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Marine Aquaculture Species for the Northeast

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Introduction

Many aquatic animals and plants are cultured commercially in the northeastern United States, while others have been grown for restoration or for use in research. Finfish, shellfish, aquatic plants, and other organisms are cultured commercially and recreationally for food, bait, stocking, research, bioassay tests, ornamental markets, and instructional aids. Table 1 lists 33 species or varieties of marine animals and plants cultured in the region. No one species dominates production: an animal or plant cultured successfully in one system or location may prove impractical or unprofitable in another.

This fact sheet describes major species currently in commercial production, those that have shown potential, and others now under experimental investigation. The descriptions summarize culture methods and regulatory considerations. Applicable regulations for proposed operations, particularly those that would employ non-native species or culture in public waters, can be obtained from extension agents and specialists in your state. For a list of aquaculture extension contacts by state and current State Situation and Outlook Reports consult the NRAC website (http://nrac.umd.edu).

Current Commercial Production

1. Hard clam or Northern quahog (*Mercenaria mercenaria*) — The hard clam is one of the most widely successful molluscs cultivated in and outside the region, from Massachusetts to Florida. Established markets exist and the product is recognized as a moderate to high price item in the restaurant trade, where the smallest, legally marketable clams bring the highest prices. Though hardy, they have been vulnerable to QPX, a major disease that has diminished their prevalence.

Hard clams, from left: little neck, top neck, cherry, and chowder (Photograph by Dale Leavitt, Roger Williams University)

Adult clams are spawned under controlled conditions. Larvae are maintained in a hatchery, fed specially prepared algal diets, and raised in land-based upwellers, tanks, or raceways. The nursery phase occurs on land or

in the water. Spat or seed are stocked on the bottom in coastal waters and grown to market size. Time to market size is site specific and varies widely: typically it takes two to five years to attain market-size, but improved strains, good site selection, and proper management can reduce culture time significantly.

2. Eastern oyster (*Crassostrea virginica*) — Culture techniques for oysters are well documented. Oysters have been farmed in the Northeast for over 100 years and are grown commercially throughout the eastern United States and the Gulf Coast. Recent advances in genetics have led to the production of selected lines and triploids that survive better in areas where diseases have depleted natural populations and have led to shorter production cycles.

Eastern oysters (*Crassostrea virginica*) (Photograph by Sandy Rodgers, Maryland Sea Grant)

Oyster seed or eyed larvae may be purchased and "set" on appropriate substrates by the process known as "remote setting." "Set" oysters may be cultured directly on the bottom or off bottom in racks. Essential management efforts include controlling predators, grading by size, periodic cleaning, and ensuring good water quality and flow. The greatest impediments to oyster culture are disease, restrictive laws, and regulations (i.e., Federal, state, local), and theft. Prospective culturists should thoroughly research potential sites.

3. Blue mussel (*Mytilus edulis*) — Through aggressive marketing, the demand and retail price for mussels has improved steadily. Most mussels are cultured in Maine, with offshore demonstration projects ongoing in New Hampshire and Massachusetts.

Blue mussels (*Mytilus edulis*) (Photograph by Joe Buttner)

There is no hatchery phase for commercial cultivation. Recently "set" wild spat are collected from nature and either replanted on the bottom at much lower densities than found in natural beds, or placed in long mesh sleeves suspended in the water column. Suspended culture of mussels using long-lines is increasingly popular and yields a superior product.

4. Softshell clam or steamer (*Mya arenaria*) — These clams can be produced in large numbers using standard hatchery techniques. The market is strong for steamed or fried product. Prices for steamers have risen: coupled with the absence of MSX and Dermo diseases that plague Eastern oysters and QPX disease that has attacked hard clams, there is renewed interest and expanded production of soft clams from Maine to Massachusetts.

Softshell clams (*Mya arenaria*) (Photograph by Joe Buttner)

A modest but growing industry exists in New England where softshell clam spat or seed are stocked on raked substrates and covered with predator exclusion netting. It takes approximately two years from stocking to harvest.

5. Atlantic salmon (*Salmo salar*) — Cultured commercially for nearly three decades, this species now constitutes the majority of all salmon consumed globally. While most coastal waters in the Northeast are too warm to support net pen culture of salmon, a major salmon industry exists in northern New England. Many coastal communities in Maine have benefited greatly from net pen culture of salmon.

