

# **Abundance and Distribution of Fishes in Riparian Wetlands of the Arkansas River**

Submitted to

Arkansas Game and Fish Commission  
2 Natural Resources Drive  
Little Rock, Arkansas 72205

Funded by the State Wildlife Grant Fund



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July 2007

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## **Abstract**

Relatively little information exists on fish abundance and distribution in riparian wetlands of the Arkansas River, ranging from contiguous backwaters to intermittently connected and isolated floodplain wetlands. We initiated this study to provide more complete information on abundances and distributions of fishes in the Arkansas River floodplain ecosystem and to better understand patterns of assemblage composition and environmental gradients across wetland types. Fish and environmental data were collected at 49 riparian wetlands representing contiguous backwaters (perennially connected to the main channel), intermittent floodplain wetlands (floodplain waterbodies that are periodically flooded), and isolated floodplain wetlands (floodplain waterbodies that no longer connect with the main channel). A multiple gear approach (seine, mini fyke nets, and experimental gill nets) was used to obtain a representative sample of fishes from each wetland. A total of 220, 116 individuals and 64 species were collected. New abundance and distribution information was obtained for numerous species including four species of conservation concern: taillight shiner, lake chubsucker, pealip redhorse, and swamp darter. Records for taillight shiner, lake chubsucker, blackstripe topminnow, and bantam sunfish may represent first documentation of these species from the mainstem Arkansas River in Arkansas. Ordination and associated analyses indicated contiguous backwaters, intermittent floodplain wetlands, and isolated floodplain wetlands had distinct fish assemblages. Contiguous backwaters were relatively open-water habitats lacking abundance of submerged vegetation taxa and inundated cypress trees. These wetlands were characterized by pelagic fishes (e.g., inland silverside and threadfin shad) and generalist species tolerant of reservoir-like conditions (e.g., bullhead minnow, longear sunfish and river carpsucker) typical of the mainstem Arkansas River in its current state. In contrast, isolated floodplain habitats tended to be heavily vegetated, cypress wetlands inhabited by fishes typical of southern bottomland hardwood wetlands (e.g., warmouth, banded pygmy sunfish, flier, and pirate perch). Intermittent floodplain wetlands as a group physically resembled both backwaters and isolated wetlands and contained elements of both assemblages. This study indicates the Arkansas River floodplain ecosystem, despite modification, continues to provide a mosaic of wetland types supporting a diversity of fishes. These data underscore the value of cypress wetlands since they harbor a unique assemblage of fishes, some of which are of conservation concern (e.g., swamp darter and taillight shiner), that enhance diversity within the Arkansas River ecosystem.

## **Introduction**

Biodiversity of river-floodplain ecosystems is among the highest in the world, primarily due to the heterogeneity of habitats created and maintained by dynamic processes associated with periodic flooding (Junk et al. 1989, Ward et al. 1999). Occupying the ecotone between river channels and upland habitats, riparian wetlands provide a mosaic of habitats to aquatic organisms ranging from backwaters perennially contiguous with the main channel to permanent lentic habitats (e.g., sloughs, oxbow lakes, floodplain ponds, and borrow pits) and ephemeral low-lying areas on the floodplain connected with the main channel only during flooding (Baker et al. 1991). The connectivity of rivers and their adjacent wetlands, vital to the functioning of these ecosystems, has been disrupted in many rivers by modifications for flood control and commercial navigation (Welcomme 1979). Restoration and management of floodplain habitat are widely recognized as being crucial to maintaining and/or restoring the ecological integrity of alluvial rivers (Bayley 1995, Ward and Stanford 1995, Sparks et al. 1998).

With the exception of a few fluvial, main channel specialists (e.g., sturgeon), most large river fishes rely heavily on riparian wetlands, particularly floodplain habitats, as feeding areas and/or for reproduction (Welcomme 1979). Indeed, wetlands throughout the Mississippi River basin historically supported a high biomass and diversity of fishes of commercial, recreational, and conservation importance (Lambou 1959, Lambou 1960, Christenson 1965, Baker et al. 1991). Occurrence of fishes in riparian wetlands is typically correlated with degree of connectivity and distance from the main channel and varies along habitat gradients associated with depth, permanence, water chemistry, and aquatic vegetation (Welcomme 1979, Baker et al. 1991, Zeug et al. 2005). Regularly connected wetlands in close association with the main river channel are characterized by both lotic transients and slack-water specialists (e.g., gizzard shad, buffalofishes, channel catfish, largemouth bass, and bluegill), whereas heavily vegetated floodplain ponds/swamps, typically located further on the floodplain and not flooded as often, support a diverse fauna comprised of swamp specialists (e.g., taillight shiner, golden topminnow, bantam sunfish, and slough darter) (Baker et al. 1991). Widespread loss and degradation of floodplain habitat has reduced the abundance and distribution of many fishes in the Mississippi River basin (Barnickol and Starrett 1951, Carlander 1954), particularly species adapted to shallow, heavily vegetated ponds and bottomland hardwood wetlands (Burr 1991, Pflieger 1997, Hoover and Killgore 1998).

The Arkansas River is a major tributary of the lower Mississippi River, draining 25% of Arkansas (Robison and Buchanan 1988), and it is managed for multiple purposes, primarily commercial navigation, hydroelectric power, flood control, and fish and wildlife resources (Limbird 1993). Despite supporting major sport and commercial fisheries and its important role in maintaining regional biodiversity, the fish community of the Arkansas River, similar to other lowland rivers in Arkansas, has not been well studied (Buchanan 1976, Buchanan et al. 2003). In fact, Buchanan (1976) presents the only comprehensive fish survey of the Arkansas portion of the river. Buchanan (1976) and other studies limited to a few localities (e.g., Sanders et al. 1985, Buchanan 2000) suggest the river continues to support a relatively diverse fish assemblage despite major modifications to the system (reviewed in Limbird 1993). However, previous efforts were primarily directed towards sampling fish in mainstem habitats. Though he conducted limited sampling in adjacent riparian wetlands, Buchanan (1976) recognized the value of floodplain lakes and swamps as important fish habitat and warned of consequences to Arkansas River fishes if degradation of these areas continued.

Fish communities of the numerous backwaters and aquatic habitats existing on the floodplain of the Arkansas River, in the form of cutoffs, sloughs, oxbow lakes, floodplain ponds, and borrow pits, remain relatively unknown. Studies in other river systems (e.g., Galat et al. 1998: Missouri River) indicate the value of riparian wetlands as unique fish habitat critical to the ecological integrity of lowland rivers. Warren et al. (2000) indicated 28% of fishes in the southern United States, many of which inhabit floodplain rivers, are imperiled. Further, knowledge of the status and distribution of many wetland fishes in Arkansas is incomplete due to lack of sampling in these habitats (personal communication, Brian Wagner, AGFC). Given this basic lack of information and the threats riparian wetlands and biota face globally, regionally, and locally (e.g., proposed channel dredging on the Arkansas River), it is imperative to document baseline abundance and distribution of fishes in wetlands of the Arkansas River to effectively manage these habitats and faunas in the future.

### **Objectives**

The principle objectives were:

- 1) to quantify the abundances of fishes in riparian wetlands of the Arkansas River,
- 2) to provide more complete information on the distribution of wetland fishes in Arkansas, and
- 3) to identify habitat variables structuring wetland fish communities.

## Methods

We sampled 49 riparian wetlands along an approximately 260-km reach of river from Pool 9 downstream to Pool 2 (Maps 1 and 2). This reach of river was of particular interest due to the general lack of sampling in this area and because it encompassed the known western distributional limit of many wetland-dependent fishes within the Arkansas River (Robison and Buchanan 1988). Study sites represented the diversity of permanent riparian wetlands existing along the Arkansas River (i.e. ephemeral wetlands were not included). They encompassed a range of sizes (0.3 - 358.6 ha), depths (0.3 - 2.8 m), and wetland types (e.g., backwaters, oxbow lakes, floodplain ponds, sloughs, and cypress swamps) (Table 1). Riparian wetlands were *a priori* classified into three groups based on degree of hydrologic connection with the main channel of the Arkansas River. Contiguous backwaters (n = 24) were lentic habitats directly adjacent to the channel that were perennially connected at base flow. These wetlands were mostly depositional habitats having vegetated shorelines. The other two riparian wetland types were located on the floodplain and included intermittently connected floodplain wetlands (n = 14) and isolated floodplain wetlands (n = 11). Intermittently connected floodplain wetlands were in the active floodplain and periodically connect with the main channel during flooding. Using flood frequency and river elevation data provided by the United States Army Corps of Engineers and corresponding wetland controlling point elevations determined from United States Geological Survey 7.5 minute series topographic maps, we estimated all but two intermittently connected wetlands probably flood every 1 to 2 years (Table 1). Isolated floodplain wetlands were distant from the main channel and separated from it by levees. As such, these landside wetlands were no longer part of the active floodplain. The 49 wetlands were sampled once over two summers (mid June to August 2005 and 2006).

A multiple gear approach was used to obtain a representative sample of large- and small-bodied fishes from each wetland. Sampling methods consisted of seining (4.5 m x 1.8 m; 3.1-mm mesh), experimental monofilament gill nets (22.8 m x 1.8 m; five 4.5 m panels; 3.8 to 8.9-cm mesh), and mini fyke nets (0.6 m x 1.2 m; 4.6 m lead; 3.1-mm mesh). Number of samples per site varied with wetland surface area (Table 2). The largest sites (> 90 ha) received the maximum amount of gear, and smaller sites received a proportion of the gear. Seine samples, mini fyke nets, and gill nets were spatially distributed to encompass the diversity of habitats at a given wetland. This was accomplished by arbitrarily dividing the wetland into 1 to 4 sections; each sampling gear was then haphazardly positioned within sections to maximize effectiveness of the gear. A seine sample (1 to 4 composite samples per

wetland) consisted of seining a reach of shoreline (20 to 30 m) for 3 minutes; net-in-water duration represented time actively capturing fish and was timed with a stopwatch. This method of standardization allowed us to use a seining method (e.g., perpendicular hauls, parallel hauls, and set-kicks around structure) that was most effective given the shoreline structure. A typical seine sample was comprised of 6 hauls/set-kicks. Gill nets (1 to 7 nets per wetland) were positioned perpendicular to the shoreline with the smallest diameter mesh closest to the shoreline. Gill nets were anchored to the substrate by weights and a lead line. A float line and buoys kept the net vertically stretched towards the surface. Mini fyke nets were used at the advice of Dr. John Jackson (Arkansas Tech University) and were generally used as described by Clark et al. (2007). Mini fyke nets (1 to 7 nets per study site) were set perpendicular to the shoreline with the lead tied/anchored to the shoreline edge. Typically, 50% of the mini fyke nets were baited (sardines and cat food). This potentially allowed us to better sample fishes that rely on chemosensory organs for prey capture (e.g., Ictaluridae). Mini fyke nets were placed in proximity to available shoreline microhabitats with 0% to 50% of the cab out of the water. Gill nets and mini fyke nets were left overnight; they were typically set in mid to late afternoon and retrieved early to mid morning. Large-bodied fishes were identified and released. Small-bodied fishes were fixed in 10% formalin and taken to the laboratory for identification and. Specimens were collected, handled, and fixed according to University of Central Arkansas Institutional Animal Care and Use Committee number 2003-002. Voucher specimens are catalogued in the University of Central Arkansas Ichthyology Collection.

Physiochemical measurements corresponded with all fish samples. A point-transect system was used to assess most environmental variables for each wetland. The number of transects (1 – 4) varied with surface area, and they were equally spaced across wetlands (Table 2). Each transect was comprised of three points at approximately 25%, 50%, and 75% of transect length. Depth (nearest 0.1 m) was measured with a SM-5 Depthmate Portable Sounder™ (Speedtech Instruments, Great Falls, Virginia) at each point. Dissolved oxygen (mg/l), temperature (°C), conductivity (mS), and pH were measured at each point with a Hydrolab Quanta™ Water Quality Monitoring System (Hach Company, Loveland, Colorado). Hydrolab measurements were taken just below the water's surface; if depth exceeded 1.0 m, then sub-surface and near-bottom measurements were taken. Amount of primary cover (herbaceous aquatic vegetated cover, coarse woody cover, and overhead canopy cover provided by wooded vegetation) was visually estimated at each transect point (0%, 1%-10%, 11%-20%, 21%-30%, etc.). Estimates were independently made by two people; discrepancies were discussed until a consensus was

reached. Secchi depth (cm) was recorded at the midpoint of one transect per wetland. Turbidity (NTU) was measured at the midpoint of each transect with an United States Environmental Protection Agency (USEPA) approved LaMotte™ model 2020 Turbidimeter (LaMotte Company, Chestertown, Maryland). Dominant substrate type (organic sand, sand/mud mix, mud, and organic mud) was estimated after seining and netting throughout the wetland. Physiochemical measurements were made between 10:00 am and 2:00 pm.

From a data analysis standpoint, we first qualitatively compared and discussed our fish abundance and distribution data relative to existing data published for the Arkansas River in Arkansas (e.g., Buchanan 1976, Robison and Buchanan 1988, Limbird 1993). Next, we examined patterns of fish assemblage composition and environmental correlates across wetlands using ordination and corresponding correlation and vector overlay techniques. Nonmetric multidimensional scaling (NMS) ordinated the 49 wetlands in multivariate space defined by the abundances of species. A wetland X species data matrix was constructed that contained abundance values representing average catch-per-unit-effort for a species combined from seine and mini fyke net samples. Abundance data were  $\log_{10}(x + 1)$ -transformed prior to analyses. Rare species, those captured at 3 or less sites, were not included in the data matrix. NMS was conducted with PC-ORD Version 4 software (MJM Software Design, Gleneden Beach, Oregon) following the general procedures recommended by McCune and Grace (2002). The Bray-Curtis distance measure was used. Random starting configurations were used during preliminary NMS runs with both the real and randomized data sets, stepping down from 6- to 1-dimensional solutions. Number of dimensions included in the final solution was determined by examining plots of stress versus number of dimensions. A Monte Carlo test determined whether the final NMS solution was significantly different from random ( $\alpha = 0.05$ ). To aid interpretation of ordination plots and to examine the relationship of the ordination with measured environmental variables, correlations of individual species and environmental variables with ordination axes were determined by examining correlation coefficients (Pearson's  $r$ ). Vector overlays depicted species and environmental variables that were the most important associations. Multi-response permutation procedures (MRPP) was used to test the null hypothesis of no difference in fish composition between contiguous backwaters, intermittent floodplain wetlands, and isolated floodplain wetlands using the previously described data matrix. Following a significant result, pairwise comparisons of groups were conducted at an alpha corrected for multiple comparisons ( $\alpha = 0.05/3$ ).



## **Results and Discussion**

### *Abundance and Distribution of Fishes*

A total of 220,116 adult and juvenile individuals, representing 64 species and 16 families, were captured in 49 riparian wetlands of the Arkansas River (Tables 3 and 4; Maps 3 to 66). Families that dominated collections were Centrarchidae (13 species), Cyprinidae (9 species), Catostomidae (8 species), Ictaluridae (7 species), and Percidae (6 species). Considering abundance of fish summed across all gears and sites, inland silverside comprised a majority of the catch (68.3%) followed by bluegill (8.8%), threadfin shad (6.3%), gizzard shad (4.9%), western mosquitofish (2.6%), and pugnose minnow (1.1%) (Table 3). Bluegill, gizzard shad, western mosquitofish, redear sunfish, warmouth, largemouth bass, and spotted gar were the most commonly collected species, occurring at greater than 75% of sites sampled (Table 3). Species rarely collected (found in less than 5% of sites) were brown bullhead, mud darter, black bullhead, skipjack herring, grass carp, longnose gar, logperch, pealip redhorse, and lake chubsucker (Table 3).

Numerous fishes were collected that were previously known from few localities within the Arkansas River floodplain ecosystem. Here, we highlight data for species that add significant information on the distribution and abundance of Arkansas River fishes in light of data reported by Buchanan (1976) and Robison and Buchanan (1988). The new distribution and abundance information resulting from this study is, in part, a reflection of the general lack of previous sampling in riparian wetlands of the Arkansas River, particularly floodplain habitats.

*Lepisosteus oculatus* - Though found throughout the Arkansas portion of the Arkansas River (Robison and Buchanan 1988), spotted gar was considered uncommon in the navigation system by Buchanan (1976) as it was the least abundant gar collected. In contrast, spotted gar were nearly 100% ubiquitous (found in 46 of 49 sites) in our study and were by far the most abundant gar species collected (Table 3; Map 3). It tended to be most abundant in floodplain habitats, but it was locally abundant in some of the largest contiguous backwaters or those having an abundance of aquatic vegetation (e.g., BRO, CPS, MCB, RBK, and RBS) (Table 4).

*Notropis maculatus* - The taillight shiner, listed as a "Species of Special Concern" by the Arkansas Natural Heritage Commission, was previously known from only two localities in the Arkansas River system; these records were associated with a tributary, Bayou Meto. We collected the taillight shiner at nine new locations, all below the Fall Line (Tables 3 and 4; Map 16). They were found in contiguous backwaters and oxbows of varying connectivity, typically having both open water and

densely vegetated shorelines (e.g., *Ceratophyllum* sp. and *Hydrocotyle* sp.). Taillight shiners were not abundant when collected, usually represented by fewer than five individuals. Most specimens were captured in overnight sets of mini fyke nets.

*Opsopoeodus emiliae* - Buchanan (1976) considered the pugnose minnow uncommon to the navigation system, as it was only found in 6.4% of collections and represented by 79 individuals. In contrast, pugnose minnow was one of the most abundant species (2,505 individuals) in our study, collected at 33 of 49 sites sampled (Table 3; Map 17). It was most abundant in contiguous backwaters having both vegetated shorelines and a high amount of open water (Table 4). Pugnose minnow was nearly absent from oxbow lakes on the floodplain that were cypress swamps with an abundance of aquatic vegetation and little open water.

*Carpiodes cyprinus* - The quillback was previously known from four locations on the mainstem of the Arkansas River in Arkansas, all below the Fall Line (Robison and Buchanan 1988). They were considered "uncommon" to the navigation system by Buchanan (1976). We collected 77 quillbacks, mostly with gillnets, from 14 sites distributed above and below the Fall Line (Table 3; Map 20). They were almost exclusively collected in backwaters contiguous with the main channel (Table 4). Quillbacks were often found with, but less abundant than, the river carpsucker (Table 4). We distinguished quillbacks in the field using the commonly applied character of lack of a nipple-like structure on the lower lip, as well as, the fact that quillbacks also had thicker, fleshier lower lips and longer backward extensions of the lower jaw when viewed ventrally.

*Erimyzon sucetta* - Considered a "Species of Special Concern" by the Arkansas Natural Heritage Commission, the lake chubsucker has previously been found sporadically distributed in lowland habitats (e.g., oxbows and tributaries) of the lower Arkansas River (Robison and Buchanan 1988). Despite sampling in numerous suitable habitats, we only captured one juvenile individual in a backwater contiguous with the main channel in Pool 2 (Table 4; Map 21). The backwater was a relatively small habitat with abundant emergent and submerged vegetation.

*Ictiobus niger* - Although the black buffalo was previously known from 12 sites in the Arkansas River system in Arkansas, it is typically rare when it occurs (Robison and Buchanan 1988) and considered "uncommon" by Buchanan (1976). We collected 38 adult individuals from seven wetlands, mostly large, isolated and intermittently connected oxbows (Table 4; Map 24). Noteworthy was the collection of 18 individuals, representing 69% of buffalo collected at the site, at Old River Lake in Conway County near Plummerville, Arkansas (Table 4).

*Moxostoma pisolabrum* - The pealip redhorse, formerly known as the shorthead redhorse *Moxostoma macrolepidotum*, is listed as a "Species of Special Concern" by the Arkansas Natural Heritage Commission. It is known from eight locations on the mainstem of the Arkansas River in Arkansas where it is usually associated with current (Robison and Buchanan 1988). We collected two adult individuals from two contiguous backwaters (Morrilton Cutoff Backwater, Conway County; Jones Cutoff Pond, Pulaski County) indicating occasional use of riparian wetlands (Table 4; Map 26).

*Ameiurus nebulosus* - The brown bullhead is reportedly uncommon in Arkansas and the few known locations may mostly represent stockings (Robison and Buchanan 1988). We collected nine individuals, primarily juveniles, from two oxbow lakes (Table 4; Map 29). Eight of the specimens,

that included one adult, were found at Rosenbaum Lake in Pulaski County. Rosenbaum Lake is a unique, densely vegetated, cypress wetland intermittently connected to the main channel. It is not known at this time if our records represent natural occurrences.

*Fundulus chrysotus* - The golden topminnow was previously known from eight sites in the Arkansas River system, mostly associated with tributaries or in the extreme lower reach of the river (Robison and Buchanan 1988). The golden topminnow was commonly encountered during our study, as we collected 1,002 individuals at 35 of 49 sites above and below the Fall Line (Table 4; Map 36). It was most abundant in wetlands having shorelines comprised of dense emergent and/or submerged vegetation. Buchanan (1976) considered the golden topminnow "accidental" and rare to the navigation system, but we found it to be relatively abundant and widespread in backwaters contiguous with the main channel.

*Fundulus dispar* - Relatively few records exist of the starhead topminnow in Arkansas, and it has been documented at five sites in the lower Arkansas River system (Robison and Buchanan 1988). We collected 169 individuals at eight sites below the Fall Line (Table 4; Map 37). It was almost exclusively found in wetlands having submerged vegetation (e.g., *Ceratophyllum* sp. and *Myriophyllum* sp.) and tended to be more common in floodplain wetlands. The starhead topminnow was always captured in conjunction with the golden topminnow that was typically more abundant (Table 4). Considered "accidental" and rare to the navigation system by Buchanan (1976), we similarly found it locally abundant in only two contiguous backwaters in Pool 2 and one backwater in Pool 5 (Map 37).

*Fundulus notatus* - The blackstripe topminnow was considered "accidental" and uncommon to the navigation system by Buchanan (1976). Four of the six locations we found them were backwaters contiguous with the main channel in Pool 2 and Pool 5 (Table 4; Map 38). Relatively high numbers and presence of juveniles indicated sustainable populations probably existed at some of the locations, congruent with the conclusion by Buchanan (1976) that this fish maintains small populations in patches of suitable habitat.

*Elassoma zonatum* - The banded pygmy sunfish is known from many tributary locations in the Arkansas River system, primarily below the Fall Line (Robison and Buchanan 1988). We collected 581 individuals at 13 sites (Table 4; Map 43). Similar to Buchanan (1976), most of our collections were made in heavily vegetated cypress swamps on the floodplain. Notably, we did collect them in low numbers from three contiguous backwaters that contained submerged vegetation. Our most upstream collections were made in Pool 7 where they were locally abundant in Rosenbaum Lake (Map 43).

*Centrarchus macropterus* - The flier is known to occur in tributaries to the Arkansas River (Robison and Buchanan 1988) and is typically found below the Fall Line in few numbers (Buchanan 1976). Similarly, we only collected fliers in cypress swamps (6 locations) on the floodplain (Table 4; Map 47). Notably, one site (ORP) was located above the Fall Line in Perry County adjacent to Pool 8. Juvenile fliers were relatively abundant (113 individuals) in mini fyke nets set at Horseshoe Lake.

*Lepomis microlophus* - The redear sunfish was rarely collected in the navigation system during the Buchanan (1976) study. It was one of the most abundant and widespread fishes collected during our

study, occurring at 42 of 49 sites (Table 4; Map 53). No clear spatial abundance pattern was detectable, as it was well-represented in both floodplain wetlands and contiguous backwaters.

*Lepomis miniatus* - Robison and Buchanan (1988) reported seven localities for the redspotted sunfish in the Arkansas River system, primarily in tributaries. Buchanan (1976) reported it "accidental" and rare to the navigation system. In contrast, we found this sunfish widely distributed in 14 sites from Pool 7 downstream to Pool 2, where it was occasionally abundant in backwaters contiguous with the main channel having vegetated shorelines of *Ludwigia* sp. and *Hydrocotyle* sp. (Table 4; Map 54).

*Lepomis symmetricus* - The bantam sunfish was previously known from only one site in the Arkansas River system located near Pool 2 (Robison and Buchanan 1988) and considered "accidental" to the navigation system (Buchanan 1976). We collected 368 individuals from 16 locations distributed from Pool 6 downstream to Pool 2 (Table 4; Map 55). The bantam sunfish was primarily found on the floodplain in cypress swamps and oxbow lakes having submerged vegetation (e.g., *Ceratophyllum* sp.). However, it was also collected in four contiguous backwaters (Pool 5 and Pool 7) that had submerged vegetation; 61 individuals were collected at CPS in Pool 2 (Map 55).

*Etheostoma asprigene* - The mud darter was previously collected at three tributary sites within the Arkansas River system (Robison and Buchanan 1988) and Buchanan (1976) considered it rare to the navigation system. Similarly, we only captured four individuals in two floodplain wetlands (Table 4; Map 60). Three of the four darters were collected in an oxbow lake (Old River Lake near Plummerville, AR) that had a lowland stream flowing into it.

*Etheostoma fusiforme* - Few records exist for the swamp darter in Arkansas, and it has only been captured at one location (Lake Merrisach) in the lower Arkansas River system (Robison and Buchanan 1988). It is considered very rare in Arkansas by the Arkansas Natural Heritage Commission. We collected 53 swamp darters at five riparian wetlands (Table 4; Map 62). It was found exclusively in heavily vegetated cypress wetlands and late-succession oxbow lakes isolated from the main channel where it was typically the most abundant darter collected. The swamp darter was most abundant in two sites located in Pulaski County near North Little Rock, AR.

*Etheostoma proeliare* - Other than records from tributaries, the cypress darter was previously known from only one site in the Arkansas River located above the Fall Line (Buchanan 1976). We collected 100 individuals from 11 sites, primarily below the Fall Line (Table 4; Map 64). Most collections were made in floodplain wetlands having abundant submerged vegetation and/or inundated *Taxodium* sp.; however, it was also collected in three contiguous backwaters located in Pool 7, Pool 5, and Pool 2.

Differences in fish distribution and abundance between the current study and the Buchanan (1976) study may be due to differences in habitat sampled and methodology, but some patterns probably reflect real changes in fish community over the time period (personal communication with Dr. Tom Buchanan). Gizzard shad, threadfin shad, freshwater drum, bluegill, inland silverside, channel catfish, white crappie, red shiner, and longear sunfish were common species collected by Buchanan (1976) based on percentage of total catch. Likewise, gizzard shad, threadfin shad, bluegill, inland silverside, and longear sunfish were

generally abundant in our sampling as well, indicating their overall abundance and stability in the Arkansas River floodplain ecosystem. However, western mosquitofish, pugnose minnow, redear sunfish, orangespotted sunfish, and bullhead minnow also numerically dominated our samples. Buchanan (1976) included sampling gear (e.g., boat electrofishing and hoop nets) more conducive to the capture of large-bodied species (e.g., freshwater drum and channel catfish), and the sampling was primarily confined to the main channel and adjacent off-channel habitats proposed as dredge disposal areas. In contrast, we only sampled backwater and floodplain habitats. However, both studies used seining (1/8 inch mesh) that is an effective method for small-bodied shoreline fishes, and the Buchanan (1976) study did include some backwater habitat. Relatively high abundance of some small-bodied species (e.g., western mosquitofish, pugnose minnow, redspotted sunfish, and golden topminnow) found in backwaters during the current study may reflect increases in abundance and distribution in response to physical changes in the navigation system since the mid 1970's. The two studies combined provide a more holistic and complete description of the abundance and distribution of fishes in the Arkansas River in Arkansas. A more detailed analysis of the 1970's data relative to the 2005-2006 data is warranted to elucidate potential changes over time in fishes of the Arkansas River.

Limbird (1993) reported that 108 fish species are known from the mainstem Arkansas River in the state of Arkansas. Presumably, "mainstem" is equivalent to fishes reported from the "navigation system" by Buchanan (1976). Backwaters contiguous with the main channel in the current study should be considered in the total number of fishes from the mainstem Arkansas River. Therefore, we report the first known occurrence, unless more recent records exist unknown to the authors, of the taillight shiner, lake chubsucker, blackstripe topminnow, and bantam sunfish in the mainstem Arkansas River since they were captured in backwaters connected to the river. Additionally, we collected the swamp darter and brown bullhead on the floodplain; neither species are included in the total reported by Limbird (1993).

Collection of species in the Arkansas River system considered rare to uncommon in the state of Arkansas underscores the value of the Arkansas River in maintaining regional fish diversity despite the widespread modifications it has incurred. Two of the species, the taillight shiner and swamp darter, were primarily collected in floodplain habitats below the Fall Line, particularly cypress swamps. With few exceptions (e.g., Rosenbaum Lake in Pool 7 and Coal Pile in Pool 2, not sampled in this study), cypress swamps of the Arkansas River are oxbows and sloughs on the floodplain in late stages of succession (shallow with abundant coverage by *Taxodium* sp. and aquatic vegetation) that are no longer part of the

active floodplain (landside of the levee system). A mosaic of these cypress wetlands remains in the vicinity of North Little Rock (Map 2), and they contain the westernmost populations of the taillight shiner and swamp darter in the Arkansas River. These old meander scars and sloughs (e.g., Faulkner Lake, Stark Bend, and Hills Lake) are located near a major metropolitan area and their long-term existence is uncertain. For example, the highest abundance of the swamp darter was in Stark Bend located directly at Interstate 40 in North Little Rock; in addition to being next to a major highway, there is substantial development on at least one shoreline of the lake. The Arkansas River is no longer naturally creating oxbow lakes and other floodplain habitats; therefore, conservation and management of remaining cypress swamps is vital to the survival of fishes unique to these habitats (e.g., taillight shiner and swamp darter).

It is noteworthy to discuss lowland fishes absent from collections during this study despite relatively intensive and widespread sampling in backwaters and floodplain habitat. The dollar sunfish *Lepomis marginatus* and ironcolor shiner *Notropis chalybaeus* are lowland species previously collected in the lower Arkansas River (Robison and Buchanan 1988; Limbird 1993). The dollar sunfish can be difficult to distinguish from longear sunfish in the field; therefore, all dollar/longear-like specimens collected from suitable habitat were brought back to the laboratory for inspection. We collected no dollar sunfish or ironcolor shiner specimens. In addition, the pallid shiner *Hybopsis amnis* and weed shiner *Notropis texanus* are lowland species sometimes found in oxbows of rivers and are known from tributaries of the Arkansas River (Robison and Buchanan 1988); however, we collected no individuals in our study. If the dollar sunfish, ironcolor shiner, pallid shiner, and weed shiner exist in backwaters and floodplain habitats of the Arkansas River, they are occurring sporadically and in very low numbers. The alligator gar *Atractosteus spatula* is historically known from the Arkansas River but few recent records exist (Buchanan 1976, Robison and Buchanan 1988). Conversations with bowfishers indicate the periodic take of large specimens from the Arkansas River, and we have recently observed and collected alligator gar from a tributary, the Fourche LaFave River. Small, juvenile individuals should have been vulnerable to our gill nets, as we collected many spotted and shortnose gar. Despite sampling in numerous backwaters and large oxbows along the river, we collected no alligator gar specimens, further indicating the rareness of this species in Arkansas.

### *Fish Communities and Environmental Gradients*

Local species richness, total number of species collected at a given site combined across all sampling gears, ranged from 11 to 32 fish species per site (Table 5). Richness was highest (32 fishes) at Morrilton Cutoff Backwater, a large contiguous backwater in Pool 8, and Taylor Old River, a relatively deep oxbow lake on the floodplain adjacent to Pool 2 (Table 5). Richness was also high (29 fishes) at Brodie Chute, Holla Bend National Wildlife Refuge, Jones Cutoff Pond and Old River Lake near Scott; these sites ranged from contiguous backwaters to intermittently connected and isolated floodplain wetlands. Lowest richness (11-12 fishes) was found in some of the most heavily vegetated floodplain wetlands (e.g., Rosenbaum Lake, Mound Lake, and Cox Lake). Richness found among riparian wetlands of the Arkansas River is within range or exceeds values reported from backwaters and floodplains of other temperate rivers. Using only electrofishing, Miranda (2005) found a total of 31 species across 11 oxbows along the lower Mississippi River. Winemiller et al. (2005) collected 3 to 19 fishes per site by seining and 1 to 9 species via gillnets at 10 oxbows of the Brazos River in Texas. Floodplain lakes of the White River in Arkansas contained from 13 to 42 fish species per lake (Jackson et al. 2006). Cumulative richness was relatively high (26-61 species) in connected and isolated scours of the Missouri River floodplain (Galat et al. 1998). Though richness was highly variable across sites, Arkansas River wetlands, as a whole, support a diversity of species comparable to other rivers in North America.

Ordination and associated analyses (e.g., vector analysis and MRPP) indicated fish communities were variable in riparian wetlands, and contiguous backwaters, intermittent floodplain wetlands, and isolated floodplain wetlands had distinctly different fish communities. Nonmetric multidimensional scaling ordination of wetlands in multivariate space, defined by abundances of 47 fishes collected by seining and with mini fyke nets, resulted in a two-dimensional solution, representing 85% of the variability in the data (Figure 1). Values of final stress (16.98) and instability (0.0005) indicated the NMS solution to be reasonably reliable and interpretable. Additionally, the ordination was significantly different from random (Monte Carlo test;  $p = 0.024$ ). Seventeen fish species were significantly correlated ( $p \leq 0.05$ ), either positively or negatively, with Axis 1, which represented 53% of the variability across wetlands (Table 6). Wetlands negatively oriented to Axis 1 were characterized by fishes such as inland silverside, gizzard shad, freshwater drum, and western mosquitofish. In contrast, species such as banded pygmy sunfish, warmouth, pirate perch, and flier were characteristic of sites positively oriented to Axis 1. Axis 2 represented 32% of the variability and had sixteen species significantly ( $p \leq 0.05$ ) correlated with

it (Table 6). Warmouth, pirate perch, banded pygmy sunfish, flier, and black crappie were characteristic of wetlands positively oriented to Axis 2; sites negatively oriented to Axis 2 were characterized by inland silverside, longear sunfish, bullhead minnow, and threadfin shad.

Contiguous backwaters, intermittent floodplain wetlands, and isolated floodplain wetlands occupied different positions in multivariate space (MRPP; all pairwise comparisons had  $p \leq 0.001$ ), indicating each wetland type supported different fish communities. Wetland types were oriented along a fish community gradient from backwaters to isolated floodplain wetlands, with intermittent floodplain wetlands intermediate between the other two types (Figure 1). The least amount of variability (average Bray-Curtis distance = 0.441) in fish composition was observed among the 24 contiguous backwaters. Backwaters were most characterized by inland silverside, longear sunfish, bullhead minnow, and threadfin shad (vector analysis; all  $r^2 \geq 0.30$ ). Additional species associated with this group (indicated by a negative  $r$  relative to both Axis 1 and 2) were shortnose gar, common carp, gizzard shad, red shiner, blacktail shiner, emerald shiner, pugnose minnow, river carpsucker, channel catfish, blackstripe topminnow, blackspotted topminnow, western mosquitofish, yellow bass, green sunfish, spotted bass, largemouth bass, and freshwater drum (Table 6). Isolated and intermittent floodplain wetlands had more variable fish communities (average Bray-Curtis distance of 0.527 and 0.534, respectively), but species associations were discernable. Isolated floodplain wetlands were most characterized by warmouth, banded pygmy sunfish, pirate perch, and flier (vector analysis; all  $r^2 \geq 0.30$ ). Additional species associated with isolated floodplain wetlands (indicated by a positive  $r$  relative to both Axis 1 and 2) were spotted gar, bowfin, taillight shiner, yellow bullhead, redfin pickerel, golden topminnow, starhead topminnow, bantam sunfish, black crappie, bluntnose darter, swamp darter, slough darter, and cypress darter (Table 6). Intermittent floodplain wetlands as a group contained elements of both backwater and isolated floodplain fish communities given their position relative to NMS Axis 1 and 2. Some of this variability was due to physical and chemical attributes shared by a given intermittent floodplain wetland with either contiguous backwaters or isolated floodplain wetlands.

Fish community composition in riparian wetlands of the Arkansas River was undoubtedly influenced by environmental conditions. Generally, all 49 sites were relatively shallow (average depth 0.4 - 2.8 m), lentic habitats having fine or fine/coarse substrates and aquatic vegetation along the shorelines (Table 7). However, combinations of physical and chemical variables characterized wetland types. Of the environmental variables quantified, all but average depth and secchi depth were



significantly ( $p \leq 0.05$ ) correlated with either NMS Axis 1 or 2, and only turbidity was not significantly correlated with both axes (Table 8). Contiguous backwaters were most characterized by higher conductivity, temperature, pH, and dissolved oxygen, whereas isolated floodplain wetlands had higher percent coverage by aquatic vegetation, higher canopy coverage by woody vegetation, and predominately organic mud substrates (vector analysis; all  $r^2 \geq 0.30$ ) (Figure 2). Increased aquatic vegetation in isolated and some intermittent floodplain sites was due to the addition of floating-leaved (e.g., Lemnaceae) and submerged taxa (e.g., *Ceratophyllum* sp., *Myriophyllum* sp., and *Potamogeton* sp.) to the aquatic vegetation community. Higher woody canopy coverage was primarily due to the presence of inundated cypress trees. Lower dissolved oxygen, conductivity, and pH are characteristic of wetlands having high amounts of aquatic vegetation and high organic inputs from cypress trees (reviewed in Mitsch and Gosselink 1993). In contrast, contiguous backwaters were relatively open-water habitats with high conductivity, dissolved oxygen, and pH, resembling water quality conditions in the main channel of the Arkansas River (Limbird 1993).

Vegetation, both herbaceous aquatic vegetation and woody vegetation, impacted chemical and physical conditions in wetlands, and, therefore, had pronounced influences on fish community composition across Arkansas River riparian wetlands. Aquatic vegetation characteristics (e.g., density, coverage, and taxa composition) are known to influence fish (reviewed in Dibble et al. 1996). Submerged plant taxa typical of isolated floodplain wetlands provided additional underwater structure relative to emergent taxa. This increased structural complexity is conducive to the behavior, morphology, and life history (reviewed in Hoover and Killgore 1998) of many of the fishes we typically found in isolated floodplain wetlands. For example, the swamp darter is known to attach eggs to aquatic vegetation (reviewed in Page 1983), and it may prefer submerged plant taxa relative to available emergent taxa. Lack of submerged vegetation in most contiguous backwaters is probably due to a combination of factors including, hydrology, substrate composition, and turbidity. Due to periodic mainstem flooding, contiguous backwaters will experience high water events more frequently than isolated floodplain wetlands. Their open-water morphology is also conducive to wind-induced wave action. Both factors cause substrate instability and increased turbidity that often limit submerged plant growth in off-channel habitats of modified rivers (Peck and Smart 1986). Substrate in contiguous backwaters tended to have a larger sand component that could also limit some plant taxa.

Along with submerged aquatic vegetation, cypress trees were a conspicuous feature in isolated floodplain wetlands. Wetlands with inundated cypress received higher amounts of coarse woody material that further enhanced underwater structure. Low dissolved oxygen and acidic waters are characteristic of cypress wetlands (reviewed in Mitsch and Gosselink 1993). Physiochemical tolerance will limit the distribution and abundance of fishes in wetlands (Hoover and Killgore 1998), but warmouth, flier, pirate perch, and banded pygmy sunfish thrived in these relatively harsh, isolated floodplain wetlands. Lack of cypress in most contiguous backwaters is probably due to the fact that cypress seedlings will not germinate underwater (reviewed in Mitsch and Gosselink 1993); therefore, permanently raised water levels following dam construction, in combination with substrate composition, likely inhibit cypress establishment in backwaters perennially connected to the main channel. The few cypress wetlands contiguous with the main channel (e.g., Coal Pile in Pool 2) probably represent re-connections following dam construction. In contrast, floodplain wetlands, particularly those distant from the current main channel and presumably older meander scars, will undergo both wet and dry periods through time. Similar to other cypress swamps in the Mississippi River Valley, isolated floodplain wetlands have probably experienced increased sedimentation from surrounding agriculture which is also conducive to the establishment of cypress trees (Brugam et al. 2007). The considerable influence of the presence and absence of cypress trees and submerged vegetation on the physiochemical environment in our study sites played a major role in patterns of fish community composition across riparian wetlands of the Arkansas River.

The influence of hydrologic connectivity on floodplain fish assemblages has received recent attention (e.g., Miranda 2005, Zeug et al. 2005, Jackson et al. 2006). The current study is somewhat unique in its inclusion of wetlands representing the full spectrum of connectivity, from perennially connected backwaters to isolated floodplain waterbodies, existing in the Arkansas River ecosystem. Distinct fish assemblages were associated with our riparian wetland classification. Contiguous backwaters were vegetated, depositional areas adjacent to the main channel, mostly inhabited by lentic fishes adapted to current conditions in the mainstem Arkansas River. This assemblage was comprised of open-water, pelagic species (e.g., inland silverside, gizzard shad, threadfin shad, and pugnose minnow) and generalists tolerant of reservoir-like environments (e.g., longear sunfish, bullhead minnow, river carpsucker, and red shiner). In contrast, isolated floodplain wetlands were heavily vegetated, cypress swamps characterized by fishes more typical of bottomland hardwood wetlands in the southeast (e.g.,

warmouth, banded pygmy sunfish, pirate perch, and flier) (Killgore and Baker 1996). Some members of this distinctive fauna are threatened in parts of their range, including Arkansas (e.g., taillight shiner and swamp darter). Conservation of cypress wetlands is important to the maintaining of bottomland hardwood fishes in the Arkansas River floodplain ecosystem. Intermittent floodplain wetlands ranged from large, steep-sided oxbows with substantial amounts of open water to shallow, mostly vegetated wetlands; as a group, they provided habitat for both open-water and structure-oriented wetland fishes. As such, this group of wetlands is particularly important from the standpoint of long-term ecosystem integrity since they remain part of the active floodplain.

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Table 1. List of 49 riparian wetlands of the Arkansas River sampled during 2005 and 2006. Longitude and latitude were taken from satellite images projected in WGS 1984. Surface area (ha) of wetlands was calculated from LSAT7 images with ERDAS Imagine 9.0 software. Wetland type was contiguous backwater (BW), intermittent floodplain (FP with corresponding flood frequency probability), or isolated floodplain (FP iso). Refer to Maps 1 and 2 for site location relative to the Arkansas River.

Site	Site Code	Longitude	Latitude	Area (ha)	Type
Airport Slough	APS	92°13'28.10"W	34°44'21.19"N	1.5	BW
Belcoe Lake	BEL	91°18'56.10"W	33°56'28.71"N	132.4	FP (iso)
Brodie Chute	BRO	92°5'33.93"W	34°27'33.56"N	83.9	BW
Cadron Backwater	CAD	92°34'15.39"W	35°6'51.45"N	2.0	BW
Cooks Landing Pond 1	CL1	92°21'17.74"W	34°47'45.30"N	2.3	FP(1-2yr)
Cooks Landing Pond 2	CL2	92°20'48.09"W	34°47'31.11"N	2.2	FP(1-2yr)
Cooks Point Slough	CPS	91°24'22.50"W	34°0'26.70"N	3.3	BW
Cox Lake	COX	92°38'9.08"W	35°7'25.15"N	37.8	FP(iso)
Crane Backwater	CBW	92°57'26.50"W	35°9'55.22"N	9.2	BW
Douglas Old River	DOR	91°33'38.15"W	34°3'19.84"N	203.4	FP(1-2yr)
Faulkner Lake West	FLW	92°9'17.50"W	34°45'20.32"N	36.1	FP(iso)
Faulkner Lake East	FLE	92°7'44.10"W	34°45'22.23"N	36.7	FP(iso)
Georgetown Lake	GTL	92°8'4.19"W	34°37'22.60"N	89.2	FP(5yr)
Gun Slough	GUN	92°22'18.42"W	34°48'18.35"N	3.7	BW
Hills Lake	HIL	92°7'14.63"W	34°46'1.41"N	61.9	FP (iso)
Holla Bend NWR	HONWR	93°3'20.55"W	35°8'19.11"N	161.0	FP (1-2yr)
Holla Bend Slough	HBS	93°2'43.62"W	35°8'39.35"N	3.0	FP (1-2yr)
Holly Bend	HOL	98°4'16.08"W	35°10'30.57"N	1.8	BW
Horseshoe Lake	HSL	92°6'2.80"W	34°41'35.42"N	9.7	FP (iso)
Johnson Lake	JOH	91°32'3.14"W	34°7'10.26"N	50.9	FP (iso)
Jones Cattail Pond	JCAT	92°8'39.55"W	34°42'56.19"N	3.1	BW
Jones Cutoff Pond	JCP	92°10'25.07"W	34°43'22.61"N	10.5	BW
Jones Cutoff Slough	JCS	92°9'17.53"W	34°43'34.99"N	2.0	BW
Maumelle Backwater	MAU	92°23'10.83"W	34°48'22.12"N	18.4	BW
Mill Bayou	MB	92°28'15.46"W	34°52'15.01"N	12.4	BW
Morrilton Cutoff Backwater	MCB	92°37'32.81"W	35°5'40.73"N	163.5	BW
Mound Lake	MDL	92°4'16.42"W	34°38'40.92"N	55.8	FP (iso)
Old River Lake (Plummerville)	ORP	92°36'22.17"W	35°7'24.82"N	62.2	FP (iso)
Old River Lake (Scott)	ORS	92°6'38.67"W	34°38'54.85"N	358.6	FP (iso)
Peach Orchard Bend	POB	92°12'6.08"W	34°44'28.36"N	1.2	BW
Rector Brake	RBK	92°25'11.97"W	34°50'7.92"N	10.7	BW
Rector Chute	RCH	92°26'48.01"W	34°51'2.14"N	16.6	BW
Rector Chute Intermittent	RCI	92°26'48.82"W	34°52'33.32"N	0.7	FP (1-2yr)

Table 1. continued

Site	Site Code	Longitude	Latitude	Area (ha)	Type
Red Bluff Slough	RBS	92°7'48.03"W	34°28'59.11"N	2.5	BW
Rose City Slough	RCS	92°12'45.38"W	34°44'41.46"N	1.2	BW
Rosenbaum Lake	ROS	92°22'6.99"W	34°48'29.98"N	18.8	FP (1-2yr)
Sample Island Backwater	SIB	91°28'4.66"W	34°5'22.10"N	6.1	BW
Sample Island Slough	SIS	91°27'54.35"W	34°5'32.50"N	12.4	BW
Stark Bend	SB	92°11'20.02"W	34°46'57.06"N	25.7	FP (iso)
Tar Camp Slough	TC	92°7'28.03"W	34°26'22.01"N	4.3	BW
Taylor Borrow Pit	TBP	91°28'47.46"W	34°3'12.13"N	6.0	FP (1-2yr)
Taylor Old River	TOR	91°28'16.56"W	34°3'43.32"N	162.0	FP (1-2yr)
Terry Backwater	TBW	92°8'45.99"W	34°39'56.44"N	27.0	BW
Terry Dam Pond	TDP	92°10'12.46"W	34°40'29.22"N	16.4	FP (20yr)
U-Slough	US	91°24'12.79"W	34°0'5.53"N	1.7	BW
Warings Bend Pond 1	WP1	92°9'39.25"W	34°34'39.61"N	0.7	FP (1-2yr)
Warings Bend Pond 2	WP2	92°9'31.59"W	34°34'27.60"N	0.3	FP (1-2yr)
Warings Bend Slough	WBS	92°9'26.16"W	34°34'15.61"N	1.5	BW
Willow Beach Pond 1	WBL	92°8'11.20"W	34°41'50.91"N	14.1	FP (5yr)

Table 2. Sampling effort relative to surface area in 49 riparian wetlands of the Arkansas River.

<b>Surface Area (ha)</b>	<b>Environmental Transects (#)</b>	<b>Seine Sample (#)</b>	<b>Mini Fyke Net (#)</b>	<b>Gill Net (#)</b>
0.3 - 2.0	1	1	1	1
2.1 - 10.0	2	2	2	2
10.1 - 30.0	2	2	3	3
30.1 - 50.0	2	2	4	4
50.1 - 70.0	3	3	5	5
70.1 - 90.0	3	3	6	6
> 90.1	4	4	7	7



Table 3. Fishes collected from riparian wetlands of the Arkansas River during 2005 and 2006. Total number of individuals is given pooled across all sites and gears. Occurrence indicates number of sites the species was present.

Common Name	Scientific Name	Total	Occurrence
Inland silverside	<i>Menidia beryllina</i>	150381	34
Bluegill	<i>Lepomis macrochirus</i>	19430	48
Threadfin shad	<i>Dorosoma petenense</i>	13897	26
Gizzard shad	<i>Dorosoma cepedianum</i>	10811	38
Western mosquitofish	<i>Gambusia affinis</i>	5828	45
Pugnose minnow	<i>Opsopoeodus emiliae</i>	2505	33
Redear sunfish	<i>Lepomis microlophus</i>	1938	42
Orangespotted sunfish	<i>Lepomis humilis</i>	1910	28
Bullhead minnow	<i>Pimephales vigilax</i>	1616	24
Longear sunfish	<i>Lepomis megalotis</i>	1563	34
Warmouth	<i>Lepomis gulosus</i>	1283	38
Golden topminnow	<i>Fundulus chrysotus</i>	1002	35
Black crappie	<i>Pomoxis nigromaculatus</i>	962	34
Largemouth bass	<i>Micropterus salmoides</i>	785	45
Banded pigmy sunfish	<i>Elassoma zonatum</i>	581	13
Golden shiner	<i>Notemigonus crysoleucas</i>	454	19
Red shiner	<i>Cyprinella lutrensis</i>	400	11
Bantam sunfish	<i>Lepomis symmetricus</i>	368	16
Spotted gar	<i>Lepisosteus oculatus</i>	350	46
Redspotted sunfish	<i>Lepomis miniatus</i>	332	14
River carpsucker	<i>Carpiodes carpio</i>	302	28
Blacktail shiner	<i>Cyprinella venusta</i>	301	15
Blackspotted topminnow	<i>Fundulus olivaceus</i>	271	12
Flier	<i>Centrarchus macropterus</i>	250	6
Channel catfish	<i>Ictalurus punctatus</i>	232	35
Emerald shiner	<i>Notropis atherinoides</i>	225	11
White crappie	<i>Pomoxis annularis</i>	219	23
Brook silverside	<i>Labidesthes sicculus</i>	177	20
Freshwater drum	<i>Aplodinotus grunniens</i>	172	18
Starhead topminnow	<i>Fundulus dispar</i>	169	8
Pirate perch	<i>Aphredoderus sayanus</i>	143	11
Yellow bass	<i>Morone mississippiensis</i>	138	22
Cypress darter	<i>Etheostoma proeliare</i>	100	11
Smallmouth buffalo	<i>Ictiobus bubalus</i>	88	19
Bluntnose darter	<i>Etheostoma chlorosoma</i>	87	7
Blackstripe topminnow	<i>Fundulus notatus</i>	85	6
Bowfin	<i>Amia calva</i>	79	22
Yellow bullhead	<i>Ameiurus natalis</i>	78	20
Quillback	<i>Carpiodes cyprinus</i>	77	14

Table 3. continued

<b>Common Name</b>	<b>Scientific Name</b>	<b>Total</b>	<b>Occurrence</b>
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>	66	14
Common carp	<i>Cyprinus carpio</i>	59	19
Taillight shiner	<i>Notropis maculatus</i>	59	9
Swamp darter	<i>Etheostoma fusiforme</i>	53	5
Spotted bass	<i>Micropterus punctulatus</i>	42	13
Shortnose gar	<i>Lepisosteus platostomus</i>	39	14
Black buffalo	<i>Ictiobus niger</i>	38	7
Slough darter	<i>Etheostoma gracile</i>	33	4
White bass	<i>Morone chrysops</i>	30	9
Blue catfish	<i>Ictalurus furcatus</i>	24	8
Flathead catfish	<i>Pylodictis olivaris</i>	20	4
Redfin pickerel	<i>Esox americanus</i>	15	4
Brown bullhead	<i>Ameiurus nebulosus</i>	9	2
Spotted sucker	<i>Minytrema melanops</i>	8	4
Tadpole madtom	<i>Noturus gyrinus</i>	6	3
Striped bass	<i>Morone saxatilis</i>	4	3
Mud darter	<i>Etheostoma asprigene</i>	4	2
Black bullhead	<i>Ameiurus melas</i>	3	2
Green sunfish	<i>Lepomis cyanellus</i>	3	3
Skipjack herring	<i>Alosa chrysochloris</i>	3	2
Grass carp	<i>Ctenopharyngodon idella</i>	2	2
Longnose gar	<i>Lepisosteus osseus</i>	2	2
Logperch	<i>Percina caprodes</i>	2	1
Pealip redhorse	<i>Moxostoma pisolabrum</i>	2	2
Lake chubsucker	<i>Erimyzon sucetta</i>	1	1

Table 4. Total number of individuals, pooled across gear types, collected at 49 riparian wetlands of the Arkansas River during 2005 and 2006. Site names are provided in Table 1. Refer to Maps 1 and 2 for site location relative to the Arkansas River.

	APS	BEL	BRO	CAD	CL1	CL2	CPS	COX	CBW	DOR	FLE	FLW
Spotted gar	4	11	10	2	3	6	12	15	0	3	13	8
Longnose gar	0	0	1	0	0	0	0	0	1	0	0	0
Shortnose gar	0	0	2	0	0	0	2	0	0	2	1	0
Bowfin	0	0	1	1	0	2	1	9	0	1	14	4
Skipjack herring	0	0	0	0	0	0	0	0	2	0	0	0
Gizzard shad	3	15	4	3	0	5	8	0	2	9320	39	2
Threadfin shad	28	0	89	0	0	375	23	0	0	0	0	0
Grass carp	0	0	0	0	0	0	0	0	0	0	0	0
Red shiner	0	0	8	0	0	0	0	0	10	0	0	0
Blacktail shiner	0	0	80	2	0	0	0	0	5	0	0	0
Common carp	0	0	0	0	0	1	0	1	1	1	0	3
Golden shiner	0	15	0	0	0	3	14	0	0	0	0	0
Emerald shiner	3	0	0	0	0	0	0	0	0	0	0	0
Taillight shiner	0	0	0	0	0	0	1	0	0	0	3	2
Pugnose minnow	0	0	209	1	0	50	103	0	0	0	0	0
Bullhead minnow	4	0	52	23	0	2	0	0	0	7	0	0
River carpsucker	8	0	27	15	4	9	0	0	7	0	0	0
Quillback	0	0	5	4	0	1	0	0	4	0	0	0
Lake chubsucker	0	0	0	0	0	0	1	0	0	0	0	0
Smallmouth buffalo	0	1	0	0	0	0	8	0	0	17	0	0
Bigmouth buffalo	0	0	0	0	0	2	0	0	0	15	0	0
Black buffalo	0	0	0	0	0	0	0	4	0	7	0	0
Spotted sucker	0	0	0	0	0	1	0	0	0	0	0	0
Pealip redhorse	0	0	0	0	0	0	0	0	0	0	0	0
Black bullhead	0	0	0	0	0	0	0	0	0	0	0	0
Yellow bullhead	0	14	1	0	0	0	0	1	0	0	2	7
Brown bullhead	0	0	0	0	0	0	0	0	0	0	0	0
Blue catfish	0	0	0	0	0	0	0	0	3	0	0	0
Channel catfish	1	3	9	0	2	1	0	0	2	8	0	3
Tadpole madtom	0	0	0	0	0	0	0	0	0	0	0	0
Flathead catfish	0	0	0	0	0	0	0	0	0	1	0	0
Redfin pickerel	0	0	0	0	0	0	0	0	0	0	0	1
Pirate perch	0	0	0	0	0	0	0	7	0	0	0	3
Golden topminnow	0	0	22	47	0	5	132	0	1	0	39	2
Starhead topminnow	0	0	9	0	0	0	26	0	0	0	26	0
Blackstripe topmin.	0	0	0	0	0	0	4	0	0	0	0	0
Blackspotted topmin.	0	0	2	2	25	9	0	0	0	0	0	0
Western mosquitofish	21	12	49	29	22	85	0	0	16	787	81	9
Brook silverside	0	1	1	16	16	0	0	0	0	0	26	0
Inland silverside	56	12	186	99	0	15	17	0	82	141447	0	0
Banded pigmy sunfish	0	0	0	0	0	0	1	23	0	0	37	43
White bass	0	0	0	0	0	1	0	0	5	2	0	0
Yellow bass	0	17	1	0	0	1	0	0	0	0	1	4

Table 4. continued

	APS	BEL	BRO	CAD	CL1	CL2	CPS	COX	CBW	DOR	FLE	FLW
Striped bass	0	0	0	0	0	0	0	0	0	0	0	0
Flier	0	0	0	0	0	0	0	5	0	0	2	24
Green sunfish	1	0	0	0	0	0	0	0	0	0	0	0
Warmouth	1	9	3	0	0	3	6	97	0	0	109	56
Orangespotted sunfish	0	23	9	1	1	13	0	0	0	73	0	1
Bluegill	39	113	771	307	96	173	514	7	85	2	881	181
Longear sunfish	6	1	63	59	8	3	57	0	17	0	0	0
Redear sunfish	0	10	290	30	1	11	132	0	1	0	0	1
Redspotted sunfish	0	0	47	0	0	0	24	0	0	0	0	0
Bantam sunfish	0	0	0	0	0	0	61	0	0	0	26	0
Spotted bass	0	0	0	10	0	0	0	0	2	0	0	0
Largemouth bass	14	15	9	10	7	42	5	3	9	0	1	4
White crappie	0	81	0	1	0	1	0	0	0	3	0	2
Black crappie	0	28	3	2	0	2	1	2	2	0	19	16
Mud darter	0	0	0	0	0	0	0	0	0	0	0	0
Bluntnose darter	0	0	0	0	0	0	0	0	0	0	0	0
Swamp darter	0	0	0	0	0	0	0	0	0	0	1	1
Slough darter	0	0	0	0	0	0	0	0	0	0	0	0
Cypress darter	0	4	0	0	0	0	0	0	0	0	0	1
Logperch	0	0	0	0	0	0	0	0	0	0	0	0
Freshwater drum	0	0	0	0	0	0	0	0	3	104	0	0

Table 4. continued

	GTL	GUN	HIL	HONWR	HBS	HOL	HSL	JOH	JCAT	JCP	JCS	MAU
Spotted gar	5	3	11	9	4	0	5	7	1	5	5	0
Longnose gar	0	0	0	0	0	0	0	0	0	0	0	0
Shortnose gar	2	0	0	8	0	0	0	0	0	3	1	0
Bowfin	5	0	0	0	1	1	5	0	0	0	1	1
Skipjack herring	0	0	0	0	0	0	0	0	0	0	0	0
Gizzard shad	263	2	1	243	0	0	0	34	11	12	21	2
Threadfin shad	313	6	0	454	0	257	0	163	238	949	1400	480
Grass carp	0	0	1	0	0	0	0	0	0	0	1	0
Red shiner	0	0	0	0	0	6	0	0	0	3	0	0
Blacktail shiner	0	0	0	0	0	2	0	0	0	3	1	2
Common carp	1	1	0	3	0	0	0	0	0	0	1	0
Golden shiner	9	74	0	2	1	0	0	0	2	0	0	11
Emerald shiner	0	0	0	0	0	3	0	0	30	16	23	0
Taillight shiner	4	0	14	0	0	0	0	16	0	0	0	0
Pugnose minnow	135	1	0	134	0	12	0	71	73	163	12	2
Bullhead minnow	0	3	0	50	0	182	0	0	37	49	5	4
River carpsucker	0	9	0	22	0	7	0	0	14	36	5	8
Quillback	0	0	0	8	0	1	0	0	4	10	0	0
Lake chubsucker	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth buffalo	0	0	0	2	0	1	0	0	5	1	0	8
Bigmouth buffalo	7	1	0	2	0	0	5	2	0	0	0	0
Black buffalo	0	0	0	0	0	0	0	2	0	0	0	0
Spotted sucker	0	4	0	0	0	0	0	0	0	0	0	0
Pealip redhorse	0	0	0	0	0	0	0	0	0	1	0	0
Black bullhead	0	0	0	0	0	0	0	0	0	0	0	0
Yellow bullhead	0	8	2	0	1	0	0	1	4	0	2	0
Brown bullhead	0	0	0	0	0	0	0	0	0	0	0	0
Blue catfish	0	0	0	12	0	1	0	0	0	0	0	0
Channel catfish	27	4	0	16	0	1	1	9	1	5	0	8
Tadpole madtom	0	0	0	0	0	0	0	0	0	0	0	0
Flathead catfish	16	0	0	2	0	0	0	0	0	0	0	0
Redfin pickerel	0	0	0	0	0	0	0	0	0	0	0	0
Pirate perch	0	0	8	0	1	0	14	0	0	0	0	0
Golden topminnow	0	15	5	54	50	0	61	0	21	6	20	0
Starhead topminnow	0	0	0	0	0	0	10	0	0	0	0	0
Blackstripe topmin.	0	0	0	0	0	0	0	0	0	0	0	0
Blackspotted topmin.	0	0	0	0	0	0	0	0	0	0	10	0
Western mosquitofish	319	70	0	135	58	126	1	0	115	63	184	2
Brook silverside	12	2	3	0	0	0	0	0	23	7	3	1
Inland silverside	288	2	0	505	0	458	0	109	294	454	100	96
Banded pigmy sunfish	0	0	59	0	0	0	51	16	0	0	4	0
White bass	1	0	0	5	0	0	0	0	0	0	0	0
Yellow bass	62	0	0	0	0	3	0	18	0	2	1	0

Table 4. continued

	<b>GTL</b>	<b>GUN</b>	<b>HIL</b>	<b>HONWR</b>	<b>HBS</b>	<b>HOL</b>	<b>HSL</b>	<b>JOH</b>	<b>JCAT</b>	<b>JCP</b>	<b>JCS</b>	<b>MAU</b>
Striped bass	0	0	0	1	0	0	0	0	0	2	0	0
Flier	0	0	0	0	0	0	113	0	0	0	0	0
Green sunfish	0	0	0	0	0	0	0	0	0	0	0	0
Warmouth	3	14	45	15	48	0	61	7	6	8	47	0
Orangespotted sunfish	46	0	0	39	2	0	0	0	11	0	0	0
Bluegill	815	273	841	732	190	236	94	102	123	179	231	179
Longear sunfish	0	1	0	37	0	59	0	0	31	21	102	31
Redear sunfish	13	27	13	68	35	0	1	40	5	12	43	13
Redspotted sunfish	0	3	0	0	0	0	0	0	0	4	30	1
Bantam sunfish	0	0	14	0	0	0	91	17	0	0	0	0
Spotted bass	0	0	0	1	0	0	0	0	1	1	0	0
Largemouth bass	8	79	19	28	0	0	9	2	32	38	14	2
White crappie	42	0	0	5	1	1	0	1	3	3	0	0
Black crappie	11	3	33	26	53	0	0	34	0	3	0	0
Mud darter	1	0	0	0	0	0	0	0	0	0	0	0
Bluntnose darter	0	0	0	0	0	0	0	2	0	0	1	0
Swamp darter	0	0	17	0	0	0	0	4	0	0	0	0
Slough darter	0	0	0	0	0	0	0	0	0	0	0	0
Cypress darter	0	0	0	0	0	0	2	0	0	0	0	0
Logperch	0	0	0	0	0	0	0	0	0	0	0	0
Freshwater drum	9	1	0	0	0	0	0	4	0	0	0	1

Table 4. continued

	MB	MCB	MDL	ORP	ORS	POB	RBK	RCH	RCI	RBS	RCS	ROS	SIB
Spotted gar	4	8	19	21	24	2	8	5	10	13	2	3	2
Longnose gar	0	0	0	0	0	0	0	0	0	0	0	0	0
Shortnose gar	0	3	0	9	0	0	0	0	1	0	0	0	0
Bowfin	0	0	0	6	2	0	0	0	0	2	0	7	0
Skipjack herring	0	0	0	0	0	0	0	1	0	0	0	0	0
Gizzard shad	0	112	92	7	386	6	0	19	5	0	4	0	15
Threadfin shad	0	4659	0	109	363	41	1509	0	0	1	37	0	0
Grass carp	0	0	0	0	0	0	0	0	0	0	0	0	0
Red shiner	1	279	0	0	0	0	44	0	0	0	0	0	1
Blacktail shiner	28	27	0	0	0	0	16	0	0	0	0	0	112
Common carp	0	22	0	9	0	0	2	2	2	0	0	0	0
Golden shiner	0	2	33	0	94	0	24	41	4	91	3	0	0
Emerald shiner	0	0	0	0	0	18	0	0	0	0	6	0	4
Taillight shiner	0	0	0	0	0	0	0	0	0	12	0	0	0
Pugnose minnow	62	73	0	8	1	49	37	16	1	33	9	0	12
Bullhead minnow	0	216	0	0	0	9	56	7	0	0	26	0	198
River carpsucker	10	39	0	10	0	5	1	11	0	5	8	0	6
Quillback	0	17	0	0	0	3	0	1	0	0	0	0	0
Lake chubsucker	0	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth buffalo	0	14	0	0	0	0	1	0	0	0	1	0	2
Bigmouth buffalo	0	4	0	8	0	0	0	0	0	3	0	0	0
Black buffalo	0	0	0	18	0	0	0	0	0	0	0	0	2
Spotted sucker	0	1	0	0	0	0	2	0	0	0	0	0	0
Pealip redhorse	0	1	0	0	0	0	0	0	0	0	0	0	0
Black bullhead	0	0	0	0	0	0	0	0	1	0	0	0	0
Yellow bullhead	0	0	6	9	1	1	3	0	0	0	1	0	0
Brown bullhead	0	0	0	0	1	0	0	0	0	0	0	8	0
Blue catfish	1	1	0	0	0	0	0	1	0	0	0	0	1
Channel catfish	1	22	14	16	12	0	4	10	2	1	0	0	4
Tadpole madtom	0	0	0	0	0	0	0	1	0	2	0	0	0
Flathead catfish	1	0	0	0	0	0	0	0	0	0	0	0	0
Redfin pickerel	0	0	0	0	1	1	0	0	0	0	0	12	0
Pirate perch	0	0	0	2	13	0	0	0	0	0	1	92	0
Golden topminnow	17	0	0	0	27	5	0	63	56	10	8	178	1
Starhead topminnow	0	0	0	0	49	0	0	0	0	17	0	0	0
Blackstripe topmin.	0	0	0	0	0	0	0	0	0	1	0	0	8
Blackspotted topmin.	3	0	0	0	7	5	0	0	0	0	12	0	0
Western mosquitofish	90	760	24	6	166	42	717	65	89	492	5	71	16
Brook silverside	0	0	0	12	0	7	0	0	0	8	5	0	0
Inland silverside	11	1928	0	0	253	303	1491	8	6	0	209	0	195
Banded pigmy sunfish	0	0	0	0	27	0	0	5	0	0	0	135	0
White bass	0	8	0	0	0	0	1	0	0	0	2	0	0
Yellow bass	0	4	0	1	6	0	0	0	1	0	4	0	0

Table 4. continued

	<b>MB</b>	<b>MCB</b>	<b>MDL</b>	<b>ORP</b>	<b>ORS</b>	<b>POB</b>	<b>RBK</b>	<b>RCH</b>	<b>RCI</b>	<b>RBS</b>	<b>RCS</b>	<b>ROS</b>	<b>SIB</b>
Striped bass	0	0	0	0	0	0	0	0	0	0	0	0	0
Flier	0	0	0	37	0	0	0	0	0	0	0	69	0
Green sunfish	0	0	0	0	0	0	0	0	1	0	0	0	0
Warmouth	5	13	31	78	158	2	8	2	30	65	14	28	0
Orangespotted sunfish	8	960	108	73	4	0	7	0	10	0	0	0	1
Bluegill	319	3507	586	747	1197	130	81	164	1054	550	88	0	84
Longear sunfish	135	196	0	0	216	48	7	33	37	3	20	0	38
Redear sunfish	87	67	0	74	353	12	23	43	72	102	21	0	2
Redspotted sunfish	0	0	0	0	0	6	0	0	0	132	0	0	0
Bantam sunfish	0	0	0	0	45	0	0	0	0	1	0	0	0
Spotted bass	0	3	0	0	0	1	0	0	0	0	8	0	1
Largemouth bass	15	10	25	40	25	17	92	36	3	1	28	0	3
White crappie	0	11	14	3	5	0	0	0	14	0	0	0	0
Black crappie	0	172	10	331	31	0	0	1	15	17	30	21	1
Mud darter	0	0	0	3	0	0	0	0	0	0	0	0	0
Bluntnose darter	0	0	0	76	0	0	0	1	0	0	0	0	0
Swamp darter	0	0	0	0	0	0	0	0	0	0	0	0	0
Slough darter	0	0	0	11	0	0	0	16	0	0	2	0	0
Cypress darter	0	0	0	0	15	0	0	0	0	8	2	0	0
Logperch	0	0	0	0	0	0	0	0	0	0	2	0	0
Freshwater drum	1	4	0	0	22	0	2	1	0	0	0	0	0



Table 4. continued

	SIS	SB	TC	TBP	TOR	TBW	TDP	US	WP1	WP2	WBS	WBL
Spotted gar	7	7	6	5	9	8	8	2	13	9	3	10
Longnose gar	0	0	0	0	0	0	0	0	0	0	0	0
Shortnose gar	0	0	0	0	0	2	0	1	0	0	2	0
Bowfin	0	3	0	9	2	0	0	0	0	0	1	0
Skipjack herring	0	0	0	0	0	0	0	0	0	0	0	0
Gizzard shad	30	14	2	5	21	10	3	11	0	0	20	59
Threadfin shad	701	0	2	0	42	954	0	703	1	0	0	0
Grass carp	0	0	0	0	0	0	0	0	0	0	0	0
Red shiner	0	0	0	0	0	41	0	3	0	0	4	0
Blacktail shiner	0	0	0	0	1	5	0	1	0	0	16	0
Common carp	1	0	0	3	0	3	0	0	1	0	0	1
Golden shiner	0	0	0	0	16	0	0	15	0	0	0	0
Emerald shiner	1	0	22	0	0	0	0	99	0	0	0	0
Taillight shiner	0	1	0	0	0	0	0	0	0	0	0	6
Pugnose minnow	40	0	149	0	604	347	25	7	13	6	47	0
Bullhead minnow	2	0	17	0	199	169	0	222	0	0	77	0
River carpsucker	4	0	10	0	2	17	0	1	0	0	2	0
Quillback	0	0	6	0	2	11	0	0	0	0	0	0
Lake chubsucker	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth buffalo	10	0	1	0	3	4	2	6	0	0	0	1
Bigmouth buffalo	1	0	0	10	5	0	1	0	0	0	0	0
Black buffalo	3	0	0	0	2	0	0	0	0	0	0	0
Spotted sucker	0	0	0	0	0	0	0	0	0	0	0	0
Pealip redhorse	0	0	0	0	0	0	0	0	0	0	0	0
Black bullhead	0	0	0	2	0	0	0	0	0	0	0	0
Yellow bullhead	0	11	0	1	0	0	0	0	0	0	0	2
Brown bullhead	0	0	0	0	0	0	0	0	0	0	0	0
Blue catfish	0	0	0	0	4	0	0	0	0	0	0	0
Channel catfish	8	0	5	0	17	4	1	3	0	0	5	2
Tadpole madtom	0	0	3	0	0	0	0	0	0	0	0	0
Flathead catfish	0	0	0	0	0	0	0	0	0	0	0	0
Redfin pickerel	0	0	0	0	0	0	0	0	0	0	0	0
Pirate perch	0	1	0	0	0	0	0	0	0	0	1	0
Golden topminnow	1	17	4	0	1	37	40	19	9	20	8	1
Starhead topminnow	0	15	0	0	0	0	0	17	0	0	0	0
Blackstripe topmin.	49	0	0	0	17	0	0	6	0	0	0	0
Blackspotted topmin.	13	0	2	0	0	0	0	0	181	0	0	0
Western mosquitofish	9	90	19	140	275	23	58	1	80	106	111	189
Brook silverside	0	0	0	0	0	11	1	0	11	11	0	0
Inland silverside	76	0	12	7	1210	304	0	121	11	16	0	0
Banded pigmy sunfish	0	23	0	0	0	0	157	0	0	0	0	0
White bass	0	0	0	0	5	0	0	0	0	0	0	0
Yellow bass	2	1	0	0	1	3	3	1	0	0	0	1

Table 4. continued

	SIS	SB	TC	TBP	TOR	TBW	TDP	US	WP1	WP2	WBS	WBL
Striped bass	0	0	0	0	0	1	0	0	0	0	0	0
Flier	0	0	0	0	0	0	0	0	0	0	0	0
Green sunfish	0	0	0	0	1	0	0	0	0	0	0	0
Warmouth	6	99	0	6	0	0	77	1	7	42	0	73
Orangespotted sunfish	11	0	0	6	31	41	3	0	35	174	29	190
Bluegill	70	642	89	37	123	129	1205	92	340	271	213	548
Longear sunfish	53	0	67	0	18	64	0	26	12	5	43	46
Redear sunfish	33	9	24	20	29	1	63	66	34	37	1	19
Redspotted sunfish	0	0	35	0	2	0	0	40	1	4	3	0
Bantam sunfish	5	2	0	68	9	5	0	7	15	1	0	1
Spotted bass	0	0	1	0	0	8	0	0	2	0	3	0
Largemouth bass	12	5	10	27	14	7	3	5	10	6	22	19
White crappie	3	1	0	0	3	0	3	0	0	1	0	17
Black crappie	1	10	0	37	1	24	15	0	0	1	0	6
Mud darter	0	0	0	0	0	0	0	0	0	0	0	0
Bluntnose darter	0	0	0	0	0	0	3	0	0	0	1	3
Swamp darter	0	30	0	0	0	0	0	0	0	0	0	0
Slough darter	0	0	0	0	0	0	4	0	0	0	0	0
Cypress darter	1	1	0	0	0	0	0	0	7	2	0	57
Logperch	0	0	0	0	0	0	0	0	0	0	0	0
Freshwater drum	0	0	1	0	4	1	1	2	0	0	4	7

Table 5. Summary statistics of fishes (number of species and total abundance of individuals pooled across all gear types) collected at 49 riparian wetlands of the Arkansas River during 2005 and 2006.

