Can We Rebuild Our Lobster Fishery?
Capstone Project Proposal – The Sound School

Timothy C. Visel

Revised October 2012 for ISSP/Capstone Credit
EPA Long Island Study Reports
The Sound School

What is Natural: How Feasible is Restoration Without a Habitat History for Connecticut Lobsters?

Original Presentation The Long Island Sound EPA Habitat Restoration Guidelines, September 2009[1]

Can We Create Additional Stage 4 Lobster Habitat in CT?

The Blackfish Sea Bass and Scup Artificial Reef Plan – Project Finfish, March 24, 2010[2]

The Historical Importance of Kelp Forests to Lobster Populations

Artificial Reef Proposal EPA Habitat Committee April 2011[3]

---

[1] The Long Island Sound EPA Habitat Restoration Initiative Guidelines – Page 6 Coastal Barrier Comments – Page 9
Modifications of Healthy Habitats – Alteration of Natural Processes
Comments from Tim Visel – Sept 2009
The Sound School Regional Vocational Aquaculture Center
The Hammonasset Beach Erosion Problem
A Case History of Habitat Transitions for Creation, Enhancement and
Mitigation – Part I
Restoring Finfish and Shellfish Populations May Require Additional Habitat Studies
Making the case for Artificial Reefs – Part II
Habitat Creation, Enhancement and Mitigation – Part III

[2] DEP/EPA HRI Committee Possible Guidelines for Habitat Enhancement
The Blackfish Sea Bass and Scup Artificial Reef Plan
Project Finfish – March 24, 2010, HRI Meeting
A Review of Florida Fish Enhancement Efforts From the 1970's
Commentary by Timothy C. Visel
The Sound School

[3] EPA/DEP Habitat Restoration Committee Long Island Sound Study
Artificial Reef Proposal March 24, 2010
Updates to the Artificial Reef Report – April 2011
Tim Visel
Potential Agenda Item for July Meeting
Can We Recycle the "Q" Pearl Harbor Memorial Bridge for Reefs?
Part I Connecticut Reef Experience, Part 2 Florida Reef Experience, Part 3 South Carolina Reef Experience

Abstract:
It is foolish to underestimate the impact we have had on the planet. In time we may know and reflect upon the extent of that impact. Until then, fishery history is one of the few instruments that can provide that reflection, and that history is not only about us but the natural world as well.

In this instance the failure in the lobster fishery is not from "us" or harvesters, but a climatic cycle. The crisis in the Southern New England lobster fishery is a classic current example. The problem is that our capacity for understanding our long term ecological impacts from natural cycles are far too short. For example, a severe storm may uproot large trees sending a cascade of small branches, twigs, and leaves to the forest floor. In several years, this wood becomes tinder dry; perhaps dry wood has accumulated in the area for decades. On a windy day, a poorly built campfire starts a horrific forest fire, the campsite is blamed for the fire, but for the conditions and amount of tinder, i.e. the huge amounts of dry combustible material is likely the result of the previous storm, and there is often no connection to these long ago natural conditions. It is natural to have forest fires; it is unnatural not to have them. We may not like them, or choose to fight them, but they are part of a natural cycle connected to climate and temperature. Forest fire capacity is enhanced in heat and dry periods, in times of above average rainfall and cool periods less forest fire capacity exists. We often forecast when extremely dry conditions are present and "issue red flag warnings" and grow up listening to "Only You Can Prevent Forest Fires". The truth of the matter is heat lightning is responsible for the greatest number of forest fires, not us or "you". It is also natural to have fishery failures following a habitat failure and for the Southern New England Lobster Fishery both have occurred.

The Law of Habitat Succession

But what happens after the fire, massive amounts of carbon are released (some would say recycled) land cleared and in time new habitats emerge. That is natural; it is natural to have storms and forest fires and habitats experience this terrestrial energy cycle. To "protect us" from this energy cycle takes an enormous effort on our part and as terrestrial beings we constantly crave that habitat stability. We want the same habitat conditions to exist forever but sadly they cannot—that is not natural. A visit to a forest fire several years later with adequate rainfall we will see different yet healthy habitats, perhaps new species that were not there before and perhaps an absence of those who were there before, but again that is natural. As one habitat clock ends another often begins. We call that the natural law of habitat succession. It is easy to see if an historical habitat history is kept and reviewed over decades such as those observations after a forest fire. If the energy pathway is large enough and the habitat clock limited by any number of factors, a habitat extinction event can occur, even extinction as it is most difficult for many to accept, is in fact, natural, and a series of extinction events can lead to a species eventual extinction; it is rarely one extinction event, however, but a series of habitat setbacks over time.

The chief advantage over terrestrial natural succession is that we can observe it on land and the impacts of climate and temperature upon species. It is known that examining the "rings" of cut trees for example, can tell us much about past climate conditions, a thick wide ring signifies good growing conditions, a series of narrow tightly grouped rings, not so good, perhaps dry or cool periods. We know that conditions change over time and what we see today may not have been so in the past, a past we often had little influence. It's not always about us, although that is often the perception after decades of public environmental policy debate. That is the largest challenge of the environmental community today is to accept the fact that we may impact the ecological balance of our planet but natural conditions must also be acknowledged and the environmental habitat history explained just as often as the negative human impacts, which seems today to be the only environmental message heard.

And it is easy policy-wise to accuse resource user groups such as the lobster fisheries of overharvesting as resource use is often the first place historically we seek to explain resource "failures" as "overfishing". With the lobster fishery this is simply not the case. While it appears that overfishing is the reason for the decline, it is changed habitat conditions that caused the lobster fishery to collapse. In fact, our lobster fishing practices has increased the habitat carrying capacity by removing the largest of lobsters, freeing up habitat space and providing additional food for more yet smaller lobsters.

The Collapse of the Southern New England Lobster Fishery – Again

In the marine environment the environmental message is far more complicated and much more dangerous policy wise. In the case of the lobster fishery it has been highly regulated for over a century accepted and management practices promoted by both the fishermen and regulatory community. Management measures include rules such as the female V notch, a large "oversize" spawning population and overall size of capture retention regulations.

In the late 1970s as our climate entered a second warming period, New England winters warmed, and the number of coastal storms declined, it became hot with a few significant energy events we call hurricanes. Hurricanes acted as forest fires, changing conditions for many species just as marine forest fires on shorelines often destructive for existing habitats but creating conditions for new robust (energized) habitats.   Hurricanes in colder weather scoured hundreds of miles of shorelines of silt, clearing near shore cobble stone habitats in which kelp often grew, clinging to cobblestones in five to fifteen feet of water. It is the long frond of ribbon like brown sea weed, a valuable crop for food that grips this cobblestone, cleaned and tumbled in the surf. Tens of thousands of acres of kelp/cobblestone habitat was created (or many might call "restored") in New England coastal areas in the 1940s and 1950s, and significant kelp forests grew upon these exposed cobbles.

In Southern New England this habitat provided critical habitat for Stage 4 lobsters, as our shores lack the enormous habitat capacity of Maine's rocks and reefs, but for Southern New England Stage 4 lobsters, the kelp forests provided this essential habitat, forage and protective cover. I used to set green crab traps in these kelp for**e**sts and would catch numerous small lobsters in them. Decades later I would begin to learn how important those kelp forests fifty years ago were although annoying for me when flounder fishing in the 1960s and 1970s. A flounder hook back then would snag the hold fast of the kelp and instead of a large winter flounder, a cobblestone and entire kelp blade came inboard, and many winter flounder fishermen at that time experienced this, which is why the flounder were also interested in what these kelp forests held – I guess even the small lobsters.

By the late 1970s the kelp "forests" started to fail in Connecticut, the cobblestones during a warmer period became buried in silt and by the mid 1980s, this habitat failed, and the shallow water kelp forests disappeared and with it, essential critically vital habitat for small lobsters especially that Stage 4 size, a critical size for our future lobster fisheries. The extent of the habitat failure would not be felt in the fishery for almost a decade; it takes about 7-10 years for a lobster to reach a size subject to legal harvesting. If a habitat failure happened it just wouldn't be known or connected to the loss of cobblestone kelp habitat many years before. The lobster industry has suffered habitat extinction events, and then a series of habitat failure episodes as waters continued to warm and near shore waters contained less and less suitable kelp habitat. It was getting too warm for the larger lobsters and they left the near shore shallows for the deeper water (shorts also), making them easier to catch and catches actually increased and then quickly collapsed. Higher temperatures drove very small lobsters from the shallows completely and caused them to suffer new and intense predator/prey relationships. This would extenuate the extent of the recruitment failure and then the eventual fishery collapse. Although fishery regulators termed it overfishing, but with the regulatory controls on effort, size, escapement panels, and egg bearing females protected, it was a fishery failure that followed a habitat failure.

