Allocation Decision Trees:
A Blueprint for Applying Biological, Social, and Economic Considerations in Allocation Decisions

South Atlantic Fishery Management Council

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Introduction

In March 2020, the South Atlantic Fishery Management Council (Council) identified criteria to consider when discussing allocations that included: *landings history, expected/known discard rate, accountability of a sector, fairness, equity, market needs, importance of a species to a sector, cultural importance, and the possibility of removing sector allocations*. At the end of March 2020, the Government Accountability Office (GAO) released a report on its review of fishery sector allocations in the South Atlantic and Gulf of Mexico.[1] The GAO recommended similar criteria when considering sector allocation needs: *trends in catch and landings, stock assessment results, economic analyses, social indicator analyses, and ecosystem models.*

Since the last reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) in 2007, which required establishing annual catch limits (ACLs) and prompted establishment of sector allocations for managed species, landings have been the primary data source used for allocation purposes in the South Atlantic region since they have been the most consistently available data and can be obtained for all species. However, the Council has acknowledged that other biological or ecosystem data sources, as well as input from economics and the other social sciences, are also important to inform sector allocation decisions.

While neither the MSA nor the National Standard Guidelines require sector allocations, they are an important management tool that is available to the Nation's fishery management councils. The Council has chosen to establish allocations for the majority of its managed species with both recreational and commercial landings. In most cases, the Council has not used data other than landings because other types of data are at times lacking for the South Atlantic region or there has not been a consistent method to apply other criteria, such as social and economic factors. Currently, the Council is reconsidering sector allocations in a systematic manner that allows for consideration of additional methods that address the current and future needs of the fisheries. Also, the Council has set an allocation review trigger policy[2] and will continue receiving stock assessments that warrant a review of sector allocations when revising the acceptable biological catch and resulting ACLs, making the development of a systematic approach to addressing allocations desirable.

The Comprehensive ACL Amendment (2012) created sector allocations for many species that did not already have them, often using landings from 1986 through 2008. The formula used a long-term "historical" time series and a more "recent" trend. Sector allocations were determined using fifty percent of the average landings from 1986 through 2008 ("historical" trend) and fifty percent of average landings from 2006 through 2008 ("recent" trend). The same amendment also put sector ACLs and accountability measures (AMs) in place. In-season harvest closures were implemented to keep landings from exceeding ACLs. Prior to 2012, in-season closures were uncommon. Since closures disrupt how the fishery would otherwise operate, and closures might occur for one sector and not the other, applying the same allocation formula to more recent years (particularly after 2012) may not reflect each sector's full harvest capacity or use when not restricted by an ACL. Hence, modifying sector allocations by using landings from years *after* AMs were implemented, particularly those used for short-term trends, could introduce a

[1] The GAO report is available at https://www.gao.gov/products/gao-20-216.
[2] The Council's Allocation Review Trigger Policy at https://safmc.net/download/AllocationReviewTriggerPolicy071619.pdf

management-induced constraining effect that should be considered when developing landings-based allocations. Nonetheless, trends in catch and landings remain a valuable source of information to help determine future modifications to sector allocations.

The Decision Tree Approach

Making sector allocation decisions is a difficult and complicated process. To help incorporate other sources of information, in addition to landings, the Council is using a decision tree approach to determine salient issues and develop an organized approach to allocation decisions. At their September 2020 meeting, the Council endorsed the concept of the decision tree approach and directed staff[3] to work on developing the approach with input from its advisors. The Council expressed concerns over establishing an approach that would be overly prescriptive and wanted to maintain flexibility in allocation decisions on a species-by-species basis. As such, the approach seeks to be informative in a methodical and consistent manner without being prescriptive.

A decision tree approach is a systematic methodology that uses the same question pattern, or tree, for each species considered. As a question is answered, the tree "branches," or directs the reader to the next question until all the relevant questions are answered, and a course of action is recommended for that species (**Figure 1**). By narrowing the focus, the Council can determine the most important factors to consider based on available data. The following items outline the approach:

1. The decision trees are slightly modified from the five criteria recommended by the GAO. There are four main decision tree categories based on:
    - Landings and discards
    - Stock status
    - Economic factors
    - Social factors
2. Each species will "pass through" all decision trees.
3. Some decision trees may not provide a relevant outcome for a given species.
4. A question in one decision tree could be applicable to another tree.

