Show Us The Databases: Rethinking access to marine science information

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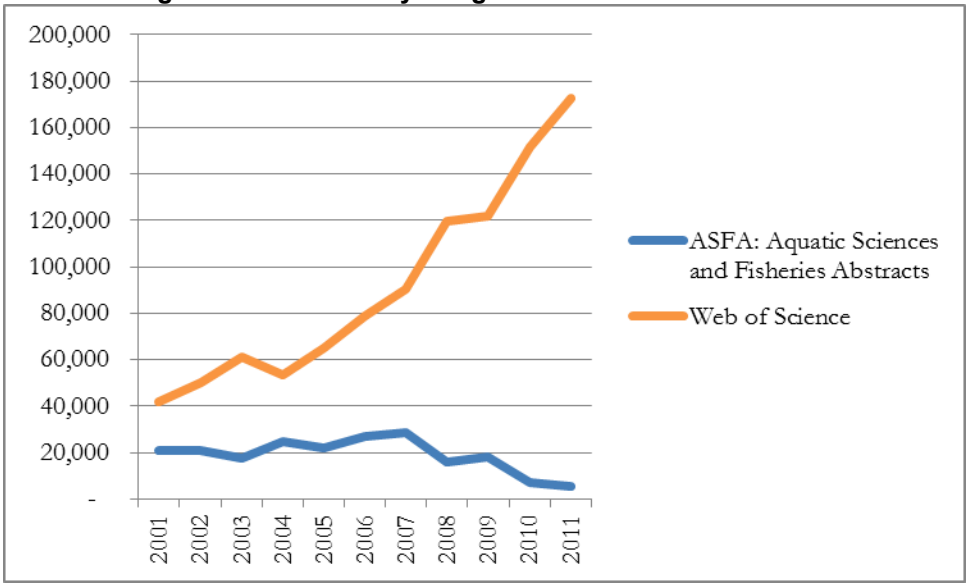
Abstract:
As IAMSLIC members will recall, in 1990 Stephanie Haas questioned ASFA's supremacy in marine science libraries and found "potential pitfalls" if relying on a single database to adequately discover the relevant literature (Haas 1990). We still question the best way to access the literature in our multidisciplinary field. Patrons and librarians want tools that are efficient, current and easy to use. We know libraries can no longer afford to purchase core journal collections (Webster and Butler, 2011) and now we ask if we can still afford the best access tools. We used a modified version of the Hass research methodology to compare the timeliness and completeness with which Aquatic Sciences and Fisheries Abstracts (ASFA), Fish, Fisheries & Aquatic Biodiversity Worldwide (FFABW), Google Scholar, Scopus and Web of Science (WOS) tracked the literature. We developed a list of journal titles for the disciplines of fisheries, marine biology and oceanography from our earlier work (Webster and Butler, 2011a) and the *Marine Science and Technology* section of Magazines for Libraries (Webster and Butler, 2011b). We report our findings on the currency of each tool as well as other issues that arose in navigating the current marine science information landscape.

Introduction:
With shrinking budgets, where do you invest your library resources, how do you evaluate various resources and what do you recommend to your patrons? IAMSLIC members have studied and compared various resources through the years (Brown 2006; Brueggeman 1993; Crampton and McPhail 1998; Fuseler 1995; Haas 1990; Haas et. al 1997; Hooper-Lane and Atkins 1996; Markham 1992; and Parker 2005). These studies ranged from oceanography to freshwater to marine biology-related resources and often compared databases available on CD-ROMs. We have come a long way since Stephanie Haas asked how comprehensive ASFA, Wildlife & Fisheries Worldwide (WFW) and Selected Water Resources Abstracts (SWRA) were in terms of covering the core journals in fisheries, limnology, oceanography and marine and freshwater biology. Today we wonder how comprehensive the databases are, how quickly they provide access to the literature given the explosion of articles appearing online in advance of a published journal issue (print or electronic), henceforth referred to as early-online, and what parts of the information landscape they cover.

