

**LAKE TAHOE AQUATIC INVASIVE SPECIES
INCIDENT REPORT**

**Notes on Visual Observations of Clams in Lake Tahoe and on the Beaches Along the
Southeast Shore – Zephyr Cove to Timber Cove Marina: April 25, 2008**

Submitted by:

Scott Hackley, Brant Allen, Geoff Schladow, John Reuter – UC Davis TERC
Sudeep Chandra – UNR
Marion Wittmann – UC Santa Barbara

May 7, 2008

On April 21, 2008 a TERC researcher (Scott Hackley) visited several beaches along the south shore of Lake Tahoe to evaluate potential periphyton sites for a new SNPLMA nearshore study. At two beach locations (Ski Run Marina Beach and Regan Beach) clam shells were found onshore (Photo 1 shows shells collected). Preliminary taxonomic identification at TERC and subsequent identification at UC Santa Barbara (Tom Dudley, Riparian Invasives Research Laboratory) confirmed the shell samples were the invasive species *Corbicula fluminea*. Sudeep Chandra (UNR) has also recently received a report from Kim Tisdale at NDOW that local citizens have observed clam shells on along the Nevada shoreline. Further, Chandra indicated that *Corbicula* had previously been reported in Lake Tahoe (see below).

On April 25, 2008 Brant Allen and Scott Hackley conducted follow up investigations on the presence of clams in the south shore area. These investigations revealed large beds of living and dead clams (2 x 5 m) with very high densities in selected areas. The beds were not found at the shoreline, but rather at depth (typically 4-10 m).

Observations by Sudeep Chandra in 2002 suggest that *Corbicula* has been in Lake Tahoe for at least 6 years; however, the densities and size of the recently observed beds appear to be the largest ever reported. A brief review of the history of *Corbicula* invasion in Lake Tahoe reveals the following (we request that if others have additional information they pass it on):

- *Corbicula* have been detected in the Western United States (Columbia River Basin) since 1938.
- Comprehensive benthic invertebrate surveys by CDFG and NDOW in the 1960's did not find *Corbicula* in Lake Tahoe.
- *Corbicula* have been present in the Lower Truckee River since 1981 when the Pyramid Lake Paiute Tribe conducted the first comprehensive studies in the river. Surveys by Chandra's laboratory in 2005-2006 show that clam densities are variable (4-212 m⁻²) in the Lower Truckee River (Clark, Wadsworth, Nixon) and its tributaries (North Truckee Drain and Steam Boat Creek)
- Chandra observed these clams at Lake Tahoe at the south shore locations in 2002 but his field notes suggest that there were present in colonies of 3-20 clams at that time. Note: this was not a comprehensive survey.
- About 2003, Dave Herbst (UC SNARL) positively identified clams collected from Nevada Beach (South Shore). Shells collect by a citizen were sent to Herbst by the League to Save Lake Tahoe; a report of this citing was first published in the League's Summer 2003 Newsletter. Almo Cordone (retired senior biologist with CDFG) reported that Dr. Herbst could not determine if the specimens came from an established population.

The initial conclusion by the reporting team is that these large beds recently observed are far more extensive than previously observed. The reporting team also considers that, based on the life history of bivalves, their densities have been building over time. The extensive European literature on *Corbicula* suggests that established populations are found in areas with calcium as low as 4-5 mg/L; calcium levels in Lake Tahoe are approximately double these threshold values. Chandra and the rest of the reporting team is concerned about the possibility that non-native species such as *Corbicula* could facilitate the invasion of other bivalves (quagga and zebra

mussels) by creating microhabitats of elevated calcium on which they can colonize (Stewart, Miner and Lowe, 1998).

UNR, UCD, and TRPA have initiated a survey this week (May 5-9, 2008) to measure calcium levels from the nearshore area of Lake Tahoe. We are modifying the surveys to include measuring calcium levels within the *Corbicula* patches to determine if these microhabitats contain sufficient calcium to support other invasive invertebrate species. UNR and UCD are creating a plan to determine where to conduct baseline surveys for benthic invertebrates from Lake Tahoe based on previous data collections. Furthermore, we are working with TRCD to develop a proposal to more fully determine the current extent of *Corbicula* in Lake Tahoe, understand the growth rates, and obtain additional information that will allow us to evaluate the potential ecological risk of a widespread *Corbicula* outbreak. Even though there are knowledge gaps at this time, we thought it would be useful to pass our current level of information on in a timely manner.

