





ESSAY

# Engaging Recreational Salmon Anglers in Fisheries Ecology

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Long-term predator diet studies are powerful ecosystem monitoring tools, as has been illustrated by the use of seabird diets to assess the response of forage fish communities to changing ocean conditions (Thayer et al. 2008). In British Columbia, Chinook *Oncorhynchus tshawytscha* and Coho Salmon *O. kisutch* are good candidates for a long-term predator diet study, due to their ubiquity in coastal waters and the diversity of their diets. While information on adult Chinook and Coho Salmon diets is well documented, most of the literature is dated with the most recent published data for British Columbia dating from the 1960s (Beacham 1986). Past diet studies generally relied on test fisheries (Beacham 1986) or sampling portions of commercial catches (Reid 1961) and focused on regions and periods where fisheries were most active, resulting in gaps in the off season and where the volume of catch is smaller. Previous ecosystem monitoring programs faced with sampling large regions year-round have engaged citizen scientists to help collect data at a scale impossible for a small research team (Dickinson et al. 2010). Engagement of citizen scientists in long-term ecosystem monitoring programs can provide a wealth of knowledge, while giving the public the opportunity to engage in scientific discussion (McKinley et al. 2017). Recreational anglers are often interested in the diets of their catch both to inform gear selection and simple curiosity. This curiosity represents a common ground between anglers and fisheries ecologists. One way to get members of the public fishery involved with fisheries research, and to collect samples that would be impossible for a small research team, is to engage with them in a salmon diet sampling program. We engaged these anglers as citizen scientists, and although we are a small research team, we have been able to collect enough biological data to create and maintain the Adult Salmon Diet Program (ASDP) at the University of Victoria.

At the inception of the ASDP in 2017, we had three main goals: fill knowledge gaps regarding Chinook and Coho Salmon diets, develop an ongoing ecosystem monitoring program, and provide anglers with a new avenue to participate in fisheries science. To accomplish these goals, we needed to reach out to participants in the public fishery to build interest in the program. Our first step was building the organizational backbone of the program. We determined what types of information would be necessary to meet the goals of the program, and could be readily collected by recreational anglers, and we set up a system of collection locations, “depots.” To broaden our reach and accomplish our third

goal, we participated in derbies, reached out to lodges and guides, and involved a group of anglers dedicated to provide information to fisheries research, the Avid Anglers. Lastly, we built up an online presence to help maintain bidirectional communication and show our citizen scientists the impacts of their efforts.

When we started the program in 2017, we knew that solid infrastructure was the key to maintaining a successful long-term citizen science program (McKinley et al. 2017). We put together an informational packet to be distributed to participants. This included background information for participants to help provide information on these diets, why it is important to collect samples now, and what it was we wanted to do. The background also included how to collect the gastro-intestinal tract of the salmon to avoid sample destruction, and what information is important to collect. Water proof data cards were provided to participants to standardize the information collected (Figure 1), and once filled out these were to be packed along with the gastro-intestinal tract in a plastic bag. One concern with citizen science programs is the quality of information provided by participants (Dickinson et al. 2010). The data we primarily focus on are the date, species, fork length, weight, origin (hatchery/wild), and fisheries management region and sub region of capture. Participants in British Columbia’s public fishery are well equipped to provide accurate information for these data, as all of these pieces of information must be known to abide by fishing regulations. For example, in the fisheries management area around Victoria, management area 19, each subregion usually has different restrictions about the minimum size (45cm or 62cm) at which a Chinook Salmon can be retained, and for Coho Salmon only hatchery fish may be retained. While we rely on the anglers for the majority of the data, we can validate species by counting pyloric caeca and through genetics, and we are working to find a way to allow anglers to record a geolocation of their catch with a smartphone. If there are inconsistencies within the data provided that we cannot resolve, we remove those pieces of information from the analysis. Once the anglers have cut out the gastro-intestinal tract and placed it in a bag with the completed data card, they are frozen and turned into one of our many collaborating depots.

At the beginning of the program, we contacted fishing stores across southern British Columbia to request that they act as depots where anglers could pick up supplies and drop off stomachs. Mailing in gastro-intestinal tracts of salmon was not an option, so we needed regional areas where samples

could be dropped off and supplies picked up. These depots are usually located in storefronts that sell products to recreational anglers. These stores are invested in the survival of Chinook and Coho Salmon stocks, because without salmon fishing they stand to lose much of their business. These stores were important to collaborate with at the start of the program to improve our collection process, so instead of visiting over 100 homes or shipping stomachs through the mail constantly, we visit these locations and pick up samples when convenient. With these lines of infrastructure built up, we started engaging more broadly with recreational anglers by various means.