<b>Site</b>	<b>Species</b>	<b>Abund.</b>	<b>Site</b>	<b>Species</b>	<b>Abund.</b>
Morrilton Cutoff BW	32	13143	Warings Bend Slough	22	616
Taylor Old River	32	2673	Willow Beach Pond 1	22	1258
Brodie Chute	29	1963	Cadron Backwater	21	664
Holla Bend NWR	29	2618	Crane Backwater	21	260
Jones Cutoff Pond	29	2059	Rector Chute Inter.	21	1414
Old River Lake (Scott)	29	3504	Terry Dam Pond	21	1676
Rose City Slough	28	558	Stark Bend	20	982
Sample Island Slough	28	1153	Belcoe Lake	19	385
Terry Backwater	28	2234	Faulkner Lake West	19	1321
Cooks Landing Pond 2	27	822	Maumelle Backwater	19	852
Jones Cutoff Slough	27	2268	Mill Bayou	19	799
Old River Lake (Plumm.)	27	1724	Warings Bend Pond 1	19	783
U-Slough	27	1478	Douglas Old River	18	151800
Georgetown Lake	26	2417	Holly Bend	18	1357
Rector Chute	25	553	Warings Bend Pond 2	17	712
Gun Slough	24	606	Hills Lake	16	1086
Jones Cattail Pond	24	1085	Horseshoe Lake	16	524
Red Bluff Slough	24	1570	Taylor Borrow Pit	16	383
Cooks Point Slough	23	1153	Airport Slough	14	189
Faulkner Lake East	23	378	Holla Bend Slough	13	445
Rector Brake	23	4136	Cox Lake	12	174
Sample Island Backwater	23	709	Mound Lake	12	962
Johnson Lake	22	661	Cooks Landing Pond 1	11	185
Peach Orchard Bend	22	713	Rosenbaum Lake	11	624
Tar Camp Slough	22	487			

Table 6. Pearson product-moment correlation coefficients ( $r$ ) indicating the direction and magnitude of association between individual species abundances and axes resulting from nonmetric multidimensional scaling ordination. Bolded and italicized coefficients were significant at  $p \leq 0.05$ .

Species	Axis 1	Axis 2
Spotted gar	0.25	0.19
Shortnose gar	-0.17	-0.05
Bowfin	0.12	0.20
Gizzard shad	<b>-0.53</b>	-0.16
Threadfin shad	-0.28	<b>-0.57</b>
Red shiner	-0.28	<b>-0.38</b>
Blacktail shiner	-0.27	<b>-0.42</b>
Common carp	-0.24	-0.12
Golden shiner	0.02	-0.07
Emerald shiner	-0.13	<b>-0.41</b>
Taillight shiner	<b>0.37</b>	0.16
Pugnose minnow	-0.25	<b>-0.53</b>
Bullhead minnow	<b>-0.43</b>	<b>-0.66</b>
River carpsucker	-0.23	-0.21
Bigmouth buffalo	<b>-0.35</b>	0.04
Yellow bullhead	0.14	<b>0.30</b>
Channel catfish	-0.19	-0.25
Tadpole madtom	0.14	-0.07
Redfin pickerel	0.25	<b>0.36</b>
Pirate perch	<b>0.57</b>	<b>0.59</b>
Golden topminnow	<b>0.39</b>	0.17
Starhead topminnow	<b>0.37</b>	0.05
Blackstripe topminnow	-0.09	<b>-0.29</b>
Blackspotted topminnow	-0.14	-0.07
Western mosquitofish	<b>-0.49</b>	-0.11
Brook silverside	-0.07	0.03
Inland silverside	<b>-0.61</b>	<b>-0.74</b>
Banded pigmy sunfish	<b>0.70</b>	<b>0.58</b>
Yellow bass	-0.21	-0.20
Flier	<b>0.49</b>	<b>0.57</b>
Green sunfish	-0.08	-0.12
Warmouth	<b>0.66</b>	<b>0.69</b>
Orangespotted sunfish	<b>-0.47</b>	0.07
Bluegill	0.07	-0.10

Table 6. continued

Species	Axis 1	Axis 2
Longear sunfish	<b>-0.32</b>	<b>-0.68</b>
Redear sunfish	0.11	-0.21
Redspotted sunfish	0.11	-0.26
Bantam sunfish	<b>0.33</b>	0.11
Spotted bass	-0.19	-0.26
Largemouth bass	-0.19	-0.21
White crappie	-0.21	0.22
Black crappie	0.23	<b>0.40</b>
Bluntnose darter	0.04	0.18
Swamp darter	<b>0.36</b>	0.21
Slough darter	0.07	0.07
Cypress darter	0.12	0.16
Freshwater drum	<b>-0.52</b>	-0.09

Table 7. Environmental data collected at 49 riparian wetlands of the Arkansas River during 2005 and 2006. Except for secchi depth and substrate, values represent averages for a given wetland.

Site	Avg. Depth (m)	Temp (C°)	Conduct. (mS/cm)	DO (mg/L)	pH	Secchi (cm)	Turbidity (NTU)	Vegetation (%)	Woody (%)	Canopy (%)	Substrate
Airport Slough	0.6	30.9	0.640	5.1	7.3	57	12.3	25.0	5.0	3.0	mud/sand
Belcoe Lake	2.1	30.6	0.093	9.2	8.3	52	14.3	0.9	1.2	8.7	organic mud
Brodie Chute	2.0	33.3	0.599	7.0	8.4	90	8.8	15.0	4.0	4.0	mud/sand
Cadron Backwater	0.5	29.9	0.541	5.7	6.8	40	15.1	5.3	2.4	0.0	mud
Cooks Landing Pond 1	2.3	29.2	0.549	8.8	8.0	81	5.0	0.0	2.0	7.0	organic sand
Cooks Landing Pond 2	1.0	29.9	0.399	7.1	8.2	23	23.7	0.0	3.0	9.0	mud/sand
Cooks Point Slough	0.7	32.9	0.552	7.9	7.8	47	10.0	53.7	0.0	0.0	organic sand
Cox Lake	1.1	24.4	0.160	1.2	6.7	52	9.6	95.0	39.0	48.0	organic mud
Crane Backwater	1.9	29.9	0.582	8.7	8.6	80	10.7	2.0	1.0	0.0	organic sand
Douglas Old River	0.7	30.7	0.292	9.0	8.1	22	80.1	0.0	1.0	0.2	mud
Faulkner Lake West	1.1	30.7	0.176	4.4	6.9	55	26.8	25.0	13.0	14.0	organic mud
Faulkner Lake East	1.2	28.1	0.109	7.1	6.4	42	11.6	1.0	1.2	4.0	organic mud
Georgetown Lake	1.1	32.1	0.103	8.3	8.1	28	26.3	0.0	1.7	3.9	organic mud
Gun Slough	1.0	26.5	0.672	4.8	7.2	58	3.6	25.0	3.0	9.0	mud
Hills Lake	1.0	28.3	0.049	4.7	5.6	61	15.0	32.5	1.3	20.0	organic mud
Holla Bend NWR	2.2	30.5	0.512	6.6	8.2	41	10.5	5.0	6.0	2.0	mud
Holla Bend Slough	0.5	27.0	0.332	0.6	7.3	86	10.0	95.0	16.0	33.0	organic mud
Holly Bend	0.7	34.0	0.567	9.1	8.3	84	15.9	0.0	0.0	0.0	mud/sand
Horseshoe Lake	1.6	28.0	0.146	1.0	6.7	91	3.6	50.0	8.0	9.0	organic mud
Johnson Lake	1.7	31.6	0.465	6.8	7.6	50	18.0	13.3	3.7	4.0	organic mud
Jones Cattail Pond	1.3	33.2	0.686	11.4	8.6	62	8.2	10.0	1.0	3.0	organic sand
Jones Cutoff Pond	0.7	28.3	0.662	10.6	8.5	45	13.5	5.0	8.0	2.0	mud/sand
Jones Cutoff Slough	0.4	30.9	0.656	6.1	7.6	37	22.5	40.0	8.0	11.0	mud
Maumelle Backwater	0.8	30.7	0.542	7.8	7.7	82	12.5	5.8	1.7	0.0	mud
Mill Bayou	0.9	30.4	0.499	7.3	7.2	60	18.1	5.0	0.3	0.0	organic sand
Morrilton Cutoff Backwater	1.6	30.7	0.585	8.0	8.2	50	16.3	5.0	4.0	4.0	mud/sand
Mound Lake	1.3	28.1	0.069	5.3	7.6	24	26.5	2.0	13.0	3.0	organic mud
Old River Lake (Plummerville)	1.1	28.9	0.241	5.5	7.4	48	13.3	5.0	13.0	40.0	organic mud

Table 7. continued

Site	Avg. Depth (m)	Temp (C°)	Conduct. (mS/cm)	DO (mg/L)	pH	Secchi (cm)	Turbidity (NTU)	Vegetation (%)	Woody (%)	Canopy (%)	Substrate
Old River Lake (Scott)	2.1	31.1	0.148	13.1	9.9	44	18.6	2.0	2.0	4.0	mud/sand
Peach Orchard Bend	1.1	28.9	0.637	4.7	7.6	65	7.1	25.0	5.0	7.0	organic sand
Rector Brake	0.5	27.6	0.510	4.8	7.9	32	15.9	0.0	5.0	2.0	mud
Rector Chute	0.9	30.0	0.561	7.7	7.8	57	15.1	3.2	2.3	2.5	mud/sand
Rector Chute Intermittent	0.4	33.0	0.625	7.1	7.4	25	19.6	3.7	0.8	1.3	organic mud
Red Bluff Slough	0.7	32.0	0.583	4.3	7.6	82	10.6	40.0	6.0	7.0	mud
Rose City Slough	2.8	30.3	0.634	6.5	7.6	64	8.5	15.0	5.0	3.0	mud/sand
Rosenbaum Lake	1.3	26.3	0.064	3.3	6.5	58	2.6	100.0	14.0	12.0	organic mud
Sample Island Backwater	2.7	30.8	0.554	6.1	7.8	65	13.5	0.8	0.5	0.0	mud/sand
Sample Island Slough	0.9	33.8	0.639	6.3	7.5	33	33.5	5.5	0.0	0.0	mud
Stark Bend	1.1	27.9	0.080	4.3	6.1	44	16.7	20.8	5.3	3.3	organic mud
Tar Camp Slough	0.6	34.0	0.545	7.8	7.6	63	14.6	15.0	1.0	0.0	mud/sand
Taylor Borrow Pit	0.3	30.4	0.219	9.2	8.2	40	52.5	23.3	0.0	0.0	mud
Taylor Old River	2.8	30.7	0.546	6.5	7.8	74	12.8	4.6	2.0	2.9	organic sand
Terry Backwater	1.1	30.2	0.667	6.4	8.5	37	17.0	5.0	6.0	7.0	mud/sand
Terry Dam Pond	1.5	31.6	0.172	15.1	9.0	43	12.3	10.0	0.0	0.0	organic mud
U-Slough	0.8	32.2	0.545	6.2	7.5	50	16.0	15.8	0.0	0.0	organic sand
Warings Bend Pond 1	0.4	28.3	0.437	3.1	7.4	44	18.2	15.0	2.0	2.0	mud
Warings Bend Pond 2	0.5	29.3	0.536	5.0	7.5	54	17.3	20.0	1.0	0.0	mud/sand
Warings Bend Slough	0.5	31.4	0.549	7.8	8.3	71	17.0	15.0	5.0	4.0	organic sand
Willow Beach Pond 1	1.3	30.0	0.142	8.5	8.7	34	18.2	5.0	9.0	5.0	mud

Table 8. Pearson product-moment correlation coefficients ( $r$ ) indicating the direction and magnitude of association between environmental variables and axes resulting from nonmetric multidimensional scaling ordination. Bolded and italicized coefficients were significant at  $p \leq 0.05$ .

Variable	Axis 1	Axis 2
Average Depth	0.05	0.02
Temperature	<b><i>-0.38</i></b>	<b><i>-0.61</i></b>
Conductivity	<b><i>-0.39</i></b>	<b><i>-0.75</i></b>
Dissolved Oxygen	<b><i>-0.50</i></b>	<b><i>-0.43</i></b>
pH	<b><i>-0.51</i></b>	<b><i>-0.44</i></b>
Secchi Depth	0.26	-0.10
Turbidity	<b><i>-0.43</i></b>	-0.21
% Vegetative Cover	<b><i>0.66</i></b>	<b><i>0.48</i></b>
% Woody Cover	<b><i>0.39</i></b>	<b><i>0.50</i></b>
% Canopy Cover	<b><i>0.42</i></b>	<b><i>0.61</i></b>
Dominant Substrate	<b><i>0.43</i></b>	<b><i>0.65</i></b>



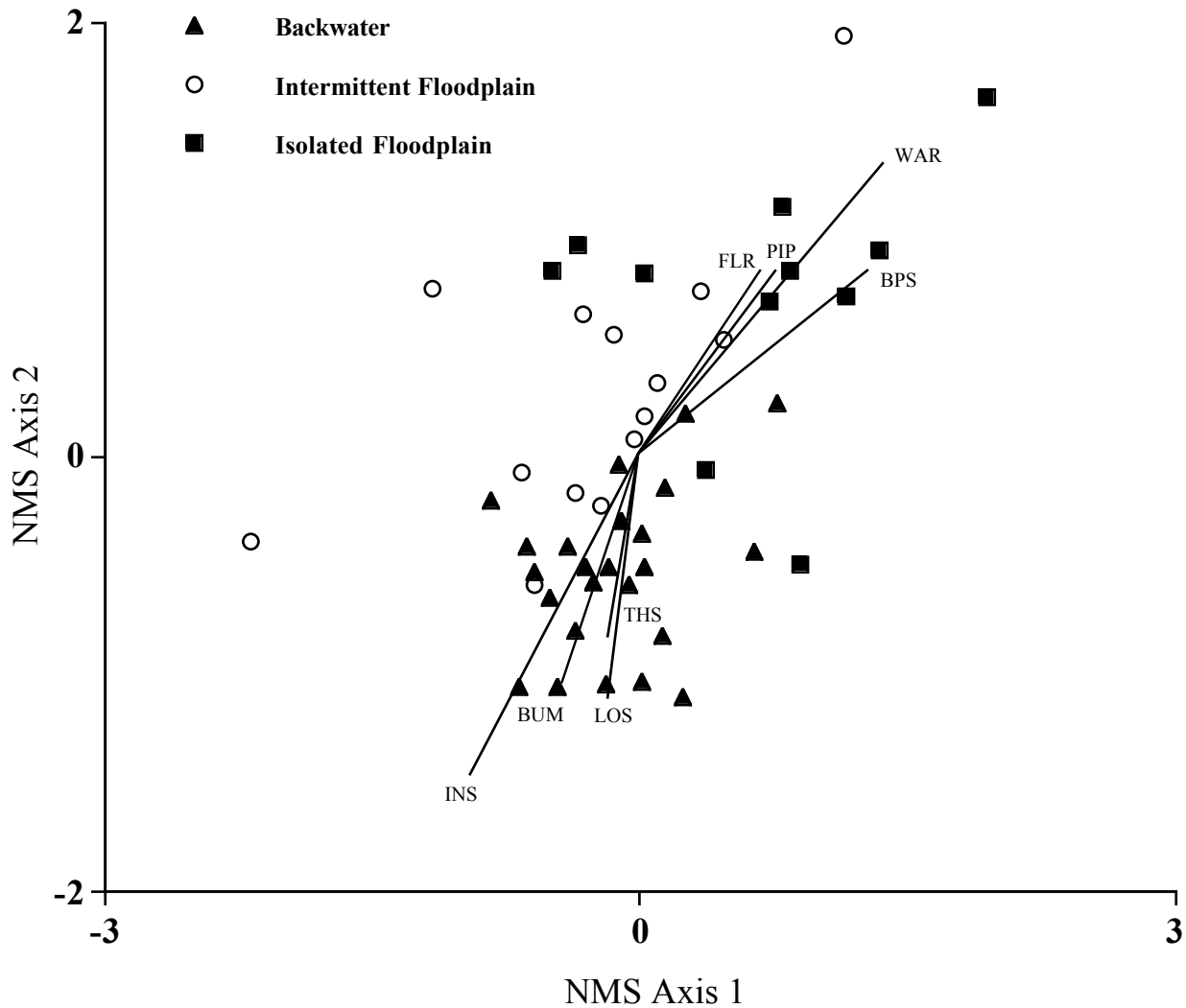


Figure 1. Nonmetric multidimensional scaling ordination of 49 riparian wetlands of the Arkansas River, coded by connectivity type, in multivariate space defined by abundances of fishes collected by seining and with mini fyke nets. Vectors represent the associations of fish species with the ordination having  $r^2 > 0.30$ : inland silverside (INS), bullhead minnow (BUM), longear sunfish (LOS), threadfin shad (THS), warmouth (WAR), banded pygmy sunfish (BPS), pirate perch (PIP), and flier (FLR). Associations of all species with NMS axes are provided in Table 6.

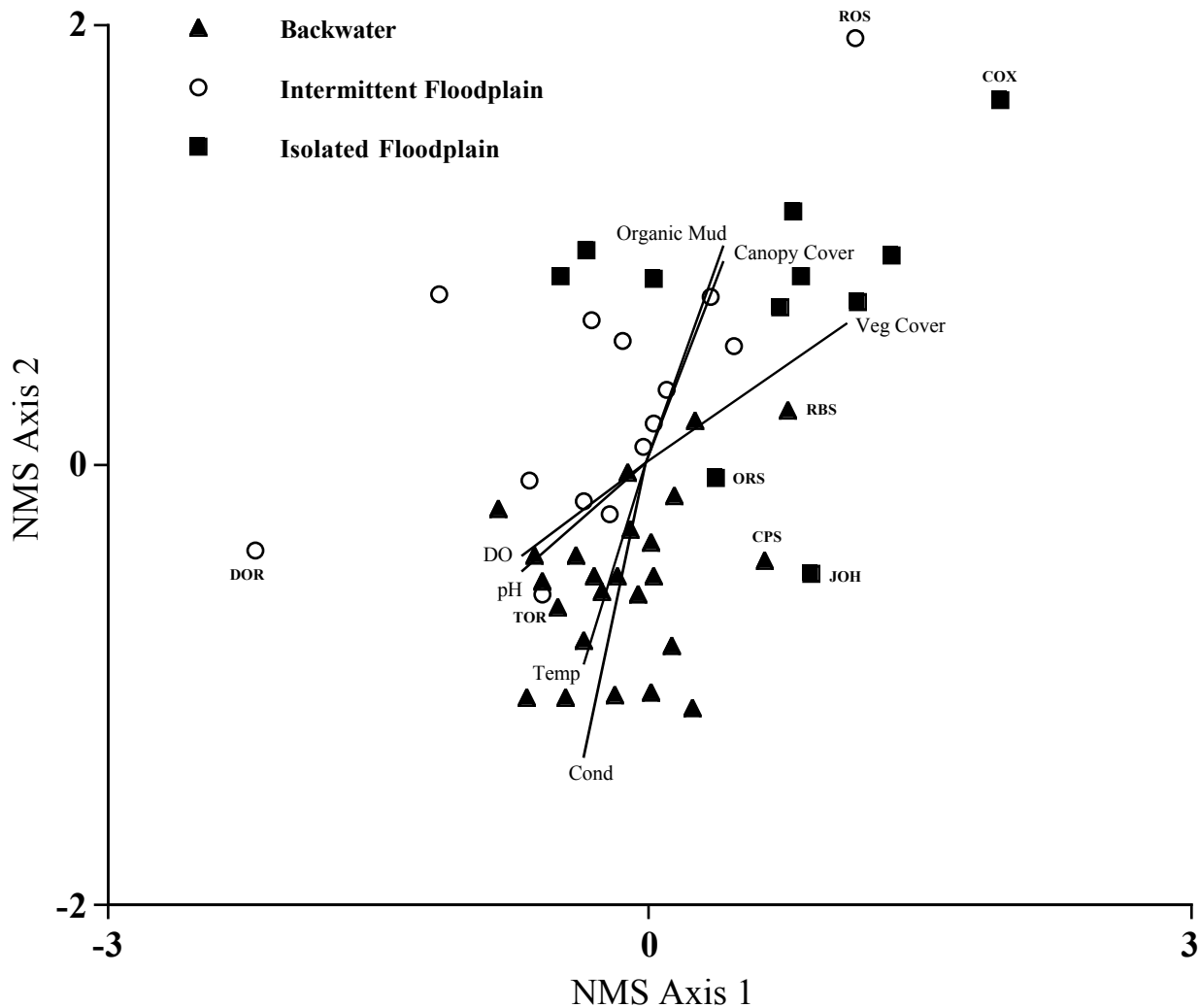
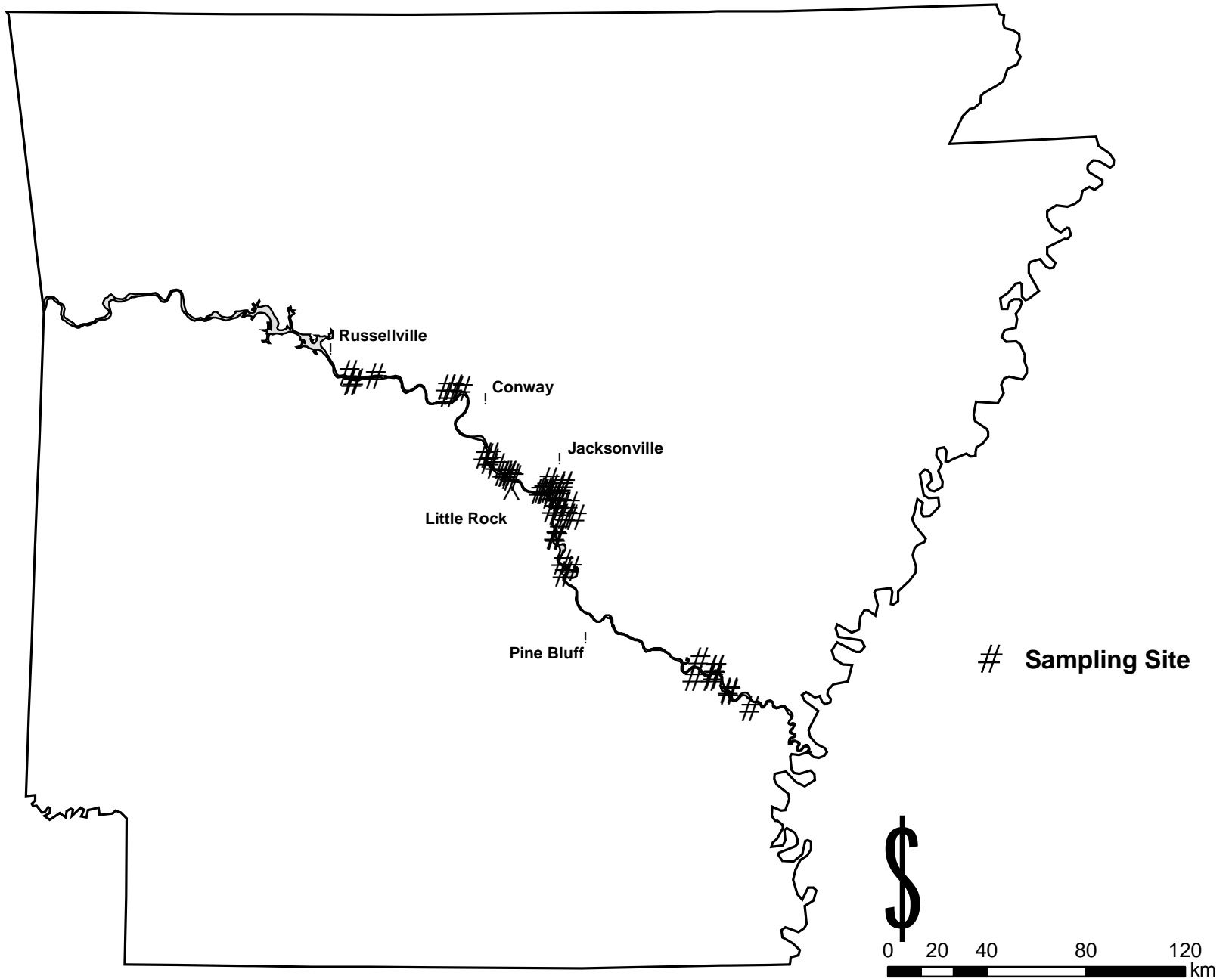
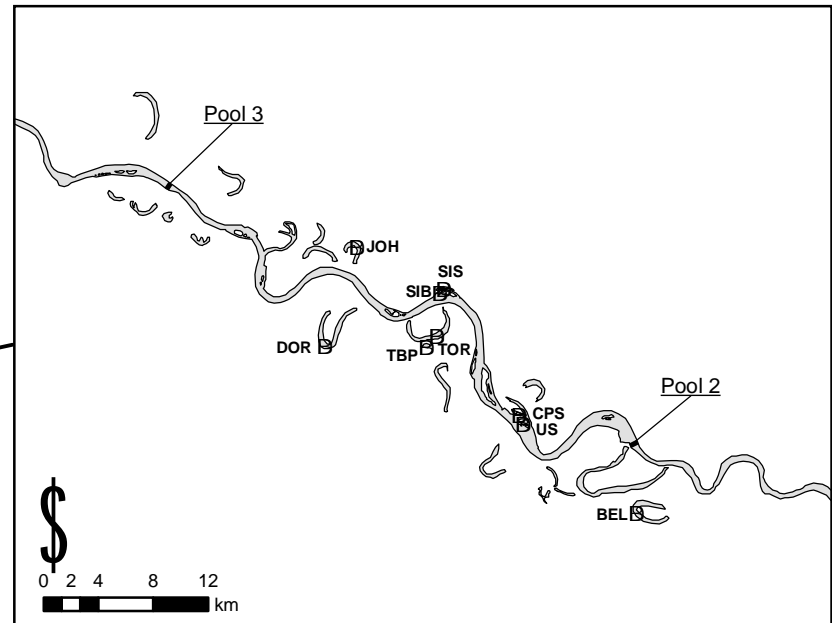
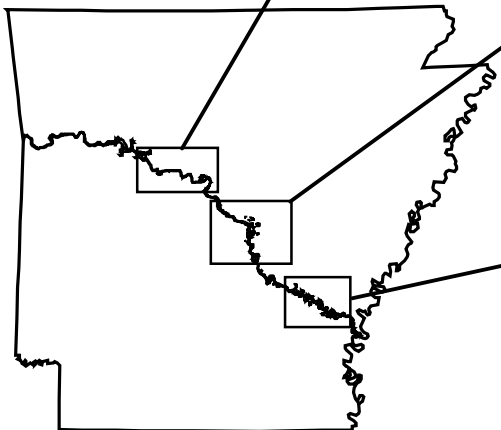
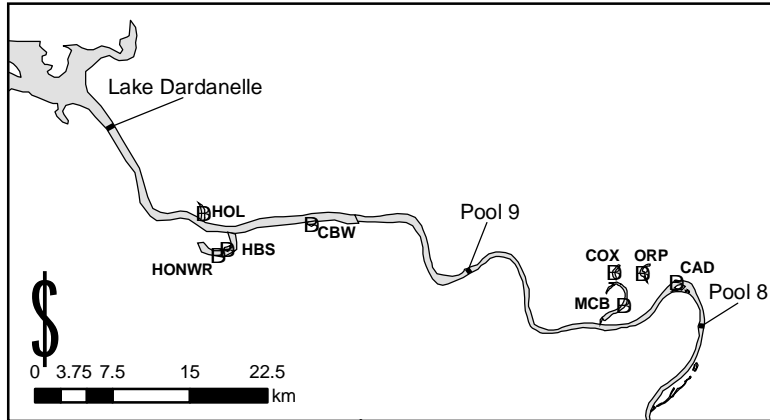
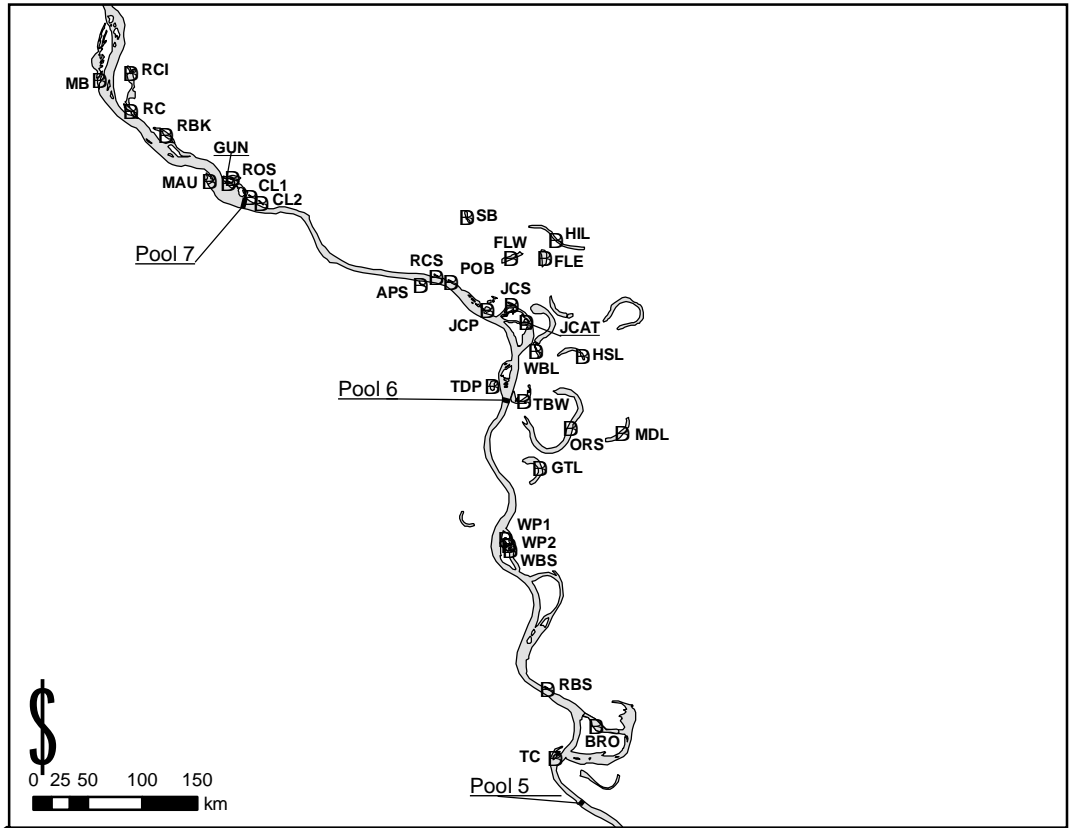


Figure 2. Nonmetric multidimensional scaling ordination of 49 riparian wetlands of the Arkansas River, coded by connectivity type, in multivariate space defined by abundances of fishes collected by seining and with mini fyke nets. Vectors represent the associations of environmental variables with the ordination having  $r^2 > 0.30$ : conductivity (Cond), temperature (Temp), pH, dissolved oxygen (DO), organic mud substrate (Organic Mud), percent canopy cover (Canopy Cover), and percent aquatic vegetation cover (Veg Cover). Associations of all environmental variables with NMS axes are provided in Table 8. Some of the wetlands with unique fish assemblages relative to others of similar classification are labeled. Site codes are listed in Table 1.

# Map 1. Sampling Sites



# Map 2. Sampling Sites



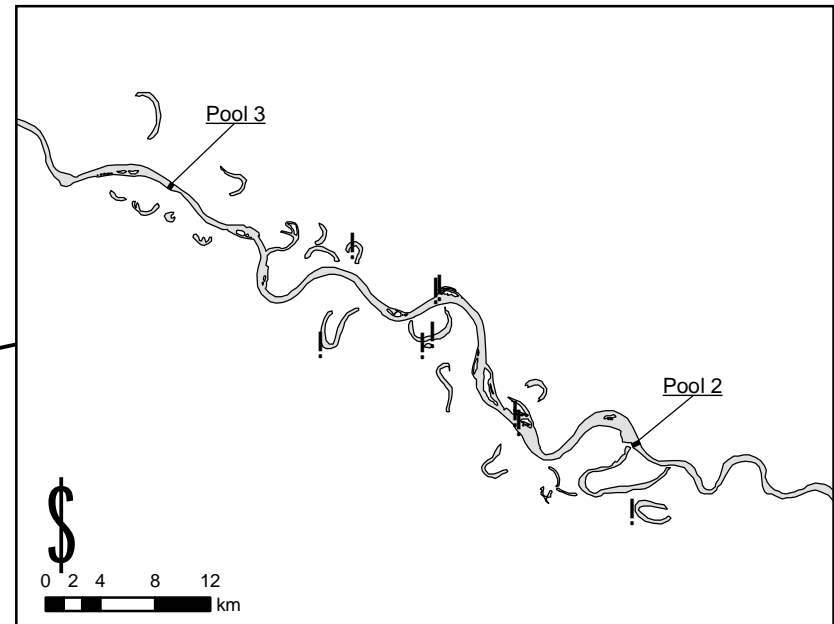
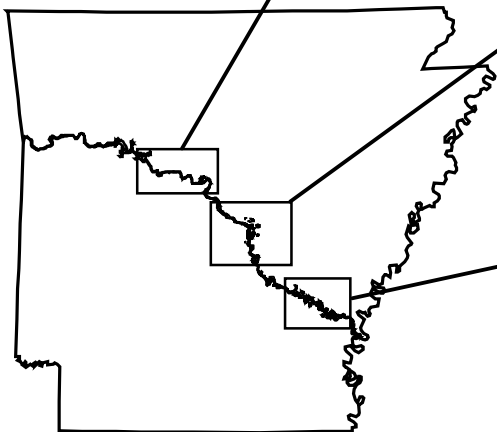
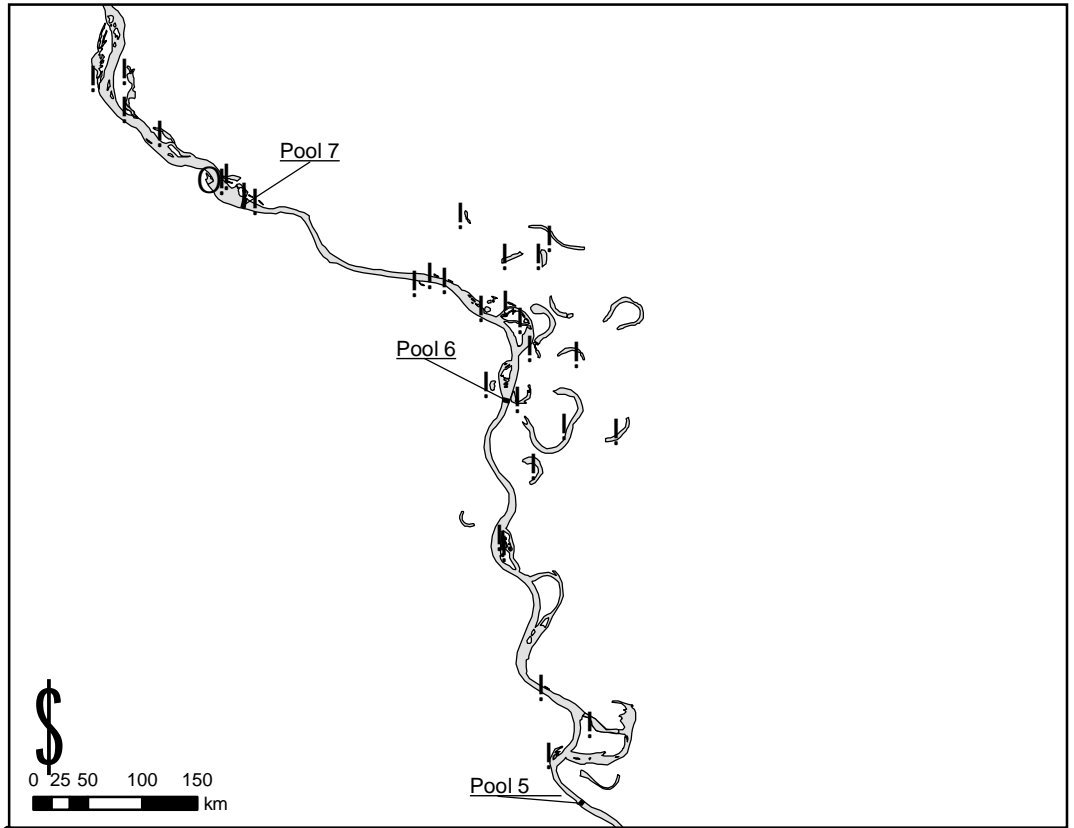
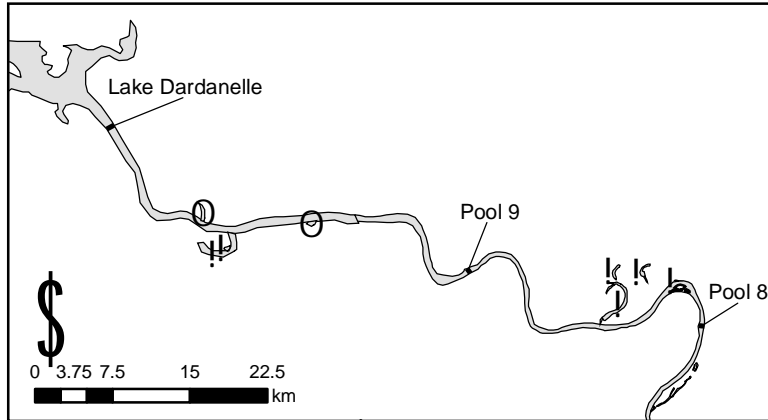
# Map 3.

# Spotted gar

*Lepisosteus oculatus*

! Present

O Absent

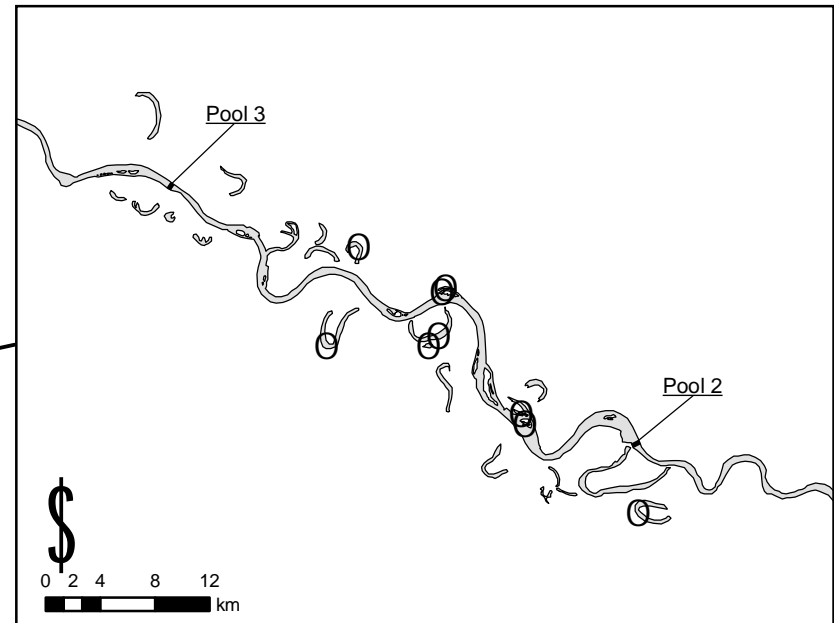
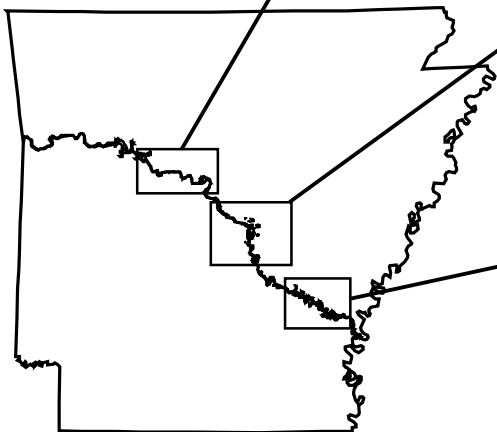
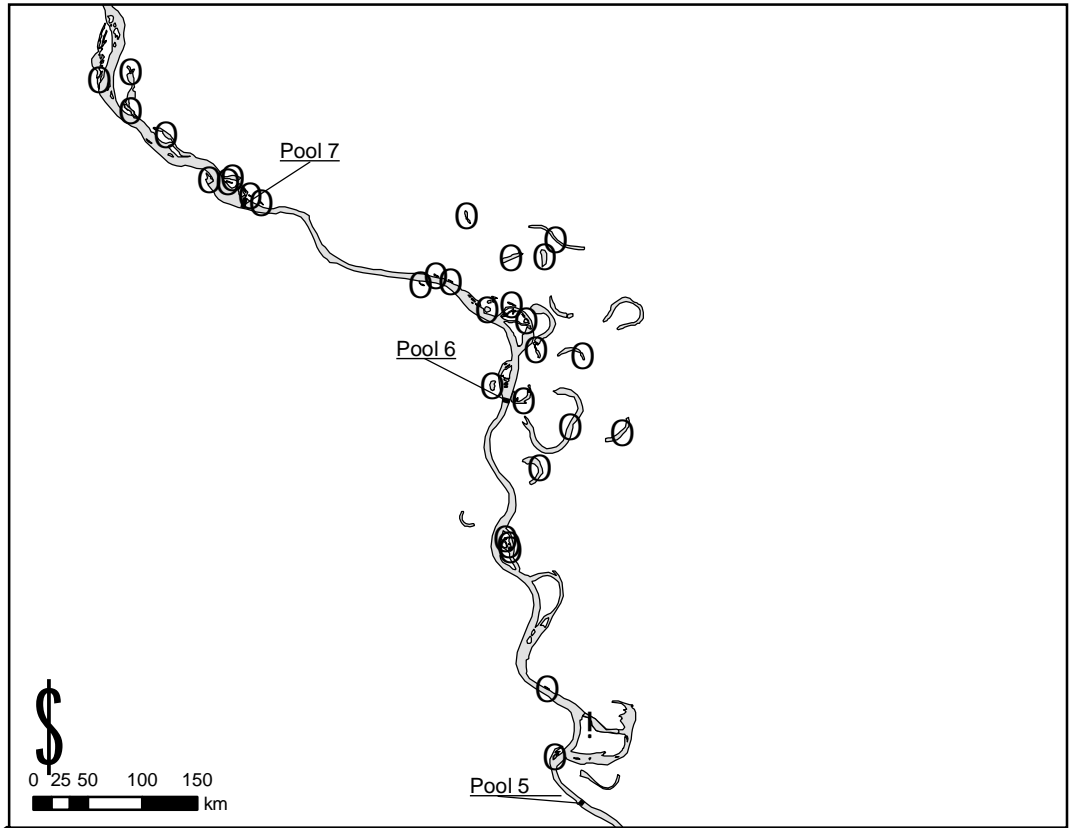
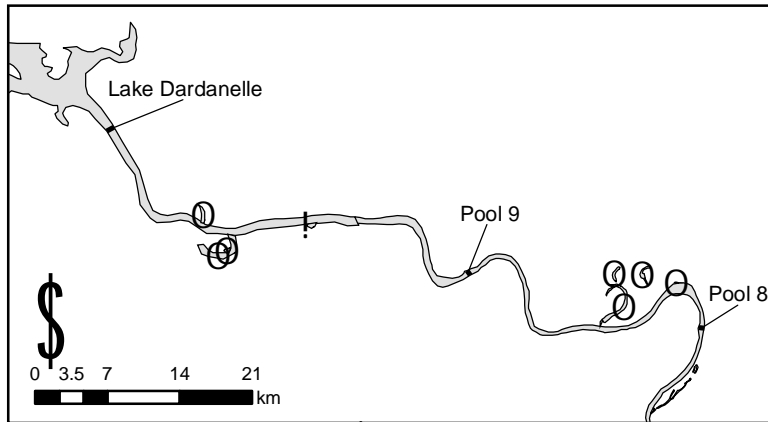


# Map 4. Longnose gar

*Lepisosteus osseus*

! Present

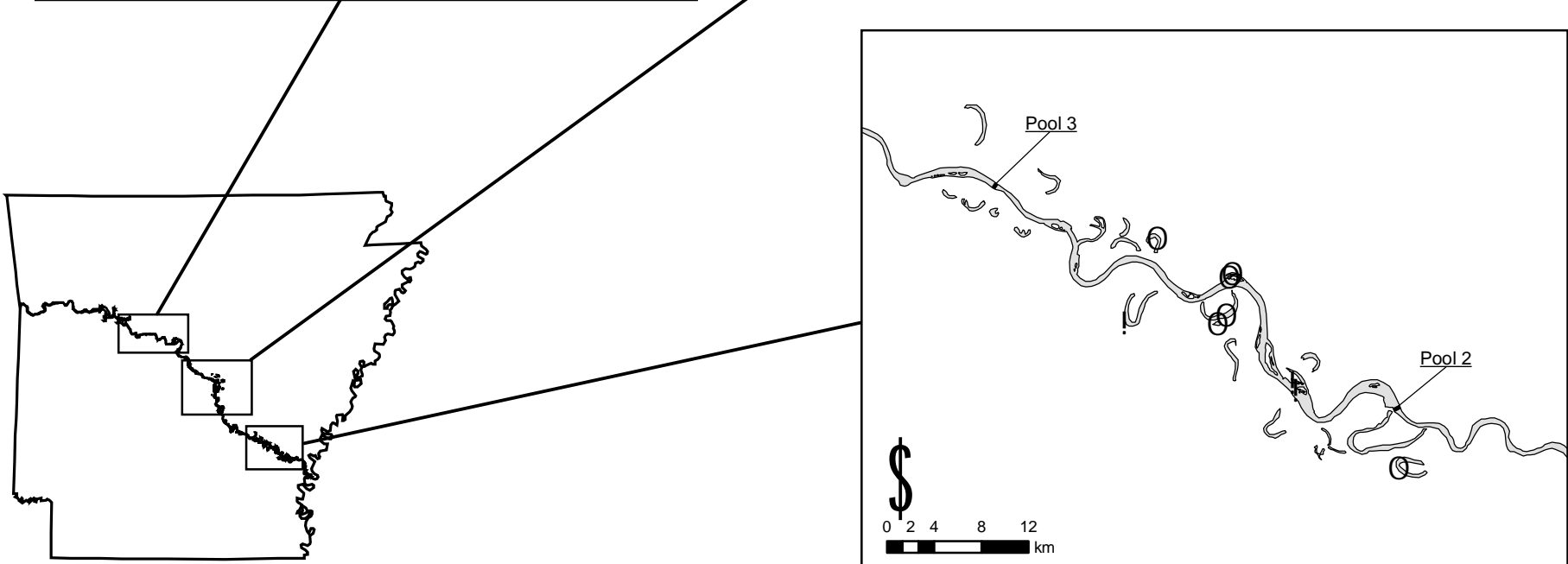
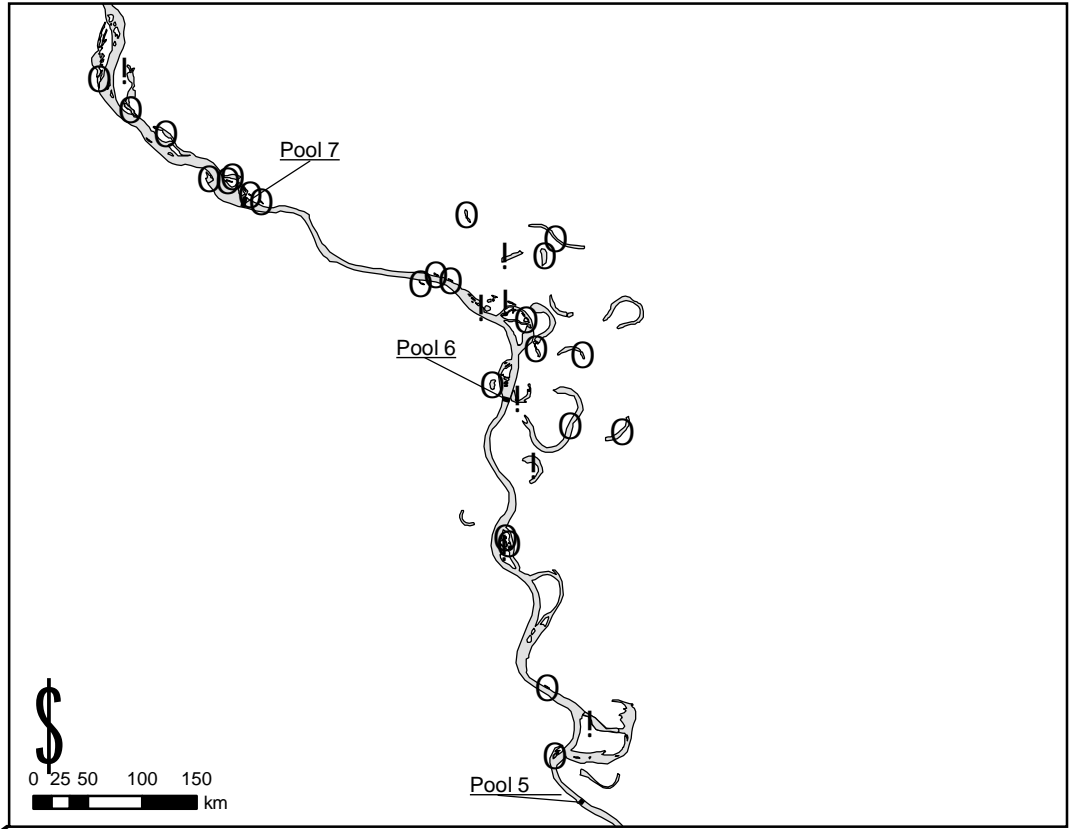
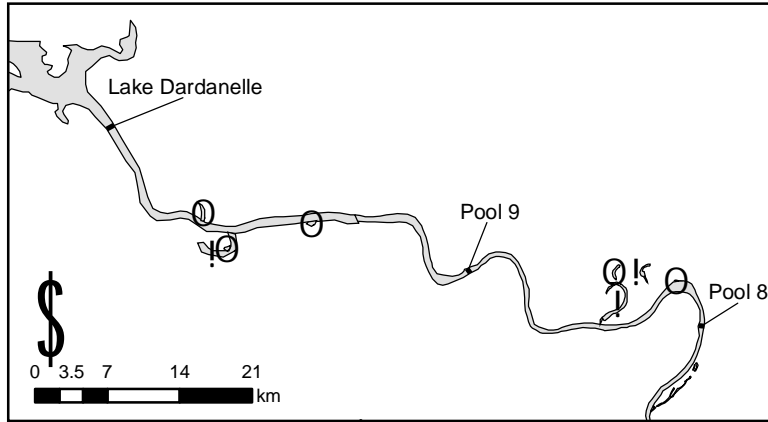
○ Absent



# Map 5. Shortnose gar

*Lepisosteus platostomus*

- ! Present
- Absent

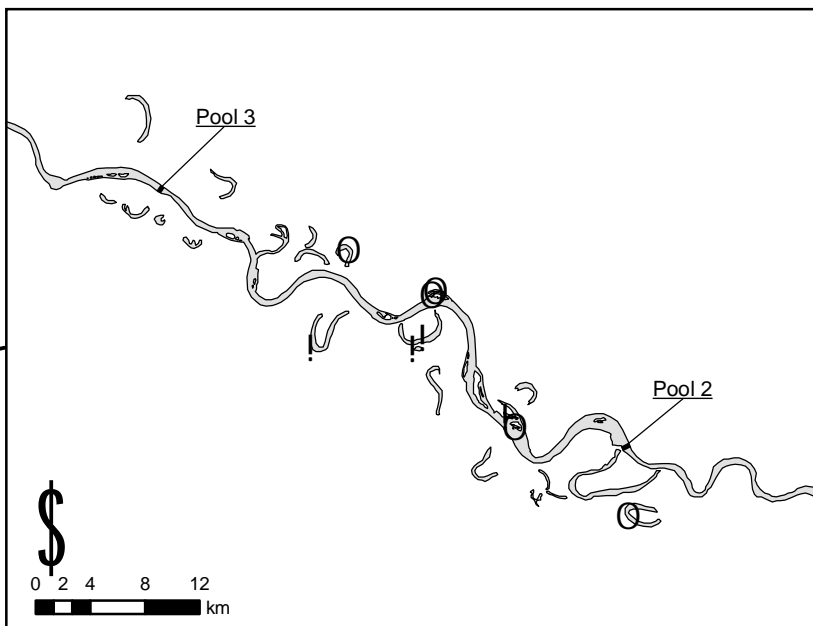
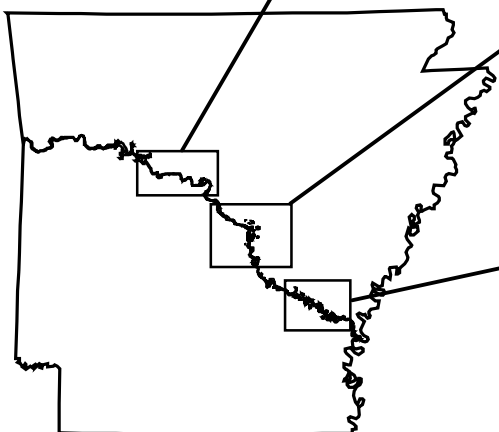
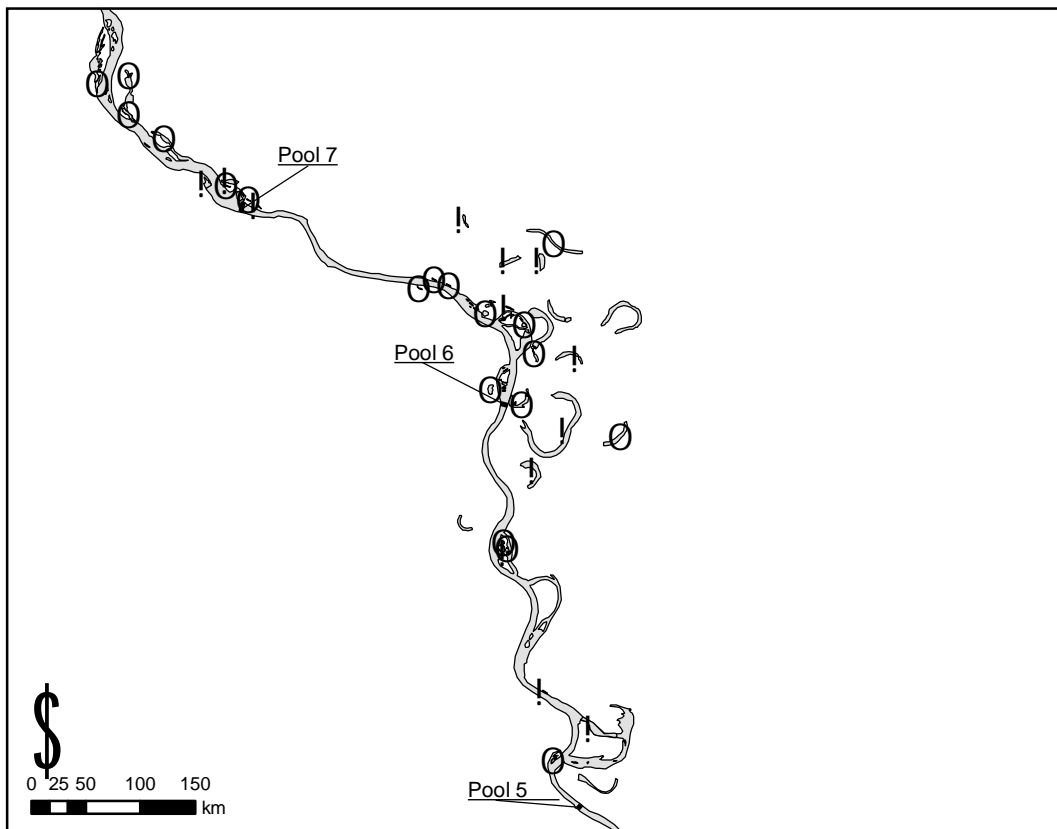
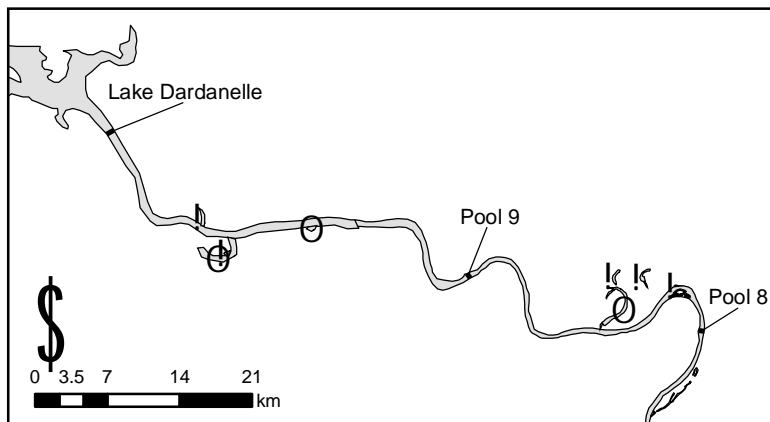


# Map 6. Bowfin

*Amia calva*

! Present

O Absent



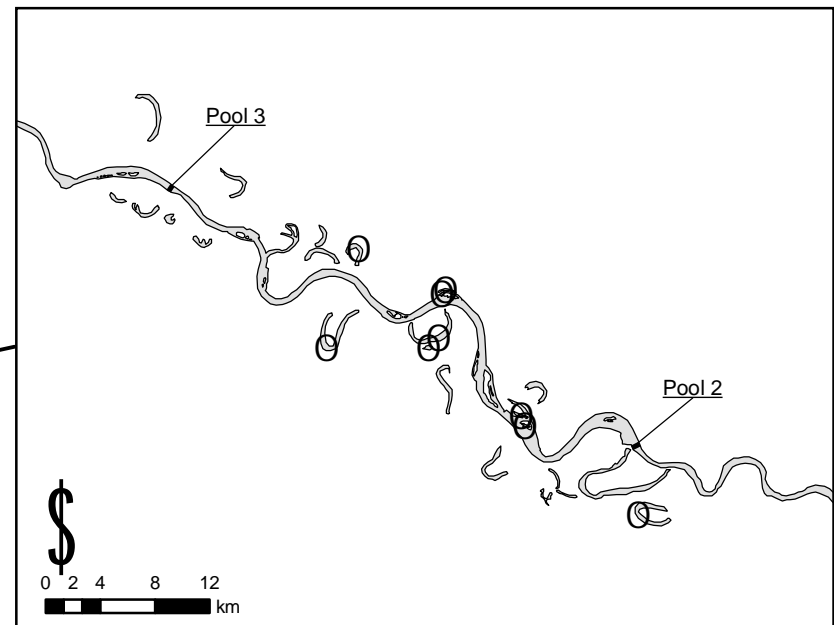
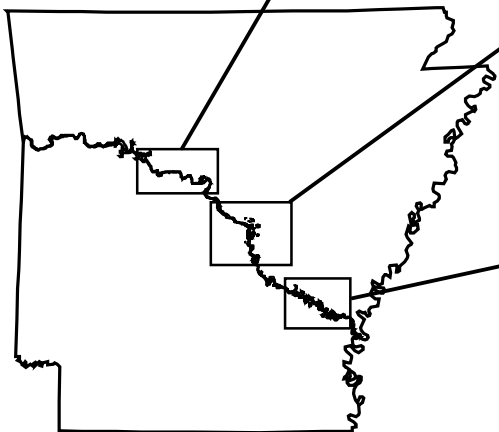
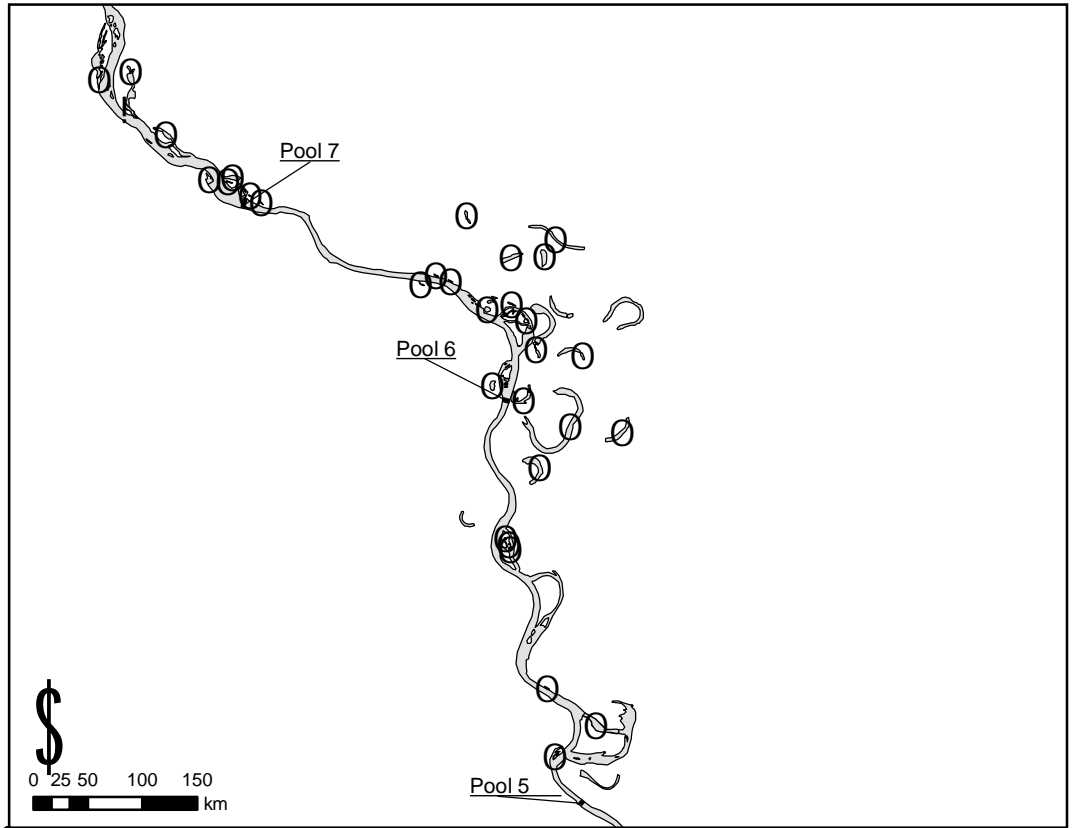
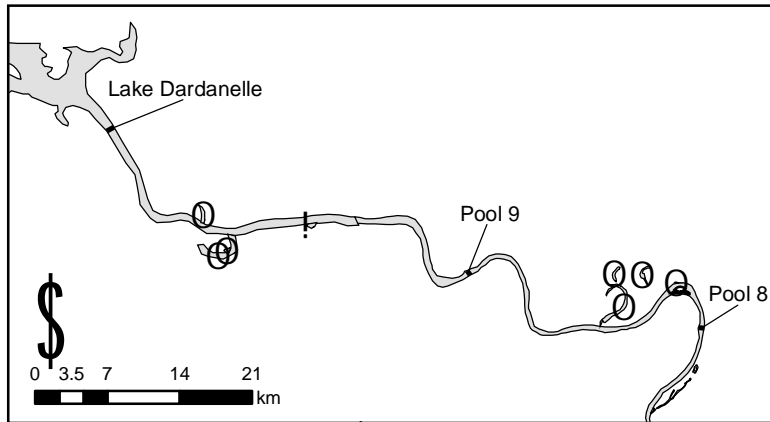


