A description of system dynamics of scamp populations in the Gulf of Mexico and South Atlantic to support ecosystem considerations in the assessment and management process

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A description of system dynamics of scamp populations in the Gulf of Mexico and South Atlantic to support ecosystem considerations in the assessment and management process

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Introduction

The purpose of this working paper is to advance ecosystem-based fishery management considerations by understanding Gulf and Atlantic scamp populations in the context of the larger socio-ecological system in which they occur. The paper also addresses the SEDAR TOR #7: "Describe any known evidence regarding ecosystem, climate, species interactions, habitat considerations, and/or episodic events (including red tide and upwelling events) that would reasonably be expected to affect scamp population dynamics, and the effectiveness of biological reference points that might ensue." Previously, the SEFSC has captured broad input on this type of information through in-person workshops with both fishermen and fishery scientists, and has used this information to hone in on the major factors that need to be explored in the assessment process. Due to ongoing travel restrictions, we were limited to virtual or phone communications; this was an opportunity to test out new methods for obtaining information from a diverse group of informants without the expense and effort involved in traveling to workshops. We recognize that for the present pilot study, the input is somewhat limited and the results may not represent a comprehensive summary regarding the species. We provide a summary of how we tested new methods for incorporating information from a variety of perspectives, and previously underutilized information (e.g., the "Something's Fishy" survey), into the stock assessment and management process. If found to be informative, the process could be expanded upon for future research track assessments.

Methods

We attempted to collect information on factors that influence the scamp fishery and scamp population through an online survey. The survey was pre-tested with four SEDAR panelists and then sent to four industry members. We found it was somewhat challenging to get the info we were looking for through a survey format; there was also a strong preference by industry participants to give input verbally rather than in a survey format. Ultimately we ended up speaking with most of the industry members over the phone, either to help guide them through the survey or to document their input. The information we had available to us to build conceptual models thus included the eight survey respondents (with either online or phone responses), plus the Something's Fishy survey from the Gulf Council and the Fishery Performance Report from the South Atlantic Council.

Models were constructed separately for the Gulf and the Atlantic, as most information sources were unique to either region. To construct the models, we went through the various sources of information and systematically pulled out linkages that were articulated within. Nodes represent elements of the ecosystem or the scamp population, and directionality is assigned based on the specific observations or perceptions. The population dynamics for scamp were kept as simple as possible and only broken out only to the specificity warranted by the linkages. For example, an observation saying "Scamp do not handle barotrauma well. If they are not vented they do not swim down" would be represented by two connected nodes: "use of venting or descending devices" → "discard mortality rate" and the directionality assigned would be negative because an *increase* in venting practices would yield a *decrease* in discard mortality rates. All possible linkages were included, regardless of how many mentions they received; the conceptual model thus represents the cumulative knowledge and perceptions of all sources. Once all information was captured and the conceptual model was built, we did a second review of the information sources to ensure that all comments and linkages had been captured as accurately as possible and that no observations were left out.

In interpreting the conceptual models below, it is important to note that they represent the cumulative perspectives of many individuals and can be representative of localized processes; i.e., not all of the relationships and drivers apply to the population as a whole. Additionally, we emphasize that most of the relationships should be treated as working hypotheses; not all of the linkages are known truths. The very purpose of summarizing the information in a conceptual model is to identify drivers and linkages that are most likely to have high influence on the system, in order to prioritize further research and/or inclusion of these factors in the assessment model and/or for consideration in management.

Results

Gulf conceptual model

The Gulf model was composed of a variety of factors including physical, biological, socio-cultural, economic, and regulatory drivers (Figure 1). With regard to the physical environment, many of the drivers are likely to act at localized scales; for example, impacts from hypoxia and freshwater inputs would be limited to areas where those phenomena occur. Other factors, such as ocean temperatures and current regimes, may impact the stock at more a population level by impacting overall abundance and recruitment, respectively. From the perspective of biological drivers, the most influential factors were perceived to be episodic mortality events (including red tide, but possible other events such as oil spills), predation, and habitat availability. All of these were thought to impact multiple life stages and thus had potentially high influence on the overall stock dynamics.

