Programmatic Review of the PIFSC Commercial Fisheries Bio-Sampling Program

Hyatt Regency Garapan, Saipan

January 26–28, 2016

Review Panel Members

- Steven G. Smith, University of Miami
- Brad R. Moore, Pacific Community (SPC)
- Frank A. Camacho, University of Guam

Reviewer 1

Introduction

In 2007, NOAA Fisheries received funding from Congress to establish fisheries monitoring programs to support requirements of the Reauthorized Magnuson-Stevens Fisheries Conservation and Management Act (RMSA) of 2006. As part of additional monitoring, the Pacific Islands Fisheries Science Center (PIFSC) established the Commercial Fisheries Bio-sampling Program within the US territories of Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI). The primary effort in each case was to establish cooperative relationships with as many fishers, vendors and markets as possible to acquire species-specific length and weight metrics, supplementary catch and effort data, and otolith and gonad samples to determine key life history parameters to support more formal stock assessments. A pilot bio-sampling program commenced in 2009 in Guam, with sampling commencing in 2010 in CNMI and American Samoa.

Sound science is critical for making informed decisions about managing fisheries resources. NOAA Fisheries constantly strives to improve the quality and timeliness of its internal and externally supported science. To that end, a review of PIFSC's Commercial Fisheries Bio-sampling Program was conducted over a 3-day period (January 26–28, 2016) in Saipan, CNMI. It was anticipated that the review would help identify gaps and areas for improvement, assist in planning for future needs within the Program, and to help ensure that current methodology is appropriately designed to meet the expressed needs of management. This document is one reviewer's attempt to synthesize the information provided during the review and make recommendations that will be helpful to PIFSC and territorial project staff as they move forward with the bio-sampling program.

I. General Observations

a. Scientific/technical approach

The sample collection and analytical processes of the laboratory sampling program are efficient, effective and clearly described. Protocols for the extraction, labelling and storage of samples are standardised, logical and efficient. Otolith and gonad processing both utilize techniques that are well-accepted in the peer-reviewed scientific literature.

Given that two different labs are contracted to process and read otoliths, effort needs to be made to ensure processing and readings protocols are standardised.

Teams in all territories appear well trained in field and laboratory protocols as a result of considerable effort by project staff in the form of in-country trainings and regional workshops. Protocols are generally standardized amongst territories, although slight (and appropriate) adaptations have been made in each case to meet local conditions.

The selection and prioritization of species for bio-sampling generally appears well-founded and suitable. Priority is given to the dominant species in the catch for which limited local life history data exists, and from which samples are available year-round (i.e. not subject to species closures) and over a wide size range.

While the sample collection protocols are generally appropriate for collecting samples from suitable commercial fishers/vendors, the premise of using samples resulting solely from the commercial spear and bottom-fishing fisheries may not be. The estimations of life history parameters resulting from samples supplied through the commercial fishery are likely to be heavily influenced by fishing. In addition, it is likely that only a proportion of the total stock is being sampled through the commercial fishery (e.g. given the high selectivity inherent with spearfishing and market preferences for certain size). Excluding young fish from estimates of growth using the VBGF may result in an underestimation of K and a corresponding overestimation of L_{∞}. I recommend that a fishery-independent sampling component be conducted at both project locations and at unfished/lightly fished locations. At project locations, this will allow for the collection of samples generated not harvested in the fishery (such as those individuals at the tail ends of the length and age frequency distributions). At unfished/lightly fished locations, this would provide estimates of key life history parameters in the absence of fishing, including a more accurate estimate of maximum age/longevity from which to calculate natural mortality. Fisheries-independent sampling at project locations could also target key prey species from which to assess ecosystem-impacts of the fishery, and control species (i.e. unharvested species) from which to decouple fishing effects from larger regional and global processes (e.g. climate change).

To date the sampling program has generated a large amount of material, and a large back-log of otolith and gonad samples remain to be processed. At last count, otolith and gonad material have been collected from 11,841 individual fishes. It is likely that the current sample sizes are far in excess of those required to meet the objectives of the bio-sampling program. For example, length-at-age/growth curves could be established with much smaller sample sizes by selecting individuals at strategic lengths, saving considerable time, effort and funding in processing otoliths. Establishment of growth curves for hermaphroditic species may require fewer samples than for gonochoristic species. Staff within the Life History Group of the PIFSC should collaborate with statisticians/PIFSC stock assessment scientists to determine minimum required sample sizes and to identify and prioritize the processing of samples which would be most informative for developing estimates of each of the life history parameters of interest (acknowledging that samples sizes and individual samples of particular interest would vary depending on the species and life history parameter being investigated).