In all probability one of the management/regulatory features of this habitat failure that worked against the lobster industry was to return "shorts" (undersized, sublegal) lobsters back to the marine environment during daylight. Here the blackfish (Tautog) and black sea bass which thrive in warmer water consumed most of the returnees which I personally observed in shallow water lobstering off the coast of Madison with my brother Raymond in the 1970s. In shallow water released lobsters were predated upon by blackfish that would dart out behind rocks and attack lobsters from the back, punching them hard and biting their tails, but it was so fast the returned lobster didn't stand a chance, especially if they landed on clear sand between rock ledges in blinding daylight. We felt badly and stopped emptying old lobster bait over them which actually chummed additional Tautog to the site and began throwing shorts up on the rocks that still had kelp so they could hide until dark, but even then a quick seagull could make short work of these shorts. Although we did not observe this activity in deeper water, we suspected it was a factor including predatory loss, we often thought about an evening haul (against conservation laws) so at least small lobsters would have some time to hide in darkness before the light.

From my modest observations many decades ago, the attack from the blackfish was strategic, a large bite from above to the tail, from behind, and just in back of the solid carapace, in a few seconds the lobsters would quickly bleed to death, and then numerous small blackfish and some cunners (Tautogolabrus adspersus) would emerge and tear and rip the lobster body to shreds. The debate over daylight releases is something that has never been adequately addressed by the research community until present times, but the predation upon sub legal lobsters is real and increases in significance in the absence of kelp forests. It is thought that kelp cobblestone habitats often fringed the lobster rocks and ledges in the eastern part of Connecticut and provided some protection to thrown overboard shorts that today may not be the case. Some discussions have included the creation and study of rubble reefs in deeper waters (artificial reefs) to increase Stage 4 capacity, even in Maine. (See Capstone proposal for reef ball studies). Rhode Island has conducted some very successful experiments in this area.

From an environmental history viewpoint, this habitat failure is not new, far from it, the lobster fishery; in Southern New England experienced that same type of habitat failure during The Great Heat 1880-1920. In this period (which is very similar to today's warmer winters) lobster recruitment levels sharply fell after decades of hot temperatures and few large storms, and strict regulations were enacted to prevent over fishing (many of the regulations today governing the lobster fishery had their beginnings during The Great Heat) and they include:

- Returning of berried or egg carrying females (Maine also had an oversize limit)
- An accurate way to measure lobsters- the lobster gauge – sublegal lobsters returned – called "shorts" today replaced length of lobsters.
- Seasons-Maine and Rhode Island only – Rhode Island in 1905 prohibited a fall fishery and reversed this decision in 1906. Maine allowed some communities to enact local management laws.
- Possession of lobster "parts"- must be whole and not mutilated.
- Licensing

What wasn't addressed was the climate and energy conditions during this period which were known for brutally hot summers (and extreme high water temperatures in shallow critical lobster Stage 4 habitat areas) and almost a total absence of hurricanes/strong storms. In this 40 year period only four significant storms, one blizzard (1888), the Portland Gale 1898 (category 2 hurricane wind gusting to 90 mph) and two summer gales 1903 and 1904 were known.

Compare this to the New England (North Atlantic) Oscillation a cooler more some filled time of 1951-1965 which saw some 27 named and severe storms. Long Island Sound would frequently freeze over or nearly so. This period would and did have significant lobster habitat impacts. It would destroy most of the deep water eelgrass meadows established during The Great Heat and replace them with kelp/cobblestone forests. The habitats created in the 1940s and 1950s (kelp forests) would sustain the lobster fishery for nearly a half century.

The Collapse of The Southern New England Lobster Fishery in 1905

In 1888, the lobster industry in Southern New England centered then in Noank, CT, began to fail and much blame was placed at lobster canneries and poor harvest restrictions at the time. The lobster canneries closed as lobster supplies diminished, but habitats continued to warm and the catch per unit effort measured by the number of lobster traps set rose accordingly. It took more and more lobster traps to catch the same number of lobsters and eventually more traps to catch fewer lobsters – a symptom of overfishing. But what was really happening was habitats favoring lobsters were declining but those favoring the blue crab were increasing. As summers warmed and the kelp forests waned, a new vegetation appeared – eelgrass and with it, the blue crab. As the habitat quality for lobsters declined, the habitat quality for blue crabs increased. Blue crab populations surged at this time in Southern New England.

The increase in the blue crab was noticed in Narragansett Bay shortly after the turn of the century and blue crab population greatly increased in the bay to the teens. At the same time lobster habitat continued to decline setting up a collapse in the Southern New England lobster stocks. Maine lobster production did fall but nearly not as much as Connecticut and Rhode Island and south of Cape Cod as declines were devastating and would take decades to "recover". (See Appendix 5).

The dramatic collapse of the Southern New England (1896) lobster fishery alarmed federal researchers, fishermen and the United States Fish Commission. By 1910, all of the New England states had built lobster hatcheries, all targeting that critical stage 4 lobsters. Millions of lobsters were released into the environment apparently with some success. Below is a short quote from "Report of Commissioners of Inland Fisheries," State of Rhode Island, (pg 5. 1905)

The practical result of this planting of young lobsters is unquestioned. Reports from the lobster fishermen show that more small lobsters were present in the localities where the fry were liberated than have been seen before for many years. It will be but a few years before these small lobsters will be of marketable size and then the expense of developing the lobster rearing plant of the Commission will be returned to the inhabitants of the state many times over.

Such results as these are very gratifying, especially when we consider that nowhere else in the world have any such results been obtained. Indeed, nowhere else has it been possible to rear lobster fry at all successfully, and the results of your Commission's work have attracted the attention of those interested in promoting the fishery interests in all parts of the world.

In this country our work has been watched by the United States Bureau of Fisheries and the commissioners of other maritime states, and now that our efforts are crowned with success both the national Bureau and the commissioners of other states are ready to follow our example. Indeed, the neighboring State of Connecticut has already appropriated $10,000 to establish a hatchery, and a committee has visited our laboratory at Wickford to secure the information necessary to begin operations in their own waters."

The book issued by the State of Rhode Island in 1905 details the lobster hatchery upweller operations in a lengthy bulletin titled, "State of Rhode Island and Providence Plantations. Thirty-Sixth Annual Report of the Commissioners of Inland Fisheries" which details in 150 pages, some of the regional lobster replenishment efforts of that period.

The end of The Great Heat saw eelgrass meadows spread into deeper and deeper waters in warm temperatures and ample nutrients dense monocultures came into being, the meadows became so thick at times to impede navigation. Special propellers were designed for vessels so that they may travel bays and coves now filled with eelgrass. In extremely hot weather and after a stormy night, beachgoers arose to find mountains of loose eelgrass on shorelines. In Massachusetts eelgrass was removed so beach goers could even walk to the water line. In the hot temperatures eelgrass worked against several colder water inshore species, by slowing tidal exchange flows and created habitat conditions (too hot low oxygen) unfavorable for lobsters. In the end, vegetation rotted on the bottom in sluggish poorly flushed coves drawing oxygen from already high temperature oxygen depleted waters. The teens are remembered for some of the most horrific fish kills (winter flounder) on the South Shore of Long island during this time.

In areas such as Southern New England the inshore habitats are limiting and greatly susceptible to fluctuations in the kelp/cobblestone habitat. Created habitats although rarely studied do provide an increase in habitat capacity. Habitat creation for the small lobsters are critical because of life history parameters mentioned above, when small the predator/prey relationship is huge and habitats required for protection when lobsters mature it becomes a food/territory issue, and a struggle for habitat against other lobsters, rather than direct predators. This issue would be changed with the invention of the wire trap, lobster habitat capacity would be enhanced by the structure lobster pots provide even the feeding of sublegal lobsters has been compared to terrestrial bird feeders and resembles extensive "aquaculture" production systems. There is little doubt that lobster fishing practices have helped habitat carrying capacity.

