

INTERNET-BASED COMMUNICATION TOOLS FOR DISSEMINATION OF INFORMATION ON HARMFUL ALGAL BLOOMS (HABS)

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ABSTRACT

An important aspect of harmful algal bloom (HAB) management is the dissemination of information among managers, between managers and the public, or among managers, the public and researchers. The Internet can be an important tool in this process. There are several different types of websites and Internet resources available to the HAB community, with different communication objectives. This paper describes these Internet-based communication tools and highlights their benefits as well as the difficulties, both technical and political, involved in establishing and maintaining them.

WEBSITES

There are a wide variety of websites devoted to HAB research, monitoring and outreach. In designing a website, managers should consider their key audience(s) and tailor the site contents to these groups. As maintenance and update can take a significant amount of time and resources, it is best to start small and build from there as time permits. It is also advisable to periodically evaluate the site's effectiveness – this can easily be done by inviting comments from site visitors through an automatic e-mail form. In this section, we provide examples of three different types of websites – all applicable to the dissemination of information on HABs.

Harmful Algae Website

The Harmful Algae website (<http://www.whoi.edu/redtide>) is maintained by the U.S. National Office for Harmful Algae and Marine Biotoxins. The primary objective of this site is to serve as a comprehensive resource for a broad range of user groups, including scientists, managers, the general public, journalists, and students. Although there are many HAB-related websites in the U.S., this is the only one that deals with the entire range of U.S. HAB problems and provides access to information on national HAB research programs. This is an example of a comprehensive, national website that could be used as a template for other national or regional websites.

The Harmful Algae page provides details on such topics as:

- U.S. HAB species and their impacts - links to additional information and images;
- human health problems associated with HABs - including information on their diagnosis and treatment;
- maps depicting the distribution of HABs in the U.S.;

- news articles of HAB events in the U.S. and foreign waters;
- funding and conference announcements;
- useful references;
- links to electronic versions of several science plans, reports, and other resource materials; and
- links to many related websites.

The webpage's primary focus is on HABs in the U.S., but information about HABs in foreign waters is included as well – for example – posting of events in the news media, and links to the Intergovernmental Oceanographic Commission (IOC) world maps depicting the distribution of HABs.

Researchers and managers view the Harmful Algae webpage as a central repository for information about HABs in the U.S. [1]. Many reports and national plans are posted here (in html and PDF format) such as: the *U.S. National Plan for Marine Biotoxins and Harmful Algae* [2]; *The Ecology and Oceanography of Harmful Algal Blooms: A National Research Agenda* [3]; and *Estimated Annual Economic Impacts from Harmful Algal Blooms (HABs) in the United States* [4]. Many questions are answered from individuals accessing this site – students seeking help with their science projects or reports, journalists looking for HAB images they can use in their articles, and concerned individuals when a toxic event occurs.

The Harmful Algae webpage is updated and revised as new information is obtained and as feedback is received from those who utilize the website. One such area worth discussing relates to the news articles posted on HAB events in the U.S. and foreign waters. These articles present a useful picture of how particular events are presented in the media and thus viewed by the general public. Ideally, news articles would be reviewed before being posted to decide if the science being reported was sound and the reporter was correct; however, the breadth of scientific expertise required for this oversight exceeds the capabilities and time commitments of most webmasters. Although a disclaimer is included on the front page of the news articles section of the site, some readers thought that posting of articles conveyed the message that the National Office approved and endorsed those articles. The *Pfiesteria* Working Group (see below) had a constructive discussion about this issue and recommended that the disclaimer be strengthened and that it include a suggestion that readers seek information from other sources. The statement reads as follows: "The purpose of this section of our website is to provide access to HAB-related articles as they are being presented in the media. Posting these articles on this site does not mean, in any sense, that we endorse them."

Please use judgment in quoting or referring to any of the information posted here and seek out other sources (scientists, journalists) to get a more complete picture.” The disclaimer is also posted on each of the individual articles. It reads: “Disclaimer: These postings were sent to us from a variety of media sources over the Internet. The content has not been reviewed for scientific accuracy or edited in any manner.”

Despite this effort to be objective, not all articles on HABs are posted. News articles viewed as “personal attacks”, sensationalistic or unprofessional are rejected.

Pfiesteria Technical Website

A second type of website is a technical website used to exchange information on a particular subject, among scientists and managers, rather than the general public. An example of such a website, is the *Pfiesteria* Technical Website (<http://www.whoi.edu/redtide/pfiesteria>). This website was used for several years by U.S. federal and state agencies and academic researchers involved in monitoring and/or research on *Pfiesteria* and *Pfiesteria*-like organisms (PLO's), but is no longer updated or maintained due to a decrease in *Pfiesteria* monitoring activities and reduced funding. A 'working group' communicated regularly via monthly conference calls to share information about ongoing monitoring efforts for *Pfiesteria* [5, 6, 7]. This webpage was initially created for use by the *Pfiesteria* Working Group and all information on the site had to meet the group's approval in advance of posting. The site was used as a repository for analytical and monitoring protocols, a glossary of *Pfiesteria*-related terms, molecular information on PLO's, workshop reports, reference lists, fact sheets, etc. This was not a public webpage, but it was not password-protected or restricted in any way, although that certainly would have been possible.