The conceptual model had separate commercial and recreational fleet components, as the factors influencing these fleets were variable (with some overlap). Factors thought to be influencing recreational effort included restrictions or lack of availability of other species, and distance from shore to access the scamp biomass. There were some perceptions that localized depletion from the commercial fleet impacted catchability of the recreational fleet. Catchability of scamp in both the recreational and commercial fleet was perceived to be driven by the area of fish distribution, as well as individual knowledge on how to catch scamp. Additionally, commercial catchability was perceived to be impacted by the depth at which fishing occurs, the use of specific bait, and abundance of dolphins (due to depredation). Commercial effort was thought to be influenced heavily by abundance of and regulation on other grouper species; this is because scamp is not seen as a primary target and is caught either in association with other species, or more frequently when other groupers are not found. It was also thought that reduction in owner-operator fleet numbers and increase in corporate fishery structure led to a decrease in diversification in the commercial fisheries and a reduction in effort on scamp.

Many of the regulations that were perceived to influence the scamp population were actually regulations on other species and not regulations on scamp itself. For example, closures of gag or restrictions on other grouper species were perceived to reduce effort on scamp because they would normally be caught with other grouper species and regulations had the impact of reducing grouper trips overall. Scamp-specific regulations included the size limit, which impacts discard mortality, and seasonal spawning closures which were perceived to be useful for protecting scamp spawning biomass. The establishment of IFQs was perceived to be influential in restructuring the commercial fishery from a largely owner-operator fleet to a more corporate structure, with multiple downstream consequences (e.g., loss of historical knowledge of the scamp fishery which reduces catchability, and decreasing diversification of the commercial fleet resulting in reduced effort on scamp).

South Atlantic conceptual model

Like the Gulf model, the South Atlantic model included regulatory, socioeconomic, biological and physical drivers in a complex web of interactions that ultimately determine the population abundance of scamp (Figure 2). With regard to the socioeconomic factors, the conceptual model divides fishing effort into commercial, for-hire and private recreational effort. Commercial effort is perceived to be in decline as commercial fishermen in the South Atlantic in general do not target scamp. Factors perceived to be affecting commercial effort include profitability, grouper regulations and fishable days. The model indicates that the number of fishable days for scamp has declined over time due to the seasonal grouper closure as well as physical factors such as changing weather patterns. The price for scamp is high, and it was thought that the fishery would be profitable if scamp could be caught in sufficient numbers. However, the risks of low catch from targeting scamp are high as a result of catchability challenges. Scamp is regarded as a clever, crafty fish that is notoriously difficult to catch, requiring the use of different rigs and techniques than those used for other grouper species. Factors such as the “graying of the fleet” involving the loss of fishermen with the expertise to catch scamp, shifting weather, and the increasing abundance of red snapper are perceived to have impacted the catchability of scamp. Overall, a general decline in working waterfronts may also be affecting fleet size and diversity and overall effort targeting scamp.

For-hire and private recreational fishing effort on scamp is perceived to be impacted by the following factors: the distance from shore to reach scamp, recent advances in gear, electronics and boat size and design, fuel prices, catchability, and diving and spearfishing. Like commercial fishing, for-hire and private fishermen apparently do not target scamp due to factors that increase the costs and effort of targeting scamp in comparison to other species including distance from shore, depth and catchability. However, there is some perception that private recreational fishing effort on scamp may be increasing due to a number of factors. These include: the increase in overall numbers of private recreational anglers, low fuel prices which decrease the costs of fishing farther from shore, the use of improved vessels that have a higher range and the increased use of gear and electronics that make amateur fishermen more efficient in targeting all species including scamp. Fishermen highlighted the increase in diving and spearfishing in particular as a significant factor that could be affecting scamp populations directly and indirectly. Diving/spearfishing is not highly regulated and there is a concern that divers are selectively targeting larger scamps, decreasing the abundance of large breeders.

As in the Gulf, there is a perception that regulatory actions related to other species of grouper, sharks and red snapper may be driving fishing behaviors that indirectly impact scamp populations. Scamp specific regulations, primarily those related to the use of descender devices, are perceived to impact scamp discard mortality. Overall, however, the general perception in the South Atlantic appears to be that the combination of regulatory and socioeconomic drivers has led to a decrease in fishing effort on the scamp population in recent years. Although changing physical and biological factors may therefore currently be driving stock dynamics, these factors are influenced by socioeconomic drivers at multiple scales such as climate change, water pollution/discharge and dredging activities.

