Aquatic Data Analysis and Database Management

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2022 Progress Report

Colorado Parks and Wildlife

Aquatic Research Section

Fort Collins, Colorado

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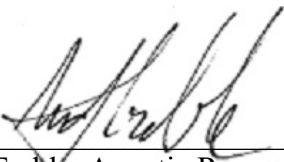
George J. Schisler, Aquatic Wildlife Research Chief

Date: ___December 28, 2022___

Contents

List of Tables

List of Figures

Overview

As in recent years, work on the Fishes of Colorado book continued to be the top priority in 2022. Again, significant progress was made, and the end is in sight. Periods of good progress seemed to be spaced between weeks where my focus was required elsewhere. Contact has been made with the publisher and we are starting to pull the various chapters together in a cohesive book for submission and review.

This year (2022) was the second full year since Bill Pate was hired to take over the bulk of the hydroacoustic survey work. While I still helped out with a few surveys and equipment upgrades, my involvement was greatly reduced and is focused now 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.

I attended several meetings with Kirk Teklits, Brandon White, Riley Morris, and April Kraft, and worked with OIT contractors, to develop an RFI and prepare and RFP concerning the replacement of all four aquatic data applications (ADAMAS, Trans6, AAHL, and Creel).

Database management was largely focused on amphibians in 2022, with improvements being made to the Boreal Toad Monitoring database, as well as the development of a new 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 first full year with 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, 2022 – December 31st, 2022.*

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 118 hours (7.4%) in 2022.

I. Temporary Supervision and Mentoring
  - YIP and temporary software training and database introductions
  - Supervising Masha Maskell (YIP), Noah Goodkind (former RiverWatch YIP), and Alissa Gigliotti, as well as CSU work-study, Elizabeth Bauer.
  - Supervising the last few months of Liz Krone's contract when she finishes work for Boyd Wright
  - Discussions with Aubrey Pelletier (Swarr/Winkle technician) to be hired as YIP in spring of 2023

II. Professional Development and Training
  - Annual OIT cybersecurity training
  - DNR Equity, Diversity, and Inclusion training
  - CPW Identity Manager software training
  - DU Daniels Leadership School Alumni Workshops
  - Tableau Online workshops
  - CO/WY AFS continuing education
  - CSU Libraries 'Cookies and Coding' R courses

Communication

This category includes meetings and conference calls, internal and external presentations, and written reports and publications. A total of 198 hours (12.4% of overall time) was devoted to communication during the period of this report. Attending meetings and preparing/delivering presentations accounted for the most significant portion within the category, mainly related to annual commitments in both areas.

I. Publications, Reports, and Peer-Review

Authoring and reviewing various reports, publications, and white papers involved approximately 25 hours of total time during the period of this report. Three reports were authored or co-authored during the period of this report. Two of these were annual status or progress reports, whereas the third was an internal report.

Recent Special Reports & White Papers:

i. **Treble, A. J.** 2022. 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.** 2022. Aquatic Data Analysis. Annual Report. Colorado Parks and Wildlife, Aquatic Wildlife Research Section. Fort Collins, Colorado.

iii. **Treble, A. J.**, Hansen, A., Pate, W. 2022. Changes in Rainbow Smelt (*Osermus mordax*) abundance in Horsetooth Reservoir, 2017-2021. Colorado Parks and Wildlife, Aquatic Wildlife Research Section. Fort Collins, Colorado.

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

    i.   Adams, C., Winkelman, D., and Fitzpatrick, R. Impact of wastewater treatment plant effluent on the winter thermal regime of two urban south plate tributaries

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

    i.   Contributions to Management by Aquatic Research

    ii.   2019-2022 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/document/d/1UIVrm_Kec__r_FfExcv5SUdskkRv9uI9/edit

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.   <u>Meetings</u>

Often maligned, both formal and informal meetings are necessary to maintain coordination and pass on knowledge concerning what is going on in other parts of the agency. They also provide opportunities to promote ways in which the data management unit can assist other units. A total of 99 hours was spent in meetings during this reporting period. There are a handful of meetings that I attend every year; these include:

- Annual CPW aquatic section meeting (Virtual in 2022)
- Annual CPW coldwater reservoir coordination meeting (Virtual in 2022)
- Annual CPW aquatic research meeting (Virtual in 2022)
- The annual meeting of the CO/WY Chapter of AFS (Virtual in 2022)
- The annual meeting of the Organization of Fish and Wildlife Information Managers (OFWIM) (Virtual in 2022)
- Annual Boreal Toad Recovery Program meeting (Virtual in 2022)
- Various meetings with CPW researchers to support ongoing research projects
- Hydroacoustic planning and analyses meetings

In addition to these annual meetings, meetings of interest in 2022 include:

- 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 the development of a CPW ANS dashboard
- Meetings with Megan McConville and external vendor about developing an RiverWatch API, to be used in the development of a RiverWatch Water Quality dashboard

- Monthly Water Temperature Research check-in meetings with Mindi May, Ashley Rust, and Ryan Fitzpatrick.
- 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.
- Meeting with Salesforce government services branch about the development of mobile data applications.
- Implementation meetings concerning Northern Leopard Frog Research project.
- Meeting with CPW Terrestrial counterparts concerning the development of the Terrestrial Tableau Network and visualizations
- Several meetings were held with OIT and aquatics unit leaders to work on an RFI and subsequent RFP for the replacement of all four aquatic data packages.

III.   Presentations

Internal Presentations:

a) **Treble, A. J.** 2022. D'ATTA Bio Awards. Annual CPW aquatic section meeting, (virtual). January 20th, 2022.
b) **Treble, A, J.** 2022. Horsetooth Reservoir Smelt Monitoring. Annual Coldwater Reservoir Meeting (virtual). February 8th, 2022.
c) **Treble, A.** J. 2022. Data Analyst Program Update. Annual CPW Aquatic Research Meeting. Fort Collins, CO. November 30th, 2022.

