Aquatic Data Analysis and Database Management

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2023 Progress Report

Colorado Parks and Wildlife

Aquatic Research Section

Fort Collins, Colorado

December 2023

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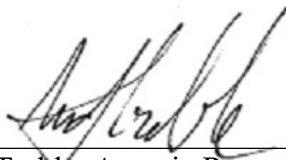
George J. Schisler, Aquatic Wildlife Research Chief

Date: December 28, 2023

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Overview

As has been the case for several years now, outside of expeditious handling of all data requests and database issues, work on the Fishes of Colorado book was a top priority in 2023. Significant progress was made over the course of the year, and the end is in sight. However, a prospective publisher has not been identified yet. Periods of good progress seemed to be spaced between weeks when my focus was required elsewhere. John Woodling and I met on a regular basis to keep things on track and continue the slow push forward. The addition of Asana project management software has greatly helped us keep track of versions and who has various chapters in review.

The addition of Asana project management software to the toolbox also greatly improved the tracking and approval process for both Scientific Collection reporting and data requests. However, training of relevant staff and modification of several reporting queries and dashboards to transition to this new tracking system took time.

This year (2023) was the third full year since Bill Pate was hired to take over the bulk of the hydroacoustic survey work. While field assistance was still provided on a few surveys, involvement in the hydroacoustic program was primarily focused on streamlining the data upload and analysis process so that the data is centralized and we are not reliant on a single antiquated Apple computer for analysis.

A record number of creel surveys were initiated in 2023, and a lot of my database work and technical support involved helping the area biologists with their creel data. Database management also focused on improving the boreal toad database and further developing the Northern Leopard Frog Project database. Both of these applications involved significant effort in developing the R code to support data upload and QA/QC.

Finally, as the second year with aquatics having access to the Tableau Network, I responded to an increasing number of requests for various analyses and dashboards to be created and published for biologist use.

Figure 1. *Allocation of Data Analyst's time, January 1st, 2023 – December 31st, 2023.*
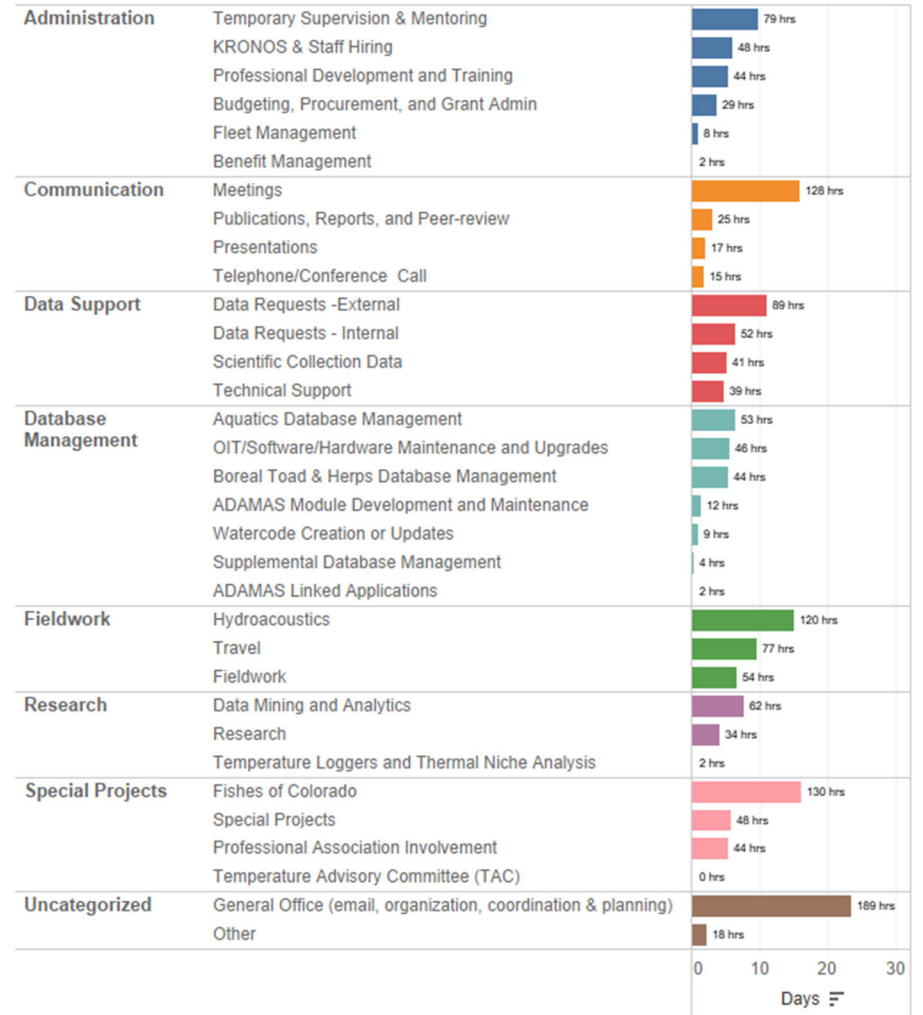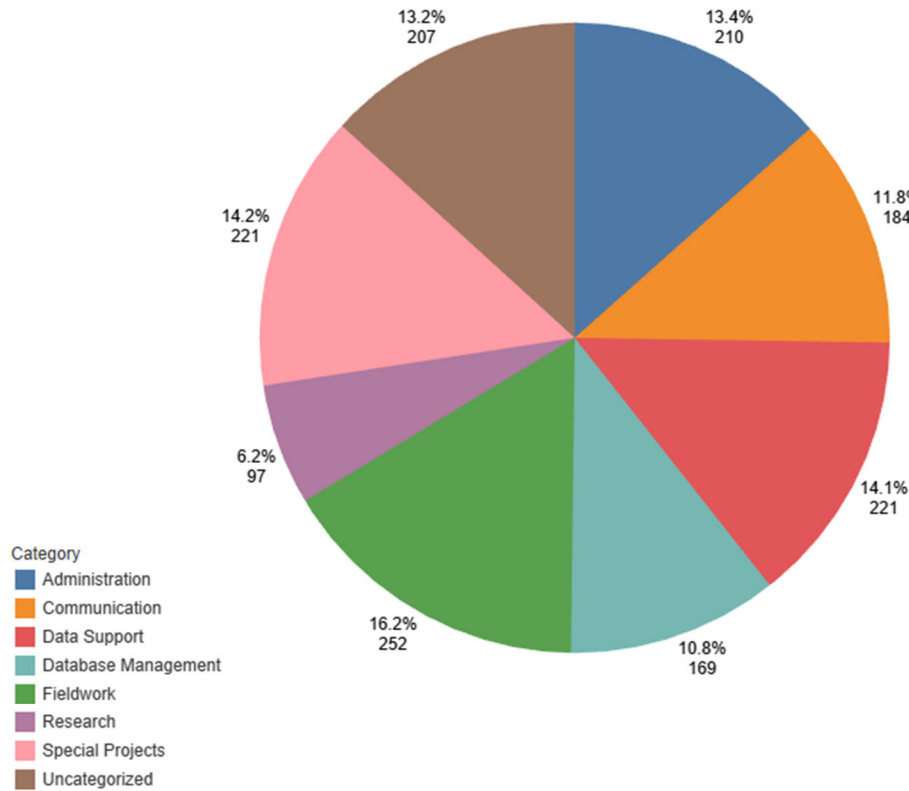
Administration

