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Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

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Important Notice: This sampling protocol consist of this Protocol Narrative and the following Standard Operating Procedures (SOP's):

SOP 1: Before the Field Season
SOP 2: Training Observers
SOP 3: Using GPS
SOP 4: Using YSI 55
SOP 5: Using YSI 63
SOP 6: Establishing and Marking Sampling Sites
SOP 7: Conducting the Fish Community Sampling
SOP 8: Documenting Habitat Variables
SOP 9: Data Management
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I. Background and Objectives

Issues Being Addressed and Rationale for Fish Community Monitoring

Once covering vast areas of the North American continent, native Great Plains grasslands (prairies) are rapidly disappearing. During the last century, large portions of grassland landscapes were plowed for cropland or converted to livestock pasture; 29% of shortgrass, 41% of mixed-grass, and 99% of tallgrass prairie (Knopf and Samson 1997). Accompanying this loss in native grasslands is a decline in the quantity and quality of stream habitat flowing through them. Topeka shiner (*Notropis topeka*), a federally listed endangered species under the Endangered Species Act of 1973, inhabits these small, low order, prairie streams of high water quality. This species as well as many other fish species have been impacted adversely throughout their ranges by a number of factors associated with the loss of prairie. A comprehensive review of the literature indicates habitat loss through stream degradation, modification, tributary impoundment, stream channelization, in-stream gravel mining, siltation, and fragmentation as reason for decline of the Topeka shiner (U.S. Fish and Wildlife Service 2000). Reduced water quality, changes in stream hydrology, de-watering of aquifers, and introduction of predaceous fish into waterways occupied by Topeka shiner have also influenced the decline of the species (U.S. Fish and Wildlife Service 2000) as well as others native species.

Warranting monitoring is the integrity of remaining prairie stream ecosystems, defined by their ability to support and maintain a balanced, integrated and adaptive community of organisms having species compositions, diversities and functional organizations comparable to that of natural streams of the region (Karr and Dudley 1981). One or more biotic components of a stream may serve to measure its ecological integrity. In fact, trends in the composition and abundance of fish populations have been used to assess the biological integrity of streams (Barbour et al. 1999, Moulton et al. 2002). However, variations in stream habitat complexity often determine biotic communities including fish found in an area (Lazorchak et al. 1998). Therefore, monitoring trends in fish community composition and diversity along with the associated habitat serves as a more complete measure of the integrity of prairie streams.

Topeka shiner, a species of special interest to this study had a historic range believed to included low order streams in six mid-western states: Iowa, Kansas, Minnesota, Missouri, Nebraska, and South Dakota. Currently, Topeka shiner inhabits less than 10% of it's original range (Tabor 1998). Most lands with waterways in which Topeka shiner exist are in private ownership (Tabor 1993). Therefore, publicly owned lands within its range may offer protected refuges for the species. Both, Tallgrass Prairie National Preserve, Kansas and Pipestone National Monument, Minnesota have known populations of Topeka shiner (Tabor, personal communication 2000: Kansas; Schmidt 1989, Tabor 1993: Minnesota). Tallgrass Prairie National Preserve may provide particularly suitable habitat for the species because watersheds of several low order streams are entirely within the Preserve.

The predominant substrate type in streams occupied by Topeka shiner is one of clean gravel, cobble, and sand (Pflieger 1975). However, Topeka shiners use streams with varying degrees of sedimentation (Blausey 2001, Kerns 1983a). Topeka shiners do require spawning sites free of sedimentation. Therefore, they often spawn with other fish that keep their spawning nest swept clean of silt, especially green (*Lepomis cyanellus*) and orangespotted (*L. humilis*) sunfish (Pflieger 1997). Food habits of Topeka shiner are such that high quality streams capable of producing good hatches of aquatic macroinvertebrates are needed (Kerns 1983b).

National Park Service lands provide some of the least impacted low order stream habitat remaining in the historic range of the Topeka shiner. As such, waterways on some National Park Service lands (i.e. Pipestone National Monument and Tallgrass Prairie National Preserve) have been proposed as habitat critical to recovering the species (Federal Register 2002). Even without the critical habitat designation, federal agencies such as the National Park Service are required to manage endangered species and their habitat to ensure species protection and persistence, Endangered Species Act 1973. Monitoring the current status and future population trends is critical to the success of the National Park Service efforts toward preserving Topeka shiner populations and managing their habitats.

Historic Development of Fish Community Monitoring in Prairie Parks

Trends in the composition and abundance of fish populations have been used to assess the biological integrity of streams (Barbour et al. 1999, Moulton et al. 2002). During 2001 - 2003, the Prairie Cluster Prototype Long-term Ecological Monitoring Program initiated fish sampling and protocol development at Pipestone National Monument and Tallgrass Prairie National Preserve to assess the integrity of prairie streams within their boundaries. Also, a strong desire by the National Park Service to locate and monitor populations of Topeka shiner, a federally listed endangered species on their lands guided the development of this project. Therefore, the goals of this initial work were 1) to identify streams with Topeka shiner population, 2) assess baseline fish communities and habitat status in streams across both parks and 3) refine fish sampling and habitat assessment techniques for low order prairie streams. Before 2001, park records from sporadic and poorly documented fish sampling suggested that Topeka shiner populations existed within both parks (Schmidt 1989, Tabor 1993: Pipestone National Monument; Tabor, personal communication 2000: Tallgrass Prairie National Preserve). Populations of Topeka shiner were confirmed in streams at Pipestone National Monument (Peitz 2001, 2003) and Tallgrass Prairie National Preserve (Peitz 2001, 2002, 2003) by Park Service personnel.

Measurable Objectives

There are four primary objectives for the monitoring described in this protocol:

1. Determine long-term trends in distribution and abundance of Topeka shiner at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas.
2. Determine annual reproductive success of Topeka shiner as determined by the ratio of juveniles to adults in samples.
3. Improve understanding of relationships between Topeka shiner and in-stream habitat by correlating annual measurements of selected aspects of Topeka shiner in-stream habitat with Topeka shiner distribution and abundance.
4. Determine long-term trends in species richness and relative abundance of fish communities in selected streams within the historic range of Topeka shiner.

II. Sampling Design

Rationale for Selecting this Sampling Design over Others

Many techniques are available for sampling fish communities, including electro-fishing, kick-net, throw-net, D-net and bag-net seining with block-nets. The intermittence of streams and resulting isolated pools in Park Service lands included in this study lend themselves particularly well to bag-net seining. This type of fish sampling only requires seining with relatively light-weight equipment; a 1/8 in. mesh minnow seines, 1.8-m deep and of varying widths less than 15-m. The small mesh size allowed for capture of large fish without sacrificing capture success of smaller ones. Properly conducted, bag-net seining results in the near complete capture of all individuals in a pool, as prairie streams tend to be shallow and narrow. Block-nets are set up to isolate interconnected pools to preclude fish from escaping capture. Electro-fishing, while effective would require transporting by hand, heavy equipment to remote areas of the park, with distances between sample reaches often greater than 1 km. Other seine methods such as kick-net, throw-net and D-net sampling generally fail to sample the whole pool or collect fish from all strata within a pool.

Stratifying stream sampling to include at least the upper, middle and lower reaches allows investigators the opportunity to sample the extent of a stream without imposing unreasonable workloads that complete steam surveys require. An attempt should be made to sample fish from at least five pools in each reach. However, preliminary monitoring suggest that not all stream reaches contain five pools to sample and many will not have enough water to allow sampling at all. Therefore, one to five sampled pools will represent stream reaches sampled.

Fish are identified in the net, which remains in the water unless identification is difficult, photo vouchering is needed or morphometric measurements required (e.g. Topeka shiner). In the conditions outlined, fish are placed in an aerated bucket containing water from the sample site until identification is made, vouchering complete or measurements taken. All fish are released as near to point of capture as possible. Habitat data collection at each pool needs to include air and water temperatures; water clarity, dissolved oxygen content, conductivity and pH; substrate cover by types; presence and type of stream bank vegetation; stream bank erosion levels; substrate conditions; and pool dimensions to meet Topeka shiner Recovery Team objectives (U.S. Fish and Wildlife Service, 2000). Within each stream reach, weather conditions, the presence of off channel pools and stream flow between pools also need to be recorded. Most habitat data at the stream basin, segment and reach levels are collected in accordance with the National Water-Quality Assessment Program (Fitzpatrick et al. 1998).

Fish surveys, when conducted in late summer – early fall allow observers to make inferences about juvenile recruitment. Most prairie stream fish species have young that are of a size large enough to identify to species by this time yet small enough to distinguish from adults. This is especially useful for those species whose adults lack breeding colors outside the breeding season. Our experience has shown that Topeka shiner young are readily identifiable by late summer – early fall.

Site Selection

Streams are stratified to include an upper, middle and lower reach, allowing investigators the opportunity to sample the extent of a stream without imposing unreasonable workloads. Therefore, Pipestone Creek at Pipestone National Monument has three sample reaches located along its length below the fall. Stream channalization within the monument above the falls has resulted in homogonous in-stream habitat considerably different from that found below the falls (Fig. 1). Thus, one additional sample reach above the falls is included in our monitoring. Initial sampling, between 2001 and 2003 has also demonstrated a suppressed fish community above the falls when compared to those below the falls (Peitz 2001, 2002, 2003). Five pools in each of four stream reaches are to be sampled annually at Pipestone National Monument.

Tallgrass Prairie National Preserve has thirty-seven identified streams or waterways within its boundaries. Initial sampling between 2001 and 2003 identified those suitable as potential monitoring sites (Fig. 2). Twenty-five streams are either dry or have insufficient water to allow for fish sampling in years of normal rain fall. Stream 35 (Fox Creek) has flow significant enough to prohibit sampling with our equipment during most years. Therefore, fish communities in 11 streams will be monitored in most years. However, drought conditions may preclude annual monitoring in some streams or stream reaches. Eighteen stream reaches within the 11 streams have been identified for fish community monitoring.

At Tallgrass Prairie National Preserve, fish communities will be sampled in five pools in each reach if possible. However, preliminary monitoring suggest that not all stream reaches contain five pools to sample and many will not have enough water in years of below average rain fall to allow sampling in five pools. Therefore, one to five sampled pools represent a stream reaches annually.

To accommodate changing water conditions, a comprehensive search of all streams within Tallgrass Prairie National Preserve will be completed every fourth year in an attempt to identify additional monitoring reaches and to document the occurrences of Topeka shiner at previously un-monitored sites. Re-visiting all potential sites in the preserve may also assist in the recovery of the Topeka shiner by identifying previously un-documented sites that are suited for Topeka shiner reintroduction. The UTM coordinates of all stream reaches and the pools within each are taken at the time they are sampled.

Population Being Monitored

Sampling will include all fish species found to low order prairie streams within a parks boundary during the time a survey is being conducted (generally later summer – fall). The presence of both adults and juveniles in fish populations of intermittent pools will be used to document breeding success in the park by those species. Of particular interest are status and trends in populations of Topeka shiner.

Sampling Frequency and Replication

Initial monitoring efforts (2001 – 2003) have identified four stream reaches in Pipestone Creek, Pipestone National Monument that will be monitored annually. Five pools within each reach will be sampled, stream flow permitting. Eighteen stream reaches across 11 streams will be monitored annually at Tallgrass Prairie National Preserve. Like Pipestone Creek, five pools within each reach will be sampled, water levels permitting. In order to monitor the status of fish communities across the entire preserve a comprehensive search of all 37 streams will be made every four years to assess stream conditions. Five pools (or less) in each stream reach identified in these comprehensive searches will be sample. If a stream reach is identified in these comprehensive searches that looks promising as a monitoring site it will be added to our annual monitoring effort. Likewise, if a site that is to be monitored annual ceases to have sufficient water conditions to allow monitoring its frequency of monitoring will be reduced from annual to every four years.

For statistical purposes it is desirable to have replicated sampling sites where Topeka shiner are found and replicated sites of similar habitat characteristics where Topeka shiner are not found. However, locating the number of sites required to accomplish paired site analysis is probably not feasible due to the constraints of park boundaries. Therefore, all data collected needs to be made available to the U.S. Fish and Wildlife Service, state fisheries agencies, and Topeka Shiner Recovery Team annually. These entities may be better able to pair our sites with similar ones monitored in the region, thus allowing for a more robust analysis of Topeka shiner data from that region.

Different characteristics of watersheds in which monitoring occur should be assessed at various frequencies during monitoring. However, the collection of watershed basin, stream segment and most stream reach data is not detailed as part of this protocol. Table 1 details the frequency various watershed characteristics should be collected and the source of this data.

Table 1. Sampling strategy for habitat characteristics of prairie streams sampled for fish community composition and presence of Topeka shiner (*Notropis topeka*). Bolded habitat characteristics are those whose collection is recommended by the National Water-quality Assessment Program (Fritzpatrick et al. 1998). Italicized habitat characteristics are those collected under this protocol.

Habitat characteristic	Monitoring frequency	Monitoring source
	Basin	
Drainage boundaries	10^+ year sequence	In-house-GIS; topo map
Drainage area	10^+ year sequence	In-house-GIS; topo map
Runoff	10^+ year sequence	National / State equations
Climate (precipitation, temperature, evaporation)	10^+ year sequence	National Weather Service
Basin length	10^+ year sequence	In-house-GIS; topo map
Basin relief	10^+ year sequence	In-house-GIS; topo map
Drainage shape	10^+ year sequence	In-house-GIS; topo map
Stream length	10^+ year sequence	In-house-GIS; topo map
Cumulative perennial stream length	10^+ year sequence	In-house-GIS; topo map
Drainage density	10^+ year sequence	In-house-GIS; topo map
Drainage texture	10^+ year sequence	In-house-GIS; topo map

Table 1. Continued.

Habitat characteristic	Monitoring frequency	Monitoring source
Entire stream gradient	10^+ year sequence	In-house-GIS; topo map
Flow characteristics (floods, low-flow)	Continues	Gauging Station
Segment (generally within park)		
Sinuosity	10^+ year sequence	In-house-GIS; topo map
Gradient	10^+ year sequence	In-house-GIS; topo map
Segment length	10^+ year sequence	In-house-GIS; topo map
Water-management features	10^+ year sequence	Field sampling - stream
Stream order	10^+ year sequence	In-house-GIS; topo map
Link	10^+ year sequence	In-house-GIS; topo map
Downstream link	10^+ year sequence	In-house-GIS; topo map
Sideslope gradient	10^+ year sequence	In-house-GIS; topo map
Reach		
Discharge	10 year sequence / continues	Field sampling-stream / Gauging station
Channel modification	10 year sequence	Field sampling-stream
Reach length	10 year sequence	Field sampling-stream
Reach water-surface gradient	10 year sequence	Field sampling-stream
Geomorphic channel units	10 year sequence	Field sampling-stream
Wetted channel width	10 year sequence	Field sampling-stream
Bankfull channel width	10 year sequence	Field sampling-stream
Channel features	10 year sequence	Field sampling-stream
Canopy angles	10 year sequence	Field sampling-stream
Dominant riparian land use	10 year sequence	Field sampling-stream
Riparian canopy closure (densiometer)	10 year sequence	Field sampling-stream
Bank angle	10 year sequence	Field sampling-stream
Bank height	10 year sequence	Field sampling-stream
Bank vegetative cover	10 year sequence	Field sampling-stream
Bank stability index	10 year sequence	Field sampling-stream
Habitat cover	10 year sequence	Field sampling-stream
Depth	10 year sequence	Field sampling-stream
Velocity	10 year sequence	Field sampling-stream
Dominant bed substrate	10 year sequence	Field sampling-stream
Embeddedness	10 year sequence	Field sampling-stream
Bank erosion	10 year sequence	Field sampling-stream
Siltation	10 year sequence	Field sampling-stream
Channel cross sections	10 year sequence	Field sampling-stream
Pebble counts	10 year sequence	Field sampling-stream
Sediment laboratory analyses	10 year sequence	Field sampling-stream
Point-quarter vegetation	10 year sequence	Field sampling-stream
Vegetation plots	10 year sequence	Field sampling-stream
Spring present	Annually	Field sampling-fish
Weather	Annually	Field sampling-fish

Table 1. Continued.

Habitat characteristic	Monitoring frequency	Monitoring source
Off-channel pools	Annually	Field sampling-fish
In stream flow	Annually	Field sampling-fish
	Pool	
Geo-referenced	Annually	Field sampling-fish
Photo-referenced	Annually	Field sampling-fish
Air temperature (C^o)	Annually	Field sampling-fish
Water temperature (C^o)	Annually	Field sampling-fish
Secchi visibility (cm)	Annually	Field sampling-fish
Dissolved oxygen (mg/l)	Annually	Field sampling-fish
Conductivity (uS)	Annually	Field sampling-fish
Relative conductivity (uS)	Annually	Field sampling-fish
PH	Annually	Field sampling-fish
Percent coverage of substrate type	Annually	Field sampling-fish
Substrate stability	Annually	Field sampling-fish
Streambank erosion level	Annually	Field sampling-fish
Dominant riparian vegetation	Annually	Field sampling-fish
Length, Width, Depth (m)	Annually	Field sampling-fish

III. Field Methods

Field Season Preparations, Field Schedule and Equipment Setup

Prior to the field season each year, usually beginning in May or June, the observer (s) should review this entire protocol including all SOP's. The observer (s) should pay special attention to task described in SOP #1 "Before the Field Season" and SOP #2 "Training Observers". Review of fish identification (see SOP #2) is particularly important each year as the misidentification of species is perhaps the most serious error one can make when sampling fish communities. Species misidentification is a much more serious error than errors in counting individuals. All equipment and supplies listed in SOP #1 should be organized and made ready for the field prior to the start of sampling. Copies of the field data forms in Appendix A should be made on write-in-the-rain paper. Specimen bottles and 80% ethyl alcohol need to be ordered in advance of the start of a field season.

Staff workloads and unpredictable weather necessitate maintaining some flexibility in scheduling the sequence and duration of sampling trips. Sampling dates should at minimum approximate those of the previous years in order to maintain the seasonality of data collections. Dates out-side the season of previous years sampling may be utilized to answer specific research questions (e.g. over winter survival, summer mortality). Sampling dates should be scheduled and logistics organized prior to the start of each field season.

Sampling Methods

Sampling locations with in identified streams are selected annual based on the extent of that years sampling (annual or comprehensive), recent rain events and amount of water in stream reaches. Most streams included in this study are intermittent and dry by fall unless unusually wet summer conditions prevail. Five pools within each stream reach if available are seined in their entirety during September-October. Spring and summer sampling may also be conducted if a need exists (e.g. identify over winter survival or summer mortality) and time permits. All stream reaches scheduled for sampling are located using GPS and walked in their entirety to locate sampling pools and assess the feasibility of sampling within the reach (SOP #6 "Establishing and Marking Sampling Sites"). Researcher should arrive at a park the day prior to the start of sampling to familiarize themselves with the park and locate streams in which to start sampling. UTM coordinates for all pools sampled are recorded at the upstream end of the pool at the time the pool is sampled (see SOP #3 "Using GPS" and SOP #6 "Establishing and Marking Sampling Sites"). The extent of annually monitored stream reaches have been established and permanent UTM coordinates recorded for the upstream and downstream ends of each reach (SOP #6). The extent and location of additional stream reaches identified during comprehensive monitoring will be recorded at the time they are sampled. Photo documentation with a digital camera of each pool sampled will be done at the time its UTM coordinates are recorded.

Prior to sampling the fish community, water clarity, dissolved oxygen, pH and conductivity of water within the pool to be sampled must be recorded. Entry into the water to sample the fish community prior to taking these measures may negatively influence their out come. Habitat measures such as dominate substrate; presence and type of stream bank vegetation; stream bank erosion levels and substrate condition can be recorded after seining has been completed. Additional habitat data collected on each stream reach including weather conditions, presence of off channel pools and flow between pools are recorded after the last pool within the reach is sampled.

Fish are sampled using bag seines varying in width to span the cross-section of the pool being sampled (SOP #7 "Conducting the Fish Community Sampling"). Fish are seined by extending the seine the full width of a pool, dragging the net across the bottom and trapping fish against a bank or shallow water area until the net can be raised to bring captured individuals to the top of the water. All captured fish are identified to species, enumerated and released immediately or placed in aerated buckets, containing water taken from the pool until identification is complete. Topeka shiner are measured, sexed and aged (adult or juvenile) also. Habitat data recorded at each pool includes water and air temperatures; water clarity; dissolved oxygen, pH and conductivity of water;

Before leaving the field each day, data sheets are checked for completeness and readability. All information pertinent to the stream reaches and pools sampled that day is recorded to avoid repeating or skipping areas needing sampled. The project manager is responsible for the safekeeping and organizing of data sheets and ensuring that data gets entered into the database.

Conducting the Fish Community Sampling

Details of how to conduct fish community monitoring and for filling out data sheets are given in SOP #7 "Conducting the Fish Community Sampling" and summarized here. Fish are captured by extending a two man bag seine the full width of a pool, dragging the net across the bottom and trapping fish against a bank or shallow water area until the net can be raised, bringing captured individuals to the top of the water. All captured fish are identified to species, enumerated and released immediately or placed in aerated buckets, containing water taken from the pool. Fish placed in buckets are identified and released as soon as possible. Topeka shiner are measured, sexed and aged (adult or juvenile) also. Pools with in a reach are sampled from the most downstream one first, than moving upstream in order to avoid fouling water in connected pools prior to sampling.

Fish specimens are handled carefully to minimize sampling mortality. Any specimens inadvertently killed during seining will be preserved as voucher specimens. In consultation with the U.S. Fish and Wildlife Service, state fisheries agencies, and the Topeka Shiner Recovery Team, all Topeka shiner specimens lost to sampling mortality will be made available for research to meet Recovery Plan objectives (e.g. assessing genetic variability across its' range, collecting voucher specimens for each locality). Presently, Topeka shiner specimens are being reposited with the Kansas Museum of Natural History, University of Kansas, Lawrence. All other fish specimens inadvertently killed during seining will be preserved as voucher specimens in 80% ethyl alcohol and stored at Prairie Cluster Prototype Long-term Ecological Monitoring Program facilities. Photo vouchers of each fish species captured in a park are taken annually using 35 mm film.

Collecting Habitat Data

Details of how to collect habitat data and for filling out data sheets are given in SOP #8 "Documenting Habitat Variables" and summarized here. Habitat data is collected on a variety of scales ranging from basin level to individual pools and frequencies. Basin wide and stream segment data are collected from topographic and other regional sources every 10 years or when updated maps become available. Most data on stream reach conditions is collected every ten years, with significant stream channel altering precipitation events dictating a shorter frequency at which these data need collected. Weather conditions, presence of off channel pools and flow between pools is collected annually on stream reaches where pools are sampled. Habitat data recorded annually at sampled pools includes water and air temperatures; water clarity; dissolved oxygen, pH and conductivity of water; dominate substrate; presence and type of stream bank vegetation; stream bank erosion levels and substrate condition. Stream water conditions are measured prior to a pool being sampled for fish. All other pool habitat data are collected by one or two individuals after seining is complete and while fish are being identified and enumerated by others.

IV. Data Management

Overview of Database Design

Appendix A, "PHYSICAL HABITAT AND SPECIES COUNT DATA – FISH COMMUNITY MONITORING PROJECT" is the standard form that will be used to collect field data. Appendix B is the screen layout for standard data entry into the ACCESS^{tm} database. Microsoft Access 2002 is the primary software environment for managing fish and habitat data. ESRI ArcInfo 8 serves as a tool for validation of spatial data residing in Access. Data products will be posted at the NPS I&M website: http://science.nature.nps.gov/im/monitor/protocoldb.cfm. Metadata for fish community monitoring data will be available at NPS I&M application server: http://science.nature.nps.gov/im/apps.htm. QA/QC guidelines in this document are based on recommendations of DeBacker et al. (2002) and S. Fancy at http://science.nature.nps.gov/im/monitor and citations therein.

The general data model for fish community monitoring consists of two sets of tables. One set manages fish abundance data the other associated habitat data. Abundance and habitat data are linked in time and space by way of standardized event and location tables. For data management purposes, it is probably easier to manage fish and habitat data separately. When the two are correctly linked, they can be integrated transparently for analysis.

The primary table for storing fish abundance data contains information about the species. Supporting tables include water and climatic information, observers and habitat assessment information. A locations table provides detailed location information associated with each sampling point. A pool habitat table serves as the star table about which all other habitat information is linked. Small look-up tables are linked to this table by way of multiple junction tables. This facilitates many-to-many relationships in Microsoft Access. Small attribute tables provide the values for pick-lists on data-entry forms, thereby reducing possible error during data entry (see Data Verification and Editing below).

Data Entry

A number of features have been designed into the database to minimize errors that occur when field data is transcribed to the database for storage and analysis. Forms are used as portals for data entry into the database. Standardized identifiers (e.g. sample event or pool) are selected from list of easily interpreted codes. Species and habitat data is entered into fields linked to appropriate tables. Look-up tables contain project specific data and prohibit entry of data into a field if a corresponding value is not included in the look-up table. Consequently, only valid names or measures may be entered and spelling mistakes are eliminated. Species or habitat measures are selected using a pick list or by typing the beginning of the name. While typing, the form searches for a similar entry, typically locating the desired species after typing only a few characters.

If a species name or habitat measure is not accepted during data entry, it may be the result of a name change or it may be a new species or habitat measure. To check the current nomenclature for a data variable, a nomenclature update form is attached to the Access data file via a button. If the species or habitat measure name has changed, the form will indicate the current accepted name. If the species or habitat measure is new to the nomenclature update form, a form is provided to update the nomenclature table with the new attribute data.

Data Verification and Editing

Data verification immediately follows data entry and involves checking the accuracy of computerized records against the original source, usually paper field records. While the goal of data entry is to achieve 100% correct entries, this is rarely accomplished. To minimize transcription errors, our policy is to verify 100% of records to their original source by staff familiar with project design and field implementation. Further, 10% of records are reviewed a second time by the Project Manager and the results of that comparison reported with the data. If errors are found in the Project Manager's review, then the entire data set is verified again. Once the computerized data are verified as accurately reflecting the original field data, the paper forms are archived and the electronic version is used for all subsequent data activities.

Although data may be correctly transcribed from the original field forms, they may not be accurate or logical. For example, a canopy height of 1125 m instead of 11.25 m or a temperature of 95°C instead of 9.5°C is illogical and almost certainly incorrect, whether or not it was properly transcribed from field forms. The process of reviewing computerized data for range and logic errors is the validation stage. Certain components of data validation are built into data entry forms (e.g. range limits). Data validation can also be extended into the design and structure of the database. As much as possible, values for data-entry forms have been limited to valid entries stored in the look-up tables.

Additional data validation can be accomplished during verification, if the operator is sufficiently knowledgeable about the data. The Project Manager will validate the data after verification is complete. Validation procedures seek to identify generic errors (e.g. missing, mismatched or duplicate records) as well as errors specific to particular projects. For example, validation of fish data includes database query and comparison of data among years. One query detects records with a location ID from a park and a period ID from a different park. Another query counts the number of pools per reach (typically there are 5) to assure that all pools were entered and pools from other reaches were not included in that reaches data. Finally, data are compared to previous years to identify gross differences. For example, *Catostomus commersoni* or *C. commersoni* may be recorded this year, but *Catostomus spp.* the previous. During the entry, verification and validation phases, the Project Manager is responsible for the data. The Project Manager must assure consistency between field forms and the database by noting how and why any changes were made to the data on the original field forms. In general, changes made to the field forms should not be made via erasure, but rather through marginal notes or attached explanations. Once validation is complete, the data set is turned over to the Data Manager for archiving and storage.

Spatial validation of database sample coordinates can be accomplished using ArcGIS (ESRI, Inc.). Because Shiner is maintained as an Access database, it can be imported directly into ArcCatalog (ArcGIS, ESRI, Inc.) as an OLE DB object. Fields "StartUTMX" and "StartUTMY" of the locations table can then be used to validate the UTM coordinate values for reach or pool locations stored in Access against the original GPS coordinates.

Metadata Procedures

Preliminary notes for metadata were developed using the Electronic Metadata Guide (developed by G. Lienkaemper, USGS FRESC, Corvallis, OR - see Appendix A of SOP # 7). Metadata are then entered into the National Park Service Inventory and Monitoring Dataset Catalog (Ver. 2002.1). Then an extended report from Dataset Catalog is generated. The Dataset Catalog report tool can be used to generate output in the text-based FGDC-compliant metadata format. The output file should be validated and parsed into html format using the USGS metaparser command tool with the following syntax "mp –e efile –h hfile infile."

Data Archival Procedure

Data sets are rarely static. They often change through additions, corrections, and improvements made following the archival of a data set. There are three main caveats to this process:

- Only make changes that improve or update the data while maintaining data integrity.
- Once archived, document any changes made to the data set.
- Be prepared to recover from mistakes made during editing.

Any editing of archived data is accomplished jointly by the Project Manager and Data Manager. Every change must be documented in the edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. The reader is referred to Tessler & Gregson (1997) for a complete description of prescribed data editing procedures and an example edit log.

Prior to any major changes of a data set a copy is stored with the appropriate version number. This allows for the tracking of changes over time. With proper controls and communication, versioning ensures that only the most current version is used in any analysis. Versioning of archived data sets is handled by adding a three digit number to the file name, with the first version being numbered 001. Each additional version is assigned a sequentially higher number. Frequent users of the data are notified of the updates, and provided with a copy of the most recent archived version.

Once the data are archived, any changes made to the data must be documented in an edit log. At this point forward, original field forms are not altered. Field forms can be reconciled to the database through the use of the edit log. Secure data archiving is essential for protecting data files from corruption. Once a data set has passed all QA/QC procedures specified in the protocol, a formal entry is made in the I&M Data Set Catalog. Subsequently, an electronic version of the data set is maintained in a read-only format on the program server. Backup copies of the data are maintained at the Wilson's Creek visitor center, and an additional digital copy is forwarded to the NPS Inventory and Monitoring Program Archive. Tape backups of the fish project databases are made daily. Two backup copies are maintained at the PC-LTEM building and two additional copies at the Wilson's Creek National Battlefield Visitor Center, Republic Missouri. Once-a-month, one tape copy is placed into permanent archive.

Currently, data are available for research and management applications on request, for database versions where all QA/QC has been completed and the data have been archived. Data can also be transferred using e-mail (most Access files are smaller than 10 Mbytes or can be compressed into .zip files) or ftp where available. Portions of the fish community monitoring data will be made available for download directly from the NPS I&M Monitoring webpage. Information related to location and persistence of species determined to be threatened or endangered (e.g. spotted sucker and Topeka shiner) will not be made available for download by the general public. In addition, metadata will become available directly from the NPS I&M metadata server. Data requests should be directed to:

Gareth Rowell, Data Manager
Wilson's Creek National Battlefield
6424 W. Farm Road 182
Republic, MO 65738-9514
gareth_rowell@nps.gov

V. Analysis and Reporting

A critical component of any long-term monitoring protocol is a consistent and systematic way of analyzing and reporting on information (data) collected. That being said, it is also important that the data analysis and reporting requirements be flexible enough to accommodate new and varied analytical methods and reporting styles as they become available. Data visualization, geostatistics and time-series analysis are but three analysis methods that may be employed with this protocol as the size and complexity of the database increases through time. SOP #10 "Data Analysis" gives step-by-step details on how to: 1) determine species abundance, fish species richness, diversity and evenness, 2) calculate descriptive statistics for habitat variables and 3) examine the relationships between fish species abundance and habitat conditions by way of correlation analysis. All calculations are made at the stream reach level so means and standard errors can be calculated by stream reach, across like stream reaches or average for park wide inferences. These parameters should be analyzed each time a survey is completed. Development of long-term trend analyses for both fish community and habitat parameters will take place once enough data has been collected for doing so, perhaps after 10 years of data collections.

Fish Data Analysis

Species richness is defined as the total number of fish species observed within a stream reach. Community diversity, calculated using the Shannon Diversity Index (Shannon 1949), measures the equitability of species across samples. The disparity among species abundance is calculated using Pielou's "J" (Pielou 1969). Relative frequency of occurrence (number of pools a species occurred in / stream reach) of each fish species is compared between surveys each time a new one is conducted to determine changes in the status of a population.

Habitat Data Analysis

Summary reports on habitat attributes of permanent stream reach features are required from time to time. Permanent features such as the location of a reach in a drainage basin, management unit or stream and the UTM coordinate values of each end of the reach are reported and assigned to a permanent locations table within the database only once. Other stream reach features including the presence of off-channel pools and in-stream flow between pools are recorded each time a survey is conducted, with changes in them reported annually.

The bulk of habitat data is collected at the pool level. Pool features reported on each time a survey is conducted include air temperature, water temperature, Secchi visibility, dissolved oxygen, conductivity, relative conductivity, pH, dominant pool substrate, substrate stability, severity of streambank erosion, dominant riparian corridor vegetation and pool dimensions. Values reported for each pool in a reach are averaged to establish single values representing the reach, see SOP #10 "Data Analysis" for details.

Watershed Data Analysis

Characterization of watersheds and streams within each watershed should be assessed at various frequencies during fish community monitoring as outlined in Table 1. Fritzpatrick et al. (1998) has detailed a comprehensive review on how watershed parameters are to be analyzed. Individuals wishing to analyze watershed level data should refer to the fore mentioned article when doing so.

Reporting

In an effort to disseminate findings in a timely manner and meet state and federal permitting requirements, reports should be completed by December 31 of the year in which data collections occur. More extensive summary reports should be completed every five to ten years depending on how fast habitat conditions are changing and how critical summary information is to setting management goals influencing fish populations within a park. Summary reports may be used in place of annual reports for the year in which the last data is collected. Refer to SOP # 11 "Reporting" for details on report structure and style. Also see, "2003 Fish Community and Topeka Shiner Monitoring Report: Prairie Cluster Prototype Long-Term Ecological Monitoring Program, NPS" (Peitz 2003) for content included in a report and reporting style.

Tables in a report should be placed within the text or immediately following the literature cited section (see Appendix B). Tables should be numbered in sequence regardless of where they are located. Table headers are placed at the top of a table. Horizontal lines are used to separate the table heading from column headings, column headings from the table and to signify the end of the table. Vertical lines should not appear on a table.

Figures (including pictures) should be placed within the text of a report or immediately following tables behind the literature cited sections (see Appendix C). Figures should be numbered in sequence regardless of where they are located. Figure captions are placed below the figure if it is included in the text or on a separate sheet of paper preceding the figure if included after the literature cited section. Both tables and figures should contain information not presented in the body of the text. Also, tables and figures should not duplicate information already presented in the body of the text.

Annual reports will be made available to the U.S. Fish and Wildlife Service, state fisheries agencies, the Topeka Shiner Recovery Team, the Inventory and Monitoring Program publication of the National Park Service and NPS units involved in the monitoring effort. Additionally, a copy will be kept on file with the Prairie Cluster LTEM office of the National Park Service, Republic Missouri, and made available to all interested parties upon request.

VI. Personnel Requirements and Training

Roles and Responsibilities

The project manager is the lead ecologist for implementing this monitoring protocol, and is supervised by the Program Coordinator for the Prairie Cluster Prototype Long-term Monitoring Program. Because of the need for a high level of training and consistency in implementing the protocol, the project manager will usually be the lead person conducting field surveys. Thus, the project manager is ultimately responsible for the quality and consistence of field collected data. The data management aspect of the monitoring effort is the shared responsibility of the project manager and the data manager. Typically, the project manager is responsible for data collection, data entry, data verification and validation, as well as data summary, analysis and reporting. The data manager is responsible for data archiving, data security, dissemination and database design. The data manager, in collaboration with the project manager, also develops data entry forms and other database features as part of quality assurance and automates report generation. The data manager is ultimately responsible for building into the database management system adequate QA/QC procedures and assuring appropriate data handling procedures are followed. The data manager in collaboration with the project manager and individuals skilled in GIS data analysis will collect all basin level and stream segment data.

Qualifications and Training

Probably the most essential component for the collection of credible, high-quality data on fish is a competent observer(s) on the crew. This cannot be overemphasized. The skill of the observer(s) will determine the quality of the data. Time should be invested in training personnel to identify fish species and assess habitat characteristics. This requires training, both in the office and in the field (see SOP #2, "Training Observers") to become proficient with fish identifications and habitat assessments. Assistants by state, federal or other fisheries experts during surveys are always welcomed.

The aquatic ecologist/project manager is responsible for training the fish sampling crew in fish identifications and conducting habitat assessments. Observers doing habitat work should familiarize themselves with the PC LTEM standard cover classes, SOP #8 "Documenting Habitat Variables". Prior to the field season, practice-estimating cover of different ground cover categories within practice plots of set sizes. Proficiency with using GPS (SOP #3) and water-quality assessment equipment (SOP's #4 and #5) must be established prior to the first day of field sampling.

VII. Operational Requirements

Annual Workload and Field Schedule

Fish community surveys are generally conducted late summer – early fall, a period that allows observers to make inferences about juvenile recruitment. Most prairie stream fish species have young that are of a size large enough to identify to species by this time yet small enough to distinguish from adults, especially species whose adults lack breeding colors outside the breeding season. Topeka shiner young are readily identifiable to species by late summer – early fall.

Inclement weather and personnel workloads will preclude the scheduling of sampling events to specific annual dates. Annual habitat monitoring at the stream reach and pool levels should be completed at the time fish surveys are conducted. Monitoring efforts will require a four to five person crew to complete efficiently. Approximately two field days are required to complete fish sampling at Pipestone National Monument and eight to ten days at Tallgrass Prairie National Preserve. The number of stream reaches and pools sampled each day will vary do to varying logistics to sample sites.

Facility and Equipment Needs

The nature of fish survey work does not require special facilities beyond normal office space and equipment storage needs, with the exception of a flame proof storage cabinet for voucher specimens. Table 1.01.1 (SOP #1 “Before the Field Season”) is a list of field equipment needs for one crew, if two or more crews work simultaneously than equipment requirements will increase accordingly.

Startup Cost and Budget Considerations

Personnel expenses for fieldwork are based on a crew of four to five; a professional aquatic ecologist or fisheries biologist to oversee the fieldwork, data collection and to coordinate surveys. Three to four seasonal biological science technicians or others are required to assist in field data collection. Assistance for both state, federal and park employees will help offset the total number of seasonal bio-technicians needed thus influence annual cost to complete fish community surveys. Help from other agencies is always welcome as their expertise in fish community monitoring and species identification is invaluable. One or two field days should be planned for Pipestone National Monument and approximately 10 days for Tallgrass Prairie National Preserve. Field costs will vary somewhat from year to year depending on the skill level and size of crew. Data management personnel expenses include staff time of biological science technicians, the aquatic ecologist and data manager. Startup cost for equipment include the purchase of equipment and supplies listed in Table 1.01.1 (SOP #1 “Before the Field Season”), as well as maintenance and or replacement of equipment shared among multiple projects (e.g. GPS units, cameras).

Estimated Costs	**TAPR**	**PIPE**
Field Work (Salary)	$6000.00	$3000.00
Field Work (Travel)	$4200.00	$1700.00
Data Management/Reporting (Salary)	$5500.00	$2200.00
Startup Equipment Costs	$600.00	$600.00
Annual equipment/supplies	$200.00	$200.00
Total	$16,500.00	$7700.00

Procedures for Making Changes to and Archiving Previous Versions of the Protocol

Over time, revisions to both the Protocol Narrative and to specific Standard Operating Procedures (SOPs) are to be expected. Careful documentation of changes to the protocol, and a library of previous protocol versions are essential for maintaining consistency in the collection of data and for appropriate treatment of the data during data summary and analysis. The MS Access database for each monitoring component contains a field that identifies which version of the protocol was being used when the data were collected.

The rationale for dividing a sampling protocol into a Protocol Narrative with supporting SOPs is based on the following:

- The Protocol Narrative is a general overview of the protocol that gives the history and justification for doing the work and an overview of the sampling methods, but that does not provide all of the methodological details. The Protocol Narrative will only be revised if major changes are made to the protocol.
- The SOPs, in contrast, are very specific step-by-step instructions for performing a given task. They are expected to be revised more frequently than the protocol narrative.
- When a SOP is revised, in most cases, it is not necessary to revise the Protocol Narrative to reflect the specific changes made to the SOP.
- All versions of the Protocol Narrative and SOPs will be archived in a Protocol Library.

The steps for changing the protocol (either the Protocol Narrative or the SOPs) are outlined in SOP #13 "Procedures for Revising the Protocol". Each SOP contains a Revision History Log that should be filled out each time a SOP is revised to explain why the change was made, and to assign a new Version Number to the revised SOP. The new version of the SOP and/or Protocol Narrative should then be archived in the LTEM/Archive/ProjectDocuments/FishCommunities Directory under the appropriate folder.

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APPENDIX A – Field data forms for recording (a) habitat and species count data and (b) Topeka shiner morphometric characteristics. These forms should be copied onto write-in-the-rain paper and taken into the field. The database has data entry screens that mimic these forms.

(a) PHYSICAL HABITAT AND SPECIES COUNT DATA – FISH COMMUNITY MONITORING PROJECT

(b) SUPPLEMENTAL SPECIES INFORMATION DATA – FISH COMMUNITY MONITORING PROJECT

PHYSICAL HABITAT AND SPECIES COUNT DATA – FISH COMMUNITY MONITORING PROJECT

Collector(s): ______________________________ (three letter initials) **Locality**: ____

Date: ___________ **Time**: ___________ **Park**: _____________ **State**: _________ **County**: ____________________

Drainage Basin: _____________________ **Stream No.**: ____ **Stream Reach** (circle)**:** Lower Middle _____Upper

Pool: __ __ __ __ __ **GPS** (Yes / No)**:** Pool 1__ 2__ 3__ 4__ 5__ stream reach only __ **{Datum: NAD 1983 (conus), 14 N}**

Spring present in stream reach (circle): Yes No

Pictures Taken? (circle): Yes No **Picture Number on Roll:** pool 1 ______ 2______ 3______ 4______ 5______

Measured parameters:

	Pool #				
	1	2	3	4	5
Air temperature (°C)					
Water temperature (°C)					
Secchi visibility (cm)					
Dissolved Oxygen (mg/l)					
Conductivity (uS)					
Relative Conductivity (uS)					
pH					
Sampling effort (min.)					

