ABSTRACT

A PICTURE’S WORTH: SUPPORTING VISUAL SCIENCE LITERACY IN AN INTERNSHIP WITH CHESAPEAKE ECOCHECK

by Melissa L. Andreychek

This report describes my internship with Chesapeake EcoCheck, a science communication program located in Maryland. Through discussions about EcoCheck, its parent organizations, my overall role as an intern, and a major internship project, I provide a context for EcoCheck’s pursuit of science literacy. Generally understood as “any specialized knowledge with a claim on the public’s attention and understanding,” science literacy is an objective feature of EcoCheck’s products because it intends to enable the informed engagement of resource managers and the general public in scientific issues. (Paisley, 1998, p. 72) EcoCheck’s use of visual communication displays (VCDs) provides the basis for a visual science literacy that not only reduces the scientific complexity of a message but also encourages civic responses to that message. In particular, I explore the revelatory function of conceptual diagrams—i.e., how they help interpret, complete, and broaden existing knowledge sets—in core products such as report cards.
A PICTURE’S WORTH:
SUPPORTING VISUAL SCIENCE LITERACY IN AN INTERNSHIP WITH
CHESAPEAKE ECOCHECK

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CHAPTER 1: An Introduction to Chesapeake EcoCheck, a Communications Partnership Program

In partial fulfillment of curriculum requirements for the Master’s of Technical and Scientific Communication (MTSC) at Miami University, I interned at Chesapeake EcoCheck, located on Maryland’s Eastern Shore in the town of Oxford, from May 24 to August 27, 2010. EcoCheck’s scientists and communicators study environmental concerns in ways that go beyond documentation to efforts of correction through assessment and forecasting publications. Visual communication displays (VCDs), such as photographs, maps, charts, and conceptual diagrams, play a vital role in the informative and persuasive capacity of these communication products. (VCDs are discussed further in Chapter 4 of this report.)

This chapter describes the mission and organizational structure of EcoCheck, my role as a science communication intern, and the ways in which I supported the overall objectives of my internship provider.

EcoCheck: Mission and Organization

Chesapeake EcoCheck is a partnership program between the Chesapeake Bay Office of the National Oceanic and Atmospheric Administration (NOAA) and the Integration and Application Network (IAN) at the University of Maryland Center for Environmental Science (UMCES). With the assistance of scientists, communication professionals, resource management agencies, conservation organizations, and other experts, EcoCheck is committed to co-developing communication solutions to environmental problems that affect the Chesapeake Bay and other watersheds. The program “enhance[s] and support[s] the science, management, and restoration” of these watersheds through the integration of its many products, such as report cards, the Chesapeake Bay summer forecasts and reviews, and other geographically detailed assessments and forecasts. These documents drive management efforts that are “essential for [the] improved health” of these watershed areas. (http://www.eco-check.org) EcoCheck’s assessment and forecasting communications are produced for a variety of clients and with the support of a
variety of contributors and partners that include federal and state offices, university departments and scholars, watershed partnership programs, and other environmental non-profits.

As a partnership program, EcoCheck is organizationally situated within its parent groups. It responds to the needs of and provides project assistance to each. The NOAA Chesapeake Bay Office (NCBO) and IAN are themselves components of larger, complex agencies, and NCBO also contains multiple internal offices for which EcoCheck provides communications support. This intricate web of offices and interrelationship is depicted in Figure 1.

The following two sub-sections discuss how NCBO and IAN fit within the frameworks of their parent agencies: NOAA and the University System of Maryland (USM), respectively. These sections are followed by a brief summary of EcoCheck’s internal organization.

**NOAA Chesapeake Bay Office**

A federal agency focused on the health of the earth’s oceans and atmosphere, NOAA is organized into 16 staff offices and six line offices. Staff offices (e.g., Acquisition and Grants, International Affairs, Workforce Management) support NOAA’s corporate functions, whereas line offices (e.g., National Ocean Service, National Weather Service, National Marine Fisheries Service) support NOAA’s environmental and scientific functions. NCBO is a division of the National Marine Fisheries Service (NMFS), which “is dedicated to the stewardship of living marine resources through science-based conservation and management, and the promotion of healthy ecosystems.” (http://www.nmfs.noaa.gov) Effective communications programs are essential to these initiatives, which require partnerships at local, state, national, and interregional levels in order to be productive.

Headquartered in Annapolis, Maryland, NCBO also maintains three regional offices at the Virginia Institute of Marine Science in Gloucester Point, Virginia; Nauticus National Maritime Center in Norfolk, Virginia; and the Cooperative Oxford Laboratory (COL) in Oxford, Maryland. COL hosts regional offices of four lab partner groups: NCBO (including EcoCheck), NOAA’s National Ocean Service, the Maryland Department of Natural Resources, and the U.S. Coast Guard.

NCBO’s presence at COL allows for an integral presence in its affiliation with the Chesapeake Bay Program (CBP), a “unique regional partnership that has led and directed the
Figure 1: EcoCheck organizational chart
restoration of the Chesapeake Bay since 1983” and includes headwater state, federal agency, academic, and other partners. (http://www.chesapeakebay.net) NCBO responds to CBP research and expertise needs on topics such as the protection and restoration of fisheries, vital aquatic habitats, and water quality and the enhancement of partnerships, leadership, and management, both within CBP and among Chesapeake Bay stakeholders (e.g., citizens, policymakers, other management groups).

By providing support to CBP and other local, state, and federal partners, NCBO addresses its core foci of science (via its Ecosystem Science Program), service (via its Coastal and Living Resources Management Program), and stewardship (via its Environmental Literacy Program). In support of these programs, EcoCheck fulfills its core objective of “enhance[ing] and support[ing] the science, management, and restoration of the Chesapeake Bay” through the production and integration of its key products. (http://www.eco-check.org) Figure 2 portrays the relationship between NCBO’s programs and EcoCheck’s key products.

![Figure 2: EcoCheck products in support of NCBO programs](image-url)
Integration and Application Network

UMCES is one of 12 institutions within USM. Considered “Maryland’s premier research institution aimed at advancing scientific knowledge of the environment,” UMCES “has a unique statutory mandate to conduct a comprehensive scientific program to develop and apply predictive ecology for the improvement and preservation of Maryland’s physical environment.”

(http://www.umces.edu) It is a research and service-driven institution with a core concentration on scientific discovery about the environment and human–environment interactions. Supporting research focuses on ecosystem-based management, restoration science, climate change programs, and environmental observation systems.

UMCES broadens its research scope through its science application initiatives. Going “beyond the generation and reporting of data,” the UMCES program IAN “attempts to synthesize and interpret the world in light of new scientific findings … to communicate [those] findings to a broader audience, and to develop ways to implement various policies that stem from research findings.” (http://www.umces.edu) Supporting projects include a seminar series, science communication courses, an image library, and IAN Press, which produces newsletters, posters, reports, brochures, books, conceptual diagrams, and other publications. Each enterprise aims to generate information (data) and knowledge (syntheses) while building credibility with its respective stakeholders.