Are the tools (databases and search engines) we use to navigate this landscape up-to-date? Is Google Scholar, a search engine, an adequate and free replacement for the indices (e.g. ASFA, FFABW or WOS)? More often than not, Google or Google Scholar is the first place our researchers and students search. As librarians, we appreciate the precision of a search within the indexes -- relevant results that usually are not too overwhelming in number. These tools appeal to our sense of logic and provide a path through the information landscape. Students who do not know this path use the simplest and most accessible tool to navigate: Google or Google Scholar. Researchers also use Google Scholar, but often in conjunction with a more specialized index they have used previously. Informal surveys at our institutions validate this impression. Our user data shows that patrons are using broader tools, e.g. WOS,

rather than the specialized subject-based options such as ASFA (Chart 1). At a time when the numbers of potential users are increasing at both Oregon State University and University of Oregon, we would expect usage of all tools to increase. Recent studies focus on citation metrics (Jacsó 2011a, 2011b) or subject coverage in other disciplines (Mikki 2010). Vieira and Gomes compared Scopus and WOS from a university perspective and mentioned Google Scholar as another possible resource (2009). We thought it was time to take another look at the tools we use in the marine and aquatic field.

Chart 1: Oregon State University Usage of ASFA and WOS 2001-2011



Methods:
We examined the timeliness and the completeness with which each of the databases indexed the core journals in fisheries, marine biology and oceanography, noting the number of months of lag if the most recent issue was not represented. We chose core journal lists from the *Marine Science and Technology* section of Magazines for Libraries (Webster and Butler, 2011b) and previous work shared with IAMSLIC (Webster and Butler, 2011a). We visited journal websites to download table of contents for the most recently published issue as of June 27, 2012. We then searched ASFA, FFABW, Google Scholar, Scopus and WOS for each of these issues and compared that with the journal websites to determine the number of months the tools take to incorporate the most recently published issue and also checked to see if each tool covered the entire contents of the issue. Typically, we searched by journal title and date of publication, and sometimes made use of the ISSN. We also checked to see if the early-online articles were indexed by the tools.

We surveyed a few journal editors to learn how each journal is handling pre-published articles (early-online) and citing patterns for articles having nothing but a DOI (digital object identifier). The definition of what is "published" is rapidly evolving, and yet still limited by the print issue model. We also looked at the value added qualities of the various tools. We attempted to resolve the question, "Are we using, recommending and buying the right tools for navigating the information highway?"

Timeliness:
The results we present regarding timeliness involves only the most recently published issue and not the early-online content. Table 1 shows the results for the fisheries titles. The darkest blue indicates the timeliest database for each title and the resulting ranking from fastest to slowest (light blue): Google Scholar, Scopus, WOS, ASFA, and FFABW. Incomplete or non-coverage had no highlighting. This same pattern is used to describe the marine biology (Table 2) and oceanography results (Table 3) as well.

While there is some variation among the subject areas, in general, Google Scholar is best for timely coverage. This is probably because Google Scholar 'scrapes' the publishers' web site for content rather than waiting for the publishers to send subject matter. While the later method assures quality of data, it appears to be limited to what is traditionally considered published (i.e. not early-online) and can lead to a lag in the appearance of citations in the database or tool.

Table 1: Fisheries Journals: Months between most recently indexed and most recently published issues (x = not covered, * = incomplete but current, # - months lag)

Titles	Google Scholar	SCOPUS	WOS	ASFA	FFBAW
American Fisheries Society. Transactions	0	0	2	16	14
Aquaculture	0	0	1	1	10
Canadian Journal of Fisheries and Aquatic Science	0	*	2	2	14
Environmental Biology of Fishes	0	0	0	2	11
Fish and Fisheries	0	0	0	0	9
Fisheries	0	1	1	10	23
Fisheries Management and Ecology	0	0	0	3	18
Fisheries Oceanography	0	12	12	2	3
Fisheries Research	0	*	1	0	12
Fishery Bulletin	0	0	0	0	18
Journal of Shellfish Research	*	0	0	17	24
Marine and Coastal Fisheries	*	X	6	6	30
Marine Fisheries Review	3	X	X	3	25
Reviews in Fish Biology and Fisheries	0	0	0	0	14

