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DEPARTMENT OF TRANSPORTATION

# Assessing the Presence and Potential Habitat for Reintroduction of Priority Freshwater Mussel Species in the Shenango River

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**16. Abstract**

The Shenango River is a principal tributary of the Beaver River, which may provide an opportunity for the relocation of clubshell and northern riffleshell. These federally listed mussels and other species of concern may be present in the Shenango River. Known as a historic location for freshwater mussels, the river has not been recently surveyed and remains a significant gap in the existing data.

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**Introduction**

The Shenango River, with a drainage area of 584 $m^2$ (940 $km^2$), is a principal tributary of the Beaver River. The 92 mi (148 km) long Shenango River may provide an opportunity for the relocation of clubshell and northern riffleshell. Historically the presence of both species has been documented in the Shenango River (Ortmann 1921). In addition to these federally listed mussels other species of concern may be present in the Shenango River. Known as a historic location for freshwater mussels, the river has not been recently surveyed and remains a significant gap in the existing data.

The Hunter Station Bridge in Forest County, PA spans the Allegheny River and its proposed construction places emphasis on the relocation of mussels in the causeway. Estimates from our 2002 mussel survey at the bridge indicate that over 100,000 northern riffleshell and clubshell are present in the direct impact area with several thousand occupying the causeway footprint. Widespread interest and inquiries from multiple states within the species' historic range, regarding translocation of the animals from this location, has been received by the USFWS PA Field Office and PennDOT. Baseline data regarding potential relocation sites is critical for the successful translocation of the Hunter Station animals within the Commonwealth. Identification of potential relocation sites in Pennsylvania could occur as a result of this project.

**Methods**

*Pymatuning Reservoir to Shenango River Lake*

We surveyed the length of the Shenango River from below Pymatuning Reservoir to King's Chapel Road in the summer months of 2009. Reaches were delineated by access locations with the next reach starting where the above ended. Each survey site is 200 m in length and 18 transects were surveyed at each site. The first 3 transects were placed using randomly generated numbers and differed among sites. The remaining transects were systematically located by adding 33 m to the first locations. An efficient design is to survey bank to bank transects oriented perpendicular to flow. All sites were surveyed using the qualitative methods described in Smith (2006). Qualitative sampling is recommended over quantitative sampling when the objective is to find rare or endangered species (Vaughn *et al.* 1997, Metcalfe-Smith *et al.* 2000). The probability of detecting species presence is related to species abundance and spatial distribution, sampling effort, search efficiency within the area sampled, and the distribution of sampling effort within a study site.

The survey was an intensive search of the substrate surface with all mussels identified to species and counted. Surveyors used snorkel, and in deeper areas SCUBA, to visually search for mussels. To minimize impact and stress, mussels were removed from the substrate for identification purposes before being replaced back in the substrate in the life position. Habitat data was documented using Nature Conservancy guidelines and substrate data based on the Wentworth scale.

*Shenango River Lake to King's Chapel Road*

Due to time constraints and in an effort to follow the original study plan the area from the spillway below Shenango River Lake to King's Chapel Road was visually searched by

floating. The study plan called for transects to be surveyed only when shells or live animals were observed. The Shenango River remains turbid regardless of a lack of watershed variables that would normally contribute to poor visibility making observing shells and live mussels extremely difficult. Combined with an overall lack of shells had the plan been followed as written the freshwater mussels located between both reservoirs would have more than likely not been as well documented. Below the Shenango River Lake several areas raised concerns as to the safety of crews as well as overall river health. The area from West Clark Street to Seig Hill Road had been deemed unsafe due to industry and therefore marked as an area to remove. The total distance eliminated was 8.91 km. Reaches were still delineated based on road access. Floating the reaches using snorkel equipment allowed biologists to focus on habitat hotspots while surveying the river entirely. Areas in which contained high densities or species of concern were recorded using a handheld GPS.


Figure 1. Aerial showing reach skipped between West Clark Street to Seig Hill Road.

*Pymatuning Reservoir to Liberty Street*

The Shenango River exits the Pymatuning Reservoir near Jamestown, Pennsylvania. The area immediately downstream of the spillway was not surveyed due to high flow and associated safety concerns. A footbridge crosses the river 317 m below the spillway and marked the beginning of the survey. From the footbridge to Liberty Street is 2.8 km. The primary habitat is run with an average width of 27 m. Substrate throughout the reach is mostly small gravel with marginal embeddedness. Riparian buffer averages 25-50 m and consists of a shrub and grass mixture with a coverage area of 50-80%. Bank riparian was marginal with 25-50% coverage from grasses and herbaceous plants. The main channel is shaded by a dense canopy which limits the growth of aquatic vegetation. Small areas of pasture and residential land use break up the otherwise forested riparian.

Results

We found 14 species and 2,710 mussels.

| Species | Count |
|---|---|
| *Actinonaias ligamentina* | 1 |
| *Amblema plicata* | 2325 |
| *Elliptio dilatata* | 26 |
| *Epioblasma triquetra* | 2 |
| *Fusconaia subrotunda* | 12 |
| *Lampsilis cardium* | 8 |
| *Lampsilis fasciola* | 1 |
| *Lampsilis ovata* | 45 |
| *Lampsilis radiata* | 3 |
| *Lampsilis siliquoidea* | 257 |
| *Ligumia nasuta* | 8 |
| *Pyganodon grandis* | 15 |
| *Tritogonia verrucosa* | 4 |
| *Utterbackia imbecillis* | 3 |

*Liberty Street to Halfway Road*

From Liberty Street downstream to Halfway Road is 4.8 km. The reach averages 30 m wide and is predominately run habitat with marginally embedded cobble. Above the banks the riparian is heavily forested extending 50 m and covering 80% of the area. The banks are fairly stable with some exposed roots. Bank vegetation is a mix of shrubs and grass with a coverage area of upwards to 80%. A dense canopy shades nearly 75% of the channel limiting aquatic vegetation growth.

Results

There were 15 species and 2,014 mussels.

| Species | Count |
|---|---|
| *A. plicata* | 1699 |
| *E. dilatata* | 4 |
| *E. triquetra* | 4 |
| *F. subrotunda* | 31 |
| *L. cardium* | 1 |
| *L. ovata* | 53 |
| *L. radiata* | 1 |
| *L. siliquoidea* | 162 |
| *Lasmigona costata* | 5 |
| *L. nasuta* | 24 |
| *Pleurobema clava* | 2 |
| *Pleurobema sintoxia* | 10 |
| *P. grandis* | 1 |
| *T. verrucosa* | 16 |
| *U. imbecillis* | 1 |

*Halfway Road to Porter Road*

To Porter Road from Halfway Road is 5.8 km. For much of the section the habitat is run, averaging 26 m wide with a mixture of slightly embedded gravel and cobble. Although the surrounding land use is primarily agriculture the forested riparian buffer extends for over 50 m from the banks with a coverage area of 80%. At the waterline the banks appear to be less stable with exposed roots. However, the vegetation is a grassy, shrub assemblage with approximately 50% coverage. More aquatic vegetation was observed as compared to the above reaches despite a similar canopy.

Results

There were 14 species and 2,410 mussels found.

| Species | Count |
|---|---|
| *A. plicata* | 2199 |
| *E. dilatata* | 8 |
| *E. triquetra* | 9 |
| *F. subrotunda* | 51 |
| *L. cardium* | 2 |
| *L. ovata* | 21 |
| *L. siliquoidea* | 69 |
| *Lasmigona compressa* | 2 |
| *L. costata* | 1 |
| *L. nasuta* | 8 |
| *P. clava* | 5 |
| *P. sintoxia* | 23 |
| *P. grandis* | 6 |
| *T. verrucosa* | 6 |

*Porter Road to Ohl Street Bridge*

This primarily forested reach, with some residential land use, is 2.8 km. Averaging 24 m wide, the predominantly run habitat consists of cobble. The substrate is only partially covered by fine sediment and is easily dislodged. The riparian buffer is moderate, extending 25 m past the banks with a fairly thick composition of grasses and shrubs. Though the banks are largely unstable they are 80% covered by thick shrubs and grasses. The canopy provides shade for about 50% of the channel allowing for the growth of aquatic vegetation, similar to what was observed in the above reach.

Results

We found 11 species and 790 mussels.

| Species | Count |
|---|---|
| *A. plicata* | 714 |
| *E. dilatata* | 1 |
| *E. triquetra* | 2 |
| *F. subrotunda* | 8 |
| *L. ovata* | 6 |
| *L. siliquoidea* | 41 |
| *L. compressa* | 1 |
| *L. nasuta* | 1 |
| *P. clava* | 2 |
| *P. sintoxia* | 5 |
| *T. verrucosa* | 8 |
| Unknown | 1 |

*Ohl Street to Wasser Bridge Road*

Four river kilometers separate the access locations. The reach is mainly forested with limited residential and agricultural land use. Averaging 25 m in width the habitat is mostly run with slightly embedded cobble. Above the banks the 25-50 m wide buffer is a fairly thick mixture of shrubs and grasses. The understory coverage approaches 80%. The banks are moderately stable with only small areas of noticeable erosion. This limited erosion nearest the river is attributable to an extremely dense (80%) stand of shrubs and grasses. Although less aquatic vegetation growth was observed the canopy remains relatively open.

Results

Twelve species and 221 mussels were found.

| Species | Count |
|---|---|
| *A. plicata* | 172 |
| *Anondontoides ferussacianus* | 1 |
| *E. dilatata* | 4 |
| *E. triquetra* | 4 |
| *L. cardium* | 2 |
| *L. fasciola* | 1 |
| *L. ovata* | 4 |
| *L. radiata* | 2 |
| *L. siliquoidea* | 25 |
| *L. compressa* | 2 |
| *P. sintoxia* | 1 |
| *P. grandis* | 3 |

*Wasser Road to Kidd's Mill Road*

Separating the 2 access locations is 2.4 river kilometers. The habitat is mostly run with cobble which is loosely embedded and easily dislodged. The heavily forested riparian is an assemblage of various trees extending 50 m from the banks. Only after this large buffer does the land use shift to agriculture. With a thick buffer above the shoreline and shrubs and grasses growing to the waterline the banks show only small areas of erosion. Despite widening slightly to 27 m the canopy is more closed than what has been observed elsewhere. Subsequently any growth of aquatic vegetation has been reduced dramatically.

Results

There were 12 species and 192 mussels found.

| Species | Count |
|---|---|
| *A. plicata* | 170 |
| *E. dilatata* | 1 |
| *E. triquetra* | 1 |
| *F. subrotunda* | 1 |
| *L. fasciola* | 1 |
| *L. ovata* | 2 |
| *L. siliquoidea* | 8 |
| *L. compressa* | 1 |
| *L. costata* | 1 |
| *P. sintoxia* | 1 |
| *P. grandis* | 1 |
| *T. verrucosa* | 4 |

*Kidd's Mill to Hamburg Road*

Pool habitat dominates this 8.4 km long section. Land use varies between agriculture, forested, and residential. Substrate is a mixture of gravel which is only slightly embedded. The riparian buffer extends 50 m from the banks and is heavily forested by a thick stand of trees. The average river width narrows to 26 m allowing for a partially closed canopy and limits aquatic vegetation growth. At the water edge the banks are fairly stable with a small percentage of noticeable erosion. This is largely due to a thick cover of grasses and shrubs to the waterline as well as the forested buffer above.