EcoCheck works closely with IAN’s science integrators and communicators on many of the same communication activities. Though each program maintains its own client list and projects, EcoCheck and IAN share responsibilities in major undertakings, such as the Maryland Coastal Bays and Great Barrier Reef report card publications and the Conservation International Science-to-Action booklets. Responsibilities may be shared within the definition, development, execution, and production stages of a given project.

EcoCheck’s internal organization

Though EcoCheck’s collaborators are many, the program’s core staff are few. Howard Townsend, Ecologist and Ecosystem Modeler, serves as EcoCheck’s NOAA manager, while Dr. Bill Dennison, Vice President for Science Applications, serves as EcoCheck’s UMCES manager. Dr. Heath Kelsey, Science Integrator, supervises EcoCheck’s remaining staff: Caroline Wicks,
Science Applications Coordinator; Sara Powell, Science Communicator; and me, Science Communication Intern. EcoCheck’s internal organization is depicted in Figure 3.

Generally, each staff member contributes to all major projects but may assume various leadership roles and support for other projects. This variability is increased when members work on IAN projects such as the Shenandoah National Park booklet and the Great Barrier Reef report card publication, which are managed primarily by IAN staff. (These projects are discussed further in Chapters 2 and 3 of this report.) In these cases, EcoCheck contributions may be limited to one or two staff members.

My Role and Contributions as a Science Communication Intern

As a science communication intern at EcoCheck, I provided general and targeted communications support to both print and electronic publications. Major tasks related to Adobe InDesign documentation; the Chesapeake Bay summer forecast; the Shenandoah National Park booklet; the Coastal Bays, Great Barrier Reef, and Deep Creek Lake report cards; and numerous other endeavors. These projects allowed me to use my writing, editing, and design skills and required the use of several software applications, including programs within Microsoft Office.
(Word, Excel, and PowerPoint) and Adobe Creative Suite (Photoshop, Illustrator, and InDesign). I also worked with additional software, such as TechSmith Snagit, in developing EcoCheck projects.

Through my contributions to EcoCheck’s assessment and forecast communications—as well as to other projects for which I provided support—I helped to generate and integrate scientific information and knowledge to be used by stakeholders in education, management, and restoration efforts. For example, by preparing Web graphics for the Chesapeake Bay summer forecast, I assisted in supplying the necessary context for anticipatory “diagnosis” and “treatment” of Bay health by providing water quality details to resource managers (e.g., ecologists, outdoor recreation coordinators, policy makers, lobbyists, and other professionals who seek to balance the needs of people and the economy with an ecosystem’s capacity to sustain its natural components and functions). And by applying content and organizational edits to the Shenandoah National Park booklet, I assisted in supplying the necessary context for understanding and contributing to the Inventory and Monitoring Program by providing a conceptual framework for the program’s data collection, cataloguing, and analysis.

I discuss further and more detailed information about these and other projects and my related tasks in Chapters 2 and 3 of this report. These chapters are followed by a theoretical reflection on visual communication displays (e.g., photographs, maps, charts, and conceptual diagrams) as tools of science literacy within EcoCheck products.
CHAPTER 2: A Survey of My Major

Internship Products

During my internship at EcoCheck, I worked in partnership with partner contributors at EcoCheck, NCBO, UMCES, and other organizations—including Johns Hopkins University (JHU), Shenandoah National Park, the Maryland Coastal Bays Program, the Queensland Department of the Premier and Cabinet, and Friends of Deep Creek Lake—to help develop a variety of communications products. These projects included a variety of publication genres (e.g., instructional documentation and brochures) and media (print and Web).

This chapter discusses four major projects in which I was involved: Adobe InDesign documentation, the Chesapeake Bay summer forecast, the Shenandoah National Park booklet, and various report card publications. These projects represented approximately 80% of my total internship time, which is represented in Figure 4. Approximately 20% of my total internship time was dedicated to additional miscellaneous tasks, such as administrative and security training.

Figure 4: Approximate internship time dedicated to major projects
IAN organizes and presents an annual course in effective science communication for interested participants in the COL and UMCES communities, as well as in-house courses for external parties via advanced arrangement. (See Appendix 1 for IAN’s science communication course flyer.) The course recognizes that the impact and persuasive power of data are limited by the effectiveness of their package and delivery, i.e., of their communication design and ability to be understood by their audience. As such, the course aims to accommodate scientists and research professionals who are without resources such as the assistance of learned communicators by “provid[ing] participants with a science communication toolbox for effectively communicating their own data.” (http://ian.umces.edu/sccourse/) IAN’s science communication courses provide focused communications training that is specific to science research endeavors and include lessons in the following topics:

- elements of science communication (defined by IAN as synthesis, visualization, and context),
- use and production of conceptual diagrams (defined as “diagrammatic representations of ecosystems in which key features and major impacts can be illustrated”) (Thomas, 2006, p. 47),
- applied principles of layout and design (e.g., balance, unity, alignment, repetition and consistency, and contrast and emphasis), and
- preparation and development of oral presentations. (http://ian.umces.edu/sccourse/)

To support training in the creation of conceptual diagrams and the applied principles of layout and design, IAN facilitates hands-on instruction in software programs commonly encountered in science communication, such as those found within the Adobe Creative Suite family. While IAN had already designed instructional documentation for Adobe Illustrator CS4, none was yet available for Adobe InDesign CS4. To address this niche, I was tasked with developing comparable InDesign documentation to:

- address the rhetorical needs of IAN’s science communication course participants,
- be readily understood and applied by other audiences, such as general IAN Web site visitors, and
- complement current IAN design styles established in existing documents.
Based upon prior courses, participants and, therefore, documentation users are assumed to have limited formal communications training and no previous experience with the InDesign program. The InDesign documentation was to be an introduction to the program’s tools, functionality, and capacity as they relate to the specific teaching points of the science communication course.

Using Microsoft Word, TechSmith Snagit, and Adobe Photoshop and InDesign, I independently developed a 14-page instruction set with the following section headings: Getting Started, Getting to Know Your InDesign Workspace, Inserting and Resizing Images, Understanding Links and the Links Palette, Creating and Resizing Shapes, Inserting and Formatting Text, Threading Text Boxes, and Wrapping Text. (See Appendix 2 for an excerpt of the InDesign documentation.) Following key tasks established by existing Illustrator documentation and defined by Caroline Wicks, a regular science communication course instructor, I walked myself through each activity to record real-action interfaces and system responses and to create screen captures as visual support for the documentation. Wicks and I each edited the instruction set for relevance, understandability, correctness, appropriateness, and effectiveness, though no target user testing was conducted or planned during my internship tenure.

I prepared this documentation for print media, but IAN had also tentatively planned to make it accessible in PDF format via its Web site on the science communication course pages, making it accessible to a wider public audience (i.e., non-course participants). I completed this project, which required me to write text, take and edit screen captures, and establish a useful and suitable layout, between May 25 and June 22, 2010.

