Enclosure 7

COE-FWS letter dated January 18, 2006
Transmittal of Draft Low Water Mussel Study Report

Depth Distribution of the Fat Threeridge Mussel, *Amblema neislerii*, during Low Flow Stages on the Apalachicola River, Florida (6 January 2005)

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

January 18, 2006

Inland Environment Team
Planning and Environmental Division

Mr. Jerry Ziewitz
U.S Fish and Wildlife Service
1601 Balboa Avenue
Panama City, Florida 32405

Dear Mr. Ziewitz:

Enclosed for your review and comment is a copy of a draft report of a survey and study conducted by Dr. Andrew Miller of the U.S. Army Corps of Engineers, Engineering Research Development Center, entitled "Distribution of the Fat Threeridge Mussel, *Amblema neislerii*, during Low Flow Stages on the Apalachicola River, Florida (6 January 2005)." This study looked at the locations and depths of known endangered or threatened mussel populations on the Apalachicola River in relationship to several low flow conditions on the river. We initiated this study in the fall of 2000 to determine the effects of a possible drought contingency action to reduce flows below the minimum flow of 5000 cfs specified in the 1989 draft Apalachicola, Chattahoochee, Flint River (ACF) Basin water control plan. Although we never pursued the proposed reduction of the minimum flow, we agreed to complete the low water mussel study in order to address the anticipated effects of low flows in planning for future drought contingency plans. This information will also be helpful in addressing the potential for impacts to mussels during future efforts to update the existing water control plan for the ACF basin. This information will eventually be incorporated into a biological assessment of the anticipated impacts of existing water management operations on federally-listed species, pursuant to Section 7 of the Endangered Species Act of 1973.

Because we are still reviewing information in the report, any reference to information in this report should cite that it is from a draft report.

If you have any questions or wish to discuss information included in this draft report, please contact Ms. Joanne Brandt, U.S. Army Corps of Engineers, Mobile District Compliance Manager, by telephone at (251) 690-3260; or by email at joanne.u.brandt@sam.usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

Enclosure

DRAFT

Depth Distribution of the Fat Threeridge Mussel, *Amblema neislerii*, during Low Flow Stages on the Apalachicola River, Florida

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Key words: endangered species, *Amblema neislerii*, mussels, Apalachicola River, Florida

6 January 2005

Abstract

A dive team was used to collect the fat threeridge mussel (*Amblema neislerii*) along transects running from shallow to deep water at moderately depositional near shore sites along the Apalachicola River, Florida, 18-20 November 2003. The purpose was to determine the depth distribution of *A. neislerii* to better evaluate effects of low water on its survival. At moderately depositional areas *A. neislerii* usually dominated, and on average comprised 35.8% of the fauna. Catch per unit effort per hour was 37.9 for all mussels and 13.6 for *A. neislerii*. These studies were completed at river stages ranging from approximately 3.5 ft to 4.5 ft, which is approximately equivalent to 9,000-11,000 cfs) on the Blountstown gage. *Amblema neislerii* was most abundant at a depth of approximately 4 ft (1.2 m) below the water surface (CPUE = 20), was common at depths of 3 ft. and 5 ft (0.9 m and 1.5 m) (CPUE = 11), and was much less common in very shallow and very deep water.

To analyze effects of extreme low water on freshwater mussels, estimates of water level elevations at discharges of 3,000 cfs (85 cms), 4,000 cfs (113 cms), 5,000 cfs (142 cms), and 6,000 cfs (170 cms) were made. These changes in elevation were used to estimate the percentage of the *A. neislerii* population that could be exposed at each study area if the discharge were to reach these reduced values. For example, it was estimated that at NM 73.3 the following percentages of *A. neislerii* would be exposed at reduced discharge: 49.1% (6,000 cfs), 53.9% (5,000 cfs), 67.9% (4,000) cfs, and 85.4% (3,000 cfs). Mussel mortality during extreme low water would be a function of duration of exposure, ambient temperature, amount of direct sunlight, and substratum type.

Introduction

Mussels of the Apalachicola River. The Apalachicola River provides habitat for an endemic freshwater mussel (Family: Unionidae) the fat threeridge, *Amblema neislerii*, which was listed as endangered on 15 April 1998. The decision to list this and 6 other mussel species in the Apalachicolan region was partially based on results of a status survey conducted at 324 sites in the Apalachicola-Chattahoochee-Flint (ACF) river basin and 77 sites along the Ochlockonee river systems, southeast Alabama, southwest Georgia, and north Florida (Federal Register 63(50): 12664-12687). The status survey was conducted by Jayne Brim Box and James D. Williams in 1991-93 using scuba, snorkeling, Plexiglas-bottomed buckets and hand-picking. Butler (1993) summarized their results for a status review of mussels of the Apalachicolan Region, and later Brim Box and Williams (2000) published their results. These and other studies were synthesized by Butler and Alam (1999) for the Technical/Agency Draft Recovery Plan, and then again for the Final Recovery Plan (Butler et al. 2003) which was signed on 19 September 2003.

Since 1996 biologists at the U.S. Army Engineer Research and Development Center (ERDC) (formerly known as the U.S. Army Engineer Waterways Experiment Station) have conducted numerous surveys for freshwater mussels (Family: Unionidae) in the Apalachicola River, using divers and waders, for the U.S. Army Engineer District, Mobile (Miller 1998, Payne and Miller 2002). Nearly 211 hours were expended searching at more than 100 sites in this 106-mile (171-km) long river. Those surveys were conducted to obtain information on the distribution and abundance of live freshwater mussels, especially *A. neislerii,* as well as a threatened mussel, the purple bank climber, *Elliptoideus sloatianus*. These surveys focused on areas proposed for use as within bank disposal areas for continued maintenance of the Apalachicola River navigation project. A few potential slough restoration sites and other potential maintenance areas were also surveyed.

Purpose of this study. The summer and fall of 1999 and 2000 in the southeast were characterized by extremely low rainfall that caused reduced flow and lowered surface water elevation in the Apalachicola River, FL. Drought conditions continued into 2001 and 2002, resulting in extended periods of times when flow conditions were as low as 5,000 cfs (142 cms), the minimum flow specified in the U.S. Army Corps of Engineers, Mobile District, current water control plan for the river basin. During the extreme drought conditions of this period, flows approached the minimum low flow of 5000 cfs for an extended period between late May and mid-November 2000. Observed inflows into the basin during the extended drought conditions in 2002 were as low as 1,000 cfs (28 cms), and storage from upstream reservoirs has been used to maintain at least the minimum flow of 5,000 cfs (142 cms) on the Apalachicola River. In the event upstream storage is not sufficient to provide the augmentation flows necessary to sustain a minimum 5,000 cfs (142 cms) discharge from Jim Woodruff Dam during future extended drought periods, a request for a variance from the 5,000 cfs (142 cms) minimum discharge in the water control plan could be requested and flows of less than 5,000 cfs (142 cms) could be experienced on the Apalachicola River. Greatly reduced water levels will negatively affect sloughs and most shallow shoreline habitats along the river and its tributaries. The major source of water for the river is discharge from Jim Woodruff Dam. Preliminary estimates have been made by the Mobile District to determine the extent of water level reduction for each 1,000 cfs (28 cms) increment of reduced discharge below 5,000 cfs (142 cms) from the dam (e.g., 4,000 cfs (113 cms) and 3,000 cfs (85 cms)). For example, at Apalachicola River Navigation Mile (NM) 35, each 1,000 cfs (28 cms) reduction in discharge could cause a decrease in surface water elevation of approximately 0.7 ft (0.2 m). Near the town of Wewahitchka, FL, there would be approximately 1.5 ft (0.5 m) decrease in elevation for every 1,000 cfs (28 cms) reduction in discharge below 5,000 cfs (142 cms).

Effects of extended periods of stage reduction could negatively affect freshwater mussels (Family: Unionidae), a resource with ecological, cultural, and economic value. Although mussels are tolerant of a certain amount of desiccation, there is no doubt that organisms stranded during low water are more likely to be eaten by predators and to be stressed or even killed by elevated air temperatures. Most backwater slough areas supporting the listed mussel species become disconnected from the main river channel at flows below 5000 cfs. This means the populations remaining in the main river channel are important to the sustainability of this species during extended drought periods. Although there are no extensive high-density mussel beds in the river, there are many moderately high-density zones in shallow areas near shore where many species, as well as one threatened and one endangered mussel species, can be collected. Reduced water levels could affect freshwater mussels in shallow areas along the main channel, as well as in backwater sloughs that normally connect to the river proper, and important mussel habitat areas in backwater sloughs and side channels could become isolated or suffer reduced inundation due to extended low river stages.

