FEATURE:
PROFESSIONAL ISSUES

Maintaining the Competitiveness of the American Fisheries Society Journals: An Assessment Based on Influence and Cost-Effectiveness

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ABSTRACT: Recent changes in the landscape of scientific publishing prompted the Publications Overview Committee of the American Fisheries Society (AFS) to review the Society's portfolio of scientific journals. We evaluated journals based on metrics in two categories: (1) citation-based measures of the influence of a journal on the scientific literature, and (2) measures of the cost-effectiveness of a journal (citation rate adjusted for subscription cost). Over the long-term, we found that ecology journals had far stronger citation-based influence than fisheries and aquatic sciences journals, and that journals publishing primarily basic research had stronger influence than journals publishing applied research (including four AFS journals and *Fisheries* magazine). In evaluating the current status of fisheries and aquatic sciences journals, we found that metrics of influence and cost-effectiveness provided considerably different portrayals of journals relative to their peers. In terms of citation-based influence, we found that the AFS journal *Transactions of the American Fisheries Society* (*TAFS*) and *Fisheries* magazine were competitive with highly regarded peer fisheries journals, but that *North American Journal of Aquaculture* (*NAJA*) and *Journal of Aquatic Animal Health* (*JAAH*) were less influential than their peers. The citation-based influence of *North American Journal of Fisheries Management* (*NAJFM*) was intermediate between *TAFS*/*Fisheries* and *NAJA*/*JAAH*. For journals like *NAJFM* and *NAJA*, we expect that much of the scientific influence on policy and management is not captured by citations in the primary literature, and alternative methods of evaluation may be needed. All of the AFS journals ranked highly with regard to cost-effectiveness because their subscription costs are low, and these rankings are in accordance with membership needs and the strategic mission of AFS to provide broad and timely dissemination of scientific information. We conclude by suggesting ways to increase the influence of AFS journals without compromising their accessibility and affordability, and offer advice about methods and frequency for future journal evaluations.

Mantenimiento de la competitividad de las revistas de la Sociedad Americana de Pesquerías: una evaluación basada en la influencia y efectividad de costos

RESUMEN: Los recientes cambios en materia de publicación científica alertaron al Comité de Revisión de Publicaciones de la Sociedad Americana de Pesquerías (SAP) a evaluar el cuadro de revistas de esta sociedad. Se evaluaron las revistas sobre la base de dos criterios: (1) medidas basadas en las citas acerca de la influencia de una revista en la literatura científica, y (2) medidas relativas a la efectividad de los costos de una revista (tasa de citas ajustada por el costo de suscripción). En el largo plazo, se encontró que las revistas de ecología tuvieron, por mucho, una mayor influencia en cuanto a número de citas que aquellas revistas de ciencias acuáticas y pesquerías; y que las revistas que publican artículos de investigación básica tuvieron mayor influencia que las que publican artículos de ciencia aplicada (incluyendo cuatro revistas de la SAP y la revista *Fisheries*). Al evaluar el estado actual de las revistas de pesquerías y ciencias acuáticas, se encontró que la métrica referente a la influencia y efectividad de costos muestra panoramas completamente diferentes de las revistas en comparación con sus pares. En términos de la influencia basada en el número de citas, notamos que dos revistas de la SAP *Transactions of the American Fisheries Society* (*TAFS*) y *Fisheries* tuvieron un importante nivel de competitividad en relación a revistas similares de pesquerías consideradas de alto nivel, pero también descubrimos que las revistas *North American Journal of Aquaculture* (*NAJA*) y *Journal of Aquatic Animal Health* (*JAAH*) tuvieron menos influencia que sus pares. La influencia de acuerdo al número de citas de la revista *North American Journal of Fisheries Management* (*NAJFM*) se colocó en un lugar intermedio entre *TAFS*/*Fisheries* y *NAJA*/*JAAH*. Para revistas como *NAJFM* y *NAJA*, esperamos que una gran parte de la influencia científica sobre política y el manejo, no es captada en la literatura, y por lo tanto pueden requerirse métodos alternativos de evaluación. Todas las revistas de la SAP obtuvieron una puntuación alta en cuanto a efectividad de costos ya que el monto de las suscripciones es bajo, y estos rankings son congruentes tanto con las necesidades de las membresías de cada revista como con la misión estratégica de la SAP en lo tocante a la difusión amplia y oportuna de información científica. Como conclusión, sugerimos algunas formas para incrementar la influencia de las revistas de la AFS sin comprometer su accesibilidad, en lo logístico y económico, y ofrecemos una guía sobre métodos y frecuencia para futuras evaluaciones de revistas.

