Southern Shrimp Trawl Shark Depredation Workshops Report

Image credit: Mark Shirley, Thu Bui. Louisiana Sea Grant

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Executive Summary

The southeastern U.S. shrimp trawl fishery is central to the economic and cultural well-being of coastal residents across the region. This fishery overlaps significantly with the distribution of many coastal shark species, including large coastal sharks like blacktip shark (*Carcharhinus limbatus*) (Scott-Denton 2012). This spatial and temporal overlap facilitates depredation (*defined as partial or complete damage to fish and/or fishing gear by non-target species*) by placing sharks near fishing gear, which can result in loss of target catch, damage to trawl gear, and lost fishing opportunities (Fertl 1994, Fertl and Leatherwood 1997).

Commercial shrimpers have raised concerns about shark depredation on their gear for years, but there have been few efforts to formally characterize these interactions. Based on field observations, Scanlon (2018) indicated shark-inflicted damage to trawl gear was pervasive, impacting 32% of observed nets. Furthermore, Louisiana shrimpers who participated in 2019 survey by Thu Bui with Louisiana Sea Grant reported losses of 14-32% in catch due to time spent on net repair from shark damage; average time reported on these repairs was four hours a day. Additionally, research proposals have been submitted to various sources by a variety of researchers on the issue of shark depredation, but often with limited feedback from the commercial shrimp fishery.

To build off these initial findings Sea Grant fisheries specialists from Texas, Louisiana, Mississippi/Alabama, Georgia, South Carolina, and North Carolina organized and facilitated two regional workshops targeting commercial shrimp industry representatives from the Gulf and South Atlantic region. Funding to support the meetings came from a 2019 National Sea Grant College Program Workshop Grant. Originally, the plan was to host one large in-person meeting in Louisiana with representatives from both regions, but travel restrictions associated with the COVID-19 Pandemic resulted in postponing the gathering several times, which is why two smaller regional meetings were organized.

The objectives of both workshops were to:
1) characterize the impacts of shark depredation on southern shrimp trawl fisheries, and
2) identify and prioritize potential gears, strategies, and/or broad technological solutions that could be field tested to mitigate incidents of shark depredation on shrimp trawl nets.
Both meetings utilized results from the 2019 Bui survey (*Appendix A*) as prompts to help guide the meetings' conversations. Participants were asked about long-term trends they have observed, impacts of shark depredation, techniques they have/currently utilize to mitigate shark depredation and potential solutions to explore.

By having shrimpers discuss the issue of shark depredation and share their experiences with each other, we are helping to generate a shared knowledge and understanding of an issue that affects a broad geographic region with significant economic impacts. Ultimately, we hope the information collected during the meetings will aid managers in better understanding the scope and magnitude of shark depredation in the region as well as help generate stakeholder-driven strategies that can be tested to minimize impacts of shark depredation in the shrimp trawl industry.

The following report summarizes the feedback received from participants in both meetings. There was widespread agreement that shrimpers in both regions have experienced increased interactions with sharks during the past five to eight years resulting in substantial loss of their time, gear and profit. Furthermore, participants have utilized a variety of methods to mitigate shark damage, (*often at their own expense*), but the overall effectiveness of these efforts to date has been minimal. Finally, while participants in both meetings were generally amendable to exploring new technologies and/or methods to mitigate gear damage, there was a strong sentiment from both groups that unless new approaches to shark management are also addressed, these other efforts will not be enough to adequately address the issue.

Regional Workshop Summaries

The Gulf shrimp trawl shark depredation meeting (Appendix B) took place at the Rural Life Museum in Baton Rouge, LA on January 25th, 2022, but had a virtual participation option as well. A total of eight shrimp industry representatives from Texas, Louisiana, Mississippi, Alabama, and Florida participated in the hybrid meeting. Sea Grant faculty from Texas, Louisiana, Mississippi/ Alabama, Georgia, and North Carolina also participated.

The south Atlantic shrimp trawl shark depredation meeting (Appendix C) took place on February17th, 2022, and was offered completely virtual. Twelve shrimp industry representatives from North Carolina, South Carolina, and Georgia participated in the meeting and Sea Grant faculty from North Carolina, South Carolina, and Georgia helped facilitate the meeting. A commercial longline fisherman from North Carolina with extensive experience fishing for sharks also participated.

Long-Term Trends

Changes in Observed Depredation

Participants at each meeting were asked how many years ago they noticed a change in shark interactions with their trawl gear and whether shrimping inshore or offshore made a difference. Gulf participants indicated depredation has been a problem for more than 10 years, but the last 5 years has gotten significantly worse. The group agreed there is a difference between offshore and inshore interactions, but inshore has gotten works in the last four to five years. General consensus from the south Atlantic group was that shark depredation has worsened in the past five to eight years, but the issue has become significantly problematic in the past two to three years. One shrimper from North Carolina, however commented that he felt depredation had been a significant problem for nearly 20 years, which roughly corresponded to changes in state regulations pertaining to bycatch reduction gear. Unlike the Gulf, South Atlantic participants did not agree that shrimping inshore or offshore made a difference in shark depredation. Participants acknowledged though, that there is not as much offshore trawling in the south Atlantic as compared to Gulf, and that besides North Carolina, trawling inshore (*in estuaries or sounds*) is prohibited in South Carolina and Georgia.

Wet vs. Dry Years

Respondents to the Bui survey indicated that shark depredation was worse during wet years. Gulf meeting participants didn't disagree with this observation but pointed out that the region has

been in a "wet period" for a decade. South Atlantic participants unanimously agreed they have not noticed any differences in shark depredation between wetter and drier years. Participants from both groups did, however, refer to warmer temperatures in recent years and the connection to increased shark activity.

Within the Year and Trip Occurrences

Participants in both meetings referenced correlations between increased water temperatures and shark encounters. Gulf participants agreed that gear damage from sharks occurs throughout the year, but there was no consensus regarding when specifically, depredation is the most problematic in their region. Based on participant input, there seems to be different trends regarding the state, time of year, and even by species.

South Atlantic participants generally agreed with the Bui survey results that May-October tends to be most problematic for depredation in their region. It was acknowledged though that this period is also when most shrimping takes place. As one shrimper commented "*where we shrimp, the sharks are*." However, the group agreed they are seeing depredation occur more often beyond these months (*as early as May and through December*), particularly as the region has experienced warmer temperatures. Several shrimpers from North and South Carolina commented they even had issues with sharks this past December (2021) when water temperatures were in the mid 50's to 60's.

Based on the Gulf participants' experiences, depredation occurs at any point of the day, but it might be worse during early/mid-day depending on where they shrimp. Similarly, the south Atlantic participants generally agreed that depredation occurs regardless of if it is day or night and there weren't any clear patterns that one time of the day was worse than another. However, there were some comments from shrimpers who fish at night that taking up around sunset can be especially troublesome for them. Shrimpers from Georgia and South Carolina also commented that historically they do not remember intense shark activity in the middle of the day, but now observe it regardless of when they fish.

Respondents to the Bui survey also indicated they observe, on average, shark damage in approximately 65% of the trips they take during a year. In contrast, there was consensus among the south Atlantic meeting participants that this estimate was too low; they indicated they experience some degree of shark damage in nearly 100% of the trips they take now. Additionally, several south Atlantic participants have observed that shark encounters tend to be worse when winds come out east and especially northeast. There were conversations that these conditions may help "muddy up the bottom" more than normal, which might add to sharks feeding.