In November 2003 divers were used to collect mussels along transects running from shallow to deep water at depositional areas where *A. neislerii* was known to exist in moderate to high numbers. The purpose of this latter study was to analyze the abundance *of A. neislerii* with respect to water depth and to estimate possible effects of extreme low water on this species. *Amblema neislerii* was chosen for this analysis, rather than another listed species of concern, *E. sloatianus*, because the former species was abundant (on average about 10% of the fauna), commonly found nearshore, and distributed throughout the river. The latter species was less common (less than 2% of the fauna, typically found in deeper water, and tended to be more common in the upper reaches of the river.

Background on *A. neislerii*. Mussels have been studied sporadically in the ACF basin since the early 20th century. Van der Schalie (1940) summarized results of surveys conducted in 1915, 1916, and 1918 by multiple collectors working under the direction of Dr. Bryant Walker. Based on Van der Schalie (1940), early workers sampled 3 sites in the mainstem Chipola River and 22 sites in tributaries. The Apalachicola River was not sampled. *Amblema neislerii* was not found in tributaries and was taken only from the Chipola River; a single individual at 1 site and 16 at a second. This species comprised 1.49 % of the unionid fauna in the Chipola River, and 0.14% of the unionids at all sites in the watershed. They identified 25 species in the watershed although only 20 were from the mainstem Chipola River.

North Florida rivers were surveyed for molluscs in 1953-54 by Clench (1955) and Clench and Turner (1956). Clench and Turner (1956) reported that *A. neislerii* was rare, although when found it could be locally abundant. They considered it to be extinct in the upper Flint River where it had not been taken since the latter part of the previous century. Evidently they found live specimens in the Flint, Apalachicola, and Chipola rivers. *Amblema neislerii* was 'amazingly abundant' in a natural impoundment in the lower Chipola River (referred to as Dead Lake) where 10-15 *Crenodonta* (=*Amblema*) *neislerii* could be found in "every square meter" along a 200-meter reach.

In a survey conducted for the Office of Endangered Species, U.S. Department of the Interior, Heard (1975) collected mussels at 150 locations in the Gulf and Southeastern States. Three sites were in the Apalachicola and four were in the Chipola River. He provided no information on sampling methods, intensity of his efforts, or exact sample locations. He collected live *A. neislerii* only in the lower Chipola River (Dead Lake). He reported no live *A. neislerii* in the Apalachicola River although he did find shells at one of his three study sites.

Richardson and Yokley (1996) collected mussels in the lower Apalachicola River using quantitative (6-0.25 sq m total substratum removal samples) at each of 3 sites where adult *A. neislerii* or *E. sloatianus* had previously been found by individuals working for the U.S. Fish and Wildlife Service and National Biological Survey. *Amblema neislerii* was found at 1 of the 3 sites (Navigation Mile (NM) 21.8) where it comprised 25% of the assemblage. Three live organisms were less than 50 mm total shell length, and Richardson and Yokley (1996) concluded that appropriate search methods (total substratum removal) at other sites in the Apalachicola River would likely yield additional evidence of recent recruitment.

Brim Box and Williams (2000) discussed results of their 1991-92 survey in which they used timed searches to collect unionids at 324 sites in the ACF River Basin. They identified 33 species from a collection of 5,757 live individuals and 2,988 shells. The majority of collecting sites were in the Chattahoochee and Flint rivers upriver of Jim Woodruff Lock and Dam. Brim Box and Williams (2000) collected 32 live *A. neislerii* at 7 sites. Four sites had shells only; live *A. neislerii* were only found in the Apalachicola River. Butler (1993) and Butler et al. (2003) summarized those results for subsequent status reviews for *A. neislerii*.

Scientists at ERDC surveyed various portions of the Apalachicola River for the Mobile District in 1996, 1997, 1999, 2001, and 2002 (Table 2). Combining all of these data (and excluding those collected in 2003), *A. neislerii* comprised 10% of the fauna and ranked 4th of 19 species (Table 2). The most abundant species in the collection of more than 4,200 specimens was *Lampsilis teres* that comprised 35.2% of the fauna. This species, typically found in sandy substratum, comprised 36% of the fauna and was found at 57% of the sites. Overall Collection per Unit Effort (CPUE per hour) for all mussels was 21.9 and for A. *neislerii* was 2.2. *A. neislerii* was approximately 1/3 as abundant as the extremely common bivalve, *L. teres*, which is typically collected in large numbers in sandy substratum in rivers, streams, and lakes throughout the Midwest (Cummings and Mayer 1992).

Amblema neislerii also dominated the fauna at a moderately depositional site (not a disposal area) where the Chipola Cutoff joins the Apalachicola River (NM 41.7). At this location overall CPUE was 145, and *A. neislerii* was collected at the rate of nearly 90 per hour and comprised slightly more than 61% of the fauna. Total shell length for this species ranged from 12.8 to 63.7 mm and this population exhibited good evidence of recruitment.

Study Area

The Apalachicola River, formed by the confluence of the Flint and Chattahoochee rivers, originates at NM 106.3, just south of Lake Seminole in the tailwater of Jim Woodruff Lock and Dam. This 171-km (106-mile) river is the largest in Florida with a mean annual flow of 690 m^3/sec (24,367 ft^3/sec) (Light et al. 1988). The river enters the Apalachicola Bay at Apalachicola, Florida. The Apalachicola-Chattahoochee-Flint (ACF) River Basin, in Georgia and northeastern Florida, drains approximately 210,448 hectares (520,026 acres).

In 1875 the U.S. Army Corps of Engineers (USACE) was authorized to maintain a navigation channel in the Apalachicola River (U.S. Army Engineer District, Mobile 1986). In the 1950s, the modern 9-foot depth x 100-foot width (2.7 m x 30.5 m) navigation project was constructed. Dredging took place in the main channel, oxbows, tributaries, and sloughs, and dredged material was placed on the floodplain and within the natural riverbanks. Dredging is now restricted to the main channel and dredged material is primarily placed at specifically designated within bank disposal areas along the channel. In the 1980s nearly 150 disposal sites were permitted throughout the river in accordance with an approved Navigation Maintenance Plan, although in any one year only some will be used. Disposal areas are typically located on point bars, which are erosional, with the intent that seasonal high water would redistribute the deposited sediments downriver to natural accretion areas. Although maintained for commercial navigation, barge traffic in the Apalachicola River is light, having reduced from over 1 million tons per year in the 1980s to less than 300K tons in recent years due to extended low water conditions and unreliable navigation channel conditions.

In 2003 divers were used to collect mussels at 6 locations along the Apalachicola River and two locations near the entry of the Chipola Cutoff off the Apalachicola River? (Table 1, Figures 1-6). *Amblema neislerii* was known to exist in high numbers at these locations based on previous sampling. Along the Apalachicola River mussels were collected immediately downriver of Disposal Areas 65A, 66A, 63, 70, 107A, as well as a location at NM 30 near Douglas Slough. On the Chipola Cutoff two non-disposal areas were sampled for mussels, one at the entry into the Chipola Cutoff and one about 500 m downstream inside the cutoff.. During this survey searches for mussels were also made at several locations in the River Styx, Battle Bend, and Swift Slough. Although live specimens of *A. neislerii* were collected at these sites, substantial numbers were not found; therefore, these sites are not included for discussion in this report.

Methods

Mussel Surveys. Mussels were collected using a 6-person dive crew equipped with surface supplied air and communication equipment on 18-20 November 2003. During the survey period gauge height and discharge at Blountstown (NM 78) was 3.63 ft, 9,420 cfs (18 Nov 03), 4.17 ft, 10,300 cfs (19 Nov 03), and 4.94 ft 11,500 cfs (20 Nov 03). All work was done tactilely since visibility was poor. At each location 2 divers worked simultaneously, usually for 15-20 minutes. They were equipped with a pneumofathometer to record water depth and were tethered to the boat with a 100-m line. Divers worked transects from shallow to deep water, collecting mussels at 1 ft (0.3 m) increments between 2 and 9 ft (0.6 and 2. 7 m) deep. At each depth interval divers worked for 15 minutes. This provided information on catch per unit effort (CPUE), and percent species abundance at each depth increment at each sampling site. Divers communicated information on substratum conditions, water velocity, water depth, and presence of mussels to the tenders as they worked. Although every effort was made to keep divers at each depth increment, in reality they probably strayed above and below each increment. For example, samples take at the 4ft depth (1.2 m) likely included mussels living at a depth between 3.5 and 4.5 ft deep (1.1 and 1.4 m).

