

American Eel in the Chesapeake Bay Watershed

Nick Walker and colleagues provide an overview of the stock assessment, prioritization of habitat and passage, and cultural significance of American eel (*Anguilla rostrata*) in the Chesapeake Bay watershed on the Atlantic coast of the United States.

The Atlantic States Marine Fisheries Commission is an interstate partnership to manage and protect migratory fishery resources. The Commission's American Eel (*Anguilla rostrata*) Fishery Management Plan began in 1999 and the most recent stock assessment was conducted in 2012. The assessment found eels are depleted, with multiple factors responsible including commercial fishing, parasites (e.g. the invasive nematode *Anguillicoides crassus*), anthropogenic habitat modification including environmental pollutants, habitat destruction and barriers to fish passage; climate change, and changes to the Sargasso Sea. The American eel is now at <1% of historic levels, with habitat also greatly reduced and degraded.

Since then, American eel has been reviewed twice by the United States Fish and Wildlife Service for consideration on the Endangered Species List. Both times, the agency has determined that listing is not warranted, although it is considered endangered by the IUCN Red List.

The Chesapeake Bay is the largest estuary in North America and includes parts of New York, Pennsylvania, Virginia, Maryland, Delaware, Washington D.C. and West Virginia, although the latter is not a member of the Atlantic States Marine Fisheries Commission. The Potomac River, between Maryland and Virginia, is also considered its own fishery, the Potomac River Fisheries Commission. Only yellow eels may be harvested in the Chesapeake Bay region (no glass eels). Regulations are separate for commercial and recreational fishing.

There are no commercial fisheries in Pennsylvania and Washington D.C. Everywhere else, regulations vary, although the Chesapeake Bay states share the commonality of a 0.5 x 0.5 inch mesh size for eel pots and a minimum 9 inch yellow eel size (except New York, which has a 6 inch minimum). New York also requires a commercial licence, places some restrictions on gear and a 14 inch maximum length in some rivers. In Maryland, only eel pots, baited traps and spearfishing are allowed between September and December. No commercial

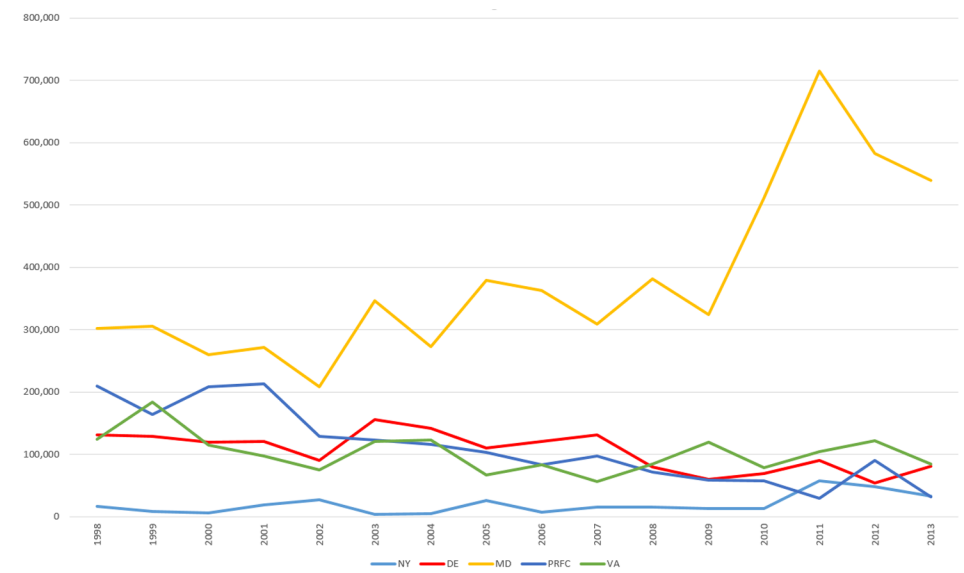


Figure 1. Yellow eel landings in Chesapeake Bay states, 1988-2013. Based on Addendum IV to the Interstate Fishery Management Plan for American Eel by the Atlantic States Marine Fisheries Commission, Oct. 2014.