**Chesapeake Bay Summer Forecast**

With support from scientists at JHU, University of Michigan, UMCES’s Chesapeake Biological Laboratory (CBL), and other locations, EcoCheck forecasts the Chesapeake Bay’s summer dissolved oxygen conditions. Dissolved oxygen (i.e., the amount of oxygen that is dissolved in the Chesapeake Bay’s waters) is important to the ecological health of the Bay because it supports the survival of aquatic life, including blue crabs, hard clams, and striped bass. These summer condition forecasts are intended to “provide … information that can be used to guide restoration, enable proactive communication of Bay conditions, and help direct research activities.”
(http://www.eco-check.org/forecast/chesapeake/2010/) They are also intended to help resource managers (e.g., ecologists, outdoor recreation coordinators, policy makers, lobbyists, and other professionals who seek to balance the needs of people and the economy with an ecosystem’s capacity to sustain its natural components and functions) understand the likely effects of environmental management decisions.

By establishing a knowledge context for summer conditions and identifying avenues and times that are likely to favor restorative success, the summer forecast encourages proactive, rather than reactive, management efforts. For example, the dissolved oxygen forecast is based on indicators such as nutrient loading (i.e., the quantity of nutrients, such as nitrogen and phosphorus, entering the Chesapeake Bay in a given period of time). One way that nutrients affect dissolved oxygen is by fueling excessive algal growth. Algae take up nutrients and grow in large, dense blooms that consume dissolved oxygen during stages of both life and decay. Lower nutrient and algal levels promote cleaner, clearer water with higher dissolved oxygen levels. Understanding the relationship between nutrient discharge and the Bay’s ecological health helps guide the reduction of nutrient loading from wastewater treatment plants, urban and suburban storm water systems, and other sources and, as a result, helps improve the Bay’s dissolved oxygen conditions.

Due in part to the variety of methodologies and models used by contributing forecast scientists, EcoCheck presented the 2010 summer forecast in a rolling release (i.e., two versions were released on two separate dates), with early and late summer anoxic (no dissolved oxygen) conditions and July and July–August hypoxic (low dissolved oxygen) conditions. To support this effort, I was tasked with redesigning and integrating into the EcoCheck Web site scientific graphs submitted by Rebecca Murphy of JHU and Younjoo Lee of CBL and with making them audience-appropriate and Web-ready. Graphs are important to the communication of the summer forecast because they reveal quantitative data and patterns within that data in a readable, readily-accessible format. Because they are also a familiar visual genre for the forecast’s intended audience of scientists and other resource managers, graphs are an especially effective way of efficiently and persuasively conveying scientific information.

I received scientific graphs as Microsoft Excel files and transferred these graphs to Adobe Illustrator, where I reformatted, adapted, and edited them to visually comply with existing graphics, to separate data into discrete items to provide focus and clarity (when appropriate), and
to optimize the images for the Web. Figure 5 illustrates an example of a graph redesign. The original graph depicts data for both early and late anoxic conditions—I enhanced clarity and readability by focusing on one time period per graph. Additionally, I edited the graphs to comply with EcoCheck’s style guide by using specific color schemes, the Cronos Pro font, and other
graphic characteristics. I prepared these graphs, along with accompanying text and other graphics, for Web media without a print counterpart.

In support of this project, I also reviewed and edited Web text to ensure all data were relevant to the 2010 forecast using EcoCheck’s Web content management system. I completed all tasks related to this project between June 1 and 18, 2010.

**Shenandoah National Park Booklet**

Natural resource monitoring at Shenandoah National Park derives from the National Park Service’s (NPS’s) Inventory and Monitoring (I&M) Program, initiated in 1992. The Inventory portion of this program “documents the key features found within parks—for example, plant and animal species, air and water resources, and natural processes such as weather patterns and wildland fire frequencies”—while the Monitoring portion “documents changes in the condition of natural resources over time and the possible impact of threats on those resources.” Vital signs, “key indicators that measure the health of park resources,” are a significant component of monitoring initiatives. (Olsen et al., 2010, p. 2) They include the targets of weather and climate, wildlife behavior and effects, and native insect activity, which help document natural disturbances and processes such as flooding and drought, the foraging mechanisms of park animals, and native plant diseases.

Shenandoah National Park has a long-standing I&M Program with relatively ample data sets, unlike some of the smaller NPS parks. In order to continue facilitating sound and productive science, Shenandoah scientists feel the park must also support effective communication of that science to both park staff and visitors. Over two years in the making, the booklet *A conceptual basis for monitoring vital signs: Shenandoah National Park* “explains why the NPS undertakes natural resource monitoring at Shenandoah National Park and provides an explanation of the underlying reasons why particular vital signs have been selected for monitoring.” (Olsen et al., 2010, p. 3) (See Appendix 3 for the booklet’s draft cover.) IAN, which shares in the importance of the science–communication perspective, assisted with the booklet’s development.

To support this project, I used Adobe Photoshop, Illustrator, and InDesign to apply a near-final round of content edits presented by booklet authors. Because I entered this project late in its development, my tasks were focused on confirming the correctness and logical
organization of text and the completeness of graphics. While other science communicators worked to establish the booklet’s appropriateness and effectiveness as they related to audience and purpose, I focused on proofreading tasks such as eliminating errors and ensuring cohesion. In accomplishing these goals, I performed the following tasks:

- rewrote and refined text,
- formatted and integrated new photographs,
- edited and adapted existing conceptual diagrams,
- adjusted layout to accommodate adapted text and visual content, and
- performed other minor, miscellaneous proofreading tasks.

My edits were largely guided by project leaders, but I also applied previously unidentified edits to ensure technical correctness and completeness, such as within visual layout and sentence and paragraph structure and development.

I implemented all edits between June 2 and 14, 2010—but, as of the end of my internship, the booklet had yet additional review steps to undergo. Following my edit, a contracted copyeditor received the publication for a terminal review. Joanna Woerner, IAN Science Communicator and project manager, will complete a terminal design review before finalizing the booklet for print, expected to begin in fall 2010.

**Various Report Card Publications**

Report cards are a distinctive product of EcoCheck and its partners in the Mid-Atlantic Tributary Assessment Coalition (MTAC), including the Chester River Association, the Mogathy River Association, the Nanticoke Watershed Alliance, the Maryland Coastal Bays Program, and other groups associated with the Chesapeake and Maryland Coastal Bays and their tributary systems. EcoCheck has also worked with other non-MTAC clients, such as the Queensland Department of the Premier and Cabinet and Friends of Deep Creek Lake, to develop report cards of other regional watersheds. These report cards are detailed scientific assessments that are generally produced annually. They are … important outreach tools for generating community interest and increasing citizen understanding of ecosystem health, water quality, and watershed issues. Report cards can also be used to provide useful and timely information on environmental issues to local
decision-makers, and can highlight actions that residents can take to become involved in the improvement and protection of their communities.

(http://ian.umces.edu/pdfs/ecocheck_newsletter_267.pdf)

So while primary report card audiences are not scientists, these publications may still contain complex information, made accessible through presentation choices and visual deliveries. These publications are also intended to serve as a communication interface between scientific and non-scientific stakeholders, as civic and political interests guide the content of the report cards’ science as much as they respond to it.

