NOAA FISHERIES

Office of Protected Resources

Oceanic Whitetip Shark Recovery Planning Workshop

Workshop Summary · Nov 13–14, 2019

Miami, Florida

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List of Acronyms and Abbreviations

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS – Convention on Migratory Species of Wild Animals
EM – electronic monitoring
ESA – Endangered Species Act
F – fishing mortality
ICCAT – International Commission for the Conservation of Atlantic Tunas
IUCN – International Union for the Conservation of Nature
MSY – Maximum Sustainable Yield
NGO – Non-Governmental Organization
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
OPR – Office of Protected Resources
PIRO – Pacific Islands Regional Office
RFMO – Regional Fishery Management Organization
SERO – Southeast Regional Office
SEFSC – Southeast Fisheries Science Center
SPAW Protocol – Protocol Concerning Specially Protected Areas and Wildlife
SPOT – smart position and temperature (tag)
US – United States
WECAFC – Western and Central Atlantic Fisheries Commission

Recovery Planning Workshop Summary

Purpose and Overview

The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS or NOAA Fisheries) Office of Protected Resources held a workshop to gather information and perspectives on how to recover the oceanic whitetip shark (*Carcharhinus longimanus*) to the point where protections under the Endangered Species Act (ESA) are no longer needed. The workshop was held November 13–14, 2019, at Florida International University Biscayne Bay Campus, Miami, Florida.

This invitational workshop was designed to bring participants together in order to obtain informed and creative input into the recovery components (see below) of the oceanic whitetip shark. NMFS will use this information to make decisions about potential recovery actions and criteria for this species. Although this Workshop Summary is inclusive of the conversation at the workshop, the Oceanic Whitetip Shark Recovery Plan may not reflect all of the ideas raised during the workshop. NMFS will seek peer review and public comment on the Draft Recovery Plan.

The workshop was not a consensus-seeking meeting; rather, participants were asked to provide their professional or personal opinion as it related to threats to or recovery of the oceanic whitetip shark. Therefore, it should be emphasized that the recommendations listed below in this report are not the consensus opinion of NOAA or the group of participants as a whole. Many recommendations represent the opinion of just one or a few stakeholders. Experts from a range of relevant disciplines were invited to participate in the workshop. We made efforts to include expertise in the following topic areas: biology, life history, stock assessment science, commercial fisheries, federal and state fisheries management, and recovery planning (see Table 1). The workshop was open to the public and public comment was invited at the end of each day.

The workshop focused on the following objectives:

- Provide input on potential recovery criteria to delist the species
- Discuss and develop potential recovery actions to reduce and/or ameliorate threats to oceanic whitetip sharks

For oceanic whitetip shark recovery planning efforts, NMFS is using a new approach[1] to the recovery planning process, developed by the U.S. Fish and Wildlife Service. This process is different from the traditional approach in that it breaks recovery planning into three independent parts (described below). Information and feedback from this workshop will help inform the recovery components for the oceanic whitetip shark. The recovery components for the oceanic whitetip shark will consist of the following:

- Recovery Status Review. This stand-alone document will summarize the species' current and future status and assess threats. Traditionally this information was included in the background of a recovery plan but often became outdated quickly. The process of revising a recovery plan makes it difficult to keep this information up-to-date and useful for resource managers. By keeping the background separate from the recovery plan (now the recovery strategy, criteria,

[1] While this new recovery planning approach is mandatory for the U.S. Fish and Wildlife Service, it is optional for NMFS. Currently, NMFS has approximately 6 recovery planning efforts underway using this new approach.

actions, and time and cost estimates) and up-to-date, information can be kept more relevant and used to inform a variety of recovery activities including ESA section 7 analyses, ESA 5-year reviews of the status of the species, and conservation plans developed under section 10 of the ESA. The 2017 Oceanic Whitetip Shark Status Review Report (Young et al. 2017) will serve as the basis for the Recovery Status Review.

- Recovery Plan. This second stand-alone document will provide a roadmap for the recovery of the oceanic whitetip shark, and will include an introduction, as well as the three statutory requirements for a recovery plan: 1) objective, measurable recovery criteria; 2) site-specific management actions; and 3) estimates of time and costs to recover the species.

- Recovery Implementation Strategy. We will also include a third stand-alone document, which step-down the recovery actions to activities that support the recovery action. The Recovery Implementation Strategy will be used for tracking progress and planning purposes.

This workshop summary is presented in six main sections: Purpose and Overview, Schedule, Participants, Recovery Criteria Discussion, Recovery Actions Discussion, and Next Steps.