Below is a brief summary on *Corbicula* (from M. Wittmann) along with the field notes and selected photographs taken by Allen and Hackley.

Asian clam (*Corbicula fluminea*) is a small (<55mm) filter feeding bivalve with a yellowish brown to black shell with concentric, evenly spaced ridges on the shell surface. *Corbicula* are native in temperate to tropical ranges of southern Asia, the eastern Mediterranean, and Australia. In North America, *Corbicula* was first collected in 1938 along the Columbia River in Washington State and has since spread across most of the temperate regions of the continent. Its means of introduction have been noted (Counts 1986): attached to boat hulls, bait bucket introduction, accidental importation with aquaculture species, and intentional introductions with intent for sale as a food item. Veligers can also transport passively with water currents. *C. fluminea* have high dissolved oxygen requirements are generally found in lakes and streams with silt, mud, sand, and gravel substrate. They can tolerate salinities of up to 13 parts per thousand for short periods (Aguirre and Poss 1999) and temperatures between 2 and 30° C. While there has been no definitive study on the impact of calcium on *C. fluminea*, it appears that at 6 mg Ca/L and a pH > 6.5, *Corbicula* populations can be relatively successful. The lowest pH limit for *Corbicula* has been reported to be 5.6 if all other abiotic and biotic conditions are suitable to sustain them (McMahon, personal communication 2008). *Corbicula* are hermaphroditic and are capable of self-fertilization. Spawning can continue year round and must be above 16°C for larval release. In North America, spawning occurs from spring to fall, and a single clam can release an average of 400 juveniles per day, with reproductive rates highest in fall (Aguirre and Poss 1999). *C. fluminea* maximum lifespan is 7 years, averaging 2 to 4 years. Predators of *Corbicula* include birds, raccoons, crayfish, flatworms and a variety of fish species including carp, catfish, largemouth bass and sunfish. Ecologically, *C. fluminea* can outcompete many native clam species for food and space, and affect manmade infrastructure by clogging of water intake pipes, affecting power, water, and other industries. (Note: citations to references are available upon request).

Observations of invasive clams (*Corbicula*) in Lake Tahoe (April 25, 2008) - South shore region between the Zephyr Cove Pier and the Timber Cove Pier

(Observations were made by Tahoe Environmental Research Center (TERC) researchers either from boat or by snorkeling to check for presence or absence of clams and to take photographs. No attempt was made at that time to conduct a detailed count of clams). Figure 1 presents a map of the sites visited to check for presence of *Corbicula fluminea*.

Zephyr Cove Marina Pier (Site A)

- Observed from boat along a transect from deep water towards shore to ~2 m depth at Zephyr Cove pier and back out to deep water. Less than 10 dead clams (shells) observed.

South Side of Zephyr Point (Site B)

- No clams found at the south side of Zephyr Point. Cove between Zephyr Point and Elk Point is deep until very close to shore.

Elk Point (approximately 300 meters north of Nevada Beach) (Site C)

- Large beds of clams (2 m x 5 m) with very high densities. Took numerous underwater photographs (Photos 2, 3, 4). The beds were at a depth of 14 feet (4.27 m) (measured with a tape). 50% of clams appeared to be alive in the dense aggregations. Many of the live clams appeared to be about ½ inch or 1.25 cm long (Photo 3). Many of the beds were visible from the surface as white appearing patches along the bottom (Photo 2), (it is likely these would be visible from the air).
- The density of clams remained relatively high out to a depth of ~15 m.