This category includes all staff hiring, KRONOS timekeeping, budgeting and expense tracking, fleet management, and professional development and training (i.e., OIT security modules and software workshops). This category also accounts for any time spent mentoring or supervising temporary personnel. This category accounted for a total of 210 hours (13.4%) in 2023, which is an 81% (96 hours) increase from the year prior. This increase can be attributed to helping terrestrial and avian research with the hiring of a database FTE, as well as increased training and involvement with two interns. The addition of Asana project management software did improve communication and efficiency of task assignments within the unit, making managing multiple technicians and interns much easier.

I. <u>Temporary Supervision and Mentoring</u>
- Primarily YIP and temporary software training and database introductions
- Supervising Aubrey Pelletier (22/23 YIP), Matt Bolerjack (23/24 YIP), and Alissa Gigliotti.
- Hired Ralph Eberhard as CSU workstudy student
- Supervising the last few months of Liz Krone's contract when she finishes work for Boyd Wright

II. <u>Professional Development and Training</u>
- Annual OIT cybersecurity training
- DNR Equity, Diversity, and Inclusion training
- CPW Identity Manager software training
- DU Daniels Leadership School Alumni Workshops
- Franklin Covey Leadership training
- Asana online training
- CO/WY AFS continuing education
- CSU Libraries R and Python courses

Communication

This category includes meetings, conference calls, internal and external presentations, written reports, and publications. A total of 184 hours (11.8% of overall time) was devoted to communication during the period of this report. This is consistent with what was done last year (198 hours). Attending meetings and working on reports or publications (either writing myself or providing peer-review) accounted for the most significant portion within the category, mainly related to annual commitments in both areas.

I. <u>Publications, Reports, and Peer-Review</u>

Authoring and reviewing various reports, publications, and white papers involved approximately 25 hours of total time during the period of this report. Three reports and one publication were authored or co-authored during the period of this report. Two of these reports were annual status or progress reports, whereas the third was a report put together for a consultant working on behalf of the Attorney General's office.

Recent Reports & Publications:

i. **Treble, A. J.** 2023. Statewide Fisheries Assessments and Surveys. Federal Aid Project F-86-R-35. Colorado Parks and Wildlife, Aquatic Wildlife Research Section. Fort Collins, Colorado.

ii. **Treble, A. J.** 2023. Estimation of fishing effort for Home Lake. Colorado Parks and Wildlife, Aquatic Wildlife Research Section. Fort Collins, Colorado.

iii. Woodling, J., **Treble, A. J.,** Cristan, E., Brandt, M., Wright, F. B., and Lackmann, A. (in prep) 2023. Otolith analysis reveals long-lived population demographics of Quillback *Carpiodes cyprinus* and River Carpsucker *C. carpio* in Colorado. Environmental Biology of Fishes.

As a researcher and subject matter expert, the data analyst is occasionally called upon to review proposed publications by colleagues before submission to fisheries or aquatic science journals. The following reports or manuscripts were reviewed:

i. COGCC Priority Habitat Map Rulemaking Update

Publication updates were also provided to several tracking documents within CPW research:

i. Contributions to Management by Aquatic Research

ii. 2019-2023 Publications and Presentation Google Sheet

https://drive.google.com/file/d/10HTfTiT7E_Qq9xH5tAgGo2EXwBJtmMYo/view?ts=5e55466f

iii. Aquatic Research Project List

https://docs.google.com/spreadsheets/d/1OvkcAfpBuLgLoo-6LXnY4U9cydyG294s/edit#gid=695841625

In addition, draft reviews and comments were provided on multiple reports and documents, including CPW's response to various Water Quality Control Commission proposals.

II. Meetings

Both formal and informal meetings are necessary to maintain coordination and distribute intra-agency knowledge. They also provide opportunities to promote ways in which the data management unit can assist other units. A total of 128 hours was spent in meetings during this reporting period. Meetings attended every year include:

- Annual CPW aquatic section meeting (Florissant, CO in 2023)
- Annual CPW Coldwater reservoir coordination meeting (Virtual in 2023)
- Annual CPW aquatic research meeting (Fort Collins 2023)
- The annual meeting of the CO/WY Chapter of AFS (Fort Collins in 2023)
- The annual meeting of the Organization of Fish and Wildlife Information Managers (OFWIM) (Fort Collins, CO in 2023)
- Annual Boreal Toad Recovery Program meeting (Colorado Springs in 2023)
- Various meetings with CPW researchers to support ongoing research projects
- Hydroacoustic planning and analysis meetings with Pate, Hansen, and Lepak
- Monthly or bimonthly meetings of CPW data working group (includes members from terrestrial programs, avian and terrestrial research, and aquatic research), which discusses projects and issues with data and data visualization across the agency.
- Monthly Water Temperature Research check-in meetings with Mindi May, Ashley Rust, and Ryan Fitzpatrick.