A copy of the agenda and all other meeting-related materials are available on NMFS' oceanic whitetip shark website at https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark.

Schedule

The two-day workshop was broken into three parts based on different threat-related themes:

- Wednesday November 13, 2019: Presentations were given from experts on a variety of topics and initial discussions were held on ideas for recovery criteria for the oceanic whitetip shark.
- Thursday November 14, 2019: Discussions focused on recovery actions related to commercial fisheries interactions, research, international coordination, as well as outreach and education.

Participants

The meeting was attended by a total of 27 workshop participants representing a variety of expertise (Table 1).

Table 1: List of invited workshop participants (in alphabetical order). Key: NGO = Non-Governmental Organization; OPR = NMFS Office of Protected Resources; PIRO = NMFS Pacific Islands Regional Office; SEFSC = NMFS Southeast Fisheries Science Center; SERO = NMFS Southeast Regional Office.

PARTICPANT NAME	STAKEHOLDER TYPE	AFFILIATION / EXPERTISE
Jamie Aquino	NGO	Haiti Ocean Project
Trevor Bacon	NGO	Moore Charitable Foundation
Larry Beerkircher	Federal Agency/Scientist	SEFSC, Miami Laboratory
Mark Bond	Researcher	Florida International University
Edward "Edd" J. Brooks	Researcher	Cape Eleuthera Institute
John Carlson	Federal Agency/ Scientist	SEFSC, Panama City Laboratory
Demian Chapman	Researcher	Florida International University
Patricia Charvet	Researcher	Federal University of Paraná (UFPR), Brazil
Therese Conant	Federal Agency	OPR, National Recovery Coordinator
Enric Cortés	Federal Agency/ Scientist	SEFSC, Panama City Laboratory
Gina Clementi	PhD Candidate	Florida International University
Sonja Fordham	NGO	Shark Advocates International
James Gelsleichter	Researcher	University of North Florida
William "Bill" Gibbons-Fly	Industry	American Tunaboat Association, Executive Director
Krista Graham	Federal Agency	PIRO, Endangered Species Biologist
Robert "Bob" Hueter	Researcher	Mote Marine Laboratory
Calusa Horn	Federal Agency	SERO; Natural Resource Management Specialist
Lucy Howey	Researcher	Microwave Telemetry, Inc.
Cliff Hutt	Federal Agency	NMFS Sustainable Fisheries, Highly Migratory Species Division
Yannis Papastamatiou	Researcher	Florida International University
Rachel Skubel	PhD Candidate	University of Miami
Scott Taylor	Industry	Day Boat Seafood, Inc.; commercial fisherman
Mariana Tolotti	International	French National Research Institute for Development
Jeremy Vaudo	Researcher	Guy Harvey Research Institute, Nova Southeastern University
Luke Warwick	NGO	Wildlife Conservation Society, Sharks and Rays Program
Mary Wunderlich	Federal Agency	SERO; Endangered Species Biologist
Chelsey Young	Federal Agency	OPR; Oceanic Whitetip Shark Recovery Coordinator

Numerous workshop participants provided presentations related to the species or threats to the species. Day one concluded with an initial discussion regarding recovery criteria for the oceanic whitetip shark. Chelsey Young provided a summary of the day to set the framework for continued discussions for day two.

Other NMFS staff and members of the public were present for one or more days throughout the workshop. Opportunities for public comment were provided at the end of each day, but we did not receive any comments during the workshop. Krista Graham served as the facilitator each day.

Recovery Criteria Discussion

The ESA requires recovery plans to include objective, measurable criteria, which, when met, would result in a determination that the species be removed from the list (i.e., delisted). Developing objective, measurable criteria for a recovery plan focuses on two areas:

- **Biology-based criteria**
  These criteria will measure the performance of the species over a meaningful period of time. These criteria can be tied to metrics relating to abundance, growth rate, and demographics (e.g., age and sex ratios, distribution of individuals among different subpopulations).

- **Threats-based criteria**
  These criteria will focus on the reduction of threats that may have caused the species' decline or that limit recovery. The five ESA section 4(a)(1) factors that were considered during listing must be considered during delisting (i.e., habitat destruction or modification; overutilization; disease or predation; inadequacy of existing regulations; and other natural or manmade factors affecting its continued existence).

During the workshop, participants were provided an overview of recovery criteria and examples from recovery plans from the loggerhead sea turtle and smalltooth sawfish, as well as previous ideas discussed at the first recovery planning workshop in Honolulu, Hawaii, April 23–24, 2019. Participants were then asked to discuss potential recovery criteria for the oceanic whitetip shark. Initial discussions noted that a lack of information made it difficult to identify recovery criteria, particularly that stock assessments for the Atlantic population are not available to help fill in data gaps necessary to better inform potential recovery criteria. Participants also discussed consideration of different types of data that would be necessary to identify quantitative targets for recovery.