Sampling gear (if something other than 1/8 in. minnow seine): ____

Weather (circle): clear-sunny partly cloudy cloudy raining other:_________________

Off-channel pools for stream reach (circle): present absent not applicable (Isolated pool / Spring)

In stream flow for stream reach (circle): pools dry isolated pools trickle between pools moderate flow between pools high flow flood flow

Pool Substrate (**by cover class: 0 = none, 1 = trace, 2 = 1 – 5%, 3 = 5 – 25%, 4 = 25 – 50%, 5 = 50 – 75%, 6 = 75 – 95%, 7 = 95 – 100% coverage)**

Substrate Type	Pool #					**Substrate Type**	Pool #				
	1	2	3	4	5		1	2	3	4	5
Muck						Coarse-gravel					
Detritus						Cobble					
Silt						Boulder					
Sand						Bedrock					
Pea-gravel						Hardpan/shale					
						Stable (S) **Unstable (U)**					

Streambank erosion level: Right bank severe moderate slight none
__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

Left bank severe moderate slight none
__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

Riparian corridor (insert code for the dominant classification within each width category):

	0 – 25 m					> 25 – 50 m					> 50 – 75 m					> 75 – 100 m					> 100 m				
Pool #	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Right bank																									
Left Bank																									

Riparian classification codes	
Mature woodland = 1	Row crops = 6
Woody shrubs / saplings = 2	Road / railroad = 7
Wetland / native grasses & forbs (prairie) = 3	Urban / industrial = 8
Domestic grass pasture / hay field = 4	Other (note in general comments) = 9
Park / lawn = 5	

Pool dimensions (several pools may occur within a stream reach):

	Length (m)	**Width (m)**	**Depth (m)**
Pool 1			
Pool 2			
Pool 3			
Pool 4			
Pool 5			
Mean dimensions			

Species list: Topeka shiner (numbers) Pool 1 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 2 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 3 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 4 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 5 counted______ collected______ preserved______
Sum______ Sum______ Sum______

Species	**Number**					
	Pool 1	**Pool 2**	**Pool 3**	**Pool 4**	**Pool 5**	**Sum**

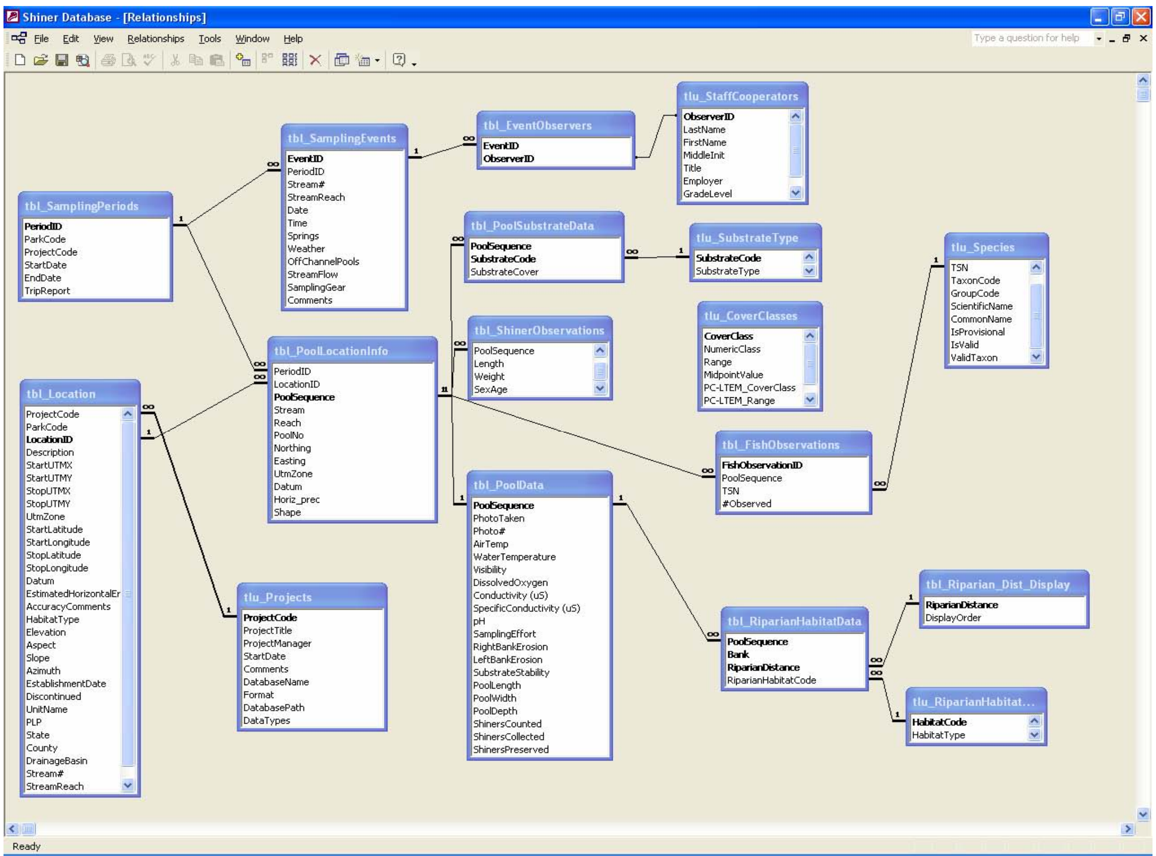
General Comments (aquatic vegetation, stream bed stability, sampling effectiveness, upstream land use, mortality, disease, etc.):____
____
____
____
____
____
____

SUPPLEMENTAL SPECIES INFORMATION DATA – FISH COMMUNITY MONITORING PROJECT

Date: ______________ **Page:** ____ **of** ____

Species	Stream #	Stream Reach	Pool #	Length (cm)	Weight (g)	Sex-age M/F/J/U

APPENDIX B – ACCESS^{tm} database tables and linkages for storage and handling fish community monitoring data.


Shiner Database - [Relationships]
File Edit View Relationships Tools Window Help
Type a question for help
tlu_StaffCooperators
ObserverID
LastName
FirstName
MiddleInit
Title
Employer
GradeLevel
tbl_EventObservers
EventID
ObserverID
tbl_SamplingEvents
EventID
PeriodID
Stream#
StreamReach
Date
Time
Springs
Weather
OffChannelPools
StreamFlow
SamplingGear
Comments
tbl_SamplingPeriods
PeriodID
ParkCode
ProjectCode
StartDate
EndDate
TripReport
tbl_PoolSubstrateData
PoolSequence
SubstrateCode
SubstrateCover
tlu_SubstrateType
SubstrateCode
SubstrateType
tlu_Species
TSN
TaxonCode
GroupCode
ScientificName
CommonName
IsProvisional
IsValid
ValidTaxon
tbl_ShinerObservations
PoolSequence
Length
Weight
SexAge
tlu_CoverClasses
CoverClass
NumericClass
Range
MidpointValue
PC-LTEM_CoverClass
PC-LTEM_Range
tbl_PoolLocationInfo
PeriodID
LocationID
PoolSequence
Stream
Reach
PoolNo
Northing
Easting
UtmZone
Datum
Horiz_prec
Shape
tbl_Location
ProjectCode
ParkCode
LocationID
Description
StartUTMX
StartUTMY
StopUTMX
StopUTMY
UtmZone
StartLatitude
StartLongitude
StopLatitude
StopLongitude
Datum
EstimatedHorizontalEr
AccuracyComments
HabitatType
Elevation
Aspect
Slope
Azimuth
EstablishmentDate
Discontinued
UnitName
PLP
State
County
DrainageBasin
Stream#
StreamReach
tbl_FishObservations
FishObservationID
PoolSequence
TSN
#Observed
tbl_PoolData
PoolSequence
PhotoTaken
Photo#
AirTemp
WaterTemperature
Visibility
DissolvedOxygen
Conductivity (uS)
SpecificConductivity (uS)
pH
SamplingEffort
RightBankErosion
LeftBankErosion
SubstrateStability
PoolLength
PoolWidth
PoolDepth
ShinersCounted
ShinersCollected
ShinersPreserved
tlu_Projects
ProjectCode
ProjectTitle
ProjectManager
StartDate
Comments
DatabaseName
Format
DatabasePath
DataTypes
tbl_Riparian_Dist_Display
RiparianDistance
DisplayOrder
tbl_RiparianHabitatData
PoolSequence
Bank
RiparianDistance
RiparianHabitatCode
tlu_RiparianHabitat...
HabitatCode
HabitatType
Ready

APPENDIX C – List of fish species recorded during surveys at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas in 2001-2003. Fish species are listed by park, family, Taxonomic Serial Number (TSN) and year.

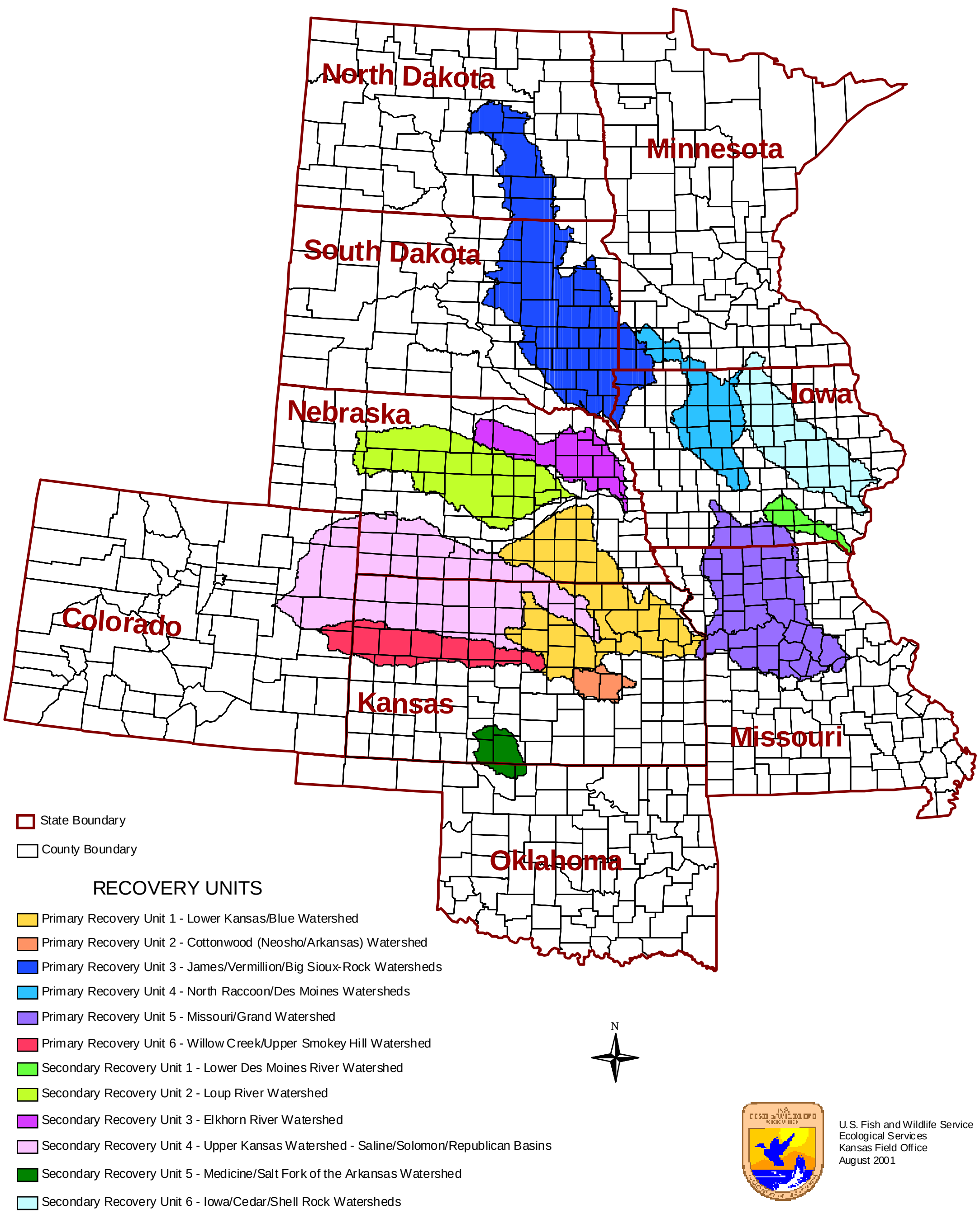
		Year		
Species	TSN	2001	2002	2003
Pipestone National Monument				
Catostomidae				
white sucker (*Catostomus commersoni*)	163895	65	26	132
Cyprinidae				
central stoneroller (*Campostoma anomalum*)	163508	53	57	191
brassy minnow (*Hybognathus hankinsoni*)	163363	2	8	--
common shiner (*Luxilus cornutus*)	163836	40	306	426
bigmouth shiner (*Notropis dorsalis*)	163439	349	72	--
sand shiner (*Notropis ludibundus*)	163419	204	--	131
Topeka shiner (*Notropis topeka)*	163471	1	--	21
bluntnose minnow (*Pimephales notatus*)	163516	23	140	16
fathead minnow (*Pimephales promelas*)	163517	163	102	432
blacknose dace (*Rhinichthys atratulus*)	163382	--	8	4
creek chub (*Semotilus atromaculatus*)	163376	76	10	44
Centrarchidae				
green sunfish (*Lepomis cyanellus*)	168132	--	--	4
orangespotted sunfish (*Lepomis humilis*)	168151	17	2	2
Esocidae				
northern pike (*Esox lucius*)	162139	1	2	--
Ictaluridae				
black bullhead (*Ameiurus melas*)	164039	--	--	4
Percidae				
Johnny darter (*Etheostoma nigrum*)	168369	2	1	10
Tallgrass Prairie National Preserve				
Catostomidae				
white sucker (*Catostomus commersoni*)	163895	--	5	--
spotted sucker (*Minytrema melanops*)	163959	1	--	16
golden redhorse (*Moxostoma erythrurum*)	163939	--	20	13
Cyprinidae				
central stoneroller (*Campostoma anomalum*)	163508	1533	2981	538
red shiner (*Cyprinella lutrensis*)	163792	491	110	58
common carp (*Cyprinus carpio*)	163344	1	--	--
cardinal shiner (*Luxilus cardinalis*)	163828	657	573	496
redfin shiner (*Lythrurus umbratilis*)	163861	297	1109	288
golden shiner (*Notemigonus crysoleucas*)	163368	--	18	6
sand shiner (*Notropis ludibundus*)	163419	105	1	--
rosyface shiner (*Notropis rubellus*)	163409	1	--	--
Topeka shiner (*Notropis topeka*)	163471	9	72	15
mimic shiner (*Notropis volucellus*)	163421	1	--	--
bluntnose minnow (*Pimephales notatus*)	163516	199	370	191
fathead minnow (*Pimephales promelas*)	163517	108	11	12
slim minnow (*Pimephales tenellus*)	163519	23	--	--
creek chub (*Semotilus atromaculatus*)	163376	198	661	270

Appendix C. continued.

Species	TSN	Year 2001	2002	2003
Ictaluridae				
black bullhead (*Ameiurus melas*)	164039	3	10	--
yellow bullhead (*Ameiurus natalis*)	164041	6	7	--
Fundulidae				
blackstripe topminnow (*Fundulus notatus*)	165663	49	28	21
Poeciliidae				
mosquitofish (*Gambusia affinis*)	165878	129	515	301
Atherinidae				
brook silverside (*Labidesthes sicculus*)	166016	3	27	7
Centrarchidae				
green sunfish (*Lepomis cyanellus*)	168132	358	474	164
orangespotted sunfish (*Lepomis humilis*)	168151	13	102	145
bluegill (*Lepomis macrochirus*)	168141	5	107	104
longear sunfish (*Lepomis megalotis*)	168153	8	9	40
spotted bass (*Micropterus punctulatus*)	168161	--	--	1
largemouth bass (*Micropterus salmoides*)	168160	3	7	7
Percidae				
orangethroat darter (*Etheostoma spectabile*)	168368	370	419	179

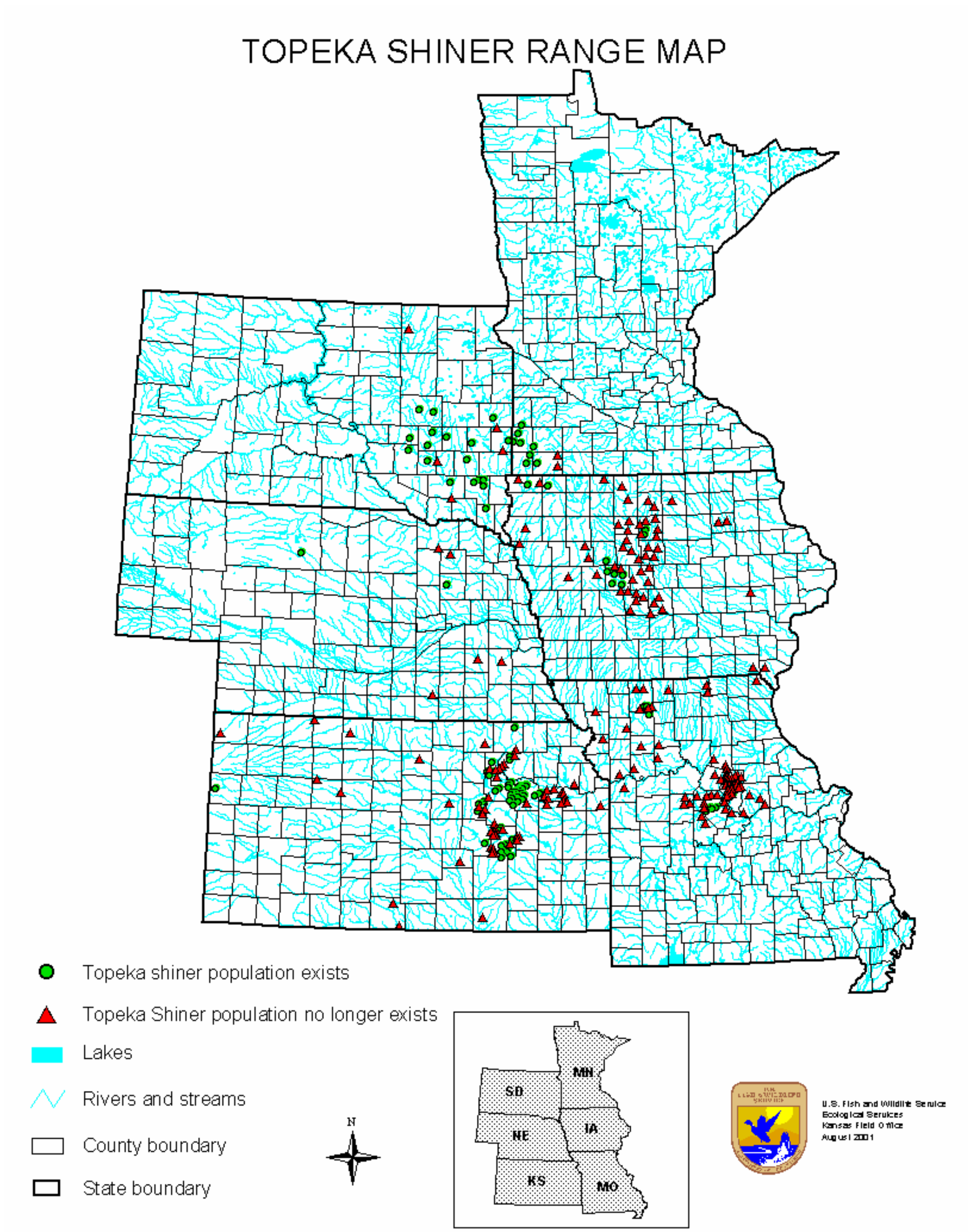
A**PPENDIX D** - Primary (PRU's) and Secondary (SRU's) Recovery Units outlined in the Topeka Shiner Recovery Plan. Also shown is the current range of Topeka shiner.

TOPEKA SHINER RECOVERY UNITS



U.S. Fish and Wildlife Service
Ecological Services
Kansas Field Office
August 2001

APPENDIX D – continued.



Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 01

Before the Field Season

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

Prior to the field season each year, usually beginning in May or June, all observers should review this entire protocol, including standard operating procedures (SOPs). Review of fish identification (SOP #2 "Training Observers") is particularly important; misidentification of a species is perhaps the most serious error you can make during a fish survey. This SOP also gives a brief description of how fish monitoring should be scheduled at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. Preseason planning facilitates the completion of both fish surveys and habitat work. All of the equipment and supplies listed in this SOP should be organized and made ready for the field season, and copies of the field data forms in Appendix A of the Protocol Narrative should be made to write-in-the-rain paper.

I. General Preparation and Review

Procedures:

1. State and federal collection permits must be obtained prior to the start of any fieldwork. Topeka shiner (*Notropis topeka*), a federally listed endangered species and several other state listed species occur in waters sampled with this protocol.
2. Notebooks from previous surveys should be reviewed if available to identify any unique events that may be encountered. A field notebook for the survey year should be prepared with pages for entry of sampling schedules, observer names, field hours and unique happenings that may influence how the data is reported. Trip reports are based on information recorded in field notebooks so it is imperative that they are clearly organized for ease of field note entry.
3. Prior knowledge of fish species most likely to be encountered in a park will aid observers in preparing for the sampling season. Therefore, species lists from previous fish sampling efforts in a park or local area should be compiled and compared to reference manuals to identify species not recorded, which have a probability of being recorded.

Copies of these combined species list should be carried into the field as quick references in helping to identify unknown fish. Appendix D of the Protocol Narrative lists fish species reported in previous sampling efforts at Pipestone National Monument and Tallgrass Prairie National Preserve.

4. Field maps of previous fish sampling events should be compiled or updated in advance of the field season, by park. Copies of these field maps should be carried into the field to ensure that each stream is located and numbered consistently with previous years.

II. Scheduling Field Work

Procedures:

1. Sampling dates, should at minimum approximate those of the previous years, late summer – early fall in order to maintain the seasonality of data collections. Sampling dates out-side those of previous years may be utilized to answer specific research questions (e.g. over winter survival, summer mortality). Sampling dates should be scheduled and logistics organized prior to the start of each field season. Inclement weather and personnel workloads preclude the scheduling of sampling events to specific annual dates. Regardless of when sampling dates are scheduled, both state and federal wildlife law enforcement agencies with jurisdiction over the survey area must be contacted and informed of the dates prior to the start of any fieldwork.
2. Monitoring efforts within Pipestone National Monument will require a four to five person crew approximately two field days to complete. Tallgrass Prairie National Preserve requires an equally manned crew eight to ten days to complete.
3. Two to three stream reaches (ten to fifteen pools) should be scheduled for completion each field day. Determine which stream reaches will be sampled each day based on their proximity to one another. Generally, the closer stream reaches are to one another the more stream reaches that can be sampled in a day.
4. Assessment of in-stream habitat and riparian conditions are complete at the time fish community sampling is done.

III. Organizing Supplies and Equipment

Procedures:

1. An equipment list should be compiled, and equipment organized and made ready for the field season several weeks in advance of the field season. This allows time to make needed repairs and order equipment. The following is a list of field equipment needs for one crew, if two or more crews work simultaneously than equipment needs will change accordingly.

Table 1.01.1. Field equipment list for Fish Community Monitoring and habitat work.

Number Req.	Description
1	YSI 55 Dissolved Oxygen meter
1	YSI 63 Temperature, pH and Conductivity meter
1	120 cm transparent Secchi tube
2	Celsius thermometer
1	GPS unit for recording the location of stream pools and reaches
2	300 mm ruler
1	35 mm camera for vouchering specimens
1	Digital camera for photographing stream pools
2	1/8" mesh minnow seine 1.8-m deep by 2.4-m wide
2	1/8" mesh minnow seine 1.8-m deep by 4.6-m wide
1	1.5 m measuring rod graduated in 10TH m
2	Metal meter stick
2	Aerators
2	100-m tapes (50-m tape may by substituted for one 100-m tape)
2	Small bait size dip nets
2	21/2 to 5 gallon bucket for holding fish and calibrating instruments
1	Cooler for holding fish on hot days
2	Clip boards for recording data and carrying data sheet
3 - 4	Cruising vest for carrying equipment (backpack and hip packs may be substituted)
several	Chest waders or hip boots
1	Fish identification notebook with species separated by parks
several	Reference books for fish identification
1 – 2	80% ethyl alcohol (gallon)
100	Specimen bottles (250 ml)
several	Insect repellent
several	Sunscreen
1	First Aid kit

2. Suggested reference manuals for fish surveys and habitat work at Pipestone National Monument and Tallgrass Prairie National Preserve:

- Page, L.M. and B. M. Burr. 1991. Peterson Field Guide to Freshwater Fishes. Houghton Mifflin Co., New York, NY. 432 pp.

- Pflieger, W.L. 1997. The Fishes of Missouri (revised edition). Conservation Commission of the State of Missouri, Jefferson City, MO. 372 pp.

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 02

Training Observers

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for training observers in fish species identification, habitat data collections and fish species vouchering. This SOP is to be used with the protocol, "Fish Community Monitoring in Prairie Parks with Emphasize on Topeka shiner (*Notropis topeka*)".

I. Identification of Fish

The most essential component for the collection of credible, high-quality fish data is well-trained and experienced observers. Review of fish identification is particularly important each year as the misidentification of species is perhaps the most serious error one can make when sampling fish communities. Species misidentification is a much more serious error than errors in counting individuals.

Procedures:

1. See Appendix D of the Protocol Narrative for a list of fish species likely to be encountered at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. Beginning several months prior to the field-season, review and practice fish identification skills.
2. Observers should pass a minimum proficiency test on the identification of fish species likely to be encountered, correctly identifying all common species likely to be encountered and 90% of the less frequently encountered species (i.e. species encountered less than ten times annually). The ability to accurately identify federal and state listed fish species likely to be encountered is of vital importance.
3. If possible, observers should spend time in the field with other fisheries experts familiarizing themselves with fish species likely to be encountered. The value of field experience can't be underestimated.

4. Suggested reference materials for conducting fish surveys at Pipestone National Monument and Tallgrass Prairie National Preserve:
   - Voucher specimens of species collected at each park. These specimen vouchers include individuals preserved in 80% ethal alcohol and those photographed. Both voucher collections are stored in the Prairie Cluster Prototype Long-term Ecological Monitoring Program Office (PC LTEM), Wilson's Creek National Battlefield, Republic, Missouri.
   - The PC LTEM key to fishes of Pipestone National Monument and Tallgrass Prairie National Preserve.
   - Pflieger, W.L. 1997. Fishes of Missouri (revised edition). Missouri Department of Conservation. Jefferson City.
   - Page, L.M. and B.M. Burr. 1991. Peterson: A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Co. New York, New York.

II. Collecting Habitat Data

Procedure:

1. Prior to entering the field, familiarize yourself with using GPS data collection units and procedures, SOP #3. Someone familiar with the protocol will assist with training to ensure that each crew can consistently and correctly operate the GPS unit.
2. Prior to entering the field, familiarize yourself with using YSI 55 data collection units and procedures, SOP #4. Someone familiar with the protocol will assist with training to ensure that each crew can consistently and correctly operate the YSI 55 meter.
3. Prior to entering the field, familiarize yourself with using YSI 63 data collection units and procedures, SOP #5. Someone familiar with the protocol will assist with training to ensure that each crew can consistently and correctly operate the YSI 63 meter.
4. Prior to entering the field, familiarize yourself with the habitat data collection procedures, SOP #8. Practice estimating cover for the different substrate types and identifying riparian habitat types. Someone familiar with the protocol will assist with training to ensure that each crew can consistently and correctly estimate cover and identify habitat types.

III. Collecting Voucher Specimens

Procedure:

1. Prior to entering the field, familiarize yourself with using a 35-mm camera to voucher fish species.
2. Prior to entering the field, familiarize yourself with preserving fish specimen with 80% ethyl alcohol. Presently, Topeka shiner specimens are being reposited with the Kansas Museum of Natural History, University of Kansas, Lawrence. Therefore, it is the responsibility of the observers to familiarize themselves with the labeling requirement of this institution. If other institutions are used, labeling requirements may vary and their requirements must be identified prior to the start of sampling.

3. All specimens reposited with PC LTEM must be labeled with common name; scientific name; stream, park, county and state where the specimen was captured; date of capture and preserving agent.

IV. Literature Cited

Pflieger, W.L. 1997. Fishes of Missouri, revised edition. Missouri Department of Conservation. Jefferson City. 372pp.

Page, L.M. and B.M. Burr. 1991. Peterson: A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Co. New York, New York. 432pp.

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 03

Using GPS

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This Standard Operating Procedure (SOP) explains the procedures that all observers should follow when collecting geo-spatial data or navigating to sampling reaches using a Mapping Grade GPS Receiver unit. This SOP is intended to complement but not replace the operations manual accompanying your GPS unit. Therefore, each observer must be familiar with the use of their particular GPS unit before entering the field to collect data or navigate between points. This SOP summarizes the instruction manual and provides procedures for applying GPS technologies to the protocol, "Fish Community Monitoring in Prairie Parks with Emphasize on Topeka shiner (*Notropis topeka*)".

I. Required Equipment

(1) GPS unit
(2-4) batteries depending on GPS unit
(1) notebook
(3-4) pencil
(1) watch
(1) compass
(1) radio or cellphone
(1-3) bug repellent
(1) operations manual

Minimum GPS Receiver Standards for Mapping and Navigating should be:

- Capable of producing and storing data in a format compatible with standard base station data used to perform differential corrections (rinex, ssf, etc.).
- Capable of storing attribute data about features collected.
- Capable of storing time and coordinates of features collected.
- Capable of exporting features collected to a format that can be used by a GIS

Minimum GPS Receiver Settings Standards

Name	**Standard**
Almanac	acquired within 10 days prior to data collection or navigating
Altitude reference	Height above Ellipsoid (HAE) or Mean Sea Level (MSL); if MSL is used, indicate Geoid Model
Antenna heights	1.0 – 2.0 meters
Datum	NAD 83
Elevation mask	15 degrees
Feature types	point, line, area (polygon)
Logging intervals	Point 1 second
Minimum number of positions for a point feature	50
Mode	3D
PDOP Mask	6.0 or less
Position mode	manual 3D
Satellite vehicles	4
SNR Mask	6.0 or greater
Unit of Measure	Meters

Systematic Errors (modified from Arkansas State Land Information Board, 2001)

Positions acquired using GPS receivers are determined based on a measurement of time and distance. Receivers calculate the time and distance from a minimum of three satellite vehicles to acquire a horizontal position and four satellite vehicles to acquire a 3D (horizontal and vertical) position. There are several known sources of error that should be taken into consideration when collecting GPS positions.

Atmospheric delay: occurs when GPS signals are interrupted by the earth's ionosphere and troposphere. As the signal is disrupted, the time it takes to reach the earth is altered, and can contribute approximately 1 meter of error. Since GPS positions are determined by time and distance, this alteration in time has an adverse effect on the accuracy of GPS fixed positions collected. The heat of the day is when atmospheric delay is greatest. Satellite vehicle signals low on the horizon also experience higher delays because the signal travels through more atmosphere.

Dilution of Precision (DOP): is the combination of error factors caused by poor satellite vehicle geometry that can alter position and time solutions. The receiver is using trilateration to determine its fixed position. If the satellite vehicles are not properly spaced the DOP values are higher and the horizontal position is degraded. Setting the receiver to accept positions when the PDOP is 6.0 or less (lower is better) will control this source of error by not allowing data with high DOPs to be saved by the receiver. Errors incurred by PDOP's higher than 6.0 can cause approximately 1 meter of inaccuracy.

Multipath error: occurs when a satellite vehicles signal is reflected off an object prior to reaching the receiver, thus causing a time delay. This can cause several meters of error. Buildings, trees, mountains, signs, etc, may cause multipath errors. Generally multipath errors are easily recognized when the GPS data collected is viewed in a geographic information system (GIS).

Obstruction errors: occur when the GPS receiver loses a lock from a satellite vehicle from which it is receiving code. Receivers and base stations both require a clear view of the sky. Weather generally does not affect the functionality of a receiver. Extreme conditions could impede a receiver's performance. A clear view of the sky is one that is not blocked by solid objects.

Satellite vehicle clock error and receiver rounding error: also contribute to GPS data inaccuracies.

Operator error: caused by using the wrong datum or coordinate system is the biggest source of error and may result in 100+ km of error.

Selective availability (SA): is an intentional degradation of the code sent from satellite vehicles. The Department of Defense degrades the code. On May 1, 2000 the Department of Defense turned off selective availability. Selective availability may be activated anytime and without notice. Errors caused by selective availability can be difficult to observe. Post-processing aids in removing time and location errors collected by the receiver. Most mapping grade receivers come with post-processing software. All fixed positions collected should be post-processed. This will increase and standardize horizontal and vertical accuracies. Raw data from the receiver and base station should be archived. Future software may allow for finer post-processing accuracies.

II. Using a GPS unit

Planning a field day

In order to facilitate data collection; ask your GIS Coordinator for the most current almanac available. The almanac is a set of data that is used to predict the timing and path of satellite orbits over approximately a month long period. For your GPS unit to function properly and collect accurate geo-spatial data there must be at least 4 satellites overhead and preferably more. In addition, PDOP must be less than 6. Schedule your field work, based on the almanac information, at a date and time when the PDOP is <6 and the number of available satellites is $\geq$ 4.

Setting up Data Dictionary

When collecting geo-spatial data, name the file in your GPS unit that data will be stored in. This file will be exported into a shapefile. If you don't name it, your data will be named a 'default' point, line, or polygon which may become confused with other files on your GPS unit.

You will need to name the features within the database. Names should correspond with field names from each project database. You will also need to designate the features as a point, line, or polygon. You will also need to define attributes you wish to record for each field in a data file. Designate whether the field entry of an attribute is optional (normal), required or not permitted. Continue until all attributes in the data file have been entered.

Setting up filters for data collections

Most GPS systems come configured with default filter settings. However you may need to make changes to these settings before going out in the field. The logging intervals and minimum positions for point and line features may need to be configured for each session, see standards listed above. Additional changes may be necessary depending on where you are collecting data. It is essential that the coordinate settings be confirmed before collecting or uploading data.

Coordinate settings for Prairie Cluster Prototype Long-term Ecological Monitoring Program parks

Park	UTM Zone	Datum
AGFO	13 North	NAD 1983 (Conus)
EFMO	15 North	NAD 1983 (Conus)
HOME	14 North	NAD 1983 (Conus)
PIPE	14 North	NAD 1983 (Conus)
SCBL	13 North	NAD 1983 (Conus)
TAPR	14 North	NAD 1983 (Conus)
WICR	15 North	NAD 1983 (Conus)

Loading Waypoint

Waypoints are named 3 dimensional positions on the earth's surface. Waypoints are assigned to fixed locations in the field so they can be navigated to consistently and accurately through time. Waypoints are generated and stored in computer databases and must be loaded onto the data logger prior to navigating to these points.

Pre-trip planning

It is essential to plan your travel route in the field. When you are recording data, having knowledge of the area allows you to maximize your time in the field by allowing you to work on several features on the same trip. In addition, the topography of the area where you are collecting data may require changes in the Data Logger's configuration. Knowing where features are located will help you prepare the data dictionary in the Data Logger for recording information in the field.

Pre-trip planning will also allow you to load required waypoints for navigating in the field. A map of the park with waypoint locations on it should be printed out prior to entering the field. This map should be used to plan the order in which waypoints will be visited. The observer should carry a copy of the map in the field to aid in navigating between points and for choosing alternative waypoint locations if the need arises.

Navigating to waypoints

GPS units provide a fast and accurate way for navigating to and between known points in the field (waypoints). From the appropriate data file on the Data Logger choose the pre-loaded waypoint you want to navigate to. Using the arrow on the handheld receiver navigate in the direction of the waypoint until it is located. From this point the next waypoint can be chosen and the direction to it determined. Pre-planning your survey route allows the observer to navigate between waypoints in close proximity to each other, thus allowing for more points to be visited during a field day.

Collecting data

Data collection can be done with data stored in a newly created database on the data logger or in an existing database not older than seven days. In either case data is generally stored in the central memory of the Data Logger. If storage space becomes a concern many GPS units contain Flash Cards (data disk) onto which data can be stored. When recording data, make sure you are where you want to be when you restart (a few feet makes a difference). Be sure and name each feature in the data dictionary that data is collected on so it can be identified later in GIS.

Many GPS units allow you to collect nested features when collecting line or polygon data. This option allows you to collect data on features that are located in or around your travel route. However, you must first transfer the Data Dictionaries for features you are likely to encounter to the Data Logger before leaving the office. If you do not, your nested points will be downloaded as generic points without feature identification. If the nested feature is not on the line you are recording, first press the *Pause key* on your unit then travel to the feature. Record the nested feature to the data file, then return to the same place you left your line and resume collecting data.

Sometimes it is necessary to collect data from a position in order to identify a second location of interest that is not accessible. This is referred to as offset data collection. The offset configuration calculates a position taking into account the change of location.

Downloading data

At the end of each field day data should be downloaded to a PC computer for safe keeping and differentially corrected as soon as possible. If this is not possible, download data and differentially correct as soon as you return to the office.

III. Literature Cited

Arkansas State Land Information Board. 2001. Standards for collecting mapping grade global positioning system positions. **http://www.gis.state.ar.us/LIB/Projects/GPS.htm**

APPENDIX A Glossary of Terms Critical to Using a GPS Unit (modified from Arkansas State Land Information Board, 2001).

Accuracy - an indication of how closely a measurement is to the true value.

Almanac - location and time supplied by satellite vehicles orbiting the earth. This information contains estimated position of satellite vehicles, precise time corrections, and potential atmospheric delay parameters.

Attributes - tabular information supplied about features. Tabular information should include latitude and longitude coordinates for the data GPS collected features. It may include other information such as feature type, quality, time, etc.

Autonomous - calculating a fixed position based solely on satellite vehicles information and a receiver. This is the least accurate means of GPS collection and typically produces accuracy errors ranging from 10-100 meters.

Base station (base receiver / base unit) - a GPS receiver that is placed in a precisely known location and serves as a means, by which the positions collected by all other receivers can be corrected. A base station is used to collect data from a number of satellite vehicles at a known position. This information may be used during real-time and differential correction processes.

C/A code- the standard (Coarse/Acquisition) GPS code; also known as the civilian code or S-code. A sequence of 1023 pseudo-random, binary, biphase modulations on the GPS carrier at a chip rate of 1.023 mhz.

Carrier phase - the difference between the carrier signals generated by the internal oscillator of a receiver and the carrier signal coming from the satellite vehicle.

Code - precise time and location information emitted by satellite vehicles.

Datum (geodetic datum) - a mathematical model that is designed to fit a point on the earth's surface to an ellipsoid. Commonly used datum's are North American Datum (NAD) 1927, and NAD 1983. GPS coordinates are based on the World Geodetic System 1984 (WGS84 datum).

Differential Correction - the process of improving fixed positions utilizing data from a base station.

Dilution of Precision (DOP) - refers to the geometry of satellite vehicles to the position of a GPS receiver. There are several types of DOP. The most common type of DOP is termed PDOP (position dilution of precision).

Elevation Mask - the minimum angle at which a GPS receiver will track satellite vehicles.

Feature - the physical location of spatial data. A GPS receiver typically collects points, lines, and areas (polygons).

Fixed position - the spatial location computed by averaging a predetermined number of positions. A fixed position is the single point or points (line and area) derived from a number of positions accepted by the GPS receiver.

Global Positioning System (GPS) - a constellation of a minimum of twenty-four satellite vehicles orbiting the earth approximately every twelve hours at an approximate pacing of sixty degrees.

Ionosphere - the part of the earth's atmosphere in which ionization of atmospheric gases affects the propagation of radio waves, which extends from about 30 miles (50 kilometers) to the exosphere, which is divided into regions of one or more layers whose altitudes and degrees of ionization vary with time of day, season, and solar cycle, and which is contiguous with the upper portion of the mesosphere and the thermosphere.

Julian Date - Day of the year between the range of 1 and 365. For example, the Julian Date for February 2 is #33. February 2 is the calendar date.

Lines **–** geographic term related to the scale that describe how a feature is drawn. Lines are linear measures of a feature.

Mapping grade - GPS receivers capable of attaining five meters of accuracy or better using differential correction.

Metadata - data about the content, quality, condition, and other characteristics of data.

Multipath - error which occurs when a GPS signal sent from a satellite vehicle is bounced or redirected by an object, prior to reaching a GPS receiver. Multipath will cause the time it takes a GPS signal sent by a satellite vehicle to reach a GPS receiver to be inflated. This will cause inaccuracies in positions collected.

PDOP mask - the maximum PDOP value that a receiver will accept positions.

Phase differential - utilizes radios to transmit signals between a mobile GPS receiver and a base station in order to differentially correct data as it is being collected.

Points – geographic term related to the scale that describe how a feature is drawn. Points are single dimensional features.

Polygons **–** geographic terms related to scale that describe how features are drawn. Polygons have area associated with the feature.

