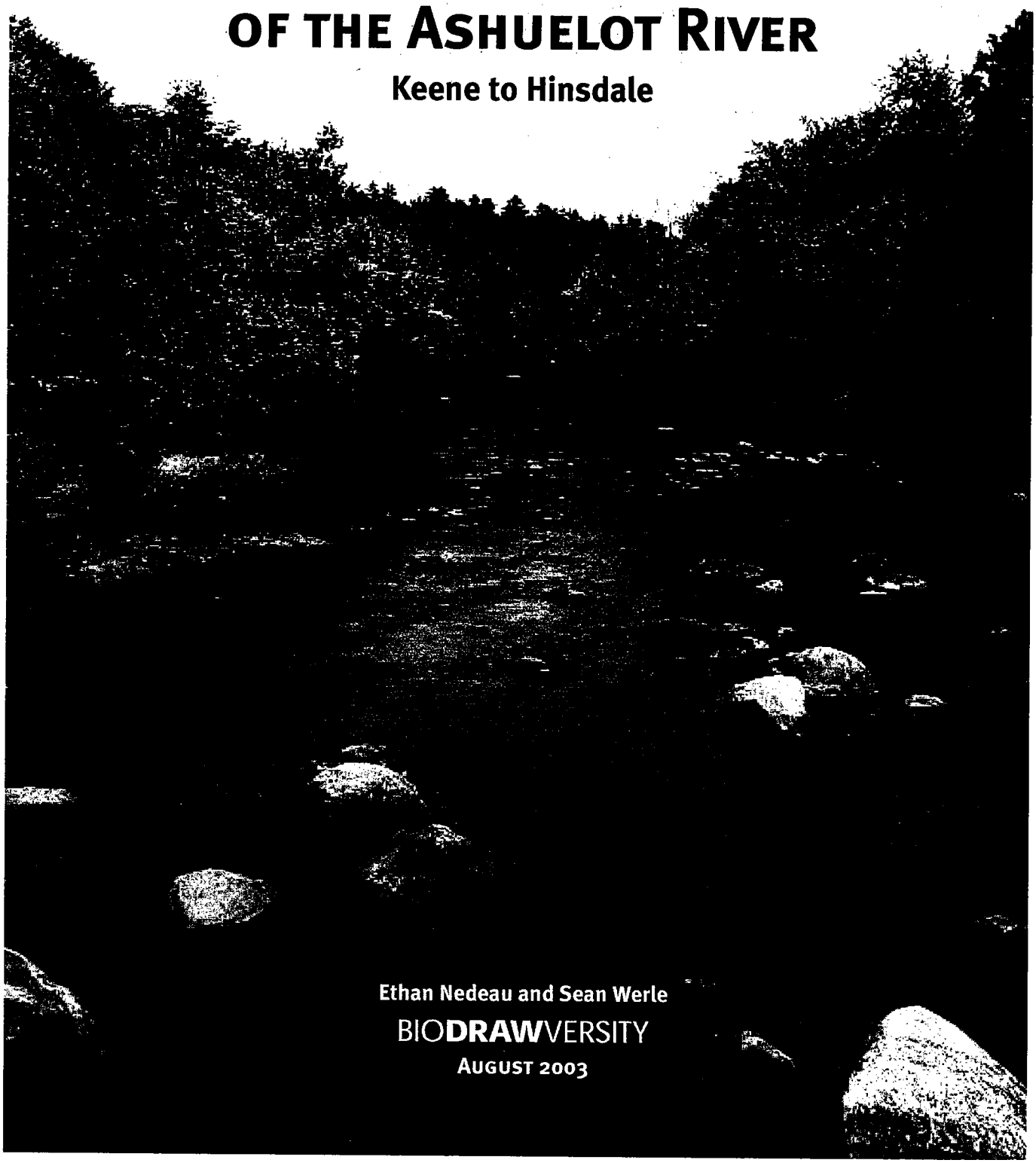
Freshwater Mussels of the Ashuelot River

Keene to Hinsdale



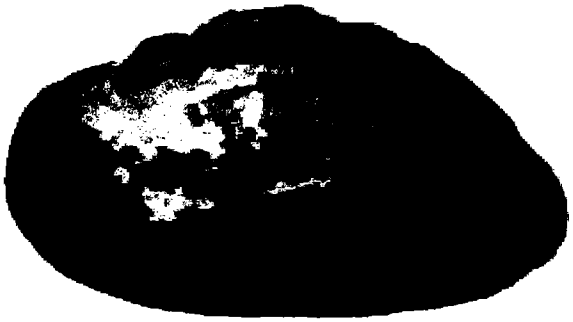
Ethan Nedeau and Sean Werle

BIO**DRAW**VERSITY

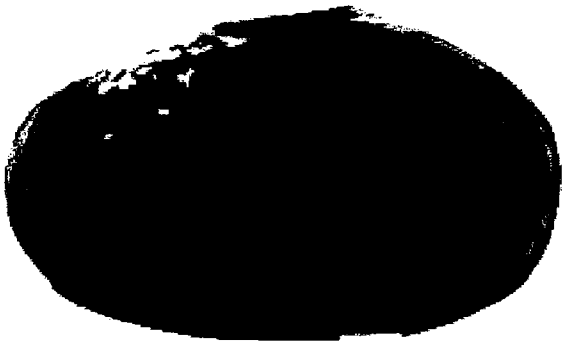
August 2003

Freshwater Mussels of the Ashuelot River

Eastern Floater
Pyganodon cataracta



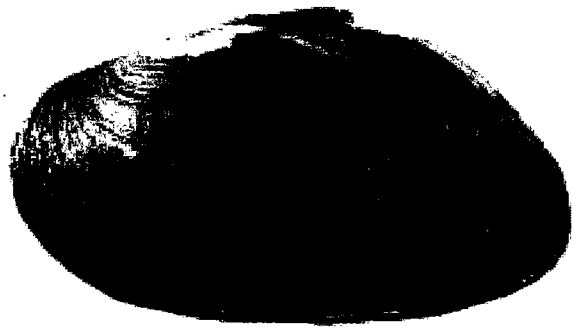
Dwarf Wedgemussel
Alasmidonta heterodon



Eastern Lampmussel
Lampsilis radiata

Triangle Floater
Alasmidonta undulata

Creeper
Strophitus undulatus



Eastern Elliptio
Elliptio complanata

FRESHWATER MUSSELS OF THE ASHUELOT RIVER

Keene to Hinsdale

Ethan Nedeau and Sean Werle
August 2003

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ABSTRACT

In July 2003, we surveyed 11 locations on the Ashuelot River between Swanzey and Hinsdale. The objectives were to try to find new populations of *Alasmidonta heterodon* (DWM) in the lower portions of the river, establish baseline information on mussel populations, and survey mussels near the dam in Hinsdale that was slated for removal. SCUBA was the primary survey method, with two divers spending 1-3 hours at each location. Snorkeling was used in water too shallow for SCUBA. Habitat throughout the river was generally ideal for freshwater mussels, water quality problems were not usually evident, and the river was teeming with both macroinvertebrates and fish. There were signs of historical water quality and habitat quality degradation in some locations. Freshwater mussels were abundant between Swanzey and Winchester, though species richness and abundance declined sharply in survey locations near Hinsdale. *Elliptio complanata* was the most common species, followed by *Alasmidonta undulata*, *Strophitus undulatus*, *Lampsilis radiata*, and *Pyganodon cataracta*. We did not find DWM downstream of the Swanzey Dam, though we did find it upstream of the dam where it had not been previously found. One large male DWM was found less than 100m upstream of the dam, and we think this discovery represents the downstream range limit of DWM in the Ashuelot River. We resurveyed Site 10 upstream of the Sawyer Crossing Road, where five live DWM were found in August 2001. We found 14 live DWM, including several young individuals that we would not have detected two years prior, indicating recent reproductive success. This report also provided an opportunity to compile information from four separate surveys that we have conducted since 2001—all of the previous abstracts, reports, maps, photographs, and data forms are included in this report. We hope local communities and conservation groups will use this report to take steps to protect the river and its freshwater mussel resources.

Previous Abstracts

Ashuelot River Freshwater Mussel Survey
Route 101 Bridge, Keene to Below Sawyers Crossing Bridge, Swanzey
Report Submitted: September 2001

We surveyed 3.4 miles of the Ashuelot River, from "The Branch" confluence downstream of the Route 101 Bridge in Keene to 0.4 miles downstream of the Sawyer Crossing Road in Swanzey. The survey was initiated because of concerns about the effect of a wastewater treatment effluent on the mussel community; therefore, we spent much time surveying upstream and downstream of the outfall. *Elliptio complanata*, *Alasmidonta undulata*, *Alasmidonta heterodon* (DWM), *Strophitus undulatus*, *Lampsilis r. radiata*, and *Pyganodon cataracta* were found in the study area. Mussel densities were low in Sites 1-4 despite what seemed like ideal habitat conditions. Mussel densities were higher in Sites 5-11, where the river was slow moving, deep, and sandy. Thirteen DWM were found at six different locations, and greatest densities were found at Site 10 (5 animals) and Site 11 (4 animals). We did not detect changes to the mussel community downstream of the wastewater effluent. Mussels were common downstream of the outfall; in fact, the two survey sites with the richest mussel assemblages were also located downstream of the outfall (Sites 10 and 11).

Ashuelot River Freshwater Mussel Survey
Sawyers Crossing Road, Swanzey to Winchester
Report Submitted: October 2001

We surveyed freshwater mussels at ten locations along 12.5 miles of the Ashuelot River from Swanzey to Winchester. We had found *Alasmidonta heterodon* (DWM) 0.5 miles south of Sawyers Crossing Road in August 2001 and the primary objective of this survey was to determine how far downstream this species existed. Five locations within three miles of where DWM had been found in August 2001 were surveyed using snorkel and SCUBA. DWM were not found at these sites, despite apparent similarities in habitat between these sites and the six locations where DWM had been found between Keene and Sawyers Crossing Road. Five additional sites were surveyed between Swanzey and Winchester, mostly in riffle habitats that we expected to provide the best opportunity to find DWM. Despite excellent habitat quality and few apparent threats to water quality, we did not find any DWM during this survey. *Elliptio complanata*, *Pyganodon cataracta*, *Lampsilis radiata*, *Strophitus undulatus*, and *Alasmidonta undulata* were common at nearly all sites.

Freshwater Mussel Survey Near Two Decrepit Dams on the Ashuelot River
Report Submitted: June 2002

Freshwater mussel surveys were conducted in the Ashuelot River near two dams in Winchester and Swanzey. These dams are candidates for removal, and this survey was initiated to determine if *Alasmidonta heterodon* (DWM) existed near the dams. The nearest known occurrence of DWM was four miles upstream of the Swanzey Dam, though habitat conditions below each of the two dams seemed suitable for DWM. Nearly 300 yards of river was surveyed near the Winchester Dam, and we found four species including *Elliptio complanata*, *Alasmidonta undulata*, *Lampsilis radiata*, and *Strophitus undulatus*. Nearly the same distance was surveyed near the Swanzey Dam, and we found the same four species plus *Pyganodon cataracta*. This report describes the mussel communities at these sites, the possibility that DWM exists in these areas, and the potential consequences of dam removal.

Looking downstream from Site 10 toward the covered bridge at Sawyer Crossing Road

INTRODUCTION

The Ashuelot River is a large tributary of the Connecticut River—it drains an area of 420 square miles of southwestern New Hampshire and flows for 64 miles from Washington to Hinsdale. It is among the most important rivers in North America for the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*, hereafter referred to as "DWM") with a large and healthy population occurring below the Surry Dam in Surry and north Keene. The river in and below Keene has been subjected to severe degradation beginning over two centuries ago, particularly from agricultural and industrial development, and wastewater treatment and dumping. Habitat quality in and downstream of Keene is generally poor because of bank erosion and sloughing (which is extreme in some locations) and sedimentation. Parts of the river are littered with tires, bottles, and other junk dating back to the 1800s, indicating that the river has long been a dumping ground for local residents.

Further downstream between Swanzey and Hinsdale, the primary threats to river health appear to be eutrophication and sedimentation resulting from agriculture and degradation of riparian areas. However, there are signs of historical disturbance, including old industrial areas in Swanzey (downtown), Winchester (downtown), the village of Ashuelot, and Hinsdale. Old effluent pipes can still be seen on the banks or underwater, and one can't help but wonder what types of toxic materials have been dumped in the river over the past 250 years. Domestic and industrial refuse is a common sight throughout the entire river.

Despite its troubled past, the Ashuelot River is now given a Class B designation, and is both fishable and swimmable. Habitat is excellent in places, water odor is generally minimal, visibility is good although excessive algal growth is evident in late summer, and fish are a common sight. Riffles support a rich diversity of benthic macroinvertebrates, including pollution intolerant insects such as stoneflies, caddisflies, and mayflies. Eutrophication problems are persistent in the lower river, but overall, the river has improved over the past few decades. Two dams have been removed in recent years, with two more slated for removal.

In the summer of 2001, nine live DWM were found at six locations downstream of Keene (North Swanzey). Before that survey, people thought that DWM were confined to areas upstream of Keene. The presence of DWM downstream of Keene was exciting from a conservation perspective because of the large amount of potential habitat that existed in the lower river. If DWM were making a natural recovery and recolonizing downstream areas, the regional importance of the Ashuelot River for DWM would be far greater than previously thought.

Surveys were then conducted at several locations between Swanzey and Winchester to get a better understanding of DWM distribution. However, no DWM were found in subsequent surveys. The current survey was a final effort to finish surveying the Ashuelot River to its mouth in Hinsdale, to compile data from previous surveys, and to provide a comprehensive report on the freshwater mussels of the river between Keene and Hinsdale.

Site Selection and Methods

Twenty-nine locations were surveyed between Keene and Hinsdale. Site selection depended on the objectives of the survey. In summer 2001, locations were chosen based on proximity to a wastewater effluent pipe and habitat conditions. In fall 2001, locations were chosen based on proximity to known locations of DWM and habitat conditions. In summer 2002, surveys were confined to two dams in Winchester and Swanzey. In summer 2003, locations were chosen based on accessibility, and available habitat. Also, in summer 2003 we surveyed near the Hinsdale Dam in advance of its removal. Some sites were revisited to check for DWM, document recent recruitment, or check habitat conditions or presence of tesselated darters.