Potential Biology-based Criteria to Delist

- Following methods outlined in Appendix I below, F (fishing mortality) must be at a risk level equivalent to or less than a medium risk ranking (level below F at Maximum Sustainable Yield (MSY)) with at least 70% probability in each recovery unit:
  - Atlantic
  - Pacific
  - Indian

- Ensure sufficient habitats are protected for the population to successfully conduct life history functions (e.g., breeding, pupping) throughout the region
  - Cuba
  - Haiti, Dominican Republic
  - Rio Grande seamounts south of Brazil near Argentina

Potential Threats-based Criteria to Delist

- Overall mortality (at-vessel and post-release) is reduced to less than 50% or a level indicated in stock assessment projections that caused the population to increase (lower than what is estimated by Clarke 2019 based on last four available years' published data from the Western and Central Pacific Fisheries Commission Secretariat and presented at the Honolulu workshop in April 2019)
- Prevalence of oceanic whitetip fins in significant trade markets is reduced to less than 0.01%

- Transshipment of illegal oceanic whitetip shark fins through the U.S. is permanently eliminated
- Foreign nations with significant oceanic whitetip shark bycatch have implemented national legislation and have acceded to international and multi-lateral agreements to ensure long-term protection of oceanic whitetip sharks
- RFMOs agree to maintain science-based measures that ensure the conservation of the species
- A post de-listing monitoring plan is in place prior to de-listing
- Compliance with existing retention prohibitions increases
- A Significant Trade Review under the Convention on the International Trade of Endangered Species (CITES) shows that the international trade of oceanic whitetip shark is sustainable
- No new significant threats are identified to the species [e.g., disease, contaminants]

Summary of Potential Recovery Criteria

Key feedback on the recovery criteria discussion included the fact that baseline data for the species in the Atlantic are unavailable in terms of historical abundance, mean size, and other estimates for the species. Therefore, it will be difficult to come up with target values for recovery criteria. However, it was noted that because ecological risk assessments have been conducted for the species in every region, they could provide some values to feed into a fishing mortality (F)-based metric that could serve as a biological-based criterion (see Appendix I below). It was also suggested that there should be a recovery unit for each ocean basin—Atlantic, Pacific, and Indian Oceans—given that abundance declines and threats vary across the species' range. In terms of threat-based criteria, emphasis was placed on observed decreases in oceanic whitetip shark retention, and increases in oceanic whitetip survival post-capture and release. A threat-based criterion showing a decrease in the level of oceanic whitetip shark fins in international markets was also suggested. These recommendations were very similar to the ones proposed at the Pacific workshop in Honolulu. Finally, this is not meant to be the final list of recovery criteria but instead is a solid start to developing recovery criteria for the oceanic whitetip shark.

Recovery Actions Discussion

The ESA mandates that recovery plans be developed and implemented for the conservation and survival of ESA-listed species. Recovery plans are not solely to guide recovery actions of NMFS; rather, they are meant to guide recovery actions of all stakeholders who may be involved or interested in conserving and recovering a species. Recovery plans are guidance documents, not regulatory documents. Recovery plans also typically identify critical research gaps that need to be filled in order to inform management actions.

Recovery actions typically fall within three categories: research, management, and monitoring, which may include enforcement, outreach and education, and international coordination efforts. Each recovery action should explicitly relate to the causes of imperilment; contribute to achieving recovery; include short and long-term actions; be site-specific; and be concise and action-oriented. Participants were asked to read the workshop summary report from the Honolulu workshop to help guide discussions and build upon previous ideas. Examples of various types of recovery actions from the loggerhead sea turtle and smalltooth sawfish recovery plans were also used.

Following an overview of recovery actions, workshop participants were divided into three breakout groups and asked to develop ideas on management, research, international coordination, and outreach and education, as they pertain to the main threats to the oceanic whitetip shark (i.e., commercial fisheries interactions and inadequate regulations). Each group was asked to record all ideas. Once completed, a nominated member of each breakout group reported their ideas out to the rest of the

room.

