testing occurs in which the accuracy of the data generated by anglers can be compared to the data generated by CDFW scientists. Finally, the program is expanding and procedures for data sharing are established.

Methods

ASSESS ANGLER CAPACITY

A ten-question, multiple-choice and open-response survey was developed and administered using Survey Monkey. The questions were designed to elucidate angler interest in a citizen science program, familiarity with online fishing logs, the measuring devices kept on their boat, and other details useful for informing the development of a user-friendly and reliable program[2]. Members of the MDRA fishing club were the targeted demographic as this group was the focus of the pilot phase. The survey was distributed to the MDRA fishing club membership (~125 anglers) by club leadership and they were sent at least one reminder to complete the survey. The survey results were analyzed by frequency of response.

ADAPT & STANDARDIZE METHODS

CDFW's standardized methods for collecting length, weight and sex of halibut are as follows: Fork length is measured from the tip of the closed mouth to the middle of the tail fin on a fish board (Figure 2). Precision is to the nearest mm. Weight is measured to the nearest 0.1kg on either a digital or spring hanging scale (Penttila 2013, pers. comm.). Sex is determined by visually inspecting the gonad (Caddell et al. 1990).

Figure 2. Proper technique for measuring halibut length.

In each case, minor adaptations were necessary to allow anglers to use the tools at their disposal. The methods were adapted based on conversations with recreational anglers and results from the survey. The adapted methods were summarized as standard operating procedures and reviewed by members of the Santa Monica Bay Restoration Commission Technical Advisory Committee and staff of the Department of Fish and Wildlife. These standard operating procedures were further revised and then included in the web-based data submission tool.

BUILD DATA SUBMISSION PLATFORM

A request for proposals was issued to solicit the development of a web-based data submission tool. Required services included:

[2] A copy of the survey can be found in Appendix 2.

- The development and creation of either a few webpages or a simple app through which anglers can enter information about their fishing trips, track their fishing activity, explore their data, and submit data to fishery managers; and
- The creation of a secure database and management system that incorporates quality assurance and quality control protocols and security settings, but allows open access to predefined queries.

Other required features include an online submission form that includes data validation; individual use statistics, such as frequency of use and accuracy of reports; secure storage of personal information, and privacy control over submitted data[3].

ASSESS DATA ACCURACY

Six fishing trips were held to test the methods and compare the data produced by anglers and scientists (primarily CDFW staff). Eleven anglers and two scientists participated in the field trials.

The scientists used a CDFW-spec'd fish board to measure length (Figure 3). The scale used varied with the trip and are a 50-lb, brass, mechanical (spring) scale; a 50-lb, stainless steel, mechanical scale (Mustad Tools); and a 100-lb, digital, hanging scale (Berkeley TEC). The measuring device used by anglers consisted of a yardstick affixed to the inside of the vessel just above the deck and abutting the stern. The scale used by anglers also varied with vessel and are a 100-lb, digital, hanging scale (Berkeley TEC, in comparison with the 50-lb brass spring scale); a 110-lb, digital, hanging scale (Mega Weigh MGH-1001); and a 50-lb, digital, hanging scale (Rapala).

Figure 3. Fish board used by scientists to accurately and precisely measure halibut length.

When a fish was brought on deck, the angler (or deckhand) measured the fish's length using the boat's measuring device to the nearest 1/16th of an inch (1.5875 mm) and the weight using the boat's scale to at least the nearest 1/10th of a pound (0.0454 kg). Then the scientist repeated the measurements using the scientific equipment and methods[4]. Both measurements were recorded by a third person on a paper data sheet. The order measurements were taken in (scientist, angler, length, weight) was chaotically determined (based on the activity occurring at that moment). If the fish was a halibut, the scientist would guide the angler through the sex-determination procedure.

[3] A copy of the RFP is available upon request.

[4] Scientist measurements of length were taken in mm, but weight was taken in pounds as this scale has finer gradations.

When possible, fishing reports were submitted to the website while on the boat. When this was not possible, data was submitted later. Any issues in entering and submitting data were reported back to the web-developer.

Measurements of length and weight were analyzed separately. A paired two-sample t-test for means was run to determine if the difference in the mean measurements differed significantly from zero. The Excel Data Analysis Tool, t-Test: Paired Two Sample for Means was used. A two-tailed test for significance and a P-value (α) of 0.01 was selected. The null hypothesis that there is no significant difference between the mean differences of the two samples and zero is rejected if the probability that t is less than or equal to the experimental value is ≤ 0.01. A paired t-test was used because the measurements being compared were taken from the same sample and the samples varied greatly in their actual length and weight. A two-tailed test was used because there is no reason to expect systematic error.

SHARE DATA

The program was assessed for likely uses and limitations. This assessment was presented to the MDRA leadership with recommendations on data sharing. Once the principles of a data sharing were agreed upon, a meeting was held with MDRA leadership and CDFW staff. The results of the data comparability study, the likely uses, limitations, and data sharing principles were presented and discussed. The resulting plan for data sharing was posted on the website.

EXPAND THE PROGRAM

After the program had been tested and an agreement on how the data would be shared was reached, efforts were made to expand the program beyond the MDRA membership.

To do this, project staff gave a short presentation at the December 3, 2014 Fish and Game Commission meeting. A public workshop to solicit and train new participants was held at the Aquarium of the Pacific in Long Beach. This workshop was advertised on fishing message boards (Bloody Decks and SpearBoard), facebook websites (MDRA, Fish Contamination Education Collaborative, Freedivers, and Southern California Fishing), other fishing websites (976Tuna), and at the Fish and Game Commission meeting earlier in the month. As an enticement, the MDRA leadership auctioned off two free entries to the 2015 Halibut Derby.