In addition to these annual meetings, meetings of interest in 2023 include:

- Meeting with ANT consulting and the AG's office to discuss how to assess damages to the loss of Home Lake fishery.
- Attended senior staff in August to present a proposal to hire another Aquatic data FTE
- Meeting between Wayne Lewis, Rebecca Ferrell, George, and myself to explore the possibilities of CPW publishing the Fishes of Colorado internally.
- Meetings with Kirk Teklits (OIT) and other aquatic program leads to discuss and develop RFI/RFP for the replacement of aquatic application by a new outside vendor.
- Meetings with Rob Walters and OIT about developing an ANS API to be used in developing a CPW ANS dashboard.
- Meeting with Kevin Pope, Schisler, and Nehring to talk about CPW's creel database and the merits of joining a national creel standardization movement
- Several meetings with Aubrey Pelletier, Mandi Brandi, and Carrie Tucker concerning the design and development of a walleye spawn data visualization and analysis dashboard in Tableau.
- Meetings with Megan McConville and external vendor about developing a RiverWatch API, to be used in the development of a RiverWatch Water Quality Dashboard
- Meetings with Ben McGee from USGS about temperature monitoring and modification of HOBO temperature loggers to record relative conductivity.
- Meetings with Chris Michaud (USFWS) about streamlining data flows between ADAMAS and the STReaMS (Upper Colorado River Recovery Program's) database.
- Implementation meetings with Boyd Wright and Waverly Davis concerning the Northern Leopard Frog Research project.
- Meetings with Eric Fethermen and Tracy Wendt concerning my taking over the AFS Western Division email list and communications
- Final meetings with OIT and aquatics unit leaders to finalize the RFI and subsequent RFP for replacing all four aquatic data packages.
- Bug Jam: Meeting with Pete Cadmus, Megan McConville, and Ashley Rust on how we will develop invertebrate database and visualization tools in the future.

III.   <u>Presentations</u>

Internal Presentations:

a) **Treble, A. J.** 2023. D'ATTA Bio Awards. Annual CPW aquatic section meeting (Florissant, CO). January 19th, 2023.
b) **Treble, A. J.** 2023. Demonstration and implementation proposal for using Asana Project Management Software. Aquatic Senior Staff Meeting (virtual). April 5th, 2023.

IV.   <u>Telephone/Conference Calls:</u>

While more efficient than traveling to meetings, telephone and conference calls still accounted for almost 15 hours (1%) of overall time spent in 2023. Most of these calls deal with organizational and coordination issues, technical support, and data requests and are not significant. Some more noteworthy calls over this reporting cycle include:

- Regular update and coordination calls with co-authors regarding Fishes of Colorado

- Monthly conference calls with OFWIM Conference Planning Committee
- Numerous technical support calls with biologists and researchers
- Numerous calls with Aquatic Seniors to discuss ongoing data requests
- Regular phone calls from biologists for tech support or specific data analyses
- Responded to numerous requests to serve as a reference or provide a letter of recommendation

V.   Outreach & Community Service:

Outreach and community service accounted for a total of 10 hours during 2023 and consisted of the following:

- Presenting to middle school Fishing Intensive group at Polaris Expeditionary School
- Presenting at International Day at Bennett Elementary School

Data Support

I.   Internal/External Data Requests
- A total of 67 data requests from sources external to CPW were processed between January 1st and December 31st, 2023. These requests a little over 89 hours of work. In addition, numerous internal (CPW) requests were handled as expeditiously as possible during this period, adding an additional 89 hours in time. The combination of internal and external requests accounted for 9.0% of total time in 2023. A detailed summary of the time and effort allocated to the data request process is provided in Figures 2 and 3.

Figure 2. Summary of external aquatic data requests by month and annual totals for the past ten years.
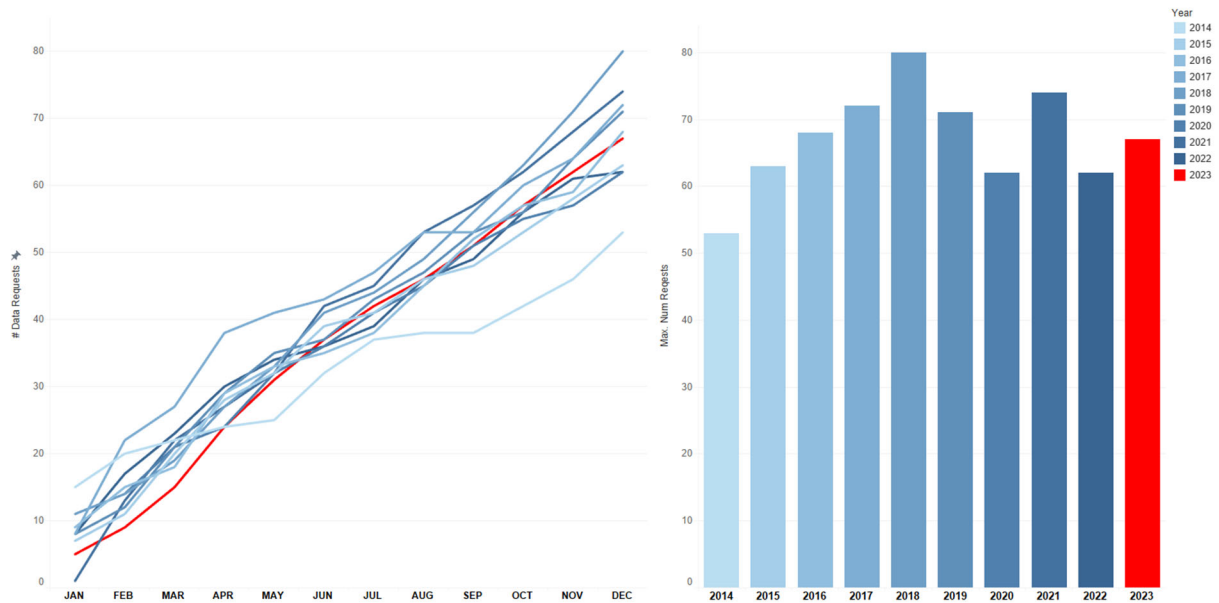
A summary of the highlights related to data requests during this reporting period is provided below:

- Aquatics did not have a single CORA request in 2023
- Updated the private property designations for survey stations statewide to ensure compliance with State statutes when releasing data
- Updated data sharing agreements to reflect recent changes by AG's office and to make the agreement more efficient by turning them into a template with boilerplate language and automatically repeating duplicate fields
- Numerous data explorations with John Woodling related to the Fishes of Colorado book project

Figure 3. Monthly allocation of effort (FTE hours) given to internal and external requests for data in 2023.
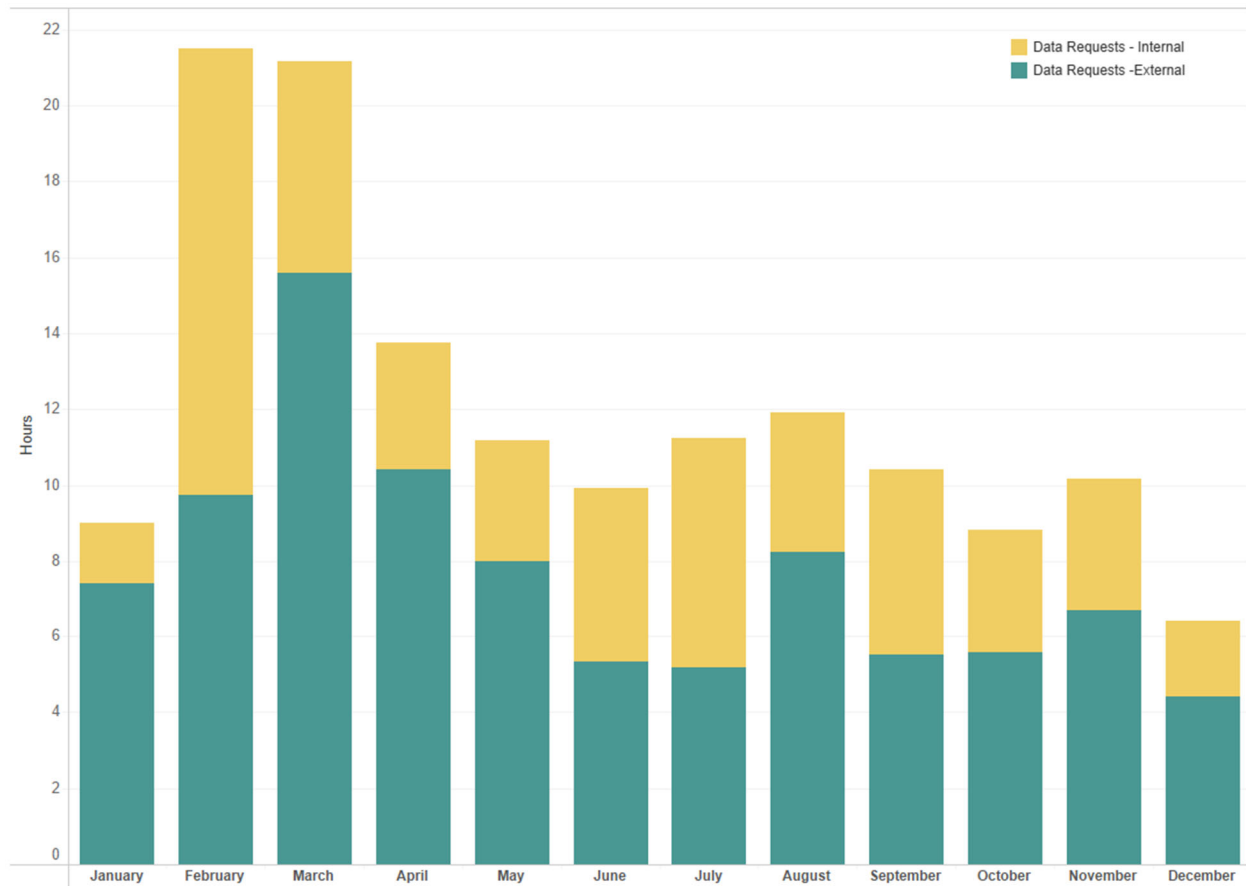
II. Scientific Collection Data

A total of 65 Scientific Collection Permits were issued for the 2023 Field season. Of these, only about a dozen have been submitted and uploaded (as of December 13th). A total of 1,115 scientific collector reports were uploaded in 2023; of these, 1,018 were associated with work done in 2022, and 97 were associated with work done in 2023. The amount of effort required to QA/QC these reports and upload them into ADAMAS was 203 hours (161 by temporary employees). A majority of the data analyst's time was associated with developing R code to bulk import SciColl data from the USFWS's Species Tagging, Research, and Monitoring System (STReaMS).

The amount of effort devoted to uploading and QA/QC of SciColl data has increased dramatically over the past several years (see Figure 4). While some of this increase can be explained by shifting the effort from the data analyst to temporary employees and interns, who are not as efficient in using the data tools available to them, QA/QC tools that have been developed are also catching more errors, requiring follow-up with permittees to obtain correct data. The decrease in effort from 2022 to 2023 is attributable to the low number of reporting permits by the time of this report.

