TAHOE: STATE OF THE LAKE REPORT 2009

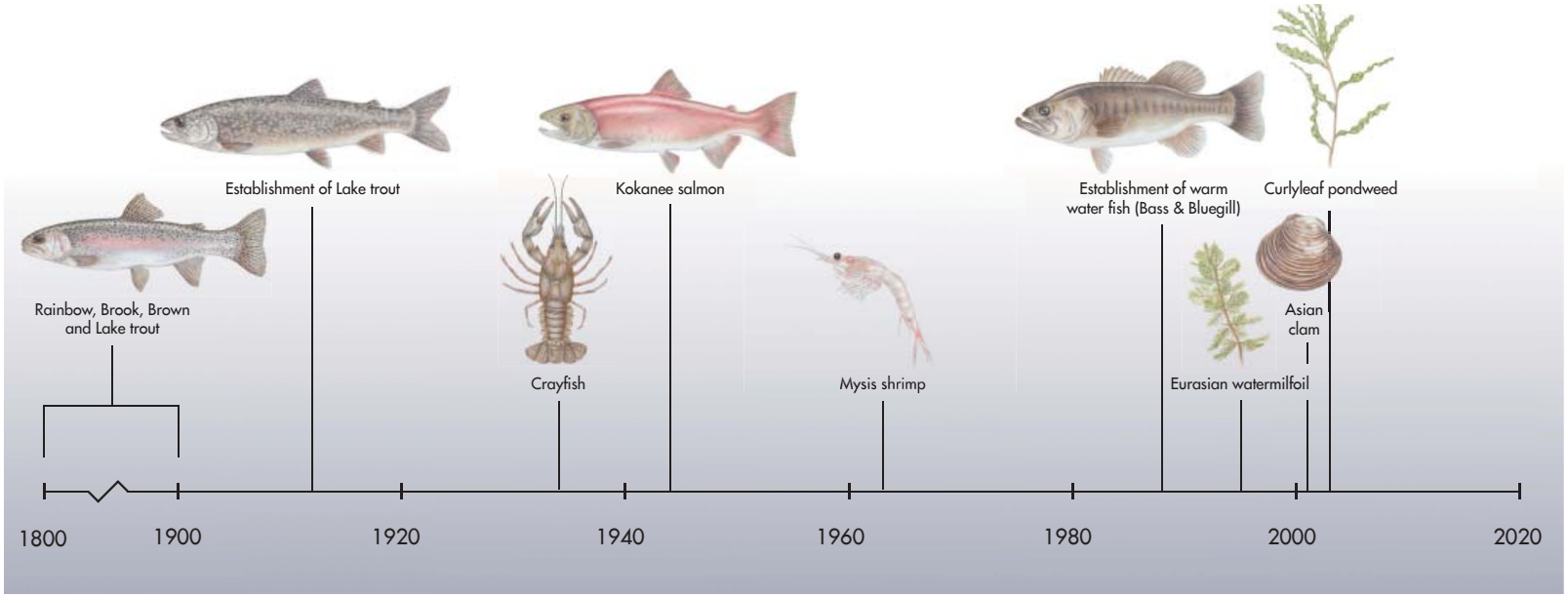
ASIAN CLAM

UCDAVIS
TAHOE ENVIRONMENTAL
RESEARCH CENTER

ASIAN CLAM

Lake Tahoe Species Introduction Timeline

There have been many non-native species introductions since the 1800's to Lake Tahoe—both intentional and unintentional. The lake has been stocked by natural resource agencies with rainbow, brook and brown trout, kokanee salmon, crayfish and mysis shrimp in attempts to boost fisheries. Unfortunately these efforts impacted the Lake Tahoe ecosystem which resulted in the dramatic decline of the native Lahontan cutthroat trout. Recently, there have been many unintentional introductions of non-native aquatic plants (Eurasian watermilfoil and curly leaf pondweed), warm water fish species such as largemouth bass and bluegill species and one bivalve mollusk, the Asian clam. The consequences of these ecosystem-wide shifts include alterations to: water chemistry through the uptake or release of excess nutrients, food web structure through resource competition, population dynamics of sports fisheries, as well as decreases in the recreational and aesthetic values of lakefronts, marinas and swimming areas through deposition of nuisance biomaterials (i.e., decomposing plant material, shells, algal blooms).