MAINTAIN THE PROGRAM

Upon completion of the pilot phase of the project, a plan was drafted for the ongoing maintenance of the program. This plan addresses breadth of membership, incentives for submitting reports, and data management.

Results

ANGLER CAPACITY

The response rate to the survey was approximately 30%. Responses indicate that 86% have access to the Internet, 78% have a phone equipped with a digital camera, and 70% have smart phones (46% Apple, 24% Android). Seventy-five percent of respondents target halibut more than once a year, while most (61%) target halibut between 2-10 times per year. One respondent indicated that more than 30 of his/her fishing trips were made with the purpose of targeting halibut. Eighty-one percent said they are willing to submit data from halibut they catch to CDFW (Figure 4).

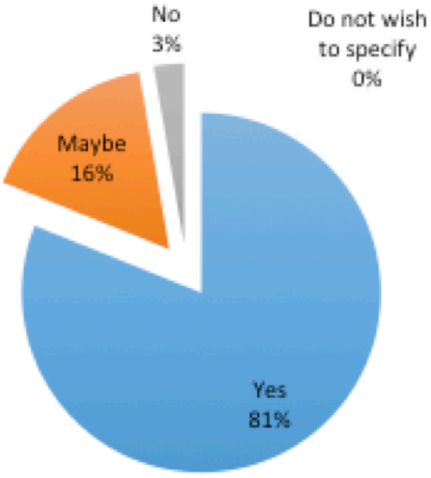


Figure 4. Responses by anglers to the survey question "Are you willing to collect weight, length, sex and age data from any California halibut you catch and submit your data to the CDFW through a web-based or mobile platform as described in the introduction to this survey?"

Nearly 50% of respondents already submit weigh slips to their fishing club and 40% have at one time kept a fishing journal. Almost 87% of respondents measure their catch and 64% carry a scale with them. Over half of the respondents (56%) have scales that are in good condition (used, slightly used, like new), while only 8% have scales that are in poor condition (very used, poor).

Most respondents (54%) use a flexible measuring tape to measure their fish and at least one indicated that (s)he used a sticker affixed to his boat that indicated legal size for a variety of commonly caught fish species. Thirty-sex percent use a fixed, rigid measuring device (Figure 5).

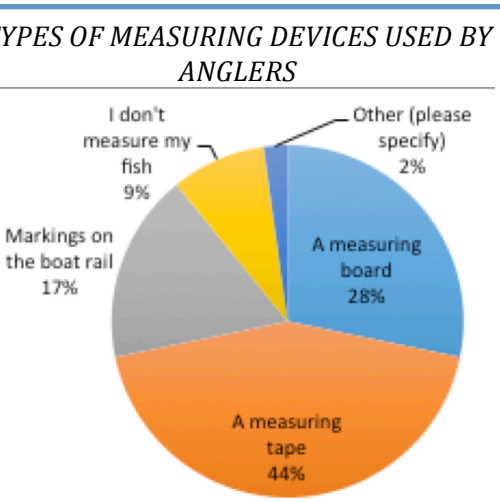


Figure 5. Responses by anglers to the survey question: "What do you use to measure your fish?

METHODS STANDARDIZATION

For the citizen science program, anglers are encouraged to measure fork length to the nearest 1/16 in. (1.5875 mm). However, in practice the precision is more likely to be to the nearest 1/8 in. (3.175 mm). Fork length is measured from the tip of the closed mouth to the center of the tail fin. Weight is measured to the nearest tenth of a pound (0.045 kg), which is of a higher precision than that employed by the CDFW. To determine sex, anglers are instructed on where and how to make the incision to expose the gonad and snap a picture, that they will upload along with the rest of the data. Sample images of male and female halibut gonads are also on the website (Figure 6).

Figure 6. Image of male and female halibut reproductive organs as seen on the website. http://mdra.fishingstatus.com

DATA SUBMISSION PLATFORM

The selected programmer runs a site called Fishing Status (www.fishingstatus.com), which is a web-based, social-media platform for fishermen to share fishing reports, stories, and tips. Modifying this popular, existing platform is a cost effective approach to building a data submission tool that would appeal to fishermen, and would likely have a higher rate of adoption. The resulting web-based data submission tool can be found at (http://mdra.fishingstatus.com/).

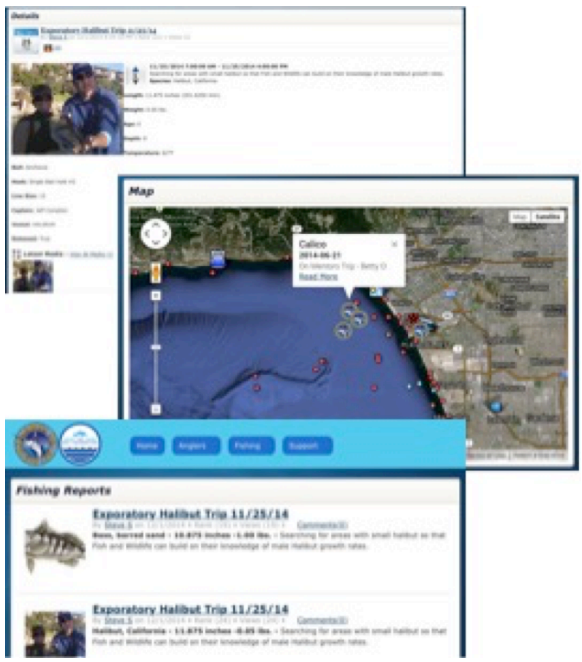


Figure 7. Screen captures of the different pages where fishing reports are viewed.