Table 2: Marine Biology Journals: Months between most recently indexed and most recently published issues (x = not covered, * = incomplete but current, # - months lag)

Title	Google Scholar	SCOPUS	WOS	ASFA	FFABW
Advances in Marine Biology	0	0	12	12	24
Annual Review of Marine Science	0	0	0	0	36
Biological Bulletin	0	0	0	0	12
Botanica Marina	1	1	1	12	24
Bulletin of Marine Science	0	0	0	1	12
Coral Reefs	0	0	*	*	24
Estuaries and Coasts	0	0	1	*	24
Estuarine, Coastal and Shelf Science	0	0	2	1	24
Harmful Algae	0	0	2	0	24
ICES Journal of Marine Science: journal du conseil	0	2	2	2	36
Invertebrate Biology	0	0	3	3	36
Journal of Cetacean Research and Management	1	X	X	1	24
Journal of Coastal Research	0	0	0	*	24
Journal of Experimental Marine Biology and Ecology	0	1	4	1	24
Journal of Fish Biology	0	0	0	1	12
Journal of Marine Research	0	X	0	12	24
Journal of Phycology	0	0	2	2	X
Journal of Plankton Research	0	0	0	0	12
Journal of Sea Research	0	0	2	*	14
Limnology and Oceanography	1	*	3	6	24
Limnology and Oceanography: Methods	1	0	1	1	48
Marine and Freshwater Research	0	0	1	24	24
Marine Biological Association of the United Kingdom. Journal	0	0	0	0	24
Marine Biology	0	0	0	0	24
Marine Biology Research	0	0	0	9	12
Marine Ecology Progress Series	*	0	1	6	24
Marine Environmental Research	0	0	1	5	12
Marine Mammal Science	0	0	0	0	12
Marine Pollution Bulletin	0	0	2	2	12
Oceanography and Marine Biology: an annual review	6	X	6	24	36

Table 3: Oceanography Journals: Months between most recently indexed and most recently published issues (x = not covered, * = incomplete but current, # - months lag)

Titles	Google Scholar	SCOPUS	WOS	ASFA	FFBAW
Continental Shelf Research	*	0	2	0	15
Deep-Sea Research. Part 1: Oceanographic Research Papers	0	*	2	0	12
Deep-Sea Research. Part 2: Topical Studies in Oceanography	0	0	6	0	12
Dynamics of Atmopsheres and Oceans	0	0	4	9	X
G3: Geochemistry, Geophysics, Geosystems	*	*	1	4	X
Geophysical Research Letters	0	1	1	1	X
Journal of Geophysical Research - Oceans	*	1	1	1	X
Journal of Geophysical Research - Solid Earth	*	*	1	1	X
Journal of Marine Systems	0	0	1	1	31
Journal of Physical Oceanography	*	1	0	2	19
Marine Chemistry	0	0	3	2	6
Marine Geology	*	0	2	2	X
Marine Geophysical Research	0	0	0	X	X
Marine Technology Society Journal	0	X	2	X	X
Oceanography	*	3	3	3	X
Paleoceanography	0	*	1	2	X
Progress in Oceanography	0	0	2	0	21

Completeness of Coverage:
It is one thing to be timely and another to be thorough. The best tools do both. Often coverage comes at the expense of speed. As expected, there is some variation in coverage among databases. Partly this is due to the focus of a particular tool, e.g. FFABW does not purport to provide in-depth coverage of oceanography. To get a snapshot of coverage, we looked closely at the issues that were either not indexed (X in Tables 1-3) or incompletely covered (* in Tables 1-3).

In the fisheries subject area, five of the fourteen titles were somewhat problematic for Google Scholar, Scopus and WOS. The other nine were completely indexed by all tools even if the timeliness varied.