A portion of the first of the four main criteria, landings history, is what the Council has primarily relied upon. This information is available for species by sector and can be applied consistently. Depending on how the decision questions are worded, the landings decision tree could provide insight into whether the current allocations are working or not. For example, a decision tree could recommend the Council explore whether one sector could benefit from increased allocation without harming the ability of the other sector to continue to land fish.

The main intent of the decision tree process is to allow the Council to work through the decision tree process when review of allocations has been triggered by the Council's allocation policy or near the beginning of a potential FMP amendment. This process is meant to aid the Council in making decisions such as whether allocations need to be

[3] Working group made up of Dr. Mike Schmidtke (SAFMC), Christina Wiegand (SAFMC), John Hadley (SAFMC), Dr. Scott Crosson (SEFSC), Myra Brouwer (SAFMC), and Dr. Brian Cheuvront (formerly SAFMC).

considered in an amendment, initial structuring of allocation alternatives, and help build rationale.

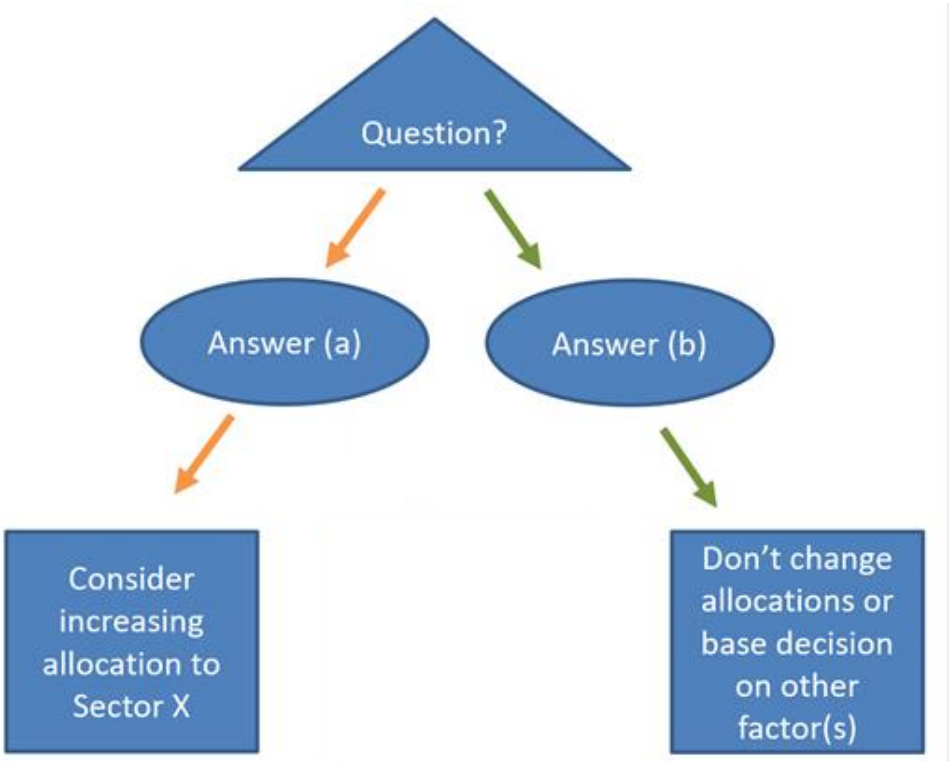

Figure 1. Conceptual example of a decision tree.

Decision Tree Questions

Topic: Landings and Discards

Landings: Should future allocations be based on harvests impacted by previous or current quotas (e.g. ACL)?