The *Pfiesteria* Technical website served as a central location for individuals directly involved in *Pfiesteria* research and/or monitoring to find the information described above. This provides an example of a technical webpage that is relatively easy to update and maintain. In short, it served the needs of a specific working group and did not need to address the issues of interest to a wider and more diverse audience.

Project-Based Websites

Two examples of project-based websites are the ECOHAB-Gulf of Maine site (<http://www.whoi.edu/ecohab>) and the ECOHAB-Florida site (http://www.floridamarine.org/features/category_sub.asp?id=1918). These sites provide information on the status of each research program, the ECOHAB – Gulf of Maine and ECOHAB - Florida. The sites are designed primarily for use by the researchers and managers involved in the ECOHAB (The Ecology and Oceanography of Harmful Algal Blooms) program. Project data are posted on each page once they become available so all investigators can have easy and prompt access. The status of data analysis

and model development is provided as well as workshop announcements, reports, etc.

The ECOHAB-GOM page has a password protected ftp site for exchanging files among the researchers and funding agencies. Understandably, project researchers are concerned about losing control of their data before they are able to publish it – the restricted section of the site addresses this potential problem.

These examples illustrate the use of webpages by research groups - however, once those programs are completed, the webpages may not remain active or be updated.

Other HAB-Related Websites

Table 1 provides information on the key elements of several relevant HAB websites. There is a wealth of information on the Internet; however, it is often scattered and it can be difficult to locate reliable sites. Although not a complete list, those sites included in the table are updated regularly and should serve as a useful resource to individuals, managers and researchers working on HABs.

The Bigelow Laboratory site provides useful information on many aspects of HABs and toxin syndromes, but presents it in a format that should prove especially helpful for students. The site includes many images and graphics, and utilizes mouse 'rollovers' to link to additional sites and information. The Florida Fish and Wildlife Conservation Commission site is extensive and provides up-to-date information on red tides in Florida as well as current HAB events in the news. A useful HAB glossary is also included on this site. The IOC website provides access to several databases, including an International Directory of HAB experts; a bibliographic database; decadal maps of HAB events in the North Atlantic; and access to HAEDAT (Harmful Algae Event Database). These selected sites were highlighted since they provide good examples of HAB-related webpages that “work” – in that they provide useful, updated information in a user-friendly manner. Those intending to set up their own webpages for HAB information might benefit by closely examining these pages. Several other sites in Table 1 are also useful, informative sites; however, they could not all be described in detail here.

INTERNET LISTSERVERS

A very useful communication tool is an Internet listserver, allowing rapid communication among subscribers about a particular topic. Announcements, information, and questions can be sent quickly to a large list. Listservers may be public (e.g., the Phycotoxins list), open to members (e.g., International Society for the Study of Harmful Algae (ISSHA) list), or restricted (e.g., the *Pfiesteria* listserver). Before being added to the *Pfiesteria* listserver, approval must be obtained by an appropriate federal or state agency. Listservers may also have a webpage associated with them, whereby all messages are archived, allowing for searches by topic.

Table 1. Selected websites with HAB-related information (in alphabetical order):

URL	Sponsored by/site name	Key elements
http://www.red-tide.org/new_site/html_index.html	Association on Harmful Algal Blooms in the South China Sea (AoHABSCS)	HAB database; images of red tide causative organisms in the South China Sea
http://cgca.rncan.gc.ca/pubprod/dinoflaj/index_e.php	Bedford Institute of Oceanography/ DINOFLAJ, Dinoflagellate Classification Database	Database system containing a current classification of fossil and living dinoflagellates down to generic rank, and an index of fossil dinoflagellates at generic, specific, and infraspecific ranks.
http://www.bigelow.org/hab	The Bigelow Laboratory for Ocean Sciences, Maine, US/Toxic and Harmful Algal Blooms	Impacts and human health problems associated with HABs; food web paths; maps of affected areas in the U.S.; toxin structures
http://www.cawthron.org.nz/harmful_algal_blooms.htm	Cawthron Institute, New Zealand	General background information on phytoplankton and harmful algal blooms; use of molecular probes for toxin detection; ongoing research
http://www.china-hab.ac.cn/english/	China Harmful Algal Bloom Page	Frequently asked questions; occurrences in China; ongoing HAB research programs in China; information on HAB organisms found in China
http://www.floridamarine.org/features/default.asp?id=1018	Florida Fish and Wildlife Conservation Commission/Florida Marine Research Institute	Florida HAB information and status; historical red tide information in Florida
http://www.cbr.nrc.ca/isssha	The International Society for the Study of Harmful Algae (ISSHA)	Numerous links to other sites with HAB information; journals that publish HAB articles
http://www.issc.org/	Interstate Shellfish Sanitation Conference	U.S. organization - resource with shellfish sanitation information, including marine biotoxins
http://www.oceanportal.org	IOC/Ocean Portal	Search tool for ocean data and information – access to over 3000 websites and indexed files
http://www.ioc.unesco.org/hab/	IOC Harmful Algal Bloom Programme	Introduction to HABs and their impacts; causative organisms; International Directory of Experts on Harmful Algae; Harmful Algae Event Database; Decadal maps of HAB occurrences in the North Atlantic; Information on training courses on harmful algae; Harmful Algae News
http://www.marine.ie	Marine Institute – Ireland	Information on the Irish monitoring program for shellfish toxins; instructions for collecting samples; causative organisms – locations, images, maps;
http://www.mote.org/~mhenry/WR_EDTIDE.phtml	Mote Marine Laboratory Red Tide Information page	Information on red tide in Florida including latest updates on outbreaks
http://www.nwfsc.noaa.gov/hab/	Northwest Fisheries Science Center/Marine Biotoxins and Harmful Algal Blooms	U.S. West Coast HAB problems; bibliographies; background information on phytoplankton and harmful algae; detection of toxins in seawater; methods of analysis; current research
http://www.pfiesteria.org/	North Carolina State University Aquatic Botany Laboratory Website	Information on <i>Pfiesteria</i> : life cycle information; human health impacts; ongoing research; bibliography; abstracts; image archive