- Google Scholar missed three articles from *Marine and Coastal Fisheries* probably due to the nature of this online journal. It pulled one article from *Journal of Shellfish Research* from an institutional repository rather than the journal, indicating something about the tool's search algorithm.
- Scopus has the most problems with coverage including missing articles from *Canadian Journal of Fisheries and Aquatic Sciences* and *Fisheries Research* and lack of coverage of the digital American Fisheries Society journal, *Marine and Coastal Fisheries*, and the classic NOAA journal, *Marine Fisheries Review*. This brings out two different issues: first, a lag in indexing new, open access journals and the second, problems in or reluctance to index irregularly published journals.
- WOS dropped indexing of *Marine Fisheries Review* in the 1980s.
- ASFA appears to have a timeliness issue with American Fisheries Society titles. This could be due to the changes in publishers to Taylor & Francis (C. Emerson, personal communication, October 9, 2012).

Twenty-one of the thirty-one marine biology titles are completely covered by the tools.

- Google Scholar missed 87% (20 of 23) of the current issue of *Marine Ecology and Progress Series,* possibly indicating a harvesting error.
- Scopus did not index *Journal of Marine Research*, a small but steady classic journal, *Oceanography and Marine Biology*, an important annual publication, and the International Whaling Commission's non-commercial *Journal of Cetacean Research and Management,* even though Scopus' list of journal indicates coverage. It also missed 75% of the current issue of *Limnology and Oceanography*.
- WOS does not cover *Journal of Cetacean Research and Management*
- The journal *Coral Reefs* includes reef reports as well articles. WOS and ASFA missed these.
- ASFA missed notes and erratum in *Estuaries and Coasts*. It missed 14 of 18 articles in *Journal of Coastal Research* as well as having an error in the volume numbering.

In the oceanography subject area, coverage is less complete. Only six of the nineteen titles were indexed completely by all of the tools.

- Google Scholar simply missed articles.
- Scopus also missed articles. This is understandable with the American Geophysical Union's journals as these are continuously published, making it a matter of timing as to when a publisher's page is harvested or the additions sent to the tool developers.
- WOS indexed all completely.
- ASFA indexes *Marine Geophysical Research* but has not caught the recent title change.
- FFABW focuses on aquatic biological information. However, many of the oceanography journals cover such topics on occasion so one would expect selected coverage.

Overall, it is difficult to understand the inconsistency in coverage. It could be workflow issues between the journal and indices publishers. Of course, some of this could be sampling errors on our part. On some of the non-commercial titles, the irregularity of their production may hinder getting into the highly automated workflow of an indexing service. Google Scholar harvests publisher web sites so may do that with varying regularity depending on the publisher's importance. FFABW appears to be transforming into an index to historical fish and fisheries information rather than a more comprehensive current search tool.

Coverage of Early-Online Publications:

The above focuses on coverage of the most recently published issues of journals. While we did not intend to study the early-online content, it was difficult to ignore. Forthcoming, or now the early-online, used to be invisible to the reader. Most journal web sites now list early-online content in various stages of finalization. Google Scholar, and to a lesser extent Scopus, picked up these early-online publications while the other three tools did not. The extent of early-online content is significant (Table 4) and somewhat pervasive. The number of early-online articles awaiting publication compared to the number of articles in the most recent issue of journals is 1.8, 1.9 and 3.0 for fisheries, marine biology and oceanography respectively. The concept of the 'published' volume may be constraining content. Some of the journals with the largest publishing backlog had many issues worth of early-online publications waiting to be incorporated in an issue (Table 5).

Table 4: Early-online content by discipline

Subject	# articles in most recently published issue	# articles available early-online	# journals	# journals w/early-online
Fisheries	197	351	14	9
Marine Biology	408	788	30	17
Oceanography	180	538	17	15

Table 5: Examples of early-online content by journal

Journal Title	# articles in current issue	# articles early-online
Aquaculture	22	87
Bulletin of Marine Science	15	29
Continental Shelf Research	8	62
Estuarine Coastal and Shelf Science	12	132
Journal of Marine Systems	4	56
Journal of Physical Oceanography	13	63
Journal of Sea Research	6	62
Marine Mammal Research	13	57
Progress in Oceanography	8	30

Early-online content from the editors' and publishers' perspectives:
The issues of timeliness and coverage become harder to assess if there is little agreement among editors and publishers on what is a published article. What should researchers, students and librarians expect to access through the various tools? We briefly explored this concept of what is considered published by asking selected editors their opinions and there is little agreement. This needs further examination. Below are a two of the various comments we received.