Answers:

1. No. *Consider allocations developed using harvests from a historical time period without quotas that limit annual harvest or other factors addressed in other decision trees.*
2. Yes. **Have both, only one, or neither sector met or exceeded the ACLs or experienced closures due to the ACLs being projected to be met or being exceeded in any of the past five fishing years?**
    a. Both sectors. *Consider maintaining current allocations or basing changes to allocations on other factors addressed in other decision trees.*
    b. One sector. *Consider reallocation of no more than the difference between the maximum annual harvest in the last five years and the ACL from the underharvesting sector. Consider a minimum threshold for the difference to avoid reallocating insignificant portions of the ACL.*
    c. Neither. *Current fisheries have not been limited by the ACLs. Consider recent proportions of total landings in allocations. Consider whether sector allocations*

are necessary for fair and equitable management of this fishery. If one sector has recently shown significant growth, consider this trend in setting future allocations.

Potential analysis: Landings and quota by sector time series, in addition to record of any quota-induced closures and when those closures occurred within the fishing year.

Discards: Has discard mortality accounted for a more substantial portion of removals for either sector in three of the past five fishing years?

Answers:

1. Yes. *Consider not increasing the allocation for a sector with a substantial amount of discard mortality.*
2. No. *Neither sector is substantially impacted by discard mortality. Consider allocation advice provided by the other decision trees.*

Potential analysis: Dead discards as a percentage of annual sector removals.

Topic: Stock Status

Stock Status: Has stock status been determined?

Answers:

1. Yes. **What is the stock status? Consider advice from all applicable statuses.**
    a. Overfished. *Prioritize reallocation towards a sector if that could increase biomass (via increased survivorship, particularly of juveniles and adult females).*
    b. Overfishing. *Prioritize reallocation towards a sector if that could decrease dead discards. Also consider measures beyond allocation to end overfishing.*
    c. Not Overfished/Not Overfishing. *Consider maintaining current allocations or basing changes to allocations on other factors addressed in other decision trees.*
2. No; stock status is unknown. **Is there an adequate index of abundance showing population trends?**
    a. Yes. **Is the population growing, stable, or decreasing?**
        i. Stable or Growing. *Consider maintaining current allocations or basing changes to allocations on other factors addressed in other decision trees.*
        ii. Decreasing. *Prioritize reallocation towards a sector if that could increase biomass (via increased survivorship, particularly of juveniles and adult females) or decrease dead discards.*
    b. No. *Consider maintaining current allocations or basing changes to allocations on other factors addressed in other decision trees.*

Potential analysis: SEDAR stock assessments and fishery stock status updates from NOAA Fisheries.

Topic: Economic Factors

Economic Importance: Do the sectors have similar or divergent trends in relative economic importance of the species?

Answers:

1. Divergent. *Prioritize reallocation towards the sector for which the species has an increasing economic importance.*
2. Similar. *Consider maintaining current allocations or basing changes to allocations on other factors.*

Potential analysis: Logbook information can be used to determine commercial importance through a comparison of gross revenue from a species to total gross revenue. Compare directed effort for a species to directed effort for all SAFMC-managed species in the appropriate region as a proxy for recreational importance.

Demand for the Species: Do the sectors have similar or divergent trends in demand for the species?

Answers:

1. Divergent. *Prioritize reallocation towards the sector that is exhibiting increasing demand.*
2. Similar. *Consider maintaining current allocations or basing changes to allocations on other factors.*

Potential analysis: Use the following as proxies for demand: Trends in ex-vessel price and landings for the commercial sector. Trends in directed effort and landings for the recreational sector. Also information may be available from Fishery Performance Reports and the Public Input Gathering Tool that specifically ask about trends in demand.

Demand for Quota: Has a sector fully harvested its ACL on a consistent basis?

Answers:

1. Yes, only one sector. *Prioritize reallocation towards the sector that would likely benefit from additional ACL.*
2. Yes, both sectors. *Consider maintaining current allocations or basing changes to allocations on other factors.*
3. No. *Consider maintaining current allocations or basing changes to allocations on other factors.*

Potential analysis: Consider historical use of sector ACLs if appropriate. Also consider projected use of new sector ACLs under the status quo allocation percentage, particularly if the methodology for estimating landings has recently changed.