To support report cards developed for the Maryland Coastal Bays, Great Barrier Reef, and Deep Creek Lake watersheds, I contributed my writing, editing, and design skills to various stages of the production of these publications. Further and more detailed information about these projects and my related tasks is presented in the following chapter of this report, and my experience developing conceptual diagrams for the Great Barrier Reef report card is discussed in Chapters 4 and 5 in more detail.
CHAPTER 3: An Overview of Report Card Publications and Associated Tasks

During my internship at EcoCheck, I worked in partnership with colleagues at IAN and clients at the Maryland Coastal Bays Program, the Queensland Department of the Premier and Cabinet, and Friends of Deep Creek Lake to help develop various report card publications. This chapter discusses three report cards in which I was involved: the Maryland Coastal Bays, Great Barrier Reef, and Deep Creek Lake report cards. These projects represented approximately 40% of my total internship time (represented in Figure 6) and are discussed in chronological order, according to start date.

Though report card indicators and thresholds may differ locally among these report cards’ regions depending upon “key ecological processes and … practical requirements such as data availability and geographic coverage,” every report card intends to meet the same objective of “provid[ing] a transparent, timely, and geographically detailed annual assessment” of its respective watershed’s health using like data definition, collection, and synthesis methods. (http://www.eco-check.org/reportcard/mcb/2009/) These efforts result in an assemblage of publications with local data and results that help resource managers (e.g., ecologists, outdoor recreation coordinators, policy makers, lobbyists, and other professionals who seek to balance the needs of people and the economy with an ecosystem’s capacity to sustain its natural components and functions) identify ecological patterns within and across larger watersheds. Report cards can also help private citizens understand how their actions influence ecosystem health and help scientists direct their research activities.

Maryland Coastal Bays Report Card

The Maryland Coastal Bays report card—a Maryland Coastal Bays Program client publication developed by EcoCheck—includes regional assessments of Assawoman Bay, St. Martin River, Isle of Wright Bay, Newport Bay, Sinepuxent Bay, and Chincoteague Bay, as well as an assessment of overall Maryland Coastal Bays health. (Figure 7 shows the cover page of the 2009
Coastal Bays report card.) These assessments are calculated using six ecological indicators that were chosen to complement priorities defined by the Maryland Coastal Bays Comprehensive Conservation and Management Plan (CCMP) (1999) for activities and research related to major problems challenging the overall health of the bays. Like the vital signs that measure the health of Shenandoah National Park’s resources (discussed in Chapter 2 of this report), the Coastal Bays indicators (chlorophyll $a$, dissolved oxygen, total nitrogen, total phosphorus, seagrass, and...
hard clams) provide direct insight into the CCMP’s goals and management solutions related to water quality, fish and wildlife, and other foci.

According to the report card Web site, “[h]ealth is defined as progress of the six indicators towards established scientifically derived ecological thresholds or goals. A low score therefore means that the region rarely meets the ecological threshold levels. A high score means that the region often meets the threshold levels.” (http://www.eco-check.org/reportcard/mcb/2009/)

High health scores—such as the 2009 scores for chlorophyll $a$ and total nitrogen in Sinepuxent Bay—are indicative of healthier ecosystems, where as low health scores—such as the 2009 scores for seagrass and hard clams in Newport Bay—help identify the location and nature of needed management actions.

These scores, combined with other report card elements (such as maps and “homework,” or suggestions for preserving and improving the health of these watersheds) are intended to help the publication meet the goal elements of science communication (identified by IAN as synthesis, visualization, and context) by providing an appropriately meaningful, informative, and effective product. Report cards are prepared for print media as letter fold brochures that supply informative and engaging overviews of the health assessments. They are distributed by EcoCheck to private citizens, resource managers, scientists, and other interested parties who have signed up for EcoCheck’s mailing list. They are also distributed at special events such as industry conferences, forums, and workshops. The Maryland Coastal Bays Program maintains its own distribution plan. Expanded information on the
assessments—including region rankings and summaries, indicator maps and rankings, discussions of methods—is available on EcoCheck’s Web site.

In support of the 2009 Maryland Coastal Bays report card, I edited the print brochure’s text and graphics, created a poster for the June 30 media release co-hosted by IAN and the Maryland Coastal Bays Program, and prepared the indicator threshold and threshold comparison maps for Web uploading. Existing audience, purpose, and style models influenced my efforts. Generally, I updated components of the 2008 report card to reflect 2009 data and syntheses. My limited influence on the project’s conception and direction was primarily due both to my late introduction to the project and to the project’s fast-approaching deadline.

Using multiple programs within Microsoft Office (Word and Excel) and Adobe Creative Suite (Photoshop, Illustrator, and InDesign), I edited photographs, captions, and acknowledgements and integrated new data into the brochure; updated the media release poster file and created comprehensive Illustrator letter-grade files for future report card projects; and prepared and uploaded indicator threshold and threshold comparison maps for the Web. These Web graphics, such as data maps that show median indicator levels at each station measured, provide empirical support for syntheses asserted in the report card. (Figure 8 depicts an example indicator threshold map.) Together with additional available information on station data and threshold levels, these graphs also intend to allow readers to draw their own conclusions about the collected data and its implications for the bays’ health.

![Coastal Bays Health 2009](image)

**Figure 8: Example indicator threshold map**
I completed all tasks between June 10 and 21, 2010, and the report card was officially released on June 30, 2010.

**Great Barrier Reef Report Card**

Report card publications have developed a respected reputation among watershed management organizations, both within and outside of the Chesapeake and Coastal Bays watersheds (which include portions of Maryland, Delaware, Virginia, Pennsylvania, New York, and West Virginia). Because of this industry reputation, as well as an existing professional relationship between IAN and partners in Australia, EcoCheck and IAN were invited to assist in the development of the baseline “paddock to reef” report card for the Great Barrier Reef (GBR) and catchment (i.e., drainage basin) regions, alongside the Queensland Department of Premier and Cabinet and various scientists. According to the IAN Web site, “the impetus for the report card is a result of the significant investments that the state and federal governments are putting into reef protection activities (AUD$200,000,000 each).” (http://ian.umces.edu/blog/) In 2003, the Australian and Queensland governments developed a Reef Water Quality Protection Plan that provides a management framework for maintaining and improving the quality of water entering reef areas from adjacent catchments. The plan, which was updated in 2009, addresses non-point source pollution from broad-scale land uses—which can include fertilizers and insecticides from agriculture, bacteria and nutrients from livestock, and sediment runoff from urban and construction sites. As a key action of the Reef Water Quality Protection Plan, the Paddock to Reef Integrated Monitoring, Modelling, and Reporting Program includes the production of an annual report card on reef water quality to help evaluate the progress, efficiency, and effectiveness of the Reef Plan objectives and actions.

