The Dameron-Kubiak Clam Dredge.

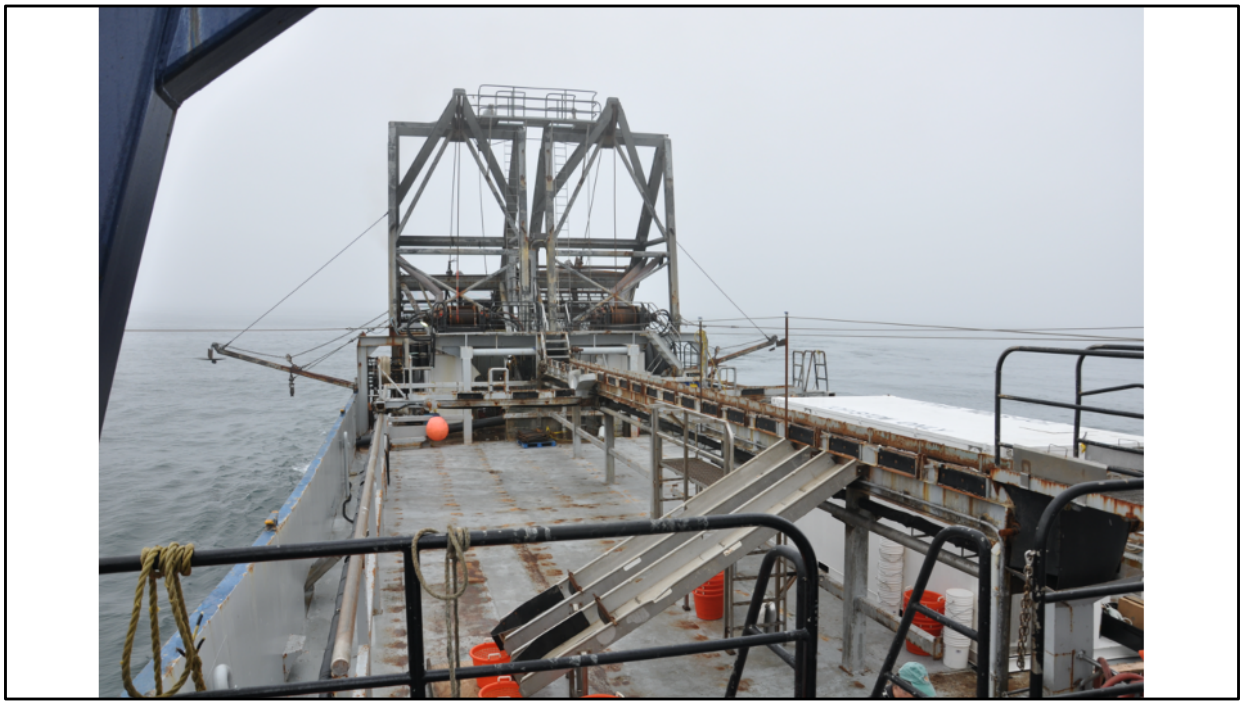
A SCeMFiS project to build and test a clam dredge to retain pre recruit to fishery sized clams in a quantitative manner.

The ocean quahog (OQ, *Arctica islandica*) is a very long lived species of clam that is fished in the Mid Atlantic and Georges Bank regions. Its geographic range extends from the Mid Atlantic to the Canadian Maritimes, Iceland, the northern European shelf and north to the Barents Sea. The fishery targets animals >65mm shell length (SL). These are robust and characterized by a black periostracum on the shell (left image). Periodicity and intensity of recruitment are important in resource management. Recruitment information is sparse because typical survey gear does not retain small clams. Given individual longevity (200 years is not considered rare) and slow growth rate, the minimum age at harvest is approximately 40 years. In 2014 the NEFSC-industry assessment survey employed the new Dameron-Kubiak dredge (DK, named after its designer Captain Tom Dameron and its fabricator Mr. Kubiak), designed to retain small quahogs in a quantitative manner, in a selectivity study (wire mesh lined dredge v DK dredge) south of Long Island. We provide a brief description of the dredge and its field trial.