North end of Nevada Beach (Site D)

- We found clams at ~4 m to ~10 m depth. Dense patches of clams ($+200 \text{ m}^{-2}$) were observed, with lower densities scattered in between. Both live clams and dead ones (shells) were present. The live ones were likely present in similar density in sections of patches.
- Large aggregations of clams were observed in the sand riffle depressions at 4 m. The sand was medium grain.
- Lower densities of clams were observed at slightly less than 4m depth (moving in toward shore) and out at depths greater than 10 m, moving away from shore.
- Clams were observed out to 15 m where bottom was no longer visible by snorkeler (depth was measured on boat depth finder). Uncertain at this time if large amounts of clams are present at 15 m depth and deeper.
- No live clams were observed from a depth of slightly less than about 4 m in to the shoreline. This region has exposure to strong S/W winds and wave activity (S. Chandra has indicated *Corbicula* does not do well in wave exposed areas).

North end of Nevada Beach to about mid-Nevada Beach offshore (Site E)

- Clams observed to be present.

Mid-Nevada Beach to north side of Edgewood Golf Course (Site F)

- No clams were observed from mid-Nevada Beach to north side of Edgewood Golf Course.

North End of Edgewood Golf Course (Site G)

- Low to moderate densities of clams in sandy bottom offshore of the piers at north end of Edgewood Golf Course.

Stateline area off Harvey's Casino (Site H)

- No clams found offshore of Harvey's Casino or along a transect away from shore out to deep water at the shelf break.

Offshore of Ski Run Marina (Site I)

- Found low densities of clams on the sand flats starting around the green channel marker buoy (~3 m). Pockets of dense (~500 m⁻²), mostly dead clams (~1% live) in depressions in the sand (Photos 5, 6, 7).

Timber Cove Marina Pier (Site J)

- Low densities of clams from 2m – 1.5m depth. Found one pocket of dead clams shell accumulation offshore of pier. (Note Ski Run and Timber Cove areas have less direct exposure to S/W winds and wave activity, a possible reason clams found closer to shore in shallower depths in these areas)

