DATA INTERPRETATION AND SYNTHESIS METHODS MANUAL

CMC
Chesapeake Monitoring Cooperative

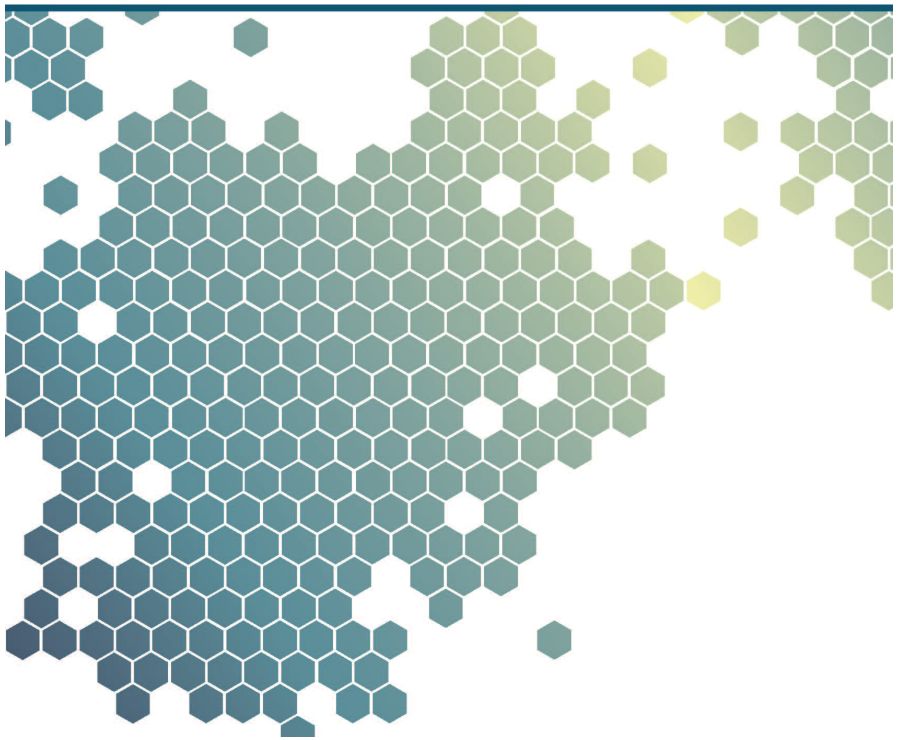

Table of contents

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

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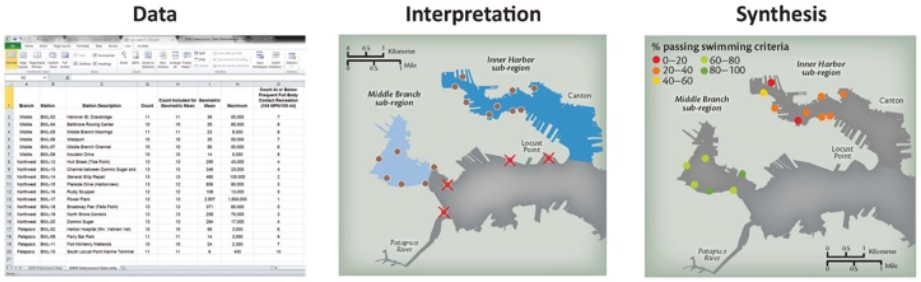
INTERPRETATION

EXPLAINING WHAT YOUR DATA MEANS

For our purposes, data interpretation is defined as the process by which you evaluate and analyze your data so that it can be communicated in a meaningful way to your selected audience. The types of analyses you will do to interpret your data is based on the sampling methods used during field collection. A critical assumption before using this manual is that your sampling methods, whether for water quality or benthic macroinvertebrate parameters, are appropriate to your overall monitoring objectives and are supported by a study design process.

