Science & Technical Advisory Committee
TEAMS Online Meeting
Dec. 4, 2020 – Meeting Summary

In Attendance:

STAC Members: Jim Ammerman, Sylvain De Guise, Kristin DeRosia-Banick, Dianne Greenfield, Beth Lamoureux, David Lipsky, Darcy Lonsdale (New York Co-chair), Kamazima Lwiza, Robin Landeck Miller, John Mullaney, Jim O'Donnell (Connecticut Co-chair), Suzanne Paton, Evelyn Powers, Julie Rose, Paul Stacey, Mark Tedesco, Maria Tzortziou, Jamie Vaudrey, Penny Vlahos, Nils Volkenborn, Laura Wehrmann, Charles Yarish, Chester Zarnoch

CAC Liaisons to STAC: Sarah Crosby (Earth Place/Harbor Watch), Mickey Weiss (Project Oceanology)

Others: David Berg (Long Island Region Planning Council/Long Island Nitrogen Action Plan), Cassie Bauer (New York Stated Department of Environmental Conservation, NYSDEC), Mike Bradley (University of Rhode Island), Jeremy Campbell, (New York State Department of State, Long Island South Shore Estuary Reserve), Christopher Clapp (The Nature Conservancy, TNC), Chantal Collier, (The Nature Conservancy, TNC), Chris Conroy (U. New Haven), Syma Ebbin (Connecticut Sea Grant, CTSG), Richard Friesner (NEIWPCC), Tessa Getchis (CTSG), Chris Gobler (Stony Brook U.), Michele Golden (NYSDEC), Matt Hare (Cornell), Kate Knight (Connecticut Department of Energy and Environmental Protection, CTDEEP), Kristin Kraseski (NEIWPCC/NYSDEC), Bill Lucey (Save the Sound, STS), Peter Linderoth (STS), Audra Martin (NEIWPCC), Katie McFarland (NOAA/NMFS Milford Lab), Joyce Novak (Peconic Estuary Partnership, PEP), Vicky O'Neill (NEIWPCC/NYSDEC, Jimena Perez-Viscasillas (New York Sea Grant), Casey Personius (NYSDEC), Chris Pickerell (Cornell Cooperative Extension, CCE), Sarah Schaefer, (PEP), Steve Schott (CCE), Nancy Seligson (Mamaroneck Supervisor, Citizens Advisory Committee New York Co-chair), Cayla Sullivan (EPA Long Island Sound Office, LISO), Nikki Tachiki (EPA LISO), Peg Van Patten (CTSG Retired), Robert Vasiluth (Save Environmental), Harry Yamalis (CTDEEP)

Jim Ammerman chaired the meeting and Jimena Beatriz Perez-Viscasillas ran the meeting Zoom logistics in the background, thanks Jimena!

Introductions, Updates; Jim O'Donnell, University of Connecticut
Jim turned to Mark Tedesco to provided background on the reason for this meeting. With the likelihood of sustained higher funding, the Long Island Sound Study (LISS) can work at a scale not before possible. The program (LISS) wants to determine the state of the science of today's topics and the potential for restoration, as well as incorporation of observational programs into restoration efforts. We just started FY21 budget discussions and are just receiving enhancement proposals. The LISS has a lot of work to do going

forward to evaluate them. The program has opportunities to extend partnerships through the Long Island Futures Fund (LIFF), managed by the National Wildlife through the National Fish and Wildlife Foundation (NFWF). The LISS wants to make more than incremental progress.

Brief Reflections on the Recent Passing of Two Long Time STAC Members: Jim Fitzpatrick and Larry Swanson; Jim Ammerman and Others

There was a brief remembrance of two long-time STAC members who had recently passed away, Jim Fitzpatrick and Larry Swanson. Jim was a modeler from HDR who had done original modeling on many important estuaries and had recently retired and stepped down from the STAC. Larry was a faculty member and former Acting Dean of SoMAS at Stony Brook and a former co-chair of the STAC and a co-editor of the 2014 Long Island Sound (LIS) synthesis book. He had spoken about the New York Ocean Acidification Task Force to the June 2020 STAC meeting. There were brief comments about both from a number of attendees along with a few pictures.