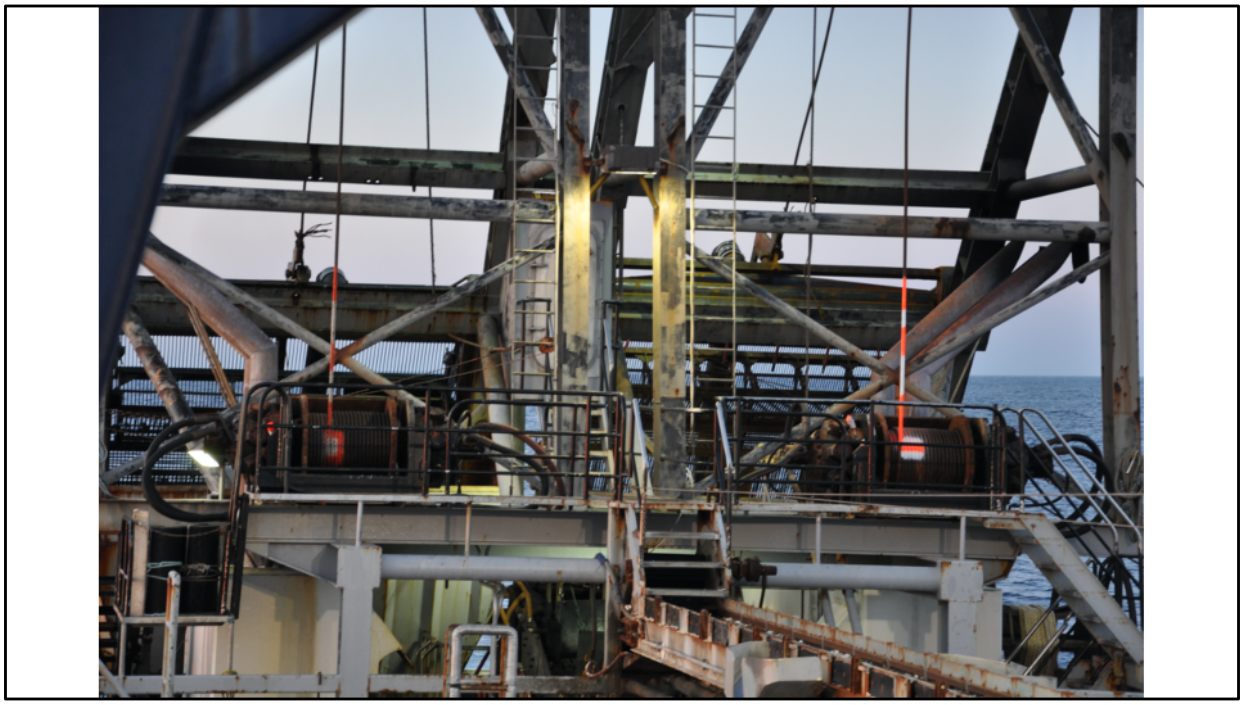
Pre recruit to fishery size ocean quahogs have a characteristic gold to mahogany colored periostracum (hence one of the common names - mahogany clams) and are very rarely retained in commercial dredges because the bar spacing in the dredge is purposely designed to collect larger clams while allowing sand, rocks, debris and small clams to pass through. The DK dredge was designed to collect these smaller clams, and thereby provide critical information on demographics (overall abundance and size frequency). In turn the material, once aged, provides a description of age structure in the pre recruit population, and thus recruitment to the population of small clams in recent years.

Surveys are completed aboard the F/V ESS Pursuit, a 164’ LOA twin dredge commercial vessel leased to the NEFSC for survey work. During surveys vessel operations are run by the commercial crew of six in cooperation with a science crew of nine led by NEFSC scientists. Operation is around the clock with a typical survey of two or three 5-day legs per annual survey. This view, taken at the Atlantic City NJ dock, shows the general arrangement of the Pursuit with forward wheelhouse and stern gantries for dredge operations.