The following section provides the suite of potential recovery action ideas, in no particular order (i.e., they were not prioritized in any way), from participants. As mentioned previously, these actions do not represent consensus views of NOAA or the entire group of workshop participants. In some cases, they may represent a single individual's view or opinion. Recovery actions were also not weighed by the group in terms of their potential effectiveness, implementation, compliance, costs, etc. Actions are grouped according to the major topic themes (i.e., fisheries interactions, research, international coordination, and outreach and education,) and then sub-grouped under specific topics. A total of 81 potential recovery actions to conserve and recover the oceanic whitetip shark were identified and are listed below. It should be noted that some potential recovery actions have similar components and may overlap with other categories since they were discussed during different days of the workshop.

FISHERIES INTERACTIONS

Research

1. Conduct research on post-release mortality of oceanic whitetip sharks and how that relates to safe handling techniques and best management practices

2. Conduct additional research to better understand spatial overlap of oceanic whitetip sharks with respect to all commercial fisheries in the region (not just U.S. fleet) and acquire more detail (e.g., bait type, gear used, target species vs. where the bycatch is occurring) to identify problem areas, problem fisheries
    a. Use data to help inform where we can put restrictions on trade/market access to restrict access to U.S. market and explore that from a U.S. and European Union perspective
    b. Use shrimp fishery (implementation of turtle excluder devices and requirement for other fisheries to use turtle excluder devices in order to participate in U.S. market) as example to follow

3. Determine optimal soak times in longline fisheries to maximize survivorship of oceanic whitetip sharks when caught, though it was noted this would be difficult to enforce

4. Determine size of artisanal fishery fleets impacting oceanic whitetip sharks, particularly in areas within the critical range of the species

5. Conduct additional research comparing impacts of circle vs. J hooks (e.g., do circle hooks help with post-release survival?)

6. Assess effects of different longline set configurations on oceanic whitetip shark bycatch vs. bycatch for other protected species (weigh pros and cons)

7. Conduct additional research on gear modifications and fishing techniques to increase survivorship of oceanic whitetip sharks when caught in commercial fisheries

8. Conduct research on potential use of deterrents (e.g., chemical deterrents or use of different metals for hooks) to reduce interactions

9. Research methods to reduce bycatch of net fisheries in and around fish aggregating devices

10. Assess the effects of hook set depth and how that influences bycatch of oceanic whitetip sharks

11. Research gear modification effects in artisanal fisheries to reduce capture and how that affects non-target species

12. Quantify amount of oceanic whitetip shark retention in areas that retain the species in fisheries

Measures to Reduce Fisheries Mortality

13. Prohibit oceanic whitetip shark retention in all U.S. Atlantic fisheries

14. Assist island nations whose artisanal fleets capture and consume juvenile oceanic whitetip sharks to develop alternative livelihoods (e.g., Haiti, Trinidad, and Tobago)
    a. Was noted that the fishery would not exist if it wasn't for trade with the United States (of what's likely associated with other non-shark species); should be able to influence these governments at enforcement level and with outreach
    b. Some consideration that cumulative total of artisanal fisheries throughout Caribbean would be a fraction of the impact of the industrial foreign fleets that are catching tens of thousands of metric tonnes of sharks per year
    c. Also need to consider life history of species caught—if artisanal fleets are having heavy impact on juvenile population, it can have a huge impact on larger population

15. Implement tools and best practices for safe handling and gear removal (e.g., removing trailing gear) and other methods for reducing stress and injury to mitigate mortality and improve survivorship when oceanic whitetip sharks are caught and released

Monitoring and Reporting

16. Evaluate effectiveness of electronic monitoring (EM) in U.S. fleets

17. Improve observer coverage in domestic and international fisheries [see International Coordination section below]
    a. Improve understanding of, and increase international observer coverage for, vessels outside U.S waters
    b. Increase use of EM in lieu of observers physically present on vessels

RESEARCH

Population Assessment

18. Conduct stock assessment for the Atlantic to get a solid baseline of the population
    a. 4 categories of information are needed: catch, catch-per-unit-effort, biological information, and length composition
    b. Where catch and abundance indices are unreliable or lacking, there are other data-limited approaches that can be used

19. Collect data on the species from the eastern Atlantic off the coast of Africa

20. Use other tools such as pelagic baited remote underwater video systems (BRUVS) to determine relative abundance of oceanic whitetip sharks

21. Review and evaluate historical records as a potential tool to determine relative abundance, specifically looking at colonial records (e.g., in the Caribbean)

Biology, genetics, life history

22. Improve estimates of reproductive periodicity (assumed they are biennual but some evidence that individuals are capable of annual reproduction) via multi-year tracking with acoustic tags
    a. It was noted that there is a lot of tracking data in certain locations, but there should be a movement component with that to determine periodicity of animals returning to certain sites (e.g., denotes females returning annually or biannually, etc.). Have to track same individuals for multiple years, which is why using acoustic tags with 10-year life would be ideal.
    b. Use of acoustic tags may be okay for return rates in a specific place, but these animals are wide-ranging where there aren't receivers; recommend smart position and temperature (SPOT) tags. Oceanic whitetip sharks appear not to be affected by its application and you may be able to put larger SPOT tags on bigger individuals; however, SPOT tags don't report very well in the Caribbean and individuals go quiet for months at a time.

