INFORMATION DOCUMENT FOR ISSC CONSIDERATION OF ATLANTIC SURFCLAM (*SPISULA SOLIDISSIMA*) TIME TO TEMPERATURE CONTROL GUIDANCE

Atlantic surfclams (*Spisula solidissima*) are distributed along the western North Atlantic Ocean from the southern Gulf of St. Lawrence to Cape Hatteras. Surfclams occur in both the state territorial waters (≤ 3 mi from shore) and within the EEZ (3- 200 miles from shore). Commercial concentrations are found primarily off New Jersey, the Delmarva Peninsula, Nantucket Shoals, and on Georges Bank in federal waters 3 – 200 miles from shore. The maximum size of surfclams is about 22.5 cm (8.9 inches) shell length, but surfclams larger than 20 cm (7.9 inches) are rare. The maximum age exceeds 30 years and surfclams of 15-20 years of age are common in many areas. Atlantic surfclams are suspension feeders on phytoplankton and use siphons which are extended above the surface of the substrate to pump in water. Predators of surfclams include certain species of crabs, sea stars, snails, and other crustaceans, as well as fish predators such cod and haddock.

Important Notes:
(1) Surfclams are not eaten whole, all surfclams have the viscera removed before processing into the final products or eaten in raw sushi form.

(2) All surfclams are inspected during processing or before being eaten in raw sushi form and all dead clams are discarded.

(3) Surfclam habitat generally remains below 50 deg. F during the summer months and drops into the 30s during late winter.

(4) Ocean Quahogs are not the subject of this Surfclam Industry Background Document. Ocean Quahogs are harvested, and machine shucked using similar methods as surfclams. The vast majority of Ocean Quahogs are thermally processed using low acid canning. A small percentage of Ocean Quahog are used in the value-added products stuffed clams and stuffed mushrooms and are regulated under Title 21 – Food and Drugs, Chapter 1 – Food and Drug Administration Department of Health and Human Services, Subchapter B – Food for Human Consumption, Part 123 – Fish and Fishery Products.

THE SURFCLAM FISHERY

The commercial fishery for surfclam in Federal waters is prosecuted with large vessels and hydraulic dredges. The total number of vessels participating in the surfclam fishery has remained relatively stable from 2007 through 2016 and has ranged from 32 vessels in 2008 to

42 vessels in 2012. Trips harvesting surfclams have increased in length in recent years as catch rates have declined and vessels are traveling longer distances to harvest.

Most of the fleet is fishing out of Ocean City, MD; Point Pleasant Beach, NJ; Atlantic City, NJ; Oceanside, NY; Hyannis, MA, and New Bedford Harbor, MA. Due to ocean temperature rise many fish species including surfclams are moving toward the poles or into deeper waters. The natural shift in the stocks distribution northwards has driven the movement of the fishery with vessels moving north and shifting effort offshore.

All but one or two surfclam vessels work exclusively for a single processor and the majority of vessels are owned or managed by the processors they supply. There is a high incentive for both the processor and harvester to ensure quality shellstock. Feedback from the processor to the harvester on the quality of the shellstock is continuous; the length of the trips is adjusted through the summer to retain quality and vessels are advised of areas that should be avoided when the quality of the harvest is sub-par. Vessels are asked to avoid areas because of low meat quality, poor yield per bushel, or undesirable sediments (sand) in the clams.

Advances in many types of technologies are regularly considered for harvest vessels because even small product improvements by the harvesters can produce meaningful results when applied over hundreds of thousands of bushels of shellfish per year. As an example, advances in paint technologies have the ability to reduce heat transfer by 3 deg. F. This new paint has recently been applied to the outside of the clam tanks on a vessel undergoing a major conversion that also includes a larger more efficient refrigeration plant, new spray foam insulation on the underneath of the hatch covers and sheet insulation attached to the bulkhead between the engine room and fish holds.

VESSEL TYPES AND SYSTEMS

Vessels range from relatively small vessels less than 70’ in length that are able to carry one truckload (448 bushels) of surfclams to vessels as large as 165’ with the ability to carry 13 truckloads (5824 bushels). By federal regulations harvest vessels must land surfclams into steel cages measuring 3’ wide X 4’ deep and 5’ high (**exhibit 1**). The cages weigh several hundred pounds empty and about 3,000 pounds when full. Loading of empty cages and offloading of full cages must be done with industrial cranes because of the size and weight of the cages and shellstock.

Surfclam vessels construction varies widely and although many vessels were built for the fishery many surfclam vessels were converted from their original purpose and design. Some vessels were designed as finfish or shrimp harvesters, and some were originally purposed for the Gulf of Mexico oil industry. Here are some of the key differences of the vessels within the fleet.

Fish hold / deck load

Some surfclam vessels carry some or all of their catch above deck while others carry the majority below deck. Most vessels have the ability to carry a portion of their catch above deck.

For these vessels the holds are always loaded first, and the decks loaded last. This is done to comply with stability instructions as well as to insure product quality.