The next challenge we faced when creating the ASDP was developing a network of anglers. Contacting anglers individually was a slow method of raising awareness of the program, so we started attending salmon fishing derbies, which sped up the process. Most derbies are multi-day affairs where dozens of anglers compete to bring in the largest salmon. These events have provided useful opportunities for us to make connections with organizers and participating anglers. The diet data collected from these derbies are spatially and temporally isolated and, therefore, of limited value for our objectives, but the ability to engage with many anglers makes attending these events worthwhile.

While salmon derbies collect a lot of diet data on a small spatial scale over a few days, salmon charters can collect a lot of samples on a larger spatial scale over the course of the year. It is estimated the majority of Canadian citizens and almost every non-Canadian that bought fishing licenses in British Columbia did so for a short trip (Sun and Hallin 2018). These short-term license holders who fish for salmon generally employ charters or lodges that provide equipment, access to a boat, and insight into where and how to fish. Some of the most valuable fish to these charters and lodges are species of Pacific salmon *Oncorhynchus* spp., especially Chinook and Coho Salmon. Salmon charters and lodges generate thousands of jobs and hundreds of millions of dollars in British Columbia (Gislason et al. 2017). Like tackle stores, charters and lodges are highly dependent on the success and sustainability of Chinook and Coho Salmon stocks for their continued livelihood. The reliance on the sustainability of Pacific salmon has led charters and lodges to be proactive in providing samples to scientists. Reciprocal trust and information sharing have provided a solid basis for the continued success of the ASDP. Having access to the majority of the recreational license holders means charter operators are well placed to provide data from the public fishery for fisheries research, especially during the summer months.

Salmon charters generally do not operate during the winter months, so we needed to reach out to additional year-round anglers to fill in this sample gap. The Avid Anglers program was started by Fisheries and Oceans Canada in 2012 to supplement biophysical data and genetic samples collected for Chinook and Coho Salmon by creel monitors at landing sites. Specifically, the program aimed to sample salmon released due to size or other restrictions (e.g. mark-selective fisheries) and those captured outside of peak summer fishing periods when the creel monitoring program is active. The program recruits participants who fish for Chinook and Coho Salmon throughout the year, including winter. The Avid Anglers program is supported because of community concerns for the continued survival of the Chinook and Coho Salmon fisheries. Citizen science programs are usually successful when community concerns

match scientific concerns (McKinley et al. 2017). Due to their background knowledge and experience in collecting biological information on Chinook and Coho Salmon, the Avid Anglers are a natural fit for engagement in the ASDP. The group is positive towards the ASDP, and some participants have stated that the program is giving them the answers they need as a community. Avid Angler engagement with the program helps to fill the gap we encounter with our winter sampling efforts (November to March), and they have contributed over 60% of our winter samples.

Along with organization and initial engagement, we have utilized online platforms to help maintain engagement with recreational anglers through consistent updates and information sharing. We made the decision early on that we would stick to a system of bidirectional communication, as this is important for the long-term success of citizen science programs (McKinley et al. 2017). Our two main methods of online engagement are a well-maintained email list and a Facebook page with regular updates. We maintain regular email correspondence with all our contributors in order to keep tabs on sampling gear and sample pick-up requirements. At the end of each year, we provide a data report for participating anglers that contains an overview and preliminary analyses for the entire dataset. The Facebook page (Southern B.C. Adult Salmon Diet Program) is updated with the progress of the program and we try to provide a weekly post describing interesting prey encountered during the week. This online engagement has allowed us to maintain a bidirectional flow of information. We also produced two articles for *Island Fisherman*, a regional fishing magazine that is available online for people to read and provide feedback. Outside of our own online initiatives, the program has been discussed on the SportFishingBC forum, in blogs run by participants, e.g., the Ardent Angler, and on the Instagram of some of our collaborators, e.g., Islander Precision Reels.

Engagement with the public angling community is essential for the success of this program. In the near future, we plan to individualize our feedback to anglers by providing them with summaries of their personal contributions to the program, so they may inform their community and participate in local resource decision making. We hope this will continue to encourage engagement of public fishery stakeholders, as we are developing a reciprocal relationship, rather than a top-down approach. Through the creation of the ASDP, we are not only addressing our goals of filling knowledge gaps, we are developing an ecosystem monitoring tool and providing an avenue for public involvement in fisheries research. We have over 130 private anglers as well as half a dozen lodges and guides now participating in the program, and together they have helped us collect over 1,800 samples thus far. We are also developing a model government agencies and other researchers can use to inform and guide their own research programs. Our program goes beyond collaboration; by providing supporters the avenue to engage with fisheries research through a reciprocal relationship of mutual information sharing, we have been able to establish an ecosystem monitoring program that would have otherwise been impossible. Our goal now is to maintain this program into the future with the continued support of our citizen scientists.

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