The stern of the Pursuit carries two clam dredges, each on a dedicated gantry. In this stern view image the DK dredge is on the port gantry and a commercial dredge on the starboard gantry. The dredges operate independently of one another and each is deployed from the gantry with a haul wire from a hydraulic winch. Once the dredge makes contact with the bottom the wire is allowed to run slack as the dredge is hauled by a separate rope hauser (tow line). These are hydraulic dredges meaning high pressure water is supplied from the vessel to the dredge via a large, flexible pressure hose to a distribution manifold in front of the dredge blade. This manifold and blade arrangement will be described in later images. The high pressure hoses are clearly visible in this image. The hose for the port dredge is rolled on its reel adjacent to the port rail near the stern. That same hose lies over the top of the dredge as illustrated to feed the manifold. Coordinated handling of the deployment/haul wire, the towing hauser and the hydraulic hose is critical to dredge operation. Frictional pressure loss as water travels within the hose and logistics of handling long hoses limits scope in towing to 2:1 through 3:1 in typical operation.

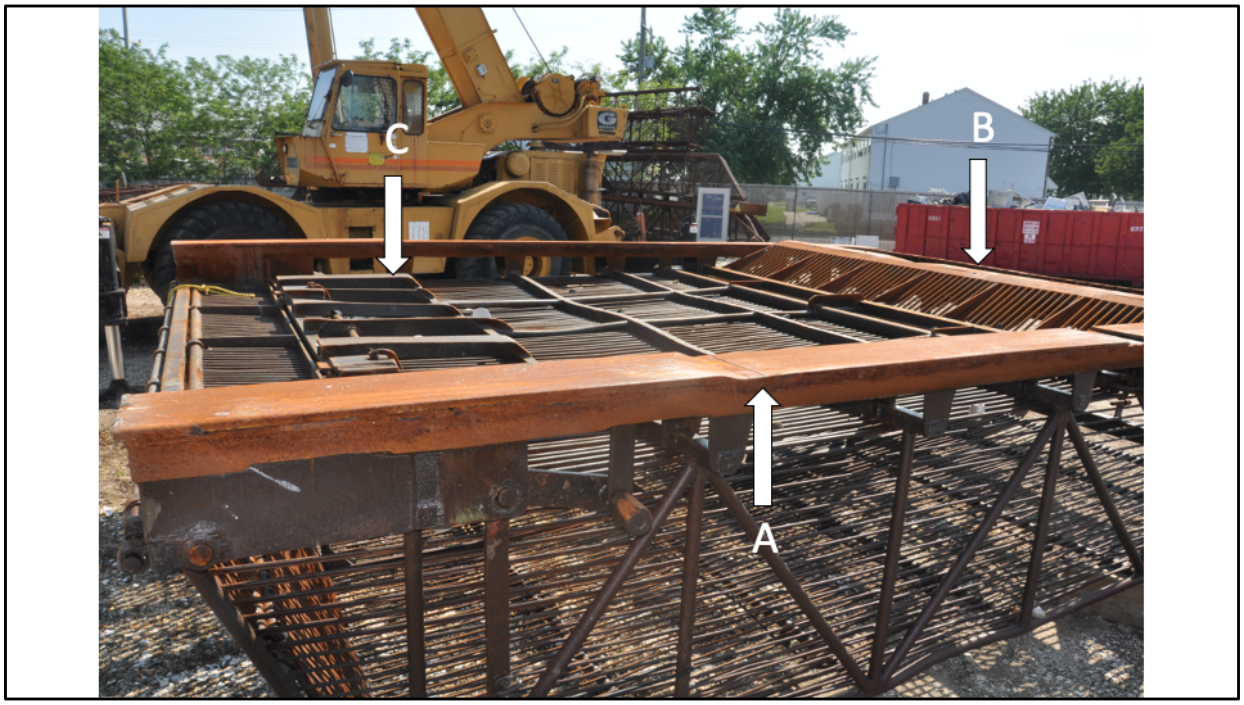


Looking aft from the wheelhouse along the work deck shows the open deck, that in fishing mode would be filled with cages for catch, the central high belt that feeds catch from the dredges to the cages, and the side by side arrangement of the stern gantries. The winches and winch wire to each dredge are clearly visible.