Capstone Proposal

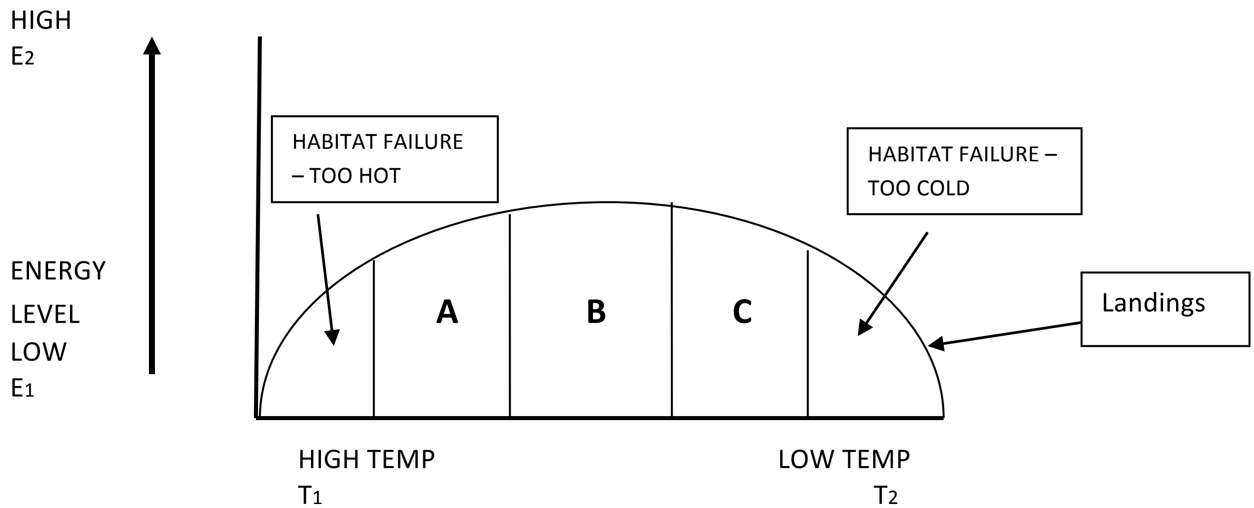
Longer lived species are able to overcome short term habitat disruptions – lobsters and hard shell clams have relatively long life spans, even longer than ours. One of the questions is why and some answers can be found in reproductive capacity, habitat capacity and habitat quality. For example, a long life span has been attributed to hard shell clams because heavy reproductive (recruitment) success is periodic after hurricanes and colder temperatures. The largest hard shell clam sets occur after strong storms and in cooler sea water temperatures, as habitat quality is then enhanced- a more alkaline soil and an absence of larval veliger predators dislodged by the previous storm or storms.

For lobsters in our area, cooler storm filled periods cleaned and sustained kelp/cobblestone habitats critical to the post larval sets, the crucial Stage 4. There can be plenty of eggs/larval presence in the water column available from plankton net tows but imagine if the critical Stage 4 habitat was gone, the predation would be immense, and a recruitment failure would most likely occur. This often happens with hard shell clams, they spawn every year and most years good quantities of clam veligers observed in the water column, but if the habitat conditions are negative (acid soil, high populations of predators) little if any "set" will mature into a clam fishery.

The same is true for the Southern New England Lobster Fishery; lobsters will continue to breed and produce eggs to viable fry but with hot temperatures and limited critical habitat most will perish and populations will decline. That is why lobsters are known as a "cold water species" but that explanation is far too simple, it's more than just warmer temperatures, it's the combination of warmer temperatures and declines in energy dependent habitat quality of a type suitable for lobsters. There is a direct climate and energy habitat link that few researchers today will acknowledge and fewer still understand and our lobster fishery has most likely the ability to make this connection from historical landing statistics more complete.

Figure 1.

INDEX OF LOBSTER HABITAT QUALITY – SOUTHERN NEW ENGLAND



T_1- LETHAL LIMIT AT WHICH LOBSTERS SUFFER RESPIRATORY COLLAPSE – TOO HOT
T_2- TEMPERATURE AT WHICH LOBSTER EGGS FAIL TO DEVELOP – TOO COLD
E_1- ONE STORM/DECADE – INSUFFICIENT ENERY – TOO LITTLE
E_2- TEN STORMS OR MORE/DECADE – HABITAT INSTABILITY – TOO MUCH ENERGY
A - BETTER FOR YOUNGER LOBSTERS TO STAGE 4- FASTER GROWTH UP TO A POINT.
B - BETTER OVERALL POPULATION
C - FAVORS FEWER BUT LARGER LOBSTERS – COLD SLOWS GROWTH.

It is the near shore habitats that drive habitat carrying capacity for the Southern New England Lobster Fishery.

It is also strongly suggested a direct movement of larval stages is to the north- due to prevailing summer winds and entrainment of larval stages held along the coast by offshore currents. If that is true an increase in water temperatures and decrease in enemy levels (storms) even wind direction and intensity would impact the southern areas first which it did at the turn of the century when it warmed noticeably from the 1870s. It was the Connecticut and Rhode Island lobster fisheries that noticed the reduction in Stage 4 lobsters: first, long before Maine and northern Massachusetts, but as the warming continued even these areas showed marked declines, lobsters could not live in the shallows as it became extremely hot (see Rhode Island Report of the Wickford Lobster Hatchery in

Appendix 6) and lobsters derived of habitat cover protection persisted with new and different predatory/prey relationships often suffering much high mortality rates.

New England Lobster Landing Compared to Habitat Indexes on Figure 1

Table A	**RHODE ISLAND**			Final		Landings to Habitat Index	
YEAR	LANDINGS lbs		HERITAGE VALUE		HABITAT INDEX	low	CATEGORY
1962	575,000		(LOW)		Cold/energy		C
1977	3.4 million		+		Transition	increase	B to C
1986	5.5 million		++		cobblestone/kelp fails	heritage	B to A

1999	8.1 million lbs		++		cobblestone/kelp failure heat	Above heritage high	B to A
2009	2.9 million		.		fishery failure heat/low energy-loss of shallow habitats	declining	A-
	CONNECTICUT						
YEAR	LANDINGS		HERITAGE VALUE		HABITAT INDEX		CATEGORY
1962	lbs 250,000		(LOW)		cold/energy	Low	C
1977	750,000		+		transition	increase	B to C
1986	1.2 million		+		cobblestone kelp fails in warming/low energy conditions	heritage	B to A
1991	2.6 million		++		cobblestone kelp failure high heat continues growth/maturation rate higher	Above heritage	A to B+
1999	3.5 million		+++ high		habitat failure shallow water	Very high	A/B-
2009	400000		.		fishery failure loss of shallow habitats	declining	A-
Table A	**MASSACHUSETTS**			Final		Landings to Habitat Index	
YEAR	LANDINGS lbs		HERITAGE VALUE		HABITAT INDEX		CATEGORY
1962	3.8 million		(LOW)		cold/storms	Low	C
1977	8.0 million		+		Transition	Heritage	C to B
1986	11.8 million		++		cobblestone /kelp* failure (heat	Above heritage	B to A
1991	11.0 million		+		habitat failiure South - habitat faiure North	Above heritage	B to A B

1999	15.8 million		.+++high		Habitat failiure South Habitat failure North	Very high	A B to A
2009	10.9 million				fishery failure South habitat failure North	declining	A A
	MAINE						
YEAR	LANDINGS		HERITAGE VALUE		HABITAT INDEX		CATEGORY
1962	lbs 22 million		low		Colds storms	Low	C
1977	20 million		low		cold storms	Stable	C
1986	20 million		low		transition South	Stable low	C to B
1991	27 million		+		South Central North	Heritage	B C C
1999	50 million		.++		South Central North	Above heritage	B B B
2009*	90 million		.+++		South Central North	Very high	B to A B B

* Southern Mass. Fishery - Buzzards Bay /Vineyard Sound * Expect Maine landings to continue unless habitat catches in South regions begin to fail - could signify habitat failure for critical Stage 4 habitats

In times of habitat failure the fishery often improves as what may be ideal recruitment habitat quality may not be the same as mid or end cycle life history. Once lobsters had molted beyond the critical Stage 4 and reached one year old, they were able to compete in deeper water by nocturnal instincts. A period of warmth and few storms would favor the adult stages yet devastate the recruitment (year classes) of the young. Eventually, there would be no smaller lobsters to replace those harvested and catches soon (naturally) would decline. If it became too hot even for the adults which it did in Long Island Sound in the 1990s--even adult lobsters would perish, a habitat extinction episode on top of all larger long term habitat extinction events. That is how lobster production soared from 1.7 million lbs in 1983 to 3.5 million lbs in 1998 but crashed when habitat conditions failed for both small lobsters and adults reducing industry harvests to under 500 thousand pounds in 2004.

