

Update on the Ecosystem and Socio-economic Profile (ESP)

S. Kalei Shotwell
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Introduction

Ecosystem-based science is becoming an integral component of effective marine conservation and resource management; however, the gap remains between conducting ecosystem research and integrating with the stock assessment. A consistent approach is lacking for deciding when and how to incorporate ecosystem and socio-economic information into a stock assessment and how to test the reliability of this information for identifying future change. Over the past several years we have developed a new standardized framework for operationalizing the integration of ecosystem and socio-economic factors within the NOAA Fisheries' stock assessment system (Shotwell et al., 2016). This baseline Ecosystem and Socio-economic Profile (ESP) uses data collected from a large variety of national initiatives in a four-step process to generate a set of standardized products that culminate in a focused, succinct, and meaningful communication of potential drivers on a given stock. The ESP process and products are supported in several strategic documents namely the Gulf of Alaska Regional Action Plan (Dorn et al., 2018), the Alaska Essential Fish Habitat Research Plan (Sigler et al., 2017), and the new Stock Assessment Improvement Plan (Lynch et al., 2018). ESPs provide a set of communication tools that can be tailored to a large variety of audiences in order to effectively merge the ecosystem, socio-economic, and stock assessment disciplines.

Where applicable, this ESP may replace the existing ecosystem considerations section described in the current Alaska Fisheries Science Center (AFSC) stock assessment and fishery evaluation (SAFE) report guidelines. Generally, these ecosystem considerations sections evaluate ecosystem effects on the stock and fishery effects on the ecosystem and provide an ecological context for the stock or stock complex. Stock assessment authors are encouraged to use indicators from the ecosystem status report (ESR) to assist with stock-specific analyses for this section. Realistically, however, the large-scale regional synthesis approach of the ESR is limited in identifying specific indicators for use in single-species stock assessments. Also, given the coincident nature of the ESR and SAFE documents and subsequent time constraints surrounding the operational stock assessment process, the ecosystem considerations sections within the individual SAFE chapters are rarely updated. A preliminary ESP was first introduced for the Alaska sablefish stock as an appendix in the 2017 sablefish SAFE report (Hanselman et al., 2017). This document was reviewed by the Groundfish Plan Teams and the Scientific and Statistical Committee (SSC) in November and December 2017. The SSC concluded that the ESPs held great promise for testing ecosystem or socio-economic linkages and offered several recommendations for improving the preliminary framework.

In this update we provide responses to the Plan Team and SSC comments and recommendations regarding the preliminary 2017 Alaska sablefish ESP report. We also include summaries on several new developments regarding manuscripts, workshops, and web pages for defining and improving the ESP framework. Three manuscripts detail the four-step ESP process with associated products and describe using integrated ecosystem research to enhance ESPs for high priority stocks. Additionally, three annual workshops are planned starting in 2019 to fine-tune the national baseline ESP framework to a more regional version that addresses the needs of the AFSC. Finally, two web pages are in development to improve communication of the ESP framework and allow timely and consistent access to regional or stock-specific ecosystem and socio-economic indicators for use in the ESPs. Altogether, these new developments create the necessary building blocks toward building next generation stock assessments and increase communication and collaboration across the ecosystem, economic, and stock assessment communities at the AFSC.

SSC and Plan Team Comments on the ESPs

In this section, we list SSC or Plan Team comments and recommendations related to the ESPs and provide brief responses relating to progress on new developments of the ESPs that are further detailed in the following section. The first set of comments relates to Plan Team or SSC recommendations to producing the ESPs, while the remaining comments relate to avenues for ESP improvement.

Comments related to Producing ESPs

“The Teams recommend producing SPECs [renamed to ESPs] for the other focal species from the GOA IERP project next (Pacific cod, walleye pollock, Arrowtooth flounder, and POP). If time allows, it would be useful to produce a SPEC [renamed to ESP] for a low-data species (perhaps “other rockfish,” as it is a habitat-focused assemblage), and to include crab through interaction with the Crab Plan Team.” (Joint Plan Team, September 2016)

“Response to Joint Plan Team Request for Clarification on Stock Prioritization...Examples of indicators of the benefits of the change [of target frequency for affected stocks and complexes of prioritization] could include: ...Development of environmentally linked assessments based on the ESP” (SSC, December 2017)