External Presentations:

a) **A. J. Treble**. A fish out of water: Tales of a Great Lakes Lamprey Biologist's adventures in the arid West. American Fisheries Society National Meeting. August 22nd, 2022

IV.   Telephone/Conference Calls:

While more efficient than traveling to meetings, telephone and conference calls still accounted for almost 15 hours (1%) of overall time spent in 2022. 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 ExComm
- Numerous technical support calls with biologists and researchers
- Numerous calls with Aquatic Seniors to discuss ongoing data requests
- Regular phone calls from biologists for data or specific data analyses

V.   Outreach & Community Service:

Outreach and community service accounted for a total of 10 hours during 2022 and consisted of the following:

- Mentoring 5th grade exhibition class at Bennett PS

- Presenting at International Day at Bennett PS
- Guest on CSU's FW 179 Career Panel

Data Support

I. Internal/External Data Requests

A total of 63 data requests from sources external to CPW were processed between January 1st and December 31st, 2022, representing a little over 93 hours of work. In addition, numerous internal (CPW) requests were handled as expeditiously as possible during this period, adding an additional 38 hours in time. The combination of internal and external requests accounted for 8.2% of total time in 2022. A detailed summary of the time and effort allocated to the data request process is provided in Figures 2 and 3.

Aside from the pandemic year (2020) this is the lowest number of requests and time spent on request since 2014. Although it would be hard to verify, I suspect that the decreases in internal requests could be related to the variety of data visualization products I have developed for biologists, researchers, and water quality staff, whereas the decreases in the number of external requests could be due to the release of Colorado's Conservation Data Explorer (CODEX).

Figure 2*. Summary of external aquatic data requests by month over the past nine years.*
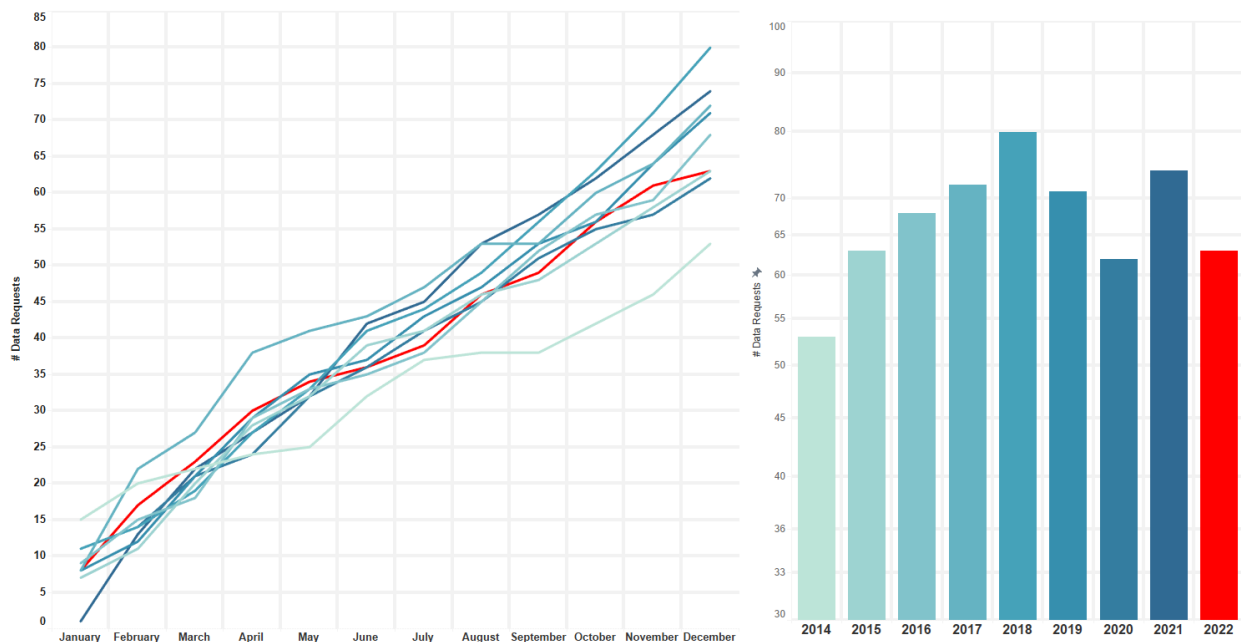
A summary of the highlights related to data requests during this reporting period are provided below:

- A single CORA request was responded to in April
- Updated the private property designations for survey stations statewide to ensure compliance with State statute when releasing data
- Updated data sharing agreement to reflect recent changes by AG's office and to make the agreement more similar to that being used in other parts of the agency
- Numerous data explorations related to the Fishes of Colorado book project