The GBR report card (which, as of the end date of my internship, was still in development) will be organized around the GBR-wide region and six constituent reporting regions (north to south: Cape York, Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy, and Burnett Mary). The following key reporting attributes, as defined in an early technical report draft, form the publication’s assessment framework:

- Improved land management (e.g., agricultural and horticultural land use and effectiveness of improved management practices)
- Catchment indicators (e.g., riparian vegetation, wetlands extent, and groundcover)
- Catchment pollutant loads (e.g., suspended sediments, nutrients, and pesticides)
- Water quality and ecosystem health (e.g., flood plume extent, seagrasses, and corals)

These reporting attributes will provide direct insight into the Reef Plan’s goals and management solutions related to the reduction of pollutant loads, the rehabilitation and conservation of reef catchment areas, and other foci.

To support the GBR report card project, I developed conceptual diagrams of each of the six reporting regions and edited a conceptual diagram of the GBR-wide region. Conceptual diagrams, detailed discussions of which are presented in the following chapters of this report, are “visual elements [that] summarize and synthesize information in a widely understandable format.” (Dennison, 2007, p. 307) They are an ideal visual element for report cards both because of their informative and persuasive power and their accessibility for non-technical audiences, such as certain resource managers. Referencing notes and sketches drafted at a May 2010 workshop, I created diagrams using Adobe Illustrator and IAN’s symbol libraries (which can be accessed by the public at http://ian.umces.edu/symbols/) to show regional settings’ catchment, land use, and marine features. The resultant diagrams depict the essential “ecosystem features, environmental indicators, and major threats” that quickly and effectively communicate environmental status, thereby providing necessary context for the remaining report card. (Dennison, 2007, p. 307)

Figure 9 shows a draft conceptual diagram that I created for the Great Barrier Reef report card. It depicts the Mackay Whitsunday region, including its key ecosystem features (e.g., natural areas, continental islands), environmental indicators (e.g., seagrass, grazing/agricultural land use), and major threats (e.g., sediment, nutrient, and pesticide inputs). Together with text and other report card features, the conceptual diagram is intended to provide a visual context for understanding the link between ecosystem processes and the measures used in the ecosystem health assessment.

I completed all tasks between July 1 and August 27, 2010—but, as of my internship end date, the GBR report card was still under development: stateside communication staff were awaiting final synthesized key results data from participating scientists, and final text, conceptual diagrams, and publication layouts were awaiting completion. Project developers expect a winter 2010/2011 completion date.
Deep Creek Lake Report Card

Much like the Queensland Department of Premier and Cabinet, Friends of Deep Creek Lake is an example of an EcoCheck client working towards annual report card assessments of a water system outside of the Chesapeake and Coastal Bays watersheds. Having received a grant from the Chesapeake Bay Trust, EcoCheck—in partnership with Friends of Deep Creek Lake—gathered and interpreted data from sources such as the Center for Watershed Protection, Maryland Department of Natural Resources, and others for a baseline “state of the lake” report.

Like other report cards, the Deep Creek Lake publication intends to encourage engagement with environmental venues and efforts by improving community members’ understanding of the attributes that affect lake health. By accessibly and succinctly communicating relevant, focused information about Deep Creek Lake—regarding, for example, dissolved oxygen, temperature, and turbidity—the report card ultimately endeavors to foster civic efforts. These may include sustainable activities in one’s own home (e.g., buying energy-efficient light bulbs, minimizing household chemical use) and on larger community or political scales (e.g., getting involved in environmental monitoring through “citizen science” programs).

A forum held on August 7, 2010, and attended by EcoCheck representatives preceded the report card’s development. In preparation for this forum, I used Adobe InDesign to co-develop a mock layout of the Deep Creek Lake report card. Emulating the designs and styles of existing

Figure 9: GBR report card conceptual diagram draft
regional report cards (e.g., for the Chester, Patuxent, and Nanticoke Rivers), I drafted two mock layouts that showed how the same sets of data and discussions might be presented in different ways to highlight variable key points, depending upon data availability and syntheses. The purpose of these dummy layouts was to show general design, graphic, and textual directions for the final publication as an avenue to both solicit feedback from the client and to demonstrate need for certain types of additional data. These layouts were then adapted by Sara Powell into a final mock report card and populated with lake map drafts. (See Appendix 4 for a draft cover of the Deep Creek Lake report card.)

I completed my tasks related to the Deep Creek Lake report card between July 15 and 28, 2010. However—similar to the GBR report card—the Deep Creek Lake report card was still in an early working phase as of my internship end date: data were still being collected, and syntheses were still being made. Additionally, the project scope was redefined to include a long technical report, in addition to the four-page newsletter indicative of traditional report cards. Text, maps, charts, photographs, and other graphics associated with the final report were to follow completed data collections and syntheses, with an anticipated publication date of winter, early 2011.

**Report Cards Summary**

My contributions to the three report cards varied in size, schedule, and scope. Of my total internship time spent working on report card projects:

- 25% was dedicated to the Maryland Coastal Bays publication,
- 65% was dedicated to the GBR publication, and
- 10% was dedicated to the Deep Creek Lake publication.

Additionally, I joined the projects during various phases of development and executed accordingly differing tasks. The Maryland Coastal Bays report card was very near completion when I joined in its development process—I therefore provided editing support and helped prepare for the publication’s media release. In contrast, the GBR and Deep Creek Lake report cards were both in early development phases when I joined in their development processes. My creation of draft graphics and preparation of dummy layouts thus best suited these projects’ needs at their relative points of progress.
Like all of EcoCheck’s products, these three report cards employ visual communication displays, such as photographs, maps, charts, and conceptual diagrams, to tell their scientific stories and to make intellectual connections with their respective audiences. Their role in the public’s comprehension of environmental science and, therefore, in support of science literacy is presented in the following chapter of this report.
Science is complex and often, as with topics including climate change and evolution, politically charged. Storytellers of science—whether they are scientists, professional science communicators, the media, or other parties—therefore need to create narratives that are both accessible and situationally framed to suit their message and purpose, if they are to connect with and affect their intended audiences in an intended manner. If report cards are to help private citizens understand how their actions influence ecosystem health, for example, they must first use communication strategies (e.g., vocabulary, visual aids) that their intended audience understands. Report cards must also forge connections between the audience’s behaviors and the value of the discussed ecosystem if they are to influence those behaviors in positive ways.

Vital to the science storyteller’s toolbox, visual communication displays (VCDs) have the capacity to inform, engage, and elicit in ways “central, rather than peripheral, [to] the construction and communication of scientific knowledge,” because, in part, they “can convey highly complex information that is not readily conveyed in linguistic symbols.” (Arsenault, 2006, p. 377) For audiences with a learning capacity that is visually dominant, VCDs accommodate that aptitude. For audiences with a learning capacity that is linguistically dominant, VCDs supplement their communication experience.

VCDs, which include photographs, maps, charts, conceptual diagrams, and other types of graphics, are also particularly useful in communications among various stakeholder and interest groups (e.g., scientists and the general public, or members of different scientific industries with separate specialized knowledge sets). VCDs provide a common dialectical framework that can, in a sense, de-specialize—and broaden the accessibility of—complex scientific information. VCDs subsequently play an important role in the public’s science literacy.