At the end of each collecting period all live mussels collected were returned to the boat or a station onshore. Live organisms were counted, identified, and returned to the river at a suitable location not likely to be disturbed by planned maintenance. Mussel taxonomy is consistent with Williams et al. (1993).

Low Water Elevation Predictions. The minimum flow specified in the current operating water control plan for the ACF is 5000 cfs. Incidents of releases from Jim Woodruff Dam below 5000 cfs have been rare, but did occur for 1 day during the 1981 drought, and on 48 days during the 1986-1988 drought. The lowest monthly observed flow on the Apalachicola River during the recent 1998-2002 drought occurred during June and July 2000 when discharge at Jim Woodruff Lock and Dam was about 5,000 cfs (142 cms). Historically, mean daily discharge at Jim Woodruff Lock and Dam has never been as low as 3,000 or 4,000 cfs (85 or 113 cms). Therefore, the slope of the river at 5000 cfs was used to estimate the equivalent river elevation at discharges less than 5,000 cfs (142 cms).

Using 5 continuous Apalachicola River recording gages, a low water profile was developed from observed daily stages. The steps below briefly describe methods to estimate the elevation at the locations where mussels were collected in November 2003.

1. Developed surface water profile for July 4-6, 2000.
2. Computed the surface water slope between each gage site.
3. Extended the Chattahoochee stage discharge rating to estimate the stage for 3,000 and 4,000 cfs (85 or 113 cms).
4. Using the slope from step 2 and estimated elevation from step 3, the river profile for 3,000 and 4,000 (85 or 113 cms) was estimated.
5. The elevation at the mussel collecting sites was computed using linear interpolation.

The above calculations required the following assumptions:

1. All elevations are feet above NGVD 1929.
2. The base flow is the same as during the June and July 2000 drought conditions.
3. There was no tidal effect at the most downstream gage, at Sumatra., Florida.
4. The hydraulic energy gradient was the same for all 3 flows.
5. Recording gages located at Chattahoochee, Blountstown, Wewahitchka, Mile 35 and Sumatra, FL.

Predicting Effects of Reduced Water Levels on the Mussel Fauna. CPUE was treated as a density estimate for these calculations. CPUE data at each sampling location was used to obtain the percentage present at each depth increment. The relationship between discharge and changes in elevation were related to depth distribution of mussels to provide an estimate of the percentage of *A. neislerii* that would be exposed at reduced water levels at each location. Mussel mortality cannot be estimated simply from exposure data. The effects of desiccation on mortality would be affected by various factors including 1) Size and age of the individual mussel, 2) Ambient temperature, 3) Duration of the atmospheric exposure, 4) Sediment type, and 5) sediment moisture content. This will be discussed in more detail below.

Results and Discussion

The Biotic Assemblage. The relative abundance of *A. neislerii* was high when sampling was restricted to moderately depositional sites downriver of point bars. At 7 moderate depositional sites this species ranked number 1 of 12 species and comprised 35.8% of the fauna (Table 2). CPUE was 37.9 for all mussels and 13.6 for *A. neislerii*. Sediment moisture content varied from 31.2 to 44.7%, and organic content from 1.2 to 2.7% along transects running from shallow to deep water (Figure 7). There was no significant relationship between water depth and organic or moisture content. CPUE ranged from 0.5 to 20.2 and from 6.3 to 55.9 for *A. neislerii* and all mussels respectively, along these transects. The maximum CPUE for *A. neislerii* and total mussels was at a depth of 1.2 m (4 ft) (Figure 2). Depths less than 1.2 m (4 ft) are probably more stressful for mussels because of predation and exposure during extreme low water. Moving toward the thalweg habitats becomes less suitable as sediments become more erosional. See Tables A1 and A2 in the Technical Appendix for detailed information on the sites surveyed in 2003.

Early reports on *A. neislerii* (van der Schalie 1940, Clench and Turner 1956, Heard 1975) give an impression of rarity, although by today's standards it is difficult to critically review these papers without knowing more details. An extreme example is a short paper (< 200 words) by Hyning (1925) in which he refers to this species as 'rare.' Hyning

(1925) described being given an unknown number of A. *neislerii* from the Chipola River by a fisherman.

Results of this survey conducted in 2003 indicate that *A. neislerii* is abundant in appropriate habitats in the Apalachicola River. Like its congener *Amblema plicata*, this species does best in slightly depositional zones in medium-sized to large rivers, and is less common in smaller streams and high-velocity zones. Therefore, *A. neislerii* was probably never common in the smaller Flint or Chipola Rivers, and is mainly found in moderate to high numbers in appropriate habitat in the Apalachicola River. It is endemic to the ACF basin because it has been isolated from the Mississippi drainage by marine conditions to the south and physiography to the east and north. It is likely that if earlier workers had access to power boats and a dive crew, they would likely have found this species alive and well in the Apalachicola River.

Results of surveys conducted by ERDC biologists since 1996 indicate that while *A. neislerii* is listed as endangered it can be easily collected at moderately depositional sites where it often dominates. During our survey, conducted 18-20 November 1993, this species was most abundant at a depth of 4 ft (1.2 m) and moderately abundant at 3 ft (0.9 m) and 5 ft (1.5 m) deep (Figure 8). It was much less common in water deeper than 5 ft (1.5 m) where conditions were likely too erosional. It was also much less abundant in water less than 0.9 m deep, probably because it was subjected to predation and desiccation.

Effects of Extreme Low Water on *A. neislerii*. To analyze effects of extreme low water on freshwater mussels, estimates of water level elevations at discharges of 3,000, 4,000, 5,000, and 6,000 cfs (85, 113, 142, and 170 cms) were made (Table 4). At each study site during the November survey, daily discharge was approximately 10,000 to 12,000 cfs (283 to 340 cms) (Table 4). Discharge of less than 5,000 cfs (142 cms) at Jim Woodruff Lock and Dam has rarely been recorded, but has occurred during extended severe drought periods. It was estimated that a discharge of 4,000 cfs (113 cms) could result in an elevation loss of from 4.1 to 5.4 ft (1.2 to 1.6 m), and a discharge of 3,000 cfs

(85 cms) could result in decline of 4.7 to 6.1 ft (1.4 to 1.8 m) (Table 5) below the river stages observed during the November 2003 survey (Table 5).

The percentage of *A. neislerii* along the shore that would be exposed by incremental declines in water level at each of the 2003 study areas was estimated (Table 6a). For example, it was estimated that at NM 73.3 the following portions of the *A. neislerii* assemblage would be exposed at reduced discharge: 49.1% (6,000 cfs), 53.9% (5,000 cfs), 67.9% (4,000 cfs) and 85.4% (3,000 cfs). At navigation miles 41.5, 46.8, 48.4, and 49.0 substantially more mussels would be exposed at each 1,000 cfs change in discharge (up to 100% at a discharge of 3,000 cfs). These percentage values were then used to estimate the actual number of *A. neislerii* that would be exposed (see Table A1)at each of the four discharge values (Table 6b). The estimated number of mussels exposed to the atmosphere at the four discharge values (Table 6b) was determined by multiplying the percentages for each discharge value (Table 6a) by the number of *A. neislerii* collected in one hour of sampling. For example, at NM 30 a total of 11 *A. neislerii* were collected in one hour. Therefore, at 3,000, 4,000, and 5,000 and 6,000 cfs it was estimated that 6.1, 5.2, 2.1 and 0.0 *A. neislerii* would be exposed to the atmosphere.

Just because mussels are exposed to the atmosphere does not necessarily mean they will be stressed or even killed. Mussel mortality will be a function of duration of exposure, ambient temperature, amount of direct sunlight, and substratum type. Mussels that are partially buried in cool, moist substratum would likely survive much better than those lying on top of the substratum and directly exposed to sunlight.