Results

There were 16 species and 1,679 mussels found.

| Species | Count |
|---|---|
| *A. plicata* | 1512 |
| *Alasmidonta marginata* | 1 |
| *E. dilatata* | 2 |
| *E. triquetra* | 15 |
| *F. subrotunda* | 5 |
| *L. cardium* | 19 |
| *L. fasciola* | 2 |
| *L. ovata* | 6 |
| *L. siliquoidea* | 52 |
| *L. costata* | 10 |
| *Obavaria subrotunda* | 2 |
| *P. sintoxia* | 4 |
| *Ptychobranchus fasciolaris* | 1 |
| *P. grandis* | 5 |
| *Quadrula cylindrica* | 9 |
| *T. verrucosa* | 34 |

*Hamburg Road to Valley Road*

Between the 2 roads is 6.2 km of river. The primary habitat remains pool with an average width of 26 m and a slight increase in residential land use. The riparian buffer however continues to be heavily forested covering an area of nearly 100%. Bank vegetation was also fairly thick and coverage by grasses and shrubs was nearly 80 %. Due to an intact and stable buffer the banks were stable showing only small areas of erosion. The substrate is partially embedded and is larger cobble with a small percentage of gravel. Despite the dense riparian the canopy was slightly more open than observed elsewhere allowing for an increased growth of aquatic vegetation.

Results

We found 18 species and 1,407 mussels.

| Species | Count |
|---|---|
| *A. marginata* | 1 |
| *A. plicata* | 1207 |
| *E. dilatata* | 4 |
| *E. triquetra* | 8 |
| *F. subrotunda* | 32 |
| *L. cardium* | 48 |
| *L. fasciola* | 1 |
| *L. siliquoidea* | 16 |
| *L. compressa* | 1 |
| *L. costata* | 3 |
| *L. nasuta* | 1 |
| *O.subrotunda* | 5 |
| *P. clava* | 1 |
| *P. sintoxia* | 5 |
| *P. fasciolaris* | 3 |
| *P. grandis* | 3 |
| *Q. cylindrica* | 25 |
| *T. verrucosa* | 42 |

The uppermost portion of the Shenango River Lake begins at Valley Road. The survey from this point forward was conducted by 2 biologists floating in wetsuits using snorkel equipment.

*Shenango River Lake Spillway to State Route 3018*

Although the habitat immediately below the spillway is riffle much of the remaining 2.33 km of river, to Buckeye Drive (3018), is pool habitat. The banks are both heavily wooded (100%) and intact with the right descending bank being protected by Mahaney State Park. Substrate throughout the section is mostly large cobble and boulder. Except for the upper portion of the survey reach the canopy directly over the river is open with few overhanging trees. Unlike upper reaches surveyed mussels were not found throughout the channel. Instead, mussel distribution was patchy. The most notable community, where more than 95% of the mussels were found in this segment, was marked using GPS. The coordinates are 41° 15.866 N 80° 28.294 W.

Results

A total of 335 mussels from 12 species were encountered.

| Species | Count |
|---|---|
| *A. ferussacianus* | 1 |
| *A. plicata* | 139 |
| *E. dilatata* | 32 |
| *F. subrotunda* | 4 |
| *L. cardium* | 15 |
| *L. costata* | 7 |
| *L. ovata* | 14 |
| *L. siliquoidea* | 59 |
| *P. fasciolaris* | 10 |
| *P. grandis* | 42 |
| *P. sintoxia* | 1 |
| *T. verrucosa* | 11 |

*Buckeye Drive (3018) to West Clark Street*

For more than half of the 3.98 km there is no riparian separating the river from the nearby industry and railroad. The right descending bank remains wooded and stable. Because of the lack of riparian the canopy is open and more aquatic vegetation was observed. The majority of the mussels found were opposite the industry in silt substrate and pool habitat. There are several series of riffles with larger substrate. The larger substrate and increased flow offered little in available habitat. Not until the bottom of these riffles, when the current slowed, were mussels encountered.

Results

Nine species were documented with 455 animals being counted.

| Species | Count |
|---|---|
| *A. plicata* | 186 |
| *E. dilatata* | 15 |
| *F. subrotunda* | 5 |
| *L. cardium* | 58 |
| *L. costata* | 7 |
| *L. siliquoidea* | 94 |
| *P. fasciolaris* | 14 |
| *P. grandis* | 70 |
| *T. verrucosa* | 6 |

*West Clark Street to Seig Hill Road*

As stated in the methods section the 8.91 km segment from West Clark Street to Seig Hill was eliminated because of safety concerns. The last portion of the above reach began to show the adverse effects of industry and no riparian. Subsequently few mussels were encountered in the lower end of that reach.

*Seig Hill to Interstate 80*

Both banks are heavily (100%) wooded and intact. The canopy is slightly open allowing for the growth of aquatic vegetation. The beginning of the 3.22 km section is a relatively swift and shallow pool. Despite more than adequate habitat no mussels were encountered. Within a few 100 m the river begins a long a sweeping turn. At this point the depth of the pool increases to over 2 m. Large trees are suspended within the water column. Because of the lack of visibility and moving water the area raises concerns for the safety of survey crews. Extreme care should be taken if this area should be surveyed again. The banks are steep and lined with organic debris.

Results

Despite good habitat in the beginning portion of this reach no mussels were encountered.

*Interstate 80 to Campground Road*

The habitat remains a relatively deep (2 m) pool until a riffle above the bridge at State Route 318. Downed trees exist within the water column. The banks are steep but wooded. Nearest the left descending bank and extending midchannel the substrate is silt, large cobble makes up the substrate on the right bank. No mussels were found in the pool habitat. Approximately 100 m above the 318 bridge a riffle develops. At the bottom of the riffle, in the shallower water, aquatic vegetation slows the flow creating pockets of silt. It is in this area where mussels were encountered. Near the bridge land use on the left descending bank becomes commercial. Several outflow pipes discharge water from the industrial area above the left bank. The right bank however, remains wooded. The runs and riffles in this portion are choked with vegetation presumably due to the shallower water allowing for more light penetration. Despite habitat conducive for finding mussels only a few were found. It was not until the end of the 5.90 km reach, where the river makes a sharp turn that mussels were encountered.

Results

Only 13 animals were found from 6 species.

| Species | Count |
|---|---|
| *A. ligamentina* | 1 |
| *A. plicata* | 1 |
| *L. cardium* | 3 |
| *L. costata* | 1 |
| *L. siliquoidea* | 6 |
| *U. imbecillis* | 1 |

*Campground Road to State Route 208*

Immediately noticeable was an increase in both flow and vegetation. The 6.44 km section contains more riffles than the adjacent sections. Canopy coverage over the river is fairly open promoting the growth of thick aquatic vegetation in areas of shallow water. Both banks are steep but densely covered by vegetation to the shorelines. Substrate within the riffles is small gravel and sand. Where vegetation reduces flow silt settles to the river bottom. In pools the substrate is mostly silt with downed tress closely associated with the shorelines. The middle segment of this reach becomes shallower and is mostly run habitat. The substrate is a mixture of gravels and sand with dense aquatic vegetation growth. It is in the finer substrate of the runs that mussels were found. The smaller more loosely compacted substrate allows mussels to burrow deeper, some of which were barely visible when surveyed. A segment of slow moving pool habitat develops after the run habitat. This area has steep banks with submerged trees lining the shores and collecting organic debris and silt. The remainder of the reach, before the State Route 208 bridge, becomes a shallow run and riffle habitat. The area is heavily vegetated and despite offering excellent habitat few mussels were found.

Results

Six species were documented for a total of 14 animals.

| Species | Count |
|---|---|
| *F. subrotunda* | 1 |
| *L. cardium* | 7 |
| *L. costata* | 1 |
| *L. siliquoidea* | 3 |
| *P. grandis* | 1 |
| *U. imbecillis* | 1 |

*State Route 208 to Nashua Road*

Immediately beginning the 6.16 km reach is a pool above what appears to be a relic dam. The majority of the flow exits the pool on the right descending side. The substrate is good in the pool area however only one mussel was found. Below the riffle associated with the dam outflow begins a long pool. The area shallows near the bottom of the pool. After a long straight away, before the river turns left, what appear to be a mussel graveyard was discovered. Thousands of shells from 5 species were discovered in an area of approximately 30 m in diameter. The shells, in order of occurrence, were *F. subrotunda*, *A. ligamentina*, *E. dilatata*, *A. plicata*, and *L. siliquoidea.* Deposition of shells reached a meter is some areas. The area was marked and the coordinates are 41° 05.812 N 80° 25.427 W. A series of questions arise with this discovery with the most important being what cause the die off of the mussel community in this reach. The remaining portion of the reach ends as pool. The substrate in the pool is loosely situated and shifty small gravel. Like other pools, large trees are submerged within the water column.

Results

One *L. siliquoidea* was found.

*Nashua Road to King's Chapel Raod*

At the time this reach was surveyed the Nashua Road Bridge was in the process of being replaced. Large pumps were used to remove water from around the support structures. This water was extremely turbid and became completely mixed with the surrounding river within 200 m of the bridge. The predominant habitat is pool with a mixture of cobble and sand substrate. The canopy is open despite both banks being heavily wooded. Throughout most of the 6.71 km segment large trees are submerged within the water column. Given the presence of such trees combined with the reduced visibility the reach was difficult to survey. Nearing the completion of the reach 2 individuals were taking water quality samples. It would not become evident until later that day that a large contaminant spill had occurred at the Duferco Farrel Corporation in Farrel, Pennsylvania. The area where the spill occurred coincides with the area skipped during this survey. The spill may signify that it was more common place before tighter regulations. Such spills may have ultimately led to overall lack of freshwater mussels below the industrial area.

**Discussion**

The 37.2 km segment from below Pymatuning Reservoir to above Shenango Lake was surveyed during the summer of 2009. The reach was divided into eight sections varying in length from 8.4 km to 2.4 km. A total of 11422 animals were found representing 23 species. The highest number of species found was in the area of river between Hamburg Road to Valley Road, just above Shenango Lake. The lowest number of species found was between Porter Road and Ohl Street. If we had adhered to the original proposal of doing qualitative surveys only where shell material or shells were found a large number of mussels would have been overlooked. Poor visibility and an overall lack of shells made it difficult to speculate on the mussel community at a given section. Above the water there were no muskrat middens observed throughout the entire reach surveyed.