Gulf meeting participants generally agreed with Bui survey respondents that shark damage occurs more often with picking up nets versus when they are actively trawling and tends to decrease with other boats nearby. Participants in the south Atlantic meeting acknowledged that picking up their nets is especially problematic; however, while they have observed sharks at the surface while actively trawling, they could not comment whether depredation was any worse/better during this time as they had no way of observing what was happening below the surface. Also, one south Atlantic participant agreed with Bui survey respondents that shark encounters tend to be worse when other boats are nearby, but the rest of the south Atlantic

participants have not noticed any differences in encounters regardless of if other boats are nearby or not.

Location of Damage

Participants in both meetings indicated that the extension portion of their shrimp nets, especially right in front of the TED experience a significant amount of damage from shark attacks. However, it was generally agreed that any portion of the net that remains in the water, particularly if gilled fish are present, is susceptible to damage including the net's wings, turtle excluder devices (TEDs) and tail bags. One Gulf participant commented that he has noticed nets nearest his try net are attacked the most as the try net gets pulled up so much.

Responsible Shark Species

Respondents from the Bui survey indicated that dusky, tiger, sandbar, silky, blacktip lemon and blacknose sharks were the shark species most often responsible for causing damage to shrimpers' gear. Gulf meeting participants commented that blacktip and sandbar sharks were two of the most common sharks they encountered. Others commented that bull sharks can become particularly problematic in springtime. South Atlantic participants identified blacktip, blacknose, and spinner sharks being the worst in all three states along with sharpnose in Georgia and South Carolina. Sandbar, lemon, bull, and tiger were identified as species that attack trawl gear as well. Participants from both meetings agreed they were more concerned about the numbers of sharks they are encountering and extent of damage they are experiencing than knowing specifically what species of sharks are responsible for the depredation. Furthermore, there was reluctance among some participants to want to correctly identify individuals for fear of increased regulations in case they encountered species that are federally protected. There was also general agreement from both groups that correct species identification can be difficult for even seasoned fisheries biologist and fishermen.

Several south Atlantic participants commented they feel sharks have learned to associate the sounds of shrimp vessel engines with a food source as dolphins have done. One participant commented he'll often notice sharks circling around his boat even when anchored up with no gear in water. On a similar note, a Gulf meeting participant mentioned, "*Gulf Sharks are smart and they adapt- you do one thing and it works and then awhile later they figure it out and it doesn't work anymore- they are just always looking for a way to get an easy meal. It's hard to predict when you are going to have the problem and when you aren't.*"

Participants from both groups also acknowledged that dolphins will depredate on shrimp nets, but are far less problematic than sharks. Shrimpers can also determine if the damage was caused shark or dolphin based on the type of damage caused. One shrimper added, "*dolphins can rip the net, but sharks will take a whole chunk out of the net.*"

Bycatch Species Associated with Sharks

Participants in both meetings agreed that regardless of the type of bycatch caught in shrimp nets, sharks will still attack them. There was general agreement though that increased quantities bycatch (*regardless of the species makeup*) is often associated with increased depredation. In fact, there was an increasing inclination among several Gulf participants to not want to push their bycatch overboard because of the severity of sharks. Several participants in the south Atlantic meetings commented that while an increase in bycatch can make the issue worse, particularly in warmer months, they are increasingly observing depredation even with "clean drags" of mostly shrimp. While Bui survey respondents indicated increased size of shrimp can equate to increased depredation, south Atlantic participants indicated they have not noticed any differences regardless of size of shrimp they catch.

Impacts of Depredation

Net Repair

Respondents to the Bui survey indicated it took an average of four hours per day (*0-9 hours*) to repair nets damaged by sharks, and the majority of shark holes observed are approximately 10-20+ inches wide. In general, participants from both groups didn't dispute these estimates, but pointed out that these figures do not accurately capture the full extent of labor needed to address the problem. A central concern raised in both meetings is not having enough qualified labor to make necessary repairs. Often "*quick fixes*" may be made while at sea just to keep nets functional. Concerns were raised about this approach as repairs may be done on top of one another, and it is not always possible to fix every hole, which ultimately affects the nets' integrity. Several participants from each meeting commented that it was not unusual to spend "several days" working on nets once back from a trip assuming they could find qualified helpers. Several also stated they have had to throw away entire nets (*even after only one use in some incidents*) because the extent of shark damage was so extensive.

Extra Gear

The issue of carrying extra gear was not discussed in the south Atlantic meeting but on average, Gulf participants report carrying an extra 10-16 nets on their boat on any additional trip. They acknowledged its often faster to swap out a net than try to repair it. Sometimes they can switch out only components of a net, while at other times they have to change out everything (rigs, nets, TEDs etc.). Time to replace these components varies, but participants indicated on average, it takes about an hour to make the switch. Regardless of the time, it was mentioned that labor for these repairs constitute a substantial hidden cost that did not used to exist.

Loss of Catch

Participants from both meetings had difficulty quantifying specific catch loss due to shark attacks as they have all experienced a wide variety of damage ranging from holes "less than 3 meshes" to having their entire tail bag being ripped away. Regardless of the percentage, any loss was recognized as 100% profit. A south Atlantic participant noted that even a small hole can quickly become problematic as shark are often seen repeatedly attacking any opening where catch is exposed. Similarly, Gulf participants mentioned the damage can result in the loss of thousands of dollars, especially for boats that do not have adequate gear to withstand repeated attacks. One shrimper said they can lose 10% of their catch as a result of a hole approximately seven to eight inches in diameter (*approximately the size of a fisheye bycatch reduction device*). Another participant who shrimps offshore commented they will lose on average two full bags out of 14 during their trips in the Gulf.

Damage to Turtle Excluder Device Flaps

Concerns were raised by both the Gulf and south Atlantic participants about the damage sharks can inflict on their turtle excluder device (TED) flaps. There was general acknowledgement that sharks often concentrate near TEDs (*regardless of whether they use top or bottom TED*) as bycatch passes out of them and will bite and damage the flaps in the process, resulting in the TED being in violation. This repeated damage makes it difficult to stay in compliance with state and federal TED regulations, which mandate that flaps do not have any broken meshes. One Gulf participant indicated he keeps 8 TEDs on his boat at any one time to ensure at least half are compliant with regulations due to shark damage.

Safety Concerns

Safety issues were not specifically discussed during the south Atlantic meeting, but as with the Gulf meeting participants, concerns have been communicated previously to Sea Grant Agents about the risks associated with falling into the water when sharks are present, especially during a feeding frenzy. Some Gulf participants also expressed concerns about trying to handle much heavier nets that have steel incorporated into the mesh; the material is less flexible than traditional nets and harder to handle (impacts on hands).

Mitigating the Impacts of Shark Depredation

Shrimpers from each meeting described trying or employing a variety of strategies to mitigate shark damage to their gear with varying degrees of success. There was consensus among Gulf and south Atlantic participants that no technique has been 100% effective.