We used three methods to search for mussels: snorkeling, bucket surveys, and SCUBA. SCUBA was preferred in deeper waters, and snorkeling was preferred in riffles. Survey duration ranged from 1-3 hours per visit. A data form was completed for each survey site (Appendix 1) that included location, GPS coordinates, habitat conditions, survey extent, species found and relative abundance, and shell condition. Photographs were taken and are provided on the compact disc that accompanies the report. Figures 1-6 show maps of all survey locations. Voucher specimens were not collected, but if possible, photographs of DWM were taken.

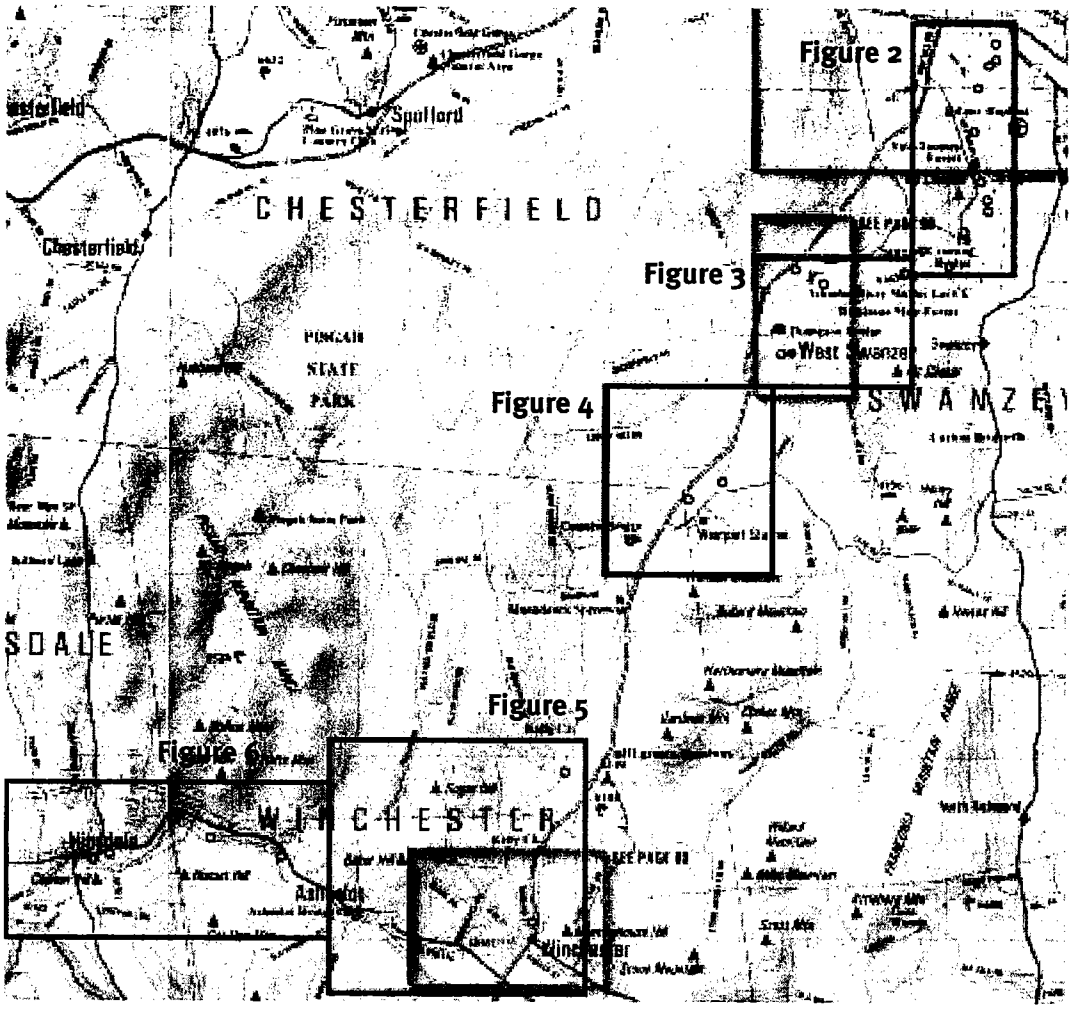


Figure 1. Ashuelot River from Keene to Hinsdale. Red dots indicate survey areas. Blue rectangles indicate areas of detail for figures 2-6. Map copied from Delorme Atlas and Gazetteer.

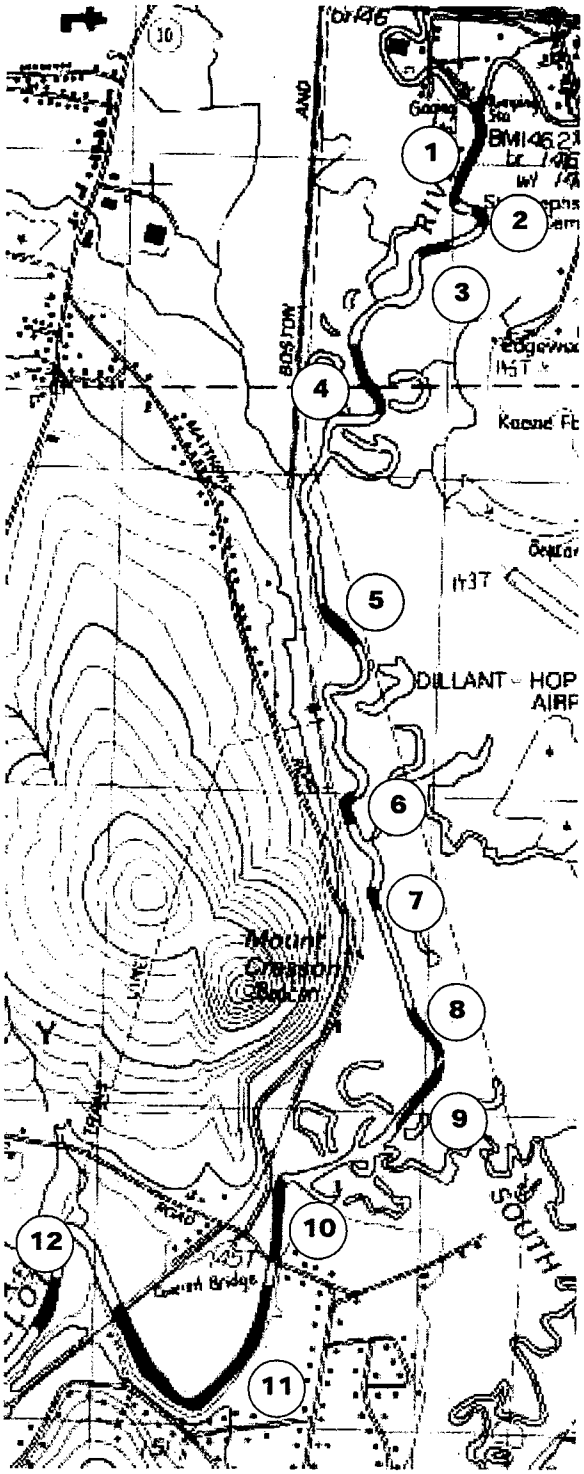


FIGURE 2. Sites 1-12

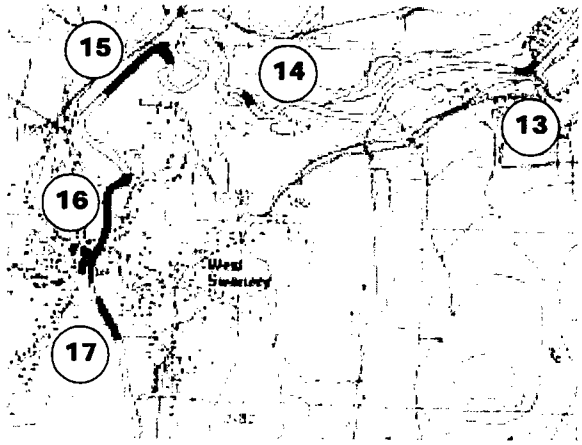


FIGURE 3. Sites 13-17

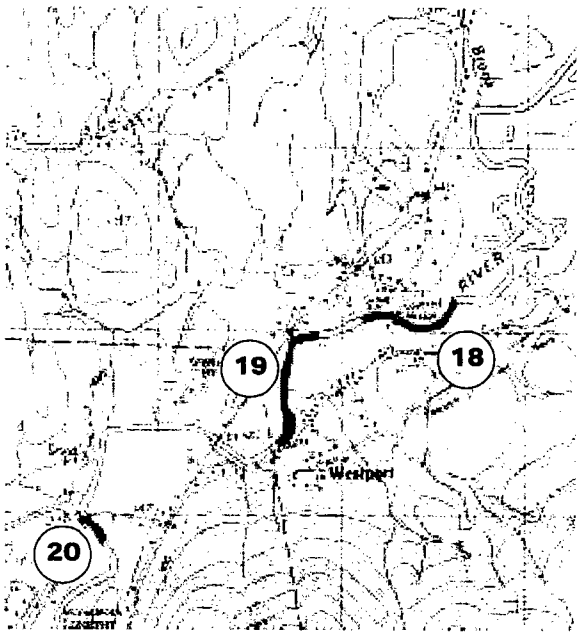


FIGURE 4. Sites 18-20

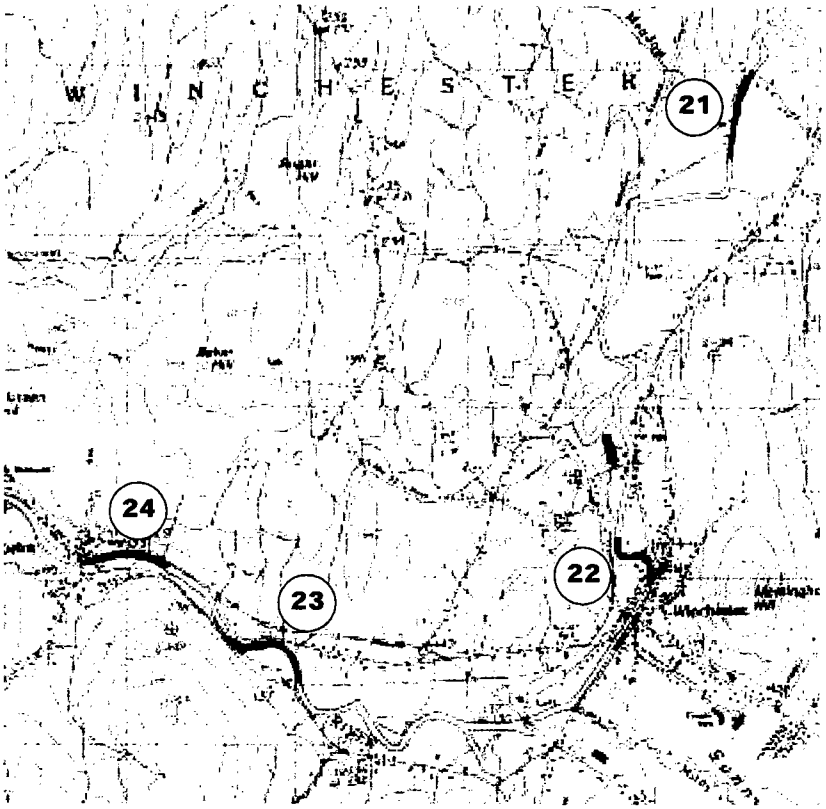


FIGURE 5. Sites 21-24

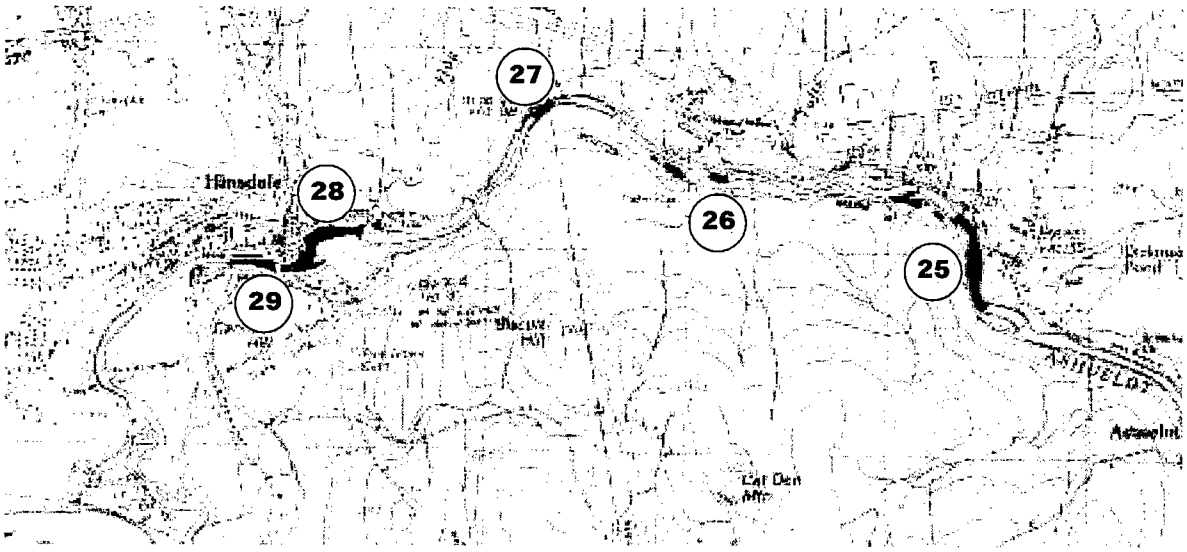


FIGURE 6. Sites 25-29

Looking upstream from Site 10. DWM were found in the right foreground and under the overhanging tree.

Results and Discussion

Throughout the text, species names are shortened to the following: Elliptio complanata = EC, Alasmidonta undulata = AU, Strophitus undulatus = SU, Pyganodon cataracta = PC, Lampsilis radiata = LR, Alasmidonta heterodon = DWM.

Summer 2001 Report: Sites 1-11

We found six species of freshwater mussels, including EC, PC, SU, AU, DWM, and LR. We found mussels at all 11 survey sites, though Sites 5-11 supported far more species. EC was the most common, followed by AU, SU, LR, PC, and DWM.

