

COMPILATION OF HISTORICAL EASTERN PLAINS
STREAM FISH RECORDS IN COLORADO

A Final Project Report

prepared by

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7 August 1995

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Introduction

In summer 1994, the Colorado Division of Wildlife (CDOW) entered into a cooperative agreement with the Larval Fish Laboratory, Department of Fishery and Wildlife Biology, Colorado State University, to create a database that summarizes historical distribution and abundance records for eastern plains stream fishes. Originally, final report requirements were limited to providing fish collection and site records to CDOW in electronic format. We have prepared this written report to facilitate understanding of project activities and protocols used, describe problems encountered, and make suggestions for future work.

Data Entry and Results

The standard process for data entry involved gathering appropriate literature and entering fish locality and abundance records into a customized dBase computer software program format. Specific dBase field names and descriptions for fish and site files are in Appendices I and II. Data associated with each fish record varied by study but may have included collection locality (region, major drainage, river/stream, more precise description of site locality, often by township, range, and section (TRS)), date of collection, collector(s), collection gear, effort, fish disposition (museum where specimens reside if they exist at all and the associated museum catalog number), citation for the literature or other source of data, taxonomist that identified specimens, taxonomic reliability index, and locality reliability index. Collection localities were then placed on a map. Each of these mapped fish collections sites were then digitized to obtain Universal Transverse Mercator (UTM) coordinates so that fish records can be analyzed by a Geographic Information System mapping program.

During this study, a total of 9,070 fish records (record = occurrence of a species at a particular site and time) were entered into the database and representing 55 species, four hybrids, and 530,859 specimens. Habitat, water chemistry, and effort data associated with fish records have been entered opportunistically, as have explanations about particular records that may have incomplete or uncertain data. As was mutually agreed upon, we initially emphasized Platte River basin, Colorado fish records. As the study progressed and it became apparent that the quality of fish collection and locality information varied markedly, we shifted emphasis to entry of data that was of the highest quality possible, regardless of where it was collected in eastern plains streams of Colorado. High quality data was generally regarded as having adequate locality descriptions and specimens that were reasonably accurately identified, or records that were of particular historical importance.

Additional Species or Hybrid Codes Used

The following abbreviations were used in the database for hybrids or taxa that were not previously identified in the species abbreviations list.

CXC = common shiner x creek chub hybrid

LXS = longnose dace x central stoneroller hybrid

NXF = northern redbelly dace x finescale dace hybrid

WXL = white sucker x longnose sucker hybrid

HYB = *Hybognathus* species

BLP = bigscale logperch *Percina macrolepida*

Note: Logperch, as identified in the species abbreviations guide, has as its correct specific epithet *Percina caprodes*. *Percina burtoni*, which is presently on the abbreviations list as logperch, has the common name blotchside logperch. The only "logperch" taxa definitively known from Colorado is the bigscale logperch *Percina macrolepida* (Platania 1990a). We did not edit the remaining species abbreviations.

Problems Encountered

Several significant problems were encountered when building the database even though we concentrated on the most reliable fish distribution and abundance records available. First and foremost were poorly organized or confusing locality data associated with fish collection records. Often sites were designated only by stream name and TRS coordinates, or worse yet, by a dot on an extremely large scale (poor resolution) hand-traced map. Because of inadequate collection locality information, collection sites may be placed on maps that may be several to many kilometers different from the original site. There may also be error associated with digitizing localities from maps to derive UTM coordinates. The result was locality information which was often much more inaccurate (i.e., at best within 100 m) than indicated by database UTM coordinates (i.e., ± 10 m).

Because of potential for fish locality inaccuracies we have assigned an arbitrary locality accuracy index score for each record. This was based on how precisely we felt the site description could be translated onto a map surface. Index scores ranged from 1 (best accuracy) to 5 (worst), with 1 = mapped fish collection site < 100 m different than the true site, 2 = 100 to < 500 m, 3 = 500 to < 1000 m, 4 = 1000 to 5000 m, and 5 = > 5000 m. One hundred

meters was chosen as the most accurate site locality index because even though a given site may have an easily identifiable bridge or road crossing designation, the actual collection site was generally not an exact point but instead a much longer stream reach. The higher index scores (2 to 5) chosen seemed reasonable given the range of detail for locality descriptions encountered in the literature. Other problems encountered included obvious but unresolvable mistakes by the original investigators in assigning TRS coordinates or locality descriptions that were incompatible with a given stream.