“The SSC’s response to the Plan Teams’ specific questions [on development of indicators of severe stock decline or ecosystem change] follow: ...The authors should be testing and evaluating how changes in the environmental and socio-economic landscape impact their stock as part of the ESP.” (SSC, December 2017)

“The SSC discussed whether this information should go into the SAFE but concluded that the best place for this information would be Environmental Socio-economic Profiles (ESPs), if ESPs are developed for crabs.” (SSC, February 2018)

Several manuscripts are in development that describe what an ESP is and provide guidelines on how and when to create an ESP (please see ESP Manuscripts section below). These manuscripts also include options for creating advanced elements of an ESP for high priority stocks. The case studies provided in the manuscripts include elements of the ESPs for the five GOA-IERP focal species, namely sablefish, GOA pollock, GOA Pacific cod, GOA arrowtooth flounder, and GOA Pacific ocean perch. As the ESPs develop at the AFSC we also anticipate including a data-limited stock assessment such as “other rockfish” or “sharks” and coordinating with the Crab Plan Team and crab assessment authors to further develop ESPs for crab stocks.

Comments related to Improving ESPs

“The SSC notes that the current version of the ESP contains a considerable amount of background information that is redundant to text already included in the assessment. This background information detracts from the utility of the ESP as a clear testing ground for the implementation of environmentally or socioeconomically linked assessments.” (SSC, December 2017)

The new baseline ESP manuscript (please see ESP Manuscripts section below) includes much of this background information because it is a stand-alone document and future ESPs may simply reference this manuscript rather than include the background. Additionally, the manuscript details two formats for an ESP so that the information can be easily integrated within a stock assessment and readily available for use in management decisions. Finally, only new life history information relating to ESP metrics or indicators are retained in the ESP report.

“The SSC also notes that the conceptual model and the literature review are not particularly useful for the process of developing environmentally or socio-economically linked assessments. The assessment authors certainly should be aware of the life history and potential environmental and socio-economic linkages impacting their stock. This type of conceptual information should be moved to the Ecosystem Considerations Chapter.” (SSC, December 2017)

The conceptual model has been removed from the ESP process and products as it did not contribute above what was already available through the metric grading and indicator development process. Only literature related to the vulnerabilities and identified bottlenecks of the stock are now retained in the ESP.

“To be useful in informing the status determination process, the ESP must shift from a collection of references about sablefish to a suite of core indicators that would be updated every year in September.” (SSC, December 2017)

The new baseline ESP manuscript (please see ESP Manuscripts section below) details how the ESP has shifted from being reference driven to identifying and monitoring a core suite of indicators specific to a stock. Additionally, the manuscript provides options for improving the timeline for ecosystem or socio-economic data delivery so that ESPs can be maintained on a schedule appropriate for the stock assessment cycle. A set of workshops is also funded (please see ESP Workshops section below) that are intended to streamline and coordinate data contributions to the ESPs.

“The SSC recommends that, if future ESPs are developed for other species, they should be developed in conjunction with the lead author. If the ESPs are developed without inclusion of the lead author, the likelihood that the document will be used as an on-ramp to environmentally or socio-economically linked assessments will be diminished. If the ESP identifies promising environmental or socio-economic linkages, it should be incumbent on the author to strive to include models that incorporate the stated relationship to explore its contribution to addressing process error.” (SSC, December 2017)

The lead authors of the stocks included as case studies in the new manuscripts (please see ESP Manuscripts section below) have all been consulted regularly on ESP development and included as co-authors in the manuscripts. Additionally, the primary audience for the set of workshops (please see ESP Workshops section below) is the stock assessment authors and all authors of priority stocks for conducting ESPs will be invited to participate in the workshops. Finally, a new web page (please see ESP Website section below) is being designed specific to the needs of the stock assessment authors for exploring and developing ecosystem and socio-economic indicators. Ultimately, the decision to produce an ESP and include the ESP report within the SAFE report will lie with the lead author.

“The SSC recommends that these species-specific predictions are transitioned to the ESPs (Ecosystem Socio-economic Profile) to ensure that they are considered by the stock assessment authors.” (SSC, December 2017)

The lead editors of both the ecosystem and economic status reports are co-PIs in the ESP workshop project (please see ESP Workshops section below). One objective of the first workshop is to develop a list of species-specific indicator contributions that can be transitioned from the ESRs to the appropriate ESPs and potentially be made available through the ESP website (please see ESP Website section below).

