Quarto template for the *Journal of Fish and Wildlife Management*

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# Abstract

**Keywords:** Findability, Accessibility, Interoperability, and Reuse (FAIR); markdown; reproducible science; journal template; Quarto

# Introduction

Modern computing tools can allow scientists and practitioners to be more efficient, transparent, and reproducible [\_doi:10.1111/2041-210X.14108; \_doi:10.1111/nrm.12318]. For example, ecologists are moving away from point-and-click statistical methods to using scripting languages with code [\_doi:10.1111/ecog.02493]. These changes not only make scientists more productive, but confer additional benefits. First, using scripting allows the ready reuse of methods by their creator. For example, scientists commonly conduct the same or similar analyses on a regular basis (such as U.S. Fish and Wildlife Service 2023a). Thus, scripting allows methods to be easily adapted and often quickly rerun with minimal formatting. Second, sharing the code allows others to reuse methods and also recreate results when data are shared as well.

The broader scientific community has begun to increasingly see the importance of reproducible results because of a perception of a reproducibility crisis exists, across scientific fields [\_doi:10.1038/533452a; \_doi:10.1073/pnas.1708272114]. Thus, scientists increasingly seek to produce reproducible results, especially for computationally intensive projects [\_doi:10.1126/science.1179653]. This lack reproducibility also occurs in natural resource fields [such as \_doi:10.1002/jwmg.21855]. Others have provided suggestions and methods for creating reproducible results in natural resource and related fields [such as \_doi:10.1111/2041-210X.14108; \_doi:10.1111/ecog.02493]. Additionally, Findability, Accessibility, Interoperability, and Reuse (commonly known as “FAIR” by the organizers) principles exist to help scientists share and produce reproducible science [\_doi:10.1016/j.molp.2018.07.005]. Likewise, professional societies and government agencies have produced guidelines for reproducible science and Table 1 of \_doi:10.1111/nrm.12318 lists example organizations.

While many scientists now use scripting languages for their statistical method [for example, see Figure 2 of \_doi:10.1002/etc.4800 who found that a plurality of authors in an the journal *Environmental Toxicology and Chemistry* use R] fewer use similar tools for writing manuscripts. However, similar tools to scripting languages for statistics (such as Python or R) exist that allow scientist to more efficiently write manuscript that are Markdown-based [\_doi:10.1002/wics.1348]. These writing tools can be especially powerful when embedded with code and released, but also include other benefits. \_10.1002/wics.1348 note that Markdown-based programs such as R Markdown and Quarto offer advantages over LaTeX, Word, or HTML for the author. These include simplicity, readability, transparency, and embedded computation.

On a more personal note, we have observed interest in Markdown-based writing documents from our colleague and collaborators. For example, Erickson co-leads a U.S. Geological Survey Markdown Community of Practice and all of the authors have presented tutorials to this group. Additionally, this group includes members from the U.S. Fish and Wildlife. We have also observed conservations about using Markdown-based writing tools in online conversations such as the U.S. Fish and Wildlife Service’s “Great Lakes R Working Group”.

For readers who unfamiliar with Markdown-based writings tools, we provide a brief history here. Stanford University computer scientist Donald Knuth had trouble typesetting his mathematical equations in the late-1970s and early-1980s and this led him to create the TeX language (Knuth 1984). Leslie Lamport create LaTeX as a set of macros to make TeX easier to use (Lamport 1985). Statistics sought to easily embed statistical code with LaTeX documents. At the time, the S-language (the language upon which R is based) was popular so the program Sweave was created to weave S with LaTeX. While brilliant in theory, Tex, LaTeX, and Sweave all can be complicated to use and Sweave can be especially cumbersome to use. This difficulty in use led Yihui Xie and others to create a Markdown-based program, RMarkdown [\_doi:10.1201/9781138359444]. The popularity of RMarkdown led Yihui Xie and others to create a more general program that works natively with many languages rather than only R, Quarto [\_doi:10.5281/zenodo.5960048].

The remaining purpose of our paper is to present our Quarto template for this journal (Erickson et al. 2023). We demonstrate useful some useful features including how to include figures, tables, and the quarto-utils package for automatic bibliography generation. We also discuss how these tools may be applied to other situations. Although our examples tend to focus on R, Quarto works with many languages.