23. Conduct age and growth studies for the North Atlantic where data are lacking in that part of their distribution

24. Improve estimates of post-release and natural mortality in the Atlantic (natural mortality estimates will be extremely important for population estimates)

25. Assess whether the species has undergone a potential range contraction given the global population reduction of the species

26. Identify potential regional stocks via genetic studies

27. Find additional locations to tag oceanic whitetip sharks to further understand movement patterns. Need to expand these studies to places that have not already been heavily studied to date (e.g., Cat Island, Cayman Islands)

28. Expand genetic studies to determine species and/or location of source/harvest, especially for international trade

29. Determine demography of individuals staying in nursery areas

Habitat

30. Collect better information on habitat use (e.g., vertical movements, behavior), etc.

31. Conduct habitat-predictive modelling to identify areas of important habitat for key life history functions (e.g., pupping grounds) in the Atlantic, both spatially and temporally, and to determine what kind of habitat they prefer at different age classes (e.g., seamounts for adults)

32. Determine high areas of occurrence (i.e., hot spots) and high habitat use areas throughout the region

33. Develop maps of important habitat areas (sonar could be used for this)

Socio-Economic

34. Conduct social science surveys to better understand perception of the oceanic whitetip shark, and thoughts on alternate livelihoods

35. Determine the scope and scale of captures and consumption of small juvenile oceanic whitetip sharks in Haiti, and how to expand that to other Caribbean nations; need to assess what's driving smaller markets economically

36. Determine the composition (percentage) of oceanic whitetip shark in the meat market

37. Determine prevalence of oceanic whitetip products within the U.S. supply chain (transshipment)

38. Increase market surveys of landings to quantify domestic capture, local consumption, and local trade of oceanic whitetip sharks

Other

39. Assess effects of ocean warming as a result of climate change on whitetip shark habitat use and distribution

40. Conduct mix-stock analysis for Hong Kong fin trade to determine which ocean basin most oceanic whitetip fins are coming from (Atlantic vs. Pacific)

INTERNATIONAL COORDINATION

Regional Fishery Management Organizations (RFMOs) Engagement

41. Increase coordination through RFMOs
    a. Enhance reporting and monitoring, especially with regards to increasing EM and observer coverage
    b. Strengthen compliance mechanisms and have consequences for non-compliance (including non-reporting)
    c. Add measures affecting/restricting access to U.S. markets

d. Greater reporting of discards, both dead and alive by the International Commission for the Conservation of Atlantic Tunas (ICCAT)

42. Increase coordination with the Western and Central Atlantic Fisheries Commission (WECAFC) as an RFMO that can be used in turn for increased coordination with ICCAT for non-ICCAT members and dealing with artisanal fishing issues throughout the wider Caribbean

43. Continue participation and coordination in WECAFC working group on sharks and rays

44. Support adoption of Port State Measures by more nations to battle illegal, unreported, and unregulated fishing that could be significantly impacting shark fisheries

45. Increase coordination and engagement with RFMO that manages West Africa fisheries as this is an area where we need more data on the species

46. Advocate through RFMOs that long-

53. Encourage data sharing among countries while still respecting issues of confidentiality

Other International Coordination Efforts

54. Increase engagement under the Specially Protected Areas and Wildlife (SPAW) Protocol to conserve the oceanic whitetip in the wider Caribbean
    a. Use ESA listing as a platform for using existing protected areas to protect the species, identify hotspots, and collaborate and develop partnerships and strategic planning among Parties
    b. Request what Parties are doing as an update on status and progress of current Annex III listing for the oceanic whitetip shark
    c. Propose uplisting the oceanic whitetip shark from Annex III to Annex II [however, it was noted that an uplisting of the oceanic whitetip shark could be problematic for the United States as an Annex II listing requires total prohibition of all forms of take and would exceed existing domestic regulations for the species in U.S. waters]

55. Have the United States support and encourage other countries to support a proposal by the Convention on Migratory Species of Wild Animals (CMS) to include oceanic whitetip shark under Appendix I at the next Conference of the Parties (COP14).