“While the referenced ESP prototype was reviewed by the SSC during its December 2017 meeting, some concern was expressed by an SSC member during the current (June 2018) SSC meeting that the socioeconomic information would need to be expanded and better integrated if future ESPs are intended to track engagement in the fisheries.” (SSC, June 2018)

The new baseline ESP manuscript (please see ESP Manuscripts section below) describes methods for first determining what metrics show important vulnerabilities for the priority ESP stock and then tests indicators of those vulnerabilities through a step-wise modeling procedure. If the socio-economic metrics are important for a particular stock, then indicators of those metrics should be included in the ESP for monitoring. The national initiatives did include some socio-economic metrics and this information is in the baseline metric profile that would be initially evaluated for each ESP priority stock. Additionally, the ESP workshops (please see ESP Workshops section below) are designed to develop indicators that are most relevant to the priorities of the AFSC and the ESP stocks. We plan to devote part of the first workshop to identifying gaps in the metric panels and subsequent indicators that could be further improved or expanded by current ongoing research on both ecosystem and socio-economic factors.

ESP Developments

In this section, we provide information on several new projects regarding the development of the ESPs and report progress in each of the main topics.

ESP Manuscripts

The baseline ESPs format is detailed in a methods manuscript describing the nationally applicable process (Figure 1) and products (e.g., Figure 2) of the ESP framework. This manuscript is currently in internal review and will serve as the starting point for refined development of the ESPs for any given region. In some cases, a baseline ESP can be enhanced by advanced elements of ecosystem or socio-economic research. The Gulf of Alaska Integrated Ecosystem Research Project (GOA-IERP) has a final theme in the synthesis phase that is dedicated to applying the results of this large-scale project to understanding recruitment variability of five focal species in the Gulf of Alaska. These species would all be candidates for conducting ESPs given the large amount of ecosystem research that was conducted on the five species over the duration of the GOA-IERP. Two additional linked manuscripts are currently being drafted to provide guidelines on how to include the specialized metrics and indicators from process studies and long-term research projects such as these IERPs. A draft version of these manuscripts is currently being prepared for the final report of the GOA-IERP Synthesis Project and we plan to have the two linked manuscripts in the final special issue of the GOA-IERP submitted this winter. Summary details regarding the three manuscripts are provided below:

Baseline ESP Manuscript

Title: Creating a proving ground for operational use of ecosystem and socioeconomic considerations within next generation stock assessments

Authors: Shotwell, S.K., K., Blackhart, D., Hanselman, C. Cunningham, K., Aydin, M., Doyle, B., Fissel, P., Lynch, P., Spencer, S., Zador

Abstract [DRAFT]: Ecosystem-based science is an important component of effective marine conservation and resource management. Some progress toward implementation has been made particularly with the comprehensive synthesis provided by the ecosystem status reports. Despite advances, the uptake of ecosystem and socioeconomic information within the operational stock assessment process has been slow to date. This may largely be due to the lack of a standardized framework and timeline to rationally adjust tactical stock assessments based on ecosystem and socioeconomic research. We propose a standardized methodology and reporting framework that facilitates the integration of ecosystem and socioeconomic factors within the stock assessment process. This Ecosystem and Socioeconomic Profile (ESP) can be viewed as an ecosystem research track that acts as a proving ground for potential operational use in quota setting and bridges the gap between the stock assessment, ecosystem, and economic communities. A four-step process utilizes data from national initiatives to guide the production of the ESP and generate a set of standardized products that can be applied to any region or stock. The first step is a focusing exercise that

utilizes data classification information to determine priority stocks for conducting ESPs and set tangible research priorities. The second step performs metric grading on the respective vulnerabilities throughout the life history of the stock to identify bottlenecks in the life history and assist with indicator development. The third step concerns the testing of relevant ecosystem and socioeconomic indicators in a monitoring environment. This testing phase consists of a sequential three-stage technical procedure appropriate for the data availability of the stock. Where possible this would include a decision table to convey the performance and uncertainty between different modeled relationships. The fourth step describes a long- and short-form reporting framework to effectively and efficiently communicate the results of the ESP process to a wide variety of user groups. Finally, the success of conducting an ESP depends largely on the timely availability of data to evaluate the impact of proposed ecosystem and socioeconomic factors; therefore, this information must be aligned with the stock assessment schedule to allow adequate time for data preparation and analysis. A case study example of the described ESP methods is conducted on Alaska sablefish and results are provide in the short and long report format. The baseline ESP framework allows for comparison across stocks and provides the necessary building blocks to move toward an ecosystem approach to fisheries management.