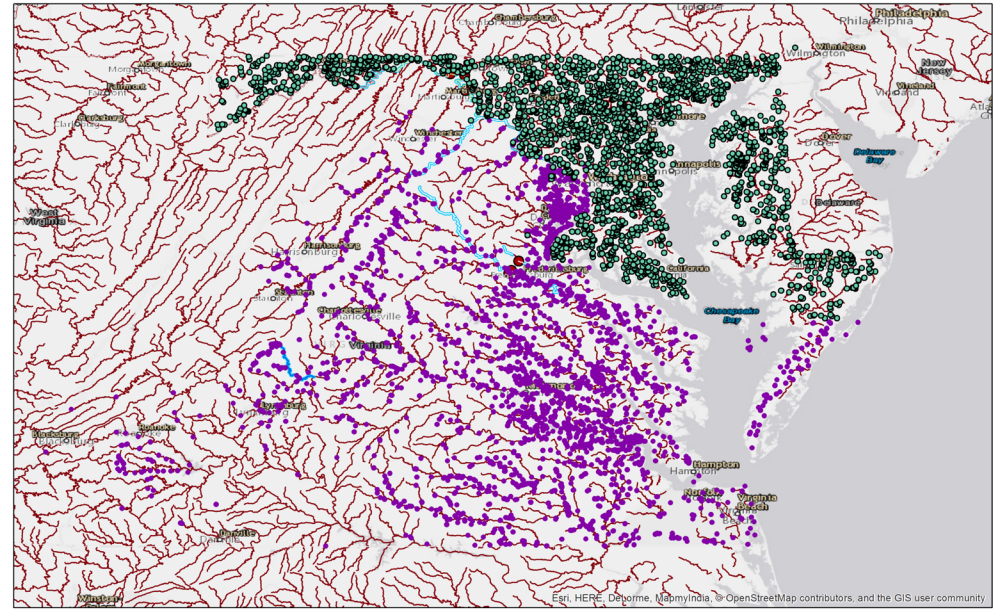


Figure 2. A partial map of eel collection data in the Chesapeake Bay watershed. Green dots indicate the presence of eels in Maryland and Potomac River Fisheries Commission; Purple dots indicate eels in Virginia. Based on Walker 2017 (unpubl. data).

fishing is allowed in tidal waters. Crabbers can use up to 50 eel pots per day. In Delaware a commercial licence is required and fishing is allowed in tidal waters only. In Virginia, a 4 inch x 4 inch escape panel is required for eel pots. From September to December, only pots and traps are allowed (no trawling), in addition to some seasonal closures. In the Potomac River Fisheries Commission, licence fees and a commercial eel pot licence are required. Eel pots may be up to 10 feet in length and are the only gear allowed from September to December. Pound nets must use approved fish cull panels.

For recreational fishing, all Chesapeake Bay states have a 9 inch minimum yellow eel size (with a 14 inch maximum in some rivers in New York). New York, Pennsylvania, Maryland, Virginia and the Potomac River Fisheries Commission limit individuals to 25 eels per day. In New York, Pennsylvania and Virginia, charter boats may take up to 50 eels per day. Virginia requires a recreational licence and has a two pot limit. Delaware has a limit of 50 eels per person per day and a two pot limit. Washington D.C. allows up to five eel traps per person and a maximum of 10 eels per day.

With the exception of Pennsylvania and Washington D.C., the Atlantic States Marine Fisheries Commission states have conducted young-of-the-year surveys to document the numbers of first-year elvers. In 2014, Delaware and Maryland had above average young-of-the-year counts, but counts were below average everywhere else and were in some cases the lowest numbers ever recorded. Yellow eel landings increased in Maryland and Potomac River Fisheries Commission, but declined in New York and Delaware. Yellow eel landings in the Chesapeake Bay states from 1988 to 2013 are shown in Fig. (1).

Several challenges exist for estimating eel abundance. This is because eels are panmictic, highly variable in individual growth and recruitment, and are affected by size-dependent (rather than age) biological parameters. Landings alone may not tell the whole story. For example, in Delaware, horseshoe crab management meant the preferred eel bait was no longer available, which meant a lot of fishermen chose to exit the fishery rather than

pay more for a less optimal bait. So, although Delaware has had a lower number of landings from 2007-present, this may not necessarily mean fewer eels. In addition, the Atlantic States Marine Fisheries Commission is limited by a lack of data on American eel.

To help improve available data, we have compiled a dataset (from dozens of sources) with observations of over 1.8 million individual American eels in the Chesapeake Bay region, 1970-present. It features over 100 variables, including biological factors such as eel abundance, location, length, life stage, incidence of parasitism and sex; and environmental factors, such as water temperature, salinity, environmental contaminants, riparian buffers, barriers and fishing pressure. A map showing some of the sites where American eel have been sampled in Virginia and Maryland (approx. 25% of the total data) is shown Fig. (2). The goal is to use these data to prioritise conservation management decisions to maximise efficiency in improving fish passage and habitat conservation, building upon the work of The Nature Conservancy's Fish Habitat Decision Support Tool <http://www.fishhabitattool.org> www.fishhabitattool.org

Finally, a conservation plan for eels must improve the public perception of this species and show why they are important ecologically, culturally and economically. Eels are food for many birds and mammals. *Elliptio* mussel larvae latch onto eels for transport. The rainbow snake, as an adult, feeds exclusively on eels. Eels were an important source of food for several American Indian tribes. The Nanticoke Nation still has an eel pot on their flag. Eel were served at the first Thanksgiving and the Indians taught the colonists how to plant an eel with corn. Today, eels are important economically and provide a source of jobs and income. Recreationally, they are a way for people to connect with nature, since eels are an accessible species that can be found in almost any waterway. Because of this, eels can serve as a bio-indicator for stream recovery and aid in conservation efforts.



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