Topic: Social Factors

Fishery Dependence: Among the top counties[4] with the highest proportion of total [landings, trips, permits] in the region, are most of them engaged in commercial fishing, recreational fishing, or both? *(Counties are considered highly engaged if they are above the one standard deviation threshold).*

Answers:

1. Most are highly engaged in commercial fishing.
    a. **Are commercial fishermen in those counties dependent on the resource for their livelihood (above the median local quotient)?**
        i. Yes. *Consider prioritizing commercial fishing opportunities.*
        ii. No. *Review fishing opportunities for associated species and consider whether adjustments to topic species allocations are necessary.*
2. Most are highly engaged in recreational fishing.
    a. **Are recreational fishermen in those counties dependent on the resource (above the median number of directed trips)?**
        i. Yes. *Consider prioritizing recreational fishing opportunities.*
        ii. No. *Review fishing opportunities for associated species and consider whether adjustments to topic species allocations are necessary.*
3. Equally engaged in commercial and recreational fishing. *Consider removing sector allocations or allocating equally between the sectors.*

Potential analysis: Social indicators, including commercial and recreational fishing engagement, regional quotient, and local quotient.[5]

Cultural Importance: Does the fishery play an important role in the history of fishing communities?

Answers:

1. Yes. **Does the fishery play an important role in community cultural tradition?**
    a. Yes. **Have changes in the regulatory environment affected the role this species plays in communities?**
        i. Yes. *Consider allocations that mirror the historical real or de facto allocations and/or current values and attitudes in the fishery, which may or may not mirror the current state of the fishery.*
        ii. No. *Consider allocations that prioritize economic, biological, or ecosystem needs.*
    b. No. *Consider allocations that mirror the historical real or de facto allocations.*

[4] Community is the ideal level of analysis for social factors. However, due to recreational data restrictions, the goal will be to conduct analysis at the county level. In some cases, data at the county level may be insufficient. In that case, analysis will be conducted by regions within the state or at the state level.

[5] ***Engagement Indices*** measure which communities are more dependent upon recreational or commercial fishing. ***Quotients*** measure the relative importance of a given species across communities or averaged by vessel.

2. No. *Consider allocations that reflect the current state of the fishery and would allow for growth and adjustment.*

Potential analysis: Summary of information provided in fishery performance reports and the Public Input Gathering Tool, available demographic data, and informed judgement.

Working through the Decision Tree Questions

To aid in working through the series of decision tree questions, Council staff will gather appropriate information, as available, towards the beginning of an amendment. Examples of such information is listed under "potential analysis" for each respective topic and includes sources such as landings data, discard data, effort data, SEDAR stock assessments, fishery stock status updates from NOAA, commercial logbooks, quotients and engagement indices, fishery performance reports, and the Public Input Gathering Tool (Appendix 1). This information will be summarized and presented to the Council using Shiny apps[6] in a fishery overview. Since most questions are not subjective, assuming the appropriate data are available, the outcomes should be available for the Council to review immediately. To help compile the outcomes, an online allocation tool will be available. A draft version of this tool can be viewed at:

Link: https://safmc-shinyapps.shinyapps.io/AllocDecTrees/

Staff will develop preliminary responses and assist the Council through the decision tree questions and resulting recommendations ahead of initial allocation decisions. Council members will be able to clarify the outcomes of each decision point, asked to address any subjective outcomes, and will review the comprehensive results through the online tool.

Working with Decision Tree Results

With multiple and varying decision tree "branches" or "nodes," there could be many different combinations of results. The most straightforward result would be that all the decision trees would give the Council the same sector allocation advice. The most likely outcome is that not all of the decision trees will point to the same advice. The Council is then left with how to resolve the differences.

Since one of the stated preferences of the Council is to maintain flexibility and evaluate allocations on a species by species basis, there is no commitment to a ranked order or preponderance of outcomes when deciding the course of action to take from the decision tree results. The Council will resolve conflicting allocation recommendations on a case by case basis. In such situation, the outcomes of the decision tree can be used to help the Council develop a range of alternatives if the Council decides that examining allocations is desired.