The Shinnecock Bay Restoration Program: Clams, Oysters, Eelgrass and Macroalgae; Chris Gobler, Stony Brook Univ.

Chris began by noting that he has been working on this project for over a decade, it is a major collaboration with Mike Doall from his lab and faculty colleagues Brad Peterson and Ellen Pikitch. He introduced his talk with Suffolk County, New York (NY) population trends and groundwater nitrogen. The main source of this increasing nitrogen is onsite wastewater (septic) systems in all of Suffolk County and on the North Shore of Nassau County. This nitrogen input has well-documented impacts on water quality all around Long Island and particularly in embayments, with a plethora of different harmful algal blooms (HABs) as well as oxygen depletion events.

Shinnecock Bay has similar issues, when the project started in 2011 the Western Bay was closed due to saxitoxin from *Alexandrium* blooms, there were regular brown tides, and the hard clams and eelgrass had declined to minimal levels. A phase shift had occurred where the system now had high phytoplankton biomass and nutrient fluxes from the sediment, and low light, eelgrass, and bivalve populations and their replacement by macroalgae. The goal of the project is to restore benthic control by increasing bivalves, keeping the nutrients in the sediment and reducing phytoplankton and turbidity and allowing seagrass to grow.

Rather than just a single species, growth of all four; clams, oysters, eelgrass and macroalgae are addressed at the same time. Another important aspect of the project is very careful monitoring. Efforts are focused on the Western Bay where the major problems have been, the Eastern Bay near the inlet has better water quality. The project focused on hard clam “spawner sanctuaries”, putting 50,000 clams in a half-acre plot to maximize fertilization. At the beginning, clam densities were less than one per square meter, which would largely prevent fertilization. Two sanctuaries were established with the collaboration of the Southampton Town Trustees, NYSDEC, and local baymen. Since 2012, over 3.5 M clams have been planted in two sanctuary sites selected for retention of larvae, good water quality, proper bottom type, lack of predators, and that are no-take zones. School groups have helped to plant clams and efforts have continued even during the pandemic. Monitoring is an important part of the effort, both in planted areas and the entire estuary. Hard clam densities have remained similar to the original density planted, about 25 per square meter.

Hydrodynamic modeling with Beth Lamoureux (Anchor QEA) was also included to determine larval transport, which was predominantly to the east but also the west. Juvenile clam numbers have increased more than ten times since 2012 in the East Bay and to a smaller extent in the west. Adult clams also increased in the east, with a range of smaller sizes suggesting that they were spawned in the bay. Landings have also increased in the Eastern Bay by more than 700% since clam planting started in 2012, primarily in the smallest size class. Clam harvest in Shinnecock Bay has rebounded to numbers last seen in 1986, now exceeding harvest in the much larger Great South Bay.

Oysters, though now sparse, are also of interest because of their past abundance in the Long Island region and their rapid rates of filtration. Two oyster reefs were installed in the west end of the Western Bay where pilot study data suggested that oysters did best, even with poor water quality. The first reef had bags with spat-on-shell arranged in a wall around a 5 x 10 m area, with loose shell and adult oysters in the middle, the second was similar but with rows of bags. Millions of oysters have been planted since 2017 and have grown rapidly to large size in the last two years. Additionally, two types of macroalgae are growing on the reef and oxygen levels on the reef are higher than in control areas. Shrimp, crabs, and fish are more abundant on the reef and fish are also more diverse.

The clam sanctuaries and oyster reefs have established significant benthic control by filtering the water in their parts of the Western Bay, and significant clam numbers have also established some benthic control in the Eastern Bay. This return of benthic control clearly contributed to the end of brown tides after 2017, the first three-year period without them since 1985.

Brad Peterson spearheaded the eelgrass restoration, quickly realizing that distributing seeds was more successful than other methods. Between 2013 and 2018 there was a net increase of 100 acres of eelgrass, some due to planting and others due to improved water clarity because of the lack of brown tides. Macroalgae like *Gracilaria* can also compete with HABs for nutrients. They are growing *Gracilaria* on ropes in the summer and kelp in the winter and removing other macroalgae by regular dredging, all of which remove nitrogen from the system. In conclusion the Shinnecock Bay Restoration Program was shown to the Governor of New York in 2017 and has become the model for the $10.4 M Long Island Shellfish Restoration Program with five new shellfish sanctuary sites. Highlights include the largest hard clam landings in Shinnecock Bay in 33 years, a 750%

increase since 2012. More than 30 million clams were produced, oyster survival has increased, and there have been no dense brown tides in four years.