INTRODUCTION

Publishers must continuously adapt to philosophical and technological changes in the expanding, dynamic marketplace of scientific information. As examples, the rise of open access publishing models and the electronic distribution of articles have rapidly and substantially altered the playing field (Bergstrom and Bergstrom 2006; Eysenbach 2006; Evans 2008; Taylor et al. 2008; Evans and Reimer 2009). In particular, professional societies and university presses must evaluate and adapt their practices in order to remain competitive with large commercial publishers, and competition has only become more acute with the recent profusion of journals (e.g., Kareiva and Yuan-Farrell 2006; Mather et al. 2008). The American Fisheries Society (AFS) recognized the need for change during the recent development of its new open access, online-only journal *Marine and Coastal Fisheries* (Eells 2006; Kohler 2006; DeVries et al. 2007; Rassam 2007; Fabrizio 2008). In addition to helping maintain relevant and competitive products, regular evaluations of journals provide a service to members of a scientific society by assisting them (as authors, reviewers, or editors) in their choices about and expectations for dissemination of scientific information.

As part of a continuing effort to evaluate and improve the scientific information products and services of AFS, the Publications Overview Committee conducted an assessment of the Society's multidisciplinary portfolio of journals. We evaluated all of the extant journals, namely *Transactions of the American Fisheries Society* (*TAFS*), *North American Journal of Fisheries Management* (*NAJFM*), *North American Journal of Aquaculture* (*NAJA*), and *Journal of Aquatic Animal Health* (*JAAH*), as well as *Fisheries* magazine, which is currently treated much like a journal. Our assessment builds on a prior analysis of co-citation patterns in fisheries and aquatic sciences (F&AS) journals that illustrated the broader interdisciplinary context in which the AFS journals function (McCain 1994).

Any evaluation of journal success depends on the criteria used to judge whether a journal has achieved its stated goals and objectives. Thus, success can mean different things for different journals. The measurement of journal influence within bibliometry has received increasing attention in recent decades and a variety of metrics are now available. We recognize that no single influence metric is without flaw, and citation-based influence may not be the only criterion to consider (Monastersky 2005; Garfield 2006; Bergstrom 2007; Lawrence 2007; Wilson 2007; Lovegrove and Johnson 2008; Taylor et al. 2008). We sought to provide a concise yet informative evaluation of the AFS journals by including two citation-based metrics of influence as well as relatively new measures of cost-effectiveness, or value. Our assessment included the familiar and long-standing Impact Factor (IF), metrics from the Eigenfactor project (EF, PPEF; www.eigenfactor.org), and the Relative Price Index (RPI; www.journalprices.com), which measures the cost-effectiveness of a journal as its influence adjusted for subscription cost (Box 1). Higher values of influence metrics indicate that journals are cited more often on average than their peers, whereas lower RPI scores indicate better relative cost-effectiveness.

We compared the AFS journals to their peers in F&AS, and also compared the AFS and other F&AS journals to classic ecology journals to provide context for our assessment. The objectives of our work were fourfold. First, we wanted to inform the AFS membership about various metrics used to evaluate journal success, as well as their advantages and disadvantages. Second, using Impact Factors, we wanted to compare long-term trends in influence for the AFS

Box 1. Descriptions of the four quantitative metrics used in our analysis of the American Fisheries Society journals and their peers. All data was accessed on 4 February 2009.

Metrics of journal influence (bigger is better)

1. Impact Factor (IF)
   - Taken from Thomson Reuters Scientific (ISI Web of Knowledge) Journal Citation Reports (JCRs)
   - Uses a 2-year window for tracking citations (JCRs now also report 5-year IFs, but our analysis used 2-year IFs)
   - Measures per-article influence of a journal based on citations from journals indexed by ISI, including citations from other journals as well as citations from within the same journal
   - All citations are considered equal
   - See www.thomsonreuters.com/products_services/scientific/Journal_Citation_Reports for more details
2. Eigenfactor (EF)
   - Taken from the Eigenfactor project
   - Uses a 5-year window for tracking citations
   - Measures total influence of a journal on the scientific literature based on citations from other journals, ignoring same-journal citations; uses the ISI JCR citation data
   - All citations are not considered equal; citation network for each journal is used to value citations depending on where they originate within the journal's network, similar to Google's PageRank algorithm
   - See www.eigenfactor.org for more details

