ESSENTIAL FISH HABITAT ASSESSMENT

MOHEGAN AQUACULTURE LLC
Department of Army Permit Application

Stonington Harbor, Niantic Bay, Pine Island Bay,
Pawcatuck River and Fishers Island Sound

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Submitted To:

National Marine Fisheries Service
Habitat Conservation Division
One Blackburn Drive
Gloucester, MA

National Marine Fisheries Service
Habitat Conservation Division
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Milford, CT

A. INTRODUCTION

The 1996 Sustainable Fishery Act amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth Essential Fish Habitat provisions to identify and protect important habitats of federally managed marine and anadromous fish species. Under these provisions, Federal agencies that fund, permit, or undertake activities that may adversely effect Essential Fish Habitat (EFH) are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH.

Congress defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. " EFH is further defined by regulation. "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

B. PROJECT DESCRIPTION

Mohegan Aquaculture LLC, 67 Sandy Desert Road, PO Box 488, Uncasville, Connecticut 06382 proposes the installation of subsurface longlines, bottom cages, floating bags, upwellers, and six new, 10-pile cluster fenders in the coastal/nearshore waters of Stonington Harbor, Niantic Bay, Pine Island Bay, Fishers Island Sound, Long Island Sound, Little Narragansett Bay and the Pawcatuck River for the establishment of a commercial shellfish aquaculture operation.

Specifically, Mohegan Aquaculture LLC proposes the installation of:

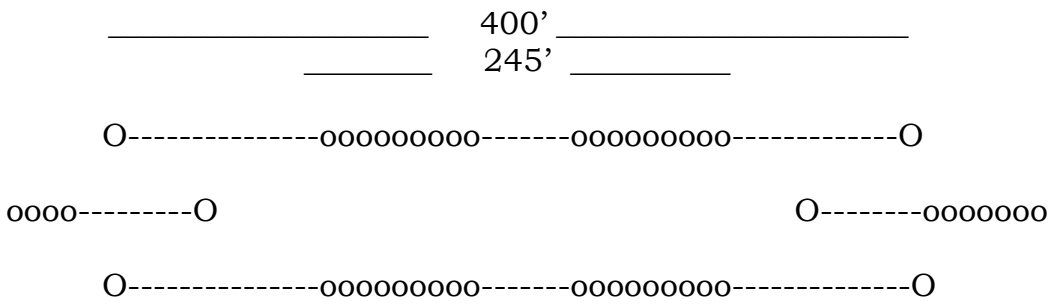
a. Six new 10-pile dolphin clusters and battered brace piles at the Water Street, Stonington Borough hatchery site;

b. Water quality monitoring equipment consisting of a remote monitoring system to measure temperature, dissolved oxygen, conductivity, chlorine, pH, redox potential, chlorophyll a and turbidity at the Stonington Borough, Pawcatuck River and Niantic Bay sites;

c. Two 32' wide by 10' high by 76' long floating upwellers;

d. Upweller moorings consisting of helix anchors and or anchor piles in the waters of Long Island Sound and the Pawcatuck River;

e. Subsurface longline shellfish rearing systems, totaling 51.3 acres at three sites in Fishers Island Sound, Niantic Bay, and Long Island Sound in year five, and consisting of a main line, two terminal primary helix anchors, two secondary helix anchors, and shellfish rearing trays installed parallel to the prevailing current direction. Each long line will be approximately 400 feet in length, and contain 50 stacks of trays, secured with tensioned anchors. The useable length of each long line will be 245 feet. 165 such long lines will be placed in a staggered configuration end to end with approximately 25' clearance between anchor lines and 50' clearance between gear, as shown below:



f. In year five, 1,166 on-bottom shellfish rearing cage trot lines, totaling 45.8 acres in Long Island Sound, Fishers Island Sound and Niantic Bay and consisting of 5 cages per trawl, set directly on the sea floor. Each cage will be 5' wide and 2' high, will be connected to a line 1.5 times the water depth (ranging from 17 to 30'), and will weigh approximately 500 pounds when full. Each set of 5 cages (trot line) will be placed in rows approximately 10 to 20 feet apart, parallel to the prevailing currents.

g. In year five, 425 floating shellfish rearing bag system, totaling 30.6 acres in Long Island Sound and the Pawcatuck River, and consisting of a grid harness with individual bags attached to the harness in pairs of five (10 bags), each separated by a recycled plastic lumber spreader bar. One unit will consist of 10 harnesses (100 bags) with typical dimension of 164' long and 8' wide and 1.5' deep, and anchored at each end with helix screw anchors. System flotation is provided by a buoyed center-line.