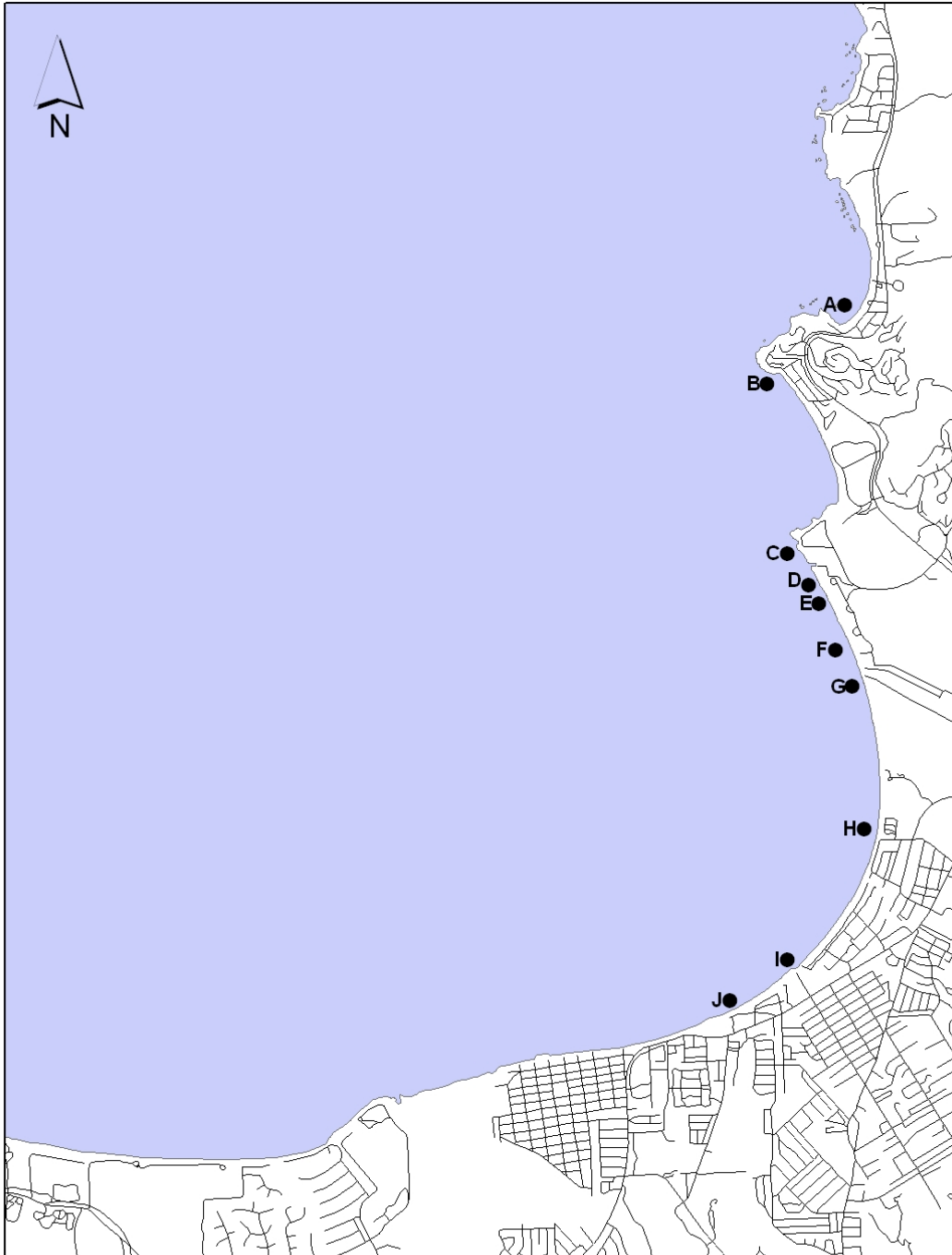


Figure 1. Map showing sites visited to check for presence of *Corbicula Fluminea* along south-east shore of Lake Tahoe on 4/25/08. (A- Zephyr Cove; B- south Zephyr Pt.; C- Elk Pt.; D- north end Nevada Beach; E- region north to mid-Nevada Beach; F- region mid-Nevada Beach to north of Edgewood Golf Course; G- north end Edgewood Golf Course; H- offshore of Harvey's Casino; I- offshore of Ski Run Marina; J- Timber Cove Marina pier).



Photo 1 – *Corbicula fluminea* shells found on Ski Run Marina beach, Lake Tahoe 4/21/08.



Photo 2 – Brant Allen observing *Corbicula fluminea* beds off Elk Pt. 4/25/08.

