Shellfish Propagation
2006

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Propagation:

Shellfish propagation for the Town of Nantucket, for the year 2006 consisted of mainly oysters, quahogs, and scallops. Muscongas Bay Aquaculture, of Maine was able to provide one million oysters at the1mm range. Several failures of quahog production due to a vibrio occurred at Muscongas, which resulted in the delay of the acquirement of quahogs. Quahogs eventually came from Aquaculture Research Corporation on the Cape. Transects and quadrates of soft shell clams and quahogs were performed to test the success of earlier plantings. Transects of scallops and eel grass were performed on a large scale, to provide a stock and habitat assessment, and will be in a separate report. Grow out of the shellfish took place at the Boat House at Brant Point, while collection of scallop spat took place in the harbor. Spawning cages were also used to increase the natural set of scallops, as well as a spawning tank at the Boat House. This year a total of 9 cages were employed. A grant from the State completed the reconstruction of the pier at the Boat House, and the use of a second flupsy was employed this summer.

Oysters:

Oyster grow out of 1,000,000 animals @ 1mm was successful with little mortality. Oysters arrived in late May 5/31, and were grown out into December, because of unseasonably warm water temperatures (45ºF @ the Boat House on 12/5). The average size range was 19-25mm upon release 11/7 -12/19. Approximately 300,000 sieved well throughout the summer attained a greater size range 30+ mm. A portion of this larger group was released at Sesachacha Pond, Hither Creek, and at the Old North Wharf. Also released with these groups were approximately 2,000 individuals that had been over wintered a second year. This allows for smaller younger males and larger older females to be set in the same location, at a size range that will hopefully escape predation. Hopefully these sites will begin to benefit from bioremediation (the filter feeding of the shellfish), which should improve water quality. This should then increase the survivability of those oysters, and allow the establishment of self sustaining reefs; which will then have the ability to set oysters in other locations.

Another portion of the large oysters, approximately 3,000 were placed in a grow out cage (3' x 2' x 3') at the Boat House to overwinter. These over wintered oysters will be used in 2007, to set both male and female oysters at the same time. Following several years of growth and maturity oysters typically change sexes, from male to female. Setting both age groups, allows for the setting of both gametes when temperatures rise. This should increase the potential for fertilization, initiating a natural setting process of propagation. Hopefully this will then begin to build a reproductive population large enough to sustain itself, and have an effect on improving water quality through biofiltration.

Another form of setting oysters with shack was employed this summer in Madaket. Spat bags were filled with shell, (slipper shells were used this summer) then oyster spat was poured into the shell bag for grow out. This form of propagation is called

a “Remote Set”, and allows the oysters to accrete to larger shell, and grow out without settling into soft sediments where they would suffocate. The shack also helps to protect against predation, until the oysters attain a larger size. This may prove to be an effective method of oyster propagation in Hither Creek where sediments are thick.

Naturally occurring sets of oysters are now being seen in Sesachacha Pond, as well as Madaket Harbor (Personal observations, and conversations with Madaket Harbormaster). Oyster propagation efforts appear to be working, however until independent reefs are established recruitment will have to be augmented via aquaculture to ensure the viability of a self sustaining reef. The potential for biofiltration is great because each adult oyster can pump up to 50 gallons of water a day. Also, if reefs can be established in closed areas now, then they will be able to set remote satellite areas on their own. Acting as spawning sanctuaries, these reefs will be able to propagate oysters in “open to shell fishing” areas where they can then be harvested.

Oysters were released prior to the winterization of the Boat House. This also coincides with falling water temperatures that would initiate the period of cessation for shellfish.

Number and location of oysters released in November and December:

1. 300,000 Sesachacha Oyster Reef
2. 400,000 Old North Wharf
3. 250,000 Madaket
4. 3,000 Brant Point
5. 3,000 Boat House Overwinter Cage

Quahogs:

Quahogs were again ordered from Muscongas Bay Aquaculture of Maine, however the first set of 1 million @ 1 mm acquired a vibrio just one week prior to shipment in early June. A second setting was attempted, with a shipment date closer to the end of July. This following set also was compromised by the same bacterial infection. These types of losses are not uncommon in aquaculture, and are almost always caught before any disease is passed on to the intended recipient. Only Massachusetts State approved facilities are used for the procurement of shellfish, and are required to pass several tests for disease control.