Avoidance

Gulf participants generally agreed that shrimpers have had to move more often to avoid sharks in recent years compared to even five years ago, but increasingly moving does not help regardless of where they go. Several mentioned not needing to move at all ten years ago, and depredation was rarely an issue in inshore waters. Now, it happens both inshore and offshore. In contrast, south Atlantic participants didn't emphasize moving as much to avoid sharks. A shrimper from Georgia commented he will move further offshore during outgoing tides to avoid having to trawl in muddier waters where he often encounters sharks. There was general acknowledgement though that shrimpers can't be too selective in choosing where or where not to fish. One shrimper commented, "*sometimes you just have to work through the sharks regardless of how bad they are if you want to catch shrimp*." Shrimpers described hauling up more in these situations so they could inspect their nets more often for shark damage.

Magnets

Participants from both meetings indicated they personally have and/or know of other shrimpers who have tried magnets to help mitigate shark attacks on their gear with overall limited success. For those who reported that they did have some success, the results were often short-lived (*likely a result of magnets losing their strength over time*). Other observations were that they only seemed to work when there were fewer sharks present and during cooler periods. While specific types of magnets used (ex: *true electropositive metals*), and arrangements were not discussed in detail, participants in the south Atlantic meeting did comment that they have tried "different types" and placed them in multiple locations around their nets.

Clean Webbing

Participants from the Gulf and south Atlantic mentioned that keeping their webbing clean of gilled fish can help minimize shark damage but will not eliminate it.
Smaller meshed webbing can help reduce gilling, but many participants commented that this is still not 100% effective. There were also concerns from some south Atlantic participants about the difficulty of pulling smaller meshed nets. In reference to mesh size, some Gulf meeting participants commented that "2 3/8" mesh results in too much gilling, but 1 ½" to 1 3/8" is better for gilling prevention." South Atlantic participants mentioned they have used 1 and 3/4-5/8" Sapphire webbing where their extension tapers down, and finds that it fishes much cleaner although they can't pull a lot of it through.

Reinforced Netting/Chafing Gear

Use of reinforced webbing (*often with steel wire*) as well as chafing gear over tail bags and/or extensions were mentioned by participants in both meetings as a common technique to help

minimize shark damage. Dyneema and Sapphire webbing were specifically mentioned several times in both meetings. Success has been mixed for participants, but even with chafing gear Gulf participants mentioned they still see sharks biting through it. Participants described various ways they modify their gear to try and minimize shark attacks. For example, several south Atlantic participants commented that double chafing gear has worked the best for them to minimize damage. Extending the length of chafing gear and tying it like the tail bags was also identified as a moderately successful technique. Other examples shared included:

- *"4" poly, skirt that goes over outside of net, goes up about 100 meshes; sew it all around and taper it on the sides; when things get real bad: added a piece 8 feet of 4" nylon chaffer laced it to bottom of net: just come down seems on side; worked well for up to 10 days w/out have to switch out net"*
- *"120 mash sapphire extension helped a lot (still getting eat on bottom of net): added 3 feet of Sapphire down middle of the net after extension to bottom line- seemed to make a big difference"*
- *"Sewing 1 and ½" mesh sleeves on inside of extension-hard to pull though; seem to work well until mesh got broken; fish more likely to get gilled; hard to repair"*

Participants from each group acknowledged while the heavier, reinforced gear can help alleviate shark damage, there are tradeoffs to using it. Often, its more expensive and much harder to handle due to its increased weight. One Gulf participant commented he is using a $1,000 stainless shark bags this year and while it has worked, it is very expensive, and expressed frustration about having to incur the cost himself.

Shark Livers/ Body Parts

Several shrimpers in the south Atlantic meeting commented they have had moderate success keeping sharks away by tying a bag of shark liver into their tail bags. However, participants commented that the livers only worked for two to three days, and if large quantities of sharks were present and in feeding frenzies, this technique didn't have much effect. Participants from both meetings also commented hanging part of or whole shark bodies from their vessels with mixed success.

Other techniques meeting participants mentioned having tried included:

- Adding streamers to their bags to "distract" sharks: no effect
- Dipping nets in different colors-*red/black vs normal green*: no effect
- Attaching bags of BB's as a noise deterrent similar to the above-mentioned chains: no effect
- Bringing nets on boat "*more smoothly"* to minimize erratic behavior of fish in nets (*hauling up and over boat as opposed to swinging catch over the side*): minimal effect
- Increased trawling speed. Mixed effect

Solutions to Explore

Improved Management

When asked what other types of solutions participants would be interested in being researched or tested, there was general agreement in both groups that regardless of what is tried, better management of sharks in the southeast needs to be addressed to truly reduce the impact of shark depredation on shrimp trawl gear. There was not necessarily opposition to exploring new technologies/methods, but there was a general feeling that these efforts would merely be "band

aids" and not true solutions if changes to management are not also undertaken (*i.e. both deterrents and population control are needed*.)

Electronic Shark Deterrent Devices

South Atlantic participants were interested in learning more about and potentially testing the various electronic shark deterrent devices being tested in other commercial fisheries (ex: Ocean Guardian). There were comments that such devices might not only be able to minimize shark damage, but also serve as a potential bycatch reduction device. However, participants acknowledged trying to adapt the devices (*which are currently being tested on individuals and hook and line fisheries*) may be difficult to apply to shrimp trawls given their sizes.

Necromones

Testing the use of necromones (*chemical cue released by dead animals to its same species that acts as a deterrent to that species*) was of interest to participants in both groups based on conversations about the perceived benefits of using shark livers to repel sharks.

Shark Harvest for Shrimpers

Some Gulf participants discussed the possibility of shrimpers being able to harvest sharks, but there were mixed responses to this option; concerns centered on adequate boat storage space, safety of handling sharks, recognition that establishing a harvest would require established guidelines to ensure protected species are not harmed, and potential revenue might not make it worth the extra expenses.

Protective Webbing

Participants from both groups acknowledged the role that protective webbing could play in minimizing shark damage, but increased costs to fishermen and added weight of such gear are major concerns. Gulf participants recommended gear grants to test metal tail bags, Dyneema Predator X webbing etc.

State Management Involvement

Participants in both groups mentioned the involvement of state management agencies to help address the issue of increased shark numbers. Besides North Carolina, Louisiana and Mississippi, other states in the southeast region do not allow commercial shark fishing in state waters. Some south Atlantic participants expressed concern by this as most of the effort in region takes place in state waters.

Shark Meat Markets

Participants at both meetings discussed the lack of local markets for shark meat. Gulf participants mentioned what exists is mainly during Lent for the Mexican market. South Atlantic participants who own retail operations commented there isn't much demand for shark at their locations (*both in South Carolina*), but also acknowledged there are few to no fishermen targeting them either. Shark fin bans in many states and the potential concern of a U.S. shark ban concerned participants in both meetings that this additional regulatory restriction will further reduce what little market is left (*only one U.S. dealer currently who is also in legal trouble with U.S. government*). Gulf participants mentioned that a black market already exists for sharks and raised the point that reducing a sustainable source will only fuel the black markets more.