Discussion:
Jeff Levinton mentioned that the Stony Brook Yacht Club has had success with clam restoration and suggested yacht clubs around Long Island Sound as a model for citizen science restoration activities. He also asked Chris why the Shinnecock clam restoration effort had succeeded where the earlier Great South Bay (GSB) effort had failed. Chris answered that GSB effort could not choose their location and were in the area with the worst water quality. Even then they had some initial success which was overwhelmed by a dense brown tide. The location of the restoration is a key to success.

Penny Vlahos asked if either the Shinnecock or GSB sites were carbonate under saturated, Chris did not think so, though the Western Bay might reach that at night. However, only oysters were being restored there and since they are in reefs that should supply needed carbonate. Penny thought that with restoration saturation might improve and allow moving further west, Chris agreed and said that that was the concept in the new State program in GSB.

Jim O'Donnell asked about water depth and current speed as applied to replicating this in other areas. Shallow water is important to facilitate benthic control. In deeper waters like LIS, larval dispersal would be greater and therefore hydrodynamic modeling is crucial to determine dispersal.

"Developing Best Practices for Shellfish Restoration in Connecticut"; Tessa Getchis, Connecticut Sea Grant
Tessa started by stating that Connecticut (CT) has had limited experience with shellfish restoration from some pilot projects and can learn from the efforts in New York as described in the previous talk. She is working with the following colleagues to develop a shellfish restoration plan for Connecticut: David Carey (CT Bureau of Aquaculture), Kristin DeRosia-Banick (CT Bureau of Aquaculture), Juliana Barrett (CT Sea Grant), Harry Yamalis (CTDEEP), and Debbie Surabian (United States Department of Agriculture, Natural Resources Conservation Service, USDA NRCS). Funding comes from an NRCS grant, and a wide range of organizations is represented on the steering committee. There are also GIS and genetic specialists who are consulting on the effort.

Tessa reviewed the benefits of bivalves, particularly reef-building forms like oysters and mussels to build habitat, stabilize shorelines, and improve water quality clarity. Their effort is particularly focused on the native eastern oyster and ribbed mussel. Additional priorities are increasing aquaculture production and recreational shellfish harvesting in CT, and includes other commercial bivalves. CT has a $30M aquaculture industry producing oysters, clams, mussels, and scallops, larger than in NY, with more than 50 companies and 300 employees. There are also 15 coastal towns which manage recreational harvest and sell permits worth more than $100,000.

There are a range of shellfish beds spanning Greenwich to Stonington, many in the western part of the state, occupying 20% of CT's LIS waters. These include managed natural beds, recreational beds, and commercial beds in both town and state waters, the latter more than half of the total area. Natural beds are aquaculture areas set aside to provide small seed oysters for planting elsewhere. Despite these shellfish resources, CT shellfisheries are increasingly challenged by coastal development, overharvesting, pollution, and disease, and the goal of this effort is to increase the available shellfish resources in CT.

The CT restoration goals addressing a diverse array of stakeholders include: 1. Improve habitat, especially settlement habitat, 2. Improve water quality, 3. Improve shoreline stabilization and erosion control, 4. Increase aquaculture production, and 5. Increase recreational shellfisheries production. CT areas of shellfish harvest are well-mapped, but other areas of CT shellfish are not and need to be. There is need for a better understanding of the human and environmental context in which shellfish thrive and a lot of data is available from the data portal and the CT Blue Plan. This project includes a GIS analysis and is beginning to look at areas suitable and optimal for shellfish production. The project endpoint is a plan that provides best practices, regulatory guidance, and has a site selection tool to allow others to develop restoration projects. This should facilitate permitting, improve project success, and reassure funding agencies that support such efforts. Such projects would probably not have been supported in the past for lack of a plan.