Enhanced ESP Manuscripts

Title Manuscript 1: Investigating a recruitment gauntlet to create specialized ontogenetic profiles that identify life history bottlenecks for use in next generation stock assessments, Part I

Title Manuscript 2: Investigating a recruitment gauntlet to create specialized early life threshold models that identify relevant indicators for use in next generation stock assessments, Part II

Authors (list not final): K. Shotwell, S. Barbeaux, A. Deary, M. Dorn, M. Doyle, G. Gibson, D. Hanselman, R. Heintz, A. Hermann, P. Hulson, C. Ladd, J. Moss, F. Mueter, O. Ormseth, J. Pirtle, I. Spies, A. Sreenivasan, W. Stockhausen

Abstract [DRAFT]: Over the past two decades, numerous ecosystem surveys and process studies have emerged to monitor and assess the Alaska large marine ecosystems. Several regional collaborative integrated ecosystem research projects (IERPs) have been conducted to gain understanding of population fluctuations in relation to the surrounding environment. The Gulf of Alaska (GOA) IERP is one example of such an effort. Products of this program include a suite of *in situ* observations from fully-integrated ecosystem surveys, laboratory experiments of physical thresholds for fish condition, and high resolution oceanographic, planktonic, and habitat distribution models. When coupled together the synthesis products of this program can be utilized to understand system connectivity and highlight the primary ecosystem drivers of the GOA. Much of this information has already been included in the GOA ecosystem status report through indicator contributions and updating the regional report cards. However, assimilation into single-species stock assessment has remained limited, despite the primary focus of the GOA-IERP on understanding fluctuations in recruitment of five commercially and ecologically valuable species. We provide a clear and direct avenue for including the products of these IERPs through the new ecosystem and socio-economic profile (ESP) framework that acts as a proving ground for testing ecosystem linkages within the stock assessment process. We use the five focal species of the GOA-IERP as a case study for testing the utility of the GOA-IERP products within the ESP framework. Data on early life distribution, timing, duration, and condition were used to develop ontogenetic profiles to identify vulnerabilities in the early life of the five species. This information was integrated into the metric grading of the ESP framework for each of the focal species and connected to physical and biological processes that may act as influential pressures during the early life bottlenecks. Data from the high-resolution modeling platforms allowed for development of spatially and temporally explicit maps and times series of a large suite of physical, biological, and terrain metrics. Species-specific thresholds and indicators were estimated and created from this metric suite and monitored using the sequential testing procedures of the

ESP framework. The coordinated nature of the IERP allowed for the creation of these enhanced species-specific profiles, thresholds, and indicators that would not be possible with the results of any one process study. However, it is also imperative that these products be funneled through the ESP process so that the ecosystem linkages are relevant to the stock assessment priorities and ultimately transferred to fishery managers in an efficient and effective format.

ESP Workshops

In addition to the ESP manuscripts described above, a three-year ESP workshop project has recently been funded by the AFSC as part of the new regional work plan process. In order to implement the ESPs, a large amount of coordination is required between a diverse set of programs within the AFSC. This ESP workshop project will conduct a series of workshops beginning in 2019 to inform and coordinate the ecosystem, economic, and stock assessment communities at the AFSC so that the recommended ESPs can be created and maintained. Details of the project are as follows:

Title: Developing Ecosystem and Socioeconomic Profiles for the AFSC

Project Principal Investigators: K. Shotwell (lead), S. Lowe, M. Dorn, B. Fissel, and S. Zador

Project Description: We will conduct three workshops (one per year) at the AFSC in Seattle to create the necessary infrastructure to implement the ESP process for priority stock assessments. Stock assessment authors along with representatives from programs within the AFSC will be invited to attend and contribute to the workshops. Additionally, a representative from Council staff will be invited to participate and provide feedback. The workshops are organized along three general themes associated with the development of an ESP but the process will be continually evaluated over the time period to determine avenues for improvement.