The remaining area from below Shenango River Lake to King's Chapel Road was completed during the summer of 2010. Seven sites were surveyed with distances varying from 2.33 km to 6.71 km. Total length surveyed was 34.74 km with 8.91 km being eliminated between West Clark Street and Seig Hill Road. Also not completed was the last portion of river between Route 60 and West Falls Street. This was due to a large contaminant spill occurring in Farrell, PA during the time that the reach was scheduled for surveying. In a stark comparison to the area between the 2 reservoirs, where 23 species were found, the highest number of species found this year was 12. The area of river immediately below the Shenango River spillway is the most diverse segment surveyed this year with 12 species found. Species counts continue to fall out as distance increases from the spillway. Only 817 animals were found in comparison to the 11422 animals found above Shenango River Lake. Reasons for the drastic decrease in the mussel community remain unknown. Speculations point to industrial impact and the overall lack of a riparian buffer near these areas. The reduction in mussel diversity may be confounded by contaminants entering the river as documented by the spill which occurred August 10, 2010. Witnessing an accumulation of freshwater mussels in one area, all of which were relatively the same age and all of which were killed near the same point in time, leads one to surmise that this has been an ongoing issue. Coincidently the area where the spill took place was one in which was deemed unsafe prior to the confirmation that indeed it was unsafe for survey procedures.

Should the notion of mussel translocation be entertained the only area of river offering a viable means would be the stretch between the 2 reservoirs. The reach contains a similar mussel assemblage to that found in the Allegheny River, one with *P. clava* as well as species with similar resource requirements.

**Bridges of Concern**

This survey was brought about to fulfill a request from the Pennsylvania Department of Transportation. Several bridges that span the Shenango River are scheduled for repair or replacement and it is imperative that before construction begins an indepth survey be completed in the proposed impact areas. As a secondary agenda it was suggested that

the river be surveyed in its entirety as a means to discuss the viability of mussel translocations from the Allegheny River.

*Ohl Street Bridge*

Ohl Street Bridge is closed to vehicle traffic. A significant amount of trash and debris has been deposited within the creek and on the shorelines nearest the bridge. Both banks are stable with minimal erosion. Habitat is predominantly shallow riffle with water depths not exceeding 1 meter. The left descending channel is shallower with aquatic vegetation rooted in fine sand and gravel substrate. Due to the relatively small size of this one lane bridge a smaller area was surveyed. From the center line of the bridge 15 meters upstream and 15 meters downstream were surveyed. Despite habitat favorable for finding freshwater mussels immediately beneath the bridge no live individuals were found. Live animals were found above and below the bridge but well outside any potential impact from construction.


Figure 2. Ohl Street Bridge location in red with coordinates.

*State Route 4003*

State Route 4003 is locally known as Wasser Bridge Road. It is currently still in use by vehicle traffic. Habitat beneath the bridge is slow moving pool with silt substrate. Nearest the banks and bridge supports large boulder rip-rap has been installed to minimize erosion and shore up foundational supports. The banks are wooded and stable. Water depth exceeds 1 meter in the main channel. The area beneath the bridge was surveyed as well as above and below the span. The installed substrate and depth most likely contributed to no live mussels being encountered. Twenty meters in either direction from the center line of the bridge were surveyed. Mussels were found above and below the bridge in more optimal habitat but were outside of any direct or indirect impact from bridge replacement procedures.


Figure 3. State Route 4003 location in red with coordinates.

*State Route 0018*

State Route 18 spans a narrow section of the Shenango River Lake. It is situated between the primary boat launching area and a large marina. The shorelines have been reinforced with large boulder rip-rap. Directly beneath the bridge a no wake ordinance is enforced. Both banks are steep at the water's edge and water depth is over 6 meters deep less than 5 meters from either shore. The main channel is deeper to allow for boat traffic to pass through safely. Most mussels prefer shallower water therefore, given the depth at the bridge, a typical snorkel survey was not conducted. Instead a small, hand-deployed dredge was used to take random samples of the lake bottom throughout the channel. Samples were taken to just short of the buoys marking the no wake zone which are approximately 15 meters from the bridge's center line. No live animals or shell material was found.


Figure 4. State Route 0018 location in red with coordinates.

*Kelly Road*

Kelly Road Bridge is located in Sharpsville and is the first bridge to span the Shenango River after the Shenango River Lake. Once a 2 lane bridge the downstream side, the original section, has been closed to vehicle traffic. The channel is fairly uniform with the left descending channel being slightly deeper than the right. Throughout much of the area surveyed the habitat is run with a mixture of cobble and boulder substrate. The more suitable habitat lies on the right descending side and was subsequently where 95% of the mussels encountered were found. Fifty-nine *Lampsilis siliquoidea* (fatmucket), 24 *Pyganodon grandis* (giant floater), and 17 *Amblema plicata* (threeridge) were found. Although shells of *Elliptio dilatata* (spike) were collected no live individuals were collected. Surface density is 0.07 $m^2$ with none of the species observed being listed either federally or by the state of Pennsylvania. Although one side of the bridge is closed it was taken into account when surveyed given it will be replaced during construction. Therefore 20 meters above and below the center line were surveyed. The area upstream and downstream has yet to be surveyed. It is scheduled to be completed during the summer of 2010.


Figure 5. Kelly Road Bridge location in red with coordinates.

*State Route 0318*

State Route 318 is locally known as Buckeye Drive and is located in West Middlesex. The right descending bank is the steeper of the 2 shorelines with large cobble and boulder substrate. The majority of the flow is confined to this side. The channel is bowl shaped with the deepest portion, 1.5 meters, found in the mid-channel. Downed trees and woody debris have collected in the silt substrate found in the mid-channel. The left descending bank is less steep and made up almost entirely of silt and organic material. The water, when the survey was conducted, was turbid and visibility reduced significantly. Three mussels were found during the survey which extended 20 meters in either direction from the center line. One *Lampsilis siliquoidea* (fatmucket) was found on the right descending bank under the bridge where a small stream enters the river. On the left descending side and just below the bridge a *Lampsilis radiata* (eastern lampmussel) was collected. An *Amblema plicata* (threeridge) was found slightly above the bridge on the same side. None of the species found are listed federally or by Pennsylvania.


Figure 6. State Route 0318 Bridge location in red with coordinates.

**Bridge Recommendations**

Of the 5 bridges surveyed, the construction and replacement of 2 represents the potential to impact freshwater mussel populations. The most significant threat to populations around and under bridges is the threat of being crushed under the weight of causeways and construction equipment. At both the Kelly Road Bridge and State Route 0318 the river is narrow and the area potentially impacted should be minimal. The removal of animals which would be affected by construction procedures would take no more than a week per bridge to conduct. Habitat immediately above both bridges is suitable for mussels, reducing the amount of time it would normally take for relocation efforts. *Amblema plicata* (threeridge) is currently up for status review in Pennsylvania and all measures to conserve this species as well as others should be taken. With survey efforts now completed it is more apparent the significance of mussels located beneath the bridges scheduled for replacement.

| Section | 1 | | | 2 | | | 3 | | | 4 | | 5 | | 6 | | | 7 | | | | 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | RKM | | | | | | | | | | | |
| **Species** | **1.4** | **2.8** | **4.4** | **6** | **7.6** | **9** | **10.6** | **12** | **13.4** | **14.8** | **16.2** | **18.2** | **20.2** | **21.4** | **22.6** | **24.7** | **26.8** | **28.9** | **31** | **32.6** | **34** | **35.8** | **37.2** |
| *A. ligamentina* | x | | | | | | | | | | | | | | | | | | | | | | |
| *A. marginata* | | | | | | | | | | | | | | | | | x | x | x | x | | | |
| *A. plicata* | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| *A. ferussacianus* | | | | | | | | | | | | x | | | | | | | | | | | |
| *E. dilatata* | x | x | x | x | x | x | x | x | | | x | x | x | x | | x | | x | | x | x | x | |
| *E. triquetra* | x | x | x | x | x | x | x | x | x | | x | x | x | x | | x | x | x | | x | | | |
| *F. subrotunda* | x | x | x | x | x | x | x | x | x | x | x | | | x | | x | | x | | | x | x | |
| *L. cardium* | x | x | x | | | x | | | | | | x | x | | | x | x | x | x | x | x | x | x |
| *L. fasciola* | x | | | | | | | | | | | x | | | x | x | | | | x | | | |
| *L. ovata* | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | | | | | |
| *L. radiata* | x | x | x | | | | | | | | | | x | | | | | | | | | | |
| *L. siliquoidea* | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| *L. compressa* | | | | | | | | | x | | x | | x | x | | | | | | | x | | |
| *L. costata* | | | | | x | | | | x | | | | | x | | x | x | x | | x | x | | |
| *L. nasuta* | x | x | x | x | x | x | x | x | | | x | | | | | | | | | | x | | |
| *O. subrotunda* | | | | | | | | | | | | | | | | | x | | x | | x | | x |
| *P. clava* | | | | x | x | x | | x | x | x | | | | | | | | | | | | | x |
| *P. sintoxia* | | | x | x | x | x | | x | x | x | | | | | | | | | | | | | x |
| *P. fasciolaris* | | | | | | | | | | | | | | | | | | x | | x | x | x | |
| *P. grandis* | x | x | | x | | x | x | x | x | | | | x | x | | x | x | x | x | x | | | x |
| *Q. cylindrica* | | | | | | | | | | | | | | | | x | x | x | x | x | x | x | |
| *T. verrucosa* | x | | x | x | x | x | x | | | x | x | | | x | x | x | x | x | x | x | x | x | x |
| *U. imbecillis* | x | x | | | x | | | | | | | | | | | | | | | | | | |

x = occurrence

| Sections | | |
|---|---|---|
| | Pymatuning to Liberty St | 1 |
| | Liberty St to Halfway Rd | 2 |
| | Halfway Rd to Porter Rd | 3 |
| | Porter Rd to Ohl St | 4 |
| | Ohl St to Wasser Rd | 5 |
| | Wasser Rd to Kidds Mill Rd | 6 |
| | Kidds Mill Rd to Hamburg Rd | 7 |
| | Hamburg Rd to Valley Rd | 8 |