This chapter discusses EcoCheck’s efforts to enhance science literacy via its integration of VCDs (in particular, conceptual diagrams) into its various communication products. After briefly defining the concept of science literacy, I discuss VCDs generally and conceptual diagrams specifically as pathways to “clearly powerful” science communication products.
Science Literacy in Context

What is science literacy—and why does it matter?

Ironically, the need for science literacy is often more easily agreed upon than the definition of science literacy. Brossard and Shanahan (2006, p. 48) have noted that both the scientific research and education industries identify “a scientifically literate population [as] needed for democratic processes to properly take place in a society that is more and more technologically demanding.” By possessing a working understanding of scientific terms, concepts, and issues, individuals and communities are better equipped to participate in those democratic processes. The capacity to engage in public discourse on science-related issues grows in importance as those issues become more prevalent in our daily lives. For example, the media, politics, classrooms, and other popular and academic venues show increasing interest in climate change. In order for the public to participate—say, by taking mitigating actions in their personal lives or by influencing the climate change policymaking process—then members of the public must first be literate about the topic.

But what makes a population scientifically literate? Science literacy may be generally described as “any specialized knowledge with a claim on the public’s attention and understanding.” (Paisley, 1998, p. 72) Upon further exploration, however, science literacy is as complicated a topic as the actual science disciplines to which it refers. There are numerous science disciplines: social sciences (e.g., anthropology, geography, psychology), natural sciences (e.g., biology, geology, chemistry), formal sciences (e.g., computer sciences, mathematics, systems science), and applied sciences (e.g., agriculture, engineering, health sciences). Whether a population requires literacy in all disciplines to be considered scientifically literate, or if single-discipline, specific literacy is sufficient, has not yet been definitively addressed. The interdisciplinary nature of many scientific issues (such as climate change, which draws from hydrology, geology, biology, physics, paleoclimatology, and countless other disciplines) further complicates the necessary scope of science literacy.

Further obscuring a definition of science literacy are the perspectives by which the public relates to a scientific concept or issue. Paisley has compiled “alternative schemata,” or varying perspectives, by which scientific information may be disseminated (Table 1). (p. 74) These schemata attempt to define science literacy. They do not, however, address whether single-discipline literacy is sufficient, and if so, which discipline best equips a population to engage in a
scientific issue. For instance, can a population be literate about climate change by understanding its effects on society, but without an awareness of how and why climate change research functions?

This extremely complex question regarding science literacy’s scope may be best answered within the context of relative need. As alluded to by Brossard and Shanahan, a population’s capacity to engage civically in scientific matters provides a measurable criterion for science literacy. If a population both possesses and uses scientific knowledge, then it is assumed to be scientifically literate. Though this perspective provides for a somewhat circular definition of science literacy, it nonetheless provides for a quantifiable definition of it.

Using Brossard and Shanahan’s definition as a framework, we can evaluate the rhetorical effectiveness of a publication within the context of science literacy. If a communications product, such as the Maryland Coastal Bays report card (see Chapter 3), intends to enable its readers “to help restore and protect the Coastal Bays,” then it may be considered a rhetorical success if its readers can use the information it contains to become involved in pertinent conservation and stewardship activities. (http://www.eco-check.org/reportcard/mcb/2009/) The publication’s readers may then also be considered scientifically literate of its subject content.

This interpretation of science literacy distinguishes between two separate, but equally important, questions:

- How do we determine or measure science literacy?
- How do we support or facilitate science literacy?
Though both questions are integral to dialogues on science literacy, the following discussions focus on supporting and facilitating science literacy because of its part in the creative (versus evaluative) process. It should be noted that EcoCheck has not yet established a formal system for assessing its publications’ rhetorical success, though it has recognized the need for product assessment and anticipates its development when resources such as funding and personnel become available.

**Visual Communication Displays in Science Communications**

Rhetoricians of science have, especially recently, acknowledged that photographs, maps, charts, conceptual diagrams, and other types of VCDs “constitute important rhetorical resources” and that their “making … is of the very essence of science.” (Arsenault, 2006, p. 418, 423) Graphics help not only to illustrate scientific terms, concepts, and issues, but also to construct knowledge upon which these terms, concepts, and issues are established. As an example, charts and graphs may reveal patterns concealed by isolated data, and photographs and maps may reveal relationships and correlated applications undisclosed by the communicative limitations of text alone. Gooding (2006, p. 42) has noted that “images convey directly features of experience that humans are biologically disposed to recognize as patterns … [and] generate new information about hidden structures and processes.” Hence, VCDs do not simply reduce the complexity of scientific information into manageable scope—they add elements that help readers interpret, complete, augment, and broaden existing knowledge sets.

The “revelatory power” of VCDs establishes an immutable “rhetorical potency,” making VCDs essential to environmental communications. (Arsenault, 2006, p. 379–380) As referred to previously, topics within the environmental sciences may be both complex and of bureaucratic interest—VCDs respond to these characteristics with their readability and, as it turns out, persuasiveness. The “evidential power” of VCDs is “especially suited to the task of convincing [readers] of the validity of one’s own viewpoint.” (379) Because sound, well-constructed graphics inform and facilitate knowledge creation that may not be possible for broader audiences with text alone, they act as authoritative tools within a communication. They inform and influence.
Environmental communications are greatly interested in identifying and encouraging conservation and restoration measures in concert with data syntheses. Therefore, rhetorically effective environmental communications must enable its scientifically literate readers to possess and use knowledge—but they must also do more. These communications must persuade their readers to use knowledge, to act, in a predefined manner. It is under this intent that EcoCheck designs its VCDs, with the understanding that these graphics must first spearhead science literacy among its readers before they can be moved to action.

**Conceptual Diagrams in EcoCheck Publications**

EcoCheck intends its many communication products for a diversity of resource manager audiences, including outdoor recreation coordinators, policy makers, lobbyists, and other professionals who seek to balance the needs of people and the economy with an ecosystem’s capacity to sustain its natural components and functions. Additional audiences include private citizens, who also possess the capacity to implement environmental management strategies on personalized and localized scales. Due to the dissimilarity in foundational knowledge sets among these various stakeholder and interest groups, EcoCheck’s communications products must narrow the gap between knowledge sets if they are to be effective—i.e., if they are to support a shared science literacy and thereby enable informed engagement in scientific matters, such as environmental science policy making processes.

VCDs provide leveled communication platforms for these various groups, because they draw on common human cognitive strengths of visual pattern recognition. (Gooding, 2006, 42) Visual representations of scientific facts and interpretations provide recognizable references that increase the degree of comprehension among intended readers. Conceptual diagrams, one type of VCD that “provide[s] diagrammatic representations of ecosystems in which key features and major impacts can be illustrated,” combine the elements of science communication (defined by IAN as synthesis, visualization, and context) with the intention to both inform and evoke. (Thomas, 2006, p. 47) This communication tool integrates visual elements (distinctive but inclusive symbols that express environmental processes) with textual elements (explanatory legends) into an autonomous VCD. Conceptual diagrams can incorporate large amounts of data into a contained, aggregated representation of synthesized environmental phenomena that build
upon visually recognizable elements and processes. When communicated within the larger context of a conceptual diagram, these symbols “link key ecosystem features, environmental indicators, and major threats.” (Dennison, 2007, 307) This visual communication experience is intended to enable science literacy, because it taps into both a collective intellectual process and familiar imagery in order to build new knowledge sets.