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Table 1. Location of samples sites searched for ***A. neislerii***, November 2003. Surveys were conducted immediately downriver of 5 Disposal Areas (DA), along the shore, near the mouth of Douglas Slough, and at 2 sites near the entry of the Chipola Cutoff off the Apalachicola River.						
WP	**Date**	**Time**	**Longitude**	**Latitude**	**Notes**	**NM**
145	18-Nov-03	2:54:00 PM	85.11685	30.02453	Near mouth of Douglas Slough	30.0
150	19-Nov-03	9:24:00 AM	85.11959	30.1978	DA 65A	48.4
152	19-Nov-03	10:28:00 AM	85.11996	30.1978	DA 65A	48.4
153	19-Nov-03	11:32:00 AM	85.11645	30.20457	DA 66A	49.0
154	19-Nov-03	12:58:00 PM	85.09632	30.22057	DA 70	53.4*
155	19-Nov-03	2:15:00 PM	85.13486	30.18173	DA 63	46.8
156	19-Nov-03	3:42:00 PM	85.147	30.12915	Near entry into the Chipola Cutoff	41.5
157	19-Nov-03	5:09:00 PM	85.14982	30.13413	500 m inside the Chipola Cutoff	41.5
158	20-Nov-03	7:55:00 AM	85.02044	30.39815	DA 107A	73.3
159	20-Nov-03	8:59:00 AM	85.02091	30.39801	DA 107A	73.3
160	20-Nov-03	9:45:00 AM	85.02015	30.39808	DA 107A	73.3
*Note - Although mussels were found at NM 53.4, no *A. neislerii* were collected at this location						

Table 2. Summary of timed searches for mussels at disposal areas, slough mouths, or banks requiring maintenance in the Apalachicola River Florida, 1996, 1997, 1999, 2001, and 2002.

Species	% Abundance	% Occurrence	CPUE, hr
Lampsilis teres	35.22	58.3	7.70
Glebula rotundata	23.81	46.9	5.20
Elliptio icterina	14.48	22.9	3.16
Amblema neislerii	10.00	22.9	2.19
Quincuncina infucata	2.76	22.9	0.60
Elliptio crassidens	1.64	16.7	0.36
Megalonaias nervosa	1.55	15.6	0.34
Elliptoideus sloatianus	1.69	9.4	0.37
Pyganodon grandis	1.31	19.8	0.29
Elliptio complanata	6.12	15.6	1.34
Toxolasma paulus	0.40	8.3	0.09
Utterbackia imbecillis	0.21	6.3	0.05
Villosa villosa	0.19	3.1	0.04
Pyganodon cataracta	0.16	3.1	0.04
Uniomerus caroliniana	0.12	3.1	0.03
Elliptio arctata	0.19	3.1	0.04
Utterbackia peggyae	0.07	2.1	0.02
Pyganodon heardi	0.05	2.1	0.01
Lampsilis claibornensis	0.05	2.1	0.01
Total locations	96		
Total individuals	4,268		
Total species	19		
Time, hr	195.3		
CPUE, hr	21.9		

Table 3. Summary statistics, freshwater mussels survey at moderately depositional sites in the Apalachicola River, Florida, 18-20 November 2003.					
	Abundance		**Occurrence**		
Species	**Number**	**Percent**	**Number**	**Percent**	**CPUE**
A. neislerii	208	35.80	47	47.0	13.57
G. rotundata	188	32.36	55	55.0	12.26
L. teres	62	10.67	28	28.0	4.04
E. icterina	48	8.26	21	21.0	3.13
Q. infucata	24	4.13	14	14.0	1.57
E. complanata	16	2.75	7	7.0	1.04
P. grandis	16	2.75	9	9.0	1.04
M. nervosa	6	1.03	4	4.0	0.39
U. peggeya	5	0.86	4	4.0	0.33
T. paulis	4	0.69	4	4.0	0.26
E. crassidens	2	0.34	2	2.0	0.13
V. lienosa	2	0.34	2	2.0	0.13
Total samples		100			
Total individuals		581			
Total species		12			
Total time, min		920			
CPUE, hr		37.9			
A. neislerii, CPUE, hr		13.6			

Table 4. Observed profile (6,000 and 5,000 cfs, 170 and 142 cms) plus estimated elevations (4,000 and 3,000 cfs, 113 and 85 cms) corresponding to survey dates. See Table 1 for sample site locations and methods section for discussion of how these data were obtained. WP = waypoint, NM = Navigation Mile, and nd = no data.

WP	NM	Notes	Estimates of elevation and discharge for survey dates		Estimates, ft			
			Elevation, ft	Daily discharge at Chattahoochee, cfs	6,000	5,000	4,000	3,000
Nd	20.3	Sumatra	nd	nd	2.2	1.8	1.1	0.5
145	30.0	Douglas Slough	6.9	9,610	3.8	3.5	2.8	2.1
Nd	35.0	Mile 35	nd	nd	4.7	4.4	3.7	3.0
156	41.5	Chipola Mouth	13.0	11,700	9.4	9.1	8.4	7.7
Nd	44.2	Wewahitchka	nd	nd	11.3	11	10.3	9.6
155	46.8	DA 63	16.2	11,700	12.5	12.2	11.5	10.8
150	48.4	DA 65A	16.9	11,700	13.3	13.0	12.3	11.6
152	48.4	DA 65A	16.9	11,700	13.3	13.0	12.3	11.6
153	49.0	DA 66A	17.2	11,700	13.6	13.3	12.6	11.9
154	53.4	DA 70	19.3	11,700	15.7	15.4	14.7	14.0
158	73.3	DA 107A	29.5	12,200	25.2	24.9	24.2	23.5
159	73.3	DA 107A	29.5	12,200	25.2	24.9	24.2	23.5
160	73.3	DA 107A	29.5	12,200	25.2	24.9	24.2	23.5
Nd	78.0	Blountstown	nd	nd	27.5	27.1	26.4	25.7
Nd	106.0	Chattahoochee	nd	nd	39.7	39.1	38.4	37.7

Table 5. Estimated water level loss (feet) at sites surveyed in November 2003 at four discharge values.

WP	NM	Estimated loss in feet 6,000	5,000	4,000	3,000
145	30.0	3.0	3.4	4.1	4.7
156	41.5	3.6	3.9	4.6	5.3
155	46.8	3.6	3.9	4.6	5.3
150	48.4	3.6	3.9	4.6	5.3
152	48.4	3.6	3.9	4.6	5.3
153	49.0	3.6	3.9	4.6	5.3
154	53.4	3.6	3.9	4.6	5.3
158	73.3	4.3	4.6	5.3	6.0
159	73.3	4.3	4.7	5.4	6.1
160	73.3	4.3	4.7	5.4	6.1

Table 6a. An estimate of the percentage of *A. neislerii* that would be exposed to the atmosphere at three locations at discharges of 3,000, 4,0000, 5,000, and 6,000 cfs, Apalachicola River, Florida, 2003.

Locations	**Discharge, cfs**			
	3,000	**4,000**	**5,000**	**6,000**
A	55	47	19.1	0
B	100	90.1	76	61
C	85.4	67.9	53.9	49.1
Locations A, B, and C, include sites at the following Navigation Miles:				
A	30.0			
B	41.5, 46.8, 48.4, 49.0			
C	73.3			

Table 6b. An estimate of the number of *A. neislerii* that would be exposed to the atmosphere at four discharge values. The percentage exposed, from Table 6a above, was multiplied by the estimated number present (i.e., number of *A. neislerii* found per hour of collecting) in column three of this table.