Figure 4. *Comparison of effort devoted to SciColl surveys over the past five years. Despite the appearance of a decrease in effort required in 2023, this is more accurately attributable to few permit reports being submitted by the time of this report.*
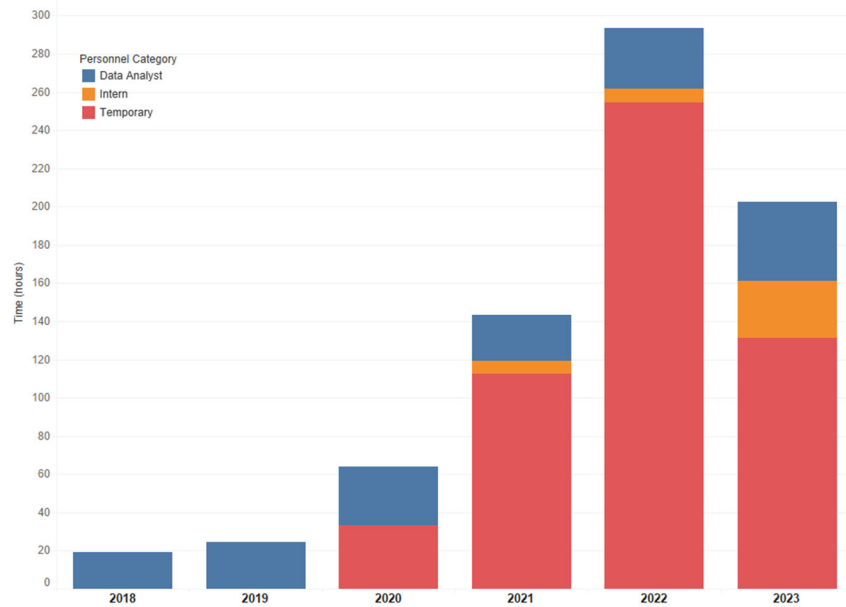
Figure 5. *Sources and number of Scientific Collection Reports submitted between January 1 and December 31, 2023.*
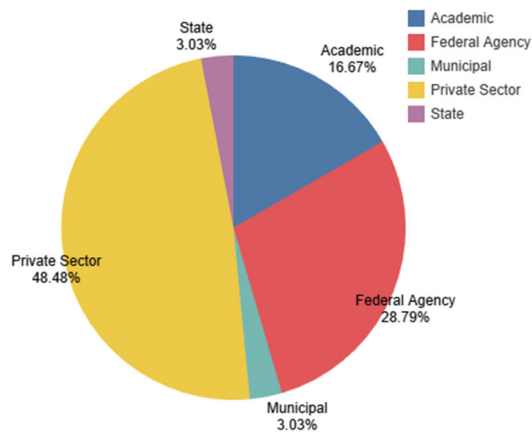
Academic	Colorado College	
	Colorado State University	18
	CSU Larval Fish Lab	
Federal Agency	Bureau of Land Manageme..	1
	Dillon Ranger District White..	
	U.S. EPA	
	U.S. Fish and Wildlife Servi..	
	U.S. Forest Service	0
	U.S. Geological Survey	11
Municipal	City of Longmont	
	Metro Wastewater	
Private Sector	Null	
	AQUA SIERRA, INC	
	Battelle	
	Beavers Fish Farm	
	Blue Valley Ranch	
	EcoResource Solutions	
	GEI Consultants, Inc.	10
	Jacobs	
	NULL	
	Owl Ridge	9
	PG Environmental	
	Trinchera Ranch	11
State	Colorado Department of Pu..	
	Utah Division of Wildlife Re..	
Grand Total		**60**

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The aquatic research data analyst is often the first point of contact for biologists, researchers, and other people within the agency regarding questions about aquatic data. In addition, due to contact and availability issues with OIT, the data analyst is often asked to assist with various technical support issues. These requests are generally accommodated as expeditiously as possible, often meaning that other issues are put on hold until the support issue is resolved. Thirty-nine hours (representing 2.5% of overall effort) were spent from January 1st to December 31, 2023, providing technical support to biologists and researchers. This amount of effort represents an increase of 52% (14 hours) over last year, mostly attributable to increased use of the new Creel application by the biologists and specific questions from new biologists.

Some examples and highlights of technical support that was rendered during this reporting period are summarized below.

- Maintained permissions list of users for CPW Tableau Network (including terrestrial and avian) and assisted OIT troubleshooting access and dashboard issues

- Assisted numerous biologists to correct data issues in the database, from status column updates to incorrect station assignments; flagging questionable surveys or species identifications to getting their technicians access to the database

- Frequently called to troubleshoot data templates or assist in the upload of biologist's survey data into ADAMAS

- Fielded numerous calls relating to the operation of the CREEL application

- Provided technical support to biologists concerning the use of their custom Tableau Workbooks and data extracts

- Worked with GIS unit to consolidate stations, add watercodes to unmanaged waters containing SGCN species, and address issues between the Watercode Locator and AquaticsT6

- Maintained and expanded Google Sites for Boreal Toad and Greenback Cutthroat Recovery Teams for Harry Crockett

Database Management

Data management represented an investment of about 169 hours, which equates to 10.8% of the total allocation for the year (not including temporaries and work-studies) (Figure 1.).This represents a 27% reduction in effort from last year. Hopefully this can be attributed to improved database schema and QA/QC routines. Approximately 31% of that effort (~53hrs) was directed at the primary aquatic data sources, 25 % (44 hrs) devoted to the Boreal Toad or Herptile databases, with the remaining 44% (~76 hrs) being split between supplemental data sources, linked applications, module development, maintenance, and watercode updates (Figure 1).

I.   Aquatics Database Management

Regular ongoing maintenance and updates to the aquatics data platform is required to keep the system operating smoothly and to advance the analytical capabilities of the related applications. In addition to the primary data applications (Trans6 - Hatcheries, ADAMAS – Fisheries Surveys, AAHL – Fish Health Lab,

CREEL – Creel Surveys), there are numerous supplemental data applications that link to these primary data sources and require various tables and views to be maintained in SQL Server Management Studio (SSMS) for them to function.

Some highlights of activities associated with the management of CPW's Aquatics Database over this reporting period include:

- Worked with numerous biologists to identify and correct erroneous data
- Improvements and updates to CurrentSummary script, which is a primary source for both data requests and linked applications
- Updates to RiverWatch and WQCD linkages
- Modified Water table schema to include Appendix C and Appendix D waters
- Updates and corrections to Area Biologist assignments to stations and waters
- Continued work to develop the SQL framework that feeds into the CPW Tableau Server
- Creation of Walleye Spawn data tables and related views to be used in development of Walleye Spawn Tableau dashboard
- Updated geometries and spatial data relating to waters and stations

II.   Aquatics Database Status

The aquatics Database continues to grow as additions from internal and external sources are added to it. A breakdown (by data project) of the surveys that were added to the database over the period of this report is provided in Table 1. The total number of various records added to the database over the period covered by this report, along with the current overall status of records in the database, is provided in Table 2.

