We have been interested in the cause(s) of stunting observed in a small portion of steelhead trout as they are transferred from the hatchery to seawater. In this study we experimented with the acclimation of the fish from their freshwater hatchery environment to seawater of different salinities. A common pool of hatchery fish (in freshwater) was divided into two groups. One was stocked into a net pen located in an estuary (lower salinity) and the other group into a net pen in the ocean (higher salinity). Plasma osmolality was measured in the days following transfer, and long-term (3 months) survival and growth were measured.

As expected, blood osmolality in the fish transferred to seawater increased over the first 2 days, began to decrease on day 3, and stabilized at from day 4 onward. The osmolality of fish transferred to estuarine waters increased only slightly, and then remained constant over the next several weeks. Sixteen percent of the fish transferred directly to seawater were stunted after 3 months, whereas only 3% of those held in the estuary were stunted. There was no difference in the blood osmolality between...
stunted and normal fish in either location. Fish grew faster in saltwater than in the estuary, but survival was lower than the estuarine fish. These preliminary data suggest that a stepwise acclimation, from freshwater to estuarine to marine, may be beneficial.

**Objectives:**

Test the hypothesis that direct transfer of juvenile steelhead trout, from freshwater to full strength seawater, results in a portion of the fish being stunted.

**Project findings/progress to date:**

One thousand juvenile steelhead trout from a freshwater hatchery, mean weight 200g, were divided into 2 groups. One group was stocked directly into a net pen located in Great Bay Estuary (NH) approximately 20km from the coast. The other group was stocked directly into a net pen in the western Gulf of Maine. Over the course of the initial 3 weeks of the experiment, salinities at the estuarine and marine locations varied from 20-25 ppt and 27-33 ppt, respectively. Blood osmolality was measured from a random sample of fish pre-transfer, from a sample of fish at each location at 12, 24, 48, 72, 120 and 168 hours post-transfer. Pre-transfer osmolality was about 300 mosm/kg. This immediately increased to 315 mosm/kg in fish transferred to estuarine water, and then remained fairly constant over the next 7 days. Osmolality in fish transferred to seawater increased to 380 mosm/kg in the first 12 hours, remained near this level for the first 4 days, and then decreased to about 350 mosm/kg on days 5-7. After 2 weeks the estuarine fish were transferred to marine waters, and placed in a net pen adjacent to the marine acclimated fish. After 3 months, all fish were counted, a random sample from both sets of fish was weighed, and blood samples were taken. Mean weight was similar between the 2 samples (~630g), as was mean osmolality (~335 mosm/kg). Mortality after 3 months was higher in the fish that had been transferred directly to seawater (40% vs. 20% transferred to estuarine water). The percentage of stunted fish, those that showed little or no growth, was higher in the population that had been transferred directly to seawater (16%), and lower in the population that had been transferred to estuarine water (3%).

**Accomplishments** (Accomplishments are the key actions, activities or products resulting from Sea Grant projects. They are distinct from impacts in that they reflect ongoing activities or key results that may not yet have had a significant economic, societal and/or environmental benefit but lay the foundation for such a benefit. Accomplishments may evolve into impacts in the future.):

Results of the study suggest that a stepwise acclimation of steelhead trout during stocking, from freshwater to low salinity to higher salinity, may be beneficial. It should be emphasized, however, that in this field study we were unable to control salinity, so the results are not definitive. The study does, however, indicate that salinity may be important, and that controlled (i.e. laboratory) experiments are needed.

**Impacts** (Impacts are significant economic, societal and/or environmental benefits of a project):

**NOTE: Include data to validate the impact, if possible**

M/D-1301 Howell – 2
There are no immediate impacts since this was a pilot study.

**Economic benefits realized to date** (businesses retained or created, jobs retained or created, market and non-market economic benefits):

*NOTE: Please quantify and provide supporting data if possible*

There are no economic benefits since this was a pilot study.

**Tools, technologies or information services resulting from this project that are being used to improve ecosystem-based management** (e.g., that reduce contaminants that harm coastal ecosystems and seafood consumers; that track changes in ecosystem processes, biological responses and conditions):

None

**Related grants and contracts** (Other grants and contracts that funded this project or that were obtained as a result of this project):

None

**Publications** (please cite and attach PDF or send a hardcopy, or provide status if not yet published):

None

**Presentations, with published abstract citation if applicable:**

*NOTE: For presentations to civic groups, etc. (i.e., to the public rather than a scientific conference), please include number of attendees*

None

**Awards:**

None

**Additional information:**

None

**Students Supported** *(see next page)*
## Students Supported

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Where is he/she now?</th>
<th>Institution/Department</th>
<th>Duration of support</th>
<th>Type of support (stipend, travel, supplies, etc.)</th>
<th>Type of degree: Undergrad Master’s PhD</th>
<th>Year degree awarded</th>
<th>Title of thesis if supported by N.H. Sea Grant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jonathan Bunker</td>
<td>UNH</td>
<td>UNH, Dept. of Biological Sciences</td>
<td>6 months</td>
<td>supplies</td>
<td>MS</td>
<td>Projected 2014</td>
<td>Acclimation of steelhead trout</td>
</tr>
<tr>
<td>Michael Chambers</td>
<td>UNH</td>
<td>UNH, Dept. of Biological Sciences</td>
<td>6 months</td>
<td>supplies</td>
<td>PhD</td>
<td>2013</td>
<td>Research and development of steelhead trout aquaculture in sea cages</td>
</tr>
</tbody>
</table>