Significantly, some reports mapped occurrence of species only with arrows, dots, or bracketed stream reaches. Those records precluded assignment of accurate collection localities, contained no information on the number of specimens collected, and often had no collection date other than that which can be derived from Methods in the literature (often only the season(s) or the year(s) in which collections were made). Some species locality problems could be resolved by examination of the original specimens, if they exist in a museum collection.

Another important problem in evaluating records for entry into the database was attempting to determine taxonomic correctness of fish records. Easily recognizable game fish species presented fewest problems, although even that level of identification was sometimes suspect. Most identification reliability problems were expected with small-bodied, more difficult to identify minnow (Cyprinidae), sucker (Catostomidae), or darter (Percidae) taxa. Because the senior author had personal knowledge of the identification abilities of many of the investigators whose data was entered, a reliability index was established. The reliability index, which ranged from 1 to 5 (one being the most reliable and five being the least, criteria

explained in Appendix I), should be considered by database users in evaluating validity of database records, especially for taxonomically difficult fish species. The index rating was assigned to individual investigations or studies rather than to individual fish records (taxa) within studies. Assigning individual index ratings to taxa by investigator would be extremely complicated, arbitrary, and not comparable between investigators. Accuracy of species identifications in records entered in the database can be verified only by examination of original specimens, many of which still exist in museums. Visits to museums to obtain specimen records were proposed while negotiating this agreement but were deemed unnecessary by CDOW.

Museum Collections

We were able to obtain some fish collection records from xeroxed catalog pages or printed output from electronic databases of museums. Museums referenced in the database are in Appendix III. Museum records were the only source of information for the locality and number of specimens caught at each site for two important documents (Fishes of Boulder County, Hendricks 1950; Fishes of the South Platte River basin, Li 1968). Hendricks (1950) studied the distribution and abundance of fishes of Boulder County and compared his collections with early Boulder County fish collections made by C. Juday and M. Ellis (Ellis 1914). Unfortunately, Hendricks listed only the species caught, gave only general notes on their distribution (e.g. plains or mountain streams), and the only map provided was of collection sites. Thus, the number and locality of species collection records and specimen numbers were unavailable. It was obvious from comparison of the Hendricks records provided

by the Museum of Southwestern Biology, University of New Mexico (MSB) and the text of Hendricks (1950) that only a portion of the specimens collected in that study were housed at MSB. It is likely that the balance of the specimens are housed at the University of Colorado, Boulder (UCB) because Hendricks was a student there. However, the only way to determine the status of remaining collections would be to examine UCB specimens because those records were not available from a computerized database.

Li (1968) studied the distribution of fishes in the South Platte River and compared his data to that reported by Ellis (1914). Collections sites provided by Li were simply arrows denoting localities of species collected, thus localities for species occurrences could be estimated only to within about ± 15 river km. There was no indication in Li (1968) of species abundance. Printouts of computerized museum records provided by the U. S. Fish and Wildlife Service (BS/ABQ) provided the more exact localities used in this database and also numbers of specimens in each collection.

In some cases, examination of museum specimens will be necessary to resolve the taxonomic identity of putative species reported in the literature or in museum databases. For example, fishes in the genus *Hybognathus* (Bestgen and Propst in press) are sometimes difficult to identify, even for experienced investigators. Because of this, records for difficult to identify species, even if from museums, should be viewed cautiously. The taxonomic history of the species also needs to be evaluated when considering validity of specimen records. Historically, only two *Hybognathus* species (brassy minnow *H. hankinsoni* and plains minnow *Hybognathus placitus*) were known to occur in the plains streams of eastern Colorado, both of which are now considered rare by CDOW in the South Platte River basin. The identity of *Hybognathus*

specimens collected prior to 1914 and reported by Ellis (1914) was unknown because brassy minnow was not described until 1929 (Bailey 1954). Thus, these early records appear in the database only as *Hybognathus sp.* (HYB) and the pre-1914 distribution and abundance of these species in the South Platte River remains unresolved.