Position - spatial location acquired from positions averaged to determine a fixed position.

Post processing - utilizing base station data, GPS software, and data acquired by a GPS receiver in the field to gain an accurate fixed position.

Precision - the degree of refinement with which an operation is performed or a measurement stated.

Pseudo-random code - a signal with random-noise like properties. It is a very complicated but repeating pattern of 1's and 0's.

Receiver, rover, GPS unit / handheld - a mobile GPS receiver that consists of an antenna, and computer that will collect and store code sent from satellite vehicles.

Selective Availability (SA) - implemented by the United States Department of Defense, degrades the satellite vehicles signal sent to receivers. SA may be turned off or on at anytime. A GPS user should always assume SA is on and take the necessary steps to correct the GPS data collected.

Signals - *see code*

Signal-to-noise ratio (SNR) - a measure of the strength of a satellite signal. SNR ranges vary based on a number of factors. GPS data should only be collected when the SNR value is six or higher.

Spatial data - information that identifies the geographic location and characteristics of natural or constructed features and / or boundaries on the earth.

Trilateration - position of an unknown point is determined by measuring the lengths of the sides of a triangle between the unknown point and two or more known points (i.e. satellite vehicles).

Troposphere - the lowest densest part of the earth's atmosphere in which most weather changes occur and temperature generally decreases rapidly with altitude and which extends from the surface to the bottom of the stratosphere.

***Waypoint* –** is a named 3 dimensional position on the earth's surface. That is, it has horizontal and vertical positions such as latitude and longitude. Waypoints are assigned to a fixed location in the field so it can be navigated to consistently and accurately through time.

APPENDIX B. Standard Operating Procedure (SOP) for Using a Trimble™ Pro XR GPS Unit.

This Standard Operating Procedure explains the procedures that all observers should follow to learn how to use the Trimble Pro XR GPS units to collect data and navigate to plots.

REQUIRED READING

Trimble General Reference Manual:

Section 1.3, pages 1-14 to 1-20; Introduction to GPS

Section 2.1 – 2.3, pages 2-1 to 2-6; Introduction to GIS: Data Capture, Data Types, and Data Structure

Section 3.1 – 3.2, pages 3-1 to 3-7; Collecting GPS Data for a GIS

Section 4.2 – 4.4, pages 4-10 to 4-31; GPS Accuracy: Planning Data Collection
Data Collection Parameters
Date Collection Procedures

Pro XR Receiver Manual: Section 4, pages 4-1 to 4-16

TSC1 Asset Surveyor Operation Manual: Section B, pages B-1 to B-8

I. SCHEDULING FIELD DAYS

For your GPS unit to function properly and collect accurate geographic locations there must be at least 4 satellites overhead and preferably more. In addition, PDOP (the measurement of relative accuracy) must be less than 6. Schedule your field work at a date and time when the PDOP is <6 and the number of available satellites is ≥ 4. In order to facilitate your data collection; ask the GIS Coordinator if the most current almanac is available, if it is not have one downloaded at this time. The almanac is a set of data that is used to predict satellite orbits over approximately a month long period.

To access current almanac

1. Open **PATHFINDER OFFICE** by double clicking on the icon on the desktop – the *Select Project* window will appear. For a specific park select the corresponding project, otherwise close the window and continue.

2. Go into -> click on *Utilities* and choose *Quick Plan* from the drop down menu.

3. Select Date by choosing *Today*, *Tomorrow*, or *Day after Tomorrow*
   a - Click on *Prev Month* or *Next Month* if the wrong month is displayed

b - If necessary, enter the *Julian* date (see Appendix A for definition) in the lower left corner and the *calendar* date in the lower right corner.
c -Press **ok** to close the dialog box.

4. *Edit Point* defines the latitude and longitude location where observations are taken. You can change the default location by clicking on *Cities* and selecting the appropriate city (e.g. Philadelphia) if it did not appear as the default location - click **ok** to accept changes. Close *Edit Point* by pressing **ok.**

5. *Status* window opens summarizing the information discussed in number's 2 and 3. Confirm the information and close the window.

6. You will now be in the *Plan: session #* window. Click on *Graphs* and choose *Number of SV's and PDOP* to get a graphical image of the number of visible satellites and the PDOP for the specified day and time. If your PDOP is above 6, that's too high and the GPS unit will reject readings. This also occurs when there are less than 4 satellites available. Therefore, you must schedule your field work for a date and time when PDOP is less than 6 and there are 4 or more satellites available.

II. PRE-TRIP PLANNING

Plan walk

It is essential to plan your route. When you are recording data, having knowledge of the area may allow you to maximize your time by allowing you to work on several features on the same trip. In addition, the topography of the area where you are collecting data may require changes in the Data Logger's configuration. The GIS coordinator will help you with any changes.

Knowing where features are located will help you prepare the Data Logger for recording information in the field. Pathfinder Office allows you to create a form for data collection in the Data Logger. This is accomplished by preparing Data Dictionaries in Pathfinder Office. They are then transferred to the Data Logger for your field work. When you return from the field, the information you recorded with the Data Logger is downloaded to the computer. The GIS Coordinator is then able to export the information directly into Arcinfo as a table.

To prepare/access Data Dictionaries

See Appendix A for definitions of terms with which you are unfamiliar.

1. Go into Pathfinder Office and click on *Utilities* to open the *Data Dictionary Editor*

2. Name the file – this will be the name that will be exported into Arcinfo. If you don't name it, your data will be named a 'default' point, line, or polygon.

3. Click on *New Feature* and enter a feature name. Feature names should correspond with fieldnames from each project database. Next designate the feature as a point, line, or polygon.

To change the name or designation of a feature, click on *Edit Feature*

4. To define attributes you wish to record in the field, click on *New Attribute* and pick *New Attribute Type* (listed below).

a) Menu – letters, numbers, or other characters. Can select only one value (use for the comment field and possibly the name field if you know all the possible names)
b) Numeric – numbers only, with decimal point (use for the i.d. #)
c) Text - letters, numbers, or other characters. Can enter any value – use for the name field if you don't use a menu
d) Date – collects a date value
e) Time – collects a time value
f) File Name – collects a file name
g) Separator – are added to break up the list of attributes and increase readability, but are not attributes and do not contain attribute values.

5. Type in *Attribute Name* and click on *New*. Type in attribute value and click *Add.* These could be the names of attributes or measurements associated with attributes. Designate whether the field entry of an attribute is optional (normal), required, or not permitted. Continue until all attributes have been entered.

III. SYSTEM ASSEMBLY

Trimble Unit Assembly

1. Each gps unit is stored in it's own case in the field equipment closet. Even though parts are interchangeable the units should be stored as complete sets.

2. At least three hours before anticipated use check to ensure that batteries have been fully charged.

3. Install three VCR batteries in the carry-pack. Two of these will be connected to the clips that are in the carry-pack. The third battery is carried as a spare. These clips are to be handled carefully. When returning the GPS unit for storage be sure to disconnect the batteries.

4. After installing the three VCR batteries, zip the carry-pack closed.

5. Carefully attach the satellite receiver (the white disk) to the top of the antenna

6. Go outside now so that you won't crash into walls. Set up the antenna to carry with the backpack and connect the long cable to the satellite receiver. The extra cable can be inserted in either the pocket of the carry-pack or in storage places on the belt of the carry-pack.

7. Connect the 2^{nd}, shorter cable to the Data Logger

Configuring the Data Logger

The system is already configured with default settings, but you may need to make changes before going out in the field. The logging intervals and minimum positions for point and line features may need to be configured for each session's use. Additional changes may be necessary depending on where you are collecting data.

CRITICAL SETTINGS:

SETTING	DEFAULT VALUE	SET TO AT WICR	USER GUIDE PAGE
Logging intervals	5 seconds	**1 second**	
Point feature	5 seconds	**1 second**	
Line/area	none	none	5-5
Not in feature	none	none	
Velocity			
Minimum positions (point feature)	3	**50**	5-8
Minimum Time (carrier phase)	10 minutes	N/A	5-10
Position Mode	Manual 3D	Manual 3D - possibly Auto 2D/3D in woods	5-14
Elevation Mask	15 degrees	15 degrees	5-17
SNR ratio	6.0	6.0 - may need to drop to 3 in woods	5-18
PDOP mask	6.0	6.0	
PDOP switch	6.0	6.0	5-19

NON-CRITICAL SETTINGS:

SETTING	DEFAULT VALUE	SET TO AT WICR	USER GUIDE PAGE
Audible Click	Yes	Yes	5-22
Log DOP Data	Yes	Yes	5-23
Dynamics Code	Land	Land	5-24
Antenna Options			
Height	meters	meters	
Measure	vertical	vertical	5-36
Type	EC	EC	
Confirm	Per feature	Per feature	

It is essential that the coordinate settings be confirmed before collecting or uploading data.

1. Turn on the Data Logger by pressing the Green-on/off button. The ***Main Menu*** screen will appear with the following options:

Data collection
File Manager

Configuration
Utilities
Navigation
Map
Receiver status
Satellite information

2. Using the arrow pad scroll down to ***Configuration***. Press **enter**. The ***Configuration*** screen will appear with the following options:

GPS rover options
GPS base station options
Communication options
Coordinate System
Map display options
Navigation options
Units and Display
Time and Date
Quickmarks (after this, use the arrow pad to scroll down further)
Constant Offset
External Sensors
Hardware

Highlight ***Coordinate System***, press **enter.** The ***Coordinate System*** screen has a listing of available projections. If UTM is not selected select it now and press **enter.** Datum should always be set to NAD 1983 (Conus). Zone should be selected based on the following table.

Park	UTM Zone	Datum
AGFO	13 North	NAD 1983 (Conus)
EFMO	15 North	NAD 1983 (Conus)
HOME	14 North	NAD 1983 (Conus)
PIPE	14 North	NAD 1983 (Conus)
SCBL	13 North	NAD 1983 (Conus)
TAPR	14 North	NAD 1983 (Conus)
WICR	15 North	NAD 1983 (Conus)

In order to change the Zone you must highlight this option and then press the **right arrow**. A menu listing all possible zones will appear. Use the arrow pad to scroll to the appropriate zone. Once you have selected the proper Zone press **enter**. Upon returning to the main projection menu ensure that the Datum is still set to NAD 1983 (Conus). If this is not the case scroll down to **Datum** and press the **right arrow**. Scroll through the list until you have selected to NAD 1983 (Conus). Press **enter**. Next scroll down to Altitude reference. This should be set to HAE. If it is not highlight this option and press **enter.** If all of the information is correct press **enter** a second time.

IV. FILE TRANSFER from PC to DATA LOGGER or Data Logger to PC

Check that you have all the necessary equipment and that it is operational. You can do this by setting up and connecting the Data Logger.

<u>Connecting the Data Logger to and transferring data from PC to Data Logger</u>

1. Connect cable from the PC to the Charging Unit (the cable extends from the back of the computer's hard drive tower and fits onto the end of the Charging Unit marked Computer).

2. Connect the cable from the Data Logger to the Charging Unit port labeled Data Logger.

Alternatively: The Data Logger may be connected directly to the PC if the battery in the Data Logger is sufficiently charged.

3. Turn the GPS unit on by pressing the **Green/On-Off** button. After a moment you will get a message on the screen saying that the GPS cabling has not established a connection and would you like to try again. Answer **no** using the softkey F1.

4. The Data Logger will show the *Main Menu* screen. Use the arrow pad to scroll down to File Manager, press **enter**. Use the arrow pad to scroll down to File Transfer, press **enter**.

5. In Pathfinder Office, click on *Utilities* and choose *Data Transfer***.** A message will appear - *connecting to data logger*. This connection will either happen quickly or it will not work due to problems with the set up. If this occurs, check the cabling and your sequence of events. Also check that the cable is attached to the proper COM port.

6. Once the connection is made, check with the GIS coordinator that the Source Directory is correct.

7. Ensure that the Send Tab has been selected.

8. Choose *Data Type* (ex: Data Dictionary, Waypoints). Click your mouse to highlight the file(s) you wish to send to the Data Logger. To choose more than one file, hold the shift key while highlighting. Click on Add then click on *Transfer.*

9. After the transfer is complete close *Data Transfer* window and close Pathfinder Office.

Note: Reverse data transfer procedure when up loading data from the Data Logger to a PC.

V. DATA CAPTURE

1. From the ***Main Menu*** screen scroll to *Data Collection* and press **enter**. Select from one of the following.

   Create new file
   Open existing file
   Create base file

2. Highlight ***Create new file***, press **enter** to get the Create new file screen with the following information:

   Filename:
   Data dictionary:
   Storage disk:
   Free space:

For the Filename you will see a default file name based on the following format.

File Naming Convention: RMMDDHHx
File Prefix = R (for Rover)
Default Naming Formula: R
MM (month)
DD (day)
HH (hour)
"x" = "a" at the start hour, "b" at the second hour, etc.
Example: May 25 at 10:00 am = R052510a

If this works for your particular project scroll down to Data dictionary and press the right arrow. If the data being collected does not have a specific data dictionary select Generic and press **enter**.

Normally files will be stored in the central memory of the Data Logger. If storage space becomes a concern please use the GPS unit containing the 64mb Flash Card. In order to access this card select Storage Disk and press the right arrow. This will provide you with the options of TSC1 (the Data Logger) or PC card. After making your selection press **enter**.

3. The ***Antenna Options*** screen will appear next -> press **enter** (settings are default and should be left as you find them).

4. The Start feature screen will appear next. Scroll down to the feature type you wish to collect and press **enter**.

5. The next screen to appear will have the form with your Data Dictionary for you to fill out. For point features, enter the values while collecting satellite positions. For line or area features, first *pause* the unit by pressing the softkey **pause (F1**). While the unit is paused, enter the values and press the softkey **resume (F1)** to start collecting data. Make sure you are where you want to be when you restart (a few feet makes a difference).

6. Filling out the Data Dictionary:
   a. A mark means it is a menu choice and you can press **enter** to get the menu. Highlight your choice and press **enter.**

b. If there is only a question mark, fill in the value or text that goes with the feature you are recording and press **enter** after each data entry.

c. While on the main screen **DO NOT PRESS ENTER** until you are finished collecting satellite positions for that feature; if you do the unit will stop collecting data.

7. Close feature when finished by pressing **enter**.

8. The screen ***Start feature*** will reappear. To begin a new feature repeat steps 6 through 8 or exit data capture by pressing **ESC** key and repeat until you are back at the main menu.

9. Note End Time (and location if different from where you started) for every file. **Write down the file name and the date and time each file was collected in your field notebook !!**

10. Data Logger may be turned off by pressing the **Green-On/Off** button when the main menu screen is showing.

VI. FIELD OPTIONS

<u>Nested Features</u>

This option allows you to collect data on features that are located in or around your travel route. You must first transfer the Data Dictionaries for features to the Data Logger before leaving the office. If you do not, your nested points will be downloaded as 'generic'.

EXAMPLE: When you are recording a trail and want to identify things such as downed trees, trail signs, etc., you could use this option.

1. If the nested feature is not on the line you are recording, first press the softkey **Pause (F1)**, then travel to the feature.

2. When you are ready to record the nested feature, press the softkey **Nest (F3)** to pop up a menu of point features that can be nested with that feature. Scroll to and highlight the appropriate point feature by using the arrow key, press **enter.**

3. Press the softkey **resume (F1)**.

4. While collecting satellite positions fill out the Data Dictionary and press **enter.** Save the nested feature by pressing **enter.** This returns you to the ***Data dictionary form*** screen.

5. Return to the same place you left your line or area feature.

6. Press the softkey **Resume (F1)** to continue collecting data.

7. When you want to record another nested feature, press the softkey **Nest (F3)** and repeat the process.

8. When you complete data capture for your line or area, press **enter** to save. This takes you back to the ***Start Feature*** screen.

Quickmarks

Use this option when you either can't or do not want to stop and record satellite positions for the feature. It will not be as accurate, but will estimate the feature position from the locations of features recorded before and after your quickmark.

It is essential that the Data Logger be configured with the correct time and date so the unit knows which positions to use. As with nesting features, in order to quickmark points in association with a line or area feature, Data Dictionaries for those features must be transferred to the Data Logger. If not, all your points will be downloaded as 'generic'. To record quickmarks do not *pause* from data collection

1. Press the softkey **Quick (F4)** to record a quickmark location. The selection of point features will appear on the Data Logger screen (generic and any Data Dictionaries you downloaded). Highlight your choice and press **enter.**

2. It does not matter if you have passed the quickmarked feature when you fill out the Data Dictionary.

3. The choice of whether to edit quickmarks in the field is made at the beginning of data collection by selecting ***Configuration*** from the ***Main menu*** screen -> scroll down to *Quickmark* and highlight -> press **enter**.

4. You will get two fields to define:
   - Attributes: *Default* (the values dictated by the Data Dictionary)

   - Confirm: choose *Yes* to review and/or edit the attributes. Choose *No* and the default attributes are saved.

5. Press **enter** to return to the Configuration screen. Press the **ESC** to return to the ***Main menu*** screen.

Offsets

This option is used when it is not possible to collect GPS positions at a feature due to interference and you must stand to the side. The offset configuration calculates a position taking into account the change of location.

EXAMPLE: If you want to record the corners of a building, the structure will interfere with data collection. Using the offset feature will allow you to move away from the building and still get the locations.

1. The choice of whether to offset features in the field is made under the ***Configuration*** screen -> scroll down to *Constant offset* and highlight -> press **enter**.

2. The default is no offset.

3. Highlight either point, quickmark, line, or area. Press **enter** and fill in values.

4. The assigned offset values will then automatically apply to each point, line, or area recorded.

5. Pressing the softkey **Format (F2)** allows you to choose between 2 methods of describing the offset.

6. After all values have been updated press **enter** to accept the values and return to the previous screen.

7. An offset can be reset to zero by following the steps listed above and then pressing softkey **Reset (F1)**.

Point Feature Offsets:

a) The easiest option to display a constant offset is as a bearing (the angle from true north), a horizontal distance (from the feature), and a vertical distance (above the horizontal distance).

b) Your other option is to enter a bearing, the slope distance (a range), and the inclination (the angle above or below the horizon).

Quickmarks, Line or Area Feature Offsets:

a) Your easiest option is to enter the option as a direction (left or right of the feature, a horizontal distance, and a vertical distance.
b) Your other option is to enter the direction, slope distance, and the inclination.

8. If you are using a constant offset and a feature doesn't need it press the softkey **Offset (F4)** then press softkey **Reset (F1)**. Press softkey **Yes (F1)** to confirm this change. Press **enter** to return to the data collection screen

9. All features (points, lines, areas, or quickmarks) can have only one offset associated with them.

10. If you need to change the offset when recording a line feature, it is necessary to segment the line so that each line segment has its own offset.

11. Be careful capturing area features with an offset, as the same offset value must apply to the entire area feature. If you need to vary the offset, you can do so by collecting the area as a series of line features or segmented lines.

12. **Applying Offsets to a specific feature:**
Offsets can be applied to a specific feature even when a Constant offset has not been established.
   a) During the collection of a feature press the softkey **Offset (F4)**.

   b) Press the softkey **Format (F2**) to switch between the two methods of display and input the appropriate values. Press **enter** to return to the data collection screen.

Segmenting a Line

1. Choose your Data Dictionary from the ***Start Feature*** screen and press **enter**.

2. You must finish entering the attributes of one line segment before you can start the next segment. When you press the softkey **Seg (F4)**, the Data Logger will confirm the previous segment's Data Dictionary values. You will have to wait at a halt to complete the first feature before starting the next segment.

3. Press the softkey **Seg (F4)**, enter values into the Data Dictionary and press **enter**. Press the softkey **Seg (F4)**. This will give you the Data Dictionary with the previous segment's values highlighted. Enter the new value for the new segment and press **enter.**

4. If there is satellite interference, the new segment will not begin at the same location as the previous segment ended.

Navigation

Navigation can be used for movement to known Waypoints and between known Waypoints. A waypoint is a named 3 dimensional position. That is, it has horizontal and vertical positions such as latitude and longitude. The 3rd position is elevation.

1. Waypoints can be recorded using 3 methods:
   a) Use the GPS unit when you want to save a location identified in the field.
   b) Plot waypoints from a map.
   c) Generate waypoints in Pathfinder Office.

2. Waypoints can be assigned in Pathfinder Office in two ways:
   a) Import a comma delimited file (csv) containing X, Y coordinates and a unique name for each waypoint (ex. 410021, 6454433, "waypoint1").
      - Click on *File* -> choose *Waypoints* to get a choice of *New*, *Open*, and *ASCIII Import.* Select *ASCII Import*.
      - Change *Files of type* to Comma-separated files (*.csv).
      - Browse to the location of your csv file. Select it and click *Open*.

   b) Open a new waypoint file and in the Waypoint Properties window, fill in the Latitude, Longitude, and Altitude fields.
      - Click on *File* -> choose *Waypoints* to get a choice of *New*, *Open*, and *ASCIII Import.* Select *New*.

- Name the new waypoint file and browse to where you would like it to be stored.
- Under the *Waypoint Properties* dialog box select create.
- Name the new waypoint, add a north and south coordinate (Altitude is optional), and click *Save*.
- When you are finished adding waypoints click *Close*.

For transfer of waypoints from computer to the Data Logger please refer to section IV.

3. Using the Data Logger to Navigate in the Field**:**
   a) From the ***Main Menu***, scroll down to *Navigation* and press **enter.**

   b) The screen that appears will be either the Direction Dial Screen or the Road Screen. You may toggle between these two screens by pressing the softkey **Mode (F1)**. By pressing the softkey **Options (F2)** you can choose the contents of the Info panels. Normally these are set to Turn, Bearing, Velocity, and Time.

   c) By pressing softkey **Target (F4)** the user is able to select from one of the listed waypoints. After a selection is made press **enter** to return to the navigation screen.

   d) Returning to the Navigation screen the display will show the bearing needed to reach the waypoint and at the bottom of the screen will be the distance to the waypoint. From the ***Main Menu*** screen, highlight *Utilities* and press **enter**.

4. Navigating between Waypoints in the Field
   a) From the *Main menu* screen, highlight *Utilities* and press **enter**.

   b) Highlight *Waypoints* and press **enter**.

   c) You will get a menu with the names of the programmed locations

   d) Highlight your start point and press the softkey **measure (F3)**. By default, this will give you the 1st and 2nd waypoints you have programmed

   e) You can switch where you wish to navigate from and/or to by highlighting the waypoint, pressing **enter**, and making a new choice. This screen will also give you the distance (in meters) between waypoints and the compass bearing you must follow to reach your destination (***T*** refers to true north, ***M*** to magnetic north).

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 04

Measuring Dissolved Oxygen with the YSI Model 55

Version 0.1 (February 28, 2003)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for measuring Dissolved Oxygen and Temperature using a YSI model 55 meter. This SOP is intended to compliment but not replace the instruction manual accompanying your meter. Operators should read the instruction manual prior to using the YSI 55 meter. This SOP summarizes the instruction manual and provides procedures for applying this meter to the protocol, "Fish Community Monitoring in Prairie Parks with Emphasize on Topeka shiner (*Notropis topeka*)".

The YSI model 55 measures dissolved oxygen by applying a voltage across two electrodes that are separated from the test solution by a thin gas permeable membrane. When oxygen diffuses across the membrane it is consumed at the cathode, setting up a "diffusion current" that is proportional to the concentration of oxygen present in the test solution. The resulting diffusion current is converted to concentration unit (mg/L) or % air saturation and read directly from the meter. The YSI 55 can measure dissolved oxygen over a range of 0-20 mg/L. However, most environmental measurements range from 0-12 mg/L unless water is supersaturated above the equilibrium level (e.g., 12-30 mg/L).

I. Equipment Preparation and Calibration

<u>Required Equipment</u>

YSI Model 55 dissolved oxygen meter
YSI Model 5775 membrane kit (1 mil – flowing water)
YSI Model 5945 O-ring Kit
KCI electrolyte probe solution (YSI O_2probe solution). Prepared annually according to directions on solution bottle.
6 AA alkaline batteries
Instruction manual
Distilled water
Oxygen solubility chart (Appendix A)

Logbook for YSI model 55 calibration values

Preparing Meter

Prior to using the YSI model 55, inspect the meter, cable and probes for obvious defects or damage. If the meter has been stored for more than a couple of weeks the batteries should have been removed, they should be re-installed at this time.

Procedure:

1. Locate the battery-chamber cover. A screwdriver or coin may be necessary to unscrew the chamber cover.
2. Install AA batteries into the chamber following the illustrations in the battery chamber. BATTERIES MUST BE INSTALLED AS ILLUSTRATED IN THE BATTERY CASE. THE METER WILL NOT FUNCTION AND THE METER (diode) MAY BE DAMAGED IF BATTERIES ARE INSTALLED INCORRECTLY.
3. Turn the instrument on by pressing the **ON/OFF** switch. As part of the polarization process, the probe consumes oxygen that is present under the membrane. This initial oxygen consumption causes short-term, high probe current, which can trigger an "**ER5**" indication on the display. This error reading is normal upon power-up, and should last less than one minute.

Replacing Sensor Probe Membrane

Prior to usage, ensure that air bubbles are not trapped beneath the membrane and that it is wrinkle free. Membrane life depends on usage. Membranes generally last 2-4 weeks if installed properly and treated with care. If the meter is not calibrating correctly, the membrane should be checked and possibly replaced. NOTE: You will not need to replace the membrane every time the meter is used.

Procedure:

1. Turn off meter before working on probe.
2. Unscrew and remove the probe sensor guard.
3. Remove the old membrane.
4. Thoroughly rinse the sensor probe reservoir with distilled water.
5. Holding the sensor probe vertically upright, fill the sensor probe reservoir with KCI electrolyte solution (YSI O_2 probe solution) until a meniscus forms. See section 4.4 (page 6) of the instruction manual for details.
6. Replace the membrane over the end of the sensor probe and secure with O-ring. Care must be taken to ensure that the membrane is taught and wrinkle free. Very little air should be trapped under the membrane.
7. Carefully trim excess membrane from around the sensor probe. Use a small sharp scissors. Do not cut onto the sensor with a knife.
8. Re-install the probe sensor guard.
9. Thoroughly rinse excess KCI electrolyte solution from the sensor tip with distilled water.

Calibrating YSI model 55

The YSI model 55 must be calibrated before any measurements are taken.

Procedure:

1. Place the sensor probe in the Calibration/Storage chamber. Never push the sensor probe to the bottom of the Calibration/Storage chamber as this may damage the membrane. The sponge at the bottom of the Calibration/Storage chamber must be moistened with distilled water before calibrating the meter. A moist Calibration chamber provides a 100% water-saturated air environment critical to calibrating the meter.
2. Press the **ON/OFF** switch to turn the meter on. Allow the Dissolved Oxygen and Temperature reading to stabilize, usually 15 minutes.
3. Press the **MODE** key until dissolved oxygen is displayed in mg/L or % saturation. To enter the calibration menu, use two fingers to press both the **UP ARROW** and **DOWN ARROW** keys down at the same time, release both keys when the calibration menu becomes activated.
4. The LCD will prompt you to enter the local altitude in hundreds of feet (e.g., 12= 1200 feet). Use the arrow keys to increase or decrease the altitude. When the proper altitude appears on the LCD, press the **ENTER** key once. Altitude for each park can be found on the inside cover of the meter carrying case.
5. The YSI Model 55 should now display "**Cal**" in the lower left of the LCD display, the calibration value should be displayed in the lower right of the display and the current DO reading should be on the main display. Make sure the temperature and DO reading (main display) is stable, then press the **ENTER** key.
6. The LCD will prompt you to enter the salinity of the sample(s) you will be measuring from 0-80 ppt. Freshwater streams have a salinity of zero (0). Use the arrow keys to increase or decrease the salinity setting. When the proper salinity appears on the LCD, press the **ENTER** key.
7. Check the calibration value with a saturation chart for dissolved oxygen (Appendix A). See next section "Calibration Check" for full description of the procedure.
8. Record date, time, calibration values, and observer three-letter initials in meter logbook.
9. If problems are encountered with calibration, please refer to the Troubleshooting Table (taken from the YSI Model 55 Manual).

Calibration Check

The internal calibration mechanisms do not allow the operator to view the relationship between barometric pressure, temperature, and the dissolved oxygen reading; therefore, the YSI 55 should be checked in operation after calibration. The errors that occur after standard calibration of the YSI 55 may be due to incorrect estimates of altitude or calibrating in less than 100% water-saturated air. In order to know with some certainty that calibration was successful, the sensor is tested in a 100% water-saturated air environment at a known temperature and barometric pressure. The observed readings are compared to a table of expected reading to determine accuracy. To run a post-calibration accuracy check, follow the procedure below.

1. After the standard YSI 55 calibration is completed, leave the sensor in the water-saturated air environment utilized in the calibration (i.e. the Calibration/Storage chamber).
2. Obtain the ambient barometric pressure for use in the dissolved oxygen table. Use a barometer or obtain the barometric pressure uncorrected for elevation (760 mmHg in 100% water-saturated air) to use as ambient barometric pressure.
3. Dissolved oxygen saturation values are estimated using temperature (^{0}C) and barometric pressure. From the table in Appendix A, find the milligram per liter (mg/L) concentration of oxygen at the ambient temperature (left column) and barometric pressure (across the top).
4. The table reading should be very similar to the mg/L readout shown on the YSI 55 display. Consult section 6.1 (pages 10-11) of the instruction manual for acceptable levels of error. Generally, percent error should not exceed 5.0 % if the meter is operating properly. Percent error is calculate:

    % Accuracy = [1 – {(large value – small value) / large value}] x 100

    % Error = (100 - % Accuracy) / 100

II. Equipment Use

<u>Using the YSI model 55</u>

The general procedure should be followed when taking measurements and are provided to facilitate operators using the meter for a variety of applications. Specific instructions describe using the meter in conjunction with collecting fish community and habitat data. These specific procedures must be followed in order to ensure data is collected accurately and consistently, both spatially and temporally.

General Procedure:

1. Once calibrated, simply insert the probe into the test solution far enough so that it is covered by liquid and gently move the probe back and forth to remove any trapped air bubbles. Readings should stabilize in approximately 60 seconds.
2. To avoid drying out the Dissolved Oxygen sensor probe membrane, store the probe in the Calibration/Storage chamber when moving between sites requiring field measurements. The Calibration/Storage chamber is on the side of the instrument; a sponge wetted with distilled water must be place in the transport chamber before use.
3. Record on the data sheets, dissolved oxygen and temperature measurements taken directly from the meter.

Protocol Specific Field Application Procedures:

1. Prior to arriving at the stream you should calibrate the instrument. One calibration per day should be adequate if the meter is not turned off. Recalibrate each time the instrument is turned off. Place the sensor probe in the moist transportation chamber

when transporting. Never push the sensor probe to the bottom of the transportation chamber as this may damage the membrane.

2. Measurements are taken from bank upon first arrival at a pool. Disturbing the flow or sediment in the water can cause errors in the instruments readings. Measurement should be taken in an area of the stream pool that is representative of the entire length of the pool.
3. When entry into the stream is required for a reading, try to disturb the area as little as possible and make sure to take measurements upstream from the area that has been disturbed.
4. Only one person needs to be in the stream to take the readings. Another person on bank can record data on data sheets. Press the **MODE** key to toggle between the various measurement readings.
5. The sensor probe should be held in the water column below the surface and above the bottom, usually 1/3 of the distance from the bottom to the surface. Allow the instrument enough time so the measurement stabilizes. After all measurements have been made place the probe in the transportation chamber. If you do not expect to use it again for multiple days it needs to be cleaned and stored properly. But remember if you plan on using it later the same day keep the instrument on or you will have to recalibrate.

III. Equipment Maintenance and Storage

Maintenance

Cleaning is required whenever deposits or contaminants appear on the sensor probe membrane. Unscrew and remove the small guard that protects the sensor. Use distilled or clean tap water and a clean cloth to remove all foreign material from the sensor membrane. If performance is not restored by the above procedure replace the existing membrane. Always rinse the sensor with clean water after each use and when a new membrane is installed.

Storing YSI model 55

Procedure:

1. Turn off meter before removing batteries and cleaning sensor probe.
2. Locate the battery-chamber cover. A screwdriver or coin may be necessary to unscrew the chamber cover.
3. Remove AA batteries from the chamber.
4. Unscrew and remove the probe sensor guard.
5. Remove the old membrane.
6. Thoroughly rinse the sensor probe reservoir with distilled water.
7. Dry the sensor probe and reservoir thoroughly.
8. Place a dry membrane over the end of the sensor probe and secure with O-ring.
9. Re-install the probe sensor guard.
10. Allow Calibration/Storage chamber to dry completely before storing sensor probe in it.

IV. Literature Cited

Instruction Manual for YSI Model 55 Handheld Dissolved Oxygen and Temperature Meter. YSI Inc., Yellow Springs, Ohio 45387.

Appendix A. Dissolve Oxygen concentrations at various barometric pressures (mmHg) and temperatures (^{0}C).

°C	P (H_2O)	760	755	750	745	740	735	730	725	720	715	710
0	4.58	14.57	14.47	14.38	14.28	14.18	14.09	13.99	13.89	13.80	13.70	13.61
1	4.93	14.17	14.08	13.98	13.89	13.79	13.70	13.61	13.51	13.42	13.33	13.23
2	5.29	13.79	13.70	13.61	13.52	13.42	13.33	13.24	13.15	13.06	12.97	12.88
3	5.68	13.43	13.34	13.25	13.16	13.07	12.98	12.90	12.81	12.72	12.63	12.54
4	6.10	13.08	12.99	12.91	12.82	12.73	12.65	12.56	12.47	12.39	12.30	12.21
5	6.54	12.74	12.66	12.57	12.49	12.40	12.32	12.23	12.15	12.06	11.98	11.89
6	7.01	12.42	12.34	12.26	12.17	12.09	12.01	11.93	11.84	11.76	11.68	11.60
7	7.51	12.11	12.03	11.95	11.87	11.79	11.71	11.63	11.55	11.47	11.39	11.31
8	8.04	11.81	11.73	11.65	11.57	11.50	11.42	11.34	11.26	11.18	11.10	11.02
9	8.61	11.53	11.45	11.38	11.30	11.22	11.15	11.07	10.99	10.92	10.84	10.76
10	9.21	11.26	11.19	11.11	11.04	10.96	10.89	10.81	10.74	10.66	10.59	10.51
11	9.84	10.99	10.92	10.84	10.77	10.70	10.62	10.55	10.48	10.40	10.33	10.26
12	10.52	10.74	10.67	10.60	10.53	10.45	10.38	10.31	10.24	10.17	10.10	10.02
13	11.23	10.50	10.43	10.36	10.29	10.22	10.15	10.08	10.01	9.94	9.87	9.80
14	11.99	10.27	10.20	10.13	10.06	10.00	9.93	9.86	9.79	9.72	9.65	9.58
15	12.79	10.05	9.98	9.92	9.85	9.78	9.71	9.65	9.58	9.51	9.44	9.38
16	13.63	9.83	9.76	9.70	9.63	9.57	9.50	9.43	9.37	9.30	9.24	9.17
17	14.53	9.63	9.57	9.50	9.44	9.37	9.31	9.24	9.18	9.11	9.05	8.98
18	15.48	9.43	9.37	9.30	9.24	9.18	9.11	9.05	8.99	8.92	8.86	8.80
19	16.48	9.24	9.18	9.12	9.05	8.99	8.93	8.87	8.81	8.74	8.68	8.62
20	17.54	9.06	9.00	8.94	8.88	8.82	8.75	8.69	8.63	8.57	8.51	8.45
21	18.65	8.88	8.82	8.76	8.70	8.64	8.58	8.52	8.46	8.40	8.34	8.28
22	19.83	8.71	8.65	8.59	8.53	8.47	8.42	8.36	8.30	8.24	8.18	8.12
23	21.07	8.55	8.49	8.43	8.38	8.32	8.26	8.20	8.15	8.09	8.03	7.97
24	22.38	8.39	8.33	8.28	8.22	8.16	8.11	8.05	7.99	7.94	7.88	7.82
25	23.76	8.24	8.18	8.13	8.07	8.02	7.96	7.90	7.85	7.79	7.74	7.68
26	25.21	8.09	8.03	7.98	7.92	7.87	7.81	7.76	7.70	7.65	7.59	7.54
27	26.74	7.95	7.90	7.84	7.79	7.73	7.68	7.62	7.57	7.52	7.46	7.41
28	28.35	7.81	7.76	7.70	7.65	7.60	7.54	7.49	7.44	7.38	7.33	7.28
29	30.04	7.68	7.63	7.57	7.52	7.47	7.42	7.36	7.31	7.26	7.21	7.15
30	31.82	7.55	7.50	7.45	7.39	7.34	7.29	7.24	7.19	7.14	7.08	7.03
31	33.70	7.42	7.37	7.32	7.27	7.22	7.16	7.11	7.06	7.01	6.96	6.91
32	35.66	7.30	7.25	7.20	7.15	7.10	7.05	7.00	6.95	6.90	6.85	6.80
33	37.73	7.18	7.13	7.08	7.03	6.98	6.93	6.88	6.83	6.78	6.73	6.68
34	39.90	7.07	7.02	6.97	6.92	6.87	6.82	6.78	6.73	6.68	6.63	6.58
35	42.18	6.95	6.90	6.85	6.80	6.76	6.71	6.66	6.61	6.56	6.51	6.47
36	44.56	6.84	6.79	6.74	6.70	6.65	6.60	6.55	6.51	6.46	6.41	6.36
37	47.07	6.73	6.68	6.64	6.59	6.54	6.49	6.45	6.40	6.35	6.31	6.26
38	49.69	6.63	6.58	6.54	6.49	6.44	6.40	6.35	6.30	6.26	6.21	6.16
39	52.44	6.52	6.47	6.43	6.38	6.34	6.29	6.24	6.20	6.15	6.11	6.06
40	55.32	6.42	6.37	6.33	6.28	6.24	6.19	6.15	6.10	6.06	6.01	5.96
41	58.34	6.32	6.27	6.23	6.18	6.14	6.09	6.05	6.00	5.96	5.91	5.87
42	61.50	6.22	6.18	6.13	6.09	6.04	6.00	5.95	5.91	5.86	5.82	5.77
43	64.80	6.13	6.09	6.04	6.00	5.95	5.91	5.87	5.82	5.78	5.73	5.69
44	68.26	6.03	5.99	5.94	5.90	5.86	5.81	5.77	5.72	5.68	5.64	5.59
45	71.88	5.94	5.90	5.85	5.81	5.77	5.72	5.68	5.64	5.59	5.55	5.51

Appendix A. Continued.