> "They are published as soon as they appear online." David Noakes, editor of *Environmental Biology of Fishes*

> "My personal take is that all of the publishers are in so much of a rush to try and beat out each other with 'new' information that they have finally reached the ridiculous. Putting uncorrected manuscripts on line, uncorrected page proofs, etc. etc. Once someone gets this information, they rarely bother to go back and get the final version or check to see what was changed/corrected." Sandra Shumway, editor of *Journal of Experimental Marine Biology and Ecology*, *Journal of Shellfish Research* and *Harmful Algae*

The explosion of early-online articles has been handled differently from publisher to publisher. The American Geophysical Union's *G3: Geochemistry, Geophysics, Geosystems* and the American Fisheries Society's *Marine and Coastal Fisheries* are two examples of journals that build volume content throughout the year rather than formally issuing sequential issues within a volume. Inter-Research's *Marine Ecology Progress Series* is published about every two weeks to keep up with the flow of articles thus avoiding early-online articles. Perhaps the time has come for others to adopt the model of an annual volume with articles identified by the date of online availability.

Utility:
Finally, we examined the utility of each index or tool. This encompasses the intangibles of coverage as well as the mechanics of searching and then manipulation of the findings.

Searching
In terms of searching, each tool has strengths and weaknesses. Librarians and more established researchers are used to certain tools and how to search them. We get thrown when an interface changes radically or we can no longer find something that we assumed would always be available. As we used the various tools and publishers' web pages, we gathered impressions about them. These are not scientific, but reflect personal opinions and biases that may or may not be extensible.

- Google Scholar advanced search capability is frustrating. It can be difficult to structure a search effectively, even one as simple as journal title and date. Limitation by year is often not accurate as the items Google Scholar returns may be early-online from 2011 rather than items published within the 2012 volume. Searching for single word journals titles is difficult if not impossible. For example, searching for the 2012 issues of *Aquaculture* returns over 11,000 items.

- Scopus was simple to search, but is a tool neither of us has access to or use on a regular basis. It does pick up more of the early-online material than any of the others tools besides Google Scholar.
- WOS covers the mainstream science journals well, but remains slow to pick up new titles and non-traditional content. The ability to select journal titles from its coverage list is useful as is the greater precision of limiting by search dates.
- ASFA's new interface through ProQuest takes some getting used to. The search boxes can have a mind of their own and the system makes it difficult to move among multiple search boxes. The date filter must be applied after the initial search and is not as precise as in the former interface. It is good for getting a quick picture of temporal coverage. The list of journals covered seems to have disappeared or is sufficiently buried to be as good as gone.
- FFABW's interface through EBSCO is familiar to many who use this platform. That is an advantage to getting students to use it.

Displaying Results
Order is becoming somewhat of a nicety in the display of results. Tools should provide default sorting that makes sense, either chronological or alphabetical.

- Google Scholar does not reveal its sorting strategy and it is not obvious to the searcher. There is an option to sort by date or relevancy once results are displayed. The date sort, however, is not accurate. The citation partially displayed as the default only gives partial information. A nice feature is being able to set library resources so a user can link to full text if he or she has set up the preferences.
- Scopus defaults to results in chronological order with early-online appearing first.
- WOS has a clean display listing results in chronological order. The citation displayed is complete.
- ASFA (ProQuest interface) displays complete information as well as keywords in context and graphics if available. The multiple sort options are useful – relevance, date ascending and date descending. Additional icons indicate whether it is peer-reviewed – useful to the student who keys in on these hints.
- FFABW on the EBSCO platform is readable and provides a snippet of the abstract for context. There are adequate sort options and the facets for additional limiting are clear. FFABW occasionally added issue numbers to journals with continuous publication.

Manipulating Results
Using search results has also been important, but new tools make manipulating them easier and more versatile. All of the tools (except Google Scholar) allow for marking and exporting of search results. A user must download Google Scholar items one by one – a flaw for librarians but not as much of a problem for students or researchers who want a single citation or two.