# Map 7. Skipjack herring

*Alosa chrysochloris*

! Present

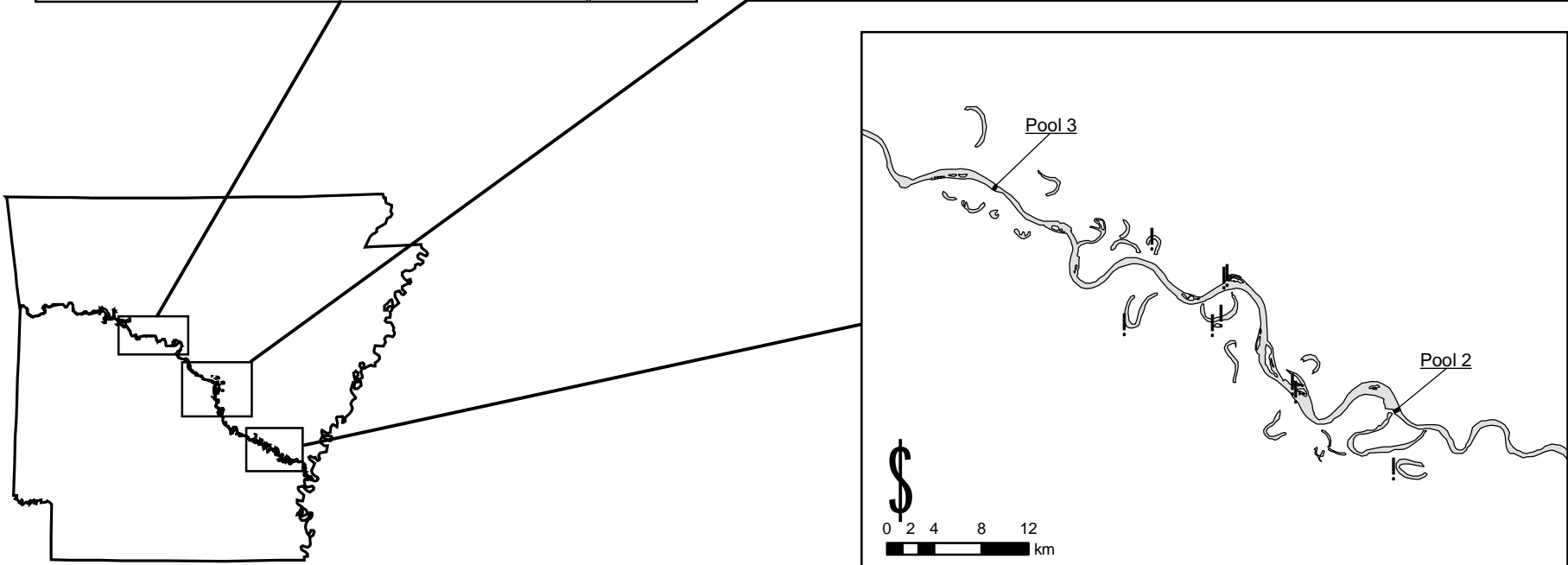
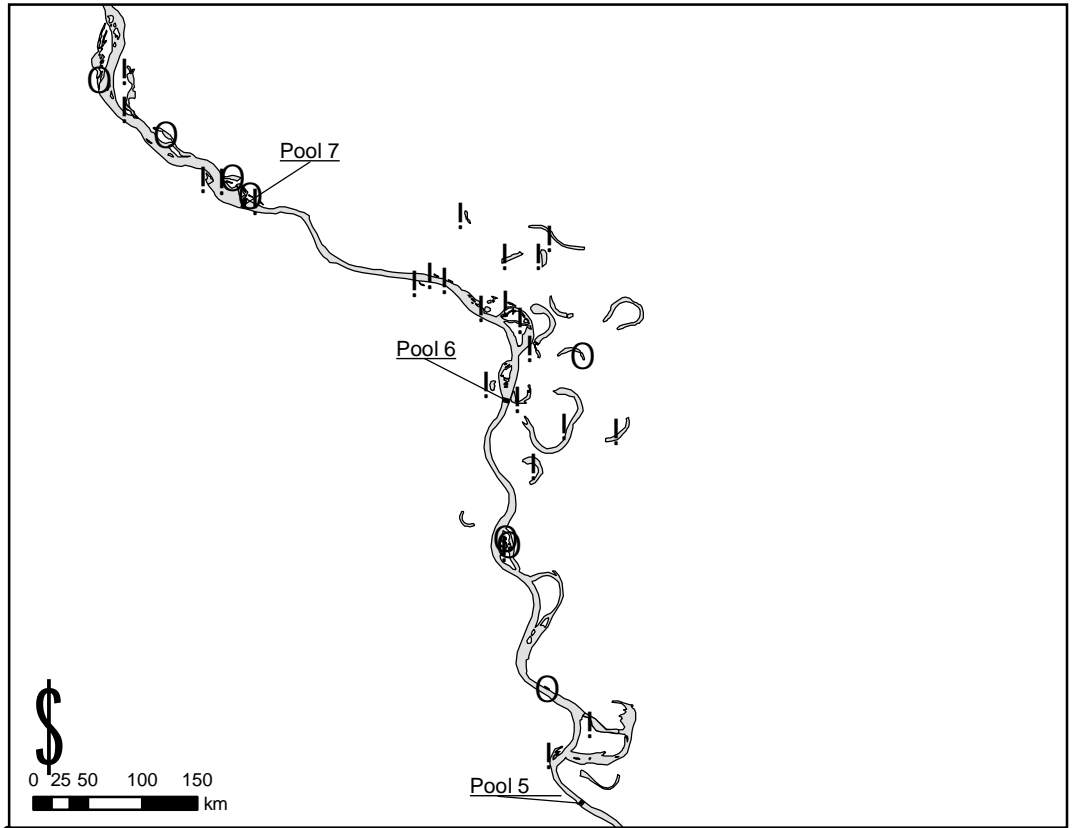
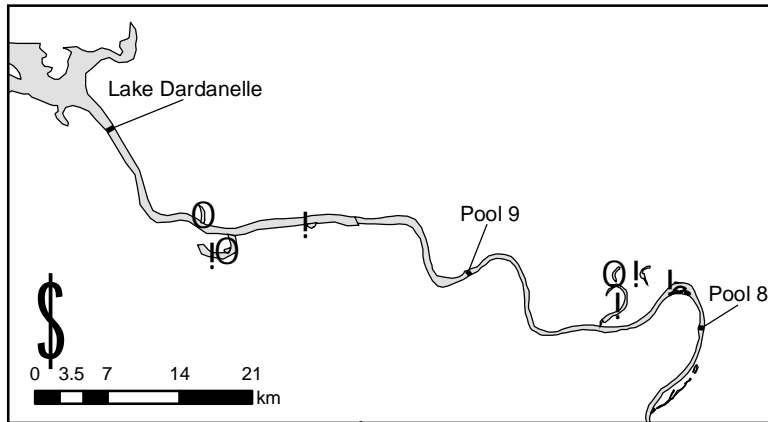
○ Absent



# Map 8. Gizzard shad

*Dorosoma cepedianum*

- ! Present
- Absent

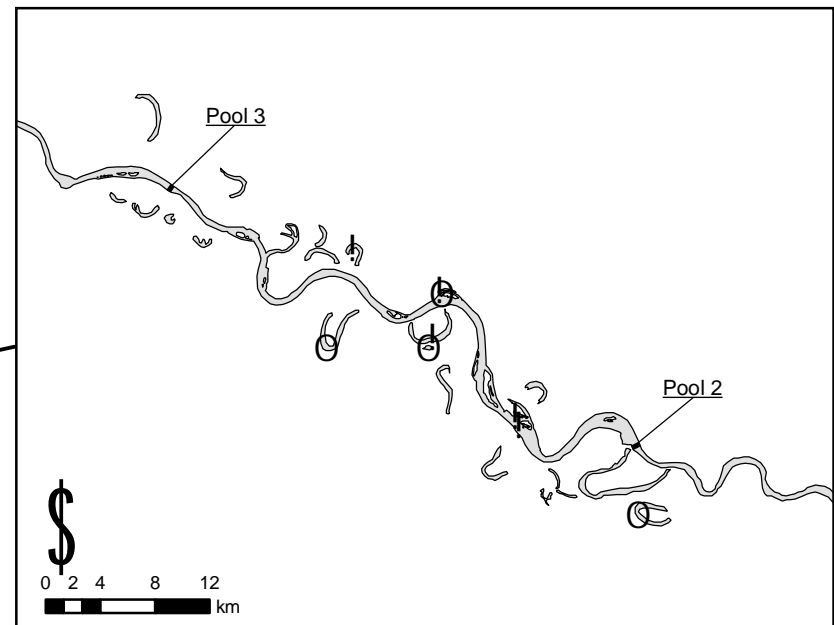
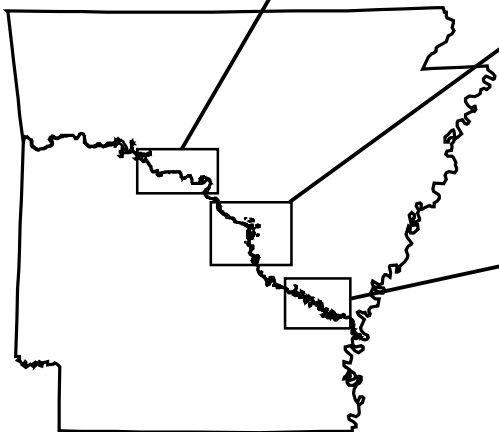
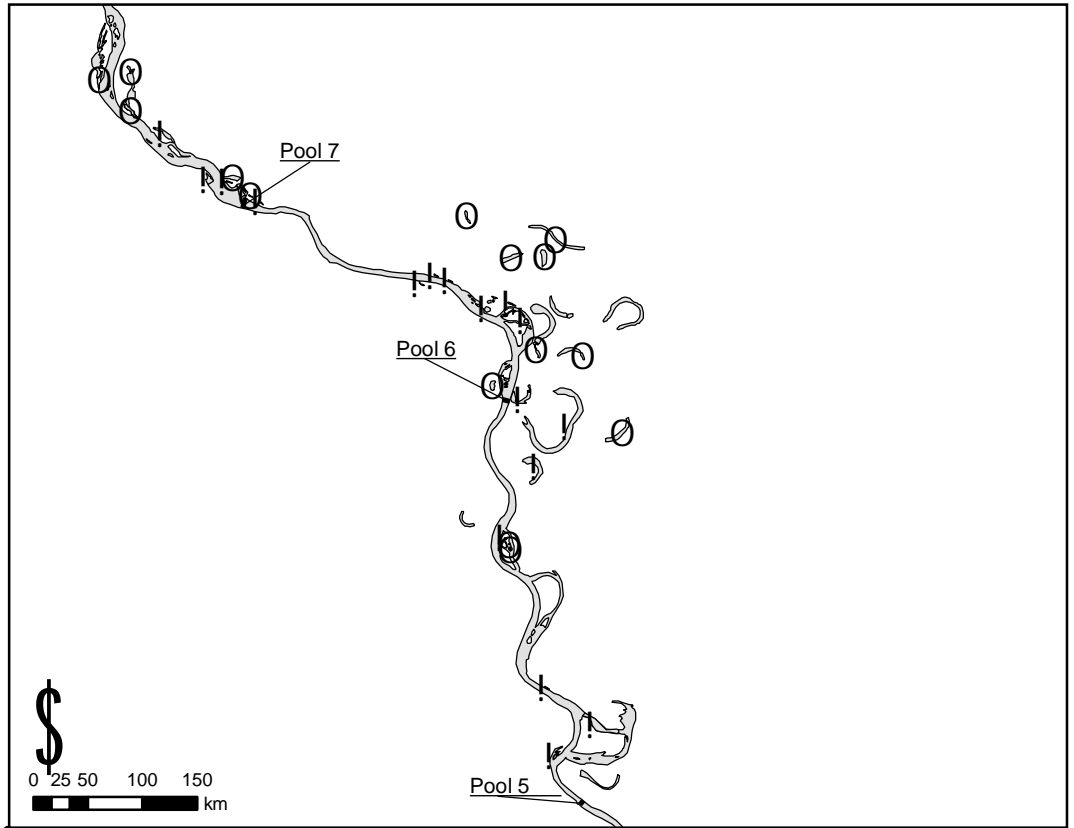
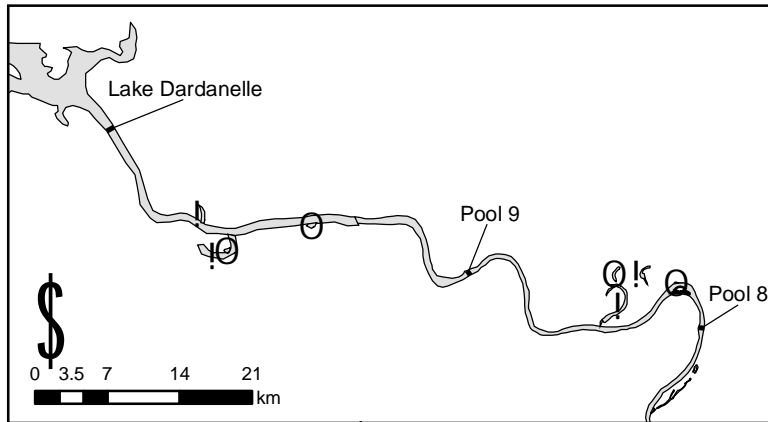


# Map 9. Threadfin shad

*Dorosoma petenense*

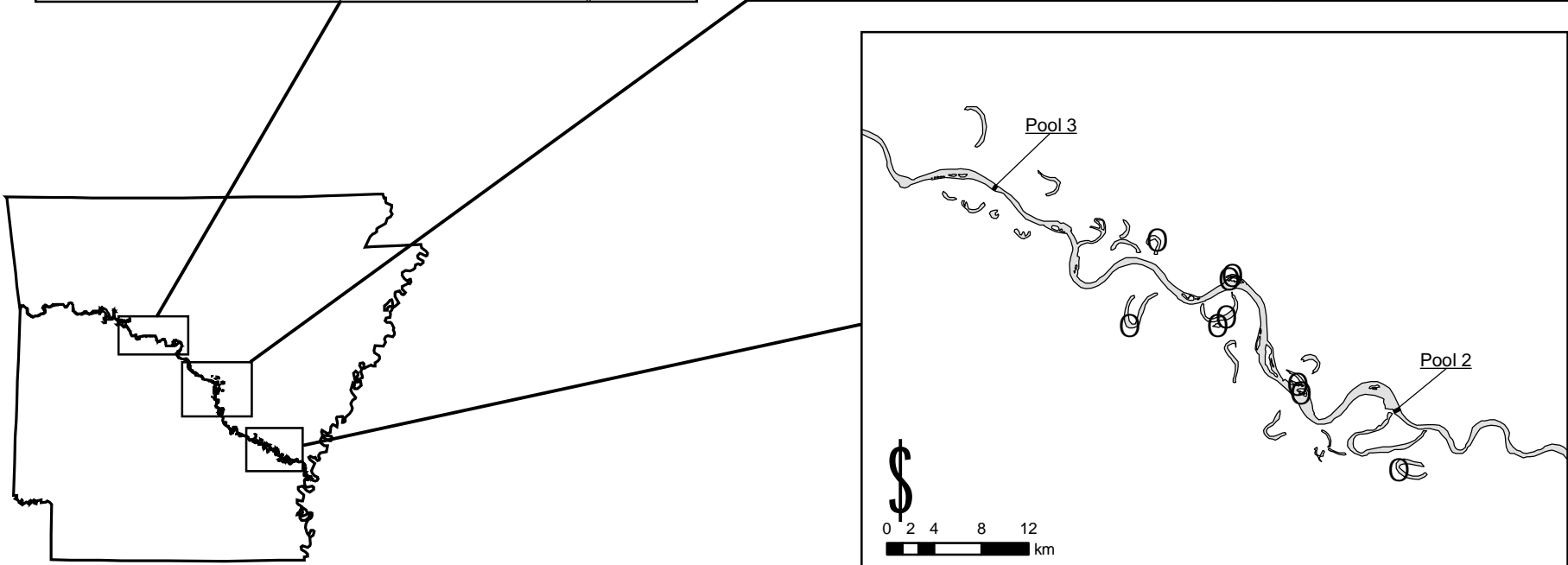
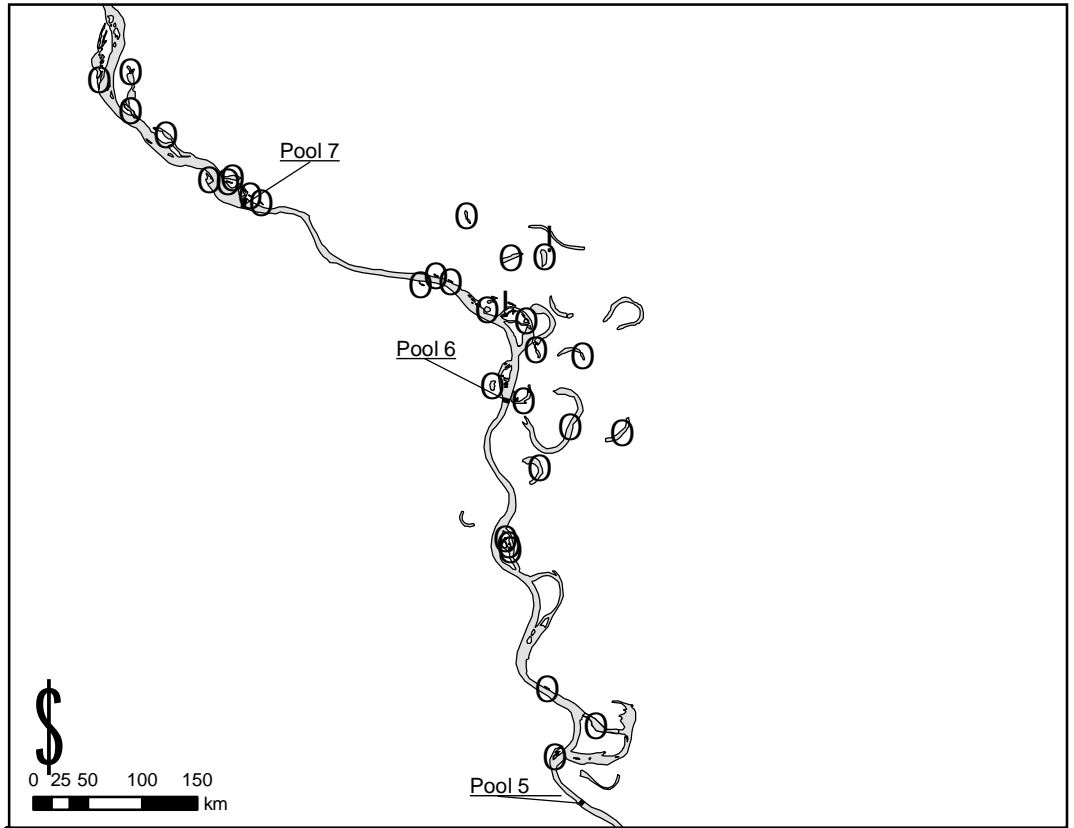
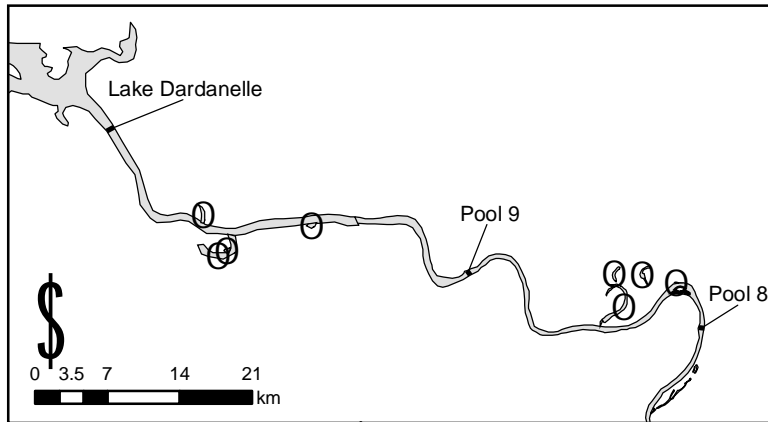
! Present

○ Absent



# Map 10. Grass carp *Ctenopharyngodon idella*

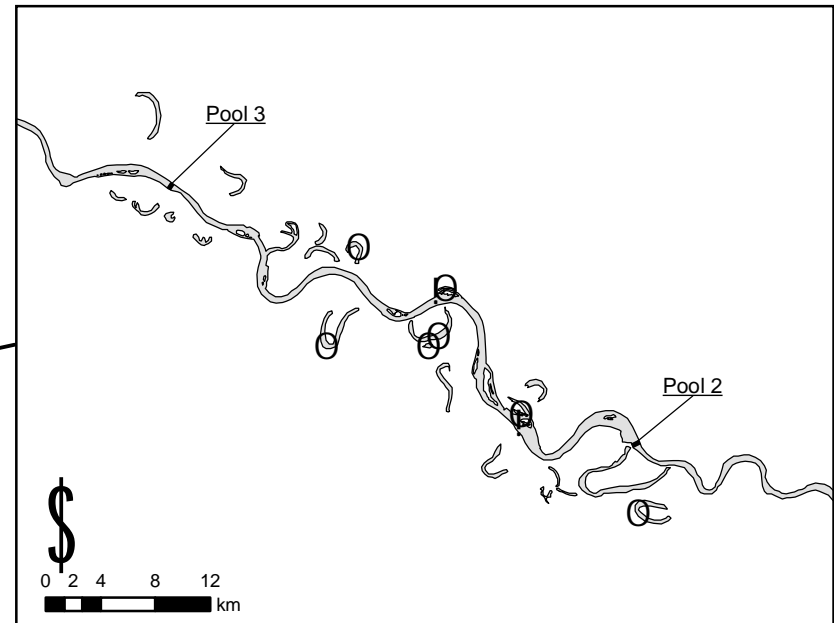
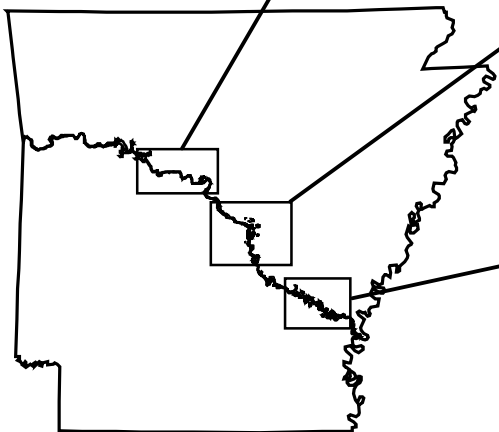
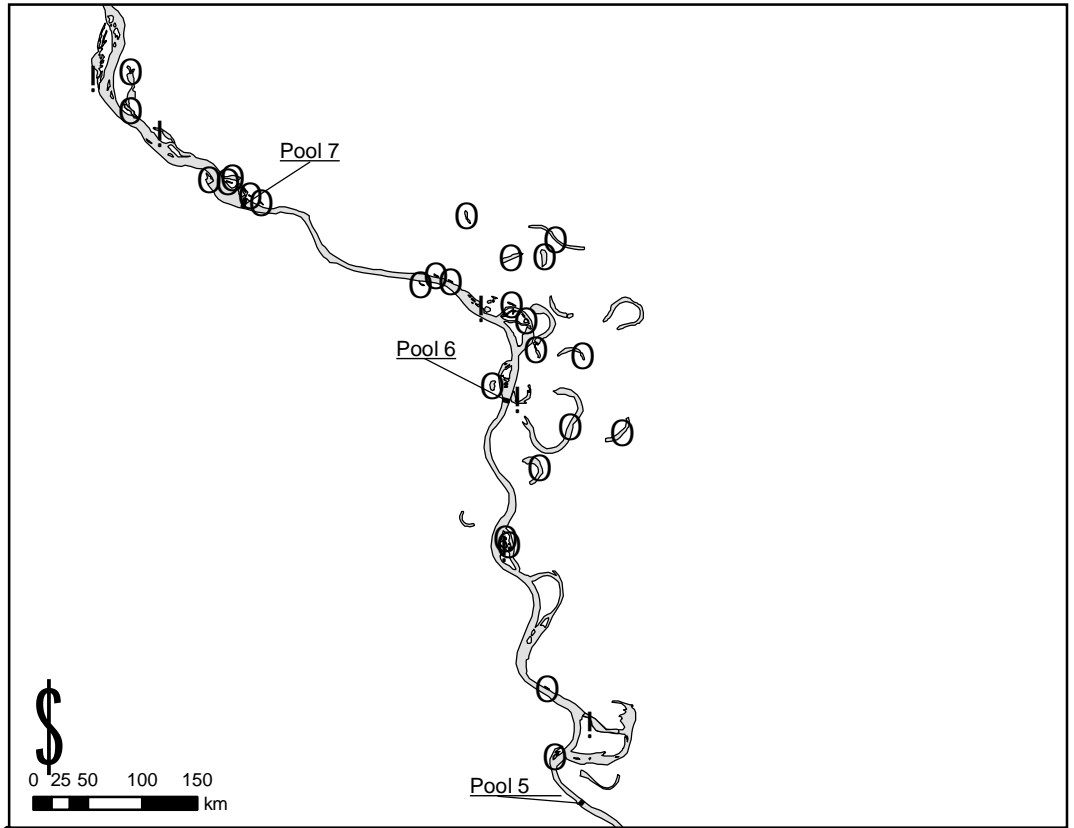
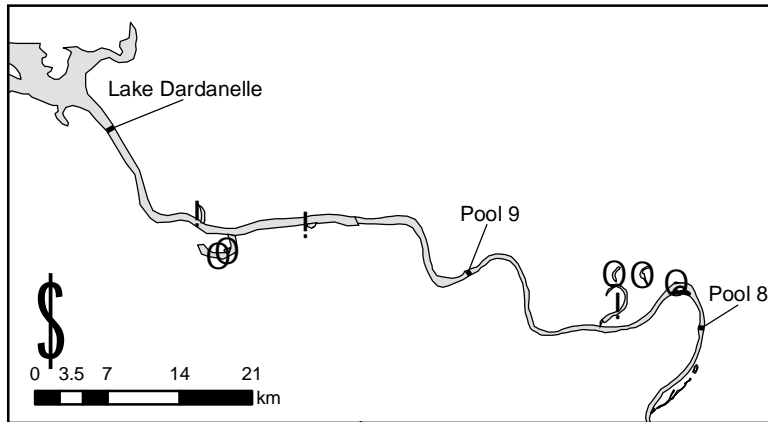
- ! Present
- Absent



# Map 11. Red shiner

*Cyprinella lutrensis*

- ! Present
- Absent

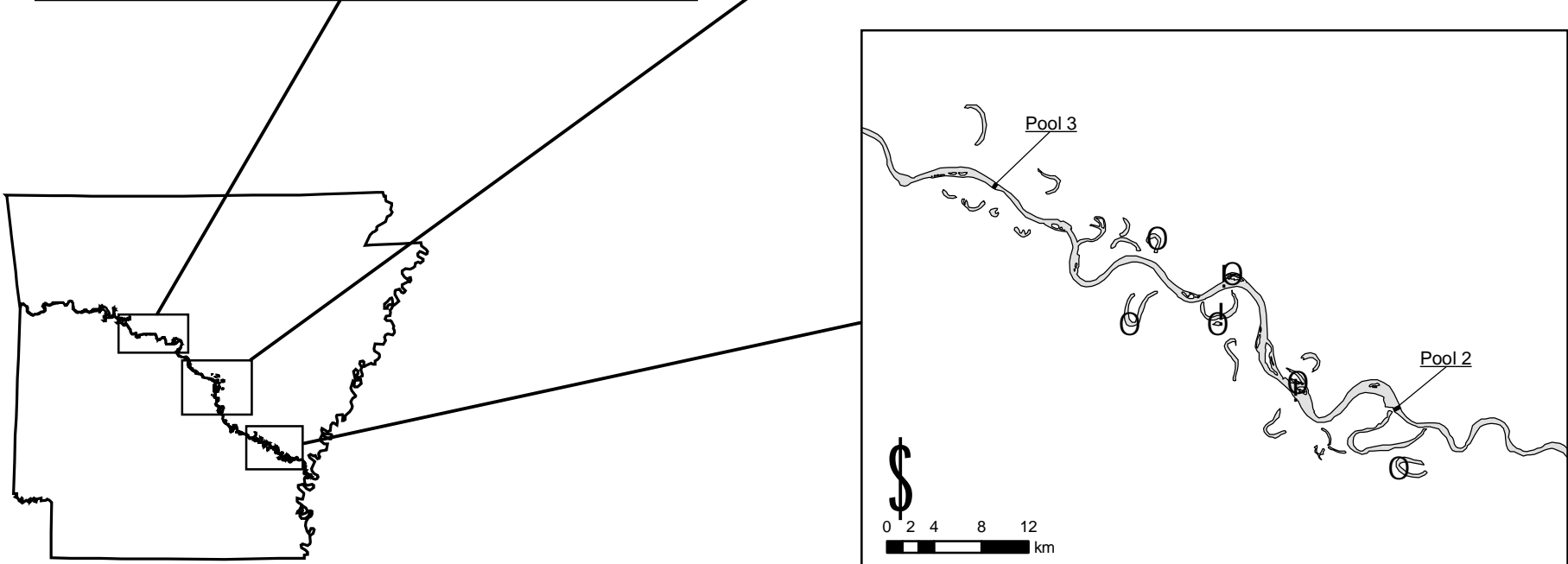
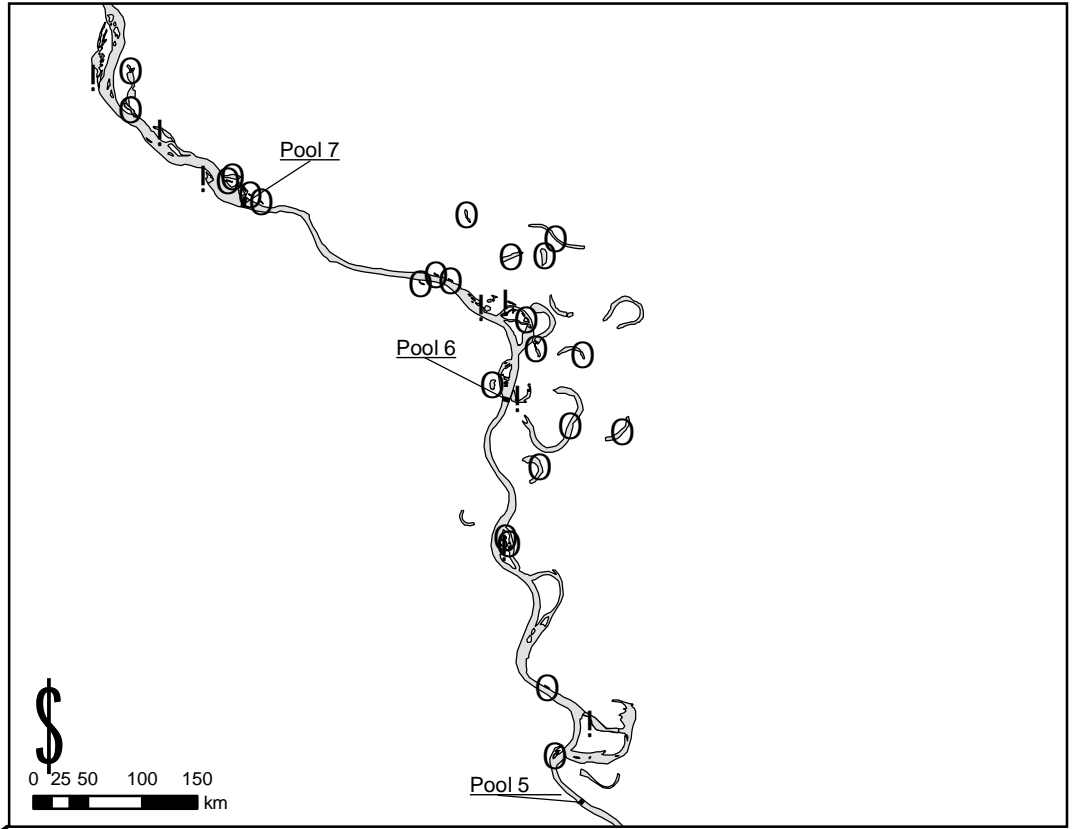
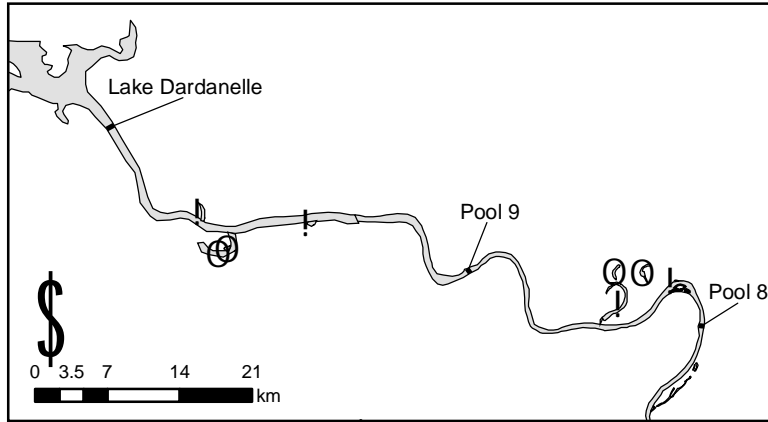


# Map 12. Blacktail shiner

*Cyprinella venusta*

! Present

○ Absent

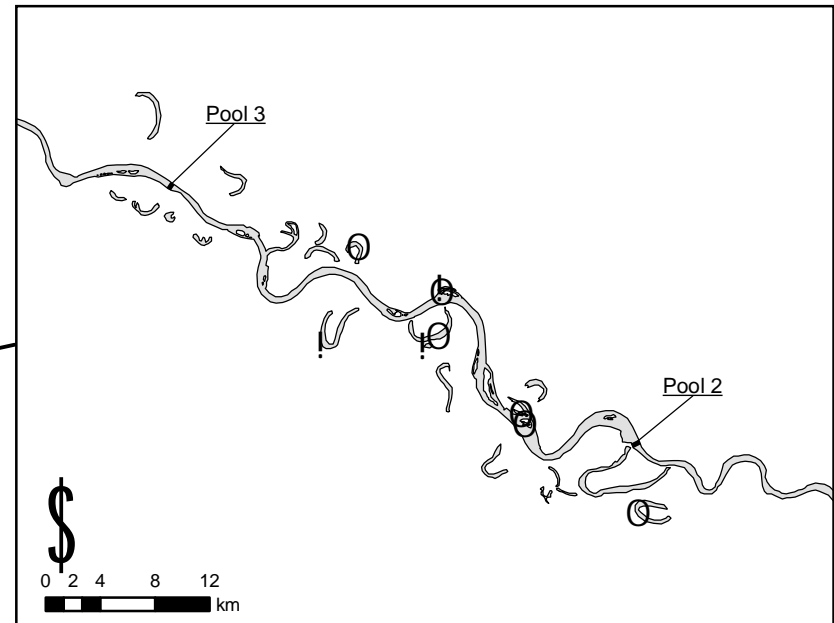
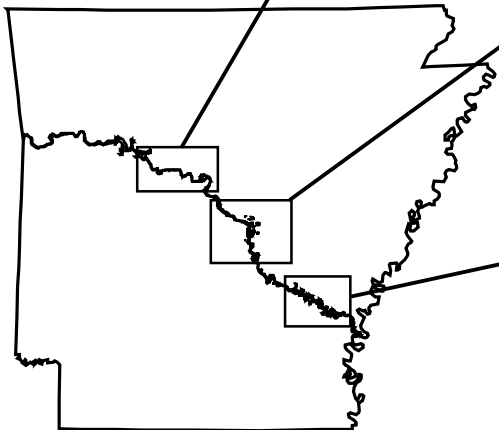
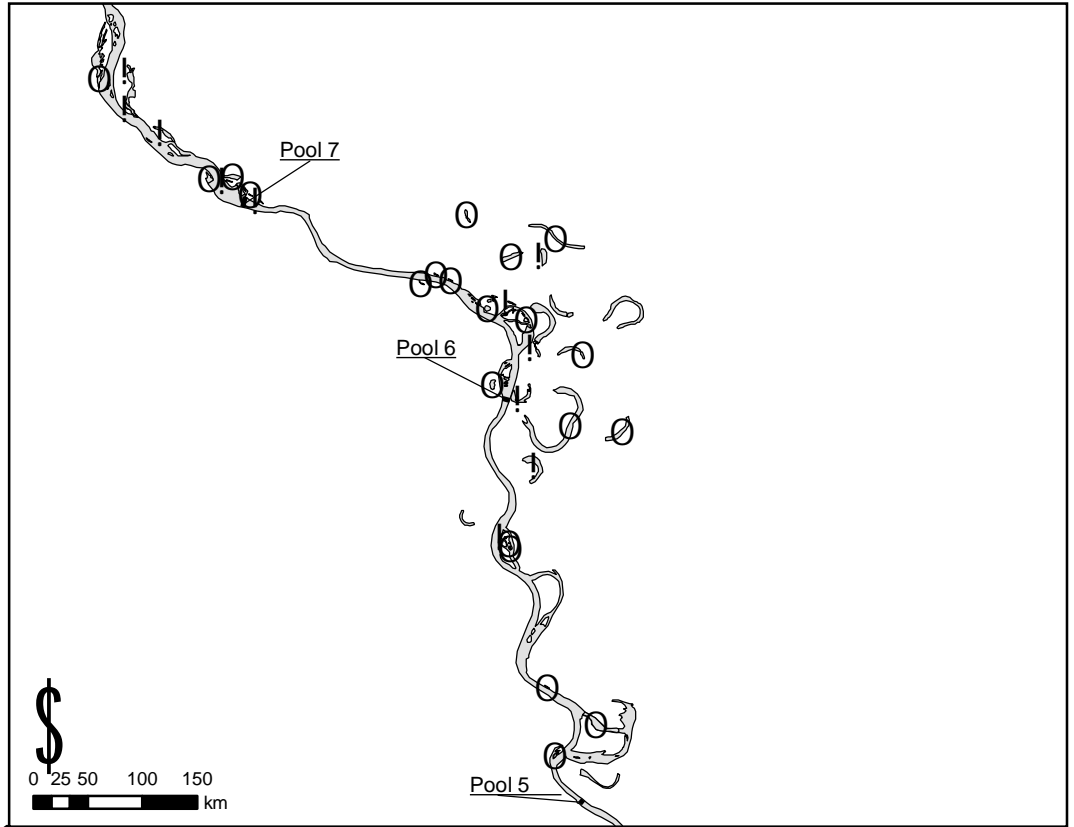
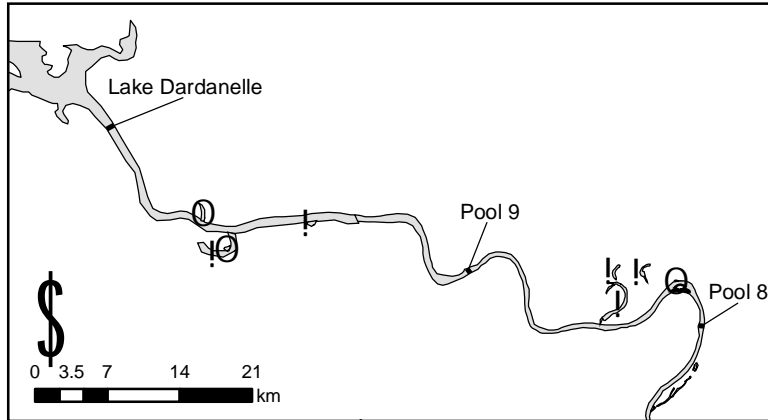


# Map 13. Common carp

*Cyprinus carpio*

! Present

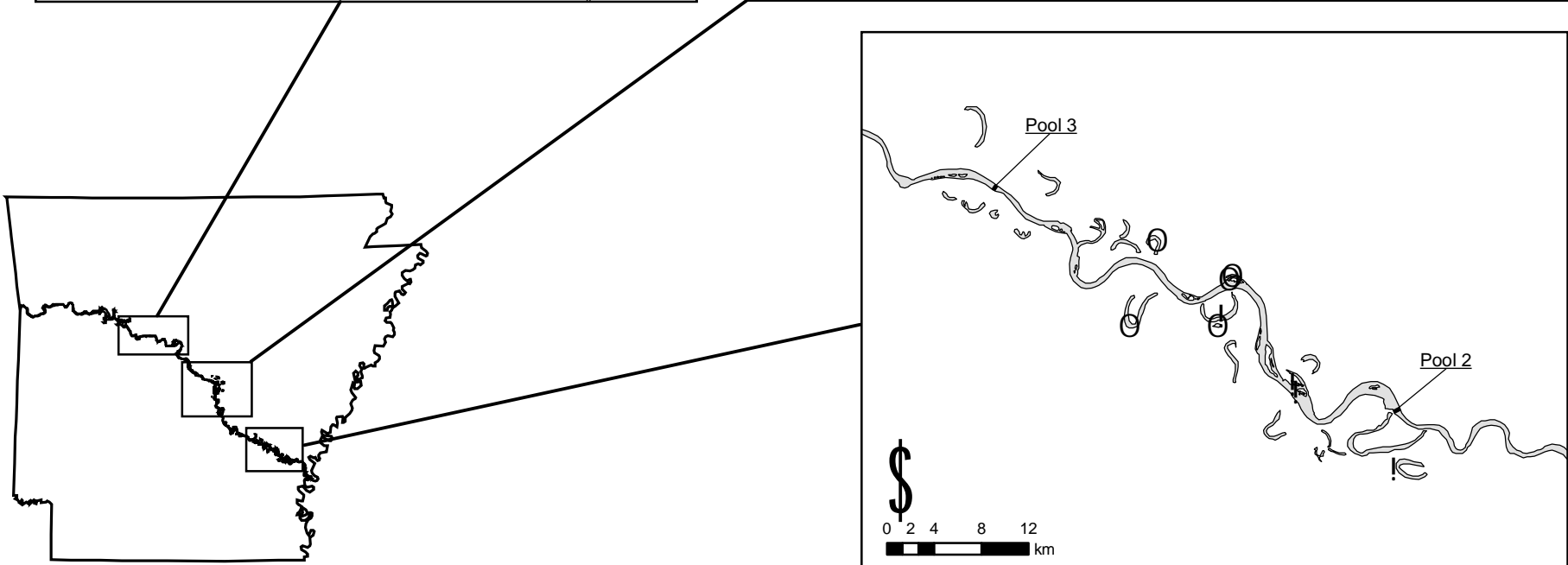
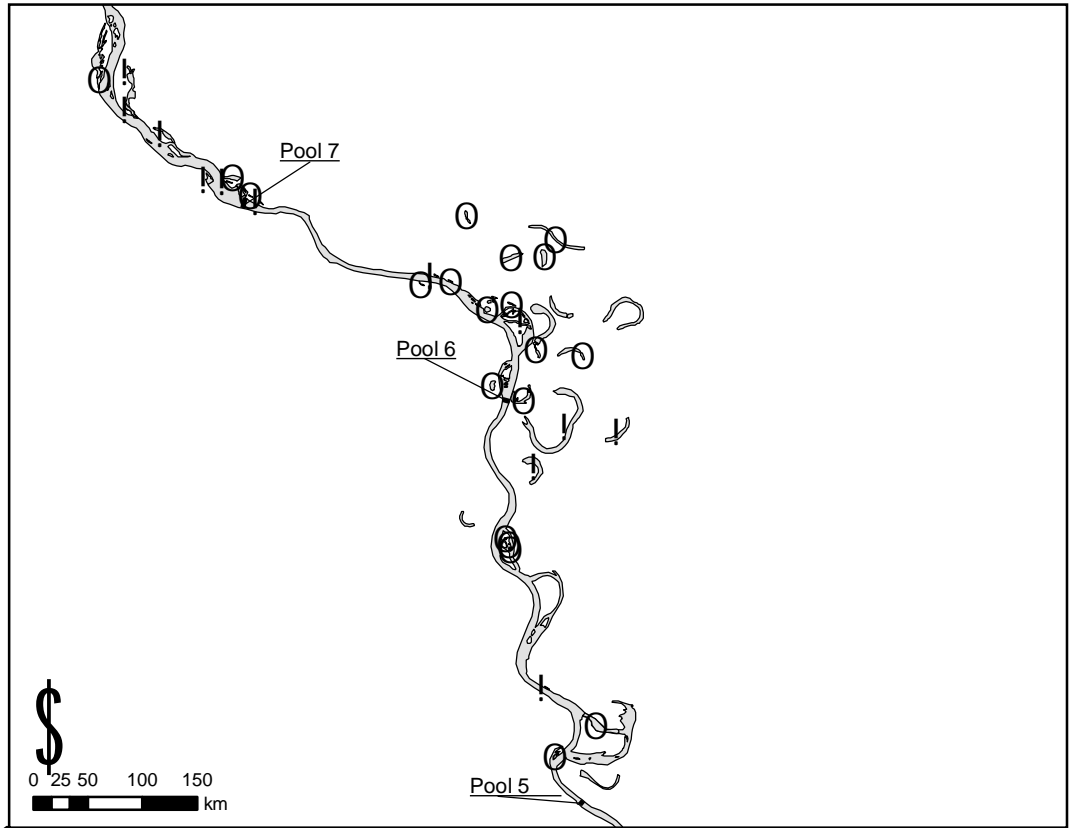
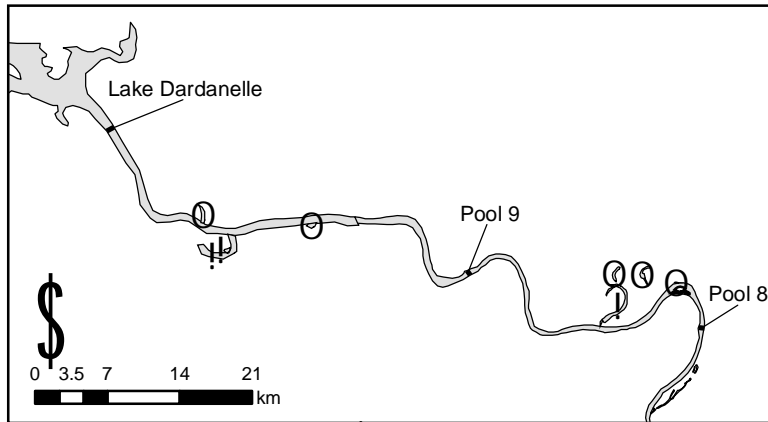
○ Absent



# Map 14. Golden shiner

*Notemigonus crysoleucas*

- ! Present
- Absent



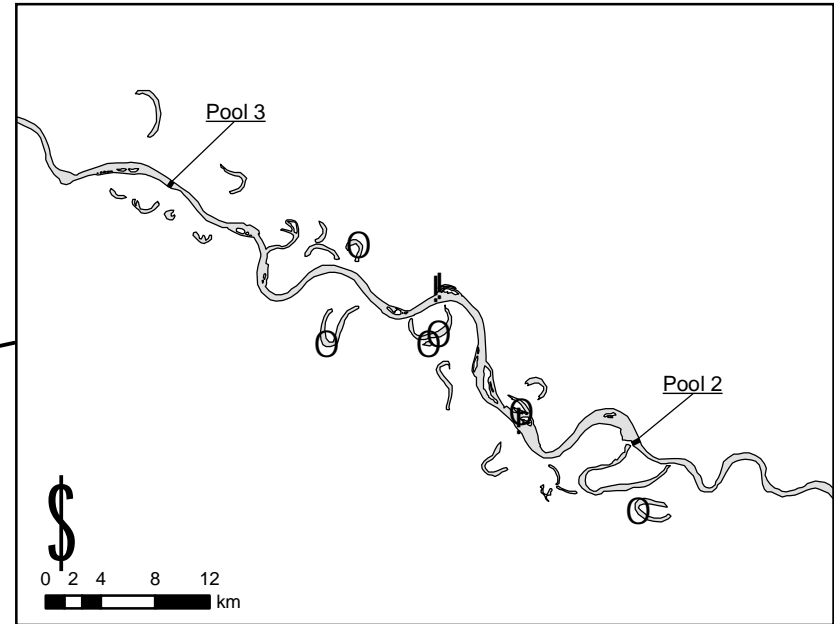
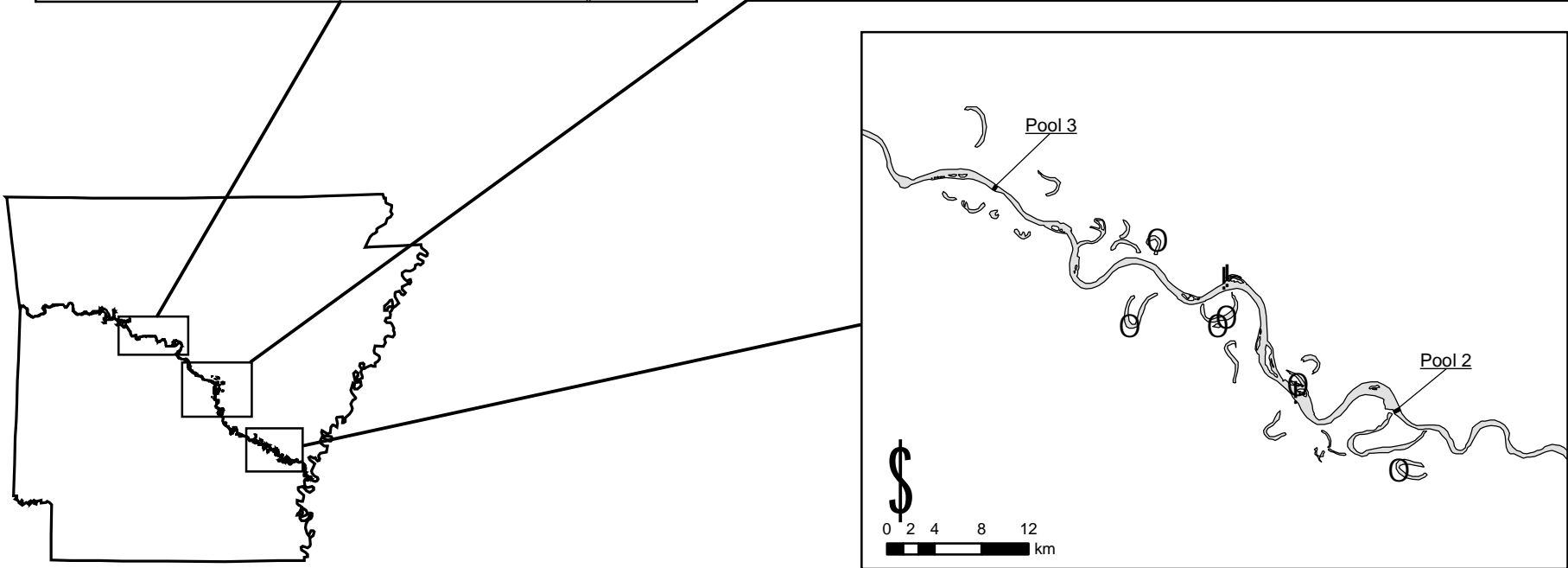
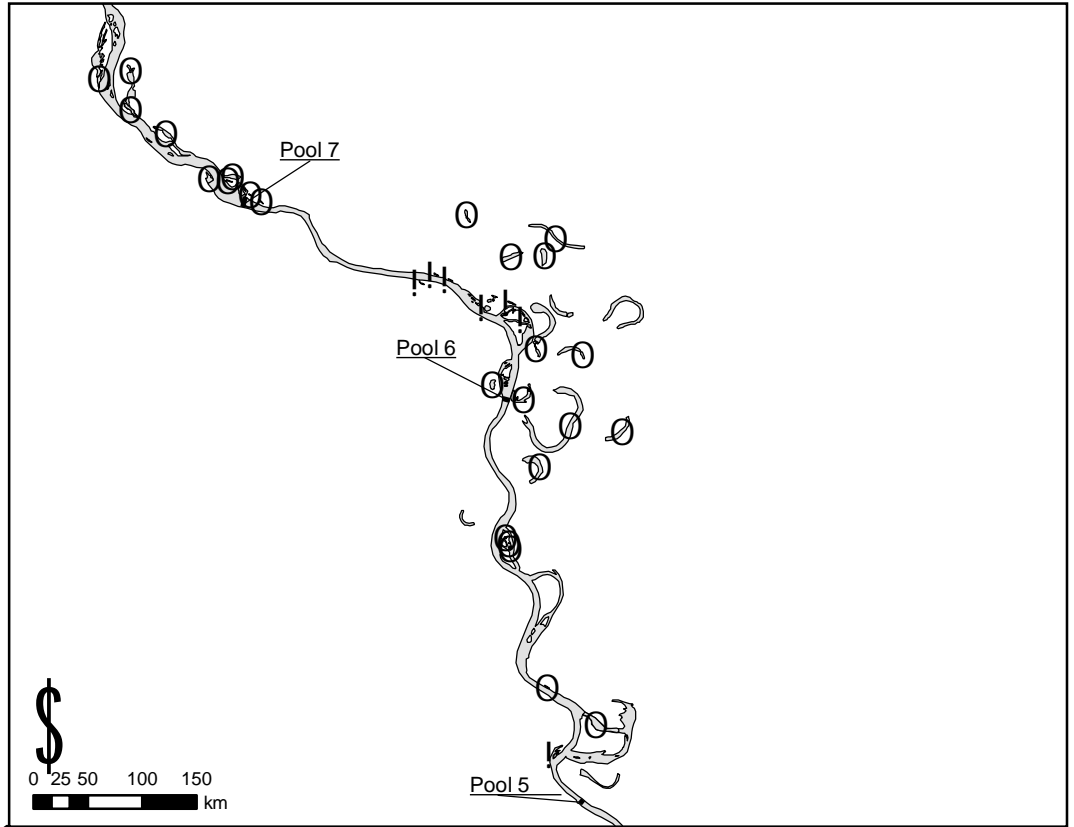
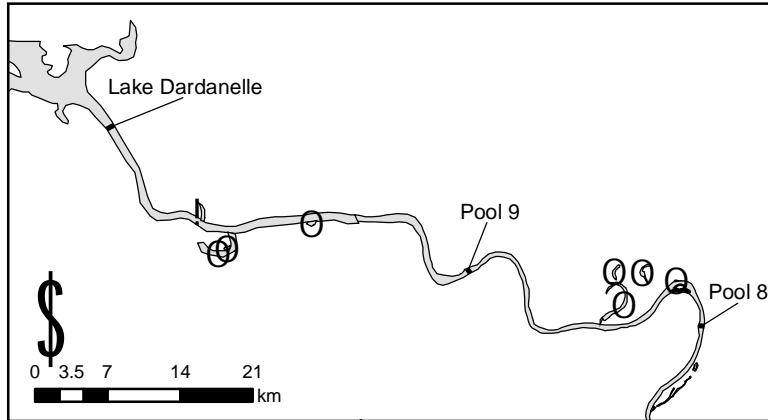


# Map 15. Emerald shiner

*Notropis atherinoides*

! Present

○ Absent

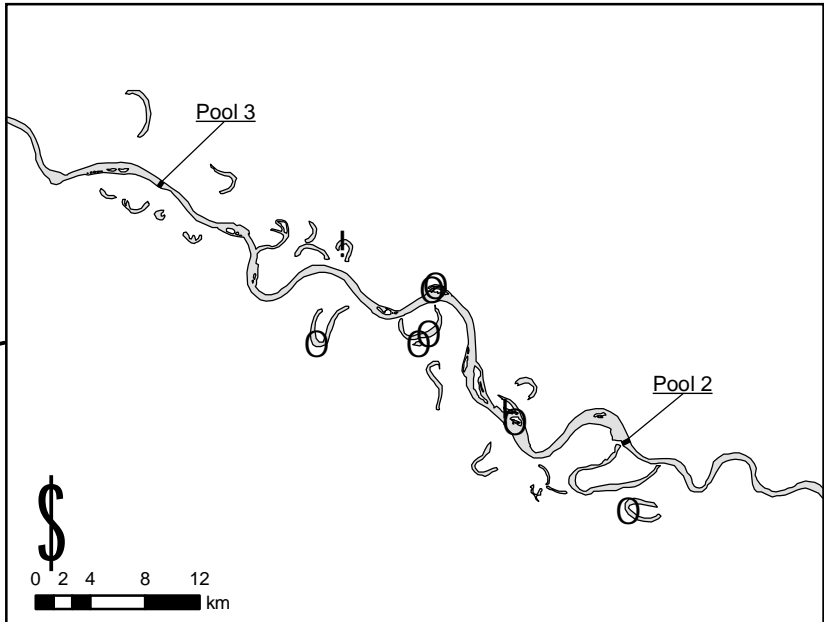
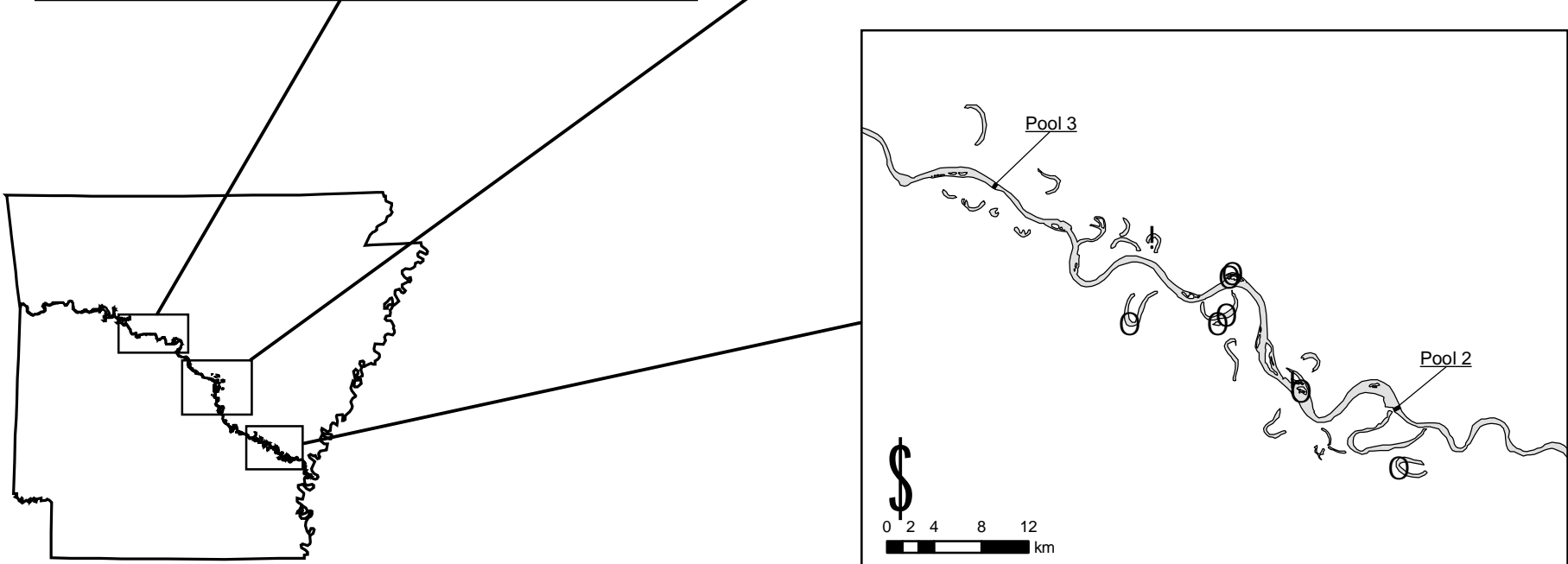
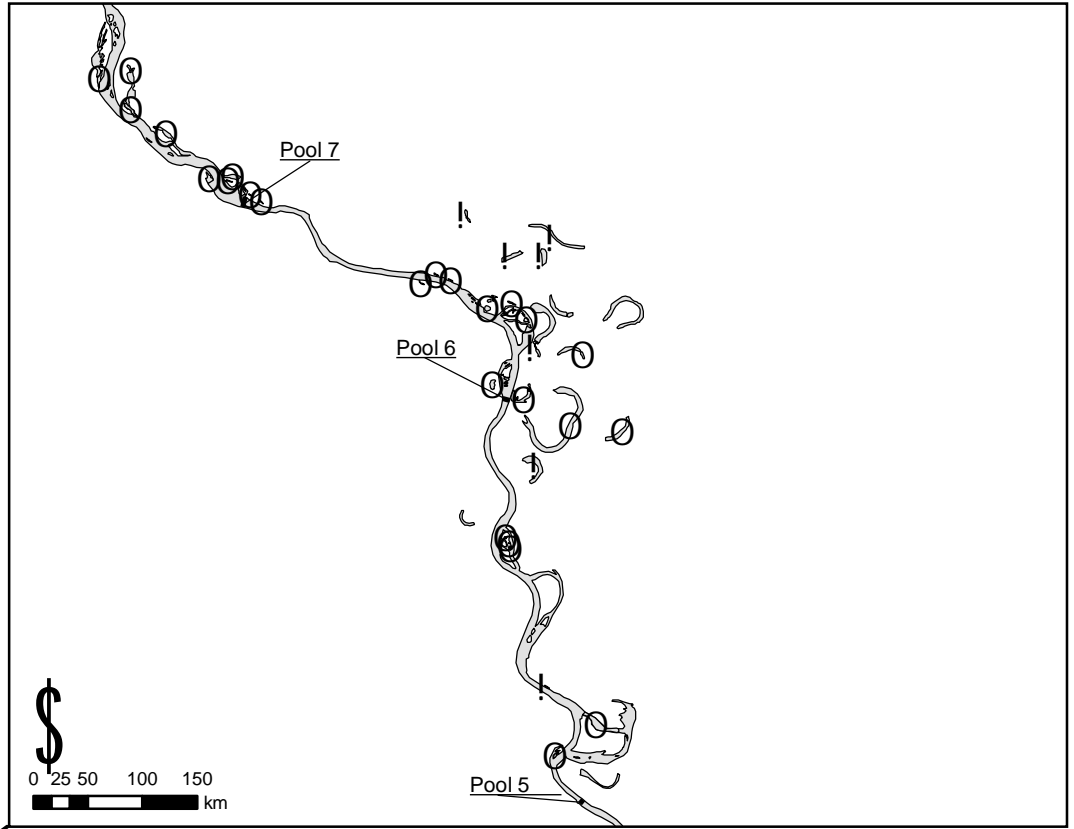
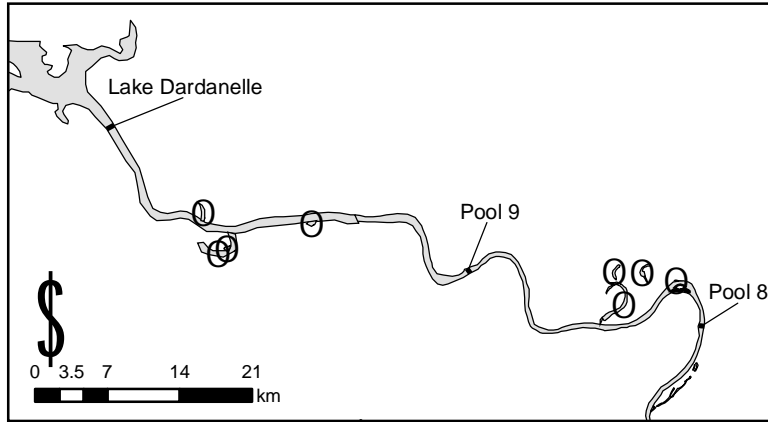


# Map 16. Taillight shiner

*Notropis maculatus*

! Present

○ Absent

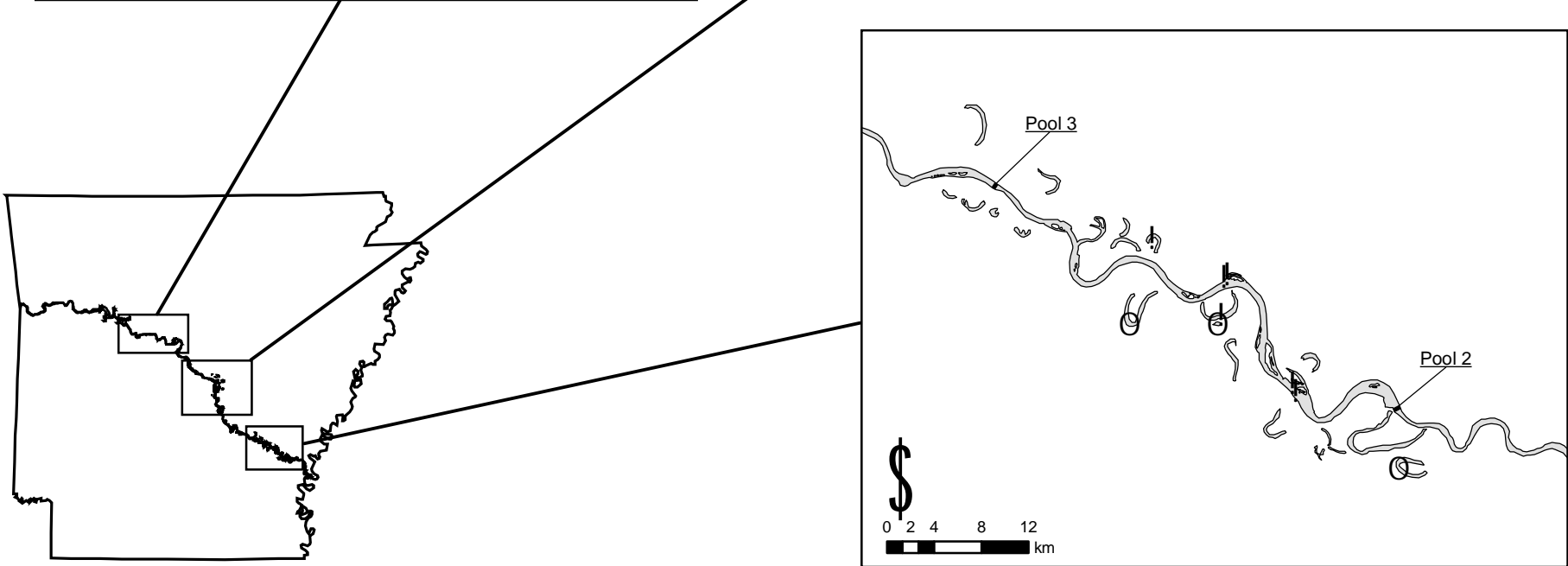
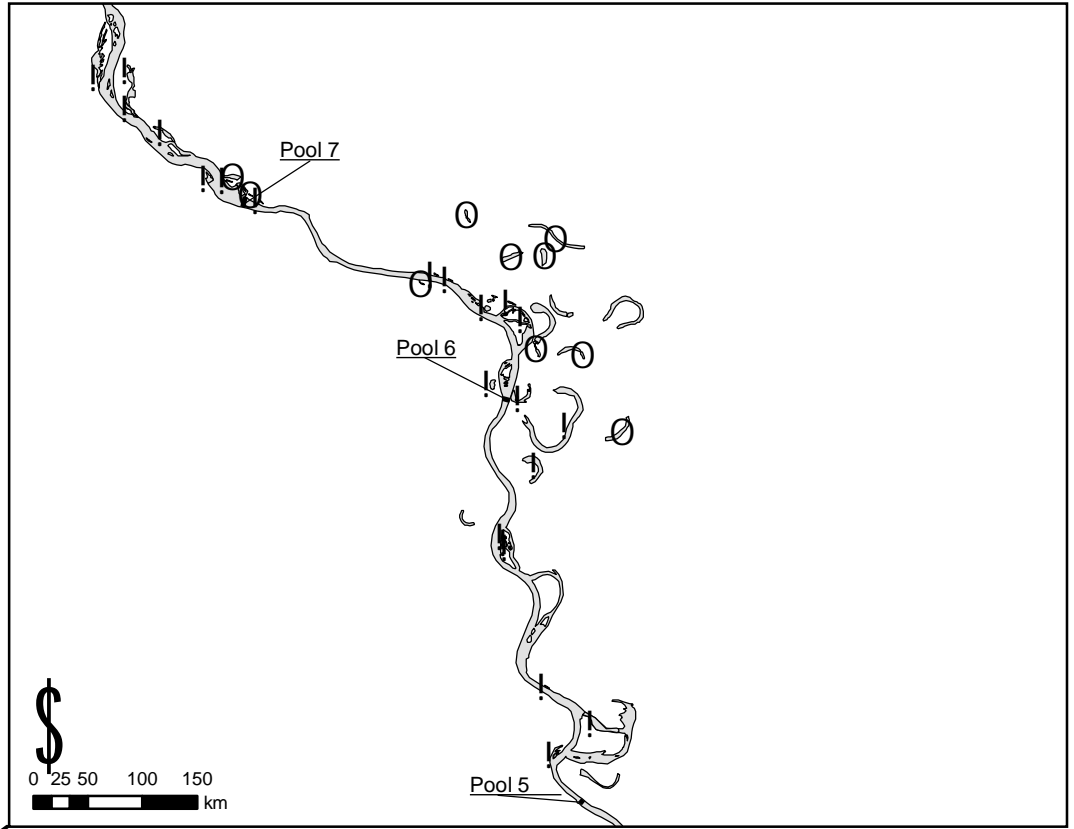
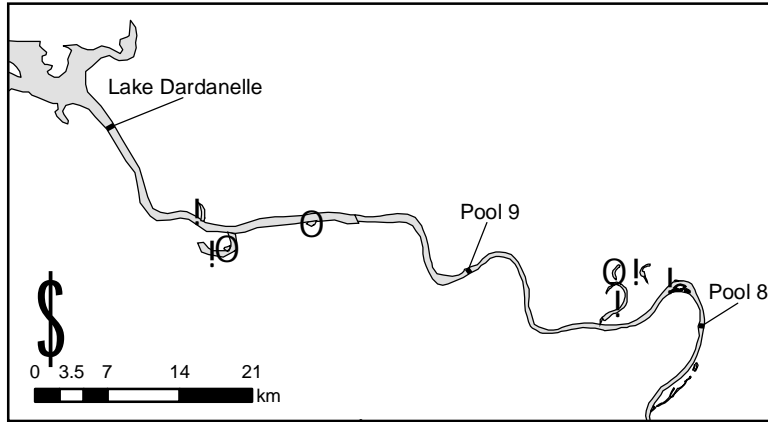