Improved Education

Participants in both groups mentioned the need for better education about the status of sharks in the United States and how they are managed. Many expressed frustrations that environmental groups often make it sound like all sharks are overfished and endangered (*there was also acknowledgement though, that some shark species such as dusky have been impacted by overfishing in the past*). Consumer education on legal, sustainable shark fisheries that are edible and favorable for cooking was mentioned as being needed; In addition, several participants commented that while there currently is not much commercial shark fishing occurring, there are misconceptions that U.S. shark fishermen only harvest sharks for their fins, and do not utilize the rest of the shark (*a practice observed in other parts of the world*).

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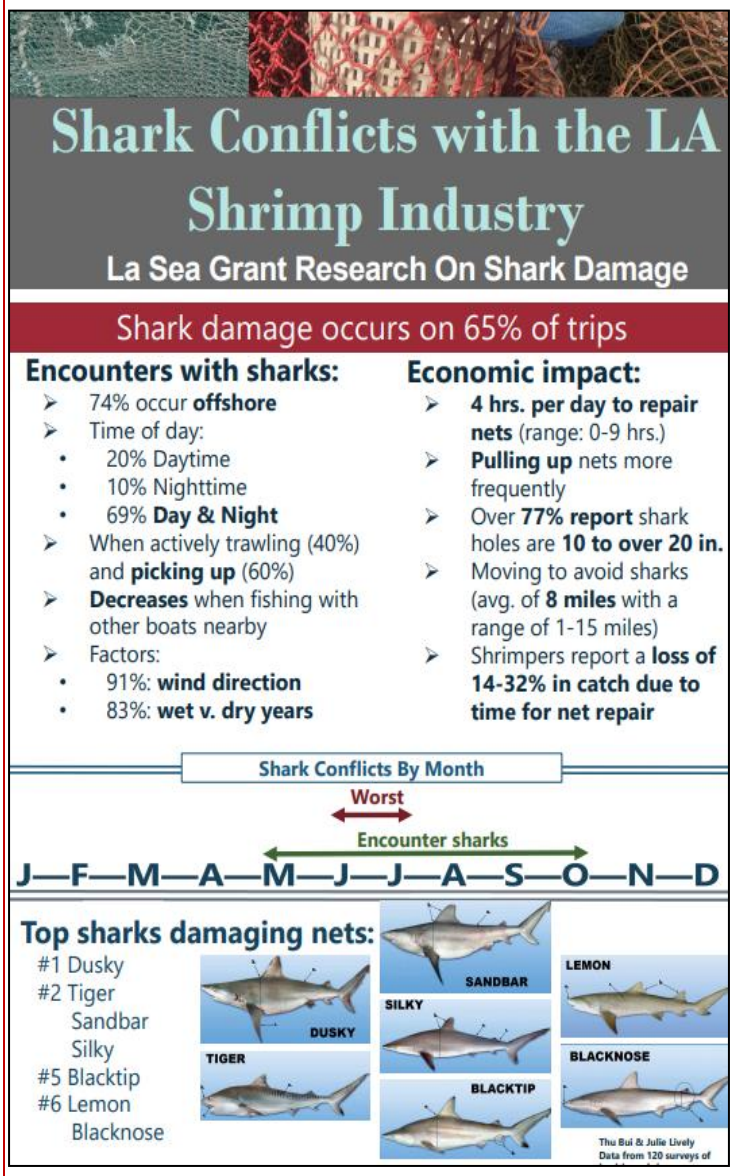
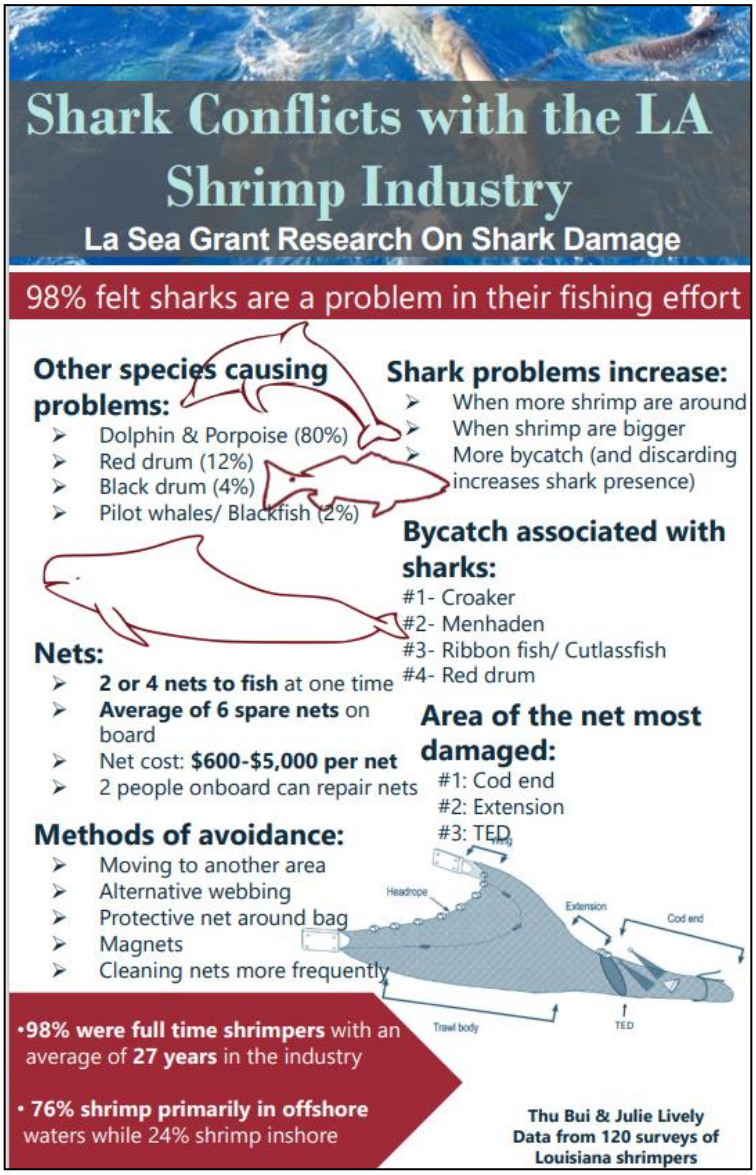
Appendices

Appendix A

Summary of 2019 Louisiana Sea Grant (Thu Bui) Survey with Louisiana Shrimpers about shark depredation on their gear.





Appendix B:

Gulf Shrimp Trawl Shark Depredation Meeting Agenda, Participants and Notes

Gulf Shrimp Trawl Shark Depredation Meeting
Tuesday, January 25th, 10AM-3PM
Rural Life Museum
4560 Essen Ln, Baton Rouge, LA 70808
Virtual option (see below)

Meeting Objectives

1. Characterize the impacts of shark depredation on southeastern shrimp trawl fisheries
2. Identify and prioritize potential gears, strategies, and/or broad technological solutions that could be field tested to mitigate incidents of shark depredation on shrimp trawl nets

AGENDA

10:00-10:20 a.m.	Welcome, Introductions (role in industry, target catch, where fish), Meeting Overview & Purpose
10:20-11:10 a.m.	Identifying the problem- Long term trends
11:10 a.m.-12:00 p.m.	Identifying the problem- Within trip occurrences
12:00 -1:00 p.m.	Lunch (*provided*)
1:00-1:50 p.m.	Identifying the impact
1:50-2:00 p.m.	Break
2:00-2:45 p.m.	Avoidance and next steps
2:45-3:00 p.m.	Recap, next steps, reimbursements
3:00 p.m.	Depart

Gulf Shrimp Trawl Shark Depredation Meeting Participants

Shrimp Industry Representatives

In person:

Texas: Gary Graham, Ernie Aparicio
Louisiana: Ronnie Anderson, Timmy Troung
Mississippi: Frank Parker, Ricky Brown,

Virtual:

Alabama: Lindsey Burroughs
Florida/Texas: Grant Erickson

Sea Grant Staff

In person:

Laura Picariello (TX),
Julie Lively (LA),
Mark Shirley (LA),
Tiffany Pasco (LA),
Marcus Drymon (MS-AL),
Ana Osowski (MS-AL)

Virtual:

Thu Bui (LA),
Julie Falgout (LA),
Bryan Fluech (GA),
Sara Mirabilio (NC),
Sarah M. (Notetaker)

Identifying the Problem-Long Term Trends

How many years ago did you notice a change? Does inshore or offshore make a difference?