Several important features were build into the website:

- *Data Privacy*. Fishing reports and report data are viewable in four places on the website: the fishing map page, report summary page, report detail page, and the exported data (Figure 7). Upon entering a report and selecting a location of fishing, the back-end programming

saves that location as GPS coordinates and converts it into the CDFW Fishing block-microblock code. A member submitting a fishing report can select from three privacy options: Private, Hide Location, and Public. If '*Public*' is selected, all information submitted in the report is viewable on the website and the GPS coordinates are listed everywhere except the exported data. If '*Hide location*' is selected, all information submitted in the report is viewable on the website except the location. Only the site name is viewable on the report summary and report detail pages and the report is not included in the map. If '*Private*' is selected, only the species, length, weight, and location name are listed in the report summary page, nothing is viewable on the report detail page, and the report is not included in the fishing map. In all cases, only the microblock code is exported to the downloadable database.

- *Head Return Program*. The report form includes a field and instructions for returning a fish head. The field allows anglers to identify the pre-defined freezer location where they left the head, along with instructions for how to label the sample. It was originally intended that this would be used to collect halibut heads for ageing. However, after discussing with CDFW staff, it was decided that setting up a halibut head return program was unnecessary, primarily because, while the department still needs sublegal male otoliths, they already have plenty of otoliths from legal sized females (which is what this program is most likely to be turning in). In addition, setting up such a program would require a considerable amount of time and effort. Scientific collection permits and freezer space would need to be secured, and a statistically defensible relationship between head and body length would need to be developed, requiring additional sampling of wild fish. However, this field was left in because there is an active program for returning white seabass heads. As such, a link to the white seabass head collection program website for more information is provided in relation to this field.

- *Tips and methods*. When entering a fishing report, a popup "tool-tip" is available for every field. This "tool-tip" describes what the field is, how to take the measurement, how it is used, etc. More detailed methods with pictures are on the "Tips" page of the website (Figure 8). If needed, it is possible for site administrators to create short YouTube clips demonstrating the methods and link to them

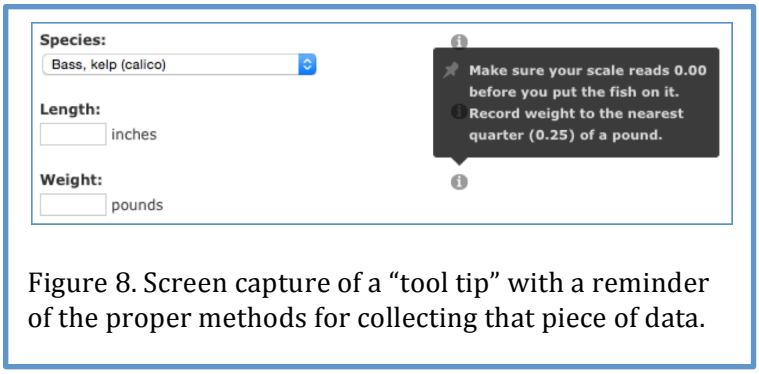


Figure 8. Screen capture of a "tool tip" with a reminder of the proper methods for collecting that piece of data.

from the Tips and Methods page on the site.

- *Incentives*. The site tallies points for each member based on their activity level. Points are earned for entering reports and engaging with other members on the site. These points will later be used to give out prizes to prolific reporting halibut fishermen. The initial prizes are designed to also improve data quality, such as new hanging scales and CDFW-type measuring boards. The website is also set up to be linked to the MDRA existing weigh-slip and "angler of the month" contest, a feature that can separately accommodate multiple fishing clubs.

- *Quality Assurance/Quality Control (QA/QC)*. It was possible to incorporate several QA/QC protocols into the tool itself. For example the species common name is selected from a pre-defined list of species to avoid accidental misspellings and uncommon common name usage. Each field includes validation to ensure the correct type and format of information is entered (i.e. numbers not text). Inches are automatically converted to millimeters upon saving to the database. Photographs of the fish and the fish's gonads are uploaded and included in the report; links to these images are included in the database for verification purposes. Additional QA/QC procedures can be performed after data is exported, such as checking that length and weight values make sense. Administrators have the means with which to notify the member if a report needs to be corrected and can issue bonus points to members for quality reporting. Member points and ratings are included in the exported data and can be used to assess reliability of the associated data.

- *Data Exploration*. In addition to viewing the additional reports, a limited amount of synthesized data are available to the general public on the website. These are the percentages of species caught in varying distances from the location of the person viewing the data, the ratio of male to female halibut caught at varying time intervals (i.e. last 6 months, last year, etc), and the top 5 catches by weight reported on the site in the time frame specified.

DATA ACCURACY

2014 was not a good year for catching halibut in the coastal waters of southern California. In approximately 110 angler-hours (calculated by multiplying the number of rods in the water by the number of hours spent targeting halibut), only 10 halibut were landed. Since very few halibut were caught, measurements of length and weight were made on all sport fish brought aboard. In addition to halibut, the sample contains measurements of lingcod (*Ophiodon elongates*), three species of bass (*Paralabrax* spp.), seven species of rockfish (*Sebastes* spp.), Pacific mackerel (*Scomber japonicus*), and Pacific bonito (*Sarda chiliensis*).