C. EFH DESIGNATIONS

The National Marine Fisheries Service (NMFS) *Guide to Essential Fish Habitat* web site was used to determine which species have designated EFH in Fishers Island Sound, Long Island Sound and the nearshore embayments from East

Lyme to Stonington, Connecticut. The NMFS guidance can be found at the following web address:

http://www.nero.nmfs.gov/ro/doc/webintro.html.

The species, and the life stages of those species, that have EFH in the study area were determined by using the quick reference 10 x 10 minute squares of latitude and longitude, and expanded upon by review of the individual species source documents. The coordinates of the 10 x 10 minute squares that are representative of the geographic area where culturing activities are proposed are provided in Table 1.

Grid	North	East	South	West
13	41° 20.0' N	72° 10.0' W	41° 10.0' N	72° 20.0' W
14	41° 20.0' N	72° 00.0' W	41° 10.0' N	72° 10.0' W
15	41° 20.0' N	71°50.0' W	41° 10.0' N	72° 0-0.0' W

Table 1. Latitude and longitude coordinates of the 10 x 10 minute squares representing the geographic area of the Mohegan Tribe enhanced aquaculture activities.

Grid Square 13 contains the western portions of the aquaculture project area from Niantic Bay to Millstone Point. Grid Square 14 covers the waters from Millstone point eastward to Groton Long point. The majority of the farm sites are located within this 10-minute grid square. The final grid (15) contains the waters eastward of Groton Long Point to just east of Watch Hill, Rhode Island and includes the Pawcatuck River site.

The region in which the Mohegan Aquaculture LLC shellfish rearing activities will be undertaken has been designated as EFH for thirteen species of commercial importance. The list includes Atlantic salmon *(Salmo salar),* pollock *(pollachius virens),* red hake *(Urophycis chuss*), winter flounder (*Pseudopleuronectes americanus*), windowpane flounder (*Scopthalmus aquosus*), Atlantic herring (*Clupea harengus*), bluefish (*Pomatomus saltatrix*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), sand tiger shark (*Odontaspis taurus*), dusky shark (*Charcharinus obscurus*) and bluefin tuna (*Thunnus thynnus*). In addition to these species, NMFS has determined that the area affords habitat to both long and short finned squid (*Lolligo pealei* and *Illex illecebrosus*), scup (*Stenotomus* chrysops), black sea bass (*Centropristus striata*), surf clam (*Spisula solidissima*), ocean quahog (*Artica Islandica*), spiny dogfish (*Squalus accanthias*) and Atlantic sea scallop (*Placopecten magellanicus*). Table 2 presents a list of these species that have designated EFH in the Mohegan Tribe aquaculture enhancement sites in Fishers Island and Long Island Sounds and their adjacent estuaries in Connecticut waters (Grid 13, 14 & 15).

Table 2: EFH Fish Species as composed within EFH Grid squares 13, 14, and 15 and individual species source documents[1]

Species	Coastal Estuaries	Fishers Island Sound	Long Island Sound
Demersal Species			
Flounder			
Summer flounder**	L J A	L J A	E L A
Windowpane flounder	E L J A	E L J A	E L J A
Winter flounder	E L J A	E L J A	E L J A
Witch flounder**	-	-	E L
Yellowtail flounder**	-	-	E L J A
Groundfish			
Atlantic cod**	-	J A	J A
Red hake	E L J A	E L J A	E L J A
Black sea bass**	J A	J A	J A
Pelagic Species			
Fish			
Atlantic butterfish**	J A	J A	J A
Atlantic mackerel**	-	J A	J A
Atlantic sea herring	J A	J A	J A
Bluefin tuna	-	A	A
Bluefish	J A	J A	J A
Cobia	E L J A	E L J A	E L J A
King mackerel	E L J A	E L J A	E L J A
Spanish mackerel	E L J A	E L J A	E L J A
Sharks			
Blue shark	-	L* J A	L* J A
Dusky shark	-	J	J
Sand tiger shark	-	L*	L*