- In the last five years, the inshore has been affected as well as offshore
- Most change has occurred in the last five to ten years. It is very bad around Apalachicola in the last 10 years
- He went to Texas a few years back and you can watch the sharks swim up but they wouldn't bite; Louisiana is a different story – you better run as soon as you see them.
- The 3-4' sharks 5 years ago are now 8-10' sharks plus new 3-4' sharks. They are just getting bigger and new smaller ones are showing up.
- One participant said years ago when he was a teenager sharks were this thick, but now it's just as bad again.

Overall: participants state depredation has been a problem for more than 10 years, but the last 5 years it's been very bad. There is a difference in offshore and inshore, but inshore has gotten worse I the last four to five years.

Did certain years seem better or worse?

- The survey found wet years were worse, but attendees pointed out it's been a wet period for a decade.
- When it's warmer, they are more aggressive, and this year is really warm so they are seeing sharks much later in the season.

Identifying the Problem-Within year and trip occurrences

What months/time of year are we seeing problems with depredations?

- Sharks are a problem all year round, but they are worse at different seasons, and it can vary by species with some species more aggressive/problematic at different times of the year
- No gulf-wide consensus; seems to be different trends in different states
- Sharks become more aggressive with increases in water temperature – "I think they get more hungry when they spawn – they have to eat"
- Offshore Louisiana: May-October was the most depredation
    - Sea Grant noted that May-October is also when the shrimpers are most active. Are we considering this? Attendees felt it was not just seeing them more because they are on the water more. It's more fish and shrimp in the nets which also means more sharks.

- In June in Louisiana, it is absolutely unfishable- they will tear you up and rip your gear near Texas; I have quit sending boats over there that time of year
- I have done the same thing off tiger pass [off Venice, LA] – the only way I've managed is to just pick up and leave
- Some in LA felt the daytime is worse, while some in MS said nighttime is worse.

Does time of day matter? As it warms up, when you first get gear in the water?

- I have seen it all times, sometimes worse at night and sometimes worse during the day- the first drag or two you're okay but then once you keep going and they start following you
- Sharks are smart and they adapt- you do one thing and it works and then awhile later they figure it out and it doesn't work anymore- they are just always looking for a way to get an easy meal. It's hard to predict when you are going to have the problem and when you aren't
- It is dependent on temperature, dependent on location, but they are eating the nets.
- Notice sharks move inshore when it gets cold and move out when its warmer – but they are following boats

Overall shark damage always occurs, regardless of time of day for the Gulf of Mexico. It may be worse early/mid-day but they are always out there. It's hard to predict issues. Damage is year-round, regardless of time of day

When does depredation seem to increase while fishing?

- The survey results indicate shark damage occurs more with picking up nets vs trawling, and tends to decrease with other boats nearby; shark depredation occurs when shrimp are bigger and when bycatch is more frequent (discarding increases shark presence)
- More fish = more sharks
- Depredation seems worse in warmer weather
- Erratic behavior by fish seems to draw sharks; some participants have employed techniques to bring nets on the boat more smoothly to minimize attracting more sharks during fishing effort (hauling up and over the boat as opposed to swinging catch over the side)

Specific Species/Bycatch associated with sharks:

- Participants report no known association, although PPT mentions menhaden and croaker. There might have been some differences in the past, but now fish = sharks.
- The more bycatch released, the more sharks drawn to the boat
- When there are more seagulls, there are more sharks (both predators are there because more bycatch).
- Shark bites are easily identifies versus dolphin damage, etc.

Overall, the increasing inclination is to not release bycatch

What species of sharks are responsible?

- PowerPoint: dusky, tiger, sandbar, silky, blacktip, lemon, blacknoses
- Blacktip and brown (sandbar) sharks
- Bull sharks are bad, especially March when they get aggressive
- Most couldn't pinpoint any one species as more problematic
- Identifying species in the water is challenging, and there is reluctance to try to identify in case it's a protected species. Most of the participants are agreeing with this statement

- However, correct species identification isn't a top concern for participants right now; they are primarily concerned with the number of sharks and depredation events, and less concerned on what species
- One participant shares a video from 2013 of many sharks near a boat; even from the video, the shark specialist expresses doubt on being able to positively identify the species
- Correct species identification is very difficult even for seasoned fisheries biologists/fishermen
- Silky and dusky sharks are under a rebuilding plan; however we have seen sandbars and blacktips having healthy/recovering populations
- This is important because if we know what species, there could be a clearer path to addressing this problem (participants don't seem to realize the importance this plays in possibly mitigating depredation).

Identifying the Impact

Damage estimates related to repair, size of holes

- Economic impact (PowerPoint): average of four hours per day (0-9 hours) to repair nets; majority of shark holes are ~10- 20+ inches
- Fishermen can make quick repairs, but it depends on the skill of a fishermen with regards to how long repairs can take. That skill set is harder and harder to find.
- Sometimes the damage is so extensive that the entire net is discarded
- Oftentimes there are repairs done on top of past repairs, and eventually this compromises the net's integrity, and it gets to the point where the net needs to get replaced anyway
- While you are offshore, there's an average of 1-1.5 hours doing net repair for three separate guys, but back at the dock they spend days repairing every single hole in the net
- Four hours per day is not an unreasonable estimate, but <u>this is just for the day-to-day repair</u> and does not encompass the detail repair that occurs after the trip
- Labor for repairs is very hard to find
- Average hole size is accurate (10-20 inches)
- Fishermen can tell by the damage if it is a shark or dolphin; dolphins are able to maneuver through the nets, whereas sharks take whole components of the net out
- Sometimes it takes hours just to patch a net to get through the day
- It is difficult to quantify number of hours to fix gear, because during fishing many are looking just to patch nets to get through the day with more extensive repair effort occurring after fishing trip
- In some areas, captains do not want their crew fixing their nets at all while on the water as they don't feel the crew know what they are doing
- Nets are often $3,000 to $6,000. One fisherman had an $8,000 net bill last year due to shark damage.
- Regardless of top or bottom TEDS, the flaps are getting attacked which then puts the TED in violation.
- A ted is $750 each
- A Dyneema net is easily $7,000 each. It performs better but is probably not enough better.

