Brood Year 2021 Winter-Run Chinook Salmon Report

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Contents

Chapter 1

About

We summarize environmental and habitat conditions in 2021 and assess the 2021 brood year of Sacramento winter-run Chinook salmon (WRCS; *Oncorhynchus tshawytscha*) (**BY 2021**). We used data available online to generate this report. This report follows the format of the BY 2019 WRCS Report written by Anchor QEA (@ref(https://www.anchorqea.com/news/brood-year-2019-winter-run-chinook-salmon-operations-and-monitoring-assessment/)).
The assessment was in collaboration with the `Sacramento River Science Partnership`.

1.1 WR Chinook Salmon Life History

Sacramento River WRCS begin their spawning migration in November, traveling from the San Francisco Bay to the upper Sacramento River, and spawning between mid-April to August. Juvenile WRCS emigrate downstream between July-March, and are present in the Delta between September-June.

1.2 WR Chinook Salmon Threats

WRCS historically spawned in cold-water reaches of the McCloud, Pit, and Sacramento Rivers. The construction of Shasta and Keswick Dams blocked WRCS from returning to the cooler spawning grounds, and the population is now limited to spawning below Keswick Dam, which experiences higher water temperatures and lower flows.

WRCS were listed under the California Endangered Species Act (CESA) in 1989, and were listed under the Federal Endangered Species Act as endangered on January 4, 1994.

1.3 References

- https://wildlife.ca.gov/Conservation/Fishes/Chinook-Salmon/Winter-run
- Moyle P.B. 2002. Inland Fishes of California, University of California Press.
- National Marine Fisheries Service (NMFS). 2014. Recovery Plan for Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct population Segment of California Central Valley Steelhead. California Central Valley Area Office, July 2014.

Chapter 2

Environmental Drivers

2.1 Water Quality

Flows at Keswick were lower in 2022 (Figure 2.1).

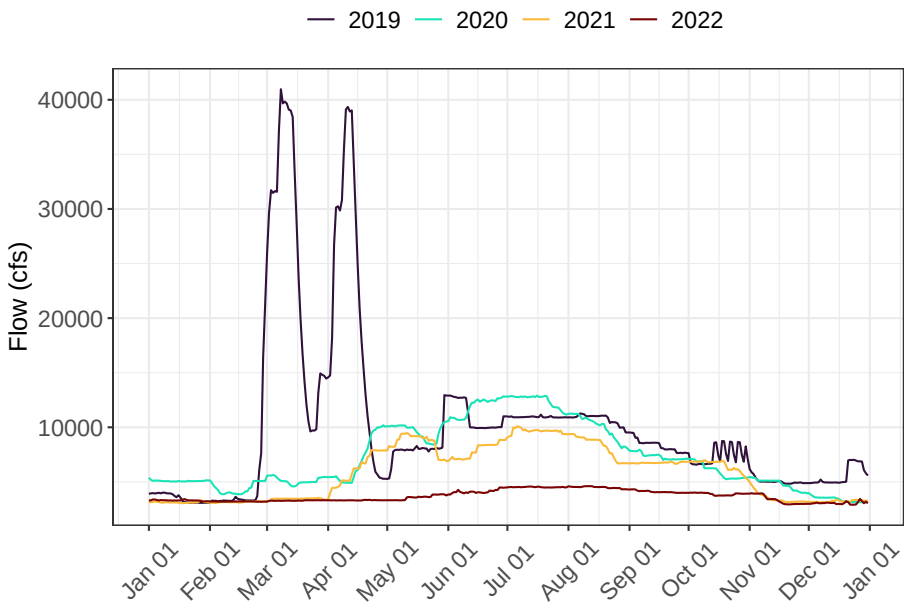

Figure 2.1: Flows at Keswick (KWK), 2019-2022.

Water temperatures were warmer than average in 2020 (Figure 2.4).