Accordingly, conceptual diagrams have become a foundational feature of IAN and EcoCheck products, including report cards, newsletters, books, and posters. The Science-to-Action booklets produced for client Conservation International provide a specific example. Science-to-Action, a partnership program led by Conservation International that is “dedicated to sustaining the health of coastal and marine ecosystems and the well-being of people who depend on them,” works to provide accessible and usable publications such as Marine Managed Areas: What, Why, and Where to managers, policy makers, and other issue stakeholders in Belize, Brazil, Fiji, Panama, the Galapagos Islands, and other locations. (Orbach, 2010, p. 16) Figure 10, which depicts a diagram from the booklet, provides an example: a succinct but information-rich definition of the goals of, and challenges facing, areas concerned with marine conservation. In “capturing the essence” of these goals and challenges, the diagram is intended to express, and provide access to, fundamental foci for successful management applications. (Arsenault, 2006, p. 382) Specifically, the diagram identifies the key ecosystem features (e.g., rivers, rain events) and environmental indicators (e.g., development, biohabitats) of both sustainable and unsustainable developments. By juxtaposing marine conservation efforts typical of sustainable development (e.g., sustainable agricultural that includes minimizing pesticide runoff, ecotourism) against major threats typical of unsustainable development (e.g., unsustainable agriculture such as palm oil plantations, unsustainable tourism development), the diagram pinpoints where management adoption practices are most needed.

This synthesis is visually and textually narrated, connecting the key ecosystem features, environmental indicators, and sustainable or unsustainable practices into a cause-and-effect process. For example, the conceptual diagram explains that unsustainable road construction may lead to the removal of trees and mangroves surrounding those roads. Without the protection of these and other types of vegetative buffers, rain events lead to increased pesticide runoff from unsustainable agriculture. Pesticide inputs reduce the water quality of rivers and other
Sustainable road construction includes locating roads further away from the coastline, constructing bridges to allow fish passage, and using plant buffers to reduce erosion of sediment into the water, resulting in smaller sediment plumes when it rains and clearer water. Sustainable agriculture includes minimizing sediment runoff, pesticide runoff, and land clearing. Encouraging ecotourism and homestay developments also helps to prevent erosion and maintain water quality. Sustainable fishing includes harvesting marine resources at levels that maintain species populations, are not destructive to habitat, and ensure the health of the larger ecosystem. These sustainable development principles help to protect livelihoods, traditional ways of life, and biodiversity.

Unsustainable road construction includes locating roads too close to the coast, blocking fish passage up and down rivers, and cutting down trees and mangroves surrounding the road, which leads to sediment runoff during rain events. Unsustainable mining practices include the operation of strip mines without plant buffers and without minesite rehabilitation. Unsustainable agriculture, typified by palm oil plantations, includes destruction of natural habitat to create farmlands as well as sediment and pesticide runoff leading to reduced water quality. Unsustainable tourism developments, which include placing developments too close to the shoreline, destroying mangroves to create land for development, and dumping improperly treated waste in the ocean, increase erosion, reduce water quality, and destroy critical habitat. Unsustainable and destructive fishing practices, including harvesting at levels that deplete species populations or using methods that damage habitats, jeopardize fish stocks and the health of the larger ecosystem. These unsustainable practices lead to a highly degraded ecosystem, which leads to reduced livelihood opportunities and losses in traditional ways of life.

Figure 10: Example conceptual diagram comparing sustainable and unsustainable development practices (Orbach, 2010, p. 3)
surrounding marine environments, which harms the waters’ biodiversity. A degraded fishery negatively impacts traditional ways of sustenance, and therefore livelihood.

The conceptual diagram is intended to stimulate an active response through a visual understanding of current unsustainable processes and possible sustainable processes, thus enabling and encouraging participation in conservation efforts. In this way, the conceptual diagram endeavors toward aligning the understanding, perception, and objectives of product developers (e.g., Conservation International, contributing scientists) and product consumers (e.g., resource managers, policy makers). Its value lies within its ability to serve a functionally blended scientific–management purpose: “to identify gaps in research and knowledge, establish priorities, and solicit an agreed synthesis.” (Thomas, 2006, p. 47, 51) Ultimately, the diagram serves a generative role in the readers’ understanding of the subject matter by stimulating a visual engagement that might otherwise be difficult, or even unlikely, via textual elements exclusively.

Because science literacy is necessary for informed civic engagement in scientific issues such as coastal and marine management, and because VCDs are recognized as “important rhetorical resources” that contribute to science literacy due to their readability and persuasiveness, conceptual diagrams are valuable communication tools. Together with other publication elements including photographs, maps, charts, and text, conceptual diagrams build concept and issue comprehension among readers to strengthen their science literacy on relevant topics. Through understandings, perceptions, and objectives shared with scientists and publication developers, intended readers should be encouraged to alter management adoption practices for beneficial ecosystem results.
CHAPTER 5: A Brief Reflection of My Internship and the “Rhetorical Potency” of Conceptual Diagrams

As a science communication intern at Chesapeake EcoCheck, I provided writing, editing, and design support and leadership to a variety of communication projects. In addition to the projects discussed in this report (Adobe InDesign documentation; the Chesapeake Bay summer forecast; the Shenandoah National Park booklet; and the Coastal Bays, Great Barrier Reef, and Deep Creek Lake report cards), I also contributed to the 2009 Chesapeake Bay report card, the 2010 Blue Crab Status report, and the Ecosystem-Based Fisheries Management newsletter (development of which has been suspended as of my internship’s end date). Each of the projects I encountered during the course of my internship demanded that I quickly assimilate into my internship provider’s overall working context by learning new communication tools and scientific information relevant to the development and creation of EcoCheck’s products. Specifically, I needed to assume a functional understanding of Adobe Illustrator and environmental health topics—such as the role of dissolved oxygen in the ecological health of the Chesapeake Bay, the role of vital signs in natural resource monitoring at Shenandoah National Park, and the role of land management practices in the ecological health of the Great Barrier Reef—to impart meaningful communications support. These were tools and information I had not encountered prior to my time at EcoCheck.

EcoCheck also introduced me to conceptual diagrams, which I have come to understand as uniquely compelling communication tools that attract, inform, and affect readers in rhetorically economic ways. They reduce both the amount of publication space dedicated to them (as compared to language-based explanations) and amount of time necessary to impress their message upon readers. By providing for a common dialectical framework, and as part of a larger publication package (e.g., newsletter, poster, report, book, brochure), conceptual diagrams have the power to support and engage a scientifically literate population.