°C	705	700	695	690	685	680	675	670	665	660	655	650
0	13.51	13.41	13.32	13.22	13.12	13.03	12.93	12.83	12.74	12.64	12.54	12.45
1	13.14	13.04	12.95	12.86	12.76	12.67	12.57	12.48	12.39	12.29	12.20	12.11
2	12.79	12.69	12.60	12.51	12.42	12.33	12.24	12.15	12.05	11.96	11.87	11.78
3	12.45	12.36	12.27	12.18	12.09	12.01	11.92	11.83	11.74	11.65	11.56	11.47
4	12.13	12.04	11.95	11.87	11.78	11.69	11.61	11.52	11.43	11.35	11.26	11.17
5	11.81	11.73	11.64	11.56	11.47	11.39	11.30	11.22	11.13	11.05	10.96	10.88
6	11.51	11.43	11.35	11.27	11.18	11.10	11.02	10.94	10.85	10.77	10.69	10.61
7	11.22	11.14	11.06	10.98	10.90	10.82	10.74	10.66	10.58	10.50	10.42	10.34
8	10.95	10.87	10.79	10.71	10.63	10.55	10.48	10.40	10.32	10.24	10.16	10.08
9	10.69	10.61	10.53	10.46	10.38	10.30	10.23	10.15	10.07	10.00	9.92	9.84
10	10.44	10.36	10.29	10.21	10.14	10.06	9.99	9.91	9.84	9.76	9.69	9.61
11	10.18	10.11	10.04	9.96	9.89	9.82	9.74	9.67	9.60	9.52	9.45	9.38
12	9.95	9.88	9.81	9.74	9.67	9.59	9.52	9.45	9.38	9.31	9.24	9.16
13	9.73	9.66	9.59	9.52	9.45	9.38	9.31	9.24	9.17	9.10	9.03	8.96
14	9.51	9.45	9.38	9.31	9.24	9.17	9.10	9.03	8.97	8.90	8.83	8.76
15	9.31	9.24	9.18	9.11	9.04	8.97	8.91	8.84	8.77	8.70	8.64	8.57
16	9.11	9.04	8.97	8.91	8.84	8.78	8.71	8.64	5.58	8.51	8.45	8.38
17	8.92	8.85	8.79	8.73	8.66	8.60	8.53	8.47	8.40	8.34	8.27	8.21
18	8.73	8.67	8.61	8.54	8.48	8.42	8.35	8.29	8.23	8.16	8.10	8.04
19	8.56	8.49	8.43	8.37	8.31	8.25	8.18	8.12	8.06	8.00	7.94	7.87
20	8.39	8.33	8.27	8.21	8.14	8.08	8.02	7.96	7.90	7.84	7.78	7.72
21	8.22	8.16	8.10	8.04	7.98	7.92	7.86	7.80	7.74	7.68	7.62	7.56
22	8.06	8.00	7.95	7.89	7.83	7.77	7.71	7.65	7.59	7.53	7.47	7.42
23	7.91	7.86	7.80	7.74	7.68	7.62	7.57	7.51	7.45	7.39	7.34	7.28
24	7.76	7.71	7.65	7.59	7.54	7.48	7.42	7.37	7.31	7.25	7.20	7.14
25	7.62	7.57	7.51	7.46	7.40	7.34	7.29	7.23	7.18	7.12	7.06	7.01
26	7.48	7.43	7.37	7.32	7.26	7.21	7.15	7.10	7.04	6.99	6.93	6.88
27	7.35	7.30	7.25	7.19	7.14	7.08	7.03	6.97	6.92	6.87	6.81	6.76
28	7.22	7.17	7.12	7.06	7.01	6.96	6.90	6.85	6.80	6.74	6.69	6.64
29	7.10	7.05	7.00	6.94	6.89	6.84	6.79	6.73	6.68	6.63	6.58	6.52
30	6.98	6.93	6.88	6.82	6.77	6.72	6.67	6.62	6.57	6.51	6.46	6.41
31	6.86	6.81	6.76	6.70	6.65	6.60	6.55	6.50	6.45	6.40	6.35	6.30
32	6.75	6.70	6.64	6.59	6.54	6.49	6.44	6.39	6.34	6.29	6.24	6.19
33	6.63	6.58	6.53	6.48	6.43	6.38	6.34	6.29	6.24	6.19	6.14	6.09
34	6.53	6.48	6.43	6.38	6.33	6.28	6.24	6.19	6.14	6.09	6.04	5.99
35	6.42	6.37	6.32	6.27	6.22	6.18	6.13	6.08	6.03	5.98	5.93	5.88
36	6.31	6.27	6.22	6.17	6.12	6.08	6.03	5.98	5.93	5.88	5.84	5.79
37	6.21	6.16	6.12	6.07	6.02	5.97	5.93	5.88	5.83	5.79	5.74	5.69
38	6.12	6.07	6.02	5.98	5.93	5.88	5.84	5.79	5.74	5.70	5.65	5.60
39	6.01	5.97	5.92	5.87	5.83	5.78	5.74	5.69	5.64	5.60	5.55	5.51
40	5.92	5.87	5.83	5.78	5.74	5.69	5.65	5.60	5.55	5.51	5.46	5.42
41	5.82	5.78	5.73	5.69	5.64	5.60	5.55	5.51	5.46	5.42	5.37	5.33
42	5.73	5.69	6.64	5.60	5.55	5.51	5.46	5.42	5.37	5.33	5.28	5.24
43	5.65	5.60	5.56	5.51	5.47	5.42	5.38	5.34	5.29	5.25	5.20	5.16
44	5.55	5.51	5.46	5.42	5.38	5.33	5.29	5.25	5.20	5.16	5.11	5.07
45	5.47	5.42	5.38	5.34	5.29	5.25	5.21	5.16	5.12	5.08	5.03	4.99

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 05

Measuring pH, Conductivity, Salinity, and Temperature with the YSI® Model 63

Version 0.1 (February 28, 2003)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for measuring pH, conductivity, salinity, and temperature of prairie streams using a YSI model 63 meter. This SOP is intended to compliment but not replace the instruction manual accompanying your meter. Operators should read the instruction manual prior to using the YSI 63 meter. This SOP summarizes the instruction manual and provides procedures for applying this meter to the protocol, "Fish Community Monitoring in Prairie Parks with Emphasize on Topeka shiner (*Notropis topeka*)".

The YSI 63 measures pH from 0 to 14 with a margin of error of +/- 0.1% when temperature is within 10° C of calibration temperature. When measuring conductivity the YSI 63 has a range from 0 to 4999 μS/cm. The YSI 63 can measure salinity from 0 to 80 ppt within 0.1 ppt accuracy. Temperatures from -5° to 75° C can also be measured.

I. Equipment Preparation and Calibration

Required Equipment

- YSI model 63 meter
- Graduated cylinder 100 mL
- pH buffers of 7.00, 4.00, and 10.00 or buffers of pH (6.86, 9.18, 4.01)
- Conductivity calibration solution 1 mS/cm (1,000 μ/cm)
- Distilled and/or deionized water
- Nylon brush
- pH storage bottle
- pH sensor probe storage solution (50% pH 4 buffer and 50% 1.5M KCL)
- 6 AA alkaline batteries
- Instruction manual
- pH buffer solution chart (Appendix A)

The YSI model 63 has six modes: you may cycle through them using the **MODE** key

pH—Displays pH and temperature (°C).
Conductivity—A measurement of the conductive material in the liquid sample without regard to temperature. Also displays temperature (°C).
Specific Conductance—Also known as temperature compensated conductivity, which automatically adjusts the reading to a calculated value that would have been read if the sample had been at 25 °C, or some other reference temperature that you choose (see manual).
Salinity—A calculation done by the instrument electronics, based upon the conductivity and temperature readings. Also shows the temperature (°C).
Recall—Allows previously stored data to be displayed.
Erase all—Allows all previously stored data to be deleted.

Preparing Meter

Prior to using the YSI model 63, inspect the meter, cable and probes for obvious defects or damage. If the meter has been stored for more than a couple of weeks the batteries should have been removed, they should be re-installed at this time.

Procedure:

1. Locate the battery cover and open it by unscrewing the thumbscrew.
2. Install AA batteries into the chamber following the illustrations in the battery chamber. BATTERIES MUST BE INSTALLED AS ILLUSTRATED IN THE BATTERY CASE. THE METER WILL NOT FUNCTION AND THE METER (diodes) MAY BE DAMAGED IF BATTERIES ARE INSTALLED INCORRECTLY.
3. Replace the thumbscrew making sure that the o-ring is still in place on the chamber lid and tighten the thumbscrew.
4. With the batteries installed correctly, press the **ON/Off** key. The instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that last for several more seconds.

Calibrating Meter

The YSI model 63 must be calibrated each day before any measurements are taken. pH calibration may be performed at 1, 2, or 3 points. A 1-point calibration may be performed if a 2 or 3-point calibration on the meter has been performed recently, within the last week**.** The first calibration point must be at pH 7 or 6.86. pH changes with temperature, therefore the pH value displayed during calibration will vary with temperature. This is OK as the YSI model 63 automatically accounts for the fact that the true pH of a buffer solution varies with temperature. Consult Appendix A for expected pH variations with temperatures. Conductivity calibrations are rarely required because the meter is calibrated at the factory, however from time to time it is wise to check the systems calibration.

pH Calibration Procedure:

1. Turn the instrument on by pressing the **ON/OFF** key. Press the **MODE** key until pH is displayed.
2. Rinse the probe with deionized or distilled water and carefully wipe dry. The probe may be rinsed with the pH buffer solution to be used in the calibration.
3. Place 30 to 35 mL of the pH buffer (pH 7 or pH 6.86) in the 100 mL graduated cylinder. Immerse the probe making sure that both the pH and temperature sensors are covered by the solution.
4. Enter the calibration menu by pressing the **UP ARROW** and **DOWN ARROW** keys at the same time. The display will show **CAL** at the bottom of the screen, and **STAND** will be flashing. The pH reading will show the pH of 7.00. If you are using a pH of 6.86 to calibrate you must press the **UP ARROW** and **DOWN ARROW** keys at the same time again; the reading will now show a pH of 6.86.
5. Press the **ENTER** key. **STAND** will stop flashing and the pH calibration value is shown with the middle decimal point flashing. Once the reading is stable the decimal point will stop flashing.
6. Press and hold the **ENTER** key to save the calibration point. **SAVE** will flash on the display along with **OFS** to indicate that the offset value has been saved. (If you are only calibrating with one point press the **MODE** key to return to normal operation.)
7. Rinse the probe with distilled water, and carefully dry the probe. Also rinse the graduated cylinder with distilled water.
8. Add the second value pH buffer (pH 4 or 10, or pH 4.01 or 9.18) to the graduated cylinder. Immerse the probe into the solution making sure that the temperature sensor is covered.
9. Press the **ENTER** key. **CAL** will be displayed on the bottom of the screen and **SLOPE** will stop flashing. The decimal point will flash until the reading is stable.
10. Press and hold the **ENTER** key to save the reading. **SAVE** will flash on the screen along with **SLP** to indicate that the first slope value has been saved.
11. **SLOPE** will start flashing again indicating that the slope is ready to be set using a third pH buffer.
12. Rinse the probe and graduated cylinder with distilled water.
13. Add the third pH buffer (pH 4 or 10, pH 4.01 or 9.18) to the graduated cylinder. Immerse the probe making sure that the temperature sensor is covered.
14. Press the **ENTER** key; the display will show **CAL** at the bottom and **SLOPE** will stop flashing.
15. When the reading is stable the decimal point will stop flashing. Press and hold the **ENTER** key to save the reading. **SAVE** will flash on the screen along with **SLP** to indicate that the second slope value has been saved. The system is now calibrated for pH measurements. Rinse the probe with distilled water before collecting data.

Conductivity Calibration Procedures:

1. If the meter is not on, turn the instrument on and allow it to complete its self-test procedure.
2. Select a calibration solution that is most similar to the sample you will be measuring.

- For sea water choose a 50 mS/cm conductivity standard (YSI Catalog #3169)
- For fresh water choose a 1 mS/cm conductivity standard (YSI Catalog#3167)
- For brackish water use a 10 mS/cm conductivity standard (YSI Catalog #3168)

3. Place at least 7 inches of solution in a plastic container or a clean glass beaker. NOTE: DO NOT USE THE 100 Ml graduated CYLINDER. THE DIAMTER OF THE CYLINDER IS TOO SMALL FOR ACCURATE CONDUCTIVITY MEASUREMENTS.
4. Use the **MODE** key to advance the instrument to display conductivity.
5. Insert the probe into the solution deep enough to completely cover the probe. Both conductivity ports must be submerged
6. Allow 60 seconds for the temperature reading to become stable; move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.
7. Press and release the **UP ARROW** and **DOWN ARROW** keys at the same time. The **CAL** symbol will appear at the bottom of the display to indicate that the instrument is now in calibration mode.
8. Use the **UP ARROW** and **DOWN ARROW** keys to adjust the reading on the display until it matches the value of the calibration solution you are using.
9. When the display reads the exact value of the calibration solution being used press the **ENTER** key. The word **SAVE** will flash across the display for a second indicating that the calibration has been accepted.

II. Equipment Use

The general procedure should be followed when taking measurements and are provided to facilitate operators using the meter for a variety of applications. Specific instructions describe using the meter in conjunction with collecting fish community and habitat data. These specific procedures must be followed in order to ensure data is collected accurately and consistently, both spatially and temporally. The first pH reading after storage in a buffer solution may take longer to stabilize, up to 10 minutes. This is why the probe should be stored in the transport chamber when moving between sites requiring field measurements. The transport chamber is on the side of the instrument; a sponge wetted with distilled water must be place in the transport chamber before use.

General Procedure:

1. Once calibrated, simply insert the probe into the test solution far enough so that the liquid covers the pH, temperature, and conductivity sensors and gently move the probe back and forth to remove any trapped air bubbles and wait for the readings to stabilize (approximately 60 seconds).
2. By pressing and holding the **ENTER** key after a measurement has been made you can save the information. However, it is recommended to record all measurements on data sheets and forego storing them on the meter.
3. By pressing the **MODE** key you can toggle between readings from the different sensors. Record each reading on the data sheet as it appears.

Protocol Specific Field Application Procedures:

1. Prior to arriving at the stream you should calibrate the instrument. One calibration per day should be adequate if the meter is not turned off. Recalibrate each time the instrument is turned off. Place the sensor probe in the moist transportation chamber when transporting. Never push the sensor probe to the bottom of the transportation chamber as this may damage the membrane.
2. Measurements are taken from bank upon first arrival at a pool. Disturbing the flow or sediment in the water can cause errors in the instruments readings. Measurement should be taken in an area of the stream pool that is representative of the entire length of the pool.
3. When entry into the stream is required for a reading, try to disturb the area as little as possible and make sure to take measurements upstream from the area that has been disturbed.
4. Only one person needs to be in the stream to take the readings. Another person on bank can record data on data sheets. Press the **MODE** key to toggle between the various measurement readings.
5. The sensor probe should be held in the water column below the surface and above the bottom, usually 1/3 of the distance from the bottom to the surface. Allow the instrument enough time so the measurement stabilizes. After all measurements have been made place the probe in the transportation chamber. If you do not expect to use it again for multiple days it needs to be cleaned and stored properly. But remember if you plan on using it later the same day keep the instrument on or you will have to recalibrate.

III. Equipment Maintenance and Storage

Maintenance

Cleaning is required whenever deposits or contaminants appear on the glass pH sensor. Unscrew and remove the small guard that protects the pH sensor. Use distilled or clean tap water and a clean cloth to remove all foreign material from the glass sensor. If pH response is not restored by the above procedure, perform the following additional pH sensor cleaning procedure. A clean sensor cell is the most important requirement for accurate conductivity measurements. Always rinse the conductivity cell with clean water after each use. If the conductivity sensor becomes fouled perform the following additional conductivity sensor cleaning procedure.

pH Sensor Cleaning Procedure:

1. Soak the probe for 10 to 15 minutes in clean water and dishwashing liquid.
2. Gently clean the glass bulb by rubbing with a cotton swab soaked in the cleaning solution.
3. Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water.

Conductivity Sensor Cleaning Procedure:

1. Dip the cell in cleaning solution and agitate for two to three minutes. Any one of the foaming acid tile cleaners will clean the cell. A solution of 1:1 ISOPROPYL ALCOHOL and one molar (1 M) hydrochloric acid will also work. Remove the cell from the cleaning solution.
2. Use the nylon brush to dislodge any contaminants from inside the electrode chamber. Rinse the cell thoroughly in distilled or clean tap water.

Storing the YSI model 63

If storing the instrument one-week or more, the pH sensor needs to be placed in the storage bottle filled with a solution of pH sensor probe storage solution. Use pH 4 buffer solution or tap water if this mixture is not available. NEVER LET THE PROBE DRY OUT or STORE THE PROBE IN DISTILLED OR DIONIZED WATER. EITHER COULD DESTROY THE PROBE. If the sensor probe should inadvertently dry out, soak the probe in the pH sensor probe storage solution to restore good functionality. Store the probe in the transportation chamber for periods less than one week. Remove batteries from the meter for storage over one week.

IV. Literature Cited

Instruction Manual for YSI Model 63 Handheld pH, Conductivity, Salinity and Temperature Meter. YSI Inc., Yellow Springs, Ohio 45387.

APPENDIX A- pH buffer solution values at various temperatures.

Temperature	pH 4	pH 7	pH 10
0°C	4.01	7.13	10.34
5°C	4.00	7.10	10.26
10°C	4.00	7.07	10.19
15°C	4.00	7.05	10.12
20°C	4.00	7.02	10.06
25°C	4.01	7.00	10.00
30°C	4.01	6.99	9.94
35°C	4.02	6.98	9.90
40°C	4.03	6.97	9.85
50°C	4.06	6.97	9.78
60°C	4.09	6.98	9.7

	pH 4.01	pH 6.86	pH 9.18
0°C	4.005	6.984	9.463
5°C	4.003	6.950	9.395
10°C	4.001	6.924	9.333
15°C	4.002	6.899	9.277
20°C	4.003	6.879	9.226
25°C	4.005	6.863	9.180
30°C	4.010	6.852	9.139
35°C	4.020	6.844	9.102
37°C	4.025	6.842	N/A
40°C	4.033	6.840	9.070
45°C	4.047	6.837	9.042
50°C	4.061	6.836	9.018

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 06

Establishing and Marking Sampling Sites

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This Standard Operating Procedure (SOP) gives step-by-step instructions for establishing and marking sampling reaches and pools within reaches at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. Preseason planning using maps facilitates the completion of both fish surveys and habitat work. A Field copy of all study areas maps with streams numbered and reaches delineated needs to be made on write-in-the-rain paper prior to the start of sampling.

I. Establishing Sampling Reaches

The feasibility and necessity of monitoring the complete length of streams within the boundaries of Pipestone National Monument and Tallgrass Prairie National Preserve, Kansas is questionable. Therefore, streams are stratified into lower, middle and upper sampling reaches. Between 2001 and 2003 all stream reaches were assessed for their feasibility as long-term fish community monitoring sites. All stream reaches with fish present and sufficient water to allow sampling in at least one pool are included in our long-term monitoring effort.

Procedures:

1. Using the combined UTM coordinates of pools sampled between 2001 and 2003 the location and extent of stream reaches were identified. Initially, because of the varying geomorphic characteristics of each stream, the location and extents of reaches could not be definitively determining prior to sampling. However, with three years of sampling within each reach we have had a good opportunity to assess the feasibility of locating enough pools (five) to sample each year within fixed reaches. The UTM coordinates of the most upstream pool within stream reaches are used to fix the upstream end of each reach. Similarly, UTM coordinates of the head end of the most downstream pool within a stream reach, plus the length (m) of the pool were used to

fix the downstream end of each reach. Annual fish community monitoring is to be confined to pools within these reaches. In droughty years when climatic conditions are not favorable for water retention in pools, reaches may contain less than five pools, our desired level of sampling intensity. In those years, all pools less than five present in a stream reaches will be sampled.

2. At Pipestone National Monument, three stream reaches have been located in Pipestone Creek below the falls and one above the falls. Thirty-seven streams have been identified and enumerated at Tallgrass Prairie National Preserve. Twenty-five streams are generally dry or have insufficient water to allow for annual fish sampling. Stream 35 (Fox Creek) has flow that is significant enough to prohibit sampling with our equipment most years. Therefore, eighteen stream reaches within the remaining 11 streams have been identified for annual sampling. All steams within Tallgrass Prairie National Preserve will be reassessed every four years as to their potential for fish community monitoring.
3. During fish sampling, use GPS way-point to locate the downstream end of a stream reach and sample pools moving upstream. The upstream end of a stream reach is located to confirm that pools sampled are contained within the reach. The UTM coordinates for the upstream end of each pool sampled during a survey should be taken using GPS at the time a pool is being sampled. See SOP #3 "Using GPS" for instructions on the use of a GPS unit to collects location data in the field. UTM coordinates are recorded for one to five (all) pools sampled in each stream reach.
4. Park maps indicating streams and stream reach locations are printed prior to the start of the field season to assist in tracking completion of the work and navigating to stream reach ends. Maps of Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas with stream numbered and reach locations delineated are included (Fig. 6.01.1 and 6.01.2).
5. UTM coordinates (way-points) and lengths of stream reaches at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas are included (Table 6.01.1)

Figure 6.01.1. Fish community and Topeka shiner (*Notropis topeka*) monitoring sites in Pipestone Creek within Pipestone National Monument, Pipestone County, Minnesota.

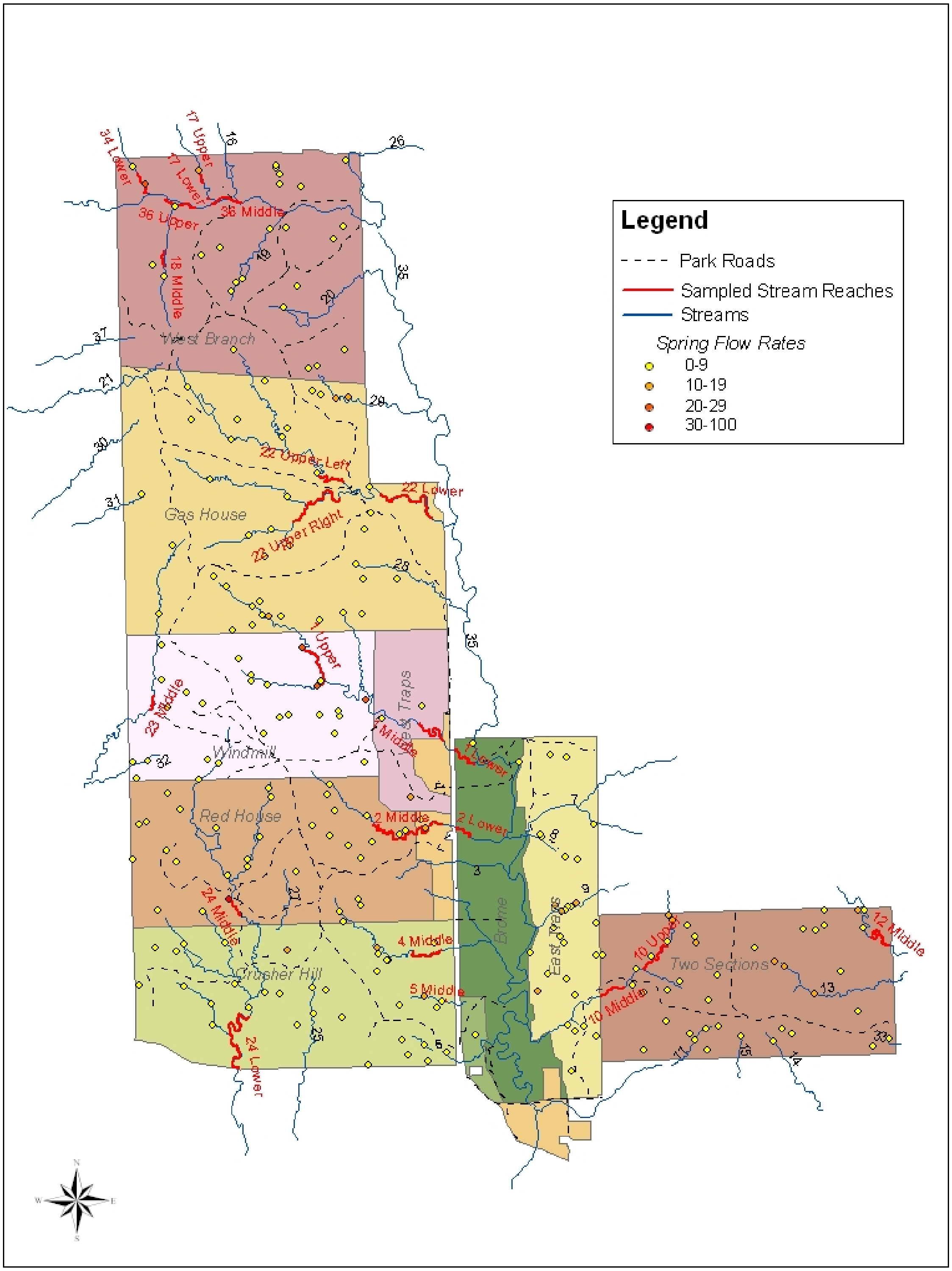


Figure 6.01.2. Fish community and Topeka shiner (*Notropis topeka*) monitoring sites in streams at Tallgrass Prairie National Preserve, Chase County, Kansas.

Table 6.01.1. UTM coordinates {NAD83 (Conus), Zone 14 N} and lengths for reaches sampled for fish community composition by stream for Pipestone National Monument, Pipestone County, Minnesota and Tallgrass Prairie National Preserve, Chase County, Kansas. Numbers of pools sampled for the first three years of monitoring are also given.

Stream		**Northing**	**Easting**	**Reach Length (m)**	**Number of Pools Sampled (Year)**
Reach	**End**				
Pipestone National Monument, Pipestone County, Minnesota					
Pipestone Creek					
Lower	Upstream	4877116.47	714317.92	202	5 (2001) 5 (2002) 5 (2003)
	Downstream	4877259.61	714204.77		
Middle	Upstream	4876962.65	714488.50	208	5 (2001) 5 (2002) 5 (2003)
	Downstream	4877050.81	714333.43		
Upper	Upstream	4877069.01	714726.41	164	5 (2001) 5 (2002) 5 (2003)
	Downstream	4876991.27	714602.51		
Above Falls	Upstream	4877045.83	714864.17	95	5 (2001) 5 (2002) 5 (2003)
	Downstream	4877060.11	714772.31		
Tallgrass Prairie National Preserve, Chase County, Kansas					
Stream 1					
Lower	Upstream	4257163.07	713236.29	366	5 (2001) 4 (2002) 5 (2003)
	Downstream	4257009.20	713468.40		
Middle	Upstream	4257459.69	712853.99	589	6 (2001) 5 (2002) 5 (2003)
	Downstream	4257264.29	713122.37		
Upper	Upstream	4258286.24	711576.64	574	5 (2001) 2 (2002) 5 (2003)
	Downstream	4257885.94	711794.25		
Stream 2					
Lower	Upstream	4256317.96	713259.72	222	3 (2001) 1 (2002) 5 (2003)
	Downstream	4256214.78	713417.68		
Middle	Upstream	4256346.06	712356.88	1320	3 (2001) 3 (2002) 5 (2003)
	Downstream	4256346.06	713116.28		
Stream 4					
Middle	Upstream	4254952.36	712782.15	449	3 (2001) 3 (2002) 5 (2003)
	Downstream	4254966.47	713101.21		
Stream 5					
Middle*	Upstream	4254410.30	713134.56	23	-- (2001) 1 (2002) – (2003)
	Downstream	4254404.62	713154.92		
Stream 10					
Middle	Upstream	4254460.87	714847.03	324	5 (2001) 5 (2002) 5 (2003)
	Downstream	4254565.19	715113.34		
Upper*	Upstream	4254758.68	715317.27	479	-- (2001) 5 (2002) – (2003)
	Downstream	4255017.08	715584.84		
Stream 12					
Middle	Upstream	4255108.78	717827.94	493	-- (2001) 5 (2002) 5 (2003)
	Downstream	4255010.98	718023.53		
Stream 17					
Lower*	Upstream	4263231.98	710536.96	10	-- (2001) 1 (2002) – (2003)
	Downstream	4263224.74	710545.05		
Upper	Upstream	4263527.37	710455.03	136	-- (2001) 4 (2002) 2 (2003)
	Downstream	4263400.48	710480.77		
Stream 18					
Middle*	Upstream	4262485.76	710058.71	207	-- (2001) 5 (2002) – (2003)
	Downstream	4262659.39	710054.55		

Table 6.01.1. continued.

Stream Reach	Stream End	Northing	Easting	Reach Length (m)	Number of Pools Sampled (Year)
Stream 22					
Lower	Upstream	4259981.04	712422.26	958	5 (2001) 5 (2002) 5 (2003)
	Downstream	4259710.35	713002.62		
Left Upper	Upstream	4260196.67	711749.11	425	4 (2001) 5 (2002) 5 (2003)
	Downstream	4260107.85	712033.21		
Right Upper	Upstream	4259678.56	711476.55	912	5 (2001) 5 (2002) 5 (2003)
	Downstream	4259940.04	711990.68		
Stream 23					
Middle	Upstream	4257773.90	709941.76	218	4 (2001) 3 (2002) 5 (2003)
	Downstream	4257614.80	709898.14		
Stream 24					
Lower	Upstream	4254233.48	710984.44	1223	5 (2001) 5 (2002) 5 (2003)
	Downstream	4253659.26	710868.26		
Middle	Upstream	4255543.21	710783.66	246	4 (2001) 5 (2002) 5 (2003)
	Downstream	4255344.17	710896.51		
Stream 34					
Lower	Upstream	4263505.05	709766.18	284	5 (2001) 5 (2002) 5 (2003)
	Downstream	4263286.45	709866.69		
Stream 36 (Palmer Creek)					
Middle	Upstream	4263172.79	710560.29	395	5 (2001) 5 (2002) 5 (2003)
	Downstream	4263176.10	710907.56		
Upper	Upstream	4263216.98	710062.04	384	5 (2001) 5 (2002) 5 (2003)
	Downstream	4263131.72	710400.63		

* Denotes stream reaches that were sampled doing the design phase of this project but are not included in our annual sampling efforts.

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 07

Conducting the Fish Community Sampling

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

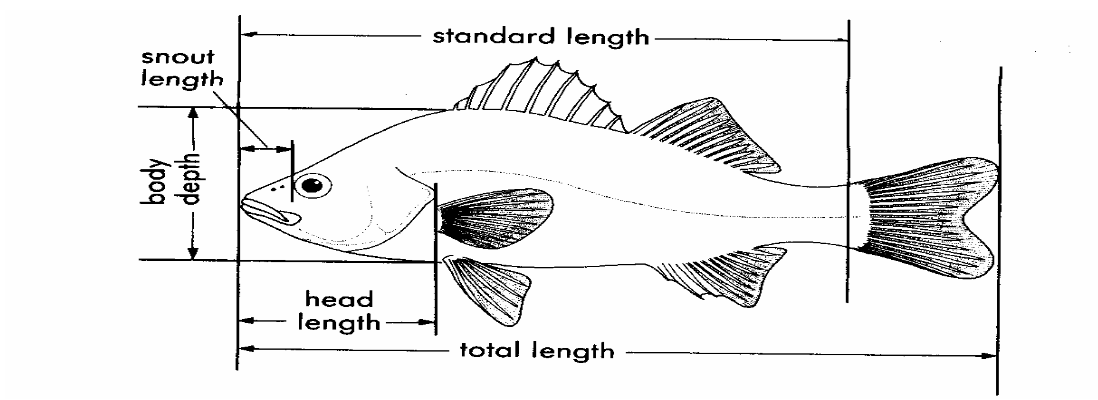
This standard operating procedure (SOP) gives step-by-step instructions for documenting fish community data at the pool level during monitoring at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. This SOP describes the procedure for collecting data and filling in the appropriate sections of the form "Physical Habitat and Species Count Data – Topeka shiner Monitoring Project" (Appendix A of the Protocol Narrative).

Procedures:

1. Well in advance (several months) of entering the field to monitor fish communities, both state and federal collection permits must be obtained. State permits are renewed annually. However, federal permits or sub-permits are valid over a number of years as long as the permitee is not in violation of their permit. Federal permits indicate the year in which they expire. Prior to the start of any fish monitoring, state and federal law enforcement agencies with jurisdiction over the study area and fisheries must be contacted. Collection permits indicate which agencies need to be contacted. Each agency will need a schedule of the days sampling is planned and a list of all participants planning to assist in monitoring.
2. Prior to the day of conducting fish sampling, determine which stream reaches will be sampled and in which order based on proximity to each other. Fish sampling should be done on pools in conjunction with habitat sampling. Streams are stratified to include at least an upper, middle and lower reach. This allows investigators the opportunity to sample the extent of a stream without imposing unreasonable workloads that complete steam surveys require. An attempt should be made to sample fish from at least five pools in each reach. However, preliminary monitoring suggest that not all stream reaches contain five pools to sample and many will not have enough water to allow sampling at all. Therefore, one to five sampled pools will represent most stream reaches sampled. Prior to arriving at the stream, check soundness of all equipment to be used.

3. Dissolved oxygen, conductivity, pH, water temperature and Secchi visibility are taken before any entries into the stream to seine for fish. Once these measurements are taken, fish sampling can begin. Other habitat parameters are recorded during or after the fish seining.
4. Fish are captured by extending a two man bag seine, 1.8-m deep, the full width of a pool, dragging the net across the bottom and trapping fish against a bank or shallow water area until the net can be raised to bring captured individuals to the top of the water. All captured fish are identified to species, enumerated and released immediately or placed in aerated buckets, containing water taken from the pool. Captured individuals must be kept moist until they are released.

5. Fish placed in buckets are identified or photographed and released as soon as possible. Photo vouchers of each fish species captured in a park are taken annually.
6. Topeka shiner are held in buckets until they can be measured (total length and weight), sexed and aged (adult or juvenile).



7. Individuals lost to netting mortality are preserved in 80% ethyl alcohol with pertinent information recorded with pencil on write-in-the-rain paper accompanying the specimen. Two labels containing information are used. The first is placed inside the vial containing the individual and the other, containing the same information, affixed to the outside of the vial.

Specimen Label

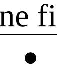
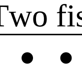
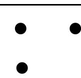
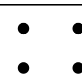
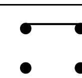
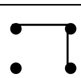
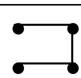
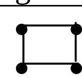
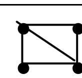
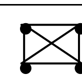
Front	Back
National Park Service Collection of Vertebrates ________ __________ ___________ genus species common name Collector ______________________ Preserved in 80% Ethyl-Alcohol Date ________	Location ______________________ Park Code __________ County __________ State __________ Township ____ Range ____ Section ____

8. Pools with in a reach are sampled starting with the most downstream one first and moving upstream in order to avoid fouling water in connected pools prior to sampling.
9. Use a new copy of the “Physical Habitat and Species Count Data – Topeka shiner Monitoring Project” (Appendix A of the Protocol Narrative) for each stream reach sampled. A stream reach will contain from one to five pools. Record the following information on the fish community section of the data sheet, see SOP #8 “Documenting Habitat Variables” for a list of remaining variables on the data sheet.

Topeka shiner:

a. counted: The number of individual Topeka shiner captured by pool within a stream reach. These numbers are summed across all pools sampled in the stream reach and this value is recorded.
b. collected: The number of individual Topeka shiner collected for scientific research by pool within a stream reach. These numbers are summed across all pools sampled in the stream reach and this value is recorded. Topeka shiner may not be intentionally collected during this monitoring, with netting mortality accounting for individuals preserved.
c. preserved: The number of individual Topeka shiner preserved by pool within a stream reach, regardless of mortality factor. These numbers are summed across all pools sampled in the stream reach and this value is recorded. No more than ten individual Topeka shiner may be preserved annually within a park.

Species and number: Record the common names of species captured and use a dot tally to enumerate the number of individuals for each species by pool. Dot tallies are recorded as follow:

One fish	Two fish	Three fish	Four fish	Five fish
				
Six fish	**Seven fish**	**Eight fish**	**Nine fish**	**Ten fish**
				

Repeat the dot tally for the next count of ten individuals and so on.

Sum: The numbers of individuals for each species are summed across all pools sampled in the stream reach and this value is recorded.

Information recorded on the “Supplemental Species Information Data – Topeka shiner Monitoring Project” (Appendix A of the Protocol Narrative):

Species: The common name, Topeka shiner or the common name of others “Species of Special” concern.

Stream #: The stream name and/or number where the individual fish is capture. Often times lower order streams in this monitoring effort are unnamed. Therefore, it is critical to identify each stream with a number, which was done the first year of monitoring. Stream numbers must remain constant and match those used on the “Physical Habitat and Species Count Data – Topeka shiner Monitoring Project” (Appendix A of the Protocol Narrative) data sheet. The ability to identify where Topeka shiner and other “Species of Species Interest” were captured is critical.

Stream reach: The unique alpha code that indicates the location of a reach where the individual fish was captured on a stream (e.g. lower, middle, upper). Stream reaches must remain constant and match those used on the “Physical Habitat and Species Count Data – Topeka shiner Monitoring Project” (Appendix A of the Protocol Narrative) data sheet. The ability to identify where Topeka shiner and other “Species of Species Interest” were captured is critical.

Pool #: The unique numeric code that indicates the pool where the individual fish was captured within a stream reach. Pool numbers must remain constant and match those used on the “Physical Habitat and Species Count Data – Topeka shiner Monitoring Project” (Appendix A of the Protocol Narrative) data sheet. The ability to identify where Topeka shiner and other “Species of Species Interest” were captured is critical.

Length (cm): The length in centimeters and 1/10 cm of the individual being measured.

Weight (g): The weight in grams and 1/10 g of the individual being weighed.

Sex-age: A coded identifier of the sex and age of the individual fish. **M =** adult male**,** **F =** adult female**, J =** juvenile of either sex**, U =** sex and/or age undetermined.

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 08

Documenting Habitat Variables

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for documenting habitat variables at the pool level during fish community monitoring at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. This SOP describes the procedure for collecting habitat data and filling in the appropriate sections of the form "Physical Habitat and Species Count Data – Topeka shiner Monitoring Project" (Appendix A of the Protocol Narrative).

Procedures:

1. Prior to the day of conducting habitat measurements, determine which stream reaches will be sampled and in which order based on proximity to each other. Habitat sampling should be done on pools in conjunction with the fish sampling. Prior to arriving at the stream you should calibrate the instruments. One calibration per day should be adequate if the meters are not turned off. Recalibrate each time an instrument is turned off. Place the sensor probe in their moist Calibration/Storage chamber when transporting. Never push the sensor probe to the bottom of the Calibration/Storage chamber as this may damage the membrane.
2. Habitat measurements are taken for each pool sampled for fish.
3. Dissolved oxygen, conductivity, pH, water temperature and Secchi visibility are taken before any entries into the stream, usually from bank. Measurements are usually taken upon first arrival at the site. Disturbing the flow or sedimentation of the water can cause errors in the instruments readings. Measurement should be taken in an area of the stream pool that is representative of the entire length of the pool. When entry into the stream is required for taking readings, try to disturb the area as little as possible and make sure to take measurements upstream from the area that has been disturbed. Only one person needs to be in the stream to take the readings. Another person on bank can record data.
4. Substrate types and coverages are determined by individual(s) familiar with the modified Daubenmire cover class used in this monitoring (Table 8.01.1). In clear shallow pools

substrate type and coverages can be determined from bank. However, in deep pools or those with a lot of suspended sediment substrate type and coverages need to be determined from someone in the pool, often an individual(s) sampling for fish.

Table 8.01.1. Cover is estimated within modified Daubenmire cover classes.

Cover class	Explanation
0	None present
1	0 – 1 % coverage of measured variable
2	1 – 5 % coverage of measured variable
3	5 – 25 % coverage of measured variable
4	25 – 50 % coverage of measured variable
5	50 – 75 % coverage of measured variable
6	75 – 95 % coverage of measured variable
7	95 – 100 % coverage of measured variable

5. Use a new copy of the “Physical Habitat and Species Count Data – Topeka shiner Monitoring Project” (Appendix A of the Protocol Narrative) for each stream reach sampled. A stream reach will contain from one to five pools. Record the following information on the habitat section of the data sheet:

   Collector(s): The initials of the first, middle, and last name of each person in the field crew collecting data.

   Locality: A general description of the location or pasture where data is collected.

   Date: The month, day and year (mm/dd/yyyy) data is collected.

   Time: The time data collection starts in a stream reach in Local Time. Individual pools within a stream reach are not recorded separately if all pools within the stream reach are sampled on the same date.

   Park: Park code for the park in which monitoring is conducted.

   State: The name of the state where data is collected.

   County: The name of the county where data is collected.

   Drainage Basin: The name of the drainage basin where data is collected.

   Stream No.: The stream name and/or number where data is collected. Often times lower order streams in this monitoring effort are unnamed. Therefore, it is critical to identify each stream with a number, which was done the first year of monitoring. Stream numbers must remain constant for comparisons of annual variations in fish communities within a stream.

Stream Reach: The unique alpha code that indicates the location of a reach where data was collected on a stream (e.g. lower, middle, upper).
Pool: The unique numeric code that indicates the pool where data is collected within a stream reach.

GPS: Indicate on the data sheet whether the location of the pool where sampling occurred has been GPS, use “Y” for yes or “N” for no. GPS all pools from the head-end of the pool facing downstream. Some situations may arise that will not allow each pool to be GPS (i.e. tree canopy, poor satellite configuration). If this occurs, then at minimum the length of the stream reach sampled should be GPS.

Spring: Circle “Yes” or “No” on the data sheet to indicate if a spring is present in the stream reach.

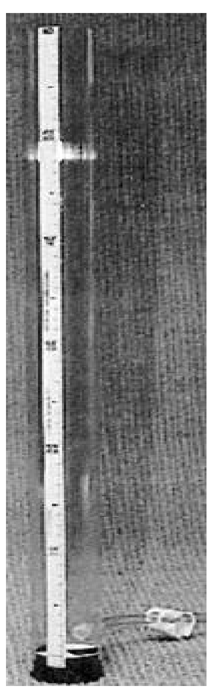
Picture Taken?: Indicate if picture(s) are taken in the stream reach being sampled by circling Yes or No. Pictures are generally taken of each pool sampled within a stream reach using a digital camera. All pictures are taken from the head-end of the pool facing downstream.

Picture Number on Roll: Record on the data sheet, the number on the roll of film or camera disk with its appropriate pool number. It is critical to record these numbers correctly, photographs of each pool are link to their corresponding fish community and habitat data.

Air temperature (^{O}C): The air temperature at the time pool data is being collected, in degrees Celsius.

Water temperature (^{O}C): The water temperature of the pool at the time data is being collected, in degrees Celsius.

Secchi visibility (cm): Vertical depth of water clarity measured in centimeters using a transparency tube. This measure serves to assess water turbidity at a site where data is collected.



Air and water temperatures plus the next four parameters are recorded for each pool sampled in a stream reach using a YSI 55, YSI 63 or standard field thermometer:

Dissolved oxygen (mg/l): Amount of dissolved oxygen in the water where data is collected. Dissolved oxygen is measured in mg/l. Record for each pool in a stream reach using a YSI 55 meter.

Conductivity (uS): Conductivity of water where data is collected. Conductivity is measured in uS and is the conductivity of the water at it current temperature. Record for each pool in a stream reach using a YSI 63 meter.

Relative Conductivity (uS): Relative Conductivity of water where data is collected. Relative conductivity is measured in uS and is the conductivity of the water if it where taken at a temperature of 25 ^{o}C. Record for each pool in a stream reach using a YSI 63 meter.

pH: The pH of water where data is collected. Record for each pool in a stream reach using a YSI 63 meter.

Sampling effort (min): The time spent sampling a pool in minutes and seconds. The time recorded should reflect actual time spent in the water seining for fish. Record for each pool in a stream reach. If more than one pass is made through a pool, sum the total amount of time spent seining.

Sampling gear: Record equipment used to capture fish species. A 1/8 in. mesh minnow seine (bag seine) should be used during monitoring efforts. However, if some other sampling technique or seine type is used this needs to be recorded.

Weather: Circle most appropriate descriptor of weather (clear-sunny, partly cloudy, cloudy, raining, other) at the time data is collected in a stream reach. Generally record this information midway through the sampling in a reach (i.e. at pool # 3 if five pools are sampled).

Off-channel pools for stream reach: Circle most appropriate descriptor of off channel pools; present, absent, or not applicable for the stream reach where data is collected. Record this information after traversing the length of the stream reach, generally while the last pool in the reach is being sampled.