We found 13 DWM at six different survey sites, though Site 10 (5 individuals) and Site 11 (4 individuals) supported greatest densities. Four DWM were found upstream of the treatment plant, including one at Site 8 found among woody debris along the stream bank in sand/silt substrates—not typical habitat for DWM in New England's rivers. The discovery of DWM at Site 8 in poor habitat suggests that DWM may exist at low densities throughout the river. However, future surveys should target areas with stable banks and stable underwater substrates, since these areas seemed to consistently support DWM.

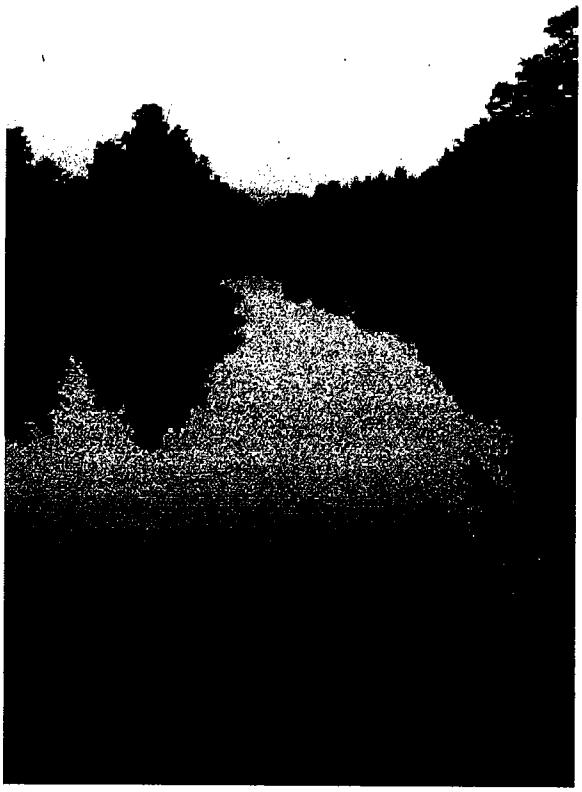
Bank erosion and sedimentation may be influencing habitat quality and mussel distribution. Stream banks throughout the study area were steep, undercut, and sparsely vegetated, with soils exposed to the river current. Flashfloods and spring runoff likely have resulted in substantial inputs of sand and silt to the river. Woody debris was common, largely from trees that fell in the river after their roots were undercut. The river was generally shallow with sandy substrates—these habitat conditions did not support high mussel density or diversity. There were some areas with cobble and boulders along the stream bank, and usually also had rocky underwater substrates—these areas often occurred on the outside of sharp bends in the river. We targeted these areas for mussel surveys because they seemed to support higher mussel densities and diversity.

The low density of mussels at Sites 1-4 is a potential concern for water resource managers. Habitat at these sites seemed better than habitat at most downstream sites, especially for species that prefer oxygenated and flowing water, such as AU, SU, and DWM. However, less than 50 animals were observed at Sites 1-4 after eight man-hours, and a total survey distance of 700 meters. In particular, Site 1 appeared to provide an ideal mix of habitat conditions yet less than ten animals were found over a distance of 400 meters. "The Branch" may be degrading water quality of the Ashuelot River—

there was some sort of fungal/bacterial flocculent material in the water and substrate, extending for ~200 yards downstream from the confluence. There was also a hydrocarbon film along the stream bank, and old tires outnumbered mussels almost 5 to 1. One adult EC was observed lying on its side out of the substrate and its valves were clamped shut, yet the animal appeared to be alive.

Results do not indicate that the wastewater treatment plant is affecting the mussel community. Mussels were equally abundant at Sites 8 and 9, and the two sites shared the same species except for one DWM and a handful of PC. All species found at Site 9 were present on the right side of the river less than 20 yards downstream of the outfall, meaning that these animals were living almost entirely within the effluent plume. Animals appeared healthy and there was no evidence of mortality. Site 10 is located 700 yards downstream from the outfall and it supported the highest richness and abundance of all survey sites.

It is unlikely that freshwater mussels will provide much insight into the effect of the wastewater treatment plant on river health. Mussels are long-lived and tolerant of many forms of environmental stress, and the effluent may have subtle, sublethal effects on mussels (growth, metabolism, or reproduction) that are difficult to detect with simple surveys. Other aquatic invertebrates might be better indicators of water quality impairment, since many are more sensitive to environmental stress than freshwater mussels.



Slow-moving, deep water at Site 16. One live DWM found in this area.

Fall 2001 Report: Sites 11-17, 19-21

We found five species of freshwater mussels during this survey, including EC, PC, SU, AU, and LR. These five species were found at all ten survey sites, except for Site 12 where we did not find LR. EC was the most common species, then AU, SU, LR, and PC.

Before our surveys on the Ashuelot River, we had thought DWM would be confined to riffles, and since this habitat type was so scarce in the Ashuelot River between Keene and Swanzey, we did not expect to find any DWM. Yet, we found that mussel densities and diversity were high near areas with steeply sloped, rocky stream banks, despite deep water and nearly imperceptible flow velocity. We found DWM in these "marginal" habitats, forcing us to reconsider the possibility that DWM existed downstream toward Winchester—if DWM could exist in habitats such as those near Sawyer Crossing Road (Sites 10 and 11), it was possible that >30% of the Ashuelot River between Swanzey and Winchester could support DWM.

Therefore, in this study we surveyed areas with stable substrates (cobble, gravel, boulders), regardless of water depth or flow conditions. Initially, surveys were confined to the area between Sawyer Crossing Road and the Swanzey Dam. There were no riffles in this reach, and the total elevation change over the four miles was less than ten feet. Based on results of the August survey near and upstream of Sawyers Crossing Road, we thought we could find DWM in "pockets" of suitable substrate throughout this reach. We did not.

After failing to find additional DWM locations between Sawyers Crossing Road and the Swanzey Dam, we reverted to our initial approach of surveying the best habitat possible. Riffle habitats were common between Swanzey and Winchester, and we spent much

time at three locations (Sites 17, 19, and 21). Habitat quality at these sites was nearly perfect for mussels, with an ideal combination of substrate, depth and flow conditions, and aquatic macrophytes. Mussels were abundant in these areas, and numbers of AU even rivaled EC at Site 20. Collectively, we spent 18 man-hours snorkeling and SCUBA diving at these sites, and though we found high densities of five species at each location, we did not find DWM.

Much remains to be understood about the distribution of DWM in the Ashuelot River. The only DWM refugia we knew about before 2001 were between Keene and the Surry Mountain Dam. Fish infected with glochidia from this population could perhaps travel downstream toward Swanzey or Winchester and help start new populations. If DWM are dispersing downstream with the help of their host fish, then perhaps this range expansion will continue in coming years. It is possible that Site 11 is as far downstream as DWM has gotten, yet it is more likely that Site 11 is the last location where DWM are dense enough to be detected in two or three hours of snorkeling. DWM probably exists further downstream, but at such low population densities that researchers will need to be persistent—and lucky—to find it.

Future Research?

- I have received a contract from the USFWS-New England Field Office to conduct a freshwater mussel survey near the Swanzey Dam and Winchester Dam. This will be conducted in June 2002.
- I would suggest that more surveys be conducted between Swanzey and Keene, including Keene itself, to pinpoint the distribution of DWM. Water quality is a concern in Keene, especially if snorkel surveys are to be conducted.
- Future surveys should include shell measurements and a quantitative component to provide better information about abundance and recruitment.
- Encouraging volunteers and school groups to become involved in mussel surveys could be an effective way of gathering important information.

Swanzey Dam at high water. SCUBA equipment on shore.

Spring 2002 Report: Sites 16 and 22

I. Swanzey Dam

The dam in Swanzey is an old wooden structure that is approximately five feet high. There are no fish passage facilities, although when we were standing at the dam on June 23, we watched four fish leap out of the foam onto the slanted wooden boards and attempt to ascend the boards in about one inch of water. Though none of these fish traversed the dam, it appeared that if there were more water coming over the dam, they might be able to ascend the slanted boards. We did not know what species of fish these were—the only fish of similar size that we saw while snorkeling were white suckers, but we doubt that these bottom-feeders would have the ambition or agility to traverse the dam. Therefore, the fish could have been salmon or shad (?).

We surveyed mussels above and below the dam in August 2001 (earlier contract) and June 2002 (recent contract) to check for DWM. The August 2001 surveys were conducted near the bridge, about 450 yards

downstream of the Swanzey Dam and below the covered bridge about 75 yards upstream of the dam. The survey was conducted below the dam and for a distance of 250 yards downstream, and above the dam for a distance of 75 yards. We surveyed about 600 yards of river bottom near the dam, for 16 man-hours.

Downstream of the dam, the substrate was a mix of sand, gravel, cobble, and boulders. Current velocity was moderate to fast, which kept coarse substrates clean and well oxygenated. Near the dam, the streambed was armored because the current was too strong to allow sediment to settle out, and therefore mussels were less abundant than they were farther downstream. Depth ranged from 5 feet under the dam to 1-3 feet in the riffles and runs further downstream. Mussels were common along the stream margins where there was more sand and fine gravel. Mussels were scarce at depths less than one foot, probably because such areas were exposed during summer low-flow periods. *Sparganium* sp. (an aquatic plant) was common in late summer.

Upstream of the dam, the river was deep (maximum = 8 feet) and slow moving. Substrate was mostly sand and silt toward the banks, and sand, cobble, and boulders in mid-channel. Visibility was poor in late summer 2001 due to algal growth and duckweed rafts on the water's surface, and was poor in June 2002 due to turbidity associated with runoff. Sean surveyed this area with SCUBA and had an underwater light so he could see well. The water was shallow near the dam, with many boulders and woody debris, including submerged remnants of the dam or perhaps an old fish weir. A thick algal mat covered much of the bottom, reducing habitat quality. The habitat conditions above the dam extended upstream for quite a long ways—in fact, the next upstream riffle habitat is over four miles upriver!

We found five species of freshwater mussels in this area. EC was the most common species, followed by LR, AU, SU, and PC. AU and AU were more common in the riffles downstream of the dam than they were upstream, whereas LR and PC were more prevalent upstream. EC was abundant everywhere. All five species were found on both sides of the dam. We found juveniles of all species, a good indication that these populations are successfully reproducing. Shell erosion was light, and there was not evidence of natural mortality.

Wooden remnants of the Winchester Dam at high water. This structure was removed in summer 2002.

One note of warning is that SU was common downstream of the dam and was reproducing well. Some juveniles of SU can look remarkably similar to AH, and if fisherman or others report finding DWM from this area, I would suggest verifying the specimens before getting too excited. This is not to suggest that DWM cannot be here—habitat certainly appears suitable, and the mussel populations appear quite healthy—but after nearly 16 man-hours of searching the stream bottom using snorkel and SCUBA gear and looking at literally thousands of mussels, we feel pretty confident that if it were here we would have found it. But we also recognize that it only takes one lucky person to prove us wrong...

Winchester Dam

The Winchester Dam is an old wooden structure that is almost entirely submerged at high flow, and exposed but porous at low flow. All that remains is portions of the log crib, which is breached on the left side of the river. Water flows through the breach unhindered, allowing migratory fish easy upstream

Sean SCUBA diving in the splash zone below the Swanzey Dam.

access. The dam seems to increase habitat diversity by creating some nice pools and eddies, increasing flow heterogeneity, and providing a structure that serves as a nursery or refuge for stream invertebrates and fish. However, its removal will surely restore a nice natural riffle that will become good mussel habitat.

Habitat downstream of the dam is a mix of riffles, runs, eddies, and pools. Substrate consists of gravel, cobble, and boulders in erosional areas and sand in depositional areas. Depth reaches four feet in some spots, but is generally shallower. Flow rate is moderate to fast. There is a large quantity of debris in the stream, particularly old logs, scrap metal, and broken glass. All of this provides ideal substrates for invertebrate colonization, but people should be extra cautious when surveying here to avoid cutting their hands and feet.

Upstream of the dam, the water is deep (6-10 feet), the current is slow, and substrate is sandy. There are some large boulders and woody debris along the left bank, below what was once a bridge (now removed), and thus there is some good habitat for stream-dwellers such as AU. However, in general, upstream habitat is more suitable for EC, LR, and PC. The dam itself may not be responsible for habitat differences above and below, because the river seems to enter a natural transition at this location to a narrower and shallower channel. The dam does not hold back much water.

We surveyed mussels for about 175 yards downstream of the dam, and for about 150 yards upstream of the dam, using both snorkel and SCUBA. We found four species of mussels, including EC, AU, LR, and SU. The latter was scarce throughout the reach, and the others were all common. There was a good size distribution of EC, AU, and LR. EC was locally abundant both downstream and upstream of the dam, particularly near the banks upstream of the dam in 2-4 feet of water and sandy substrates. We did not find any middens, and there were large numbers of shells on the bottom, indicating some mortality.

We do not think DWM exists in this reach. We have not seen it since North Swanzey, almost 14 miles upstream, despite many hours of SCUBA and snorkel surveys in excellent habitat. Recent improvements in water quality and habitat restoration may allow this species to recolonize the river from refugia above and below Keene.

Conclusions

Since finding four live DWM about 700 yards below the Sawyer Crossing Bridge in North Swanzey in August 2001, we have surveyed 11 downstream sites for a total of almost 50 man-hours in fair to excellent habitat, and have not found any more DWM. If this species occurs throughout this river segment, it is localized and sparse. My hypothesis is that the DWM that we found in North Swanzey represent individuals that hitched a ride on host fish from known populations north of Keene. If true, this population may continue to expand its range downriver in the future. Water quality improvements and habitat restoration may help facilitate this range expansion.

Removal of the Swanzey Dam and Winchester Dam may be an important step in returning the river to its original condition. The fish we saw trying to traverse the Swanzey Dam might be a clear indication that at least some fish will benefit from dam removal. Dam removal may cause some mussel mortality, but the species we found near these dams are common and abundant throughout the river, and the long-term benefits of habitat restoration will outweigh the loss of a few common individuals. All species we found appeared to be reproducing, and therefore we think recolonization will be fast.

Shallow riffle area at Site 24, just upstream of the covered bridge in the village of Ashuelot.

