Long Island Sound Study Science and Technical Advisory Committee
Meeting Summary, November 19, 2010 – Stony Brook University

Larry Swanson brought the meeting to order at 9:00 a.m. and participants introduced themselves.

STAC Fellow Presentation

Jim Rice (Queens College) gave a presentation that discussed whether it is possible to distinguish a signal of climate change within the LIS ecosystem from among other potential drivers of ecosystem change. Jim presented his own data and an analysis of three additional datasets - the Riley et al. 1956 study of LIS, the follow-up by Capriulo et al. 2002, and CT DEP's survey from 1991-2010. His work indicates that cyclopoid copepod species richness has increased by at least two species, while calanoid copepod species richness has possibly decreased. Jim reported that these changes are consistent with observations by Turner (1981) that lower latitude estuaries along the North Atlantic coast tend to have more cyclopoid species than higher latitude estuaries, and that this relationship is more significant than the relationship between calanoid diversity and latitude (which is similar). Jim also reported that the average *Acartia tonsa* prosome length as measured by Riley et al. (1956) was significantly (α=0.05) larger than the *Acartia tonsa* prosome length he measured from the same location. This change would also be consistent with theories of the effect of warming temperatures on growth rates among copepods and Jim stated that this is further evidence that climate change is affecting the mesozooplankton of LIS.

A discussion of Jim's presentation followed. Art Glowka asked whether Jim had looked for changes in zooplankton food as part his work. Jim replied has looked at the phytoplankton community and did not detect major changes in the phytoplankton community between the Riley book (Conover's paper on the phytoplankton community) and the samples taken more recently by CTDEP as part of the LIS Water Quality Monitoring Program. Hans Dam asked about some of the temperature regressions that Jim presented. Hans has not been able to detect significant temperature trends in the CTDEP data due to high variability. Jim replied that the CTDEP dataset is not long enough to resolve small changes in temperature, but that the Millstone and Woods Hole datasets show clearly warming as well, and those are of sufficient time length and power to detect significant warming. Paul Stacey asked about other anthropogenic stressors and the sensitivity of some of the copepods to metals and other contaminants. Jim replied that there is not enough information in the literature about toxicity in copepods to know if toxicity could be a major factor in structuring communities in LIS. Bob Wilson asked whether community changes akin to what has been observed in Narragansett Bay have been observed in LIS. Jim replied that he is looking at ctenophores for this reason but that a historical dataset of the biological community, analogous to the Narragansett dataset, does not exist for LIS.

Science Discussion: Climate Change and Long Island Sound

Hans Dam spoke about the need for experimental work in Long Island Sound related to climate change, in addition to the strong programs currently in place for monitoring and observation. He emphasized that field data alone can suggest, but not test, mechanistic hypotheses of the response of populations/species/communities to climate change. Hans

also stressed the importance of being able to separate ecological from evolutionary responses to temperature changes. He reviewed many of the available time-series datasets for the Sound and stated that most time-series data is unsuitable for detecting phenological cycles related to climate. Hans recommended an approach based on Yamamira et al (2007) paper about temperature compensation/ evolution of seasonality/mixed models.

Darcy Lonsdale reviewed changes in the plankton community that could occur under warming conditions in LIS. She discussed a series of papers that have been published about northeastern US estuaries with extended time-series datasets. Major changes in the plankton community seem to be linked to winter temperature increases rather than other seasons. Warm winter temperatures have been reported to be related to lower chlorophyll concentrations, smaller (or no) phytoplankton blooms, more copepods, and a closer match between phytoplankton and their zooplankton grazers (which may constrain the phytoplankton community beginning in early spring). Darcy suggested that smaller phytoplankton blooms could stress the benthos due to a reduced flux of organic matter, which also has implications for hypoxia. Additionally, warmer winter temperatures could result in greater overwintering survival of young-of-the-year fish, ctenophores and jellyfish. Darcy also discussed available evidence of shifts in species ranges and shifts in seasonal dominance of existing species.

Stuart Findlay discussed the effects of climate change on tidal freshwater wetlands. He reviewed the importance of tidal freshwater wetlands on estuarine water quality, and described how vegetation can influence nutrient removal effectiveness. Stuart focused on forecasting effects of sea level rise on wetland vegetation. He predicted that rising sea levels will favor the replacement of the broadleaf cover class over graminoid vegetation, which would result in less nitrate removal and a significant reduction in ecosystem services. Stuart said that in the Hudson River region (and Long Island Sound) there is limited spatial availability for upland migration of wetlands, due to topography as well as existing development. Alternatives such as dredge spoil are unpalatable due to contaminants. Charlie Yarish suggested that relatively clean dredge spoil might be an option.