Typically, adult salmon are spawned, eggs incubated, and resultant immature fish raised in land-based, freshwater systems. When salmon fingerlings smolt and transform from a freshwater to marine fish, they are transferred to

Atlantic salmon (*Salmo salar*) (Photograph by Chris Bartlett, Maine Sea Grant College Program/University of Maine Cooperative Extension)

net pens in coastal waters and grown to market-size. The industry is heavily regulated and considerable capital is needed to setup and operate a commercial scale farm.

6. Macroalgae, most notably nori seaweed (*Porphyra* sp.) — Cultured in Maine, microalgae are under study for use as a finishing biofilter around net pens and as a lipid substitute in fish feeds. While the potential of macroalgae in integrated aquaculture is strong, commercial viability for production of algae as a single crop throughout the Northeast remains to be demonstrated.

Nori seaweed (*Porphyra* sp.) (Photograph by Joe Buttner)

Potential Commercial Species

1. Bay scallop (*Argopecten irradians*) — These scallops can be cultured in the hatchery or obtained from the wild. Relatively little attention has been directed to their culture. Overwinter survival can be problematic in the Northeast; in addition, scallops can move, so containing them is a challenge. Lantern nets have been used to culture scallops in Asia, though similar efforts in the United States have proven too labor intensive for commercial success. Some production in lantern nets and bags occurs in Massachusetts and New York for enhancing wild populations. Subtidal culture in racks and use of a predator fence to restrict dispersal are being investigated. Prospective culturists should carefully assess the management and economics of scallop culture before proceeding.

Bay scallops (*Argopecten irradians*) (Photograph by Rick Karney, Martha's Vineyard Shellfish Group)

2. Blue crab (*Callinectes sapidus*) — Long popular in the marketplace, recent research has led to successful spawning of blue crabs in a hatchery and rearing them to juvenile stages. The resulting production has been used for restocking and population studies. Profitable commercial production of hard crabs has not been demonstrated, largely due to the cannibalistic nature of the animal. A high-value market does exist for "soft shell" crabs — the soft shell stage occurs immediately after molting. Crabs with body signs indicating an impending molt (peeler crabs) are collected from the wild and held in shallow tanks until they emerge from their shell — the shedding systems are fairly simple and the potential for commercial success is good, provided an adequate supply of high quality and reasonably priced peeler crabs is readily available.

Blue crabs (*Callinectes sapidus*) (Photograph from www.ag.auburn.edu/fish)

3. European oyster (*Ostrea edulis*) — Cultured in the Northeast, this species is tricky to produce in the hatchery and vulnerable to Bonamia disease in the field. No commercial production occurs at this time. Investigations to define and refine hatchery, nursery, and growout techniques are ongoing.

European oysters (*Ostrea edulis*) (Photograph by Joe Buttner)

4. Marine fishes and invertebrates for the pet industry — As with freshwater ornamental fish, much production is diffuse and occurs in basements and garages. Commer-

Clownfish (*Premnas* sp.) (Photograph by Bud Borque, Roger Williams University)

cial operations exist in Maine and Maryland. Considerable potential exists for expanded production of these and other marine organisms for aquarium hobbyists, particularly in modest-size recirculating systems. However, because culture procedures are established for only a few species, culture of ornamentals must be viewed as experimental.

5. Mummichog (*Fundulus heteroclitus*) — This species is an extremely hardy fish with established markets as a live bait and for use in research laboratories. Recently, several northeastern states have expressed interest in growing the mummichog. Culture procedures should be relatively easy to define, though competition with abundant, wild harvested fish could prove problematic.

Mummichogs (*Fundulus heteroclitus*) (Photograph by Joe Buttner)

6. Sandworm (e.g., *Nereis virens*) — Cultured on a limited basis in Maine as a live bait and food for fish, worms are grown intensively in tanks. While markets exist, further analysis is needed to assess depth and breadth of demand.

Sandworm (*Nereis virens*) (Photograph by Joe Buttner)

Experimental Species

1. Atlantic clam or Surf clam (*Spisula solidissimia*) — Grown occasionally in the Northeast, surf clams are being farmed experimentally in Maine, where they have been successfully cultured through hatchery and nursery phases. Grow-out requires cold water and culture procedures have not been defined. At this time, it is unclear how or whether culture techniques can be pursued commercially.

Atlantic clam (*Spisula solidissimia*) (Photograph by Joe Buttner)

2. American lobster (*Homarus americanus*) — This species is regarded as an animal with potential for aquaculture because of high economic value. Key problems are its cannibalistic nature and relatively long grow-out time of five to seven years. Public hatcheries have cultured lobsters to a juvenile stage for stock enhancement and for population studies. Private attempts at culture cannot be recommended at this time.

