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

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# Abstract

To do:

* ☐ Finish repo metadata, including readme, license, etc.
* ☐ Finish writing first draft of this document

**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 (Erickson et al. 2021; Braga et al. 2023). For example, ecologists are moving away from point-and-click statistical methods to using scripting languages with code (Borregaard and Hart 2016). 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 (Baker 2016; Fanelli 2018). Thus, scientists increasingly seek to produce reproducible results, especially for computationally intensive projects (Borregaard and Hart 2016). This lack reproducibility also occurs in natural resource fields (such as wildlife research published in the *Journal of Wildlife Management* and descrbed by Archmiller et al. 2020). Others have provided suggestions and methods for creating reproducible results in natural resource and related fields (Borregaard and Hart 2016; such as Braga et al. 2023). Additionally, Findability, Accessibility, Interoperability, and Reuse (commonly known as “FAIR” by the organizers) principles exist to help scientists share and produce reproducible science (Reiser et al. 2018). Likewise, professional societies and government agencies have produced guidelines for reproducible science and Table 1 of Erickson et al. (2021) lists example organizations including professional societies and governmental agencies.

While many scientists now use scripting languages for their statistical method (for example, see Figure 2 of Erickson and Rattner 2020 who found that a plurality of authors in an the journal *Environmental Toxicology and Chemistry* use R), we have observed that fewer scientists use similar tools for writing manuscripts. However, similar tools to scripting languages for statistics (such as Python or R), other tools exist that allow scientist to more efficiently write manuscript that are Markdown-based (Baumer and Udwin 2015). These writing tools can be especially powerful when embedded with code and released, but also include additional benefits. Baumer and Udwin (2015) 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, a U.S. Geological Survey Markdown Community of Practice exists 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 (Leisch 2002). While brilliant in theory, we have observed that Tex, LaTeX, and Sweave all can be complicated to use and Sweave can be especially cumbersome to use because it requires the source file to be complied multiple times. Others noted these difficulties as well and Yihui Xie and others to create a Markdown-based program for use with R, R Markdown (Xie et al. 2018), that overcomes many of these limitations. The popularity of R Markdown led Yihui Xie and others to create a more general program that works natively with many languages rather than only R, Quarto (Allaire et al. 2022).

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 **?@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)
* Purpose of this manuscript
  + Present a template for JFWM using Quarto
  + Demonstrate some useful features: table creation and quarto-utils package
  + Examples tend to focus on R, but Quarto works with many languages. In fact, one of the authors does not use R at all.

# 1. Materials and Methods

* Quarto [Figure 1](#fig-qurto)
* Quarto-utils Python package
* Tables with R and Python
* Inline code with R (currently underdevelopment with Python https://github.com/quarto-dev/quarto-cli/pull/6190)

## 1.1 Background knowledge

* Basic Markdown

## 1.2 Specific steps

1. Write document.
2. Optionally, include code or call code through knitr::read\_chunk() Table 1.

# 2. 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-qurto)) 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 Lightsom et al. (2022)
  + Likewise, FWS uses FAIR principles (U.S. Fish and Wildlife Service 2023b)
* Ideally, if a manuscript submitted to JFWM using this manuscript gets denied (gasp!), fairly easy to modify format to other journal requirements
* Pragmatically, helps author be more efficient and avoid formatting of word documents

# Conflict of Interest

The authors report no conflicts of interest.

# Acknowledgments

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# Data availability

# Figures

|  |
| --- |
| Figure 1: Exampe 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 Connection | | Wisconsin Acadmeic Connection |
| --- | --- | --- | --- |
| Author | Intership | Undergraduate | Univeristy of Wisconsin (UW) System |
| RAE | University of Minnesota | -- | Undergraduate, 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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