Summer 2003 Report: Sites 10, 15, 16, 18, 23-29

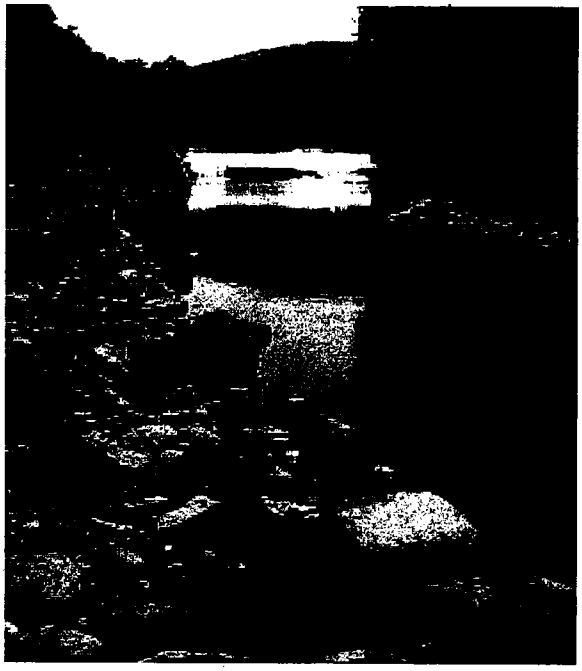
In July 2003, we surveyed seven new sites between Swanzey and Hinsdale, particularly in areas downstream of Winchester. We also resurveyed three sites upstream of the dam in Swanzey to check for recent recruitment of DWM at Site 10, observe habitat conditions, and record the presence and relative abundance of tesselated darters. We found one live DWM upstream of the Swanzey Dam in an area that we previously surveyed. We also resurveyed Site 15 but did not find DWM.

The river between Winchester and Hinsdale provides excellent habitat for freshwater mussels, including shallow fast water with gravel and cobble substrates, and low gradient areas that are slow moving and deep. The riffles seemed to consistently support a lower abundance of mussels than the deeper sections. The "best" areas in terms of overall mussel abundance were areas where the water was moving very slowly, depth ranged from 4-8 feet, and substrate was a mix of coarse sand and gravel in mid-channel, and sand and boulders toward the banks. Diversity was higher in such areas because PC and LR preferred these habitats and coexisted with EC, AU, and SU, whereas only EC, AU, and SU commonly inhabited riffles.

EC was found at every location except Site 27 where no mussels were found. Although AU is a Special Concern species throughout much of the Northeast, it too was found throughout the river at 27 of 29 locations, though we found less than five animals at six of the sites. SU was found at 26 of 29 locations overall, making it the third most widely distributed mussel in our study area. LR was noticeably absent in the last five downstream locations, but was otherwise common throughout the area between Swanzey and Winchester. PC was only found at 16 of 29 sites, and we often only found a handful of live animals. This may be partially because of sampling bias, since we did not spend as much time in areas where PC is likely most abundant—in semi-lentic conditions near banks.

Mussel populations between Ashuelot and Hinsdale are less diverse and abundant than we might expect, indicating a potential habitat or water quality problem. Site 25 supported four species, but less than five AU, SU, and PC, whereas Site 24, only a few hundred yards upstream, had a much more abundant mussel community. Very few mussels were found at Site 26 despite good habitat, and no mussels were found at Site 27 (though habitat was not good). Site 28 had three species, but mussels were scarce in riffles. Only EC was found below the Hinsdale Dam.

Despite excellent habitat and sizeable populations of tesselated darters, DWM have yet to be found downstream of the Swanzey Dam. Darters were common at several sites above and below Winchester, including Sites 18, 23, 24, and 25. In previous years, we were not careful about observing and recording darters, though we seem to remember seeing them almost everywhere. Since both habitat and host fish are present downstream of Swanzey, the absence of DWM may be due to historical water quality problems



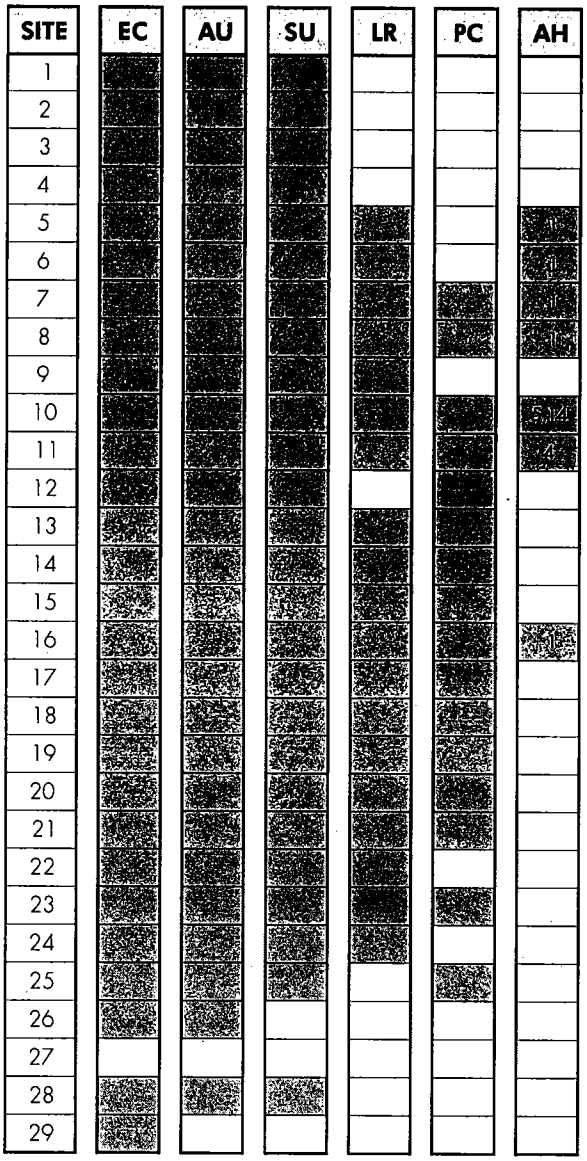
Looking upstream toward the Hinsdale Dam.

or other types of disturbance. The DWM population may have been extirpated in earlier decades because of pollution. It is possible (but hard to prove) that DWM are recolonizing the lower river from upstream refugia upstream of Keene.

The discovery of a live DWM above the Swanzey Dam was surprising, and provided some food for thought about our efforts—populations may exist at such low densities that they are hard to detect with a few hours worth of diving and snorkeling. We had already surveyed above the dam, and we spent over 2.5 hours scuba diving (5 hrs total) on the third visit and found one live DWM, a large (>40mm) male.

We also resurveyed Site 10, which was the best DWM site we had found to date. Four DWM were found in 2001, and this time we found 14 animals, including several small animals (15-25mm) that would have been too small to detect two years ago. This indicates that this population is reproducing, not just "hanging on". Quantitative surveys in this area, and perhaps Site 11, would help to confirm the status of these populations. In future years, DWM at these locations may be the source of new colonizers for areas downstream of Swanzey.

FIGURE 7. Mussel distribution in the Ashuelot River between Keene and Hinsdale. See Figures 1-6 for locations. Red indicates presence. Numbers of *Alasmidonta heterodon* are included; the two numbers for Site 10 indicate two different surveys.



Suggestions for Future Research:

- Resurvey sites 5-8 and 10-12 for DWM. Use either stratified random or adaptive sampling techniques to get abundance estimates, and record lengths to document size-class distribution.
- Resurvey Site 16 using adaptive sampling.
- Research the potential for relocation of DWM into favorable habitats downstream of Swanzey.

Appendix 1
MUSSEL SURVEY DATA FORMS

SEE COMPACT DISC FOR PHOTOGRAPHS

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/11/01
Water Body: Ashuelot River	Site: 1	# Times Surveyed: 1
Town: Keene	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 55.05	Long: 72 16.75
Photos? Yes	Map? Yes	Sketch? No

Directions: Canoed downstream from Route 12 bridge approximately 0.5 miles to upstream end of survey site. The survey was conducted from the confluence of The Branch downstream to a sharp bend in the river, a distance of approximately 400 yards. There is no road access to this site and the best way to reach it is by canoe.

Habitat: There seemed to be a large quantity of very good mussel habitat at this site. The average stream depth was about 1.5 feet, and ranged from 0.5 to 4 feet. The flow was about 0.25-0.35 meters per second, creating favorable riffle conditions. The substrate was a mix of gravel, cobble, and sand, though the stream margins were largely sand and some silt. Sparganium sp. was common in some locations, though the dense forest canopy shaded the stream in places and inhibited macrophyte growth. Tires and other trash littered the stream bottom and streambanks, and there was some orange-colored flocculent evident in pools and also coming out of The Branch. There was also a skim of hydrocarbons in some pools. Water quality is a high concern here.

Survey Type: Snorkel, Bucket	Duration: 1.5 hours	Area Covered: 400 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	7L, 2S	1L					1L				

Mortality, Shell Erosion, Reproduction: We found only 9 live mussels after 1.5 hours and 400 meters of stream bottom. This is remarkably low density, especially considering the apparent quality of the habitat at this site. This is also true for nice-looking riffles further downstream (Sites 2, 3, 4). The mussels look fine - shell erosion is light and they appear healthy except that there are no younger size classes indicating poor recruitment success. Not only were densities of live animals very low, but we also found only two shells of Elliptio, so if there was an event that caused them to die-off, it was a long time ago and the shells have since been buried by sedimentation. There were no shell middens at this site.

Additional Comments: Though we did not conduct any formal surveys further upstream, as we canoed back upriver we did notice a larger number of live animals in the quiet meanders just downstream from the Route 12 bridge - certainly more than what we saw at Site 1. We believe that water quality is the major reason for the virtual absence of mussels at Site 1, and The Branch may be the primary culprit. The Branch smelled very foul and there was a lot of fungi/bacteria/metals present in the water. We found one adult Elliptio that was out of the substrate and lying on its side with its valves clamped shut, but appeared to be alive. It didn't look happy.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/9/01
Water Body: Ashuelot River	Site: 2	# Times Surveyed: 1
Town: Keene	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 54.95	Long: 72 16.72
Photos? Yes	Map? Yes	Sketch? No

Directions: Canoed upstream approximately 2.6 miles upstream from covered bridge on Sawyer Crossing Road.The survey was conducted near a sharp bend in the river with a steep gravel bank on the inside of the bend. This site is located approximately 100 yards downstream from Site 1, and approximately 200 yards upstream from Site 3. There is no road access to this site, though St. Josephs Cemetary is located a short distance to the east, though you cannot see it from the river.

Habitat: This site seemed to offer fair mussel habitat. Depth ranged from 0.5 to 6 feet (on the outside of the bend), and the substrate was comprised of sand, gravel, and cobble. There was a lot of woody debris from overhanging & fallen trees, and the streambanks were steep, undercut, eroded, and poorly vegetated. Substrate seemed stable in mid-channel yet was very unstable toward the banks, where the steep & loose sediment indicated that most flood events cause more of the streambank to slough into the river. There were some scattered beds of Sparganium, especially toward the upper end of the survey area. Streamflow ranged from approximately 0.25-0.35 m/s at upstream end to 0.05-0.15 m/s at the lower end. Visibility fair.

Survey Type: Snorkel	Duration: 0.5 hours	Area Covered: 75 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	5L	1L					4L				

Mortality, Shell Erosion, Reproduction: We found less than 10 mussels after 30 minutes of snorkeling along 75 meters of stream bottom. The Strophitus were found in the deeper water toward the lower end of the survey area and the Elliptio were scattered. There was no evidence of mortality (dead shells, middens), but also no evidence of recruitment (all mussels were large). Mussel densities were extremely low, especially considering the apparent quality of habitat. The ones we did find appeared healthy - shell erosion was light and there were no visible problems. Lack of mussels at this site could be attributed to sedimentation problems or water quality; the latter is more likely especially considering the conditions we observed at Site 1, only a short distance upstream.

Additional Comments: There is a very large & unvegetated sand bank on the outside of the sharp bend in thE river about 50-75 yards upstream from this site. Streambank erosion is severe, especially during flood events, and it is likely that the enormous quantities of sand washed into the river is impairing the mussel community.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/9/01
Water Body: Ashuelot River	Site: 3	# Times Surveyed: 1
Town: Keene	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 54.90	Long: 72 16.83
Photos? Yes	Map? Yes	Sketch? No

Directions: Canoed upstream approximately 2.5 miles upstream from covered bridge on Sawyer Crossing Road. The survey was conducted about 100 meters upstream from a bend in the river that is riprapped with large boulders. We surveyed approximately 100 yards. This site is located approximately 200 yards downstream from Site 2, and approximately 500 yards upstream from Site 4. There is no road access to this site, though the bike path is visible on the left bank.

Habitat: Mussel habitat good at this site. Depth ranged from 0.5 to 3 feet, flow rates were moderate ranging from 0.10 to 0.4 m/s, providing nice riffle habitats. The substrate was a mix of gravel and sand though the banks were largely sand and silt. There was quite a lot of woody debris and tires in the stream and along the streambanks, and macrophytes were common throughout. Streambanks were steep and undercut along the left bank and less steep but also eroded along the right bank. Overhead canopy was thick toward the upper end of the survey site but more open below.

Survey Type: Snorkel	Duration: 0.5 hours	Area Covered: 100 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	7L	1L					3L				

Mortality, Shell Erosion, Reproduction: This area offers seemingly ideal habitat for some species of mussels - especially Alasmidonta undulata and Strophitus undulatus, yet there was an extremely low density of mussels at this site, and this phenomena was also observed at Sites 1, 2, and 4. It is uncanny how few mussels were present at this site. The mussels we found appeared healthy, with light shell erosion. Yet we did not observe juveniles, indicating low recruitment success. There was no evidence of mortality, including middens or shells.

Additional Comments: Sean Werle collected a live burbot (Lota lota) at this site. Ethan Nedeau found a wood turtle a short distance downstream on July 5th 2001.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/9/01
Water Body: Ashuelot River	Site: 4	# Times Surveyed: 1
Town: Keene/Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 54.71	Long: 72 17.01
Photos? Yes	Map? Yes	Sketch? No

Directions: Canoed upstream approximately 2.1 miles upstream from covered bridge on Sawyer Crossing Road. We surveyed approximately 150 yards of river starting from a bend in the river and working upstream. The upstream end of this site is located approximately 500 yards downstream from Site 3, and the downstream end is approximately 1000 yards upstream from Site 5. The Swanzey-Keene town line passes through this survey site. There is no road access.