Similarly, the project group should corroborate with stock assessment scientists to determine minimum data requirements for the assessment procedure to be used. A PIFSC stock assessment scientist should be identified to work with staff from the Life History Group. It was unclear from the review whether project staff have discussed data requirements with the stock assessment team or which stock assessment procedure will be utilized. It is apparent that creel survey data, where collected, are unlikely to be of sufficient quality for use in stock assessments of species in the night-time spear fishery, due to issues with grouping species (e.g. *Scarus* spp.), incorrect species identification where individuals are identified to species, lack of individual length data for many landings surveyed and uncertainty over whether the lengths that are collected are representative of the total catch, and lack of survey effort into this fishery in general. The size-based approach recently developed by PIFSC scientists and collaborators for the assessment of coral reef fish stocks in Hawai'i (Nadon et al. 2015), using estimates of life history parameters specific to each territory, would appear the most suitable stock assessment approach in the long-term. Of note, the current data collection program (ideally 20 specimens per month per size interval for each species of interest) precludes using the age-composition data from catch curves to estimate total mortality and subsequent fishing mortality rates, as the samples collected are not representative of the proportions of age classes observed in the commercial catch.

In both American Samoa and the CNMI, multiple fishers and vendors are surveyed, helping to ensure that the data collected and samples obtained are representative of the entire catch. However in Guam, data and samples are collected from a single vendor only (the Guam Fisherman's Cooperative Association). Additional markets have recently opened up in Guam to sell catches of foreign national living on the island; however these are not presently sampled due to concerns of damaging existing relationships with locals. Accordingly, it is unlikely that catches at the GFCA are representative of total catches in Guam. Effort should be made to develop strategies and build effective working relationships with other markets without compromising the strong relationship between project staff and the GFCA.

b. Data and data management

Data collection protocols appear well documented, clearly articulated amongst territories and sampling teams and are streamlined, efficient and appropriate to the data collected. Some simple improvements could be implemented to assist project staff in the territories, particularly with data storage. In CNMI for example, a scanner is required to digitize datasheets, which would greatly improve long-term data storage and security.

Data review, quality control, data integrity, transparency, confidentiality, and PII, etc. are treated appropriately. Data stewardship is taken very seriously and the level of pride and professionalism in data QA/QC and confidentiality is evident.

It is intended that the samples collected through the bio-sampling program data will be used to established key biological parameters of the species of interest (including age and growth parameters $L\infty$, t_0 and K, length and age at maturity profiles, length and age at sex change profiles (for hermaphroditic species)) for use in stock assessments, calculation of annual catch limits, formulate management strategies (e.g. minimum size limits based on length-at-maturity) and support and complement existing data collection programs (e.g. creel surveys). For reasons discussed above (point Ia), using individuals solely from the commercial catch, as is currently undertaken, is considered insufficient to meet these needs.

c. Communications

Working relationships between project staff and vendors/fishermen generally appear to be highly effective, resulting from significant relationship-building initiatives by territory project staff. Considerable effort has been made to incorporate the bio-sampling program into existing business operations without significantly disrupting daily operations. Significantly, the effective working relationships allow fish to be sampled from fishers and vendors without having to purchase entire fish, resulting in considerable financial savings to the program. In some cases (e.g. Guam), vendors allow project staff to take fish to the NOAA lab for extraction of otoliths and gonads and return them for later sale. This is a remarkable achievement and one that deserves to be applauded.

Communication between territorial and federal bio-sampling staff is regular, effective and at the appropriate level to meeting the needs of territorial and federal mandates. Surprisingly however, the review was the first opportunity for relevant staff from each of the territories to come together to discuss the program since its inception. It is recommended that more opportunities are provided to territory staff to come together to discuss progress, issues and learn from each other's experiences.

At the time of the review few results from the bio-sampling work were available to communicate to stakeholders and the general public. However, it appears that few formal strategies for communicating results were developed at the conception of the project. Communication of program objectives, methodologies or results to date to stakeholders and the general public has largely been led by the territory project staff on their initiative. In each of the territories, members of the project team have put considerable effort into community outreach and have developed a number of excellent initiatives. When providing results of the more formal stock assessments to fisheries agencies, managers and other stakeholders, the bio-sampling program could benefit from the development of a formal communication strategy, given the complex nature of stock assessment reports.

d. Organization and priorities

The PIFSC and territory partners appear well-organised, highly motivated, and capable. Key gaps and issues to the collection of data and biological samples (e.g. species identification) have been recognised and remedied (e.g. through the development of species ID guides/keys). Facilities are suitable for bio-sampling, and labs for sample collection are well-supplied. The selection and prioritization of species for bio-sampling generally appears well-founded and suitable.