Metrics of journal cost-effectiveness (smaller is better)

1. Price per Eigenfactor (PPEF)
   - Taken from the Eigenfactor project
   - Includes citation data through 2006 and journal subscription prices for 2008 (prices taken from Journal Cost-Effectiveness project; see below)
   - Calculated for each journal as EF (left) divided by subscription price
2. Relative Price Index (RPI)
   - Taken from the Journal Cost-Effectiveness project
   - Includes citation data through 2006 and journal subscription prices for 2008
   - Calculated for each journal using a combination of subscription price, number of articles published, and a recent citation rate based on ISI JCR citation data
   - Compares the cost-effectiveness of a journal to the median cost-effectiveness of non-profit (cheaper) journals in the same JCR subject category
   - Journals are subjectively categorized as to their value based on the following criteria: RPI < 1.25 = High Value; 1.25 ≤ RPI < 2.5 = Medium Value; RPI ≥ 2.5 = Low Value
   - See www.journalprices.com for more details, particularly information on how journal subscription prices were determined

journals with other F&AS and ecology journals. Third, we wanted to explore the relationship among metrics of influence and cost-effectiveness and compare what the metrics indicate about the current status of the AFS journals relative to their peers. Lastly, we developed suggestions for strategic changes in publishing practices that may be worthy of consideration to make the AFS journals more effective and influential in communicating science to the global fisheries community.

METHODS

In compiling a list of F&AS journals, we used two primary sources as guides: (1) the list of journals included in the Fisheries category of the 2007 Science edition of the ISI Web of Knowledge Journal Citation Report (JCR; Thomson Reuters Scientific), and (2) the list of journals included in the previous analysis by McCain (1994). We also included and excluded some journals based on our own collective judgment, and we attempted to provide a balance between journals that covered marine and freshwater ecosystems. Our list is intended to be representative rather than exhaustive, and the selection process is prone to subjectivity because of the interdisciplinary nature of the F&AS literature (McCain 1994). For example, Mather et al. (2008) included fish-related journals that had been assigned to seven different categories in the JCR. We included 22 of the 40 journals in the JCR Fisheries category for 2007, 18 of the 43 journals identified by McCain (1994; 10 of which were not included in the JCR Fisheries category), and 4 other journals we felt were important to include. In sum, 36 F&AS journals were included in the assessment (Table 1). We also included 10 well-known ecology journals that we felt provided a representative set for comparisons with the F&AS literature (Table 1).

By consensus and generally in accordance with published journal descriptions, we categorized each of the F&AS journals with regard to their subdiscipline (disease, aquaculture, general fisheries, general aquatic sciences) and the primary type of research that they publish (basic or applied). We included all aquatic disease and aquaculture journals, as well as most general fisheries journals, in the applied research category. However, we recognize that most journals fall on a continuum between basic and applied research and other judgments are possible. For the journals included in McCain (1994), we followed the results of her citation analysis in categorizing journals as general fisheries or general aquatic sciences. For journals not included in McCain (1994), we categorized journals based on our consensus judgment. We also included the profit status (for-profit or non-profit) of each of the journals from a web site dedicated to providing information on the economics of scholarly journals (www.journalprices.com).

To evaluate journal influence, we used the familiar per article influence metric Impact Factor (IF; Garfield 1955, 2006) from the JCRs and Eigenfactor (EF) scores from the Eigenfactor project. We also examined the separate per article influence metric from the Eigenfactor project (known as Article Influence, or AI), but found that it was highly correlated with Impact Factor ($r > 0.95$). Although AI provides different information than IF because of different methodology, we excluded AI from our evaluation for simplicity of presentation. Essentially, journals are considered relatively more influential if they publish articles that are cited more often on average than articles in other peer journals. Both IF and EF are intended to measure the relative influence of journals, but rather than measuring per article-influence like IF, EF measures the total influence of a journal on the scientific literature. Calculations of EF differ from calculations of IF in two important ways (see Box 1).