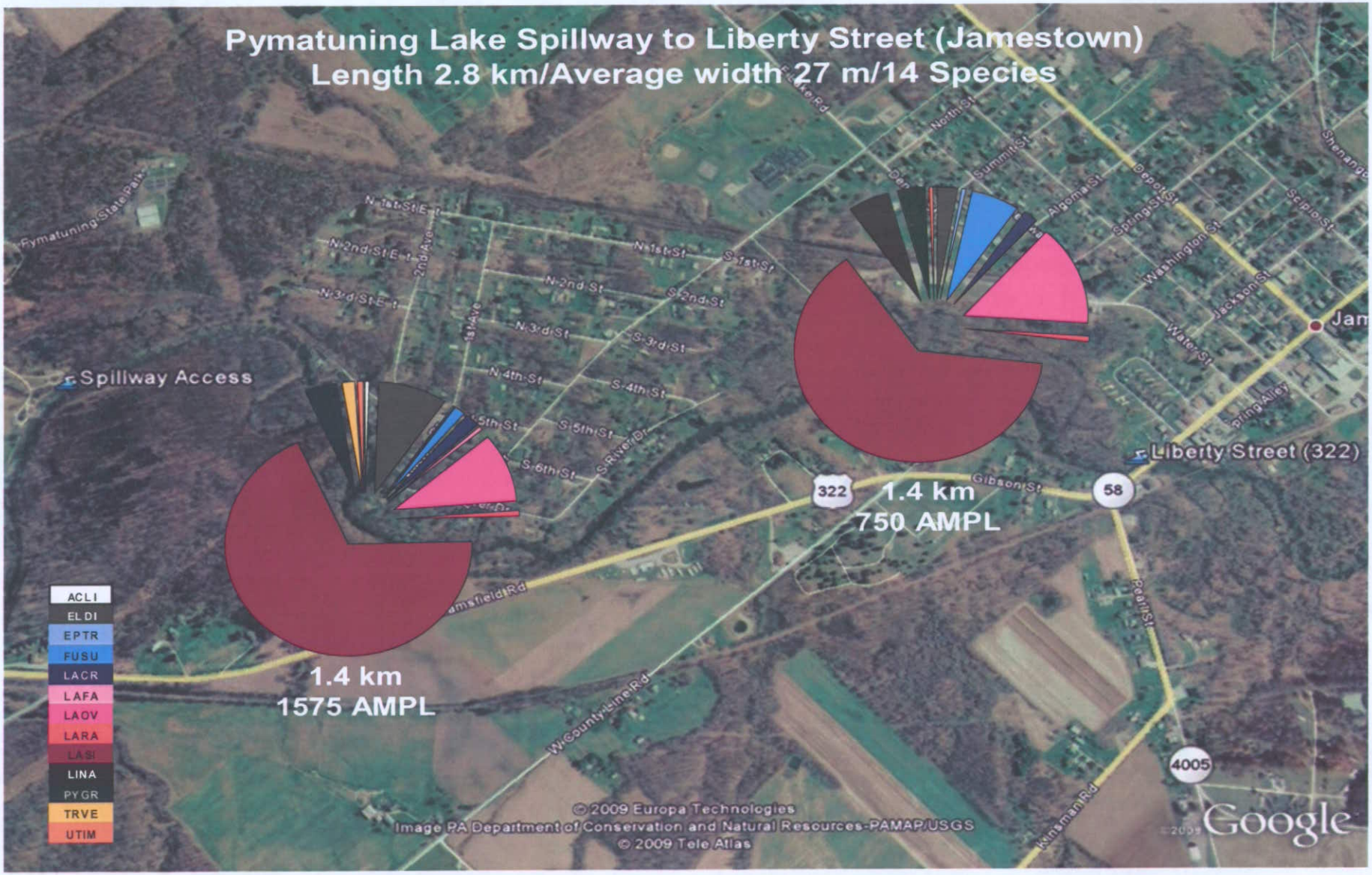
Figure 1. Occurrence of freshwater mussels in the Shenango River Pymatuning Reservoir to Shenango River Lake.

# Appendix 1

The following 8 slides (A-1 through A-8) begin at the spillway below Pymatuning Lake and are arranged upstream to downstream. Included is the reach name based on access locations, average width, number of species encountered, and length. For graphing purposes the total length was divided into shorter segments and that distance, in km, can be found beneath each graph. Also below each graph is the total number of *A. plicata* (AMPL) found. The species was often found in such high numbers that including them drowned out other species encountered less frequently. For mussels found in each reach a color coded legend is included on the bottom left of each slide. Below is a legend which includes all 23 species found, their abbreviation, full scientific name, and common name.

Legend

| Species | | |
|---|---|---|
| Abv | Scientific Name | Common Name |
| ACLI | *Actinonaias ligamentina* | mucket |
| ALMA | *Alasmindonta marginata* | elktoe |
| AMPL | *Amblema plicata* | threeridge |
| ANFE | *Anondontoides ferussacianus* | cylindrical papershell |
| ELDI | *Elliptio dilatata* | spike |
| EPTR | *Epioblasma triquetra* | snuffbox |
| FUSU | *Fusconaia subrotunda* | longsolid |
| LACO | *Lasmigona costata* | fluted shell |
| LACP | *Lasmigona compressa* | creek heelsplitter |
| LACR | *Lampsilis cardium* | plain pocketbook |
| LAFA | *Lampsilis fasciola* | wavy-rayed lampmussel |
| LAOV | *Lampsilis ovata* | pocketbook |
| LARA | *Lampsilis radiata* | eastern lampmussel |
| LASI | *Lampsilis siliquoidea* | fat mucket |
| LINA | *Ligumia nasuta* | eastern pondmussel |
| OBSU | *Obavaria subrotunda* | round hickorynut |
| PLCL | *Pleurobema clava* | clubshell |
| PLSI | *Pleurobema sintoxia* | pigtoe |
| PTFA | *Ptychobranchus fasciolaris* | kidneyshell |
| PYGR | *Pyganodon grandis* | giant floater |
| QUCY | *Quadrula cylindrica* | rabbitsfoot |
| TRVE | *Tritogonia verrucosa* | pistolgrip |
| UNKN | Unknown | |
| UTIM | *Utterbackia imbecillis* | paper pondshell |