As mentioned above, sample collection has been one of the key priorities to date (along with building effective working relationships with fishers and vendors). This has generated a large amount of biological material that remains to be processed. It is recommended that processing of existing biological material be prioritized over continuing the sample collection. This is to ensure life history and stock assessment results are provided to stakeholders within a timeframe relevant to management (noting that sample collections commenced approx. 6 years ago). This is particularly important given that it is likely the data from the bio-sampling will be used for stock assessment in view of the inadequacies of using data resulting from the existing creel survey programs for stock assessment purposes as previously described.

e. Accomplishments relative to management needs

Although few formalized life history results have been supplied to date, significant in-roads to improving management in the territories have been made. For example, life history data are currently used to provide length-weight info for species underrepresented in creel survey programs, allowing for both a more efficient creel survey program (as weight data does not need to be collected for all species) and a better estimate of annual total catch (by weight). The bio-sampling program also provides valuable information from fisheries not targeted or are seldom targeted during the current creel survey programs (e.g. the night-time spear fishery in Guam), and has significantly improved staff species identification skills, greatly improving data quality in the creel surveys. Perhaps most significantly, the excellent effort by project staff to work with and include fishers and vendors has helped to build trust amongst the parties, to the benefit of data collection and quality.

f. Opportunities

Several presentations spoke to the bottlenecks in processing otolith and gonad material. Tremendous scope exists for capacity building of territorial project staff in preparing otolith sections and gonad histological slides to a stage where they are ready to be provided to experts for reading/interpretation. This would help to reduce the back-log of collected samples and make for more efficient processing, whilst significantly building capacity in the region. Similarly, engaging students from relevant academic institutions (e.g. University of Guam, University of Hawai'i) to work up samples as part of student projects may also be a viable option. As with training of territorial fisheries staff, this would help alleviate the back-log of otolith and gonad samples whilst fostering the next generation of fisheries biologists in the region.

g. Other

In all three territories, the bio-sampling work in being conducted in conjunction with other data collection programs, in particular creel surveys and vendor logs. Care needs to be taken to ensure the bio-sampling work remains complementary to, rather than in competition with, these programs, and especially the creel surveys. In American Samoa for example, there is evidence that the incentives offered to fishers for allowing access to their catch are actively impairing the creel survey program.

Considerable scope exist for project staff to collaborate with those working in tropical, data-poor fisheries, such as the Southeast Fisheries Science Centre and other parties and neighboring countries and territories in the Pacific that are also implementing bio-sampling and creel survey programs (e.g. SPC). Given the likelihood of shared stocks, it would be highly beneficial to ensure data collection, sample processing, analytical protocols and stock assessment criteria are standardised not just among the three US Pacific territories but with other Pacific neighbors.

II. Key (Specific) Recommendations

The below list represents my key recommendations for moving the Commercial Fisheries Bio-sampling Program forward and to ensure that it addresses the expressed needs of management:

- Include fishery-independent sampling at project locations and unfished/lightly fished populations. For project locations, this will help to ensure the entire stock is sampled (including the tails of the length and age frequency distributions), while at unfished/lightly fished locations this will provide an assessment of life history parameters in the absence of fishing, in particular species longevity/maximum age. Fisheries-independent sampling could also target key prey species from which to assess ecosystem-impacts of the fishery, and control (i.e. unharvested) species from which to decouple fishing effects from larger regional and global processes (e.g. climate change).

- Collaborate with statisticians/stock assessment scientists to determine the minimum data requirements for determining life history parameters from samples collected to date and to prioritize which individual samples would be most informative (acknowledging that samples sizes and individual samples of interest would vary depending on the species and life history parameter being investigated). Similarly project staff should work closely with stock assessment scientists to determine the minimum data requirements of the stock assessment approach to be used. To this end, a dedicated PIFSC stock assessment scientist should be identified to work with colleagues in the Life History Group.

- Expand data collection and bio-sampling operations in Guam beyond the GFCA to alleviate issues with data confidentially and whether samples from this vendor are representative of the fishery as a whole.

- Provide material required to ensure safe and secure long-term storage of datasheets (e.g. scanners for digitizing sheets).

- Prioritize processing of existing biological material over further sample collection (to ensure that results are provided within a timeframe relevant to sample collection, noting that collections commenced approx. 6 years ago).

- Should additional species be warranted, it is recommended that their selection be based not only on criteria described above (i.e. importance in the catch, data gaps etc.) but also based on the readability of otolith samples. A subsample of otoliths of additional species of interest, covering a range of sizes and locations, should be assessed for readability prior to wholesale collections are undertaken for bio-sampling. Given that two different labs are currently contracted to process and read otoliths, effort needs to be made to ensure processing and readings protocols are standardised.