To explore long-term trends in journal influence, we plotted the average annual IF from 1975 to 2007 for three comparisons: (1) journals that publish primarily applied research versus those that publish primarily basic research, (2) the AFS journals versus a comparable set of other F&AS journals and a set of ecology journals, and (3) *TAFS* versus a set of four peer applied fisheries journals. The number of journals included in group averages usually increased over time because not all journals were indexed by ISI back to 1975, and some were newly established during the period. We excluded journals that were indexed for only a short portion of the time period, such as *Fisheries Management and Ecology* (first indexed by ISI in 1999).

To evaluate journal cost-effectiveness, we included derived calculations from the Journal Cost-Effectiveness project and the Eigenfactor project (Box 1). Essentially, cost-effectiveness is calculated by adjusting the cost of a subscription with an influence metric (e.g., Price per Eigenfactor, or PPEF). Lower scores indicate that journals receive more citations per unit cost and are thus relatively more cost-effective.

We provide a more complete comparison of four specific subsets of journals: (1) aquaculture journals, (2) disease journals, (3) fisheries review journals, and (4) journals we considered to be peers of *TAFS*, *NAJFM*, and *Fisheries* (hereafter, the AFS general fisheries journals). These subsets of journals were separated to provide a fairer comparison among direct peers. In all comparisons, we included both influence and cost-effectiveness metrics. We based our evaluations of influence on means across the last three years (IF: 2005–2007; EF: 2004–2006) and report the most recent measures of cost-effectiveness (PPEF and RPI). The subsets for aquaculture and disease journals included two peer journals for the AFS journal in each subset. We included 27 journals in the subset we considered to be peers of the AFS general fisheries journals. For this subset, we also performed a principal components analysis using the most recent data for influence and cost-effectiveness metrics (IF [2007]; EF, PPEF, and RPI [2006]) to illustrate the difference in perspective provided by the two types of metrics.

RESULTS

Long-term trends in average Impact Factor showed that journals that publish applied research had lower influence than basic research journals through the 1980s, but are increasing in parallel with basic research journals in recent years (Figure 1). A comparison of the average IF for the AFS journals with average IFs for groups of ecology and F&AS journals indicated that the AFS journals had far lower influence than general ecology journals and somewhat lower influence than other F&AS journals (Figure 2). The average IF for all three groups has risen over the last decade or so, but the increase in IF for ecology journals has far surpassed that of F&AS journals. A comparison of the longest-standing AFS journal, *TAFS*, with four peer applied fisheries journals that we deemed to be similar showed that *TAFS* was competitive in terms of influence throughout the time series (Figure 3). Note that the time series for *TAFS* illustrates a related point—snapshot comparisons among journals, like those we make here, must be interpreted with some caution. Most journals experience year-to-year variation in influence metrics (e.g., 0.1–0.2 IF for *TAFS*) that can be as large as differences among journals, especially for IF given the shorter window for tracking citations.

Table 1. The list of journals included in our evaluation, with categorizations by five factors: (1) whether they were included in the Fisheries category of the 2007 Science edition of the ISI Web of Knowledge Journal Citation Report (JCR), (2) whether they were included in the citation analysis by McCain (1994), (3) subdiscipline (aquaculture, disease, general fisheries, general aquatic sciences, or ecology), (4) type of research (basic or applied) [review journals indicated separately], and (5) profit status (For-profit or Non-profit). American Fisheries Society journals are highlighted in yellow.