Additional Data Sources

The original agreement negotiated for this work stated that as much data would be entered as the budget allowed. We were able to enter fish collection records from many of the most important and reliable data sources available for eastern plains stream fishes (see Bibliography). However, more records are available and need to be entered before the database can be considered complete. Notable among these unentered data sources are museum records which were not initially requested (KU records from the 1960's for the Republican and Arkansas River systems, other museum records), some literature records describing fishes in river basins which were not initially emphasized (Republican, Arkansas, Rio Grande), and possibly, unpublished records from other investigators at CSU or those in CDOW files. We would urge however, that additional historical records be screened and assigned quality rankings (accuracy of species identification and locality records) as they were in this initial database compilation effort. New records from ongoing studies should also be carefully assessed with regard to the identification capabilities of the investigator(s) prior to entry of records into the database. Assignment of a realistic identification reliability index score will allow database users to objectively assess the veracity of fish distribution and abundance records.

Acknowledgments

Funding for this project was provided by the Colorado Division of Wildlife (CDOW) to the Larval Fish Laboratory (LFL) (Memorandum of Understanding 835-95 C103889, GOCO Biology Conservation Data System). M. Jones, R. Tietje, and R. Anderson of CDOW and R. T. Muth and D. Snyder (LFL) provided technical and administrative support for this project. We thank C. Ramotnik (U. S. Fish and Wildlife Service Museum, University of New Mexico, Albuquerque), S. Platania and A. Snyder (Museum of Southwestern Biology, University of New Mexico), and E. Wiley and K. Shaw (University of Kansas) for graciously providing records of specimens housed at their respective institutions. The assistance of several technicians who participated in data entry is also appreciated. This is LFL contribution 84.

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APPENDIX I. FIELD DESIGN FOR ALL FISH FILES.

FIELD NAME	FIELD TYPE	WIDTH	DECIMAL
WCODE	Numeric	5	0
NAME	Character	25	
DATE	Date	8	
UTMMAPCODE	Character	6	
LOCATION	Character	60	
CITATION	Character	35	
COLLECTORS	Character	30	
FIELD_NUM	Character	30	
ID_BY	Character	30	
MUSEUM_CAT	Character	10	
RELIABILITY	Character	1	
METHOD	Character	25	
EFFORT	Memo	10	
SPECIES	Character	3	
NUM_TAKEN	Numeric	7	0
AVE_SL_MM	Numeric	8	1
SL_RANGE	Character	12	
AVE_TL_MM	Numeric	8	1
TL_RANGE	Character	12	
AVE_WT_G	Numeric	8	1
WT_RANGE	Character	12	
REL_ABUND	Character	20	

APPENDIX I CONT.

Fish File Field Descriptions

Each fish dBase file contains information pertaining to a single species or hybrid collected at one site on a particular date. In other words, other fish species may have been collected at that site on that date and each would have its own record. These fish records can be cross-referenced by WCODE, NAME, DATE, and LOCATION. Similarly, the same species may have been collected more than once at a given site but on different dates resulting in multiple records. These records could be cross-referenced by WCODE, NAME, LOCATION, and SPECIES.

Description of Field Names for FISH Files

WCODE: Water code designation assigned by the Colorado Division of Wildlife for lakes, streams, and river reaches. Applications for water code numbers were submitted for canals, ponds, and tributaries not yet having an assigned water code.

NAME: The name of the lake, stream, or river reach where sampling occurred. NAME corresponds to the name used by the Colorado Division of Wildlife for their water code system.

DATE: Date when sampling occurred. If the exact sampling date was not known, the year of the data reference was used as the collection date, having a month and day designated as 01/01/year, since no collections were known or likely corresponding to 01/01/. Although most records available were from the 1900's, we recommend inclusion of the full year (dBase "Century" option on as default) because many historic records are from the 1800's and within 5 years new data will be from yet another century.

UTMMAPCODE: Code identifying a specific sampling site location used to coordinate dBase data entry with GIS mapping. Each site is identified by a unique code. Sites may have been sampled more than one time but, as long as it was the same site, only a single UTMMAPCODE was assigned.

LOCATION: As detailed of a site description as possible from the literature used.