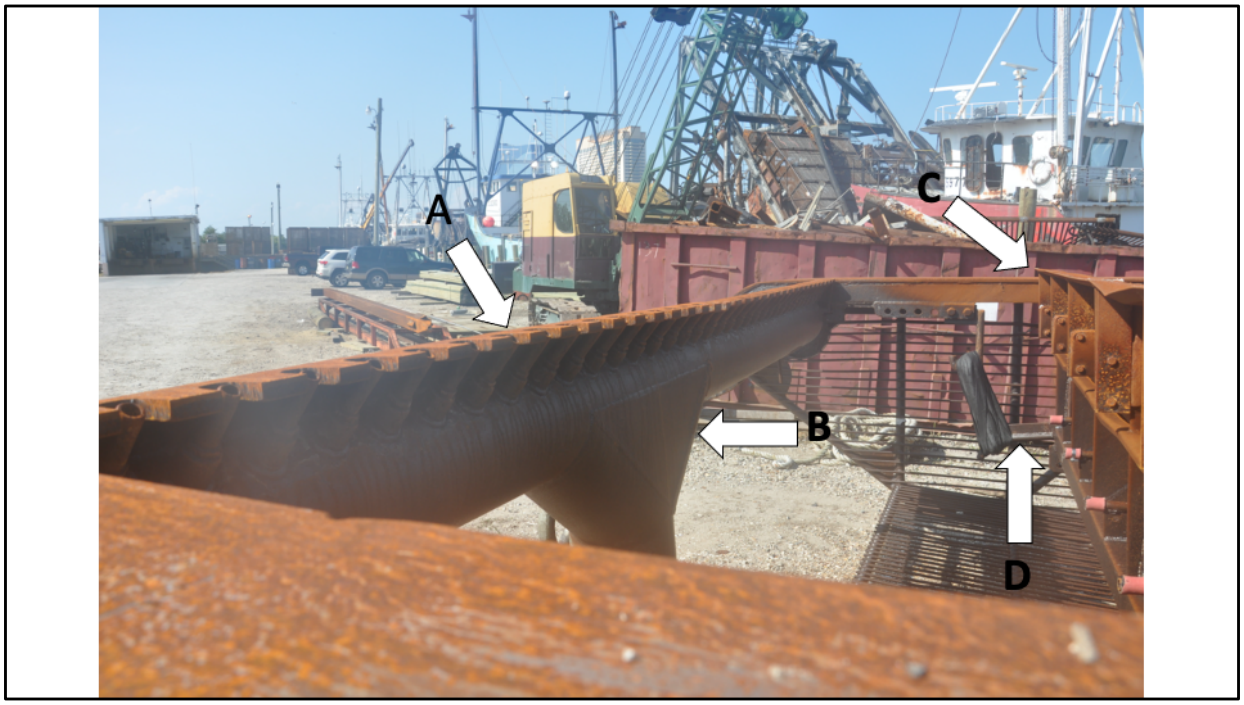


For survey use the winch wire is marked at intervals aid in release, retrieval and estimation of depth of operation. There are also extensive electronic instrument packages on the dredge to record bottom contact and time, depth, temperature and attitude of the dredge during tow.

The general structure of the dredge is a rectangular box with evenly spaced bars on the top, bottom, sides and back. The dredge rides on two runners that run along the sides of the bottom of the dredge. The outer frame of the dredge is heavily and diagonally braced. The floor at the rear of the dredge is a door that trips open as the dredge is hauled up the gantry, with the dredge content falling into a hopper. This door arrangement is shown in a later image. From the hopper a series of belts moves the catch to the open belt above the deck, as shown in an earlier image, where it can be sorted by the crew before loading to deck cages.



