A Behavioral Study of Sharks in Captivity

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Abstract

Sharks have long been thought of as aggressive and even murderous creatures. They have been on display in aquaria for decades. They were originally put on display for entertainment purposes, but this quickly transitioned into a learning experience. While fear of sharks was, and still is present, people slowly began to learn about these creatures. Originally, humans didn't take the time to learn how these environments affected the sharks themselves. Precautionary measures weren't taken until recently to ensure the sharks safety and satisfaction in these habitats. In this project four behaviors (biting, fast swimming, rest, curiosity) before, during and after feeding, of Nurse (*Ginglymostoma cirratum*), Sandbar (*Carcharhinus plumbeus*) and Sand Tiger (*Charcharias taurus*) sharks were observed in 4 man-made aquaria (National Aquarium in Baltimore, New York Aquarium, Adventure and Jenkinson's Aquaria in New Jersey) and compared to published studies of these species in the wild. Multiple observations were made at each location. In addition, data were gathered on habitat size (gallons of water), shape (round vs. perpendicular), and other tank features (objects and organisms present). The hypothesis was that sharks in captivity will be less aggressive than those in the wild. For each of the three species studied, the number of behaviors observed, per shark, per visit were calculated. No aggressive biting was observed before, during or after feeding in any shark. The primary shark behavior observed was curiosity in all four aquaria. The sharks displayed minimal fast swimming. This may be attributed to the limitations of tank size. The sharks tended to be more motionless or at rest after feeding, perhaps because they were satiated. More activity was observed in Nurse sharks in Jenkinson's (58000 gal) and New York Aquaria (90000 gal) as compared to Baltimore (225000 gal) and Adventure (550000 gal) aquaria. Tank size may be a factor. The Sand Tigers were more active than Nurse sharks before feeding with respect to curiosity. The average numbers of observed curious behaviors were 12.17+/-11.83 per shark per visit versus 1.56+/-1.94 per shark per visit, respectively. The hypothesis was accepted. The sharks observed in captivity in this study were less aggressive than their counterparts in the wild. There may be a number of reasons for this, such as less competition for food and lack of stimulation. Studies of this nature may provide an animal model for studying similar human behaviors. Future studies will include additional aquaria over longer time periods. This work was supported by Grant 2R25GM06003-05 of the Bridges to the Baccalaureate Program of NIGMS and Grant 0537101091 of the CSTEP Program of the NYS Department of Education. Jenkinson's Aquarium in New Jersey is acknowledged for their generous help with this project.

Introduction

Sharks in captivity don't often fare well in unnatural environments, such as aquaria. The expenses and care necessary to provide for these animals are often times beyond the capacity of what humans are currently capable of. Yet, research into the lifestyle of these animals and the effects of having them in captivity do help further our knowledge and, consequently, our ability to care for them. Sharks play an intricate part in the global food chain, so the opportunity to study these amazing creatures is a gift we should not take lightly. The species of sharks that we can keep in captivity serve as a template to expand our knowledge of their behavior. Yet, we can only do that by making these unnatural environments as "natural" as possible. In studying the effects of various aquaria on their shark inhabitants, relationships were sought between their behavior and the tanks themselves. By comparing our data to known shark behaviors in the wild we sought to determine if these habitats are viable homes for the sharks.

Hypothesis

Sharks in captivity will be less aggressive than those in the wild.

Materials

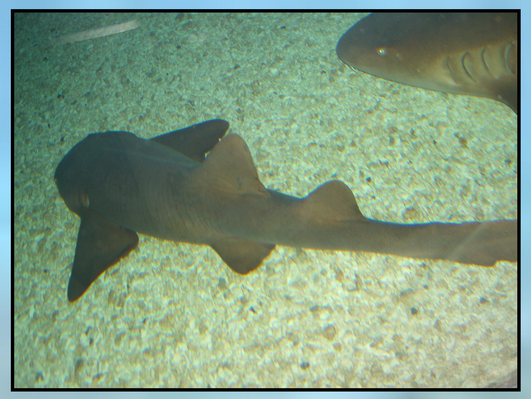
1. Notepad
2. Pen
3. Camera
4. Microsoft Excel Software
5. Wetsuit
6. Snorkel & Goggles

