



Larry Hogan, Governor
Boyd Rutherford, Lt. Governor
Mark Belton, Secretary
Joanne Throwe, Deputy Secretary

MEMORANDUM

October 18, 2016

TO: The Sport and Tidal Fisheries Advisory Commissions
FROM: Fishing and Boating Services staff
RE: Background Information on Cownose Rays -
Summary of updated science: 2016 Cownose Ray Study

The department is currently scoping a regulation to declare cownose rays 'in need of conservation' which gives the department authority to place reasonable guardrails on the taking of cownose rays, thereby preventing a sudden and potentially insupportable increase in harvest. This memo summarizes the most recent science which indicates that cownose rays are sensitive to additional sources of mortality including fishing, and that cownose rays are not likely to threaten oyster populations within Chesapeake Bay.

In 2007 an article¹ was published in the journal *Science* that claimed to demonstrate that a severe decline in coastal sharks had 'released' cownose rays from predation, allowing the cownose ray population to grow unchecked and decimate commercial bivalve (e.g. oyster) stocks. This article has been widely cited (946 citations according to Google Scholar) and garnered wide media coverage, leading to the widely accepted notion that the decline in sharks has led to an increase in cownose rays which are ecologically destructive to the Bay ecosystem. This series of events caused by the removal of a top predator (sharks) is known as a trophic cascade.

In 2016, a group of eight leading shark and ray experts published a new peer reviewed study in the *Nature* journal *Scientific Reports*² that reexamined the data used in the 2007 study along with additional survey and stock assessment data and strongly challenged many of the conclusions of the 2007 study. This new study critically examines criteria that would need to be met for the existence of a trophic cascade. These criteria include: 1) whether the decline in large coastal sharks actually coincides with an apparent increase in cownose ray abundance; 2) whether the commercial bivalve stock declines coincide with the apparent increase in cownose rays abundance; and 3) whether the cownose ray population is capable of rapid growth. The authors not only find weak or contradictory evidence in support of a trophic cascade but also find the 2007 study mis-used and misinterpreted survey data. The authors of the 2016 study emphasize that inferring population wide trends from limited survey data can lead to spurious conclusions that are counterproductive to conservation and management policies.

Did a severe decline in large coastal sharks allow the cownose ray population to grow unchecked?

¹ Myers, R. A., Baum, J. K., Shepherd, T. D., Powers, S. P., & Peterson, C. H. (2007). Cascading effects of the loss of apex predatory sharks from a coastal ocean. *Science*, 315(5820), 1846-1850.

² Grubbs, R. D., Carlson, J. K., Romine, J. G., Curtis, T. H., McElroy, W. D., McCandless, C. T., ... & Musick, J. A. (2016). Critical assessment and ramifications of a purported marine trophic cascade. *Scientific reports*, 6.

- While the 2007 study relied solely on the University of North Carolina (UNC) longline survey to detect shark abundance trends, the new study also included information from stock assessments and the VIMS longline survey. The UNC longline survey is based on two fixed stations with very limited geographic scope for inferring population wide trends. For many shark species the trends between the UNC and VIMS survey do not agree and in fact show increasing trends since the 1990s when at the same time cownose rays were supposedly released from predation.
- The authors of the 2016 survey caution that stock assessments which include multiple sources of data are more robust than simply relying on individual sources of survey data for inferring population wide trends: “Considering all data sources, we conclude that large coastal shark populations did decline during the 1970 s and 1980s, but not as dramatically as described and these populations have at least started to recover. In addition, several other shark populations have been recovering since the 1990s when the U.S. initiated management of federal shark fisheries. These results illustrate the dangers of broadly interpreting results from a single index with limited scope and applying those results to an entire population.”

Did an increase in cownose ray abundance cause the collapse of commercial shellfish stocks along the Atlantic seaboard?

- Various survey data appear to show an increasing trend in cownose ray abundance during the 1990s. However, commercial shellfish stocks had previously experienced very well-documented long-term declines due to harvest, disease, and pollution. In Chesapeake Bay oysters had already reached low levels by the 1980s.
- The 2016 study concludes: “Cownose rays are natural predators in these systems and may inhibit some efforts to mitigate for shellfish stock declines that resulted from overfishing, disease, and habitat loss, but there is no evidence that cownose rays were the cause of the declines, but rather have been portrayed as scapegoats for these declines.”

Has the cownose ray population grown dramatically in abundance?

- There is no stock assessment which examines the status of the cownose ray population or whether it has increased.
- Cownose rays exhibit life history characteristics which limit their potential for population growth. In particular, they exhibit one of the lowest lifetime fecundity estimates (<14 offspring) of any fish species due to their late age at maturity (7-8 years) and low annual fecundity of one offspring per year. Given these limits on reproductive capacity it is therefore unlikely that cownose rays have undergone rapid population growth at any time.
- The intrinsic rate of population growth (r) estimated for cownose rays (-0.018 per year to 0.032 per year) indicates that cownose rays are the least productive of any shark, ray, or skate species.
- In the 2007 study various surveys displayed apparent increasing trends in cownose ray abundance. However, these surveys were not designed to detect cownose ray abundance and in all of them cownose rays are rarely caught. For example, the MD DNR seine survey is designed to detect the abundance of young-of-the-year rockfish and from the time series used to show an increasing trend in cownose ray abundance (1976 to 2003) only 26 rays were ever caught in thousands of seine hauls. The apparent increase in cownose rays is therefore more likely related to changes in distribution rather than relative abundance.