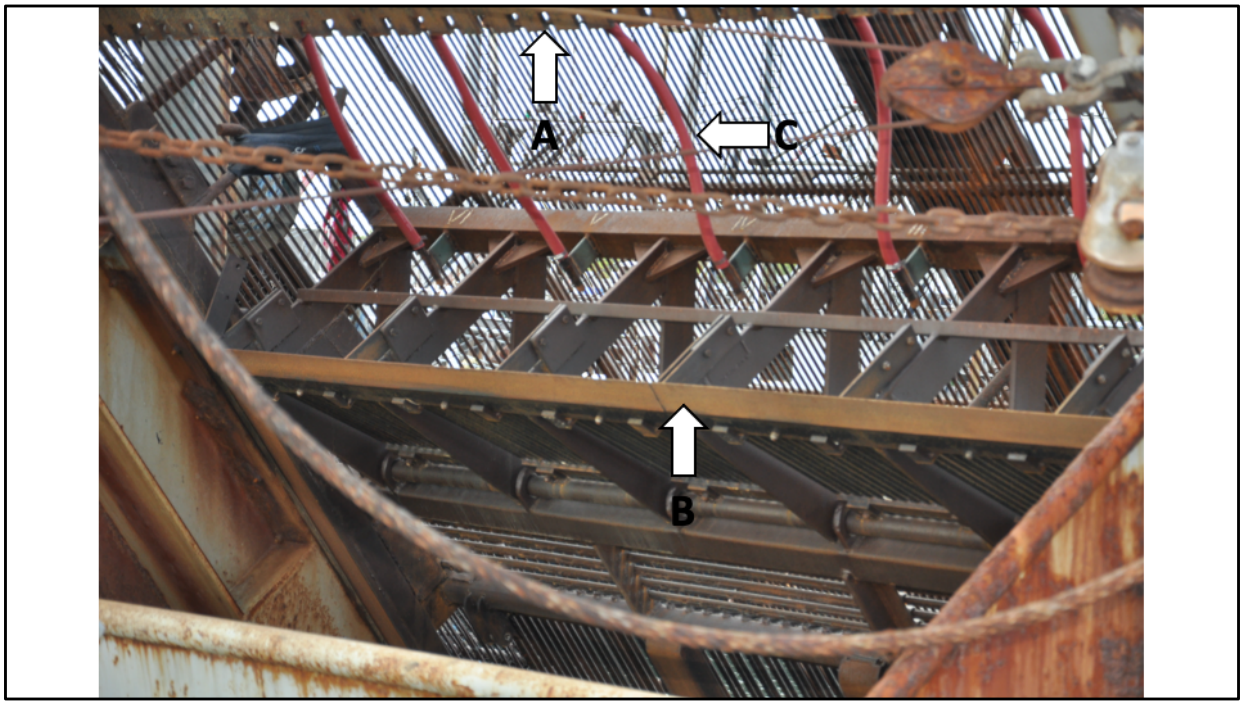
This view of an inverted dredge in the shipyard shows the runners (A), position of the knife (B) to the right (front of the dredge) and the door at the rear of the bottom of the door (C) that opens a the dredge is hauled up the gantry on retrieval.



The manifold (A) serves as both the leading edge of the dredge as seen in this image of an inverted dredge in the shipyard. One runner is in the immediate foreground. The manifold extends across from one runner to the other. High pressure water is supplied to the manifold down the large flexible pipe seen in previous images. The pipe feeds into the manifold through the triangular connection (B) seen here under the manifold (over the manifold when the dredge is in operating position. The leading edge of the knife (C) is seen in the far right of the image. Note the position of the barred sides and top of the dredge body with respect to the positions of the manifold and the knife. Finally, also note the adjustable lever (D) that sets the height of the blade with respect to the runners.

The relative positions of the manifold and knife are seen in this image of an inverted dredge in the shipyard. One runner of the dredge is in the immediate foreground. The manifold is on the extreme left, this image being taken from the corner of the base of the dredge. Moving right we view the knife blade extending upwards (in this image but downwards when the dredge is in operating mode) from the line of the runners. The space between the manifold and the knife is where the sediment is fluidized allowing the knife to lift the clams into the body of the dredge.

An alternate view of the manifold from below as the dredge rests on the gantry “right side up”. Again note the connection of the flexible hose and the line of high pressure nozzles that direct water into the sediment as the dredge is towed.