E = Eggs L = Larvae; * for the shark species indicates neonates and early juveniles

J = Juvenile A = Adult

** Included based on discussions within EFH Species Source Documents but not identified on Grid Squares 13, 14 or 15.

D. AFFECTED SPECIES SUMMARIES

A short summary of EFH for each life stage of the most prevalent species is described in this section. Information on the species was taken in large from the NOAA Technical Memorandum Series, *Essential Fish Habitat Source Documents* for the managed species and from the NMFS "*Guide to EFH Species Designations*." Additional sources used to describe life history characteristics of the various species include Bigelow and Schroeder's "*Fishes of the Gulf of Maine*"(1993), "*The First Year in the Life of estuarine Fishes in the Middle Atlantic Bight*" by Able and Fahay (1998) and the U.S. Fish and Wildlife Service's "*Development of the Fishes of the Mid-Atlantic Bight: An atlas of egg, larval and juvenile stages*" (1978; Volumes I through VI).

Red Hake

EFH is defined within the project area for eggs, larval, juvenile and adult red hake, encompassing both estuarine and marine waters of Fishers and Long Island Sounds and the adjacent estuaries. Adult red hake EFH includes bottom habitats of sand, muddy sand, mud and gravel substrate, between water depths of 10-130 meters (30 to 420 feet) salinities of 31 to 34 ‰ and water temperatures below 12°C. Adult red hake are seasonally common in the Sounds and estuaries between May and November. Eggs, Larval and juvenile red hake are pelagic, the larvae maturing to become demersal after reaching a length of 22mm to 40mm after 60 to 90 days in the water column. Eggs and larvae are most abundant in June and July. Once demersal, juveniles seek shelter along the continental shelf bottom among protective structures, and are most commonly associated with sea scallop beds. Structure appears to be a critical component to survival of recently-settled red hake. In fact, a pattern of early juvenile red hake seeking and maintaining cohabitation within living sea scallop shells is well documented. They remain associated with sea scallop beds through their first fall and winter (until approximately 8.9 cm to 11.5 cm length), and then occupy either estuarine or inshore marine waters over sand or mud substrate, at water temperatures less than 16°C and salinities between 31 and 33 ‰, prior to joining adults in the offshore migration during their second winter.

Winter Flounder

EFH is defined within the project area for eggs, larval, juvenile and adult winter flounder. Habitat and environmental conditions within the Sounds and the estuary are typical for all life stages of winter flounder. Specifically, the project area includes protected shallow water shoals and subtidal areas (< 6 meters [20ft]) over bottom habitats of sand, muddy sand, mud and gravel substrate. Adult winter flounder spawn in late winter through spring over substrates of

sand, muddy sand, mud and gravel in water depths usually less than 6 meters, water temperatures below 15°C and salinities between 5‰ and 36‰. Both eggs and larvae are found in shallow waters at salinities between 10‰ and 30‰, and 4‰ and 30‰, respectively. Winter flounder eggs are non-buoyant and sink to the bottom. Early stage larvae are primarily pelagic with some demersal characteristics. Nursery habitat for larval and juvenile life stages includes littoral and sub-littoral saltwater coves, coastal salt ponds, estuaries and protected embayments. A preferred habitat is muddy sand with patches of eelgrass or other marine vegetation. Early juvenile (i.e., young-of-year) and juvenile winter flounder utilize shallow water, as well as deep water, estuarine and marine waters. Although present in the project area throughout the year, abundance of these life stages varies with season.

Windowpane Flounder

Windowpane flounder EFH encompasses both the estuarine and marine waters of the project area. EFH of spawning adults and eggs is limited to the seawater salinity zones (15 to 33 ‰), specifically, Long Island Sound and Fishers Island Sound. Eggs and early larvae are pelagic and are most commonly found in the mid to upper water column. At approximately 0.8 to 1.6 mm (0.4 to 0.8 in) the larvae will settle to the bottom (late-spring and early-summer) in polyhaline estuarine areas, primarily in spring. Although windowpane flounder occur at all depths within the above area, juveniles and adults are seasonally more abundant in deeper channels, occurring over bottom habitats of mud or fine-grained sand. Use of shallow water areas is usually limited to the summer months. The lowest abundance of windowpane flounder in the subject area is observed from January through March and June through October.