Methods

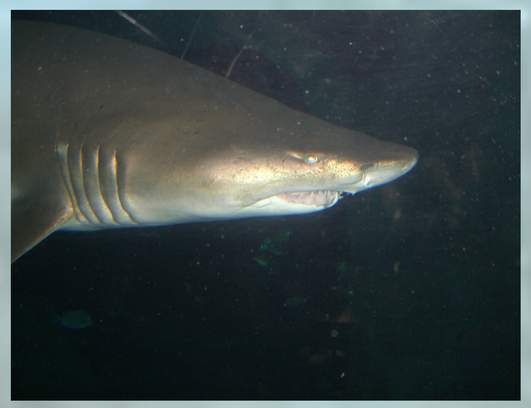
To execute this research project we first had to choose which aquaria to visit in order to collect data. We researched local aquaria and contacted their staff to decide if their respective aquaria would satisfy the requirements of the project. Decisions were based on proximity and which sharks inhabited the aquaria. We decided upon four aquaria: Adventure Aquarium in New Jersey (550,000 gal), National Aquarium in Baltimore (225,000 gal), New York Aquarium (90,000 gal), and Jenkinson's Aquarium in New Jersey (58,000 gal). Tank shape also played a role in the decision. Adventure Aquarium and New York Aquarium both had tanks with perpendicular corners. National Aquarium was rounded, and Jenkinso's Aquarium formed a semi-circle. We narrowed what we would observe to three species of shark: Sand Tiger (*Carcharias taurus*), Nurse (*Ginglymostoma cirratum*), and Sandbar (*Carcharhinus plumbeus*). We decided to narrow the number of shark species we studied because of the numerous species of sharks that the various aquaria offered. We chose these three particular species because of their frequency throughout the aquaria. The Sand Tiger shark and the Nurse shark were featured in all of the aquaria, and the Sandbar shark was featured in all, but one. We decided to remain with the Sandbar shark because they were often the most active and provided a good deal of data. Our research is based upon the behavior observations of the sharks before, during, and after feeding. We tried to observe the sharks for one hour before feeding, the entire duration of the feeding (usually around 20 min), and one hour after feeding to record the data. Depending upon the feeding schedules of the aquaria, observation times would vary as we would not be able to observe for an entire hour. Four common shark behaviors were chosen to observe based on research of these species prior to beginning observations. The behaviors included: biting, fast swimming, motionless/rest, and curiosity. A miscellaneous category was added for any activity that didn't fit properly in the other behaviors. Each aquarium was visited three times on feeding days. Aquaria were visited three times each because most aquaria would feed their sharks three times weekly.

Mario Flunory in shark tank

Sandbar Shark
(Carcharhinus plumbeus)



Nurse Shark
(Ginglymostoma cirratum)



Sand Tiger Shark
(Carcharias taurus)

Results

Nurse Shark

BEFORE FEEDING	Jenkinson (58K Gal)	Baltimore (225K Gal)	New York (90K Gal)	Adventure (550K Gal)	*Average*	*Standard Deviation*
Biting	0	0	0	0	*0*	*0*
Fast Swimming	0	1.63	0	0	*0.41*	+/-0.82
Motionless/ Rest	1.22	0	1.00	0.67	*0.72*	+/-0.53
Curiosity	4.00	2.25	0	0	*1.56*	+/-1.94
Miscellaneous	1.11	0	0	0	*0.28*	+/-0.55
DURING FEEDING						
Biting	0	0	0	0	0	0
Fast Swimming	0.33	0	0	0	0.08	+/-0.17
Motionless/ Rest	0	0	0	0	0	0
Curiosity	1.67	1.13	5.83	0.33	2.24	+/-2.46
Miscellaneous		0	0	0	0.11	+/-0.22
AFTER FEEDING						
Biting	0	-	0	0	0	0
Fast Swimming	0	-	0	0	0	0
Motionless/ Rest	2.00	-	2.00	0.33	1.44	+/-0.96
Curiosity	3.67	-	0.67	0	1.45	+/-1.95
Miscellaneous	0.22	-	0.33	0	0/18	+/-0.17

Sand Tiger

BEFORE FEEDING	Jenkison (58K Gal)	Baltimore (225K Gal)	New York (90K Gal)	Adventure (550K Gal)	*Average*	*Standard Deviation*
Biting	0	0	0	0	0	0
Fast Swimming	0	0	0	0.11	0.03	+/-0.06
Motionless/ Rest	0	0	0.13	0	0.03	+/-0.07
Curiosity	28.33	5.75	13.20	1.39	12.17	+/-11.83
Miscellaneous	0.33	0	0.07	0.08	0.12	+/-0.14
DURING FEEDING						
	Jenkison (58K Gal)	Baltimore (225K Gal)	New York (90K Gal)	Adventure (550K Gal)	*Average*	*Standard Deviation*
Biting	0	0	0	0	0	0
Fast Swimming	0	0	0	0.06	0.02	+/-0.03
Motionless/ Rest	0	0	0	0	0	0
Curiosity	5.17	5.50	5.73	0	4.1	+/-2.74
Miscellaneous	0.17	0.50	0	0.06	0.18	+/-0.22
AFTER FEEDING						
	Jenkison	Baltimore	New York	Adventure (550K	*Average*	*Standard*
Biting	0	-	0	0	0	0
Fast Swimming	0	-	0	0	0	0
Motionless/ Rest	0	-	0.20	0	0.07	+/-0.12
Curiosity	19.50	-	17.27	0.61	12.60	+/-10.43
Miscellaneous	0.33	-	0.13	0	0.15	+/-0.17