Habitat: This site provides excellent riffle habitat for freshwater musels. Depth ranges from 0.5 to 2 feet, gravel and cobble is the primary substrate along with sand in quieter water, and the flow rate ranges from 0.10 to 1.0 m/s, providing for excellent flow and substrate conditions. There is some large woody debris embedded in the sediment and along the streambanks, providing some stability, along with scattered patches of Sparganium. The banks are somewhat steep & eroded on the left bank and more sloping on the right bank, and the canopy is dense and thus little sunlight reaches the stream. Stream width is 5-15 m. There is some deeper water at the downstream end of this reach.

Survey Type: Snorkel, Bucket	Duration: 1 hour	Area Covered: 150 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	10L	4L					4L				

Mortality, Shell Erosion, Reproduction: As we saw in Sites 1,2, and 3, there were far fewer mussels than we would predict given the quantity and apparent quality of the habitat. There were some younger mussels here, indicating some recent recruitment, and no evidence of mortality (middens or shells).

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/9/01
Water Body: Ashuelot River	Site: 5	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 54.27	Long: 72 17.07
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Canoed upstream approximately 1.6 miles upstream from covered bridge on Sawyer Crossing Road. We surveyed approximately 250 yards of river starting from a just upstream of where the powerlines border the river upstream to the bend. The survey focused on the upstream end of the site where habitat conditions were more favorable and more mussels were found. The upstream end of this site is located approximately 1000 yards downstream from Site 4, and the downstream end is approximately 900 yards upstream from Site 6. There is no road access.

Habitat: We did not expect this site to support good populations of mussels. This reach was very slow-moving (flow rate less than 0.05 m/s) and deep (2-8 feet), and the substrate was a mix of large boulders, especially toward the upstream end of the site, and sand. There were some macrophytes and quite a lot of filamentous algae. The lower end of the site was 2-5 feet deep and almost entirely sand, with silty margins and lots of garbage and woody debris along the streambanks. Banks were steep and eroded. The upstream end had more stable rocky banks and was quite a bit deeper and had a more favorable substrate of boulders, cobble, gravel, and sand. Canopy was fairly dense, and the river was well shaded.

Survey Type: Snorkel	Duration: 1.25 hour	Area Covered: 250 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	>30L	1L				>15L			>15L	

Mortality, Shell Erosion, Reproduction: This site supported a diverse & abundant community of mussels. Many juvenile mussels were observed, especially for Elliptio complanata, indicating consistent & excellent recruitment. Alasmidonta undulata was common, and Lampsilis radiata appeared for the first time. Mussels appeared quitre healthy - shell erosion was light and there was no evidence of mortality (shells or middens).

Additional Comments: Habitat at this site did not appear nearly as good as it did at Sites 1,2,3, and 4, yet we found far more mussels here than at all of the upstream sites combined. Either we approached this survey with an incorrect understanding of the habitat requirements of these mussels, or for whatever reason (pollution, sedimentation), mussels are unable to persist in the good habitats that exist upstream. Unfortunately there are no more good riffle habitats between here and Sawyer Crossing Road, and so we cannot test whether habitat availability or pollution/water quality is responsible for absence of mussels upstream.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/9/01
Water Body: Ashuelot River	Site: 6	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 53.95	Long: 72 17.03
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Canoed upstream approximately 1.1 miles upstream from covered bridge on Sawyer Crossing Road. This site is located 1000 yards upstream from the wastewater treatment plant effluent pipe. It is located 350 yards upstream from Site 6 and 900 yards downstream from Site 5. There is no road access. We surveyed for about 150 m around a bend in the river.

Habitat: Habitat appeared quite good at the lower part of the survey area but became more sandy & unfavorable toward the upper end. At the lower end the river was approximately 10-15 yards wide and 1-4 feet deep with a substrate comprised of large boulders, gravel, and sand. Flow rate was fairly quick, ranging from 0.2 to 0.4 m/s at the lower end but becoming more sluggish at the upper end. Substrate at the upper end was predominantly sand, and there was a lot of woody debris from overhanging and fallen trees. This reach did not provide true riffle habitats that we saw at Sites 1-4, but the streambed seemed more stable and there was enough flow to keep fine sediment in suspension. Riparian canopy was heavy, and the streambanks were stabilized by rocks.

Survey Type: Snorkel	Duration: 1 hour	Area Covered: 150 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	>30L	1L				>15L			>15L	

Mortality, Shell Erosion, Reproduction: The mussel community at this site was very healthy; Elliptio complanata and Alasmidonta undulata were both common here and there were a lot of juveniles indicating recent recruitment. Strophitus undulatus and Lampsilis radiata were also fairly common, and we found 1 live Alasmidonta heterodon. There were very few shells on the streambed and no shell middens, and this community appears to be thriving with few serious threats. Mussels were more common here than at Site 5, though both sites support very good mussel communities.

Additional Comments: This site provides what we would consider to be the "best" mussel habitat of sites 5-11, though it doesn't rival the apparent habitat quality of sites 1-4. It seems that mussels are most common in these types of reaches where there are boulders on the streambank and in the stream, providing a good indication of stable substrates. These types of reaches with a boulder-dominated streambank and stream bottom are not very common along the river, and seem to occur only where the stream takes a sharp turn. This observation may help streamline future survey efforts, since the sharp meanders are easily identified on the map.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau	Affiliation: Biodrawversity	Date: 8/8/01
Water Body: Ashuelot River	Site: 7	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 53.79	Long: 72 16.97
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Canoed upstream approximately 0.9 miles upstream from covered bridge on Sawyer Crossing Road. This site is located about 600 yards upstream from the wastewater treatment plant effluent pipe. It is located 350 yards downstream from Site 6. There is no direct road access, though Matthews Road runs close to the river on the left bank. I surveyed for about 50 yards around a bend in the river.

Habitat: There was a limited amount of good habitat at this site; the upstream and downstream ends of this reach were shallow & sandy, and the inside of the bend was also sandy. The good habitat was confined to a 40 yard area around the outer margin of the bend (see sketch) where large boulders anchored the substrate and provided some stability. Depth here ranged from 1-6 feet and the substrate (in the good area) was a mix of sand, gravel, and boulders. Streamflow was slow (<0.10 m/s). Riparian canopy is minimal and thus this area receives a lot of sunlight. Streambanks on the left bank were rocky and stable, but on the right bank were steep and eroded.

Survey Type: Snorkel, Bucket	Duration: 1 hour	Area Covered: 50 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>50L	>10L	1L		2L		>10L			>10L	

Mortality, Shell Erosion, Reproduction: This site supported a diverse mussel community of six species, including 1 mature Alasmidonta heterodon which appeared to be in good health. There were numerous juvenile mussels, especially of Elliptio complanata but also Alasmidonta undulata, indicating recent recruitment. There was no evidence of mortality, except for a small number of old dead shells on the stream bottom. Shell erosion was light.

Additional Comments: This site is the last "stronghold" for mussels above the wastewater treatment plant outlet; the next site with favorable habitat is Site 10, about 1350 yards downstream. Although all six species were found in the river between here and Site 10, habitat is very poor and the mussels are in low density and generally confined to the stable stream margins.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau	Affiliation: Biodrawversity	Date: 8/8/01
Water Body: Ashuelot River	Site: 8	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 53.79	Long: 72 16.97
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Canoed upstream to the wastewater treatment plant outlet which is located approximately 1000 yards upstream from the covered bridge on Sawyer Crossing Road. I surveyed for a long time above and below the effluent to determine if the effluent was affecting the mussel community. Site 8 represents the areas surveyed from 10 to 200 yards upstream of the effluent. Bucket surveys were conducted along the left bank for approximately 100 yards and snorkel surveys were conducted along a 75 yard section mostly in mid-channel. I also surveyed the right bank from the canoe. See sketch for details.

Habitat: Habitat conditions at Site 8 were very poor. The stream is approximately 20-25 yards wide and quite shallow (< 3 feet) though there are some deeper spots along the banks. The flow is very slow (<0.10 m/s) and homogenous, and the substrate is almost entirely sand with silt and clay on the margins and lots of woody debris from fallen and overhanging trees. There are virtually no areas with stable substrate throughout this reach. There is very little riparian canopy toward the upper end of the survey area and the stream gets almost full sunlight, though the downstream part of this reach is shaded in the afternoon. There are some patches of aquatic macrophytes (mostly Sparganium) Streambanks are steep and eroded in places.

Survey Type: Snorkel, Bucket	Duration: 2 hours	Area Covered: 200 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>30L	>10L	1L		>10L		>10L			>10L	

Mortality, Shell Erosion, Reproduction: Mussel densities were quite low throughout this reach, which is what we would expect for these types of habitats. Yet all six species were found here, including 1 Alasmidonta heterodon that was found along the streambank in sand among woody debris, in virtually no flow. Mussels were concentrated along the stream margins among the woody debris and roots, which presumably provide more stability. Mussels were found in very low densities in the middle of the river. There was no evidence of mortality, and the mussels exhibited very light shell erosion. There were some juveniles, especially of Elliptio complanata, but not enough of the other species to draw conclusions about recruitment success.

Additional Comments: Site 8 is located immediately upstream of the wastewater effluent, and it is very unfortunate that habitat quality is so poor because the density of mussels at this site is too low to detect significant changes in the mussel community downstream of the effluent. The fact that all six species are found at this site DESPITE the poor habitat suggests that water quality is not too bad, and certainly there ar as many mussels at this site than Sites 1-4 combined. Nevertheless, habitat-related issues and low mussel densities will probably preclude the utility of mussels for assessing the effects of the wastewater effluent.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau	Affiliation: Biodrawversity	Date: 8/8/01
Water Body: Ashuelot River	Site: 9	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 53.48	Long: 72 16.83
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Canoed upstream to the wastewater treatment plant outlet which is located approximately 1000 yards upstream from the covered bridge on Sawyer Crossing Road. I surveyed for a long time above and below the effluent to determine if the effluent was affecting the mussel community. Site 9 represents the areas surveyed from the effluent to about 200 yards downstream of the effluent, particularly along the right bank (which is the side where the pipe is located). I conducted bucket surveys along the right bank near the effluent, and used a DNet to collect mussels immediately below the effluent (because of water quality concerns), and snorkeled for a ways about 125 yards downstream. The coordinates provided above represent the exact location of the wastewater outfall.

Habitat: Habitat conditions at Site 9 were very poor, similar to conditions at Site 8. Substrate was almost entirely sand and silt, flow was generally less than 0.1 m/s, and depth ranged from 0.5 feet on the left bank to 4-5 feet along the right bank. The right streambanks were very steep and eroded and there was a very large amount of woody debris in the stream from overhanging & fallen trees. There was a very strong sulfur smell bubbling out of the sediment along the right bank, indicating anaerobic decomposition in the sediments. There was also a fairly strong "sewer smell" down stream of the effluent. Aquatic macrophytes & filamentous algae were common downstream of the effluent, perhaps due to nutrient enrichment but also because riparian canopy was sparse and the stream received much sunlight.

Survey Type: Snorkel, Bucket, DNet	Duration: 2 hours	Area Covered: 200 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>30L	>10L					>10L			>10L	

Mortality, Shell Erosion, Reproduction: Despite the fact that this reach was downstream and within the plume of the wastewater effluent, mussel densities and diversity were similar to Site 8. In fact, I found four species only 20-30 yards downstream from the effluent on the same side of the river, which means that these animals were living almost entirely within the wastewater. These mussels appeared healthy with light shell erosion and no signs of mortality. The same four species were also found further downstream, albeit at low densities, particularly Alasmidonta undulata which was frequently collected in extremely shallow water by following its trails. I collected several juveniles of each species, so not only were mussels existing in the wastewater but also reproducing. I didn't find any Alasmidonta heterodon, though I found 4 at Site 10 only 700 yards downstream.

Additional Comments: It appears as though the wastewater effluent is not affecting freshwater mussels. More detailed quantitative surveys might yield more insight, but I doubt that the mussel community will prove to be a reliable indicator of water quality impairment. The benthic macroinvertebrate community (insects, crustaceans, molluscs) may be better suited for this purpose. I noticed the artificial substrates that were deployed by the NHDES; I would suggest that they use more than 1 upstream control and conduct their studies during times of the year when the benthic invertebrate community is most diverse (late autumn or early spring).

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/11/01
Water Body: Ashuelot River	Site: 10	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 53.26	Long: 72 17.18
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Parked at the rest area/picnic area on Sawyer Crossing Road just upstream from the covered bridge. We surveyed from the covered bridge to the bend in the river, approximately 300 yards upstream. The lower 200 yards of the survey area was surveyed by SCUBA by 1 person, and the upper 100 yards was surveyed with SCUBA and snorkel with two people. Surveys were focused on the left side of the river where the substrate was more favorable. The upstream end of this survey site is approximately 700 yards downstream from the wastewater effluent.

Habitat: Habitat conditions at this site were similar to what we saw at Sites 5, 6 , 7, and11, with fairly deep water, slow flow rate, and a substrate of boulders and sand. Depth at this site reached 11 feet, but was generally 2-6 feet. Flow rate was very slow (<0.10 m/s) and uniform throughout. The substrate was mostly sand and silt on the right side of the river and in the first 150-200 yards upstream from the bridge, but became very rocky toward the upper part of the survey area, especially on the left bank. Woody debris was common throughout from overhanging or fallen trees. Streambanks were steep on the left bank but stabilized by roots & rocks, and were less steep but also less stable on the right bank.

Survey Type: Snorkel, SCUBA	Duration: 2 hours	Area Covered: 300 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	>50L	5L		>15L		>30L			>30L	

Mortality, Shell Erosion, Reproduction: This was a very healthy mussel community. All six species were present in fairly high numbers, including 5 Alasmidonta heterodon. Juveniles were also abundant, especially for Elliptio complanata and Alasmidonta undulata, though we saw some juveniles of all six species. No significant mortality was observed here - a few dead shells but nothing worrisome and no shell middens. Shell erosion very light. Overall these mussels appeared to be living the good life.