- Develop a strategy for communicating complex stock assessments results to fisheries managers, other key stakeholders and the general public.

- Examine the potential for using otolith morphometrics to provide an estimate of age, such as those recently performed on eteline snappers in the western Pacific (Williams et al 2015).

- Explore opportunities for leveraging the lessons learned and improved capacity of territorial staff to improve the creel survey programs in each of the territories.

III. Conclusions

Overall, the Commercial Fisheries Bio-sampling Program has made considerable progress to date. Significant achievements have been made with respect to building trust and effective working relationships with fishers and vendors in each of the territories, and considerable advancement has been made on data and sample collection. The bio-sampling program has significantly improved overall staff capacity and data quality of complementary activities such as the territorial creel survey programs. Strategic planning is now required to address the processing of collected biological material and the data requirements for stock assessments.

Reviewer 2

Programmatic Review of the PIFSC Commercial Fisheries Bio-Sampling Program

Hyatt Regency Garapan, Saipan

January 26–28, 2016

Review Panel Members

- Steven G. Smith, University of Miami
- Brad R. Moore, Pacific Community (SPC)
- Frank A. Camacho, University of Guam

Introduction: The stock assessment context of the Bio-Sampling Program

The coastal marine ecosystems of Hawaii, American Samoa, Guam, and the Northern Marianas Islands (CNMI) support economically- and culturally-important fishing industries as well as lucrative tourism industries. While hundreds of species of fish and shellfish are captured by commercial, sport, and subsistence fishers in the marine waters of these regions, very few have undergone formal stock assessments. A key management concern is thus whether these species/stocks are being fished in a sustainable manner. The main scientific roadblock stems from the lack of fundamental data for assessment for many species, a common problem for tropical marine fisheries around the globe.

There are two main types of data for developing indicator variables for assessment: (1) relative abundance, e.g., catch-per-unit effort (CPUE) from fishery-dependent dockside sampling or animal density from fishery-independent sampling of fishes in the water; and (2) length composition. These data types can be used in two different classes of assessment models to evaluate fishing mortality rates and stock sustainability. The first class is unstructured surplus production models which utilize relative abundance information. The second class is size/age structured models which utilize relative abundance-at-length information as well as life history data on growth and reproduction. Although developed from different branches of population dynamics theory, these two model classes should produce similar results for the same fish stock. For previously un-assessed species, it is prudent to collect both relative abundance (e.g., catch-per-unit effort) and length composition data for developing indicator variables for stock assessment, and then use both model classes to evaluate sustainability status, thus providing a cross-check to guard against things going awry during the modeling process. It is also advantageous to collect both relative abundance and length-composition data from different fishery sectors, e.g., the commercial fleet, recreational fleet, subsistence fleet, and fishery-independent surveys. Using data from multiple sources allows further cross-validation of the assessment results, and may provide a clearer understanding of stock sustainability status since it is often the case that no single data source—commercial, subsistence, or fishery-independent—covers the full spatial distribution of any given species. For example, the commercial fleet may fish deeper reef habitats than either the subsistence fleet or fishery-independent surveys, while fishery-independent surveys employing non-extractive gears may sample inside no-take marine reserves that are off limits to fishing by the extractive fleets.

Compounding the problems of data assessment and collection for tropical coastal fisheries are the vast number of species captured and the spatially-dispersed nature of artisanal fishers and landing sites. Designing fishery-dependent monitoring programs to obtain a representative sample of species catch and effort by gear and sector is a very complex endeavor.

I. General Observations

There appears to be two major components of the Bio-Sampling Program as presented to the review panel:

(1) Pilot program to improve data quality for the long-term creel sampling program. Creel data are intended to ultimately produce CPUE and CPUE-at-Length abundance indices, and estimates of total fishing effort and total catch. These abundance metrics are fundamental inputs for stock assessment models to ascertain sustainability status for fished species.

(2) Collection of life history data and tissues for developing population dynamics functions and parameters for stock assessments. The principal measurements and tissues collected by field samplers are length, weight, otoliths, and gonads for individual fish of a target suite of species. The key functions derived from this information include:

Length-Age growth function (e.g., von Bertalanffy). The function is used to convert numbers-at-length to numbers-at-age for estimating annual survivorship/mortality rates. The function also provides the important parameters of maximum age (lifespan) and average length at maximum age.

Weight-Length function. Used to convert numbers-at-length to biomass.

Proportion Mature-Length functions for females and males. Used to compute reproductive capacity of a population (e.g., spawning stock number, spawning stock biomass).