Costs of Shark deterrent netting:

- "High-tech" netting is very costly
- Using different net material will not alleviate problem-problem is the management, not the equipment
- Some participants have used nets with steel incorporated into the mesh, but this is much harder to use-it is less flexible, harder on hands, and possible safety concerns with handling
- With heavier gear fishermen may be incurring higher fuel costs (estimate between 50-60 lbs. heavier than lighter gear)
- Gear that is heavier/made to endure more damage is generally too expensive to afford, and thus it is not universally used
- Heavy webbing costs ~$30/lb.
- One is using $1,000 stainless shark bags this year and they work, but they are really expensive. Why is it on the fishermen to pay all the costs for species conservation? He's only using in the main bag because of cost.
- Extra chafing gear, etc. is estimated to be an extra 60 lbs./ bag

Catch Loss

- Results in the loss of thousands of dollars, especially for smaller shrimp boats that can't handle these interactions with sharks.
- With a hole that's ~7-8 inches (about the size of a fish eye), they lose 10% of their catch
- Offshore shrimping: they will lose on average 2 full bags out of 14 during their trip
- This varies by boat size and boat type
- All loss is 100% profit as expenses don't change. Already paid for the fuel and time to make the tow.
- It's not completely uncommon to have whole tail end ripped out for total loss.
- Have lost over $2,000 in just one tow when the tail bag was fully compromised.

Extra gear

- On average, **participants report they carry an extra 10-16 nets** on the boat on any additional trip (PowerPoint only listed 6)
- They carry so many extra as it's faster to swap nets out than it is to repair them during fishing effort
- Just to buy tail bags is $1k a piece; in any given year, participants are replacing ~4 at a minimum
- Participants see evidence of sharks biting through the chafing gear-this does not deter them
- Using chafing gear is also much more labor intensive on top of repairing "typical" gear
- When changing nets, there are times when participants are changing out everything-bags, nets, TED's, etc.
    - Sometimes they only switch out some components and leave others to try and get nets back in the water asap
    - Labor for repair constitutes a large hidden cost that did not used to be there
- Changing out components can take ~1hour (some can do quicker, but 1 hour is average)

- Put chains around the bag, and need to shackle, not tie. The noise seems to deter the sharks.
- One carries 10 extra nets at $1,500 to $5,000 per net; another keeps 16 total complete nets on board.
- One is carrying 8 total TEDS on board so hopefully 4 are always compliant.
- Four extra tail bags would be $4,000 total of the 1 ¾" stainless steel

Where is the damage?

- Majority of the damage occurs right in front of the TED (main components are cod end, extension, and TED components)
- The damage is worse on the plastic nets than the dyneema.
- Wherever and whenever fish are getting gilled in the nets is an attraction for sharks, then they go for the TEDS, then to the BRDs.
- Nets nearest the Try net are the worst as the try net gets pulled up so much.

Safety concerns

- Some participants have used nets with steel incorporated into the mesh, but this is much harder to use-it is less flexible, harder on hands, and possible safety concerns with handling
- Sharks on board: Are only small sharks are getting in the bags because of the TED?
    - Sometimes a big shark can get through a tri-net
    - One report of a large shark breaking the TED and getting into the net, but this seems to be an exception rather than a common occurrence
- Is safety a concern when entering water to repair/retrieve gear? **Yes!** If you fall overboard during a feeding frenzy, it's going to be deadly.
- Sharks are now breaking into the nozzles and breaking shafts.

Other costs

- Some reports of extensive movement to different areas to avoid sharks; this is common among participants
- TED violations are major regulatory concerns.

Overall, participants agree with survey statements but add that this underestimates labor to get one net functional again. Sometimes net can't be fixed with mending due to damage. Taking at least 10 extra nets to swap out (avg. 1 hour to swap). Labor to fix nets is more expensive and harder to find. Anti-shark gear is more expensive, typically harder to handle, and heavier than current gear.

Summary of costs

- Lost shrimp/ catch
- Time repairs nets on the water
- Lost time fishing during repairs
- Lost time swapping nets
- Time to repair nets at the dock

- Extra gear to swap
- More expensive gear to deter
- Extra weight from heavier metal mesh or chafing gear
- Extra fuel and time moving away from sharks

Avoidance and Solutions

What methods do you employ to improve the problem?

- Power point: moving to another area, alternative webbing, protective net around bag, magnets, cleaning nets more frequently
- Participants strongly feel the problem is the management of shark populations, and that these other methods are just a band aid on the problem
- All agree they move significantly more now than they did 5 years ago
- 10 years ago, they didn't need to move to avoid sharks, and it was rarely a problem inshore. Now it affects both offshore and inshore areas
- Moving doesn't solve the problem anymore
- Many participants have tried magnets, and they worked for a time
- Magnets might help more in colder months
- Magnets help when there aren't very many sharks.
- General sentiment is they may work when there are fewer sharks, but not effective with large numbers of sharks
- The more bycatch released the more sharks are drawn to the boat. Fishermen don't want to lose bycatch anymore
- Fishing speed might help with shark interactions; Some participants say it does, others say slowing down makes shark depredation more common
- Erratic behavior by fish seems to draw sharks; some participants have employed techniques to bring nets on the boat more smoothly to minimize attracting more sharks during fishing effort (hauling up and over the boat as opposed to swinging catch over the side)
- Put chains around the bag, and need to shackle, not tie. The noise seems to deter the sharks.
- 2 3/8" mesh results in too much gilling, but 1 ½" to 1 3/8" is better for gilling prevention
- Trying to mud up a bit can help deter, but you have to be very careful to not do too much.
- Large mesh sections were popular to reduce bycatch, but now they let out more which means more sharks. They don't want to let it all out during the trawl or the sharks will be attracted even more while still trawling.

What solutions do you think should be explored?

- Discussion of possible use of necromones-chemical cue released by dead animal to its same species that acts as a deterrent to that species; Some evidence that shark necromone could be effective but this project was never funded; Some participants have tried using the body (consensus is it doesn't work), some tried just the liver (may be highly effective); Possible market for shark liver in this regard, but there is no documentation on effectiveness; Participants very willing to try this option
- Shark harvest for shrimpers

    - When asked if participants would be willing to keep sharks while out on the water, some say no some say yes
    - Establishing a harvest encompasses care when ensuring protected species are not being kept
    - Sharks take up a lot of room on the boat because they need to be fully intact
    - Might be situation-dependent: on a slow day, it's better to catch something than nothing, but catching sharks is not the priority. They will only catch sharks if they can't catch shrimp
    - Shrimp crew isn't necessarily experienced in handling large, toothed animals- could be a significant liability
    - Pound for pound, the revenue simply can't be generated in the same amount as other species
    - LA blacktip quota goes unfilled as bull shark fills and can't target just blacktip.
    - Need handling information- can you throw in the hold like shrimp?
- Many are in support of funds to supplement more protective webbing, but it might be too heavy
- Webbing is too thick for the extension part of the net, so it will only help with the bag portion
- Interest in trying cowbells.
- Focusing on state fisheries first might be the best option.
- Other federal agencies, like Dept. of Interior/ Dept. of Ag. Has gotten involved when predators/ consumers interfere with food production (blackbirds and grain; wolves and livestock) so will NOAA help with fishers? NOAA/ NMFS can help the current industry and create more jobs with harvest.
- Need deterrents AND population control.
- What restoration/ conservation do TEDs and BRDs provide if just feeding the sharks?
    - Some conservation groups recognize the conflict and may be willing to try to help
- Efforts need to focus on all fishing using one voice as this is not just a shrimp or commercial problem.
- A black market already exists for sharks. Reducing a sustainable source will only fuel the black markets.
- The majority of current harvest is during Lent for the Mexican market.
- Gear grants could help with metal tail bags, dyneema webbing, predator X webbing
- Any harvest changes need to have a lot of education and outreach to make sure dusky or other protected species aren't taken or harmed.