Therefore, temperature energy and climate conditions must take into account local water depths. The impacts would be first felt in the shallow coves and bays – those which warmed first, and the spread out eventually to even deeper waters.

Lobsters would naturally seek out colder waters, but those trapped in warm oxygen depleted waters would have only a few minutes at best to seek (some would say run) to deeper cooler waters. That is what happened during The Great Heat and the late 1990s again in response to warmer temperatures. Often lobsters trapped in lobster pots and unable to escape localized lethal oxygen depletion events and would perish in the lobster trap itself. This frequently happened during periods when oxygen depletion is most strong, just before sunrise.

During The Great Heat, 1880-1920, lobster production at first went up, and then dropped like a rock. It would take decades for lobster habitats to recover. That only happened after a period of cold and more "habitat" energy. The same pattern happened again (see chart #1).

As such the beginnings of massive habitat shifts at first are difficult to detect. In fact increases of catches of adults can often occur and those of a regulated size that enter the fishery actually increases as shown in figure one (B & C). Warmer temperatures for lobsters at first helps smaller lobsters survive (usually indicative of less damaging storms also) or are beneficial to habitat cover protection or availability of food (A & B). Colder temperatures most likely restrict larval production and over time, generally favors much fewer but much larger lobsters. This partially explains the first settler reports of giant lobsters in shallow waters – the first Colonists arrived during a harsh mini ice age and most likely approximated the natural carrying capacity of extreme cold or the C area of Figure 1 – extreme cold would restrict larval production but be offset by the extremely long life span of lobsters. In a higher temperature more juveniles could survive but increasing habitat competition if the adult habitats were limiting—less space and limited food availability. Due to the age and size restrictions, a movement to the left – adult numbers would rise and landings also masking for a while, the shift in habitat quality until catches fell off the left edge. In a climate/temperature habitat quality scenario, southern areas would experience a sudden surge in production first, followed by a dramatic collapse which is exactly what happened. It just got too hot and the juveniles' could not adapt and survive such conditions. That would be reflected in recruitment "failures" that preceded fishery failures.

The lobster fisheries of Southern Mass – RI and CT all show historic rapid rises in production, habitat index shifts to the left and then far to the left – to much heat for a fishery collapse. Larger lobsters who survive will seek out colder deeper waters. Many of the female V-notched lobsters in eastern CT according to some lobster fishermen at a Sound School meeting July 2010 were reported to be caught off Block Island Sound. Those Long Island Sound lobsters that remained would tend to move to the deepest, cooler waters as possible.

Secondary Mortality Features

When lobster mortalities hit Connecticut in the late 1890s (1898 being the worst) black tail was described to me by Jeff Wilcox of Stonington CT. Oral history recalls by Mr. Wilcox reports of lobsters dying in heat on the way to Fulton Fish Market then on trains after the Civil War, with lobster showing "black tail" which could be red tail – a bacterial disease that collapses the circulatory system and the tail meat appears dark red. It is known that in waters so warm heat stress can weaken lobsters promoting diseases and related mortalities. Certain disease organisms thrive in warmer waters and induce oyster and blue crab diseases as well. Waters with contaminants also have a role, any substance that could weaken or harm lobsters (like pesticides) in warm or hot water is far more dangerous. Organisms already stressed by environmental conditions (low oxygen) have reduced disease fighting capacity, may be too stressed to feed or even too weak to avoid predators. Lobstermen in Connecticut refer to lobsters in 1998 as lifeless and lethargic that was why. All of these factors should be taken into consideration.

With the continued warm temperatures and recruitment failures in the Southern New England Lobster fishery – (CT lobster production has fallen to below 300,000 lbs –an historic low).

In 2009 Southern Massachusetts Fishery (Buzzards Bay and Vineyard Sound) landed 177,000 lbs also historic lows for that region.

However, the lobster fishery in Maine continues to improve indicating enhanced growth rates and enhanced habitat reproductive capacity. It is also known that the warmer temperatures in Maine have favored the growth of kelp – thought to be habitat limiting in our region. The 2011 catch in Maine is now over 100 million lbs or four times its estimated heritage or baseline value of 25 million lbs. It is thought that wire lobster traps have enhanced habitat carrying capacity (i.e. feeding stations for sublegal lobsters). Warmer water has enhanced kelp and may have improved juvenile survival. It is also shown that warmer waters lobsters do grow faster and sexually mature quicker. In Long Island Sound's western region in the 1970s and 1980s had 30% of sublegal female lobsters were sexually mature and often egg bearing. All of these factors should be considered in Maine's tremendous surge in production.

But what about the other states, Southern Mass, Rhode Island and Connecticut could it be just coincidence that all three states reached record landings in 1999. No, I don't believe so, all indicate massive habitat failures for several cold water species not just lobsters, and they include bay scallops, winter flounder and lobster share most of not all of that critical shallow water habitat during part of a critical life cycle stage; all have had "fishery failures" after "habitat failures". Good fisheries management policies (regulations) could not stop region wide climate/energy shifts or impacts habitat losses continued, just as it could not a century ago during the period 1880-1920 when the New England states all built lobster hatcheries after a similar habitat failure occurred- Boothbay Harbor, Maine being the site of the largest US Lobster hatchery ever built to date.

Capstone Questions

(1) Is it possible to build a habitat history for Connecticut lobsters – most of our fisheries history records still exist in storage at the DEEP Marine headquarters in Old Lyme, CT.

(2) Can we build or demonstrate opportunities for increasing Stage 4 lobster habitats- in deeper cooler waters, such as reef balls or rubble reefs similar to similar reefs built in Rhode Island.

(3) What is the historical importance of kelp forests to lobster populations – current reports or papers on the subject are available.

Thank you for considering the Connecticut lobster fishing as a possible Capstone project. If you have questions about the State of Connecticut high school graduating requirement – "Capstone Project" you should contact your guidance counselor.

Appendix 1 Predator/Prey Relationships

There is some evidence that in western Long Island Sound, other habitat types also helped lobsters – oyster beds both cultivated and natural and soft mud bank burrows in rivers and creeks. In cooler temperatures, lobsters frequently dug in soft clay sediments have making extensive lobster burrows. In times of high heat these habitats would also fail, and if temperature were high enough would stress and perhaps kill adults who often left small lobsters to the predatory impacts of libina, the spider crab with this long tapered claws could reach in and capture small lobsters. Reports in the 1980s include reports from Connecticut lobstermen that huge populations of the spider crabs "had overrun" rock ledge habitats once known to contain thousands of shorts (lobsters). It was felt that the larger lobsters that defended territories and tended to keep spider crabs from juvenile nursery areas left the shallows leaving small lobsters defenseless against enhanced spider crab populations.

Appendix 2

Habitat Limitations for The Southern New England Lobster Fishery

An interesting feature of some isolated habitats in Connecticut a small outcropping of rocks surrounded by firm mud featureless bottom was a habitat capacity based upon size. Upon discovery (a method of blind trap sets as these areas were small consisted of dropping strings of baited traps in lines) or a hit, a small patch of rocks or a large rock sometimes the size of a car. Larger lobsters would always be trapped first, sometimes up to 2.5 lbs. Then after a few sets 1.5 lbs. to 1.25 lb. to chicken lobsters, eventually culls and some eggers. There appeared to be a "pecking" order based upon size around the perimeter of the rock or boulders. This was repeated many times with the capture of a single larger lobster, we knew we were close to a rock or ledge. Lobster pots would then be bought to surround this “hit” and the next haul would show precisely the habitat area. We would also learn to move on after a few trap pulls, as the larger lobsters held a perimeter from the habitat and tended to reflect a size gradient, based upon (I feel) developing defense from predators and the ability for larger lobsters move the farthest from habitat safely.

Observed features of isolated habitats:

1. These structure areas were small and the number of lobsters they supported were limiting.

2. Larger lobsters always surrounded the perimeter as traps were set close on the structure smaller lobsters were taken after several pulls.

3. As larger lobsters were harvested, increases in the Spider Crab (Libinia emarginata) frequently occurred.

4. In time two to three years, these areas would “recover” sometimes in less than a year and be productive again for a few hauls.

As such we would also question the release of short lobsters to such areas, in the process of a drift, we would move tens of yards to hundreds of feet, clearing out old bait (which we observed in shallow water actually chummed tautog to us and then consumed short illegal size lobsters as we returned them) many feet from any chance of protective cover, never mind the tides or currents) on the way back to the bottom.