Table 1. *The number of surveys, by project, added to the database during 2023.*

Data Project	#Surveys
Aquatic Database	2
CDOW Water Quality	0
Northeast Region Fisheries Management	251
Northwest Region Fisheries Management	305
Scientific Collections Permit	1310
Southeast Region Fisheries Management	80
Southwest Region Fisheries Management	33
Species Conservation	35
Upper Colorado River Recovery Program	79

Table 2. *Recent additions and the overall status of the aquatics database (as of 12/13/2023).*

This reporting cycle:	
Number of new surveys entered	2,095
Number of new watercodes added	170
Number of new sampling stations added	139
Number of new fish measured	230,152
Number of new fish enumerated	387,087
Overall:	
Total # of managed waters	13,606
Total # of sampling Stations	19,524
Total # of Surveys	65,606
Total # of measured fish	4,994,023
Total # of enumerated fish	11,504,995

III.   Boreal Toad and Statewide Herptile Database Management

Due to the increasing amounts of time and effort being allocated to the Boreal Toad Monitoring and Statewide Reptile and Amphibian databases, this work has been pulled out of Supplemental Database Management and given its own subcategory. A total of 90 hours (45 hrs each for temporaries and the data analyst), representing 5.6% of total time were devoted to Boreal Toad and Herp database development and management in 2023. Highlights of this work include:

- Further development of the Northern Leopard Frog data module within the Statewide Reptile and Amphibian database (housed on the SQL test server in Denver). Work included the development of R code to download, format, and upload NLF data into the database.
- Boreal Toad conservation map and time series with Harry Crockett and Grant Wilcox
- Setting up new online data submission process and online form to request new breeding site codes, both using Asana
- Improvements and updates to Boreal Toad Database in preparation for the annual recovery program meeting
- Updated R code used to upload data into Boreal Toad and Herps databases
- Data-mining of citizen science apps for Colorado Herp data, including iNaturalist, HerpMapper, and
- Still need to incorporate Bd swab and eDNA results in the database

IV.   Supplemental Database Management

In addition to the central AquaticsT6 and CPW_AquaticDataAnalysis databases and directly-linked applications (Trans6, ADAMAS, AAHL, Creel), numerous supplemental databases have been developed to support aquatics projects further statewide. These databases typically are upgraded on a needs basis but also require occasional maintenance to keep them current with the underlying database schemas. A total

of 3.5 hours (1.7%) was spent updating and maintaining supplemental databases during this reporting period. This equates to an 87.5% reduction, which can be traced back to a reduced reliance on ADAMAS-Links, PIT Tag, and Fishes of Colorado databases. There was also very little work done on the Water Temperature and Temp Logger database. Examples of CPW aquatic supplemental databases include:

(1) ADAMAS-Links
(2) Water Temperature database
(3) PIT tag database
(4) Data Request and SciColl Tracking database
(5) Fishes of Colorado Project Tracking database
(6) Thermal Niche – Logger Placement database
(7) Hydroacoustics database
(8) Data Analyst and Data Temporaries Time Allocation databases
(9) Walleye spawn database (within CPW_AqDatAnalysis)

Highlights from the previous year of some of the work performed on Supplemental Databases include:

- Recovering lost records from Hydroacoustics database and further refining SQL-Tableau links

- Writing code to import tables from historical spreadsheet into SQL data tables

- Cross-validating hobo logger files have all been uploaded to water temperature database

V. Software and Hardware Maintenance and Upgrades

Approximately 46 hours (2.9%) were spent over the period covered by this report obtaining OIT permissions and installing or updating various hardware unique to the data management unit. This is consistent with the amount of effort expended in years past. A list of these software updates or additions of provided below.

- Setting up a new computer

- Installing Asana software on unit computers and setting up workflows and reporting

- Transferring my research library from Mendeley to EndNote

- Setting up two new Samsung Active Tab tablets for digital data entry development

- Regular updates to Tableau, SQL Server Management Studio, R Studio and various R packages

- Tableau Network connection issues with OIT

- Various OIT access requests for aquatics FTEs and temporaries

VI. ADAMAS Module Development and Maintenance

Twelve hours (<1%) of time was invested in bug fixes to the application and development of SQL code that utilizes the data tables in ADAMAS.

Other activities and accomplishments associated with the various ADAMAS modules is listed below.

- Started experimentation with AppSheet and development of a digital Creel data entry application.

- Updating STReaMS-to-ADAMAS templates with Colorado River Recovery Program Team biologists
- Database permissions for new staff and data entry assistants across the state.

VII.   Watercode Creation or Updates

The creation of new watercodes for biologists and hatchery managers required about nine hours of time in total, which is almost double from last year. A total of 6 new lakes, 6 new stream segments, 47 new coded fish units, and 1 canal/ditch were added to the growing list of 13,601 managed waterbodies in the state. An additional 110 wetlands were added, as all historic and active Boreal Toad breeding sites were given their own codes, to ensure that they received proper protections based on management category and stocking codes.

A breakdown of all the currently managed waters in the state is provided below in Table 3.

Water Type	# Watercodes	
	New in 2023	Overall
Stream	6	8,815
Lake	6	4,490
Fish unit	47	115
Canal/Ditch	1	55
Wetland	110	126

Table 3. *A summary of newly created and all managed waters held within CPW's Aquatics Database.*

VIII.   ADAMAS-Linked Application Creation and Maintenance

This task includes database development and maintenance for data applications that ADAMAS is not able to generate itself. These applications include ADAMAS-Links and the numerous Tableau workbooks and dashboards that biologists may use to generate analysis and visualizations that ADAMAS cannot. This section also includes the development and maintenance of specific linkages to the data from outside the aquatics section, namely Mindi May and the water quality staff.

A total of 41 hours was devoted to linked applications during this reporting period. Highlights of some of the work completed include:

- Updates and improvements to the Tableau Reader Biologist workbooks
- Development of new analyses and visualizations for biologists outside of biologist-specific workbooks

Fieldwork

A total of 252 hours (~16.2% of overall time) was spent conducting fieldwork, which can be broken down into hydroacoustics, travel, and other fieldwork. This represents a 5% reduction in time allocated to

fieldwork over last year. This estimate is somewhat of an overestimate, as the category includes travel of all kinds (i.e., to meetings), not just travel related to fieldwork. It also includes all time spent on the hydroacoustics project, which, for 2023, included a lot of data management and analysis, in addition to time spent in the field conducting sonar transects.