56. Support implementation of actions of the CMS Memorandum of Understanding for oceanic whitetip sharks

57. Encourage the International Union for the Conservation of Nature (IUCN) Sharks Specialist Group to make a species-specific press release on status of oceanic whitetip sharks. It was previously assessed in 2006 and has recently been reassessed and it could be the 3rd elasmobranch to have a global strategy developed, behind sawfish, guitar, and wedgefishes

58. Designate a single point person in U.S. government that can liaise across treaties and other agreements to guide the species' recovery so that there is consistent representation

59. Design multi-national information transfer methods (e.g., where migratory circuits are noted (e.g., Bahamas, Cuba, and Haiti) and concentrations of oceanic whitetip sharks are observed), and develop some multi-national agreements with these countries for oceanic whitetip sharks and incorporate more countries as needed (use a step-wise approach)

60. Encourage international agreements for protecting seamounts and other critical areas for the species

61. Promote CITES compliance by advocating for significant trade review of the oceanic whitetip shark. Based on results, potentially support uplisting of the oceanic whitetip shark from Appendix II to Appendix I if the trade review shows that trade is not sustainable

62. Advocate for an increase in compliance with CITES permitting and reporting

63. Explore potential for establishing bilateral agreements/MOUs with countries that have known illegal trade of oceanic whitetip sharks—Colombia, Seychelles, United Arab Emirates, Ecuador, Taiwan, Costa Rica, Mexico, and Cuba—to help them combat illegal trade

64. Develop a coordination mechanism of boarder control agencies (e.g., having multiple checkpoints along common trade routes of shark fins) to improve enforcement related to illegal fin trade (targeted enforcement in certain key transshipment locations).
    -Collaborate with RFMOs to agree to some small excise tax to help fund enforcement to try and stop illegal fin trade

65. Continue engagement by the United States in the international Illegal Wildlife Trade Conference where the United States has donated money to help track the illegal wildlife trade

OUTREACH AND EDUCATION

66. Increase education of and outreach to fishing communities
    a. Conduct fisher outreach to influence behavioral changes of fishers, especially small-scale fisheries; determine best methods to influence behavioral changes
    b. Develop networks of local artisanal fishers in the Caribbean to educate individuals on shark identification, best handling and release practices, and data collection
    c. Educate fishers in shark identification to improve data collection efforts, including recreational reporting of catches and releases
    d. Conduct workshops with fishers and scientists in certain hotspot regions throughout Atlantic and Caribbean to share information, provide data, identify new pupping areas, etc.
    e. Conduct fishermen and community outreach on the importance of sharks in general, and particularly oceanic whitetip sharks
    f. Educate crews of industry vessels regarding safe handling and release of protected species (e.g., in U.S., use similar placards for safe handling that are required for sea turtles or marine mammals) to do the same thing for oceanic whitetip sharks
    g. Increase awareness throughout recreational fisheries, while being respectful of socio-economic and political views
    h. Increase education efforts to promote best handling and release practices in all fisheries
    i. Translate best practices brochures into various languages and distribute throughout species' range

67. Assess the feasibility of diving ecotourism for oceanic whitetip sharks as an alternative livelihood (this is growing in popularity for oceanic whitetips in certain areas of Caribbean); assess as an avenue for outreach and education among divers, and whether dive operators could safely and responsibly conduct shark dives with oceanic white tips; quantify ecotourism dollars to see if this would be a viable option

68. Develop recreational reporting of interactions for oceanic whitetip sharks (similar to smalltooth sawfish)

69. Conduct consumer outreach on responsible seafood consumption in general

70. Use cultural perspectives and insights to develop country-specific and language-specific conservation campaigns for the species

71. Develop and expand community and citizen science programs to increase data collection on

oceanic whitetip sharks; develop strong community relationships to explain goals of data collection

72. Increase awareness of the status of the species to the public and link to a concrete goal (e.g., call to action, the fact that it's listed as threatened under the ESA and to ensure the regulatory strength of the ESA is maintained)

73. Educate lawmakers (U.S. Senate & House) and advocate for Senator Marco Rubio led bill Sustainable Shark Fisheries and Trade Act S. 1008

74. Continue implementing existing shark conservation laws (Shark Conservation Act 2010) and hold defaulters accountable

75. Increase training for recreational fishermen who fish for highly migratory species; collect reports and define who manages database

76. Pressure consumers to be aware of bycatch of oceanic whitetip sharks in tuna fisheries with a goal of increasing the number of Marine Stewardship Council certifications moving forward

77. Conduct regional workshops with pertinent high-level government officials (e.g., in Caribbean and Central and West Africa coasts) about potential ways to combat issues related to oceanic whitetip sharks