Sandbar

BEFORE FEEDING	Jenkinson (58K Gal)	Baltimore (225K Gal)	New York (90K Gal)	Adventure (550K Gal)	*Average*	*Standard Deviation*
Biting	0	0	-	0	0	0
Fast Swimming	0.50	0.25	-	0.19	0.31	+/-0.16
Motionless/ Rest	0	0	-	0	0	+/-0
Curiosity	43.67	1.00	-	3.69	16.12	+/-23.90
Miscellaneous	2.17	14.50	-	0.74	5.80	+/-7.56
DURING FEEDING						
	Jenkinson (58K Gal)	Baltimore (225K Gal)	New York (90K Gal)	Adventure (550K Gal)	*Average*	*Standard Deviation*
Biting	0	0	-	0	0	0
Fast Swimming	0.33	0	-	0.14	0.16	+/-0.17
Motionless/ Rest	0	0	-	0	0	0
Curiosity	6.17	0.75	-	0.19	2.39	+/-3.30
Miscellaneous	0.83	15.50	-	0	5.44	+/-8.72
AFTER FEEDING						
	Jenkinson (58K Gal)	Baltimore (225K Gal)	New York (90K Gal)	Adventure (550K Gal)	*Average*	*Standard Deviation*
Biting	0	-	-	0	0	0
Fast Swimming	0	-	-	0.10	0.05	+/-0.07
Motionless/ Rest	0	-	-	0	0.07	+/-0.12
Curiosity	39.50	-	-	2.86	21.18	+/-25.91
Miscellaneous	1.50	-	-	0.81	1.16	+/-0.49

Discussion

For each of the three species studied, the number of behaviors observed, per shark, per visit were calculated. No aggressive biting was observed before, during or after feeding in any shark. The primary shark behavior observed was curiosity in all four aquaria. The sharks displayed minimal fast swimming. This may be attributed to the limitations of tank size. The sharks tended to be more motionless or at rest after feeding, perhaps because they were satiated. More activity was observed in Nurse sharks in Jenkinson's (58000 gal) and New York Aquaria (90000 gal) as compared to Baltimore (225000 gal) and Adventure (550000 gal) aquaria. Tank size may be a factor. The Sand Tigers were more active than Nurse sharks before feeding with respect to curiosity. The average numbers of observed curious behaviors were 12.17+/-11.83 per shark per visit versus 1.56+/-1.94 per shark per visit, respectively.

The data show a trend of behaviors that seemed to be regulated by both shape and size of the tanks. The sharks in the rounded tanks exhibited more activity overall than those in the tanks with perpendicular corners. This may be due to the fact that sharks are more adapted to circular boundaries, and do not navigate perpendicular corners as well. The data also depict that the sharks in the smaller tanks show an increase in curiosity when compared to those in the larger tanks. This can be attributed to the confined space within the tanks. With less room and limited mobility they may be more aware of the larger area and free moving organisms outside the tanks.

The sharks observed in captivity in this study were less aggressive than their counterparts in the wild. There may be a number of reasons for this, such as less competition for food and lack of stimulation. There is a limit to the amount of stimuli (coral, submerged objects, etc.) that can be placed in a confined environment. Individual personalities of the sharks may also explain certain patterns of behavior. While general behaviors are attributed to specific species of sharks, individual behavior must also be taken in to account as some of the sharks observed tended to be more likely than others to behave in certain ways. Studies of this nature may provide an animal model for studying similar human behaviors. Perhaps eating patterns in humans with abnormal behavior may help to moderate aggressive demonstrations. Future studies will include visiting additional aquaria over longer time periods. The data taken here are preliminary and require further study.

Conclusion

Based on the results of this study, the sharks observed here in captivity were less aggressive than their wild counterparts. They mimic the overall behavior of their species, yet showed decreased aggression, perhaps because of the non necessity of competition for resources. They seem to be affected by the unnatural environment, but not radically enough to be considered unhealthy. Therefore, the hypothesis is supported: the sharks in captivity were less aggressive than those in the wild.

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Acknowledgements

This work was supported by Grant 1R25GM62003 of the Bridges to the Baccalaureate Program of NIGMS and Grant 0516051091 of the CSTEP Program of the New York State Department of Education. Jenkinson's Aquarium in New Jersey is acknowledged for their generous help with this project.

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