Brian Colle spoke about the challenges of making climate predictions specific to the level of Long Island Sound. He reported that global scale models are well resolved, but scaling down to regional levels is very difficult. Brian described the North American Regional Climate Assessment Program underway (www.narccap.ucar.edu), which is focused on regional climate modeling at the 50 km grid scale. Brian discussed the use of "ensemble analysis" to reduce error by combining output from multiple regional climate models. Johan Varekamp asked how local variations in CO2 emissions affect regional models. Brian said that there are urban centers built into the models but that at the 50 km scale, it's difficult to capture this information. Brian also pointed out that the societal demand/need is way ahead of the science right now, and there are not enough scientists looking at the atmospheric models to keep up with the demand.

Penny Howell described her analysis of the LIS finfish community response to climate change, based on the CTDEP LIS Trawl Survey. This dataset contains information on 95

species of finfish, with 25 years of sampling in spring and fall. The average annual biomass catch of all finfish has not changed over the time series, but there have been seasonal changes: early in the trawl survey, spring and fall catches were fairly even, but from the late 1990's into this century the fall catches greatly exceed the spring catches. Penny reported a strong trend in spring for decreasing numbers of "cold-adapted" species and a strong trend in fall for increasing numbers of "warm-adapted" species. Overall, species diversity did not change much. Hans Dam asked which season of temperature changes has the greatest effect on species composition, because he doesn't think that there is a significant increase in summertime temperatures. Penny said that many of the cold-adapted species don't necessarily prefer the cold, but are cold-tolerant and use it to escape predation – when temperatures warm, they lose this competitive advantage.

Chris Gobler focused his presentation on ocean acidification. He reported that as pH declines, the concentration of carbonate ions in seawater also declines, with accompanying negative impacts on calcifying organisms. He also pointed out that this could have repercussions for many economically important fisheries. Chris showed data from his laboratory that suggested negative effects of increased pCO_2 on hard clam larval survival and bay scallop size. He observed interactive effects of increased temperature and pCO_2 on larvae. Chris also drew a connection between increasing LIS water temperatures and increasing relative contribution of dinoflagellates to total chlorophyll in the CTDEP phytoplankton pigment dataset (station A4). He suggested niche expansion with future increases in LIS water temperature. Gillian Stewart asked about the larval shellfish data – she observed a big shift between preindustrial and present, but not much of an effect from today into the future. Gillian wanted to know if it was possible that we have already passed an ecological tipping point for these species? Chris agreed, replying that CO_2 levels have been relatively low until the last 200 years. Jim Latimer asked about interactions between temperature and nutrients with regard to future dinoflagellate dominance – Chris said that also the relative contribution of organic/inorganic nutrients is important as well.

John Mullaney discussed the USGS precipitation runoff modeling system (PRMS), that includes northern inputs into LIS and is based on datasets from 1961-2007. He and his colleagues have used GCM outputs downscaled by USGS National Research Program to look at LIS changes projected from 2011-2099 for the low and high emissions scenarios. They predict declines in snowfall but increased groundwater recharge, and thus greater flows. Changes in flow could mean changes in timing of spring freshet, smaller snowpack, earlier spring flows; changes in land cover and forest cover, urbanization; greater groundwater recharge, changes in time distribution of streamflow. Paul Stacey suggested that earlier leafout causing changes in evapotranspiration could be an important additional factor to consider.

Ralph Tiner provided an update on the National Wetlands Inventory (NWI) activities for Long Island Sound and the vicinity. The goals of the NWI work include monitoring wetlands and evaluating changes over time. The NWI inventory work has been completed for Long Island, updated to 2004, and the data is accessible on the USFWS website. An early 2011 publication will look at trends, based on historic data (1928-2004); inventory of potential wetland restoration sites, and landscape-level functional assessment of Long

Island's wetlands. USFWS has also been doing LIS eelgrass mapping about every 5 years, a 2011 inventory is planned. NWI mapping for CT has been funded by CTDEP and is scheduled to be completed in late 2011/early 2012. The mapping will be statewide, will assess recent and historic wetland trends and ID potential wetland restoration sites. Ralph is working to establish permanent plots in tidal marsh, freshwater wetland and low-lying upland, plans to monitor vegetation and soil changes every 5 years. He has set up one plot in NJ so far in one of their refuges; he reported interest by others in setting up similar plots in Long Island Sound. Larry asked if Ralph had a definition of a healthy wetland, and Ralph said no. Bob asked about delineating wetlands and whether it was possible to detect intertidal wetlands – Ralph said it was based on digital photography and that yes this was possible. Ann asked about separating *Phragmites*- dominated from *Spartina*-dominated areas in wetlands by digital photography, Ralph said this was possible for areas dominated by one or the other, but a mix was difficult.