In stream flow for stream reach: Circle most appropriate descriptor of in stream flow (pools dry, isolated pools, trickle between pools, moderate flow between pools, high flow, flood flow) where data is collected. Record this information after traversing the length of the stream reach, generally while the last pool in the reach is being sampled.

Pool substrate: Circle most appropriate descriptor of dominant substrate where data is collected. Record for each pool in a stream reach.

Table 8.01.2. Substrate types, size ranges and description.

Substrate Type	Size Range (mm)	Description
Muck	<0.004	Fine material, remains together when squeezed between fingers – not gritty between fingers
Detritus		Fine decayed organic material, original form not distinguishable
Silt	0.004 to 0.06	Fine material, falls in pieces when squeezed between fingers – not gritty between fingers
Sand	0.06 to 2.0	Smaller than ladybug size, but visible as particles – gritty between fingers
Pea-gravel	2.0 to 16.0	Lady bug to marble size
Coarse-gravel	16.0 to 64.0	Marble to tennis ball size
Cobble	64.0 to 256.0	Tennis ball to basketball size
Boulders	256.0 to 4000.0	Basketball to car size
Bedrock	> 4000	Rock bigger than a car
Hardpan/shale		Firm, consolidated fine substrate or shale
Other		Cars, asphalt, concrete, etc.

Substrate stability: Indicate the most appropriate descriptor of substrate stability, "S" for stable or "U" for unstable. As a rule, particles, cobble size and larger are generally considered stable and those smaller are unstable. Recent flood events may alter ones assessment of substrate stability. Record for each pool in a stream reach.

Streambank erosion: Indicate by recording the pool number under the most appropriate descriptor (severe, moderate, slight, none) of the erosion level of the streambank. Record for both the right and left streambank of each pool in a stream reach. Right and left streambanks are determined looking downstream.

Riparian corridor: Indicate with a coded descriptor the dominant vegetation along the right and left riparian area of the pool where data is collected. Dominant vegetation is identified for distances of 0 – 25 m, >25 – 50 m, > 50 – 75 m, >75 – 100 m, and >100 m. Record for both the right and left streambank of each pool in a stream reach. Right and left streambanks are determined looking downstream. Vegetation types include:

Table 8.01.3. Codes used to identify dominant riparian corridor vegetation on the data sheet.

Vegetation	**Code**	**Description**
Mature woodland	1	Large trees present, few mid-story trees or shrubs
Woody shrubs / saplings	2	Small to midsize trees, early succession trees and shrubs present. Area typical of one disturbed in the recent past
Wetland / native grasses & forbs (prairie)	3	Native or restored wetland or prairie. Diverse collections of native plants present
Domestic grass pasture / hay field	4	Dominated by one or two domesticated grasses. Grazed by livestock or hayed
Park / lawn	5	Frequently mowed or maintained vegetation
Row crops	6	Area under agricultural crop production
Road / railroad	7	Dominated by road or railroad bed, vegetation absent
Urban / industrial	8	Housing or industrial operations present, vegetation absent
Other	9	Any vegetation type or land use not defined above

Pool dimensions:

a. Length (m): Length of the pool between its head and tail ends. Generally, this is the area seined for fish. However, for some pools the length is greater than the area seined do to obstructions. Also, some pools may not have well defined ends and the observer will have to determine these points.
b. Width (m): Width of the pool at a point that is representative of the entire pool.
c. Depth (m): Depth of the pool at a point that is representative of the entire pool

Each pool sampled in a stream reach is measured and the average of these measurements used to describe the morphometric characteristics of the reach.

General comments: Enter any comments that will help better describe the sampling effort, habitat conditions or activities within the stream reach.

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 09

Data Management

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for managing data from the fish community monitoring at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. Microsoft Access 2002 is the primary software environment for fish data. ESRI ArcInfo 8 is used for managing spatial data associated with pool sampling locations. Data products will be posted at the NPS I&M website: http://science.nature.nps.gov/im/monitor/protocoldb.cfm. QA/QC guidelines in this document are based on recommendations of DeBacker et al. (2002) and S. Fancy at http://science.nature.nps.gov/im/monitor and citations therein.

Procedures:

I. Fish Community Database - Metadata

Metadata for the fish community database are developed using Intergraph SMMS (Spatial Metadata Management System) Ver. 5.1. Standard FGDC compliant metadata format is given in Appendix A. Metadata for fish community monitoring data will be available at NPS I&M application server: http://science.nature.nps.gov/im/apps.htm.

II. Fish Community Database - Data Model

A diagram of the fish community database is given in Figure 1. Sampling periods and location tables information form the two upper tables of the database (on the left of Figure 1). All information can be logically organized into one of two levels: stream reach data or pool data (there are normally 5 pools sampled within each stream reach). General information pertaining to the stream-reach level is maintained in the tbl_SamplingEvents. This includes information such as staff observers, date, time, weather and equipment used. Detailed information pertaining to each individual pool sampled is maintained under tbl_PoolLocationInfo and several associated tables (such as tbl_PoolSubstrateData, tbl_ShinerObservations, tbl_FishObservations and tbl_PoolData).

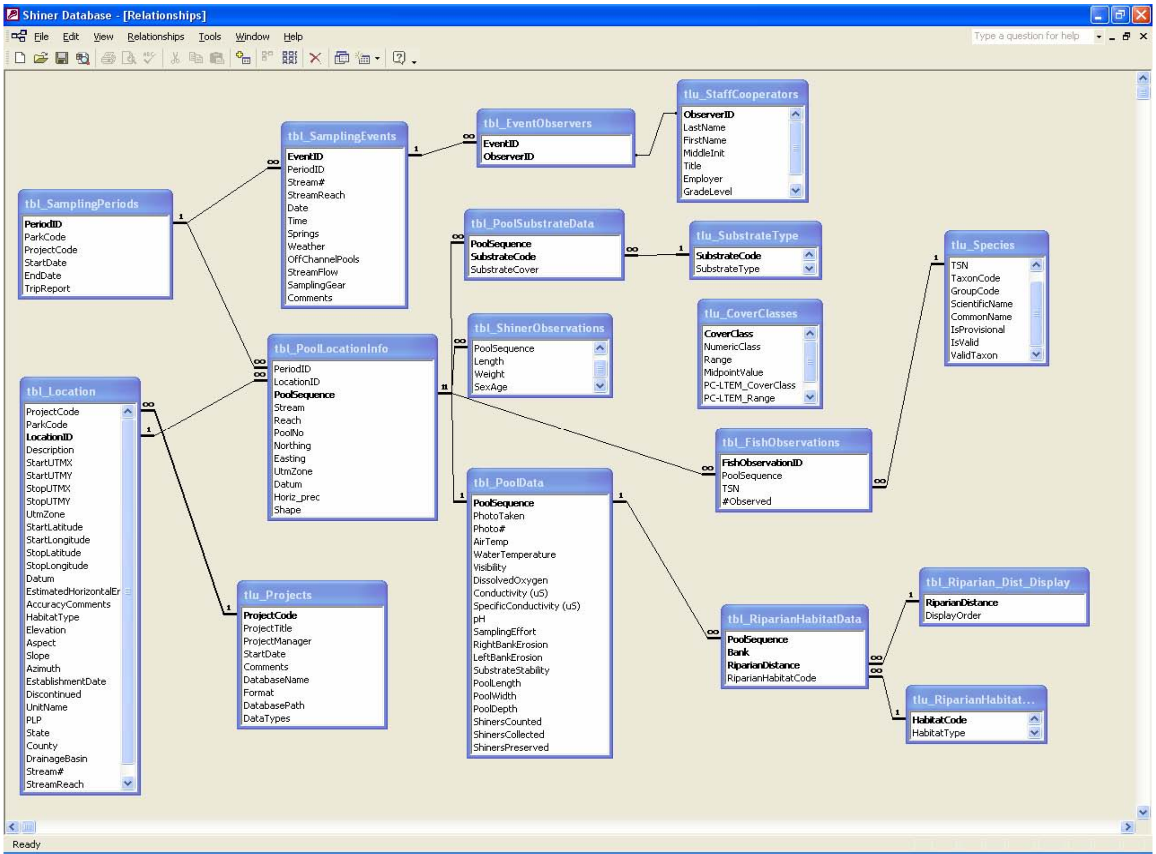


Figure 1. Data model for fish communities monitoring. Note tbl_SamplingEvents tracks stream-reach data while tbl_PoolLocationInfo serves as the organizing hub for all pool data. The data entry forms (below) follow these two levels of information organization.

III. Data Entry

Data entry is accomplished using a two-form front-end. The first form is dedicated to the general data gathered from each stream reach (see Figure 2). It requires the selection of input of stream number and reach (upper, middle, and lower) prior to proceeding to pool data-entry.

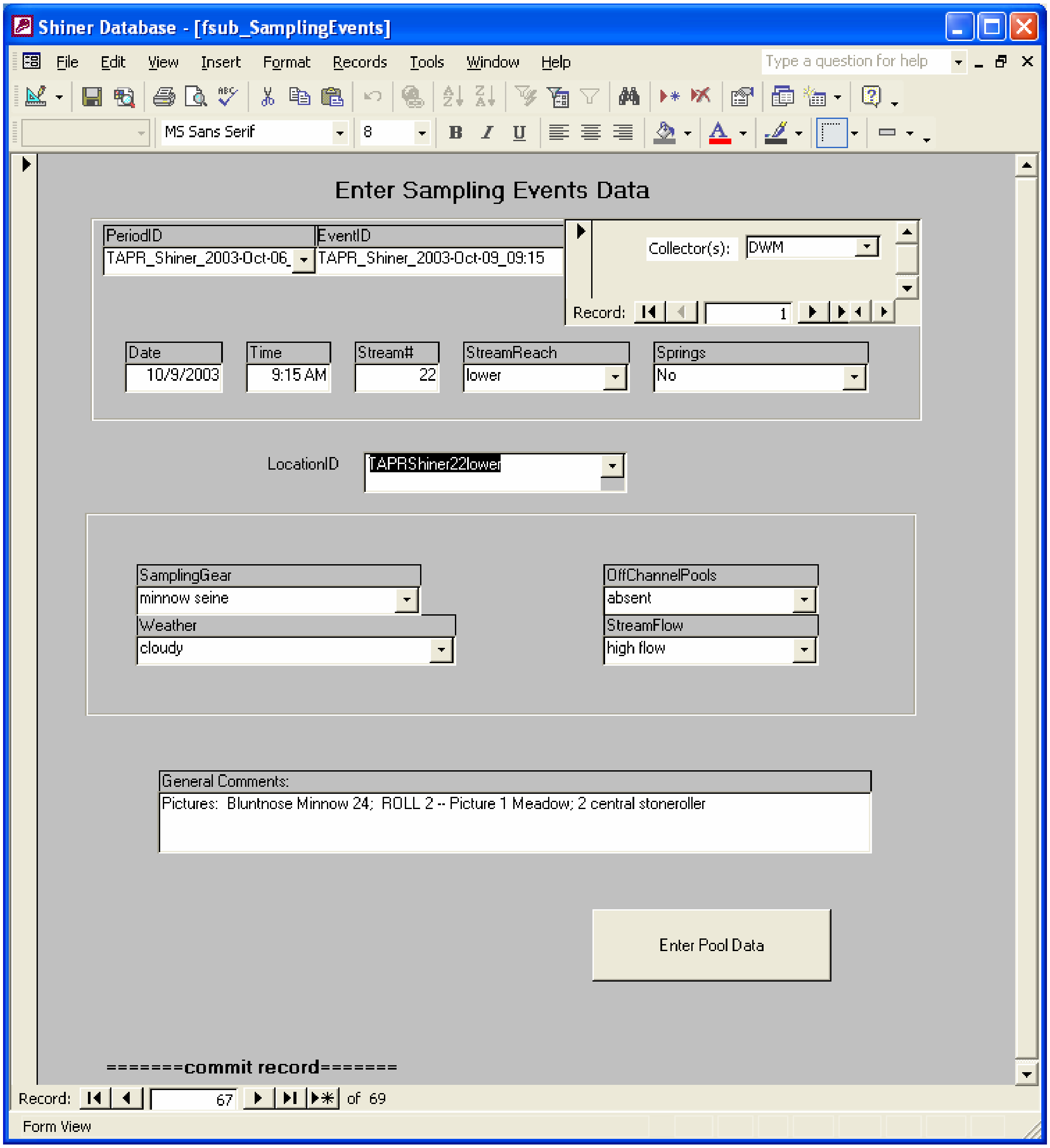


Figure 2. Data entry form for fish communities monitoring data – Entry form for stream reach data.

Once all fields for the stream reach have been completed, data can be entered for individual pools with the given stream reach. Figure 3 shows some of the fields used to enter pool data.

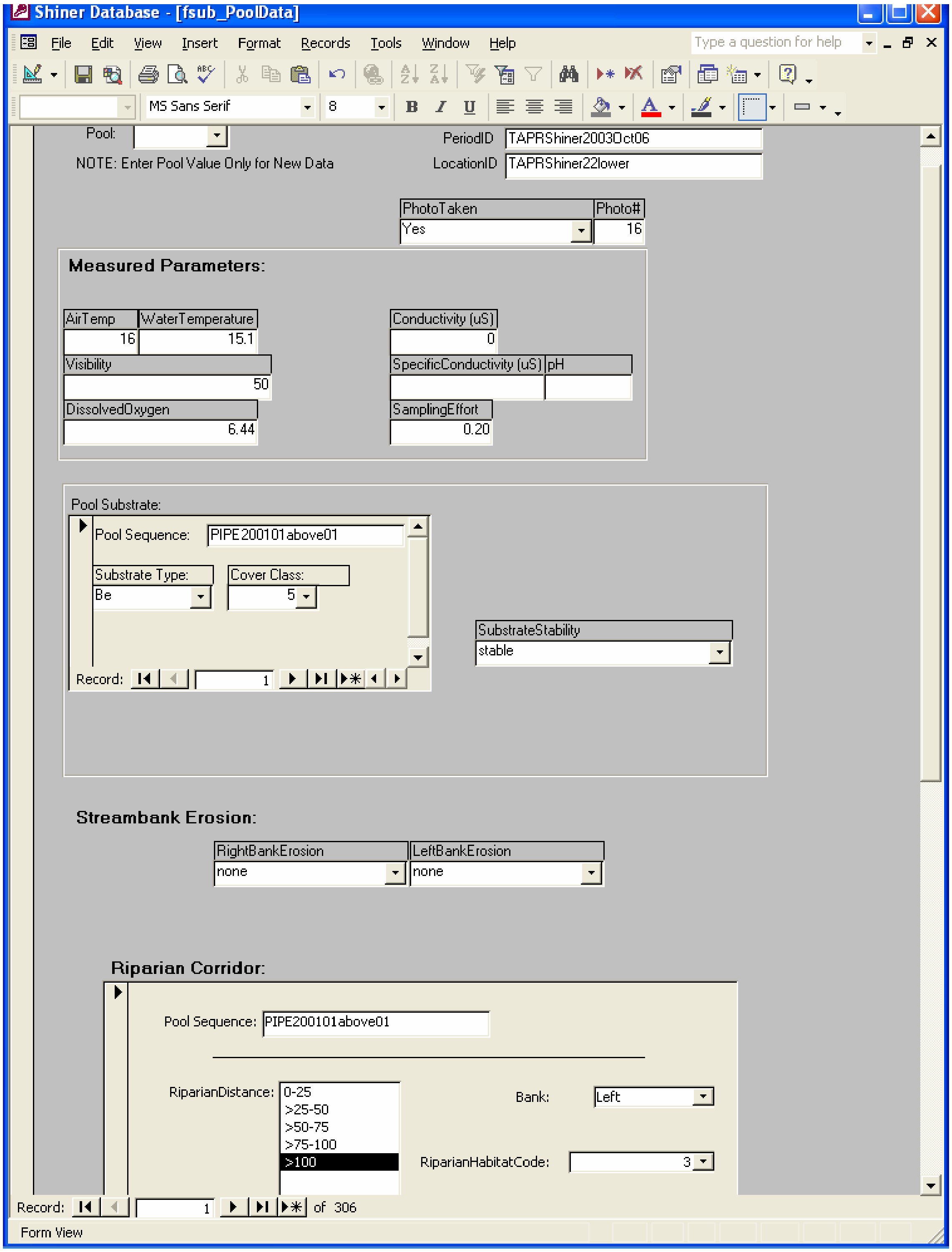


Figure 3. Data entry form for fish communities monitoring data. Form allows input for measured parameters at individual pools within stream reaches.

IV. Data Verification

Data verification immediately follows data entry and involves checking the accuracy of computerized records against the original source, usually paper field records. While the goal of data entry is to achieve 100% correct entries, this is rarely accomplished. To minimize transcription errors, our policy is to verify 100% of records to their original source by staff familiar with project design and field implementation. Further, 10% of records are reviewed a second time by the Project Manager and the results of that comparison reported with the data. If errors are found in the Project Manager's review, then the entire data set is verified again. Once the computerized data are verified as accurately reflecting the original field data, the paper forms are archived and the electronic version is used for all subsequent data activities.

V. Data Validation

Validation Methods

Although data may be correctly transcribed from the original field forms, they may not be accurate or logical. For example, a pH of 70.1 instead of 7.1 or a temperature of 95°C instead of 9.5°C is illogical and almost certainly incorrect, whether or not it was properly transcribed from field forms. The process of reviewing computerized data for range and logic errors is the validation stage. Certain components of data validation are built into data entry forms (e.g. range limits). Data validation can also be extended into the design and structure of the database. As much as possible, values for data-entry forms have been limited to valid entries stored in the look-up tables.

Additional data validation can be accomplished during verification, if the operator is sufficiently knowledgeable about the data. The Project Manager will validate the data after verification is complete. Validation procedures seek to identify generic errors (e.g. missing, mismatched or duplicate records) as well as errors specific to particular projects. For example, validation of fish data includes database query and comparison of data among years. One query detects records with a location ID from a park and a period ID from a different park. Another query counts the number of pools per reach (typically there are 5) to assure that all pools were entered. Finally, data are compared to previous years to identify gross differences. For example, Topeka shiners may be recorded at a location this year, but not in previous years, thus representing a possible new locality. During the entry, verification and validation phases, the Project Manager is responsible for the data. The Project Manager must assure consistency between field forms and the database by noting how and why any changes were made to the data on the original field forms. In general, changes made to the field forms should not be made via erasure, but rather through marginal notes or attached explanations. Once validation is complete, the data set is turned over to the Data Manager for archiving and storage.

Spatial Data Validation

Spatial validation of pool sample coordinates can be accomplished using ArcGIS 8.x (ESRI, Inc.). Because fish community attribute data are maintained as an Access database, GPS coordinates and stream-reach line features can be stored in a geodatabase using ArcGIS and integrated into the Access fish community database. Pool sampling point coverages can then be compared for validation against DRG base maps and the stream-reach line coverages at each study site.

VI. Database Administration

Data Maintenance

Data sets are rarely static. They often change through additions, corrections, and improvements made following the archival of a data set. There are three main caveats to this process:

1) Only make changes that improve or update the data while maintaining data integrity.
2) Once archived, document any changes made to the data set.
3) Be prepared to recover from mistakes made during editing.

Any editing of archived data is accomplished jointly by the Project Manager and Data Manager. Every change must be documented in the edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. The reader is referred to Tessler & Gregson (1997) for a complete description of prescribed data editing procedures and an example edit log.

Data Organization

The various databases, reports, GIS coverages, etc. used and generated by the monitoring program create a large number of files and folders to manage. Several experiences from the PC-LTEM reinforce the complicated nature of file management. For example, databases are occasionally stored in two versions of MS Access in order to accommodate data users with different software versions. Further, GIS data are sometimes stored in two projections – one for navigation, the other for use with existing base GIS data. Poor file organization can lead to confusion and data corruption. Figure 4 (below) depicts the file organization structure for the monitoring project.

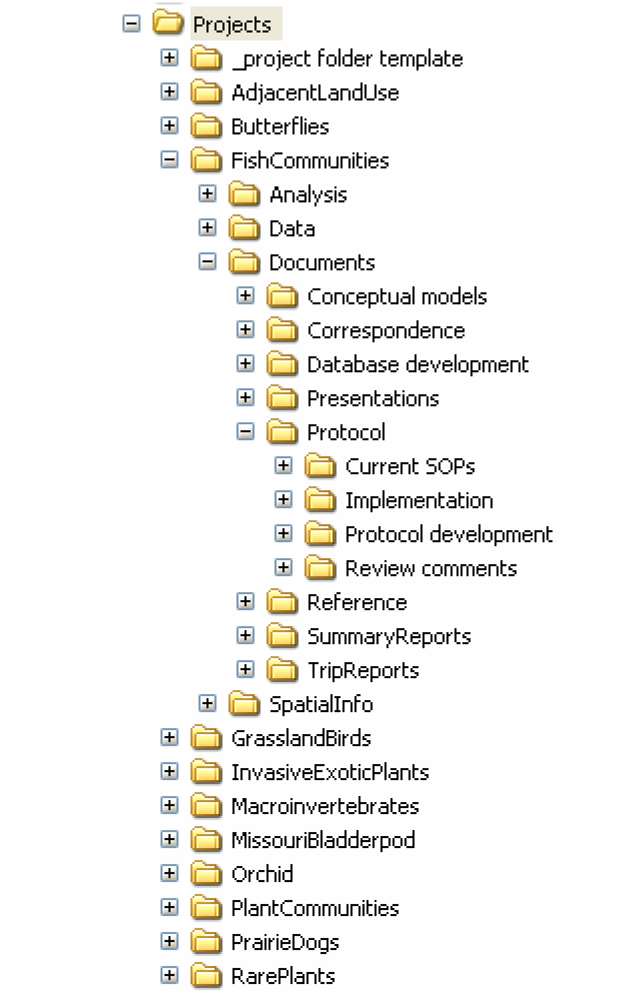


Figure 4. File structure for monitoring projects.

Version Control

Prior to any major changes of a data set, a copy is stored with the appropriate version number. This allows for the tracking of changes over time. With proper controls and communication, versioning ensures that only the most current version is used in any analysis. Versioning of archived data sets is handled by adding a floating-point number to the file name, with the first version being numbered 1.00. Each major version is assigned a sequentially higher whole number. Each minor version is assigned a sequentially higher .01 number. Major version changes include migrations across Access versions and complete rebuilds of front-ends and analysis tools. Minor version changes include bug fixes in front-end and analysis tools. Frequent users of the data are notified of the updates, and provided with a copy of the most recent archived version.

Data Logs and Backups

Once the data are archived, any changes made to the data must be documented in an edit log. At this point forward, original field forms are not altered. Field forms can be reconciled to the database through the use of the edit log. Secure data archiving is essential for protecting data files from corruption. Once a data set has passed the QA/QC procedures specified in the protocol, a new metadata record is made in SMMS. Subsequently, an electronic version of the data set is maintained in a read-only format on the program server. Backup copies of the data are maintained at the Wilson's Creek visitor center, and an additional digital copy is forwarded to the NPS Inventory and Monitoring Program Archive. Tape backups of all project databases are made daily. A total of eight tape copies are maintained at any given time, five at the HTLN/PC-LTEM building and three at the Wilson's Creek NB Visitor Center. Quarterly, one tape copy is placed into permanent archive.

VII. Data Availability

Currently, data are available for research and management applications on request, for database versions where all QA/QC has been completed and the data have been archived. Data can also be transferred using e-mail (most Access files are smaller than 10 Mbytes or can be compressed into .zip files) or ftp where available. As mentioned in the introduction, the plan is to make fish community data available for download directly from the NPS I&M Monitoring webpage. In addition, metadata will become available directly from the NPS I&M metadata server. Data requests should be directed to:

Gareth Rowell, Data Manager
Wilson's Creek National Battlefield
6424 W. Farm Road 182
Republic, MO 65738-9514
gareth_rowell@nps.gov

VIII. Tables – Functional List

Table: tbl_SamplingPeriods
Description: Core table describing the time, duration and location of each data collection period.
Fields:

Name	*Data Type*	*Description*
PeriodID	Text	Unique identifier for the data collection period, based on the park code, project code, and start date of the sampling period
ParkCode	Text	Links to Parkcode look-up table
ProjectCode	Text	Links to Projectcode look-up table
StartDate	Date/Time	Sampling period start date
Enddate	Date/Time	Sampling period end date
TripReport	Hyperlink	Trip report in MS Word format, describing protocol implementation details and special circumstances

Table: tbl_Location
Description: Core table describing the sites where data collection occurs.
Fields:

Name	*Data Type*	*Description*
ProjectCode	Text	6-character code for the monitoring project
ParkCode	Text	4-character park code
LocationID	Text	Unique identifier for the location, based partly on the park code and project code
Description	Text	Location description
StartUTMX	Number	UTM X (northing) coordinate for the center of the plot or location OR starting point of a line or polygon
StartUTMY	Number	UTM Y (easting) coordinate for the center of the plot or location OR starting point of a line or polygon
StopUTMX	Number	UTM X coordinate (northing) of ending point of line or polygon
StopUTMY	Number	UTM Y coordinate (easting) of ending point of line or polygon
UtmZone	Number	UTM zone
StartLatitude	Number	Latitude in decimal degrees for the center of the plot or location OR starting point of a line or polygon
StartLongitude	Number	Longitude in decimal degrees for the center of the plot or location OR starting point of a line or polygon
StopLatitude	Number	Latitude in decimal degrees for the ending point of a line or polygon
StopLongitude	Number	Longitude in decimal degrees for the ending point of a line or polygon
Datum	Text	Datum of mapping ellipsoid
EstimatedHorizontalError	Number	Estimated horizontal accuracy error—see users guide for complete details and examples
AccuracyComments	Memo	Comments about how positional (horizontal) accuracy was estimated
HabitatType	Text	Habitat type
Elevation	Number	Elevation in meters
Aspect	Number	Slope aspect in degrees (level surfaces have a value of -1)
Slope	Number	Slope angle in degrees
Azimuth	Number	Compass bearing between start and stop coordinates
EstablishmentDate	Date/Time	Date site was established
Discontinued	Date/Time	Date site was discontinued

UnitName	Text	Management unit in which site is located
PLP	Text	Indicates whether location is point, line or polygon
State	Text	Name of state (postal code) where stream reach is located (limit to list)
County	Text	Name of county where stream reach is located
DrainageBasin	Text	Drainage basin (limit to list)
Stream#	Number	Stream number (limit to range)
StreamReach	Text	The section of stream in which sampling occurred. Each stream reach contains 1 to 5 pools (limit to list).
Locality	Text	Pasture name (limit to list)

Table: tbl_SamplingEvents
Description: Core table describing conditions at time-of-day of data capture including stream conditions, weather and equipment used.
Fields:

Name	*Data Type*	*Description*
EventID	Text	Sampling event ID code
PeriodID	Text	Foreign key to tbl_SamplingPeriods
Stream#	Number	Unique number identifier for a stream
StreamReach	Text	The section of stream in which sampling occurred. Each stream reach contains 1 to 5 pools (limit to list).
Date	Date/Time	Date (MMDDYY) when the sampling began
Time	Date/Time	Time (99:99 AM/PM) when sampling began
Springs	Text	Identifies if a spring was present in the stream reach being sampled (limit to list).
Weather	Text	Weather conditions (limit to list).
OffChannelPools	Text	Off-channel pools present/absent/na (pool/spring) (limit to list).
StreamFlow	Text	Description of in stream flow (limit to list).
SamplingGear	Text	Type of equipment used to sample pool (to be limited to list).
Comments	Memo	Any comments recorded in the field that are pertinent to the sampling effort and data quality.

Table: tbl_EventObservers
Description: Staff associated with the observation of sampling events (junction table).
Fields:

Name	Data Type	Description
EventID	text	Foreign key to tbl_SamplingEvents
ObserverID	text	Foreign key to tlu_StaffCooperators

Table: tlu_StaffCooperators
Description: Lookup table, comprehensive list of staff, field workers, and cooperators.
Fields:

Name	Data Type	Description
ObserverID	Text	Initials of observer (primary key)
LastName	Text	Last name of observer
FirstName	Text	First name of observer
MiddleInit	Text	Middle initial of observer
Title	Text	Position. title of observer
Employer	Text	Employer of observer
GradeLevel	Text	GS level (if applicable)
Notes	Memo	Miscellaneous notes

Table: tbl_PoolLocationInfo
Description: List of unique pool sequences by year including stream, reach, and pool information.
Fields:

Name	Data Type	Description
PeriodID	Text	Foreign key to tbl_SamplingPeriods
LocationID	Text	Foreign key to tbl_Location
PoolSequence	Text	The sequence of pools visited in the reach. Compound ID based on park, year, stream number, reach location and pool sequence number.
Stream	Number	Stream identifier
Reach	Text	Reach identifier
PoolNo	Text	Pool number in current year (location varies between years)
Northing	Number	Down load from GPS unit. UTM X (northing) coordinate for the downstream end of the pool or the ends of a stream reach (double precision to15 significant digits)
Easting	Number	Down load from GPS unit. UTM Y (easting) coordinate for the downstream end of the pool or the ends of a stream reach (double precision to15 significant digits)
UtmZone	Number	Down load from GPS unit. UTM zone

Datum	Text	Down load from GPS unit. Datum of mapping ellipsoid
Horiz_prec	Number	Down load from GPS unit. Estimated horizontal accuracy error--see users guide for complete details and examples
Shape	Text	Down load from GPS unit. Indicates whether location is a point, line, or polygon

Table: tbl_PoolData
Description: Measured parameters gathered for each pool.
Fields:

Name	*Data Type*	*Description*
PoolSequence	Text	The sequence of pools visited in the reach. Compound ID based on park, year, stream number, reach location and pool sequence number (one-to-one relationship with tbl_ PoolLocationInfo.PoolSequence)
PhotoTaken	Text	Was the pool photographed (yes/no)
Photo#	Number	Frame number of photo
AirTemp	Number	Air temperature in degrees celsius (limit to range)
WaterTemperature	Number	Water temperature in degrees celsius (limit to range)
Visibility	Number	Secchi visibility in pool/run (0-120cm or >120cm) (limit to range)
DissolvedOxygen	Number	Dissolved oxygen (mg/l) (limit to range)
Conductivity (uS)	Number	A measure of the conductive material in a liquid sample (pool) with out regard to temperature.
RelativeConductivity (uS)	Number	A measure of the conductive material in a liquid sample (pool) automatically adjusted to a temperature of 25 C.
pH	Number	The pH of a liquid sample (pool).
SamplingEffort	Number	Total time spent sampling pool
RightBankErosion	Text	Degree of erosion on the right bank looking downstream (limit to list)
LeftBankErosion	Text	Degree of erosion on the left bank looking downstream (limit to list)
SubstrateStability	Text	Stability of substrate (limit to list)
PoolLength	Number	Pool length (limit to range)
PoolWidth	Number	Pool width (limit to range)
PoolDepth	Number	Pool depth (limit to range)
ShinersCounted	Number	Number of Topeka Shiners found in pool (limit to range)

ShinersCollected	Number	Number of Topeka Shiners collected for research (limit to range)
ShinersPreserved	Number	Number of Topeka Shiners collected as a voucher specimen (limit to range)

Table: tbl_RiparianHabitatData
Description: Habitat type at varying distances from left and right bank (0 – 100m).
Fields:

Name	*Data Type*	*Description*
PoolSequence	Text	Foreign key to tbl_PoolData.
Bank	Text	Right or left bank data was collected on
RiparianDistance	Text	Distance class for right and left sides of the stream bank
RiparianHabitatCode	Number	Habitat code for dominant habitat type

Table: tbl_Riparian_Dist_Display
Description: Allows display sort order of character field “RiparianDistance” using numerical field.
Fields:

Name	*Data Type*	*Description*
RiparianDistance	Text	Distance class for right and left sides of the stream bank
DisplayOrder	Number	Numerical field to sort “Riparian Distance”

Table: tlu_RiparianHabitatType
Description: Lookup table of habitat types and associated habitat descriptions.
Fields:

Name	*Data Type*	*Description*
HabitatCode	Number	Primary key used for riparian habitat type lookup.
HabitatType	Text	Habitat type class
Description	Text	Description of habitat type

Table: tbl_PoolSubstrateData
Description: Type of pool substrate and cover class.
Fields:

Name	*Data Type*	*Description*
PoolSequence	Text	Foreign key to tbl_PoolLocationInfo
SubstrateCode	Text	The code given a substrate type (limit to list).
SubstrateCover	Number	Cover class for thpe of substrate (limit to list).

Table: tlu_SubstrateType

Description: Lookup table of stream substrate classes (based on particle size <0.06 mm to > 4000 mm).
Fields:

Name	*Data Type*	*Description*
SubstrateCode	Text	Two-letter lookup code
SubstrateType	Text	Name of substrate type
Description	Text	Description of the size class of the substrate type

Table: tbl_ShinerObservations
Description: Length, weight, and other observations of shiners.
Fields:

Name	*Data Type*	*Description*
IndividualNumber	Autonumber	Unique id for each individual observed
PoolSequence	Text	Foreign key to tbl_PoolLocation
Length	Number	Length of individual observed (cm)
Weight	Number	Weight of individual observed (g)
SexAge	Text	Sex/Age of individual (M/F/J/U)

Table: tbl_FishObservations
Description: Fish species and number of individuals at each pool.
Fields:

Name	*Data Type*	*Description*
FishObservationID	Autonumber	Primary key
PoolSequence	Text	Foreign key to tbl_PoolLocationInfo
TSN	Number	IT IS taxonomic serial number
#Observed	Number	Number of individuals observed

Table: tlu_Species
Description: Lookup table, list of species observed and cross-referenced synonyms.
Fields:

Name	*Data Type*	*Description*
RecordID	Autonumber	Unique identifier of the record
TSN	Number	ITIS taxonomic serial number
TaxonCode	Text	Locally-unique code for taxa without an assigned TSN
GroupCode	Number	Group of organisms of which this is a member: birds, fish, etc.
ScientificName	Text	Scientific name of the taxon
CommonName	Text	Common or vernacular name for the species
IsProvisional	Yes/No	Indicates that the species name represents a temporary identification which will be revised once the identity has been better resolved
IsValid	Yes/No	Indicates whether or not this name is

		currently accepted as the valid name
ValidTaxon	Text	Indicates the valid name of this synonym

IX. Queries – Functional List

Queries for Data Entry Forms

Query: qryfrm_SamplingEvents
Description: Selects all fields from tbl_SamplingEvents for the event-related data entry form, fsub_SamplingEvents.
SQL:
```
SELECT tbl_SamplingEvents.*
FROM tbl_SamplingEvents;
```

Query: qryfrm_EventObservers
Description: Selects fields from tbl_EventObservers for entry of staff observers on sampling event data entry form, fsub_Collectors.
SQL:
```
SELECT tbl_EventObservers.EventID,
     tbl_EventObservers.ObserverID
FROM tbl_EventObservers;
```

Query: qryfrm_PoolData
Description: Selects fields from tbl_PoolLocationInfo and tbl_PoolData for measured parameters on pool-specific data entry form, fsub_PoolData.
SQL:
```
SELECT tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID,
     tbl_PoolLocationInfo.PoolSequence,
     tbl_PoolData.PhotoTaken, tbl_PoolData.[Photo#],
     tbl_PoolData.AirTemp, tbl_PoolData.WaterTemperature,
     tbl_PoolData.Visibility, tbl_PoolData.DissolvedOxygen,
     tbl_PoolData.[Conductivity (uS)],
     tbl_PoolData.[RelativeConductivity (uS)],
     tbl_PoolData.pH, tbl_PoolData.SamplingEffort,
     tbl_PoolData.RightBankErosion,
     tbl_PoolData.LeftBankErosion,
     tbl_PoolData.SubstrateStability, tbl_PoolData.PoolLength,
     tbl_PoolData.PoolWidth, tbl_PoolData.PoolDepth,
     tbl_PoolData.ShinersCounted,
     tbl_PoolData.ShinersCollected,
     tbl_PoolData.ShinersPreserved
FROM tbl_PoolLocationInfo
INNER JOIN tbl_PoolData
ON tbl_PoolLocationInfo.PoolSequence =
     tbl_PoolData.PoolSequence;
```

Query: qryfrm_FishObservations
Description: Selects fields from tbl_FishObservations for entry of fish species and abundance data into subform fsubsub_FishObs.
SQL:
```
SELECT tbl_FishObservations.*
FROM tbl_FishObservations;
```

Query: qryfrm_PoolsSubstrateData
Description: Selects fields from tbl_PoolsSubstrateData for entry of pool substrate data onto subform fsubsub_PoolSubstrateData
SQL:
```
SELECT tbl_PoolSubstrateData.*
FROM tbl_PoolSubstrateData;
```

Query: qryfrm_RiparianHabitatData
Description: Selects fields from tbl_RiparianHabitatData for entry of riparian habitat data into subform fsubsub_RiparianHab.
SQL:
```
SELECT tbl_RiparianHabitatData.*
FROM tbl_RiparianHabitatData;
```

Query: qryfrm_ShinerObservations
Description: Selects fields from tbl_ShinerObservations for entry of shiner observation data.
SQL:
```
SELECT tbl_ShinerObservations.*
FROM tbl_ShinerObservations;
```

<u>Queries for Fish Summary Reports</u>

Query: qryrpt_RelAbundance2
Description: Determines values of relative abundance by species, pool sequence, and sampling period. Values used in relative abundance report.
SQL:
```
SELECT tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.PoolSequence,
     tlu_Species.CommonName, tbl_FishObservations.[#Observed],
     qryana_RelAbundance1.Total, Round([#Observed]/[Total],2)
     AS rel_Abundance
FROM tlu_Species
INNER JOIN ((tbl_PoolLocationInfo
INNER JOIN qryana_RelAbundance1
ON tbl_PoolLocationInfo.PoolSequence =
     qryana_RelAbundance1.PoolSequence)
INNER JOIN tbl_FishObservations
ON tbl_PoolLocationInfo.PoolSequence =
     tbl_FishObservations.PoolSequence)
ON tlu_Species.TSN = tbl_FishObservations.TSN
```

```
ORDER BY tbl_PoolLocationInfo.PeriodID,
tbl_PoolLocationInfo.PoolSequence, tlu_Species.CommonName;
```

Query: qryrpt_RelAbundance1
Description: Determines total abundance for all fish species, by pool sequence and sampling period. Values used in relative abundance report.
SQL:

```
SELECT tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.PoolSequence,
     Sum(tbl_FishObservations.[#Observed]) AS Total
FROM tlu_Species
INNER JOIN (tbl_PoolLocationInfo
INNER JOIN tbl_FishObservations
ON tbl_PoolLocationInfo.PoolSequence =
     tbl_FishObservations.PoolSequence)
ON tlu_Species.TSN = tbl_FishObservations.TSN
GROUP BY tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.PoolSequence
ORDER BY tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.PoolSequence;
```

Query: qryrpt_means_and_likelihoods
Description: Reports mean abundance and likelihood of occurrence for each fish species in each stream-reach combination to rpt_Means_and_likelihoods
SQL:

```
SELECT qryana_MeanSEspeciesAbundance2.PeriodID,
     qryana_MeanSEspeciesAbundance2.LocationID,
     qryana_MeanSEspeciesAbundance2.CommonName,
     qryana_MeanSEspeciesAbundance2.mean,
     qryana_MeanSEspeciesAbundance2.SE,
     qryana_MeanSEspeciesAbundance2.n, Round([Likelihood1],2)
     AS Likelihood
FROM qryana_MeanSEspeciesAbundance2
INNER JOIN qry_Likelihood_of_Encounter
ON (qryana_MeanSEspeciesAbundance2.CommonName =
     qry_Likelihood_of_Encounter.CommonName)
AND (qryana_MeanSEspeciesAbundance2.LocationID =
     qry_Likelihood_of_Encounter.LocationID)
AND (qryana_MeanSEspeciesAbundance2.PeriodID =
     qry_Likelihood_of_Encounter.PeriodID);
```

Query: qryana_MeanSEspeciesAbundance2
Description: Gives mean abundance, SE and n for each fish species in each stream-reach combination. Values are used in qryrpt_means_and_likelihoods. Values are just round-offs from calculations in qryana_MeanSEspeciesAbundance1.
SQL:

```
SELECT qryana_MeanSEspeciesAbundance1.PeriodID,
```

```
     qryana_MeanSEspeciesAbundance1.LocationID,
     qryana_MeanSEspeciesAbundance1.CommonName,
     Round([mean1],2) AS mean, Round(IIf([SE1] Is
     Null,0,[SE1]),2) AS SE, qryana_MeanSEspeciesAbundance1.n
FROM qryana_MeanSEspeciesAbundance1;
```

Query: qryana_MeanSEspeciesAbundance1
Description: Calculates mean abundance, SE and n for each fish species in each stream-reach combination. Values are used in qryana_MeanSEspeciesAbundance2.
SQL:

```
SELECT tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID, tlu_Species.CommonName,
     Avg(tbl_FishObservations.[#Observed]) AS mean1,
     StDev(tbl_FishObservations.[#Observed]) AS SD1,
     Count(tbl_FishObservations.[#Observed]) AS n,
     [SD1]/Sqr([n]) AS SE1
FROM tlu_Species
INNER JOIN (tbl_PoolLocationInfo
INNER JOIN tbl_FishObservations
ON tbl_PoolLocationInfo.PoolSequence =
     tbl_FishObservations.PoolSequence)
ON tlu_Species.TSN = tbl_FishObservations.TSN
GROUP BY tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID, tlu_Species.CommonName
ORDER BY tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID;
```

Query: qry_Likelihood_of_Encounter
Description: Draws values from qry_LikehoodTotal and qry_FishLikelihood. Calculates likelihood of encounter by species, stream reach and sampling period, based on relative frequency of a species in all pools in a stream reach. Values are used in qryrpt_means_and_likelihoods.
SQL:

```
SELECT qry_LikelihoodTotal.PeriodID,
     qry_LikelihoodTotal.LocationID,
     qry_FishLikelihood.CommonName,
     [Species_Totals]/[Total_Pools] AS Likelihood1
FROM qry_LikelihoodTotal
INNER JOIN qry_FishLikelihood
ON (qry_LikelihoodTotal.LocationID =
qry_FishLikelihood.LocationID)
AND (qry_LikelihoodTotal.PeriodID =
qry_FishLikelihood.PeriodID);
```

Query: qry_LikelihoodTotal
Description: Counts the total number of pools in each stream reach. Values are used to determine likelihood of species encounter in qry_Likelihood_of_Encounter.