Journal title	2007 JCR Fisheries	McCain (1994)	Subdiscipline	Basic/Applied	Profit status
Fisheries and Aquatic Sciences Journals					
Aquaculture	Yes	Yes	Aquaculture	Applied	For
Journal of the World Aquaculture Society	Yes		Aquaculture	Applied	Non
North American Journal of Aquaculture[1]	Yes	Yes	Aquaculture	Applied	Non
Diseases of Aquatic Organisms	Yes		Disease	Applied	For
Journal of Aquatic Animal Health	Yes		Disease	Applied	Non
Journal of Fish Diseases	Yes	Yes	Disease	Applied	For
Bulletin of Marine Science[2]			GenFish	Basic	Non
Canadian Journal of Fisheries and Aquatic Sciences[3]	Yes	Yes	GenFish	Applied	Non
Copeia		Yes	GenFish	Basic	Non
Ecology of Freshwater Fish	Yes		GenFish	Basic	For
Environmental Biology of Fishes		Yes	GenFish	Basic	For
Fish and Fisheries	Yes		GenFish	Review	For
Fisheries Oceanography	Yes		GenFish	Basic	For
Fisheries Research	Yes		GenFish	Applied	For
Fisheries	Yes		GenFish	Applied	Non
Fisheries Management and Ecology	Yes		GenFish	Applied	For
Fishery Bulletin	Yes	Yes	GenFish	Applied	Non
ICES Journal of Marine Science[4]	Yes		GenFish	Applied	Non
Journal of Applied Ichthyology[5]	Yes		GenFish	Applied	For
Journal of Fish Biology	Yes	Yes	GenFish	Applied	For
North American Journal of Fisheries Management	Yes	Yes	GenFish	Applied	Non
Reviews in Fish Biology and Fisheries	Yes		GenFish	Review	For
Reviews in Fisheries Science	Yes		GenFish	Review	For
River Research and Applications[6]			GenFish	Applied	For
Transactions of the American Fisheries Society	Yes	Yes	GenFish	Applied	Non
Aquatic Conservation: Marine and Freshwater Ecosystems			GenAquat	Applied	For
Estuaries and Coasts[7]		Yes	GenAquat	Applied	Non
Estuarine Coastal and Shelf Science[8]		Yes	GenAquat	Basic	For
Freshwater Biology		Yes	GenAquat	Basic	For
Hydrobiologia		Yes	GenAquat	Basic	For
Journal of Experimental Marine Biology and Ecology		Yes	GenAquat	Basic	For
Journal of Freshwater Ecology			GenAquat	Basic	For
Limnology and Oceanography		Yes	GenAquat	Basic	Non
Marine and Freshwater Research	Yes		GenAquat	Basic	Non
Marine Biology		Yes	GenAquat	Basic	For
Marine Ecology Progress Series		Yes	GenAquat	Basic	For
Ecology Journals					
Biological Conservation			Ecology	Applied	For
Conservation Biology			Ecology	Applied	Non
Ecological Applications			Ecology	Applied	Non
Ecology			Ecology	Basic	Non
Ecology Letters			Ecology	Basic	For
Frontiers in Ecology and the Environment			Ecology	Applied	Non
Journal of Applied Ecology			Ecology	Applied	Non
Oecologia			Ecology	Basic	For
Oikos			Ecology	Basic	Non
Trends in Ecology and Evolution			Ecology	Basic	For

1 Published as *The Progressive Fish-Culturist* prior to 1999
2 Published as *Bulletin of Marine Science of the Gulf and Caribbean* prior to 1965
3 Published as *Journal of the Fisheries Research Board of Canada* prior to 1980
4 Published as *Journal du Conseil int. Explor. Mer* until mid-1991
5 Published as *Z. angew. Ichthyol.* prior to 1986
6 Published as *Regulated Rivers: Research and Management* prior to 2002
7 Published as *Estuaries* prior to 2006 and *Chesapeake Science* prior to 1978
8 Published as *Estuarine and Coastal Marine Science* prior to 1981

Comparisons of influence and cost-effectiveness metrics for the aquaculture, disease, and fisheries review journals showed that the metrics provided contrasting rankings (Table 2). Among aquaculture journals, the AFS journal *NAJA* is the least influential but ranks best in terms of cost-effectiveness. The same is true for *JAAH* among the disease journals, and we note that trends in both influence metrics for *JAAH* have been declining in recent years. The disease journal subset also illustrates that IF and EF can provide different interpretations about journal influence. For the most recent years, *Diseases of Aquatic Organisms* ranked highest in terms of EF but ranks behind *Journal of Fish Diseases* in terms of IF. Among the three fisheries review journals, the relatively new journal *Fish and Fisheries* appears to be the most influential, but all three journals are for-profit and none are considered cost-effective.

Within the subset of journals that we considered peers of the AFS general fisheries journals, there was a reasonable balance between journals published by for-profit and non-profit publishers (Table 3). Furthermore, some of the cost-effective non-profit journals were among the most influential applied fisheries journals, such as *Canadian Journal of Fisheries and Aquatic Sciences* and *TAFS*. However, as with the disease journals, IF and EF sometimes provided different rankings of relative journal influence, and influence was often inversely related to cost-effectiveness. For example, *Fisheries* and *Ecology of Freshwater Fish* ranked high in terms of IF but low in terms of EF, and the for-profit journal *Fisheries Oceanography* ranked high for influence but low for cost-effectiveness. Only one for-profit journal, *Journal of Freshwater Ecology*, was highly cost-effective and rated a High Value, but it ranked near the bottom of the list on both influence metrics. The situation for *NAJFM* is interesting—it did not rank particularly high with regard to either influence metric, perhaps reflective of its management emphasis, but was ranked highly with regard to cost-effectiveness.