Data interpretation is a broad subject that can be applied in different ways. We will focus on basic interpretation of water quality and benthic macroinvertebrate data that were collected in the field. Sampling water quality or benthic macroinvertebrate parameters, such as dissolved oxygen or percent clingers, yields data in the form of qualitative or quantitative measurements. For example, a dissolved oxygen measurement might read 5.2 milligrams per liter (mg/l). Interpreting that measurement includes giving it meaning—is that particular measurement at a healthy dissolved oxygen level? Does it mean that the entire stream being measured is healthy or just that portion of that stream where the dissolved oxygen was measured? How does that measurement fit into the context of the entire stream you're monitoring? Does it seem unusual to get a reading of 5.2 mg/l and if so, what might be causing such an irregular number?



This section of the manual focuses on Interpretation—giving your data meaning.

The first step for any data analyst is to look at the data values and check for errors. The next steps are to calculate basic statistics of the data and graph or map the data values. These types of interpretation must occur before advanced data visualization and assessment (e.g., report cards) and is a critical missing link between measuring the parameters in the field and using the data to assess ecosystem health. This manual is intended to provide a basic understanding of the different types of data, give you confidence in that data, and interpret it in the right way for your intended audience. Introductory

Interpretation flow

Table of contents

SYNTHESIS

VISUALIZATION AND STORYTELLING HELP SYNTHESIZE DATA INTO INFORMATION

While interpreting data is a critical aspect of any volunteer monitoring or research project and needs to be conducted before synthesis, data contained within spreadsheets or a database cannot be useful until it is properly synthesized into a story that is digestible by your intended audience. In *Houston, we have a narrative*, Randy Olson defines a story as "a series of events that happen along the way in the search for a solution to a problem." More on stories, narrative, and storytelling can be found later in this manual. But, the key point here is that a stated problem and an attempt at a solution is necessary to engage and inform your audience. The following pages will help you learn how to synthesize your interpreted data into key messages and an overarching story. The key messages, story, and report cards are the foundations of your communication strategy and should be given the proper amount of time and effort needed to be effective.

Data visualization is one key aspect of synthesis and includes proper design of graphs, figures, and tables as well as producing conceptual diagrams and infographics. These visual elements will be incorporated into products, such as presentations, newsletters, websites, report cards, and social media content as support for the overarching story that you will be telling.

Storytelling is another key aspect of synthesis and one that most people struggle to articulate and use in their scientific presentations and products. Storytelling includes giving key messages, using narrative, and providing context (Why should I care about your story?). Storytelling and science are not mutually exclusive and anyone producing scientific data should incorporate storytelling into their repertoire to be more effective with their intended audience.

Report cards are a commonly used tool for synthesizing and integrating data into a short, overarching story about ecosystem health. However, that isn't to say that report cards are basic communication tools. The amount of sampling, analysis, and technical skills needed to produce a report card should not be underrated. A special note about report cards: Only those groups that are collecting Tier 2 or 3 level data should be producing report cards.

For more extensive information on synthesis, please see the list of Supporting Materials at the beginning of this manual as well as the reference section at the end of the document. This part of the manual is here to provide an overview of ways to synthesize your data, but there are many topics covered in the resources and references list that will help you tell your story.

Synthesis flow

Table of contents

SciComm principles throughout

Balancing function with form in data visualizations

Use visual cues to help guide your audience through the data. Every choice—from size, color, and shape of each symbol to the way the symbol is positioned—needs to be made with your communication goals in mind.

- Use colors and symbols to emphasize important elements and help tell your story.
- Symbols can be used as visual aids to directly show your audience what you are talking about, rather than depending on text alone. Symbols are language independent and universal.

Symbols can represent something tangible

 *Callinectes sapidus* (blue crab)  *Vallisneria americana* (wild celery)

Symbols can represent something invisible or intangible, like a chemical process (e.g. photosynthesis)

Photosynthesis

Symbols are consistently recognizable all over the world no matter a person's language, culture, or heritage: mathematics π, weather, music, religion, corporate branding, signage, and organizations

- Fonts can be used as a design element and for contrast.