These isolated habitats would reopen the habitat capacity question – if these habitats were not fished would it be possible that fewer yet larger individuals (lobsters) would eventually inhabit them? The removal of larger lobsters (initial reports of spearing huge inshore lobsters sometimes three to four feet long exist in the Colonial literature) may have altered the natural carrying capacity of existing habitats.

The life history of the lobster itself, larger lobsters are known to have few natural predators and can live to be 200 years old. They are also known to be fierce protectors of habitat and when young, cannibalistic towards each other, older larger lobsters need larger habitats and habitat capacity (if limited) would cause a general migration from nursery/habitat limited areas to those with greatest habitat capacity. We see that in a general movement into deeper water offshore areas from shallow inshore areas.

Appendix 3

The Long Island Sound EPA Habitat Restoration Initiative Guidelines – Page 6 Coastal Barrier Comments – Page 9

Modifications of Healthy Habitats – Alteration of Natural Processes

A Case History of Habitat

Creation, Enhancement and Mitigation

Reference for the Lobster Industry Pages 21-22 2009

Updated Comments from Tim Visel – July 2010

The Sound School Regional Vocational Aquaculture Center
High Heat Loss of Critical State 4 Lobster Habitat

Lobster Habitat Carrying Capacity – Tim Visel – September 2009

This summer I have contacted several organizations seeking more up to date information on the carrying capacity of various types of lobster habitat. By the end of September 2009 no responses as yet have arrived. Until I have more recent studies I'm using notes from a 1978 fishery economics course at the University of Rhode Island for estimates of habitat capacities.

The example below provided by a guest lecturer who used a 60 foot circle dropped over a certain habitat type (the example was a drinking glass on a desk). The circle when placed over smooth featureless bottom yields less than one pound/year (harvest size). Cobble stone/kelp circle – 3 to 5 lbs/year with more structure such as small stones – glacial boulders 5 to 8 lbs/year. Large boulders/reefs up to 12 lbs/year of harvest size lobsters. For the carrying capacity the highest value can be one 12 lbs or 12 - 1 pound lobsters. Nature tended toward larger lobsters. This can be considered a background or heritage value.

Today, lobster fishers seek out habitats with structure so the above capacities may seem smaller or larger that actual but the difference between smooth featureless bottoms (no structure) to those if that contain a high degree of structure should yield 12 times as much lobster each year. Lobsters can be trapped on sandy and even muddy bottoms as they search for food or burrow into muddy bottoms for shelter. The lobster fishery has enhanced the carrying capacity of the existing habitat by providing both, food/shelter and maintaining a constant reproductive population (gauge limits and the Vnotching of female egg bearing lobsters). Food availability among rocks/ledges is slight but provides key habitat as lobsters increase in size. This is not to say the other habitats are not important but similar to the oyster industry with supplemental shell, balance is needed to sustain lobsters at different stages of their life cycle. This appears to be in the Southern New England Lobster fishery as limiting for stage 4 – the cobblestone kelp habitat associated with cooler and more storm filled periods.

Lobster Habitat Carrying Capacity – Fisheries History United States Fish Commission

The Fisheries and Fishery Industries of the United States by George Brown Goode, Assistant Secretary of the Smithsonian Institution and A Staff Associates, Section V, History and Methods of the Fisheries, in two Volumes, with an atlas of two Hundred and Fifty-Five Plates, Volume II, Washington, Government Printing Office 1887.

The Lobster Fishery – Page 701

South Harpswell, ME – Between 1850 and 1855, at South Harpswell, the fishermen were accustomed to go out two in a boat, each boat setting from fifty to seventy-five traps, and obtaining a daily average of from 400 to 500 lobsters of marketable size. All lobsters weighing less than 2 pounds were thrown away, and the remainder were sold to the canneries at an average price of 3 cents each in the spring, and 2 cents each in the fall, the canneries agreeing to take only those above 2 pounds weight. The fishing season lasted from March until May, and again from September until about the middle of November. When the factories were closed, the fishermen sold to the smacks running to New York and Boston, scarcely any of the lobsters being disposed of to Portland parties. The smacks paid about the same prices as the canneries, beginning in the early spring at 3 1/2 to 4 cents, and falling later as low as 1 1/2 cents, when the lobsters had become more abundant. Frequently, when the markets were dull, the fishermen, after culling out all lobsters under 2 pounds in weight, would bring the remainder to the smacks, where about one-third more in number would be rejected, only the larger individuals being bought. This would happen only late in a season, or during a very dull market. Marketable lobsters then averaged about 3 1/2 pounds each.

At all points along the coast, from Cape Small Point to Pemaquid Point, the fishermen are agreed in saying that formerly lobsters were very abundant and of large size, and that overfishing has reduced them both in size and in numbers. They are quite unanimous in the opinion that if the present State law is continued, it will be better for the fishermen.

Appendix 4 Habitat and Biology "The die-offs" – 1886-1920; 1997 to present

At The Sound School lobster industry meeting organized by DEP Marine Fisheries (July 15, 2010), several speakers comments mentioned that large number of female V-notched lobsters were caught offshore of Montauk, New York. That was not a surprise to me as earlier studies largely regarded Long Island Sound as a nursery ground for lobsters. Larger lobsters within established habitats capacity balance would displace others creating a general migration out of Long Island Sound. Although increasing the gauge would alter habitat carrying capacities most lobsters were caught up before they could migrate out (west to east). V-notching females to some extent would reestablish this previous migration pattern. Naturally larger lobsters would establish larger territories and fight to keep competition of other lobsters out. The extremely large lobsters with large territories were mostly caught up by the early 1800s. Anecdotal reports were attributed to early spearfish fisheries and spearing four foot long lobsters. Large lobsters were reported being speared in Connecticut and continued until the 1830s. As bottom trawls fisheries developed in the 1950s and 1950s, relic large lobsters were found in untapped lobster populations offshore on Georges Bank. At the July 2010 lobster industry meeting several fishermen also raised the "daylight" discard mortality issue and David Simpson Marine Fisheries Director recognized this fishery mortality as a concern.

The Apparent Collapse of the Southern New England Lobster Stocks – The Failure of the Nearshore Cobblestone/kelp Habitats -

At the beginning of The Great Heat (1880 to 1920 approximately) landings of lobsters, especially smaller ones increased fueling the rapid growth of lobster canneries in several states. Catches quickly fell from the much colder 1870s and beginning of 1886 collapsed in southern regions especially Rhode Island and Connecticut but eventually spread to Massachusetts and Maine as well. The lobster canneries literally ran of product to can and many blamed the fishermen for over fishing. The truth of the matter was a huge habitat shift was occurring – a shift that few could recognize at the time. The effort to build lobster hatcheries was attached to a general concept that man (overfishing) was the reason for the decline. No attempt was made to classify habitat quality. Winter flounder, bay scallops saw similar habitat failures.

The cobblestone/kelp habitat was failing in shallow waters, it was too hot and few storms caused cobblestone to become buried in silt and kelp perished and now a new vegetation grew, and that was eelgrass and dense meadows formed sometimes out to 60 feet deep in the same areas that once supported the kelp forests. The very hot temperatures continued causing salt ponds and bays to become stagnant hot and oxygen depleted.

Record fish kills occurred during this period and the Southern New England Lobster Fishery Collapsed – following a habitat failure in very shallow but critical lobster habitats. Rhode Island was the first state to respond to this collapse, commissioning several studies and the building first lobster hatchery to raise and release stage four lobsters. In time with continued lobster landing declines all New England States would build them, the Connecticut lobster hatchery would begin in 1910 and be located in Noank at the site of an abandoned velvet factory. The Noank Lobster hatchery would produce stage 4 lobsters until the 1950s as it became cooler, eelgrass died off or was carried away by storms and the kelp cobblestone habitats restored. The Noank facility is now longer a state lobster hatchery but continues in Aquaculture production as a regional shellfish cooperative.

Part 1 – Madison, Connecticut Reef Creation 1975-1978 – Historic Lobster Fisheries practices.