I. Hydroacoustics:

FY2023 represented the first complete field season with a dedicated sonar research associate, Bill Pate. Much of my involvement (120 hours) with the program during 2023 focused primarily on the continued development of the sonar SQL database, centralizing all of the data, and developing analysis routines in R and Tableau for both HTI and BioSonics systems.

Highlights from the sonar program last year include:

- Performed detailed comparison surveys with Wyoming Game and Fish to evaluate differences between HTI and BioSonics sonar gear on Lake Granby
- Final testing and verification of analysis dashboard in Tableau that will calculate echo-integration estimates for Smelt from Horsetooth Reservoir.
- Continued with the work of centralizing historic hydroacoustic data and developing SQL analyses and Tableau dashboards to streamline the analysis workflow and expedite annual sonar population estimates, as well as adding the ability to look across multiple sonar surveys on a specific waterbody with the click of a button.
- Assisted sonar technician with surveys on Horsetooth, Ruedi, Dillon, and Nighthorse reservoirs.
- Performed analysis of all Horsetooth echo-integration data and generated annual smelt estimate
- A reliable dashboard to perform all of the necessary target-tracking calculations is still in development

II. Travel:

A total of 77.5 hours (4.9%) were spent traveling in 2023, up 7.5 hours from last year. This number is not just travel for fieldwork however, but also includes travel to meetings and conferences as well.

III. Other Fieldwork:

Helping other units and staying connected with what is going on in the field is an important component of the data management program. Hands-on experience with how data is being collected in the field leads to a better understanding of the data itself and often leads to efficiencies in how the data is uploaded or analyzed. A total of 54 hours (3.2%) was devoted to helping other units in the field during 2023. This was a 26% increase from last year, as this was also the first full field season free of COVID restrictions. Some highlights of this work include:

- Assisting Kevin Rogers with index gill net surveys on Trappers Lake
- Working with Tory Eyre's crew on Recovery Program assessments and invasive species removals on the Yampa River
- Assisted northeast aquatics with annual survey netting of Jumbo and Prewitt Reservoirs

- Assisted with Walleye spawn operations at Cherry Creek

Research

While the data management subunit spends most of its time supporting other biologists/researchers and managing data from internal and external sources, the unit still falls within the aquatic research unit and strives to conduct meaningful research when time allows. A total of 97 hours (6.2% of overall time) were spent on various research topics. This was a 55% reduction in time devoted to research from last year.

I.   Thermal Niche Analysis:

This project has been put somewhat on hold until we can find a technician to take over the duties of placing and retrieving temperature loggers in the field. Several meetings with Ryan Fitzpatrick and Dana Winkleman were held to see if we could link some of this effort to another project, but as of this report, we do not have anyone set up.

Only two hours were devoted to the Thermal Niche Analysis project in 2023, which involved updating the SCTF progress report for this project and attending temperature check-in meetings with Mindi May and Ryan Fitzpatrick.

II.   Data Mining and Analytics:

Perhaps one of the more enjoyable aspects of the job is when there is time to delve into the database and use various analytical techniques to explore a question. Often, these opportunities present themselves as a question posed by a biologist or researcher. Invariably, the solution involves a lot of data filtering and manipulation, often involving a combination of Excel, SQL, ArcGIS, Tableau, and R. The bulk of the time spent conducting research was doing data mining and analytics of some sort, totaling 62 hours (7.2% of total time). Unfortunately, this was still a significant decrease from what was done last year (54% reduction).

Some projects of note from the past year include:

- Adapting many Tableau Reader dashboards to the Tableau Network and publishing them

- Demonstrating Tableau to new terrestrial data managers

- Further refinements and improvements to the Creel dashboard

- Developed a new Walleye Spawn dashboard in cooperation with Mandi Brandt and Aubrey Pelletier

- Designed a new Water Quality Control Division dashboard to provide them with limited data of interest to them

- Worked with Alex Townsend and Eric Gardunio to develop a stocking requests by region dashboard for use by DWMs

- Developed a Big Fish Dashboard to explore largest fish by species and location, and to help identity data errors

- Adding new users and permissions to Tableau Network

- Developed several custom analysis dashboards for Jesse Lepak to support his research into Tiger Muskie and Gizzard Shad.

- Built new Tableau dashboard that links to new Asana software to aid in project tracking and summarizing annual activities for this report

III. <u>Other Research</u>:

Additional research is conducted as time allows, usually involving statistical data exploration, researching a topic in the primary literature, or other research in support of biologists/aquatic researchers. Thirty four hours ((<1% overall) was devoted to doing research, which was two and a half times more than was accomplished last year. Some highlights of research-related work that was conducted over the past year include:

- Performed cluster analysis on a group of morphometric characteristics used to separate Quillback from River Carpsucker. That will be part of a paper with John Woodling

- Developed a protocol and methodology in R to estimate creel parameters on waters that have no creel data, but comparing them with other similarly sized and managed waters.

- Updated my research citation library with new references and migrated the database from Mendeley to EndNote

- Exploring the use of ChatGBT to aid in writing of reports, research papers, and letters of reference

- Assisted Jesse Lepak with Tiger Muskie and White Sucker analyses and looked at Tiger Muskie-Mountain Whitefish interactions

- Investigating current genetics research on Sculpin, Northern Redbelly Dace, Stonerollers, and Carpiodes species

- Continued development of R code library

Special Projects
This category captures those activities that have recurring but not indefinite investments in time that do not fit neatly in any of the other categories. The subcategories involved may change from year to year depending on the current needs of the research unit or the agency.

A total of 221 hours (14.2% overall) was devoted to special projects, which was almost exactly what was spent last year on this category..