Figure 3. Monthly allocation of effort (FTE hours) given to internal and external request for data in 2022.
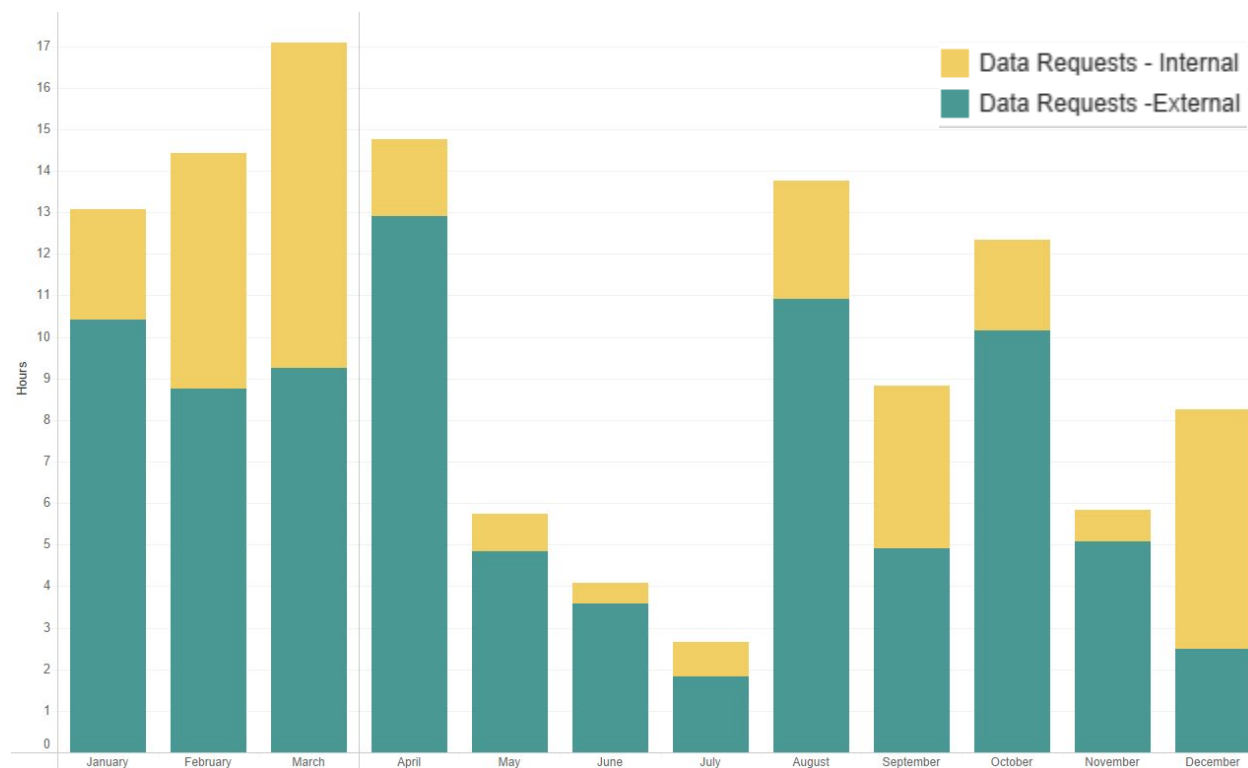
II. Scientific Collection Data

There were a total of 55 Scientific Collection Permits submitted data during the period of this report (the remaining three from 2021 and 52 from 2022), which equated to a total of 677 survey reports being added to the database (204 of these were from 2021). The amount of effort required to QA/QC these reports and upload them into ADAMAS was 292 hours (129 by temporary employees). 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..

Figure 4*. Comparison of effort devoted to SciColl surveys over the past five years.*
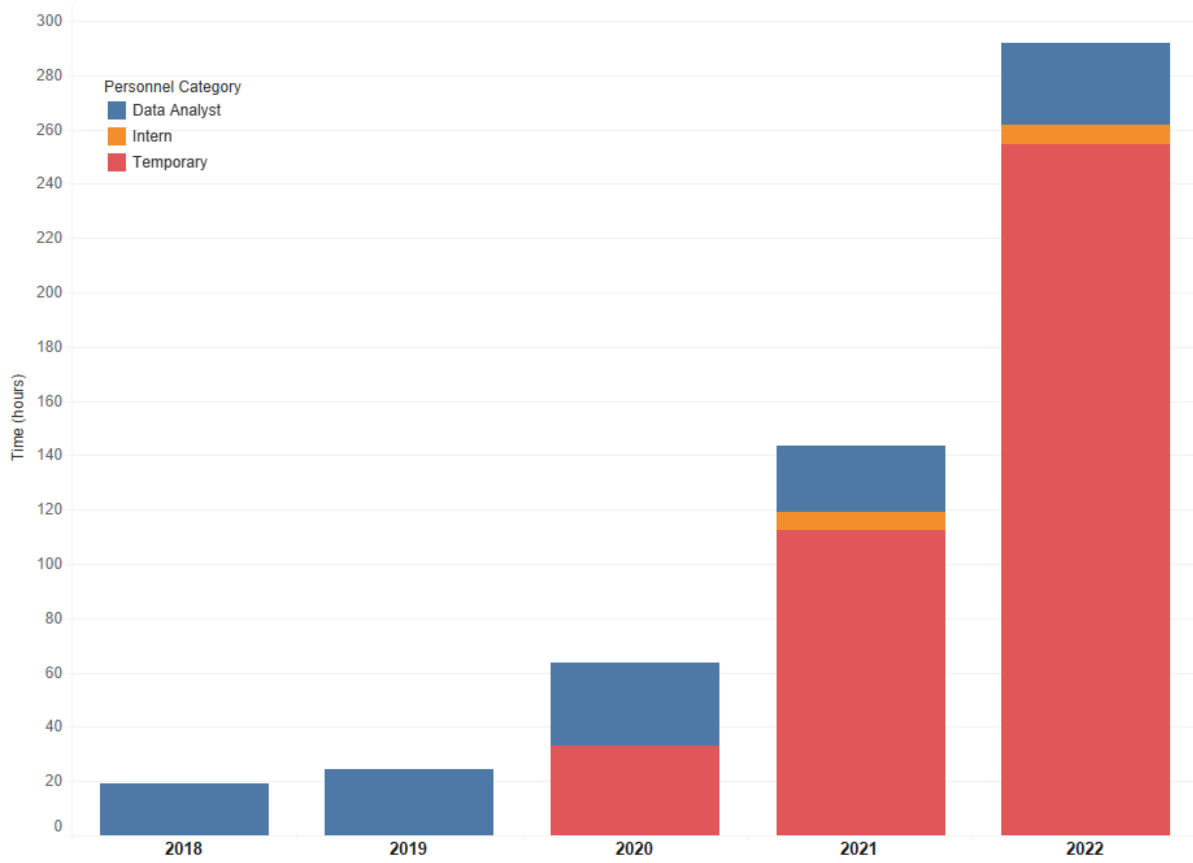
Figure 5. Sources and number of Scientific Collection Reports submitted between January 1 and December 31, 2022.
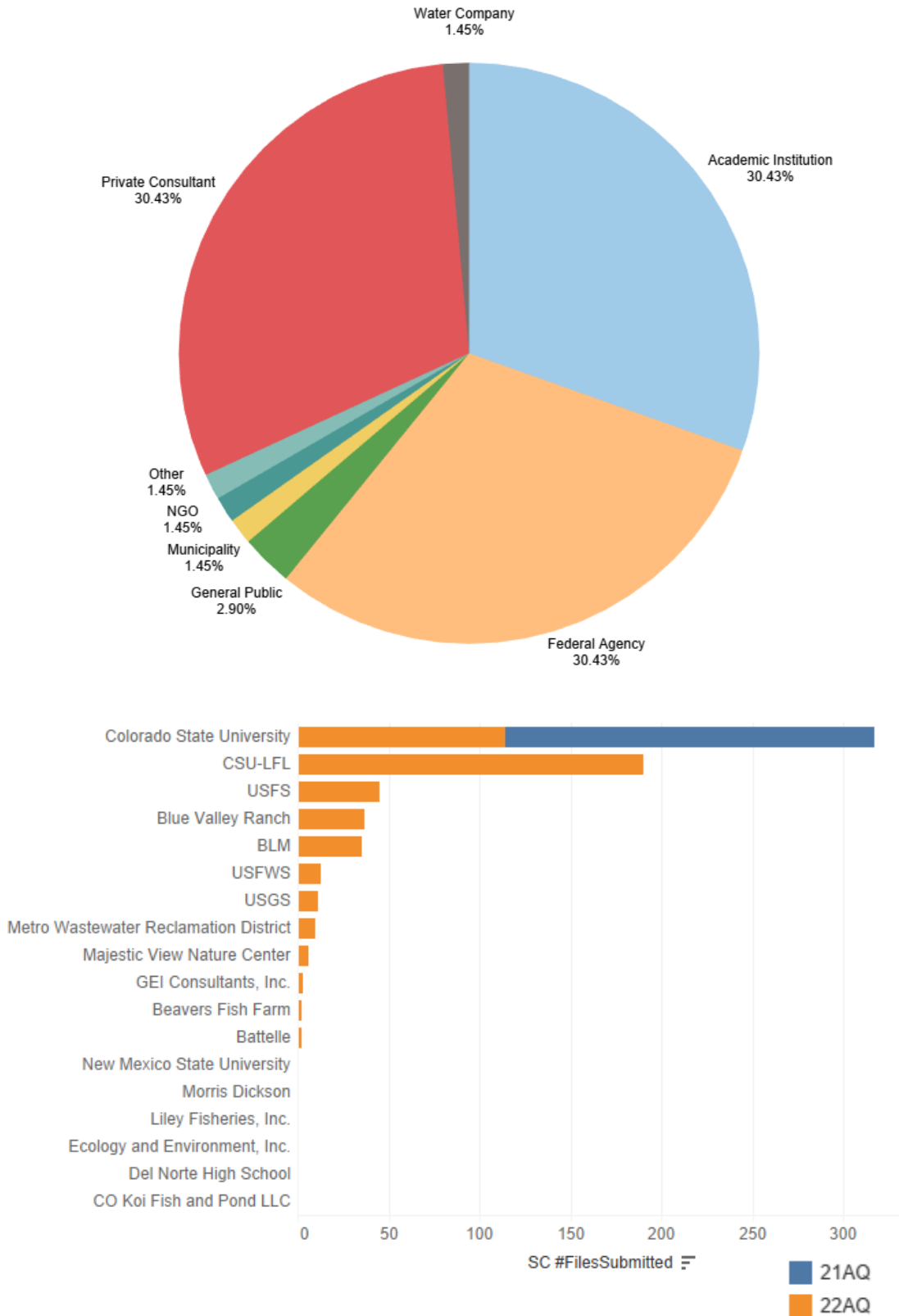
III.   Technical Support