Paul Stacey discussed his work with the infrastructure subgroup of the CT Governor's Steering Committee on Climate Change. He pointed out that states and municipalities already plan for many of the predicted impacts of climate change (e.g. floods, hurricanes, other extreme storms). The goal for the infrastructure subgroup was to determine if new standards are needed for protection. The group assessed risk based on likelihood of occurrence vs. magnitude of impact for different predicted changes. They found that increased extreme precipitation events and sea level rise were most serious risks to CT. Coastal flood control, dams, stormwater, transportation, facilities/buildings, wastewater were most imperiled planning areas. Paul described the challenge facing planners as where to draw the line for engineering standards? He stated that we as a society already don't plan for the worst-case scenario, so what happens when this gets worse? What level of climate change makes the most economic sense to plan for? Paul stressed the importance of doing a cost-benefit analysis for available adaptation options.

Charlie Yarish commented on the challenging need for a cultural change – how to get the word out that protecting habitat is going to be protecting properties? Paul agreed and added that a lot of the property-protecting engineering solutions are not as effective or durable. Anne McElroy pointed out that we need to more successfully argue that the environmental solutions are more cost-effective than engineering solutions in order to get the public to buy into these options. Paul highlighted the Groton project with CRE/ICLEI as a way to reach out to municipalities/local officials/public for planning purposes. Brian Colle asked about time scale and planning; currently cities/states seem to plan for 30-50 years but this is likely not long-term enough. Paul replied that when planning new development it's relatively easy to think 60-80 years out but that it's a lot more difficult for existing infrastructure.

Gary Wikfors stated that Ocean Acidification cannot occur in Long Island Sound because LIS is not the ocean; it is an estuary. An example of diurnal pH fluctuation in a highly-productive estuary (East Creek, in the Peconic Estuary) was presented graphically. During two weeks from the end of May to mid-June in 2010, pH, measured at 15-minute intervals by sondes deployed in a commercial oyster nursery, fluctuated between 7.4 at night and 8.4 in the afternoon. Almost all of this fluctuation is attributable to photosynthetic assimilation of dissolved inorganic carbon in daylight and respiratory release of carbon dioxide in

darkness by the planktonic community. Gary contrasted this range of pH fluctuation with the projected drop in open-ocean pH, assuming equilibrium with atmospheric carbon dioxide, from 8.15 to 8.05 in the next 100 years. Organisms inhabiting highly-productive estuaries may be subjected to both more-basic and more-acidic conditions than current or projected oceanic values. During the time interval that Gary's group monitored in East Creek, oysters in the nursery system were doubling in volume in one week, indicating that the oysters were able to maintain homeostasis under the fluctuating pH regime. To investigate the homeostatic mechanisms whereby oysters are able to function, calcify, and grow under acidic conditions, his group measured the intracellular pH of oyster hemocytes, the cells responsible for initial calcification using a fluorescent probe and flow-cytometry. They found the intracellular pH of oyster hemocytes to remain constant at 7.2-7.3 while hemolymph (the serum in which hemocytes are suspended) fluctuated with environmental levels that were varied experimentally from 7.8 to 6.8. Thus, oysters maintain intracellular pH within calcifying cells at a level lower than environmental pHs encountered and well-below the projected 100-year Ocean Acidification value of 8.05. Gary reported that they intend to conduct similar analyses with other bivalve mollusks, both estuarine and oceanic, to determine the relative susceptibilities of these species to Ocean Acidification disruption of calcifying-cell homeostasis.

Sentinel Monitoring: Julie Rose provided an update on the work group's activities. The bi-state coordination work group distributed a survey last summer to the state technical work groups in order to rate the sentinels that had been proposed previously. Approximately half of the technical work group members participated in the survey, which asked respondents to rate sentinels based on availability of historical/current datasets, and the ability to distinguish a climate change signal from other natural and/or anthropogenic influences. The work group was able to narrow down the list of proposed sentinels to seven, which will be used in an upcoming RFP. The RFP will ask for pilot-scale monitoring programs that incorporate a combination of data synthesis and on-the-ground monitoring. The bi-state coordination work group plans to release their Draft Strategy for Sentinel Monitoring in Long Island Sound at the same time as the RFP. Public comment on the strategy will be sought for incorporation into future versions as the program moves forward.