CITATION: A brief citation containing author(s) names and date of the report used. A detailed citation is contained within this report under the BIBLIOGRAPHY section. It is recommended that the Bibliography be maintained as the database expands so that users can cross-reference data with a specific source.

COLLECTORS: Names of the personnel who conducted the field collection.

FIELD_NUM: Collectors personal identification numbers associated with that collection.

ID_BY: Personnel responsible for the identification of the fish species.

MUSEUM_CAT: Museum catalog number where fish are stored and cataloged. See **ABBREVIATION** section to determine the name and location of the museum.

RELIABILITY: Subjective index of the reliability of fish identification, ranging from 1 to 5 (1 = highly reliable, 5 = highly questionable). Reliability index was applied to an entire collection, not on a single fish species. Consequently, many easily recognized fish species within a collection may be correctly identified. Likewise, the presence or absence of a fish species may also be due to incorrect identification. Care and judgement should be used when relying upon fish records with questionable reliability. A reliability index of 1 was assigned when investigators were intimately familiar with the potential fauna of the collection sites and would be expected to make few or no mistakes. This rating was generally assigned only to practicing ichthyologists. A reliability index of 2 was assigned to experienced investigators who would be expected to correctly identify most species and specimens but may occasionally (< 2% of specimens) mis-identify a rare or taxonomically difficult species. A reliability index rating of 3 was assigned to investigators who were expected or were known to routinely (2-15% of specimens) mis-identify rare or taxonomically difficult species, but could be expected to accurately identify all fish species to family. An index rating of 4 would be assigned to investigators who were capable only of accurately identifying familiar fish species (usually game fishes) and all other species only to family level. A reliability index rating of 5 was assigned to investigators who were obviously unfamiliar with the potential taxa involved and were perhaps guessing at identity of most fish species in collections. Index ratings of 4 and 5 were not assigned in this study because only higher quality data were used. These lower ratings should be assigned when appropriate to alert the database user to possible fish identification inconsistencies.

METHOD: The technique, typically seining or electrofishing, used to collect fish at a site.

EFFORT: A description of the type of gear used and sampling time period.

SPECIES: A three-letter code used by the Colorado Division of Wildlife to identify a fish species or hybrid. Species or hybrids encountered for which there was not code were assigned one.

NUM_TAKEN: The number of fish collected at the site. Only the number of fish of the species identified in SPECIES are reported.

AVE_SL_MM: Average standard length (SL) of fish reported in millimeters.

SL_RANGE: Range of standard length measurements with values reported in millimeters.

AVE_TL_MM: Average total length (TL) of fish reported in millimeters.

TL_RANGE: Range of total length measurements with values reported in millimeters.

AVE_WT_G: Average weight of a single fish reported in grams.

WT_RANGE: Range of fish weights with values reported in millimeters (unless otherwise noted).

REL_ABUND: Relative abundance of the species reported as a percentage of the total number of all fish caught during a collection.

APPENDIX II. FIELD DESIGN FOR ALL SITE FILES.

FIELD NAME	FIELD TYPE	WIDTH	DECIMAL
WCODE	Numeric	5	0
NAME	Character	25	
DATE	Date	8	
CITATION	Character	35	
COLLECTORS	Character	30	
TOPO	Character	20	
TRS	Character	14	
REGION	Character	2	
ELEVATION	Numeric	5	0
STATION	Numeric	2	0
STATLENGTH	Numeric	6	0
AVGWIDTH_M	Numeric	5	1
UTMZONE	Numeric	2	0
UTMX	Numeric	11	2
UTMY	Numeric	11	2
UTMMAPCODE	Character	5	
LOC_ACURCY	Numeric	1	0
LOCDESC	Character	60	
MAJ_DRAIN	Character	2	
FISHPRSNT	Character	1	
FLOWPROFIL	Character	1	
FLOWTYPE	Character	20	
HABITATEVL	Character	1	
HABITATYPE	Character	20	
WATERCHEM	Character	1	
COMMENTS	Memo	10	



APPENDIX II CONT.