The aquatic research data analyst is often the first point of contact by 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 in a wide variety of 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. Twenty-seven hours (representing 1.6% of overall effort) were spent from January 1st to December 31, 2022, providing technical support to biologists and researchers.

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 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 236 hours, which equates to 15% of the total allocation for the year (not including temporaries and work-studies) (Figure 1.). Approximately 23% of that effort (~58hrs) was directed at the primary aquatic data sources, with the other 77% (~178 hours) 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, WQCD linkages
- Developed HUC12 and Elevation data update routines in R
- Updates and corrections to Area Biologist assignments to stations and waters
- Development of Creel SQL analysis code to summarize the entire Creel database, similar to CurrentSummary for fisheries surveys
- Continued work to develop the SQL framework that feeds into the CPW Tableau Server
- Historical Creel upload and verification

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.

Data Project	#Surveys
Aquatic Database	1
CDOW Water Quality	2
Northeast Region Fisheries Management	140
Northwest Region Fisheries Management	187
Scientific Collections Permit	1691
Southeast Region Fisheries Management	127
Southwest Region Fisheries Management	22
Species Conservation	42
Upper Colorado River Recovery Program	90

Table 1. *The number of surveys, by project, added to the database during 2022.*

This reporting cycle:	
Number of new surveys entered	2,302
Number of new watercodes added	17
Number of new sampling stations added	185
Number of new fish measured	283,493
Number of new fish enumerated	509,491
Overall:	
Total # of managed waters	13,460
Total # of sampling Stations	19,397
Total # of Surveys	63,572
Total # of measured fish	4,773,638
Total # of enumerated fish	11,135,663

Table 2. *Recent additions and the overall status of the aquatics database.*

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 84 hours (5.2%) were devoted to Boreal Toad and Herp database development and management in 2022. Highlights of this work include:

- Creation and 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.
- 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

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 further support aquatics projects 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 28 hours (1.7%) was spent updating and maintaining supplemental databases during this reporting period. 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

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

- Creation and development of a centralized Hydroacoustics database (house on the SQL Test server in Denver). Work included developing a schema that will fit with both historic HTI and newer BioSonics data formats. Uploading of all historic sonar data.

- Several functional updates to ADAMAS_Links, which allows for the querying and analysis of data across multiple surveys. ADAMAS_Links allows for the temporal and/or spatial aggregation of fisheries data that the ADAMAS application does not

- Minor upgrade to FTE and Temporary Time Allocation databases to improve accounting and ease the merging of data for reporting purposes.