SQL:
```
SELECT tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID,
     Count(tbl_PoolLocationInfo.PoolSequence) AS Total_Pools
FROM tbl_PoolLocationInfo
GROUP BY tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID
ORDER BY tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID;
```

Query: qry_FishLikelihood
Description: Counts species totals in each stream reach. Values are used to determine likelihood of species encounter in qry_Likelihood_of_Encounter.
SQL:
```
SELECT tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID, tlu_Species.CommonName,
     Count(tbl_FishObservations.PoolSequence) AS
     Species_Totals
FROM tlu_Species
INNER JOIN (tbl_PoolLocationInfo
INNER JOIN tbl_FishObservations
ON tbl_PoolLocationInfo.PoolSequence =
     tbl_FishObservations.PoolSequence)
ON tlu_Species.TSN = tbl_FishObservations.TSN
GROUP BY tbl_PoolLocationInfo.PeriodID,
     tbl_PoolLocationInfo.LocationID, tlu_Species.CommonName;
```

Query: qryana_DiversityEvenness
Description: Provides species diversity and species evenness indices for each pool sequence. Values used in rpt_DiversityEvenness. Values drawn from qryana_Diversity1, qryana_Evenness1, and qryana_Evenness3.
SQL:
```
SELECT tbl_PoolLocationInfo.PeriodID,
     qryana_Diversity1.PoolSequence, qryana_Diversity1.N,
     qryana_Evenness1.Spp_Richness, qryana_Evenness3.Hprime,
     qryana_Evenness3.Jprime
FROM ((qryana_Diversity1
INNER JOIN qryana_Evenness1
ON qryana_Diversity1.PoolSequence =
     qryana_Evenness1.PoolSequence)
INNER JOIN qryana_Evenness3
ON qryana_Diversity1.PoolSequence =
     qryana_Evenness3.PoolSequence)
INNER JOIN tbl_PoolLocationInfo
ON qryana_Evenness3.PoolSequence =
     tbl_PoolLocationInfo.PoolSequence;
```

Query: qryana_Diversity1
Description: Calculates the total number of observations by pool sequence. Values used in qryana_Diversity2 and qryana_DiversityEvenness.
SQL:
```
SELECT tbl_FishObservations.PoolSequence,
Sum(tbl_FishObservations.[#Observed]) AS N
FROM tbl_FishObservations
GROUP BY tbl_FishObservations.PoolSequence;
```

Query: qryana_Evenness1
Description: Calculates the total number of species (species richness) by pool sequence. Values used in qryana_Evenness2 and qryana_DiversityEvenness.
SQL:
```
SELECT tbl_FishObservations.PoolSequence,
     Count(tbl_FishObservations.TSN) AS Spp_Richness
FROM tbl_FishObservations
GROUP BY tbl_FishObservations.PoolSequence;
```

Query: qryrpt_MainLevel
Description: Lists values for main SamplingEvent parameters.
SQL:
```
SELECT tbl_SamplingEvents.EventID,
     tbl_SamplingEvents.PeriodID,
     tbl_SamplingEvents.[Stream#],
     tbl_SamplingEvents.StreamReach, tbl_SamplingEvents.Date,
     tbl_SamplingEvents.Time, tbl_SamplingEvents.Springs,
     tbl_SamplingEvents.Weather,
     tbl_SamplingEvents.OffChannelPools,
     tbl_SamplingEvents.StreamFlow,
     tbl_SamplingEvents.SamplingGear,
     tbl_SamplingEvents.Comments
FROM tbl_SamplingEvents
ORDER BY tbl_SamplingEvents.EventID;
```
Query: qryrpt_FishObservations
Description: Summarizes fish abundance data by sampling event, species and by pool.
SQL:
```
SELECT tbl_SamplingEvents.EventID,
     tbl_PoolLocationInfo.PoolSequence,
     tlu_Species.CommonName, tbl_PoolLocationInfo.PoolNo,
     tbl_FishObservations.[#Observed] AS [Count]
FROM tlu_Species
INNER JOIN ((tbl_SamplingEvents
INNER JOIN tbl_PoolLocationInfo
ON (tbl_SamplingEvents.PeriodID =
     tbl_PoolLocationInfo.PeriodID)
AND (tbl_SamplingEvents.StreamReach =
     tbl_PoolLocationInfo.Reach)
```

```
AND (tbl_SamplingEvents.[Stream#] =
     tbl_PoolLocationInfo.Stream))
INNER JOIN tbl_FishObservations
ON tbl_PoolLocationInfo.PoolSequence =
     tbl_FishObservations.PoolSequence)
ON tlu_Species.TSN = tbl_FishObservations.TSN;
```

X. Literature Cited

DeBacker, M.D., B. Witcher, and J.R. Boetsch. 2002. Prairie Cluster Prototype Long-term Ecological Monitoring Program. Data Management Plan. Prairie Cluster Protoype LTEM Program, National Park Service. Wilson's Creek National Battlefield. Republic, Missouri. 26pp.

Appendix A.

Metadata for Fish Community Monitoring Database

Identification_Information:
Citation:
Citation_Information:
Originator: NPS Prairie Cluster Prototype LTEM Program
Publication_Date:20040301
Title: Fish Community Monitoring in Prairie Streams with Emphasis on Topeka Shiner (Notropis topeka)
Geospatial_Data_Representation_Form: map
Description:
Abstract: Decline in stream habitat on North American prairies is associated with loss of native grasslands. The purpose of this project is to monitor fish communities and their associated habitats, including the federally-listed Topeka shiner, in streams at Tallgrass Prairie National Preserve in Kansas, and Pipestone National Monument, Minnesota. Threats to Topeka shiner and other native stream species have included reduced water quality, changes in stream hydrology, de-watering of aquifers, and introduction of predaceous fish into waterways. Monitoring trends in fish community composition and diversity along with their associated habitat serves as a measure of the integrity of prairie streams on these two National Parks.
Purpose: To provide long-term monitoring data for the management of fish communities in freshwater streams at Tallgrass Prairie National Preserve in Kansas, and Pipestone National Monument, Minnesota.
Supplemental_Information: Monitoring protocol and standard operating procedures (SOPs) for this data set are available from the Point of Contact. All spatial coordinates are provided for Pipestone National Monument ONLY.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 20010911
Beginning_Time: 083000
Ending_Date: 20031009
Ending_Time: 114500
Currentness_Reference: publication date
Status:
Progress: In Work
Maintenance_and_Update_Frequency: Annually
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -96.332163
East_Bounding_Coordinate: -96.317239
North_Bounding_Coordinate: 44.019558
South_Bounding_Coordinate: 44.008484
Data_Set_G-Polygon:
Data_Set_G-Polygon_Outer_G-Ring:
G-Ring_Point:
G-Ring_Latitude: 44.008484
G-Ring_Longitude: -96.317239
G-Ring_Point:
G-Ring_Latitude: 44.019558
G-Ring_Longitude: -96.332163
Keywords:
Theme:
Theme_Keyword_Thesaurus: fish communities
Theme_Keyword: monitoring
Theme_Keyword: fish community
Theme_Keyword: streams

Theme_Keyword: prairie
Theme_Keyword: Topeka shiner
Theme_Keyword: endangered species
Place:
Place_Keyword_Thesaurus: National Parks
Place_Keyword: Pipestone National Monument
Place_Keyword: Tallgrass Prairie National Preserve
Access_Constraints: Distribution data are not available for Topeka shiner.
Use_Constraints: This data set shall not be used to capture, harm, or take endangered species as defined under Section 9 of the U.S. Endangered Species Act.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Gareth Rowell
Contact_Organization: National Park Service
Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address: Prairie Cluster Prototype Long-Term Ecological Monitoring Program, National Park Service, 6424 West Farm Rd. 182
City: Republic
State_or_Province: Missouri
Postal_Code: 65738
Country: USA
Contact_Voice_Telephone: 417-732-6438 ext. 272
Contact_Facsimile_Telephone: 417-732-7660
Contact_Electronic_Mail_Address: Gareth_Rowell@nps.gov
Hours_of_Service: 8 am - 5 pm Central Time, Monday - Friday
Browse_Graphic:
Browse_Graphic_File_Name: http://www1.nature.nps.gov/im/units/htln/data_management/data_management.htm
Browse_Graphic_File_Description: Data diagram of Prairie Cluster database
Browse_Graphic_File_Type: JPEG
Data_Set_Credit: David G. Peitz, Prairie Cluster Prototype Long-term Ecological Monitoring Program, National Park Service. U.S. Department of the Interior.
Security_Information:
Security_Classification_System: Limited distribution due to species-of-concern (SOC)
Security_Classification: Federally listed species (US Endangered Species Act)
Security_Handling_Description: Dataset includes site-specific information for endangered species on National Parks. Data use is limited to NPS staff and designated partners.
Native_Data_Set_Environment: Microsoft Access 2002; ESRI ArcGIS 8.3;
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: See logical consistency report.
Logical_Consistency_Report: Data QA/QC was maintained by using using referential integrity in all table rationships. In addition, data entry forms relied on pull-down choices limiting the user to valid data values. Post-data entry validation procedures were used to identify generic errors (e.g. missing, mismatched or duplicate records) as well as errors specific to fish community monitoring. For example, generic validation of fish data included database

query for total records and records by year and location. Another generic validation query detects records with a location ID from a park and a period ID from a different park. A validation query specific to counts the number of pools per reach (typically there are 5) to assure that all pools were entered. Finally, data are compared to previous years to identify gross differences. For example, Topeka shiners may be recorded at a location this year, but not in previous years, thus representing a possible new locality. Such instances were manually verified against the original field data. Spatial validation of pool sample coordinates was accomplished using GIS overlay between pool coordinates and DRGs and stream-reach line coverages at each study site.

Completeness_Report: Between 2001 and 2003, all stream reaches were assessed for their feasibility as long-term fish community monitoring sites. All stream reaches with fish present and sufficient water to allow sampling in at least one pool are included in our long-term monitoring effort.

Positional_Accuracy:
- Horizontal_Positional_Accuracy:
  - Horizontal_Positional_Accuracy_Report: Less than 10 m.
  - Quantitative_Horizontal_Positional_Accuracy_Assessment:
    - Horizontal_Positional_Accuracy_Value: 10
    - Horizontal_Positional_Accuracy_Explanation: meters. Value is average of 60 points using mapping grade GPS.
- Vertical_Positional_Accuracy:
  - Vertical_Positional_Accuracy_Report: unknown

Lineage:
- Source_Information:
  - Source_Citation:
    - Citation_Information:
      - Originator: NPS Prairie Cluster Prototype LTEM Program
      - Publication_Date: 20040301
      - Title: Fish Community Monitoring in Prairie Streams with Emphasis on Topeka Shiner (Notropis topeka)
  - Source_Scale_Denominator: 12000
  - Type_of_Source_Media: digital file in MS Access format
  - Source_Time_Period_of_Content:
    - Time_Period_Information:
      - Beginning_Date: 20010911
      - Ending_Date: 20031009
    - Source_Currentness_Reference: ground condition
  - Source_Citation_Abbreviation: Peitz, D.G. and G. A. Rowell. (2004) Fish Community Monitoring in Prairie Park Streams
  - Source_Contribution: Provides narrative of sampling protocol to be used for long-term monitoring of fish communities on National Park lands. Includes detailed standard operating procedures for all aspecits of monitoring project.
- Process_Step:
  - Process_Description: Fish communities and their associated habitat features were monitored for three years. Monitoring is ongoing. Data are represented as sampling pools along stream reaches, and attribute data in a relational database (MS Access).
  - Source_Used_Citation_Abbreviation: Peitz, D.G. and G. A. Rowell. (2004) Fish Community Monitoring in Prairie Park Streams
  - Process_Date: Not complete
  - Process_Contact:
    - Contact_Information:
      - Contact_Person_Primary:
        - Contact_Person: Gareth Rowell

Contact_Organization: National Park Service
Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address: Prairie Cluster Prototype Long-Term Ecological Monitoring Program, National Park Service, 6424 West Farm Rd. 182
City: Republic
State_or_Province: Missouri
Postal_Code: 65738
Country: USA
Contact_Voice_Telephone: 417-732-6438 ext. 272
Contact_Facsimile_Telephone: 417-732-7660
Contact_Electronic_Mail_Address: Gareth_Rowell@nps.gov
Hours_of_Service: 8 am - 5 pm Central Time, Monday - Friday
Spatial_Data_Organization_Information:
Indirect_Spatial_Reference: sampling pools
Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 306
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Local:
Local_Description: UTM Zone 14
Local_Georeference_Information: NAD83
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 298.257
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Datum_Name:
Altitude_Resolution:
Altitude_Distance_Units: meters
Altitude_Encoding_Method:
Depth_System_Definition:
Depth_Datum_Name: No correction
Depth_Resolution: 0.01
Depth_Distance_Units: meters
Depth_Encoding_Method: Field measured values
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_SamplingPeriods
Entity_Type_Definition: Table listing periods of field seasons at each park and links to trip reports.
Entity_Type_Definition_Source: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish Community Protocol
Attribute:
Attribute_Label: EndDate
Attribute_Definition: Ending date of field season.
Attribute_Definition_Source: None

Attribute_Domain_Values:
Attribute:
Attribute_Label: ParkCode
Attribute_Definition: Four letter code indicating National Park
Attribute_Definition_Source: National Park Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: PeriodID
Attribute_Definition: Primary Key: Sampling period identifier
Attribute_Definition_Source: PRCL Data Management Plan
Beginning_Date_of_Attribute_Values: 8/28/01
Ending_Date_of_Attribute_Values: 10/6/03
Attribute_Value_Accuracy_Information:
Attribute_Value_Accuracy_Explanation: date value is start date for season
Attribute_Measurement_Frequency: Once per season/park
Attribute:
Attribute_Label: ProjectCode
Attribute_Definition: Six-letter project identifier
Attribute_Definition_Source: Prairie Cluster Prototype LTEM Program, Inventory and Monitoring Program, National Park Service.
Attribute_Domain_Values:
Attribute:
Attribute_Label: StartDate
Attribute_Definition: Starting date of field season.
Attribute_Definition_Source: None
Attribute_Domain_Values:
Attribute:
Attribute_Label: TripReport
Attribute_Definition: Hyperlink to MS Word document containing field trip report.
Attribute_Definition_Source: None
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_Location
Entity_Type_Definition: Table contains locations of stream reaches at Tallgrass Prairie National Preserve and Pipestone National Monument.
Entity_Type_Definition_Source: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program
Attribute:
Attribute_Label: County
Attribute_Definition: County name
Attribute_Definition_Source: County
Attribute_Domain_Values:
Attribute:
Attribute_Label: Description
Attribute_Definition: Site description or notes
Attribute_Definition_Source: PC-LTEM staff
Attribute_Domain_Values:
Attribute:
Attribute_Label: DrainageBasin
Attribute_Definition: Drainage name
Attribute_Definition_Source: USGS 1:250,000 Hydrologic Units
Attribute_Domain_Values:
Attribute:

Attribute_Label: Locality
Attribute_Definition: management unit within Park
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: LocationID
Attribute_Definition: Primary Key: Unique identifier for each stream reach. Concatenated ParkCode + ProjectCode + 2 digit number + (above or upper or middle or lower)
Attribute_Definition_Source: Prairie Cluster Prototype LTEM Program. Inventory and Monitoring Program, National Park Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: ParkCode
Attribute_Definition: Four letter code indicating National Park
Attribute_Definition_Source: National Park Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectCode
Attribute_Definition: Six-letter project identifier
Attribute_Definition_Source: Prairie Cluster Prototype LTEM Program, Inventory and Monitoring Program, National Park Service.
Attribute_Domain_Values:
Attribute:
Attribute_Label: State
Attribute_Definition: Two-letter state abbreviation
Attribute_Definition_Source: US Postal Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: Stream#
Attribute_Definition: Stream number within Park
Attribute_Definition_Source: None
Attribute_Domain_Values:
Attribute:
Attribute_Label: StreamReach
Attribute_Definition: abovefalls, upper, middle or lower
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_SamplingEvents
Entity_Type_Definition: Table includes dates, times and stream reaches sampled. Also includes weather, stream flow, and misc. comments re. Sampling conditions.
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: Comments
Attribute_Definition: Comments - general comments pertaining to aquatic vegetation, stream bed stability, sampling effectivenness, upstream land use, mortality, disease, etc.
Attribute_Domain_Values:
Attribute:
Attribute_Label: Date
Attribute_Definition: Date
Attribute_Definition_Source: None
Attribute:

Attribute_Label: EventID
Attribute_Definition: Primary Key: Unique event identifier that includes Park code, Project code, year, month, day, hour and minute.
Attribute_Definition_Source: PRCL Data Management Plan
Attribute_Value_Accuracy_Information:
Attribute_Value_Accuracy: 1
Attribute_Value_Accuracy_Explanation: Accurate to nearest minute
Attribute_Measurement_Frequency: As needed
Attribute:
Attribute_Label: OffChannelPools
Attribute_Definition: OffChannelPools - Pools located off the main channel, offset to one side of the main channel flow.
Attribute:
Attribute_Label: PeriodID
Attribute_Definition: Sampling period identifier
Attribute_Definition_Source: PRCL Data Management Plan
Attribute_Measurement_Frequency: Once per season
Attribute_Domain_Values:
Attribute:
Attribute_Label: Sampling Gear
Attribute_Definition: Sampling Gear - notes if something other than 1/8 in. minnow seine.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Springs
Attribute_Definition: Springs (Yes or No)
Attribute_Domain_Values:
Attribute:
Attribute_Label: Stream#
Attribute_Definition: Stream number at each Park
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: StreamFlow
Attribute_Definition: StreamFlow - In stream flow for stream reach (pools dry, isolated pools, trickle between pools, moderate flow between pools, high flow, flood flow)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: StreamReach
Attribute_Definition: Stream reach within stream number: above, upper, middle, lower.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Time
Attribute_Definition: Time
Attribute_Definition_Source: Central Time
Attribute_Domain_Values:
Attribute:
Attribute_Label: Weather
Attribute_Definition: Weather: clear-sunny, partly cloudy, cloudy, raining, other
Attribute_Definition_Source: None

Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_Projects
Entity_Type_Definition: Table contains project identifier for long-term ecological monitoring projects at Prairie Cluster I&M Program
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: DatabaseName
Attribute_Definition: DatabaseName - Name of MS Access file
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: DatabasePath
Attribute_Definition: DatabasePath - Mapped drive and absolute path to Access file containing database
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: DataTypes
Attribute_Definition: DataTypes - kinds of information maintained in the database (demographic, habitat, occurrence, etc.). Does not refer to computer program data types.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Format
Attribute_Definition: Format - Version of MS Access (Access97 or Access2002)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectCode
Attribute_Definition: Primary Key: Unique identifer for Prairie Cluster I&M project. 6 letters: MOBLAD, SHINER, TWEETY, VEGMON
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectManager
Attribute_Definition: Project Manager - one who managers the project
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectTitle
Attribute_Definition: Project Title - Title of project narrative
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_PoolLocationInfo
Entity_Type_Definition: Table linking foreign keys: PeriodID and LocationID with primary key PoolSequence
Entity_Type_Definition_Source: none
Attribute_Domain_Values:
Attribute_Label: LocationID

Attribute_Definition: foreign key to tbl_LocationID
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PeriodID
Attribute_Definition: foreign key to tbl_SamplingPeriods
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolSequenceID
Attribute_Definition: Primary key
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_EventObservers
Entity_Type_Definition: Contains initials of staff participating in each data gathering event.
Attribute:
Attribute_Label: EventID
Attribute_Definition: Foreign key to tbl_SamplingEvents; concatenated with ObserverID make primary key.
Attribute_Definition_Source: see tbl_SamlingEvents
Attribute_Domain_Values:
Attribute:
Attribute_Label: ObserverID
Attribute_Definition: Foreign key tlu_StaffCooperators; concatenated with EventID to make primary key
Attribute_Definition_Source: ref. Table tlu_StaffCooperators
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_StaffCooperators
Entity_Type_Definition: Table listing Prairie Cluster staff and cooperators (USGS, USFWS, universities, etc.)
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: Employer
Attribute_Definition: Employing entity and program of staff or cooperator
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: FirstName
Attribute_Definition: First name of staff
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: GradeLevel
Attribute_Definition: Grade level of staff (federal employees)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: LastName
Attribute_Definition: Last name of staff or cooperator
Attribute_Definition_Source: none

Attribute_Domain_Values:
Attribute:
Attribute_Label: MiddleInit
Attribute_Definition: Middle initial of staff
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Notes
Attribute_Definition: Notes - misc. comments.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ObserverID
Attribute_Definition: ObserverID - primary key, staff initials.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Title
Attribute_Definition: Position or title of staff
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_PoolSubstrateData
Entity_Type_Definition: Table identifies substrate type and extent for each pool.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolSequence
Attribute_Definition: PoolSequency - foreign key to tbl_PoolLocationInfo
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateCode
Attribute_Definition: SubstrateCode - foreign key to look-up table tlu_SubstrateType
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateCover
Attribute_Definition: SubstrateCover - foreign key to tlu_CoverClasses which indicate extent of cover.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_ShinerObservations
Entity_Type_Definition: Table contains details about individual Topeka shiners found in parks.
Attribute:
Attribute_Label: Length
Attribute_Definition: Length of individual shiner (cm)
Attribute_Definition_Source: none
Attribute_Domain_Values:

Attribute:
Attribute_Label: PoolSequence
Attribute_Definition: PoolSequence - foreign key to tbl_PoolLocationInfo.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Weight
Attribute_Definition: Weight of individual shiner (g).
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_PoolData
Entity_Type_Definition: Table contains measured parameters that characterize pool
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: AirTemp
Attribute_Definition: Air temperature (°C)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Conductivity
Attribute_Definition: Conductivity of stream water (μS).
Attribute_Definition_Source: Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Operating Procedure #05 - Measuring pH, Conductivity, Salinity, and Temperature with the YSI Model 63.
Attribute_Domain_Values:
Attribute:
Attribute_Label: DissolvedOxygen
Attribute_Definition: Dissolved oxygen - mg/L.
Attribute_Definition_Source: Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Oprating Procedure #04 - Measuring Dissolved Oxygen with the YSI Model 55.
Attribute_Domain_Values:
Attribute:
Attribute_Label: LeftBankErosion
Attribute_Definition: LeftBankErosion - severe, moderate, slight, none
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: pH
Attribute_Definition: pH of stream water
Attribute_Definition_Source: Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Operating Procedure #05 - Measuring pH, Conductivity, Salinity, and Temperature with the YSI Model 63.
Attribute_Domain_Values:
Attribute:
Attribute_Label: Photo#
Attribute_Definition: Photo number recorded from field.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PhotoTaken
Attribute_Definition: Photo of pool taken (yes or no)
Attribute_Definition_Source: none
Attribute_Domain_Values:

Attribute:
Attribute_Label: PoolDepth
Attribute_Definition: PoolDepth - meters
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolLength
Attribute_Definition: PoolLength - meters
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolSequence
Attribute_Definition: PoolSequence - foreign key to tbl_PoolLocationInfo
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolWidth
Attribute_Definition: PoolWidth - meters
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: RelativeConductivity
Attribute_Definition: Conductivity (μS) compensated for temperature.
Attribute_Definition_Source: Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Operating Procedure #05 - Measuring pH, Conductivity, Salinity, and Temperature with the YSI Model 63.
Attribute_Domain_Values:
Attribute:
Attribute_Label: RightBankErosion
Attribute_Definition: RightBankErosion - severe, moderate, slight, none
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SamplingEffort
Attribute_Definition: Sampling effort - duration of sampling effort (min), usually with 1/8 in. minnow seine.
Attribute:
Attribute_Label: ShinersCollected
Attribute_Definition: ShinersCollected - No. of Topeka shiners collected.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ShinersCounted
Attribute_Definition: ShinersCounted - no. of Topeka shiners counted in pool.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ShinersPreserved
Attribute_Definition: ShinersPreserved - No. of Topeka shiners preserved.
Attribute_Definition_Source: none
Attribute_Domain_Values:

Attribute:
Attribute_Label: SubstrateStability
Attribute_Definition: SubstrateStability - Stable (S), Unstable (U).
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Visibility
Attribute_Definition: Visibility - Secchi tube method (cm)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: WaterTemperature
Attribute_Definition: Water temperature (°C)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_SubstrateType
Entity_Type_Definition: Look-up table containing descriptions characterizing stream substrate.
Entity_Type_Definition_Source: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute:
Attribute_Label: Description
Attribute_Definition: Description of substrate type.
Attribute_Definition_Source: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateCode
Attribute_Definition: SubstrateCode - Be, Bo, CG, Co, De, HS, Mu, PG, Sa, Si
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateType
Attribute_Definition: SubstrateType - Bedrock, Boulder, Course-gravel, Cobble, Detritus, Hardpan/shale, Muck, Pea-gravel, Sand, Silt
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_CoverClasses
Entity_Type_Definition: Classes indicating percent cover of a particular cover type.
Entity_Type_Definition_Source: Program look-up table: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program
Attribute:
Attribute_Label: CoverClass
Attribute_Definition: CoverClass - discrete (non-continuous) set of classes to classify amount of cover
Attribute_Definition_Source: none
Attribute:
Attribute_Label: MidpointValue

Attribute_Definition: MidpointValue - midpoint of the range of each cover class.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: NumericClass
Attribute_Definition: NumericClass - numeric assignment to cover class (non-unique values across different distributions).
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PC-LTEM_CoverClass
Attribute_Definition: PC-LTEM_CoverClass - modified CoverClass
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PC-LTEM_MidpointValue
Attribute_Definition: PC-LTEM_MidpointValue - modified MidpointValue.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PC-LTEM_Range
Attribute_Definition: PC-LTEM_Range - modified Range.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: Range
Attribute_Definition: Range - range of cover.
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_FishObservations
Entity_Type_Definition: Table contains number of individual fish by species sampled in each pool.
Entity_Type_Definition_Source: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#7 - Conducting Fish Community Sampling.
Attribute:
Attribute_Label: #Observed
Attribute_Definition: #Observed = No. of fish observed.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: FishObservationID
Attribute_Definition: FishObservationID - primary key.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PoolSequence
Attribute_Definition: PoolSequence - Foreign key to tbl_PoolLocationInfo; Pool identifier.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: TSN
Attribute_Definition: TSN - Foreign key to tlu_Species; Taxonomic Serial No.
Attribute_Definition_Source: Integrated Taxonomic Information System (ITIS).
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_Species

Entity_Type_Definition: Look-up table containing taxonomic information for all species of interest in Monitoring Program.
Entity_Type_Definition_Source: Integrated Taxonomic Information Sytem (ITIS) - http://www.itis.usda.gov/index.html
Attribute:
Attribute_Label: CommonName
Attribute_Definition: Common Name
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: GroupCode
Attribute_Definition: GroupCode - birds, fish, aquatic macroinvertebrates, mammals, vascular plants, Lepitopterans.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: IsProvisional
Attribute_Definition: IsProvisional - yes, no
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: IsValid
Attribute_Definition: Is Valid - yes, no
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: RecordID
Attribute_Definition: RecordID - Primary key for table
Attribute_Definition_Source: none
Attribute:
Attribute_Label: ScientificName
Attribute_Definition: Scientific Name
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: TaxonCode
Attribute_Definition: TaxonCode - taxonomic code, alphanumeric abbrev. For scientific name.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: TSN
Attribute_Definition: TSN - Taxonomic Serial No.
Attribute_Definition_Source: ITIS.
Attribute:
Attribute_Label: ValidTaxon
Attribute_Definition: ValidTaxon is Scientific Name is not valid (is synonym or other).
Attribute_Definition_Source: ITIS
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_RiparianHabitatData
Entity_Type_Definition: Table containing habitat characteristics describing riparian corridor
Entity_Type_Definition_Source: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute:
Attribute_Label: Bank
Attribute_Definition: Bank - Left, Right (looking downstream)
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PoolSequence

Attribute_Definition: PoolSequence - Foreign key to tbl_PoolLocationInfo
Attribute_Definition_Source: none
Attribute:
Attribute_Label: RiparianDistance
Attribute_Definition: RiparianDistance - Distance (m) class for right and left sides of the stream bank - 0 -25; >25 - 50; >50 - 75; >75 - 100.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: RiparianHabitatCode
Attribute_Definition: RiparianHabitatCode - Foreign key to table tlu_RiparianHabitatType.
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_Riparian_Dist_Display
Entity_Type_Definition: Table sorts display of riparian data by distance class (not alphanumberic) order.
Attribute:
Attribute_Label: DisplayOrder
Attribute_Definition: DisplayOrder: orders records so that lower distance classes are displayed before higher distance classes.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: RiparianDistance
Attribute_Definition: RiparianDistance - primary key. Links to RiparianDistance field of table tbl_RiparianHabitatData.
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_RiparianHabitatTypes
Entity_Type_Definition: Table describes habitat types associated with dominant riparian corridor vegetation.
Entity_Type_Definition_Source: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute:
Attribute_Label: Description
Attribute_Definition: Description - Extended description of dominant riparian vegetation types.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: HabitatCode
Attribute_Definition: HabitatCode - Primary key.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: HabitatType
Attribute_Definition: HabitatType - Brief description of habitat type.
Attribute_Definition_Source: none
Overview_Description:
Entity_and_Attribute_Overview: Database Name: Shiner1.1 Prairie Cluster Program (Heartland I&M Network) monitoring databases contain locations and events tables which are linked to multiple monitoring data tables. Child tables are used to capture ecological and environmental data recorded in field, in this instance, environmental factors such as stream substrate, bank

condition, water chemistry, fish frequency by species, frequency of Topeka shiner, and adjacent stream habitat.

Entity_and_Attribute_Detail_Citation: Peitz, D.G. and G.A. Rowell. 2004. Fish community monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (Notropis topeka). Prairie Cluster Prototype Long-Term Ecological Monitoring Program. National Park Service, U.S. Department of Interior.

Metadata_Reference_Information:
Metadata_Date: 20040308
Metadata_Review_Date:
Metadata_Future_Review_Date:
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Gareth Rowell
Contact_Organization: National Park Service
Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address: Prairie Cluster Prototype Long-Term Ecological Monitoring Program, National Park Service, 6424 West Farm Rd. 182
City: Republic
State_or_Province: Missouri
Postal_Code: 65738
Country: USA
Contact_Voice_Telephone: 417-732-6438 ext. 272
Contact_Facsimile_Telephone: 417-732-7660
Contact_Electronic_Mail_Address: Gareth_Rowell@nps.gov
SMMS_Contact_Email_Hyperlinked: true
Hours_of_Service: 8 am - 5 pm Central Time, Monday - Friday
Metadata_Access_Constraints: Distribution data are not available for Topeka shiner.
Metadata_Use_Constraints: This data set shall not be used to capture, harm, or take endangered species as defined under Section 9 of the U.S. Endangered Species Act.
Metadata_Security_Information:
Metadata_Security_Classification_System: none
Metadata_Security_Classification: Unclassified
Metadata_Security_Handling_Description: Access limitations due to federally-listed species, site specific information.

Fish Community Monitoring in Prairie Streams with Emphasis on Topeka Shiner (Notropis topeka)

Metadata also available as

Metadata:

- Identification_Information
- Data_Quality_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Entity_and_Attribute_Information
- Metadata_Reference_Information

Identification_Information:
Citation:
Citation_Information:
Originator: NPS Prairie Cluster Prototype LTEM Program
Publication_Date: 20040301
Title:
Fish Community Monitoring in Prairie Streams with Emphasis on Topeka Shiner (Notropis topeka)
Geospatial_Data_Representation_Form: map
Description:
Abstract:
Decline in stream habitat on North American prairies is associated with loss of native grasslands. The purpose of this project is to monitor fish communities and their associated habitats, including the federally-listed Topeka shiner, in streams at Tallgrass Prairie National Preserve in Kansas, and Pipestone National Monument, Minnesota. Threats to Topeka shiner and other native stream species have included reduced water quality, changes in stream hydrology, de-watering of aquifers, and introduction of predaceous fish into waterways. Monitoring trends in fish community composition and diversity along with their associated habitat serves as a measure of the integrity of prairie streams on these two National Parks.
Purpose:
To provide long-term monitoring data for the management of fish communities in freshwater streams at Tallgrass Prairie National Preserve in Kansas, and Pipestone National Monument, Minnesota.
Supplemental_Information:

Monitoring protocol and standard operating procedures (SOPs) for this data set are available from the Point of Contact. All spatial coordinates are provided for Pipestone National Monument ONLY.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 20010911
Beginning_Time: 083000
Ending_Date: 20031009
Ending_Time: 114500
Currentness_Reference: publication date
Status:
Progress: In Work
Maintenance_and_Update_Frequency: Annually
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -96.332163
East_Bounding_Coordinate: -96.317239
North_Bounding_Coordinate: 44.019558
South_Bounding_Coordinate: 44.008484
Data_Set_G-Polygon:
Data_Set_G-Polygon_Outer_G-Ring:
G-Ring_Point:
G-Ring_Latitude: 44.008484
G-Ring_Longitude: -96.317239
G-Ring_Point:
G-Ring_Latitude: 44.019558
G-Ring_Longitude: -96.332163
Keywords:
Theme:
Theme_Keyword_Thesaurus: fish communities
Theme_Keyword: monitoring
Theme_Keyword: fish community
Theme_Keyword: streams
Theme_Keyword: prairie
Theme_Keyword: Topeka shiner
Theme_Keyword: endangered species
Place:
Place_Keyword_Thesaurus: National Parks
Place_Keyword: Pipestone National Monument
Place_Keyword: Tallgrass Prairie National Preserve
Access_Constraints: Distribution data are not available for Topeka shiner.
Use_Constraints:
This data set shall not be used to capture, harm, or take endangered species as defined under Section 9 of the U.S. Endangered Species Act.
Point_of_Contact:

Contact_Information:
Contact_Person_Primary:
Contact_Person: Gareth Rowell
Contact_Organization: National Park Service
Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address:
Prairie Cluster Prototype Long-Term Ecological Monitoring Program, National Park Service, 6424 West Farm Rd. 182
City: Republic
State_or_Province: Missouri
Postal_Code: 65738
Country: USA
Contact_Voice_Telephone: 417-732-6438 ext. 272
Contact_Facsimile_Telephone: 417-732-7660
Contact_Electronic_Mail_Address: Gareth_Rowell@nps.gov
Hours_of_Service: 8 am - 5 pm Central Time, Monday - Friday
Browse_Graphic:
Browse_Graphic_File_Name:
<http://www1.nature.nps.gov/im/units/htln/data_management/data_management.htm>
Browse_Graphic_File_Description: Data diagram of Prairie Cluster database
Browse_Graphic_File_Type: JPEG
Data_Set_Credit:
David G. Peitz, Prairie Cluster Prototype Long-term Ecological Monitoring Program, National Park Service. U.S. Department of the Interior.
Security_Information:
Security_Classification_System: Limited distribution due to species-of-concern (SOC)
Security_Classification: Federally listed species (US Endangered Species Act)
Security_Handling_Description:
Dataset includes site-specific information for endangered species on National Parks. Data use is limited to NPS staff and designated partners.
Native_Data_Set_Environment: Microsoft Access 2002; ESRI ArcGIS 8.3;

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: See logical consistency report.
Logical_Consistency_Report:
Data QA/QC was maintained by using using referential integrity in all table rationships. In addition, data entry forms relied on pull-down choices limiting the user to valid data values. Post-data entry validation procedures were used to identify generic errors (e.g. missing, mismatched or duplicate records) as well as errors specific to fish community monitoring. For example, generic validation of fish data included database query for total records and records by year and

location. Another generic validation query detects records with a location ID from a park and a period ID from a different park. A validation query specific to counts the number of pools per reach (typically there are 5) to assure that all pools were entered. Finally, data are compared to previous years to identify gross differences. For example, Topeka shiners may be recorded at a location this year, but not in previous years, thus representing a possible new locality. Such instances were manually verified against the original field data. Spatial validation of pool sample coordinates was accomplished using GIS overlay between pool coordinates and DRGs and stream-reach line coverages at each study site.
Completeness_Report:
Between 2001 and 2003, all stream reaches were assessed for their feasibility as long-term fish community monitoring sites. All stream reaches with fish present and sufficient water to allow sampling in at least one pool are included in our long-term monitoring effort.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: Less than 10 m.
Quantitative_Horizontal_Positional_Accuracy_Assessment:
Horizontal_Positional_Accuracy_Value: 10
Horizontal_Positional_Accuracy_Explanation: meters. Value is average of 60 points using mapping grade GPS.
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: unknown
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Publication_Date 20040301
Title:
Fish Community Monitoring in Prairie Streams with Emphasis on Topeka Shiner (Notropis topeka)
Source_Scale_Denominator: 12000
Type_of_Source_Media: digital file in MS Access format
Source_Time_Period_of_Content:
Time_Period_Information:
Beginning_Date: 20010911
Ending_Date: 20031009
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation:
Peitz, D.G. and G. A. Rowell. (2004) Fish Community Monitoring in Prairie Park Streams
Source_Contribution:
Provides narrative of sampling protocol to be used for long-term monitoring of fish communities on National Park lands. Includes detailed standard operating procedures for all aspecits of monitoring project.
Process_Step:

Process_Description:
Fish communities and their associated habitat features were monitored for three years. Monitoring is ongoing. Data are represented as sampling pools along stream reaches, and attribute data in a relational database (MS Access).
Source_Used_Citation_Abbreviation:
Peitz, D.G. and G. A. Rowell. (2004) Fish Community Monitoring in Prairie Park Streams
Process_Date: Not complete
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Gareth Rowell
Contact_Organization: National Park Service
Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address:
Prairie Cluster Prototype Long-Term Ecological Monitoring Program, National Park Service, 6424 West Farm Rd. 182
City: Republic
State_or_Province: Missouri
Postal_Code: 65738
Country: USA
Contact_Voice_Telephone: 417-732-6438 ext. 272
Contact_Facsimile_Telephone: 417-732-7660
Contact_Electronic_Mail_Address: Gareth_Rowell@nps.gov
Hours_of_Service: 8 am - 5 pm Central Time, Monday - Friday

Spatial_Data_Organization_Information:
Indirect_Spatial_Reference: sampling pools
Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 306

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Local:
Local_Description: UTM Zone 14
Local_Georeference_Information: NAD83
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 298.257

Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Datum_Name:
Altitude_Resolution:
Altitude_Distance_Units: meters
Altitude_Encoding_Method:
Depth_System_Definition:
Depth_Datum_Name: No correction
Depth_Resolution: 0.01
Depth_Distance_Units: meters
Depth_Encoding_Method: Field measured values

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_SamplingPeriods
Entity_Type_Definition:
Table listing periods of field seasons at each park and links to trip reports.
Entity_Type_Definition_Source:
NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish Community Protocol
Attribute:
Attribute_Label: EndDate
Attribute_Definition: Ending date of field season.
Attribute_Definition_Source: None
Attribute_Domain_Values:
Attribute:
Attribute_Label: ParkCode
Attribute_Definition: Four letter code indicating National Park
Attribute_Definition_Source: National Park Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: PeriodID
Attribute_Definition: Primary Key: Sampling period identifier
Attribute_Definition_Source: PRCL Data Management Plan
Beginning_Date_of_Attribute_Values: 8/28/01
Ending_Date_of_Attribute_Values: 10/6/03
Attribute_Value_Accuracy_Information:
Attribute_Value_Accuracy_Explanation: date value is start date for season
Attribute_Measurement_Frequency: Once per season/park
Attribute:
Attribute_Label: ProjectCode
Attribute_Definition: Six-letter project identifier
Attribute_Definition_Source:
Prairie Cluster Prototype LTEM Program, Inventory and Monitoring Program, National Park Service.