# Methods

## Quarto workflow

* Quarto [Figure 1](#fig-quarto)
  + write a Markdown file with .qmd extensions
  + Header contains the metadata in yml format, minimal customization needed for this template
  + Template file is jfwm\_template\_template.docx
  + User simply renders file
    - Posit’s RStudio likely easiest program
    - Visual Studio Code another easy editor
    - Command line a third option
  + End results is a Word .docx file
  + Intermediate step involves a Markdown file (md) but not germane to our example
* Journal pipeline for us (Table 1)

## Useful feature

* basic Markdown
* Use LaTeX for math
* Reference
  + .bib file, references.bib with our template
  + Enter in by hand or using editor
  + easier to copy over from Google Scholar and edit
  + Or, convert DOI to bib entry using Quarto-utils Python package
* Quarto-utils
  + Mike add here
* Tables with R and Python
  + Table 1, simple and included because we wanted to show
  + Table 2 demonstrates complex headings and formatting,
  + Can use Markdown, but also easier to use flextable package (b/c it produces nice Word outputs)
  + Also, similar features exist with Python, but not included here
  + Imagine a standardized report, we have known statistical consultants who do this and are very efficient
* Inline code with R
  + For example typing r 2 + 2 yields 4
  + Imagine calculating and saving some like n\_fish\_year in an R script based upon annual catch data and then having the code update your inline text every time you run the file. Useful for annual reports, but also manuscript if you update things.
  + (currently underdevelopment with Python https://github.com/quarto-dev/quarto-cli/pull/6190)

# Results

We have demonstrated how to use Quarto to prepare manuscript for the *Journal of Fish and Wildlife Management*. This includes Figures (such as [Figure 1](#fig-quarto)) and Tables (Such as Table 1 and Table 2).

We have also described the co-authors random links to the upper Midwest (Table 2). The main purpose of this sentence sentence is to be a placeholder to demonstrate the second paragraph and the related indentation.

# Discussion

* Reproducible methods such as Quarto can help science through following principles such as FAIR
  + USGS uses FAIR principles as part of their roadmap \_doi:10.3133/ofr20221043
  + Likewise, FWS uses FAIR principles (U.S. Fish and Wildlife Service 2023b)
* Pragmatically, helps author be more efficient and avoid formatting of word documents
* Also, scientific workflow that differs by authors
  + \_doi:10.5066/P9Q6SUML supported \_doi:10.3996/JFWM-20-070 will often use multiples files: For example (1) format data (2) export data (3) run a long bayesian model and (4) call an R script from an R Markdown or Quarto file to produce a summary report
  + Fienen will often times run everything in Python and then write manuscript using Quarto
* Applications to other systems such as reports (key is to create template)
  + Other journals may have LaTeX templates that can readily be used
  + Easy to change reference formatting by changing style file
  + Ease of reformatting also allows for easy reformatting a resubmitting when rejected by a journal

# Conflict of Interest

The authors report no conflicts of interest.

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# Data availability

# Figures

|  |
| --- |
| Figure 1: Example of quarto workflow. |

# Tables

Table 1: Steps to use the Quarto template associated with this manuscript with the *Journal of Fish and Wildlife Management*.

| order | step |
| --- | --- |
| 1 | Obtain template from DOI |
| 2 | Write your text using Markdown |
| 3 (optional) | Run Python script to populate bibliography file |
| 4 | Break Quarto-Word link and do final formatting manually |
| 5 | Submit to \_Journal of Fish and Wildlife Management\_ |

Table 2: Author trivia to demonstrate a table. The table awkwardly includes wide and long form data to demonstrate how to use the flextable package.

|  | Minnesota Academic Connection | | Wisconsin Academic Connection |
| --- | --- | --- | --- |
| Author | Intership | Undergraduate | Univeristy of Wisconsin (UW) System |
| RAE | University of Minnesota | -- | Undergarduate, UW-Stevens Point |
| -- | -- | Internship, UW-Madison |
| -- | -- | Graduate facutly, UW-La Crosse |
| AAA | University of Minnesota | Gustavus Adolphus | Graduate Certificate, UW-Madison |
| MNF | -- | Macalester | Graduate facutly, UW-Madison |

# Supplemental Material

**Supplement S1** U.S. Fish and Wildlife Service. 2023a. Waterfowl population status, 2023. U.S. Department of the Interior, Washington, D.C. USA.  
**Supplement S2** U.S. Fish and Wildlife Service. 2023b. Budget justifications and performance information fiscal year 2024. U.S. Department of the Interior, Washington, D.C. USA.

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