There are a total of 390,000 acres of CT LIS waters potentially available for aquaculture or restoration, current shellfish areas must be excluded, but that still leaves 80% of the above available. Other areas of regulatory exclusion currently being investigated include marinas and mooring areas, protected habitats, commercial fishing areas, military zones, and navigation channels. Further considerations include bathymetry, distance from shore, tides and tidal restrictions, current or future living shorelines projects, shoreline and streambank erosion, and sea level rise projections. GIS specialists from the University of Connecticut Center for Land Use Education and Research (U. Conn. CLEAR) are applying data layers to determine areas for potential future aquaculture or restoration areas with a tool called the Aquaculture Mapping Atlas.

After determining exclusion zones, the next step is site suitability analysis. This includes potential interactions with other species, including fish and essential fish habitat, listed species, marine mammals, birds, turtles and invertebrates. The team must also consider shellfish production factors, including salinity, temperature, dissolved oxygen, nutrients, chlorophyll, substrate, as well as circulation and recruitment. Much but not all of this data is available statewide, so they are reaching out to others to fill the gaps, but more monitoring is likely needed. There are also many available resources, including the NOAA Milford Lab and hatchery, increasing industry hatchery capacity, new groups exploring shellfish genetics and shellfish interactions with ocean acidification, and a new state shellfish pathologist. The 15 town shellfish commissions and the existing aquaculture industry also have local experts who can help identify suitable sites.

Ongoing challenges include the lack of genetic information about native and introduced shellfish populations in LIS, as well as limited information about disease resistance in populations that have suffered during past outbreaks. Population dynamics, including larval dispersal and the scale, timing, and scale of recruitment are also poorly understood. Since commercial shellfish areas are leased, they cannot be used for restoration as there are no funds to pay lease holders. Likewise, shellfish restoration might be prohibited in areas that need water quality improvements because of public health security concerns. The plan moving forward is to finish the data viewer by the end of 2020, identify priority sites by the spring of 2021, and along with developing best practices and regulatory guidance, complete the final plan and map viewer by September 2021.

In the spring of 2020 the CT shellfish market collapsed because of COVID-19, most workers were laid off, inventory accumulated, and oysters grew beyond market size. The state of CT employed laid-off shellfishermen to rehabilitate 1900 acres of shellfish beds and plant three acres with oyster broodstock. By employing a ready workforce with the necessary skills and equipment, the condition of the shellfish beds and ecological services were improved.

Discussion:
Jeff Levinton said the he was concerned with the idea that shellfish planting might provide an "attractive nuisance". He suggested shellfish <u>should</u> be planted in "dirty water" which is often low salinity and does not have oyster disease. Furthermore, clams are already found in high abundance in closed creeks near his house so the idea of an "attractive nuisance" may be an illusion. Tessa agreed and while addressing the concerns of state regulators said the not all such areas would have to be closed to restoration.

Jim O'Donnell asked about the constraints on understanding larval recruitment, as some areas regularly recruit and others does do not. Jim asked about what properties need to be identified to address the recruitment issues. This issue should be addressed to the Aquaculture Bureau and the state shellfish pathologist.

<u>Eelgrass Restoration;</u> Chris Pickerell, Cornell Cooperative Extension, Suffolk County Marine Program
Chris noted that Stephen Schott and Kimberly Manzo were co-authors. He also acknowledged several funding sources including LISS and NFWF and noted that some of the studies discussed go back more than 15 years. Chris noted that he gave a similar talk to the Peconic Estuary 16 years ago. He showed a map of eelgrass planting sites around Long Island and stressed that LIS

is very different than the South Shore Estuarine Reserve (SSER) of Long Island and the Peconic Estuary, and eelgrass restoration methods may work in one area but not another. Major differences include depth, wave energy, water clarity, and temperature. The Sound is more energetic during seasonal storms than the other environments. Methods have evolved and improved over time as we gain a better understanding.

The Suffolk Marine Program first heard about eelgrass on the north shore of Long Island in 2002 in the area of Petty's Bight, Fishers Island, and Plum Island in the Town of Southold. Some of the meadows were very different from other environments, with rock and cobles and macroalgae. The existing eelgrass meadows provided important information about site selection parameters to consider in future restoration efforts. These included protection from northwest winds, sandy or rocky substrate, attached macroalgae but not drift macroalgae or other debris, high currents but below the wave surge zone, and beneficial grazers (snails) but few crabs. They tested restoration at sites further west which met these criteria, most successfully at St. Thomas Point and also further east around Great Gull Island.