Research on Asian clam and other aquatic invaders to Lake Tahoe is being done in complete partnership between scientific teams at UC Davis - TERC and the University of Nevada, Reno. Lake Tahoe Species Introduction Timeline developed by Sudeep Chandra, Ph.D. (University of Nevada, Reno) with scientific illustrations by Sarah Adler.

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Asian Clam in Lake Tahoe

In spring 2008 UC Davis researchers discovered extensive and often dense beds of an invasive bivalve, the Asian clam (Corbicula fluminea) in southeastern Lake Tahoe in nearshore areas from Zephyr Cove to El Dorado Beach. Observations by researchers at the University of Nevada Reno of small numbers of clams (densities of 3-20 individuals per square meter) in 2002 suggest that Asian clam may have been in Lake Tahoe for at least 6 years; however, the densities and size of the recently observed beds are much larger than previously reported.

Asian clams are relatively small in size, ranging from 1 mm to 55 mm in most systems. In Lake Tahoe, the largest clam only gets to be about 30 mm in size, likely due to colder water temperatures and low calcium and food (algal) availability in the lake.

Asian clams live within the sandy bottom of lakes. They can burrow into the sediments using a strong muscle called a “foot”. Ridges on their shells help them burrow into sediments and stay anchored in the bottom when water currents move across them. Asian clam are capable of both filter feeding and pedal (foot) feeding—drawing from both the water column and the bottom sediments for nutrition. One reason for the Asian clam’s success in a wide range of habitats is that it can effectively filter phytoplankton and bacteria out of the water column and deposit feed when pelagic (lake water) food becomes scarce.

Researchers are currently studying the impacts of the clams to Lake Tahoe. By measuring sediment porewaters (the water between sediment grains on the bottom of the lake) scientists can understand how Asian clam are contributing to the amount of nutrients in the lake bottom, including the deposition of calcium through degrading clam shell matter. These accumulations of high calcium regions may facilitate the invasion of other calcium loving species, such as the quagga or zebra mussel.