- Updates and improvements to Temperature Database schema

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. A list of these software updates or additions of provided below.

- Setting up a new computer

- Installing a new docking station and monitors at my workstation

- Updating monitors at three of my temporary workstations

- 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

Thirteen hours (<1%) of time was invested in bug fixes to the application and development of SQL code that utilizes the data tables in ADAMAS. All the modules are now complete and deployed to production, and Terry Robinson is retired. Therefore, the number of updates and bug fixes should fall off dramatically in the future. Terry still honors any bugs we encounter, but they are becoming more infrequent.

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

- Several go-arounds with OIT to have various database updates and bug fixes uploaded to TEST for evaluation and then eventual push to PRODUCTION

- Worked with Terry on a few bugs specific to the Colorado River Recovery Program upload template and related schema in the database

- Finished developing a SQL script, similar to CurrentSummary, which analyzes and summarizes the creel database. This script will be used to pull information concerning creels from multiple watercodes or over a range in dates simultaneously.
- 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 five hours of time total, spread out over the past year. A total of 65 new lakes, 83 new stream segments, seven new coded fish units, 34 canals/ditches, and seven wetlands were added to the growing list of 13,445 managed waterbodies in the state. Most of these additions were associated with a push to give all unmanaged waters with a record of SWAP species being present their own watercode.

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

WaterTypeName	#Watercodes
Stream	8,809
Lake	4,499
Fish unit	68
Canal/Ditch	54
Wetland	16
Other	14

Table 3. *A summary of 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 264 hours (~16.5% of overall time) was spent conducting fieldwork, which can be broken down into hydroacoustics, travel, and other fieldwork. This estimate is biased somewhat high, 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 2022, included a lot of data management and analysis, in addition to time spent in the field conducing sonar transects.

I.   Hydroacoustics:

FY2022 represented the first complete field season with a dedicated sonar research associate, Bill Pate. Much of my involvement (152 hours/9.4%) with the program during 2022 focused primarily in developing a new 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:

- Interpretation and training with BioSonics software and analyzing data collected with the new BioSonics sonar system.

- Development of an analysis dashboard in Tableau that will calculate echo-integration estimates for Smelt from Horsetooth Reservoir.

- Centralization of historic hydroacoustic data and development of SQL analyses and Tableau dashboards to streamline the analysis work flow and expedite annual sonar estimates, as well as adding the ability to look across multiple sonar surveys on a specific waterbody with the click of a button.

- Limited my involvement in conducting actual sonar surveys, worked with Bill Pate to perform sonar surveys only on Blue Mesa and Horsetooth Reservoirs.

- Performed analysis of all Horsetooth echo-integration data and generated annual smelt estimate

II.   Travel:

A total of 70 hours (4.4%) were spent traveling in 2022. 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 43 hours (2.7%) was devoted to helping other units in the field during 2022. Some highlights of this work include:

- Assisting with Arctic Grayling spawn operations at Joe Wright Reservoir.

- Worked with Kevin Rogers and Bill Atkinson to remove pike from Catamount reservoir

- Assisting Matt Kondratieff with electrofishing surveys of Dream Stream restoration sites to evaluate the efficacy of using toe wood as a habitat improvement technique.

- Assisted Jesse Lepak and Adam Hansen with setting vertical nets on Blue Mesa Reservoir in conjunction with annual hydroacoustic surveys

- Assisted with Walleye spawn operations at Cherry Creek

- John Woodling and I sampling fish at Running Dear Open Space in Fort Collins to collect photography specimens of PTM and BST for the book.

Research

While the data management subunit spends the majority of 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 150 hours (9.4%) of overall time was spent on various research topics.

I. Thermal Niche Analysis:

Through my involvement with the Temperature Advisory Committee (CDPHE and WQCD), I have become interested in the realized thermal niches of fish species in Colorado. This involves using temperature loggers to measure water temperatures throughout the year at specific sites and then relating these temperatures to species that are found at those sites. In FY2020, I received an SCTF grant ($38k) to support logger purchases, travel, and analysis of paired fish-temperature data.

Only one hour of effort was allocated to the Thermal Niche Analysis project in 2022, which involved updating the SCTF progress report for this project and submitting a request to reallocate monies from a redundant SCTF project to extend this one.

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. A total of 135 hours (2.2%) was spent during the reporting period on analytics.

Some projects of note from the past year include:

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

- Adding new users and permissions to Tableau Network

- Development of an ANS dashboard

- Development of a Gold Medal Fisheries dashboard for GM committee to aid in their analysis

- Development of an aggregated CPUE dashboard for NE biologists

- Occupancy analysis dashboard published to Network

- Further improvements to Creel dashboard

- Water temperature dashboard creation and modification with for water quality staff

III. Other Research:

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. Only 13

hours ((<1% overall) was devoted to doing research, which I would like to see increase in the coming years. Some highlights of research-related work that was conducted over the past year include:

- Updated Mendeley and CPW research library with new references

- Assisted Jesse Lepak with TGM and WHS analyses, and looked at TGM-MWF interactions

- Researching current genetics research on Sculpin

- Continued development of R code library

- Reading of numerous research papers

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 224 hours (14% overall) was devoted to special projects, representing the largest proportion of time relative to any other category.

I.   Fishes of Colorado:

Going into its fifth year, this project to update and publish a new version of the Fishes of Colorado continues to slowly move forward toward completion. 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. A summary of the status of the book is provided in Table 4.

Development Stage	# Species	Score
Literature Review	0	0
Rough Draft	5	10
Formatted Draft	0	0
Draft version is in Review	7	28
Final version	0	0
DONE	105	630
Percent complete		95%

Table 4. *Status overview of the Fishes of Colorado project*

This project continues to garner the most time devoted to it of any subcategory, despite this project often being placed 'on the backburner' when other commitments arise. A total of 178 hours (11% of total) were allocated to the book this year, not including the efforts of John Woodling, Liz Krone, or various contributing biologists and researchers.