Attribute_Domain_Values:
Attribute:
Attribute_Label: StartDate
Attribute_Definition: Starting date of field season.
Attribute_Definition_Source: None
Attribute_Domain_Values:
Attribute:
Attribute_Label: TripReport
Attribute_Definition: Hyperlink to MS Word document containing field trip report.
Attribute_Definition_Source: None
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_Location
Entity_Type_Definition:
Table contains locations of stream reaches at Tallgrass Prairie National Preserve and Pipestone National Monument.
Entity_Type_Definition_Source:
NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program
Attribute:
Attribute_Label: County
Attribute_Definition: County name
Attribute_Definition_Source: County
Attribute_Domain_Values:
Attribute:
Attribute_Label: Description
Attribute_Definition: Site description or notes
Attribute_Definition_Source: PC-LTEM staff
Attribute_Domain_Values:
Attribute:
Attribute_Label: DrainageBasin
Attribute_Definition: Drainage name
Attribute_Definition_Source: USGS 1:250,000 Hydrologic Units
Attribute_Domain_Values:
Attribute:
Attribute_Label: Locality
Attribute_Definition: management unit within Park
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: LocationID
Attribute_Definition:
Primary Key: Unique identifier for each stream reach. Concatenated ParkCode + ProjectCode + 2 digit number + (above or upper or middle or lower)
Attribute_Definition_Source:

Prairie Cluster Prototype LTEM Program. Inventory and Monitoring Program, National Park Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: ParkCode
Attribute_Definition: Four letter code indicating National Park
Attribute_Definition_Source: National Park Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectCode
Attribute_Definition: Six-letter project identifier
Attribute_Definition_Source:
Prairie Cluster Prototype LTEM Program, Inventory and Monitoring Program, National Park Service.
Attribute_Domain_Values:
Attribute:
Attribute_Label: State
Attribute_Definition: Two-letter state abbreviation
Attribute_Definition_Source: US Postal Service
Attribute_Domain_Values:
Attribute:
Attribute_Label: Stream#
Attribute_Definition: Stream number within Park
Attribute_Definition_Source: None
Attribute_Domain_Values:
Attribute:
Attribute_Label: StreamReach
Attribute_Definition: abovefalls, upper, middle or lower
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_SamplingEvents
Entity_Type_Definition:
Table includes dates, times and stream reaches sampled. Also includes weather, stream flow, and misc. comments re. Sampling conditions.
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: Comments
Attribute_Definition:
Comments - general comments pertaining to aquatic vegetation, stream bed stability, sampling effectivenness, upstream land use, mortality, disease, etc.
Attribute_Domain_Values:
Attribute:
Attribute_Label: Date
Attribute_Definition: Date

Attribute_Definition_Source: None
Attribute:
Attribute_Label: EventID
Attribute_Definition:
Primary Key: Unique event identifier that includes Park code, Project code, year, month, day, hour and minute.
Attribute_Definition_Source: PRCL Data Management Plan
Attribute_Value_Accuracy_Information:
Attribute_Value_Accuracy: 1
Attribute_Value_Accuracy_Explanation: Accurate to nearest minute
Attribute_Measurement_Frequency: As needed
Attribute:
Attribute_Label: OffChannelPools
Attribute_Definition:
OffChannelPools - Pools located off the main channel, offset to one side of the main channel flow.
Attribute:
Attribute_Label: PeriodID
Attribute_Definition: Sampling period identifier
Attribute_Definition_Source: PRCL Data Management Plan
Attribute_Measurement_Frequency: Once per season
Attribute_Domain_Values:
Attribute:
Attribute_Label: Sampling Gear
Attribute_Definition:
Sampling Gear - notes if something other than 1/8 in. minnow seine.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Springs
Attribute_Definition: Springs (Yes or No)
Attribute_Domain_Values:
Attribute:
Attribute_Label: Stream#
Attribute_Definition: Stream number at each Park
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: StreamFlow
Attribute_Definition:
StreamFlow - In stream flow for stream reach (pools dry, isolated pools, trickle between pools, moderate flow between pools, high flow, flood flow)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: StreamReach

Attribute_Definition: Stream reach within stream number: above, upper, middle, lower.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Time
Attribute_Definition: Time
Attribute_Definition_Source: Central Time
Attribute_Domain_Values:
Attribute:
Attribute_Label: Weather
Attribute_Definition: Weather: clear-sunny, partly cloudy, cloudy, raining, other
Attribute_Definition_Source: None
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_Projects
Entity_Type_Definition:
Table contains project identifier for long-term ecological monitoring projects at Prairie Cluster I&M Program
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: DatabaseName
Attribute_Definition: DatabaseName - Name of MS Access file
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: DatabasePath
Attribute_Definition:
DatabasePath - Mapped drive and absolute path to Access file containing database
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: DataTypes
Attribute_Definition:
DataTypes - kinds of information maintained in the database (demographic, habitat, occurrence, etc.). Does not refer to computer program data types.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Format
Attribute_Definition: Format - Version of MS Access (Access97 or Access2002)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectCode

Attribute_Definition:
Primary Key: Unique identifer for Prairie Cluster I&M project. 6 letters: MOBLAD, SHINER, TWEETY, VEGMON
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectManager
Attribute_Definition: Project Manager - one who managers the project
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ProjectTitle
Attribute_Definition: Project Title - Title of project narrative
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_PoolLocationInfo
Entity_Type_Definition:
Table linking foreign keys: PeriodID and LocationID with primary key PoolSequence
Entity_Type_Definition_Source: none
Attribute_Domain_Values:
Attribute_Label: LocationID
Attribute_Definition: foreign key to tbl_LocationID
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PeriodID
Attribute_Definition: foreign key to tbl_SamplingPeriods
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolSequenceID
Attribute_Definition: Primary key
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_EventObservers
Entity_Type_Definition:
Contains initials of staff participating in each data gathering event.
Attribute:
Attribute_Label: EventID
Attribute_Definition:

Foreign key to tbl_SamplingEvents; concatenated with ObserverID make primary key.
Attribute_Definition_Source: see tbl_SamlingEvents
Attribute_Domain_Values:
Attribute:
Attribute_Label: ObserverID
Attribute_Definition:
Foreign key tlu_StaffCooperators; concatenated with EventID to make primary key
Attribute_Definition_Source: ref. Table tlu_StaffCooperators
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_StaffCooperators
Entity_Type_Definition:
Table listing Prairie Cluster staff and cooperators (USGS, USFWS, universities, etc.)
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: Employer
Attribute_Definition: Employing entity and program of staff or cooperator
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: FirstName
Attribute_Definition: First name of staff
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: GradeLevel
Attribute_Definition: Grade level of staff (federal employees)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: LastName
Attribute_Definition: Last name of staff or cooperator
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: MiddleInit
Attribute_Definition: Middle initial of staff
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Notes
Attribute_Definition: Notes - misc. comments.

Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ObserverID
Attribute_Definition: ObserverID - primary key, staff initials.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Title
Attribute_Definition: Position or title of staff
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_PoolSubstrateData
Entity_Type_Definition: Table identifies substrate type and extent for each pool.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolSequence
Attribute_Definition: PoolSequency - foreign key to tbl_PoolLocationInfo
Attribute_Definition_Source: none Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateCode
Attribute_Definition: SubstrateCode - foreign key to look-up table tlu_SubstrateType
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateCover
Attribute_Definition:
SubstrateCover - foreign key to tlu_CoverClasses which indicate extent of cover.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_ShinerObservations
Entity_Type_Definition:
Table contains details about individual Topeka shiners found in parks.
Attribute:
Attribute_Label: Length
Attribute_Definition: Length of individual shiner (cm)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolSequence

Attribute_Definition: PoolSequence - foreign key to tbl_PoolLocationInfo.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Weight
Attribute_Definition: Weight of individual shiner (g).
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_PoolData
Entity_Type_Definition: Table contains measured parameters that characterize pool
Entity_Type_Definition_Source: none
Attribute:
Attribute_Label: AirTemp
Attribute_Definition: Air temperature (°C)
Attribute_Definition_Source: none Attribute_Domain_Values:
Attribute:
Attribute_Label: Conductivity
Attribute_Definition: Conductivity of stream water (μS).
Attribute_Definition_Source:
Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Operating Procedure #05 - Measuring pH, Conductivity, Salinity, and Temperature with the YSI Model 63.
Attribute_Domain_Values:
Attribute:
Attribute_Label: DissolvedOxygen
Attribute_Definition: Dissolved oxygen - mg/L.
Attribute_Definition_Source:
Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Oprating Procedure #04 - Measuring Dissolved Oxygen with the YSI Model 55.
Attribute_Domain_Values:
Attribute:
Attribute_Label: LeftBankErosion
Attribute_Definition: LeftBankErosion - severe, moderate, slight, none
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: pH
Attribute_Definition: pH of stream water
Attribute_Definition_Source:
Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Operating Procedure #05 - Measuring pH, Conductivity, Salinity, and Temperature with the YSI Model 63.
Attribute_Domain_Values:
Attribute:
Attribute_Label: Photo#

Attribute_Definition: Photo number recorded from field.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PhotoTaken
Attribute_Definition: Photo of pool taken (yes or no)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolDepth
Attribute_Definition: PoolDepth - meters
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolLength
Attribute_Definition: PoolLength - meters
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolSequence
Attribute_Definition: PoolSequence - foreign key to tbl_PoolLocationInfo
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: PoolWidth
Attribute_Definition: PoolWidth - meters
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: RelativeConductivity
Attribute_Definition: Conductivity (μS) compensated for temperature.
Attribute_Definition_Source:
Prairie Cluster Program - Fish Community Monitoring Protocol: Standard Operating Procedure #05 - Measuring pH, Conductivity, Salinity, and Temperature with the YSI Model 63.
Attribute_Domain_Values:
Attribute:
Attribute_Label: RightBankErosion
Attribute_Definition: RightBankErosion - severe, moderate, slight, none
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SamplingEffort
Attribute_Definition:
Sampling effort - duration of sampling effort (min), usually with 1/8 in. minnow seine.

Attribute:
Attribute_Label: ShinersCollected
Attribute_Definition: ShinersCollected - No. of Topeka shiners collected.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ShinersCounted
Attribute_Definition: ShinersCounted - no. of Topeka shiners counted in pool.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: ShinersPreserved
Attribute_Definition: ShinersPreserved - No. of Topeka shiners preserved.
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateStability
Attribute_Definition: SubstrateStability - Stable (S), Unstable (U).
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: Visibility
Attribute_Definition: Visibility - Secchi tube method (cm)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: WaterTemperature
Attribute_Definition: Water temperature (°C)
Attribute_Definition_Source: none
Attribute_Domain_Values:
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_SubstrateType
Entity_Type_Definition:
Look-up table containing descriptions characterizing stream substrate.
Entity_Type_Definition_Source:
NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute:
Attribute_Label: Description
Attribute_Definition: Description of substrate type.
Attribute_Definition_Source:
NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute_Domain_Values:
Attribute:

Attribute_Label: SubstrateCode
Attribute_Definition: SubstrateCode - Be, Bo, CG, Co, De, HS, Mu, PG, Sa, Si
Attribute_Definition_Source: none
Attribute_Domain_Values:
Attribute:
Attribute_Label: SubstrateType
Attribute_Definition:
SubstrateType - Bedrock, Boulder, Course-gravel, Cobble, Detritus, Hardpan/shale, Muck, Pea-gravel, Sand, Silt
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_CoverClasses
Entity_Type_Definition: Classes indicating percent cover of a particular cover type.
Entity_Type_Definition_Source:
Program look-up table: NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program
Attribute:
Attribute_Label: CoverClass
Attribute_Definition:
CoverClass - discrete (non-continuous) set of classes to classify amount of cover
Attribute_Definition_Source: none
Attribute:
Attribute_Label: MidpointValue
Attribute_Definition: MidpointValue - midpoint of the range of each cover class.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: NumericClass
Attribute_Definition:
NumericClass - numeric assignment to cover class (non-unique values across different distributions).
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PC-LTEM_CoverClass
Attribute_Definition: PC-LTEM_CoverClass - modified CoverClass
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PC-LTEM_MidpointValue
Attribute_Definition: PC-LTEM_MidpointValue - modified MidpointValue.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PC-LTEM_Range
Attribute_Definition: PC-LTEM_Range - modified Range.
Attribute_Definition_Source: none
Attribute:

Attribute_Label: Range
Attribute_Definition: Range - range of cover.
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_FishObservations
Entity_Type_Definition:
Table contains number of individual fish by species sampled in each pool.
Entity_Type_Definition_Source:
NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#7 - Conducting Fish Community Sampling.
Attribute:
Attribute_Label: #Observed
Attribute_Definition: #Observed = No. of fish observed.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: FishObservationID
Attribute_Definition: FishObservationID - primary key.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PoolSequence
Attribute_Definition:
PoolSequence - Foreign key to tbl_PoolLocationInfo; Pool identifier.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: TSN
Attribute_Definition: TSN - Foreign key to tlu_Species; Taxonomic Serial No.
Attribute_Definition_Source: Integrated Taxonomic Information System (ITIS).
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_Species
Entity_Type_Definition:
Look-up table containing taxonomic information for all species of interest in Monitoring Program.
Entity_Type_Definition_Source:
Integrated Taxonomic Information Sytem (ITIS) -
<http://www.itis.usda.gov/index.html>
Attribute:
Attribute_Label: CommonName
Attribute_Definition: Common Name
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: GroupCode
Attribute_Definition:
GroupCode - birds, fish, aquatic macroinvertebrates, mammals, vascular plants, Lepitopterans.

Attribute_Definition_Source: none
Attribute:
Attribute_Label: IsProvisional
Attribute_Definition: IsProvisional - yes, no
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: IsValid
Attribute_Definition: Is Valid - yes, no
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: RecordID
Attribute_Definition: RecordID - Primary key for table
Attribute_Definition_Source: none
Attribute:
Attribute_Label: ScientificName
Attribute_Definition: Scientific Name
Attribute_Definition_Source: ITIS
Attribute:
Attribute_Label: TaxonCode
Attribute_Definition:
TaxonCode - taxonomic code, alphanumeric abbrev. For scientific name.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: TSN
Attribute_Definition: TSN - Taxonomic Serial No.
Attribute_Definition_Source: ITIS.
Attribute:
Attribute_Label: ValidTaxon
Attribute_Definition:
ValidTaxon is Scientific Name is not valid (is synonym or other).
Attribute_Definition_Source: ITIS
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_RiparianHabitatData
Entity_Type_Definition:
Table containing habitat characteristics describing riparian corridor
Entity_Type_Definition_Source:
NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute:
Attribute_Label: Bank
Attribute_Definition: Bank - Left, Right (looking downstream)
Attribute_Definition_Source: none
Attribute:
Attribute_Label: PoolSequence
Attribute_Definition: PoolSequence - Foreign key to tbl_PoolLocationInfo

Attribute_Definition_Source: none
Attribute:
Attribute_Label: RiparianDistance
Attribute_Definition:
RiparianDistance - Distance (m) class for right and left sides of the stream bank - 0 -25; >25 - 50; >50 - 75; >75 - 100.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: RiparianHabitatCode
Attribute_Definition:
RiparianHabitatCode - Foreign key to table tlu_RiparianHabitatType.
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tbl_Riparian_Dist_Display
Entity_Type_Definition:
Table sorts display of riparian data by distance class (not alphanumberic) order.
Attribute:
Attribute_Label: DisplayOrder
Attribute_Definition:
DisplayOrder: orders records so that lower distance classes are displayed before higher distance classes.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: RiparianDistance
Attribute_Definition:
RiparianDistance - primary key. Links to RiparianDistance field of table tbl_RiparianHabitatData.
Attribute_Definition_Source: none
Detailed_Description:
Entity_Type:
Entity_Type_Label: tlu_RiparianHabitatTypes
Entity_Type_Definition:
Table describes habitat types associated with dominant riparian corridor vegetation.
Entity_Type_Definition_Source:
NPS Prairie Cluster Prototype Long-Term Ecological Monitoring Program: Fish community monitoring:SOP#8 - Documenting Habitat Variables.
Attribute:
Attribute_Label: Description
Attribute_Definition:
Description - Extended description of dominant riparian vegetation types.
Attribute_Definition_Source: none
Attribute:
Attribute_Label: HabitatCode
Attribute_Definition: HabitatCode - Primary key.

Attribute_Definition_Source: none
Attribute:
Attribute_Label: HabitatType
Attribute_Definition: HabitatType - Brief description of habitat type.
Attribute_Definition_Source: none
Overview_Description:
Entity_and_Attribute_Overview:
Database Name: Shiner1.1 Prairie Cluster Program (Heartland I&M Network) monitoring databases contain locations and events tables which are linked to multiple monitoring data tables. Child tables are used to capture ecological and environmental data recorded in field, in this instance, environmental factors such as stream substrate, bank condition, water chemistry, fish frequency by species, frequency of Topeka shiner, and adjacent stream habitat.
Entity_and_Attribute_Detail_Citation:
Peitz, D.G. and G.A. Rowell. 2004. Fish community monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (Notropis topeka). Prairie Cluster Prototype Long-Term Ecological Monitoring Program. National Park Service, U.S. Department of Interior.

Metadata_Reference_Information:
Metadata_Date: 20040308
Metadata_Review_Date:
Metadata_Future_Review_Date:
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Gareth Rowell
Contact_Organization: National Park Service
Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address:
Prairie Cluster Prototype Long-Term Ecological Monitoring Program, National Park Service, 6424 West Farm Rd. 182
City: Republic
State_or_Province: Missouri
Postal_Code: 65738
Country: USA
Contact_Voice_Telephone: 417-732-6438 ext. 272
Contact_Facsimile_Telephone: 417-732-7660
Contact_Electronic_Mail_Address: Gareth_Rowell@nps.gov
SMMS_Contact_Email_Hyperlinked: true
Hours_of_Service: 8 am - 5 pm Central Time, Monday - Friday
Metadata_Access_Constraints: Distribution data are not available for Topeka shiner.
Metadata_Use_Constraints:

This data set shall not be used to capture, harm, or take endangered species as defined under Section 9 of the U.S. Endangered Species Act.
Metadata_Security_Information:
Metadata_Security_Classification_System: none
Metadata_Security_Classification: Unclassified
Metadata_Security_Handling_Description:
Access limitations due to federally-listed species, site specific information.

Generated by mp version 2.7.33 on Tue Mar 09 13:15:42 2004

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 10

Data Analysis

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for data analysis for the fish community monitoring at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. This SOP is divided into two sections: Section A, annual data summary and analysis and Section B, long-term trend and species-habitat relationship analysis. Section A methods consist of 1) determining individual occurrence by fish species, 2) determining fish species diversity, richness and distribution evenness by stream reach and 3) calculating descriptive statistics for habitat variables. Section B methods consist of 1) examining the relationships between fish species abundance and habitat conditions by way of correlation analysis and 2) consideration of other possible approaches including, but not limited to; data visualization, geostatistics and time-series analysis are reviewed. Section B will not be fully developed until after several years (> 5 yr.) of data have been collected.

I. Section A – Annual Data Summary and Analysis

<u>Fish Community Data Summaries and Reports</u>

The fish community variables and indices selected for data summary purposes are complete, descriptive, and easily interpretable and will provide resource managers timely feedback to help assess management practices (Pickett et al. 1992). Mean (± SE) relative abundance of each fish species is calculated annually for each stream reach. Relative abundance is calculated for each pool prior to estimating stream reach means (± SE). Also, the likelihood of encountering a species when seining a pool within a stream reach (pools observed in / pools seined) is determined. Results are plotted from most to least common species within a stream reach on a park.

Mean (± SE) fish species diversity, richness and distribution evenness are calculated for stream reaches from pool estimates annually. Fish diversity for each pool in a reach is calculated using Shannon Diversity Index:

$$H' = -\Sigma(n_1/N)\ln(n_1/N),$$

were n_1/N is the proportion of the total number of individuals in a population consisting of the i^{th} species (Shannon, 1949). Species richness is determined as the total number of fish taxa recorded per pool. Species distribution evenness is calculated by pool using Pielou (J):

$$J' = H' / Hmax ,$$

were H' is the Shannon Diversity Index and Hmax is the maximum possible diversity for a given number of species if all species are present in equal numbers ((ln(species richness)). J' is a measure of how evenly individuals are distributed within a community when compared to the equal distribution and maximum diversity a community can have (Pielou, 1969).

Annual data summaries and reports for fish observation data should be generated using the front-end within the database called "Shiner1.1". When Shiner1.1 is opened, a switchboard form is displayed which includes the heading "National Park Service Inventory and Monitoring – Fish Community Monitoring: Fish Surveys" (see Figure 10.01.1). Fish observation summaries should be obtained in the following way:

> Click on the Data Summaries and Reports button to see the various options for data analysis available. The data summary form is divided into fish community summary reports, Topeka shiner summary reports, and habitat summary reports. Habitat parameters are summarized for each stream reach and also for individual pools within each stream reach (see Figure 10.01.2).

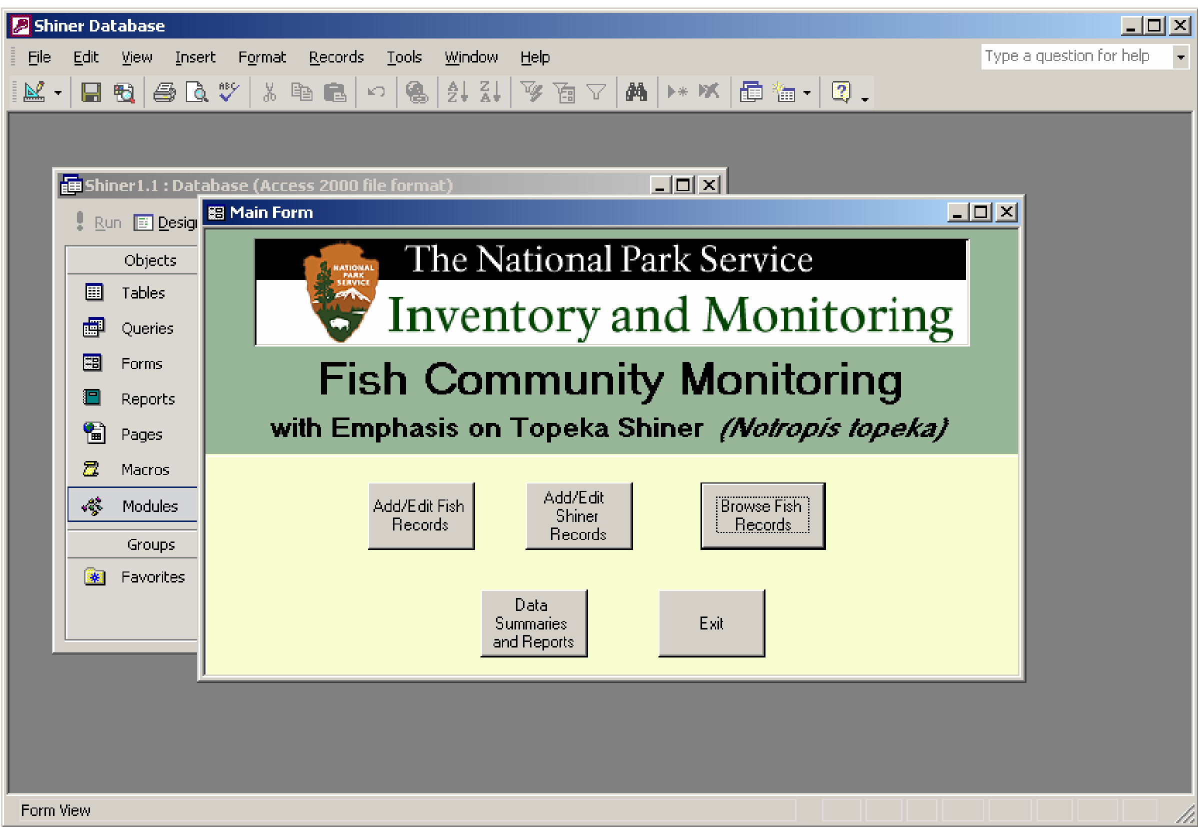
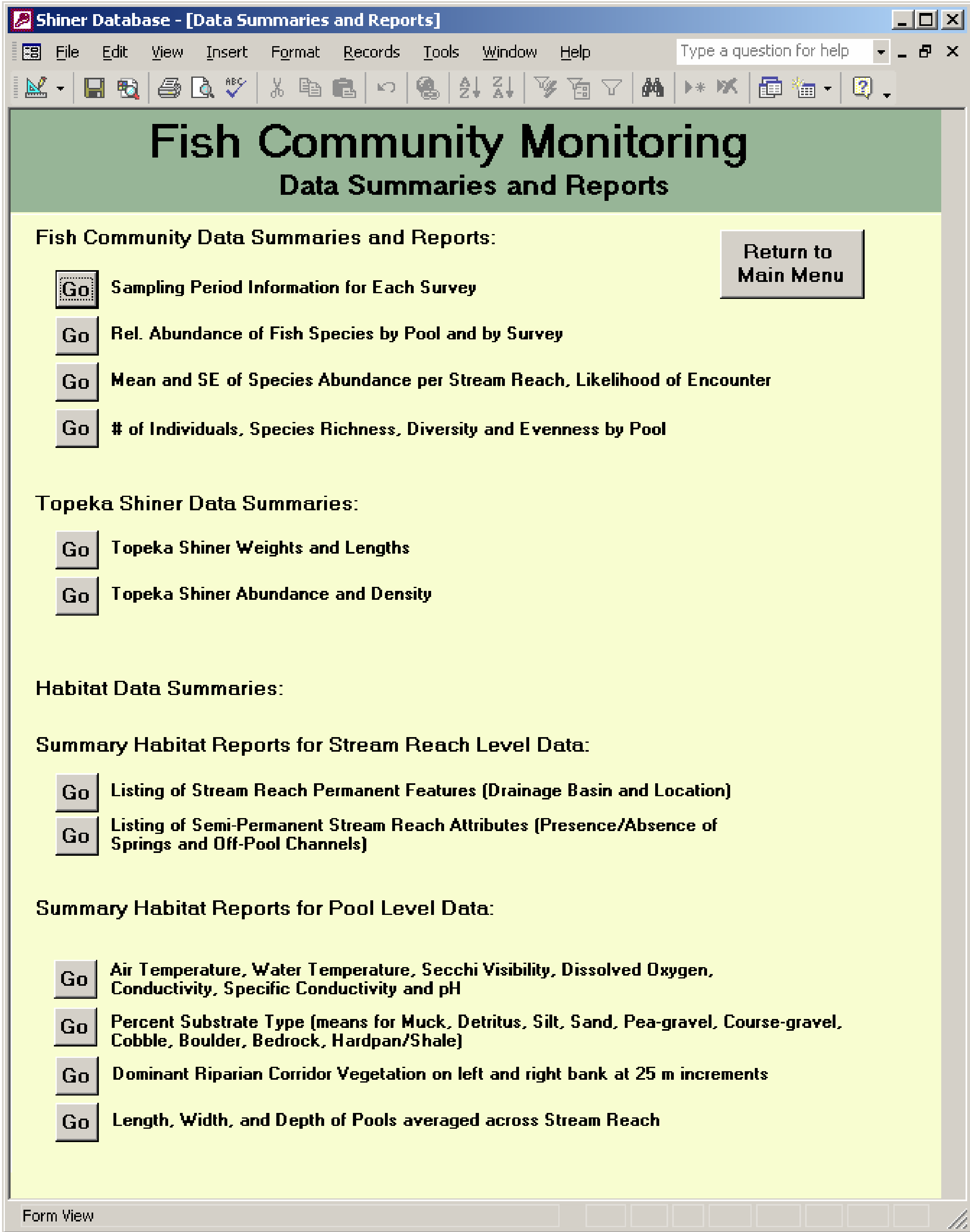


Figure 10.01.1: Main switch board for database front-end for Fish Community Monitoring with Emphasis on Topeka shiner (*Notropis topeka*).



Shiner Database - [Data Summaries and Reports]

File Edit View Insert Format Records Tools Window Help

Type a question for help

Fish Community Monitoring

Data Summaries and Reports

Fish Community Data Summaries and Reports:

Return to Main Menu

Go Sampling Period Information for Each Survey

Go Rel. Abundance of Fish Species by Pool and by Survey

Go Mean and SE of Species Abundance per Stream Reach, Likelihood of Encounter

Go # of Individuals, Species Richness, Diversity and Evenness by Pool

Topeka Shiner Data Summaries:

Go Topeka Shiner Weights and Lengths

Go Topeka Shiner Abundance and Density

Habitat Data Summaries:

Summary Habitat Reports for Stream Reach Level Data:

Go Listing of Stream Reach Permanent Features (Drainage Basin and Location)

Go Listing of Semi-Permanent Stream Reach Attributes (Presence/Absence of Springs and Off-Pool Channels)

Summary Habitat Reports for Pool Level Data:

Go Air Temperature, Water Temperature, Secchi Visibility, Dissolved Oxygen, Conductivity, Specific Conductivity and pH

Go Percent Substrate Type (means for Muck, Detritus, Silt, Sand, Pea-gravel, Course-gravel, Cobble, Boulder, Bedrock, Hardpan/Shale)

Go Dominant Riparian Corridor Vegetation on left and right bank at 25 m increments

Go Length, Width, and Depth of Pools averaged across Stream Reach

Form View

Figure 8.01.2. Data Summaries and Reports form for the Fish Community Monitoring database front-end. Options in the upper half of the form provide summaries of fish observation data. Options in the lower half of the form provide summaries of habitat data.

Fish community summaries and reports --

1. The first option is to provide an overview of each survey conducted including starting and ending dates and links to trip reports.
2. The next option, labeled Rel. Abundance of Fish Species by Pool and by Survey", lists the actual number of fish and their relative abundance by species at each pool sampled.
3. The third option is labeled mean and SE of Species Abundance per Stream Reach, Likelihood of Encounter. This report summaries the mean and SE of fish sampled by species (n = number of pools sampled along each stream reach). Likelihood is the chance this species would be observed along this stream reach based on observed data.
4. The last option under Fish Community summaries is the # of individuals observed, species richness, species diversity index (H') and evenness (J') statistic for each pool in a stream reach.

Topeka Shiner Data Summaries and Reports

Annual means, medians and modes of Topeka shiner weights and lengths are calculated for each stream reach. Also, weights and lengths are assessed for all individuals to identify juveniles from adults (adults >1.0 g weight and 4.0 cm length, Pflieger 1997). When distinguishable in the field, sex of each individual is determine with numbers of each sex reported by stream reach.

Density of Topeka shiner may be calculated by first determining the volume of a pool sampled:

$$\text{Volume } (m^3) = \text{length } (m) \times \text{width } (m) \times \text{depth } (m)$$

and then divide the volume by the number of individuals taken from that pool. Density is averaged across a stream reach and reported as individual per meter cubed.

Topeka Shiner Data Summary Reports – The database front-end gives two options for summary reports for Topeka shiner survey data:

1. Topeka Shiner Weights and Lengths – this report summaries for each survey: average weight (g), average length (cm), and total number of individual shiners sampled in each pool.
2. Topeka Shiner Abundance and Density – this report gives the abundance and relative density of Topeka shiners by pool.

Habitat Data Summaries and Reports

The procedures for documenting habitat characteristics are described in SOP #8. Data are collected at both the stream reach and pool level.

Summary Habitat Reports for Stream Reach Level Data – Stream reach locations are used to assure that fish community and habitat data collections are conducted on the relatively same section of a stream each year. Summary reports for habitat attributes at the reach level are provided for "permanent" and "semi-permanent" features. For permanent features, the generated report is a listing for drainage basin, stream reach (lower, middle or upper) and UTM coordinates for reach ends. These values are measured only once and are assigned to a permanent locations table. Semi-permanent plot features are not expected to change much. Semi-permanent plot features include the presence or absence of springs and off channel pools within a stream reach, and are recorded each time a survey is conducted.

Summary Habitat Reports for Pool Level Data -- The bulk of habitat data is collected on from one to five pools within a stream reach, generally five pools. Within each stream reach, the temperature of water, Secchi visibility, dissolved oxygen, conductivity; relative conductivity and pH are recorded for each pool and averaged for the reach. Ambient air temperature is records at this time and averaged for the stream reach. Also recorded at each pool is the coverage of various substrate types and substrate stability. Percent coverage is recorded by cover class with median values from each cover class used to calculate means (± SE). Dominant riparian corridor vegetation on each bank, in 25-m increment to 100-m and one measure greater than 100-m are recorded for each pool and the most common type for each increment reported for the stream reach. Length, width and depth of pools are averaged across a stream reach and reported.

There are six options in the database front-end to generate analysis reports for habitat data, two options describe stream reach level data, and four options describe pool level data:

1. The 1st option under habitat data summaries for stream reach level data provides a listing of permanent features. This listing includes stream reach locationID, drainage basin, and park management unit, where applicable.
2. The 2nd option, Semi-Permanent Stream Reach Attributes, gives a report of presence/absence of springs and off-pool channels observed at each stream reach. Data are organized by Survey and EventID.
3. The 1st option under habitat data summaries for pool level data is a collection of measured physical and chemical parameters including air temperature, water temperature, water visibility, dissolved oxygen, conductivity, relative conductivity, and pH. These measures are grouped by survey and by pool sequence ID.
4. The 2nd option under habitat data summaries for pool level data is percent substrate type (muck, detritus, silt, sand, pea-gravel, course gravel, cobble, boulder, bedrock, and hardpan/shale). Percent substrate is averaged across pools and reported for each stream reach.
5. The 3rd option is Dominant Riparian Vegetation. Dominant vegetation at varying distances from either bank is grouped into habitat-type categories. Distance classes are 0-25m, >25 – 50 m, >50 – 75 m, >75 – 100m.
6. The 4th and final option under habitat reports for pool level data is length, width and depth of pools, averaged across stream reaches.

II. Section B – Trend Analysis

<u>Analysis of Variance</u>

If the Shannon index is calculated for a number of similar stream reaches the indices themselves will be normally distributed. This property will makes it possible to use parametric statistics, including the powerful analysis of variance method to compare sets of samples for which the diversity has been calculated (Magurran 1988). We may want to compare diversity in stream reaches of like habitat with equal numbers of dissimilar ones. It could also be that reaches with equal numbers of pool replicates may be compared for fish community and habitat differences using analysis of variance methods. However, assumptions of independence of samples, randomness of samples collected, and the normality of the distribution of sample means must be assessed prior to using this method. It will be a rare event when more than a few reaches sampled during a year can be analyzed using this technique.

Species-Habitat Correlation Analysis

Where sample sizes are sufficient, fish species abundance will be compared with habitat factors such as temperature, pH, oxygen, conductivity, and pool size and substrate. Significant associations between fish species abundance and habitat correlates will be identified where they exist. Partial correlation coefficient analysis may be used to examine habitat requirements for certain fish species where multiple physical factors appear to affect their abundance.

Other Data Analysis Techniques (in development)

Data visualization – We are currently considering the use of USGS Digital Elevation Models (DEMs) and Digital Ortho Quarter Quads (DOQQs) to visualize the relationship between prairie stream drainage physical features and the structure of fish communities that occur there. In particular, a surface viewshed of neighboring drainages may help to elucidate the relative roles of slope, aspect, and isolation (either by distance or by barriers such as dams on livestock ponds) in shaping the fish community structure.

Network Analysis – Another GIS approach, network analysis, may assist in quantifying effective isolation by distance among sampling pools. USGS National Hydrographic Datasets (NHD) are available for the Tallgrass Prairie vicinity. NHD provides continuous network data for Cottonwood River watershed which includes the steams at TAPR. Hydrography data exists for PIPE in the form of 1:24000 USGS DLGs. Unfortunately, these do not provide continuous watershed linear features. Significant investment in data conversion would be required to prepare these data for network analysis. USGS plans to convert southwest Minnesota watersheds including the Pipestone Creek watershed into NHD data format in the near future.

Two other statistical approaches that might be considered in the future include geostatistics and time-series analysis. Additional information the application of these analyses for fish community monitoring will be included in a future revision.

III. Literature Cited

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Fish Community Monitoring in Prairie Park Streams with Emphasize on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 11

Reporting

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for reporting on fish community monitoring and habitat survey data collected at Pipestone National Monument, Minnesota and Tallgrass Prairie National Preserve, Kansas. The SOP describes the procedure for formatting a report, the review process and distribution of completed reports. Efficient reporting on monitoring results is critical in assisting park Resource Managers in management decisions. Therefore, a reporting schedule is given with critical dates identified. Also included is an example of a report in proper format (Appendix A).

I. Report Format

General

Reports should be produced on high quality white paper, 215 x 280 mm in size. Font size of all text should be 12 point unless smaller font aids in fitting information on tables. Times New Roman font should be used throughout text. However, other text fonts are acceptable if used consistently throughout the document. Text is left justified with 3-cm margins on all sides. Words should not be hyphenated on the right side of text.

Page numbers and headers should be placed in the upper-right corner of each page starting with page two of the report. One exception to page numbering and headers is with figures (including pictures and illustrations), if a separate figure title pages is used place number and heading on these pages and leave them off pages containing the figures. Headers should contain an abbreviated version of the report title.

Bolding and underlining should be used minimally in the body of the text unless used on section headings and subheadings. Use italic font for scientific names of species. When using both common and scientific names, list scientific name with first mention of common name only.

Three levels of section headings may be used. First-level headings are all upper-case letters, bolded and left-justified with a sequenced whole number to it left. Second-level headings are bolded and left justified similar to first-level headings with sequenced numbers to the first decimal place. However, only the first letter in each word is capitalized. Third-level headings are indented five spaces and the first letter in each word is capitalized. Third level heading are not bolded, underlined or numbered. Third-level headings may be italicized followed by a period and two hyphens or bulleted.

Reports should be direct and concise, avoid superfluous wording. Refer to CBE Style Manual (CBE Style Manual Committee 1994) or Writing with Precision, Clarity and Economy (Mack 1986) for aids in writing. Also see article by Strunk and White (1979), Day (1983) and Batzli (1986) for help in structuring sentences for clarity.

Tables

Tables should be placed within the text of a report or immediately following the literature cited section. Tables should be numbered in sequence regardless of where they are located. Table headers are placed at the top of a table. Horizontal lines are used to separate the table heading from column headings, column headings from the table and to signify the end of the table. Vertical lines should not appear on a table.

Figures

Figures should be placed within the text of a report or immediately following tables behind the literature cited sections. Figures should be numbered in sequence regardless of where they are located. Figure captions are placed below the figure if it is included in the text or on a separate sheet of paper proceeding the figure if included after the literature cited section. Both tables and figures should contain information not presented in the body of the text. Also, tables and figures should not duplicate information already presented in the body of the text.

Pictures

Treat as figures.

Report Outline

TITLE PAGE

- Title
- Author(s)
- Institutions
- Prepared for
- Date

TABLE OF CONTENT PAGE (optional)

EXECUATIVE SUMMARY PAGE (abstract)

1.0 INTRODUCTION

1.1 Background

1.2 Justification for Study

1.3 Objectives

2.0 METHODS

2. 1 Study are(s)

2.2 Field method(s)

2.3 Analytical method(s)

3.0 RESULTS

4.0 DISCUSSION

5.0 MANAGEMENT IMPLICATIONS

6.0 ACKNOWLEDGEMENTS

7.0 LITERATURE CITED

7.1 Examples of Literature Citations

Peitz, D. G., M. G. Shelton, and P. A. Tappe. 2001. Forage production after thinning a natural loblolly pine-hardwood stand to different basal areas. Wildlife Society Bulletin 29:697-705. (journal article)

Ralph, C. J., J. R. Sauer, and S. Droege, technical editors. 1995. Monitoring bird populations by point counts. U.S. Forest Service General Technical Report PSW-GTR-149. (government reports)

Hamel, P. B. 1992. Land manager's guide to the bird's of the south. The Nature Conservancy, Southeast Region, Chapel Hill, North Carolina, USA. (book)

Day, R. A. 1983. How to write and publish a scientific paper. Second edition. ISI Press, Philadelphia, Pennsylvania, USA. (book with more than one edition)

Palmer, R. S. 1976. Handbook of North American birds. Volume 2. Yale University Press, New Haven, Connecticut, USA. (book with more than one volume)

Chapman, J. A., J. G. Hockman, and W. R. Edwards. 1982. Cottontails (*Sylvilagus floridanus* and allies). Pages 83-123. i*n* J. A. Chapman and G. A. Feldhamer, editors. Wild Mammals of North America: biolgy, management, and economics. The Johns Hopkins University Press, Baltimore, Maryland, USA. (chapter within a book)

Peitz, D. G. 1993. Essential amino acid nutritional ecology of cottontail rabbits (*Sylvilagus floridanus*). Theses, Oklahoma State University, Stillwater, Oklahoma, USA. (theses or dissertations)

APPENDIX (optional)

II. Review Procedure

Internal Review

One or more reviews for grammatical soundness need to be sought prior to submitting the report for review by staff in the park(s) where monitoring occurred and before external review. Internal review by person(s) skilled in technical writing for clarity and directness should fulfill this review requirement. Internal reviews will be conducted by PC-LTEM staff or persons sought out for their language skills.

If reports are written to update findings only and they do not deviate significantly from previously reviewed and distributed reports than the review process may stop here. However, review by park staff and subsequent external reviews must be sought for new reports or those that deviate significantly from previously reviewed and distributed reports. Also, if management activities within a park are not clearly understood than park review should be sought for a report to clarify results and management implications.

Park Review

Park staff, generally the Resource Managers are in a unique position in that they can supply details about management actives that may influence findings presented in a report. Also, they will be the ones applying management recommendations to their respective parks. Therefore, review by park staff is vital to the interpretation of findings and the assessment of proposed management implications. Review by park staff should be conducted before a report is submitted for external review.

External Review

External review by two or more experts in fish community monitoring should be sought for the first report in a series of annual reports. In addition, analytical methods employed on data presented in the report need to be reviewed by one or more statisticians. If a report updates a previously reviewed and distributed report than external review is not required. However, external reviews must be sought for new reports or those that deviate significantly from previously reviewed and distributed reports. In order to conserve reviewer time, external reviews must follow the internal and park review process.

All review comments must be address, be it there inclusion in the report or reason for excluding them from the report. The responsibility to edit a report falls to the senior author of the report or their designee.

III. Distribution Procedure

Identifying Stakeholders

The number one stakeholder in our Fish Community Monitoring efforts is the Park Service staff at Pipestone National Monument and Tallgrass Prairie National Preserve. Additional stakeholders include the National Park Service's Heartland I&M Network program, U.S. Fish and Wildlife Service, Kansas and Minnesota Game and Fish Agencies and the Topeka shiner Recovery Team. Potential stakeholders include any of the national fish monitoring programs, state and federal wildlife agencies in the Midwestern United States, universities and the general public.