Pymatuning Lake Spillway to Liberty Street (Jamestown)
Length 2.8 km/Average width 27 m/14 Species
Spillway Access
Liberty Street (322)
1.4 km
1575 AMPL
1.4 km
750 AMPL
ACLI
ELDI
EPTR
FUSU
LACR
LAFA
LAOV
LARA
LASI
LINA
PYGR
TRVE
UTIM
322
58
4005
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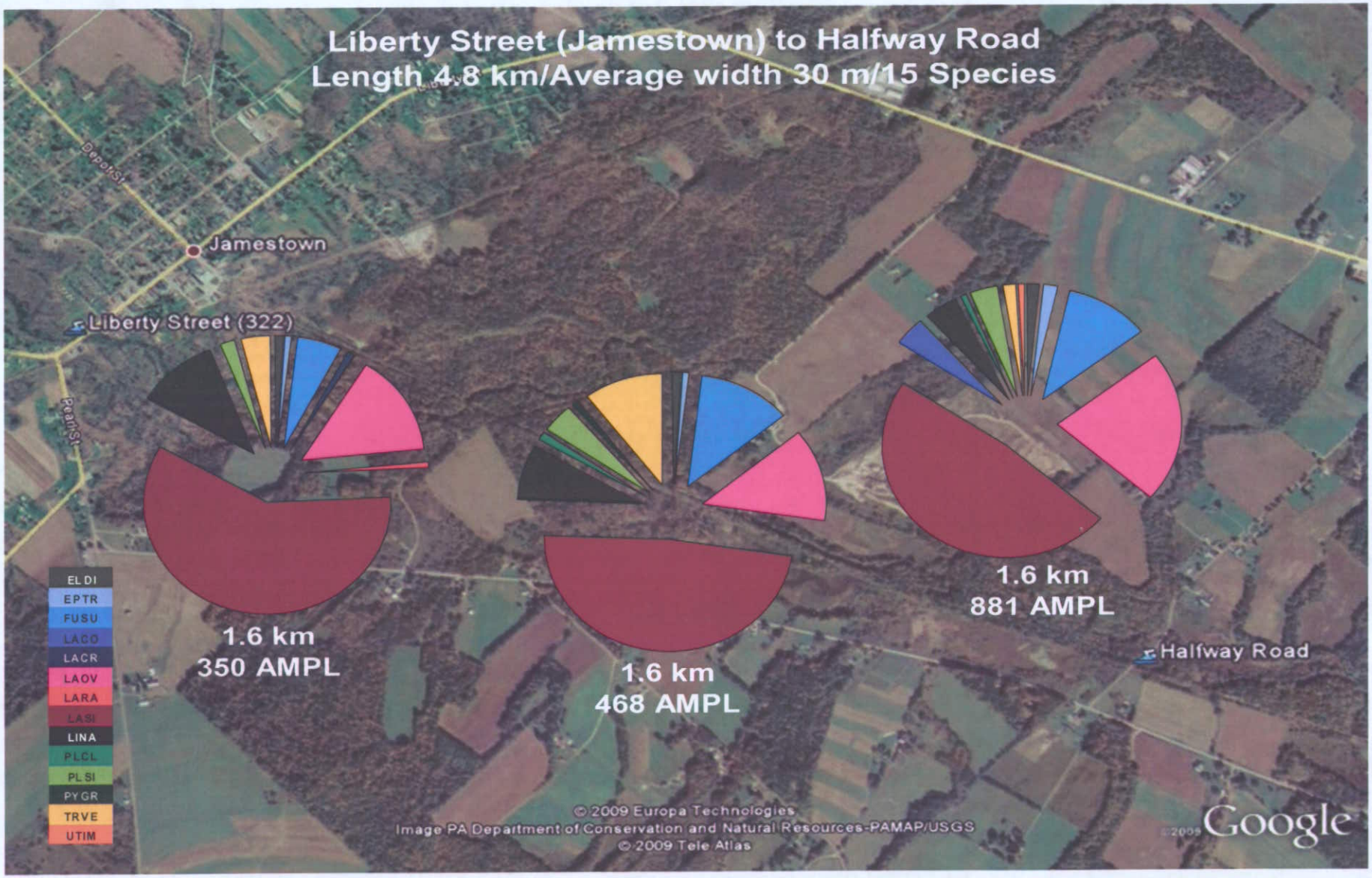
Liberty Street (Jamestown) to Halfway Road
Length 4.8 km/Average width 30 m/15 Species
Depot St
Jamestown
Liberty Street (322)
Pearl St
EL DI
EPTR
FUSU
LACO
LACR
LAOV
LARA
LASI
LINA
PLCL
PL SI
PYGR
TRVE
UTIM
1.6 km
350 AMPL
1.6 km
468 AMPL
1.6 km
881 AMPL
Halfway Road
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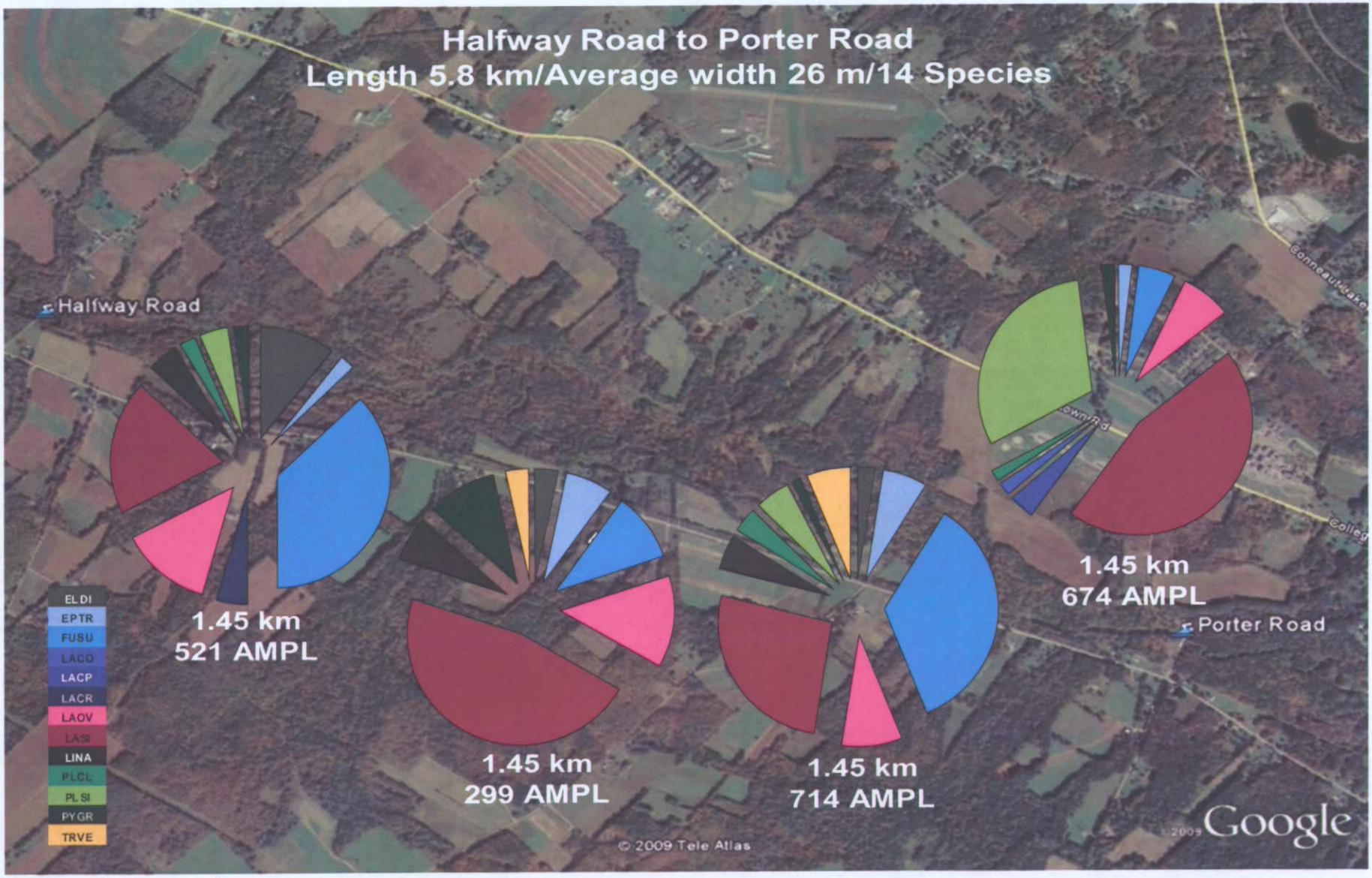
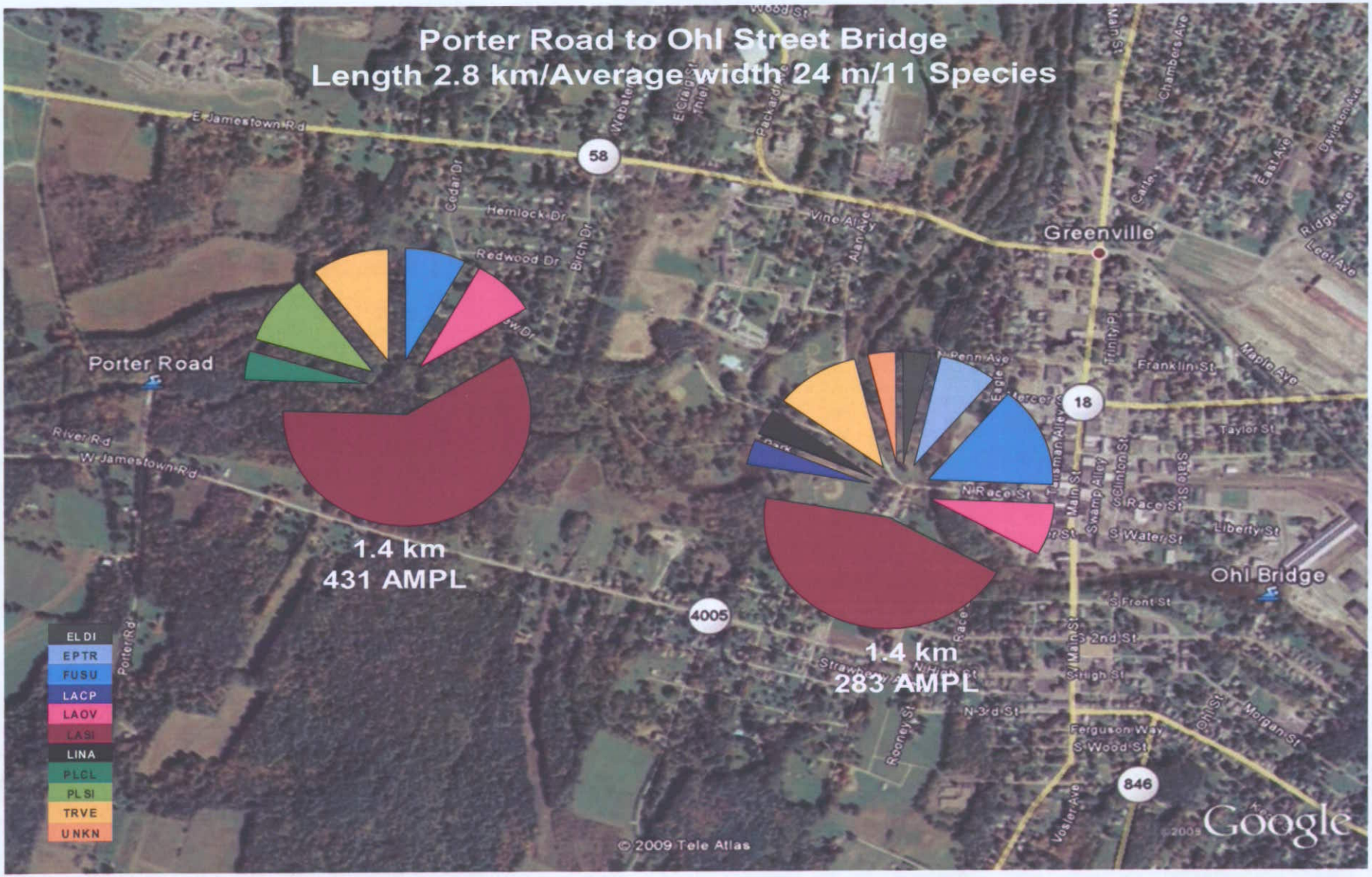

Halfway Road to Porter Road
Length 5.8 km/Average width 26 m/14 Species
Halfway Road
Porter Road
1.45 km
521 AMPL
1.45 km
299 AMPL
1.45 km
714 AMPL
1.45 km
674 AMPL
ELDI
EPTR
FUSU
LACO
LACP
LACR
LAOV
LASI
LINA
PLCL
PLSI
PYGR
TRVE
© 2009 Tele Atlas
Google