Location	**NM**	**Estimated Mussels Present**	**Discharge, cfs**			
			3000	**4000**	**5000**	**6000**
A	30.0	11.0	6.1	5.2	2.1	0.0
B	41.5	42.6	42.6	38.4	32.4	26.0
B	41.5	3.0	3.0	2.7	2.3	1.8
B	46.8	3.8	3.8	3.4	2.9	2.3
B	48.4	5.3	5.3	4.8	4.0	3.2
B	48.4	1.5	1.5	1.4	1.1	0.9
B	49.0	3.0	3.0	2.7	2.3	1.8
C	73.3	10.5	9.0	7.1	5.7	5.2
C	73.3	1.0	0.9	0.7	0.5	0.5
C	73.3	34.7	29.6	23.6	18.7	17.0

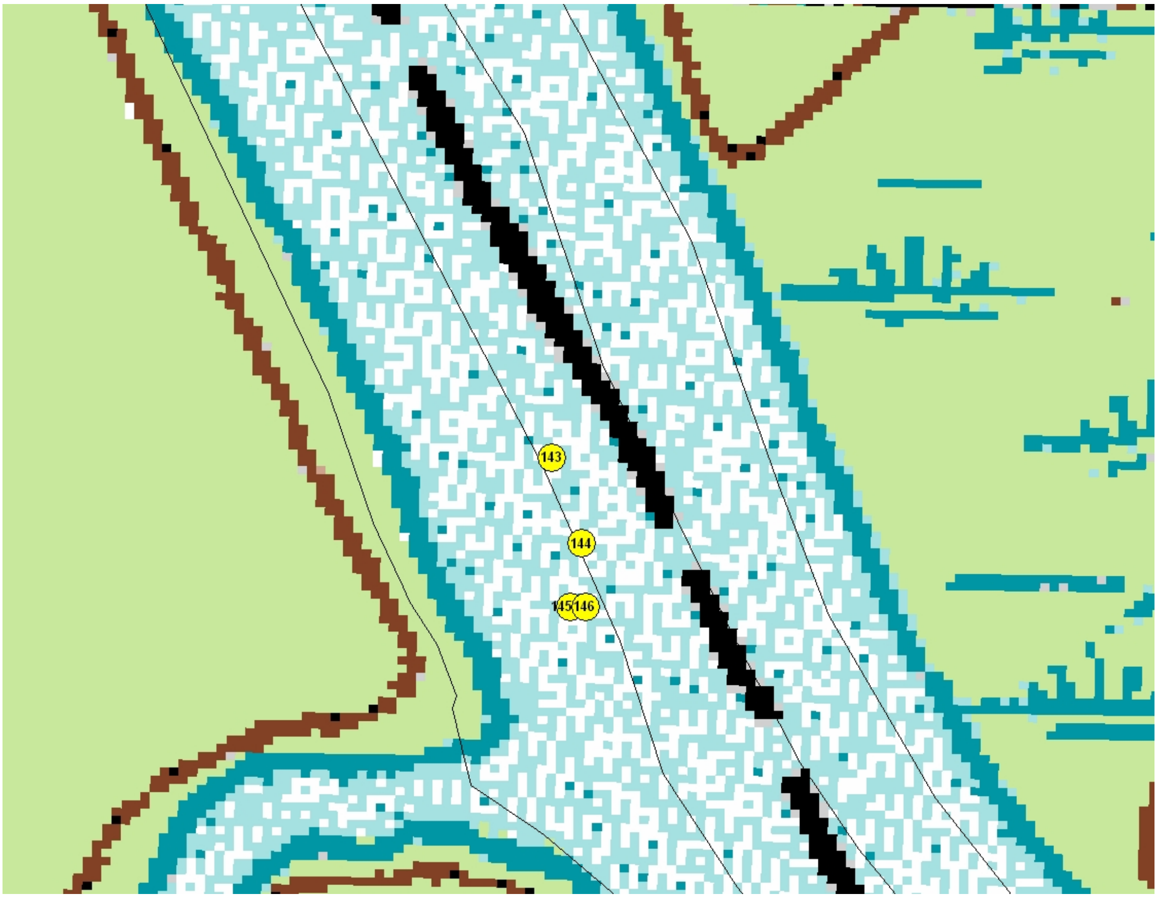

Figure 1. Mussel distribution versus depth was studied at Waypoint 145, near the mouth of Douglas Slough, near NM 30, Apalachicola River, Florida, November 2003.

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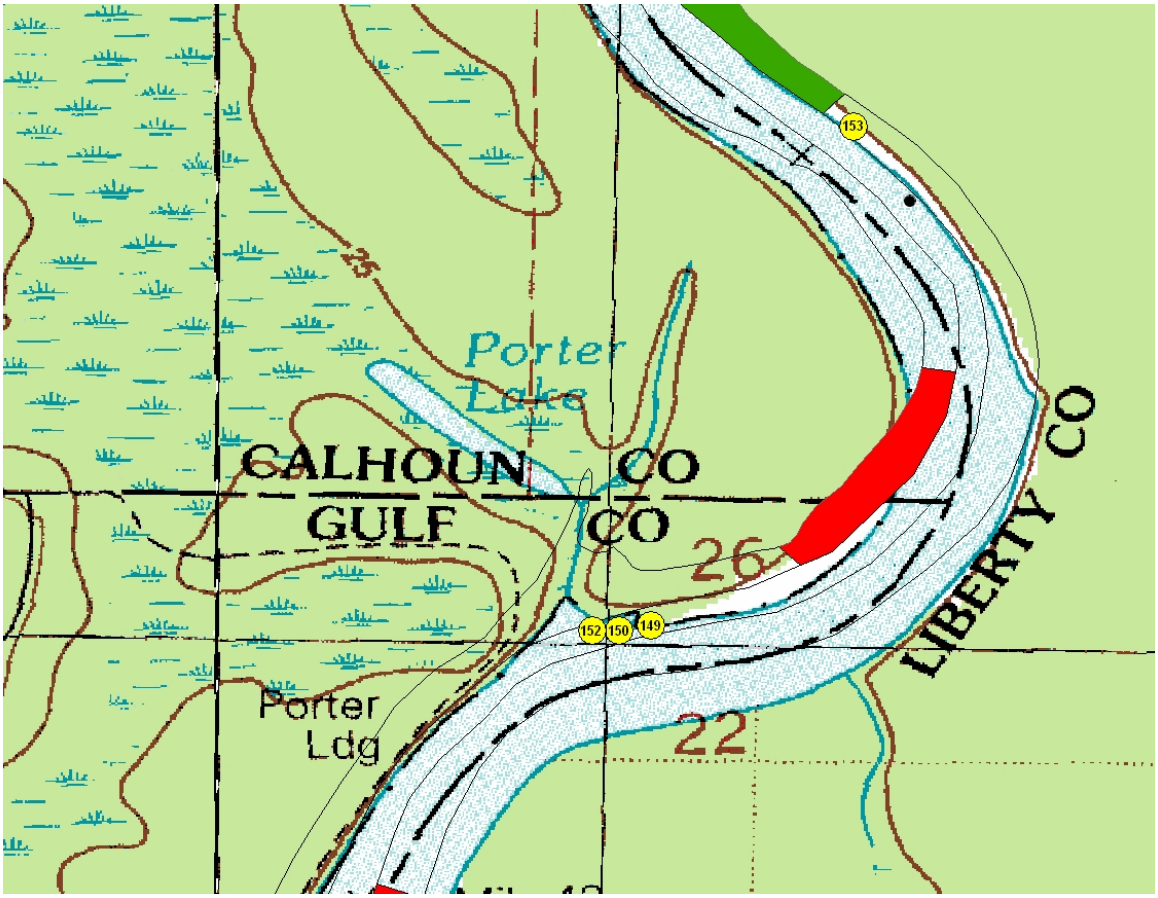

Figure 2. Mussel distribution versus depth was studied at Waypoints 150, 152, and 153, near NM 49 and Disposal Area 65A, Apalachicola River, Florida, November 2003.