Atlantic Sea Herring

Atlantic herring EFH encompasses both the estuarine and marine salinity zones of the project area (salinities >26 ‰). Juveniles and adults occur in the project area during winter and spring months (January through May), when water temperatures settle to and remain below 10°C. Juvenile sea herring are most common during the late-summer and fall (July through September). Adult sea herring are most common in the spring and early summer (April through June) and in the late-fall/winter (November and December). Both juvenile and adult sea herring tend towards the utilization of deeper water areas typical of the open Sound's habitats. Specifically, it is a schooling pelagic species, not generally associated with bottom habitats. Eggs and spawning adults are absent from the Sound. Larvae are very rare.

Bluefish

EFH is designated for juvenile and adult lifestages of bluefish within the project area, which includes both the estuarine and marine salinity zones. The species is a common, seasonally abundant, inshore inhabitant which usually arrives in

the project area in late-April and early-May and usually departs by November. It is a migratory, pelagic species which can be commonly found in water depths of 2 to 27 meters. Because bluefish usually spawn offshore, eggs and larvae are rarely collected in Long Island Sound and Fishers Island Sound estuarine ichthyoplankton samples.

Atlantic Butterfish

Butterfish EFH within the project area is identified for larvae, juveniles and adults. Juvenile and adult EFH includes both the estuarine and marine salinity zones (25 to 29 ‰), while larval EFH includes only estuarine waters. Larval, juvenile and adult butterfish are pelagic, occurring in the project area during late spring to early fall months (May through November) in both shallow (1.5 meters) and deeper waters (9 to 27 meters) of the Sound. During the summer, butterfish can be found over shallow flats and within the surf zone of sheltered bays and estuaries. Larger juveniles and adults may congregate near the bottom during the day and disperse upwards at night. Because butterfish is a pelagic species, it is not generally associated with a specific bottom habitat type.

Atlantic Mackerel

EFH for Atlantic mackerel within the project area is limited to juvenile and adult life stages within the seawater salinity zone. Atlantic mackerel is a pelagic, schooling species which is not generally associated with a specific bottom type. It is mostly the juvenile life stage that enters the estuaries and harbors in search of food. The adults mostly prefer open water and are not dependent on proximity to coastline. Juvenile and adult mackerel are present in the Sound from April through November, but the species is most abundant from August through November (primarily juveniles). Adults can usually be found in the Sound from April through July.

Summer Flounder

EFH designations for summer flounder include the freshwater, brackish, and seawater salinity zones of the project area. EFH is designated for larvae, juvenile and adult life stages. Spawning adults reproduce during their offshore migration to open ocean waters. Consequently, eggs are not usually found in Long Island Sound. However, the larvae are pelagic and can occasionally occur in nearshore waters during between April and December. Once demersal, early juvenile summer flounder inhabit a wide range of high salinity (26 to 30 ‰), subtidal habitats including marsh creeks, coves, bays and inlets (both vegetated and unvegetated). Adult and juvenile winter flounder occur in the project area during the warmer months, primarily May through October, usually in shallow water (< 6 meters) over a substrate of sand or mud.

Scup

EFH for the egg, larval, juvenile and adult life stage of scup is limited to the seawater salinity zone of the project area. Spawning occurs in coastal waters from May through August when water temperatures exceed 10°C. The eggs and newly hatched larvae of the species are pelagic. At a length of approximately 1.2 mm to 3.0 mm (0.5 to 1.2 in) the larvae become demersal and are commonly found in shoal waters. Within the project area, juveniles and adults occur in similar demersal habitats, using intertidal and subtidal waters over a variety of substrates. Juvenile scup are most common in inshore estuarine waters during the warmer months (April through November) when water temperatures are between 7 and 27°C. Adult scup use coastal habitats over soft, sandy bottoms and on or near submerged structures, rocky ledges, or mussel beds until water temperatures fall below 10°C.