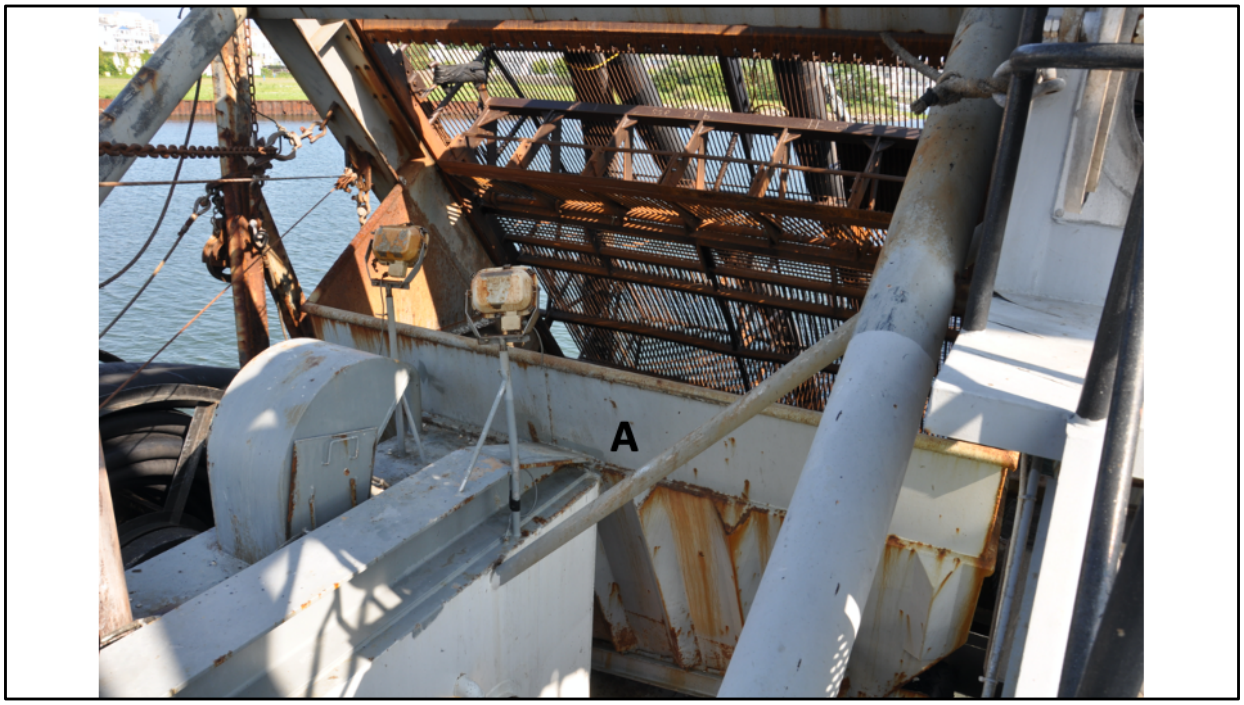


Moving under and to the side of the gantry allows a view of the underside of the dredge as it rests in position prior to release. The manifold (A) is in the very top left of the image and marks the leading edge of the front of the dredge when it is towed on the bottom. Moving backwards at the level of the sediment water interface there is an open space behind the manifold where the high pressure water fluidizes the sediment with the clams in this fluid mix. As the dredge is towed forward the knife (B) directs these clams upwards and backwards into the body of the dredge. The position of five of the six blow back pipes (C) are evident.