Wet hold / dry hold

Most vessels which were designed specifically for the clam fishery have what is referred to as wet holds in the industry. Wet holds split the catch into smaller, separate compartments. These smaller compartments allow for the crew to flood one or two compartments at a time in the winter when the water temperature is cold. As cages are filled in a flooded compartment the clams experience much less breakage and result in a higher quality product. As sea water surface temperatures rises the practice of flooding holds to avoid breakage is discontinued (even on vessels with refrigeration) because it can result in the clams dying before reaching the processing plant. Clams that are not alive when processed are discarded as waste.

A dry hold vessel is one that has one large hold where all the catch is kept. The hold is kept dry because the introduction of water results in a negative stability condition called free surface effect and puts the vessel and crew in danger. It is a much more dangerous for a vessel with a single hold to experience free surface effect than a vessel where the hold is separated into 4 or 6 compartments. Deck loaded vessels carry their cages on deck, not in a fish-hold.

Temperature controls

Surfclams are hardy animals but they must be kept alive until they are processed. Temperature abuse, high humidity, and fresh water (rain) are detrimental to surfclams. All clams are inspected, and all dead clams are discarded. It is a benefit that surfclam habitat generally remains below 50 deg. F during the summer months and drops into the 30s during late winter, the clams come aboard the vessel cold, even in the summer.

The fact that the ocean water temperature rises and cools much slower than the air temperature is of additional benefit to fishermen. This is easily observed by comparing the inland air temperature with the ocean water temperature during the height of the summer or in the winter. The temperature out on the ocean is typically 10 degrees cooler during the summer months and 10 degrees warmer during the winter than it is on land. Vessels with and without refrigeration systems often employ means to reduce the speed of temperature change and maintain the quality of the harvest. Spray foam or insulation sheets, sometimes up to 4” thick, is used on the underneath of the decks and hatch covers.

Refrigeration systems

Refrigeration systems used in the industry are the sprayed refrigerated sea water (RSW), single pass type. Seawater is pumped in from the bottom of the vessel, usually 8’ to 15’ below the surface and run through a system that lowers the water temperature. The industry design standard is for the refrigeration system to lower the water temperature by 30 deg. F; for an inlet sea water temperature of 75 deg. F a drop to 45 deg. F is expected. Vessel crews monitor the spray water temperature closely.

Vessels also employ shading techniques to ensure shellfish quality. Techniques range from immediate transfer of product from above deck to below deck after harvest to large custom tent like tarps that remain hung on cables throughout the summer and are pulled over the deck cages after they are filled.

Ultimately there are limitations to onboard temperature control, but crews do everything in their control to maintain the quality of the harvest. Vessel design often dictates the temperature control techniques that can be utilized. Vessels with large open holds may not be able to get the approval of their naval architect to introduce refrigerated sea water, when the effects on stability are taken into consideration, without additional modifications such as the installation of additional sumps, pumps and redundant alarm systems. Vessels that utilized large tent like tarps may not be able to deploy the tarps when the winds are above 20 knots. It may be impossible to keep rain off of the catch while offloading and nothing can be done about high humidity levels.

Harvesting Technique

The commercial fishery for surfclam in Federal waters is prosecuted with large vessels and hydraulic dredges. A hydraulic dredge is fabricated from steel and has several main components making up the whole. The dredge is a sled like structure that is pulled along the bottom in areas of sand on runners made of wear resistant steel. The leading edge of the dredge contains a manifold with water jets angled back toward the dredge frame. Water is pumped from the harvest vessel down through a hose and out through the manifold. The water pressure fluidizes the bottom sediment loosening the clams from their habitat. kìBehind the manifold is a knife frame with a leading knife edge. The knife frame carries the clams into the main frame of the dredge that is made up of steel round bars that are spaced so that sand, shells and below market size clams pass through the dredge and are not retained while the larger clams are retained. After tows ranging from several minutes up to an hour the dredge is retrieved, the harvested clams are discharged onto the vessel and the dredge is returned to the bottom. This process is repeated until the vessel is full or has reached time limits imposed by regulation or the harvester's processor.

FISHING GROUNDS

The distribution of the fishery has changed over time, with a shift to increased landings in Southern New England, Nantucket Shoals, and Georges Bank areas. Ports in New Jersey and Massachusetts handle the most volume and value, particularly Atlantic City and Point Pleasant, New Jersey, and New Bedford, Massachusetts. There are also landings in Ocean City, Maryland, and Gloucester, Massachusetts.

TIME TO TEMPERATURE CONTROL

Steaming (traveling) distances and time

Vessels with onboard refrigerated sea water spray systems can achieve very low time to temperature control, usually just a few minutes. Clams are dumped in the vessel hopper, carried by conveyor belt to a sorting machine where the clams get a quick wash and sand and shells are removed. The clams then continue by conveyor belt to be loaded in empty cages. For vessels without onboard refrigeration, the time from first harvest to the temperature control of a refrigerated trailer or the refrigeration unit at the processing plant is dependent upon several factors. Vessels may be as close as three or four hours from the dock when fishing waters of the Mid-Atlantic, as far as 10 hours from the dock fishing Nantucket Shoals or even as far away as 18 hours when fishing Georges Bank and offloading in New Bedford.