Additional Comments: This site and Site 11 are the best two sites surveyed in terms of diversity and numbers of mussels. These types of habitats - slow moving, deep, large boulders - seem to be the best habitat for these animals. We are only about 700 yards downstream from the wastewater effluent at this point, and there seems to be no lasting negative consequences on the mussels. I also quickly surveyed the area between Site 9 and Site 10 by canoe and found quite a few mussels there, including many Alasmidonta undulata in the shallow sandy habitats. It seems that theeffluent has no effect on mussels.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 7/15/03
Water Body: Ashuelot River	Site: 10	# Times Surveyed: 2
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 53.26	Long: 72 17.18
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Parked at the rest area/picnic area on Sawyer Crossing Road just upstream from the covered bridge. We surveyed the bend in the river, approximately 300 yards upstream of the bridge. We each used SCUBA. Surveys were focused on the left side of the river where the substrate was more favorable.

Habitat: Habitat conditions at this site were similar to what we saw at Sites 5, 6 , 7, and11, with fairly deep water, slow flow rate, and a substrate of boulders and sand. Depth at this site reached 11 feet, but was generally 2-6 feet. Flow rate was very slow (<0.10 m/s) and uniform throughout. Substrate was rocky toward the upper part of the survey area, especially on the left bank. The deepest part of the channel had gravel and cobble substrates with a fine layer of silt covering everything. The right half of the channel was mostly sand. Mussels were concentrated in the left half of the channel. Woody debris was common throughout from overhanging or fallen trees. Streambanks were steep on the left bank but stabilized by roots & rocks, and were less steep but also less stable on the right bank.

Survey Type: SCUBA	Duration: 1.75 hours	Area Covered: 100 meters

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	>50L	14L		>10L		>30L			>30L	

Mortality, Shell Erosion, Reproduction: This was a very healthy mussel community. All six species were present in fairly high numbers, including 14 DWM. Juveniles were also abundant, especially for Elliptio complanata and Alasmidonta undulata, though we saw some juveniles of all six species. No significant mortality was observed here - a few dead shells but nothing worrisome and no shell middens. Shell erosion very light. Overall these mussels appeared to be living the good life.

Additional Comments: This is the second time we have surveyed this location -- the last time being August 2001 (nearly two years ago) when we found similar conditions and 5 live DWM. We found 14 this time, and it was promising to find some young DWM that would have been too small to detect two years ago. This indicates that DWM is definitely reproducing and growing at this site. Darters were abundant throughout this reach, including some large adults in deeper water among the rocks (probably males guarding nests).

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/9/01
Water Body: Ashuelot River	Site: 11	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 52.98	Long: 72 17.47
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Parked at the rest area/picnic area on Sawyer Crossing Road just upstream from the covered bridge and canoed downstream for 700 yards around the sharp bend in the river. This site is also about 250 yards upstream of the railroad bridge. The survey was primarily along the right side of the river where boulders were present along the streambank and in the stream. We covered a distance of about 75 yards.

Habitat: Habitat conditions at this site were similar to what we saw at Sites 5, 6 , 7, and10, with fairly deep water, slow flow rate, and a substrate of boulders and sand. Depth at this site reached 8-10 feet, but was generally 2-6 feet. Flow rate was very slow (<0.10 m/s) and uniform throughout. The substrate was mostly sand and silt on the left side of the river but was rocky toward the right bank. In fact, there was a very distinct line separating the two "sides" of the river, along which Alasmidonta spp. seemed to be concentrated (see sketch). Streambanks were very steep & rocky on the right bank, and the left bank had a more gentle slope and abundant aquatic macrophytes along the edge. Woody debris was common on the right due to overhanging and fallen trees.

Survey Type: Snorkel	Duration: 45 minutes	Area Covered: 75 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	>50L	4L				>15L			>15L	

Mortality, Shell Erosion, Reproduction: This was a very healthy mussel community, similar to what we observed at Site 10. We did not find Pyganodon cataracta here but it probably is present in the sandy/silty habitats along the left bank. There was a remarkable number of juveniles (<2 yr) mussels at this site for both Alasmidonta undulata and Elliptio complanata, though I found juveniles of all species. Two of the Alasmidonta heterodon were smaller, so it seems that even they are reproducing. Shell erosion was light, and there was no evidence of mortality except for a handful of old shells.

Additional Comments: This site and Site 10 are the best two sites surveyed in terms of diversity and numbers of mussels. These types of habitats - slow moving, deep, large boulders - seem to be the best habitat for these animals. We are about 1500 yards downstream from the wastewater effluent at this point, and there seems to be no lasting negative consequences on the mussels. We came this far down to look for more of the boulder-dominated habitat, but there was also fair habitat conditions closer to the bridge where each of these species likely exist.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 9/16/01
Water Body: Ashuelot River	Site: 11	# Times Surveyed: 2 (this 2nd time)
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 52.98	Long: 72 17.47
Photos? Yes	Map? Yes	Sketch? No

Directions: Parked at the rest area/picnic area on Sawyer Crossing Road just upstream from the covered bridge and canoed downstream. We began surveying about 200 yards downstream of the covered bridge along the right bank and snorkeled all the way to the old rr bridge located about 250 yards downstream of the first survey at this site; thus Site 11 now includes a total distance of about 0.5 miles, almost entirely on along the right bank of the river. The initial survey on August 9th covered a distance of 75 yards.

Habitat: Habitat at this site was generally poor though there were some patches of suitable habitat along the right bank. There was a narrow strip of gravel and cobble substrate along the right bank in the upstream part of the survey area which supported a fair number of mussels, but there was a far greater expanse of sandy conditions here. Some mussels existed in the sand & silt, including many juvenile Elliptio & A. undulata, but in general mussels were sparse. The best conditions were located in the area of the first survey at this site, and also downstream to the old rr bridge along the right bank where gravel & boulders was the predominant substrate. Flow conditions throughout were very slow, and depths ranged from 1-10 feet. The left bank was gradually sloping and had a well established littoral plant community, whereas the right bank was steeper and generally rocky.

Survey Type: Snorkel, SCUBA	Duration: 2.5 hours	Area Covered: 800 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>50L	15-30L			5-10L		15-30L			5-10L	

Mortality, Shell Erosion, Reproduction: Shell erosion light, good size classes of Elliptio, and A. undulata. Seemingly healthy mussel population - numbers probably greater than we would expect given habitat conditions. This second visit to this site probably didn't provide much more insight into this site's ability to support A. heterodon, especially since we didn't find any this time! Last time we found 4 live A. heterodon. There are a couple reasons why we think we didn't find A. heterdon this time.....(see additional comments)

Additional Comments: The water was much colder this time than it was in early August. We both used drysuits and were still quite cold - especially fingers and faces. This made it difficult to survey effectively. Also, the drysuits are extremely buoyant, making it difficult to dive down and look closely at the river bottom. Some mussels may have responded to the sharp drop in temperature by burrowing into the sediment, or at least partially so, which would make it more difficult to see them. We think this experience provides an important lesson about the importance of water temperature in conducting a thorough survey. We also think the element of chance & luck is an important component of mussel surveys, since we KNOW A. heterodon exists here yet but still couldn't find it today.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/24/01
Water Body: Ashuelot River	Site: 12	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 53.05	Long: 72 17.73
Photos? Yes	Map? Yes	Sketch? No

Directions: A non-descript location - we stopped here because there seemed to be a strip of good habitat along the right bank. This site is located about 700 yards downstream of the old rr bridge (and the downstream end of Site 11), and about 500 yards upstream of Site 13. We canoed to this site.

Habitat: Habitat conditions in this location were generally shallow & sandy, especially toward the left bank, but there was a narrow strip of gravel substrate extending outward from the right bank for about 5 yards, for a distance of 50 yards. Flow rates were extremely slow, and depth ranged from 1-5 feet. Woody debris fairly common on left bank but less so on right bank; dominant trees on right were hemlock.

Survey Type: Snorkel, SCUBA	Duration: 45 minutes	Area Covered: 75 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	>50L			5-10L		>15L				

Mortality, Shell Erosion, Reproduction: Mussels fairly common in the gravel & cobble substrates but sparse elsewhere at this site. Good size classes of EC, AU, and SU. Even though habitat limited, we expected to find A. heterodon here because it was found less than o.5 miles upstream. Also we did not find any L. radiata. No evidence of mortality - no shell middens, few shells.

Additional Comments: Not a great survey site but we surveyed anyway because we had found A. heterodon at Sites 10 and 11 and thought that it could be found in similar habitats all the way to WInchester. This was a rude awakening to the fact that we would not be able to find A. heterodon EVERYWHERE!!

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/24/01
Water Body: Ashuelot River	Site: 13	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 52.86	Long: 72 17.96
Photos? Yes	Map? Yes	Sketch? No

Directions: This site is located just upstream of the powerline crossing, approximately 500 yards downstream of Site 12 and one mile upstream of Site 14. The survey was confined to the outside of the bend in the river, on the right bank. We covered a distance of about 100 yards. We canoed to this site.

Habitat: Habitat at this site was similar to upstream sites where we had found A. heterodon - it was fairly deep, with little or no flow, and the substrate was largely boulders and cobble with sand in between. There was also some clay along the banks. Depth up to 12 feet, lots of BIG boulders which made snorkeling interesting. Riparian canopy fairly heavy on the right bank, consisting mainly of hemlock. Left bank a more gradual slope, sandy & silty, with a more open canopy.

Survey Type: Snorkel, SCUBA	Duration: 2 hours	Area Covered: 100 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>200L	50-100L			5-10L		25-50L			2L	

Mortality, Shell Erosion, Reproduction: The mussel community here appeared to be very healthy & stable. Many size classes represented, indicating strong & consistent recruitment. Mussels quite dense in places, especially among the stable substrates on the right bank. Fewer mussels in sand along left bank. This site is very similar to Sites 10 and 11 from the first survey, and thus we really expected to find A. heterodon here. Not much mortality observed here - no shell middens, and only a few scattered shells on the bottom.

Additional Comments: I'm 90% certain that A. heterodon exists in this area. The water temperature was quite a bit cooler on this date than it was in early August, and I was a little uncomfortable (cold!). I'd like to return to this site next JUly or August to take a second look here.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/24/01
Water Body: Ashuelot River	Site: 14	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 52.79	Long: 72 19.08
Photos? Yes	Map? Yes	Sketch? No

Directions: This is a very small and isolated location accessible by canoe only. The location is shown on the map. Surveyed a distance of 50 yards only, mostly on the left bank. This site is located one mile downstream of Site 13, and about 1500 yards upstream of Site 15.

Habitat: The only reason we stopped at this site is because there was a small patch of gravel/cobble on the streambank and we were wondering if this type of substrate extended into the river. It turns out that there was a fairly large patch of gravel & coarse sand here, in fairly deep water (up to 12 feet deep). The banks were steeply sloped and predominantly sand and silt, but gravel & cobble in one spot. There were lots of emergent macrophytes along the banks, and also lots of duckweed "rafts" floating by. Little riparian canopy, full sun. There is also a small wetland on the left side of the river a little bit upstream. Flow rate VERY slow - not even noticeable.

Survey Type: Snorkel, SCUBA	Duration: 1 hour	Area Covered: 50 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	25-50L			25-50L		10-20L			25-50L	

Mortality, Shell Erosion, Reproduction: This was a great spot for mussels, which was surprising because we could have easily cruised by this spot without giving it a second glance. Lots of mussels, all of which appeared really healthy with little shell erosion and good size variability. We have seen some shell middens along the streambank between here and the upstream site, which is the first time we've seen evidence of predation on the river.

Additional Comments: I think sites like this indicate that there are 5 species that can be found almost everywhere in the river. Unfortunately we have not found any A. heterodon since Site 11, which is nearly two miles upstream. In many ways this site resembles upstream sites where we found A. heterodon ,such as Site 5,6,7, and 8 from the first survey. Perhaps we found the "downstream extent" of the species; if so it is possible that it is dispersing downstream from known refugia above Keene. If that is true, then it'll be interesting to survey these sites in the coming years to see if it continues to disperse downstream.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/24/01
Water Body: Ashuelot River	Site: 15	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 52.92	Long: 72 19.48
Photos? Yes	Map? Yes	Sketch? No

Directions: This site is located at a bend in the river where the river runs very close & parallel to Route 10. We canoed to this site but you could also get here by parking on Route 10 about 1/4 mile south of Sawyers Crossing Road and walking down the steep bank to the river. We surveyed from the remains of an old bridge cribwork (which is mostly submerged) downstream to around the bend, a total distance of about 150 yards. This site is located about 1500 yards downstream of Site 14 and 1500 yards upstream of the covered bridge in "downtown" Swanzey.

Habitat: There was great habitat at this site. Substrate was mostly gravel, cobble, and sand, though the margins were sandy & silty in places. Maximum depths were about 8-10 feet and averaged 3-4 feet. Flow rate was very slow. There was quite a lot of algae on all submerged surfaces making it difficult to see mussels in some places, and also large "rafts" of duckweed. Some submerged macrophytes, especially toward the upstream end of the survey area. The stream was fairly wide here (30-40 yards) and not very shaded except along the banks.

Survey Type: Snorkel, SCUBA	Duration: 1.5 hours	Area Covered: 150 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>200L	25-50L			25-50L		25-50L			50-100L	

Mortality, Shell Erosion, Reproduction: There were lots of mussels here, including all five species we have been finding pretty regularly. Little mortality, recruitment success high for all species. No A. heterodon, and we are starting to doubt whether they exist downstream of Site 11.