# Map 17. Pugnose minnow

*Opsopoeodus emiliae*

! Present

○ Absent

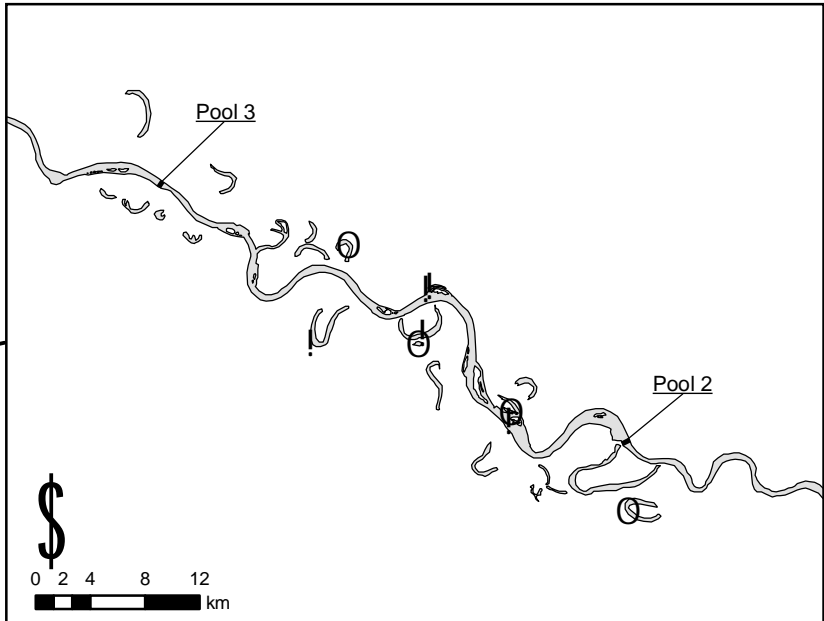
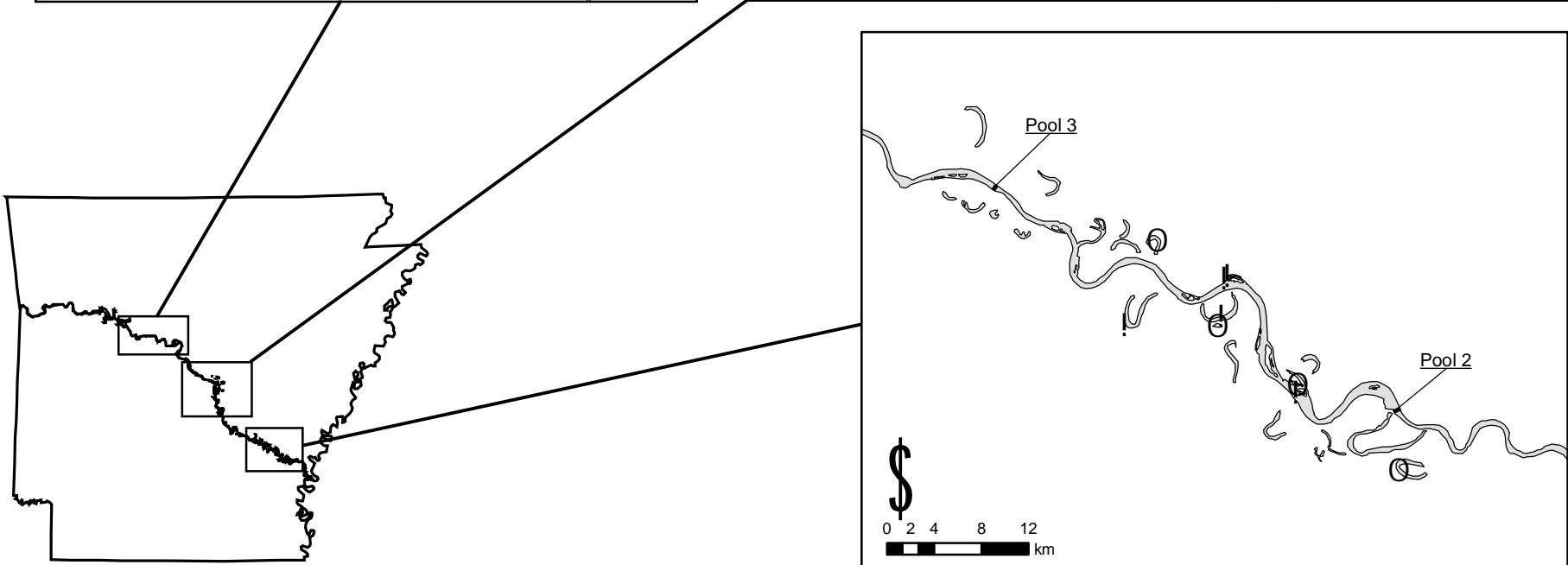
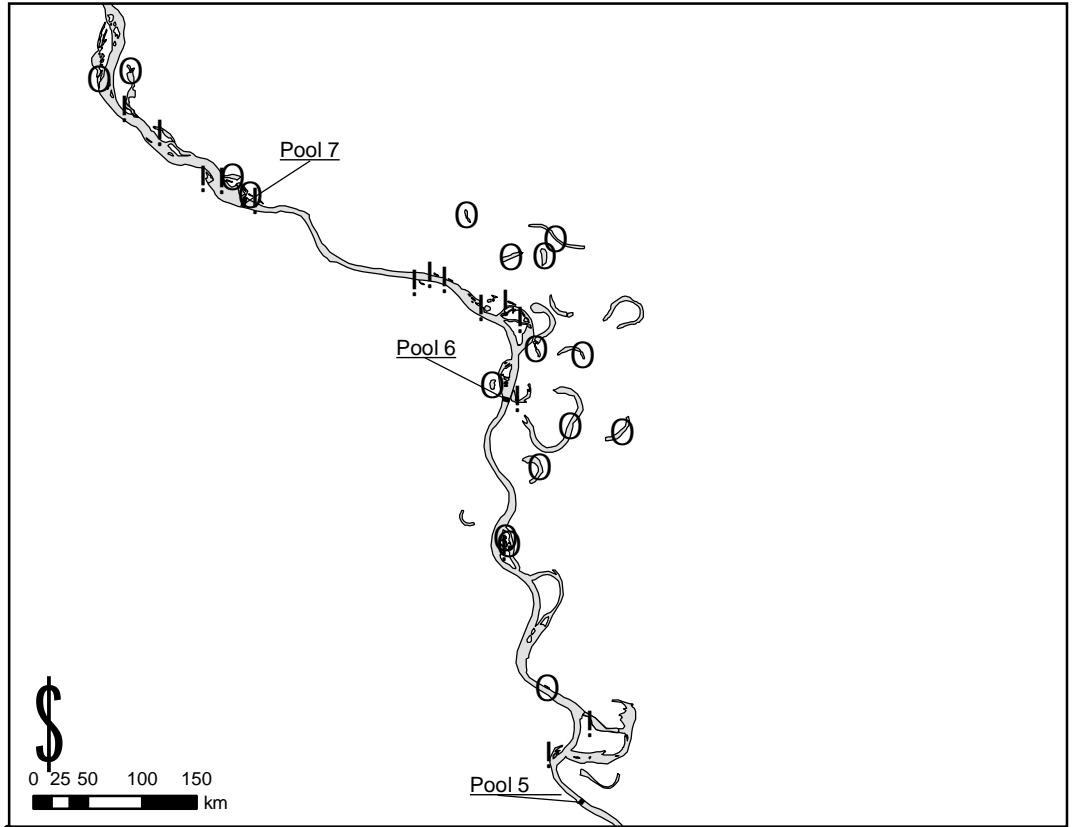
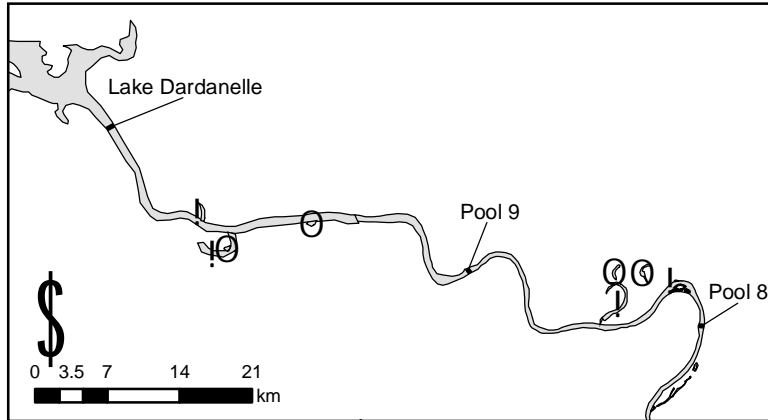


# Map 18. Bullhead minnow

*Pimephales vigilax*

! Present

○ Absent

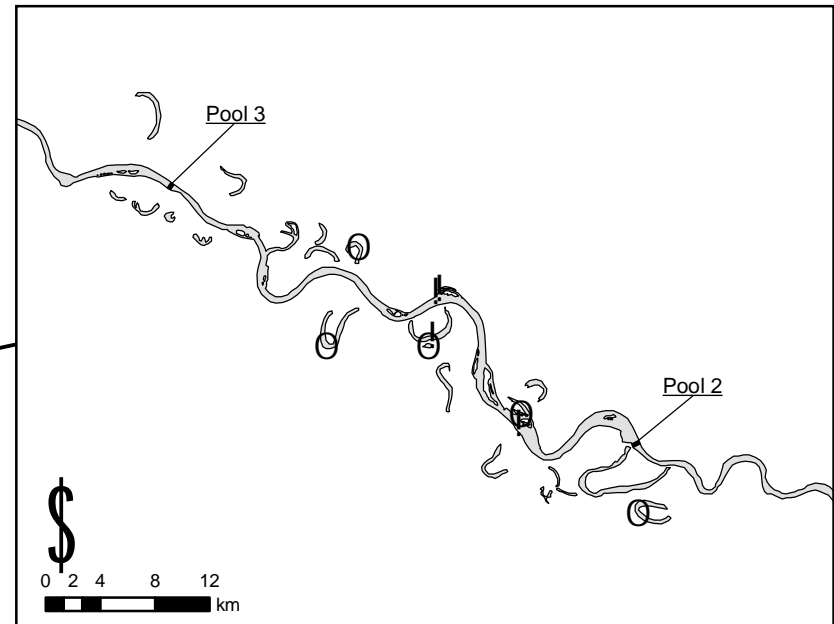
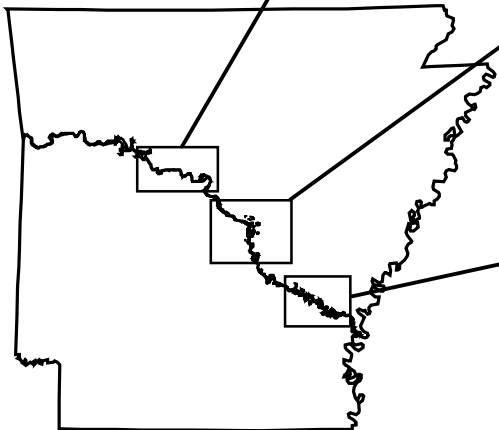
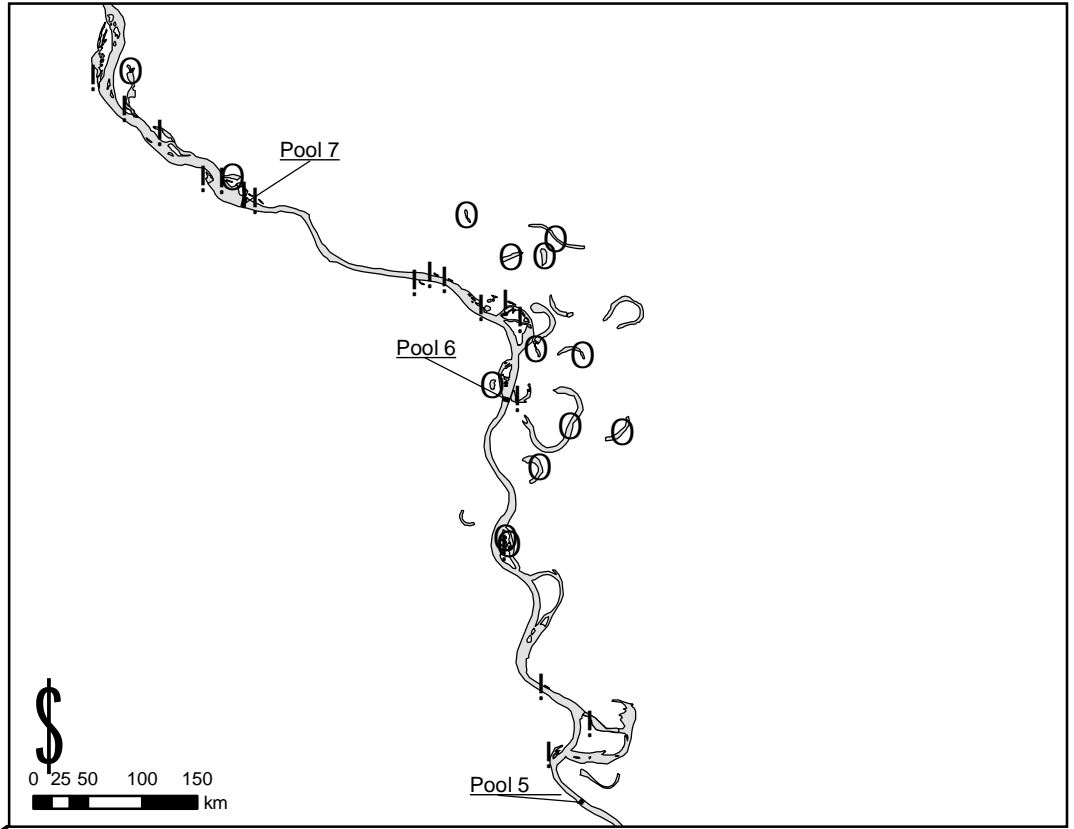
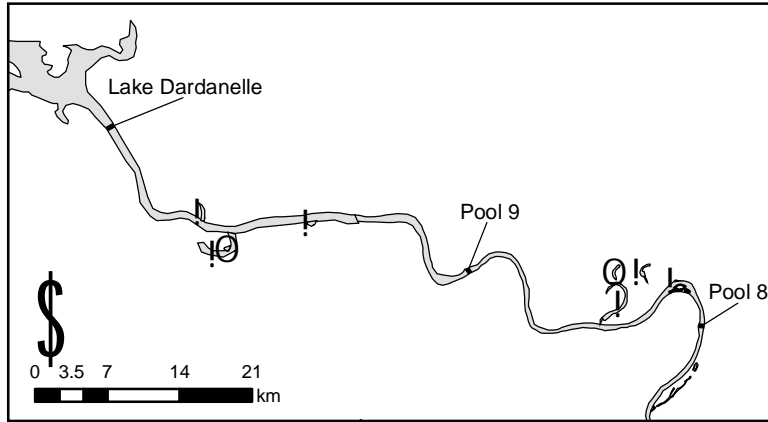


# Map 19. River carpsucker

*Carpoides carpio*

! Present

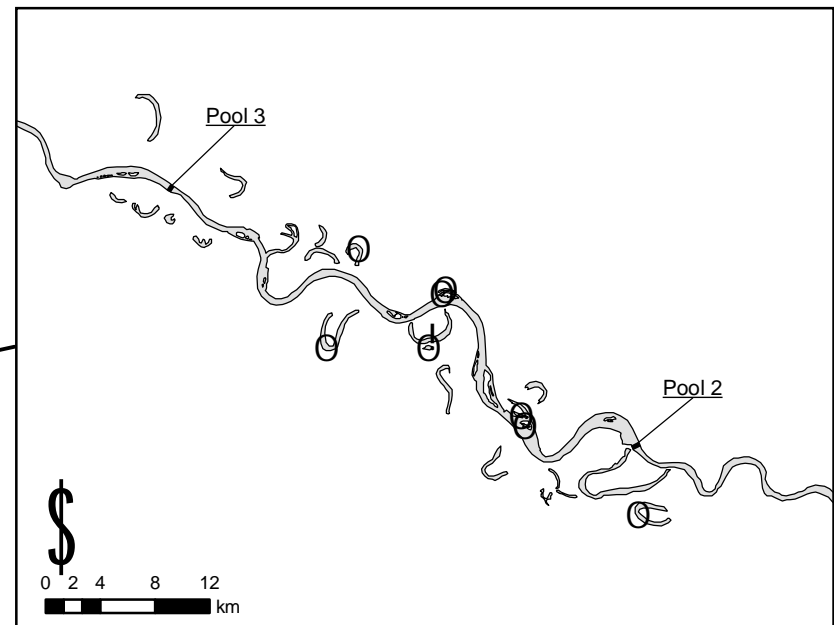
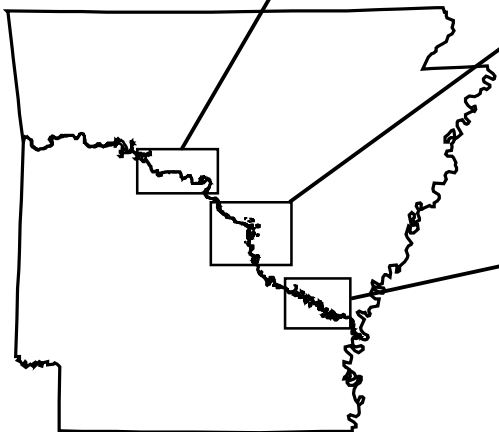
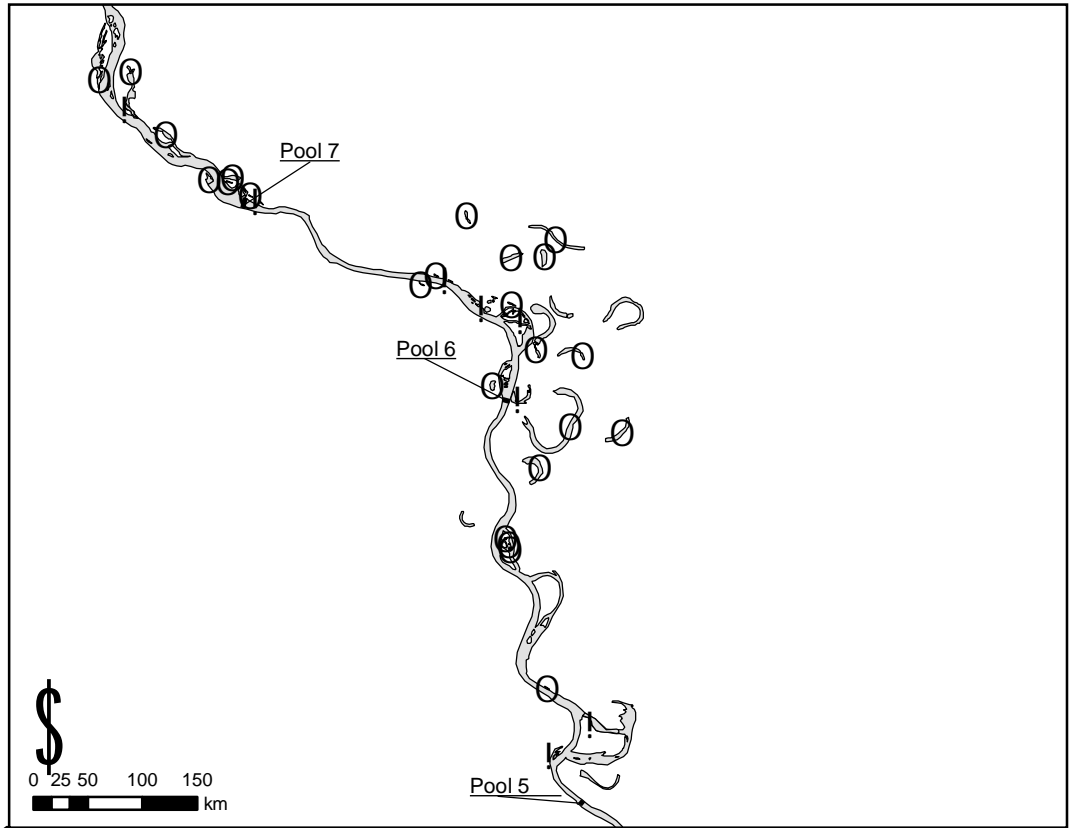
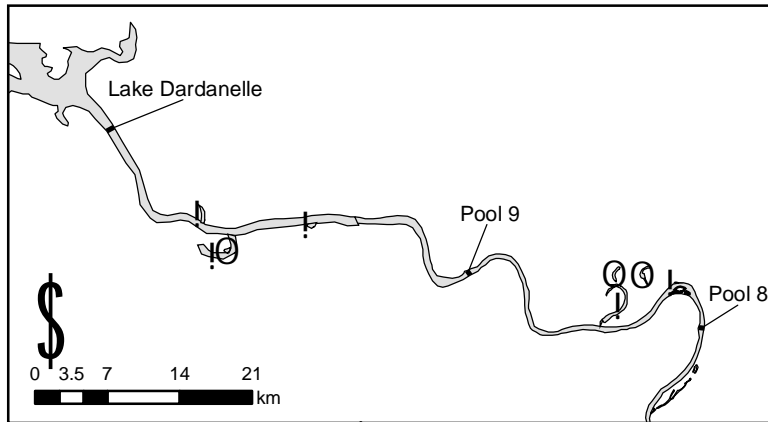
○ Absent



# Map 20. Quillback

*Carpoides cyprinus*

- ! Present
- Absent

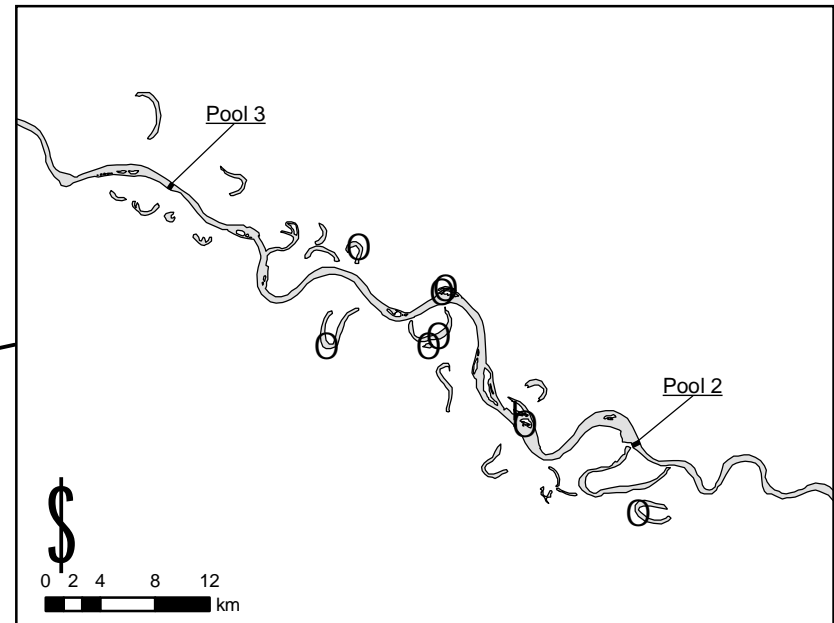
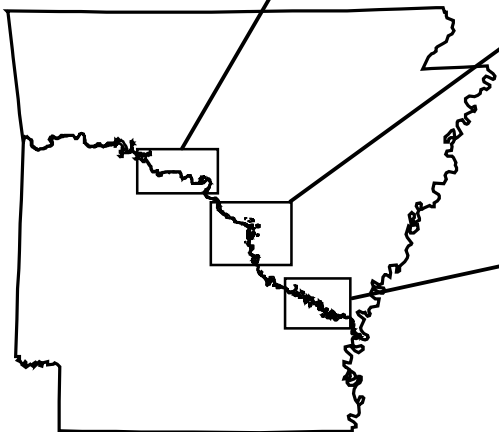
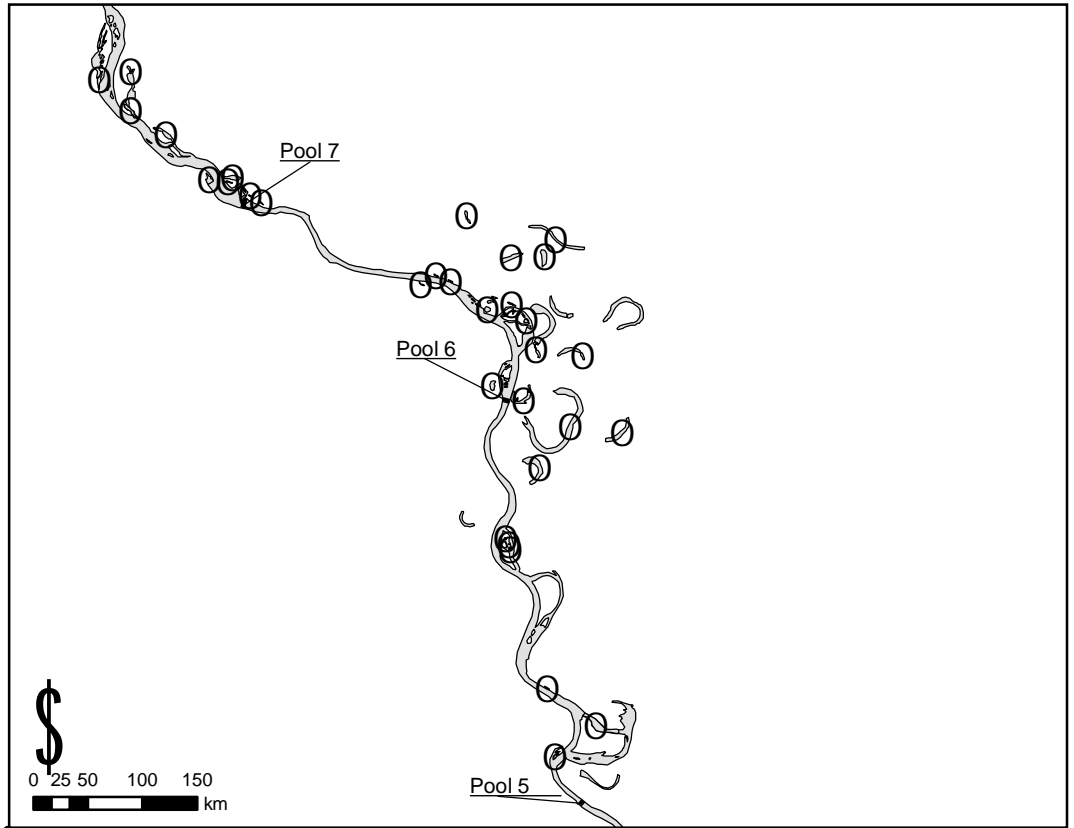
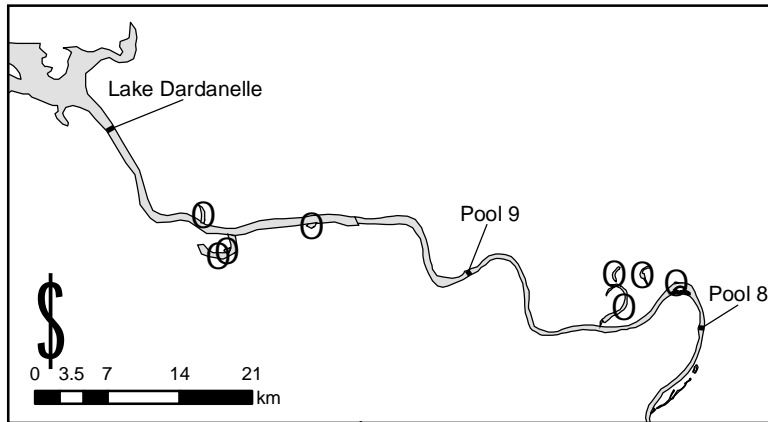


# Map 21. Lake chubsucker

*Erimyzon sucetta*

! Present

○ Absent

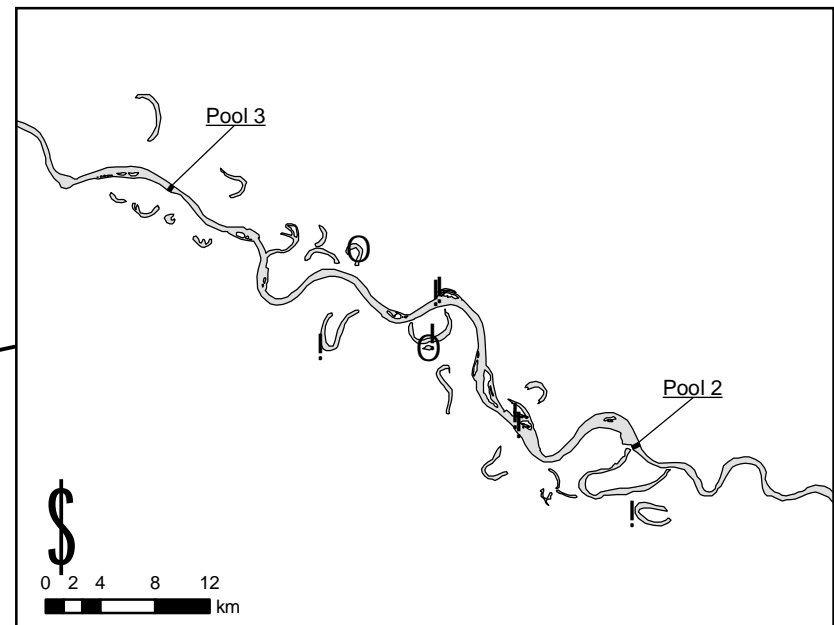
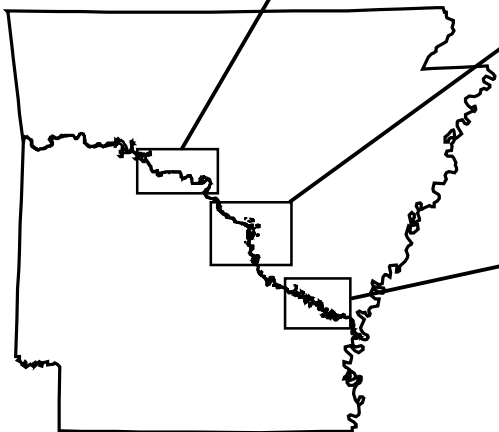
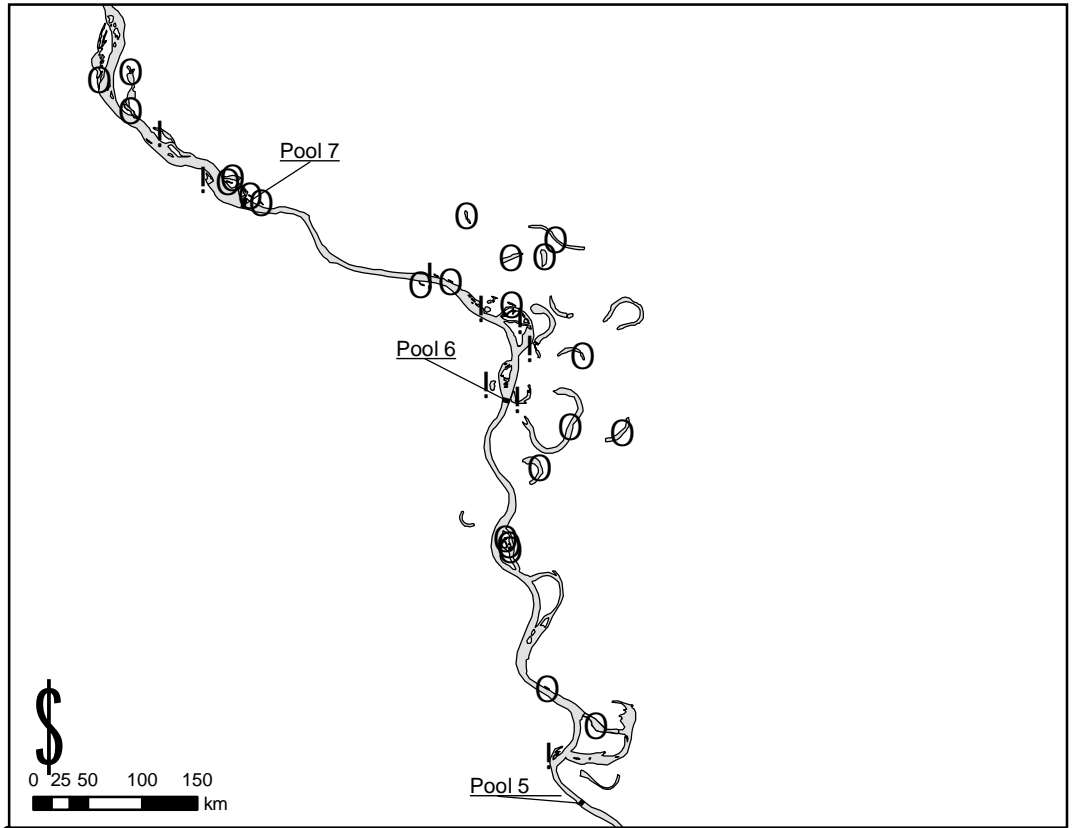
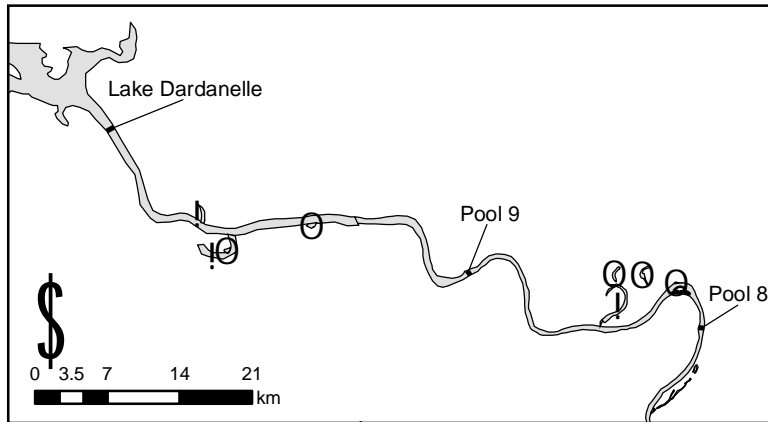


# Map 22. Smallmouth buffalo

*Ictiobus bubalus*

! Present

○ Absent



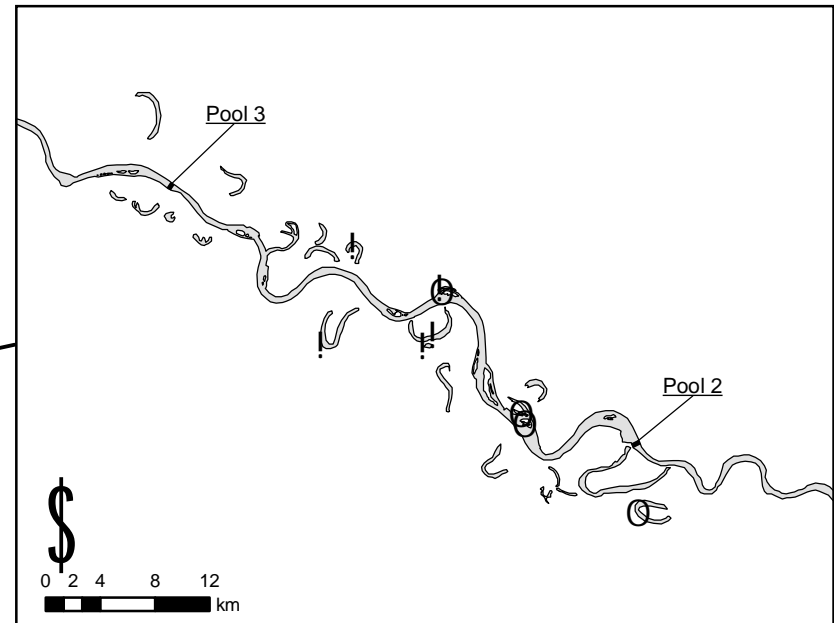
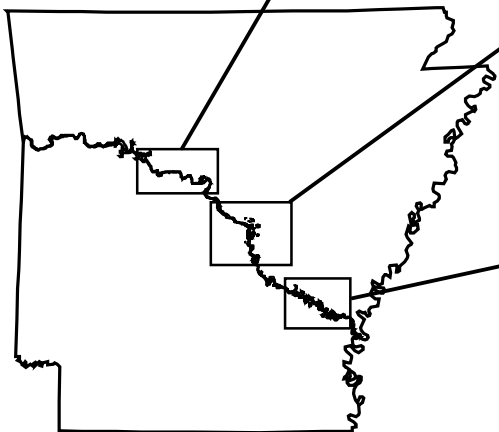
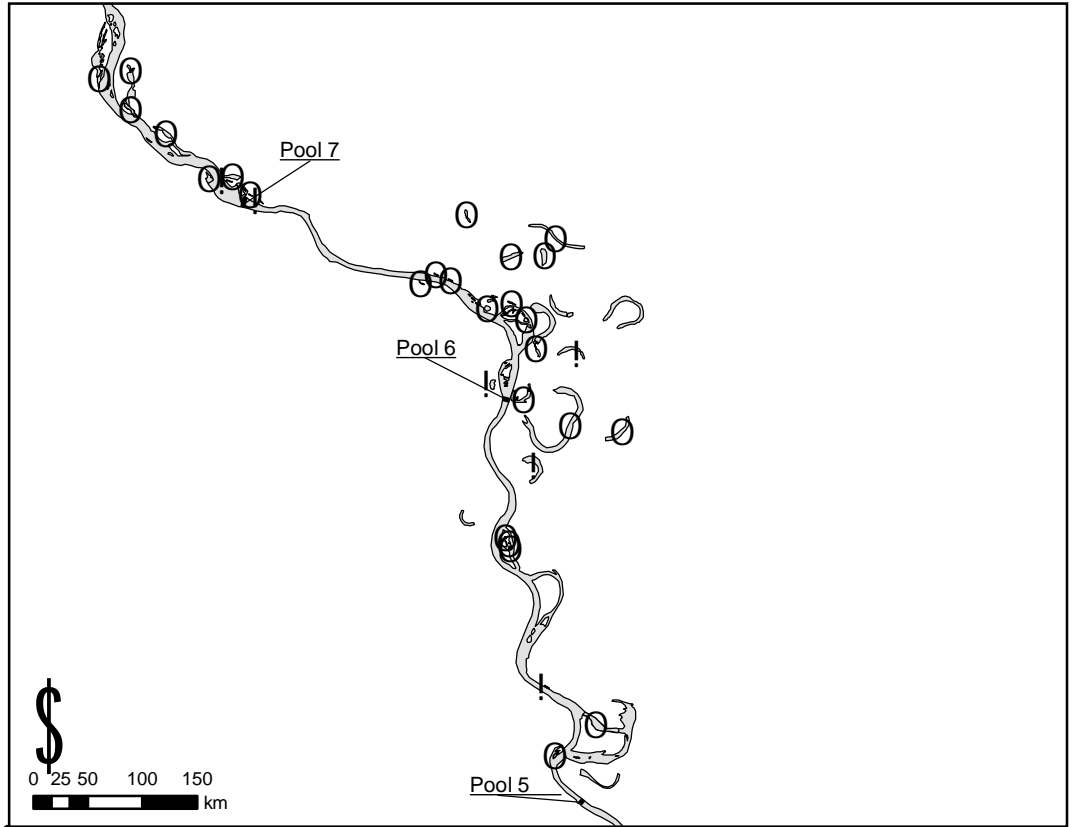
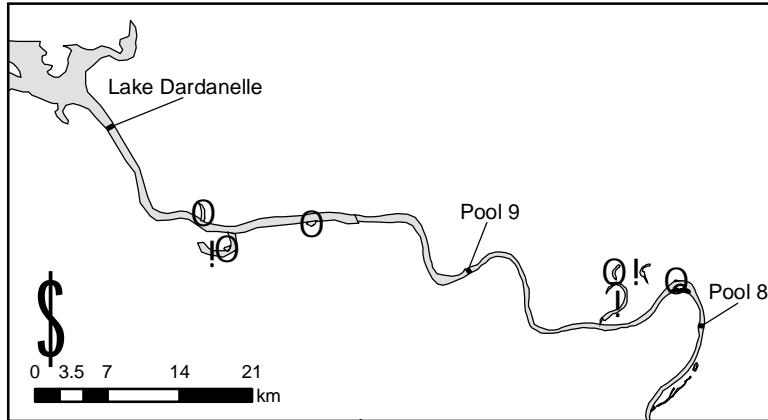


# Map 23. Bigmouth buffalo

*Ictiobus cyprinellus*

! Present

○ Absent

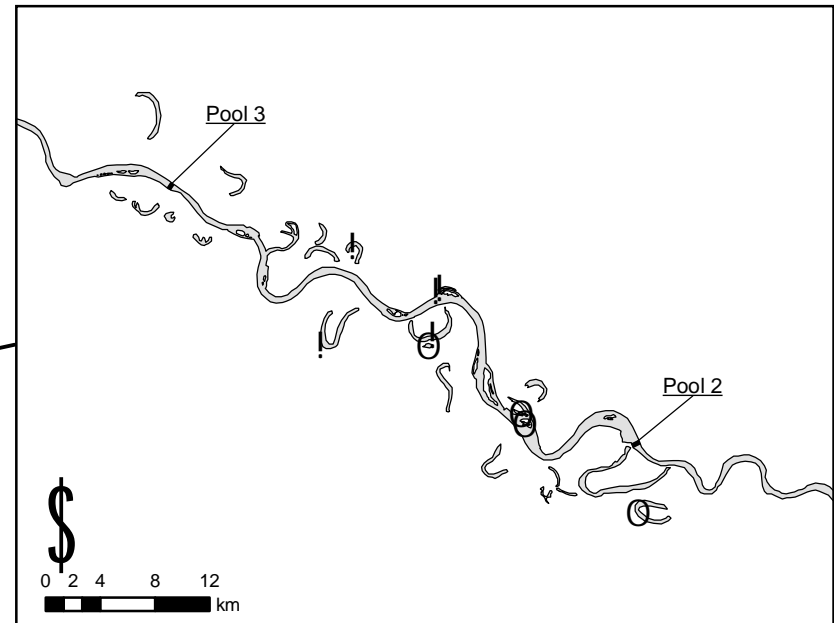
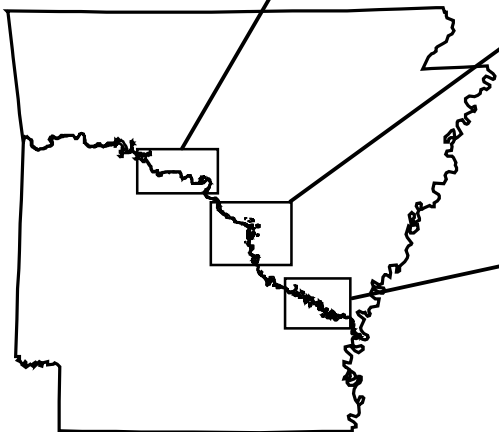
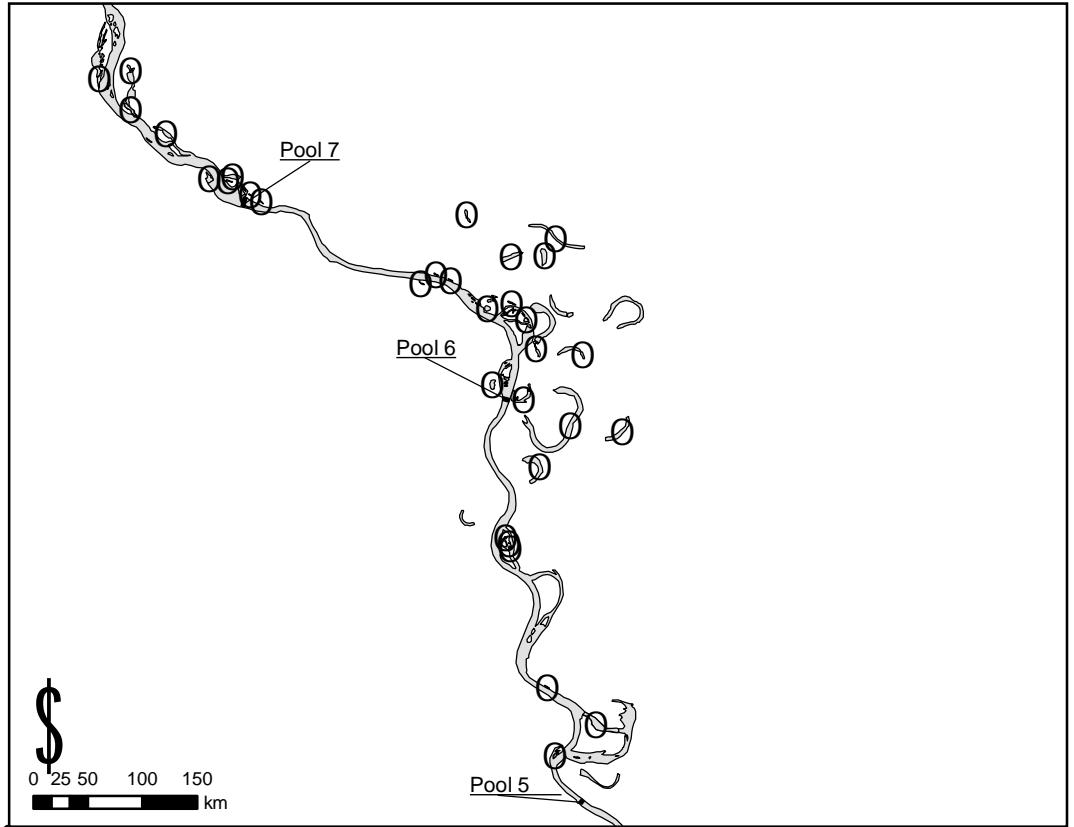
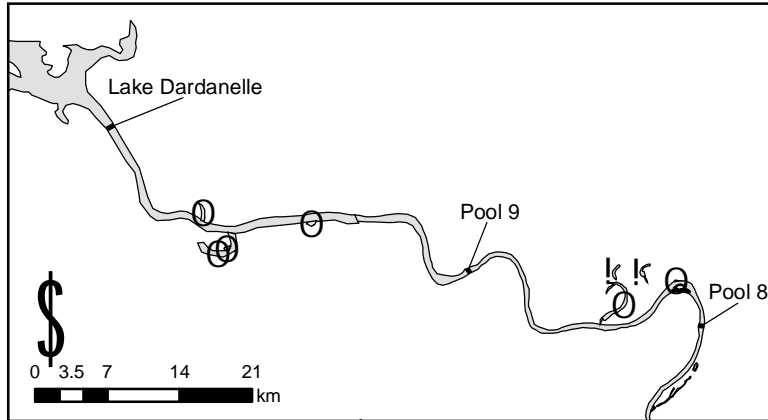


# Map 24. Black buffalo

*Ictiobus niger*

! Present

○ Absent

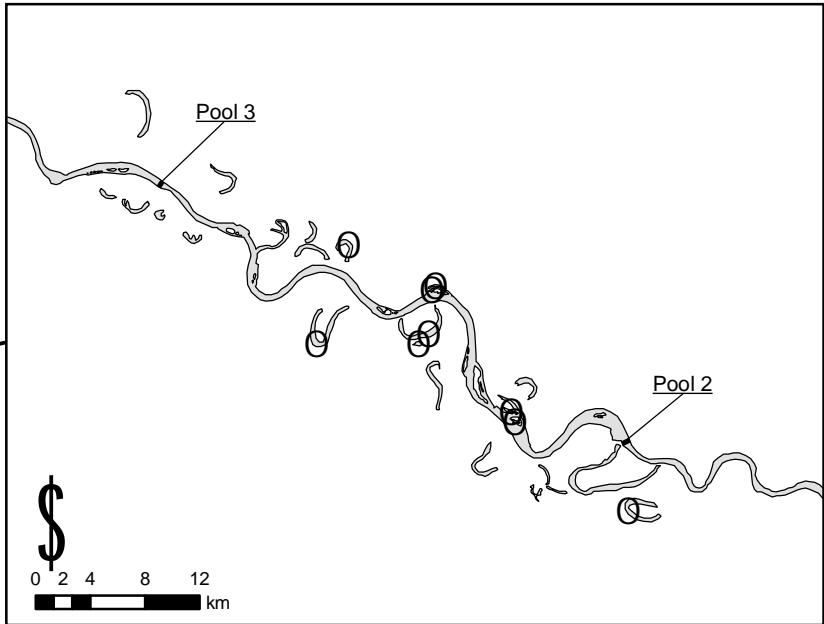
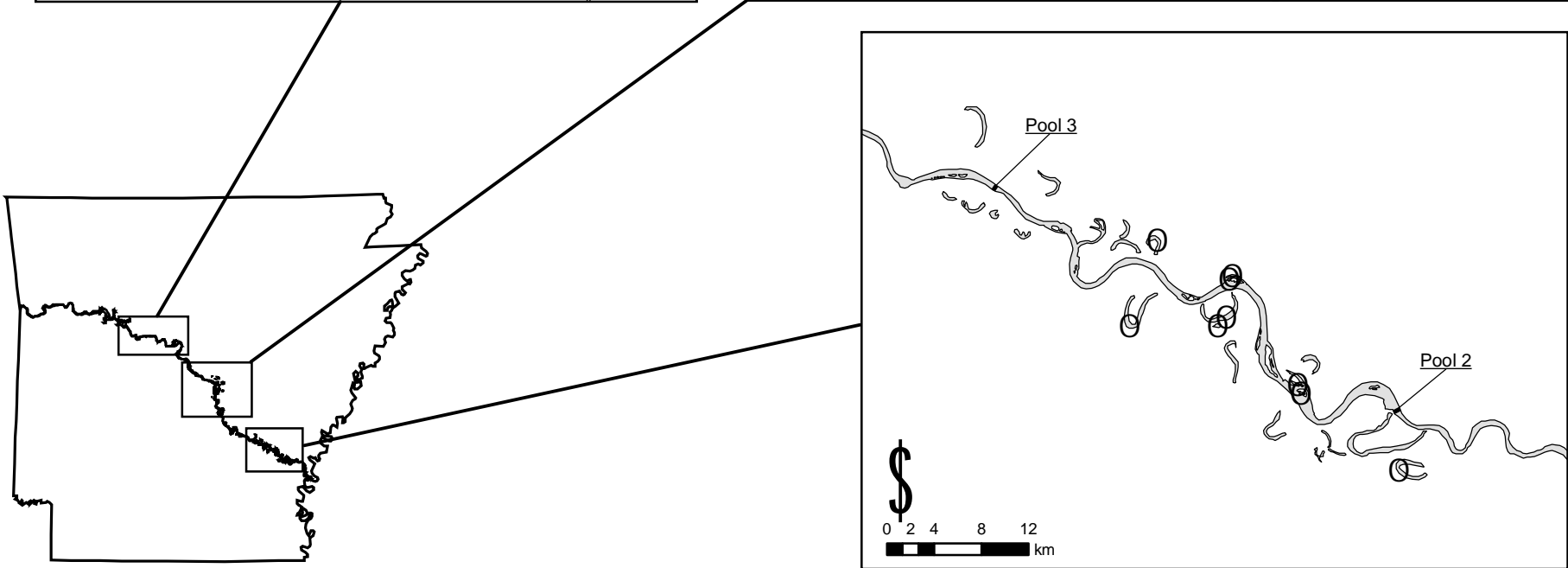
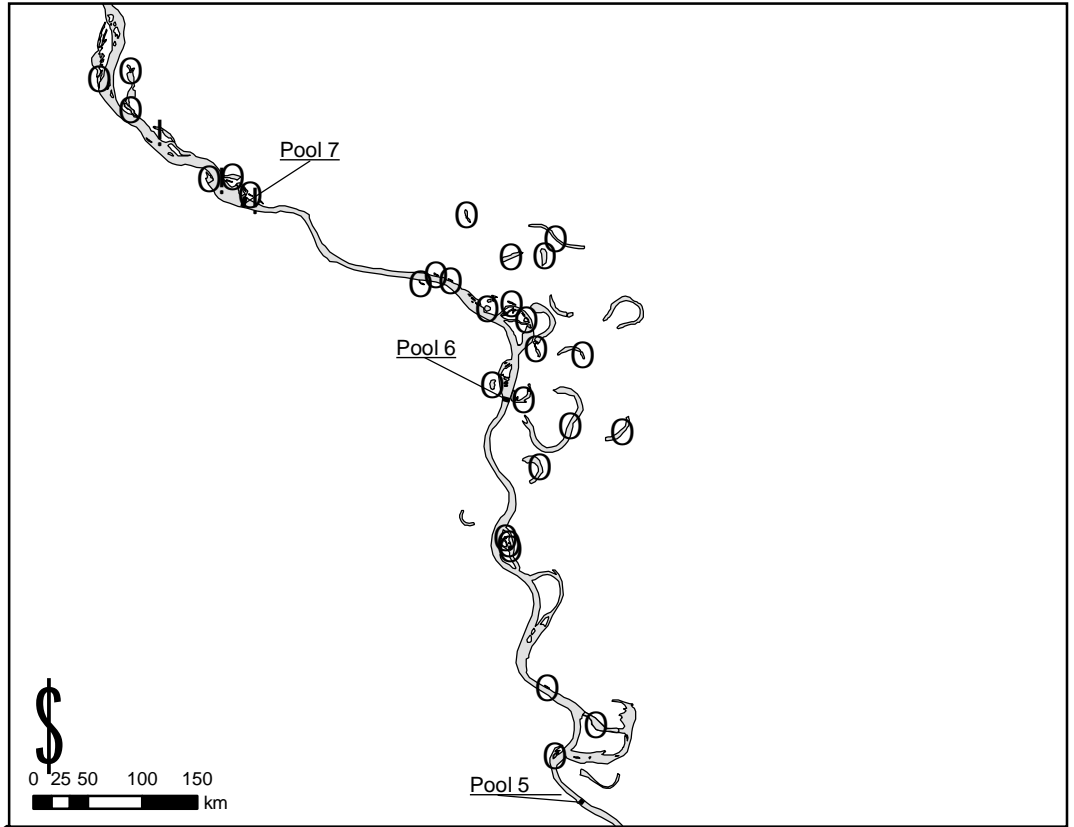
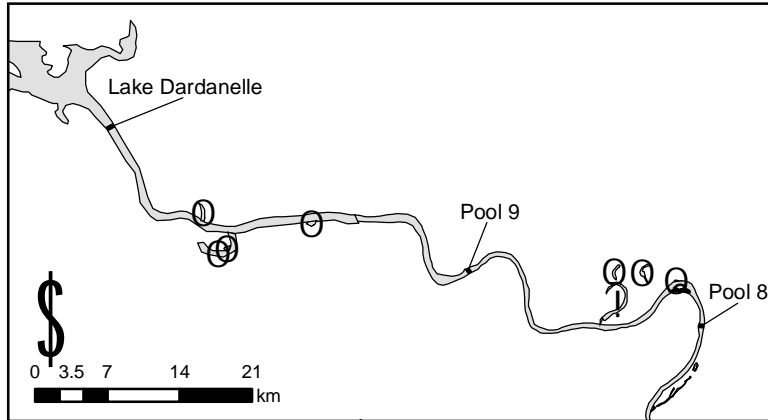


# Map 25. Spotted sucker

*Minytrema melanops*

! Present

○ Absent

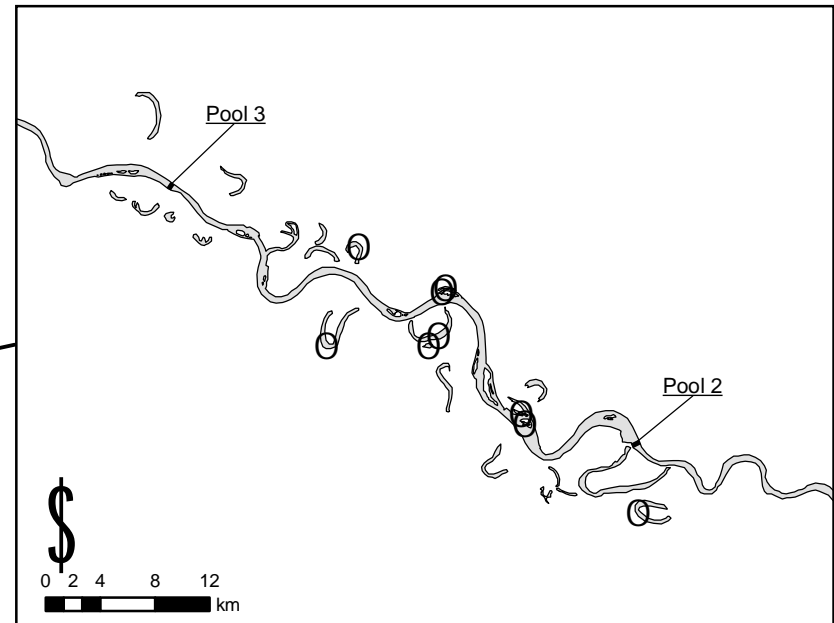
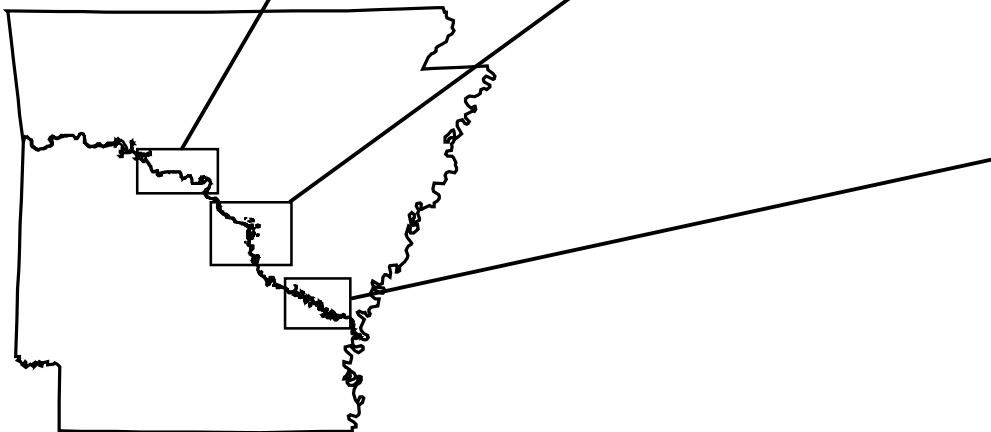
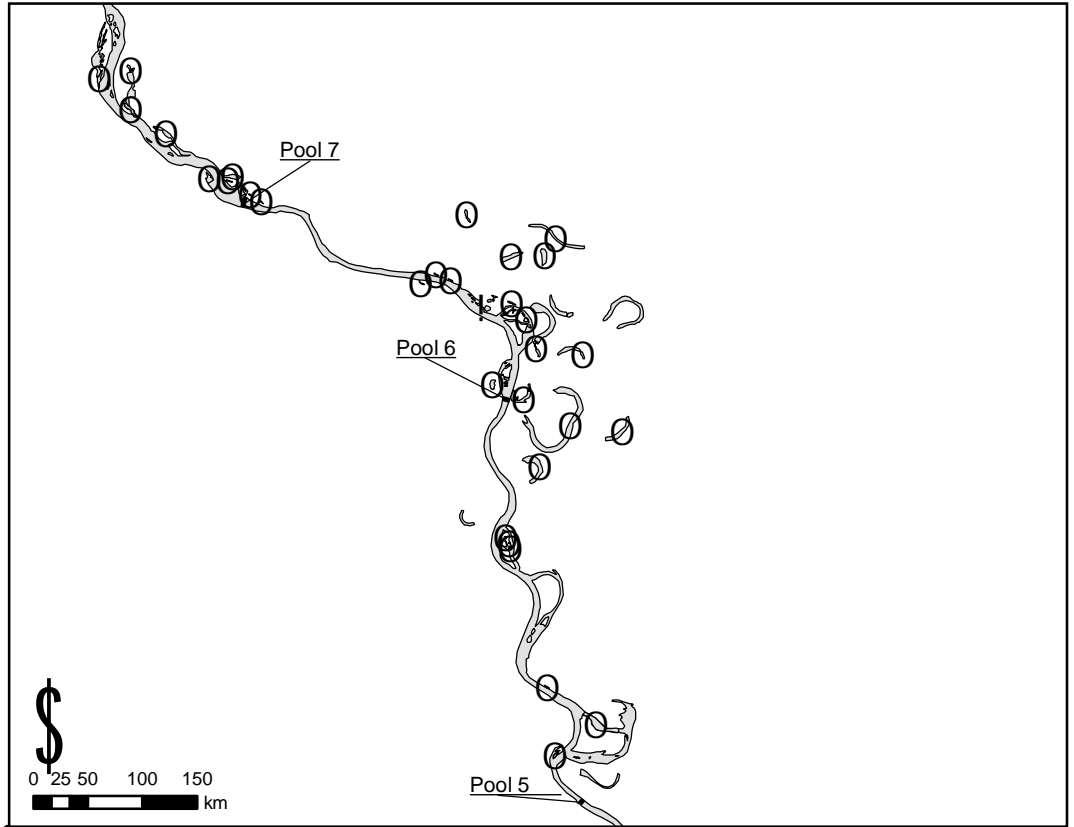
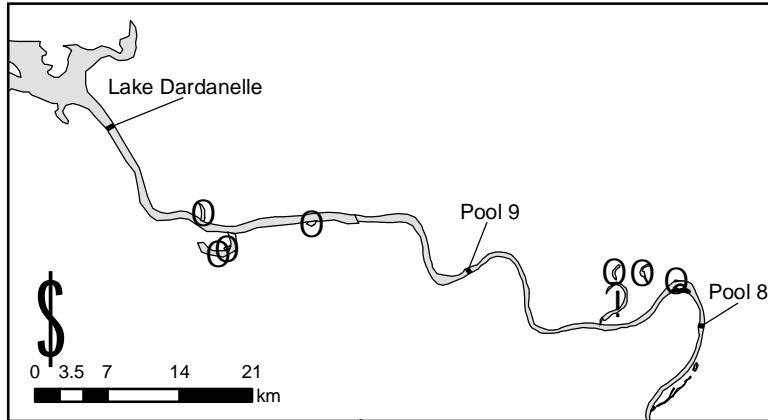


# Map 26. Pealip redhorse

*Moxostoma pisolabrum*

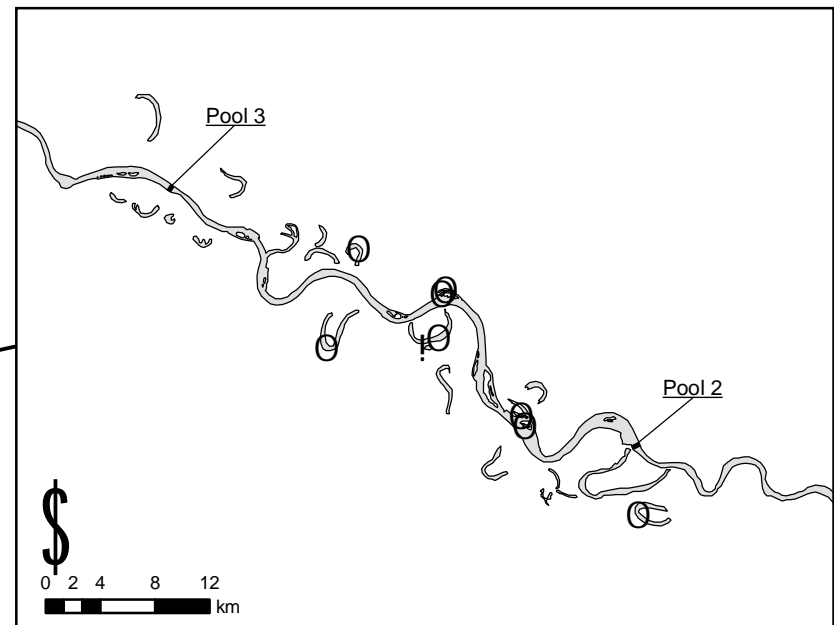
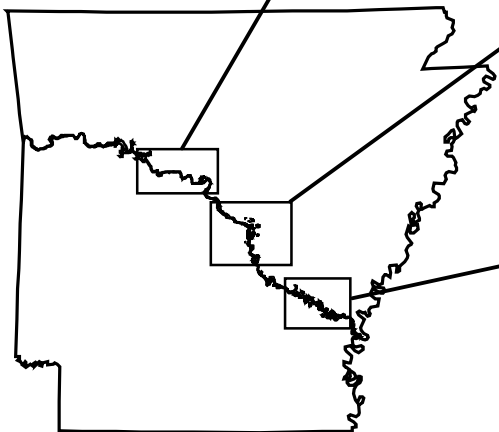
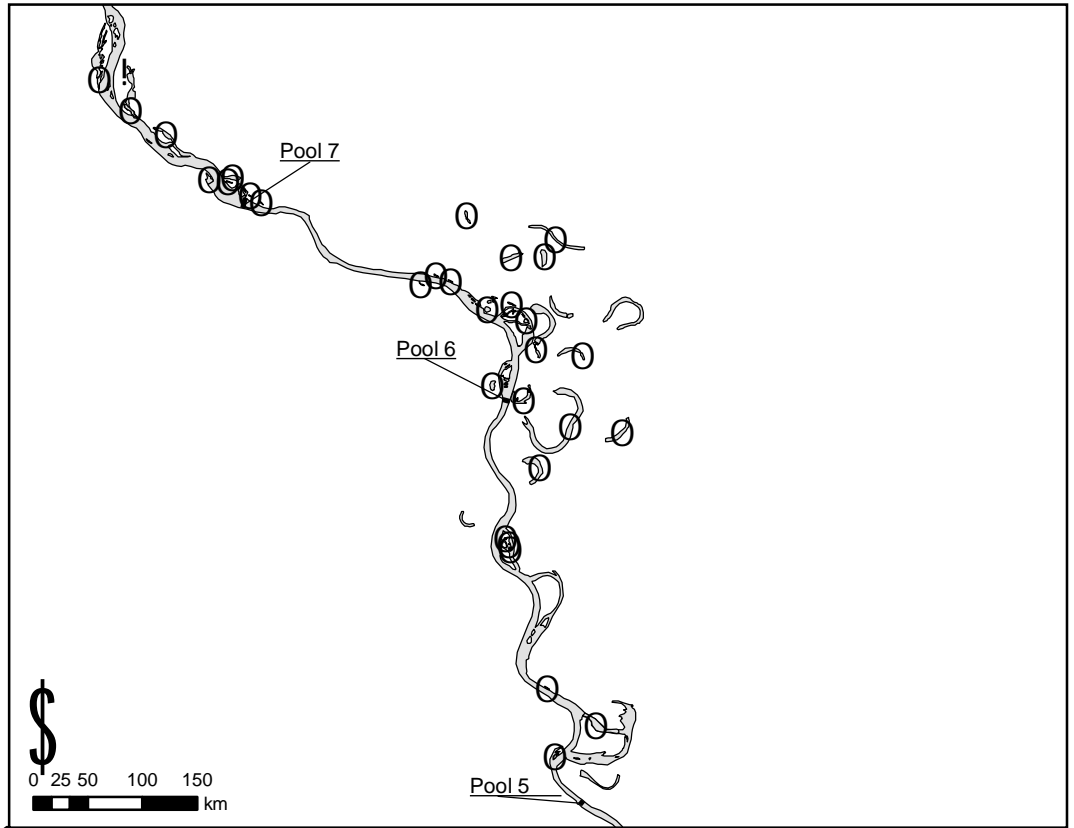
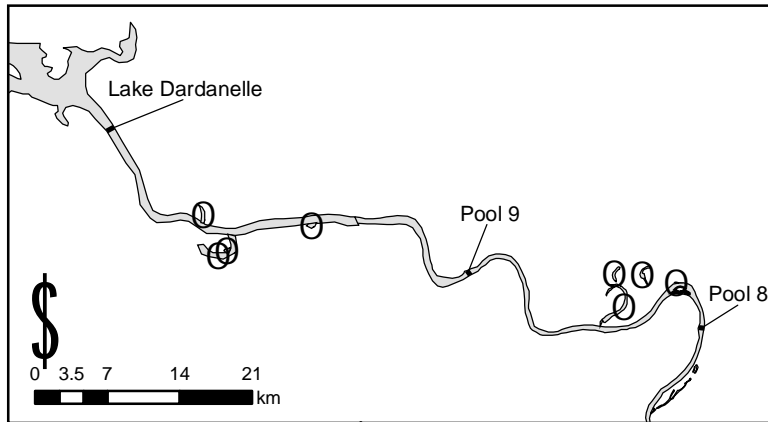
! Present