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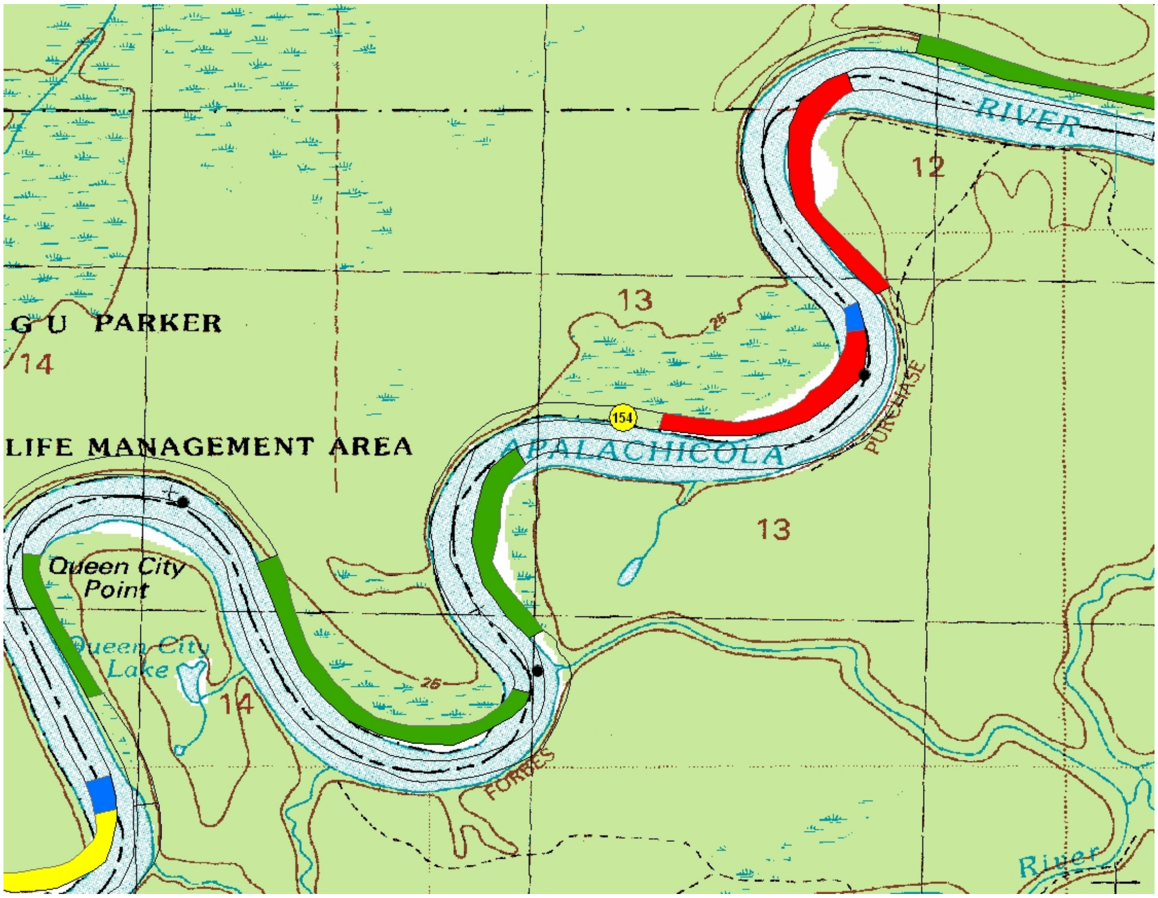

Figure 3. Mussel distribution versus depth was studied at Waypoint 154, near NM 53, Disposal Area 70, Apalachicola River, Florida, November 2003.

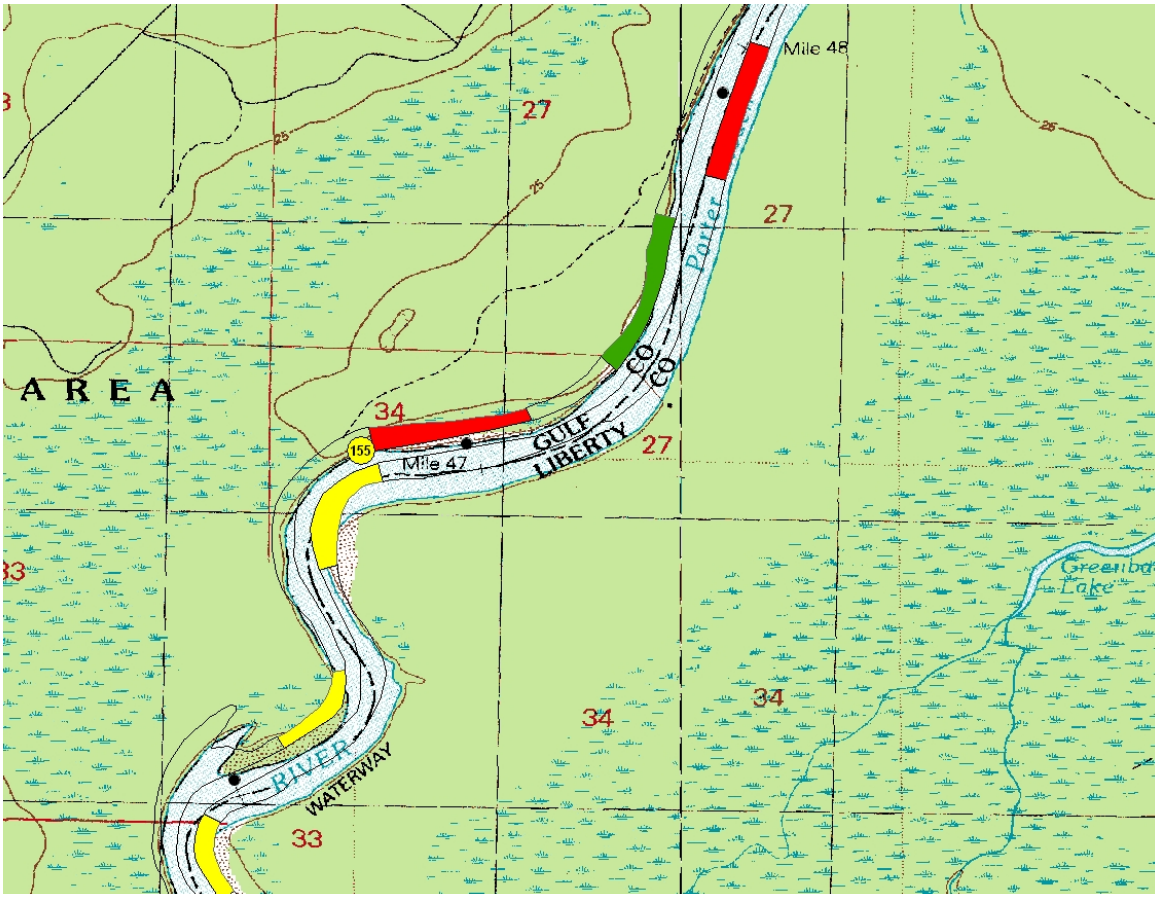

Figure 4. Mussel distribution versus depth was studied at Waypoint 155, near NM 47, Disposal Area 63, Apalachicola River, Florida, November 2003

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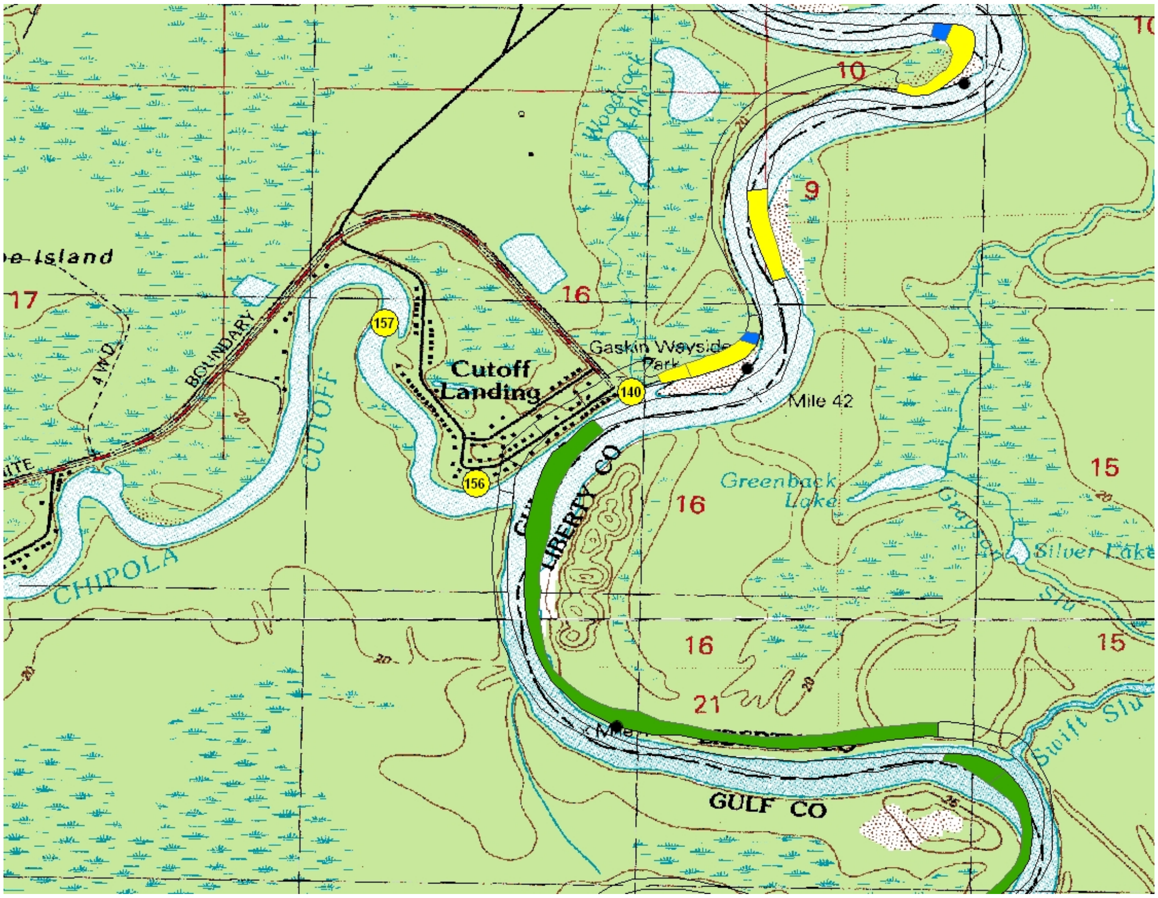

Figure 5. Mussel distribution versus depth was studied at Waypoints 156 and 157, Chipola Cutoff, Florida, November 2003.