Notable accomplishments for component (1), the creel improvement pilot program, are:

- Identification of captured fish to species level rather than genus or family or species group. Development of impressive fish ID keys to facilitate training.
- More complete catch-at-length and effort data, e.g., sampling of whole catch from an individual fishing trip for species and lengths.
- Intercepting trips from components of the fishery that were previously not well sampled by the general creel program, e.g., night spearfishing.
- Impressive and innovative approaches for improved relationships between field scientists and fishers/vendors. These include sampling method refinements for minimal disruption to the normal business of selling/buying catch, and building relationships of mutual respect and trust among all involved parties. These advancements have undoubtedly led to better quality intercept sampling data from a greater number of fishers/vendors.
- Development of uniform data collection protocols among regions, including QA/QC procedures, a uniform data entry system tailored to each specific region, and a central database.
- Improved lines of communication between territorial and PIFSC bio-sampling staff.
- Impressive efforts at public outreach, and initial development of communication of bio-sampling data summaries and results to stakeholders and participating vendors and fishers.

Notable accomplishments for component (2), life history data, are:

- Initiating life history studies by obtaining specimens from the commercial catch, a logical and low-cost approach.
- Selecting target species for tissue sampling based primarily on important species in the catch with sparse or no previous life history information. Also, additional species of management concern were added to the target list in some cases.
- Development of standard and appropriate methods for tissue sample collection, labeling, preparation, storage, data recording and analysis that are fairly uniform among the 3 regions.

- Impressive numbers of tissue samples have been collected to date for many of the target species in all 3 regions.
- As for component (1), building relationships of mutual respect and trust among field scientists, fishers, and vendors were instrumental to the success of the life history component.

II. Key (Specific) Findings and Recommendations
(1) Pilot program to improve the creel survey
Finding: Great strides have been made in the pilot program for improving the quality of data in the intercept sampling of fishing trips and catches.

Recommended Next Steps:
1A) Use these improved practices/techniques to refine the general creel sampling program.

1B) Identify a statistician/analyst (or team of people) from the Stock Assessment group to work with Fishery-Dependent Data group. Begin the process of refining the sampling strategy for creel program to optimize sampling effort by fishery sector (commercial, recreational, subsistence), gear/method, time, and space for producing accurate and precise estimates of species-specific abundance metrics—CPUE, CPUE-at-length, Total Effort, Total Catch, Average Length, etc.—for use in stock assessments.

(2) Life history sampling
Finding #1: There is a large backlog of otoliths and gonads to prepare and analyze. Likely there has been some level of oversampling of these tissues for some species for developing population dynamics functions.

Recommended Next Steps:
1A) Identify a Stock Assessment statistician/analyst (person or team of people) as a key collaborator with life history group. Use the completed life history data for some of the principal species to evaluate the minimum required sample sizes by sex, length interval, location, etc., for developing accurate and precise length-age and maturity-length relationships. These initial sample size targets could then be used to randomly select specific otoliths and gonads by species, sex, length interval, location, etc., from the backlog of collected tissues for final preparation and analysis. These sample targets can also be used to guide future collection of tissues by Bio-Samplers for species, sexes, and size intervals that currently do not have a sufficient number of collected otoliths and gonads.

1B) Continue efforts to train and equip territorial scientists in tissue sample preparation and analysis to assist with the backlog and with future tissue collections for additional species and locations.

Finding #2: The general problem of deriving population dynamics functions and parameters from fished populations. In theory, population dynamics functions for growth, lifespan, and reproduction should be developed from data from a representative sample of a fish population that has never been subject to exploitation. Of course, the usual situation is that collection of life history information for a fish population begins after the stock has already been fished for many decades. With increased fishing, the chance of observing a fish at its maximum lifespan diminishes. In addition, the number of fish in the population above the minimum length of capture is lower than for an unfished population. These problems result in derived length-age relationships that have a lower maximum age than the true ecological maximum age, and expected length-at-age values lower than the true values over the exploited length range. In short, the species is perceived to grow to a smaller maximum length and age than the actual maximum length and age. This biased growth relationship results in biased estimates of mortality rates, all of which create biased results of sustainability status: the stock is perceived to be able to withstand higher rates of fishing and associated catch limits than the correct levels of exploitation and catch limits. Thus, the bias in the life history functions derived from fished stocks affects the assessment in a particularly negative way that could lead to a stock collapse. Consequently, the life history tissue sampling from the commercial catch needs to be augmented by other methods for collection which may hopefully overcome these biases.

Recommended Next Steps:
2A) The Stock Assessment statistician/analyst identified above should collaborate with the Fishery-Independent Sampling group and Life History group to develop a sampling plan for fishery-independent collection of life history data from lightly fished/pristine areas relative to the 3 regions. This would entail (i) comparison of existing FI and FD length composition data to identify potential habitats and regions with extended size ranges (both smaller and larger than found in the fishery-dependent sampling) for life history fishery-independent sampling. Some of these locations are fairly well-known, e.g., Rose Atoll in the general vicinity of American Samoa.