II.   <u>Temperature Advisory Committee (TAC) Involvement:</u>

My involvement with the Temperature Advisory Committee arose from a need to support Mindi May with fisheries data to support her defense of agency interests in water quality meetings. I attend meetings, provide data and fisheries expertise, develop analytical tools for the group, and author white papers when necessary.

Due to the pandemic, the TAC did not meet again during 2022 and remains pretty much on hold. Also, the Poudre River Working Group disbanded soon after we delivered the Status of the Fishery Report. I like to think that CPW's sampling data and the thoroughness of the report caused Northern Water and the City of Fort Collins to rethink their positions and move in another direction.

III.   <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 active and former Excomm member of the Organization of Fish and Wildlife Information Managers (OFWIM), participating on several of their committees.

A total of 44 hours (2.7%) of overall effort was devoted to professional association involvement in 2022, mainly involving calling into monthly OFWIM conference planning committee planning meetings, as the annual meeting in 2023 will be held in Fort Collins, CO.

While I attended both the OFWIM annual meeting and the annual CO/WY AFS chapter meeting virtually this year, I had an AFS travel grant that allowed me to attend the national AFS meeting in person in Spokane, where I was invited to speak in one of the symposia (see page 5).

Other highlights under professional association involvement include:

- Moderating a session at CO/WY AFS annual meeting
- Presentation judge at CO/WY annual meeting
- Discussions with Western Division AFS excomm to take over maintenance of the listserv.

On the Horizon

Research and work-related points of interest that are coming up in 2023 include:

- Hosting the 2023 annual OFWIM meeting here in Fort Collins at the Hilton
- Providing a ADAMAS and Tableau training session at the 2023 biologist's training day
- Finalizing Fishes of Colorado and getting it to the publisher
- Hiring Aubrey Pelletier, longtime technician for Tyler Swarr and Paul Winkle, into a 3-month internship position.
- Continued development of the library of Tableau Dashboards available on the network for biologist to use.
- Continuing to work with OIT to get the RFP out for modernizing each of the aquatic applications
- 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.
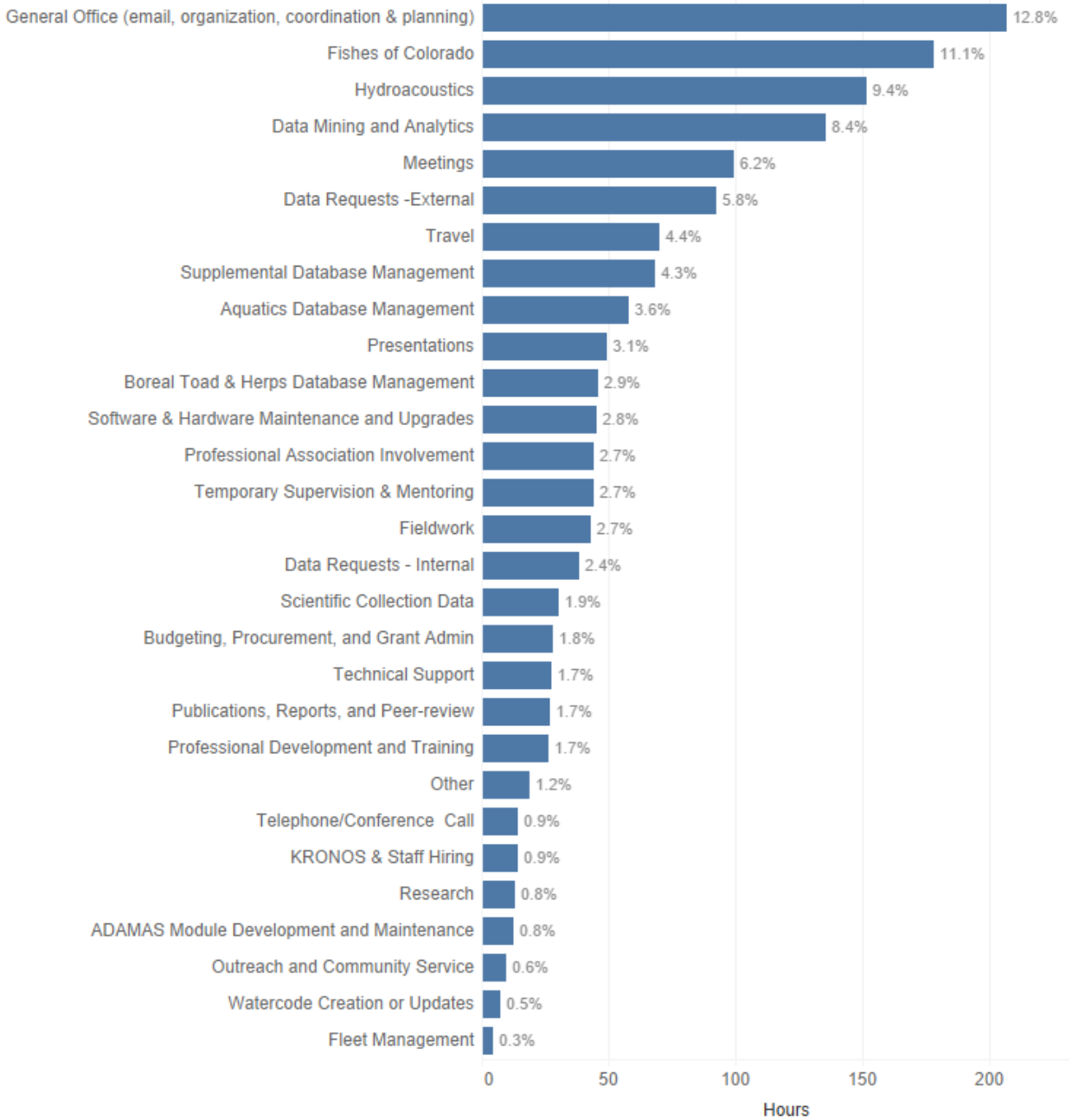
Appendix B. Bar graph showing the percentage of Temporary time spent on individual subcategories.