Specific tasks are detailed below for each workshop:

- 2019 Data Workshop: 1) review ESP framework and step through current ESP examples, 2) review current AFSC ecosystem and socio-economic research and discuss how it may contribute to the ESPs metrics and indicators, 3) present/discuss guidelines for streamlining data contributions to the ESPs, 4) create general timeline and personnel matrix for determining when and how to conduct ESPs
- 2020 Model Workshop: 1) review current ESPs (anticipating 4) and any accompanying Council recommendations, 2) present/discuss modeling applications in the ESPs (data-limited and data-rich examples), 3) present/discuss guidelines for indicator selection and ecosystem research model performance, 4) review data contributions, timeline, personnel involvement and discuss what is working and what needs improvement in the process
- 2021 Advice Workshop: 1) update on current ESPs and Council recommendations, 2) present/discuss forecasting applications in the ESPs and resulting management decisions, 3) present/discuss guidelines for ecosystem model projections and decision tables for quota recommendations, 4) review and improve templates for ESP reporting (e.g. short two-page communication for stakeholders and the Council, long-forms for the stock assessment reports)

This project will help bridge the gap between the ecosystem, economic, and stock assessment communities at the AFSC by encouraging cooperation and communication amongst a wide variety of programs toward the common goal of implementing EBFM. The results of the workshops will create guidelines that detail the ESP process tailor fit to the ecosystem and socio-economic research conducted at the AFSC. Deliverables include three proceedings reports following each workshop with detailed minutes, a final manuscript summarizing the resulting guidelines by workshop theme and overall recommendations of the three workshops, and an ESP web page on the new NMFS website that reviews

the ESP process and provides links to ESP templates, code, and examples at the AFSC for potential application at other science centers.

ESP Website

We are in the process of developing two new web pages to assist with communicating the ESP process and products. The first web page will provide an overview of the ESP process, products, and workshops. Several infographics will assist with communicating the nature of the ESPs and how they connect with other aspects of the research conducted at the AFSC. The page will also contain links to ESP templates, examples of ESPs conducted at the AFSC, and potentially a GitHub page with scripts that allow for creating the baseline elements of the ESP. The AFSC Communications group will be working with us to develop this page. The second web page will be designed to allow quick access to indicators specifically intended for use in the ESPs. The web page will be designed following several commonly used oceanographic and ecosystem web pages including CoastWatch west and east coast data access pages, the California Integrated Ecosystem Assessment indicators pages, and the Bering Climate data access page (see reference links listed below). Personnel from the CoastWatch West Coast Node will be developing this page with our assistance and feedback.

Initially, the indicators hosted on the ESP Indicators page will be based on a list that was developed by the stock assessment authors when answering the stock assessment prioritization form questions for their stocks in 2016. We will begin with developing easily accessible and consistently updated indicators from remote sensing sources (e.g., sea surface temperature, ocean color, winds) and provide them at regional scales appropriate to management (e.g., eastern/central/western GOA, Aleutian Islands, Bering Sea). As the ESPs are more fully developed and the ESP workshops are conducted, this list of indicators will be refined for the priorities of the ESPs and the stock assessment authors. We will also coordinate with the editors of the ecosystem and economic status reports to include any species-specific indicators available from those reports.

Reference list of web pages:

Alaska Science NMFS page: <https://www.fisheries.noaa.gov/region/alaska#science>

Bering Climate data page: <https://www.beringclimate.noaa.gov/data/index.php>

California Integrated Ecosystem Assessment indicators page:

<https://www.integratedecosystemassessment.noaa.gov/regions/california-current-region/indicators/climate-and-ocean-drivers.html>

CoastWatch West Coast Regional Node: <https://coastwatch.pfeg.noaa.gov/index.html>