Additionally, it is possible that not all decision trees are going to have meaningful input every time for every species. This could be due to lack of relevant data readily available to inform answers to the questions, or the answers to the questions may not add relevant information to make a decision about sector allocations for a given species.

[6] https://shiny.rstudio.com/

Review and approval of the Decision Tree Approach

The Council asked staff to develop the allocation decision tree approach and work with advisors from the Socio-Economic Panel (SEP), Scientific and Statistical Committee (SSC), Advisory Panels (APs), NOAA Southeast Regional Office (SERO), and NOAA Southeast Fisheries Science Center (SEFSC) to help modify and calibrate the methodology. Review of the Blueprint as well as the associated inputs from fishery performance reports and the Public Input Gathering Tool took place throughout 2021 and the first half of 2022 (**Table 1**). The comments provided through this review process have been incorporated where possible and as appropriate. Of note in the timeline for development is the Council's approval of the decision tree approach in March 2022, the SEP's approval of the revised social and economic components of the allocation decision tool in April 2022, and the Council's approval of the Public Input Gathering Tool in June 2022. The approach and allocation decision tool will be first applied to the Spanish mackerel fishery, with the results being reviewed during the Council's December 2022 meeting.

Table 1. Review of the Allocation Decision Tree Approach.

Review Type	**Timing**
Approach reviewed by the SSC and SEP	April 2021
Approach reviewed by SERO and SEFSC	July 2021
Approach reviewed by Council AP Chairs	August 2021
Approach reviewed the Council	September 2021
Approach reviewed the Council	February 2022
Approach reviewed by the Council and approved for future use	March 2022
Approach, Fishery Performance Report, and Public Input Gathering Tool socio-economic questions reviewed by the SEP	April 2022
Public Input Gathering Tool reviewed by the Council and approved for future use	June 2022

Appendix 1. Public Input Gathering Tool

SALTWATER CONVERSATIONS

A Public Input Gathering Tool

South Atlantic Fishery Management Council

At the March 2022 meeting, the South Atlantic Fishery Management Council (Council) requested staff develop an online form to gather input from the public, similar to the Gulf of Mexico Fishery Management Council's (Gulf Council) Fishermen Feedback (formerly 'Something's Fishy') tool. The purpose of this new public input tool would be to gather information from Council stakeholders' experiences and observations on the water and in the marketplace. The information gathered would be and used in conjunction with Fishery Performance Reports to complement scientific and landings data and to aid in management decisions, specifically sector allocations.

THE TOOL

In response to the Council's request, staff has developed a public input gathering tool named Saltwater Conversations.

Members of the public will have the opportunity to provide their input on the topics such as:

- Have there been substantial changes in fishing behavior and catch levels for shadow shark over the last five years? How important is catch and release for shadow shark?
- How have social and economic influences (ex. price and demand, infrastructure, community dependance) affected the shadow shark fishery? Is shadow shark a driver of tourism?
- What environmental conditions influence the shadow shark fishery? Over the last five years have you seen changes in the distribution and size of fish, spawning months etc.
- Are there different management measures that the Council should consider or are there existing management measures (such as size limit, trip limit, bag limit, season, etc.) that should be changed?
- What else is important for the Council to know about shadow shark?

Those providing input using Saltwater Conversations will also be asked to provide their name, email, home port, state, and stakeholder affiliation (private recreational, commercial, for-hire, wholesale, non-governmental organization, or other). This information is consistent with what is provided during general Council public comment opportunities.

THE PROCESS

Saltwater Conversations will be made available through the Council's website.

Similar to Fishery Performance Reports, Saltwater Conversations would gather information on a fishery species in advance of a scheduled stock assessment or to establish a baseline for an unassessed fishery. The intent is to collect information from stakeholders during the same quarter a Fishery Performance Report is being conducted by an advisory panel.

- Availability of the tool would be advertised through various Council outreach tools, including the website, social media, and the South Atlantic Bite e-newsletter.
- The tool would remain open for the public to provide their input for approximately two months (see **Figure 1** for full timeline).
- While name and sector affiliation will be collected, individual information (e.g., email address) will be kept confidential. Only aggregate information will be presented.