The total number of fish sampled was 55. When the fish are biting, the activity on a fishing boat can become chaotic. As a result there were some instances where only one set of measurements were taken (scientist or angler), only one type of measurement was taken (length or weight), the same person took both sets of measurements, or the wrong equipment was used for one set of measurements (scientist or angler). These errors reduced the sample size and resulted in different sample sizes for the length and weight analyses.

Fork Length: A total of 40 fish ranging in size from 265 mm to 625 mm were included in this analysis. The mean difference between the measurements made by scientists and anglers using different equipment (M = -2, SD = 7, N = 27) did not differ significantly from zero (t(26) = 2.78, two-tailed p = 0.30). See Figure 9. Due to the 13 inadvertent measurements taken by scientists and anglers using the same equipment (a CDFW fish board), it was also possible to compare angler measurements with scientist measurements when the equipment used is not a factor. In this case, the mean difference between the measurements made by scientists and anglers using the same equipment (M = -1, SD = 5, N = 13) did not differ significantly from zero (t(12) = 3.05, two-tailed p = 0.65). Finally, the difference between the difference of the measurements made by scientists and anglers when using the same or different equipment did not differ significantly from zero (t(38) = 2.71, two-tailed p = 0.68).

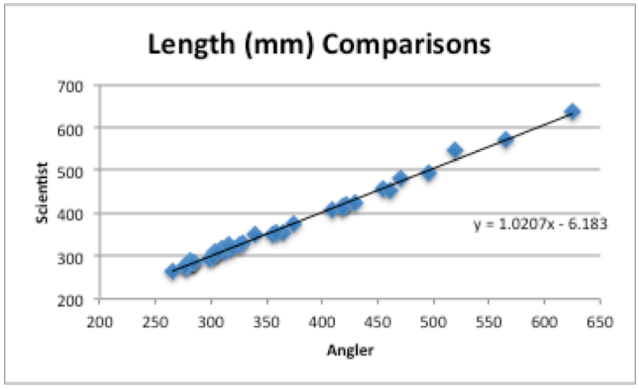


Figure 9. Comparisons of length measurements made by scientists and anglers.

Weight: Fish ranging in weight from 0.50 lbs to 7 lbs were included in this analysis. The mean difference between the measurements made by scientists and anglers (M = 0.26, SD = 0.20, N = 34) was significantly different from zero (t(33) = 2.73, two-tailed p = $1.18E^{-08}$). See Figure 10. The type of scale used for scientist and angler measurements differed by trip.

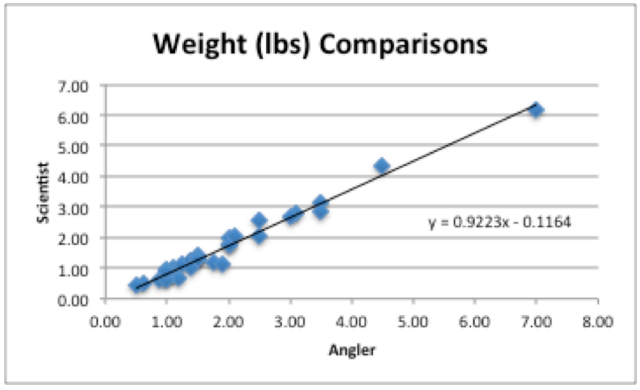


Figure 10. Comparisons of weight measurements made by scientists and anglers.

DATA SHARING

Recreational halibut fishing is generally restricted to a limited number of very active fishermen. As such, this citizen science program is more likely to generate information from a handful of participants and therefore restricts the use of data to parameters that are not representative of the recreational fishing fleet, such as gear selectivity. In the near-term, CDFW is likely to use the data collected by this program to feed the following parameters in the stock assessment:

Gear Selectivity: Determine the vulnerability of different size and sex halibut to hook and line or spear gear based on the length, weight, and sex frequencies taken by different the gear types. In the last stock assessment, DFW used commercial data to estimate this for the recreational fleet.

Size frequencies, including short halibut: Estimate the proportion of short halibut caught based on the number of shorts marked as released (the photo is used for verification). In the last stock assessment, DFW estimated that no short halibut were caught. Knowing the proportion of short halibut caught can indicate good recruitment (lots of small fish in specific size ranges) or heavy fishing pressure on legal-sized fish (lots of small fish in all size ranges and very few legal sized fish).

In addition these uses, MDRA has identified other possible uses for the data, such as informing the discussions surrounding a halibut restocking program and Marine Protected Areas. The MDRA will retain control over the data and will share data upon request.

PROGRAM EXPANSION

Following the presentation at the Fish and Game Commission meeting, representatives from recreational fishing organizations approached project staff in order to learn more. However, attendance at the public workshop was limited (two recreational and four commercial halibut fishermen).

PROGRAM MAINTENANCE

The leadership of the Marine Del Rey Anglers fishing club will maintain the website and be responsible for ongoing data collection, data management, and program expansion. The following tactics have been determined:

- To encourage participating halibut fishermen to continue submitting reports an incentive program will be implemented. Prizes, such as digital fish scales, and fish boards will be awarded regularly to the fisherman who submits the most, complete halibut reports in the applicable time frame. Preference may be given to released fish. Winners will be announced in regular newsletters along with the next contest. Quizzes on knowledge of the methods might also be created and incentivized.

- A designated member of the MDRA leadership will respond to requests for data. This provides the fishermen with some level of control over who uses their data and for what purpose, which we believe will reduce barriers to participation in data collection.
- Project staff and MDRA leadership will identify and attend meetings of southern California fishing clubs to inform fishermen about the program and promote participation in it.