I. <u>Fishes of Colorado</u>:
Going into its seventh year, this project to update and publish a new version of the Fishes of Colorado continues to move forward toward completion slowly. The work of John Woodling continues to be an invaluable constant in the project, as involvement by other authors comes and goes with their availability and other commitments. Nicole Vieira was brought on to offer another set of eyes for review and editing. All chapters are in a final draft state and are just being reviewed and updated where necessary. Families such as Carpiodes (Quillback and River Carpsucker) and the Sculpins continue to present challenges, as current genetic methods is changing the way we view this species taxonomically. A total of 130 hours (11.4% of total hours) were allocated to the book this year, not including the efforts of John Woodling, Liz

Krone, or various contributing biologists and researchers. Aside from unspecific office tasks (emails, etc.), no other sub-category had more time devoted to it than the book.

 II. <u>Professional Association Involvement</u>:

I am an active member of the American Fisheries Society (AFS) and typically attend both the national and CO/WY local chapter meetings annually. I am also an active and former Excomm member of the Organization of Fish and Wildlife Information Managers (OFWIM), participating on several of their committees. In 2023 I was also recruited to take over the email and listserv responsibilities for the Western Division of AFS.

A total of 44 hours (2.7%) of overall effort was devoted to professional association involvement in 2023, which is unchanged from last year.

Other highlights under professional association involvement include:

- Served as host for the 2023 Organization of Fish and Wildlife Information Managers in Fort Collins, with all the associated logistics and responsibilities
- Presentation judge at CO/WY annual meeting in Fort Collins
- Management of AFS's Western Division listserv and all associated emails sent out from the division. Led the transition of the listserv away from a costly Mail Chimp account to SimpleLists

On the Horizon

Research and work-related points of interest that are coming up in 2024 include:

- Finalizing Fishes of Colorado and getting it to a publisher (whoever that may turn out to be) is priority number one
- Working with aquatic leadership to hopefully get an additional aquatic data FTE position approved
- Working on additional publications with John Woodling, Jesse Lepak, Adam Hansen, and Bill Pate
- Completion of development and testing of a target-tracking analysis dashboard in Tableau
- Providing ADAMAS and Tableau training to a host of new biologists at the 2024 biologist's summit
- Continued development of the library of Tableau Dashboards available on the network for biologists to use.
- Attending Annual Aquatic Biologist, Coldwater Reservoir, Boreal Toad Recovery Team, and CO/WY AFS meetings in person.

Appendices

Appendix A. Bar graph showing the percentage of FTE time spent on individual subcategories.
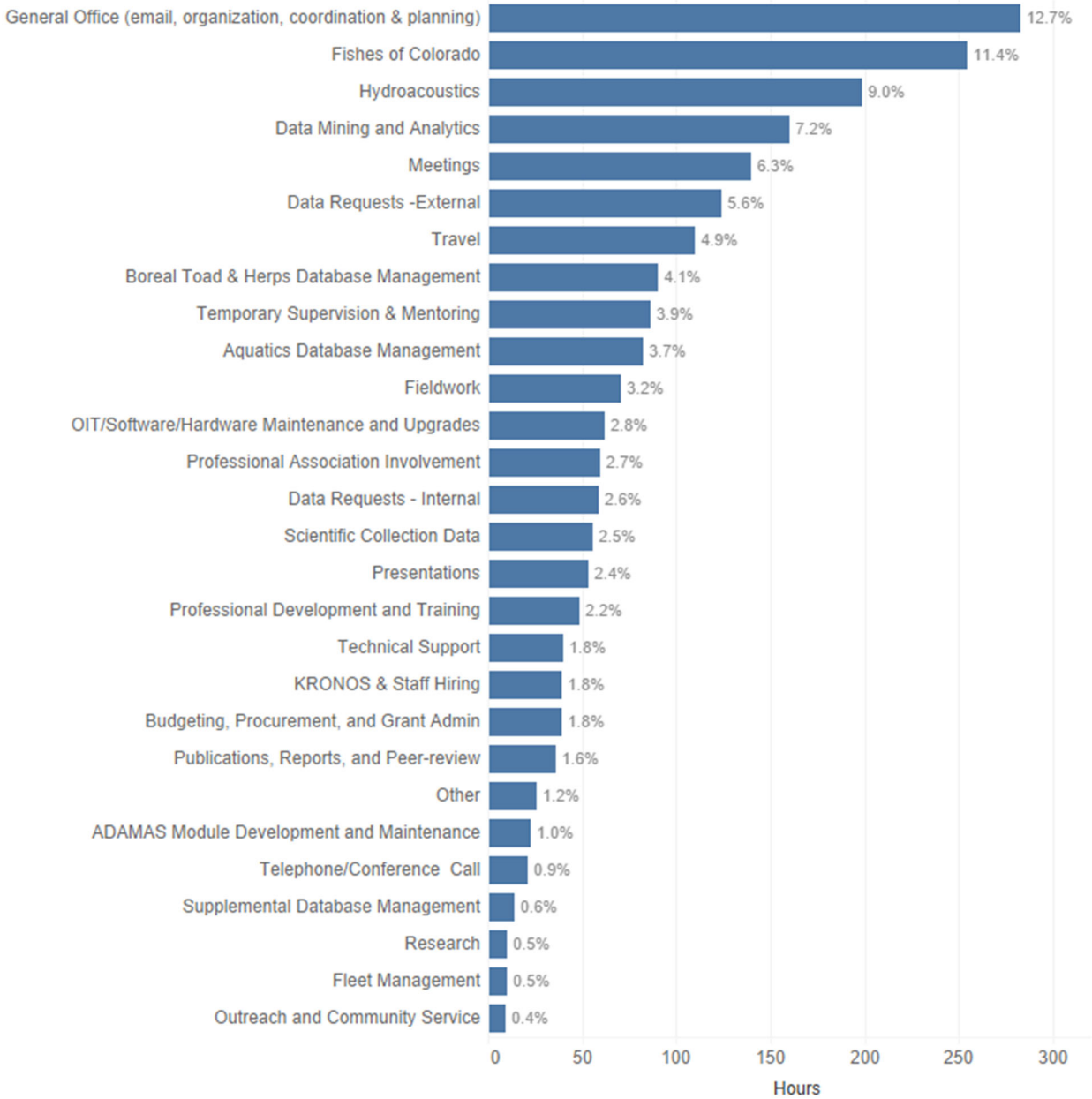
Appendix B. Bar graph showing the percentage of Temporary time spent on individual subcategories.