Discussion Summary

Uncertainty seems to be the biggest challenge - how can managers/officials plan for an uncertain future? Stuart Findlay suggested that politicians need to be prepared to react, because we know that change itself is coming. Paul Stacey pointed out that many things we are already doing help address resilience, but that the importance of this is not necessarily recognized. Gillian Stewart suggested that the concept of scale is really important, both spatial and temporal. She also emphasized that we need to make sure that the public understands that climate change is not in the future, we are starting to see effects now (e.g. very warm summers). Charlie Yarish pointed out that we need to do a better job keeping the public informed and interested. Sylvain DeGuise wanted to know who is going to take the lead pulling together the physics, chemistry and biology (which are all being studied individually in general) – what about the synthesis book? Is this something the STAC should look at? Larry Swanson said he assumes it will be in the synthesis book, that is, if

we can get the authors to actually do what they have agreed to do. Mark Tedesco pointed out that the original statement about the synthesis book was that climate changes is a good way to start to pull together all of these topics about LIS.

Synthesis Book Discussion

The book is planned to be 562 book pages of text/tables. Jim Latimer reviewed progress that has been made: the wiki sharing site was set up 2009; funding was secured for honoraria/publication costs in 2009, author workshops were held in 2009 and 2010. Jim proposed that each chapter have a single point of contact to coordinate the chapter leads and chapter authors. Jim reported that the book is a year behind schedule and we need to revise the schedule again. A challenge to be faced is a September 2011 expiration date for some of the funding for honoraria, purchasing copies of book from publisher, etc., and the indication is that there will not be an opportunity for another extension. There have been concerns expressed by Management Committee about the lack of progress and some Management Committee members have proposed reducing funding for LIS research program. A new timeline was suggested,

March 1, 2011:	final draft of all chapters
April 1, 2011:	chapters distributed for outside peer review (30 d)
May 15, 2011:	internal and external review comments compiled (45 d)
June 30, 2011:	response to comments completed (45 d)
July 30, 2011:	final submitted to Springer (30 d)

Expiration of funding vehicle: September 2011 (but work must be completed before disbursement)

Louise Harrison pointed out that the publisher is going to need a book in hand in order to price it for purchase, which makes September 2011 a very short deadline. Anne McElroy pointed out that it's unfair to punish the whole research community based on delinquency of a handful. Penny Howell asked for authors to be given specific assignments, because there have been too many people involved, the process has been confusing, and in some cases it is no longer clear who is left writing each chapter.

Updates and Other Agenda Items

The Nominating Committee for the NY Chair for upcoming elections: Pete Sattler, Bob Wilson

STAC members interested in being on the Monitoring Committee: Pete Sattler, Hans Dam, Charlie Yarish, Larry Swanson, Jim Latimer, Bob Wilson, Jim O'Donnell (volunteered by Hans), Ellen Thomas (volunteered by Johan Varekamp), Suzanne Paton –a general email will be sent out to the STAC

Modeling Committee: Mark Tedesco distributed a description of modeling funds available, the project duration and project description. The core team is not being asked to draft RFP but will be asked to participate in a few conference calls to review objectives and discuss

approaches to help direct crafting of RFP. Previous volunteers included Bob Wilson, Jim O'Donnell, Jim Latimer; additional volunteers include Paul Stacey (others can email Mark).

The next STAC meeting will be devoted to presentations by synthesis book chapter leads, since the bulk of the writing should be done by then (according to the revised schedule).

Future meeting topics and meeting format discussion:
Sentinels were proposed as a potential future topic. Larry Swanson suggested limiting numbers of future presentations. Julie Rose asked how to narrow the speaker list – do we make it first come, first-served? Do we keep inviting outside speakers? Currently we have an open format where anyone who wants to present is allowed. Sylvain DeGuise asked which of the speakers we could have cut at today's meeting? Sylvain said that we should limit presentation time, not number of presentations. Mark Tedesco said to limit both presentation number and time. Anne McElroy asked if the STAC keeps this format moving forward, do we lose other functions that the STAC is supposed to be performing? Mark said that this format is important for moving forward with synthesis of LIS science and that we can cut it in future meetings if there are other things that need to be discussed at a specific meeting. Cornelia seconded the recommendation that next meeting be about the book and said it could be an opportunity for cross-fertilization across chapters. Mark Tedesco agreed this is a good idea and said we should make sure videoconference available so everyone can participate.

The next meeting is scheduled for Friday February 11, 2011. Meeting adjourned.