78. Increase social media campaigns on awareness; highlight specific expeditions or other on-going research projects

79. Use video and film tools such as OceanX films for effective storytelling and distribute to various audiences, particularly young people (e.g., make conservation "cool" to young people)

80. Encourage conservation messaging in film making (e.g., Discovery Channel's Shark Week)

81. Develop "brand" for oceanic whitetip sharks—similar to public awareness campaigns for other threatened and endangered species

Recovery Actions Summary

Key feedback during the brainstorming sessions regarding recovery actions is that an international component and focus will be absolutely critical to the successful recovery of the oceanic whitetip shark. Most (if not all) participants agreed that the major threat posed to the species (i.e., fisheries mortality) is largely an international problem that therefore needs an international solution. Many of the recommended actions focused on utilizing existing international mechanisms (RFMOs, CITES, SPAW Protocol, CMS, etc.) to enhance international coordination for the conservation of oceanic whitetip sharks.

Next Steps

This workshop summary will be posted on our oceanic whitetip shark web page at https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark. Additionally, the following actions will continue or commence:

- Update the 2017 Oceanic Whitetip Shark Status Review Report (Young et al. 2017) to serve as the Oceanic Whitetip Shark Recovery Status Review. As previously discussed, this information is typically included in the background section of a recovery plan, but we will separate the status of the species into its own living document and update it with any new information that has been published since the final listing rule was published in January 2018.

- Draft the Oceanic Whitetip Shark Recovery Plan. This document will be peer reviewed and will go out for public comment.

- Draft the Oceanic Whitetip Shark Recovery Implementation Strategy.

Appendix I

Brief description of method and rationale for using F-based reference points as recovery criterion for the oceanic whitetip shark

If a credible index of relative abundance is not available, F (fishing mortality rate)-based reference points can be used as an alternative recovery criterion. These reference points can be derived analytically using life history information as contemplated in the SAFE (Sustainability Assessment for Fishing Effects) approach (Zhou and Griffiths 2008, Zhou et al. 2009) and further demonstrated in Zhou et al. (2011, 2019). This approach assumes that reference points are a function of life history parameters, specifically that F-based reference points are related to the intrinsic rate of population increase (r_{max}) and M (natural mortality rate). Since M is used in the computation of r_{max}, the proposal here is to use only relationships between F and r_{max} to define three reference points: F_{msy}, F_{limit}, and F_{crash}, such that:

$F_{msy} = r_{max}/2$, where F_{msy} is the instantaneous fishing mortality rate that results in the maximum sustainable yield (MSY), which corresponds to a level of biomass of B_{msy},

$F_{lim} = 0.75\ r_{max}$, where F_{lim} is the instantaneous fishing mortality rate that corresponds to the limit biomass, where $B_{lim}=0.5B_{msy}$,