Digital Object Identifiers
Exported or downloaded items include DOIs (digital object identifiers). The American Geophysical Union adopted DOIs in 2002 as its standard article identifier replacing volume number and pagination (Renner 2002). Some librarians were reluctant to accept these, yet over time DOIs are becoming ubiquitous and proving to be very useful if not essential for properly citing articles. Users may be at a loss for how to use them when citing publications, as most instructions to authors do not specify how to incorporate DOIs into references. Only fifteen percent of the Marine Biology titles mentioned how to cite DOIs in their instructions to authors. Follow-up emails to editors clarified that most will accept DOIs and it is simply that their style manuals have not kept pace with their desire to publish early. Not only are the journal style guides behind the times, but EndNote and Zotero output styles have not been consistently updated to include the citation of DOIs.

Observations:
Comprehensive coverage by any individual tool remains elusive. Rather, we still must use a variety of tools to get relevant and robust results. One researcher noted that "different literature is pulled in each search, so multiple search engines are a good idea" (S. Heppell, personal communication, August 14, 2012).

- Google Scholar is good for known item searching yet returns too many irrelevant results (Gray 2012). Also, there is the big question about how long Google will support this tool. Although it is no longer labeled as being in beta testing, it is slowly getting buried in the list of Google applications and services,
- Scopus and WOS are excellent tools for accessing a wide array of mainstream science journals. The additional value of both is in their citation resources, an aspect we did not explore in this study but others have (Adriaanse and Rensleigh 2011). Scopus handles some early-online articles while WOS does not.
- ASFA remains strongest in coverage of the international aquatic sciences literature and is adding value with links to full text of formerly hard to get grey literature. It includes tables and graphs as appropriate. This feature was originally an additional product that has been integrated into the standard display.
- FFABW provides access to older US state and federal literature as well as literature of the southern hemisphere. However, it has lost its utility for access to current information as it is only updated twice a year (H. Wolf, personal communication, October 1, 2012).

Staying current today means using tools differently. Journal web pages usually have the most recent articles and offer access to what used to be "forthcoming". The indexes offer subject and journal content alerts, but none are consistently current given lags in indexing and growth in early-online content. For a table of contents search, an index will not be the most current. Google Scholar's alert system provides another way to stay on top of topics. For example, in a 2 month test of alert systems, we found that an alert on the phrase "Coos Bay" resulted in19 items (journal citations, web pages and news items) from Google Scholar whereas ASFA or WOS returned far fewer but all were journals articles and relevant.

Our faculty members get grants and write articles, editors vet those articles, publishers publish, and the journal content is indexed. Libraries select indices so we have reliable access to our own institution's and others' research. This cyclical flow can be disrupted by problems (e.g. missed file transfer of one issue from publisher to database vendor) or by more significant gradual changes to one part of the cycle that is not adequately addressed by the other parts. This can be due to the publisher (early-online), the index service (slow or incomplete coverage), utilities (Zotero, EndNote), or the discovery platforms libraries encourage students and researchers to use. Journal editors need to define what is published and what is not rather than leaving that decision to the publisher or the user. Index providers should examine their workflow to incorporate current and early-online content. The bibliographic software developers need to address the inclusion of DOIs in citation output style templates. Finally, libraries should insist that information providers include all licensed resources in discovery tools (e.g. ASFA is not included in Summon as of October 2012).

This study focused on known items and timeliness, in particular. Topic searching would reveal different strengths, weaknesses and issues, and warrants a separate study. To improve timeliness and hence the utility of the specialized indexes we traditionally use, we should have collaborative relationships with database producers. This is lacking with Google Scholar so we have no impact on how they shape the products our students and faculty use (Hamilton et. al. 2012). With other producers, we can suggest and negotiate. This can help maintain the relevance of a tool. For example, the producers of ASFA traditionally have listened to the marine and aquatic library community. They retrospectively covered the journals issues they had missed once we asked. They have added full-text links and continue to gather the world's grey literature. Yet, they seem to be missing something in consistent current coverage. We suggest that continued collaboration with database producers will help librarians make more informed decisions about what to license and what to promote to our users. Such collaboration would ideally allow us to retain the value of the specialized tools and integrate them with the current search habits of users as they navigate the information landscape.

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