One of the primary physical factors perceived to be affecting overall scamp abundance includes shifting weather patterns attributed to climate change. Climate change is perceived to have increased the intensity of storms, including hurricanes, and affected water temperatures and water clarity and turbulence. These factors are viewed as having affected the number of available fishing days for scamp as well as its catchability, and to possibly be changing the migratory range of the scamp population further north, into the mid-Atlantic region. Other physical factors include changes in water quality influenced by human activities such as discharges from Lake Okeechobee, which are perceived to have increased harmful algal bloom events (HABs), and dredging, which may affect populations and alter habitat at more localized levels. These physical factors interact with biological factors that influence overall stock dynamics. The primary biological drivers highlighted in the model are recruitment, predation and habitat change. Water quality issues, alteration of available habitat, and the abundance of big breeders selectively targeted by divers impact recruitment. With regards to life stages, the focus tended to be on the abundance at the larval and juvenile stages, with fishermen reporting currently seeing relatively few smaller scamp in comparison to the past. Larval and juvenile stage abundance is affected by low recruitment and was theorized to also be affected by predation by growing populations of lionfish and red snapper.

Similarities between Gulf and Atlantic conceptual models

- Both models suggest that scamp play a less significant role in the overall grouper fisheries and are often caught in association with other groupers. The models highlight how effort on scamp is largely influenced by regulations on other grouper species.
- Distance from shore was seen as an important factor influencing the accessibility of the recreational fleet and subsequently effort on scamp.
- Both models highlighted the influence of venting and the use of descending devices in reducing discard mortality.
- There were many sentiments that scamp are difficult to catch; both models highlighted the importance of local angler knowledge or experience in catchability and the importance of specific gear or bait when targeting the species. In both models, the retirement of older fishermen with expertise in catching scamp was identified as a factor in reducing the number of vessels that target scamp.
- Both models had a water quality component, although the nature of the specific localized factors impacting water quality differed between the regions. HABs and red tides were identified in both models as factors that could be affecting scamp recruitment.

Differences between Gulf and Atlantic conceptual models

- In the Gulf, scamp population abundance was thought to be mostly influenced by fishing (although red tide, prey populations, and ocean temperatures were hypothesized to have some effect). In the Atlantic, however, there was widespread concern that factors other than fishing were contributing significantly to stock abundance.
- In the Atlantic there were concerns about absence of large spawners in the population as well as lack of recruitment to fill in the population. A number of potential causes were linked to abundance of spawners and juveniles (e.g., spearfishing pressure, red snapper predation). These were not mentioned in the Gulf model.
- In the Atlantic model changes in the weather attributed to climate change, including an increase in severe events and changes in water temperature, were perceived to be impacting scamp habitat and the migratory range of the scamp population, possibly impacting local population abundance.
- In the Atlantic, the concern tended to focus on impacts in recruitment and the larval and juvenile stages of scamp, whereas the Gulf model focused on impacts across multiple life stages.
- In the Gulf, the establishment of IFQs was seen to impact the structure of the commercial fleet that had subsequent impacts on catchability and effort via loss of knowledge and

reduced diversification of fleet with respect to target species. Because the Atlantic has no IFQ system, these factors were not present in the model.

Discussion

Through this pilot exercise, we learned that it is relatively easy and efficient to summarize a large body of observations from diverse sources (written reports, surveys, oral interviews) in a standardized and concise format. We were able to make use of information sources that are currently underutilized in the assessment and management process (e.g., Something's Fishy survey, Fishery Performance Report). Although the present effort was somewhat limited in terms of the number of perspectives included, the approach could be easily expanded upon for future assessments. In-person workshops, while advantageous in terms of information content gained and level of trust and rapport that are built, are somewhat costly in terms of travel expenses and staff time. A survey platform is advantageous in that a wide number of people can be reached with little preparation time and effort; however we found it difficult to gain the information we were trying to get through this mechanism. Having semi-structured conversations with folks over the phone one-on-one was a good way to capture the information, and might be a way to efficiently capture knowledge from groups of individuals representative activity across the entire management region in the future.