Site File Field Descriptions

A dBase site file was created for each sampling site on a specific date. However, since repeated collections may have been taken at the same site, the identifying UTM MAPCODE and LOC_DESC was kept constant (i.e. only the date was changed). If personnel sampled a site but collected no fish, a site record was entered and the absence of fish was noted in FISHPRSNT. Obviously there would be no corresponding fish collection information available for this site at that date. More commonly, one or more fish species were present at a site so there are often multiple fish records associated with a single site record. Many data fields within each site file are blank since reports and museum records often did not contain the information needed.

Description of Field Names for SITE Files

WCODE: Water code designation assigned by the Colorado Division of Wildlife for lakes, streams, and river reaches. Applications for water code numbers were submitted for canals, ponds, and tributaries not yet having an assigned water code.

NAME: The name of the lake, stream, or river reach where sampling occurred. NAME corresponds to the name used by the Colorado Division of Wildlife for their water code system.

DATE: Date when sampling occurred. If the exact sampling date was not known, the year of the data reference was used as the collection date, having a month and day designated as 01/01/year, since no collections were known or likely corresponding to 01/01/.

CITATION: A brief citation containing author(s) names and date of the report used. A detailed citation is contained within this report under the BIBLIOGRAPHY section. It is recommended that the Bibliography be maintained as the database expands so that users can cross-reference data with a specific source.

COLLECTORS: Names of the personnel who conducted the field collection.

TOPO: Topographical 7¹/₂" map where sampling site can be located.

TRS: Township, range, and section (and ¹/₄ section, if available) containing the sampling location.

REGION: One of five regions (NE, SE, CE, SW, and NW) designated by the Colorado Division of Wildlife.

ELEVATION: Elevation at the site reported in meters.

STATION: Station number assigned by collectors to differentiate between sampling locations. These numbers are found within the original citation.

STATLENGTH: Length of the sampling site reported in meters.

AVGWIDTH_M: Average width of the site reported in meters.

UTMZONE: UTM zone coordinates.

UTMX: UTM X coordinates.

UTMY: UTM Y coordinates.

UTMMAPCODE: Code identifying a specific sampling site location used to coordinate d-Base data entry with GIS mapping. Each site is identified by a unique code. Sites may have been sampled more than one time but, as long as it was the same site, only a single UTMMAPCODE was assigned.

LOC_ACURCY: Subjective index used to estimate how close UTM coordinates were to the actual collection site. Values range from 1 to 5.

1 = < 100 meters

2 = 100 to 500 meters (site approximately within 1/4 section)

3 = 500 to 1000 meters (site approximately within a section)

4 = 1000 to 5000 meters

5 = > 5000 meters

LOC_DESC: As detailed a site description as possible from the literature used.

MAJ-DRAIN: The major river drainage containing the sampling site. Major drainages are the Arkansas (AR), Colorado (CR), Republican (RE), Rio Grande (RG), South Platte (SP), White (WR), and Yampa (YR) Rivers.

FISHPRSNT: Denotes the presence or absence (Y or N, respectively) of any fish at the site. If fish were present (Y), then records for each fish species caught are available.

FLOWPROFIL: Indicates whether a flow profile was conducted or not (Y or N).

FLOWTYPE: Describes the type of flow profile conducted at the site.

HABITATEVL: Indicates whether a habitat evaluation was conducted or not (Y or N).

HABITATYPE: Describes the type of habitat evaluation used.

WATERCHEM: Denotes if water chemistry data are available from original reference (Y or N).

COMMENTS: Additional information.

APPENDIX III. MUSEUM ACRONYMS AND DESCRIPTIONS FOR SOME DATABASE RECORDS.

ABQ/BS = U. S. Fish and Wildlife Service, Biological Services Museum, University of New Mexico, Albuquerque, New Mexico.

CSULFL = Fish collection stored at the Larval Fish Laboratory, Colorado State University, Ft. Collins, CO 80523.

FC/BS = U. S. Fish and Wildlife Service, Biological Services Museum, Fort Collins, Colorado (now ABQ/BS after 1994)

KU = Museum of Natural History, University of Kansas, Lawrence, KS 66045-2454.

MSB = Museum of Southwestern Biology, University of New Mexico

UCB = University of Colorado, Boulder museum

USTC = State Teachers College, Greeley (Now University of Northern Colorado)

USNM = U. S. National Museum (Smithsonian)