American lobster (*Homarus americanus*) (Photograph courtesy of the New England Lobster Research and Rearing Facility)

3. Marine finfish traditionally pursued by commercial fishers: American halibut (*Hippoglossus hippoglossus*), Atlantic cod (*Gadus morhua*), cobia (*Rachycentron canadum*), summer flounder (*Paralichthyes dentatus*), American shad (*Alosa sapidissima*) — American shad has been cultured for enhancing wild populations. Research on culture techniques, nutrition, and genetics is required before these fish can be considered for commercial aquaculture.

Flounder (*Paralichthyes dentatus*) (Photograph from www.ag.auburn.edu/fish)

4. Sea scallop (*Placopecten magellanicus*) — Extremely popular in the Northeast, the sea scallop commands a premium price. In addition to sharing many of the same challenges to culture as the bay scallop, it takes two to three times longer to attain market size. While potentially attractive because of consumer

Sea scallops (*Placopecten magellanicus*) (Photograph by Dana Morse, Maine Sea Grant College Program, University of Maine Cooperative Extension)

demand, the sea scallop cannot be recommended for commercial aquaculture at this time.

5. Green sea urchin (*Strongylocentrotus droebachiensis*) — With the overexploitation of wild sea urchins for export to oriental markets, interest in their culture has expanded. Investigations on the aquaculture potential have been initiated in Maine and at least three hatcheries are producing urchins for biological experiments and stock enhancement. Commercial production is problematic and not likely in the near future.

Green sea urchin (*Strongylocentrotus droebackiensis*) (Photograph by Ted Maney, Northeastern University)

References

Several relevant fact sheets are available on the culture of different species from the North Central Regional Aquaculture Center (www.ncrac.org) and Southern Regional Aquaculture Center (www.msstate.edu/dept/srac). The fact sheets are accessible and may be downloaded from Center websites. The Aquaculture Network Information Center (http://aquanic. org) provides access to many aquaculture resources.

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Table 1. Marine animals and plants cultured in the Northeastern United States. Importance in northeast (M=major species, S=secondary species, D=demonstration species, E=experimental species) and systems used (I=in substrate, O=on substrate, R=in rafts, bags or lantern nets, LL=long-line, N=net pens, L=land-based recirculating systems) are indicated.

Common Name	Scientific Name	Importance	System
Molluscs			
Eastern oyster	*Crassostrea virginica*	M	O,R
European oyster	*Ostrea edulis*	S	O,R
Northern quahog (hard clam)	*Mercenaria mercenaria*	M	I,O
Softshell clam	*Mya arenaria*	S	I
Bay scallop	*Argopecten irradians*	E	R,LL
Sea scallop	*Placopecten magellanicus*	E	O
Blue mussel	*Mytilus edulis*	M	O,LL
Atlantic (or Surf) clam	*Spisula solidissimia*	E	O
Fish			
Atlantic salmon	*Salmo salar*	M	N
American shad	*Alosa sapidissima*	E	L
Atlantic cod	*Gadus morhua*	D	L,N
Atlantic halibut	*Hippoglossus hippoglossus*	E	L,N
Summer flounder	*Paralichthyes dentatus*	D	L,N
Cobia	*Rachycentron canadum*	D	L,N
Mummichog	*Fundulus heteroclitus*	D/S	L
Clownfish	*Premnas* sp.	D/S	L
Clarkii clownfish	*Amphiprion clarkia*	D/S	L
Tomato clownfish	*Amphiprion frenatus*	D/S	L
Percula clownfish	*Amphiprion percula*	D/S	L
Cinnamon clownfish	*Amphiprion melanopus*	D/S	L
Neon dottyback	*Pseudochromis aldabraensis*	D/S	L
Sunrise dottyback	*Pseudochromis flavivertex*	D/S	L
Orchid dottyback	*Pseudochromis fridmani*	D/S	L
Splendid dottyback	*Pseudochromis splendens*	D/S	L
Common seahorse	*Hippocampus kuda*	D/S	L
Angelfish	*Pterophyllum scalare*	D/S	L
Crustaceans			
Penaeid shrimp	Penaeidae	D	L
Blue crab	*Callinectes sapidus*	D	L
American Lobster	*Homarus americanus*	D	L
Annelids			
Sandworm	*Nereis virens*	S	T
Echinoderms			
Green sea urchin	*Strongylocentrotus droebachiensis*	D	T
Cnidarians			
Soft coral	*Alcyonacea* sp.	E	L
Algae			
Nori seaweed	*Porphyra* sp.	S	R