Overall, participants are willing to try a variety of options, but generally seem to concur that management is the core problem

Summary of Gear/techniques mentioned

- Tried some techniques to deter sharks, but most are not effective, and some techniques are too expensive to be feasible
    - Noise seems to deter some sharks (use of cow bells), but disagreement among some shrimpers as to effectiveness

- Many have used magnets, but the type of magnet might explain the range of effectiveness (need a big magnet for boats) (Marcus suggests most trials are under powered)
- Fishing without TED flap (inshore)
- increased bag mesh size (2.25inch) – no go for some
- Smaller mesh size prevents depredation once in bag
- Fishing speed

Appendix C:

South Atlantic Shrimp Trawl Shark Depredation Meeting Agenda, Participants and Notes

South Atlantic Shrimp Trawl Shark Depredation Meeting Agenda
Virtual-see link below
Thursday, Feb 17th,
6PM-9PM EST

Meeting Objectives

1. Characterize the impacts of shark depredation on southeastern shrimp trawl fisheries
2. Identify and prioritize potential gears, strategies, and/or broad technological solutions that could be field tested to mitigate incidents of shark depredation on shrimp trawl nets

AGENDA

6:00 – 6:15 p.m.	Welcome, Introductions, Meeting Overview & Purpose
6:15 – 7:15 p.m.	Identify the Scope and Nature of Shark Depredation
7:15 – 7:30 p.m.	Break
7:30 – 8:30 p.m.	Discuss Potential Strategies to Mitigate Shark Depredation
8:30 – 9:00 p.m.	Brainstorm Research Needs and Next Steps
9:00 p.m.	Depart

Topic: S. Atlantic Shark Depredation Meeting
Time: Feb 17, 2022 06:00 PM Eastern Time (US and Canada)

Join Zoom Meeting
https://zoom.us/j/94761377131?pwd=QThOOXlYL3lzc3NIWHV5VVlDTEpaUT09

Shrimp Industry Representatives:
North Carolina: Jeff Frye, Clyde Phillips, Joel Norris
South Carolina: Cameron Reeves, Cindy Tarvin, Eddie Tyler, Chip Racine,
Georgia: Bubba Crum, Bill Harris, Johnathan Bennett, Michael Dubberly, Michael Boone

Commercial Longline Representative:
Charlie Locke: North Carolina

Sea Grant Staff:
Sara Mirabilio (NC)
Graham Gaines (SC)
Bryan Fluech (GA)
Herbert "Truck" Mciver (GA)
Lindsey Parker (*GA-retired*)

Identifying the Problem-Long Term Trends

How many years ago did you notice a change? Does inshore or offshore make a difference?

- General consensus that the last 5 to 8 years have gotten worse, but the last 2-3 years have been particularly bad. Particular emphasis on the 2021 season...one participant commented it gets "worse every year"
- One shrimper from NC commented sharks have been major problem for 20 years (*referenced changed state polices with bycatch reduction gear*). He ended up moving from shrimping in the ocean to Pamlico Sound because it got bad for him.

Do certain years seem better or worse?

- Participants from the Gulf survey found depredation in wet years were worse, but there was general consensus among our meeting participants they have not noticed any major differences between wetter or drier years.
    - There were comments that they have seen higher water temperatures over the past several years

Identifying the Problem-Within year and trip occurrences

What months/time of year are we seeing problems with depredations?

- Participants generally agreed with Gulf survey results of May-Oct, but have noticed encounters extend even beyond these months in recent years especially in warmer years.
    - NC and SC participants commented that this past December was even bad for them; (even when water temp was in mid 50's to 60's)
- One GA shrimper noticed it can start getting bad in April (referenced white shrimp are closer to shore in S Atl, which might make earlier encounters worse than in Gulf.); another commented he has seen drops in encounters in September in past years, but saw no difference with encounters through the fall
- Group didn't notice any differences between inshore/offshore interactions, but acknowledged that in the south Atlantic they don't fish as far offshore as in Gulf. Also, only NC allows shrimping in their sounds
- Another commented once water gets around 72-73 degrees sharks start feeding:
- It was also mentioned that regardless if you are trawling in 10 or 40 feet (Georgia), encounters are the same…"*Where we shrimp, the sharks are*"

Time of Day

- Most of the effort in the S. Atl region takes place in state waters where night trawling is illegal; general agreement that time of day doesn't seem to make a difference with number of attacks. Attacks don't gradually increase: even first pick up can have severe damage.
- Those who do trawl at night mentioned time of day doesn't make a big difference in terms of shark encounters, but a few shrimpers commented that taking up around sunset seems to get worse: "*once the sun goes down it gets bad; if you can make it half through the night, it usually won't be so bad*"
- There were comments from some GA/SC shrimpers about attack intensity not seeming to be as bad during day in the past, but in recent years its bad throughout the day.

Wind Direction

- Many commented that shark encounters tend to be worse when winds come out of East, particularly NE; might be more of a factor of water quality issues.
- Comments that Nor'easters help to muddy up waters which might help the issue; however Nor Easters are different between NC and GA so that might not always be the case.
- NC longliner participated commented that NE winds make the sharks worse in the gillnet fisheries in NC.

Percent of Trips with Shark Damage

- Participants felt the 65% shark damage mentioned in the Gulf survey was too low compared to what they observe
- General consensus from participants (NC, SC & GA) is they are experiencing some kind of shark damage on every trip they take *(nearly 100%)*, but extent of damage is what varies throughout the season
- There were comments that about know not knowing what's happening (as far as shark attacks) when dragging, but general consensus that nets are being attacked when taking up- easier to observe
    - Several comments were made about the severity of net damage during the 2021 season: one shrimper ended up throwing away nets in May; another commented that sharks were still attacking nets while they pulled their doors out.
- One participant commented he thinks encounters are worse when other boats are nearby, but general consensus was they do not notice a difference if more or less shrimp boats are nearby

Bycatch Association with Sharks

- Star drum, spot, croaker, tonguefish, ribbon fish commonly gilled, menhaden sometimes: redfish not common at all; general consensus is that this is more a factor of mesh size and sharks attacking whatever gets caught vs. them attacking targeted species.
- Fish gilled in nets can make the issue worse particularly in warmer months: however even with clean catches, sharks are observed hitting nets
- Keeping webbing clean will help minimize damage, but not eliminate it. Smaller mesh will help, but you can't pull it all the way.
- When a hole is created and catch starts to come out, it makes the problem worse
- Comments made that the trend in GA is to have top shooters with 2" bar spacing to help reduce bycatch: however, sharks hang out by openings and severely damage flaps. Per NMFS rules can't have any damage to flaps. Makes it hard to comply when they get damaged so often. LE has made them make repairs to their flaps before being able to fish again (even when LE sees the sharks attacking the nets)
- One shrimper commented that shaking net to try and rid of gilled fish does help, but often sharks are back attacking nets anyway.
- Dolphins will interact with gear to eat fish, have observed them causing damage: however doesn't cause near the problems that sharks do; "*dolphins can can rip the net, but sharks will take a whole chunk out of the net*"