Selection of restoration sites is compromise between water quality and wave energy, creeks and harbors were low in both, and were the known historical locations of eelgrass, and the first areas where restoration was attempted. Over time, however, after some eelgrass was found in bays and the Sound, these areas were also considered for restoration efforts, as both water quality but also wave energy were higher. At St. Thomas Point they tried to replicate the Petty's Bight natural meadow but found that planting neither seeds or adult shoots in sand were successful, only when the shoots were planted under rocks did they thrive. Even at Petty's Bight the eelgrass was rooted into the rocky bottom under the sand.

The physiological requirements of eelgrass are important to consider in site selection. Briefly: 1. High light intensity--20-25% of surface light is required, 8 or more hours of enough light to saturate photosynthesis, 2. Moderate temperatures (10-20^{O}C) are optimal for growth, and 3. Above 25^{O}C, respiration can exceed photosynthesis and the plants may die. Chris's group deployed light and temperature loggers at promising sites before conducting test plantings. These areas included three zones in the Peconics from west to east where eelgrass disappeared 50 years ago in the west, a central zone which lost grass in the last decade, and more than eastern zone where it is found today. Only in the eastern zone do the eelgrass meadows get more than 8 hours of saturating light in August, the central zone about 8, and the western zone less. The optimal combinations of light and temperature, with 8 hours or more of saturating light and temperatures below 25^{O}C, were found in all three zones in June and July, though temperatures were approaching 25^{O}C in the western zone, and by August both the central and western zones exceeded 25^{O}C. Temperature declined below 25^{O}C in September in all zones, but saturating light also declined to near 8 hours or less. This explains why the grass in past plantings would be dead by August in the central and western zones.

These factors were elaborated in the 2013 GIS-Based LIS Eelgrass Habitat Suitability Index Model with Jamie Vaudrey and others which included other parameters (dissolved oxygen, sediment grain size, and sediment organic matter) in addition to light and temperature. However, for optimal use of this model, there are data gaps; additional site-specific data is needed, especially high resolution bathymetry near shore, but also better temperature and light and any other site-specific information.

For LIS, especially, the Long Island shore, a key indicator for potential eelgrass sites is the presence of attached macroalgae on rocks (particularly *Laminaria* and *Chondrus*). Their presence integrates conditions better than snapshot water quality measurements, and suggests that there is not excessive seasonal physical scouring. The occurrence of green algae, however, may suggest inadequate water quality. Others areas which are problematic include sand ripples and waves which may indicate current or wave-driven sand movement; as well as areas with debris and shells or mud and macroalgae which suggest high organic matter, sulfides, ammonia, and perhaps bioturbation.

Typical restoration efforts start with test plantings at a range of water depths from just below Mean-Low-Low-Water to prevent wave damage, to depths where light is likely to be limiting. Growth is then expected in the mid-depths, with failures at the extremes. The planting is then extended down the shoreline in the successful depth range. Planting methods include seeds, either broadcast or deployed from a buoy, or shoots planted under rocks or with the "tortilla method" where shoots are inserted in burlap disks. (The tortilla method has the advantage that most of the work is done on land and can involve volunteers to help insert the shoots into the disks.) In LIS, at least the south shore, seeds would probably be scattered or buried by the wave energy, so other methods should be used. Planting season is usually the fall or the spring to avoid high summer temperatures, though in LIS the temperatures are usually below 25^{O}C so you could plant all year around. Successful bed plantings often accumulate enough mud and organic matter within the interior sediments that they would be outside the criteria for initial plantings.

Discussion:
Chantal Collier asked a question about source populations for transplants. Chris said they try to take them from similar areas, match site conditions, and collect shoots by hand. Many from Orient Point meadow near the ferry. At St. Thomas Point added seeds from other sites to add genetic diversity.