While the 2009 paper I submitted to the Long Island Sound Study Habitat Restoration Committee talked about alteration of natural habitats from environmental viewpoint and last years report (March 2010) recalls an attempt in 1973-75 to construct reefs with sidewalk concrete slabs, (unsuccessful) from the regulatory viewpoint. The March 2010 report however failed to mention a small private artificial reef constructed from old plumbing fixtures – mostly old bear claw bath tubs and cracked cleaned porcelain fixtures during the same period. Although not personally connected or involved in the reef building and learned of it after it was well underway. It did support it, and was influenced by my earlier conversations following exposure to the Florida artificial reef program in 1974. A Madison neighbor who liked to recreationally lobster asked about a creating a reef for them. After several conversations about lobster carrying capacity (mostly about the lack of it) in our area except for the few existing rock out croppings. One day we were discussing the lack of structure, he asked how large it would need to be and how the cobblestone/kelp habitat was needed for post stage 4 lobsters. Would structure extend to even the size of water closets, tubs and broken sinks? He was a plumbing and heating contractor and a relative of the person who had the Hartford, Connecticut sidewalk slabs recycled into a retaining wall. They shared cottages on the same property. The response I gave was yes, it was during the 1970s fuel crisis and the desire to have a suitable reef closer to the beach was of great interest. It meant less fuel for lobstering and rod/reef fishing for my neighbor. As part of his business he would remove old fixtures and at time landfill them. After our discussions he saw the utility in recycling them as habitat, durable and once cleaned. Apparently, he was a bit ahead of his time, several green initiatives are in place now to recycle/reuse such fixtures and crushed porcelain has been used to build oyster reefs in southern

[2] It is illegal to build artificial reefs in Connecticut without a permit even if the framework for obtaining such permits does not yet exist. In no way do I support artificial reef construction to enhance fish and lobster habitats or populations without regulatory agency approval. The placement of materials even small stones in Long Island Sound without permission violates state and federal law. Habitat enhancement or creation for enhancing recreational marine fish species is a regulated activity which has at present has no policy or regulatory endorsement. The purpose of this report is educational and to assist such policy development if it is deemed to be in the best interest of the state, it's citizen's and the Long Island Sound Study, T. Visel

waters, see Alliance for the Chesapeake Bay – Journal November 2004. The bear claw old fashioned tubs have come back into fashion and as one of my Rhode Island contacts mentioned these most likely today end up in antique stores. But yes they could provide suitable structure for lobsters (J. Stanley Cobb, personal communication T. Visel, October 15, 2009.) From descriptions of materials, the pieces never measured more than 15 inches high and were broadly distributed over a shoal area south of the western of Hammonasset Beach.

Previously devoid of structure the site was located using NOAA navigational charts. It was not a lobstering area consisting of smooth mud/sand bottom. The shoal area was picked hoping that the bottom was firmer. I learned about the reef building activities about four years after it had commenced[2]. In the late 1970s word of it spread into the local Clinton fishing community.

According to my neighbor the reef took many years to build and it was supplanted from time to time with stonewall sized fieldstones and "ballast stones" from lobstering wood traps. The results were almost immediate first, the presence of small lobsters occurred between the yellow marking buoys only after three weeks after the initial placement. Many short lobsters (non legal sized) had congregated around the new reef. Within one year legal size lobsters were being caught constantly and within five years it became very productive area for both sub legal and legal lobsters. Reefing building continued for several years from 1974-1979. Although I did not help sink the broken porcelain clay fixtures or pieces of cast iron tubs – I did know about it after 1979. When informed I strongly suggested these efforts cease as the state was formulating its coastal area policy regarding marine resource restoration, shellfish and finfish restoration guidelines (CAM Planning Report #27) and were in the process of being developed (1978). Artificial reefs were most definitely going to be a regulated activity even if old lobster pots were filled with stone, *see note 3.

Note 3-

The practice of sinking field stones in lobster pots was an old one. Before lobsters traps utilized preformed bricks to sink them, fieldstones under a lath band or leather strap were used, wood traps without an extra stone would float away. Since field stones were common and easy to attain to lug these back and forth to shore was not productive and stones often were cast out to save effort. It soon was realized that the practice enhanced habitat for lobsters. Although not mentioned in many reports the practice continued in a modified way with wood traps into the late 1970s. When traps were dry they would need an extra stone or cobble (called ballast stones) while the traps absorbed water and after a few days discarded. Thus the first lobster habitat enhancement effort came as a result of the lobster fishery itself. In the New Haven area old street pavers were used – later in the 1950's railroad tie nail plates (iron) were utilized but most used beach cobbles. With the conversion of the fishery to wire traps in the early 1980s ballast rocks were no longer needed. For about a century hundreds of thousands of such stones were placed over lobster grounds. A century ago the lobster fisheries were keenly aware of the importance of bottom structure. In Madison three such lobster grounds were reported to have been established by a long time Madison lobsterman Captain Dowd. Instead of throwing out ballast stones randomly over the years he had established productive areas by placing ballast stones in a series of locations north of Whale Rock off East Wharf in Madison. No one else was allowed to fish them except Captain Dowd as it was recognized among other fishermen that he had made them over the many years. This practice was agreed to by all other lobsters fishers at the time – personal communication Charles Beebe/Tim Visel 1971. Old lobster pots built from wood and natural fiber heads lobster pot (funnels) were often filled with rocks. The wood and manila twine rotted away leaving the stones as structures. In the 1970s (late) these cobblestone features had kelp and small stones caught in the front in line. Vincent Clark traps had a cobble with kelp wedged in the front funnel. They were very productive for lobsters for decades.

Appendix 5

United States Dept of Interior Statistics Digest 59

Fishery Statistics of the United States 1965

Charles H. Lyles GPO 1967

Washington, DC

History Fishery Statistics for New England Northern Lobster Catch

1879-1965

The Collapse of the New England Lobster Stocks during the Great Heat 1880-1920

All states Maine, Massachusetts, Rhode Island and Connecticut total pounds of lobsters landed – 1924 being the base of the collapse except RI 1889 base year

Maine 1889 – 25 Million lbs *[1]

1924 – 5.5 Million lbs

1965 – 19 Million lbs

Massachusetts 1889 – 3.3 million lbs

1924 – 1.6 Million labs

1965 – 6.5 Million lbs

Rhode Island 1889 – 500,000 lbs *[2]

1924 – 1.5 Million lbs

1965 – 1.8 Million lbs

Connecticut 1889 – 1.6 Million lbs *[3]

1924 - 700,000 thousand lbs

1965 – 743,000 thousand lbs

*[1] Maine's Heritage Production value is suspected being 25 million lbs.

*[2] Rhode Island collapse started in 1886 – closed lobster fishery in 1905 – from the 15 of November to the 15th of April – repealed in 1906.

*[3] Reflects landing from New York and Rhode Island waters also

----

Appendix #6

State of Rhode Island and Providence Plantations

Thirty–Sixth Annual Report

Of the

Commissioners of Inland Fisheries

Made to the

General Assembly

At Its

January Session, 1906

Providence:

E. L Freeman & Sons, State Printers

1906

Report of Commissioners of Inland Fisheries

VIII. The Propagation of Lobsters Fry for the Purpose of Increasing the Supply of Lobsters in the Waters of the State. Methods of Artificial Propagation and Cultivation.

Lobster Culture in 1905

By Earnest W. Barnes,

Assistant Superintendent of the Wickford Experiment Station

The first mature lobster eggs were scraped into a hatching bag about noon on the 21st of May, and by 1pm of the same day nearly all had hatched. These eggs were obtained from one egg lobster, and no more lobsters with mature eggs were found till the 24th. The hatching then proceeded quite rapidly. The last lot of eggs was hatched on the 21st of July. By August 1st al the fry had reached the fourth stage, except a few weak undersized ones. Consequently, after a continuous run of 71 days, the engine was shut down and the season closed. The work usually closes by the middle or last of July, and it is quite remarkable that the season should last till the first of August.

The weather conditions throughout the season were very good. The absence of any bad storms and the many bright warm days made the season one of the best the station has had.

Introduction

The success in lobster culture attained by the Commission of Inland Fisheries, at their Experiment Station at Wickford, is one of those few remarkable successes in artificial marine culture which have been reached through a long course of slow and, at times, disheartening experiments. The ordinary method employed in the artificial propagation of fishes, the mere hatching the eggs, has been of little avail in the case of the lobster. Its failure may be stated, briefly, as due to two causes: The first and most important of these is the slow growth of the lobster, the length of time required to reach maturity and propagate itself naturally; the second is the prolonged period of larval helplessness.