2B) Use target sample sizes in step 1A to guide collection of specimens.

3B) The trained territorial scientists (step 1B) can assist with tissue sample preparation and analysis.

Finding #3: Ageing of longer-lived species is sometimes problematic.

Recommended Next Step:
3A) Continue efforts for age corroboration between otolith and radiocarbon methods for species with lifespan > 30 years.

Finding #4: Variation in weight-at-length can be very high at larger lengths for some species. Some species reach their maximum length fairly early in their life history, and then remain at that length for many years to end of their lifespan. This is analogous to the growth strategy for mammals, for example. Weight, however, often increases with age (like humans, for example).

Recommended Next Step:
4A) The Stock Assessment statistician/analyst should collaborate with the Life History group to explore using girth as an additional metric for improving accuracy and precision of weight estimates from length.

III. Conclusions

Impressive strides have been made in improving the tactical aspects of Bio-Sampling. The program has sufficiently matured to the point where it is time to work on the strategic aspects in providing the essential information for conducting stock assessments. The specific recommendations above provide some examples for moving forward on this front.

Final Recommendation/Opportunity:

The struggles of PIFSC and state and territorial agencies with developing requisite information systems for conducting species-specific stock assessments and moving towards ecosystem-based fisheries analysis for coral reef ecosystems in the U.S. Pacific parallel those of the Southeast Fisheries Science Center (SEFSC) and state and territorial agencies in the southeastern U.S. and U.S. Caribbean. Parallel efforts spearheaded by SEFSC scientists are underway to improve: (i) fishery-dependent data collection and estimation of Catch, Effort, CPUE, and CPUE-at-Length for coral reef fishes; (ii) fishery-independent surveys for estimating size-structured abundance of target and non-target species; and (iii) life history data to support stock assessments. Likewise, similar problems and efforts to improve them are likely underway in neighboring countries/regions to American Samoa, Guam, and CNMI. It would greatly benefit all agencies and scientists involved to form trans-agency, trans-ocean, and trans-national working groups and meet on an occasional basis to inform, discuss, share methodologies and approaches, and perhaps develop innovative solutions to meet the scientific challenges of tropical fisheries ecosystem assessment.

Reviewer 3

Programmatic Review of the PIFSC Commercial Fisheries Bio-Sampling Program
Hyatt Regency Garapan, Saipan
January 26–28, 2016

Review Panel Members

- Steven G. Smith, University of Miami
- Brad R. Moore, Pacific Community (SPC)
- Frank A. Camacho, University of Guam

Background

The Magnuson-Stevens Reauthorization Act created greater data requirements for fisheries in territorial waters. The territorial biosampling program was developed in an effort to support of this new management regime by enhancing the capacity of U.S. territories of the western Pacific to collect life history data.

Starting in 2009, biosampling programs were implemented in Guam, the Commonwealth of Northern Mariana Islands, and American Samoa. These programs have generally adopted a market-based sampling strategy to acquire their samples. In all cases, training and support was provided by the Pacific Islands Fisheries Science Center to purchase equipment and support staff working in those territories.

A three-member external panel convened from January 26-28, 2016 to review the territorial biosampling programs and to provide recommendations to improve their performance. In particular, panel members were asked to review the following dimensions of those programs according to the established terms of reference:

- Scientific/Technical approach
- Data and data management
- Communication
- Organization and priorities
- Opportunities
- Other issues

I. General observations

a. Scientific/technical approach

The species prioritized for biosampling were generally the 20 species with the highest catches from each territory. Each territory adopted a stratified sampling approach across the known size range of the species. Sampling included length and weight estimates and, for certain specimens, otolith and gonad extraction and preservation. Otoliths are currently processed either in the territories or through third party laboratories. Gonads are preserved before transshipment to PIFSC for processing and analysis. The technical methods for processing and analyzing otoliths and gonads are based upon well-established, peer-reviewed methods that are appropriate and sound for most of the target species.

A major challenge to these programs is training personnel to identify and sample fish in the field and to process the tissues at the laboratory. To that extent each region has made fish identification a top priority and the teams are proficient in their sampling techniques in the field. However, there is still a critical skill gap in extracting and preparing otoliths and gonads in the lab and even less local expertise in analyzing those tissues.

As mentioned above, species were selected based upon historical catch data from each region. The use of catch history to choose stocks is logical, but as the program begins to expand, there should be an effort to characterize life history parameters for other stocks that may not be commercially valuable, but may have cultural and/or ecological importance.