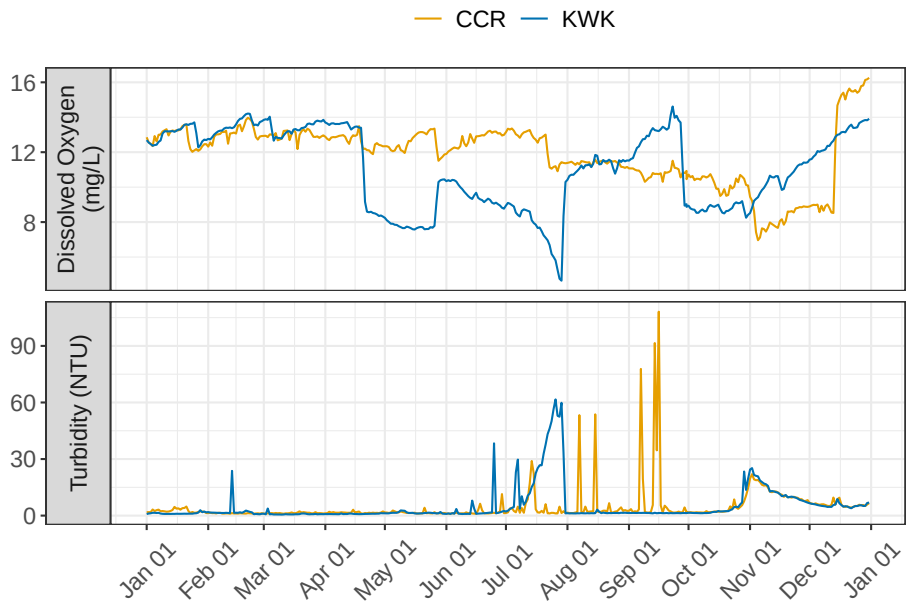

Figure 2.2: Dissolved Oxygen and Turbidity at Keswick Dam (KWK) and Sacramento River upstream from Confluence with Clear Creek (CCR).

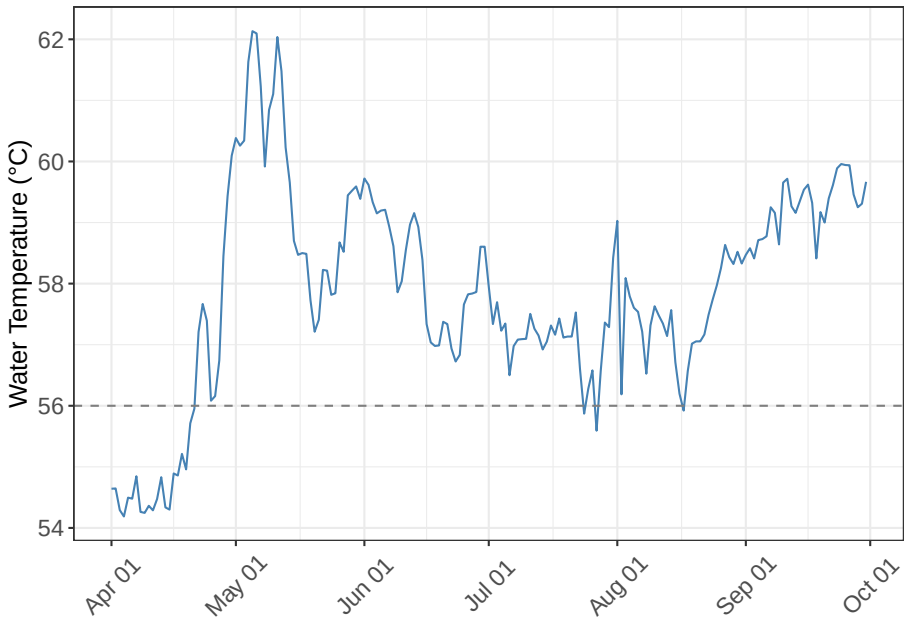

Figure 2.3: Sacramento River Water Temperature at Ball's Ferry Bridge TCP (BSF).