Black Sea Bass

Designated EFH of juvenile and adult black sea bass includes the marine and estuarine waters of the project area (25 to 29 ‰). In the eastern part of Long Island Sound, juvenile and adult black sea bass begin moving into inshore coastal waters of varying depth (1 to 50 m) in, or around, April when water temperatures exceed 6°C. The fish may remain in the Sound until the fall (October) and is strongly associated with structured habitats such as jetties, piers, wrecks, submerged aquatic vegetation and shell bottoms such as oyster reefs. However, the species' annual occurrence in Long Island Sound and Fishers Island Sound is highly variable.

The remaining species identified as possessing EFH in the three grid squares, listed in Table 2, have been determined to either occupy the habitat only incidental to normal haunts, rely on much larger habitat zones, or have no recognized concentrations within the footprint of the proposed activities.

E. ASSESSMENT OF IMPACT TO EFH AND FISH SPECIES OF PARTICULAR CONCERN

a. Nature of Impacts to EFH

The proposed retention structures and their contents may result in impacts to the biological, chemical or physical properties of the environment (e.g. biomass, organic content of the sediment, water temperature) at the water surface, in the water column and/or at the sediment surface. For example:

- Alteration of water clarity and light energy absorption rates can alter the thermal loading of the aquatic environment

- Changes in substrate, including sediment composition or vegetated habitat characteristics, as a result of alteration of circulation and near bottom currents could occur

- Changes in benthic community structure could occur

- Sediment resuspension resulting from system deployment and seasonal maintenance could occur

In particular, the zone of potential impact is influenced by the physical attributes of the structures, the types of organisms deployed within, and the characteristics of natural environment in which they are placed.

i. Water Quality / Clarity

It is foreseeable that short-term physical impact to water quality will be limited to changes in the level of suspended sediments in the water column as a result of mooring installation and associated tensioning of the shellfish rearing gear. Long-term adverse impact to water quality as a result of the shellfish retention structures is expected to be negligible, primarily because the proposed project does not include the addition of a food source into the water column and the proposed culture sites have sufficient tidal currents to facilitate dispersal of shellfish feces and pseudofeces. Also, use of off-bottom shellfish retention devices helps to avoid the repeated disturbance to the benthic environment commonly associated with traditional methods of shellfish harvesting (bottom manipulation and dredging). However, to insure that water quality impacts will be no more than minimal in the long-term, a water quality-monitoring program will be implemented at the more shallow culture sites.

ii. Benthic Community Structure / Composition

Installation of the proposed structures has the potential to result in the alteration of benthic community and sediment composition at, and in the general vicinity of, the installation sites by modifying current circulation patterns and facilitating the deposition of fine sediment and organic materials. However, the physical characteristics of the selected lease sites and the use of suspended gear, as opposed to the use of all on-bottom gear, will minimize the potential for significant habitat alteration associated with the aquaculture activity. Suspended gear, because of its position in the water column, will help to facilitate the dispersal of wastes that are a byproduct of active shellfish feeding.

iii. Submerged Aquatic Vegetation

Direct impact to vegetated habitat, in particular, submerged aquatic habitat (a Habitat Area of Particular Concern under MSCMA) will not occur, as the proposed structures will be sited to avoid beds of submerged aquatic vegetation, as well as, those habitats with the potential to support SAV. In addition, the resuspension of sediment is not likely to adversely effect SAV beds in the vicinity of the lease sites for the reasons identified above, and also because elevated levels of total suspended solids are likely to be short-term in nature and well below background levels currently attributed to natural occurrences in Long Island and Fishers Island Sound.

b. Species Impacts

The potential for adverse impact to fish with EFH designated in the project area is likely to differ from species to species, depending upon life history, habitat use (demersal vs. pelagic), and distribution and abundance. However, it is anticipated that short-term impacts to older life-stages of fish (both pelagic and demersal) will be limited to temporary displacement during initial installation of the retention structures (anchor installation), and subsequently, during seasonal maintenance activities. There may be some one-time loss to eggs and early larval stages of fish species during the anchor installation process. Long-term adverse impacts are likely to be associated with displacement of demersal fish species and life stages in association with installation of cages on the bottom and displacement of pelagic species and life stages from some portion of the water column. However, it is anticipated that this displacement will not be significant because pelagic larvae and eggs will continue to be carried through the project area with prevailing currents and tides, and adult and juvenile life stages will be able to readily negotiate the open spaces in the retention devices (50' between longlines, 20' between cages, and 6' between lantern nets). In fact, it is expected that the introduction of structural complexity will provide smaller species with living space, increased food abundance and refuge from predation.