Typically we try to obtain larger quantities of shellfish which can be purchased at reduced costs at smaller size ranges, then gown out to a larger size to avoid predation. This was not possible this summer, but we were fortunate to find a State approved hatchery that had stock available. Approximately 350,000 @ 4-6mm were purchased from the Aquaculture Research Corporation or (ARC) on Cape Cod. Because of the mishaps and delays we did not receive the quahogs until 8/1. The grow out process continued for as long as possible, so as to maximize growth throughout the summer. The quahogs were released between 11/10 and 11/14 in two areas (Monomoy, and the Horseshed). These are the two largest areas where recreational fishing for quahogs is primarily done.

The release of the shellfish was as close to the cessation period as possible. This is when temperatures fall, (approximately 45º F), before winter. This will also increase survival, because this is when many marine species, including predators go into a dormancy. This more intensive strategy toward propagation should produce shellfish at a greater size, thus reducing predation. This then should help maintain a shellfish population that is actively fished. Sizes ranged from 6 to18mm with some incidental mortality, and release at the Boat House from handling.

Number and location of quahogs released in November:

1. 200,000 Horseshed
2. 150,000 Monomoy
3. 1,000 Brant Point

Soft-Shell Clams:

Soft-shell clams were not ordered this year as the propagation efforts from ’02 and ’03 appear to have taken off well. Transects and quadrants were limited this year as more time was spent on an eel grass and bay scallop stock assessment. An order in 2007 will be placed for soft shell clams, so as to buffer the continual loss in heavily fished areas like the mud flats outside Polpis Harbor. The lower harbor appears to be acting well as a spawning sanctuary, as it is closed to shell fishing because of fecal coliform counts, and Division of Marine Fisheries standards.

The planting of soft shell clam seed also appears to be working well as sites are carefully selected. If sites show a lack of clams, but an abundance of worms they are left fallow for at least two years. This is to allow the predator to prey ratio to balance out before plantings. If site selection were ignored, then plantings may only be feeding the worms, and crabs in that area. The monitoring of populations must continue to be performed if a healthy population, (one that can be fished steadily, and has the ability to replenish itself) is to be maintained.

Scallop Spat Collection:

Spat collection for ’06 was as poor as the ’05 season, with substantial losses from improper boating, and or vandalism. Spat bags on 5 lines, with 20 bags each for a total of 100 bags were set early to late June 6/5-6/27. A small line of six was also hung off one of the flupsy units at the Boat House to check for setting times and development of larval scallops in the harbor. Temperatures increased early in the Head of the Harbor (68ºF on 6/5), then slowly warmed into the Lower Harbor to reach (68ºF on 6/13) at the Boat House. Temperature fluctuations occurred oddly throughout the summer with regards to spawning regimes. This may have contributed to an early set, from nub adults and 2nd yr. adults. This recruitment was most likely minimal, because of the limited number of these age classes present and available to spawn. This would however lead to some very large seed being produced in the ’06 spawning season. A fall spat line with 20 bags was set 8/24. Final setting temperatures occurred between 9/5 and 9/8.

Growing temperatures (45ºF and >) fluctuated well into the winter and the following year at some locations in the Harbor (40ºF @ Wauwinet on 12/5). Spat checked from a bag off the fall line does appear to be in cessation (45ºF @ Boat House 1/9/07), as there is no apparent shell growth occurring throughout the winter months. However these higher than normal temperatures, and temperature fluctuations may have consequences not readily discernable. For example, a continued metabolic activity may cause a certain stress which could result in a decrease in longevity. This may also however result in a more sexually mature group of scallops that would be able to spawn as soon as temperatures reach the spawning zone, resulting in larger seed scallops that will be capable of the same. Unfortunately large seed scallops are often fished on because they produce a marketable sized meat.

Summer Spat Lines with 20 Bags:

Line:	Date Placed:	Location:	Date Removed:	# Collected:	Range:
1	6/5	Haul Over	Missing	Unknown	Unknown
2	6/8	Pocomo East	8/23	Cut w/ 78	8-43mm
3	6/14	Quaise	8/28	Cut w/ 53	12-50mm
4	6/23	4th Bend	Missing	Unknown	Unknown
5	6/27	3rd Bend	8/11	Cut w/ 11	8-32mm

Traditionally there are two spawning sets in Nantucket Harbor. The first occurs in the late spring / early summer when temperatures rise rapidly from 68ºF to 72ºF, and the second when temperatures fall back through that range (Belding, 1910). These are called the summer set, and fall set. However any temperature fluctuations through that range either up or down may induce additional spawning events. This will result in wide range of size groups with the majority being somewhere in the middle of that range. The fall set occurs during the last temperature drop through the range mentioned above. Before temperatures drop further and cessation (45ºF) sets in, these fall set (nub) scallops may reach up to 20mm and commonly have size ranges between 3-20mm, with averages close to 10mm.