One issue is that the sampling strategy was developed without considering the level of effort necessary to generate life history parameters that are useful for integrating into stock assessments. The current design may in fact result in oversampling certain size classes of particular species. It is recommended that the current design be revised in collaboration with stock assessment scientists to improve the efficiency of the sampling strategy.

Another key issue is that samples are collected almost exclusively from commercial catches and the size ranges of fish that make it to market are typically different than what occur in natural populations. Program personnel are aware of these limitations and there are efforts to improve sampling individuals at the tails of the size distributions. For some stocks, I would recommend contracting skilled fishermen to augment the sampling. Furthermore, in Guam only one vendor is currently surveyed. This has created confidentiality issues with respect to vendor data. At the same time, there has been and increasing number of Micronesian-owned fish vendors on Guam. It would be useful to expand the market sampling to those vendors to augment the sampling efforts on Guam.

As the biosmpling programs have grown, there is a growing backlog of biosamples remaining to be analyzed by PIFSC staff. To alleviate the backlog, territories should be responsible for as much of the processing as possible prior to sending the samples to PIFSC.

b. Data and data management

Territorial biosampling teams have converged on similar data collection protocols. The different territories have all tried to experiment with different approaches to data collection and input with varying levels of success. There is thus a need to capture the changes in how data were collected since the inception of the program. It is also apparent that sampling of market-based catches is labor intensive and requires a minimum of two team members to efficiently process the fish. Technological improvements may streamline the process, such as using photographic records of length and weight for each fish.

Regarding data confidentiality, there are standardized protocols established to protect the identity of fishermen and vendors. The situation is complicated in Guam where there is currently one vendor supplying all of the market-based catch, creating a confidentiality issue. Expanding the market survey in Guam to include other fish vendors would mitigate that issue.

Data are stored in a WPacFIN database and data requests by are routed through the WPacFIN program. The WPacFIN database has built-in tools that estimate life history parameters and highlight outlying datapoints and thus provide some degree of quality control. In the CNMI, there is a data manager on staff, but it was not clear if other territories had similarly dedicated personnel.

It is clear that PIFSC anticipates that the life history data will feed directly into future stock assessments for those species. If successful, this would represent a clear improvement over the current approach to estimating reference points for these particular stocks. However, there has not been enough engagement with stock assessment scientists and statisticians in designing the different biosampling programs. PIFSC should re-evaluate their sampling strategy with input from stock assessment scientists and statisticians to determine if the sampling effort is sufficient to meet management needs.

c. Communications

It is obvious that the success of these programs is based on the mutual trust and respect of the biosampling staff and the fishermen and vendors. One of the greatest strengths of the territorial teams is their willingness to cultivate relationships with these people. To that end, an impressive amount of effort is dedicated to minimizing the sampling burden on the participants.

The biosampling teams all effectively sample from the most productive markets in each of the territories. However, the shifting demographics of the fishery and markets in Guam are providing some emergent challenges. In particular, several fish markets have recently opened on Guam that are supplied and managed by the migrant Micronesian community. These is a clear need to develop trust among those vendors in order to sample from those markets. It should be noted that at least some of these vendors are likely supplementing their local catch with imported fish.

Communication appears to be effective between territorial and federal biosampling WPacFIN staff. All of the biosampling programs are also involved in extensive outreach and educational activities. In some of the territories, length-weight data have already been shared publicly at community events. Age and reproductive data are far more limited, however. In the future, it is hoped that products would be available for the public that summarize the results from the biosampling programs as these data become available.

d. Organization and priorities

The territorial biosampling programs have developed very quickly with very modest levels of funding. The different territories essentially manage their biosampling efforts with relatively modest oversight from PIFSC. This has allowed for a great deal of flexibility in how these programs adapted to local challenges and leveraged available strengths. Nevertheless, the regional programs could benefit from additional guidance from PIFSC in terms of project design. Perhaps PIFSC might consider a program coordinator who could interface with stock assessment and life history personnel to oversee the biosampling operations in the territories.

There is a need to prioritize processing tissue samples for analyses for those stocks with potentially robust sampling across their size range. Future sampling designs should also include non-commercial species, such as those that may be important ecosystem component species or that be an important prey item for target species.

e. Accomplishments relative to management needs

A significant achievement by the territorial biosampling programs has been the cooperative participation with vendors. The biosampling program has substantially improved the taxonomic resolution of the data collected, in most cases to the species level. This represents a major improvement for many of these taxa. In addition, the market-based catch has also allowed the territories to calibrate the accuracy of their creel surveys. These programs have also made progress toward securing equipment and training for staff on tissue sampling and analyses.

f. Opportunities

A number of excellent opportunities are available to the territories and PIFSC to support and enhance the biosampling programs. There are already partnerships with the University of Guam that have provided additional capacity to process samples for PIFSC. In addition, the UH Medical School has been contracted for the histological preparation of gonads from American Samoa and similar partnerships could be developed in other territories.