Distributing Report

Annual reports will be provided to the respective parks, Pipestone National Monument and Tallgrass Prairie National Preserve where fish community monitoring was done. Additionally, a copy will be kept on file with the PC-LTEM office of the National Park Service, Republic, Missouri and made available to all interested parties upon request.

All data collected by the PC-LTEM is of course, public property and is subject to requests under the Freedom of Information Act (FOIA). The data management plan for Channel Island National Park (Dye 1998) describes appropriate procedures to respond to FOIA requests, including the protection of sensitive data such as endangered species locations. In the future, reports containing non-sensitive data will be disseminated through a website. Through the website, those requesting data will be asked to provide information to document by whom and for what purpose the report is being used. By documenting requests, users can be informed when updated reports are available. Users requesting paper copies will be documented also.

In an effort to disseminate findings in a timely manner and meet state and federal permitting requirements, annual reports should be completed by December 31 of the year data was collected. More extensive summary reports should be completed every five to ten years depending on how fast habitat conditions are changing and how critical summary information is to setting management goals influencing fish populations within a park. Summary reports may be used in place of annual reports for the year in which the last data is collected.

IV. Literature Cited

Batzli, G. O. 1986. Thoughts while cleaning out old editorial files. Bulletin of the Ecological Society of America 67:167-168.

CBE Style Manual Committee. 1994. Scientific style and format: the CBE manual for authors, editors, and publishers. Sixth edition. Council of Biology Editors, Cambridge University Press, New York, New York, USA.

Day, R. A. 1983. How to write and publish a scientific paper. Second edition. ISI Press, Philadelphia, Pennsylvania, USA.

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Mack, R. N. 1986. Writing with precision, clarity, and economy. Bulletin of the Ecological Society of America 67:31-35.

Strunk, W. Jr., and E. B. White. 1979. The elements of style. Third edition. Macmillan, New York, New York, USA.

APPENDIX A.

2003 Fish Community and Topeka Shiner Monitoring Report: Prairie Cluster Prototype Long-Term Ecological Monitoring Program, NPS.

Prepared by:

David G. Peitz (Ecologist)

Prairie Cluster Prototype Long-Term Ecological Monitoring Program
Wilson's Creek National Battlefield
National Park Service
6424 West Farm Road 182
Republic, Missouri 65738

Annual Report of Activities Conducted in 2003 Under Permits:
U.S. Fish and Wildlife Service Subpermit # SP01-07-01 under authority of permits PRT-704930 and PRT-697830
Kansas Permit # SC-046-2003
Minnesota Special Permit # 11418

December 5, 2003

EXECUTIVE SUMMARY

Topeka shiner (*Notropis topeka*), a federally listed endangered species under the Endangered Species Act of 1973, was monitored along with the complete fish community in streams at Pipestone National Monument, Minnesota (PIPE) and Tallgrass Prairie National Preserve, Kansas (TAPR). Fish community and Topeka shiner monitoring in Pipestone Creek at PIPE produced a total of 1417 individuals of 13 different species. Using equivalent sampling efforts in 2002 and 2003, 93% more individuals were captured in 2003 than 2002. Twenty-one Topeka shiners were captured in this year's monitoring effort. Five of the Topeka shiners were identified as adult males, the remaining 16 were not identified to sex or age. However, judging by size (> 4.0 cm length and 1.0 g weight) we can assume most were adults.

Monitoring efforts at TAPR produced a total of 2872 individuals of 21 different species. Using equivalent sampling efforts in 2002 and 2003, 62% fewer individuals were captured in 2003 than 2002. Topeka shiner were not captured in reaches of stream one, a stream they had been captured in previously. Fifteen individuals were captured in the middle reach of stream 23, a stream where they had first been recorded in 2001. Of the 15 Topeka shiners captured, there were five adult males, three adult females, three juveniles, and four too small to definitively identify age or sex. With juveniles present in stream 23 it can be inferred that Topeka shiner reproduced successfully at TAPR in 2003. Also, 16 Spotted suckers (*Minytrema melanops*), a species in need of conservation in Kansas were captured in this year's sampling effort.

In 2003, UTM coordinates of pools from all sampling years were combined to identify the location and extent of stream reaches. Fixed upstream and downstream ends of each reach were established. Future sampling will be confined to pools within these reaches. Habitat measures will be analyzed and reported in subsequent annual reports.

INTRODUCTION

Topeka shiner (*Notropis topeka*), a federally listed endangered species under the Endangered Species Act of 1973, inhabits small, low order, prairie streams with high water quality (Pflieger, 1997). As such, this species has been impacted adversely throughout its range by a number of factors. A comprehensive review of the literature indicates habitat loss through stream degradation, modification, tributary impoundment, stream channelization, in-stream gravel mining, siltation, and fragmentation as reason for decline of the species (U.S. Fish and Wildlife Service, 2000). Reduced water quality, changes in stream hydrology, de-watering of aquifers, and introduction of predaceous fish into waterways occupied by Topeka shiner have also influenced the decline of the species (U.S. Fish and Wildlife Service, 2000).

National Park Service (NPS) lands may provide some of the least impacted low order stream habitat remaining in the historic range of the Topeka shiner. Consequently, waterways on NPS land may be critical to recovering this species. In fact, the U.S. Fish and Wildlife Service (FWS) have proposed to designate streams in Pipestone National Monument, Minnesota (PIPE) and Tallgrass Prairie National Preserve, Kansas (TAPR) as habitat critical for the recovery of the species (Federal Register, 2002). Also, pursuant with Endangered Species Act mandates, federal agencies such as the NPS are required to manage endangered species and their habitat to ensure the species persistence. In an attempt to meet these mandates, the Prairie Cluster Prototype Long-term Ecological Monitoring Program (Prairie Cluster LTEM) of the NPS initiated a fish community and Topeka shiner-monitoring program in the fall of 2001. Preliminary data have been collected annually at both PIPE and TAPR with results of the third year's effort contained in this report.

1.1 Monitoring Objectives

1) To monitor through time the status and trends in species richness and relative abundance of fish communities.
2) To monitor through time the status and trends in the relative abundance and distribution of Topeka shiner within NPS units in the species historic range.
3) To monitor annual reproductive success of Topeka shiner as evidenced by the capture and documentation of juveniles.
4) To monitor annually the quality and quantity of Topeka shiner habitat.

Initial monitoring efforts have focused on PIPE and TAPR where populations of Topeka shiner have been documented in recent years. Initially, the survey design was spatially exhaustive and included recording an intensive amount of data at each pool. The baseline data will be analyzed as part of protocol development to determine the spatial extent and intensity of a survey design adequate to detect trends over time. Other NPS units with potential Topeka shiner populations will be inventoried for the species presence as time and personnel permits.

Annual reports will be written that summarize the monitoring effort. The reports will also include recommendations to PIPE and TAPR that will help stabilize, protect, and enhance the existence of Topeka shiner and meet their habitat needs within each unit. Furthermore, annual reports of all findings will be submitted to the U.S Fish and Wildlife Service (FWS), appropriate state fisheries agencies, and Topeka Shiner Recovery Team. Annual reports to the FWS and appropriate state fisheries agencies of our findings are required by permit and will greatly assist them in reaching recovery goals set forth in the Topeka Shiner Recovery Plan.

2.0 METHODS

2.1 Site Selection

Pipestone National Monument: Five pools in each of four stream reaches in Pipestone Creek were sampled (Fig. 1). As in previous years, three stream reaches were located below the falls and one above the falls. No attempt was made to identify and sample the same pools within each reach that were sampled previously; although in many cases they were probably the same. UTM coordinates of all pools sampled within a reach were taken at the time sampling occurred using a Trimble XRPro GPS unit. Using UTM coordinates from 2003 and previous years, stream reach lengths were determined and coordinates established for the upstream and downstream ends of each reach (Appendix A).

Tallgrass Prairie National Preserve: Thirty-seven streams identified and numbered in 2001 were again assessed for potential monitoring sites (Fig. 2). Twenty-five streams were either dry or had insufficient water to allow for fish sampling. Stream 35 (Fox Creek) had flow that was significant enough to prohibit sampling with our equipment. Eighteen stream reaches in the remaining 11 streams were sampled. As with Pipestone Creek, no attempt was made to identify and sample the same pools within each reach that were sampled previously; although in many cases they were probably the same. UTM coordinates of all pools sampled within a reach were taken at the time sampling occurred using a Trimble XRPro GPS unit. Using UTM coordinates from 2003 and previous years, stream reach lengths were determined and coordinates established for the upstream and downstream ends of each reach (Appendix A).

2.2 Fish Surveys

In 2003, NPS staff from the Prairie Cluster LTEM continued fish community and Topeka shiner monitoring and protocol development for streams at PIPE and TAPR (Peitz 2001). The Prairie Cluster LTEM was assisted in this effort by other NPS personnel and personnel from the Kansas Department of Wildlife and Parks, Environmental Services Section, Pratt. In summary, fish samples were collected by seining pools using 1/8 inch mesh minnow seines, 6 feet deep and of varying widths. The small mesh size allowed for capture of large fish without sacrificing capture success of smaller ones. Stream sampling was stratified to include at least the upper, middle and lower reaches. An attempt was made to sample fish from five pools in each reach. However, one stream reach on TAPR contained only two pools to sample and many did not have enough water to allow sampling at all. Therefore, stream reaches sampled are represented by two to five pools.

Fish were captured using a two-person seine extended the full width of a stream pool, dragging the seine across the bottom and trapping fish against a bank or shallow water area until the seine could be raised out of the water. Seined fish were retained in the net in water until they could be examined or in an aerated bucket of water from the site if additional passes through the site were needed. Fish were also placed in a bucket if identification was difficult, photo vouchering was needed or morphometric measurements required (e.g. Topeka shiner). Fish were identified to species with Topeka shiner being measured, sexed and aged (e.g. adult or juvenile, Appendix B). Fish were released as near to point of capture as possible. Habitat data collected at each pool included air and water temperature; water clarity, dissolved oxygen content, conductivity and pH; substrate cover by types; presence and type of stream bank vegetation; stream bank erosion level; substrate condition; and pool dimensions (Appendix B). Within each stream reach, weather conditions, the presence of off channel pools and stream flow between pools were recorded.

An attempt was made to photo voucher at least one individual of each species. However, this was not always accomplished. Appendix C lists the species vouchers, vouchering method and location of each specimen.

Fish monitoring at Pipestone National Monument, Pipestone County, Minnesota was conducted under state **Special Permit No. 11418** and U.S. Fish and Wildlife **Subpermit SP01-07-01**. Fish monitoring at Tallgrass Prairie National Preserve, Chase County, Kansas was conducted under state **Permit No. SC-046-2003** and U.S. Fish and Wildlife **Subpermit SP01-07-01**.

3.0 RESULTS and DISCUSSION

Fish community and Topeka shiner monitoring in Pipestone Creek at PIPE produced a total of 1417 individuals of 13 different species (Table 1). Using equivalent sampling efforts in 2002 and 2003, 93% more individuals were captured in 2003 than 2002. Stream flow was low but stable resulting in ideal sampling conditions. Fish were concentrated in semi-isolated pools for some time prior to sampling and not dispersed in recent flood water as occurred in 2001. Also, Northern pike (*Esox lucius*) were not observed or captured in the stream in 2003, thus their predation on other fish and their influence on numbers of individuals may have been minimal.

Twenty-one Topeka shiners were captured in this year's monitoring effort at PIPE. Five of the Topeka shiners were identified as adult males, the remaining 16 were recorded with sex and age unidentified. However, judging by size (> 4.0 cm length and 1.0 g weight, Pflieger 1997), we can assume that most were adults, either females or males out of breeding color. Juveniles, if present, were of significant size to suggest they would be from early season spawns.

Monitoring efforts at TAPR produced a total of 2872 individuals of 21 different species (Table 2). Using equivalent sampling efforts in 2002 and 2003, 62% fewer individuals were captured in 2003 than 2002. Low stream flow throughout the summer (Paula Anderson personal comm.) resulted in less in-stream habitat. Thus, many individuals either died out or migrated to more suitable habitat. The remaining fish concentrated in isolated pools and dispersed when rain events occurred shortly before and during our sampling.

Topeka shiner where not captured in reaches of stream one at TAPR during 2003 (Fig. 2), a stream where they have been recorded in previous years. However, fifteen individuals were captured in the middle reach of stream 23, a stream where they had first been recorded in 2001. Of the 15 Topeka shiners captured, there were five adult males, three adult females, three juveniles, and four too small to definitively identify their age or sex. With at least three juveniles present in stream 23 it can be inferred that Topeka shiner reproduced successfully at TAPR in 2003. Also, 16 Spotted suckers (*Minytrema melanops*), a species in need of conservation in Kansas, were captured in this year's sampling effort.

In 2003, UTM coordinates of pools from all sampling years were combined to identify the location and extent of stream reaches. Fixed upstream and downstream ends of each reach were established. Future sampling will be confined to pools within these reaches. In previous years, because of the varying geomorphic characteristics of each stream, the location and extents of reaches could not be definitively determined prior to sampling. However, with three years of sampling within each reach we have had a good opportunity to assess the feasibility of locating enough pools (five) to sample each year within fixed reaches. In droughty years when climatic conditions are not favorable for water retention in pools, reaches may contain less than five pools, our desired level of sampling intensity. In those years, all pools less than five present in a stream reaches will be sampled.

Habitat measures will be analyzed and reported in subsequent annual reports.

4.0 PLANS FOR FY 2004

- Implement fish community and Topeka shiner population monitoring at PIPE and TAPR.
- Complete the draft protocol narrative and SOPs for conducting fish community and Topeka shiner monitoring. Solicit scientific review of fish community and Topeka shiner monitoring protocol.
- Continue to partner with state and federal agencies to complete fish community monitoring efforts and protocol development.
- Report 2003 fish community Topeka shiner monitoring results.

5.0 ACKNOWLEDGMENTS

I would like to thank Dale F. Kohlmetz, April J. Deming (Pipestone National Monument, Pipestone, MN), Paula J. Andersen, Daryl W. Meierhoff (Tallgrass Prairie National Preserve, Kansas), Leo L. Acosta (NPS Midwest Region, Nebraska), Iralee Barnard (Volunteer) and Chris S. Mammoliti (Kansas Department of Parks and Wildlife, Environmental Services Section, Pratt) for their help in sampling. Special thanks go to Mr. Mammoliti for his expertise in fish identification. It is with their help that this monitoring is possible.

6.0 REFERENCES

Federal Register. 2002. Endangered and threatened wildlife and plants; designation of critical habitat for the Topeka shiner; proposed rule. 50 CFR Part 17, RIN 1018-AI20, Federal Register 67(162):54261-54262.

Peitz, D.G. 2001. Long-term monitoring protocol for Topeka shiner (*Notropis topeka*) in National Park Service units within the Midwest Region: with emphasis on Tallgrass Prairie National Preserve, Kansas and Pipestone National Monument, Minnesota (**Draft**). National Park Service, Republic, MO. 40 pp.

Pflieger, W.L. 1997. The fishes of Missouri. Missouri Department of Conservation, Jefferson City, MO. 372 pp.

U.S. Fish and Wildlife Service. 2000. Topeka shiner recovery plan (draft). U.S. Fish and Wildlife Service, Manhattan, KS. __ pp.

Table 1. Fish species found in Pipestone Creek within the boundaries of Pipestone National Monument, Pipestone County, Minnesota, 3 September 2003.

	Stream reach of Pipestone Creek				
Fish Species	Lower n = 5	Middle n = 5	Upper n = 5	Above the falls n = 5	**Park Total**
White Sucker (*Catostomus commersoni*)	24	5	103	--	**132**
Central Stoneroller (*Catostomus anomalum*)	88	8	93	2	**191**
Orangespotted Sunfish (*Lepomis humilis*)	1	1	--	--	**2**
Fathead Minnow (*Pimephales promelas*)	193	72	144	23	**432**
Common Shiner (*Luxilus cornutus*)	302	54	70	--	**426**
Creek Chub (*Semotilus atromaculatus*)	15	1	23	5	**44**
Johnny Darter (*Etheostoma nigrum*)	7	--	3	--	**10**
Bluntnose Minnow (*Pimephales notatus*)	--	--	12	4	**16**
Sand Shiner (*Notropis ludibundus*)	24	15	92	--	**131**
Topeka Shiner (*Notropis topeka*)	19	2	--	--	**21**
Green Sunfish (*Lepomis cyanellus*)	1	--	3	--	**4**
Black Bullhead (*Ameiurus melas*)	1	--	3	--	**4**
Blacknose Dace (*Rhinichthys atratulus*)	--	--	4	--	**4**

Table 2. Fish species found in streams within the boundaries of Tallgrass Prairie National Preserve, Chase County, Kansas, 6 – 9 October 2003 (n = pools sampled).

Stream #	1				2			4
Stream Reach	Lower	Middle	Upper	**Sum**	Lower	Middle	**Sum**	Middle
Fish Species	n = 5	n = 5	n = 5		n = 5	n = 5		n = 5
Central Stoneroller (*Campostoma anomalum*)	30	4	2	36	4	28	32	39
Cardinal Shiner (*Luxilus cardinalis*)	125	15	--	140	60	31	91	--
Red Shiner (*Cyprinella lutrensis*)	15	21	--	36	3	3	6	6
Orangethroat Darter (*Etheostoma spectabile*)	2	2	13	17	--	1	1	8
Largemouth Bass (*Micropterus salmoides*)	--	--	--	--	--	--	--	--
Spotted Bass (*Micropterus punctulatus*)	1	--	--	1	--	--	--	--
Green Sunfish (*Lepomis cyanellus*)	--	--	--	--	7	5	12	3
Creek Chub (*Semotilus atromaculatus*)	5	--	--	5	--	--	--	6
Redfin Shiner (*Lythrurus umbratilis*)	26	--	--	26	--	--	--	3
Bluntnose Minnow (*Pimephales notatus*)	33	7	--	40	6	3	9	19
Topeka Shiner (*Notropis topeka*)	--	--	--	--	--	--	--	--
Fathead Minnow (*Pimephales promelas*)	--	--	--	--	--	--	--	--
Orangespotted Sunfish (*Lepomis humilis*)	46	--	7	53	17	--	17	4
Bluegill (*Lepomis macrochirus*)	12	--	--	12	--	--	--	--
Golden Redhorse (*Moxostoma erythrurum*)	--	--	--	--	3	--	3	--
Longear Sunfish (*Lepomis megalotis*)	--	--	--	--	--	--	--	1
Blackstripe Topminnow (*Fundulus notatus*)	--	--	--	--	--	--	--	--
Brook Silverside (*Labidesthes sicculus*)	--	--	--	--	--	--	--	--
Golden Shiner (*Notemigonus crysoleucas*)	--	--	--	--	--	--	--	--
Mosquitofish (*Gambusia affinis*)	--	--	--	--	--	--	--	1
Spotted Sucker (*Minytrema melanops*)	--	--	--	--	--	--	--	--

Table 2. Continued.

Stream #	10	12	17	22				23
Fish Species / **Stream Reach**	Middle n = 5	Middle n = 5	Upper n = 2	Lower n = 5	Left Upper n = 5	Right Upper n = 5	**Sum**	Middle n = 5
Central Stoneroller (*Campostoma anomalum*)	7	2	--	5	27	1	33	21
Cardinal Shiner (*Luxilus cardinalis*)	--	14	--	131	21	19	171	--
Red Shiner (*Cyprinella lutrensis*)	--	--	--	1	--	--	1	--
Orangethroat Darter (*Etheostoma spectabile*)	29	--	--	1	3	1	5	1
Largemouth Bass (*Micropterus salmoides*)	--	3	--	--	--	--	--	--
Spotted Bass (*Micropterus punctulatus*)	--	--	--	--	--	--	--	--
Green Sunfish (*Lepomis cyanellus*)	--	2	7	--	--	--	--	44
Creek Chub (*Semotilus atromaculatus*)	3	--	--	--	--	3	3	16
Redfin Shiner (*Lythrurus umbratilis*)	--	1	--	6	--	--	6	45
Bluntnose Minnow (*Pimephales notatus*)	--	26	--	13	10	4	27	--
Topeka Shiner (*Notropis topeka*)	--	--	--	--	--	--	--	15
Fathead Minnow (*Pimephales promelas*)	--	--	--	--	--	--	--	--
Orangespotted Sunfish (*Lepomis humilis*)	1	--	--	--	1	--	1	--
Bluegill (*Lepomis macrochirus*)	--	15	--	2	--	--	2	--
Golden Redhorse (*Moxostoma erythrurum*)	--	1	--	--	--	--	--	--
Longear Sunfish (*Lepomis megalotis*)	--	--	--	--	--	--	--	1
Blackstripe Topminnow (*Fundulus notatus*)	--	--	--	--	--	--	--	--
Brook Silverside (*Labidesthes sicculus*)	--	--	--	--	--	--	--	--
Golden Shiner (*Notemigonus crysoleucas*)	--	--	--	--	--	--	--	4
Mosquitofish (*Gambusia affinis*)	--	--	--	--	--	--	--	--
Spotted Sucker (*Minytrema melanops*)	--	--	--	--	--	--	--	--

Table 2. Continued.

Stream #	**24**			**34**				
Fish Species / **Stream Reach**	Lower n = 5	Middle n = 5	**Sum**	Lower n = 5	Middle n = 5	Upper n = 5	**Sum**	**Park Totals**
Central Stoneroller (*Campostoma anomalum*)	--	78	78	76	111	103	214	**538**
Cardinal Shiner (*Luxilus cardinalis*)	--	--	--	8	47	25	72	**496**
Red Shiner (*Cyprinella lutrensis*)	2	2	4	--	--	5	5	**58**
Orangethroat Darter (*Etheostoma spectabile*)	9	16	25	63	18	12	30	**179**
Largemouth Bass (*Micropterus salmoides*)	2	2	4	--	--	--	--	**7**
Spotted Bass (*Micropterus punctulatus*)	--	--	--	--	--	--	--	**1**
Green Sunfish (*Lepomis cyanellus*)	5	24	29	--	64	3	67	**164**
Creek Chub (*Semotilus atromaculatus*)	1	88	89	64	21	63	84	**270**
Redfin Shiner (*Lythrurus umbratilis*)	15	--	15	1	167	24	191	**288**
Bluntnose Minnow (*Pimephales notatus*)	48	5	53	--	14	3	17	**191**
Topeka Shiner (*Notropis topeka*)	--	--	--	--	--	--	--	**15**
Fathead Minnow (*Pimephales promelas*)	--	12	12	--	--	--	--	**12**
Orangespotted Sunfish (*Lepomis humilis*)	4	6	10	--	28	31	59	**145**
Bluegill (*Lepomis macrochirus*)	48	27	75	--	--	-	--	**104**
Golden Redhorse (*Moxostoma erythrurum*)	1	--	1	--	6	2	8	**13**
Longear Sunfish (*Lepomis megalotis*)	7	--	7	1	24	6	30	**40**
Blackstripe Topminnow (*Fundulus notatus*)	21	--	21	--	--	--	--	**21**
Brook Silverside (*Labidesthes sicculus*)	7	--	7	--	--	--	--	**7**
Golden Shiner (*Notemigonus crysoleucas*)	--	2	2	--	--	--	--	**6**
Mosquitofish (*Gambusia affinis*)	27	273	300	--	--	--	--	**301**
Spotted Sucker (*Minytrema melanops*)	15	1	16	--	--	--	--	**16**

Figure 1. Fish community and Topeka shiner (*Notropis topeka*) monitoring sites in Pipestone Creek within Pipestone National Monument, Pipestone County, Minnesota.

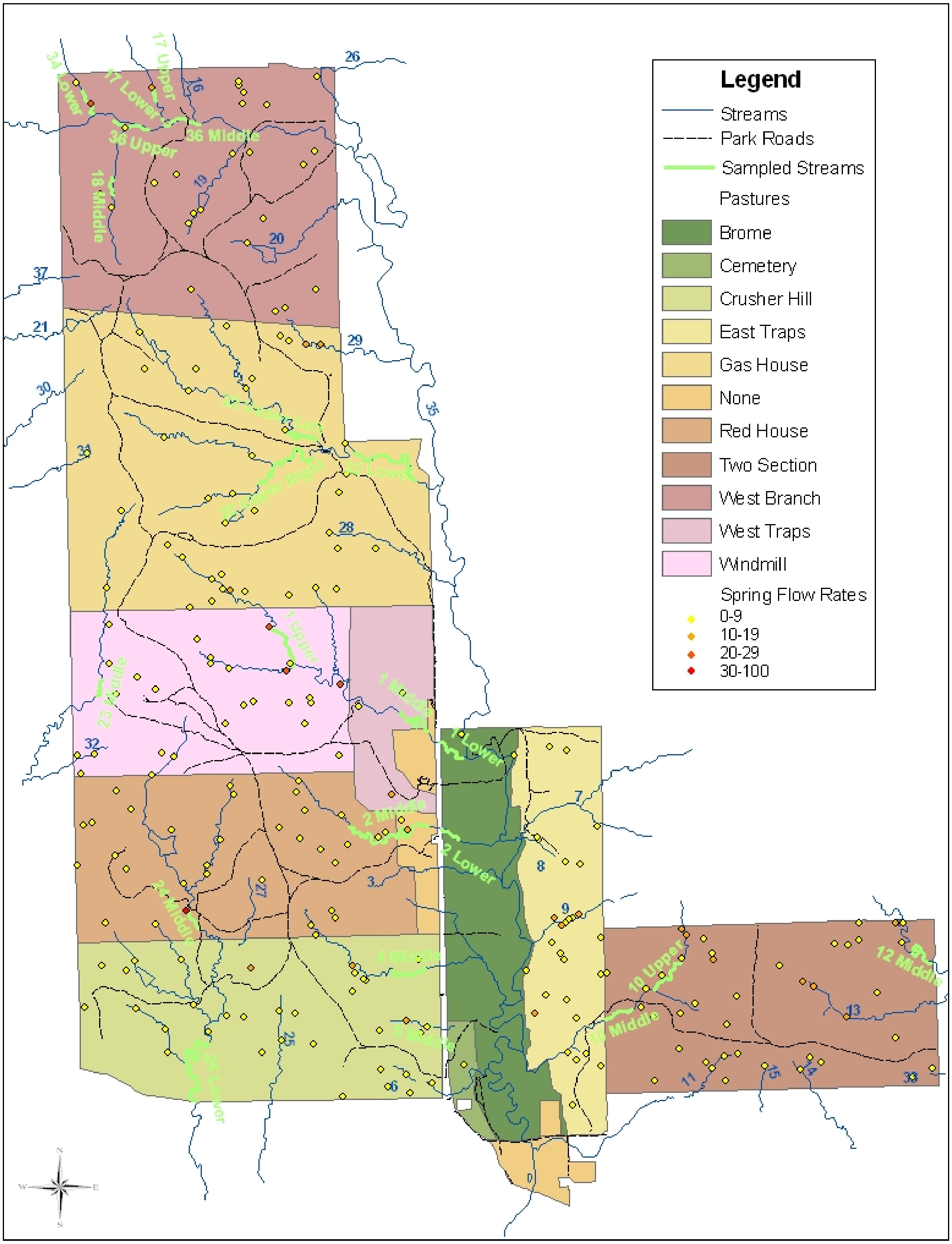

Figure 2. Fish community and Topeka shiner (*Notropis topeka*) monitoring sites in streams at Tallgrass Prairie National Preserve, Chase County, Kansas.

APPENDIX

Appendix A. Reach location {UTM, NAD83 (Conus), Zone 14 N}, length and number of pools sampled for fish community composition by stream for Pipestone National Monument, Pipestone County, Minnesota and Tallgrass Prairie National Preserve, Chase County, Kansas, during 2003. Stream reaches were sampled 3 September, PIPE and 6 – 9 October, TAPR.

Stream		Northing	Easting	Reach Length (m)	Pools sampled
Reach	**End**				
Pipestone National Monument, Pipestone County, Minnesota					
Pipestone Creek					
Lower	Upstream	4877116.47	714317.92	202	5
	Downstream	4877259.61	714204.77		
Middle	Upstream	4876962.65	714488.50	208	5
	Downstream	4877050.81	714333.43		
Upper	Upstream	4877069.01	714726.41	164	5
	Downstream	4876991.27	714602.51		
Above Falls	Upstream	4877045.83	714864.17	95	5
	Downstream	4877060.11	714772.31		
Tallgrass Prairie National Preserve, Chase County, Kansas					
Stream 1					
Lower	Upstream	4257163.07	713236.29	366	5
	Downstream	4257009.20	713468.40		
Middle	Upstream	4257459.69	712853.99	589	5
	Downstream	4257264.29	713122.37		
Upper	Upstream	4258286.24	711576.64	574	5
	Downstream	4257885.94	711794.25		
Stream 2					
Lower	Upstream	4256317.96	713259.72	222	5
	Downstream	4256214.78	713417.68		
Middle	Upstream	4256346.06	712356.88	1320	5
	Downstream	4256346.06	713116.28		
Stream 4					
Middle	Upstream	4254952.36	712782.15	449	5
	Downstream	4254966.47	713101.21		
Stream 5					
Middle	Upstream	4254410.30	713134.56	23	0
	Downstream	4254404.62	713154.92		
Stream 10					
Middle	Upstream	4254460.87	714847.03	324	5
	Downstream	4254565.19	715113.34		
Upper	Upstream	4254758.68	715317.27	479	0
	Downstream	4255017.08	715584.84		
Stream 12					
Middle	Upstream	4255108.78	717827.94	493	5
	Downstream	4255010.98	718023.53		
Stream 17					
Lower	Upstream	4263231.98	710536.96	10	0
	Downstream	4263224.74	710545.05		
Upper	Upstream	4263527.37	710455.03	136	2
	Downstream	4263400.48	710480.77		
Stream 18					
Middle	Upstream	4262485.76	710058.71	207	0
	Downstream	4262659.39	710054.55		
Stream 22					
Lower	Upstream	4259981.04	712422.26	958	5
	Downstream	4259710.35	713002.62		

Appendix A. continued.

Stream		Northing	Easting	Reach Length (m)	Pools sampled
Reach	End				
Stream 22 cont.					
Left Upper	Upstream	4260196.67	711749.11	425	5
	Downstream	4260107.85	712033.21		
Right Upper	Upstream	4259678.56	711476.55	912	5
	Downstream	4259940.04	711990.68		
Stream 23					
Middle	Upstream	4257773.90	709941.76	218	5
	Downstream	4257614.80	709898.14		
Stream 24					
Lower	Upstream	4254233.48	710984.44	1223	5
	Downstream	4253659.26	710868.26		
Middle	Upstream	4255543.21	710783.66	246	5
	Downstream	4255344.17	710896.51		
Stream 34					
Lower	Upstream	4263505.05	709766.18	284	5
	Downstream	4263286.45	709866.69		
Stream 36 (Palmer Creek)					
Middle	Upstream	4263172.79	710560.29	395	5
	Downstream	4263176.10	710907.56		
Upper	Upstream	4263216.98	710062.04	384	5
	Downstream	4263131.72	710400.63		

Appendix B. Field data sheets.

PHYSICAL HABITAT AND SPECIES COUNT DATA – FISH COMMUNITY MONITORING PROJECT

Collector(s): ______________________________ (three letter initials) **Locality**: ____

Date: ___________ **Time**: ___________ **Park**: ____________ **State**: _________ **County**: ____________________

Drainage Basin: _____________________ **Stream No.**: ____ **Stream Reach** (circle)**:** Lower Middle _____Upper

Pool: __ __ __ __ __ **GPS** (Yes / No)**:** Pool 1__ 2__ 3__ 4__ 5__ stream reach only __ **{Datum: NAD 1983 (conus), 14 N}**

Spring present in stream reach (circle): Yes No

Pictures Taken? (circle): Yes No **Picture Number on Roll:** pool 1 ______ 2______ 3______ 4______ 5______

Measured parameters:

	Pool #				
	1	2	3	4	5
Air temperature (°C)					
Water temperature (°C)					
Secchi visibility (cm)					
Dissolved Oxygen (mg/l)					
Conductivity (uS)					
Relative Conductivity (uS)					
pH					
Sampling effort (min.)					

Sampling gear (if something other than 1/8 in. minnow seine): ____

Weather (circle): clear-sunny partly cloudy cloudy raining other:_________________

Off-channel pools for stream reach (circle): present absent not applicable (Isolated pool / Spring)

In stream flow for stream reach (circle): pools dry isolated pools trickle between pools moderate flow between pools high flow flood flow

Pool Substrate (by cover class: 0 = none, 1 = trace, 2 = 1 – 5%, 3 = 5 – 25%, 4 = 25 – 50%, 5 = 50 – 75%, 6 = 75 – 95%, 7 = 95 – 100% coverage)

Substrate	**Pool #**					**Substrate**	**Pool #**				
Type	**1**	**2**	**3**	**4**	**5**	**Type**	**1**	**2**	**3**	**4**	**5**
Muck						Coarse-gravel					
Detritus						Cobble					
Silt						Boulder					
Sand						Bedrock					
Pea-gravel						Hardpan/shale					
						Stable (S) **Unstable (U)**					

Streambank erosion level: Right bank severe moderate slight none
__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
Left bank severe moderate slight none
__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

Riparian corridor (insert code for the dominant classification within each width category):

	0 – 25 m					**> 25 – 50 m**					**> 50 – 75 m**					**> 75 – 100 m**					**> 100 m**				
Pool #	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Right bank																									
Left Bank																									

Riparian classification codes	
Mature woodland = 1	Row crops = 6
Woody shrubs / saplings = 2	Road / railroad = 7
Wetland / native grasses & forbs (prairie) = 3	Urban / industrial = 8
Domestic grass pasture / hay field = 4	Other (note in general comments) = 9
Park / lawn = 5	

Pool dimensions (several pools may occur within a stream reach):

	Length (m)	Width (m)	Depth (m)
Pool 1			
Pool 2			
Pool 3			
Pool 4			
Pool 5			
Mean dimensions			

Species list: Topeka shiner (numbers) Pool 1 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 2 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 3 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 4 counted______ collected______ preserved______
Topeka shiner (numbers) Pool 5 counted______ collected______ preserved______
Sum______ Sum______ Sum______

Species	Number					
	Pool 1	**Pool 2**	**Pool 3**	**Pool 4**	**Pool 5**	**Sum**

General Comments (aquatic vegetation, stream bed stability, sampling effectiveness, upstream land use, mortality, disease, etc.):____

SUPPLEMENTAL SPECIES INFORMATION DATA – FISH COMMUNITY MONITORING PROJECT

Date: ______________ Page: ____ of ____

Species	Stream #	Stream Reach	Pool #	Length (cm)	Weight (g)	Sex-age M/F/J/U

Appendix C. Species vouchers and vouchering method used during the 2003 fish community and Topeka shiner (*Notropis topeka*) monitoring at Pipestone National Monument (PIPE), Pipestone County, Minnesota and Tallgrass Prairie National Preserve (TAPR), Chase County, Kansas. Also shown are the number and location of vouchers by species.

Species	Park	Number of Individuals	Vouchering Method	Location of Specimen*
Black Bullhead (*Ameiurus melas*)	PIPE	3	35 mm photograph	Prairie Cluster LTEM
Blacknose Dace **(*Rhinichthys atratulus*)**	PIPE	2	35 mm photograph	Prairie Cluster LTEM
Bluntnose Minnow (*Pimephales notatus*)	PIPE	2	35 mm photograph	Prairie Cluster LTEM
Common Shiner (*Luxilus cornutus*)	PIPE	1	35 mm photograph	Prairie Cluster LTEM
Green Sunfish (*Lepomis cyanellus*)	PIPE	3	35 mm photograph	Prairie Cluster LTEM
Johnny Darter (*Etheostoma nigrum*)	PIPE	4	35 mm photograph	Prairie Cluster LTEM
Sand Shiner (*Notropis ludibundus*)	PIPE	2	35 mm photograph	Prairie Cluster LTEM
Topeka Shiner (*Notropis topeka*)	PIPE	5	35 mm photograph	Prairie Cluster LTEM
White Sucker (*Catostomus commersoni*)	PIPE	1	35 mm photograph	Prairie Cluster LTEM
Blackstriped Topminnow (*Fundulus notatus*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Bluegill (*Lepomis macrochirus*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Bluntnose Minnow (*Pimephales notatus*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Brook Silverside (*Labidesthes sicculus*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Cardinal Shiner (*Luxilus cardinalis*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Fathead Minnow (*Pimephales promelas*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Golden Redhorse (*Moxostoma erythrurum*)	TAPR	4	35 mm photograph	Prairie Cluster LTEM
Golden Shiner (*Notemigonus crysoleucas*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Largemouth Bass (*Micropterus salmoides*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Longear Sunfish (*Lepomis megalotis*)	TAPR	2	35 mm photograph	Prairie Cluster LTEM
Mosquitofish (*Gambusia affinis*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Orangespotted Sunfish (*Lepomis humilis*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Orangethroat Darter (*Etheostoma spectabile*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Spotted Sucker (*Minytrema melanops*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM
Topeka Shiner (*Notropis topeka*)	TAPR	1	35 mm photograph	Prairie Cluster LTEM

* Address: National Park Service
Prairie Cluster Prototype Long-term Ecological Monitoring Program
Wilson's Creek National Battlefield
6424 West Farm Road 182
Republic, MO 65738-0403

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 12

After the Field Season

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This Standard Operating Procedure (SOP) explains procedures that all field observers using the "Fish Community Monitoring in Prairie Streams with Emphasize on Topeka shiner (*Notropis topeka*)" protocol should be familiar with and follow after the field season is completed.

Procedures:

1. Clean, dry and repair all equipment prior to returning them to their proper storage areas in the Prairie Cluster I&M building or the Prairie Cluster storage building. All references manuals should be re-shelved on their appropriate bookshelf. Other reference materials and extra data sheets need to be filed in their appropriate filing cabinet. Clean the insides and outsides of all vehicles used in the field.
2. Compare all unidentified specimens that were collected with voucher specimen to make positive identifications. If a species is observed in the field and characteristics recorded but it was not identified, it should be identified at this time using reference materials.
3. Organize field data sheets and check that they have been filled out completely. As a rule, all data sheets need to be reviewed for completeness before the crew leaves the field. However, because of the number of field days and crewmembers, some deficiencies in data recording may not be identified until all data sheet have been organized and reviewed as a group.
4. Identify and obtain ancillary data. It is of critical importance that this data be incorporated into the fish community monitoring efforts. First and foremost, knowledge of management efforts in a park for that year (i.e. controlled burns and cattle grazing) will be used to assess the effects of these efforts on stream quality and fish present. Climate can also influence fish numbers, both directly and indirect. Excess precipitation can disrupt breeding success while drought conditions may limit habitat availability. Therefore, annual climate data will be obtained from the park weather station or from a region wide climatic database on the inter-net.

5. At the end of each field trip, file a trip report with the data manager outlining hours worked, field-crew members and their responsibilities on the project, and any unique situations encountered. This information is incorporated in the database and used during data analysis. This information is critical for identifying causes for discrepancies and inconsistencies in the data. The project manager is responsible for filing all field report.
6. Store all voucher specimens in their appropriate location. Send all Topeka shiner specimens to the appropriate repository as determined by permitting agencies and the Topeka Shiner Recovery Team.

Fish Community Monitoring in Prairie Park Streams with Emphasis on Topeka Shiner (*Notropis topeka*)

Standard Operating Procedure (SOP) # 13

Procedure for Revising the Protocol

Version 0.1 (February 2, 2004)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standard operating procedure (SOP) gives step-by-step instructions for revising the "Fish Community Monitoring in Prairie Park Streams with Emphasize on Topeka shiner (*Notropis topeka*)" Protocol Narrative and SOPs, and tracking these changes. Observers asked to edit the Protocol Narrative or any one of the SOPs need to follow this outlined procedure in order to eliminate confusion in how data is collected and analyzed. All observers should be familiar with this SOP in order to identify and use the most current methodologies.

Procedures:

1. The Protocol Narrative for "Fish Community Monitoring in Prairie Park Streams with Emphasize on Topeka shiner (*Notropis topeka*)" and accompanying SOPs has attempted to incorporate the most-sound methodologies for collecting and analyzing fish community data. However, all protocols regardless of how sound require editing as new and different information becomes available. Required edits should be made in a timely manner and appropriate reviews undertaken.
2. All edits require review for clarity and technical soundness. Small changes or additions to existing methods will be reviewed in-house by Prairie Cluster Prototype LTEM staff. However, if a complete change in methods is sought, than an outside review is required. Regional and National staff of the National Park Service with familiarity in fish community research and data analysis will be utilized as reviewers. Also, experts in fish community research and statistical methodologies outside of the Park Service will be utilized in the review process.
3. Document edits and protocol versioning in the Revision History Log that accompanies the Protocol Narrative and each SOP. Log changes in the Protocol Narrative or SOP being edited only. Version numbers increase incrementally by tenths (e.g. version 0.1, version 0.2, …etc). Record the previous version number, date of revision, author of the

revision, identify paragraphs and pages where changes are made, reason for making the changes along with the new version number.

4. Inform the Data Manager about changes to the Protocol Narrative or SOP so the new version number can be incorporated in the Metadata of the project database. The database may have to be edited by the Data Manager to accompany changes in the Protocol Narrative and SOPs.
5. Post new versions on the inter-net and forward copies to all individuals with a previous version of the effected Protocol Narrative or SOP.