Shark Species Associated with Depredation

- Blacktips (#1), blacknose and spinner sharks mentioned the most being the worst in all three states along with sharpnose in GA and SC
- Sandbars and lemons encountered occasionally as well as bull sharks….NC has also seen good amounts of bull sharks, but they also are allowed to trawl in their sounds
- Georgia shrimper commented they have seen tigers too. NC shrimper commented an occasional thrasher based on long caudal fin
- Commercial long liner commented only time he catches silkys (*in reference to Gulf survey*) is 20 fathoms or deeper.; don't catch duskies near shore; in summer probably aren't seeing sandbars – they are a cool water shark; He's mainly observed blacknose from the videos he sees from shrimpers; anything over 5 ft. it's a blacktip or spinner;
- There was general consensus that there was no value (to them) in understanding the species level of which sharks are causing the problems although facilitators commented this being important for management considerations.

<u>Identifying the Impact</u>

Damage to Nets

- Participants had hard time quantifying loss on average (*depends where and how often they bite*), but general agreement that 100% loss has occurred to them before due to their bags being completely ripped open:
- In general participants agreed on average size of holes they've seen ranged from 10" to 20" to as big as 40" +. One commented he had a hole as big as a 50-gallon drum.
- Comments about extent of damage on nets ranged from 3 meshes "tearing the whole thing off." Another participants commented, "*mostly people lose one side more than both sides; usually they get one side as opposed to both*" (losing 50 % of catch vs 100% catch)
- Several shrimpers commented that extension is a bad spot for being attacked; doubling up (putting a sleeve over webbing) seems to help some in reducing damage, but does not eliminate it; one GA participant commented they put 120 meshes Sapphire webbing in their extension to minimize damage
- Also comments about damage to the wings of the net; and another mentioned any part of the net that is in the water while bags are being dumped can have damage on them.
- Any net part left in water susceptible when taking up

Repairing Nets

- In reference to the Gulf survey, participants thought 4 hours/per day sewing nets might be accurate <u>if</u> you averaged for whole year, but many commented its not uncommon to spend all day (*or days*) on the hill sewing without being able to finish.
- General consensus finding qualified net repairmen is getting harder. Often more demand on the hill when boats come back than are people to help do it. When possible try to hire someone when they get back to dock if available to minimize work hours on boat crews; often have to "get in line" to wait to be repaired
- Between lack of qualified net menders and extent of damage they often encounter, participants often have to triage damage; repair the most severe damage first. Not always possible to fix all holes before going out again;

- Several participants commented shrimpers should do a better job of tracking specific times to repair nets and associated expenses to help get better estimates of their economic losses.

Avoidance and Solutions

Mitigation Techniques

- Nothing has been 100%, but double chaffing tail bag seems to have performed the best to minimize damage among participants. Several participants commented about effectiveness of shark liver, but effectiveness was short lived; also one observed that if sharks are in frenzy mode, the livers won't do anything. Magnets (*not discussed in detail-what kinds were used-need to have true electropositive metals; strengths of electrical field from a true magnet will dissipate over time in saltwater*) had minimal to no affect for those who tried it.
- Non-Tech methods varied among groups with mixed success rates.
  - Shark livers in a bag sewed in the tail bag (*can last 2-3 days*)
  - Magnets on various parts of net
  - Chaffing gear with stainless steel wire sewn in on tail bag (*Shark Chaffer gets from Gordan Nets in NC*);
  - Double Chaffer on tail bag double chaffing gear with wire and tying it shut
  - Flaps over extensions
  - Wire woven into webbing (*modest successes*)
  - Dipping nets with red or black instead of green (*didn't work*)
  - Extending length of chaffing gear and tieing it like the tail bags
  - Streamers on end of bags (*didn't work*)
  - Different sized webbing to minimize fish gilling
  - Zip tied foot or two of chains on chaffing gear-let it flap and sometimes that helps
  - Where extension tapers down; Sapphire webbing 1 ¾ -5/8" fishes much cleaner (can't pull a lot of it though)
  - 4" poly, skirt that goes over outside of net, goes up about 100 meshes; sew it all around and taper it on the sides; when things get real bad: added a piece 8 feet of 4 inch nylon chaffer laced it to bottom of net: just come down seems on side; worked well for up to 10 days w/out have to switch out net
  - 120 mash sapphire extension helped a lot (still getting eat on bottom of net): added 3 ft. sapphire down middle of the net seemed to make a big difference: after extension to bottom line.
  - Bags of BB's tied to net to make noise (didn't work)
  - Sewing sleeves (*inch and half webbing*) on inside of extension-hard to pull though; seem to work well until mesh got broken; fish more likely to get gilled; hard to repair
- Sara with NCSG showed group the electronic shark deterrent device being tested with commercial longliner in NC; one shrimper who is familiar with it commented that it "worked pretty good" when zip tied to his trawl when trying to reduce bycatch of fish.
- General interest in learning more/testing electronics devices -Shark Shield, Ocean Guardian and other tech devises intended to mitigate shark interactions: also could help minimizing bycatch….serve as a "2 for 1" effort

- Many felt studying different net materials, configurations would just be a band aid. Concerns about trying to tow extra weight.
- Conversation from participating longliner about efforts to use derivatives of shark body parts to repel sharks on long lines: has had some success, but not sure how this could apply to a trawl situation. Same concern about some of the various devices being tested in other fisheries: how do you adapt the technology to shrimp trawls? Needs to be robust and probably put all over net to generate enough of an impact

Changed Behaviors

- Acknowledgements that sometimes you just have to work through the sharks regardless of how bad they are if you want to catch shrimp-no other choice; can't be too selective in choosing where/where not to shrimp
- Comments about working with the tides; if tide going out may work a little further offshore to avoid sharks: making shorter tows to check extent of damage; if damage is minimal they will extend tow times. Other behaviors included taking up in muddy water to minimize damage and not dragging if catch isn't good.
- Discussion arose whether sharks are learning to associate sound of engine with a food source like Dolphins have done. Is it a learned behavior? Audience generally seemed to agree with this statement. One participant commented he's notice sharks circling around his boat even when anchored up with no gear in water: other commented he's observed sharks trailing his boat for days.

Management/ Market Concerns

- A bigger issue the group agreed upon is there isn't anyone fishing for shark; concerns about overpopulations: recognition that quotas have increased but not serving any management point when there isn't anyone targeting them.
- Concerns about fin bans that have occurred in various states (*particularly with Chinatowns/Asian markets*), Essentially ended up with one dealer and since then that dealer has been in legal trouble. No one to buy sharks right now.
- Very close to a national shark ban in the U.S due to pending national legislature: concerned what effect this will have on other fisheries
- Commercial shark fishing in state waters only allowed Louisiana and North Carolina (i*n southeast*). Concerns about what impact this is having in other states since shark interactions often occur in state waters.
- Participants who also run retail stores mentioned there isn't much demand for shark so they don't sell often: can only sell so much.