Discussion

Recreational anglers are generally comfortable with techniques to accurately measure the length and weight of fish they catch. This is not surprising, as popular fish often subject to a legal minimum size, and weights are frequently used in fishing contests. However, most use measuring devices that are flexible, not rigid, making them trickier to use when properly measuring length. In addition, some fishermen do not have a scale at all, but use a sticker that has the minimum legal lengths for popular sport fish marked affixed to a solid surface. Digital scales are common and in relatively good condition. Determining the sex of a halibut, where to make the incision, and what to photograph is less familiar and requires training.

Using a web-based platform for data reporting is appropriate, since a large majority of fishermen have access to the Internet. In addition, relying on photographs for verifying species and sex fields is reasonable as most fishermen have a phone equipped with a camera. A future upgrade to a smart-phone app would also be possible, but would have to be built for both major platforms (Apple and Android).

Unfortunately, not enough halibut were encountered during this project to satisfactorily train anglers in this method, nor were enough data points containing halibut sex (many of the halibut caught were undersized and released alive) obtained to be able to assess practicality of the reporting platform for this field, let alone the quality of the data.

Fishermen's length measurements are comparable to scientists'. However, comparisons of weight measurements were significantly different. Multiple measurements of the same fish (or weight) taken by the same person were not made in this study. Had we included this, we would have had a better sense of the source of the difference between the angler measurements and the scientist measurements. Given the nature of hanging scales, particularly the digital kind, it is unlikely that the differences could be attributed to errors in reading the weights. The source of the difference we observed can most likely be attributed to two factors: 1) the use of scales rated up to 50 or 100 lbs to measure fish

weighing less than 5 lbs (M of 1.63 – 1.89, SD of 1.2 – 1.28) and 2) the use of spring scales, which we observed to be less reliable when measuring light weights than the digital scales. In the near future, an attempt should be made to more accurately characterize the reliability of the fishermen's weight measurements. Fortunately, most anglers use digital scales.

In the end, the usefulness of these data lies not just in the reliability of the measurements themselves, but also in the volume of reports submitted. While it is unlikely this data will ever be representative of all recreational fishermen, it has the potential to generate a robust data set that is representative of those who specialize in halibut and the gear that is used to catch them. If the program is successful and continues indefinitely, it will generate relatively affordable long-term time series data that can be used in successive stock assessments and other as yet undefined resource management decisions.

Long-term recommendations

Interest exists among the recreational fishing community in collecting data about their fishing trips and sharing this data with resource managers in order to better manage popular sport fish. Resource managers are also increasingly open to using data collected by citizen scientists provided there are means with which they can verify the reliability of this data. Likewise, fishermen are particularly concerned with sharing fishing locations and must feel comfortable with how their data will be used. The system developed here is transparent about the data collected and how it will be used. It also gives fishermen control over access to the data, which engenders trust in the program itself. Attempts were also made to create a system that has some inherent benefits for continuing to submit reports, in an effort to create a self-perpetuating program and minimize the costs of running it. Along these lines, a wish list of upgrades to the site have been identified, some of which would incorporate the powerful analytical components of the main fishingstatus.com website and generate private analysis of an individual's reports (i.e. which fishing spots are most productive at different times of the year, etc). This has the dual benefit of providing participants with tangible benefits and incentives for submitting fishing reports to the website.

This program can and should be expanded throughout southern California. If for no other reason than in recent years halibut fishing has been very limited and localized to hot spots of activity, with the rest of the region void of a bite. However, fishermen are more likely to participate in this program and submit reports if it is linked to their fishing club's activities. The back end of the website is designed to accommodate this through the ability to create

groups that different permissions can be assigned to (i.e. a Club Members Only page can be made visible only to website members who are assigned to the specified club's "group").

Working with the leadership of other southern California fishing clubs to give presentations about the program at their fishing club meetings will be the most effective way to expand this program. It will be important to target club leaders as they can be called on later to send reminders to their members and incorporate the reports into their own fishing tournaments and contests.

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FINANCIAL REPORT

As proposed, the project was expected to cost $38,182 ($24,996 from CFR-West, and $13,185 in matching funds). Due in large part to increased in-kind contributions in services and from CDFW, the actual project cost was $40,409 ($24,996 from CFR-West, and $15,413 in matching funds). The costs beak down by institution as follows:

Division of Project Total	**Expected ($38,182)**	**Actual ($40,409)**
SMBRC:	$16,067	$17,544
MDRA, Anglers:	$13,015	$9,251
Other (services):	$9,000	$10,575
CDFW:	$100	$3,038

Changes to the Budget

A few changes were made as the project progressed that affected the budget. Poor landings reports for halibut from the Los Angeles area prompted us to make changes to our field-testing venue. After some research, it was decided that the best solution was to charter a six-pack vessel out of Santa Barbara that specializes in catching halibut, rather than chartering a party boat out of Marina del Rey. In addition, CDFW and a member of the MDRA volunteered the use of their boats (R/V Garibaldi and F/V Halibum) for the day for this project. These changed resulted in an increase in the "Other Expense" match line. In addition, and as mentioned earlier, CDFW determined that collecting otoliths was no longer necessary. As a result, parts of the budget set aside for this purpose could be reprogrammed to other expenses and additional travel for the P.I. The reprogramming was requested as part of the Quarterly Progress Report submitted on October 15, 2014. Please see the budget detail on the next page for more information.