Jim O'Donnell mentioned that for purposes of designing coastal resilience programs, they developed a model of wave characteristics around LIS. They also have an archive of storm simulations to provide statistics. It could be useful to describe nearshore conditions and you could suggest additional features of use.

<u>Growing Macroalgae for Bioextraction and Other Uses;</u> Charlie Yarish, U. Conn. Stamford

Charlie has been working on seaweed aquaculture for many decades and his presentation had many co-authors. He started with the importance of economic utilization, stressing that the value chain has to be considered first. Currently, most commercial seaweeds are used as human food which is in middle of the value chain ranging from commodity colloids to pharmaceuticals. He has worked with colleagues at the GreenWave non-profit to help market seaweed, including the type of marketing opportunity, the intended customers, the formats and volumes needed, and the price per pound. Developing the value chain is critical in the LIS area, then you can work with established food businesses in the region to develop processing capacity and sales channels for kelp. Processing can be expensive and CT kelp farmers are using CT River valley barns to dry kelp and give them a cost advantage compared to producers in other states.

A benefit of seaweed and shellfish aquaculture is nutrient bioextraction from urban waters. Charlie has grown seaweeds in open waters in the East River and the western and central Sound near the CT shore, not surprisingly, the nitrogen and phosphorus concentrations were much higher at the East River site than those in LIS. Seaweed was grown year-around under research permits. A native *Gracilaria* species (*Gracilaria tikvahiae)*, a warm temperate red seaweed genus with a worldwide market, was grown in the summer in LIS. A nursery system was developed (and a seaweed culture handbook published) to grow *Gracilaria* from test tubes to large tanks, and then the seaweed from the tanks as seed stock for LIS. Small bundles of seaweed hung on long lines just under the surface of the East River quickly grew to larger size in weeks without any contamination from green algae. Growth rates reached almost 17% per day. Monthly yields in July of *Gracilaria* were 365 kg per 100 m of longline in the East River and 73 kg in LIS, both within economic values in Asian production systems. Nitrogen removal was also several times greater in the East River than in LIS.

The winter grown species was *Saccharina latissima*, a brown alga known as sugar kelp. *Saccharina* is the most widely cultivated genus throughout the world and is used for human food, alginates, biofuels, and nutrient bioextraction. The optimum depth in LIS was 2 m and a 100 m longline produced over 1,700 kg in the December to May growing season, comparable to Asian yields. Kelp removed large amounts of both nitrogen and CO_2 in both the East River and LIS, more than was removed by *Gracilaria* because of the larger biomass. Charlie has gotten Advanced Research Projects Agency–Energy (ARPA-E) support from the Department of Energy's Mariner Program to increase kelp productivity. They have developed longline cultivation systems for kelp in LIS and elsewhere, including the Gulf of Maine and the Gulf of Alaska. The work in Alaska with collaborators is testing a compact array with longlines spaced only a half a meter apart; with nutrient limitation as a potential concern. Under the same program they have done genetic analysis of sugar kelp from 16 sites from LIS north to the Canadian border and determined that there are two clades, one for LIS and east to Rhode Island, and another in the Gulf of Maine. They have germplasm from each of these locations to make available to kelp farmers.

On their experimental farms in LIS, kelp production ranges from 9-24 kg fresh weight per meter, with slightly higher production in the Gulf of Maine. Nitrogen and carbon bioextraction values in LIS ranged from 38-180 kg N per hectare, and 1,100-1,800 kg C per hectare. These nitrogen removal values for winter grown kelp and summer grown *Gracilaria* are comparable to values for oysters and mussels in East Coast estuaries. Kelp is often grown by farmers who also grow shellfish and kelp cultivation can also raise pH values in some environments which aids shellfish. Charlie has suggested including seaweed and shellfish aquaculture in the CT nitrogen trading program to provide additional revenue to farmers. He provided estimates of the value of nitrogen and carbon removal by seaweed grown in LIS based on the Nitrogen Credit Exchange. A bill was introduced into the CT legislature in 2017 to do this but to date has been unsuccessful, of the eleven states with environmental credit trading programs (principally nitrogen and some carbon), none currently include seaweed farming. LIS may be able to lead the way in adding seaweed farming to nutrient trading.