○ Absent



# Map 27. Black bullhead *Ameiurus melas*

- ! Present
- O Absent

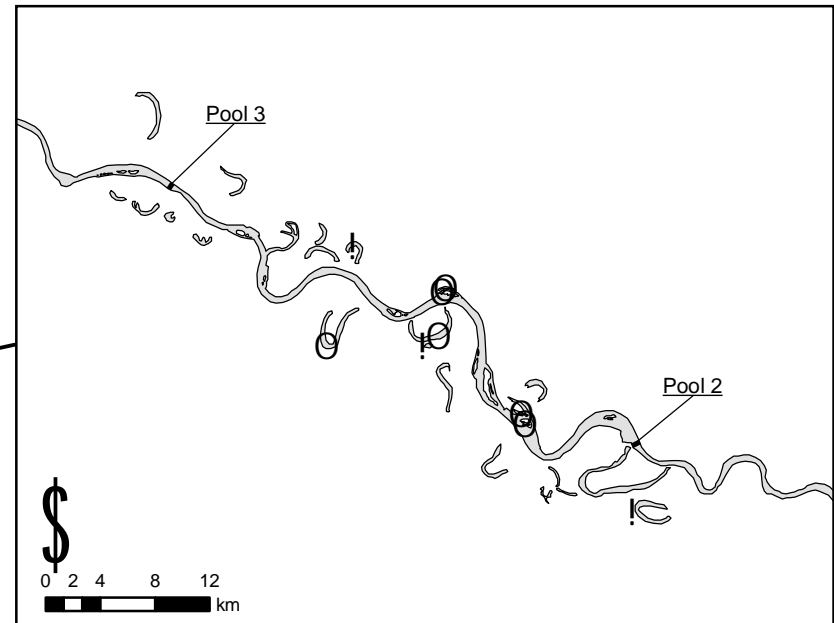
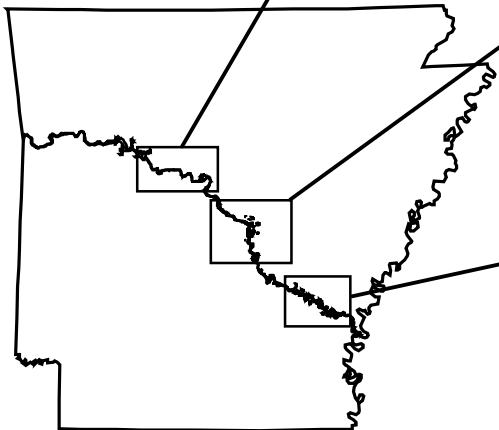
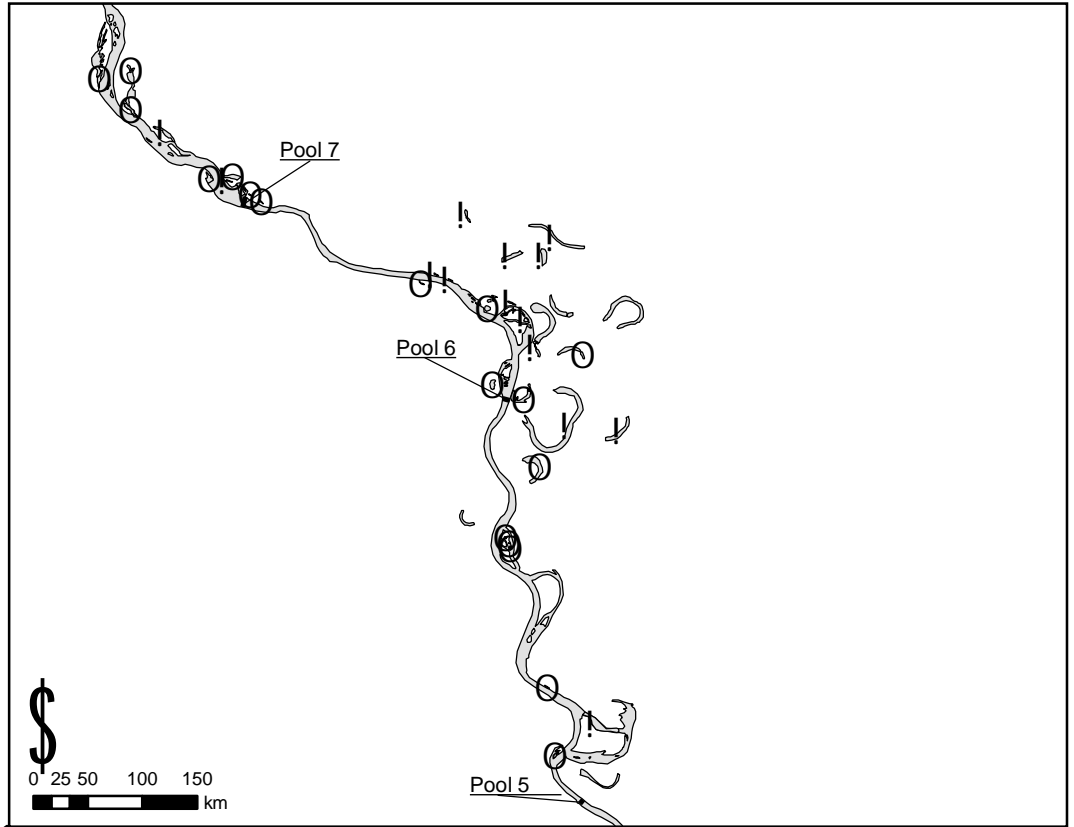
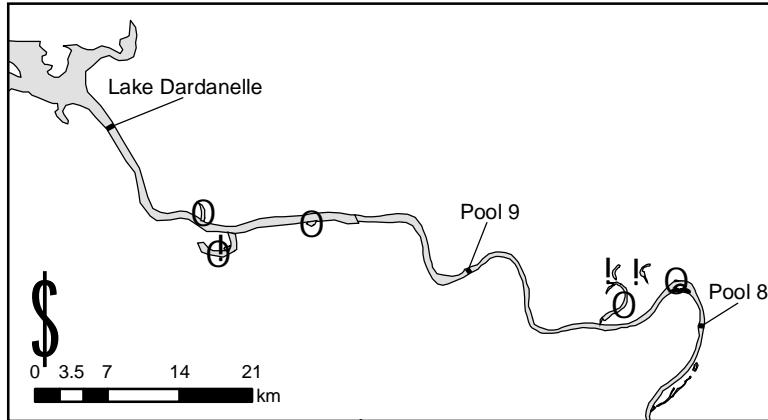


# Map 28. Yellow bullhead

*Ameiurus natalis*

! Present

O Absent

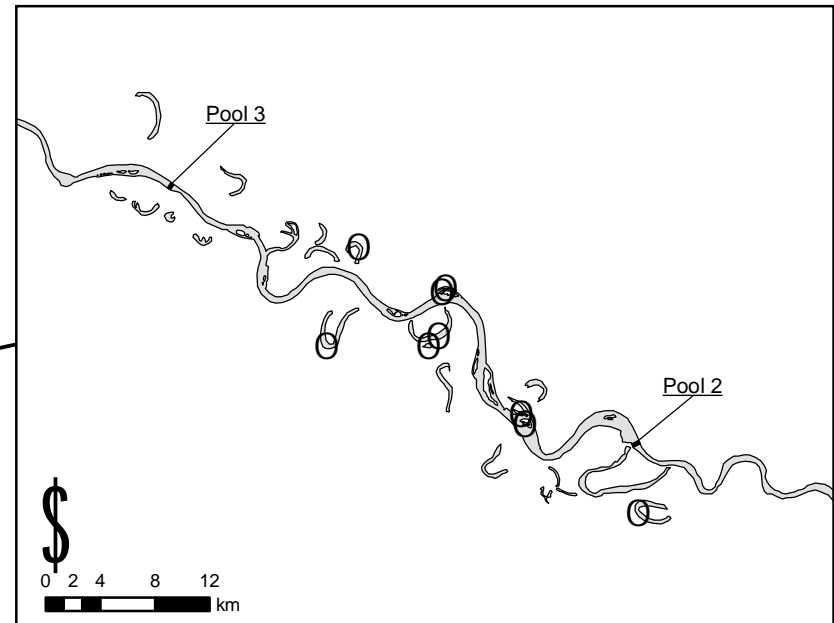
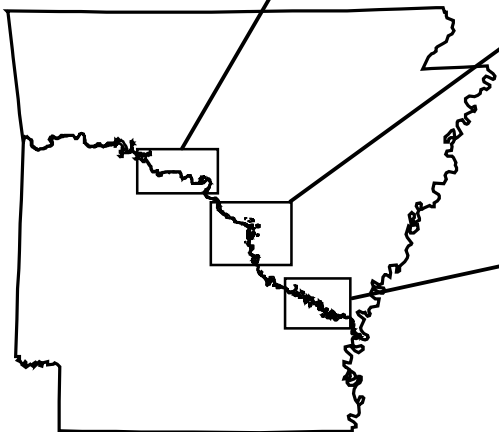
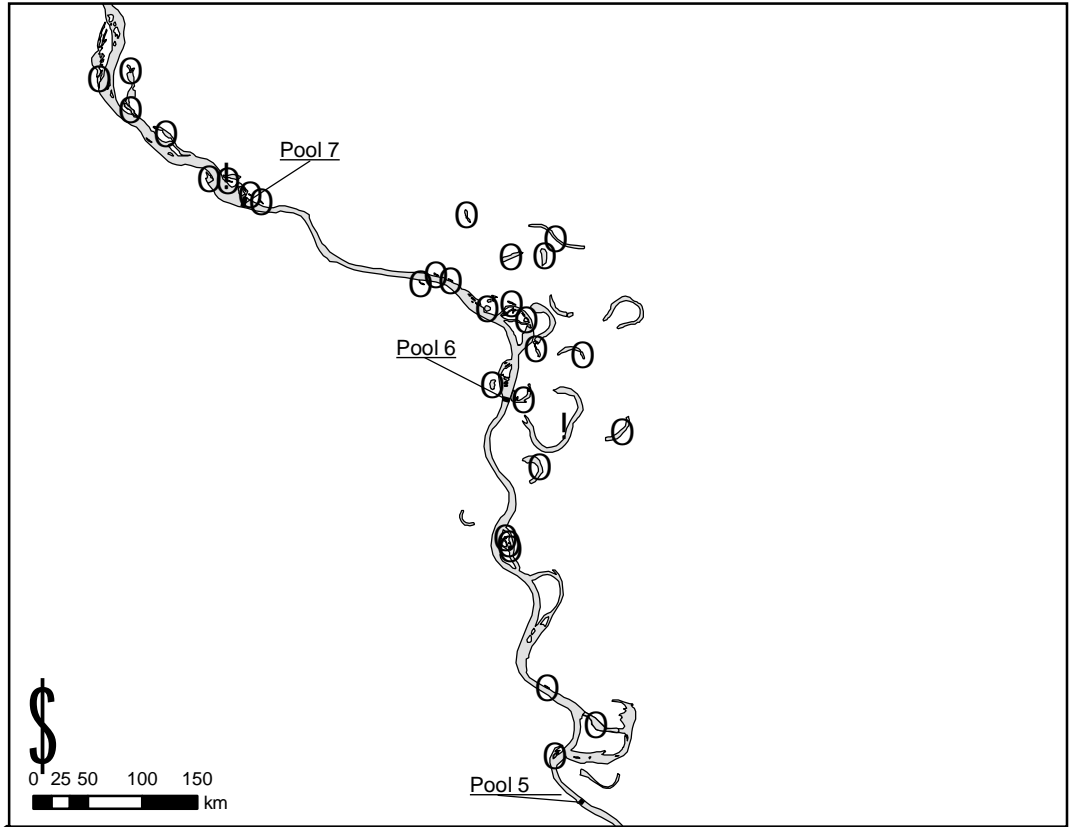
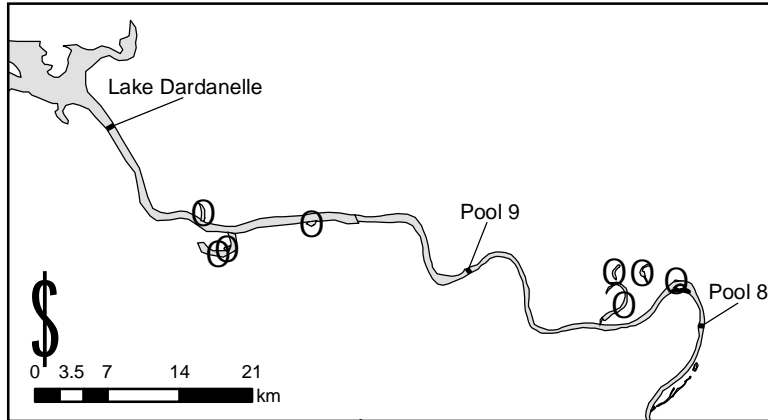


# Map 29. Brown bullhead

*Ameiurus nebulosus*

! Present

O Absent

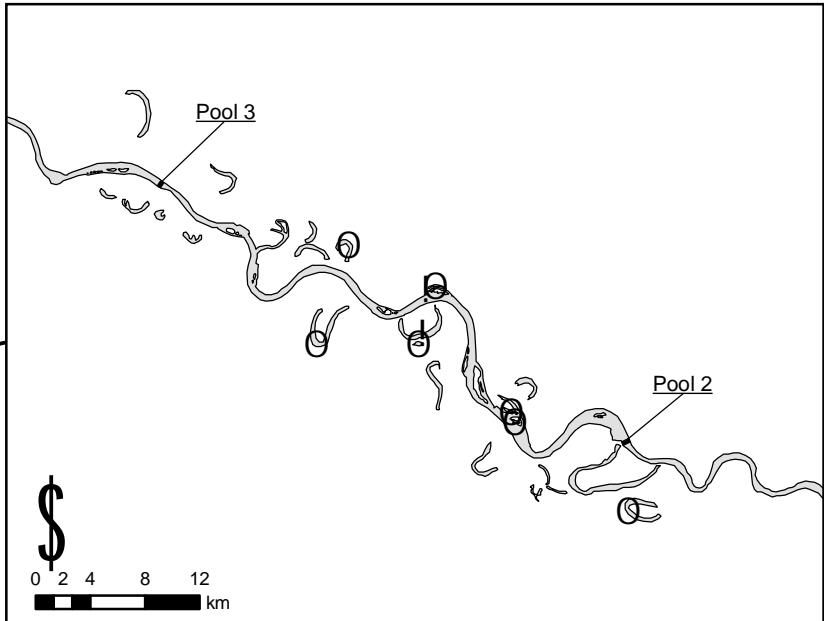
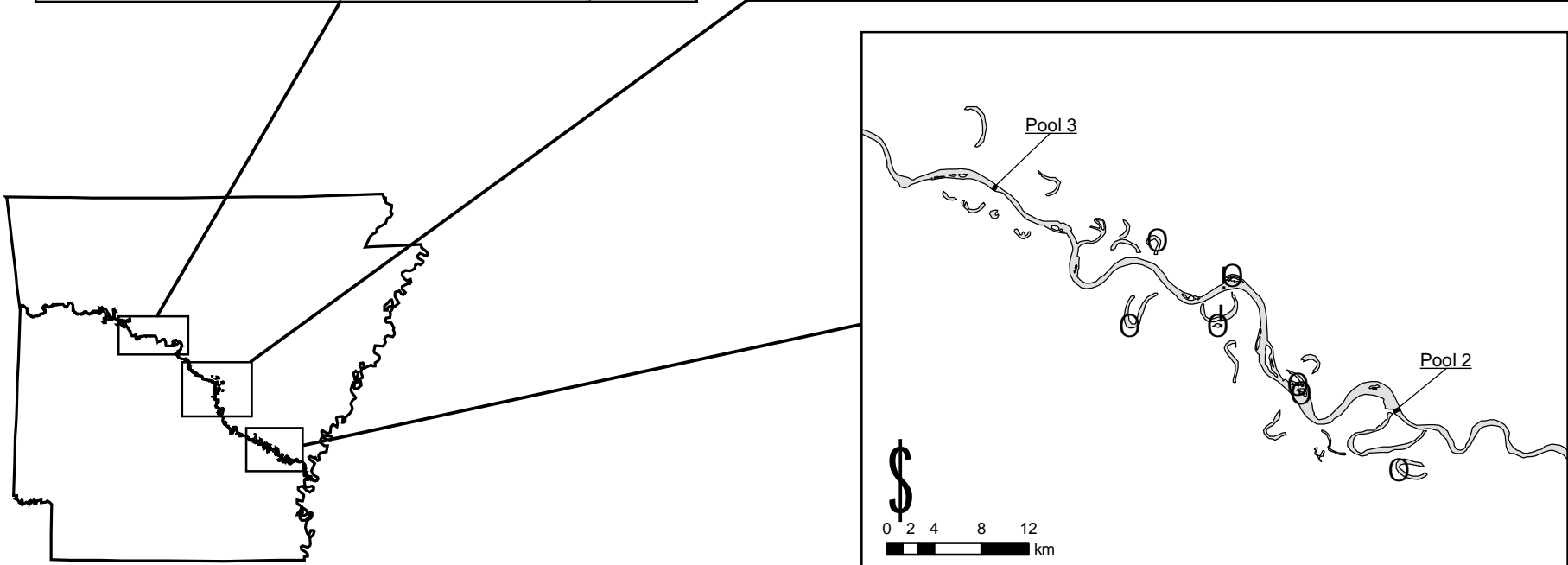
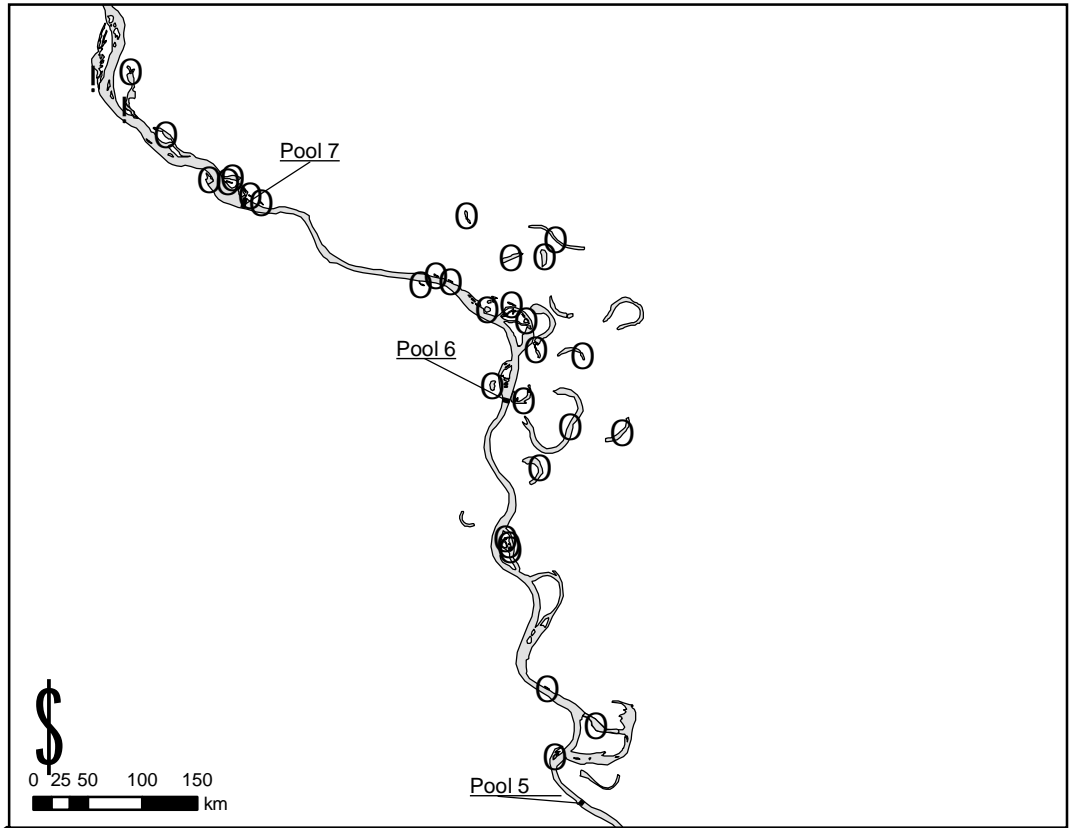
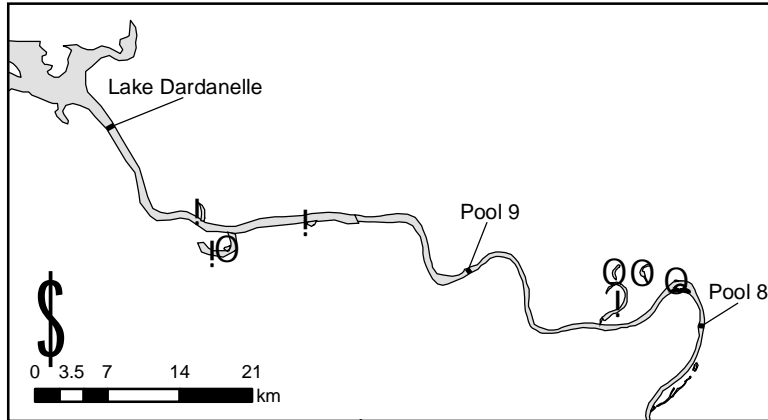


# Map 30. Blue catfish

*Ictalurus furcatus*

! Present

○ Absent



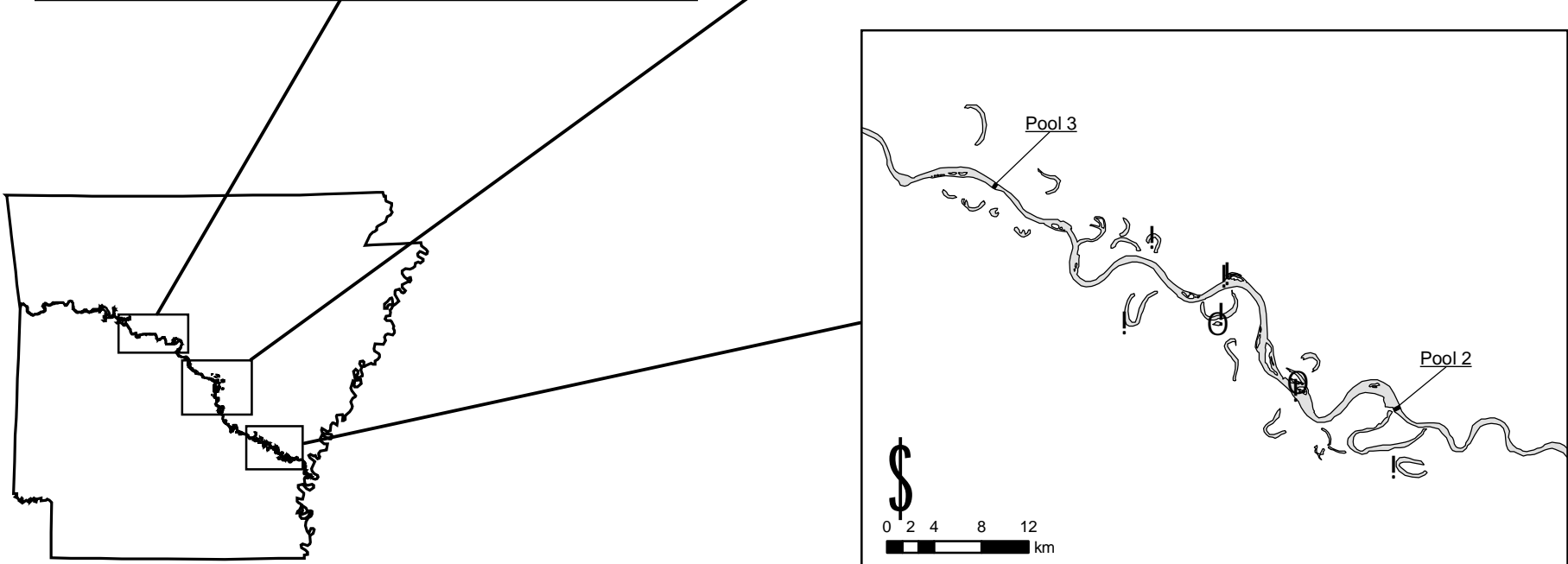
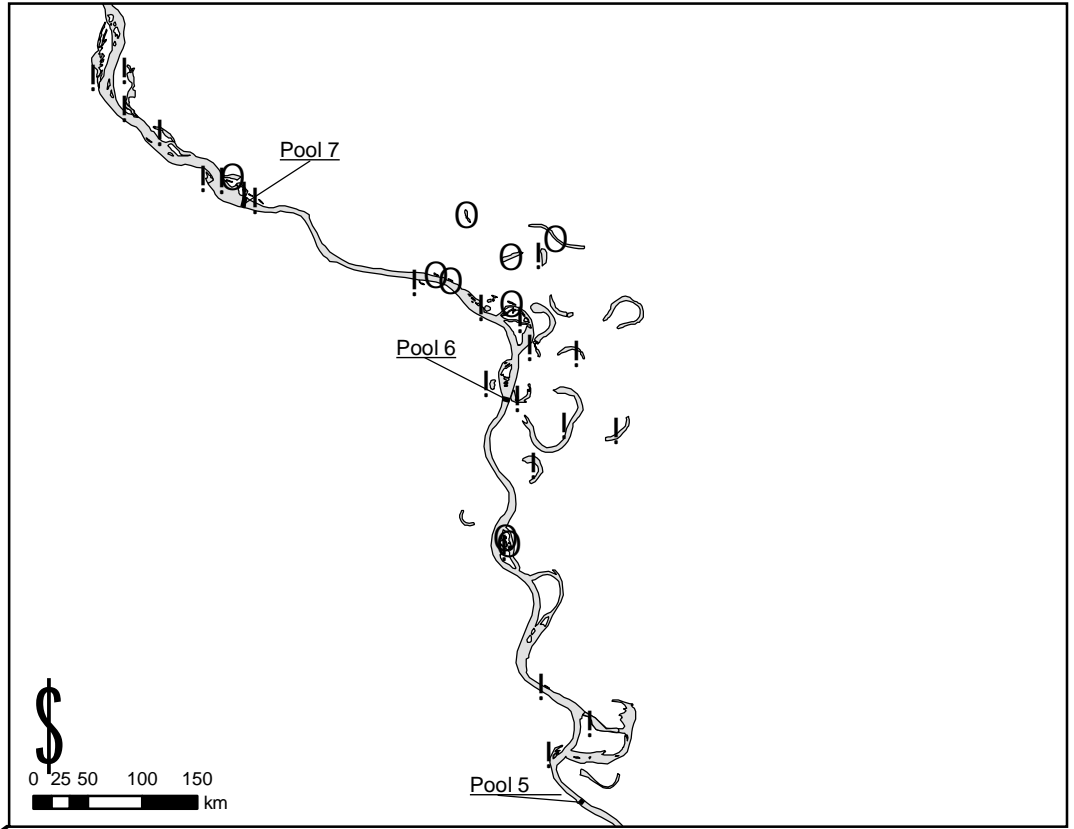
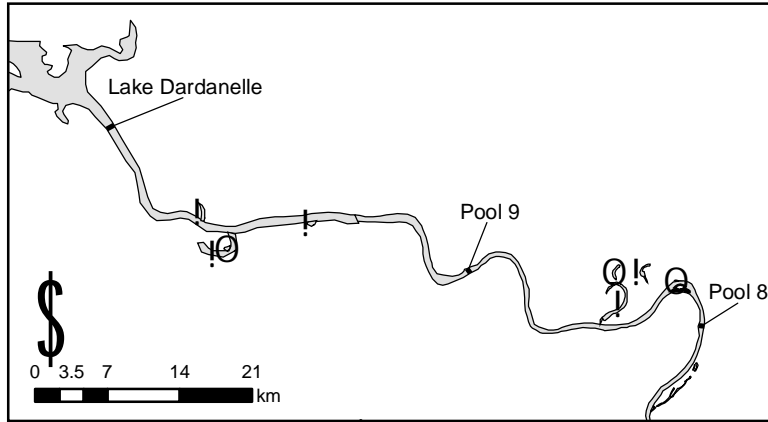


# Map 31. Channel catfish

*Ictalurus punctatus*

! Present

○ Absent

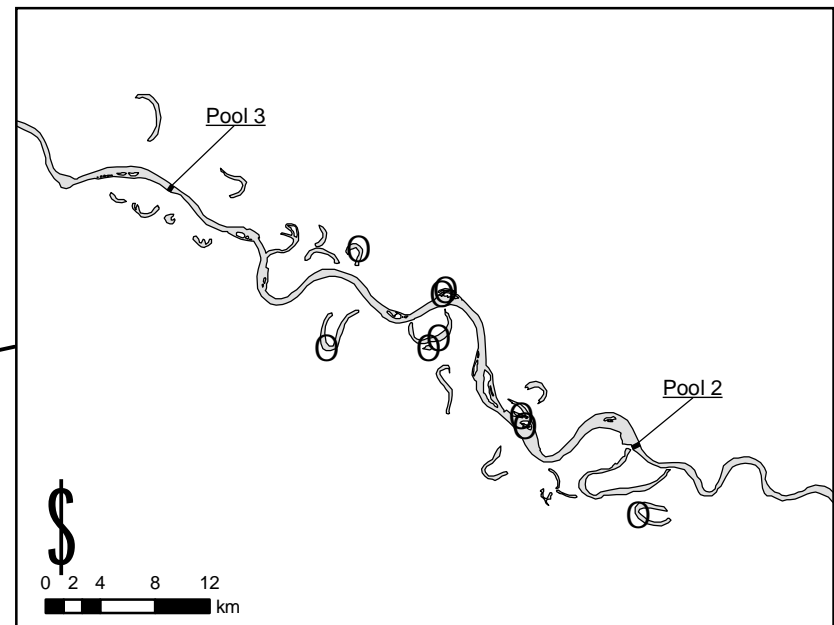
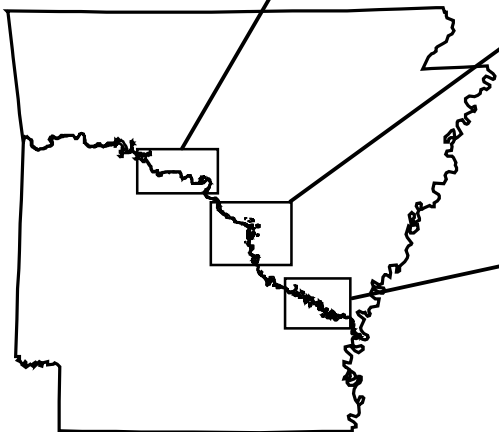
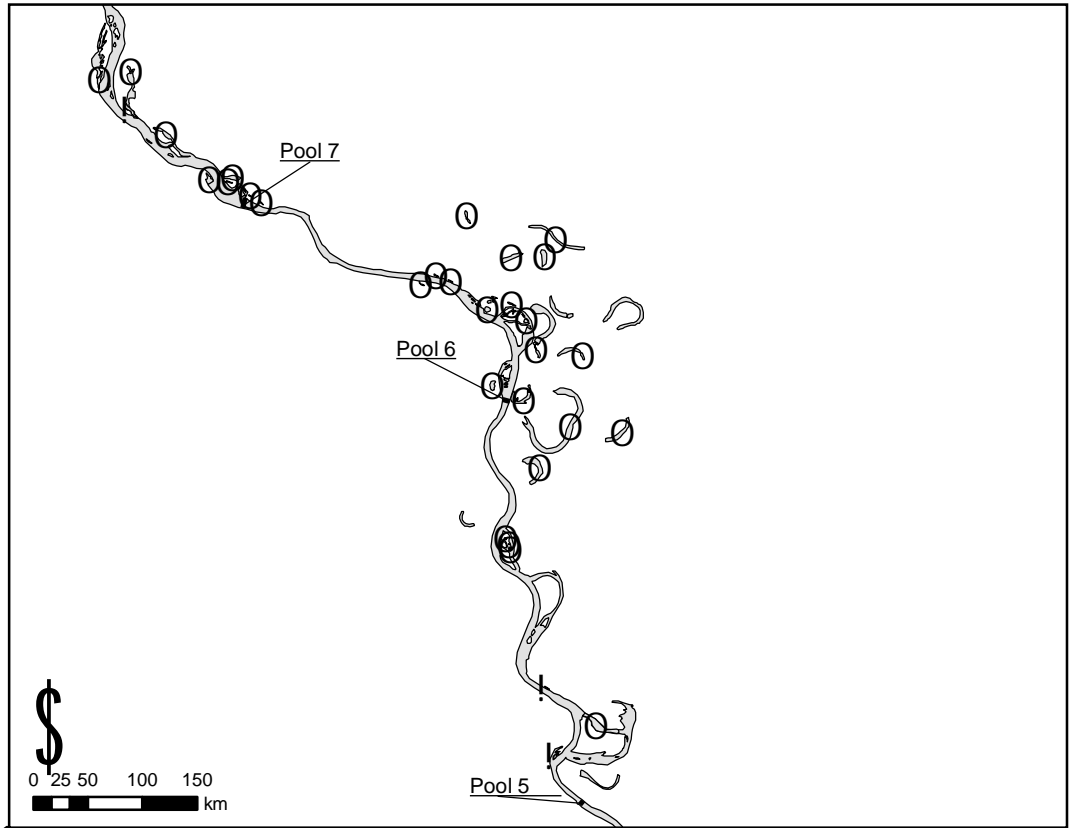
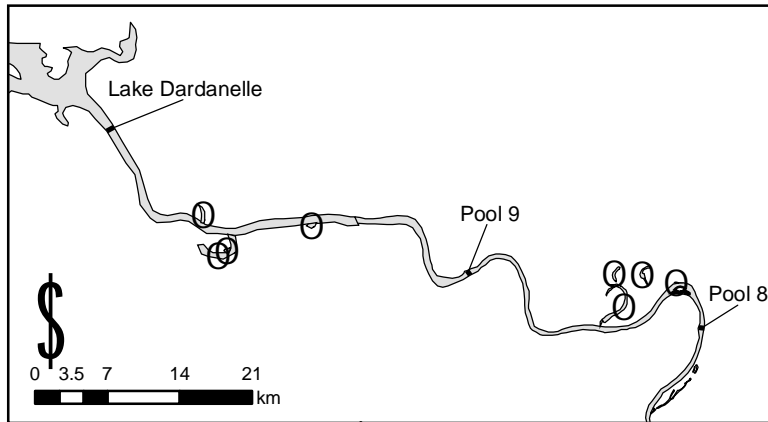


# Map 32. Tadpole madtom

*Noturus gyrinus*

! Present

○ Absent

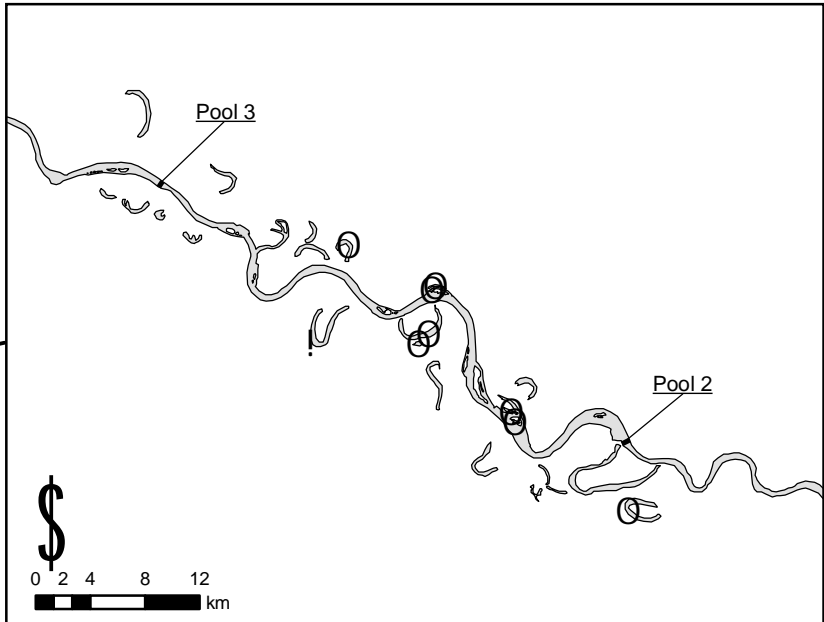
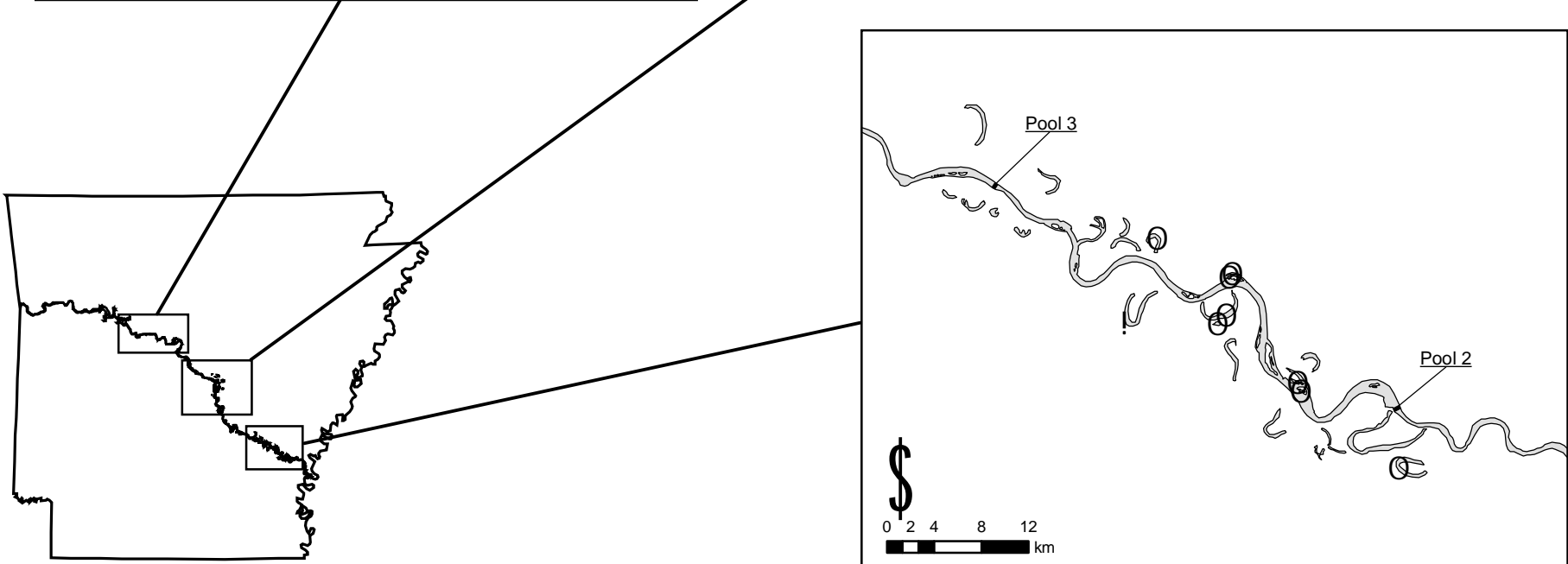
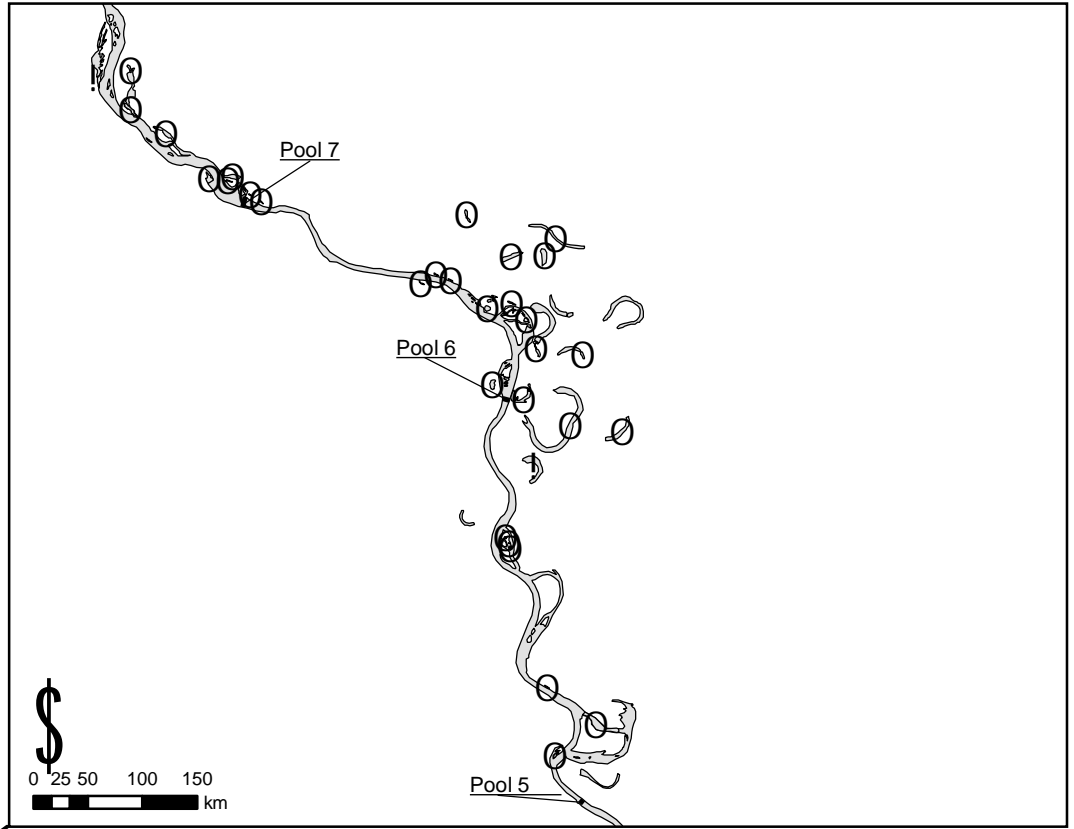
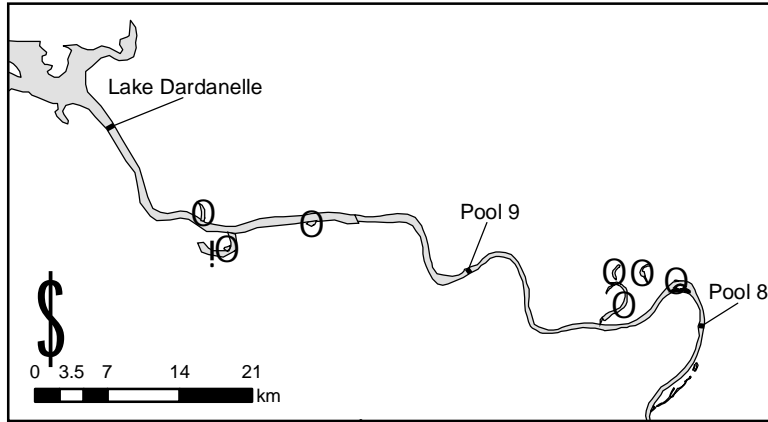


# Map 33. Flathead catfish

*Pylodictis olivaris*

! Present

○ Absent

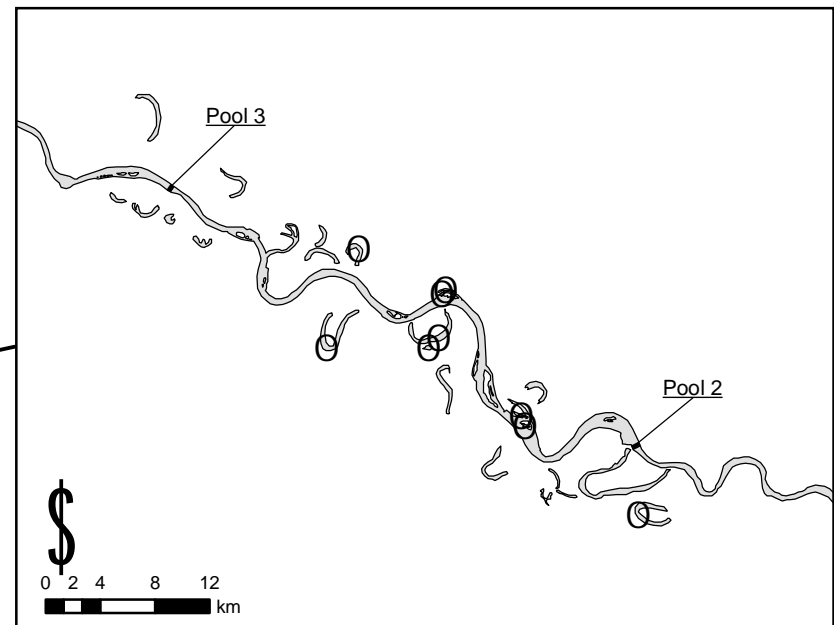
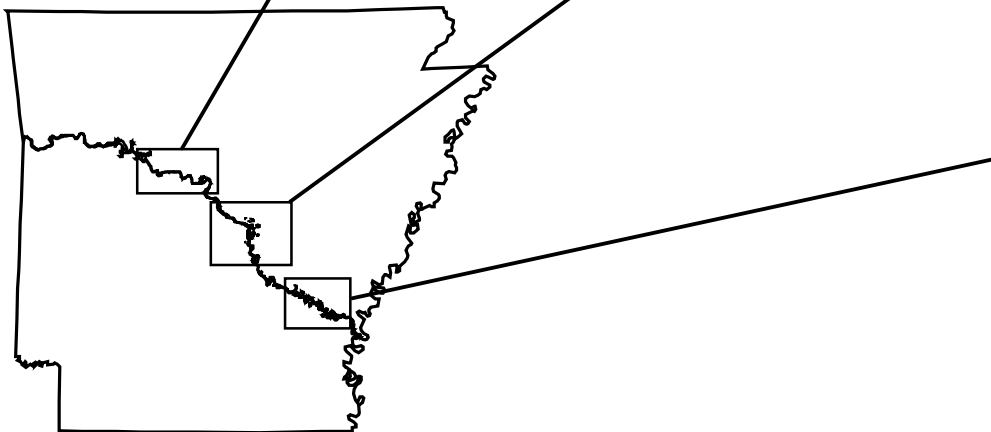
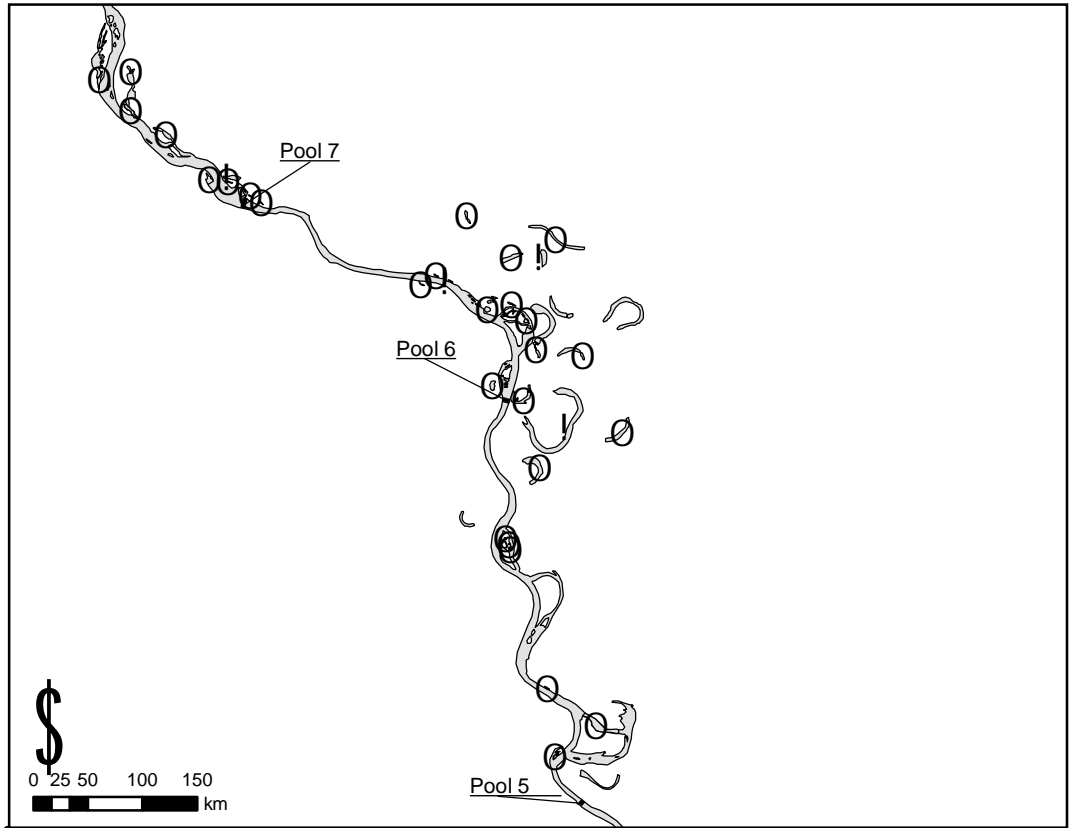
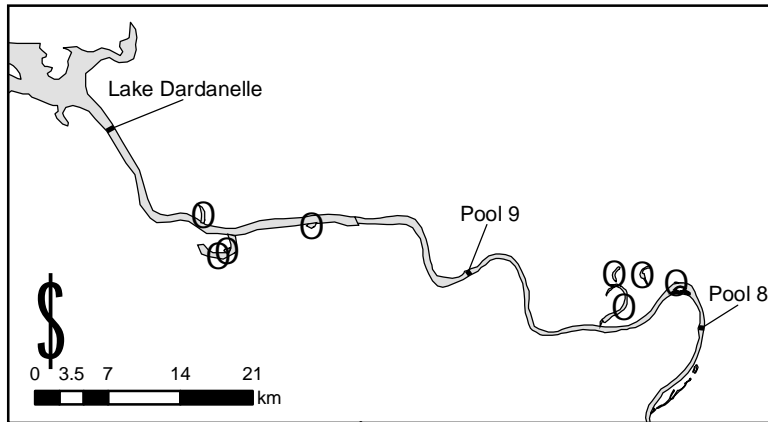


# Map 34. Redfin pickerel

*Esox americanus*

! Present

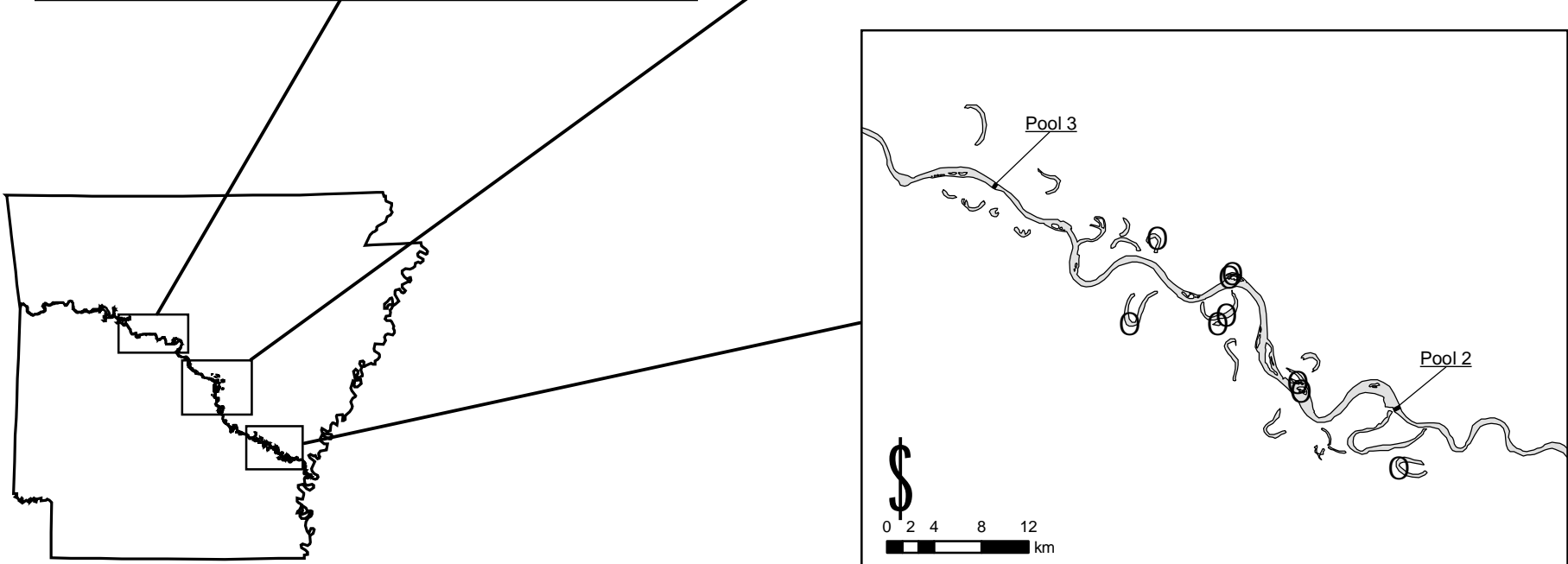
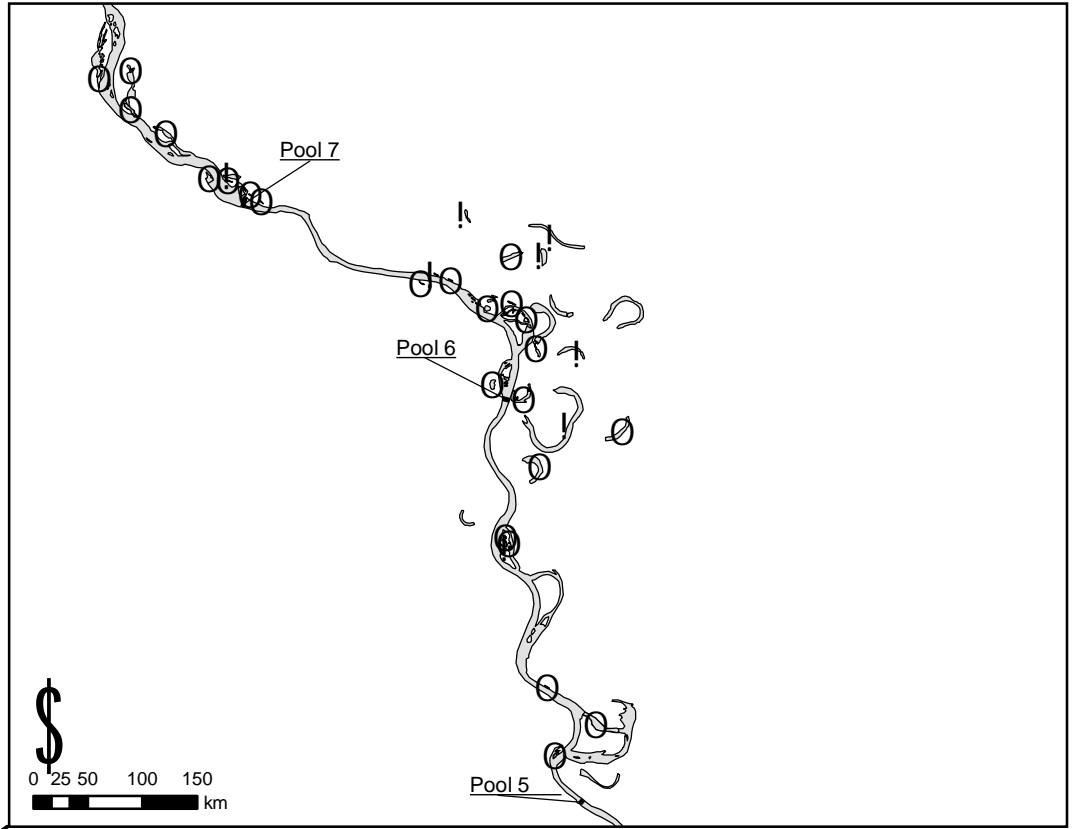
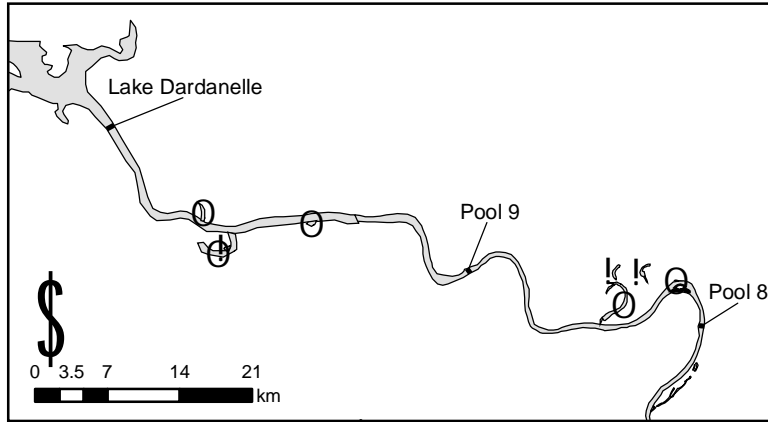
○ Absent



# Map 35. Pirate perch

*Aphredoderus sayanus*

- ! Present
- Absent

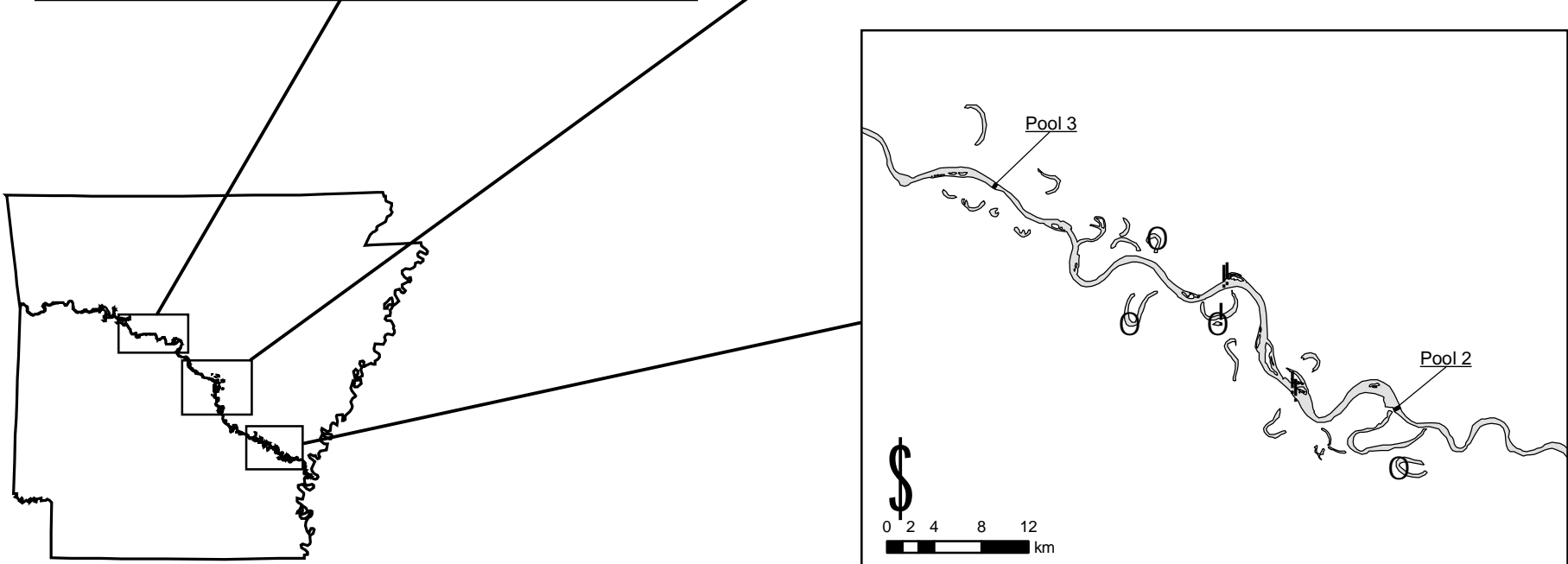
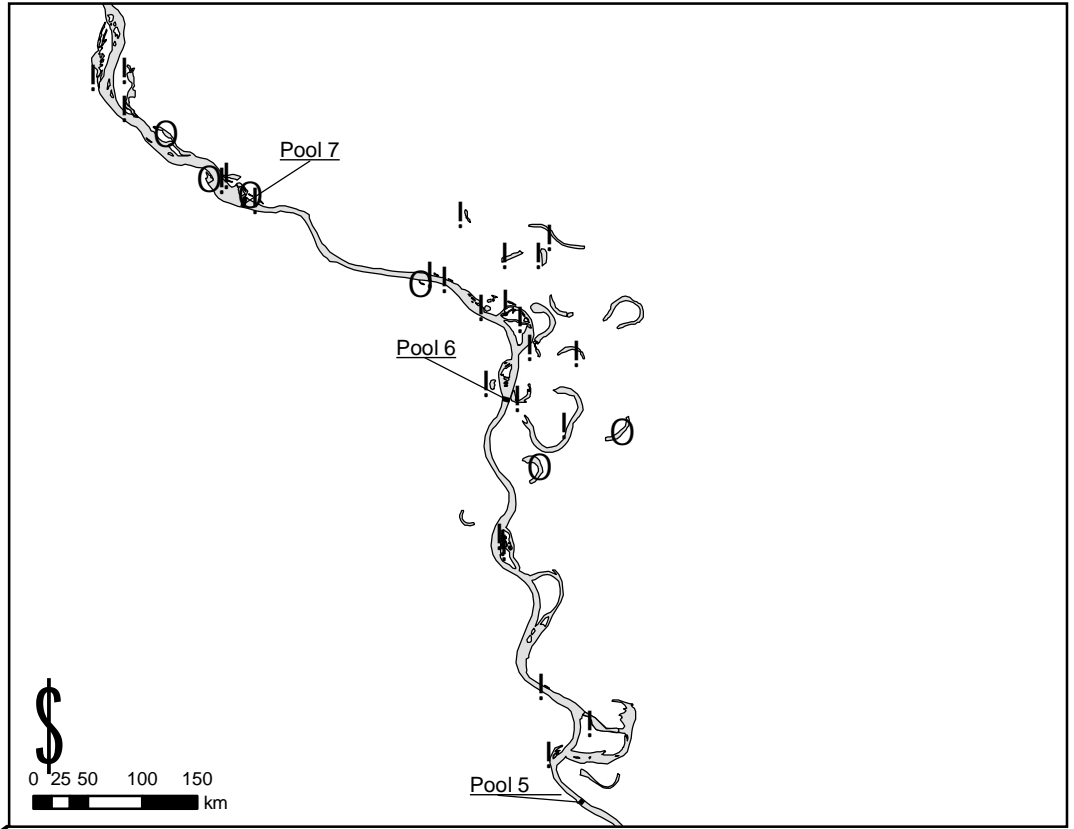
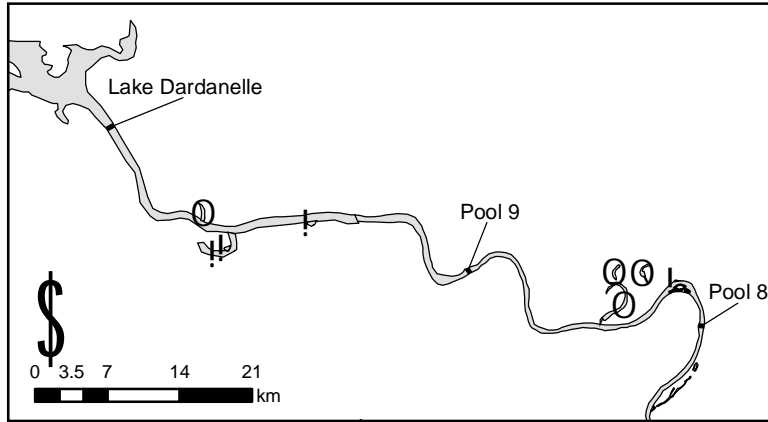


# Map 36. Golden topminnow

*Fundulus chrysotus*

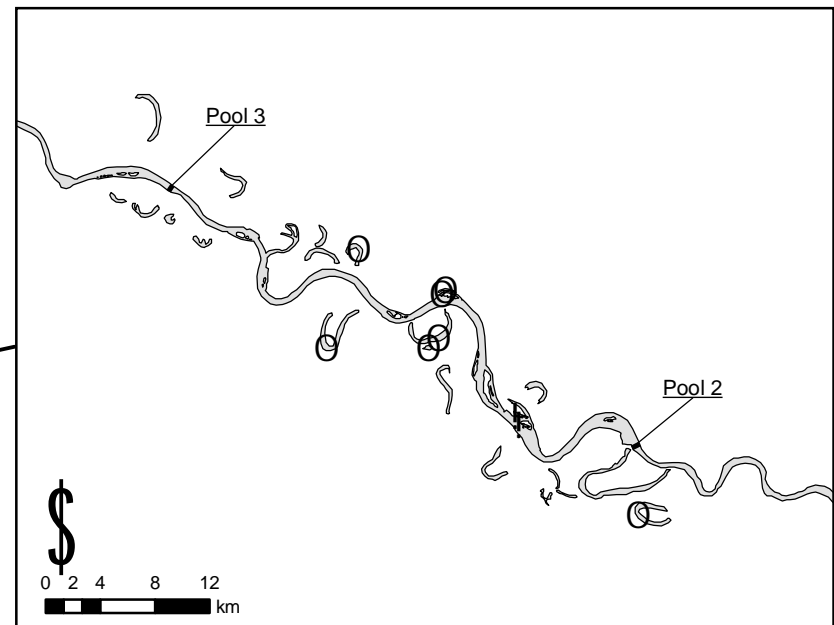
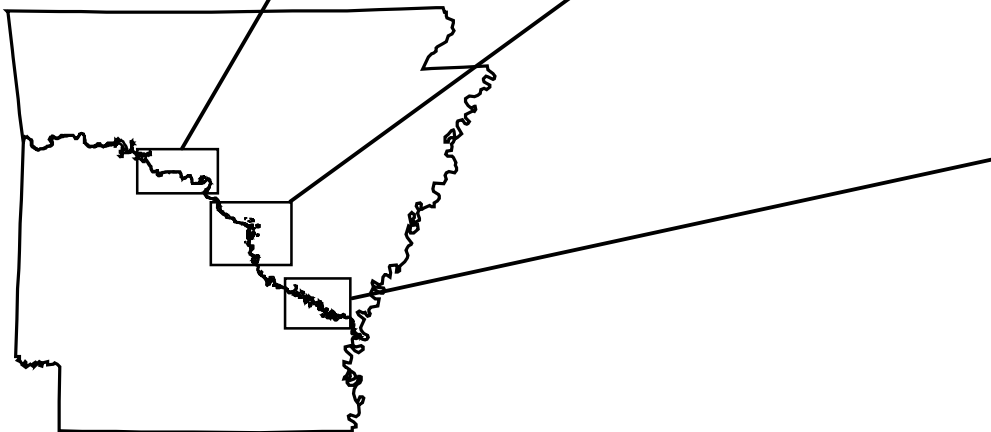
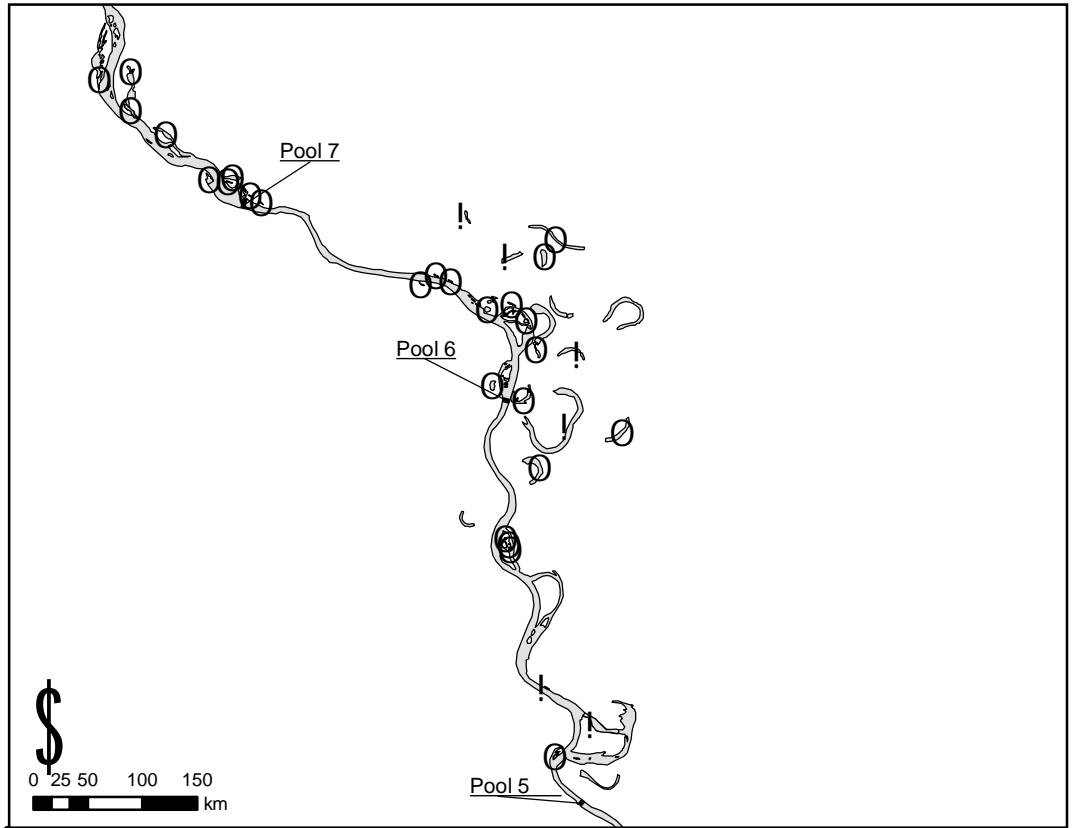
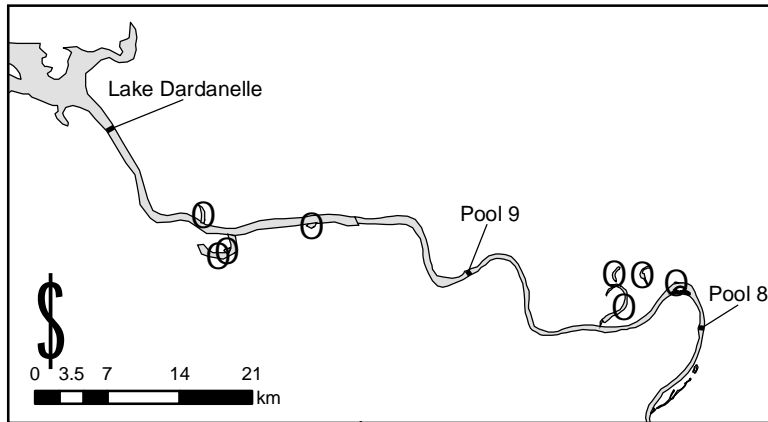
! Present