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 7/17/03
Water Body: Ashuelot River	Site: 15 (2)	# Times Surveyed: 2
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Keene NH-VT	Lat: 42 52.92	Long: 72 19.48
Photos? Yes	Map? Yes	Sketch? No

Directions: This site is located at a bend in the river where the river runs very close & parallel to Route 10. WWe first surveyed this location nearly two years ago, but are revisiting it now because of the recent discovery of DWM above the Swanzey Dam, and because we knew habitat conditions at this site were suitable for DWM. We reached this site by driving through the Christian campground on the right side of the river and parking within 10 yards of the survey spot (very handy!). We began surveying about 150m downstream of the bend in the river up around the bend to the old bridge cribwork (which is mostly submerged). This site is located about one mile upstream of the Swanzey Dam

Habitat: There was great habitat at this site. Substrate was mostly gravel, cobble, and sand, though the margins were sandy & silty in places. Maximum depths were about 8-10 feet and averaged 3-4 feet. Flow rate was very slow. There was quite a lot of algae on all submerged surfaces making it difficult to see mussels in some places. The stream was fairly wide here (25-35 yards) and not very shaded except along the banks.

Survey Type: SCUBA	Duration: 2 hours	Area Covered: 150 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>200L	>100L			25-50L		>50L			>50L	

Mortality, Shell Erosion, Reproduction: There were lots of mussels here, including all five species we have been finding pretty regularly. Little mortality, recruitment success high for all species. We did not find any DWM, nor did we find it here the first time we surveyed this reach 2 years ago. Yet we did find one DWM downstream, above the Swanzey Dam. DWM probably does exist throughout this reach, but in such low densities that it is difficult to find with short qualitative surveys. There are numerous shell middens along the banks throughout this area, and though we did not check them (we were all decked out in SCUBA gear), it might be worthwhile to check the middens for DWM.

Additional Comments: Saw a beautiful female Lampsilis radiata in full display, with remarkable mantle margin "lures". When I touched her she discharged little packets of glochidia. I wished I were a fish and could help her out!

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 8/24/01
Water Body: Ashuelot River	Site: 16	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Winchester NH-VT	Latitude: 42 52' 18"	Longitude: 72 14' 41"
Photos? Yes	Map? Yes	Sketch? No

Directions: Sean briefly surveyed underneath the covered bridge in "downtown" Swanzey. We did not spend much time here and should probably to a more complete survey if the dam is to be removed someday. The bridge is located about 75 yards upstream of the dam, and is also near some old brick factory buildings.

Habitat: Substrate type was a mix of boulders (some human-made), gravel, and sand. Substrate definitely modified by human activity.. Depth reached 8 feet and averaged 4-6. Lots of algae & other slimy stuff on submerged surfaces, and also a lot of debris (junk) and logs. Very slow current. Not great mussel habitat but pretty stable and thus all five species were found here.

Survey Type: SCUBA	Duration: 0.5 hours	Area Covered: 50 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	50-100L	10-20L			5-10L		5-10L			10-20L	

Mortality, Shell Erosion, Reproduction: Everything seemed ok.

Additional Comments: Water quality here was not great. Nutrients seemed to be the main problem - there was lots of algal growth and the water was quite turbid. Most of the houses upstream have lawns that come right to the edge of the river with no buffer vegetation.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 6/23/02
Water Body: Ashuelot River	Site: Swanzey Dam (#16)	# Times Surveyed: 2
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 52' 16"	Longitude: 72 19' 42"
Photos? Yes	Map? Yes	Sketch? Yes

Directions: We parked in the little parking area/canoe launch on the east side of the river, next to the USGS gauging station. This is the best access to the bridge. Sean surveyed the very close to the dam - in fact, he worked his way along the base of the dam in the white water, and also in further downstream a few yards into the pool/eddies. We also surveyed along the east bank for a distance of about 200 yards using snorkel gear. Sean also surveyed to about 75 yards upstream of the dam using SCUBA. This area was also surveyed last August, as was a long reach located about 1/4 mile downstream at the bridge. Thus, overall we surveyed about 600 yards of excellent habitat within close proximity to the dam, for almost 16 total hours.

Habitat: Upstream of the dam the water is fairly deep (max = 8 feet) and slow-moving. The stream margins are primarily sand and silt with some macrophytes, and the deeper channel is a mix of large cobble and boulders embedded in gravel and sand. Overall, the habitat is pretty good for species that can tolerate lentic conditions. Downstream habitat is a more typical lotic habitat, with shallow (up to 3 ft) riffles & runs at a fairly fast flow rate, and a gravel, cobble, and boulder substrate. There is a paucity of fine substrates near the dam because of the high flow rates that keep sediment and suspension, and these fine substrates are deposited in the quieter water downstream of the next bridge. The substrate is clean and well-oxygenated, and there seemed to be a fairly high diversity of riffle insects such as several species of stoneflies, mayflies, and caddisflies. Habitat was ideal for the triangle floater and creeper, and perhaps the dwarf wedgemussel, though we did not find the latter after many hours of searching.

Survey Type: Snorkel, SCUBA	Duration: 4 hours (x2 people = 8)	Area Covered: 275 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	L,S	L,S			L		L.S			L,S	

Mortality, Shell Erosion, Reproduction: We only found two Pyganodon cataracta, though our survey was focused on A. heterodon habitat and P. cataracta may have been more abundant in the semi-lentic conditions upstream of the bridge. A. undulata and S. undulatus were both fairly common in riffles below the bridge, and each species displayed a good range of size classes indicating successful recruitment. L. radiata was less common downstream of the dam (perhaps 15-20 indivuduals), but was relatively more common upstream of the dam. Elliptio was common everywhere. Shell erosion was moderate downstream and light upstream. There was little natural mortality, and we did not see any shell middens nearby.

Additional Comments: Habitat does seem okay for A. heterodon here, but we feel pretty confident that we would have found it if it were here. Between Sean and I, we spent almost 16 hours snorkeling or SCUBA diving in close proximity to the dam, and despite ideal conditions and a very healthy mussel community, we were not able to locate any A. heterodon. There is always a chance we missed it, but we don't think so...

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/15/03
Water Body: Ashuelot River	Site: Swanzey Dam (#16)	# Times Surveyed: 3
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 52' 16"	Longitude: 72 19' 42"
Photos? Yes	Map? Yes	Sketch? Yes

Directions: We parked in the little parking area/canoe launch on the east side of the river, next to the USGS gauging station. This is the best access to the bridge. We surveyed upstream for a distance of nearly 500m to the sharp bend in the river, though the entire area was not searched thoroughly. We were mostly here looking to see if tesselated darters were present and to see how much potential habitat was available for DWM.

Habitat: Upstream of the dam the water is fairly deep (max usually 8 feet, though a couple deeper holes) and slow-moving. The stream margins are primarily sand and silt with some macrophytes though there are some rocky sections that kind of look like riprap. The main channel is a mix of large cobble and boulders embedded in gravel and sand. There was a fine layer of silt over much of the bottom, and rocks were often covered with a dense filamentous algae. Macrophytes were not that common. Overall, the habitat is pretty good for species that can tolerate lentic conditions.

Survey Type: SCUBA	Duration: 2.5 hours (x2 people = 5)	Area Covered: 500 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>500L	>50L	1L		15-30L		25-50L			>50L	

Mortality, Shell Erosion, Reproduction: Mussels were common throughout this reach, and though habitat conditions appeared marginal (at best), substrate was better than we expected, and we found far more A. undulata and S. undulatus than we would have guessed. All species seemed to be faring well. Darters were abundant throughout, and there were areas where there always seemed to be at least one darter in my field of view. We have surveyed the lower part of this area before and didn't think DWM was here. However, we found one this time, about 30-60m (not sure of the exact location) upstream from the bridge. This was a surprise! To find only one DWM after 5 man-hours (this survey) and several additional hours in previous surveys, indicates that DWM exist at extremely low population densities in this reach. This is a concern, since the dam is slated for removal and we are not sure how much of the streambed will be dewatered and how many DWM are at risk.

Additional Comments: In 2001 I wrote "Habitat does seem okay for A. heterodon here, but we feel pretty confident that we would have found it if it were here. Between Sean and I, we spent almost 16 hours snorkeling or SCUBA diving in close proximity to the dam, and despite ideal conditions and a very healthy mussel community, we were not able to locate any A. heterodon. There is always a chance we missed it, but we don't think so..." Well, its here afterall. This goes to show that persistence and luck are sometimes helpful.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 9/15/01
Water Body: Ashuelot River	Site: 17	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Winchester NH-VT	Latitude: 42 52' 5"	Longitude: 72 19' 37"
Photos? Yes	Map? Yes	Sketch? Yes

Directions: The first bridge downstream of the old dam in Swanzey. We parked at the MoldPro building and walked across the field in back to get to the river. Surveyed from about 100 yards downstream of the bridge to about 150 yards upstream, though we spent much more time downstream. We had drysuits and surveyed exhaustively in shallow water (1-2 feet).

Habitat: Habitat here was fantastic - not since Sites 1-4 (previous survey) has there been such good habitat. In other words, the riffles located here are the first in nearly 7-8 miles!! Depth reached 3 feet but averaged 1-2 feet, flow rate was variable but generally moderate-fast. Substrate was a nice mix of gravel, cobble, and sand, along with some boulders. Some macrophytes were present, especially Sparganium sp. There was little canopy downstream of the bridge but upstream the river was a little more shaded. Stream width ranged from 20-50 yards.

Survey Type: Snorkel	Duration: 3 hours	Area Covered: 250 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>200L	>100L			10-20L		50-100L			50-100L	

Mortality, Shell Erosion, Reproduction: Abundant mussels, all five species we've been finding, some predation but not excessive, little natural mortality. Good size variability of all species, and in particular there were a lot of very large and colorful A. undulata. This was the best mussel habitat & community we've seen so far.

Additional Comments: We spent a lot of time here because it seems that A. heterodon should be here. We couldn't find it, though we found a number of small Strophitus that confused us a little. More surveys should be conducted here, all the way to the dam. We think A. heterodon probably exists here in extremely low densities, and it might require some persistence & luck to find it.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/15/03
Water Body: Ashuelot River	Site: #18	# Times Surveyed: 1
Town: Swanzey	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 50.84	Longitude: 72 20.4
Photos? Yes	Map? Yes	Sketch? No

Directions: Take Route 10 north of Winchester for about 7.5 miles (after about 6 you'll cross the Ashuelot River), and take a sharp right hand turn at the gas station (not sure of street name). See map. This road heads back in a southerly direction. After about .75 miles you'll come to a new covered bridge. We surveyed about 300 yards above and below the bridge.

Habitat: Substrate was mainly sand along one side of the river, and a mix of sand, gravel, and boulders on the other side. Some boulders. At about mid-channel, there was a distinct line separating the sandy slope to the left and the rocky habitat to the left. Mussels were concentrated along this line. Depth was usually 4-6 feet with some areas exceeding 10 feet. Some macrophytes and algae, but survey conditions and visibility was quite good. Flow velocity very slow..

Survey Type: SCUBA	Duration: 2	Area Covered: 600 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>1000's	50-100L			25-50L		50-100L			50-100L	

Mortality, Shell Erosion, Reproduction: Mussels very common. We found good numbers of all five common species, and each species appeared to be reproducing well. Habitat was a bit sandy, but overall supported abundant mussel populations. We did not see middens or many dead shells.

Additional Comments: None

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 9/16/01
Water Body: Ashuelot River	Site: 19	# Times Surveyed: 1
Town: Swanzey/Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester NH-VT	Lat: 42 50.67	Long: 72 20.88
Photos? Yes	Map? Yes	Sketch? No

Directions: We parked in an old parking area off Rte 10 where the river comes very close to the road. There is some old cement debris in the parking area, and some sort of building next to the parking area. This spot is located about 1/2 mile north of where the Ashuelot River crosses Rte 10, and just past the Swanzey/Winchester town line. We surveyed quite a ways downstream, past a rocky section with fast-moving water to the pools below, where the river turns to the west.

Habitat: There was a good mix of habitat conditions at this site. The first 400 yards of the survey area consisted of slow-moving water 3-8 feet deep with a substrate of boulders & cobble in some spots and sand in others. There was a surprising amount of good habitat in the upper part of the survey area, since we guessed that it would be mostly sand and silt. After 400 yards or so the stream begins to narrow & become more rocky and shallow, and then it enters a fairly long series of riffles as it drops nearly ten feet of elevation over a short distance. This would be pretty exciting whitewater during high water, but was a little too rocky to canoe in September. There was some very nice mussel habitat below the rips - mostly gravel, cobble & sand substrates with moderate flow.

Survey Type: Snork., SCUBA, Bckt.	Duration: 2.5 hours	Area Covered: 600-700 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>200L	>100L			10-20L		50-10-0L			50-10-0L	

Mortality, Shell Erosion, Reproduction: Abundant mussels, all five species we've been finding, some predation but not excessive, little natural mortality. Good size variability of all species. We didn't spend much time below the rips but that was a very nice looking spot - seemingly ideal for A. heterodon..

Additional Comments: This was a good survey site because the wide variety of habitat conditions present here, including some of the best riffle habitats we've seen so far. Between Site 17, 20, and 18 we've spent nearly 8 hours (16 man hours) snorkeling & scuba diving in terrific habitat. We have to think that if we haven't found A. heterodon yet, it probably isn't here, or at least its density is so low that one would need to spend countless hours - or be extremely lucky - to find it.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 9/15/01
Water Body: Ashuelot River	Site: 20	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester NH-VT	Lat: 42 50.27	Long: 72 21.67
Photos? Yes	Map? Yes	Sketch? Yes

Directions: Coombs Bridge (a covered bridge) located about 0.5 miles west of Route 10 on Coombs Bridge Road (see map). There is a short riffle below the bridge, and we surveyed downstream for a distance of about 200 yards. This site is located about 1 mile downstream of Site 18, and almost 4 miles upstream of Site 20.

Habitat: There is a short riffle area below Coombs Bridge that provides about 100 yards of ideal substrate and flow conditions, but then the river enters a large pool with deep water and sand/silt substrates. Our survey focused on the transition area between the riffle habitat and the pool habitat, where there was a nice mix of gravel, cobble, and sand substrates, moderate flow rates, and water depths of 1-6 feet. There is some severe bank erosion happening on the right side of the river, and more stable streambanks on the left side (due in part to filling). Some overhanging trees near the bridge but below there is no canopy and the river receives full sunlight.

Survey Type: Snork., SCUBA	Duration: 1 hour	Area Covered: 200 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100L	50-100L			10-20L		10-20L			50-100L	

Mortality, Shell Erosion, Reproduction: Not a ton of good habitat -- certainly not as much as we saw at Site 20, Site 17, or Site 18, but we still were able to find decent numbers of the 5 species we've been finding. We saw good size variation of all species indicating recent recruitment.