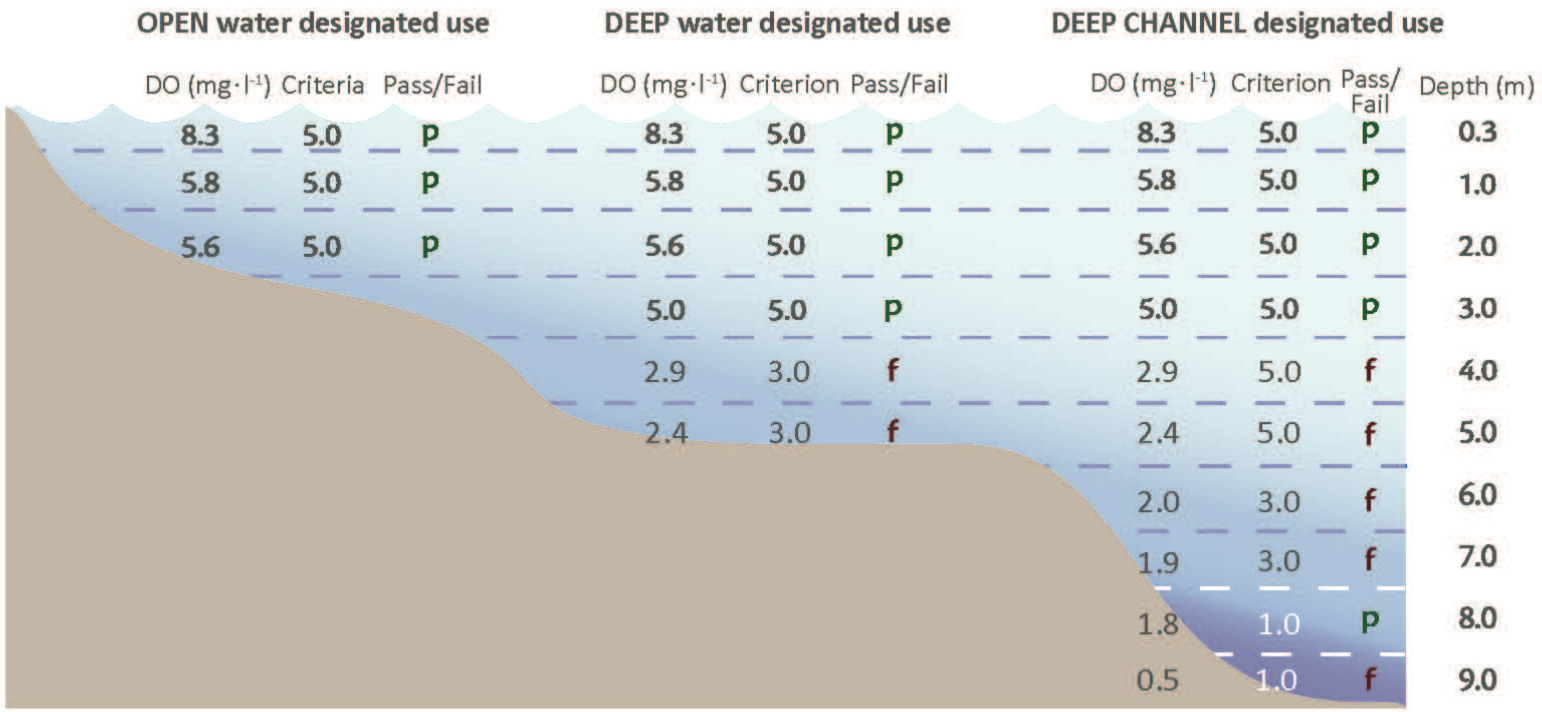
Contrast with SIZE

Contrast with color

Contrast with TYPE

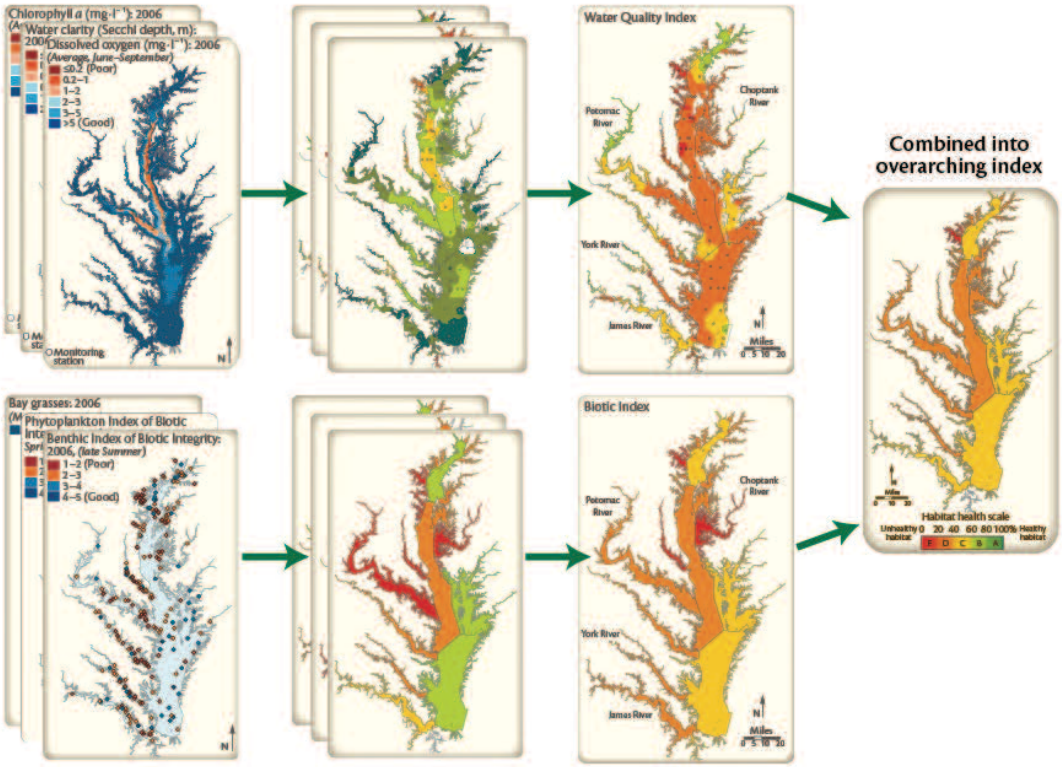
- Use color, size, scale, shapes, and labels to direct attention to key messages.

SciComm principles throughout



Measuring DO using profiles is especially important when there is a pycnocline. This figure shows an example of how to compare measured values against the appropriate threshold to determine pass/fail values.