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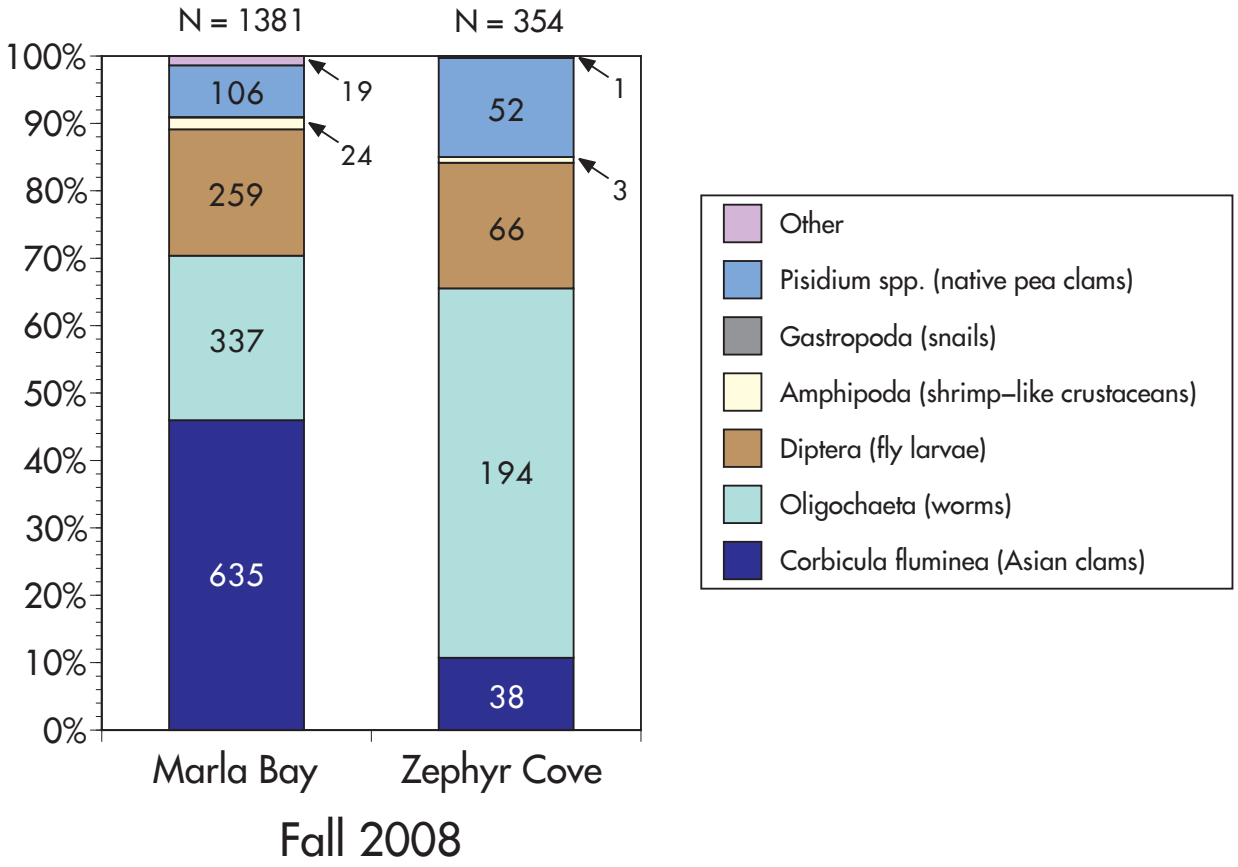
Invertebrate Composition

In addition to Asian clams, there are a number of other native benthic invertebrates that live in the sandy bottom of Lake Tahoe. This includes a native pea clam which can get up to 4 mm in length, only ~1/8 as large as the Asian clam adult. There are also many other snail, worm, and crustacean species that live in the bottom where Asian clam are found. Researchers are currently studying the impacts of Asian clam on other invertebrate species, such as the possible decrease of benthic biodiversity as a result of Asian clam. In areas where Asian clam densities are high, it has been observed that native pea clam densities are relatively lower.



Fall 2008

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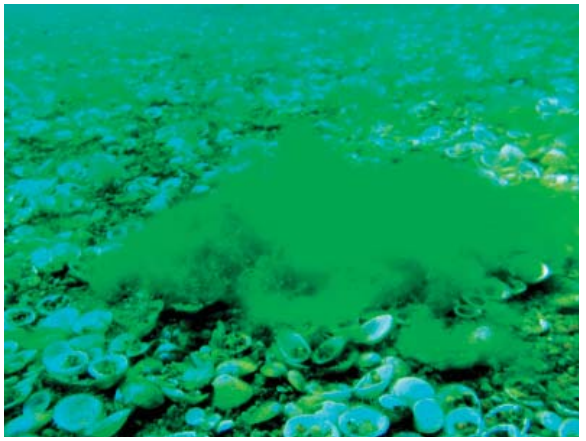
Increased Algae

Along the southeastern portions of Lake Tahoe during July through September 2008 dense algal blooms of the green filamentous algae *Zygnema* and *Spirogyra* were often co-located with Asian clam beds. These are both filamentous green algal species, which may exist attached or unattached to substrate, whose accelerated growth in other lakes and reservoirs has been linked to increased levels of nutrient in the water column, sometimes as a result of bivalve excretion.

The 2008 algal bloom reached estimated densities of approximately 125 mg Chl/m2, which is considered to be at or above nuisance levels. The primary bloom extended as significant patches from South Zephyr Point to Elk Point. Additional patches of bright green algae were observed from Zephyr Cove to Timber Cove along the south shore.