CoastWatch West Coast Data Catalog: <https://coastwatch.pfeg.noaa.gov/data.html>

CoastWatch East Coast time series page:

https://eastcoast.coastwatch.noaa.gov/time_series_sst_regions.php

Summary and Conclusions

The baseline ESP framework starts the conversation of whether a stock or stock complex should consider ecosystem or socio-economic linkages and takes the first steps toward integrating that information into the stock assessment process. This is essentially a bottom-up approach toward EBFM from the perspective of the individual SAFE reports, while the ESRs would be the top-down representation of EBFM. The four step ESP process creates 1) a priority list of stocks to conduct ESPs, 2) a set of metrics to grade stock vulnerabilities, 3) a set of indicators to monitor and 4) reporting templates to include in the SAFE reports and provide to fishery managers. The consistent and easily updateable nature of these products allows the ESP operations to be timely and efficient which should increase uptake of ecosystem and socio-economic information within the stock assessment process. Additionally, the ESPs can be easily compared across stocks or stock complexes which will help with identifying potential system level

concerns and allow for effective allocation of resources to fund future process studies or inform survey design. This comparative nature can also assist with identification of data gaps across groups of species and be used to construct future AFSC research priorities.

The ESPs are designed to identify priority assessments for integrating ecosystem information, identify vulnerabilities in the life history, test indicators of these bottlenecks through structured modeling procedures, and communicate the results in an efficient and effective format. This supports the third and fifth guiding principles in the EBFM Road Map and several of the objectives detailed in the NOAA Fisheries Climate Science Strategy. The ESPs also support the recommendations of the new Stock Assessment Improvement Plan (Lynch et al., 2018) by providing a framework for including these ecosystem linkages within the stock assessment process (Theme 1) and creating a type of research track for testing the expanded scope of the stock assessment model outside the operational model (Theme 3). The results of the ESPs are distilled into decision tables for fishery management and several different reporting formats to effectively communicate with the scientific community, stakeholders, and the public. Closing this communication gap is a research priority of nearly all strategic documents.

The baseline ESP is a useful starting point for understanding ecosystem or socio-economic linkages; however, the nature of a baseline, is just that, a beginning. Specialized data from dedicated process studies to large-scale IERPs are available that could supplement and enhance this baseline. Ontogenetic profiles can help pinpoint life history bottlenecks that would not otherwise be identified with baseline metrics. Regional indicators finely tuned to the life-history thresholds for a given stock would be better suited for detecting ecological shifts that would directly impact the stock at the level of management rather than large-scale climate indices or extremely fine-scale time series. When incorporated through the ESP framework in a synthesized manner and at the appropriate level for management, this enhanced information may be critical to create a next generation operational stock assessment and ultimately inform harvest advice.

The ESP workshops and web pages will help bridge the proverbial gap between the ecosystem, economic, and stock assessment communities at the AFSC. We aim to create guideline documents following the three dedicated workshops that will tailor fit the ESP process to the ecosystem and socio-economic research conducted at the AFSC. The project will encourage cooperation and communication amongst a wide variety of programs toward the common goal of implementing EBFM. The Plan Teams and SSC have supported development of the ESPs for priority stocks in the Alaska groundfish and crab fishery management plans. Additionally, the SSC just recently requested the AFSC to coordinate efforts to integrate ecosystem indicators into stock assessment at their June 2018 meeting. The planned ESP workshops and web pages will effectively respond to this request.

Although the ESP project may help contribute to the AFSC mission to move toward next generation stock assessments, it is also useful to contribute to stakeholder interest/trust/buy-in. Most stakeholders are very unlikely to peruse the comprehensive ecosystem or economic status reports and synthesize that information into how that affects their stock of interest. Often due to time constraints for estimating stock assessment models and producing large SAFE reports, recommended lower quotas are given a vague justification of "recruitment failure" or some other unknown environmental driver. The standardized format of the ESP allows for a clear and consistent assessment of potential influential ecosystem and socio-economic drivers using data that is collected similarly across the nation. Placing this analysis within the individual SAFE reports would put information regarding potential explanations for variable quotas into one place for stakeholders to review and consider with regard to their future investments into their stock of interest.

