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tbeptools: An R package for synthesizing estuarine data for environmental research

Marcus W. Beck[*1], **Meagan N. Schrandt**[2], **Michael R. Wessel**[3], **Edward T. Sherwood**[1], **Gary E. Raulerson**[1], **Adhokshaja Achar Budihal Prasad**[4], **and Benjamin D. Best**[5]

1 Tampa Bay Estuary Program, St. Petersburg, Florida, USA **2** Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, St. Petersburg, Florida, USA **3** Janicki Environmental, Inc., St. Petersburg, Florida, USA **4** University of South Florida, Tampa, Florida, USA **5** EcoQuants, LLC, Santa Barbara, California, USA

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Software

- Review
- Repository
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Reviewers:

- @paleolimbot
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Summary

Many environmental programs report on the status and trends of natural resources to inform management decisions for protecting or restoring environmental condition. The National Estuary Program (NEP) in the United States is one example of a resource management institution focused on "estuaries of national significance" that provides place-based solutions to managing coastal resources. There are 28 NEPs in the United States, each with similar but location-specific programmatic goals to address environmental challenges related to water quality, alteration of hydrologic flows, invasive species, climate change, declines in fish and wildlife populations, pathogens and other contaminants, and stormwater management. A critical need of each NEP is the synthesis of data from disparate sources that can inform management response to address these environmental challenges.

The Tampa Bay Estuary Program (TBEP) in Florida, USA is responsible for developing and implementing a place-based plan to sustain historical and future progress in the restoration of Tampa Bay (N. O'Hara, Shafer Consulting, Inc., 2017). The needs of TBEP for reporting on indicators of environmental condition are similar to other environmental organizations. Multiple local and regional partners collect data that are used for different reporting products. Without data synthesis tools that are transparent, accessible, and reproducible, NEP staff and colleagues waste time and resources compiling information by hand. The `tbeptools` R software package can be used for routine development of reporting products, allowing for more efficient use of limited resources and a more effective approach to communicate research to environmental decision-makers. The package also imports required data directly from sources, removing the need to manually obtain information prior to reporting.

Statement of need

The `tbeptools` R package was developed to automate data synthesis and analysis for many of the environmental indicators for Tampa Bay, with more general application to commonly available datasets for estuaries. The functions in the package were developed to extract methods from existing technical documents and to make them available in an open source programming environment. By making these tools available as an R package, routine assessments are now accomplished more quickly and other researchers can use the tools to develop more specific analysis pipelines.

*Corresponding author

The function names were chosen with a typical analysis workflow in mind, where functions are available to `read` data from a source (typically from an online repository), `anlz` to analyze the imported data using methods in existing technical documents or published papers, and to `show` the results as a summary graphic for use by environmental managers. The functions are used to report on water quality (M. Beck et al., 2021), fisheries (Schrandt et al., 2021), benthic condition (D.J. Karlen, T. Dix, B.K. Goetting, S.E. Markham, K.Campbell, J. Jernigan, J.Christian, K. Martinez, A. Chacour, 2020), tidal creeks (Wessel et al., 2021), and seagrass transect data (Sherwood et al., 2017). The vignettes for the package are topically organized to describe the functions that apply to each of the indicators.

Most of the NEPs do not have analysis software to operationalize data import, analysis, and plotting for reporting. Recently, a similar software package, `peptools` (Marcus Beck, 2021), was developed for the Peconic Estuary Partnership (New York, USA) using many of the functions in `tbeptools` to develop reporting products for a new water quality monitoring program. This successful technology transfer demonstrates the added value of presenting these methods in an open source environment available for discovery and reuse by others. We expect other NEPs to begin using these tools as their application becomes more widespread among estuarine researchers.

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