Due to the pandemic situation, which caused some fluidity and uncertainty in timelines and travel capabilities, planning for this exercise was delayed. Ideally such a process could be carried out earlier within the SEDAR timeline, as some of the findings are relevant to the data exploration phase. The conceptual models can be used to hone in on key external drivers (e.g, temperature, red tide) that could be considered in the data exploration process. Other information coming out of the conceptual models could be useful in the assessment review phase and for consideration by the SSCs and Councils. For example, understanding of how regulations on other groupers impact effort on scamp, or potential effort shifts that might occur with restrictions on scamp, could be important to consider from a management perspective. All in all, based on the present pilot study, the conceptual modeling framework has the potential to capture diverse information sources in a concise and digestible manner that could be used to inform the stock assessment data preparation, model building, review, and management uptake processes.

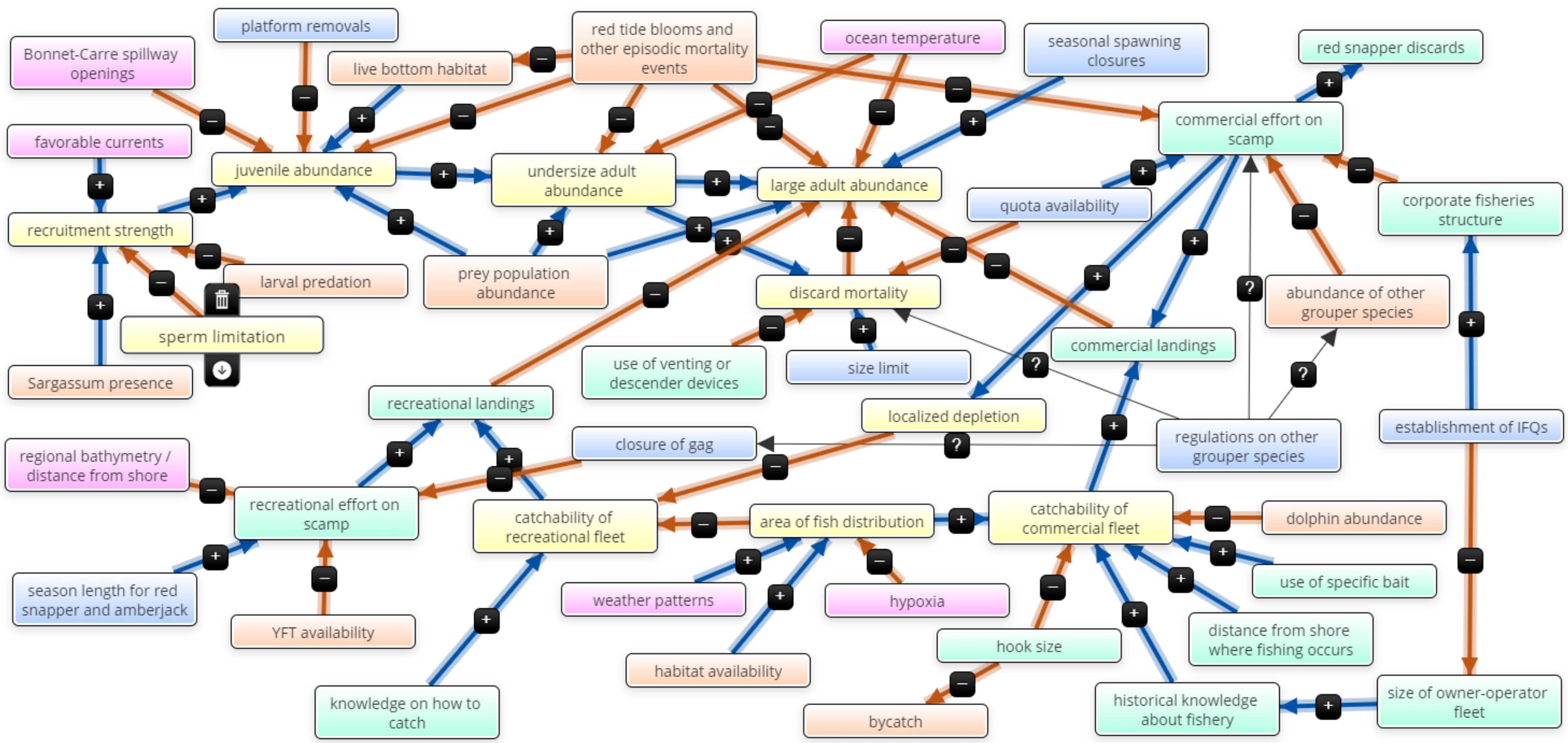

Figure 1. Scamp-centric system conceptual model for the Gulf of Mexico. Model components are color-coded as follows: pink - physical factors; orange - biological factors; yellow - scamp population dynamics; green - socioeconomic factors; blue - regulatory factors.