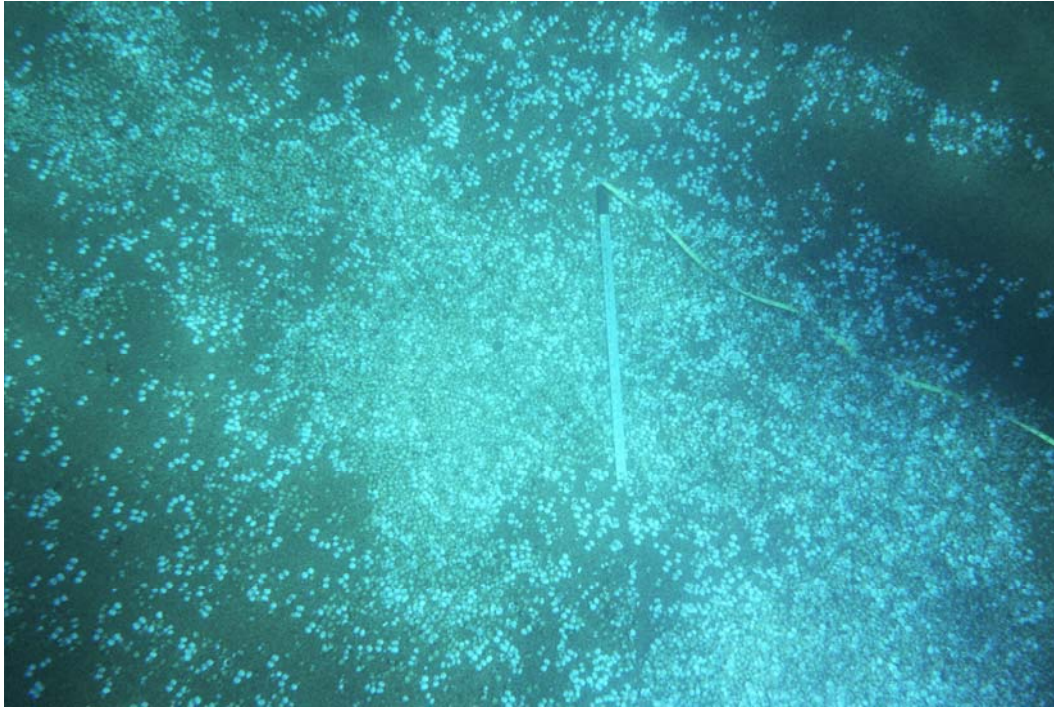


Photo 3 – *Corbicula fluminea* bed at 4m depth off Elk Pt. 4/25/08 (for reference: ruler is 0.91m).

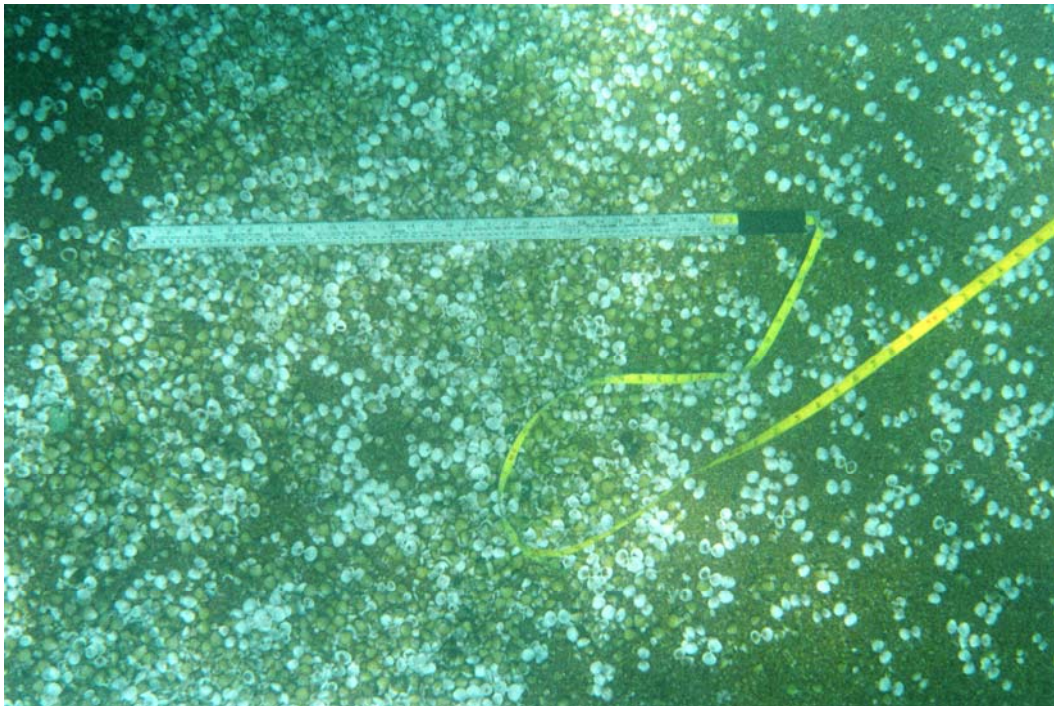


Photo 4. *Corbicula fluminea* bed of mixed live (light brown) and dead (shells), near Elk Pt. ~ 4m depth, 4/25/08.



Photo 5. Bed of *Corbicula fluminea* shells and some live clams offshore of Ski Run Marina at 2-3m depth, 4/25/08.



Photo 6. Bed of *Corbicula fluminea* shells and some live clams offshore of Ski Run Marina at 2-3m depth, 4/25/08.



Photo 7 – *Corbicula fluminea* shells and some live clams at 2-3m depth in depression offshore of Ski Run Marina 4/25/08.