Categories	Budgeted Costs	Budgeted Match	Actual Costs	Actual Match	DIFF (cost)	PROJECT TOTAL
Personnel (subtotal)	*$13,269*	*$13,201*	*$13,269*	*$10,799*	*$0*	*$24,068*
Lia Protopapadakis - PI	$13,269	$826	$13,269	$1,264		
Volunteers (anglers and interns)	$-	$12,375	$-	$4,119		
Steve Santen - Collaborator	$-	$-	$-	$4,181		
Kyle Evans	$-	$-	$-	$1,235		
Supplies (subtotal)	*$290*	*$500*	*$100*	*$500*	*$190*	*$600*
Scales	$100	$-	$100	$-		
Printed outreach material	$50	$-	$-	$-		
Bags and sharpies (otolith collection)	$40	$-	$-	$-		
Slides & cases, lapping paper (otoliths)	$100	$-	$-	$-		
Measuring boards	$-	$500	$-	$500		
Domestic Travel	*$165*	*$-*	*$255*	*$940*	*$90*	*$1,195*
Lia Protopapadakis - PI	$165	$-	$255	$384		
Steve Santen - Collaborator	$-	$-	$-	$376		
Kyle Evans	$-	$-	$-	$179		
Other Expenses (subtotal)	*$9,000*	*$-*	*$9,100*	*$3,174*	*$100*	*$12,274*
Charter boat	$4,000	$-	$4,000	$700		
Web programming	$5,000	$-	$5,100	$275		
Meeting Space	$-	$-	$-	$500		
Jeff Compton boat	$-	$-	$-	$75		
CDFW boat	$-	$-	$-	$1,624		
Subtotal	*$22,724*	*$13,701*	*$22,724*	*$15,413*	*0*	*$38,137*
Indirect Costs (10%)	$2,272		$2,272		0	$2,272
TOTAL	**$24,996**	**$13,701**	**$24,996**	**$15,413**	**0**	**$40,409**
% Match*	**55%**		**62%**			

LIST OF PUBLICATIONS AND DESCRIPTION OF OUTREACH EFFORTS

Publications

- No publications have been prepared to date.

Outreach Efforts (Examples of the outreach material generated for this project are in Appendix 1.)

Survey

- An internet-based survey (Survey Monkey) targeted MDRA members to assess interest and educate about the program. One hundred and twenty-five anglers were contacted with the survey, and 37 responded. (December 2013)

Tabling

- MDRA Halibut Derby Signups and Event Info Night (July 11, 2014) –Flyers containing information about the project were handed out to the 4-5 anglers that showed up.

- MDRA Halibut Derby (July 12, 2014) – Flyers containing information about the project were handed out to ~10 anglers that showed up. CDFW staff provided demonstrations of proper measuring techniques and sex identification.

Direct Outreach

- Lia Protopapadakis discussed expanding the project into other regions with key halibut constituents (Paul Romanowski – Fathomiers, and Joe Exline – San Diego Anglers) at Marine Resources Committee meeting (August 5, 2014)

- Lia Protopapadakis and Steve Santen met with key Department of Fish and Wildlife staff (5 in total) to describe the data being collected and its credibility, and to discuss possible uses for the data in the stock assessment. (December 9, 2014)

Public Workshops

- The first public workshop was held as part of the MDRA' August club meeting. There were approximately 30 fishermen in attendance. Participants were solicited for the field-testing phase of the project. (August 14, 2014)

- The second public workshop was held at the Aquarium of the Pacific in Long Beach. Outreach for the event included posting on fishing message boards (Bloody Decks

and SpearBoard), facebook websites (MDRA, Fish Contamination Education Collaborative, Freedivers, and Southern California Fishing), other fishing websites (976Tuna), and at the Fish and Game Commission meeting earlier in the month. Turnout was small (2 spearfisherman and X commercial halibut fishermen). (December 10, 2014)

Field Trainings

- August 21, 2014 in Santa Barbara
- September 2, 2014 in Ventura
- October 9, 2014 in Santa Barbara
- October 16, 2014 in Santa Barbara
- October 21, 2014 in Santa Barbara
- November 25, 2014 in Marina Del Rey
- In all 11 anglers were comprehensively trained in weighing, measuring, and sexing California halibut.

Presentations

- Fish and Game Commission (December 3, 2014) – Lia Protopapadakis and Steve Santen gave a short presentation to the California Fish and Game Commisison during a broadcasted public meeting about the project and how anglers can get involved.
- Present at Club Meetings – Lia Protopapadakis and Steve Santen are scheduled to attend the Fathomiers club meeting on March 12, 2015 to describe the project and solicit participants. The possibility of repeating this at regular meetings of other fishing clubs from San Diego to Santa Barbara is being discussed.

Newsletter

- A monthly newsletter will be distributed through the project website to remind members to continue reporting data and announce various incentivized contests.

Press / Blogs / Reports

- LA Register (July 6, 2014) – *MDRA hope to rebuild sea bass pens.*

- CASG Blog (February 9, 2015) – *Taking Stock: With a little help from scientists, fishermen reel in data on California halibut*. [https://caseagrant.ucsd.edu/news/with-a-little-help-from-scientists-fishermen-reel-in-data-on-california-halibut]

- SMBRC Annual Report 2014 (in press) – *Collaborative Research Supports Management of California Halibut.* [http://www.smbrc.ca.gov/annual_reports/]

DATA HANDLING AND AVAILABILITY

Data collected through the citizen science program developed by this project are stored on the program's website (http://mdra.fishingstatus.com). Because of the ongoing nature of the data collection it is impractical to store this data elsewhere. However, requests for data can be made through the website and are handled by the MDRA.