i. Prey Species

The abundance and/or distribution of prey species for fish, for which EFH has been designated, may be adversely impacted, in the short term, by an increase in suspended solids resulting from equipment deployment and seasonal maintenance activities. As a result of sediment resuspension there is the potential for some change in local dissolved oxygen levels. However, if such a change were to occur it is anticipated it would be short term in nature and not appreciable, well below the normal variation usually attributed to a natural event (storm).

As indicated above, many of these fish will feed on the organisms that live in, or on, the sediment or colonize the lines and structures of the retention devices. At locations that are to be farmed, these prey species may be disrupted or displaced during the site development and seasonal maintenance activities. During all of these activities, prey species are unlikely to be seriously impacted. However, the nature of the proposed activities carries a number of beneficial aspects (e.g. food, shelter, egg attachment and predation avoidance). Following the initial installation of the proposed gear, native communities consisting of benthic prey species will quickly recolonize the estuarine bottom, ensuring that impacts to fish populations during as a result of gear installation and operation will be minimal at all of the aquatic sites.

Prey species that live in the water column are also likely to be impacted during installation and operation of the farming activities. The total suspended solids (TSS) resulting from disruption of the seafloor during installation and subsequent maintenance activities may adversely affect planktonic species in the vicinity of the activities. However, following the initial installation and the seasonal maintenance of the proposed gear, these species natural populations will readily reestablish themselves within the local plankton community. Net beneficial impacts that may occur as a result of installation of the shellfish retention structures include attraction of prey species to the structures (stereotropism) for the purposes of refugia and forage.

ii. Red Hake

Potential impacts to red hake EFH would be primarily limited to the short-term disruption of primarily juvenile, and some adult, bottom habitat at the deeper water sites. Also there may be some behavioral disturbance during retention device installation and seasonal maintenance activities. It is after their first winter that demersal red hake will occupy estuaries and inshore marine waters over sand and mud substrate. Because structure appears to be a critical component for survival of early juvenile red hake, it is also possible that the benthic cages associated with the Mohegan Aquaculture proposal may afford the structure sought by this species' life stage.

iii. Winter Flounder

Placement of the retention devices in preferred spawning and nursery areas is very limited (primarily surface floating gear) and is not likely to measurably diminish the species' activity in shallow water habitat (0 to 4 meters). Potential impacts include displacement or temporary disruption of early life stage development (larval settlement) from installation of the shallow water gear (FADPI). However, it is not anticipated that there will be any permanent loss of shallow water habitat. In addition, project installation activities (anchor setting

and system assemblage) can be scheduled to avoid potential adverse impact to winter flounder spawning and early development periods. Although there may some minor displacement of adults and juveniles in deeper areas, this impact is likely to be mitigated by the addition of benthic structure and access to additional sources of forage.

iv. Windowpane Flounder

EFH for windowpane flounder eggs and spawning adults is limited to the seawater salinity zones in Fishers Island and Long Island Sound. Although the species occurs at all depths, juveniles and adults are seasonally most abundant in deeper channels. Consequently, potential impacts are expected to be limited to temporary disruption of bottom habitat during setting of the gear and associated ground tackle, as well as potential behavioral impairment of movement in the open waters offshore of Groton (589) and Ram Island (525). Impacts are anticipated to be seasonal in nature (April and May). Although there might be some species displacement, the impact is likely to be mitigated by the addition of benthic structure and access to additional sources of forage.