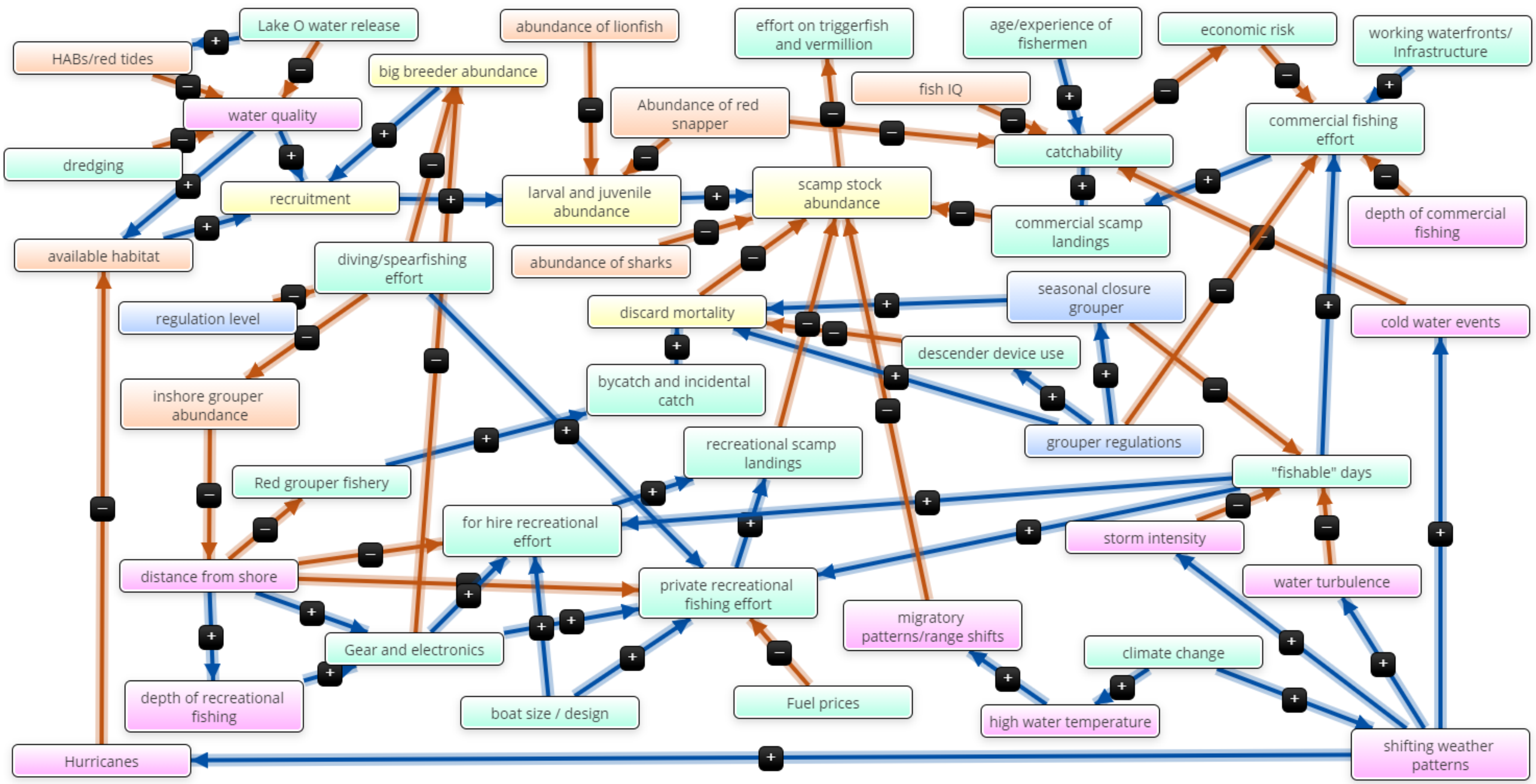

Figure 2. Scamp-centric system conceptual model for the South Atlantic. Model components are color-coded as follows: pink - physical factors; orange - biological factors; yellow - scamp population dynamics; green - socioeconomic factors; blue - regulatory factors.