PROJECT MEDIA

Photographs taken by the PI and project participants during the course of the project are available upon request to the PI.

APPENDIX 1: SAMPLES OF OUTREACH MATERIAL GENERATED FOR THIS PROJECT

1. Page 1 of a double-sided, tri-fold handout distributed to participants in the 2014 Marina Del Rey Halibut Derby.

MARINA DEL REY ANGLERS
&
THE BAY FOUNDATION

ABOUT THIS PROJECT...

MDRA and The Bay Foundation have partnered to create a **fishing log and weight slip** that you can fill out and submit **online**.

This reporting system will also let you share data with fish biologists at the Department of Fish and Wildlife.

Better data will help sort out what is going on with halibut in the Santa Monica Bay and speed up the process for improving fishing here.

FUNDED BY

COLLABORATIVE
FISHERIES RESEARCH
WEST

CONTACT INFO:

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Marina Del Rey Anglers
Info@mdranglers.com
www.mdranglers.com

Fishing Log and "Halibut Sexting" Tool

mdra.fishingstatus.com

2. Page 2 of a double-sided, tri-fold handout distributed to participants in the 2014 Marina Del Rey Halibut Derby.

USING THE FISHING LOG...

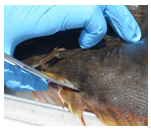
MDRA.FISHINGSTATUS.COM

After you've registered and logged in to the website you are ready to enter a report and collect data.

BELOW ARE TIPS ON HOW TO TAKE CONSISTENT MEASUREMENTS FOR THE SCIENTISTS

Total Length: Tip of closed mouth to end of the tail's longest lobe. Record to nearest 1/16th of an inch.

Weight: Make sure scale reads zero and the fish touches nothing but the scale. Record to nearest 0.1 of a lb.



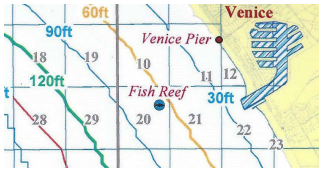
Sex Pic: Insert knife into anal pore. Cut along bottom edge toward the tail ~2in. Lift skin and take picture.

Sex: Male halibut parts are creamy-white and smooth.

Female parts are orange-colored and spongey.

OTHER STUFF

White Seabass Head location: Return your White Seabass heads. Select the freezer location where you will be dropping it off. Put the head in a bag. On the bag, write down the report confirmation number, your name, phone number, the date you caught the fish, and the location (lat. and long. would be best) where you caught it.



Location data and MBlock: Instead of reporting GPS coordinates, scientists will only see a code that represents a 1min lat. x 1min lon. block that the coordinates fall within.

HANDLING FISH FOR RELEASE

Avoid damaging your fish.

- ⇒ Use a circle hook to catch your fish
- ⇒ Land it quickly to reduce fish stress
- ⇒ Use a knotless fine mesh net to bring on board
- ⇒ Transfer fish **immediately** to holding tank without letting the fish touch anything else
- ⇒ Remove hook while fish is still in net. If it is difficult, cut the line and leave hook in place.
- ⇒ Use latex or rubber gloves to handle fish
- ⇒ Never put hands or fingers under the operculum or in gill cavity.
- ⇒ Live well should be big enough to allow the fish to lay flat and have a fresh seawater supply that replaces the water in the tank every 15 minutes.

3. Flyer announcing the public workshop distributed to tackle shops and shared online.

PUBLIC WORKSHOP | THE AQUARIUM OF THE PACIFIC

December 10, 2014 from 7-9pm (doors open at 6pm)

The Marina Del Rey Angler's Halibut Derby is the longest standing fishing tournament on the West Coast. The number of halibut caught in the contest has dwindled over the years and the club wants to know why. Fishermen who catch halibut, can collect data and help answer that question.

Learn how to sign up, how to collect data, and how the data will be used

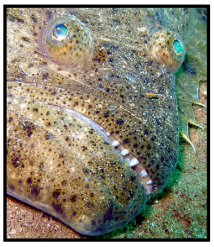
2 WILL WIN FREE ENTRY TO THE 2015 HALIBUT DERBY