SciComm principles throughout

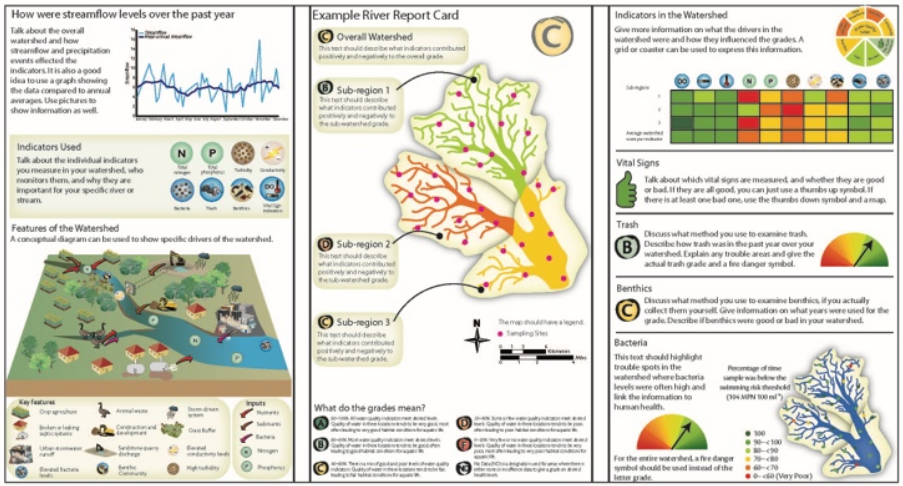


The Chesapeake Bay-wide report card: three water quality indicators and three biotic indicators are evaluated against threshold values. The water quality indicators are then averaged into a water quality index, and the biotic indicators are averaged into a Biotic Index. These two sub-indices are then averaged into an overall Health Index and given a grade.