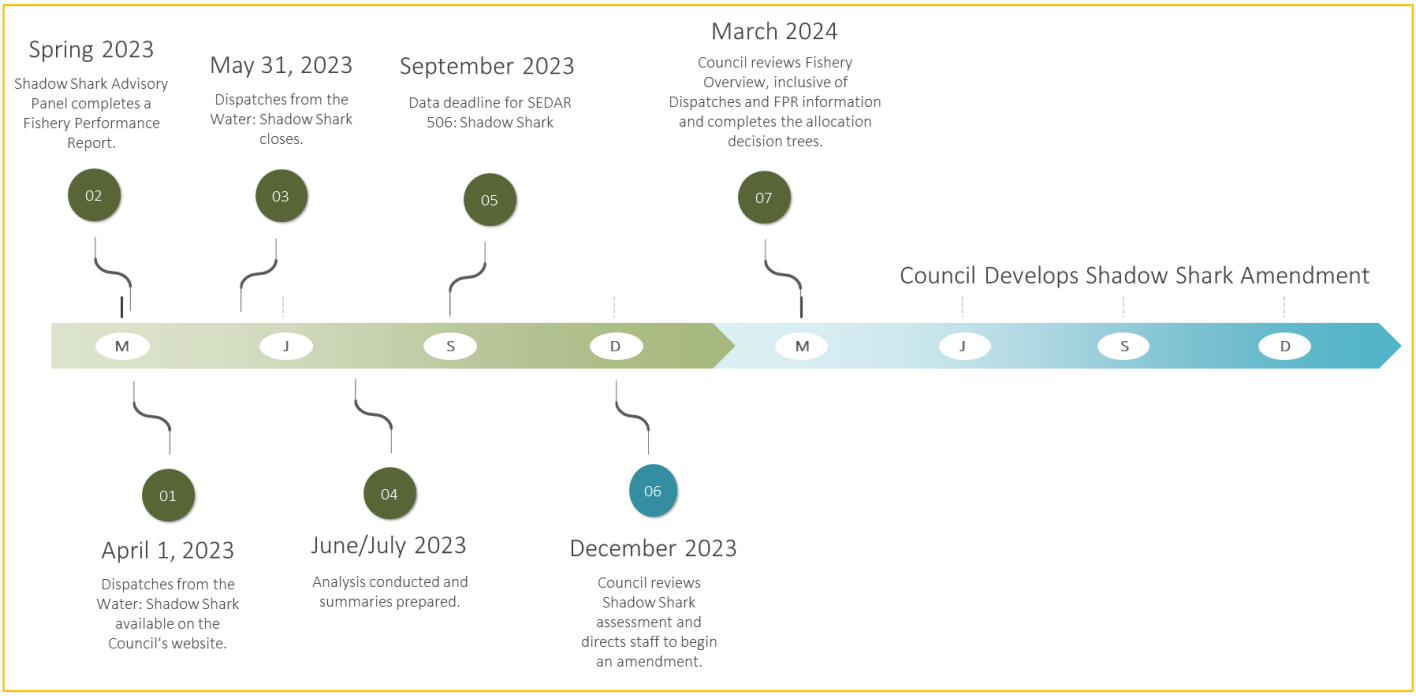

Figure 1: Sample timeline for development and use of Saltwater Conversations for Shadow Shark.

THE ANALYSIS

A variety of qualitative analysis can be conducted using information collected through Saltwater Conversations as well as from the Fishery Performance Reports.

Simplified Thematic Analysis

- Information submitted via Saltwater Conversations and minutes from Fishery Performance Reports would be examined to identify topics, concepts, and patterns that come up repeatedly.

Example from the Gulf Council's Fisherman Feedback Tool for Gulf Cobia:[7]

[7] https://gulfcouncil.org/wp-content/uploads/Somethings-Fishy-Cobia-Summary.pdf

- Many comments indicated that the average size of fish encountered is smaller than it has been historically.
- Comments indicating a negative trend in abundance noted that the spring migration had either diminished or moved farther offshore. This was attributed to red tide, influx of fresh water, or removal of structure.
- Comments indicated that the population decline has been occurring since about 2010.