If we leave out of consideration the helpless larval period we find that the lobster in its natural state is not materially handicapped in its struggle for maintenance, except in the particular fact of its slow growth. With reference to the natural advantages it might be stated that its life on the sea bottom, together with the instinct of hiding in burrows in the mud or under rocks, affords much better protection than fishes seem to posses. Besides, there is perhaps no external part, unless it is the eye, which can be lost in injured without the lobster being able to replace it. The loss of a fin or the upturning of a few scales will often be sufficient cause for the death of a fish. The lobster also has the advantage of having its eggs more surely fertilized and afterwards cared for by the parent until hatched. The eggs of most fishes are thrown into the water, and depend on chance fertilization and favorable circumstances for their fostering. But against the human foe the lobster in powerless, and there has been a rapid decrease in their abundance since there was a demand for them in the market.

Because the lobster possesses, in a high degree, natural advantages for protecting itself, except in its larval helplessness, it seemed necessary to adopt some measure of rearing them through this latter period. For more than a decade experiments were pushed with vigor by the various States, the United States Government, and also by European governments. The many difficulties, however, prevented success till 1900, when the honor of having offered the first and, up to the present time, the only solution of the problem was won by a Rhode Island Commission at Wickford. It has taken, nevertheless, since the discovery of the principle, five years of slow and tedious experiments to develop the scheme to the point where it is practical and economical.

Fifty per cent in round numbers (48.2 per cent actually) have been reared from the first to the fourth stage in lots of 20,000. It is in this stage that the fry commence to burrow and are, therefore, more able to care for themselves. These figures will be appreciated when it is recalled that the best result in Europe was 6.6 per cent from an estimated 3,000 fry in the first stage of Woods Hole.

Appendix 7

SHORT LOBSTERS.

There was a greater number of small lobsters caught last season tan there has been before for a great many years. It is quite significant that this reported increase in number comes almost entirely from that part of the Bay where the Commission has liberated its fourth stage lobsters. Because of its nearness, the region about Conanicut Island has received the greater part of the output in the past years. Walter H. Munroe, who sets lobster pots along the west shore of Conanicut, reports that during the past year he very seldom pulled in his pots but that four or five small lobsters would slip out between the slats. At Dutch island harbor, somewhat near the central part of the island, the lobsters under nine inches area so numerous that the lobster deputies have had considerable difficulty in preventing their sale. It is the common opinion that, in spite of their vigilance, barrels of "shorts" have found their way into the market from this place. The two deputies are very much handicapped in their efforts by having such an extensive shore to cover, especially considering that their only means of getting to the pots is in what boats they can get on the nearest shore. The great number of small-sized lobsters looks very promising for the future supply of lobsters in Narragansett Bay, and extremely encouraging for the scheme of rearing used at Wickford.

RECORDS.

A careful record of each lot of lobsters, with conditions under which they were reared, was made and filed in a card catalog. From this catalogue the following tables are taken:

LIBERATION OF FOURTH STAGE LOBSTERS, 1905.

Date	Locality.	Number	Character of Shore
13-Jun	East Poplar Point	400	Rocky
26-Jun	Little Tree Point	3000	Very rocky, abundance of rockweed
27-Jun	East Poplar Point	9000	Rocky
28-Jun	Wickford Cove	200	Muddy Bottom
6-Jul	Point Judith Pond, Billings' Cove	15000	Stony, light seaweed
11-Jul	Warwick Neck, below Rocky Point	10000	Rocky
13-Jul	Portsmith	10000	Rocky, rockweed
13-Jul	Kickemuit River	15000	Rocky, rockweed
17-Jul	Conanicut Island	12000	Rocky ledge, rockweed below
21-Jul	Dutch Island Harbor	20000	Muddy Bottom
29-Jul	Conanicut Island	6000	Muddy bottom
	Total liberated	100600	
	Used for experimental purposes	2972	

*This number is that of the fourth stage lobsters actually counted. In addition to these there were many first, second and third stage lobsters preserved for study, and some fourth lobsters were liberated in the cove by accident to the bags.

Total Number of Fourth Stage Lobster Reared Each Year Since 1900.

	1900	3425
	1901	8974
	1902	27300
	1903	13500
	1904	50597
	1905	103572
Total		207368

The Historical Importance of Kelp Forests to Lobster Population

The Value of High Energy Habitats

Timothy Visel

Waves and Currents Keep Kelp/Cobblestone Habitats from Failing As Juvenile Lobster Refugia – A Look at Reef Ecological Services

Appendix IV, Part II

April 2011

In the late 1960s especially after the winter ice left Long Island Sound the waters were very clear. Visibility to 15 feet was not uncommon in Long Island Sound so anyone close to the shore in March and April would have no difficulty seeing the habitat value of structure – rocks, boulders or rubble-for fish. In our area around rocks and granite reefs contained small kelp forests which grew among fields of cobble stones. The area in which I grew up in was Webster Point, Madison, a point of land created by Toms Creek at the westerly edge of Hammonasset State Beach. Its position as a headland after an indentation of the coast in which formed a one mile stretch of beach against higher ground called SeaView Beach, this area tended to suffer the most change during storms and movements of the creek exit which would change over time according to residents at the time (M. Brown, personal communications 1970s). Some of the largest changes occurred after the 1938 Hurricane which removed much of the coastal "shore" road between Seaview Beach and Webster Point; the remains of glacial cobblestones were left at the low tide line, and after strong coastal storms the remains of this coastal road and cobblestones could be clearly seen in March. By June or July however sand bars moved from offshore to the beachfront covering these cobbles and broken seawall pieces. One of the features that made Webster Point such a popular fishing location was the construction of two driven sheet pile steel and wood jetties that extended 200 feet out into Long Island Sound about 300 feet apart.

Between them was Tom's Creek, which effectively together stabilized the creek's mouth. These jetties consisted of the sheet pilings driven about 10 feet beyond the bottom and reinforced with a 12 inch diameter pilings opposite every 10 feet with thru bolts past a 8X12 pressure treated timber with 8x8 wood blocks. The pressure treated timbers made a narrow but sufficient walkway leading out to two higher pilings. This put anglers out from the beach and into a kelp cobblestone habitat. Years later that stability the creek had deflected the energy from waves and jetty back wash kept these cobbles from being buried in sand. At low tide on clear days you could see this cobble stone bottom, and in patches kelp grew on it, creating thick patches of kelp cobblestone habitat some 200 feet beyond the jetties. To the right of the western jetty was clear sand. After a few years it was easy to see that the best fishing especially for winter flounder as at the edge of kelp-cobblestones into the clear sand. Fishing too close to the jetty and you frequently caught a kelp hold fast the tough finger like structure that as its name implies holds the cobblestone with a firm grip. Many a time I snagged one of them believing just hooked a huge winter flounder only to pull in the kelp still attached to the cobble stone. At the lowest tides and calmest of waters you could easily see why winter flounder fishing so good at times the cobblestones were alive with activity, small mud and green crabs abounded in these areas, so it was a place to feed, and therefore a very productive fishing location. The shore areas away from the jetties had the usual sand bars and flat featureless bottoms with few crabs and often few fish.

The inch thick metal plates formed like a flattened W to create an elongated ribbon of steel (Note 1). The sheets were joined in a knuckle connection similar to the connection on old steam train cars for the entire length as one sheet was driven into the next and so on to create a connection over the length of metal pilings. These indented sheets created a slight back current with each wave and small bait fish would tend to gather between them. When snapper blue fishing season occurred, this feature made this artificial reef assembly prove that it held small bait, especially silversides and this made for excellent snapper blue fishing. Conversations at the time soon showed that word of this reef aspect (Jetty) to provide great snapper blue fishing was well known and people would travel from Rhode Island, inland Connecticut and New York to enter Hammonasset State Park, not for swimming or the beach, but the chance to snapper blue fish on the west “metal jetty.” It was *that* good. The jetties held this artificial reef habitat feature until they were encapsulated with a heavier granite groin in 1978 (see note 1 for description).

Winter flounder fishers would often seek out these structures and surrounding cobblestones habitat with kelp (oyster beds also) to fish for winter flounder. Often a hold fast would be snapped and the entire kelp frond would be hauled in. If you fished for winter flounder in coves, kelp/cobblestone was often outside of channels or by rocks which were the places to catch winter flounder.

In time of cold conditions these cobblestone bottoms were “clean” free of silt or organic matter. The jetties’ had during storms directed the reflected energy off them to clean the area and prevent the movement of sand bars on either side. The kelp/cobblestone patches lay to the west of the jetties into the prevailing mostly south western chop of late summer afternoons as a “shore breeze” would frequently develop. It would be a decades before the proximity of kelp/cobblestone would be associated with coastal energy. On a few occasions the water clarity allowed me at low tide to observe the kelp cobblestone patches in back of Toms Rocks located offshore of Webster Point. Quahog clamming years later in back of Tom’s Rock would often yield a cobblestone with the kelp still attached. Winter flounder fishing was always good among these kelp cobblestone patches from Webster Point to the shore side of Toms Rock. A series of strong storms could end and did change depths of these cobble and sand bars (US Army Corps Study).