○ Absent



# Map 37. Starhead topminnow *Fundulus dispar*

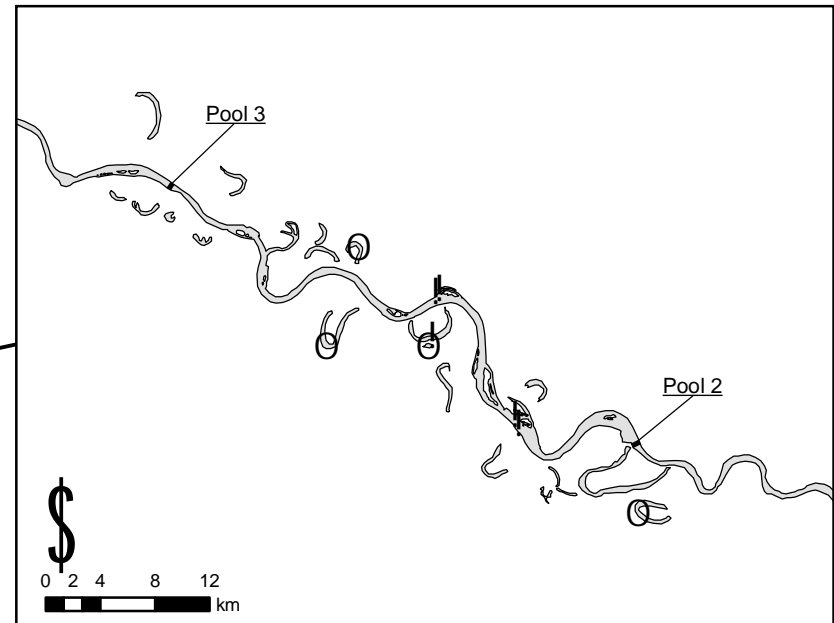
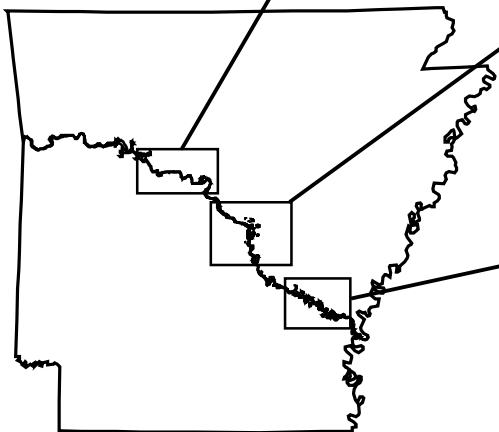
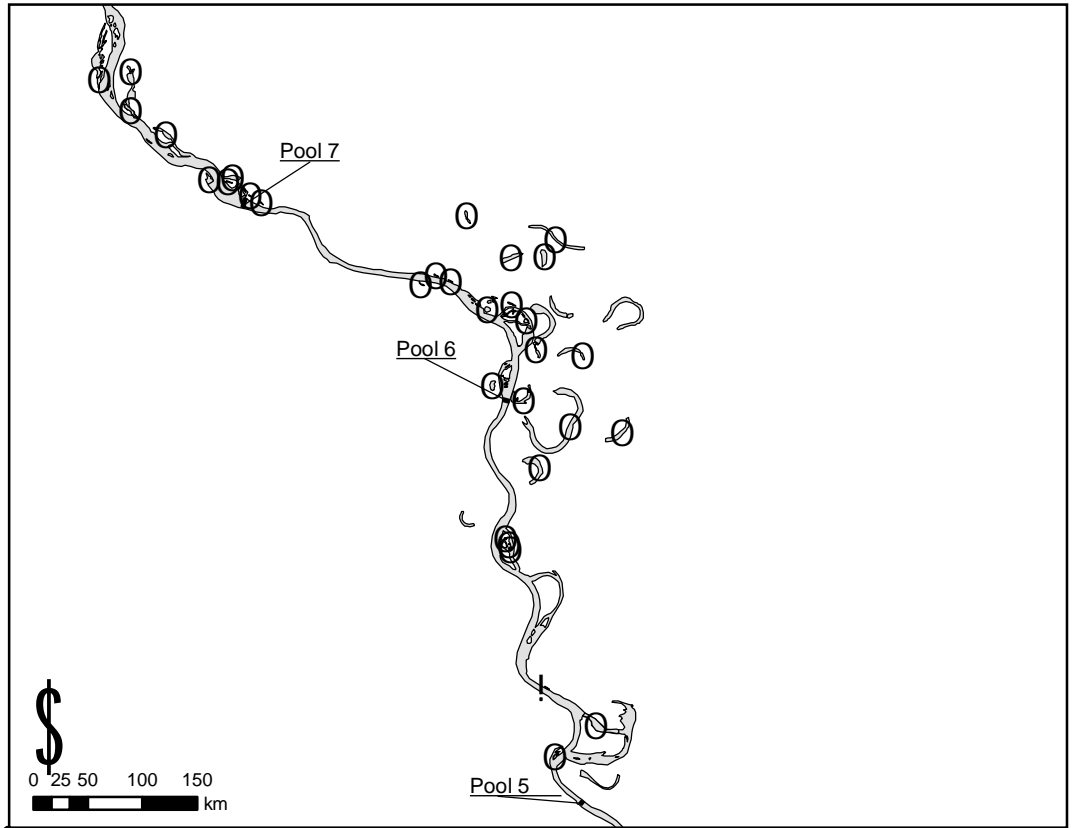
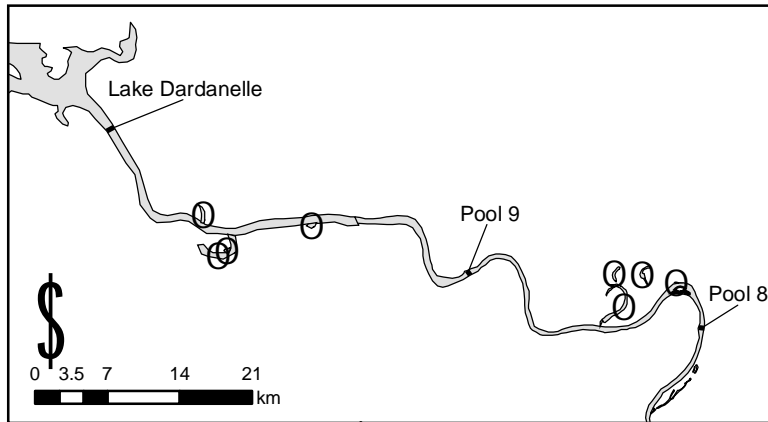
- ! Present
- Absent



# Map 38. Blackstripe topminnow

*Fundulus notatus*

- ! Present
- Absent

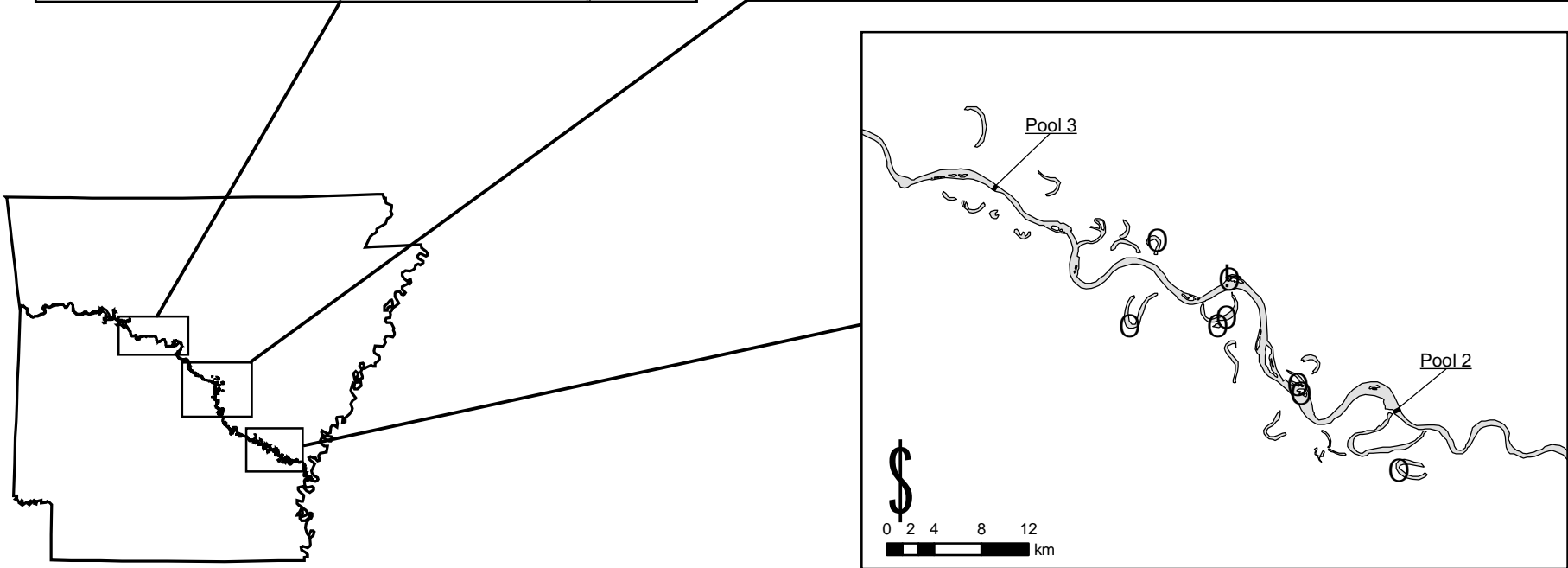
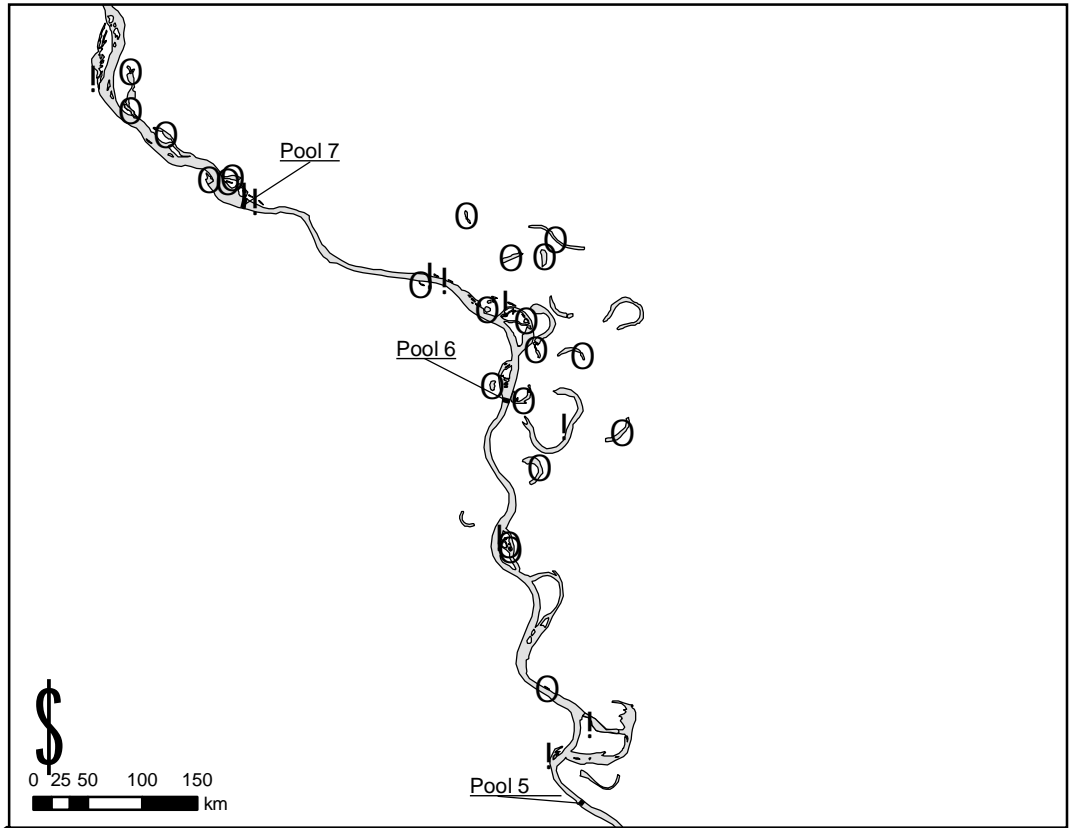
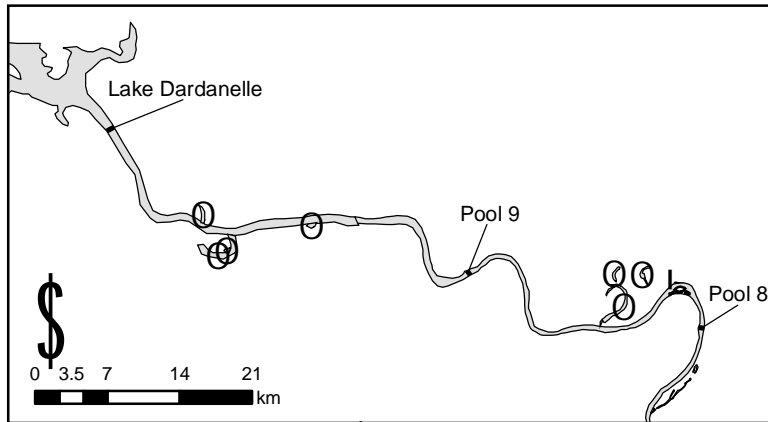




# Map 39. Blackspotted topminnow

*Fundulus olivaceus*

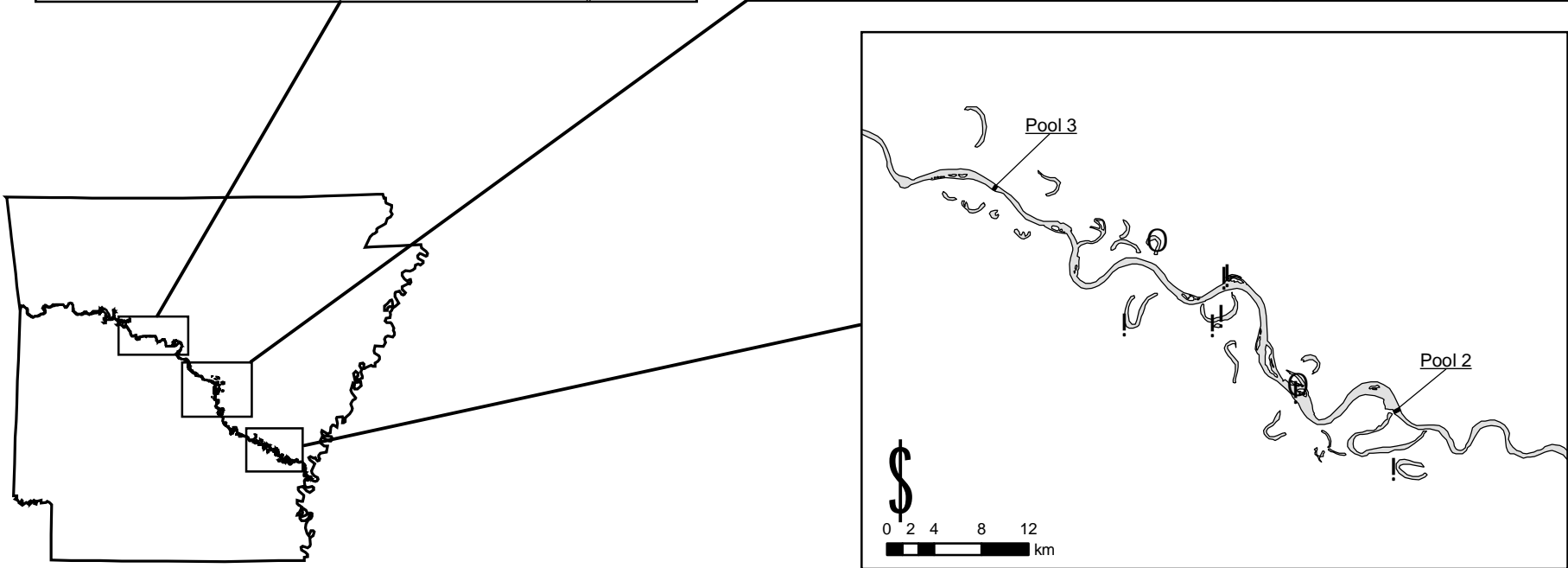
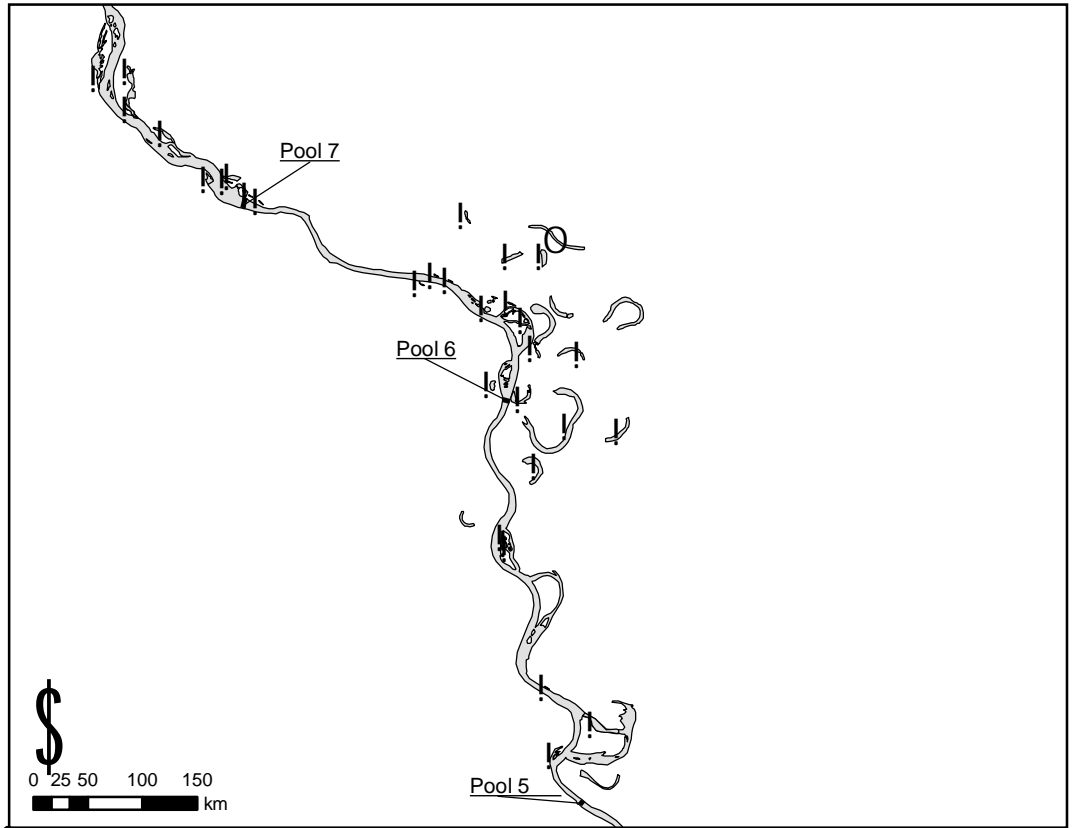
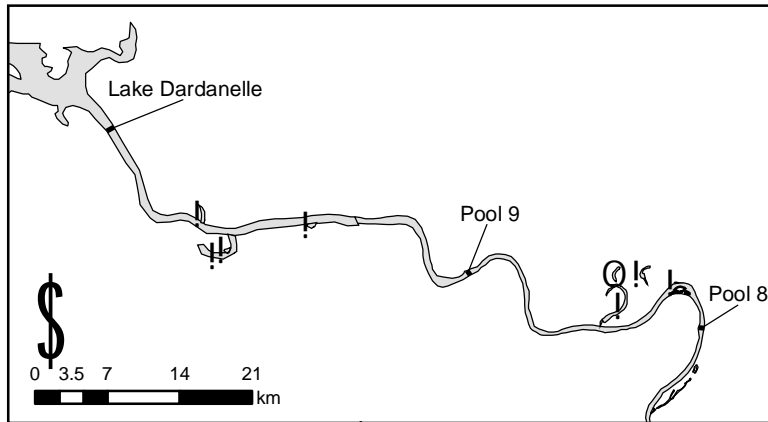
- ! Present
- Absent



# Map 40. Western mosquito fish

*Gambusia affinis*

- ! Present
- O Absent

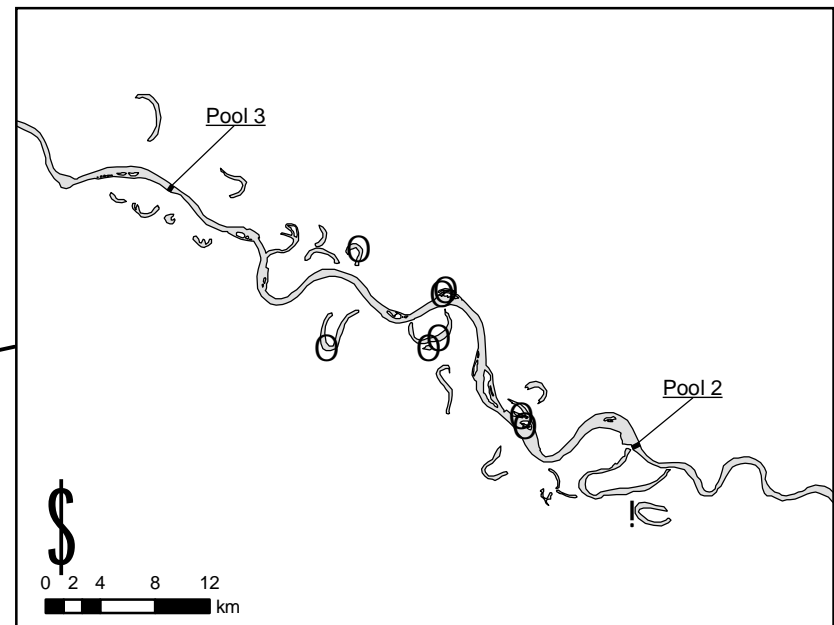
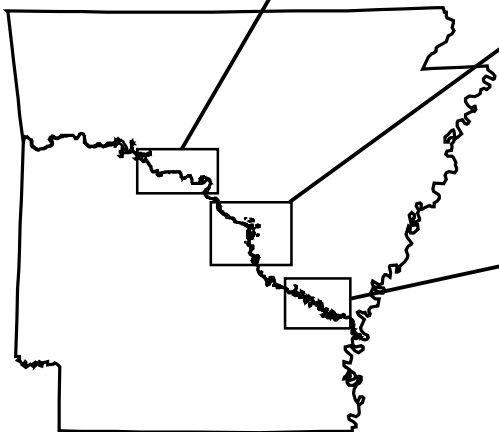
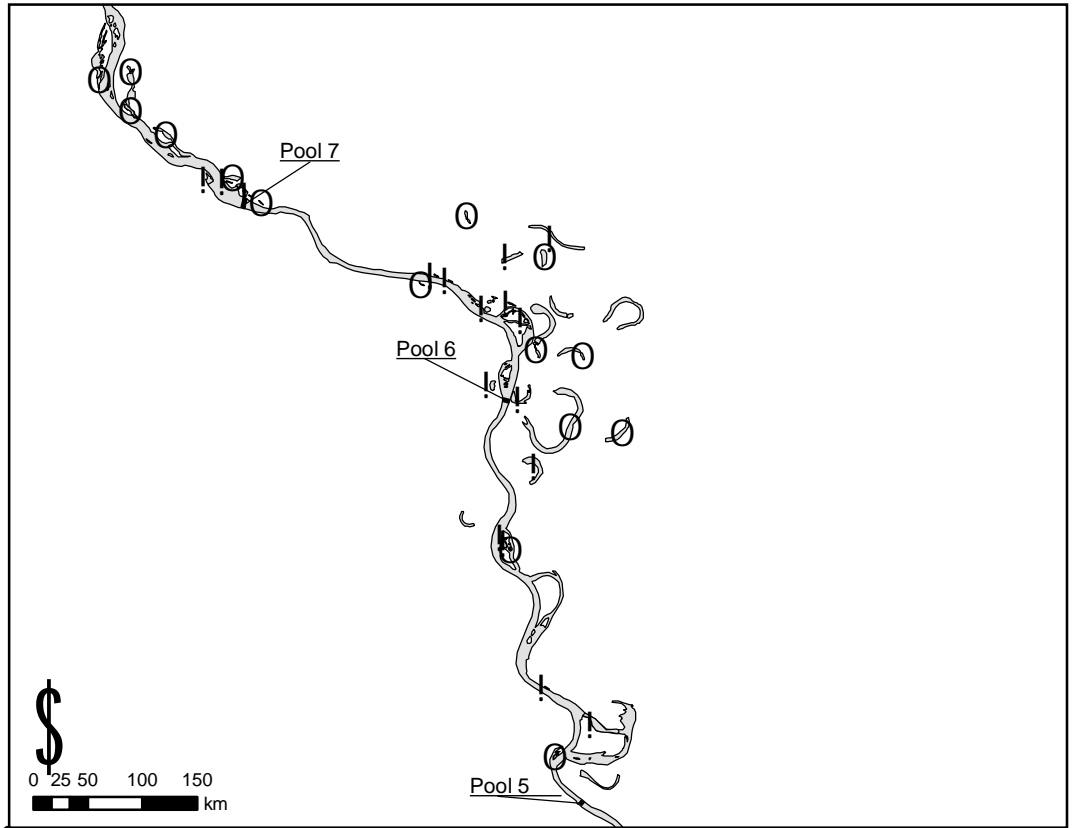
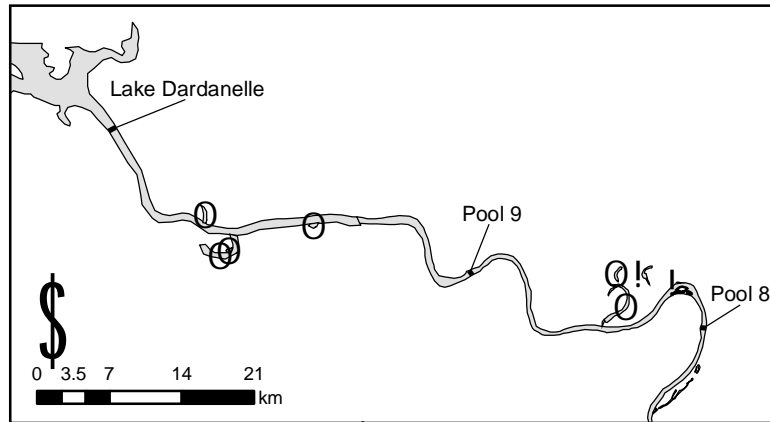


# Map 41. Brook silverside

*Labidesthes sicculus*

! Present

○ Absent

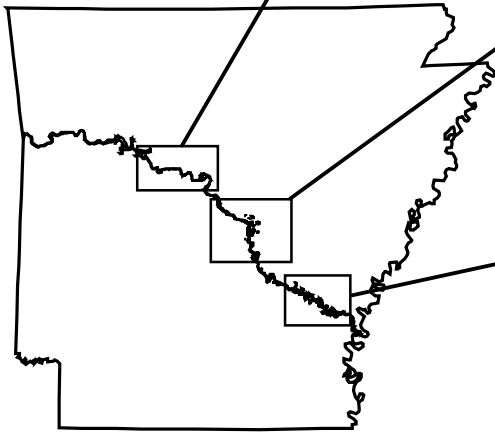
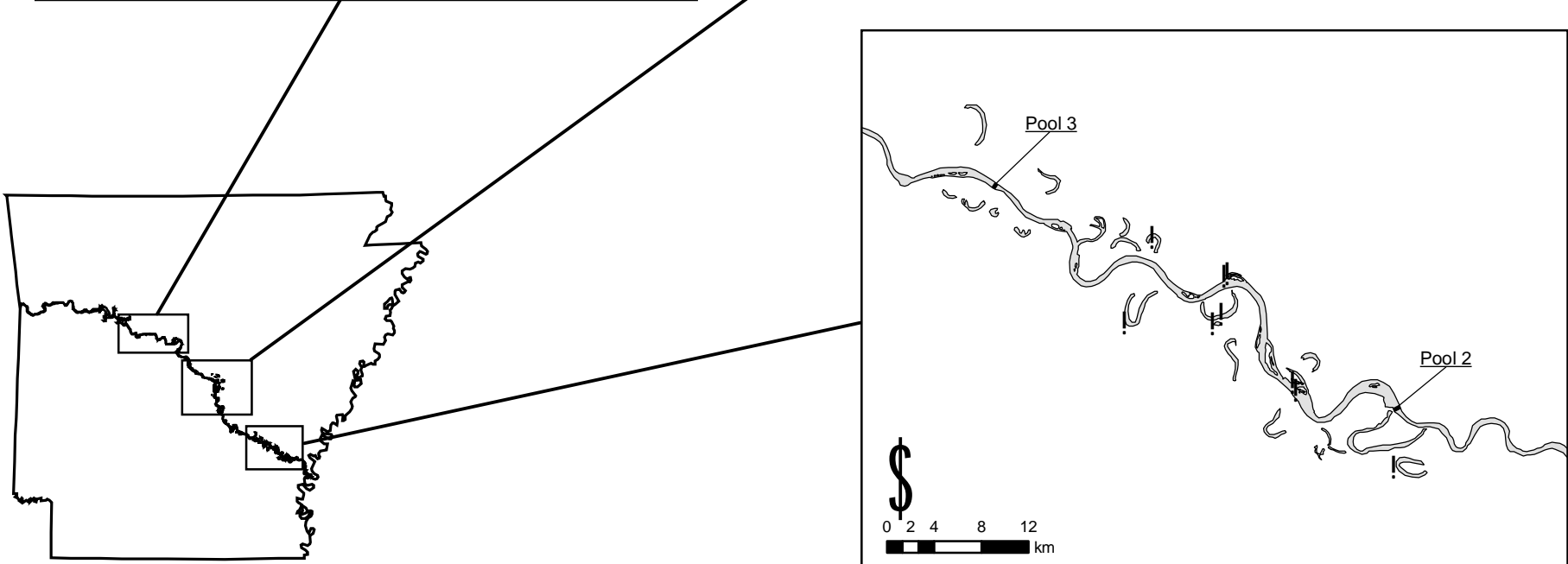
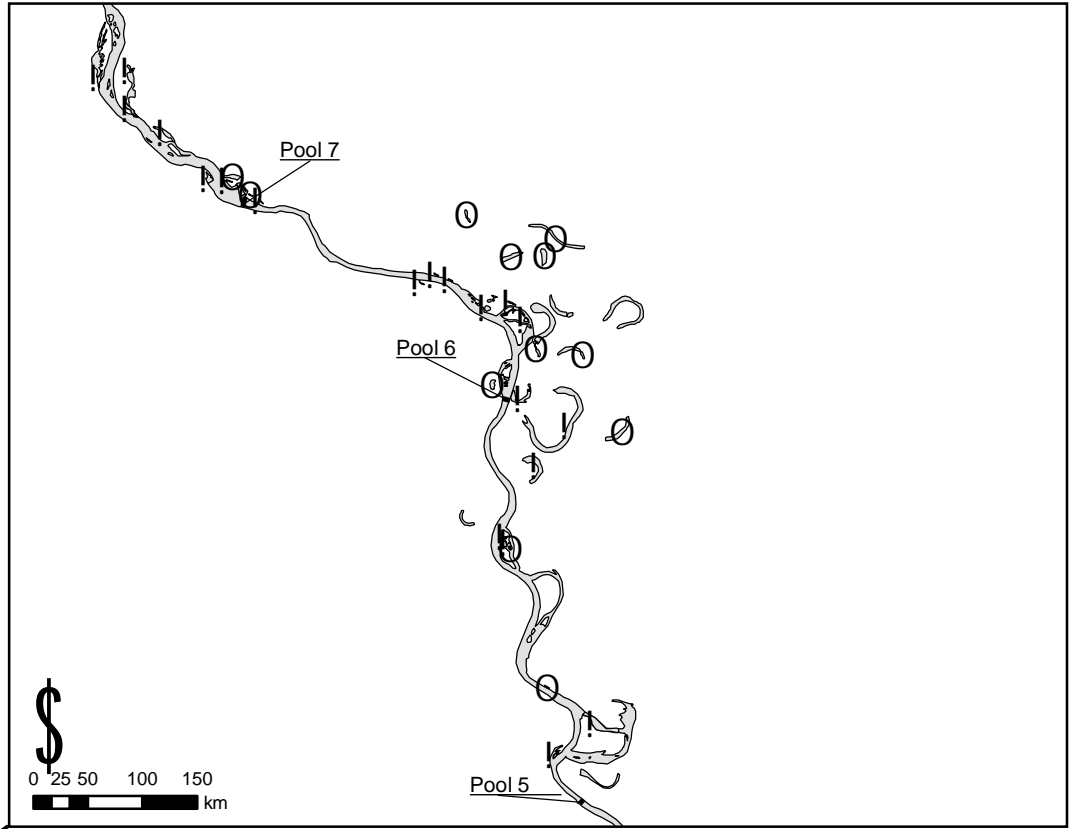
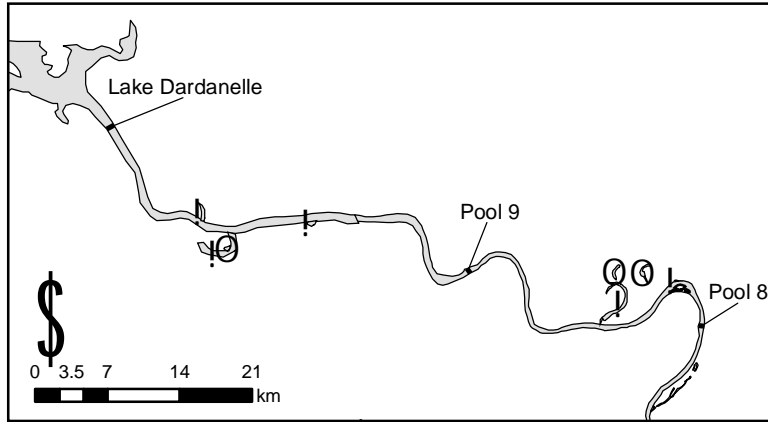


# Map 42. Inland silverside

*Menidia beryllina*

! Present

○ Absent

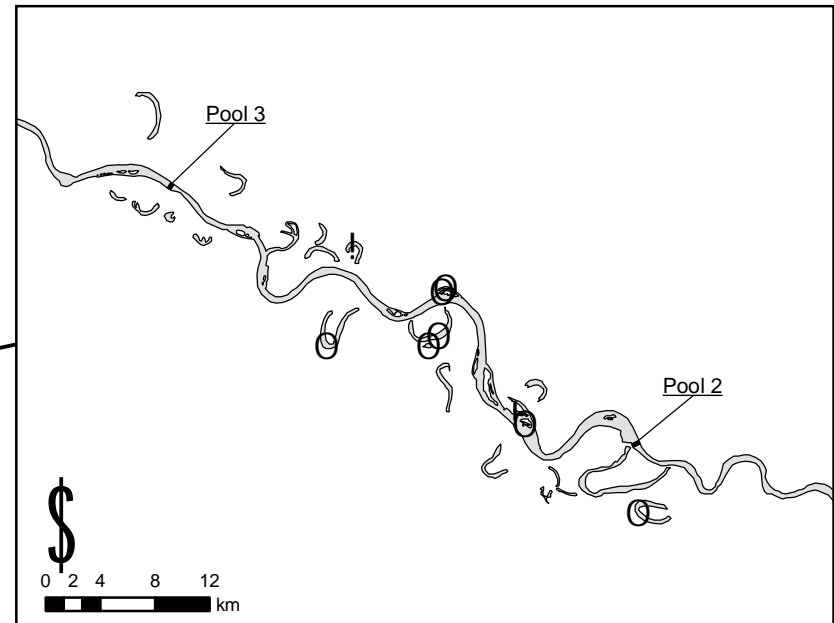
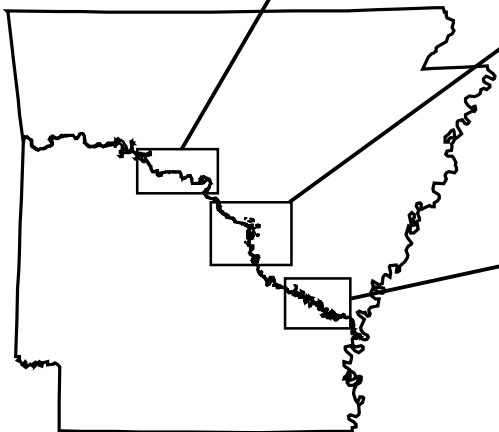
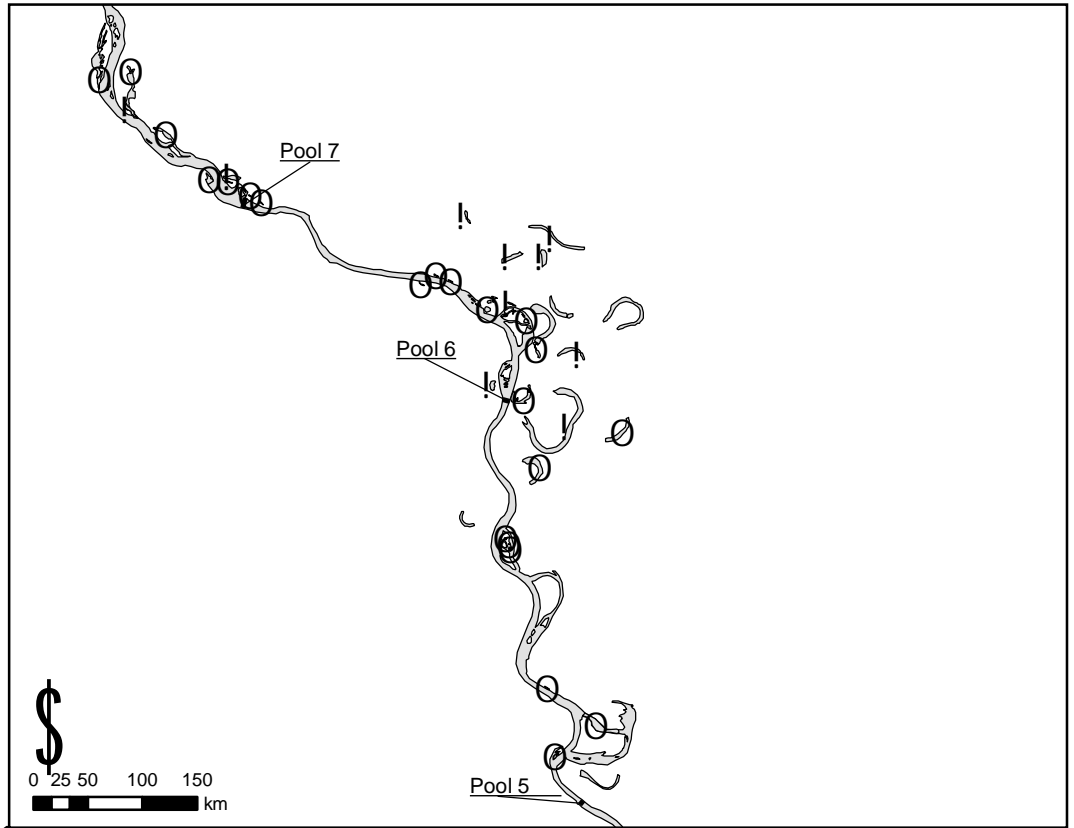
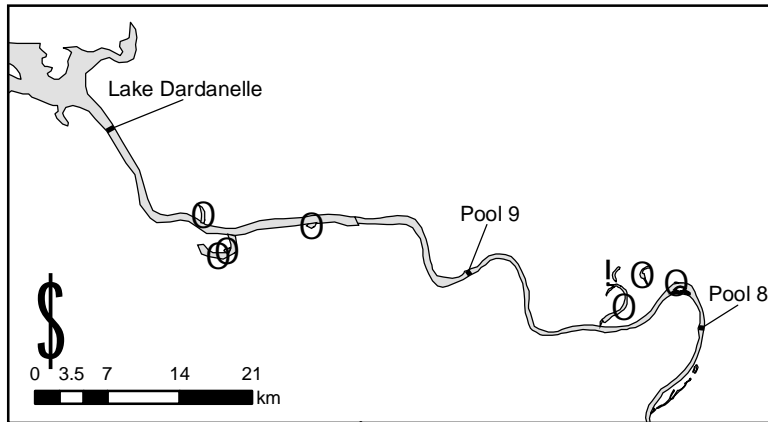


# Map 43. Banded pygmy sunfish

*Elassoma zonatum*

! Present

O Absent

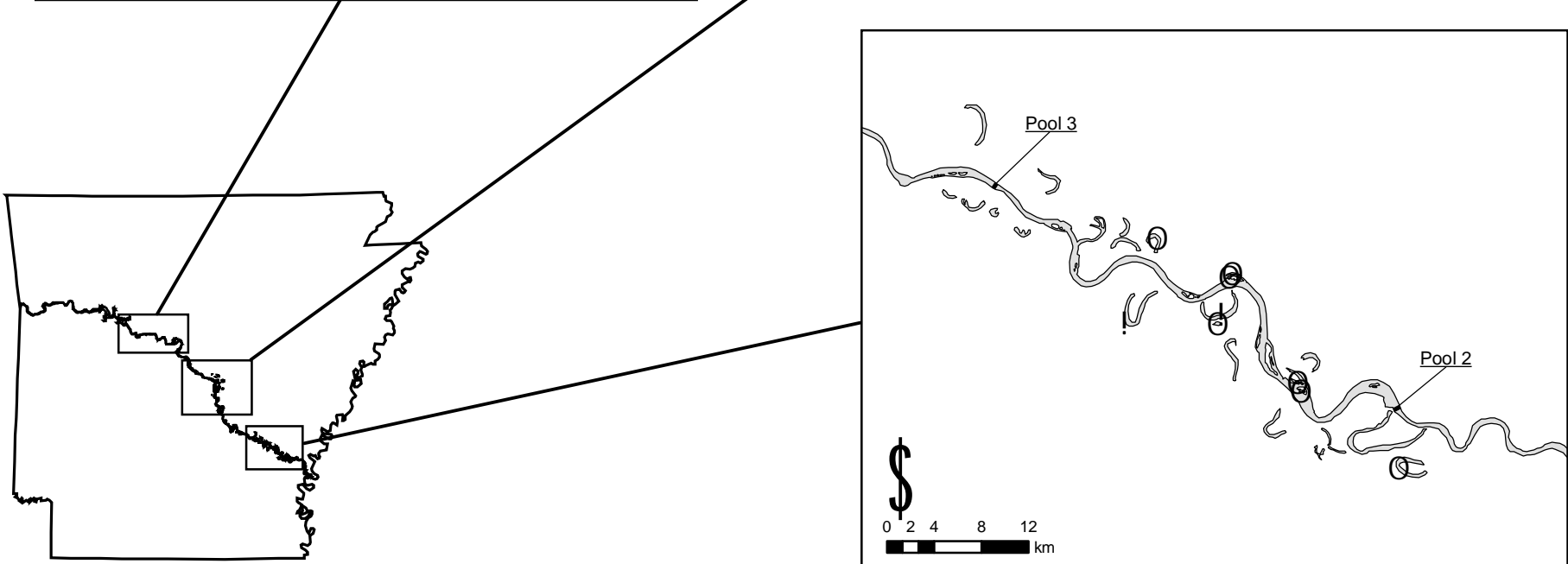
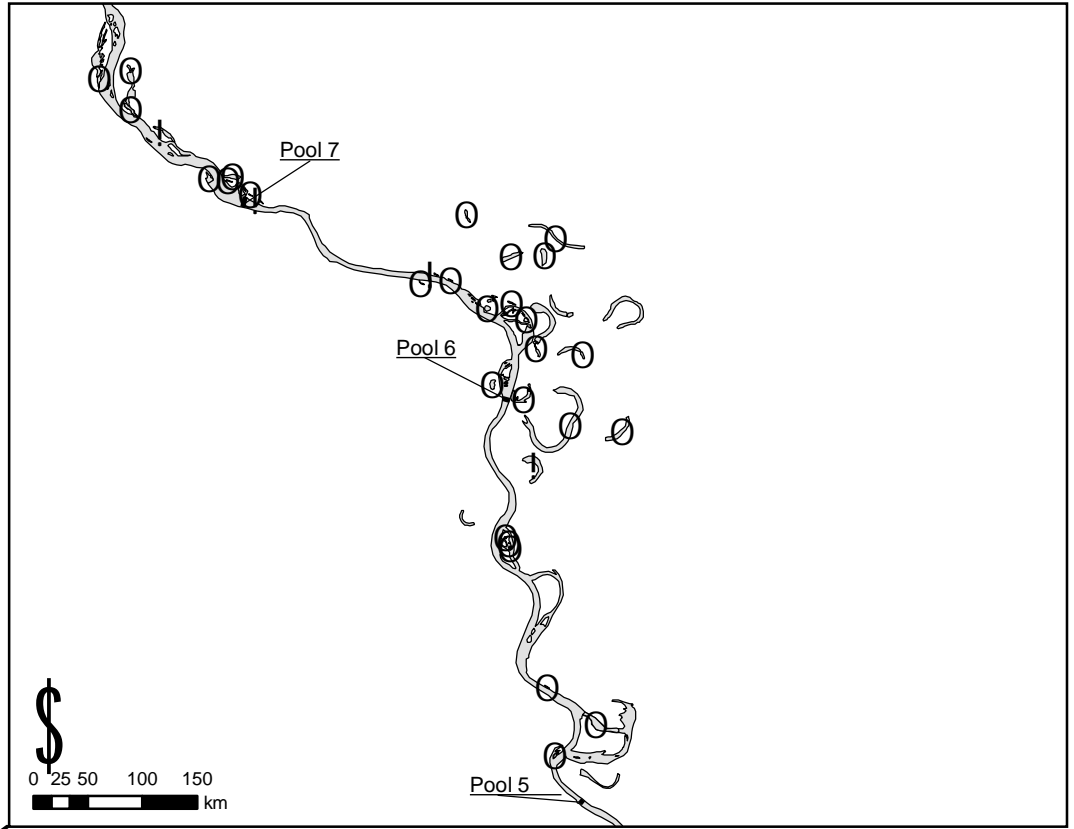
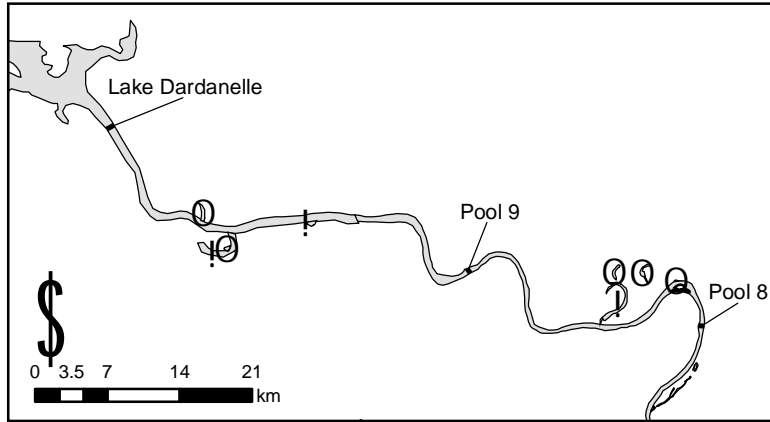


# Map 44. White bass

*Morone chrysops*

! Present

○ Absent

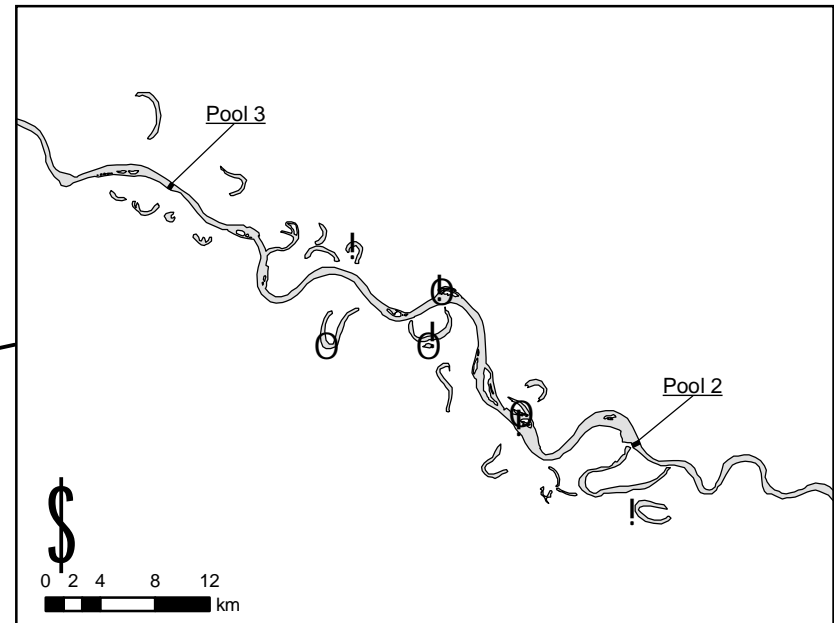
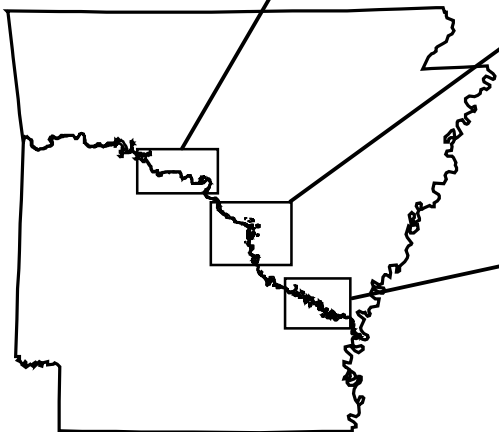
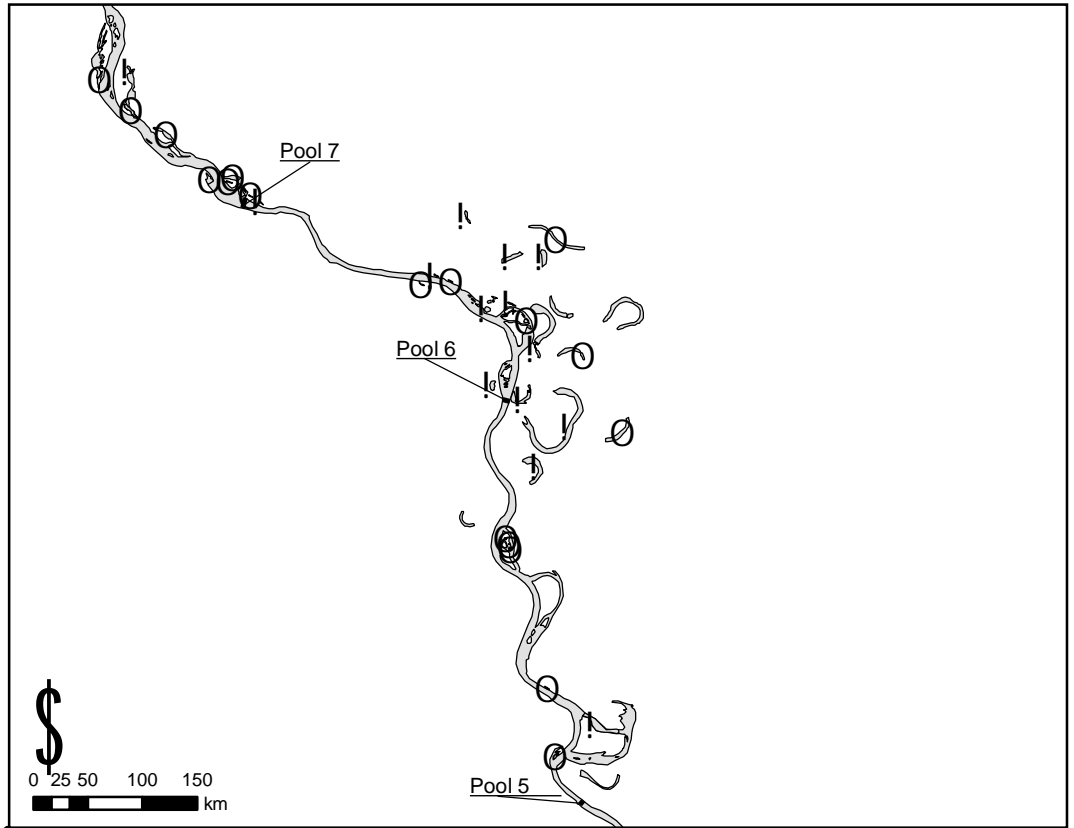
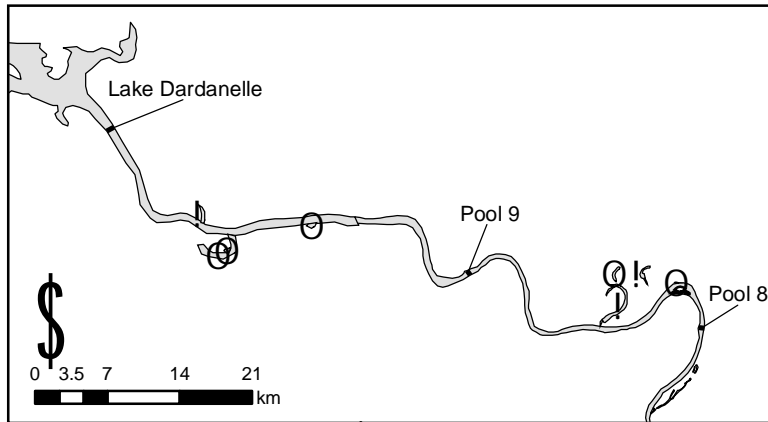


# Map 45. Yellow bass

*Morone mississippiensis*

! Present

○ Absent

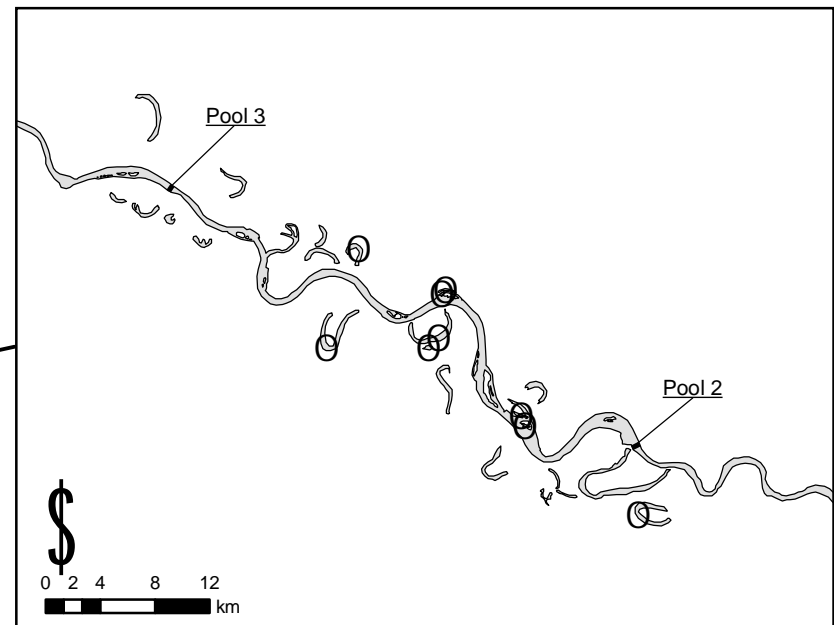
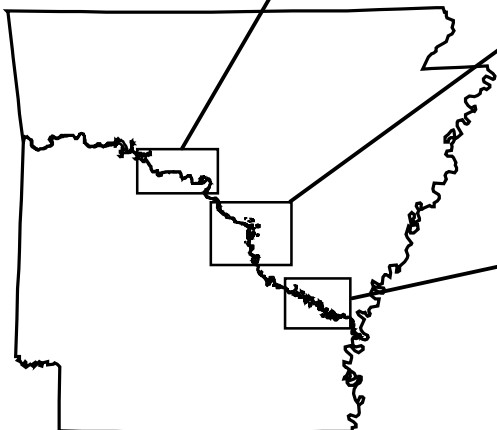
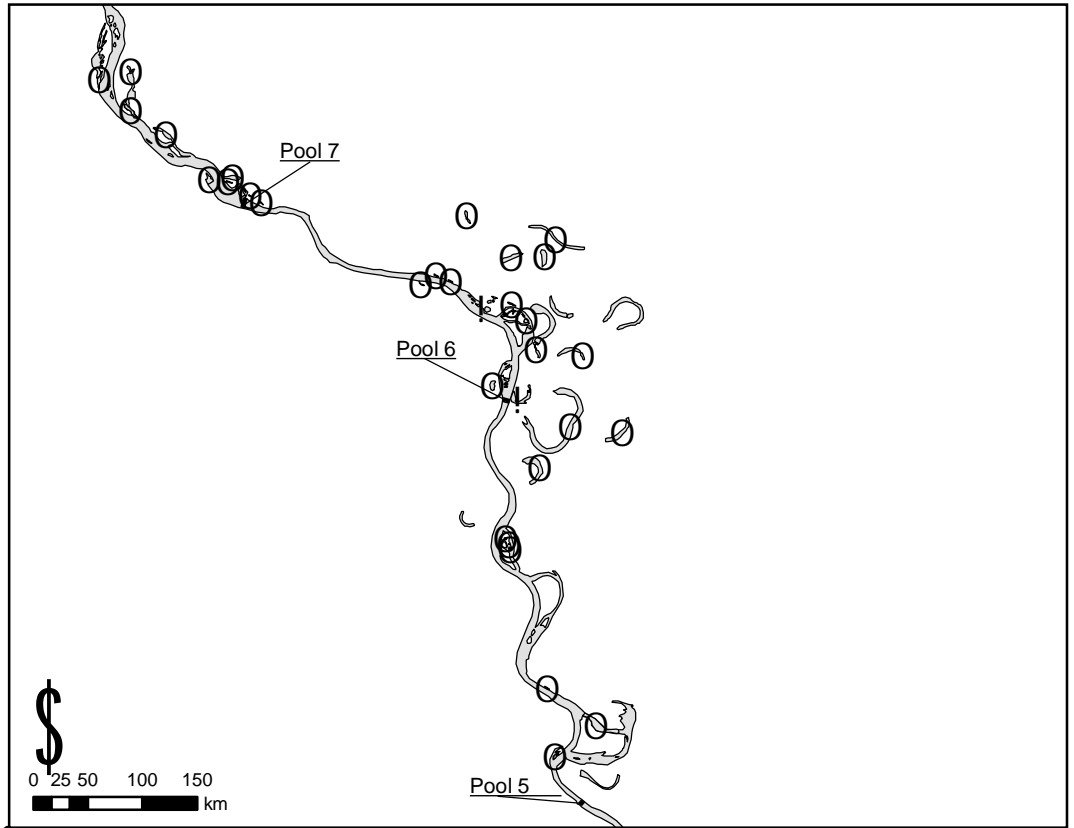
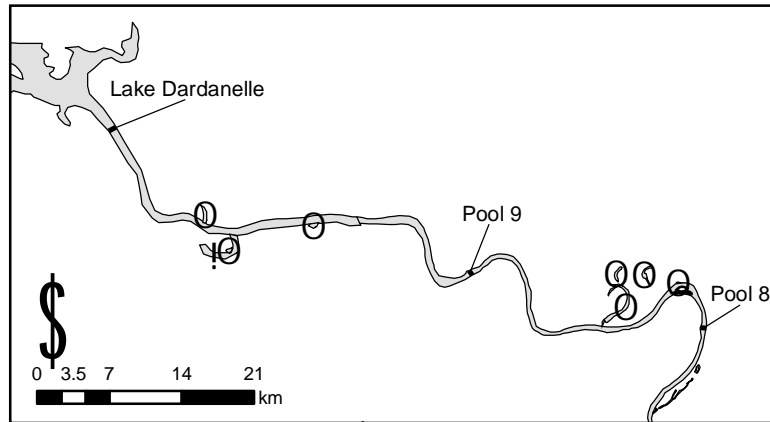


# Map 46. Striped bass

*Morone saxatilis*

! Present

○ Absent





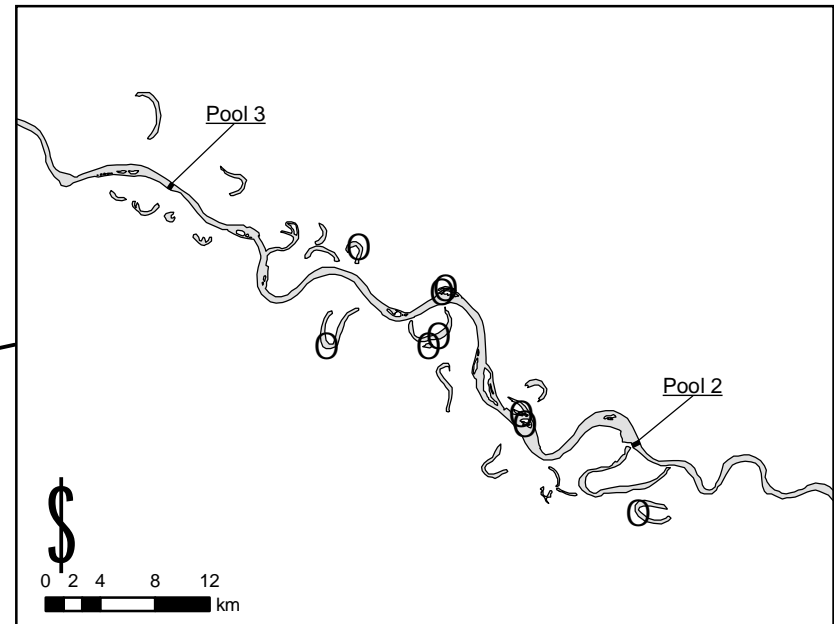
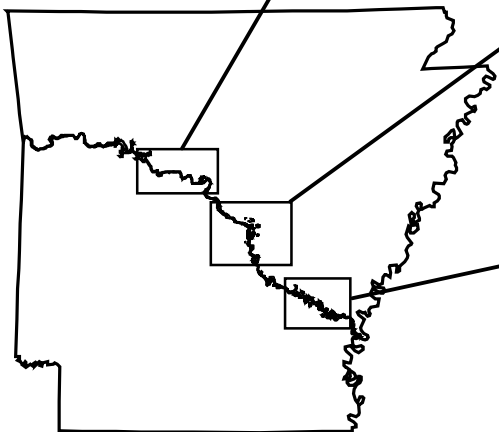
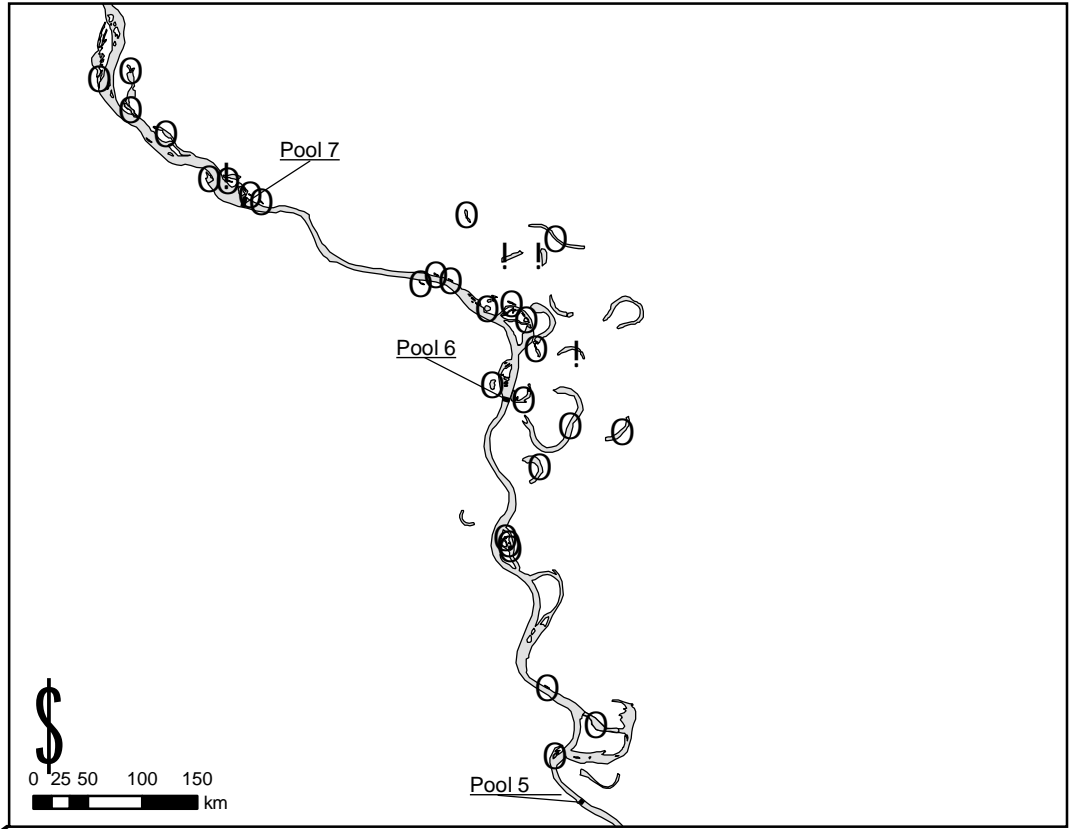
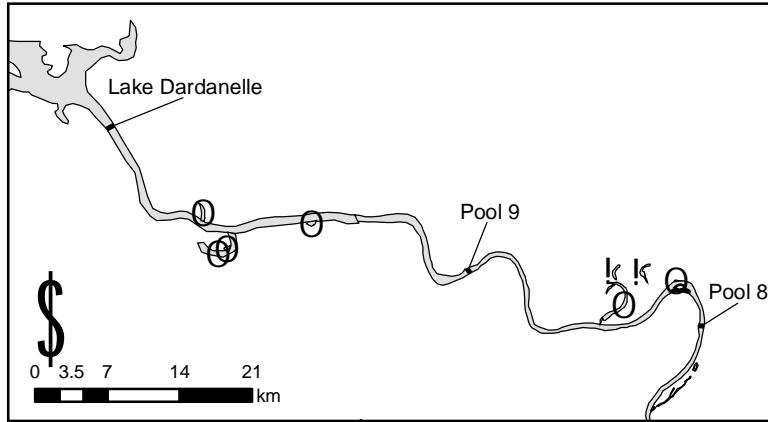
# Map 47.