Fall Spat Line with 20 Bags:

Line:	Date Placed:	Location:	Date Removed:	# Collected:	Range:
1	8/24	Pocomo West	10/31 to Boat House	Cut w/ 1,000	3-15mm

Initial indications from the fall line represent greater spawning activity at the end of the season, which can translate to a greater portion of the biomass being of less mature adults than would be preferred. It could also mean that water quality issues are delaying the spawning of already mature individuals. However there is limited early spawning occurring. So, it is more likely an issue of the lack of older age classes present; as the result of intense fishing pressure and natural mortality.

Sexual maturity of the bay scallop plays a major role as to when spawning events may occur. Scallops over the age of 12 months with sufficient shell height, sizeable body mass, and well developed gonads will spawn with the as mentioned temperature fluctuation. There may be as many as 6 age classes of scallops in the waters of Nantucket following the Fall set of any given year (see power point presentation '06), however only three of these would have been able to spawn during that summer season. Two of these age classes are actively fished, leaving only one age class (1st yr. Classic Adults) to spawn prior to the fall of any given year.

An age class represents scallops spawned at different times, from the summer and fall, overlapping a period of three years. The reproductive stock at the age of spawning of this biomass would include 1st yr. Classic adults (12-14 months, with a growth ring between 1 1/5" (30mm) to 2 3/5" (65mm)), potentially Nubs (12-14 months, provided that they have an annual ring > 1/5" (10mm)) (Belding,1910). Also capable of spawning are scallops that have two growth rings, Nub adults (18-20 months), and 2nd yr. Classic adults (22-24months). The early spawning scallops that would create Classic adults (scallops with growth rings high on their shell) are the 1st and 2nd yr. Classic adults, and the Nub adults. Nubs will spawn late, if at all, depending on size of growth ring, maturation of gonad, and time of falling temperatures. This results in the creation of more Nubs. Variations on this model may occur, dependant on the health of the previous groups, water quality conditions, and fluctuating temperatures. So, even 1st yr. Classic Adults with growth rings in the lower range may spawn late. Resulting in the creation of more Nubs, or scallops with growth rings low on their shells near the hinge.

A decline in spat collection can also be expected when there is a decline in the overall biomass. The '05/'06 fishing season harvest was the worst on record, approximately 5,490 bushels. The season prior, 32,500; and five years prior to that there was an average of approximately 15,000 bushels landed each year. Nub scallops are now being harvested, and the sharp increase in landings, followed by an even sharper decline is now an intense debate. The '06/'07 fishing season may be worse than the last, and this could mean that the biomass has reached a threshold limit for natural reproduction. In order to increase or even sustain the fishery, hatchery raised animals may be required to strengthen the population. A fisheries closure may also prove successful to restore the biomass; however neither of two choices would come without undesired affects. Never the less some sort of conservation measure should be implemented, such as re-instating the nub or ring (minimum growth line) rule being.

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Scallop Seed Relocation:

The Marine Dept. has often worked in the past with fishermen to move large amounts of scallop seed at the end of the fishing season. The purpose of this endeavor is to improve environmental conditions for the seed, so that spawning and development are optimal. The decision to do so is often based on location, and depth in the harbor, as well as the concentration or number of seed in any given area. The need for relocation is not always necessary. However if there are high concentrations in shallow areas, or areas of poor water quality characteristics, the areas must be investigated with relocation in mind. Optimal relocation sites would be in mid harbor areas, where there is a depth of 8-10', and where eel grass is present in concentrations of 25% or greater. This takes into

consideration conditions for spawning purposes, such as circulation with respect to larval retention time, and environmental conditions; such as water temperature and dissolved oxygen content. Multiple spawning sites may also be chosen, allowing for a division of the setting process; which avoid subject a significant portion of the reproductive biomass to any one adverse environmental or climatological affect.

Verbal reports of large numbers of seed were received from several fishermen during the '05/'06 fishing season. However spat collection from '05 spawning season was low, and dive transects from '06 spawning season did not reveal any great quantity maturing adults prior to the opening of the '06/'07 fishing season. Nor was there seen any great quantity of shack, or shell from a supposed large set of seed from the '05 spawning season. At the close of the '05/'06 fishing season there were no reports of large numbers of seed in danger, or in shallows that needed relay to deeper water, or movement from areas with poor grow out conditions. Hence no seed relocation was performed for at the time of the closure of the '05/'06 fishing season. In stead plans were drawn up for a stock and habitat assessment, during which maturing adults would be collected for the spawning cages for the summer of '06.