Catch Per Unit of Effort

Catch per unit of effort (CPE), expressed in the amount caught, measured in cages or bushels, per hour, is another determining factor for time to temperature control for vessels without refrigeration. Catch rates are cyclical over long periods of time. When there are big spawning events and large sets of clams settle into an area they mature to market size within 5 to 7 years. Vessels target areas of the largest concentrations of market sized clams, moving on when it is determined that higher clam catches can be located elsewhere. A vessel may leave an area where it is catching 3 cages per hour only to return several years later when 3 cages per hour is attractive. Current CPUs are historically low, often as low as one cage per hour, but not unprecedented, there are many clams but spread thin and large concentrations are of small clams not yet market size. This presents a challenge for vessels without refrigeration systems to remain profitable within short time to temperature requirements.

OFFLOADING AND GROUND TRANSPORTATION

Vessels offload at docks specially equipped to handle the heavy cages. If offloading directly at a processing plant clams are offloaded directly into the cooler or into the production flow for shucking. If the harvest is to be transported to a processing plant off site, which is the majority of the catches, pre-chilled trailers arrive with empty cages to be put back on the vessel after the offload is complete; the trailers are staged for loading and transportation to the processor. Full cages are taken off vessels by crane and must be moved by fork-truck, because of their size and weight, into the pre-chilled trailers. Trucks transport the clams to the processor, unload and reload their trailers with empty cages and return to the dock for another load.

In the best-case scenario clams arrive for processing “just in time”, meaning the clams are put into processing directly from the vessel or directly from the refrigerated trailers used to transport the clams to the processor. Processors have built in buffers with large coolers that can store cages of clams so that when production begins the processor doesn’t run out of clams during a shift. Processors each have one or two company personnel that schedule operations for maximum efficiency. This begins with scheduling the harvest vessels. The processor must

track each vessel's average time dock to dock for their trips so that multiple vessels don't arrive at the same time, the averages rise and fall over time and sometimes week to week. The number of tractor trailers available to the processor must be considered, as well as the DOT driver time limits and log books, they can be behind the wheel only so long before driver rest is required by federal mandate. Vessels are scheduled so that they are spaced out, so they can offload as soon as they arrive at the dock, tractor trailers and drivers are available, and the processor receives product on a just in time basis for processing.

Scheduling operations is as much an art as a science. The choreography can be perfectly orderly but sometimes the process can resemble the first day of rehearsal for the second-grade play. Trips can take longer or shorter than average for many reasons including breakdowns, weather and catch rates. Multiple vessels may only have a short weather window to fish and are unable to spread out arrival times. Trucks can be delayed by summer traffic or even plant breakdowns; because trucks must often wait for empty cages from the plant before returning to the dock.

PROCESSING TECHNIQUES

All processing techniques consist of (1) removing the clam from the shell (shucking), (2) cleaning the clam (removing the viscera, shell fragments and sand), inspection and grading. Surfclams are not eaten whole, all surfclams have the viscera removed before processing into the final products.

Hand shucking

– Hand shucking is the process of removing the clam meat from the shell using human labor. (**exhibit 2**) Some processors' blanch the raw clams before shucking at 160 degrees F.

Machine shucking

– Machine shucking is the process of removing the clam meat from the shell using machinery. The process typically involves using steam to release the adductor muscle from the shell before a mechanized process separates the meat from the shell, removes the viscera and further processes the clam. (**exhibit 3**) Some plants blanch the clams 10 - 15 seconds before going into the steam shucking machine that operates between 240 and 265 degrees F.

PRODUCT FORMS

Thermally Processed

Low acid canning has been validated as thermally processed. Examples of thermally processed canned clams are chopped and minced clams in clam juice, clams added to canned soups and chowders, canned red and white clam sauce and clam juices for both retail and food service.

Other methods of thermally processing can be accepted once validated by the processor. Although heat may be used in the process of shucking surfclams in the form of preheated dip tanks or steam shucker, these are not considered thermally processed unless the process has been validated.

Raw shucked surfclam meats (any product that has not been thermally processed)

Raw surfclams are sold to manufactures, retail stores, and wholesalers for uses such as soups, chowders, sauces, fried clams, and further value-added processing.

Raw shucked surf clam meats are packaged in many different packs, e.g. 1, 4, 5, and 25-pound, pint, ½ gallon, and gallon packaging.

Raw shucked surf clam meats are also mechanically stripped, with the strips for use in breading and deep frying. Some processing companies bread, pre-fry, and freeze “breaded and pre-fried strips”. Some companies sell fresh and frozen strips to be breaded and fried in restaurant kitchens or at home by the consumer.

Breaded clam strips are neither thermally processed or considered raw but are products that are generally accepted will be deep fried before consumption and are regulated under Title 21 – Food and Drugs, Chapter 1 – Food and Drug Administration Department of Health and Human Services, Subchapter B – Food for Human Consumption, Part 123 – Fish and Fishery Products.