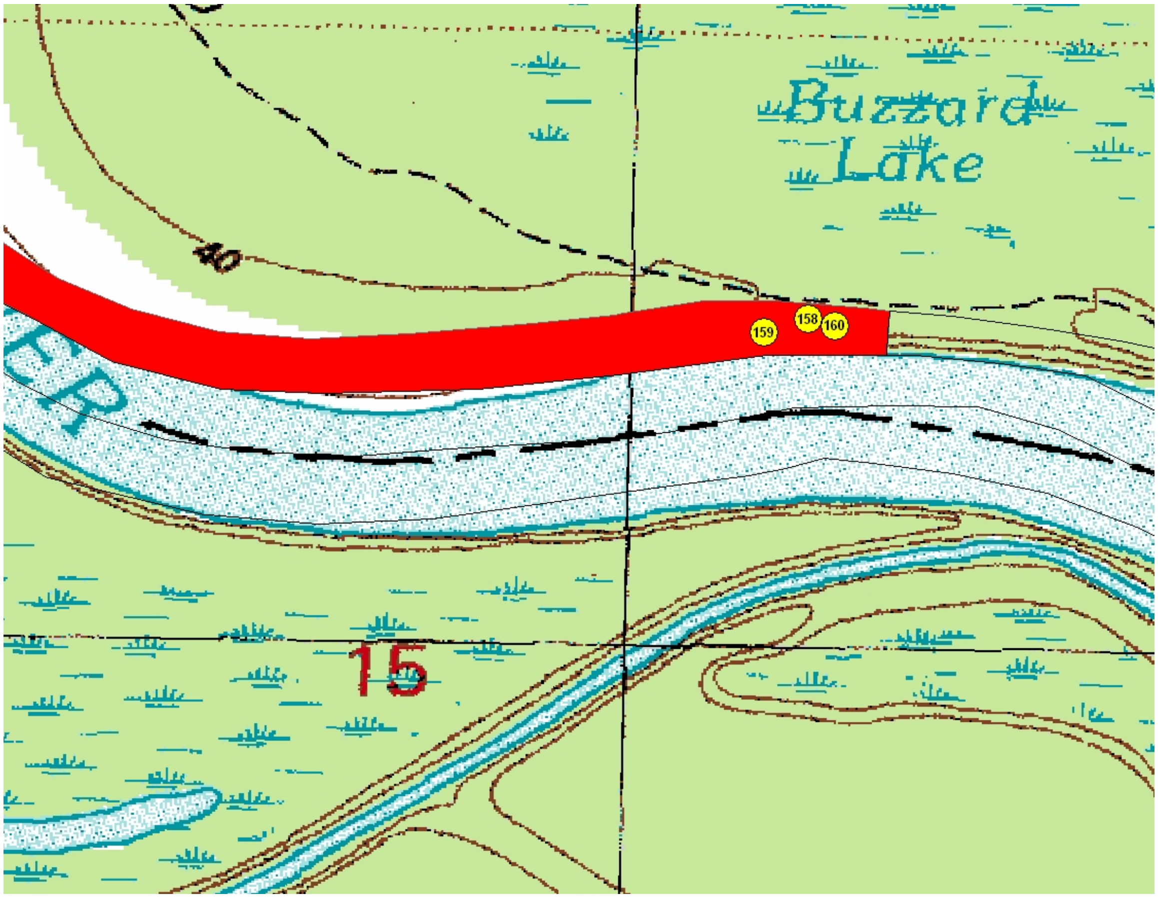

Figure 6. Mussel distribution versus depth was studied at Waypoints 158, 159, and 160, near NM 73, Disposal Area 107A, Apalachicola River, Florida, November 2003.

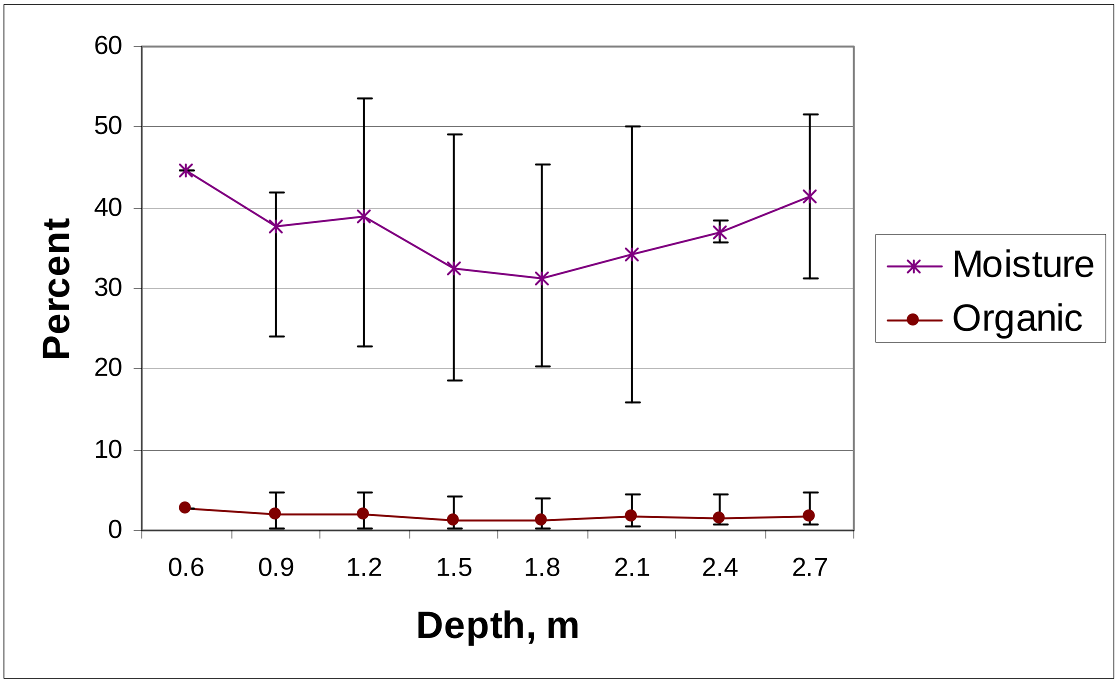

Figure 7. Moisture and organic content of sediments at moderately depositional zones in the Apalachicola River where *A. neislerii* dominated.