Porter Road to Ohl Street Bridge
Length 2.8 km/Average width 24 m/11 Species
Porter Road
1.4 km
431 AMPL
1.4 km
283 AMPL
Ohl Bridge
Greenville
EL DI
EPTR
FUSU
LACP
LAOV
LASI
LINA
PLCL
PL SI
TRVE
UNKN
58
18
4005
846
E Jamestown Rd
W Jamestown Rd
River Rd
Porter Rd
Cedar Dr
Hemlock Dr
Redwood Dr
Birch Dr
Vine Alley
Alan Alley
Penn Ave
Franklin St
Maple Ave
Taylor St
N Race St
S Race St
S Water St
Liberty St
S Front St
S 2nd St
N 3rd St
S Main St
Ferguson Way
S Wood St
Morgan St
Rooney St
Voller Ave
Chambers Ave
East Ave
Ridge Ave
Swamp Alley
Clinton St
Trinity Pl
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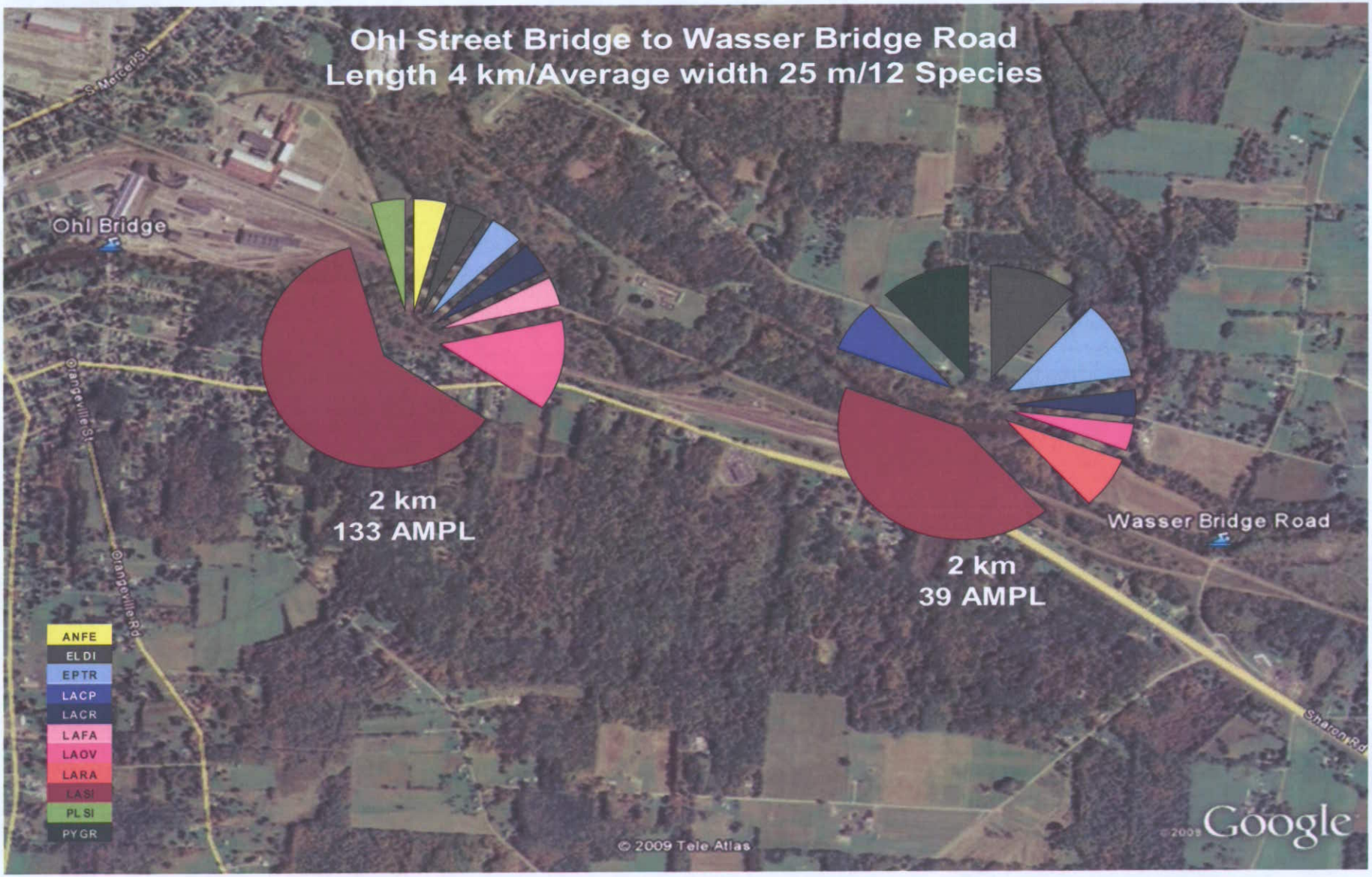
Ohl Street Bridge to Wasser Bridge Road
Length 4 km/Average width 25 m/12 Species
Ohl Bridge
2 km
133 AMPL
2 km
39 AMPL
Wasser Bridge Road
ANFE
ELDI
EPTR
LACP
LACR
LAFA
LAOV
LARA
LASI
PLSI
PYGR
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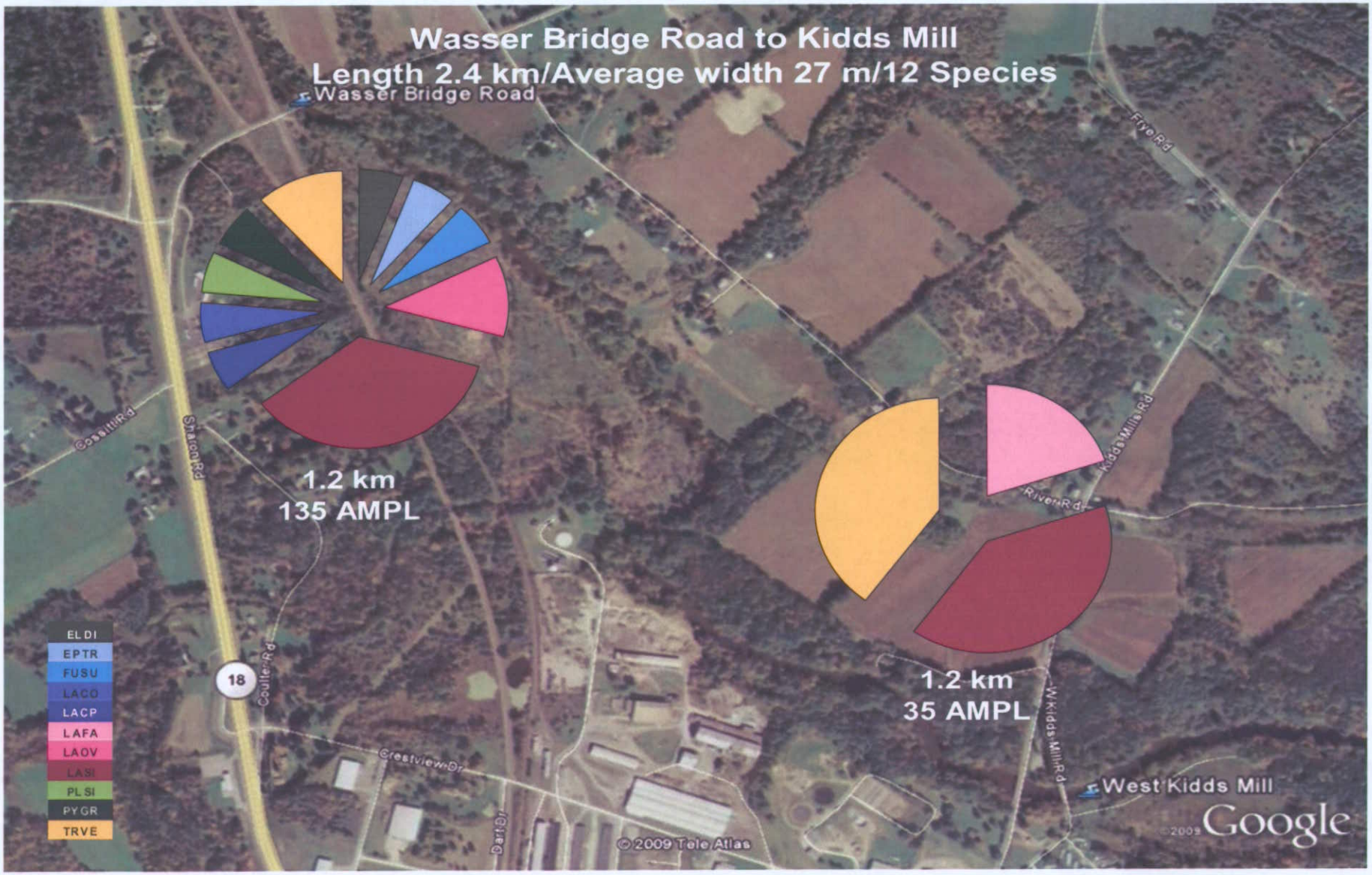
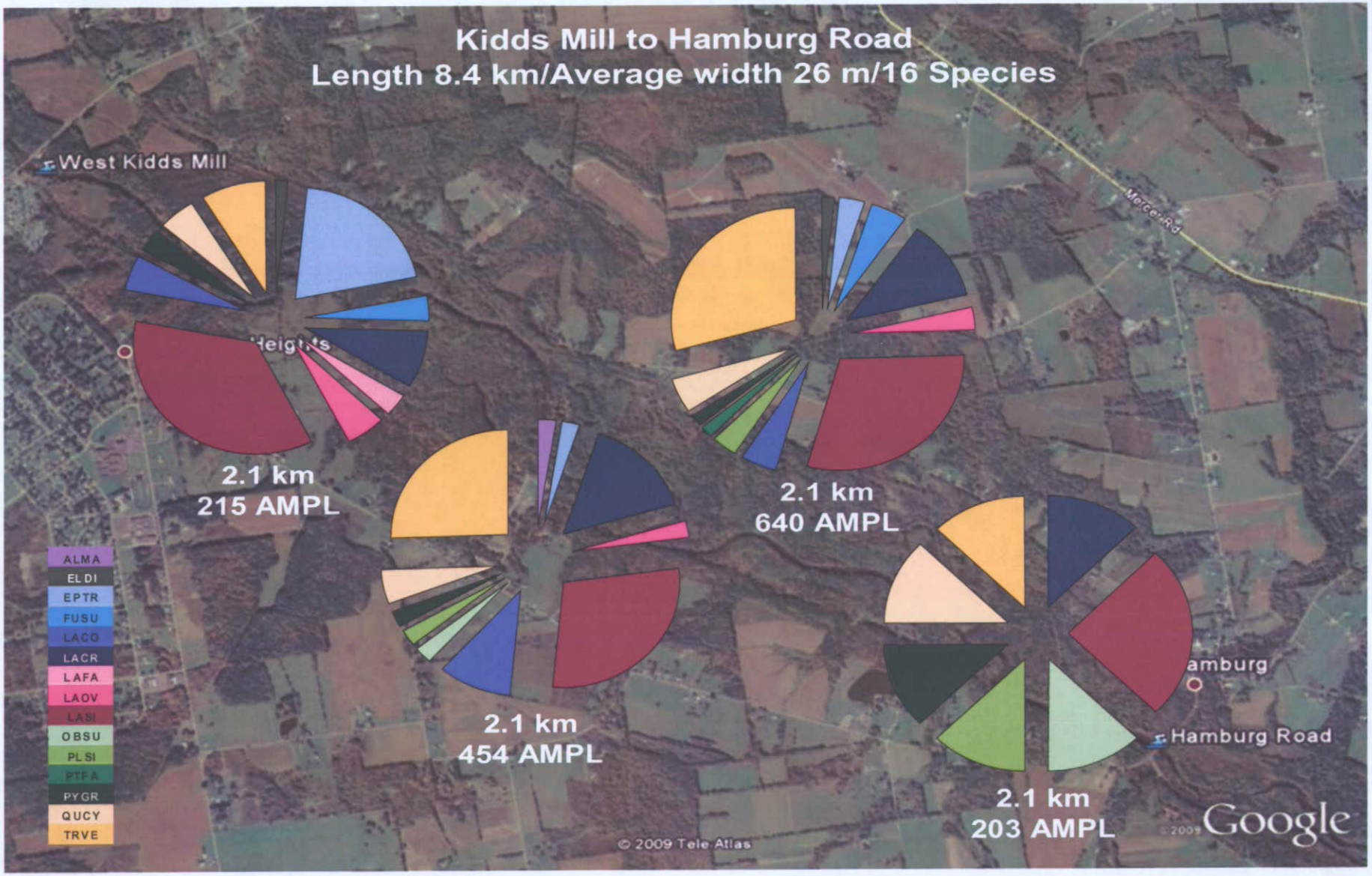

Wasser Bridge Road to Kidds Mill
Length 2.4 km/Average width 27 m/12 Species
Wasser Bridge Road
Frye Rd
Cassell Rd
Shannon Rd
1.2 km
135 AMPL
Kidds Mills Rd
River Rd
1.2 km
35 AMPL
N Kidds Mill Rd
West Kidds Mill
18
Coulter Rd
Crestview Dr
Dart Dr
© 2009 Tele Atlas
©2009 Google
ELDI
EPTR
FUSU
LACO
LACP
LAFA
LAOV
LASI
PLSI
PYGR
TRVE