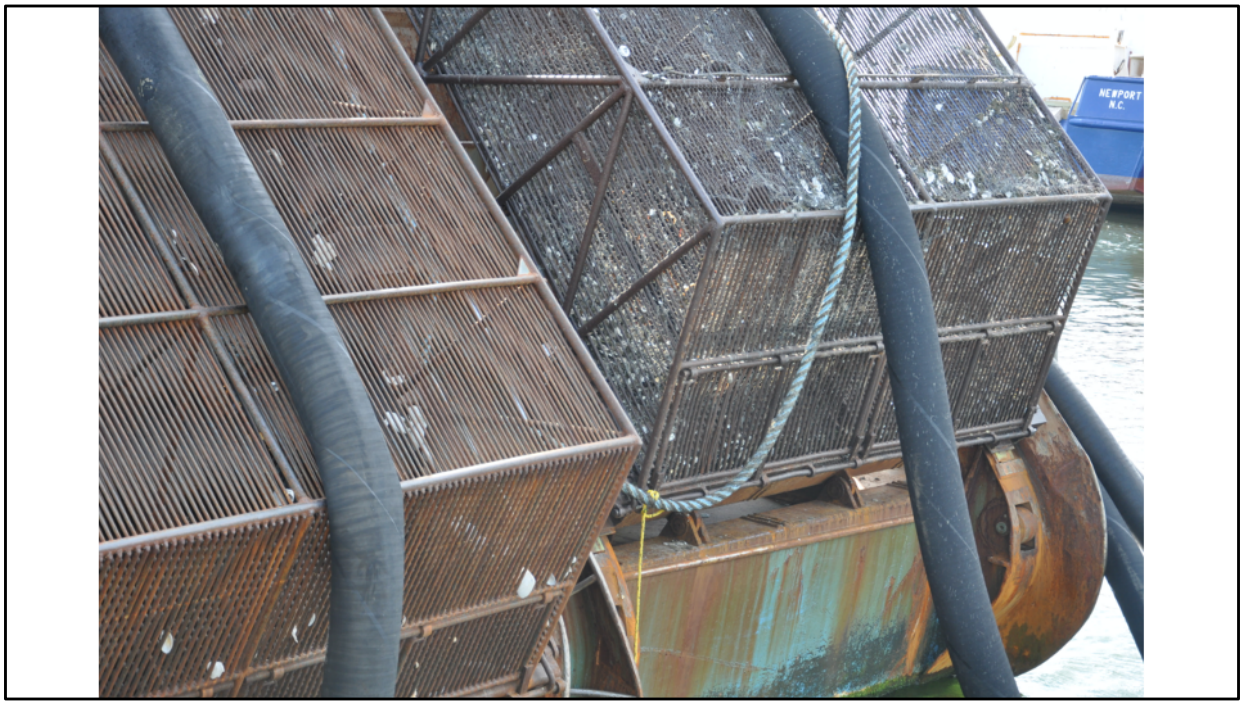
Knives are the most fragile part of the dredge and are designed to be replaced at sea as needed.

A closer view of an earlier image illustrates how the knife sections can be bolted into place (arrows) as a replacement action.

A side view of the front of the dredge shows the variable position of the tow point on the frame above the front of the enclosed section of the dredge. Note also the position of the red pipes of the blow backs – extra water jets from the hydraulic manifold that are directed back into the dredge to assist in washing sediment out of the catch and through the bars of the dredge.



A view of the underside of the dredge on the gantry from gantry superstructure. The dredge is low on the structure in this image, the large hopper into which the dredge empties is marked A.



A closer view of the DK (port) and commercial (starboard) dredges shows the experimental set up for the two dredges with the commercial dredge, as used in general surveys, lined with chicken wire to increase retention of small clams. Lined dredges have been used previously to catch pre recruit size clams but are prone to filling with sediment this compromising collection (lots of sediment, short tow lengths, not many clams, requirement for hand sorting the catch) and creating unsafe conditions where filled dredges challenge winch operation.

Note that although the chicken wire liner produces a limited “aperture” size the mesh pattern, as opposed to the long rectangular spaces between bars on the DK dredge, increases the opportunity for the lined dredge to fill with sediment and other fauna.

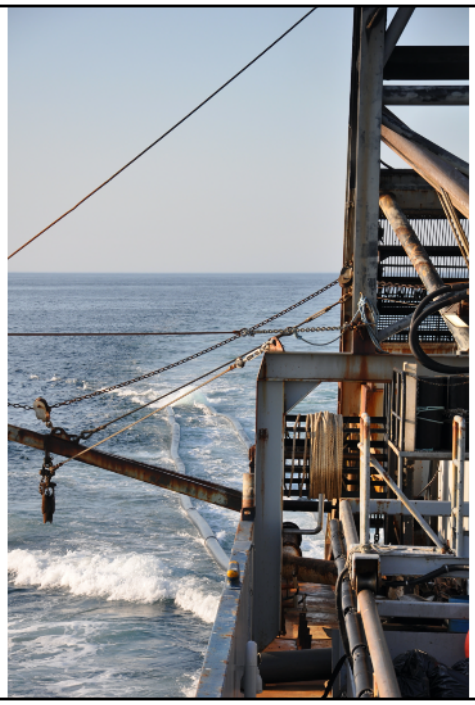
The floor of the DK dredge is unique in that alternating bars can be raised or lowered thus increasing or decreasing the spacing between adjacent bars. The minimum spacing is 20 cm. The design spacing is discussed in an accompanying document and dictated by the shape and size of the target size clam to be retained.

This close up shows the mounting points of the alternating bars. Moving the alternate bars upwards increases between bar spacing.

This close up shows the mounting points of the alternating bars.