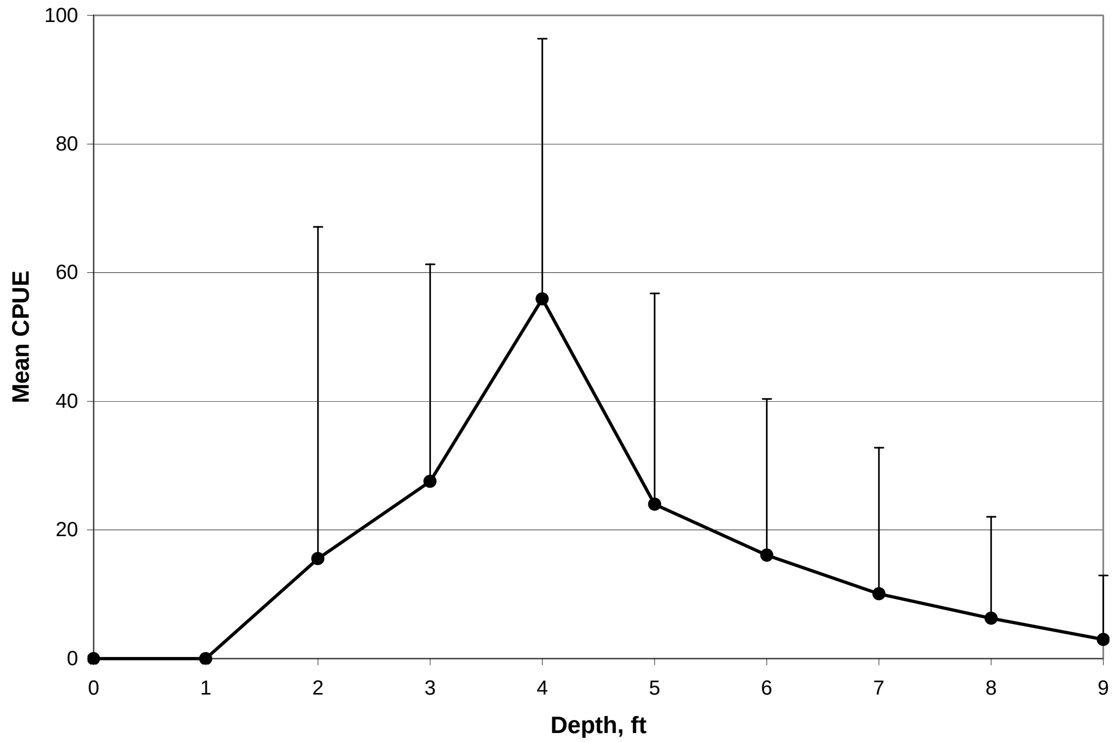

Figure 8. Distribution of CPUE versus depth for total mussels, at moderately depositional areas in the Apalachicola River, Florida, 18, 19, 20 November 2003. During the survey period gauge height and discharge at Blountstown (NM 78) was 3.63 ft, 9,420 cfs (18 Nov 03), 4.17 ft, 10,300 cfs (19 Nov 03), and 4.94 ft 11,500 cfs (20 Nov 03).

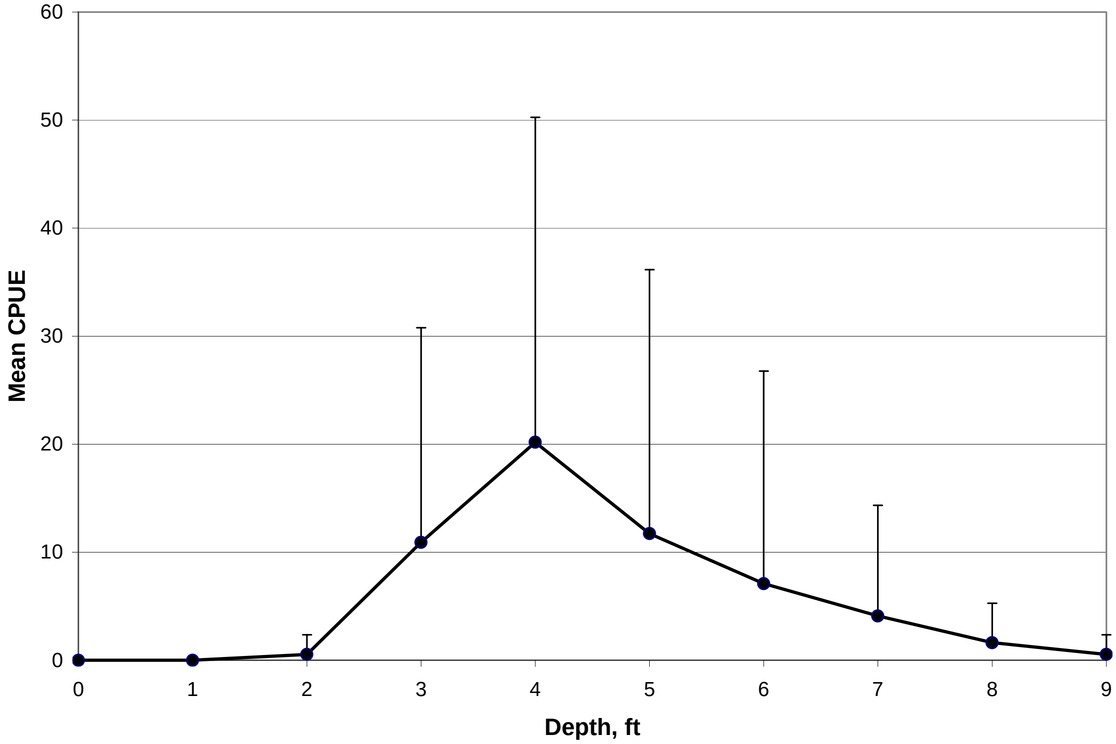

Figure 9. Distribution of CPUE versus depth for *A. neislerii* at moderately depositional areas in the Apalachicola River, Florida, 18, 19, 20 November 2003. During the survey period gauge height and discharge at Blountstown (NM 78) was 3.63 ft, 9,420 cfs (18 Nov 03), 4.17 ft, 10,300 cfs (19 Nov 03), and 4.94 ft 11,500 cfs (20 Nov 03).

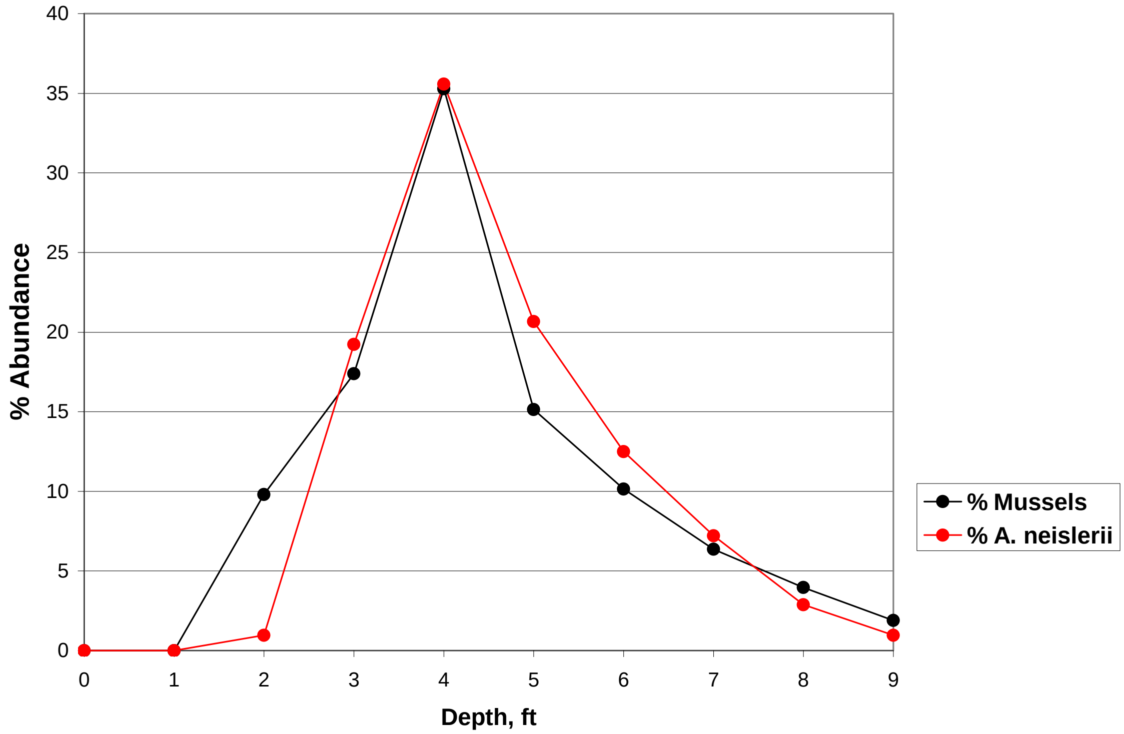

Figure 10. Percent abundance of total mussels and *A. neislerii* at selected depths at moderately depositional areas in the Apalachicola River, Florida, 18, 19, 20 November 2003. During the survey period gauge height and discharge at Blountstown (NM 78) was 3.63 ft, 9,420 cfs (18 Nov 03), 4.17 ft, 10,300 cfs (19 Nov 03), and 4.94 ft 11,500 cfs (20 Nov 03).