There were no seaweed farms on the US East Coast in 2010, LIS and the Gulf of Maine had the first. There are now numerous seaweed farms in Rhode Island, CT, and NY and a few hatcheries to provide seed stock. Sea Grant programs have been instrumental in this increase. Most growing systems are currently single longlines, multiple longlines would be more efficient, especially for nutrient bioextraction. Currently CT leads the seaweed harvest in Southern New England, which is highly dependent on both markets and permitting, NY still needs to develop a pathway for commercial harvest. Finally, with support from ARPA-E and collaborators, they have developed a nutrient extraction toolkit to distribute to seaweed farmers on the East and West coasts to determine the amount of nitrogen and carbon bioextraction by farmed sugar kelp as a measure of ecosystem services. Charlie closed with acknowledgement of the backing of the LISS, NFWF, NOAA, ARPA-E and others, especially the early support from LISS and NFWF.

Discussion:
Jeff Levinton asked about the genetically distinct southern population of *Saccharina* and Charlie replied that it was more temperature tolerant and they were using molecular tools to investigate that and disease resistance. Jeff followed with a question about whether seaweeds could be crossed with other strains for selection studies and Charlie said that such experiments were underway.

Breakout Group Summary Reports:
Mixed Species (Jim Ammerman): Is the Shinnecock project uniquely lucky or have they done a very good job or both? They have significant monetary and personnel support. Is Shinnecock a particularly advantageous environment or can their successes be applied to other environments? They are located near the Southampton marine lab and have good support and access. The driving factor has been the chronic brown tides of the past which have now abated. There were questions about why the bay was not attractive to the private sector for harvest, perhaps because of the brown tides. Further discussion of multispecies restoration efforts noted that “living shorelines” are a type of multispecies environment, though not discussed today. Unfortunately, funding from the Federal Emergency Management Agency (FEMA) and related sources which requires cost-benefit analysis does not include living shorelines.

Shellfish (Tessa Getchis): Discussed projects presented and past data and important issues going forward. Issues like HABs and a better understanding of biogeochemistry including denitrification in the sediments and water column. Lot of discussion about mapping and what is available and the interest of CT in mapping shellfish reef and resources. There is some data available through the LISMaRC Study (Long Island Sound Habitat Mapping). Much of the focus of shellfish restoration is on reef-forming and commercial species but we also have to think about clams and bioturbation and their ecological role as well as the loss of biodiversity. Emerging problems include the cyanobacterial toxin, microcystin, in both NY and CT waters. Jim O'Donnell raised the issue of what other available data and models could be used and what additional information is needed. He also mentioned the recent support that CTDEEP had received from the LISS to model CT embayments which should also be useful, Kelly Streich is the contact person.

Eelgrass (Chris Pickerell, Harry Yamalis): Jamie Vaudrey discussed the model presented earlier, she reiterated that bathymetry data was limited, and said that the model was used to establish eelgrass restoration goals for the Sound. Chantal Collier (TNC) said that the model was being used in restoration efforts around Fishers Island. The largest scientific hurdle besides funding is water quality, both temperature and chemistry. Water clarity was less discussed. Solutions include funding, some want to see more experimental restoration as has been done in the South. Additional issues include legal and economic hurdles, use conflicts and anchorage areas. The Niantic River cove should improve with sewering. Restoration projects need someone who has done successful transplanting as an advisor or lead on restoration projects.

Macroalgae (Charlie Yarish): Kristin noted that the CT permitting regulations could serve as a model for NY. Charlie said that growers should have carbon and nitrogen contents for macroalgae at the time of harvest. Regulators will have to look at single vs. multi-longline systems, in high-nutrient areas like the western LIS, multiline systems are more efficient. Also growers need information about the surrounding facilities near seaweed growing areas such as wastewater treatment plants and industrial facilities. Need to measure contaminants in seaweed tissue, especially if food use is anticipated; there is more flexibility if not. A map of potential seaweed growing areas in LIS would be useful, it is clear that they do not do well in low-salinity waters. Also need to monitor water quality to demonstrate nitrogen removal and cultivate only native not invasive species.

Jim O'Donnell concluded by reminding everyone that the February STAC meeting will focus on modeling and said suggestions should be submitted soon.