After storms, a cobble with a kelp frond would sometimes be washed up by Tom’s Creek, but the waves along the jetty seemed to break the sand bars that generally ran east to west in our area. The jetty also seemed to attract fish; each of the pilings had a crust of algae barnacles, and at times small mussels circling each of them. Small fish and silversides ran up and down the sheet metal piles also loaded with barnacles. Large blackfish (Tautog) would come up and bite off hunks of barnacles, crushing them and spitting out shell fragments. It was amazing to watch this process which I did on many occasions.

Note: See Beach Erosion Control Study, A Cooperative Study of Connecticut Area 2 Hammonasset River to East River, February 7, 1949. Corps of Engineers, US Army Office of Division Engineer, new England Division, Boston, Massachusetts-Tom’s Creek – Structure recommendations, two sheet pile training walls, 400 and 320 feet long, the latter to be a 210 foot extension on an existing sheet pile groin, stabilization of creek mouth (TOMS) cost-9,600 square feet steel sheet piling at $2.25 square foot $21,600.

Because fish seemed to be present many times as much as the open sand bars to the right and left, they (jetties) became popular fishing locations because you could catch fish. Even eels seemed to hang around the poles and by chance, I learned how important it was to very small lobsters.

Green crabs and small eels were both valuable bait, small eels for stripers but mostly green crabs for blackfish bait. As it was easier to set eel pots from the jetty than to walk hundreds of feet into Tom's Creek, and battle biting insects which clung to every blade of marsh grass, which was to the east, and we used them to set small traps frequently instead. Because the kelp cobblestones were close to the jetty, green crabs there were very dense and small eels also. It was a great place to set bait traps; the outflow of Tom's Creek also was a great striped bass areas, especially on ebb tides so "floating" a small eel was very successful for catching them next to these jetties and an eel pot by the jetty was a good place to catch small eels. A similar homemade green crab trap often caught both eels and crabs amongst the kelp covered cobblestones next to these jetties. My father who built these metal crab and eel traps and did so out of standard width metal hardware cloth, a metal mesh rectangular weave sold locally. He preferred the smallest mesh 3/8 (three eighths) of an inch square, and wove circular traps with copper wire. (It made good soft shell clam wash baskets also) when baited these traps caught well both green crabs and small eels but if pulled very quickly caught sixth and seventh stage lobsters as well, dozens of them sometimes only an inch long. The smallest of lobsters would be caught in an unusual way, at times, the usual crab bait, cracked mussels would be hard to get and time consuming, so at times, a can of fish cat food would be used; several triangular openings were made in the small can and thrown in the trap. The smallest lobsters were in the can and I discovered this by accident, a small trap, within the trap itself.

At first I thought of this as an accident, that small lobsters sought refuge from the waves or predators but when it happened several days in a row, I came to the conclusion that small lobsters preferred this, kelp cobblestone habitat. They had in fact had entered for the canned bait. Several years went by and eventually a large supply of hermit crabs (caught while commercial lobstering offshore) reduced the need of setting crab traps for black fish bait. When Dr. Stanley Cobb guest lectured for Dr. Adreas Holmson in 1977 during a University of Rhode Island Fisheries Resource Economic's class about lobster habitat and lobster capacity, I listened very carefully. When Dr. Cobb stated that between hatching and the first appearance of "shorts" in commercial lobster traps scientists didn't really know much about where lobsters lived. I had an answer. After class, I shared my Connecticut experience with these small lobsters in the late 1960s that these lobsters lived in kelp/cobblestone high energy environments. I have since detailed this experience in a short paper about Lobster habitat carrying capacity for the Long Island Sound Study in 2009 titled, "Long Island Sound EPA Habitat Restoration Committee Guidelines Parts II, III, 23 pages." [2]

The kelp/cobblestone was very important to post stage 4 lobsters and that habitat type needed coastal energy to sustain it. [4]Visible observations of small boulders to the west by East Wharf a town beach in Madison also found that beside the boulders the same kelp cobblestone bottoms, it is now thought that theses small boulders broke much of the wave energy and in doing so maintained small patches of kelp cobblestone. Small boulders even the size of refrigerators and smaller rocks were very effective in breaking wave energy and keeping kelp cobblestone habitats clean. These kelp beds were also very productive for adult lobsters as well.

A large patch of kelp cobblestone habitat was created over time in Madison by the placement of beach cobblestones and once used to weight during wooden lobster pots. Once "soaked" (pre 1980 most lobster traps were wood not metal) and dumped overboard (when the pots absorbed water), between two existing natural reefs, Whale Rock then the east of East Warf and outer reef a ledge that is awash at low tide directly east of Tuxis Island. There for decades, Captain Dowd had dumped cobbles to make an manmade lobster ground as kelp cobblestones were known to be good lobstering places (Charles Beebe personal communication, 1969-70).

The cobbles held in place I feel because the cobble reef was between the two natural reefs. The practice of artificial reefs may be more widespread than just Madison as rotation of lobster traps were made every 4 to 6 weeks to avoid the wood eating marine worms. Lobster traps would need to be dried, and carrying the beach cobbles back to shore was just extra work. Over the years I too, would add my share of beach cobbles to this artificial reef.

What sustained this kelp/cobblestone habitat was energy. After the 1938 Hurricane and the Hurricanes of the 1950s and 1960s these storms had stripped sand from beaches leaving large areas of Madison's shore now

---

[2] The Long Island Sound EPA Habitat Restoration Initiative Guidelines – Page 6 Coastal Barrier Comments – Page 9
Modifications of Healthy Habitats – Alteration of Natural Processes
The Hammonasset Beach Erosion Problem - A Case History of Habitat Transitions for Creation, Enhancement and Mitigation – Part I

Restoring Finfish and Shellfish Populations May Require Additional Habitat Studies Making the case for Artificial Reefs – Part II
Habitat Creation, Enhancement and Mitigation – Part III
Comments from Tim Visel – Sept 2009
The Sound School Regional Vocational Aquaculture Center

largely cobblestone (Charles "Bud" Schroeder, chairman of Madison Shellfish Committee, personal communication).

The kelp/cobblestone habitat appears to have a direct storm and energy link. In times of warmth and few storms sand bars soon returned and covered cobblestone areas between Tom's Rock and Sea View Beach in the 1980s. Low tide observations confirmed this decline while looking for areas to set lobster pots during this period.

Later in studies of lobster habitat preference would include the value of kelp cobblestone in our area now become fully validated as structure as rocks was in places limited along this coast. The finding of just one new small boulder at low tide in clear water could yield dozens of adult lobsters over the summer. Every shallow water boulder had kelp cobblestone habitat around it, and potential nursery area for young lobsters, to hide from

predators, find food and grow. In time, as these smallest of lobsters grew, they would leave the kelp cobblestone habitats no doubt, and move to the reefs and crevices. I would catch them later lobstering as "shorts".

In 1998, I would look again at the mouth of Tom's Creek from a small boat, but the bottom conditions had changed.

In the twenty years since the old jetties had been covered with a granite blocks (1978), sand bars were now observed and the kelp cobblestone habitat was gone not doubt buried in sand. The gradual tapered edges of the groin now deflected the wave energy, as they were designed to do and did not have the sharp flat wave deflection of the previous sheet steel wall. Having fished them in strong storms (striped bass move to the beach front to feed them) and felt the whole metal jetty shake each wave as if it would topple over. Anyone who fished these metal pile jetties will recall the spray of water from the wood blocks going up along them as a big wave ran along side. They definitely had high energy role as they were first intended to break the energy at Webster Point.

That higher energy condition no longer existed and had I felt increased "scour" which kept this kelp/cobblestone habitat viable. When the energy level declined, this habitat failed for lobsters, and other species perhaps not instantly, but between 1978 and 1998 in two decades. The jetties in a small way were an experiment for this high energy habitat type which was now covered in silt and sand in an increasingly hot period of warmer water temperatures and few strong storms. By the time of the huge lobster die-off in the fall of 1998, the cobblestone

Madison beaches of 1938 were distant memories, so also was the kelp cobblestone habitats that lobsters in our area needed.

Although much current reason focuses upon the negative impacts of coastal energy upon natural resource values – very little has been done to talk about high energy habitats or the high energy events that frequently proceed them.