Appendix C. Status of individual fish chapters within Fishes of Colorado

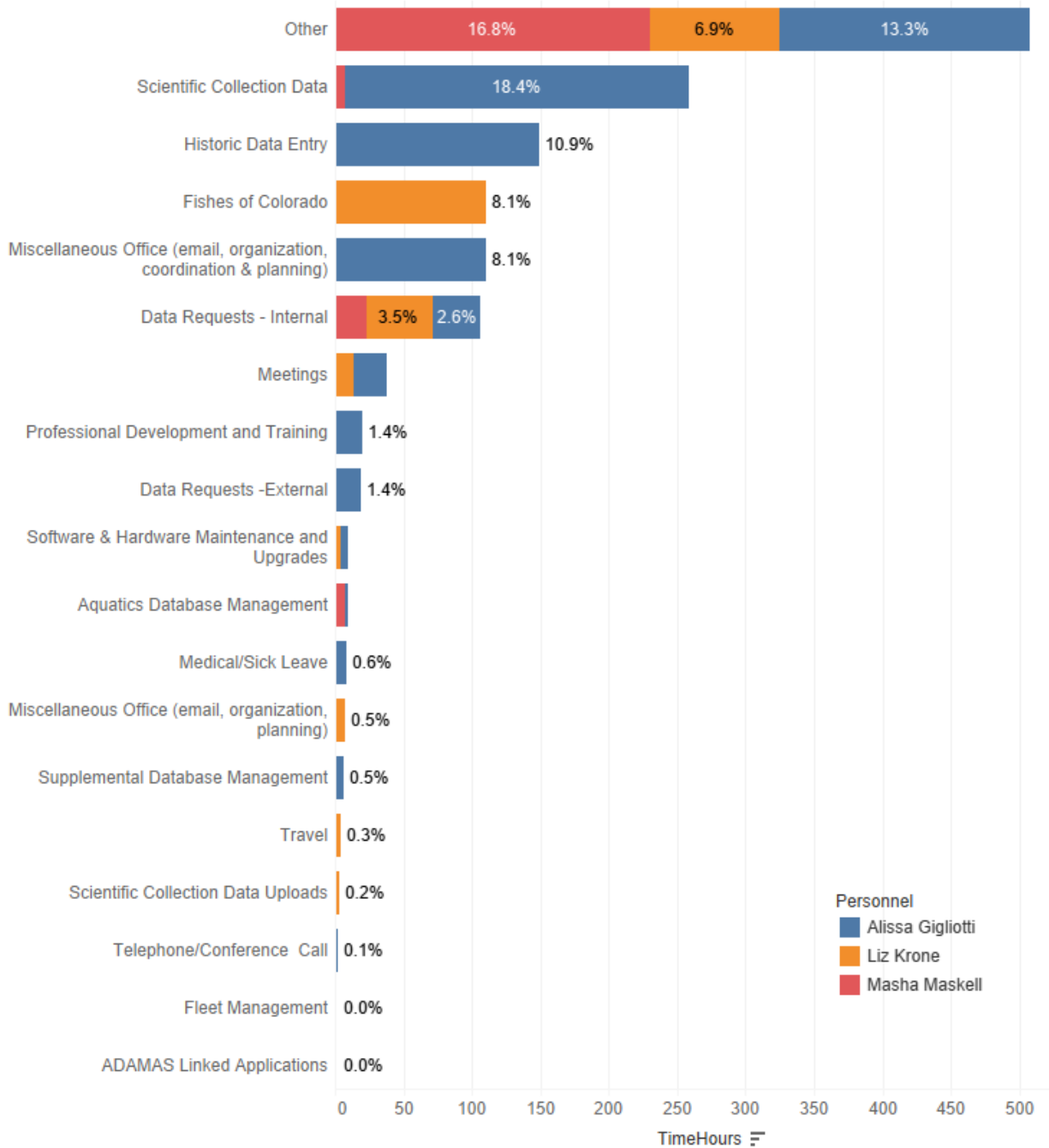|			
Rough Draft			
	GREENBACK CUTTHROAT	Kevin Rogers	
	RIO GRANDE CUTTHROAT	Kevin Rogers	
	SAN JUAN CUTTHROAT	Kevin Rogers	
	SNAKE RIVER CUTTHROAT	Kevin Rogers	
	YELLOWSTONE CUTTHROAT	Kevin Rogers	
In Review			
	BONYTAIL (CHUB)	Woodling & Hooley-Underwood	
	BROOK TROUT	Kendall Bakich/Yoichiro Kanno	John is still retooling this one. Need citation for picture #1 and should crop it for a close-up
	Bullhead Minnow	Woodling, Zuckerman & Treble	Needs a distribution map and for the annotated illustration to be finalized
	Colorado River Sculpin	Woodling	in review
	Eagle River Sculpin	John Woodling	out for review
	STONECAT	Liz Krone	Species has been uploaded to Google drive and needs to be reviewed by Woodling and Schisler. Also need to add these photos into the text.
	SUCKERMOUTH MINNOW	Woodling & Foutz	with Foutz and Wright for comment
Final Draft			
	BLACK CRAPPIE	Ben Swigle	Just waiting on Swigle for final approval
	BROWN TROUT	Dan Kowalski	Revised edition in review with Kowalski
	COLORADO RIVER CUTTHROAT	Kevin Rogers	Just a few comments to be addressed
	PLAINS TOPMINNOW	Elizabeth Krone	Just needs final approval
	RAZORBACK SUCKER	Woodling and Travis Francis	In Woodling's court to address remaining questions with Travis Francis