The difference in bar spacing between the wire lined commercial dredge (left) and the DK dredge (right) is small but significant. Note also the obvious challenge with passing sediment (not clogging) caused by the chicken wire liner in the lined dredge.

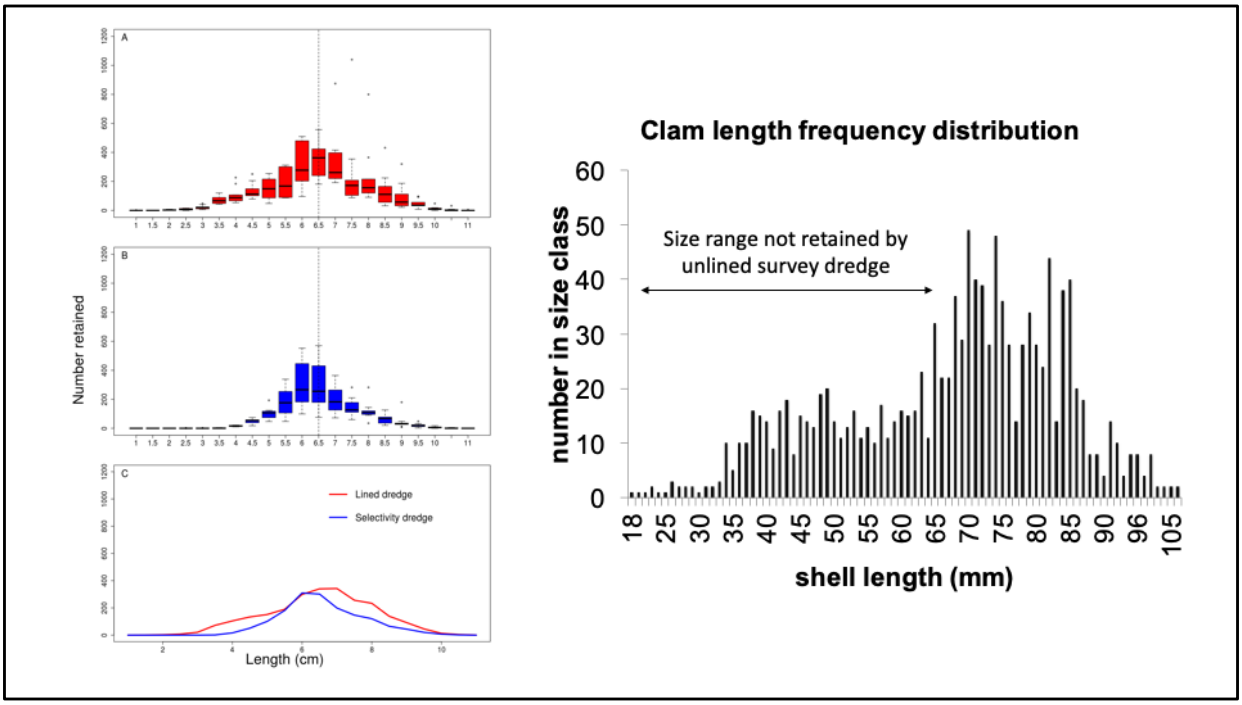
At sea the floating hose is trailed aft of the vessel between dredge tows. Note the dimension of the tow hauser – the large blue rope on the right of the image.



In commercial operation both dredges can be operated simultaneously, but this requires skill in maintaining the hoses separate from one another.

The ability of the DK dredge to pass unwanted material is shown in the above images – that on the left is of the lined commercial dredge whereas that on the right is of the DK dredge at the same station.

Success! A selection of pre recruit to fishery size ocean quahogs from the DK dredge.



Results from the dredge comparison selectivity study are given in left figure as size frequency distributions of quahogs retained in each dredge during comparison trials (n = 10 tows each). The box height represents the interquartile range and the thick vertical line in each box is the median for each 5 mm size bin. Both the lined and DK (= selectivity) dredge retain well below the size range (>65mm) retained by the commercial dredge in survey mode. The lined dredge had slightly better retention at the smallest sizes retained. Both dredges provide size frequency data in the 30-65mm shell length range; the right figure illustrating a single tow plot of length frequency in 1mm intervals.