http://megasun.BCH.UMontreal.CA/protists/	Protist Image Data Website	Pictures and information on selected genera of algae and protozoa; links to several protist databases
http://ccmp.bigelow.org/	Provasoli – Guillard National Center for Culture of Marine Phytoplankton (CCMP)	Information on culturing of marine phytoplankton; database of phytoplankton cultures
http://www.start1.com/	START (Solutions to Avoid Red Tide)	Non-profit citizen's organization - information on red tide conditions, impacts in Florida and current research programs
http://www.tpwd.state.tx.us/hab/	Texas Parks and Wildlife Red Tide page	Red tide FAQs and updates on conditions in Texas; information on red tide and "golden algae" blooms – caused by <i>Prymnesium parvum</i>
http://www.geo.ucalgary.ca/~macrae/palynology/dinoflagellates/dinoflagellates.html	University of Calgary/ Dinoflagellate Page	Information and images of dinoflagellates, including: basic anatomy, biology and life cycle, classification, cyst structure and fossil record
http://www.rsmas.miami.edu/groups/niehs/science/toxins.jsp	University of Miami, Marine and Freshwater Biomedical Sciences Center	Background on marine biotoxins including: clinical presentation; diagnosis; management and treatment; chemical structure; molecular mechanism of action; references and sites
http://vm.cfsan.fda.gov/~mow/intro.html	U.S. Food and Drug Administration/Bad Bug Book	Information on shellfish toxins and ciguatera fish poisoning
http://www.who.edu/redtide	U.S. National Office for Marine Biotoxins and Harmful Algal Blooms/Harmful Algae Page	HAB information including photographs of various HAB organisms, blooms, and impacts; human health problems and information on diagnosis and treatment; national program documents and reports; many links to other HAB resources; maps depicting the distribution of HABs

The Phycotoxins listserver is used for reporting significant HAB events and for discussions of bloom dynamics, taxonomy, laboratory techniques. It is also used extensively for announcing relevant conferences and workshops. Individuals wishing to subscribe to the Phycotoxins listserver may find the relevant information at this website: <http://www.agr.gc.ca/archives/phycotoxins.html>.

ISSHA's mandate is to "promote and foster research and training programs on harmful algae, and to co-sponsor meetings on this topic at the national, regional, and international level." New members of ISSHA are automatically added to the mail server. The following website provides the information necessary to join ISSHA:

http://www.cbr.nrc.ca/issaha/New_ISSHA/Member_info.html.

One area deserving careful consideration when setting up a listserver is the handling of replies. When the *Pfiesteria* listserver was initially set up, replies were automatically sent to every subscriber on the list. In principle, this was a good idea, since everyone would have the opportunity to see the replies and would benefit from discussions involving others. Problems arose, however, with individuals who were away or on vacation and had set up an automatic reply on their e-mail account.

These e-mails were automatically sent to the whole list, generating a continuous loop of e-mail replies from the vacationing subscriber that filled everyone's mailboxes. Filters can be used to identify and isolate these type of automatic messages – using key words such as "vacation", "away", "automatic", etc., but since each message is unique, it is impossible to filter them all. Another option is to have all e-mails go through a moderator before posting to the list, but that requires constant monitoring. The final option is to set up the listserver so that replies go to the sender only. This means that the replier has to consciously address the e-mail to the whole list if he or she wishes broader communication. This method is currently used on the *Pfiesteria* listserver as well as the Phycotoxins listserver.

SUMMARY

Several types of Internet communication tools are available for disseminating information on HABs, ranging from basic websites providing general information to sophisticated, interactive sites. Depending on the need and desired audience, Internet websites and listservers may be completely open and unrestricted, partially restricted or password-protected, or completely restricted. Since no resource can serve all needs,

managers should give careful consideration to their target audience and objective before setting up a website or listserver. Additionally, they should periodically review these objectives to determine if they are still being met and to make any necessary revisions or updates to their communications resources. Individuals accessing these resources should seek information from multiple sources as the depth and focus of web sites can differ significantly.

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