The process of conceptualizing key ecosystem features, environmental indicators, and major threats—i.e., of developing conceptual diagrams—is collaborative in nature. The first stage of developing diagrams for the Great Barrier Reef (GBR) report card, for example,
consisted of a workshop held in Brisbane, Australia, during the first week of my internship. (See Chapter 3.) Though I did not attend, other IAN and EcoCheck communicators did facilitate the workshop, which was organized by the Queensland Department of Premier and Cabinet. Together with contributing scientists and other stakeholder parties, workshop facilitators and organizers sketched out the conceptual framework for the report card and accompanying technical report. The components of the diagrams were defined so as to visually assist in assessing the progress, efficiency, and effectiveness of the Reef Water Quality Protection Plan’s objectives and actions. They were also defined by local communities’ values and, therefore, did vary some among each of the six constituent reporting regions (north to south: Cape York, Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy, and Burnett Mary). Example components of the Cape York region included continental islands and mangrove habitats (i.e., key ecosystem features), seagrass and grazing/agricultural land use (i.e., environmental indicators), and sediment, nutrient, and pesticide inputs (i.e., major threats).

I received copies of workshop notes and sketches and used them to create digital conceptual diagrams in Adobe Illustrator. I began with a generic ecosystem base, depicted in Figure 11, that generally represents the paddock, catchment, and reef sections of all regions and that could be easily manipulated to show unique regional features. An IAN communicator created the generic base previously, and I accessed it from IAN’s internal symbol library. I then identified existing symbols in IAN’s internal library and, when necessary, created new symbols

![Figure 11: Generic base for GBR conceptual diagrams](image-url)
to represent the defined key ecosystem features, environmental indicators, and major threats of each region. Figure 12 illustrates examples of the symbols included in the Cape York region.

Much like the Conservation International diagram discussed in Chapter 4, I then developed a threaded narrative that combined visual and textual elements to communicate a synthesis of process, represented in Figure 13. For example, the conceptual diagram explains that horticulture is a source of nutrient and pesticide inputs. These inputs are delivered to offshore portions of the reef in pulsed flows as a result of occasional cyclones and summer-dominated rainfall. High nutrient and pesticide levels negatively affect the health of these reefs. The health of offshore reefs is important to the regional economy, because the reefs are sources of tourism and commercial and recreational fisheries. In concert with other elements of the report card, readers come to understand that excess nutrients and pesticides from unsustainable agricultural practices degrade the reef ecosystem. In order to protect the reef and related economic activities, local communities need to identify ways to decrease nutrient and pesticide inputs from major sources such as agricultural practices. By understanding this process, readers also understand why management and policy decisions are made, and why the success of those decisions is vital to the health of the ecosystem and the economy.

Participating in the development of conceptual diagrams has helped me appreciate the complexity and interconnectedness of terms, concepts, and issues that are the focus of environmental communication. Through the conceptualization of key features, environmental indicators, and major threats of an ecosystem, I have more effectively communicated the definitions and implications of environmental processes and concerns within various EcoCheck

![Mangrove habitat, Seagrass, Pesticide inputs](image)

*Figure 12: Example symbols from the Cape York conceptual diagram*
products. As part of larger assessment projects, conceptualizing helps direct research activities by identifying where additional data is needed, and helps establish a focus for management efforts.

Ultimately, my internship has helped me to appreciate the relationships between populations and their marine environments, but also the relationships between communicators. We are members of a common community: a general community of environmental residents, and a categorical community of science communicators. As part of those communities, we have a responsibility to share and help expand knowledge as it relates to the health of our ecosystems and our skills and capabilities as communication professionals. I believe that IAN and EcoCheck accomplish both of these objectives through its publications, programs, and resources.

Figure 13: Cape York conceptual diagram draft from GBR report card
References


**Acronyms**

CBL – Chesapeake Biological Laboratory  
CBP – Chesapeake Bay Program  
CCMP – Comprehensive Conservation and Management Plan  
COL – Cooperative Oxford Laboratory  
GBR – Great Barrier Reef  
I&M – Inventory and Monitoring  
IAN – Integration and Application Network  
JHU – Johns Hopkins University  
MSG – Maryland Sea Grant  
MTAC – Mid-Atlantic Assessment Coalition  
MTSC – Master’s of Technical and Scientific Communication  
NCBO – NOAA Chesapeake Bay Office  
NMFS – National Marine Fisheries Service  
NOAA – National Oceanic and Atmospheric Administration  
NPS – National Park Service  
UMCES – University of Maryland Center for Environmental Science  
USM – University System of Maryland  
VCD – visual communication displays
APPENDIX 1: Science Communication Course Flyer

From the Integration & Application Network (IAN)
University of Maryland Center for Environmental Science (UMCES)

COMMUNICATING SCIENCE EFFECTIVELY

A Science Communication Course

This three-day course (Day 3 optional) provides participants with a science communication toolbox for effectively communicating their data. At the end of the course, participants will have been introduced to the principles of effective science communication, used hands-on sessions to create their own science communication products (symbols, conceptual diagrams, presentations, newsletters, posters), and gained experience using the IAN Symbol Libraries, MS Powerpoint, Adobe Illustrator, and Adobe InDesign.

Agenda

Conceptualization: the tools of effective science communication
- learn Adobe Illustrator to create conceptual diagrams

Presentations: the art of effective science communication
- learn MS PowerPoint tips and tricks

Publications: the principles of layout and design
- learn Adobe InDesign to create a storyboard

Mass Communication: engaging the community

Integration: the principles of integrated assessment
- learn how to create a report card

Course Requirements

Course participants MUST come to the course with their own computer with the following software already loaded and configured (free trial versions available - see below):

Computer Hardware
- Computer (laptop or desktop) with a network card (wired or wireless)
- Computer mouse (not laptop touchpad)

Computer Software
- PowerPoint 2000+, Adobe Illustrator 10+, Adobe Photoshop 6+, Adobe InDesign CS+

If you do not already have the software, please download free trial versions (www.adobe.com/downloads) in mid April as they are only valid for 30 days!

- IAN Symbol Libraries
If you do not already have the IAN symbol libraries, please download them for free from ian.umces.edu/symbols/

Please make sure that you have properly installed and tested all these programs well before the course.

Questions? Problems?
Contact us at ian@umces.edu

Registration and More Information:
Visit ian.umces.edu/5course/

For more information about the Integration & Application Network (IAN) at the University of Maryland Center for Environmental Science, visit:
www.ian.umces.edu
Navigating Adobe InDesign: An Introductory Guide
This guide is intended for use by participants of the Communicating Science Effectively course, presented by the Integration and Application Network (IAN) at the University of Maryland Center for Environmental Science (UMCES). Visit http://ian.umces.edu for more information.

Getting Started

1. Open Adobe InDesign.
   - An introductory dialog box will open with the program.

2. Select “Don’t show again” in the lower left-hand corner of the dialog box.

3. Click the “X” in the upper right-hand corner to close the dialog box.

4. Click Edit > Preferences > Units and Increments.

5. Select preferences for Ruler Units > Horizontal and Vertical (e.g., points, inches, centimeters).
APPENDIX 3: Draft Cover of Shenandoah National Park Booklet

A Conceptual Basis For Monitoring Vital Signs: Shenandoah National Park