Excretion of nutrients by clams is a natural part of their feeding and growth. Nitrogen and phosphorus contained in the clam excretion readily stimulates algal growth. This is one of the most likely sources of nutrients fueling the observed algal growth. Other contributing factors could include smoke and ash associated with wildfires, warming in the nearshore zone, and urban runoff. However, the fact that this bloom of bottom algae persisted for so long supports the idea that clam excretion played an important role.



An extended algal bloom has long lasting impacts on the nearshore condition of Lake Tahoe. Residual dead and dying biomass is washed up onto south shore beaches where it decomposes and influences nearshore water quality.

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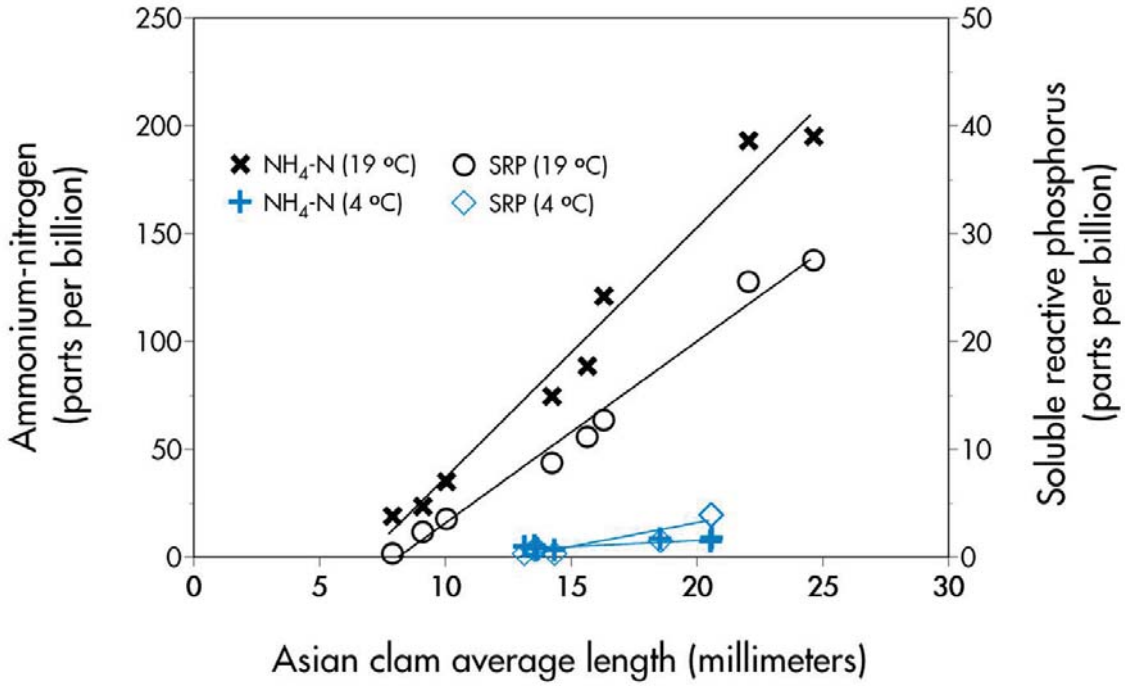
Asian Clam Excretion Experiment

Researchers conducted simple experiments to observe the rates of nitrogen and phosphorus excretion by Asian clams. For a 12-hour period, five similarly sized clams were placed in a single beaker containing 250 mL of filtered lake water and incubated at both 19 °C (Lake Tahoe nearshore summer water temperature) and 4 °C (Lake Tahoe nearshore winter water temperature). Results from the warm temperature (19 °C) experiment show that larger clams excrete more N and P than smaller clams and both excrete more than background concentrations in Lake Tahoe water column. The largest clams in this experiment were approximately 25 mm and excrete at rates an order of magnitude larger than the smallest clam size class considered here. Furthermore, tests designed to evaluate the impact of clam excretion products on algal growth showed a dramatic (3-fold) increase in phytoplankton biomass over a 7-day incubation period in the laboratory.