Additional Comments: None

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: Biodrawversity	Date: 9/15/01
Water Body: Ashuelot River	Site: 21	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester NH-VT	Lat: 42 48.05	Long: 72 22.53
Photos? Yes	Map? Yes	Sketch? No

Directions: See map. I'm not sure of the name of the road we were on, but it runs parallel to the river on the west side, and at one point the river runs very close and parallel to the road before the road cuts off to the southwest. At the head of this reach there is the remains of what looks to be an old bridge that was entirely dismantled, leaving just the stone foundations on either side of the river. We surveyed approximately 400 yards of this reach. This location is about 4 miles downstream of the Coombs Bridge, and only 1.5 miles upstream of the old bridge in downtown Winchester.

Habitat: This site offered some of the finest riffle habitats we've seen on the river. There were lots of boulders in the stream channel and a nice mix of gravel, cobble, and sand substrates in midstream and sand/silt on the margins. Flow rates were variable but quite strong in some places (probably 0.7 to 1 m/s), and depth reached 4-5 feet in spots but was generally 1-2 feet. Some riparian canopy on both sides of the river but for the most part the river received full sunlight. Habitat conditions were near perfect for mussels.

Survey Type: Snorkel, Bucket	Duration: 2.5 hours	Area Covered: 400 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>200L	>200L			10-20L		50-100L			50-100L	

Mortality, Shell Erosion, Reproduction: Lots of mussels. A. undulata seemed to rival E. complanata in abundance in the riffle areas, though Elliptio was also common in the sandy & silty substrates along the stream margins. Mussels looked good although the shells were a little more eroded, which probably is the result of living in a riffle habitat with strong current and presumably more scour. Some shell middens here and natural mortality, but the populations seem large enough to withstand almost anything.

Additional Comments: This spot represents some of the finest habitat that the Ashuelot River has to offer. It seems that if A. heterodon existed between Swanzey and Winchester it would be found here. But we didn't find it - to our dismay! We are starting to think it just doesn't live down here - yet!

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 6/20/02
Water Body: Ashuelot River	Site: Winchester Dam, #22	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 46' 37"	Longitude: 72 23' 2"
Photos? Yes	Map? Yes	Sketch? Yes

Directions: We parked on the west (south) side of the river at the Winchester factory, which provided us great access to the dam. This building is not seen on the current USGS map because it is relatively new, but the building is big and the folks in the office were supportive of us using their parking lot and surveying mussels. We surveyed an area from about 175 yards downstream of the dam to about 150 yards upstream, though the upstream survey was confined to the shallower water within 5 yards of each streambank. Though the current was fairly strong, we were able to effectively survey most of the good habitat below the dam, right up to the old wood crib.

Habitat: Upstream of the old dam the river was fairly deep and slow-moving, with large boulders and cobble in some places (near what was once a bridge), and sand and silt along most of the banks. Depth was about 8-10 feet in places, though usually 4-6. Elliptio was very abundant in the sand/silt streambanks in about 2-3 feet of water. Downstream of the dam, there was a nice mix of riffle, eddy, and pool habitat with the dominant substrates being gravel, cobble, and small boulders. Sand was more common in depositional areas, though in general the embeddedness was low and the substrates seemed clean and well oxygenated. Lots of junk here, particularly scrap metal and broken glass. The current was fairly strong, though swimmable. Overall very good mussel habitat for stream-dwellers below the dam and for more silt/sand tolerant species upstream.

Survey Type: Snorkel, SCUBA	Duration: 5 hours (x2 people = 10)	Area Covered: 300 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	L,S	L,S					L			L,S	

Mortality, Shell Erosion, Reproduction: Elliptio was abundant, A. undulata and L. radiata were present but not abundant, and S. undulatus was very scarce. The mussel community seemed fairly healthy, though perhaps not as abundant or evenly distributed as we have seen further upriver (Site 20, previous survey). Habitat is somewhat limited upstream of the dam due to unstable substrates and deep water. Habitat appears very good below the dam, and though mussels were abundant in places, we would have expected to find larger numbers of A. undulata and S. undulatus. The absence of A. heterodon is not surprising since we have not seen it for many many miles of seemingly ideal habitat. Shell erosion light to moderate, reproduction evident for all species except for S. undulatus. Little natural mortality.

Additional Comments: The dam seems to have a minimal effect on riverine habitat. It is almost entirely breached on one side, and fish are probably able to pass through with ease. If anything, the dam seems to increase habitat diversity here by providing good instream structure, trapping some sediment upstream, increasing flow heterogeneity, and providing a refugia for crayfish and young fish.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/2/03
Water Body: Ashuelot River	Site: #23	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 46.34	Longitude: 72 24.55
Photos? Yes	Map? Yes	Sketch? No

Directions: Take 119 West from Winchester, turn left onto Ashuelot Road (also shown as old Rte 119 on Atlas) and follow for about a mile to where the road closely parallels the river. Surveyed from head of riffle at downstream end, for about 400m upstream to the railroad bridge. It was just deep enough for SCUBA surveys..

Habitat: Habitat was very good for mussels. The current was quite slow in the area we surveyed, but the substrate was a mix of sand, gravel & cobble, and large boulders. Substrate was a bit sandier toward the upstream end, but still okay for mussels. Many of the rocks were covered with thick filamentous algae. Depth 3-8 feet. Some macrophytes present. I had visited this area a few years before but did not survey here, and at the time there were obvious signs of eutrophication (excessive algal growth, turbidity). This will probably happen later this summer.

Survey Type: SCUBA	Duration: 2 hours	Area Covered: 400 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	Many L,S	25-50L			5-10L		10-20L			<5L	

Mortality, Shell Erosion, Reproduction: Same five species we have been seeing. LR less common than we would have expected, and we barely found it downstream at the covered bridge either. This species definitely seems to prefer the upper river more than the lower river...not sure why. We saw many darters in this reach and habitat seems suitable for DWM.

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/2/03
Water Body: Ashuelot River	Site: #24	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 46.65	Longitude: 72 25.33
Photos? Yes	Map? Yes	Sketch? No

Directions: Parked at the small grassy parking area just upstream of the Ashuelot Covered Bridge in the village of Ashuelot (a few miles west of Winchester on Rte 119). Surveyed shallow riffles near the bridge (one person) and flatwater section that begins about 100m upstream (one person on the left bank for a distance of 500m, and one person on right bank for a distance of 150m). Too shallow for SCUBA, so we snorkeled.

Habitat: Habitat was mostly shallow riffle/run habitat, 1-4 feet deep. Variable flow but some fast water near the bridge, which is the start of a long rocky high gradient reach. Further upstream, the current is slower and substrate less rocky. Overall, habitat was a bit too rocky to support abundant mussel populations, but there were patches of sand and gravel that provided good habitat. Conditions got better toward the upper end of the survey area. There were a few aquatic macrophytes, and a filamentous alga was abundant on rocks.

Survey Type: Snorkel	Duration: 1.5 hours	Area Covered: 400 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>1000's	100-200L					>50L			1S	

Mortality, Shell Erosion, Reproduction: AU was quite common, both small and large animals. We found many large SU but mostly larger specimens. EC very common. Shell erosion was heavy, which is to be expected in shallow, rocky habitats.

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/15/03
Water Body: Ashuelot River	Site: #25	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 47.2	Longitude: 72 26.34
Photos? Yes	Map? Yes	Sketch? No

Directions: Take 119 West of Winchester, through village of Ashuelot, and drive for 1.5 miles past Ashuelot to the next bridge (left hand turn). Cross bridge, turn left onto dirt road, and park about 200 m up the road (at the gate). The Algonquin hydro dam is located about 200+ m downstream of the bridge. We surveyed from near the bridge upstream to the beginning of a long rocky riffle section.

Habitat: Habitat was mostly sand and some gravel (but not much) toward the lower end of the survey area, with some large rocks toward either bank. As we moved upstream, there were more and more rocky areas, with some large boulders and bedrock in places. Sand and fine gravel was common between the boulders. At the upstream end of the survey area, substrate was mostly cobble and boulders, which were mostly covered with dense filamentous algae and some type of macrophyte (not sure what...). Mussels were scarce at the upstream end of the survey area. Depth up to 15 feet, but in general it was 5-8 ft. Flow velocity minimal, visibility good.

Survey Type: SCUBA	Duration: 2 hours	Area Covered: 400 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	>100s	2-3L			2-3L		2-3L				

Mortality, Shell Erosion, Reproduction: Habitat conditions were poor throughout this reach, and there were few mussels. Elliptio was common (as always), but we found less than 5 AU, SU, and PC, and no LR. There was not evidence of mortality Ñ no dead shells, middens, etc. Overall, diversity and abundance is lower than we might have expected in this area. Darters were abundant here, mostly small (0.5-1.5 inch) fish living in sunny sandy areas.

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/2/03
Water Body: Ashuelot River	Site: #26	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 47.39	Longitude: 72 27.19
Photos? Yes	Map? Yes	Sketch? No

Directions: Take Rte 119 east of downtown Hinsdale for a bit over a mile, take right turn onto unnamed paved road that runs parallel to the river. After about ½ mile you'll pass a small industrial area on the opposite side of the river, then pass a hydroelectric dam. We parked on the road about 100m upstream from the dam, and surveyed upstream for a distance of 80m.

Habitat: Depth 3-15 ft but generally 6-12. Substrate mostly large boulders, with some gravel and sand in between. No silt. Flow velocity slow, though there is a riffle at the head of the pool. Steep rocky banks with overhanging trees. Overall, habitat is decent for mussels-a bit too rocky in areas but there is enough fine substrates among the rocks to support mussels.

Survey Type: SCUBA	Duration: 1 hour	Area Covered: 80 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	<25L	1L									

Mortality, Shell Erosion, Reproduction: Mussels noticeably scare here. Even Elliptio was rare, which tells us that something is not quite right... With two divers spending a combined total of 2 hours, we would have expected to find more than 25 mussels. Not sure why mussels are scarce. There are not any noticeable water quality problems. There is another dam and industrial area upstream, and a wastewater treatment plant somewhere upslope of here.

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/2/03
Water Body: Ashuelot River	Site: #27	# Times Surveyed: 1
Town: Winchester	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 47.58	Longitude: 72 27.89
Photos? Yes	Map? Yes	Sketch? No

Directions: Take Rte 119 east of downtown Hinsdale for a bit over a mile, take right turn onto unnamed paved road that runs parallel to the river. Park about 100m down this road. We descended a steep trash-strewn bank to survey in a large deep pool situated between two fast-water sections. Our survey was confined to the swimmable pool.

Habitat: Depth up to 8 feet. Substrate mostly large boulders, with some gravel and sand in between. No silt. Flow velocity fast, especially upstream and downstream of the pool. Steep rocky banks with overhanging trees. Virtually no suitable mussel habitat at this location - its just too rocky. Currents must be incredibly strong here during spring runoff and flood events, leaving a heavily scoured streambed.

Survey Type: snorkel	Duration: 45 min	Area Covered: 50 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN

Mortality, Shell Erosion, Reproduction: No mussels! (or habitat)

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/3/03
Water Body: Ashuelot River	Site: #28	# Times Surveyed: 1
Town: Hinsdale	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 47.24	Longitude: 72 28.75
Photos? Yes	Map? Yes	Sketch? No

Directions: Parked at small roadside parking area (with grassy area, benches) about 1/8 mile east of downtown Hinsdale on Rte 119, on a little "bluff" overlooking the river. Swam upstream beyond the island on the left side of the river, until it became too shallow for SCUBA. Then turned around and swam below and a short distance beyond the tall bridge, to within 40m of the dam. The total distance covered was about 450 yards.

Habitat: Habitat mostly sand, gravel, and cobble upstream, with some large boulders along the bank. There was also a lot of trash, apparently dumped by old industry or by residents living on the streambank. Water quality did not seem all that good. Depth 1-5 feet upstream, flow velocity slow to moderate. Downstream, depth was up to 15 feet below the bridge, and the substrate was primarily sand and gravel, with rockier conditions under and downstream of the bridge. Macrophytes scarce.

Survey Type: SCUBA	Duration: 1:45	Area Covered: 450 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	100's	10-20L					20-30L				

Mortality, Shell Erosion, Reproduction: There were many more mussels toward the downstream end of the survey area. Mussels were conspicuously scarce upstream, and we think that perhaps some of the areas we surveyed are dewatered during low flow.

Additional Comments: None.

MUSSEL SURVEY DATA FORM

Observer: Ethan Nedeau, Sean Werle	Affiliation: BIODRAWVERSITY	Date: 7/15/03
Water Body: Ashuelot River	Site: #29	# Times Surveyed: 1
Town: Hinsdale	County: Cheshire	State: New Hampshire
USGS Quad: Winchester	Lat: 42 47.17	Longitude: 72 28.98
Photos? Yes	Map? Yes	Sketch? No

Directions: Surveyed below the dam in downtown Hinsdale. Parked at the riverside park, and surveyed from about 200 yards below the dam into the splash zone below the dam (within a couple feet of the structure).

Habitat: Substrate was mainly cobble and boulders, with very little fine substrate (especially toward the downstream end of the survey area where the stream channel was narrow). Depth 1-8 feet, though 2-3 was typical. There were some deeper areas along the opposite (right) side of the river that were fairly deep and had some sandy & gravel habitats. Mussels were not real common throughout the survey area, though there were some spots where Elliptio was clustered. Scouring in this area seems to be high, limiting the amount of good mussel habitat.

Survey Type: Snorkel	Duration: 2	Area Covered: 200 yards

Species Found and Relative Abundance. L = LIVE, S = SHELL

MM	EC	AU	AH	AV	PC	AI	SU	LO	LC	LR	LN
	50-100L										

Mortality, Shell Erosion, Reproduction: Mussels scarce. Only found Elliptio, which was not real common but patchy. No signs of heavy mortality, such as shell middens or dead shells. No darters, but there were some very large bass near the dam.

Additional Comments: There are signs of historical water quality and habitat quality problems: old rusted effluent pipes, junk, etc. The park itself was likely once an industrial complex. Lord knows what types of materials were dumped into the river in the last 200 years.