# Flier

*Centrarchus macropterus*

! Present

○ Absent

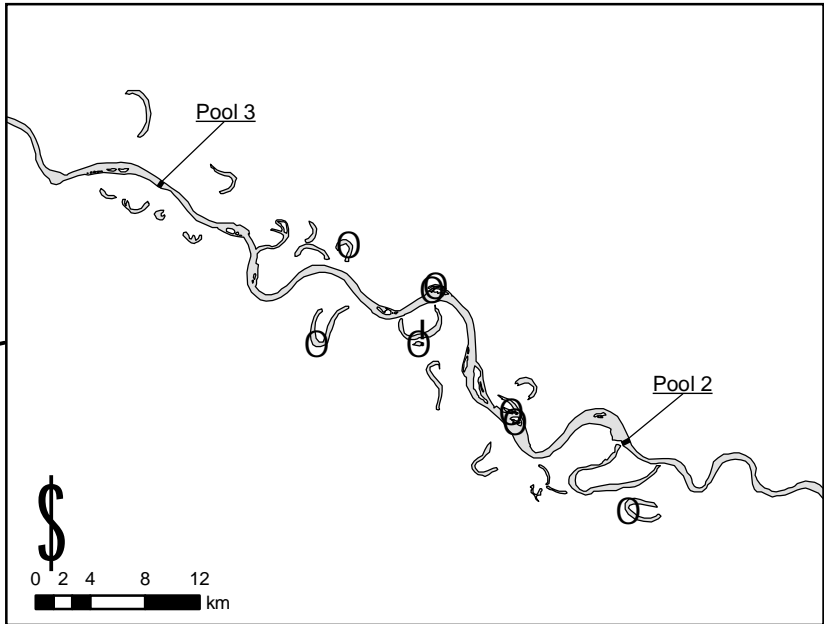
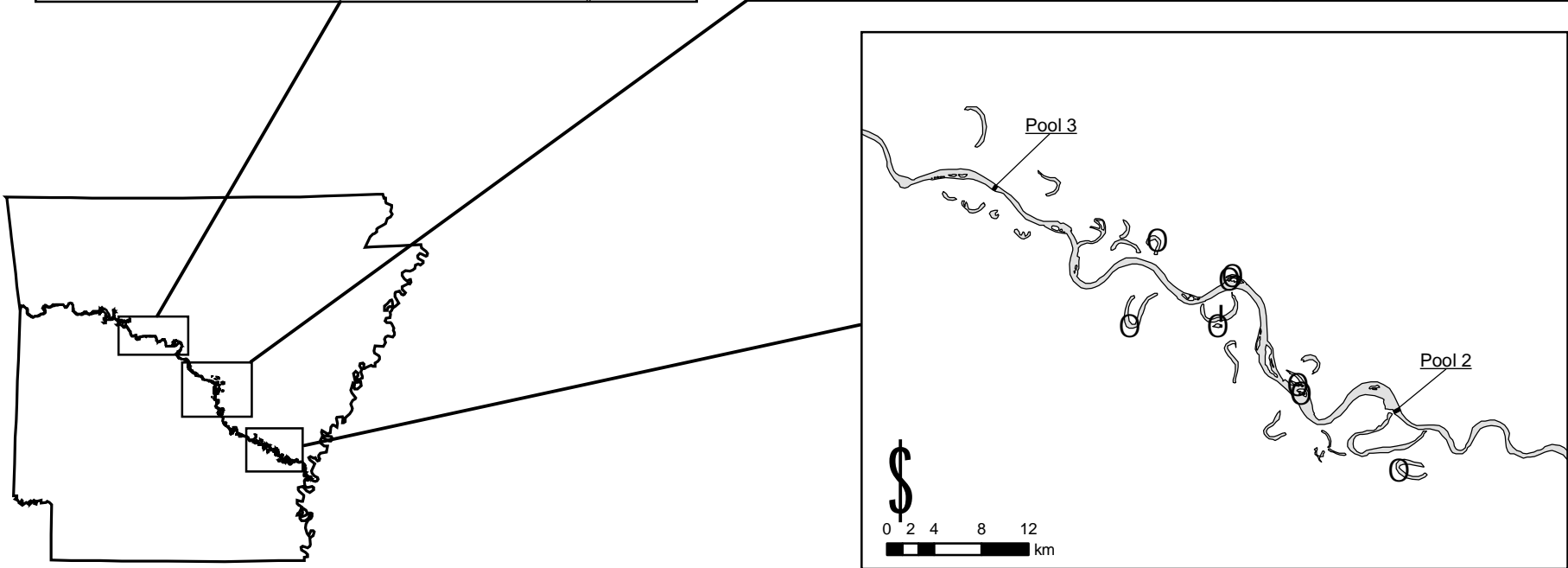
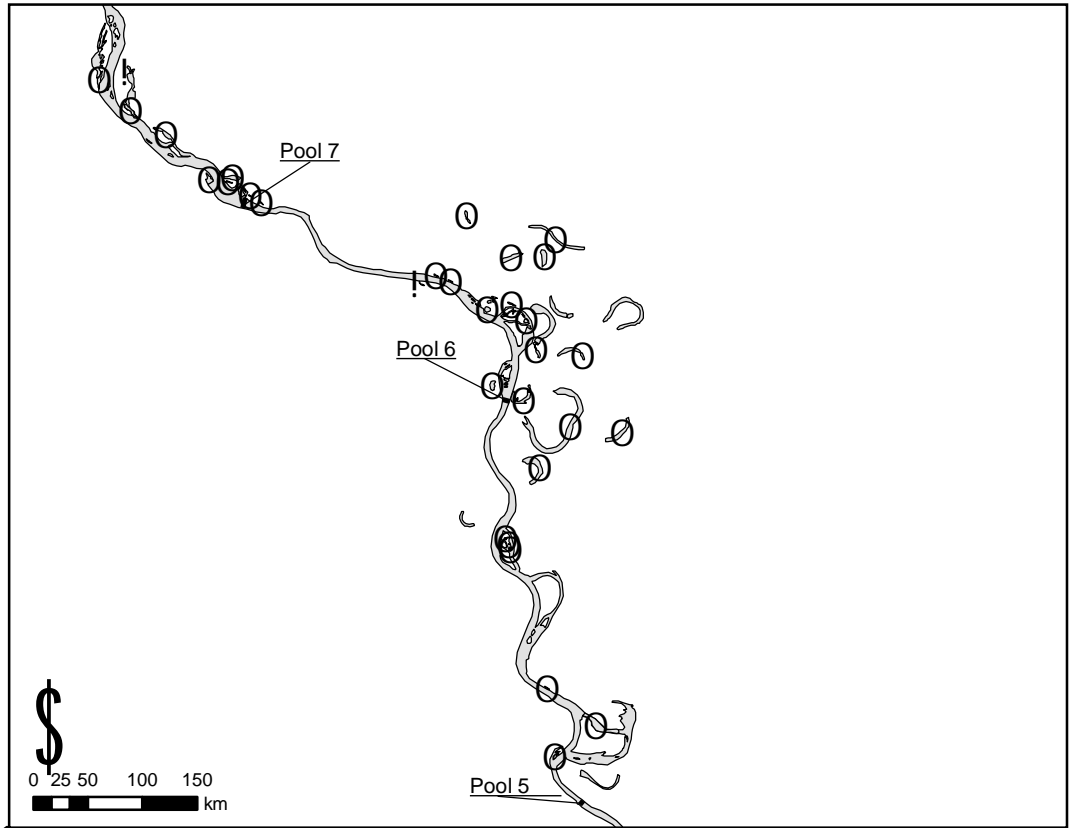
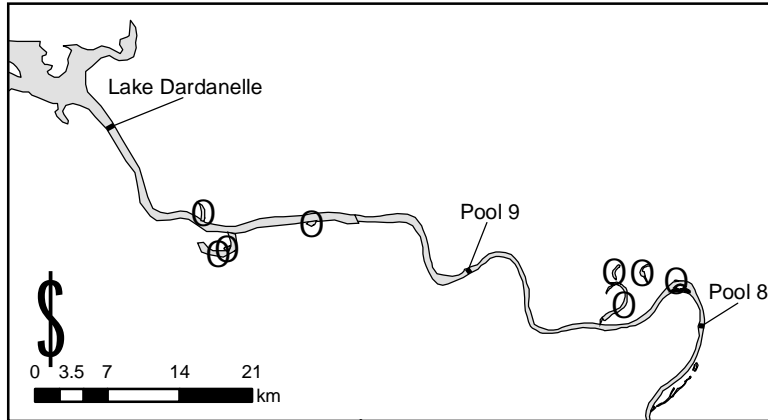


# Map 48. Green sunfish

*Lepomis cyanellus*

! Present

○ Absent

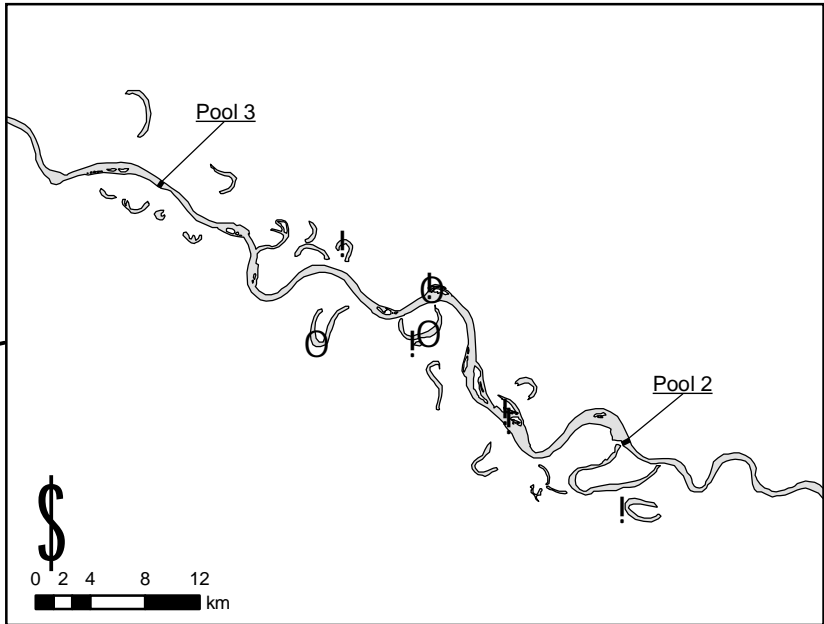
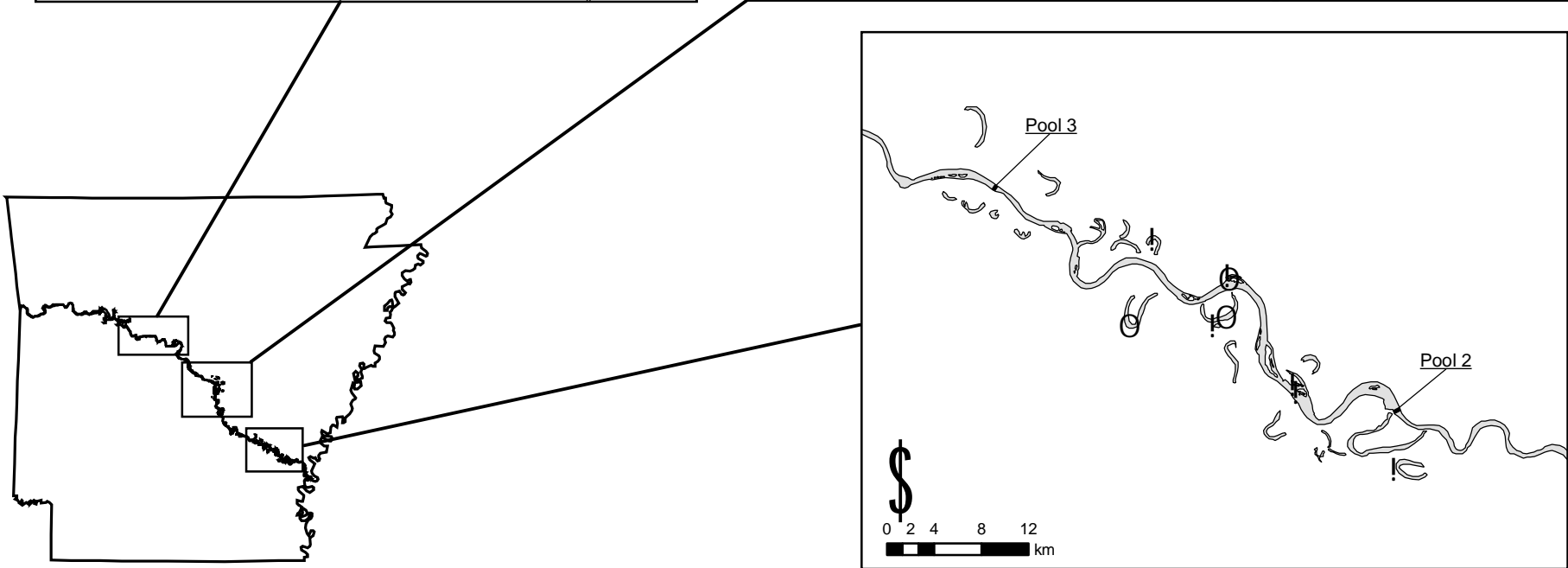
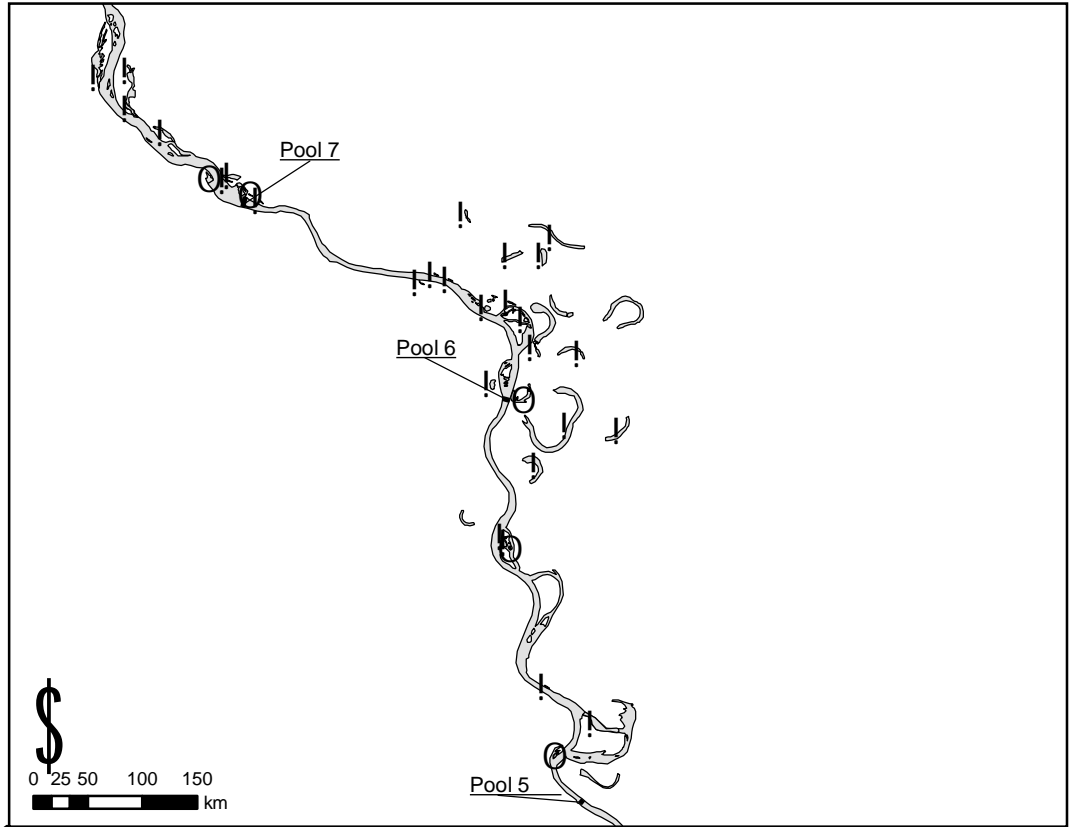
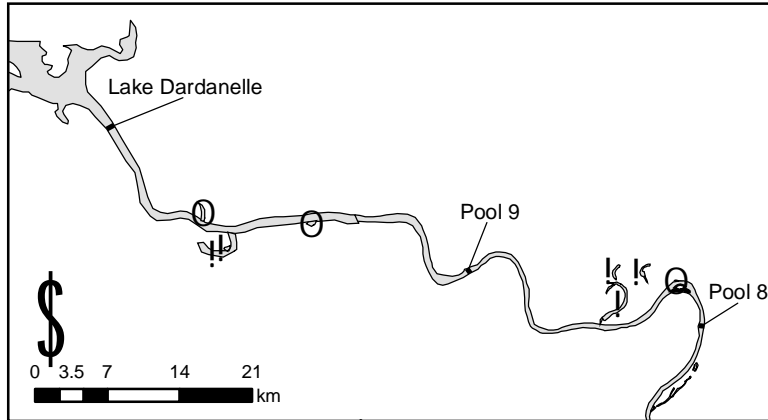


# Map 49. Warmouth

*Lepomis gulosus*

! Present

○ Absent

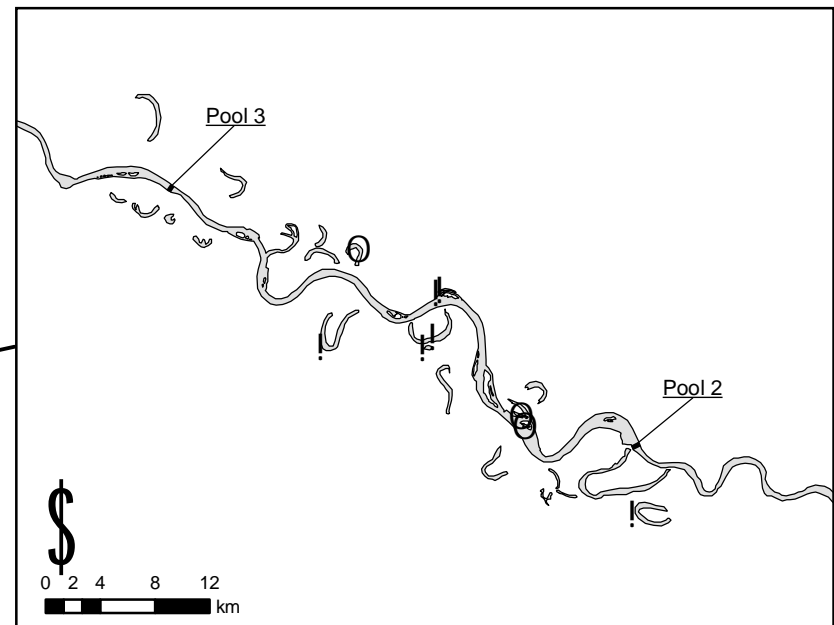
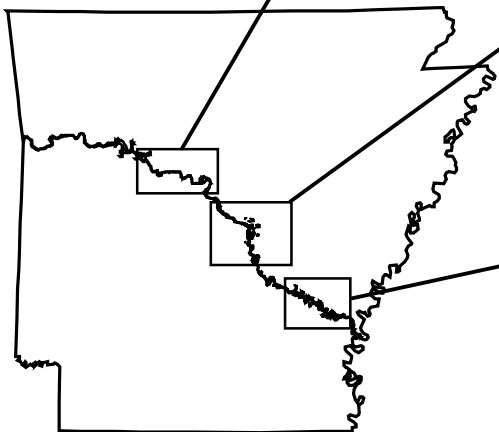
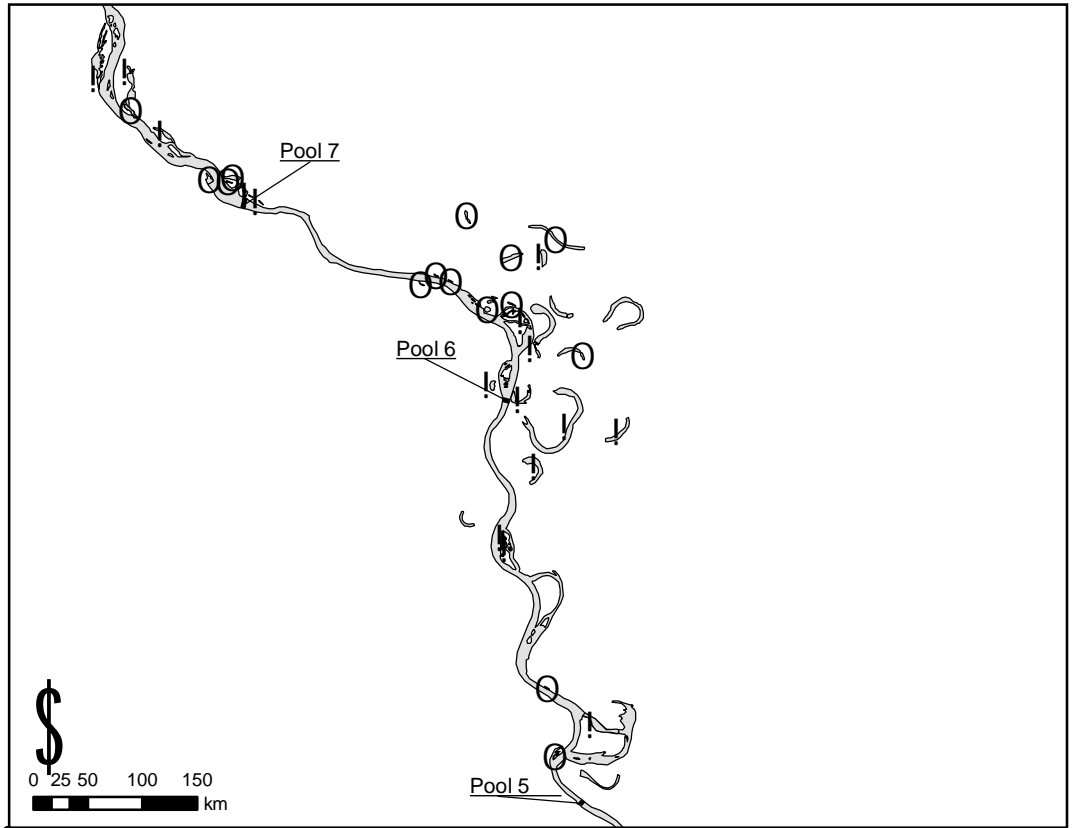
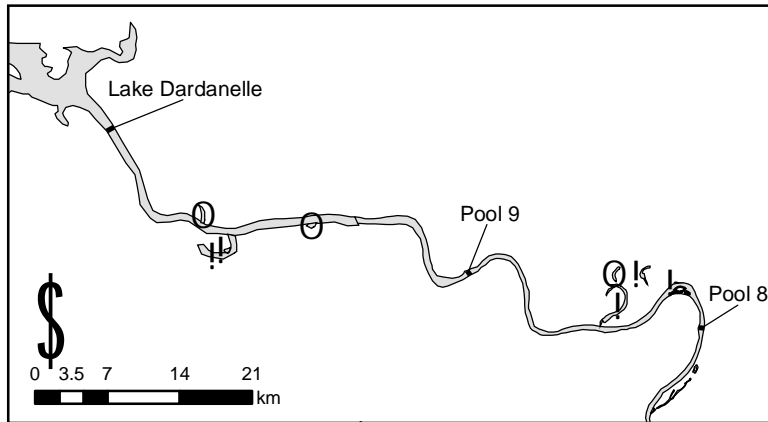


# Map 50. Orangespotted sunfish

*Lepomis humilis*

! Present

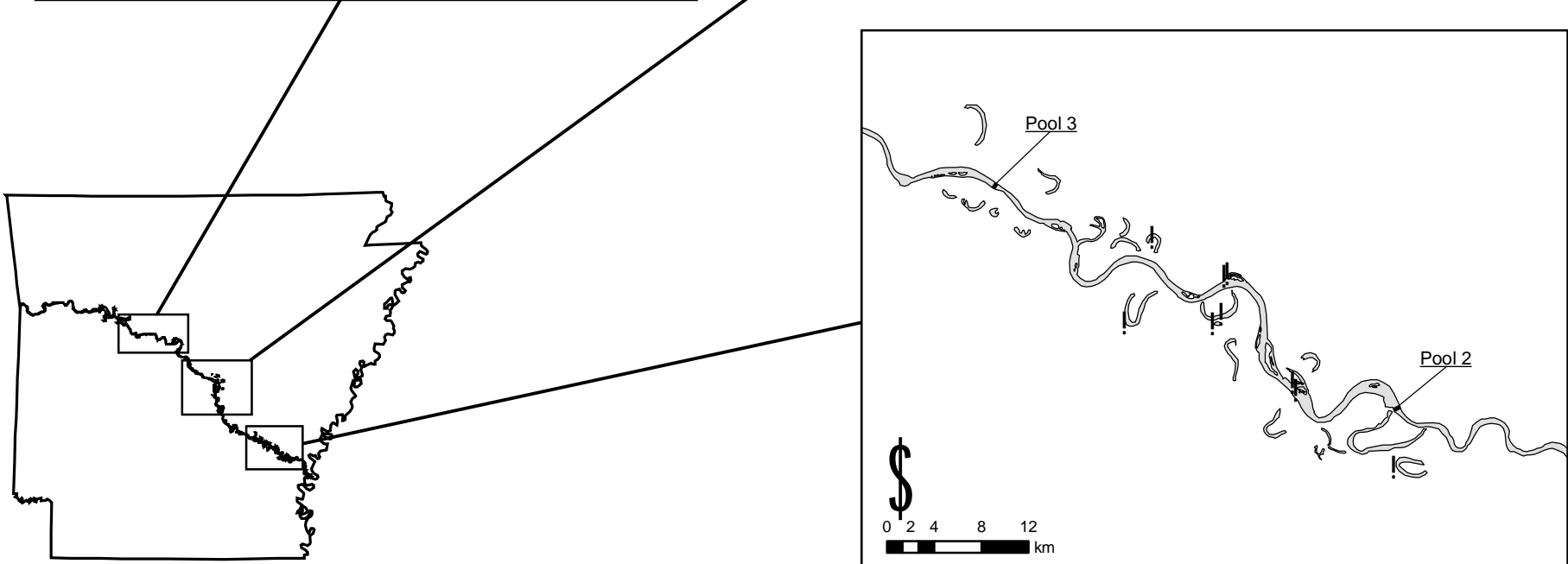
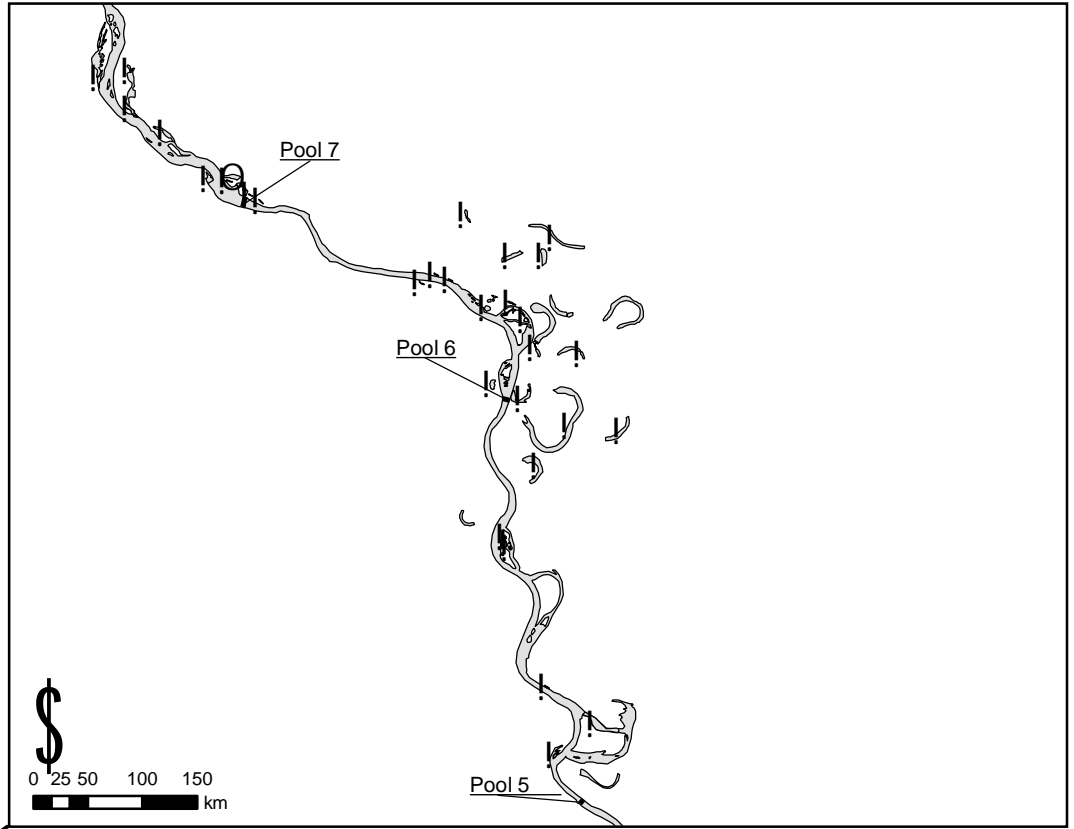
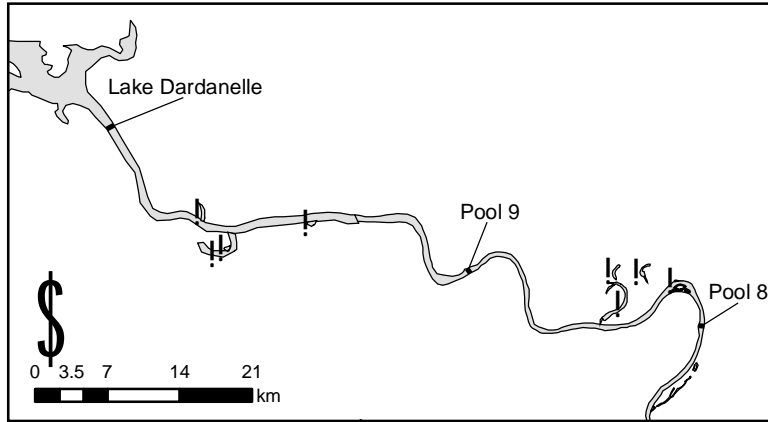
○ Absent



# Map 51. Bluegill

*Lepomis macrochirus*

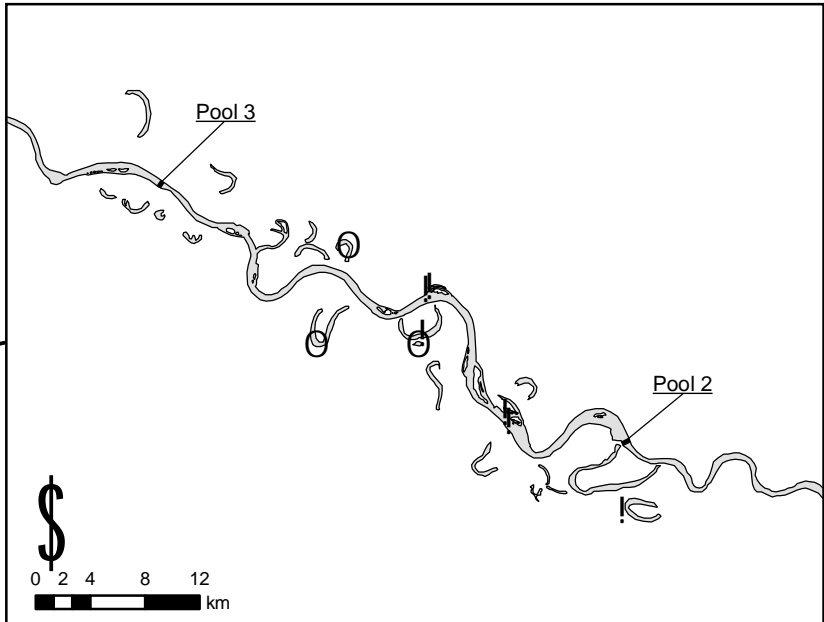
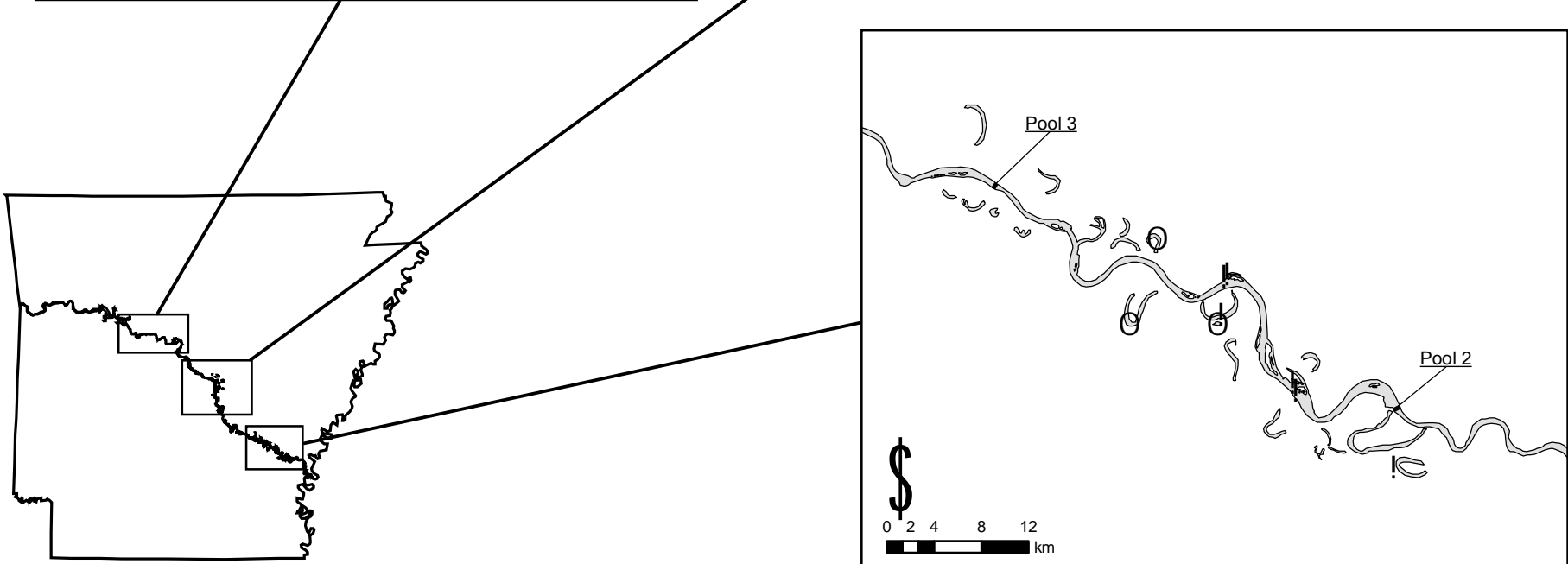
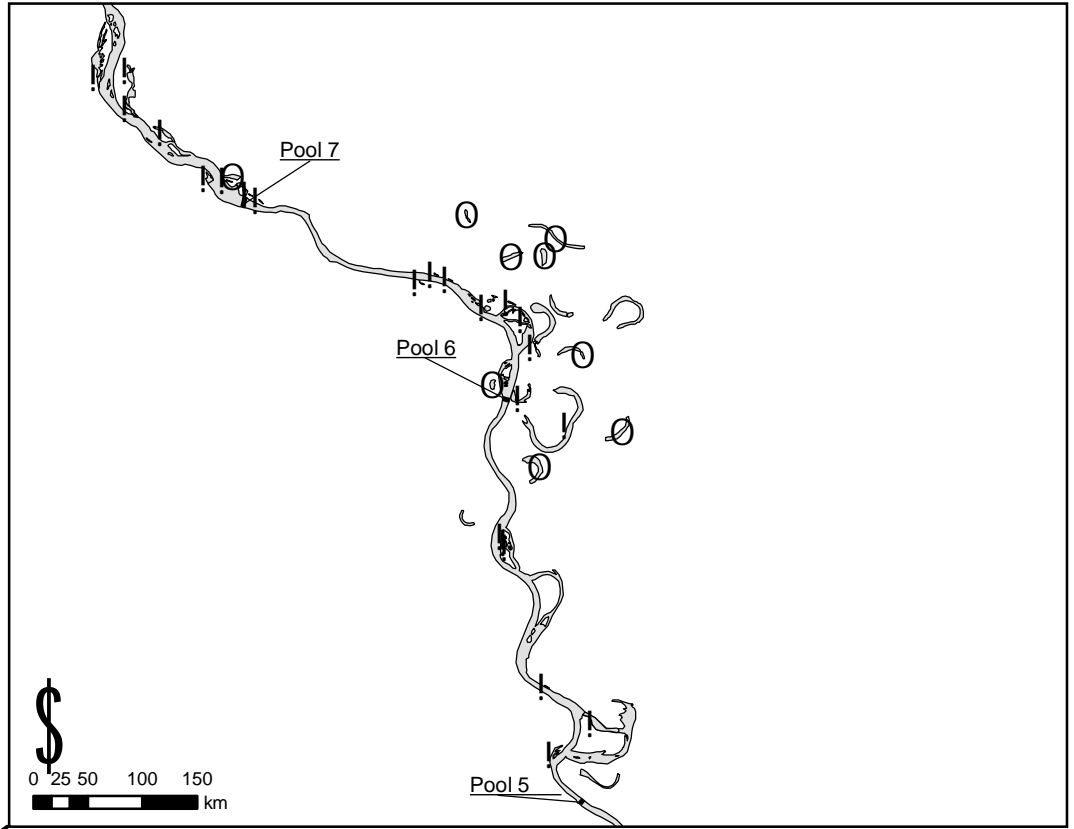
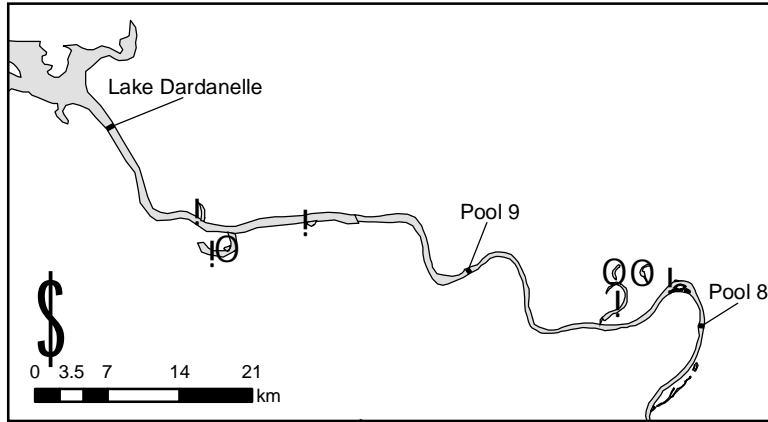
- ! Present
- Absent



# Map 52. Longear sunfish

*Lepomis megalotis*

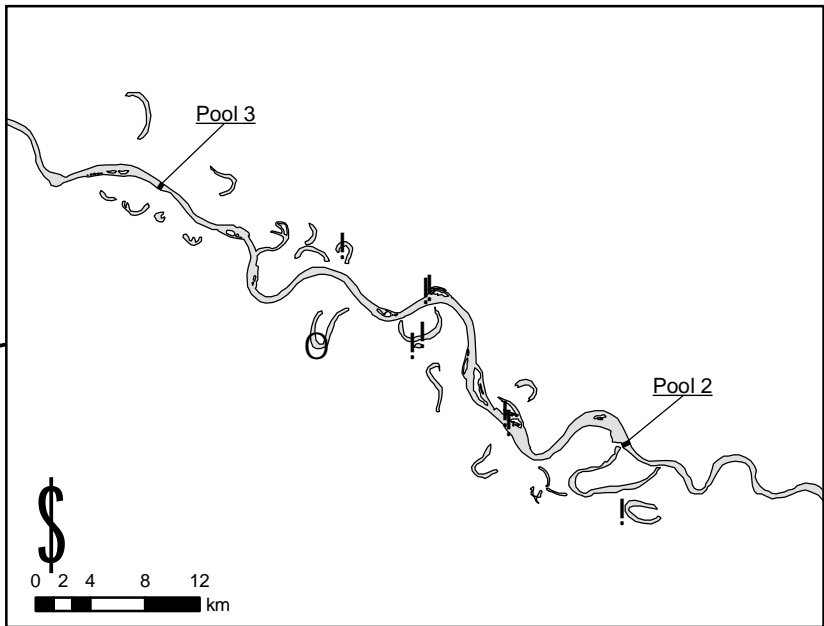
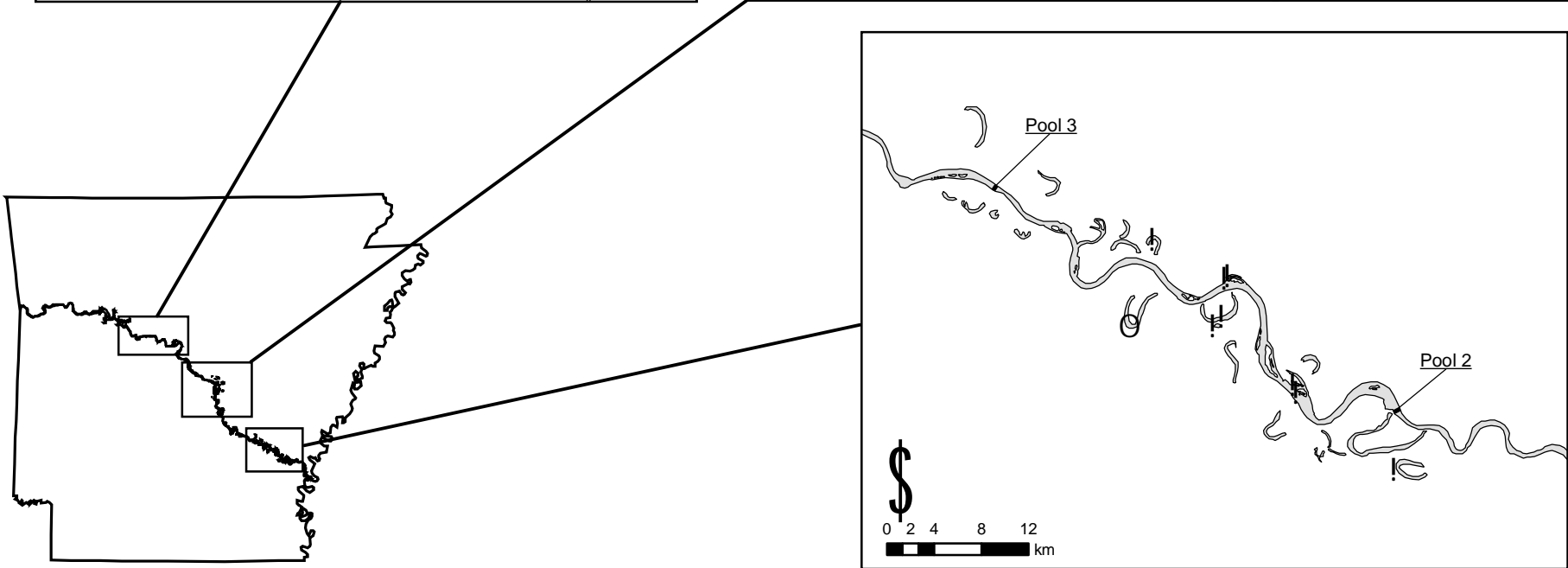
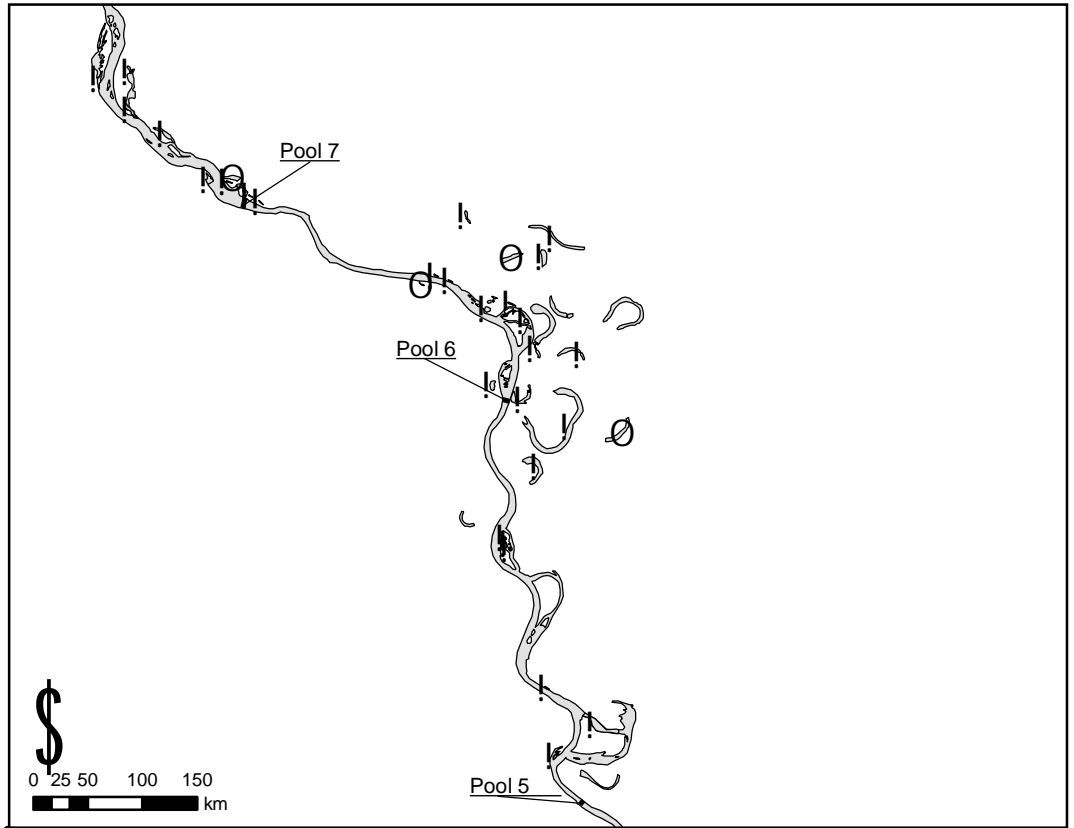
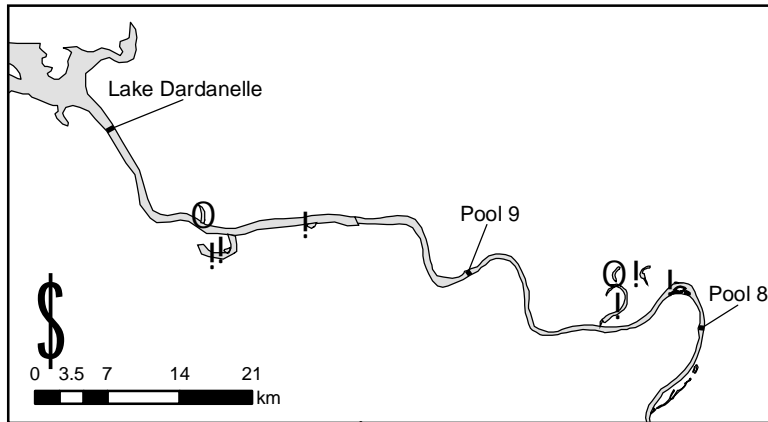
- ! Present
- Absent



# Map 53. Redear sunfish

*Lepomis microlophus*

- ! Present
- Absent

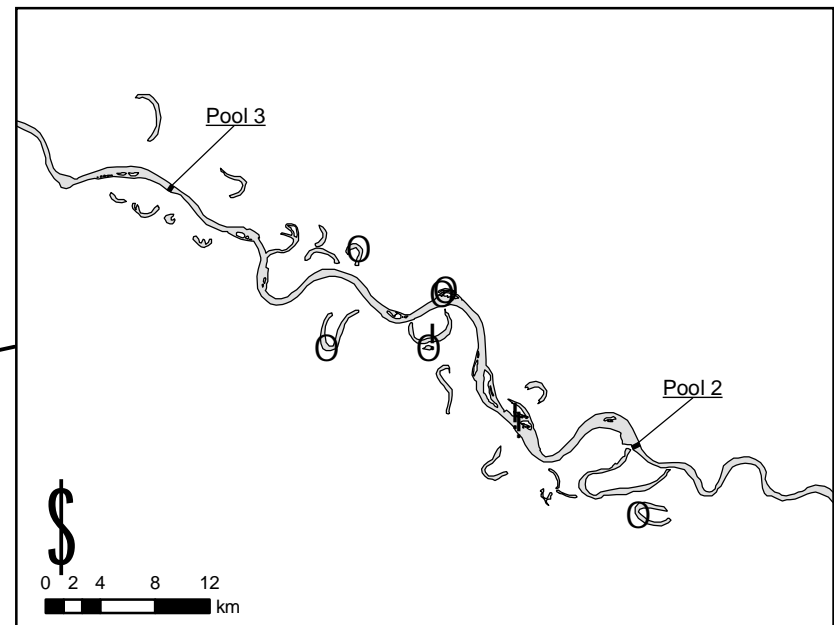
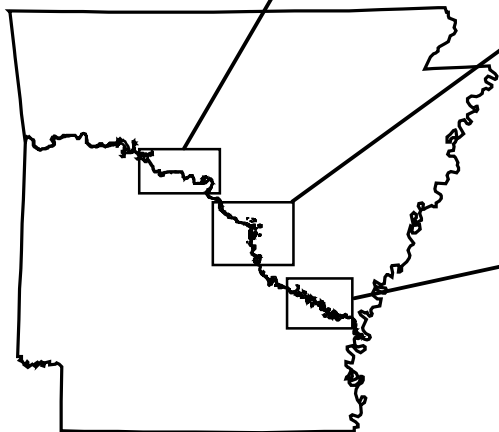
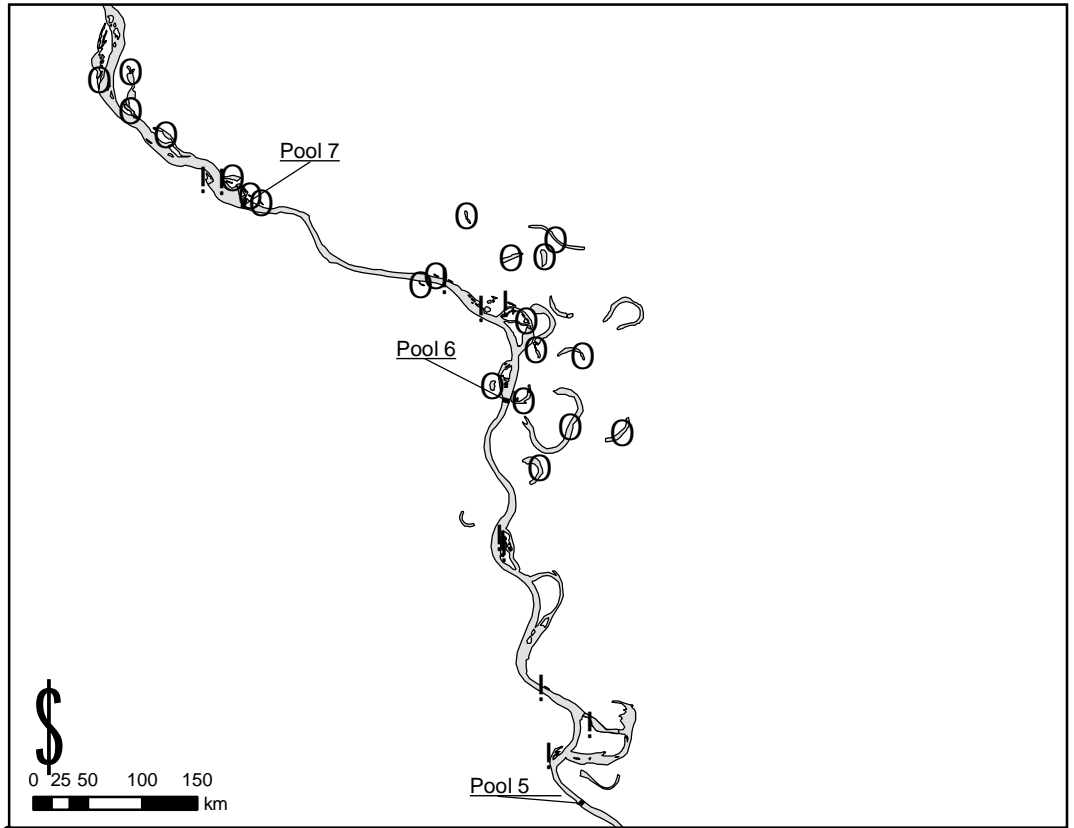
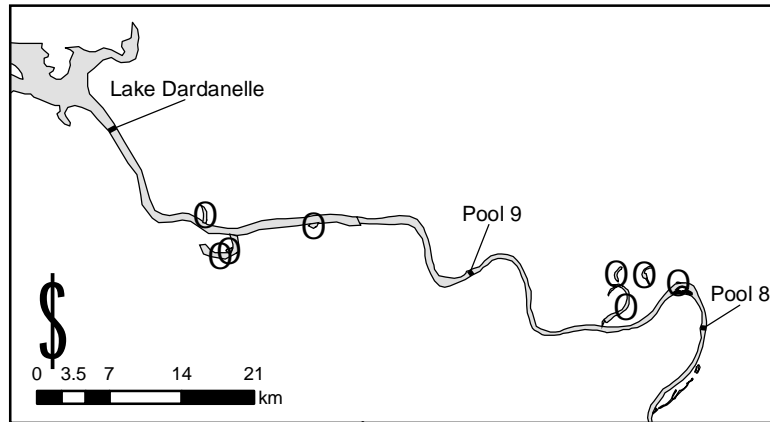


# Map 54. Redspotted sunfish

*Lepomis miniatus*

! Present

○ Absent



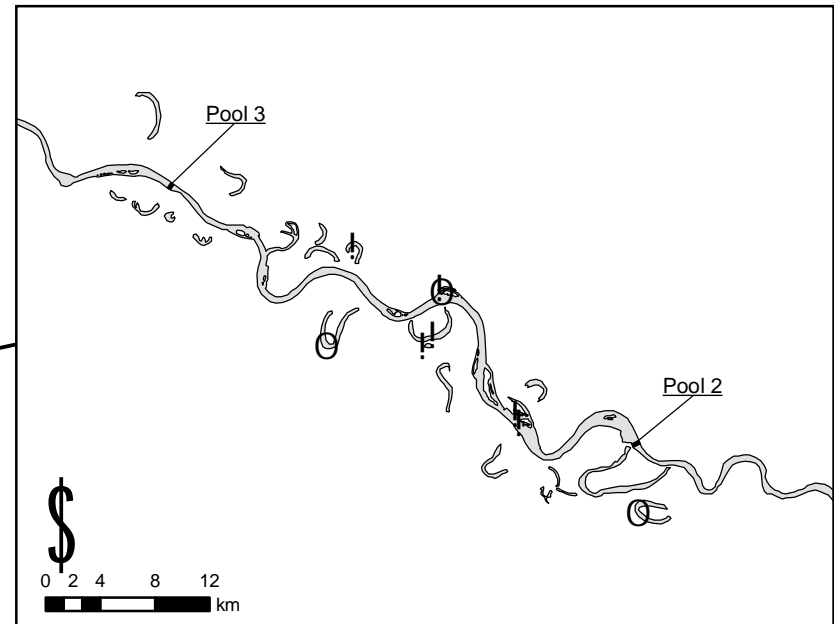
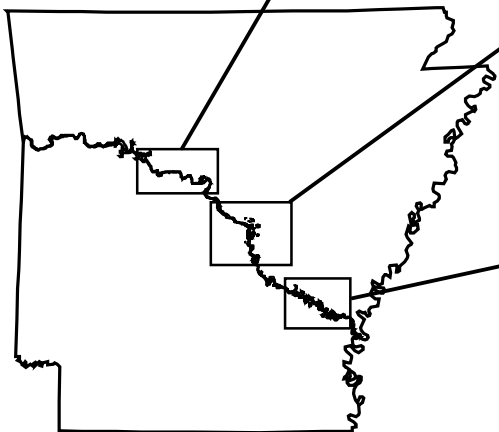
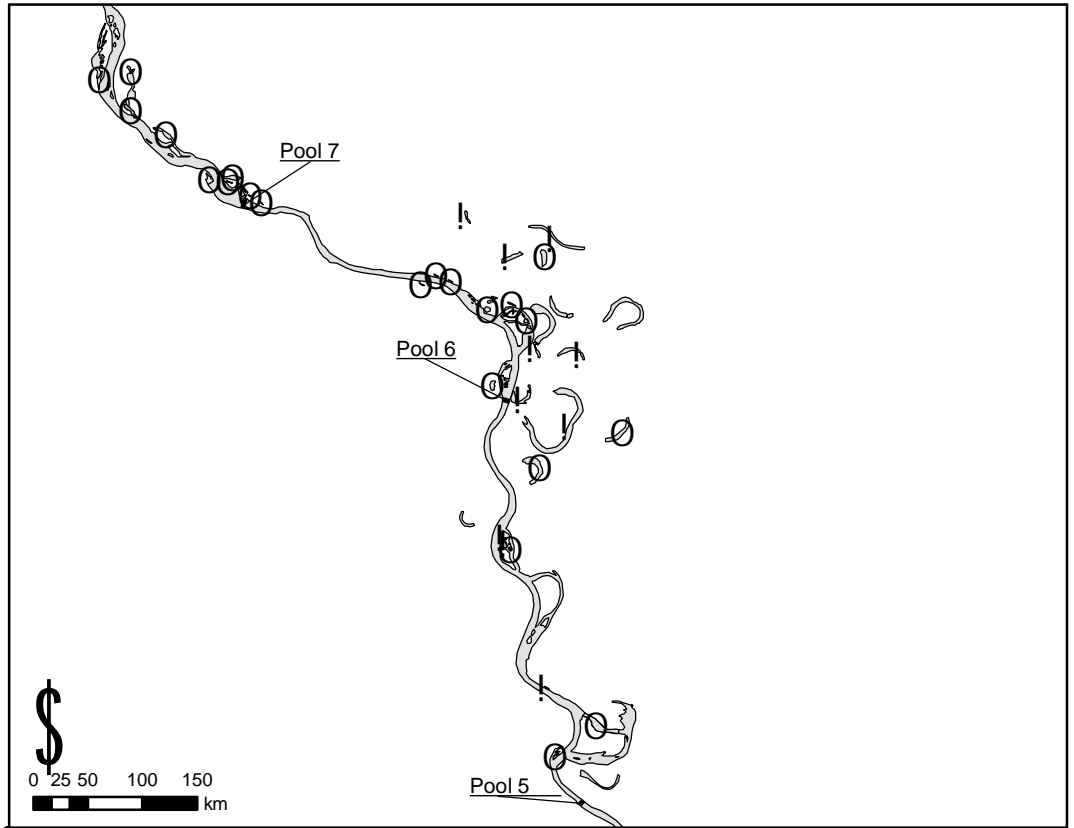
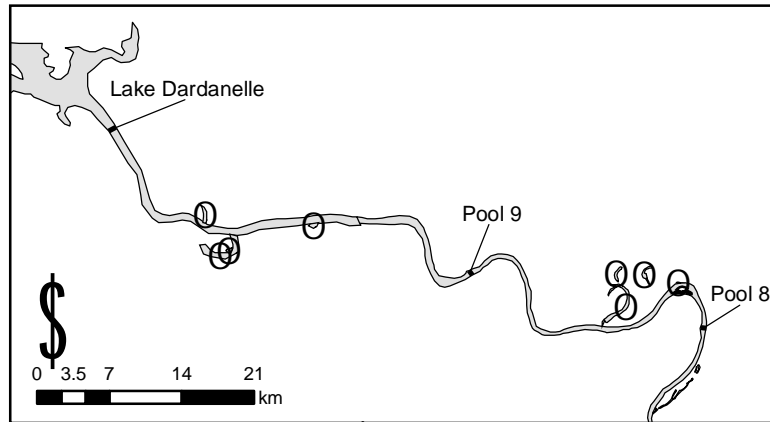


# Map 55. Bantam sunfish

*Lepomis symmetricus*

! Present

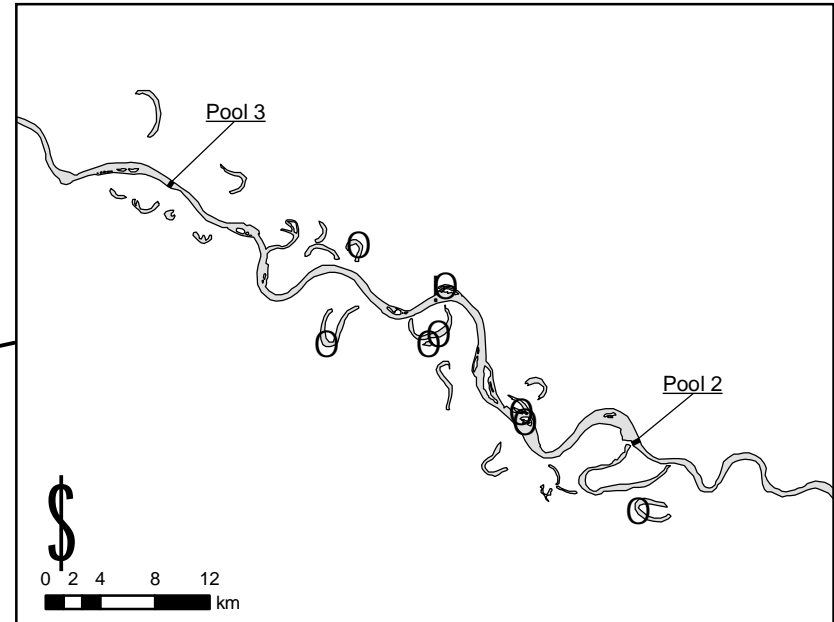
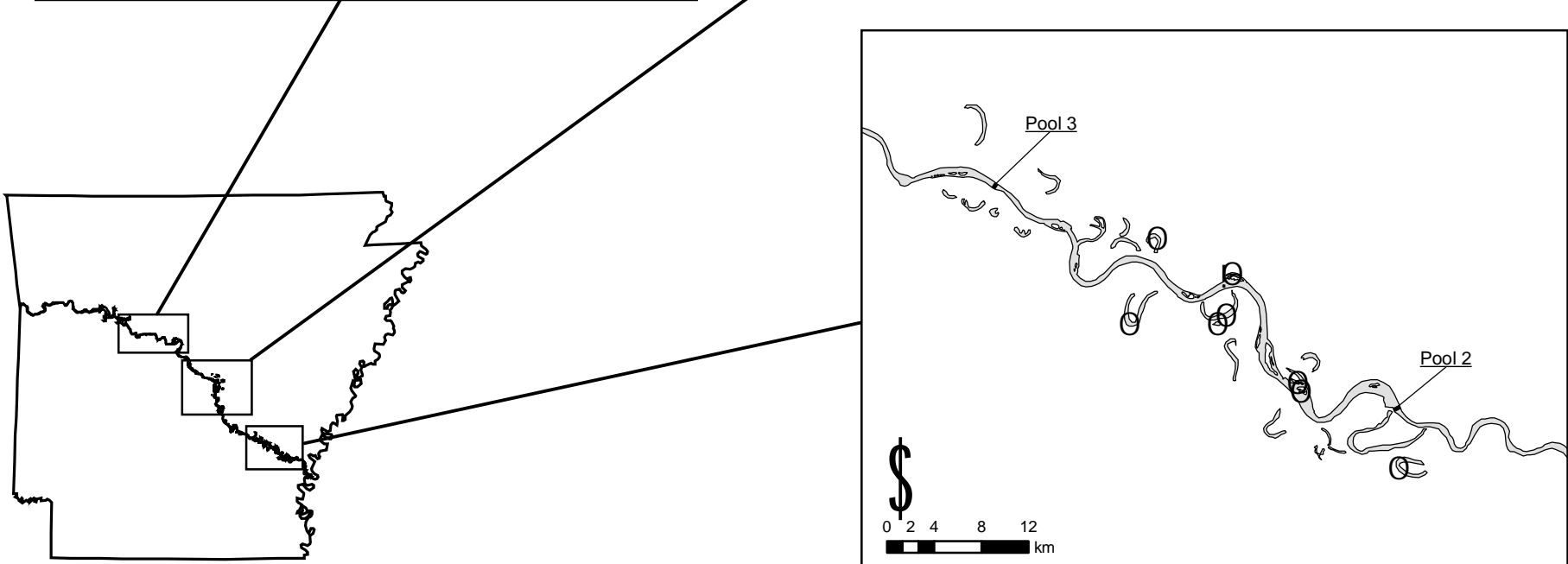
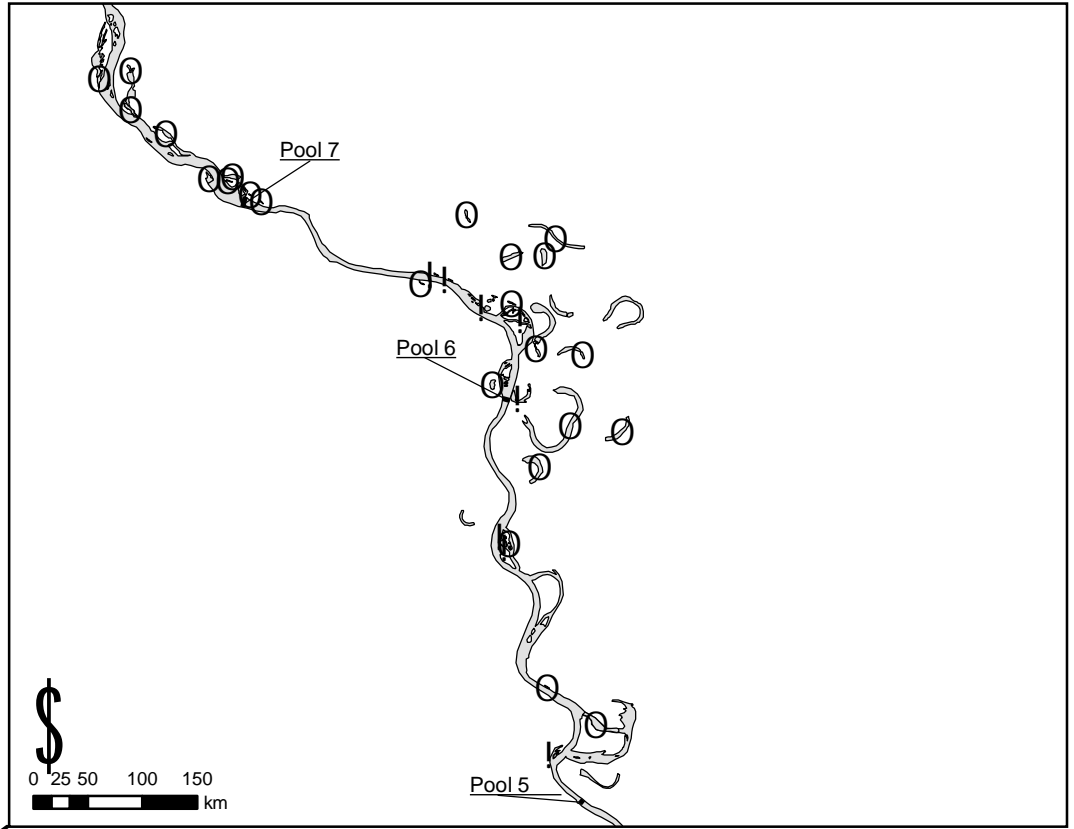
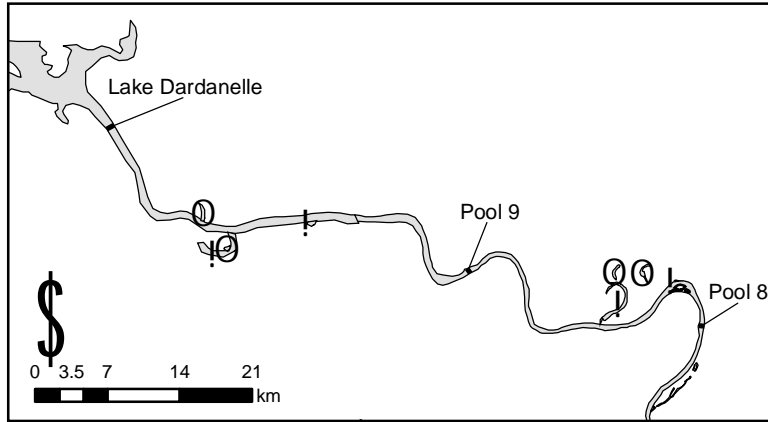
○ Absent



