THE PEW ENVIRONMENT GROUP

Considering Shark Biology in Management

Swell Shark (*Cephaloscyllium ventriosum*) egg cases with embryos.

The population growth of any species depends on such life-history characteristics as the age at which the species can begin reproducing, how long it will live, and how many offspring it will have. These factors are also useful in predicting how quickly a population can recover from human activities such as fishing. With many of the world's shark populations declining, it is important to examine shark life-history characteristics and their management implications.

COMPARING SHARKS, OTHER FISH, AND MAMMALS

In most cases, bony fish—even those that reach large sizes—develop relatively quickly, reach sexual maturity at an early age, can reproduce often, and produce many offspring. For example, swordfish mature by age 5 and can spawn multiple times a year, and females produce millions of eggs. In comparison, sharks grow slowly, mature later in life, reproduce as infrequently as once every three years, and produce few offspring.

The life histories of many sharks are more similar to those of large mammals than other fish. For example, dusky sharks, sperm whales, and brown bears each have gestation periods – the period from conception to birth – of more than a year. They also have few offspring, give birth to live young, and reproduce only once every few years. Female dusky sharks in the Atlantic Ocean do not mature until age 21, while female sperm whales and brown bears mature at about nine years.

In each of these instances, the animal's life-history characteristics impact the entire population's ability to grow. For example, a female shark that produced 10 pups every two years for 20 years would add only about 100 individuals to the population. In contrast, a female swordfish could theoretically contribute millions of offspring, and it is possible that thousands of these could survive if natural mortality from predators, disease, or starvation was low.

MANAGEMENT IMPLICATIONS

Because of their life histories, sharks cannot quickly replenish their populations after high levels of fishing mortality, unlike many other species of fish. The management approaches used for large mammals may therefore suggest more appropriate techniques for use with sharks. Numerous shark species have already experienced steep population declines; below are two examples of management measures for mammals that have undergone similar losses to their populations.

Sperm whales were heavily exploited during the 20th century, and early efforts to allow whaling while rebuilding sperm whale populations failed. In 1982, the International Whaling Commission imposed a global moratorium on commercial whaling that remains in effect today. In addition, trade in sperm whale products is strictly regulated under Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the species is protected by Appendixes I and II of the Convention on Migratory Species. Some countries have additional measures. For example, the United States protects sperm whales under the Endangered Species Act (ESA) and the Marine Mammal Protection Act.

Brown bears are also strictly managed using a variety of international and national approaches after a history of exploitation. A variety of factors, including habitat loss, caused their populations to decline until international trade in brown bear products was regulated through listings in CITES Appendixes I and II. U.S. protections include prohibitions by the ESA on hunting in some parts of the country, and in areas of Canada through the Species at Risk Act.

In contrast, conventional marine fisheries management focuses on maximizing the sustainable yield of the population. Common regulations

Summary

1. **Life-history characteristics help determine how quickly the population can grow and what management approaches are most appropriate.**
2. **Sharks are often managed like other fish, but their life histories are more similar to mammals'.**
3. **Management of large mammals may suggest useful approaches for shark management.**

Sharks: Not Like Other Fish

Given the slow rate at which many shark species reproduce, their populations can quickly be depleted by human activities like fishing. It is important to consider different management approaches for sharks than those used for fish, which can generally reproduce faster than sharks.

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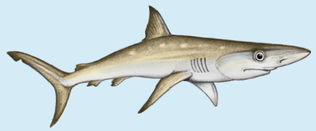
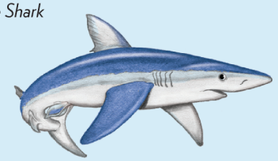
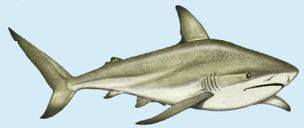
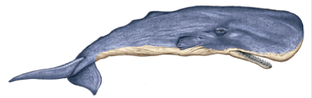
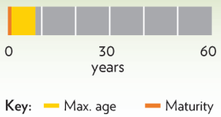
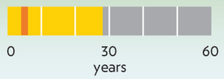
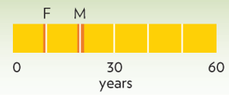
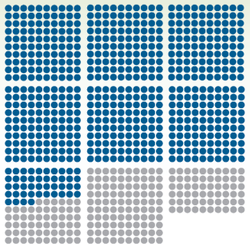
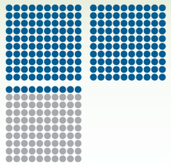
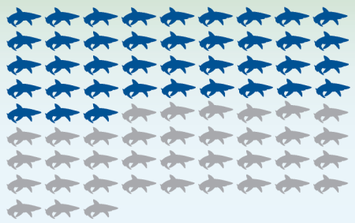
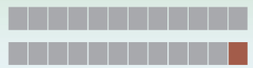
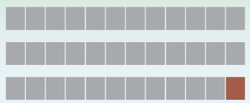
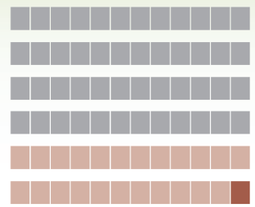
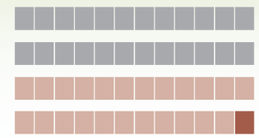
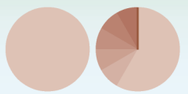
OTHER FISH		SHARKS			MAMMALS	
Spanish Mackerel	*Swordfish*	*Atlantic Sharpnose Shark*	*Blue Shark*	*Dusky Shark*	*Sperm Whale*	*Grizzly Bear*
						
Lifespan: Many shark species can live longer than other fish and reproduce later in their lives.						
						
Litter Size: Sharks produce far fewer offspring than other fish.						
Up to 4.3 million eggs	Up to 1.5 million eggs	1 to 8 pups	27 to 75 pups	3 to 14 pups	1 whale	1 to 3 cubs
						
Up to 75% survive per day	*Up to 70% survive per day*	*Up to 34% survive to adulthood*	*54% survive to adulthood*	*Up to 98% survive to adulthood*	*91% survive to adulthood*	*Up to 88% survive to adulthood*
Capacity to Reproduce: Sharks reproduce infrequently compared to other fish.						
Multiple times per year	Multiple times per year	Once a year	Every 2 years	Every 3 years	Every 4 to 6 years	Every 2 to 4 years
						
Gestation Length: Sharks carry their young longer than some mammals.						
25 hours	2.5 days	11 months	9 to 12 months	24 months	15 months	8 months
						

include large quotas or catch limits, gear restrictions, size limits, and seasonal or area closures, and fisheries are generally permitted to remove a significant share of the population. Biological factors such as life span, litter size, and reproductive cycles limit the ability of shark populations to recover from intense fishing pressure.

CONCLUSION

Many sharks have life-history characteristics that more closely resemble large mammals than other fish. Conventional fisheries management approaches, therefore, may not be sufficient to halt or rebuild the ongoing declines in many shark populations. Some of the more stringent approaches used to conserve and reverse declines in large mammals may be appropriate for sharks as well.

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