v. Atlantic Sea Herring

Both juvenile and adult sea herring tend towards the utilization of deeper water areas typical of the open Sound's habitats. Specifically, it is a schooling pelagic species, not generally associated with bottom habitats. Consequently, potential adverse impacts should be limited to the disturbance of bottom sediments during system deployment. Resuspended sediments in high concentrations have the potential to interfere with feeding, predation avoidance and migratory movement of these pelagic fish. However, it is anticipated that through careful installation of the retention devices, in particular the ground tackle, the increase in total suspended solids will not be appreciable, and any adverse impacts will be localized in nature. Also, it is expected that any adverse impact is likely to be mitigated by the addition of benthic structure and access to additional sources of forage.

vi. Bluefish

Bluefish is a schooling, pelagic species, not generally associated with bottom habitats; therefore potential long-term adverse impacts due to presence of benthic structures are not expected to occur. However, both the floating retention devices and the long lines are expected to represent a fish attraction device (FAD). We expect that both juvenile and adult bluefish will congregate in the lee of the structures and will benefit from the increased abundance and diversity of forage organisms that will be attracted to the gear. Also, because the species use of the area serves a recreational fishery, placement of a FAD to concentrate the fish could have the potential to significantly adversely affect

the population as a result of over harvesting. However, recreational take limit restrictions for bluefish currently exist, so over-harvesting is not expected to represent a foreseeable impact to the species or its designated essential fish habitat.

vii. Atlantic Butterfish

Because butterfish, is for the most part, a pelagic species, it is not generally associated with a specific bottom habitat type. Impacts to the butterfish are expected to be similar to those described for Atlantic herring.

viii. Atlantic Mackerel

Atlantic mackerel is a pelagic, schooling species which is not generally associated with a specific bottom type. It is mostly the juvenile life stage that enters the estuaries and harbors in search of food. The adults mostly prefer open water and are not dependent on proximity to coastline. Impacts to the Atlantic mackerel are expected to be similar to those described for Atlantic herring above.

ix. Summer flounder

Potential impacts are expected to be limited to temporary disruption of bottom habitat during setting of the gear and associated ground tackle, as well as potential behavioral impairment of movement in areas associated with the installation of bottom cages. Impacts are anticipated to be seasonal in nature (May through October). Although there might be some displacement, the impact is likely to be mitigated by the addition of benthic structure and access to additional sources of forage

x. Scup

The eggs and newly hatched larvae of the species are pelagic, and the older larvae, juvenile and adult life stages are demersal. For the species' pelagic stages, potential adverse impacts could include the disturbance of bottom sediments during system deployment. Resuspended sediments in high concentrations have the potential to interfere with feeding, predation avoidance and migratory movement of pelagic life stages. However, it is anticipated that through careful installation of the retention devices, in particular the ground tackle, the increase in total suspended solids will not be appreciable, and any adverse impacts will be localized in nature. Pelagic life stage impacts could also include displacement or temporary disruption of early life stage development (larval settlement) from areas dominated by the shallow water gear (FADPI). However, it is not anticipated that there will be any permanent loss of shallow water habitat for the species. Although there may some minor displacement of

adults and juveniles in deeper areas associated with installation of bottom cages, this impact is likely to be mitigated by the addition of benthic structure and access to additional sources of forage.

xi. Black Sea Bass

Potential impacts to black bass EFH within the project area are expected to be minimal and limited to the short-term disturbance of bottom sediments during system deployment and seasonal maintenance. It is not anticipated that displacement will be significant as the species is strongly associated with structured habitats such as jetties, piers, wrecks, submerged aquatic vegetation and shell bottoms. It is anticipated that habitat diversity will be increased by installation of the retention devices.

Table 4 Summary of fish species by life stage with habitat in the Mohegan Aquaculture LLC Project area and foreseeable potential for adverse effects.