Watershed Classroom, 100 Aquarium Way, Long Beach, CA 90802

RSVP: Lia Protopapadakis
lprotopapadakis@santamonicabay.org

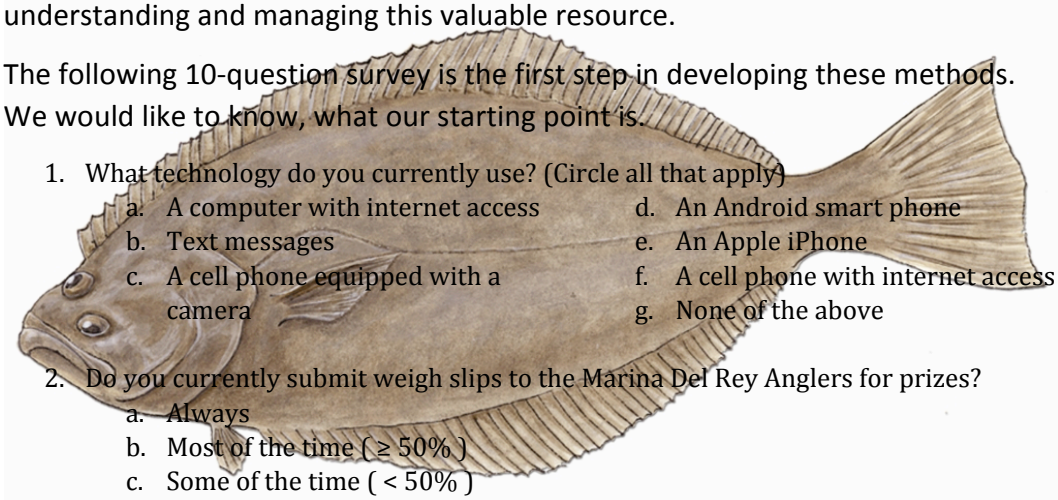
APPENDIX 1: SAMPLES OF OUTREACH MATERIAL GENERATED FOR THIS PROJECT

1. Page 1 of a two-page, PDF version of the online survey given to anglers during the pilot phase of this project.



ANGLER SURVEY

The Marina Del Rey Anglers and The Bay Foundation are working together on a project related to California halibut. Over the next year, we will be developing and testing methods that anglers can use to collect the length, weight, sex, and age of California halibut. The goal is to develop a web-based platform and eventually an app by which anglers that catch California halibut can submit their data to the California Department of Fish and Wildlife (CDFW). The CDFW can then use these data to improve the growth models they will use in the next stock assessment for halibut. A stock assessment is the important first step in understanding and managing this valuable resource.



The following 10-question survey is the first step in developing these methods. We would like to know, what our starting point is.

1. What technology do you currently use? (Circle all that apply)
   a. A computer with internet access
   b. Text messages
   c. A cell phone equipped with a camera
   d. An Android smart phone
   e. An Apple iPhone
   f. A cell phone with internet access
   g. None of the above

2. Do you currently submit weigh slips to the Marina Del Rey Anglers for prizes?
   a. Always
   b. Most of the time (≥ 50%)
   c. Some of the time (< 50%)
   d. Never

3. Have you ever keep a fishing journal (where you record the conditions, time of day, location, species of fish caught, size, etc)?
   a. Yes, I still do
   b. Occasionally
   c. I used to
   d. No, never
4. If you bring a weigh-scale with you when you go fishing, what condition is it in?
   a. Like new
   b. Slightly used
   c. Used
   d. Very used
   e. Poor

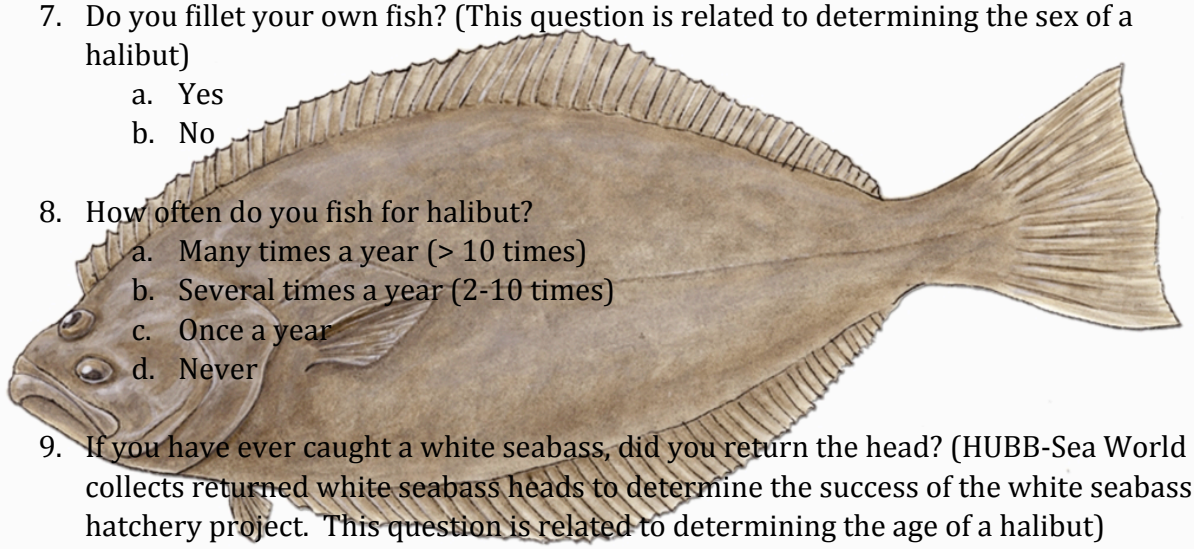
2. Page 2 of a two-page, PDF version of the online survey given to anglers during the pilot phase of this project.

f. I don't bring a weigh-scale when I fish

5. Do you ever measure the length of your fish?
   a. Always
   b. Most of the time
   c. Some of the time
   d. Never

6. If yes, what do you use?
   a. A measuring board
   b. A measuring tape
   c. Markings on the boat rail
   d. Other, please specify

7. Do you fillet your own fish? (This question is related to determining the sex of a halibut)
   a. Yes
   b. No



8. How often do you fish for halibut?
   a. Many times a year (> 10 times)
   b. Several times a year (2-10 times)
   c. Once a year
   d. Never

9. If you have ever caught a white seabass, did you return the head? (HUBB-Sea World collects returned white seabass heads to determine the success of the white seabass hatchery project. This question is related to determining the age of a halibut)
   a. Yes
   b. No
   c. I've never caught a white seabass

10. Are you willing to participate in this project, including submitting your data to the CDFW?
   a. Yes
   b. No
   c. Maybe
   d. Do not wish to specify