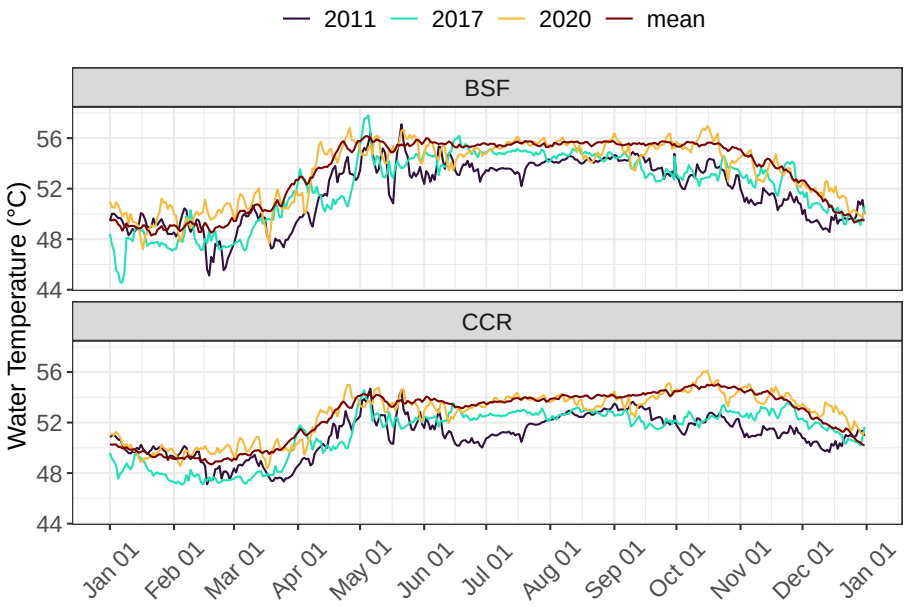

Figure 2.4: Historical Comparison of Sacramento River Water Temperature at Clear Creek (CCR) and Balls Ferry Bridge (BSF).

2.2 Habitat

Weir Overtopping

WUA

Chapter 3

Biological Responses

3.1 Spawners

Estimated Total Mainstem In-River Spawners of Natural and Hatchery Origin Carcass Fork Length Distributions A) Male, B) Female

3.2

Chapter 4

Useful info

4.1 Parts

You can add parts to organize one or more book chapters together. Parts can be inserted at the top of an .Rmd file, before the first-level chapter heading in that same file.

Add a numbered part: `# (PART) Act one {-}` (followed by `# A chapter`)

Add an unnumbered part: `# (PART\*) Act one {-}` (followed by `# A chapter`)

Add an appendix as a special kind of un-numbered part: `# (APPENDIX) Other stuff {-}` (followed by `# A chapter`). Chapters in an appendix are prepended with letters instead of numbers.

4.2 Footnotes and citations

4.2.1 Footnotes

Footnotes are put inside the square brackets after a caret `^[]`. Like this one [1].

4.2.2 Citations

Reference items in your bibliography file(s) using `@key`.

For example, we are using the **bookdown** package [Xie, 2023] (check out the last code chunk in index.Rmd to see how this citation key was added) in this

[1] This is a footnote.

sample book, which was built on top of R Markdown and **knitr** [Xie, 2015] (this citation was added manually in an external file book.bib). Note that the `.bib` files need to be listed in the index.Rmd with the YAML `bibliography` key.

The RStudio Visual Markdown Editor can also make it easier to insert citations: https://rstudio.github.io/visual-markdown-editing/#/citations

4.3 Blocks

4.3.1 Equations

Here is an equation.

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \tag{4.1}$$

You may refer to using `\@ref(eq:binom)`, like see Equation (4.1).

4.3.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref(thm:tri)`, for example, check out this smart theorem 4.1.

Theorem 4.1. *For a right triangle, if c denotes the* length *of the hypotenuse and a and b denote the lengths of the* ***other*** *two sides, we have*

$$a^2 + b^2 = c^2$$

Read more here https://bookdown.org/yihui/bookdown/markdown-extensions-by-bookdown.html.

4.3.3 Callout blocks

The R Markdown Cookbook provides more help on how to use custom blocks to design your own callouts: https://bookdown.org/yihui/rmarkdown-cookbook/custom-blocks.html

4.4 Cross-references

Cross-references make it easier for your readers to find and link to elements in your book.

4.4.1 Chapters and sub-chapters

There are two steps to cross-reference any heading:

1. Label the heading: `# Hello world {#nice-label}`.
    - Leave the label off if you like the automated heading generated based on your heading title: for example, `# Hello world` = `# Hello world {#hello-world}`.
    - To label an un-numbered heading, use: `# Hello world {-#nice-label}` or `{# Hello world .unnumbered}`.
2. Next, reference the labeled heading anywhere in the text using `\@ref(nice-label)`; for example, please see Chapter 4.4.
    - If you prefer text as the link instead of a numbered reference use: any text you want can go here.

4.4.2 Captioned figures and tables

Figures and tables *with captions* can also be cross-referenced from elsewhere in your book using `\@ref(fig:chunk-label)` and `\@ref(tab:chunk-label)`, respectively.

See Figure 4.1.

```
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```

Don't miss Table 4.1.