Kidds Mill to Hamburg Road
Length 8.4 km/Average width 26 m/16 Species
West Kidds Mill
Mercer Rd
2.1 km
215 AMPL
2.1 km
640 AMPL
2.1 km
454 AMPL
2.1 km
203 AMPL
Hamburg Road
ALMA
ELDI
EPTR
FUSU
LACO
LACR
LAFA
LAOV
LASI
OBSU
PLSI
PTFA
PYGR
QUCY
TRVE
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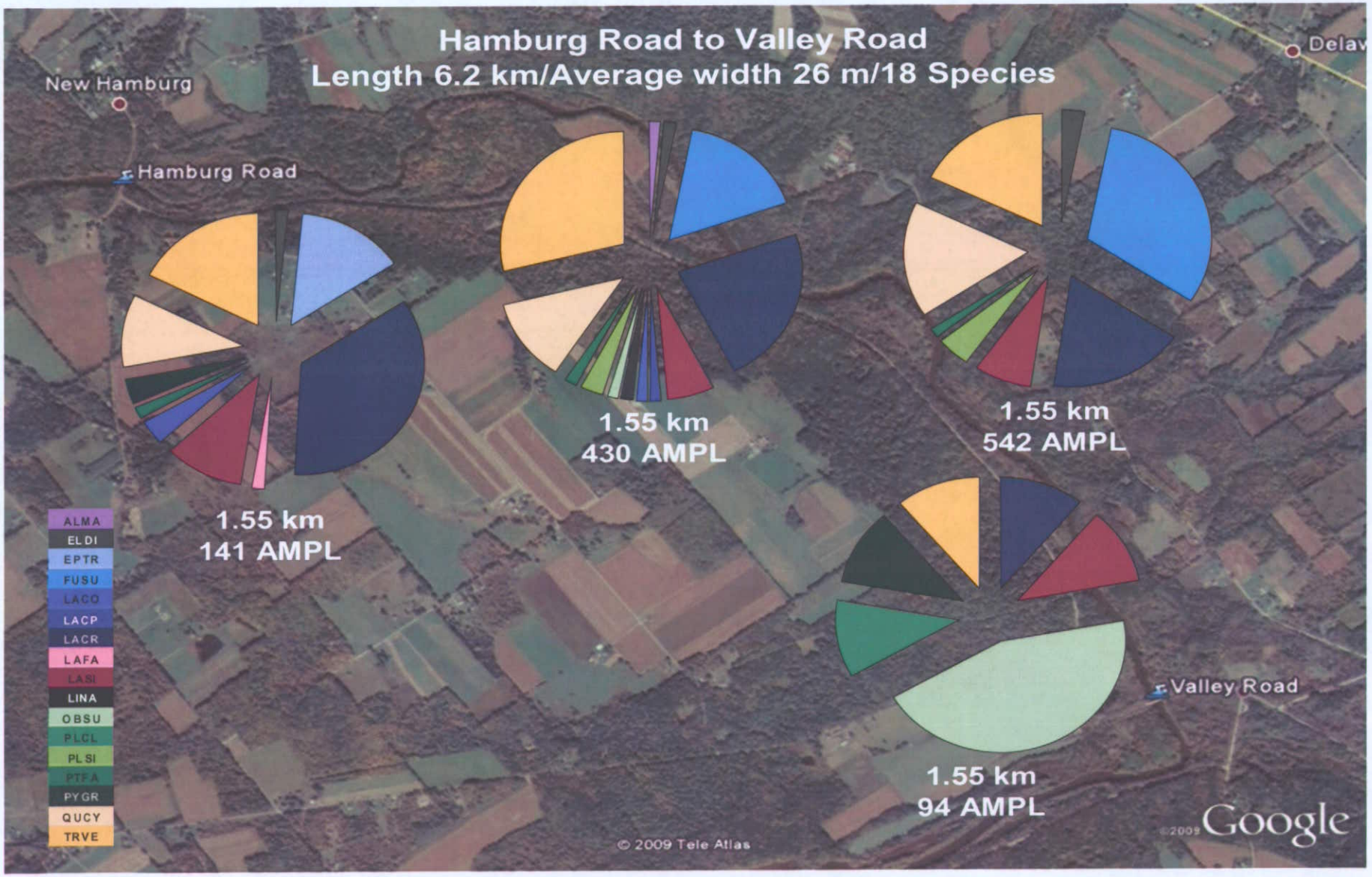
Hamburg Road to Valley Road
Length 6.2 km/Average width 26 m/18 Species
New Hamburg
Hamburg Road
Valley Road
1.55 km
141 AMPL
1.55 km
430 AMPL
1.55 km
542 AMPL
1.55 km
94 AMPL
ALMA
ELDI
EPTR
FUSU
LACO
LACP
LACR
LAFA
LASI
LINA
OBSU
PLCL
PLSI
PTFA
PYGR
QUCY
TRVE
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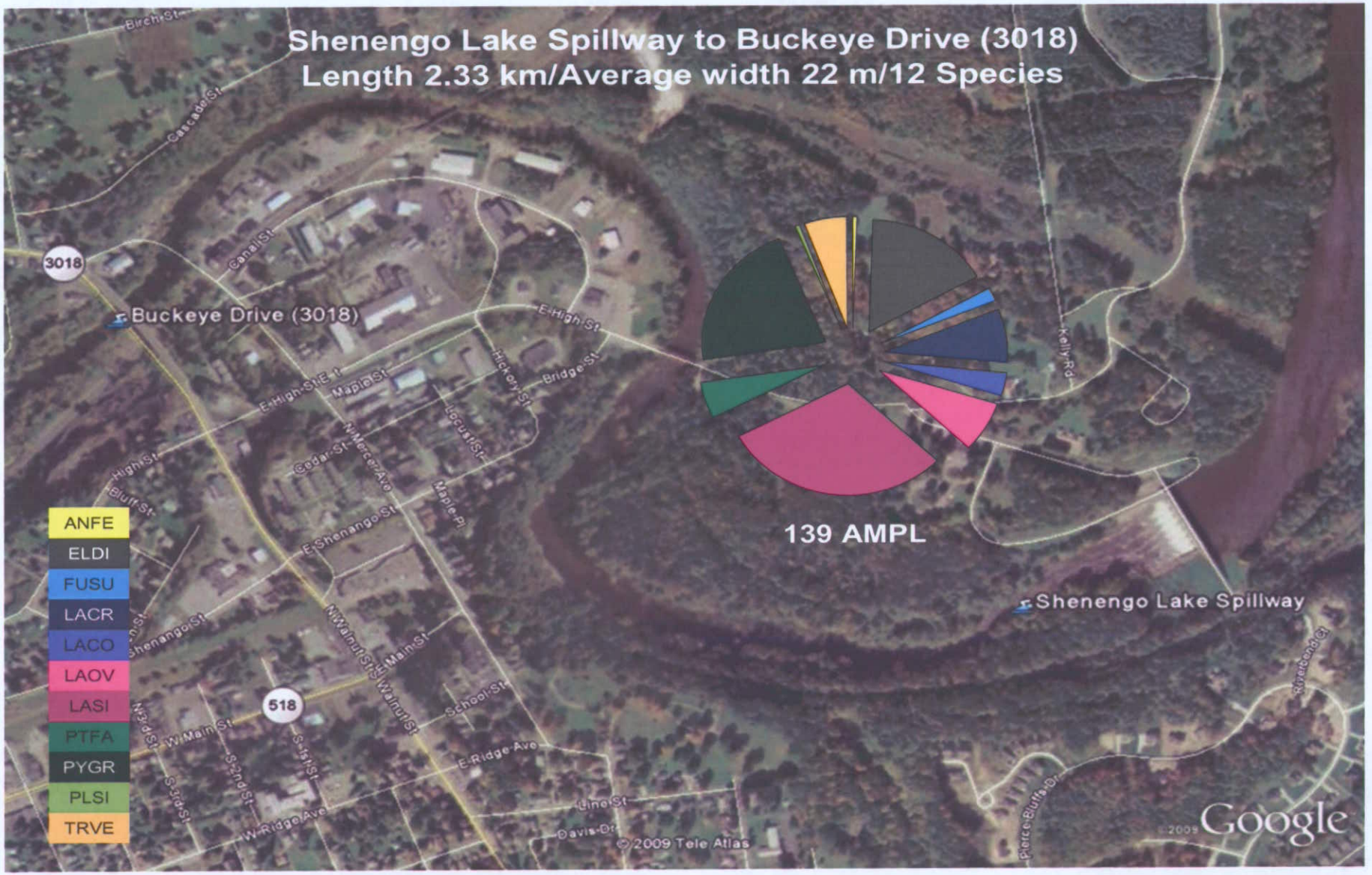
Shenengo Lake Spillway to Buckeye Drive (3018)
Length 2.33 km/Average width 22 m/12 Species
139 AMPL
ANFE
ELDI
FUSU
LACR
LACO
LAOV
LASI
PTFA
PYGR
PLSI
TRVE
Buckeye Drive (3018)
Shenengo Lake Spillway
3018
518
Birch St
Cascade St
Canal St
E High St
Maple St
Hickory St
Bridge St
Kelly Rd
Cedar St
N Mercer Ave
Locust St
High St
Bluff St
E Shenango St
Maple Pl
Shenango St
N Walnut St
S Walnut St
Main St
School St
W Main St
N 1st St
S 1st St
S 2nd St
S 3rd St
E Ridge Ave
W Ridge Ave
Line St
Davis Dr
Pierce Bluffs Dr
Shoreland Ct
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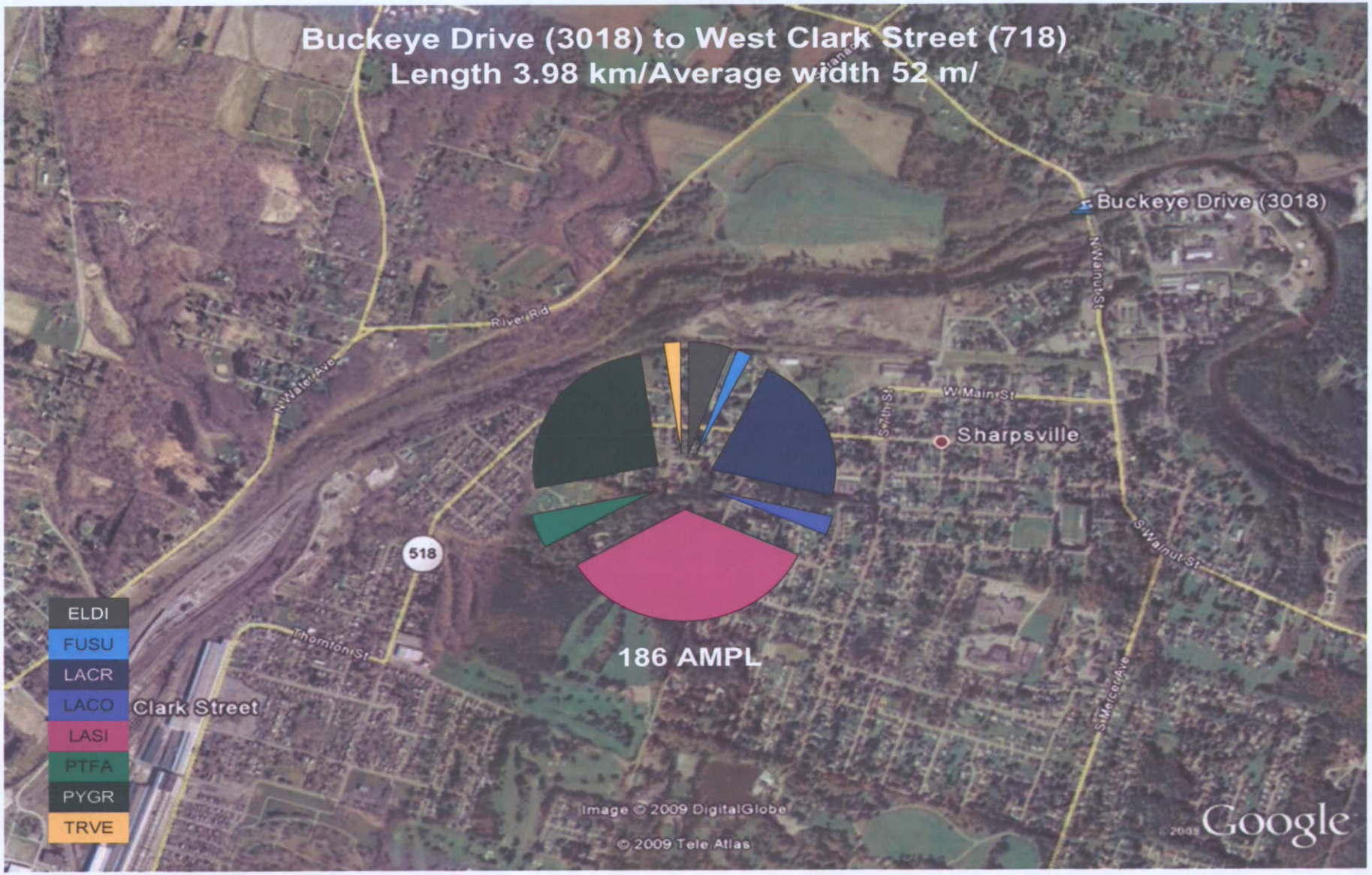
Buckeye Drive (3018) to West Clark Street (718)
Length 3.98 km/Average width 52 m/
Buckeye Drive (3018)
River Rd
N Water Ave
N Main St
W Main St
S 4th St
Sharpsville
518
S Walnut St
S Mercer Ave
Thornton St
Clark Street
ELDI
FUSU
LACR
LACO
LASI
PTFA
PYGR
TRVE
186 AMPL
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Seig Hill Road to Inters
Length 3.22 km/Average width 27
No Mussels Found
Broadway Rd
Council St
Seig Hill Road
718
Interstate 80
80
Image © 2009 DigitalGlobe
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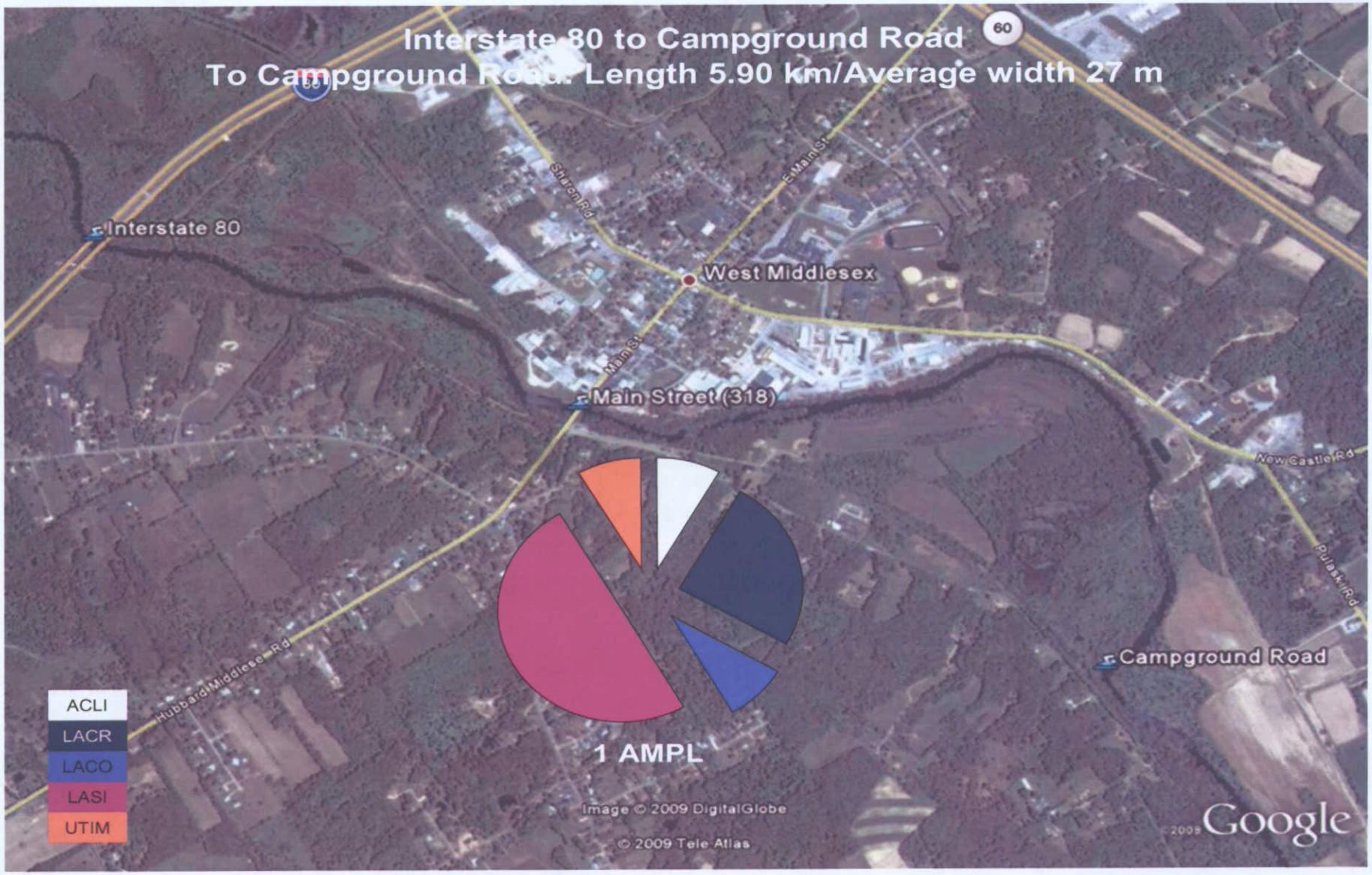
Google