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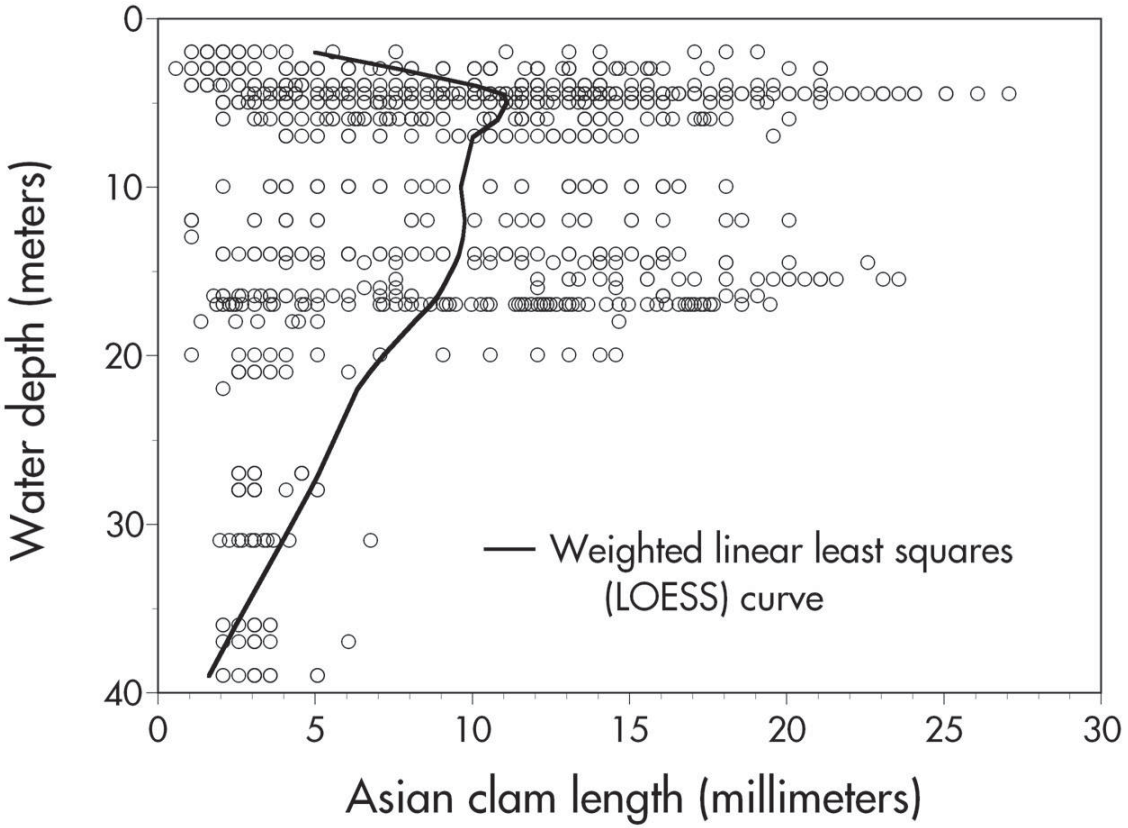
Asian Clam Size Distribution by Depth

Asian clam ranges in size from 1 to approximately 30 mm in length in Lake Tahoe. The bulk of the Asian clam populations in the southeast portion of the Lake occur at a 5 meter depth, with a few small-sized individuals occurring down to 40 meter depth. The circles in the figure show the size and depth distribution for individual clams. The solid line represents a statistical approach to better visualize the complete depth distribution.



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Asian Clam Size Distribution

The research teams surveyed the southeastern portion of Lake Tahoe in late summer and early autumn 2008. They found that the highest Asian clam densities occur at Marla Bay and at Elk Point ranging from 1 to 3000 individual clams per square meter. Patchy densities of clams were also observed in Zephyr Cove and east of these areas along the south shore. This survey was carried out using a combination of tools: by deploying a sediment grab sampler off the side of a boat, along with snorkel and scuba surveys. This is not a comprehensive survey and researchers at UC Davis and University of Nevada, Reno are doing a whole-lake survey in 2009.