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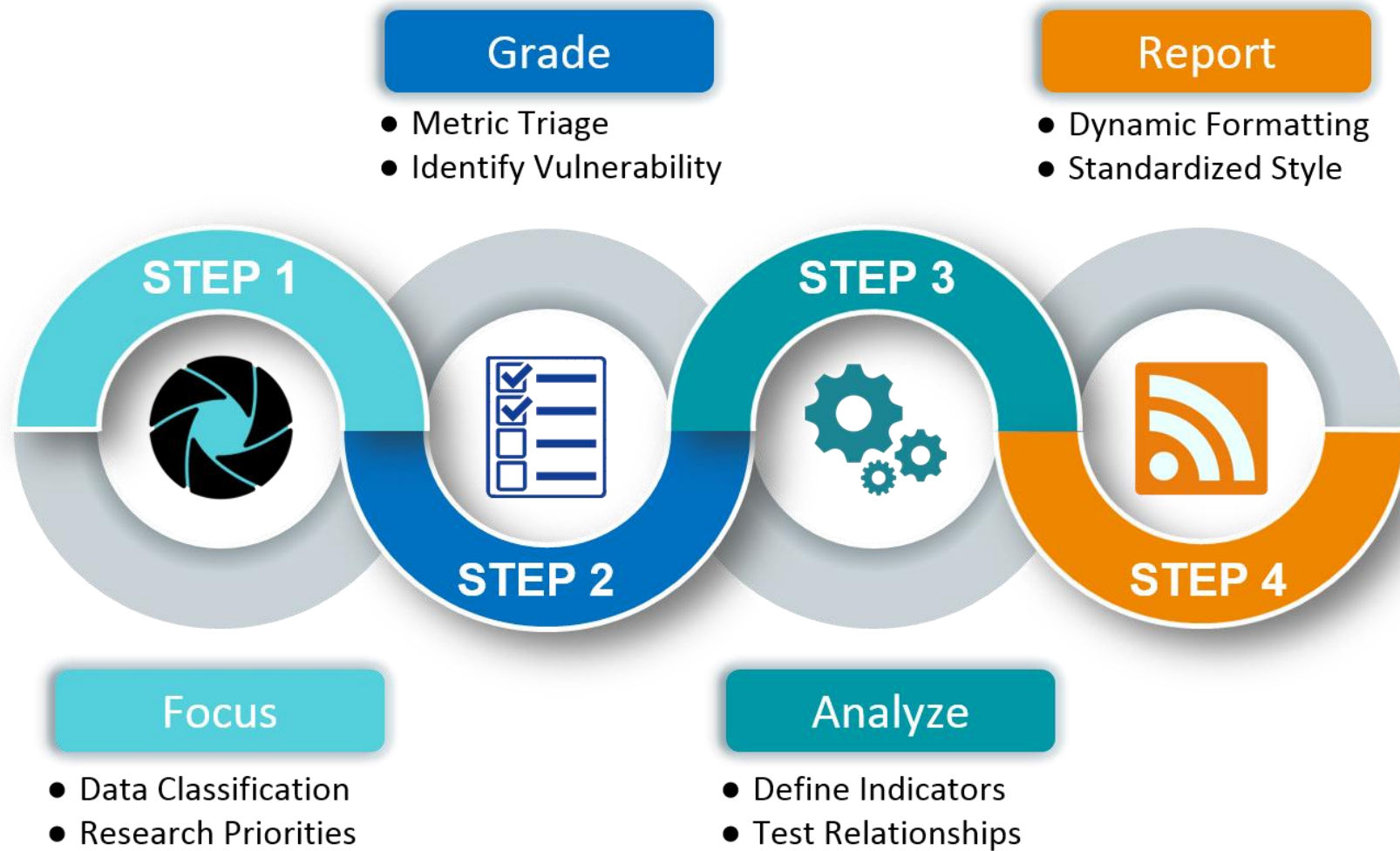
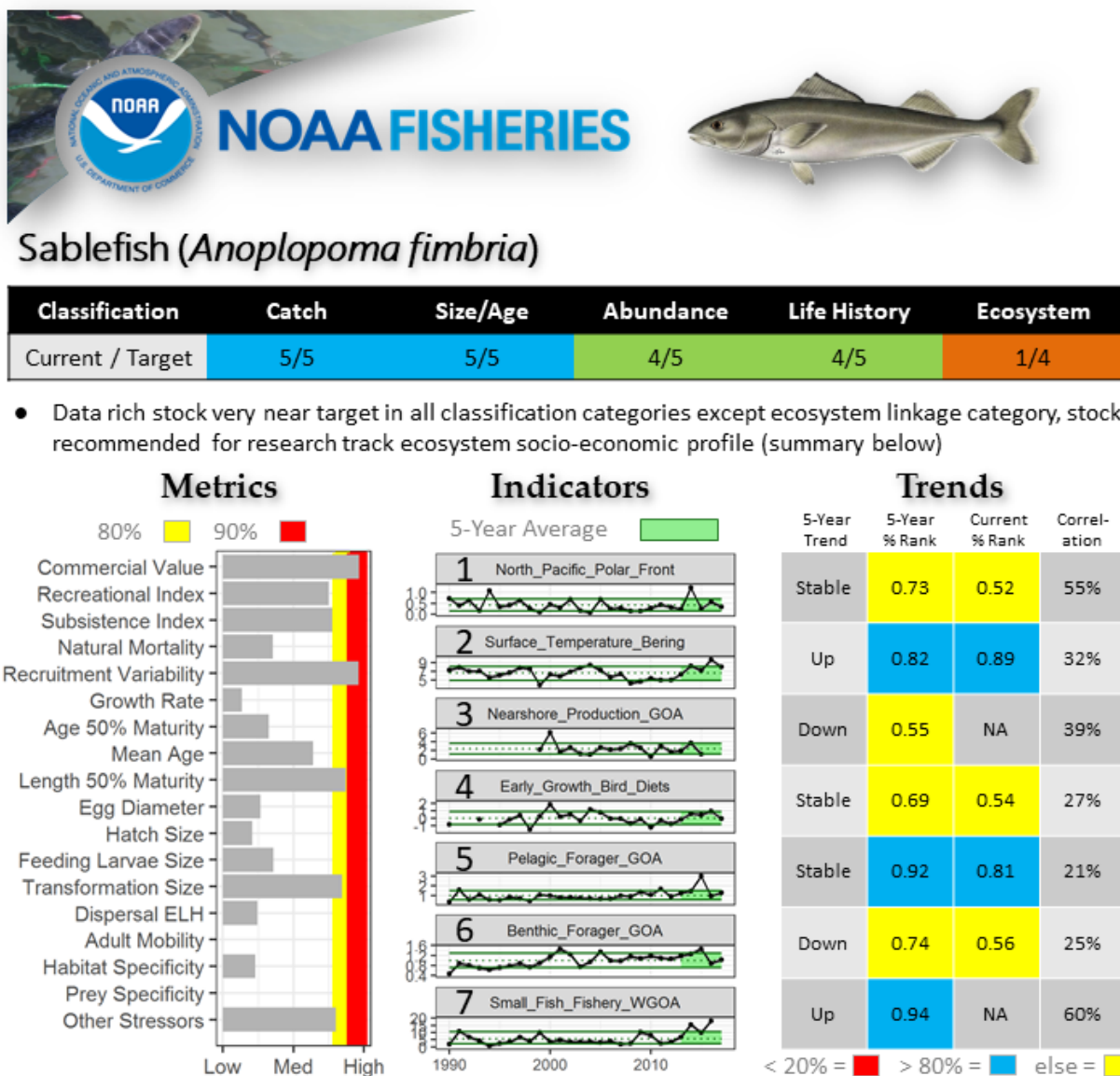


Figure 1: Four step process to develop an ecosystem and socio-economic profile (ESP)



- High economic value and recruitment variability coupled with large size at transformation and large size 50% maturity resulted in 7 indicators as proxy for offshore thermal experience, larval transport, food availability, early growth, pelagic and benthic competition, and percent small fish in the fishery
- Operational model 16.5 suggests stock near B_{MSY} but ecosystem model runs (*hypothetical values below*) show improved current and future stock condition over 16.5 with low risk of overfishing

New Model	Indicators Used	ABC	OFL	Performance		Risk Assessment (Probabilities)		
				Cross Validation	Retro-spective	ABC>OFL (P*)	R(2017-2019)<(R̄)	SSB(2019)<B _{MSY}
M16.5E1	1,2,3	16,150	25,240	28% +/- 6%	-0.04	0.08	0.65	0.30
M16.5E2	1,2,3,7	14,480	23,570	46% +/- 12%	+0.07	0.16	0.80	0.42

ESP: <https://www.afsc.noaa.gov/REFM/Docs/2017/GOAsablefish.pdf>, Contact: Kalei.Shotwell@noaa.gov

Figure 2: DRAFT ecosystem and socio-economic profile (ESP) short-form template on Alaska sablefish