Interstate 80 to Campground Road
To Campground Road. Length 5.90 km/Average width 27 m
Interstate 80
West Middlesex
Main Street (318)
Campground Road
Sharon Rd
E Main St
Main St
New Castle Rd
Pulaski Rd
Hubbard Middlesex Rd
ACLI
LACR
LACO
LASI
UTIM
1 AMPL
Image © 2009 DigitalGlobe
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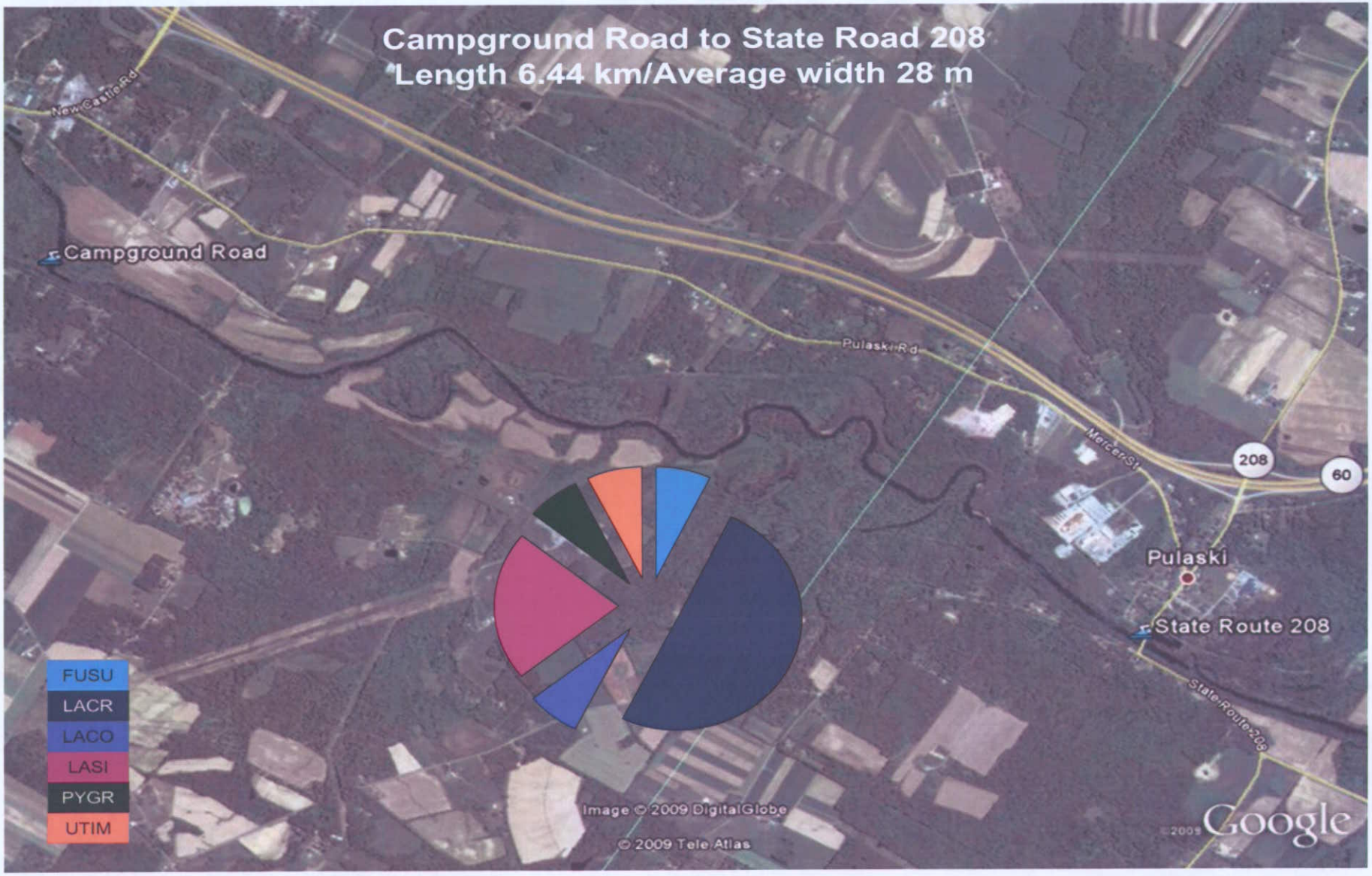
Campgroundd Road to State Road 208
Length 6.44 km/Average width 28 m
New Castle Rd
Campground Road
Pulaski Rd
Mercer St
208
60
Pulaski
State Route 208
State Route 208
FUSU
LACR
LACO
LASI
PYGR
UTIM
Image © 2009 DigitalGlobe
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State Road 208 to Nashua Road
Length 6.16 km/Average width 23 m
1 L. siliquoidea Found
208
60
Nashua Road
Nashua
Pulaski
State Route 208
551
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Nashua Road to King's Chapel Road
Length 6.71 km/Average width 28 m
No Mussels Found
Nashua Road
Nashua
60
Pulaski Rd
Kings Chapel Road/Pulaski Road
422
51
Image © 2009 DigitalGlobe
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