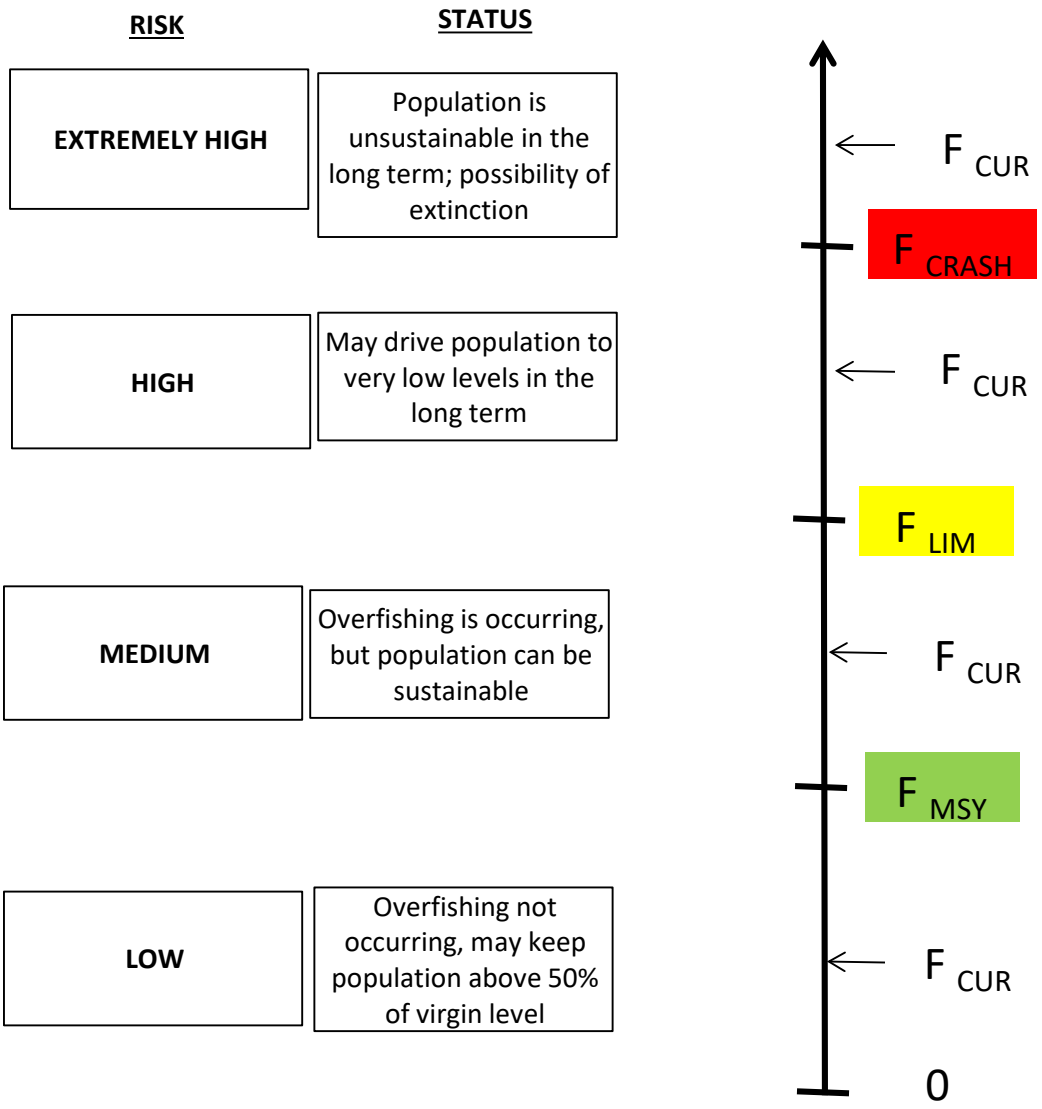
$F_{crash} = r_{max}$, where F_{crash} is the minimum unsustainable instantaneous fishing mortality rate that theoretically will lead to population extinction in the long term.

Note that these relationships assume that MSY is reached at half of the carrying capacity, or in other words, they are based on a Schaefer production model. While F-based reference points can also be derived based on species-specific productivity and considering the effect of gear selectivity (Cortés and Brooks 2018), we found that the position of the inflection point for oceanic whitetip shark is close to 0.5 (mean=0.55 for the Atlantic Ocean, mean=0.53 for the Pacific Ocean; Cortés 2019) and so the assumption of a Schaefer model seems valid.

Once the F-based reference points are derived, one needs an estimate of the current level of F to compare to them. In the absence of a formal stock assessment, $F_{current}$ can be obtained using area-based methods (as used in the SAFE approach, which is a quantitative Ecological Risk Assessment), catch-based methods (catch curves), length-based methods, or other independent estimates of F (e.g., from conventional or electronic tagging).

A level of risk can then be established based on where $F_{current}$ falls relative to the F reference points (Figure 1). For the stock to be considered recovered under the ESA one would want $F_{current}$ to be at least between F_{msy} and F_{lim} such that $F_{lim}>F_{current}>F_{msy}$, or in other words, to have a “medium risk” such that while overfishing may still be occurring, the population can be considered nevertheless to be sustainable. This approach can be made probabilistic to define, for example, a 70% probability of the population being in the medium risk zone by incorporating uncertainty into the calculation of r_{max} (Cortés 2019) and comparing the independently derived estimate of F ($F_{current}$) to the F-based reference point at each iteration. The population would then be deemed to have recovered if $F_{current}<F_{limit}$ at least 70% of the time.

Figure 1. Graphical representation of F-based reference points and risk levels modified from Table 1 in Zhou et al. (2011).



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Group Photo

Back row*:** Mark Bond, Luke Warwick, Edd Brooks, Yannis Papastamatiou, Larry Beerkircher, Demian Chapman, Enric Cortes, Bob Hueter, Mary Wunderlich, Cliff Hutt, Calusa Horn, John Carlson; ***Front Row: Ariadna Roja, Rachel Skubel, Lucey Howey, Trevor Bacon, Mariana Tolotti, Jamie Aquino, Jeremy Vaudo, Sonja Fordham, James Gelsleichter, Chelsey Young, Therese Conant, Patricia Charvet, Krista Graham.