Interestingly, this program review represented the first time all the key territorial and federal biosampling personnel had met to discuss their individual programs. More than anything else, there must be more frequent dialog and coordination among the territories and with PIFSC. There also exist opportunities to share training, expertise and data with other life history labs in the Pacific, such as the SPC, as well as with the Southeast Fisheries Science Center and other laboratories working on reef stocks in the Caribbean. However, the territorial biosampling programs must also interact more frequently with each other in order to share ideas and solutions.

With the creation of biosampling laboratories in the territories, there is a tremendous opportunity for capacity building. There are two-year colleges in the territories that could provide student for training and to assist in the analyses. An undergraduate from the biology program at the University of Guam is already volunteering with the Guam biosampling program and is currently processing otoliths as part of a research project.

A recurring theme identified by biosampling team members is the need for accurate, comprehensive fish identification keys. In some cases, territories have developed their own key, which has minimized the potential for misidentification. It would be valuable for the staff in the territorial fisheries agencies to continue to develop their skills in fish identification and life history sampling.

Other

A critical question that needs to be asked is whether local fisheries agencies will eventually inherit the biosampling programs. In some jurisdictions, the biosampling programs compliment the territorial creel surveys and personnel from the local agencies already assist with the sampling. In other areas, biosampling is proceeding with little to no participation from local agency staff.

At the federal level, there is concern that there currently are no stock assessment personnel dedicated to territorial nearshore fisheries. It is also unclear the process by which stocks would be chosen for assessments, although this is beyond the scope of this report.

II. Key Findings and Recommendations

- A significant amount of effort is being placed on collecting fish lengths and weights from market samples. **A more strategic sampling design is needed in order to improve the sampling efficiency. This re-evaluation should be in collaboration with statisticians and stock assessment scientists.**
- Certain size classes of stocks are underrepresented in the biosamples. **The territories should explore contracting fishermen to target areas where size classes of those individuals might occur.**
- Catch history was the primary way stocks were identified for biosampling. **In the future, culturally and ecologically important fish (and invertebrates) should be considered as well.**
- There is a significant amount of heterogeneity in training and equipment among the territories for processing and analyzing tissue samples. **PIFSC and the territories must continue to identify funds to enhance the skills of biosampling staff to a level of proficiency suitable for basic ageing and staging. The territories must also interact with each other and with other groups engaged in life history research in tropical nearshore systems.**
- Several of the territorial labs lack the equipment to reliably age otoliths. **Some funding sources should be identified to assist with modernizing and standardizing equipment between the different territories.**
- The lack of other vendors being sampled in Guam has raised concerns about data confidentiality. However, there is evidence that the catch among other vendors may be a mixture of local and imported fish. **If the Guam program wants to continue with a market-based approach, then the sampling effort must be expanded to other vendors, with the understanding that the source of the fish samples (local or imported) must be validated.**
- There is a growing backlog of tissue samples in need of analysis by PIFSC staff. **It is recommended that biosampling teams redirect more of their efforts to processing the samples in the territories in order to allow PIFSC to focus primarily on analysis.**

- Data collection in the field is labor intensive and often requires more than one staff member. **Biosampling teams should continue to investigate technological solutions (e.g., photographic records, optical character recognition, voice recognition software, etc.) to minimize the sampling and data transcription times.**

III. Conclusions

Overall, the territorial biosampling programs have successfully developed a sound framework for collecting and analyzing biosamples. The primary programmatic issue is that there has not been enough engagement with stock assessment scientists and statisticians to determine the most effective sampling strategy for these fish. Furthermore, there must be more collaboration between the territories and with other national and international science centers investigating similar systems. PIFSC life history staff should guide these efforts.

One of the strengths of these programs is the degree of trust cultivated between program staff and the participants. It is clear that these programs would fail without the cooperation of the fishermen and vendors. Other sampling programs would benefit from studying the approach that these programs have taken.

There remain significant challenges to removing bottlenecks in the sample pipeline. Improving the skills of the program staff is one obvious way to catalyze these analyses. Leveraging partnerships with local community colleges and universities has also been effective at relieving some of the backlog. In the limited funding environment of the territorial biosampling programs, it is likely that student and community volunteers will continue to be essential in to the success of these programs.

Finally, there is a tremendous value in biosampling staff sharing ideas and solutions to similar problems. That these teams have been able to create these programs in such a short time with fairly limited resources is a testament to the creativity and hard work of the territorial and federal program staff.