```
knitr::kable(
  head(pressure, 10), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

4.5 Sharing your book

4.5.1 Publishing

HTML books can be published online, see: https://bookdown.org/yihui/bookdown/publishing.html

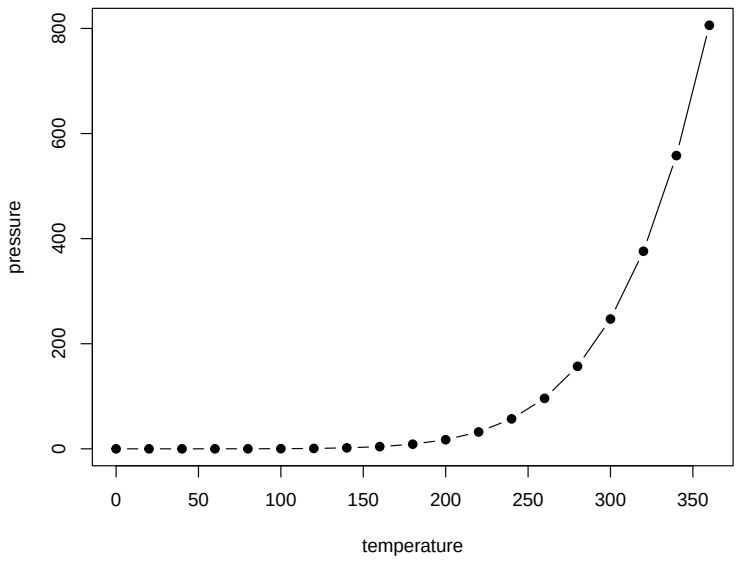

Figure 4.1: Here is a nice figure!

Table 4.1: Here is a nice table!

temperature	pressure
0	0.0002
20	0.0012
40	0.0060
60	0.0300
80	0.0900
100	0.2700
120	0.7500
140	1.8500
160	4.2000
180	8.8000

4.5.2 404 pages

By default, users will be directed to a 404 page if they try to access a webpage that cannot be found. If you'd like to customize your 404 page instead of using the default, you may add either a `_404.Rmd` or `_404.md` file to your project root and use code and/or Markdown syntax.

4.5.3 Metadata for sharing

Bookdown HTML books will provide HTML metadata for social sharing on platforms like Twitter, Facebook, and LinkedIn, using information you provide in the `index.Rmd` YAML. To setup, set the `url` for your book and the path to your `cover-image` file. Your book's `title` and `description` are also used.

This `gitbook` uses the same social sharing data across all chapters in your book- all links shared will look the same.

Specify your book's source repository on GitHub using the `edit` key under the configuration options in the `_output.yml` file, which allows users to suggest an edit by linking to a chapter's source file.

Read more about the features of this output format here:

https://pkgs.rstudio.com/bookdown/reference/gitbook.html

Or use:

```
?bookdown::gitbook
```

4.6 Render book

You can render the HTML version of this example book without changing anything:

1. Find the **Build** pane in the RStudio IDE, and
2. Click on **Build Book**, then select your output format, or select "All formats" if you'd like to use multiple formats from the same book source files.

Or build the book from the R console:

```
bookdown::render_book()
```

To render this example to PDF as a `bookdown::pdf_book`, you'll need to install XeLaTeX. You are recommended to install TinyTeX (which includes XeLaTeX): https://yihui.org/tinytex/.

4.7 Preview book

As you work, you may start a local server to live preview this HTML book. This preview will update as you edit the book when you save individual .Rmd files. You can start the server in a work session by using the RStudio add-in "Preview book", or from the R console:

```
bookdown::serve_book()
```

4.8 Footnotes and citations

4.8.1 Footnotes

Footnotes are put inside the square brackets after a caret `^[]`. Like this one [2].

4.8.2 Citations

- https://www.anchorqea.com/news/brood-year-2019-winter-run-chinook-salmon-operations-and-monitoring-assessment/

Reference items in your bibliography file(s) using `@key`.

For example, we are using the **bookdown** package [Xie, 2023] (check out the last code chunk in index.Rmd to see how this citation key was added) in this sample book, which was built on top of R Markdown and **knitr** [Xie, 2015] (this citation was added manually in an external file book.bib). Note that the `.bib` files need to be listed in the index.Rmd with the YAML `bibliography` key.

The RStudio Visual Markdown Editor can also make it easier to insert citations: https://rstudio.github.io/visual-markdown-editing/#/citations

[2] This is a footnote.

Bibliography

Yihui Xie. *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, Boca Raton, Florida, 2nd edition, 2015. URL http://yihui.org/knitr/. ISBN 978-1498716963.

Yihui Xie. *bookdown: Authoring Books and Technical Documents with R Markdown*, 2023. URL https://CRAN.R-project.org/package=bookdown. R package version 0.34.