# Map 56. Spotted bass

*Micropterus punctulatus*

- ! Present
- Absent

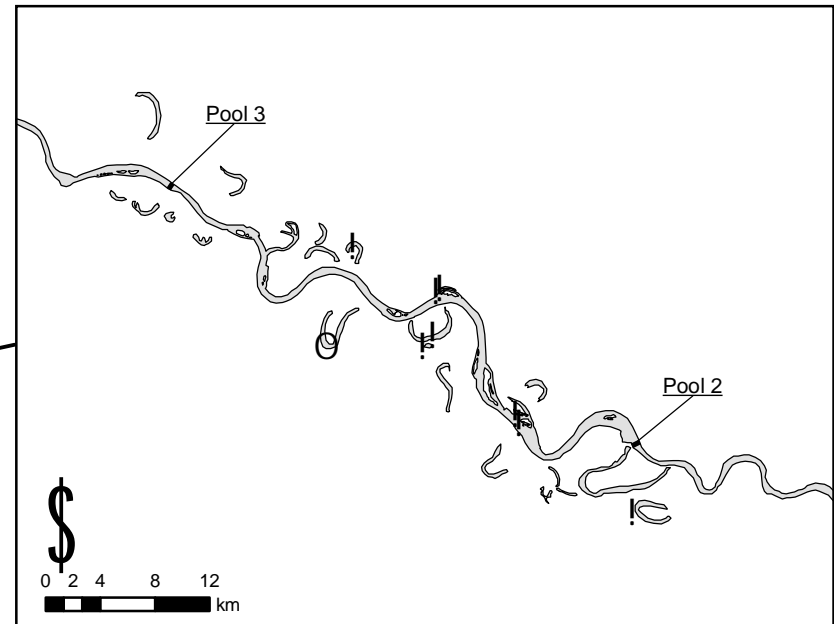
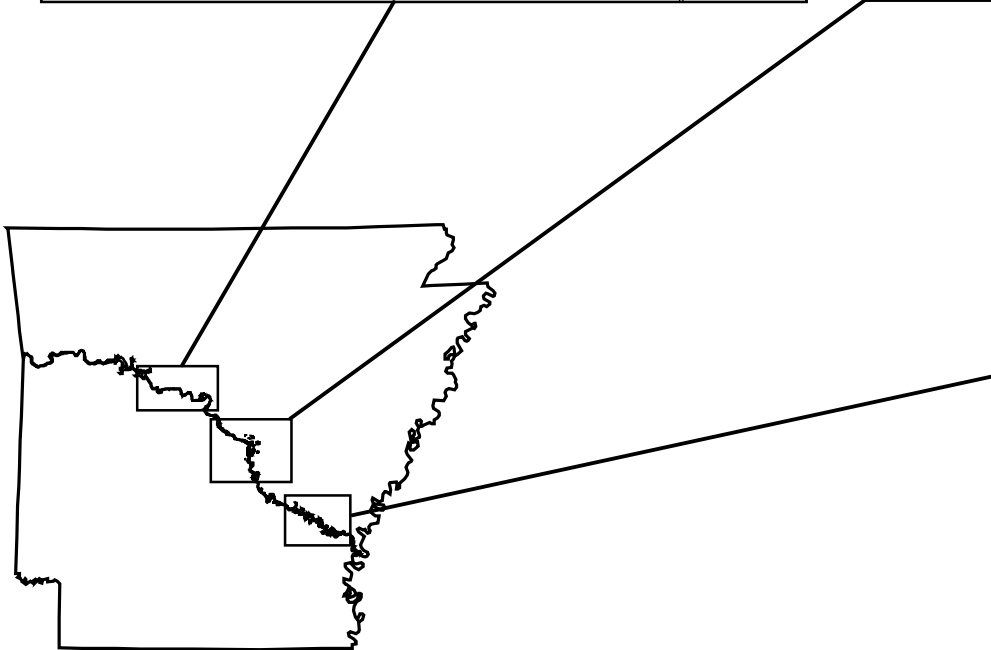
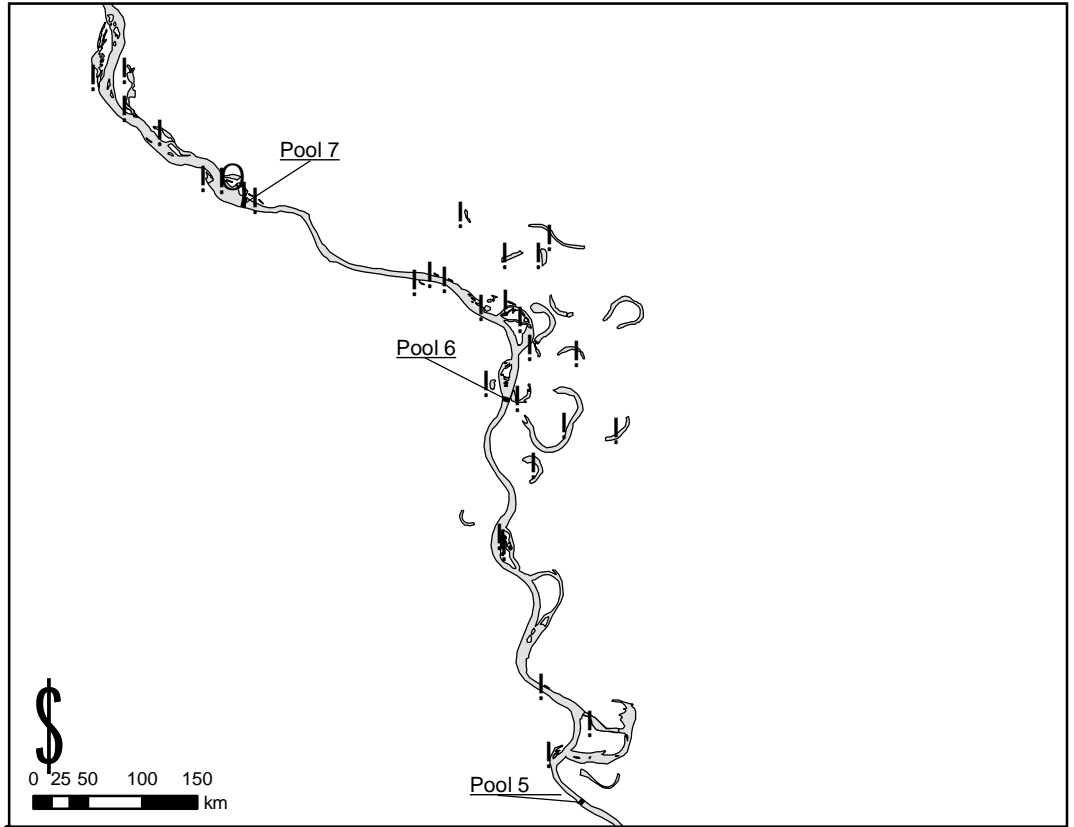
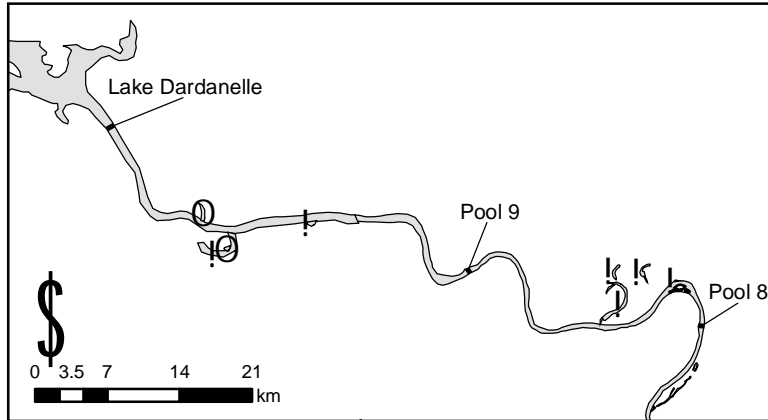


# Map 57. Largemouth bass

*Micropterus salmoides*

! Present

○ Absent

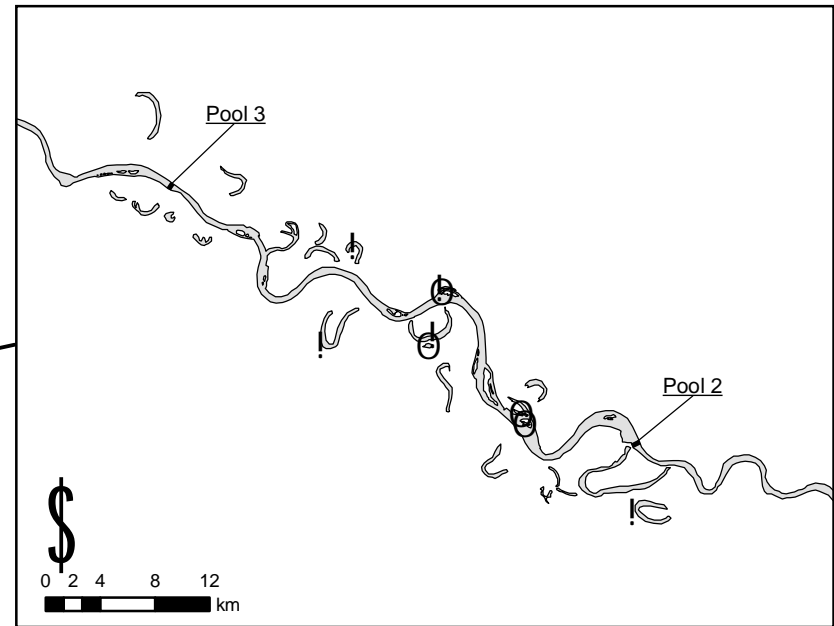
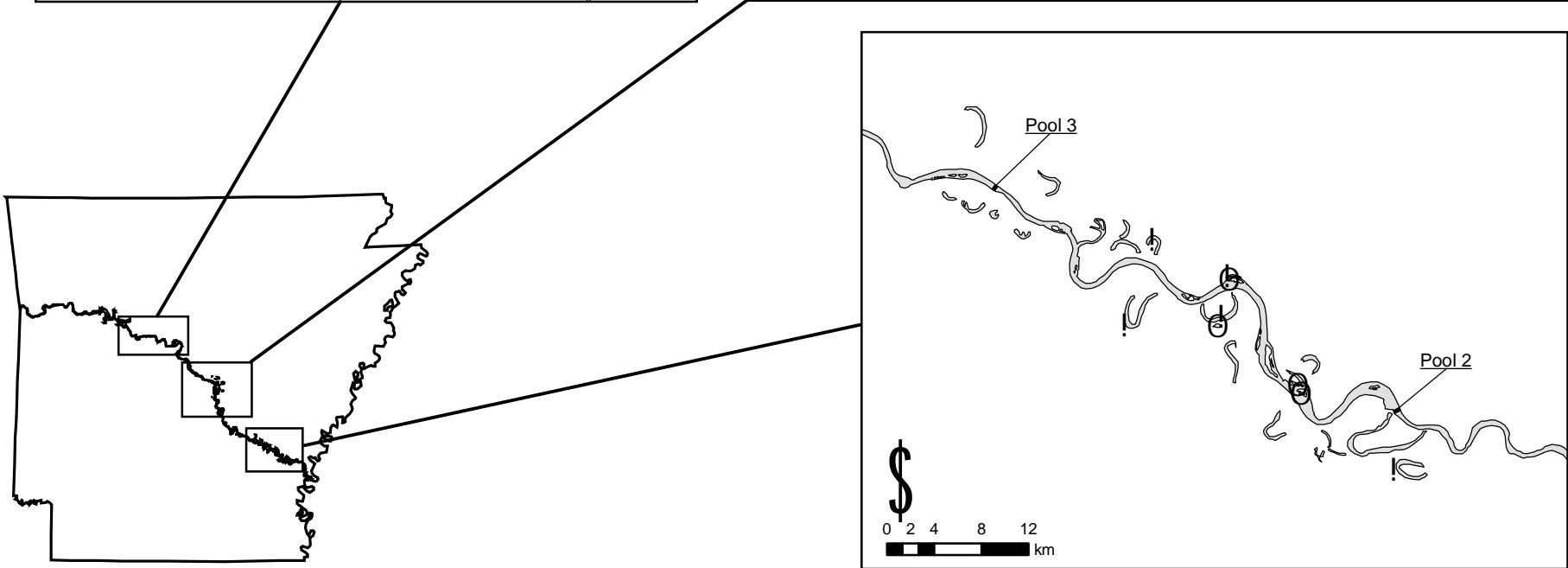
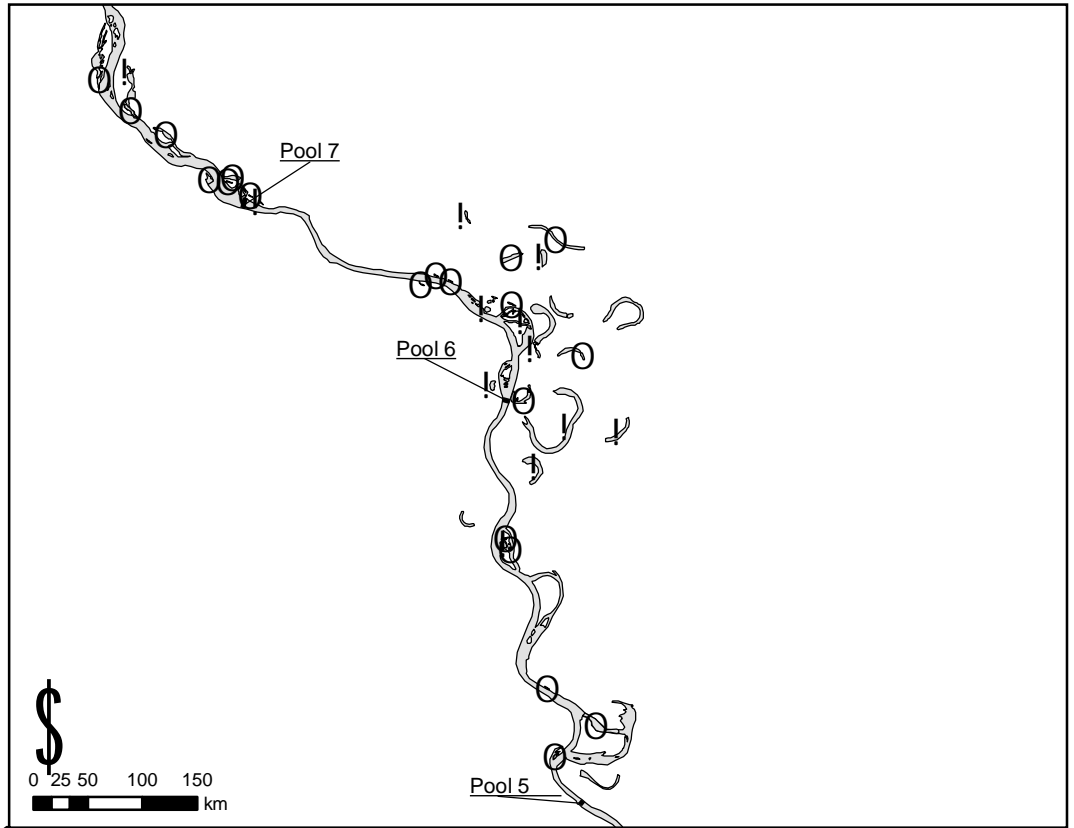
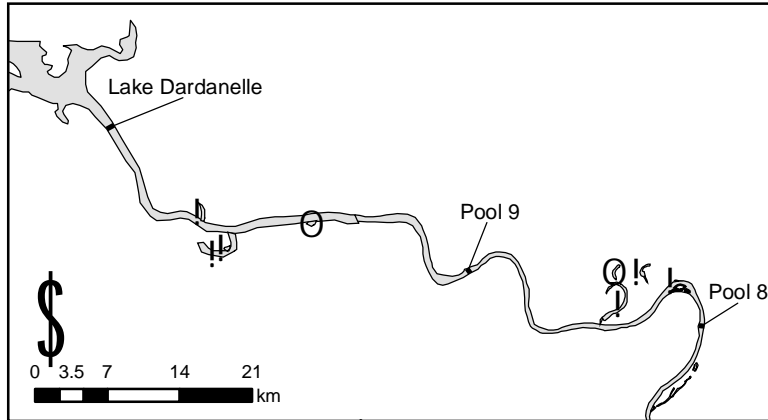


# Map 58. White crappie

*Pomoxis annularis*

! Present

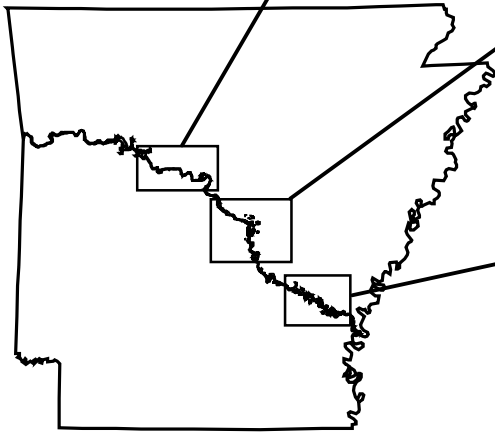
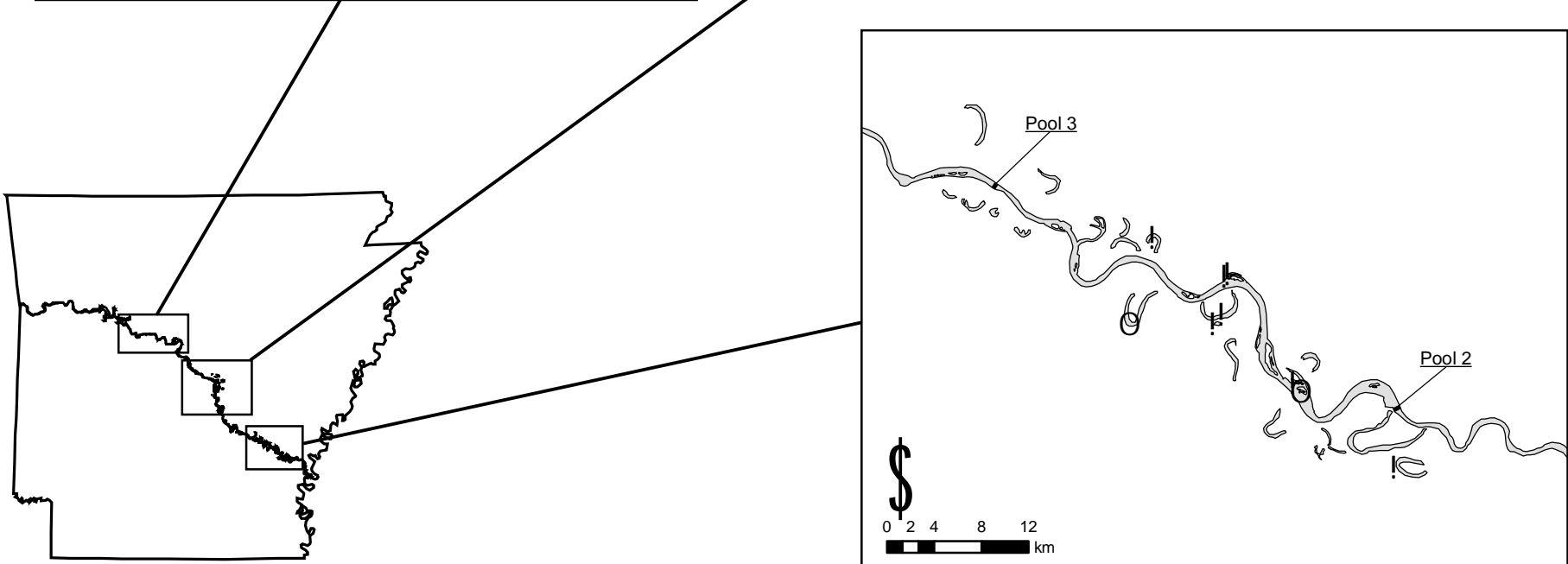
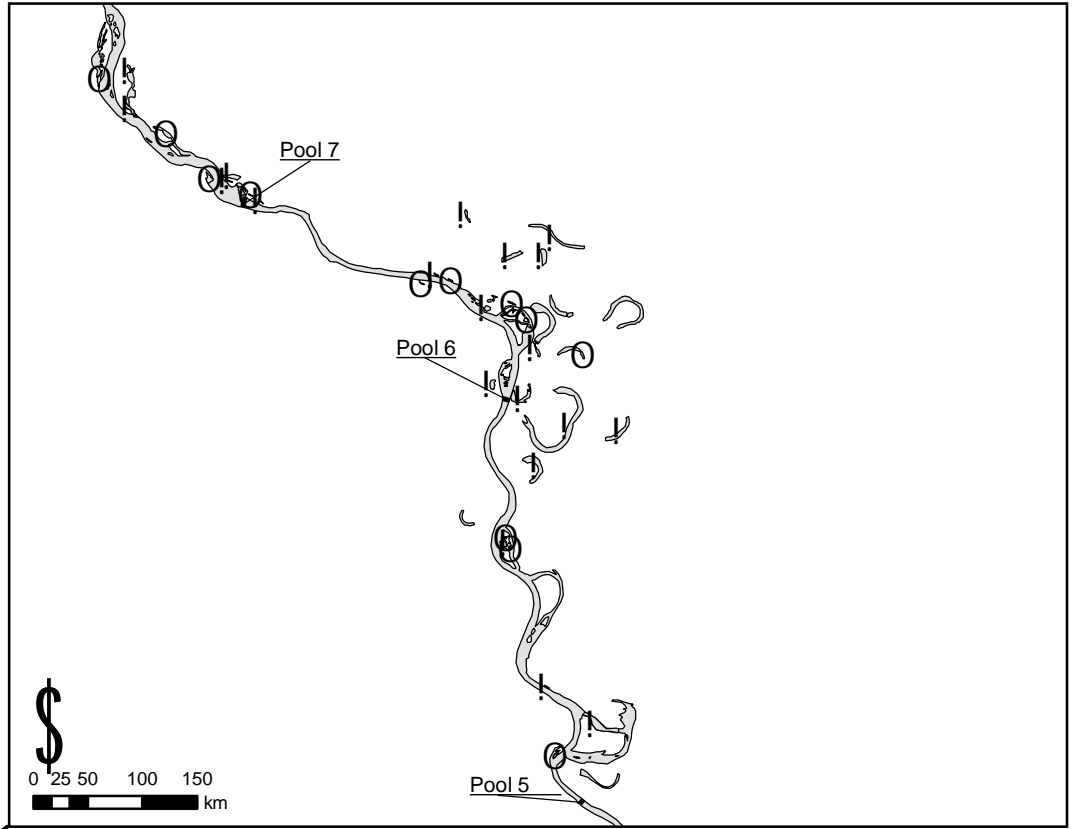
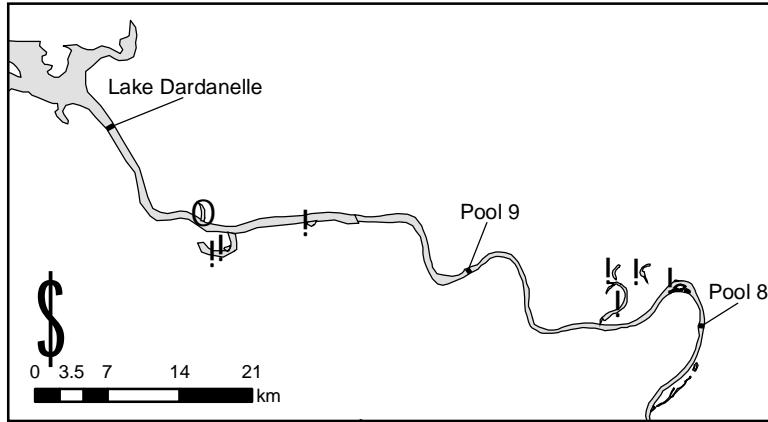
○ Absent



# Map 59. Black crappie

*Pomoxis nigromaculatus*

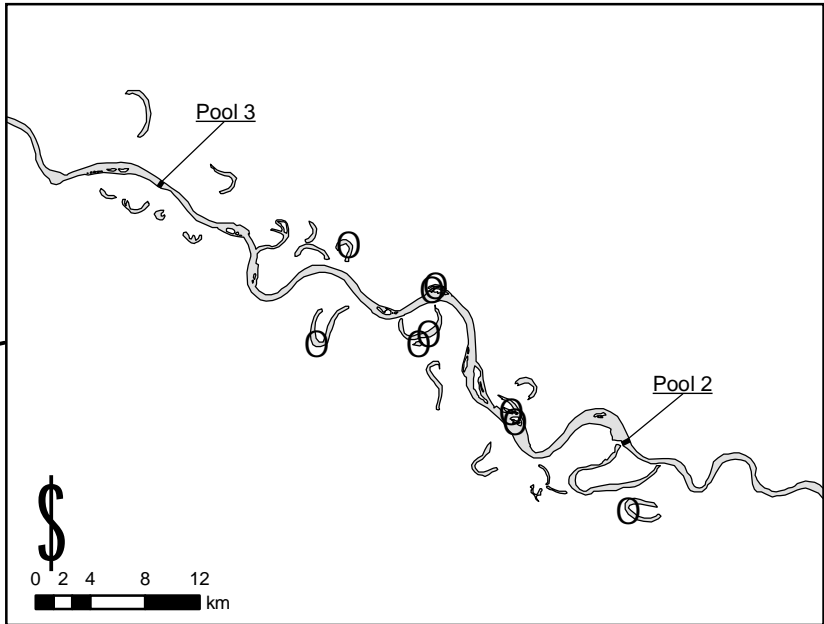
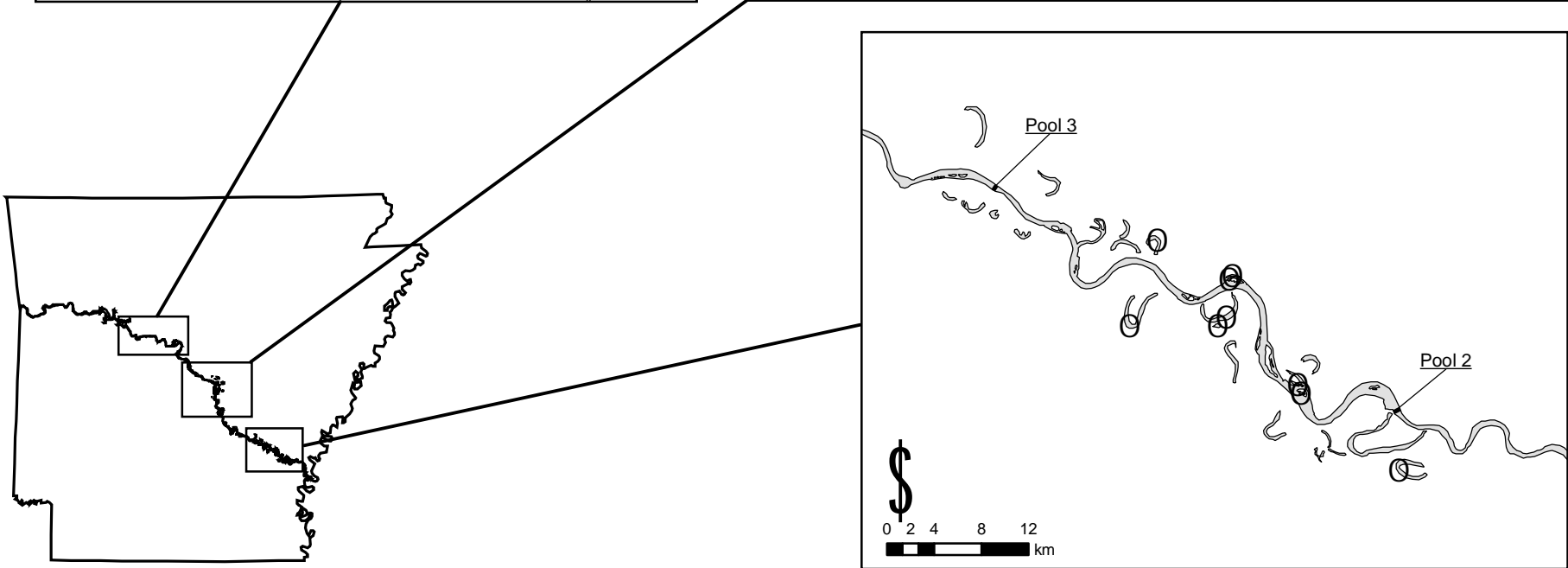
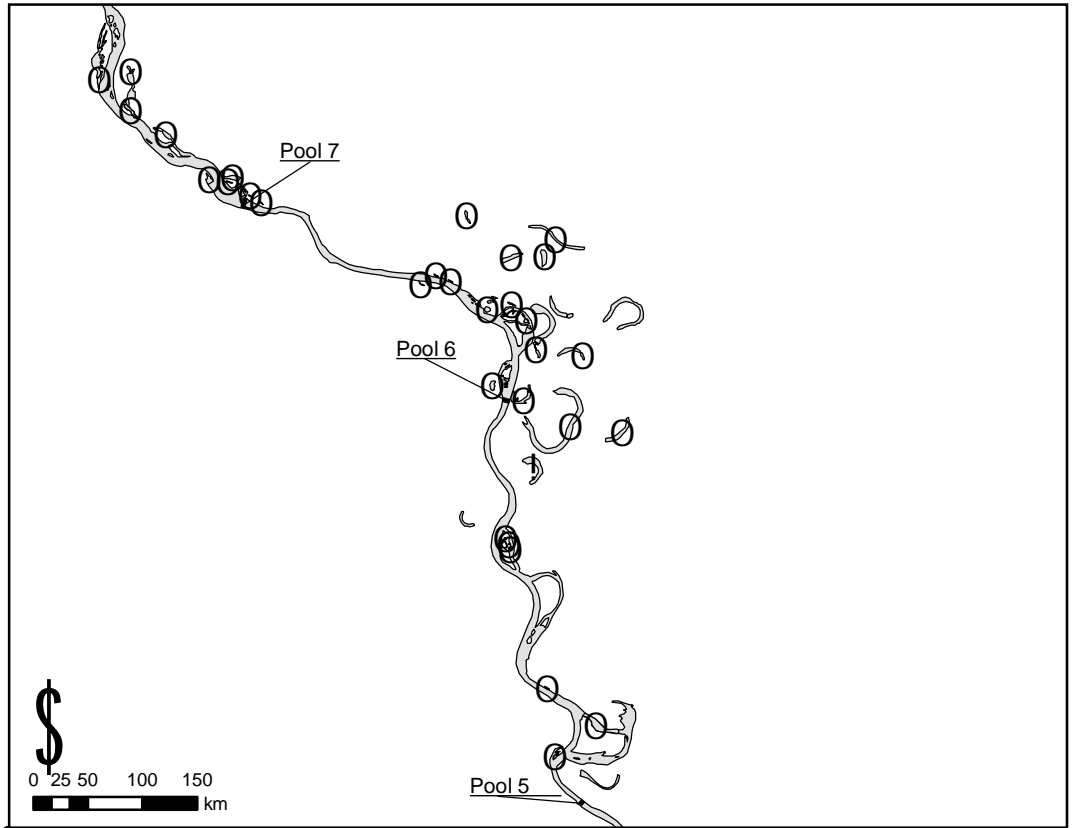
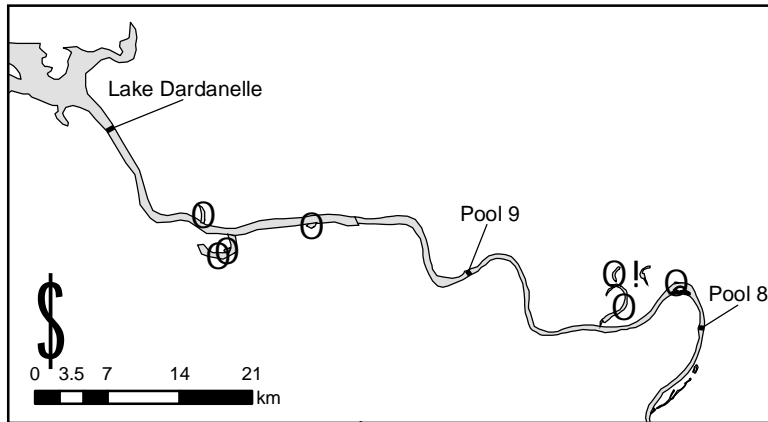
- ! Present
- Absent



# Map 60. Mud darter *Etheostoma asprigene*

! Present

○ Absent

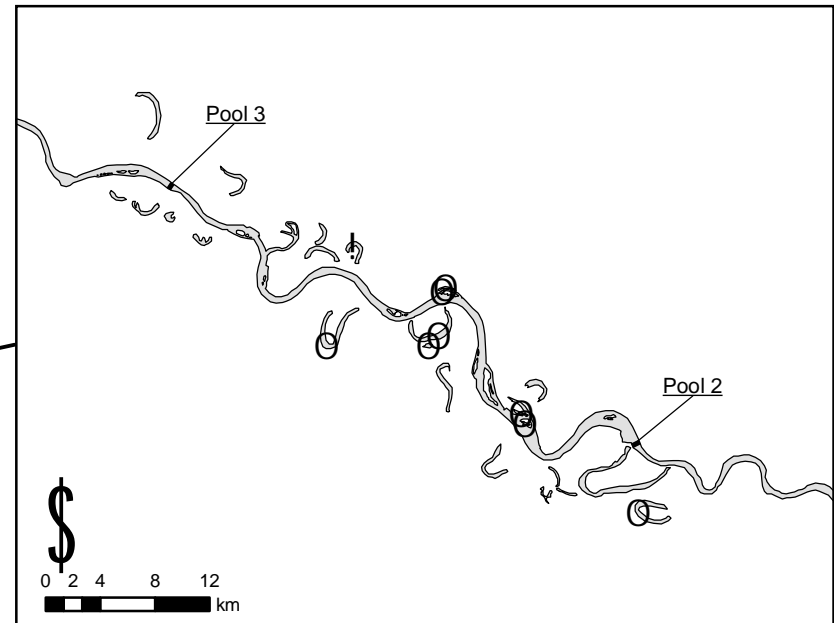
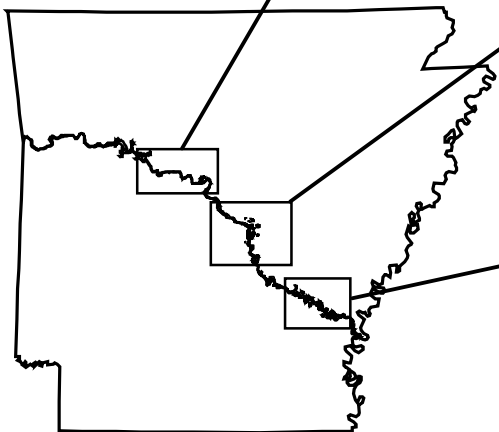
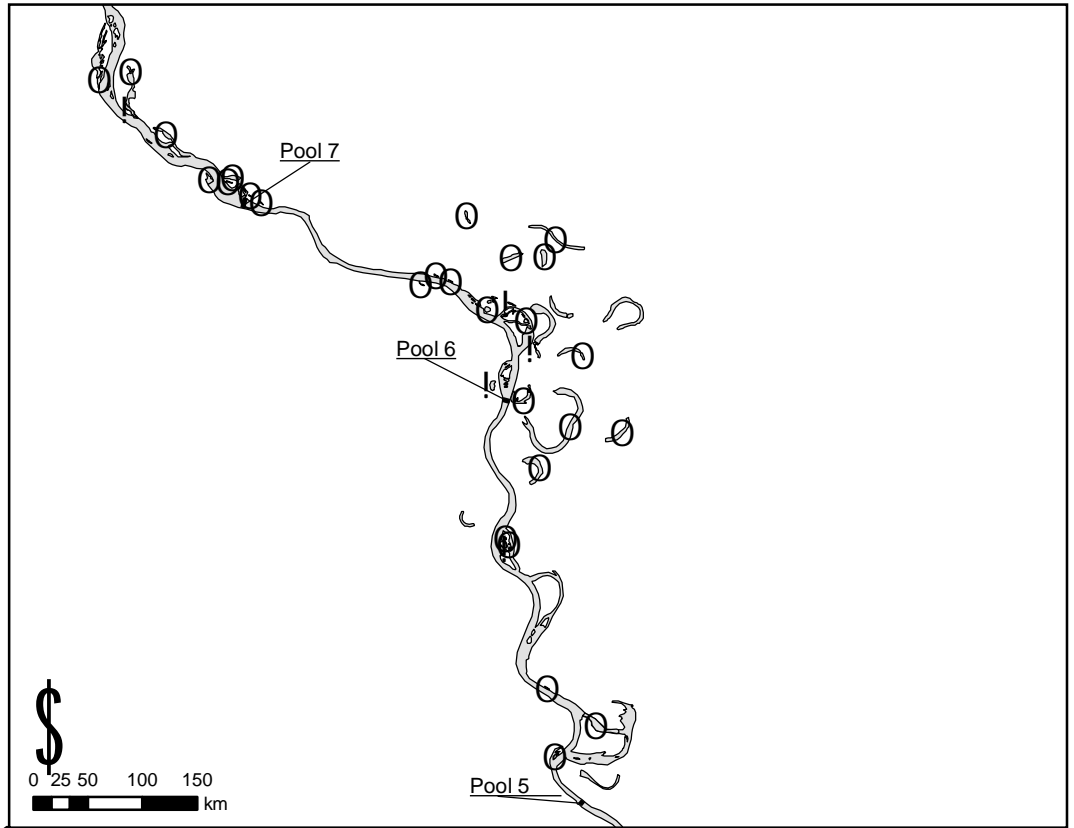
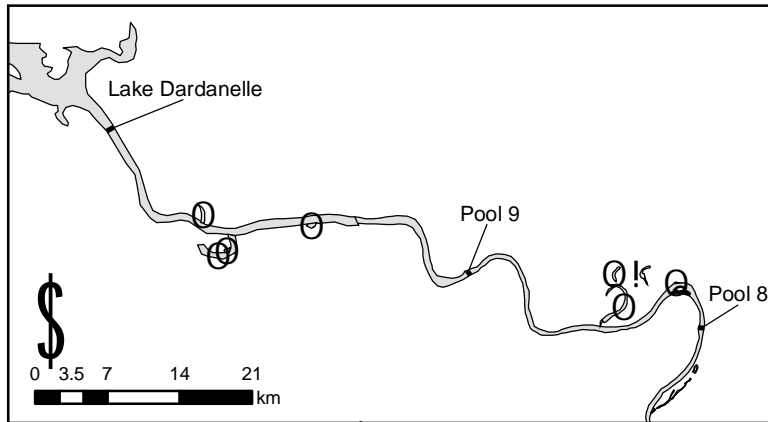


# Map 61. Bluntnose darter

*Etheostoma chlorosoma*

! Present

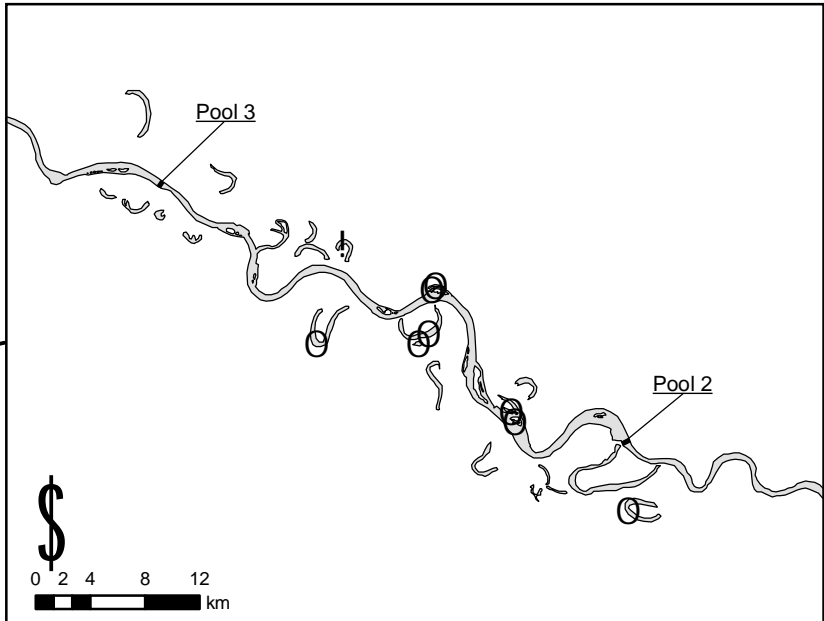
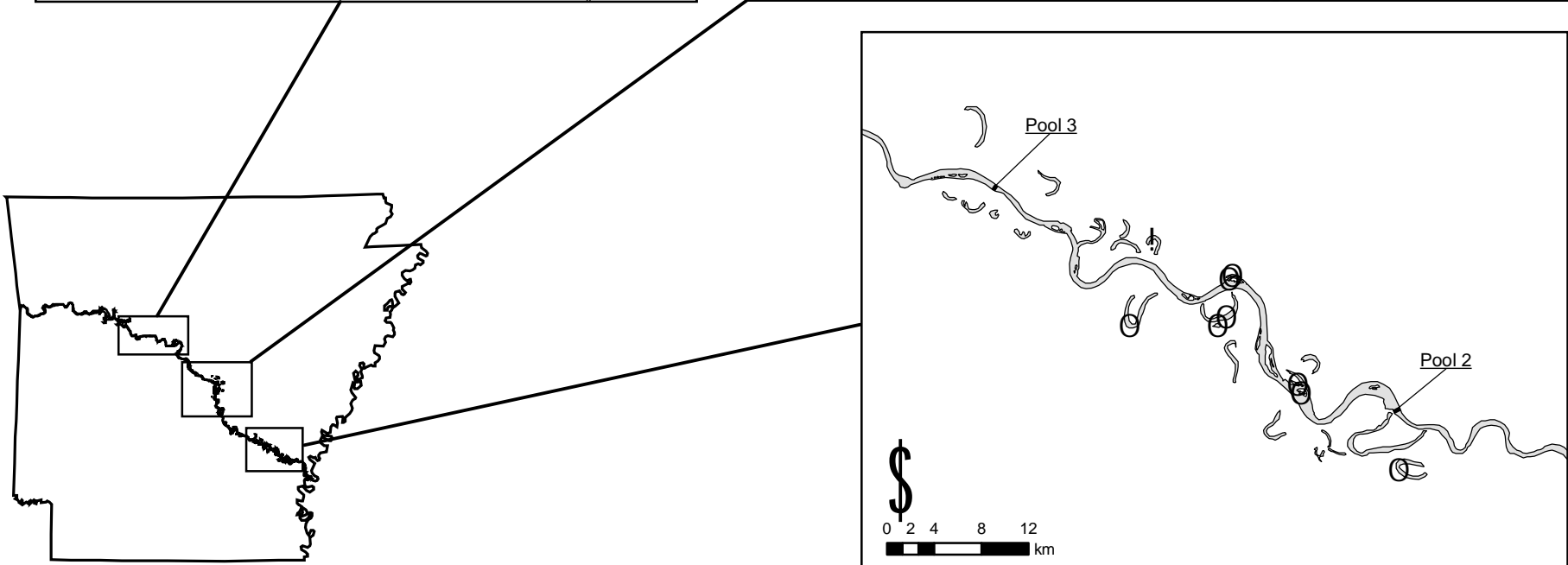
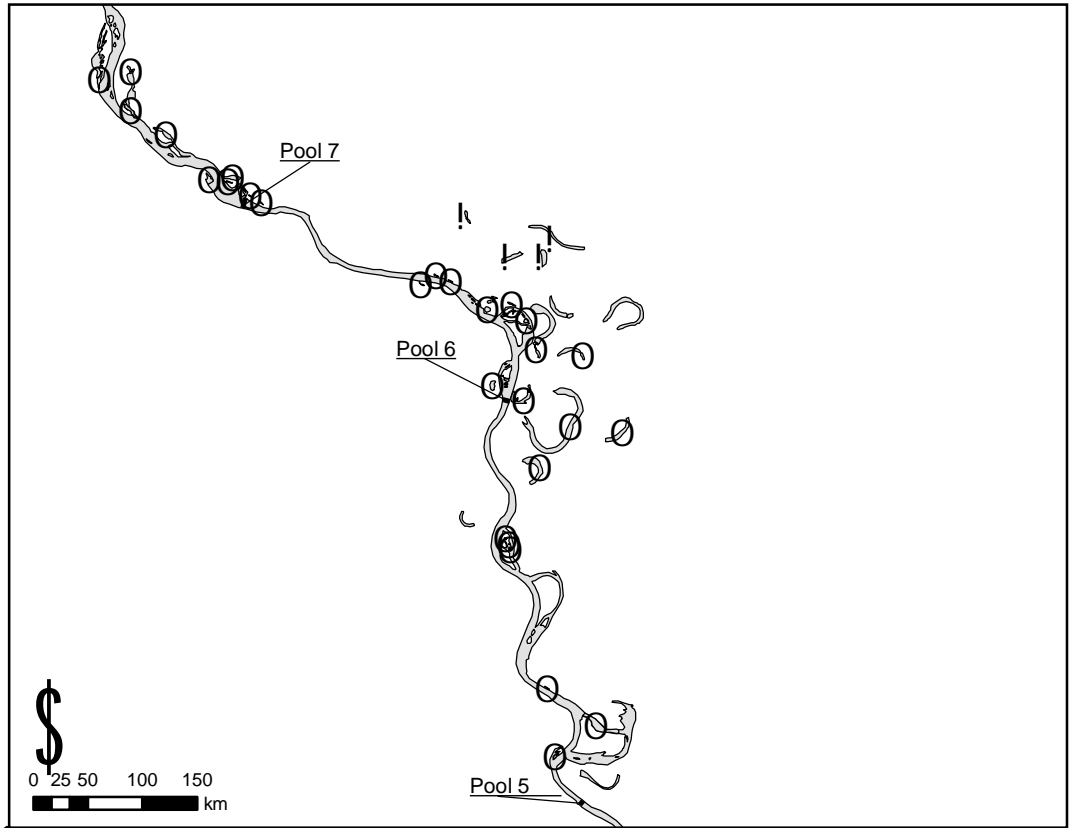
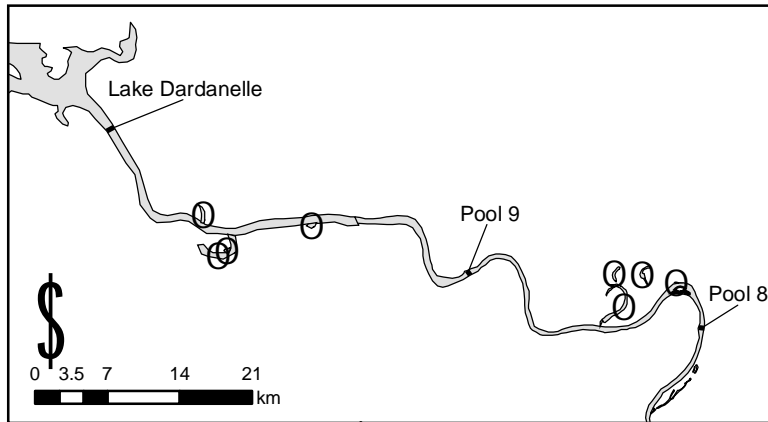
○ Absent



# Map 62. Swamp darter

*Etheostoma fusiforme*

- ! Present
- Absent



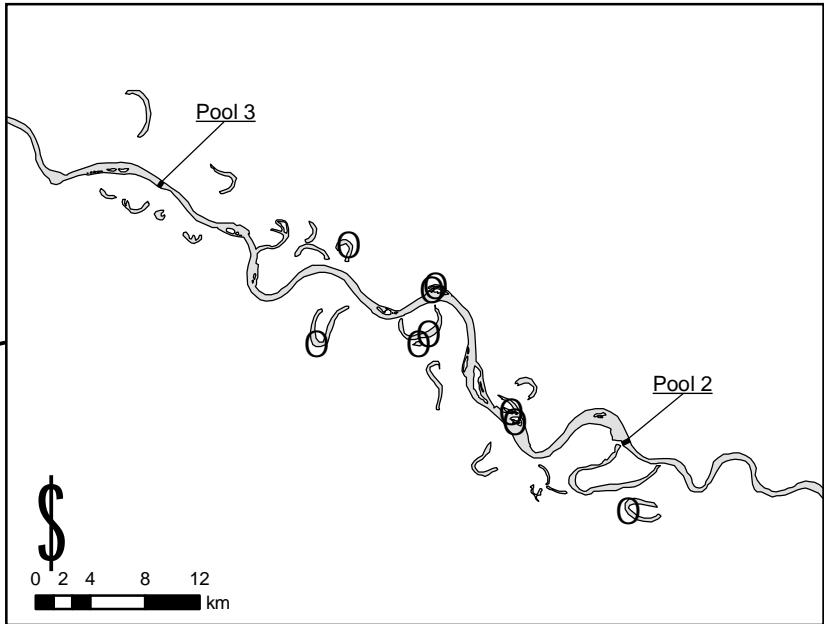
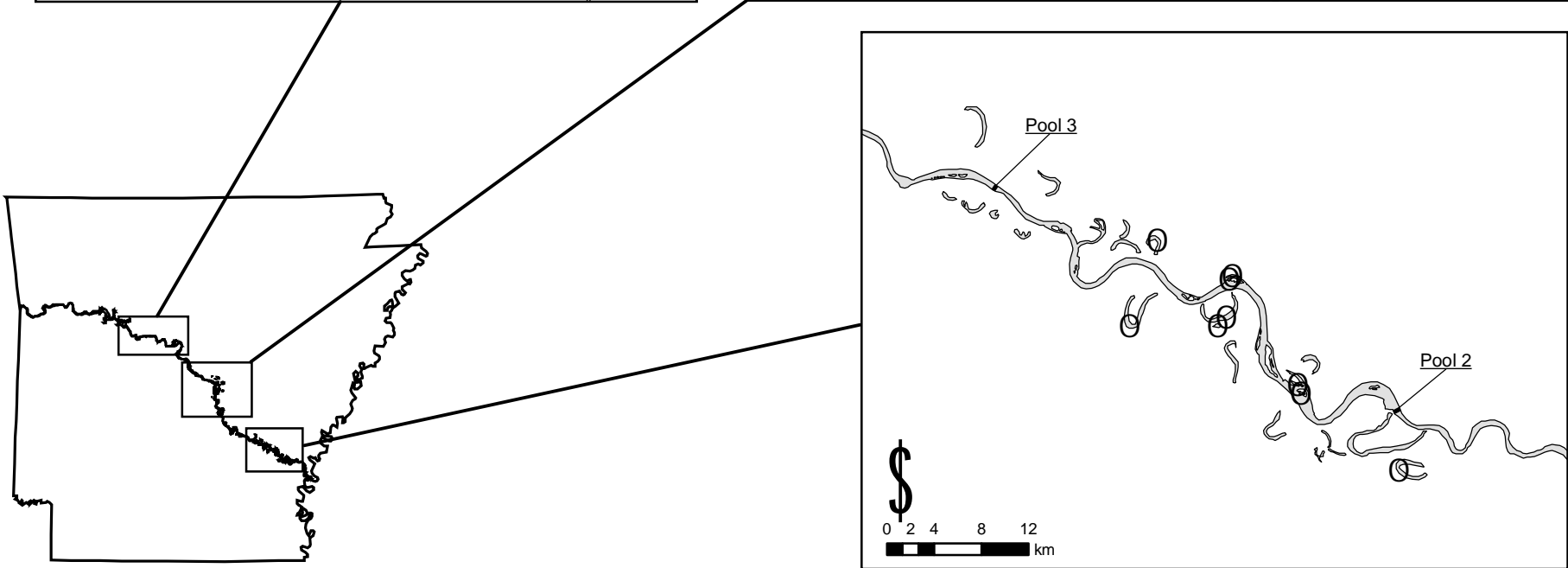
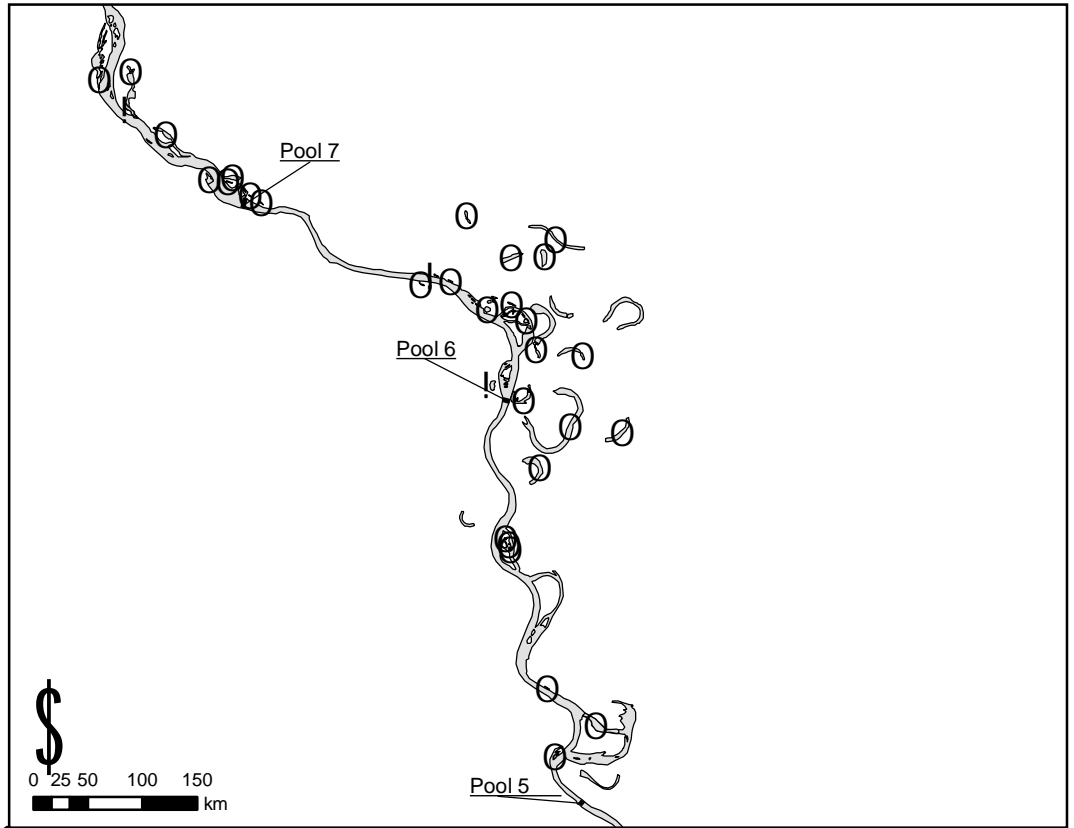
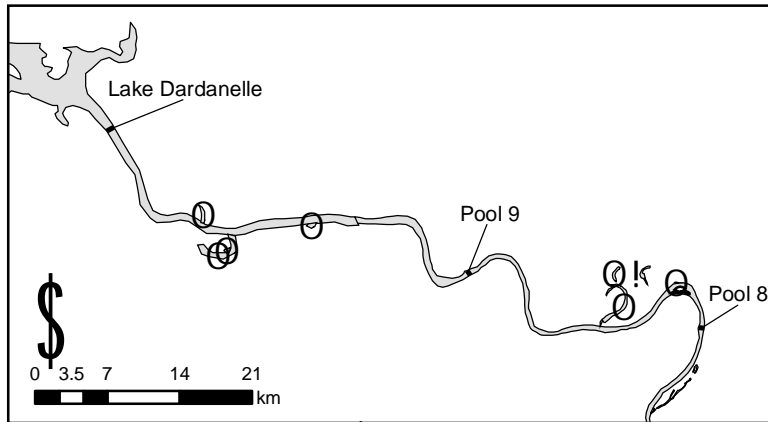


# Map 63. Slough darter

*Etheostoma gracile*

! Present

○ Absent

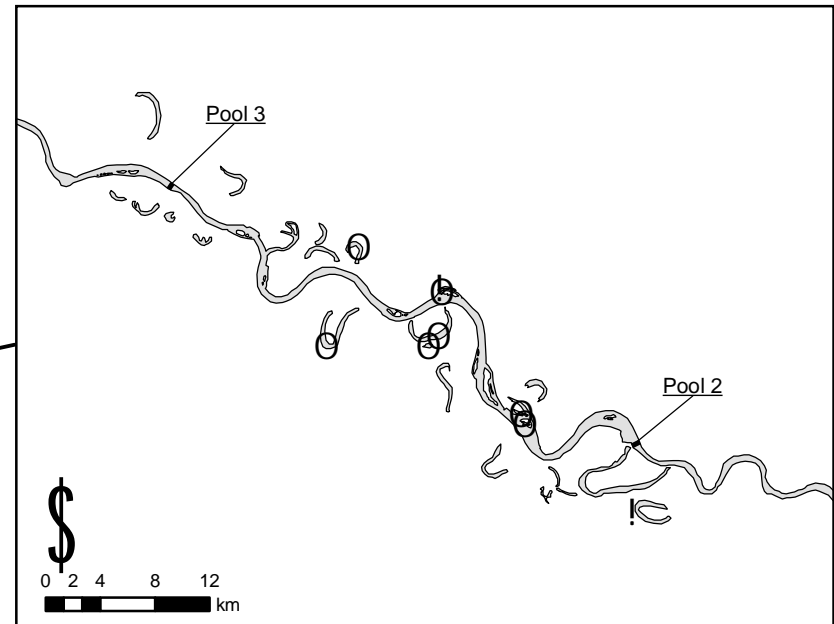
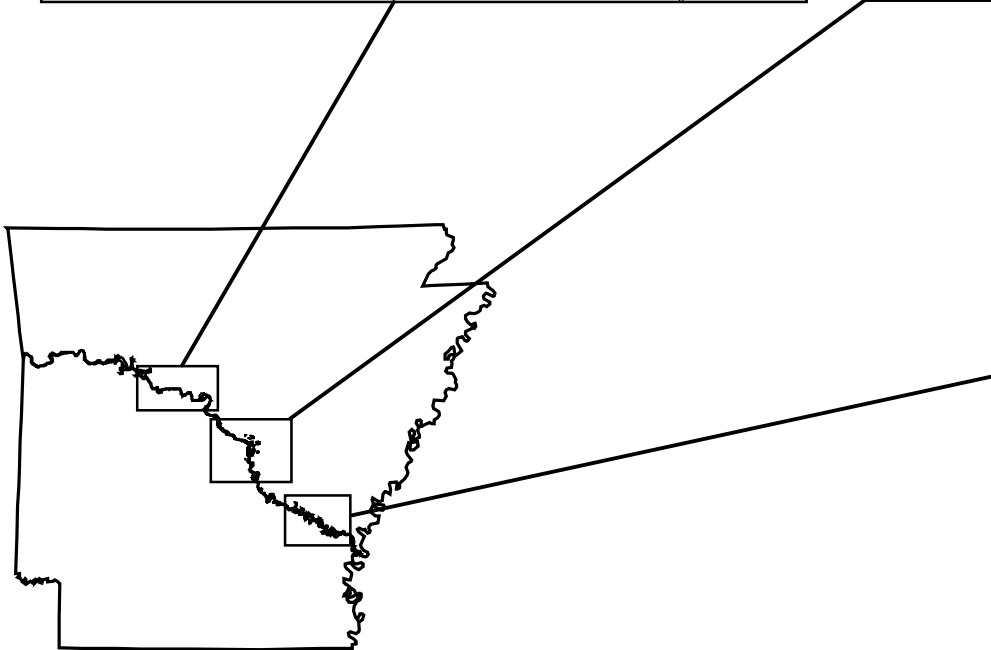
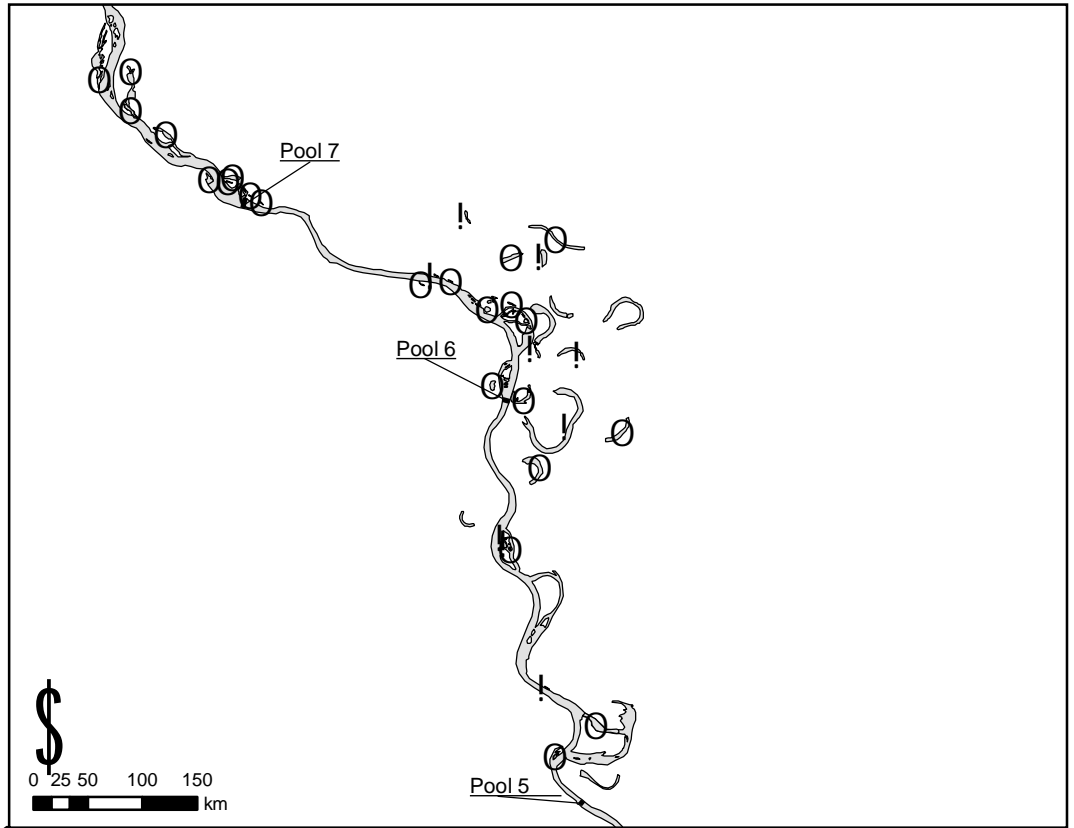
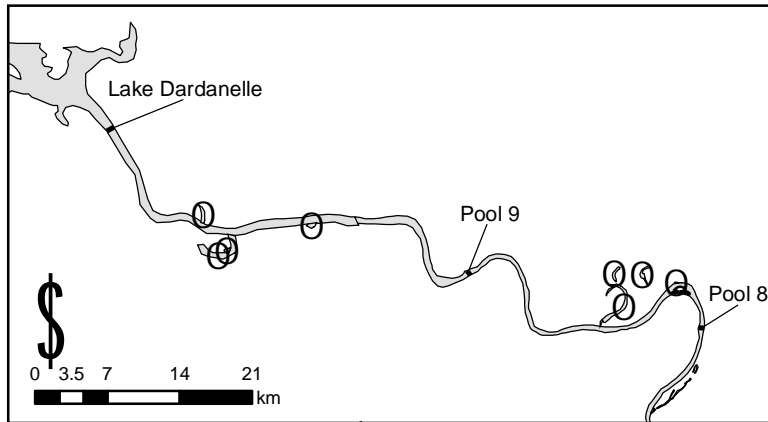


# Map 64. Cypress darter

*Etheostoma proeliare*

! Present

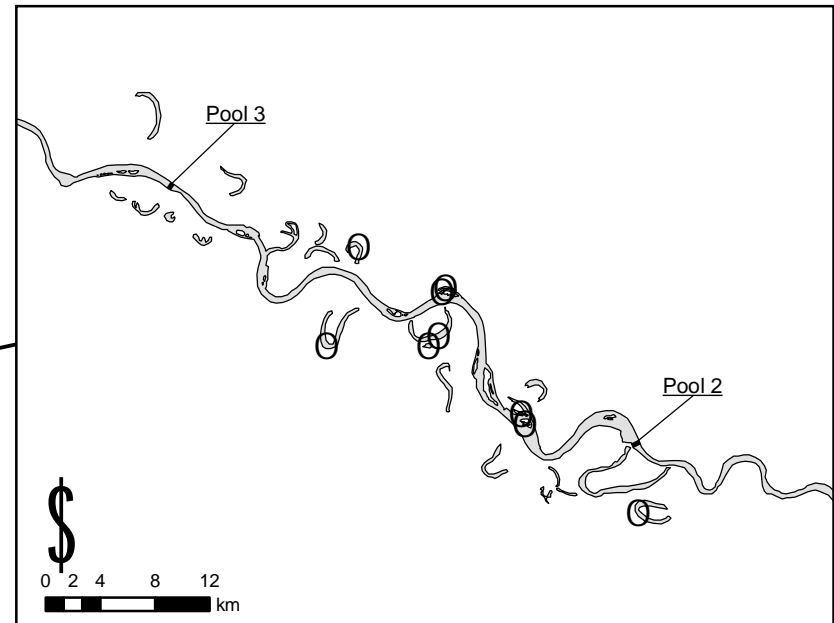
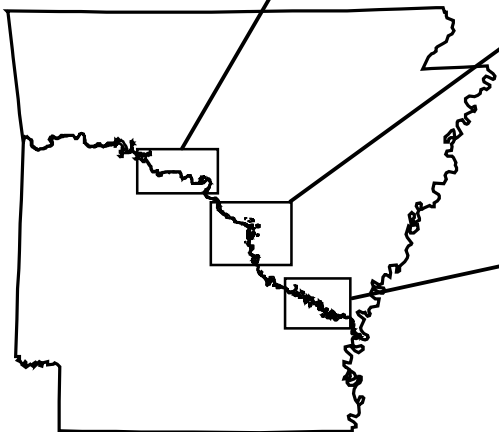
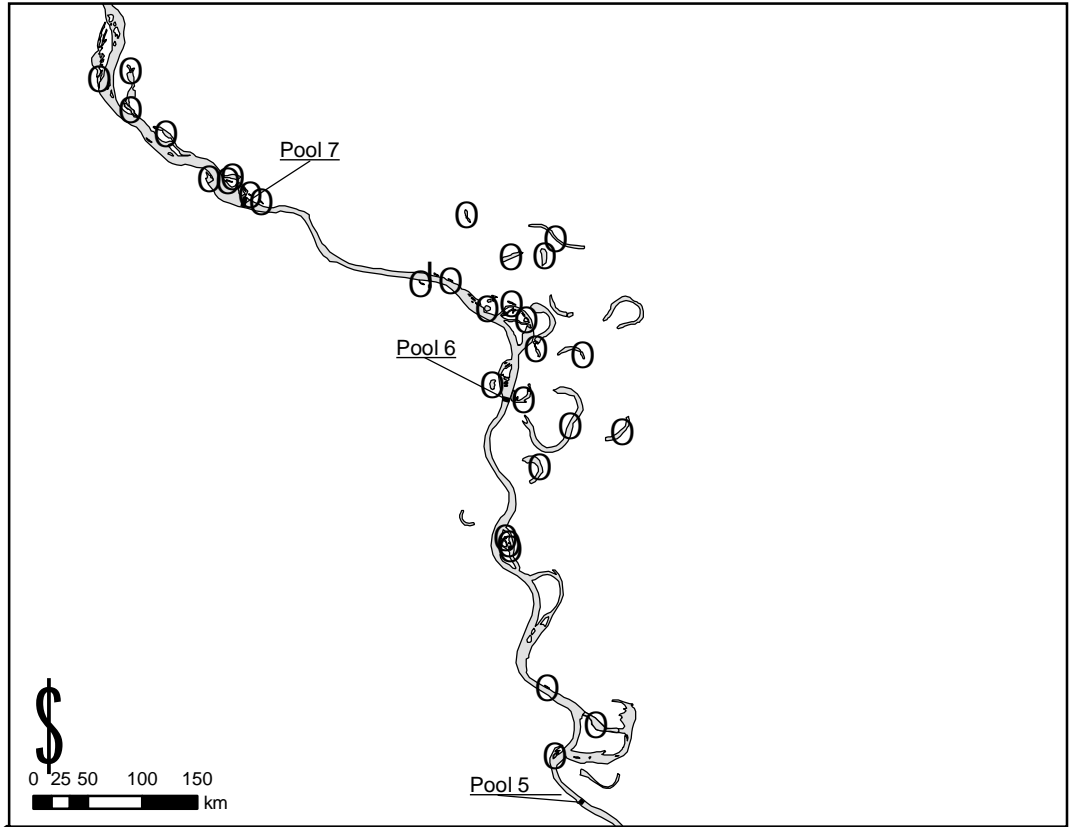
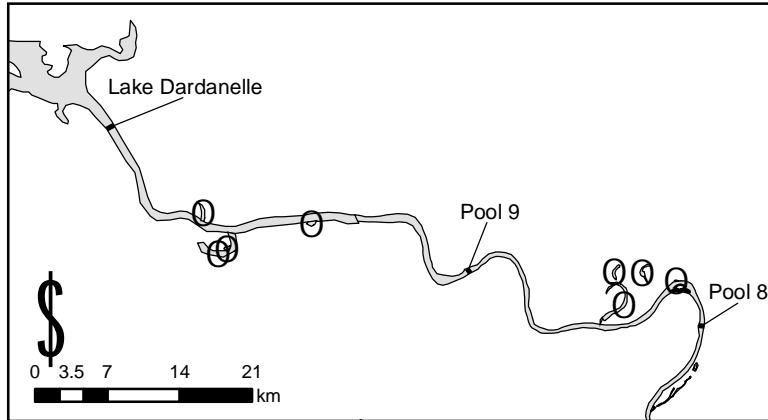
○ Absent



# Map 65. Logperch

*Percina caprodes*

- ! Present
- Absent



# Map 66. Freshwater drum *Aplodinotus grunniens*

! Present

○ Absent