Sentiment Analysis

- Submissions to Saltwater Conversations would be read by staff and classified as positive, negative, or neutral and/or an automated software would conduct the analysis.

<u>Example from the Gulf Council's Fisherman Feedback Tool for Gulf Cobia:</u>

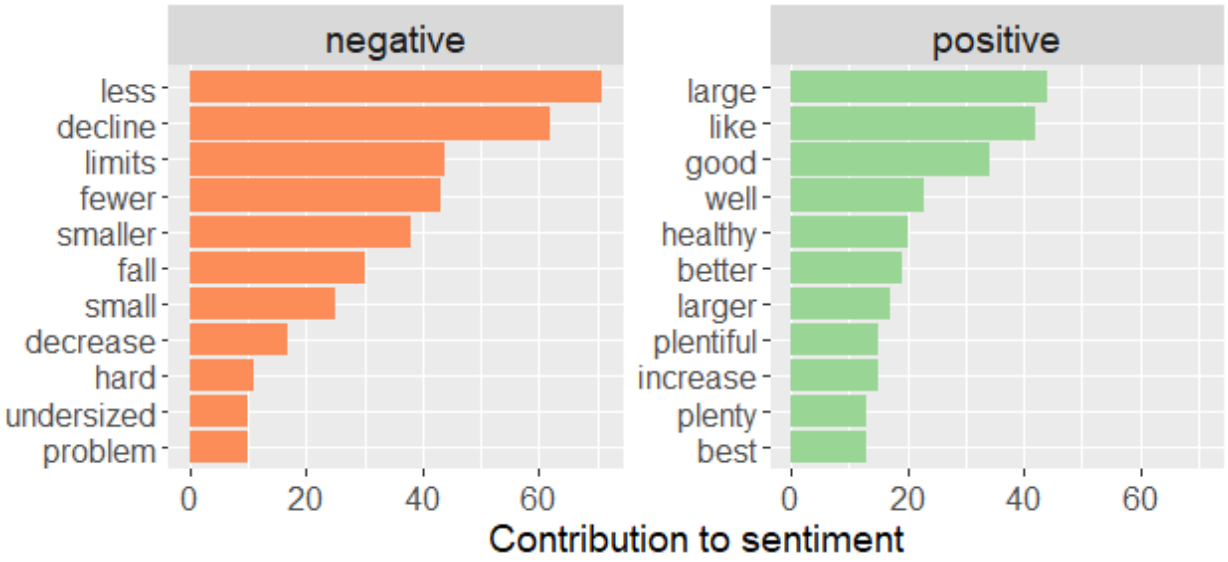

Figure 2: Most frequent words contributing to comment sentiment identified by automated sentiment analysis.

Word Clouds

- Submissions from Saltwater Conversations and minutes from Fishery Performance Reports could be used to generate a word cloud, which identifies which words and phrases are most common.

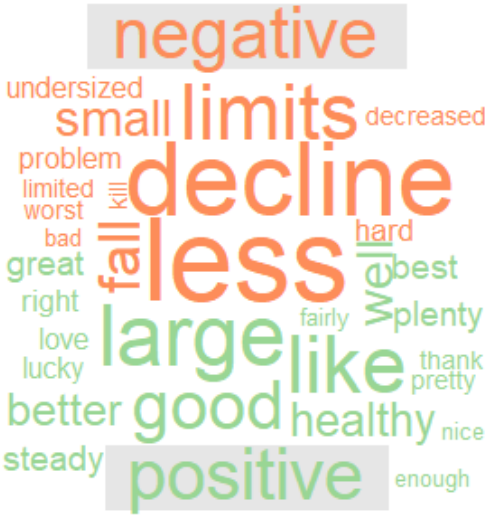

Figure 3: Most frequent words contributing to comment sentiment identified by automated sentiment analysis.