Life History Stage	Water Column Position	Species	Likelihood of Presence[1]	Habitat Requirement[2]	Potential for Adverse Effects[3]
Eggs	Demersal	Winter flounder	High	High	Medium[4]
	Planktonic	Windowpane flounder	Medium	Medium	Medium[5]
		Scup	Medium	Medium	Medium[5]
		Atlantic mackerel	Medium	Medium	Medium[5]
		Cobia	Low	Low	Low
		King mackerel	Low	Low	Low
		Spanish mackerel	Low	Low	Low
Larvae	Planktonic - Flounders	Winter flounder	High	High	High[4]
		American plaice	Low	Low	Low
		Summer flounder	Medium	High	Low
		Windowpane flounder	Medium	Medium	Medium[5]
	Planktonic - Groundfish	Atlantic cod	Low	Low	Low
		Red hake	Medium	Low	Low
		Scup	Medium	High	Low
	Planktonic - Pelagic fish	Atlantic mackerel	Medium	Medium	Medium[5]
		Atlantic sea herring	Medium	Medium	Medium[5]
		Cobia	Low	Low	Low
		King mackerel	Low	Low	Low
		Spanish mackerel	Low	Low	Low
Juveniles	Demersal	Summer flounder	Low	High	Low
		Windowpane flounder	Medium	High	Low
		Winter flounder	High	High	Low
		Black sea bass	Medium	Medium	Low
		Red hake	Low	Medium	Low
		Scup	Medium	Medium	Low

Life History Stage	Water Column Position	Species	Likelihood of Presence[1]	Habitat Requirement[2]	Potential for Adverse Effects[3]
	Pelagic	Atlantic mackerel	Medium-Low	Medium	Low
		Atlantic sea herring	Medium	Low	Low
		Bluefish	High	High	Low
		Cobia	Low	Low	Low
		King mackerel	Low	Low	Low
		Spanish mackerel	Low	Low	Low
Adults	Demersal	American plaice	Low	Low	Low
		Summer flounder	High	High	Low
		Windowpane flounder	High	High	Low
		Winter flounder	High	High	Low
		Black sea bass	Medium	Medium	Low
		Red hake	Medium	Medium	Low
		Scup	Medium	High	Low
	Pelagic	Atlantic mackerel	Medium-Low	Medium	Low
		Atlantic sea herring	Medium	Low	Low
		Bluefish	Medium	High	Low
		Cobia	Low	Low	Low
		King mackerel	Low	Low	Low
		Spanish mackerel	Low	Low	Low

1 Likelihood of presence information is based on publications by NMFS. Low - not present; Medium - present but not abundant; High - present and at least fairly abundant

2 Habitat requirement information refers to the substrate type, water depth, and salinity of the project area. Low - not suitable habitat; Medium - moderately suitable; High - suitable

3 Low – no effects or effects highly unlikely; Medium – some adverse effects are likely (displacement to moderate mortality); high – adverse effects are likely

4 Adverse effects may include burial, physical damage or death associated with resuspension of sediments

5 Adverse effects may include physical damage or death associated with resuspension of sediments

F. ACTION AGENCY'S VIEW REGARDING THE EFFECTS OF THE ACTION ON EFH

Based upon our review of the available information, and as summarized above, it is our conclusion that the proposed structures, their operation, and seasonal maintenance will not represent a substantial adverse, individual or cumulative

threat to essential fish habitat or fish species regulated under the Magnuson-Stevens Fishery Conservation and Management Act.

G. PROPOSED MITIGATION

In addition, the following special conditions will be included in the permit to insure that habitat, designated as EFH under the MSFCMA, is adequately protected:

- The permittee will be required to undertake the development of, and submit for Army Corps approval, an environmental monitoring plan to provide for the long term evaluation of the aquaculture project's potential to change the character of productive pelagic and benthic communities. The permit will be conditioned to ensure that, at a minimum, environmental monitoring will be conducted during the first year of installation and for three years subsequent to the extent of full project build-out.

- To ensure that impacts to water quality will be no more than minimal, in the long term, the permittee will be required to undertake the development of, and submit for Army Corps approval, a water quality monitoring program to assess the potential for nutrient enrichment at the shallow water culture sites including Stonington Borough, Pawcatuck River, and Niantic Bay. At a minimum, the water quality monitoring program should assess temperature, dissolved oxygen, conductivity, chlorine, pH, redox potential, chlorophyll a, total organic carbon, and total suspended solids. The monitoring plan will include provisions for mitigating action should episodes of water quality violations occur.

- Installation of proposed structures will be sited to avoid beds of submerged aquatic vegetation, as well as, those habitats having the potential to support SAV.

- Project initial installation activities (anchor setting and system assemblage) will be seasonally restricted to avoid potential adverse impact to winter flounder spawning and early development periods.