SciComm principles throughout

The high profile and sometimes controversial nature of report cards necessitates special attention to the communication strategy. A communication strategy needs to consider the main messages that the report card will deliver, how to best deliver the message, and how to reach a broad audience. In terms of messaging, a report card provides an opportunity to communicate the overall health of a region, how one region compares to another, and how health may have changed from one year to another. The report card also provides a vehicle to communicate other related messages such as restoration efforts being undertaken in the area or how the audience can become involved and help in restoration activities. Before releasing a report card, it is advisable to brief appropriate people and agencies about what the report card scores will be (with an embargo on their release until the chosen release date) so that they have the opportunity to prepare appropriate responses.

All of these products—a printed report card, website, and a general communication strategy—have varying amounts of time and effort associated with them. Discussion of these time constraints are beyond the scope of this protocol, but a thorough explanation of different communication products, time commitments, and audiences is provided in Longstaff et al. 2010.



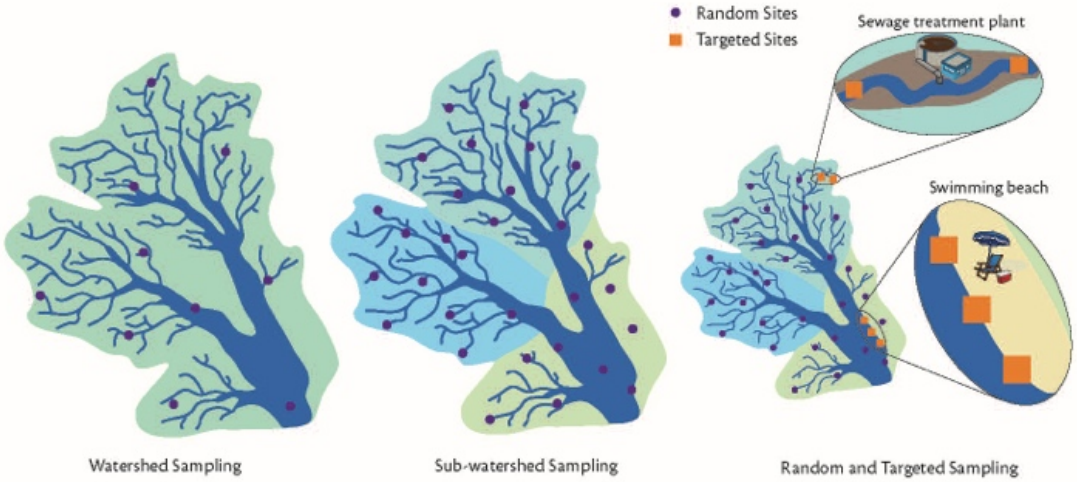
This sample spread of a report card shows how to integrate all of the elements to create a visually appealing and informative communication product.

SYNTHESIS

SciComm principles throughout

Selecting reporting sub-watersheds

Sub-watersheds of your system may have already been determined to help clarify where to assign sampling sites. However, if they have not already been defined, it is one of the first tasks in developing a report card. There must be a sufficient number of sampling sites (at least 10 are recommended) in a sub-watershed to provide a representative and accurate score for each indicator. The boundaries of the sub-watersheds are defined by topography, but when delineating sub-watersheds, consider the land use, population, and contribution of the sub-watershed to the entire watershed.



A minimum of 10 sites should be chosen at either the watershed scale, or for each sub-watershed. Site locations should be randomly selected for an unbiased condition assessment. Targeted sampling sites can also be selected to study specific issues, like the safety of swimming beaches or the effectiveness of a sewage treatment plant.

The workbook in action!

The workbook in action!