Scallop Spawning Cages:

Spawning cages are maintained and monitored from year to year to supplement the natural spawning biomass of bay scallops in Nantucket Harbor. Scallops are known to spawn in mass, and so the density of scallops in close proximity should increase the potential for fertilization. Stocking densities have varied slightly from year to year. An optimal number for survival through the spawning season was determined following the summer of '03. The mortality rates were very similar between the densities of 30 -50 scallops per tray, so the number was increased to 50 individuals per tray.

The caging of these animals is extremely detrimental to their health, decreasing circulation, increasing mortality; these conditions also delay the time period of spawning. Because of this scallops were collected in dive transects just prior to the '06 spawning season to allow for natural conditioning, and to reduce the amount of stress the individuals would be subjected to. The 1st yr. Classic adults, at or around 12 months of age were the target age class for this years spawning cages. Collection was carried out from the end of May to mid June, up to the point where by the scallops were spawning as they were being loaded into the last cage. The temperature throughout the harbor was approximately 68°F at this time, 6/13. Nine cages were completed, each holding 150 individuals, placed on three trays in bags.

Cages 1-8 were taken to Quaise based on prior knowledge of circulation and environmental conditions, with regards to optimum spawning and recruitment conditions. The 9th Cage because of its condition, (which was probably due to the agitation the animals experienced in the caging process), was placed off the east side of Pocomo. This was done to avoid disrupting the natural spawning process in cages 1-8. Most of these scallops at this time had glossy black gonads, and we wanted to avoid an unnaturally initiated partial spawn of scallops not yet fully mature. The point of the spawning cages is to place as many individuals in close proximity to one another in order to maximize the incidence of fertilization, and bolster the natural recruitment process and there by increase the biomass as a whole.

On 8/4 the cages were inspected to clean the bags of biofouling, remove dead or dying scallops, and collect one individual from each cage for histology. Usually only a visual gonadal inspection is done, but this year Val Hall and her team of interns were equipped with a Microtome machine. This allowed them to perform a micro-cross-dissection histology of the gonads. Also performed to test for spawning activity, was a gonadal smear, or staining process perfected by Dr. Stephen Estabrooks; also at the Nantucket Marine Biological Laboratory, a.k.a. the Boat House. For this test one scallop was taken from each cage during the inspection. The histology proved the scallops had ripened, and were spawning. Mortality was very low at this point in time, and averaged only one individual per bag, equal to three per cage. Plus the one for dissection, mortality by 8/4 equates to only 3%.

Total Mortality and Deployment Time Period:

Cage #	Deployed	Retrieved	Alive	Dead	Slipped	%Mortality
1	5/30	10/13	69	81	10	60%
2	6/1	10/13	111	39	9	31%
3	6/1	10/16	67	83	9	61%
4	6/6	10/19	71	79	7	57%
5	6/9	10/23	89	61	2	41%
6	6/12	10/26	72	78	14	62%
7	6/12	10/26	70	80	6	57%
8	6/12	10/31	76	74	1	49%
9	6/13	10/2	75	75	7	54%

* % Mortality includes the number of individuals with slipped hinges, but does not include the scallops used for histological dissection.

The average mortality in the spawning cages for the ’06 season was on the high end,(52%); incidentally harbor temperatures reached 80°F for the first two weeks of August. This would be especially not good for a caged group of scallops that was recovering from the spawning process. This total mortality is also based upon a late retrieval, ensuring that all scallops in the cages would have had a chance to spawn. A gross dissection was performed on the surviving scallops. Of interest, was that not all scallops showed signs of having completely spent gonads; as referenced to by their color on a gonadal indicies chart. Mostly these scallops came from the group known as slipped hinge scallops, which had suffered some stress from the caging process.

A decrease in mortality in the future would most likely be attained if the scallops are released from the cages shortly after spawning. The 8/4 inspection showed very little mortality, and the ensuing dissections showed a definite incidence of spawning. A release of the cage scallops in the future, following a two month period of proper spawning temperature, should decrease mortality in the spawning cages. This in conjunction with an, as late as collection date as possible should maximize the spawning potential, with out negatively affecting the biomass.

The spawning potential of a “scallop cage” has never been measured, but it must greatly contribute to the overall biomass of any given area when deployed properly. Spawning cages will continue to be used in the future in order to enhance the fecundity of the natural population. However the over wintering process for these cages will be discontinued, as it is detrimental to the health of the animals. The locations for deployment will be based on water quality, habitat viability, and circulation. The timing of deployment will be based upon water temperature, and maturity of the age class being utilized for the process.

References

Belding, D.L. 1910. The scallop fishery of Massachusetts. Mass. Dep. Cons., Div. Fish. Game, Mar. Fish. Ser. No. 3. 51pp.