WHITE CRAPPIE	Ben Swigle & Andrew Treble	Just waiting on Swigle and George
DONE		
AMERICAN EEL	Woodling & Myrick	DONE
ARCTIC CHAR	Woodling and Johnson?	DONE
ARCTIC GRAYLING	Kehmeier & Battige	DONE
ARKANSAS DARTER	Woodling	DONE
Arkansas River Shiner	Woodling	DONE
ATLANTIC SALMON	George Schisler	Combined with Chinook and DONE
Bighead Carp	Treble and Woodling	DONE
BIGMOUTH BUFFALO	Woodling	DONE
BIGMOUTH SHINER	Woodling	DONE
BIGSCALE LOGPERCH	Treble & Woodling	DONE
BLACK BULLHEAD	Woodling & Treble	DONE
BLACKNOSE SHINER	Woodling	DONE
BLUE CATFISH	Treble, Woodling, & Winkleman	DONE
BLUEGILL	Ben Swigle	DONE
BLUEHEAD SUCKER	Thompson/Hooley-Underwood	DONE
BRASSY MINNOW	Woodling & Krone	DONE
BROOK STICKLEBACK	Woodling	DONE
BROWN BULLHEAD	Woodling & Treble	DONE
BURBOT	Schisler and Smith	DONE
CENTRAL STONEROLLER	Woodling	DONE
CHANNEL CATFISH	Winkleman	DONE
CHINOOK SALMON	George Schisler	Combined with Atlantic Salmon and DONE
COHO (SILVER) SALMON	George Schisler & Andrew Treble	DONE

	COLORADO PIKEMINNOW	John Woodling (with Jim White & Jenn Logan?)	DONE
	COMMON CARP	Woodling	DONE
	COMMON SHINER	Woodling & Wright	DONE
	CREEK CHUB	Woodling	DONE
	Cutbow	Fethermen/Schisler	DONE
	EMERALD SHINER	Ben Swigle	DONE
	FATHEAD MINNOW	Woodling	DONE
	FLANNELMOUTH SUCKER	Thompson	DONE
	FLATHEAD CATFISH	Woodling & Bennet	DONE
	FLATHEAD CHUB	Woodling/Fitzpatrick	DONE
	FRESHWATER DRUM	Woodling	DONE
	GIZZARD SHAD	Woodling & Treble	DONE
	GOLDEN SHINER	Woodling & Tucker	DONE
	GOLDEN TROUT	Andrew Treble	DONE
	GOLDFISH	Woodling	DONE
	GREEN SUNFISH	Woodling	DONE
	HORNYHEAD CHUB	Woodling	DONE
	HUMPBACK CHUB	Woodling & Travis Francis (Jenn Logan?)	DONE
	IOWA DARTER	Woodling	DONE
	JOHNNY DARTER	Woodling	DONE
	KOKANEE (SOCKEYE) SALMON	Brett Johnson and Pat Martinez	DONE
	LAKE CHUB	Crockett & Woodling & Jones	DONE
	LAKE TROUT (MACKINAW)	Brett Johnson and Pat Martinez	DONE
	LARGEMOUTH BASS	Swigle/Myrick	DONE
	LONGNOSE DACE	Woodling and Treble	DONE

	LONGNOSE SUCKER	Tyler Swarr	DONE
	Mississippi Silversides	Woodling & Treble	DONE
	MOUNTAIN SUCKER	Carl Medley	DONE
	MOUNTAIN WHITEFISH	Rogers and Schisler	DONE.
	MUSKELLUNGE	Swigle	DONE
	NORTHERN PIKE	Kevin Rogers	DONE
	NORTHERN PLAINS KILLIFISH	Woodling	DONE
	NORTHERN REDBELLY DACE	Woodling	DONE
	ORANGESPOTTED SUNFISH	Woodling	DONE
	ORANGETHROAT DARTER	Woodling & Foutz	DONE
	PALMETTO BASS (WIPER)	Mandi Brandt and John Woodling	DONE
	PEPPERED CHUB	Woodling	DONE
	PLAINS KILLIFISH	Woodling	DONE
	PLAINS MINNOW	Woodling & Foutz	DONE
	PUMPKINSEED	Woodling	DONE
	QUILLBACK	Woodling & Brandt	DONE
	RAINBOW SMELT	Hansen	DONE.
	RAINBOW TROUT	Fethermen & Schisler	DONE
	RED SHINER	Woodling	DONE
	REDEAR SUNFISH	Woodling and Brandt	DONE
	REDSIDE SHINER	John Woodling	DONE
	RIO GRANDE CHUB	Woodling and Alves	DONE
	RIO GRANDE SUCKER	Alves and Woodling	DONE
	RIVER CARPSUCKER	Woodling & Brandt	DONE
	RIVER SHINER	Woodling	DONE. Could use some better pictures.

ROUNDTAIL CHUB	Crockett & Woodling & Jones	DONE	
RUDD	Woodling	DONE	
SACRAMENTO PERCH	Woodling & Treble	DONE	
SAND SHINER	Woodling	DONE	
SAUGER	Woodling & Ramsay	DONE	
SAUGEYE	Jim Ramsay	DONE	
SHORTHEAD REDHORSE	Wright and Treble	DONE	
SMALLMOUTH BASS	Ben Swigle	DONE	
SOUTHERN REDBELLY DACE	Woodling & Foutz	DONE	
SPECKLED DACE	John Woodling & Andrew Treble	We are going to move this DONE however, will revisit similar species and use of peritoneum to distinguish from longnose pending Mike Young analysis	
SPLAKE	Treble	DONE	
SPOTTAIL SHINER	Woodling	DONE	
SPOTTED BASS	Ben Swigle	Still needs a reference for habitat. Maybe final review by Tucker or Noble?	
STRIPED BASS	Woodling	DONE	
TENCH	Woodling	DONE	
THREADFIN SHAD	Woodling & Krone	DONE	
TIGER MUSKIE	Treble and Rogers	DONE	
TIGER TROUT	Adam Hansen	DONE	
WALLEYE	Woodling, Kehmeier, Brandt	DONE	
WESTERN MOSQUITOFISH	Woodling	DONE	
WHITE AMUR (DIPLOID GRASS CARP)	Woodling/Brandt	DONE	
WHITE BASS	Woodling, Brandt, & Swigle	DONE	
WHITE SUCKER	George	DONE	
YELLOW BULLHEAD	Woodling	DONE	

YELLOW PERCH	John Woodling	DONE
Yellowfin Cutthroat	Rogers	Pretty much done. Need to create a historic distribution map.