The principal components analysis clearly illustrated that the influence and cost-effectiveness metrics describe different things about the journals. Two components explained 91% of the variation in the data, as would be expected with only four variables included. One principal component axis explained variation in cost-effectiveness and the other explained variation in influence (Figure 4). All of the AFS general fisheries journals cluster together near the bottom center of the biplot with *Copeia*, *Bulletin of*

Figure 1. Comparison of the average Impact Factor between selected sets of applied and basic research journals during the period 1975–2007. Not all of the journals were indexed for the entire time period; the first year of inclusion is given in parentheses after the journal name. The set of 14 applied research journals includes *Canadian Journal of Fisheries and Aquatic Sciences* (1975), *Fishery Bulletin* (1975), *Journal of Applied Ecology* (1975), *Journal of Fish Biology* (1975), *North American Journal of Aquaculture* (1975), *Transactions of the American Fisheries Society* (1975), *Aquaculture* (1977), *Journal of Fish Diseases* (1979), *Fisheries* (1980), *Conservation Biology* (1990), *Ecological Applications* (1992), *ICES Journal of Marine Science* (1992), *Journal of Aquatic Animal Health* (1999), and *North American Journal of Fisheries Management* (2003). The set of 7 basic research journals includes *Copeia* (1975), *Ecology* (1975), *Oecologia* (1975), *Oikos* (1975), *Environmental Biology of Fishes* (1981), *Marine Ecology Progress Series* (1981), and *Ecology of Freshwater Fish* (1999).

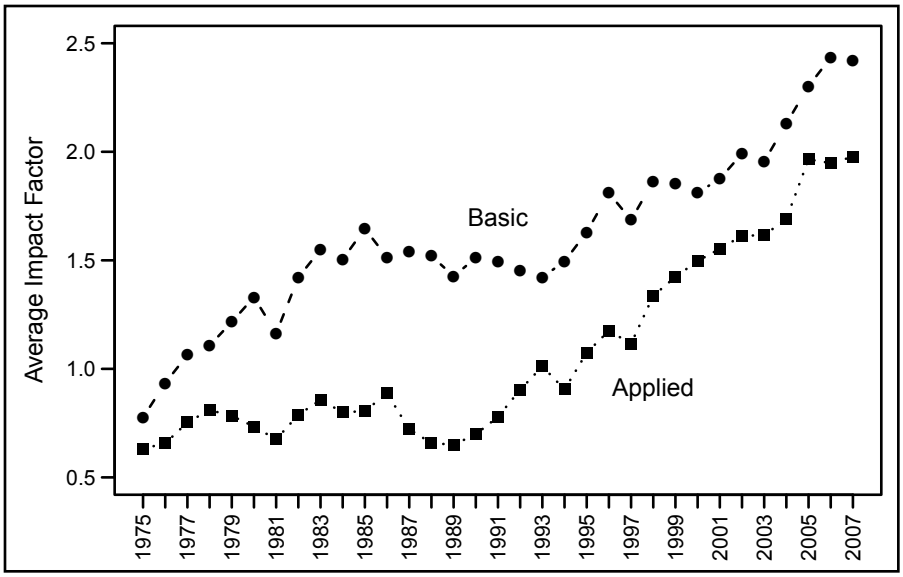


Figure 2. Comparison of the average Impact Factor among three sets of journals during the period 1975–2007: (1) the American Fisheries Society journals; (2) a set of other fisheries and aquatic sciences (F&AS) journals, both freshwater and marine, including representatives of both basic and applied research as well as the subdisciplines of aquaculture and disease; and (3) a set of basic and applied ecology journals. The included journals are the same as those used in Figure 1, except that the categorizations are different. Refer to the caption for Figure 1 for first years of inclusion. The set of 10 F&AS journals includes *Canadian Journal of Fisheries and Aquatic Sciences, Copeia, Fishery Bulletin, Journal of Fish Biology, Aquaculture, Journal of Fish Diseases, Environmental Biology of Fishes, Marine Ecology Progress Series, ICES Journal of Marine Science,* and *Ecology of Freshwater Fish.* The set of 6 ecology journals includes *Ecology, Journal of Applied Ecology, Oecologia, Oikos, Conservation Biology,* and *Ecological Applications*.

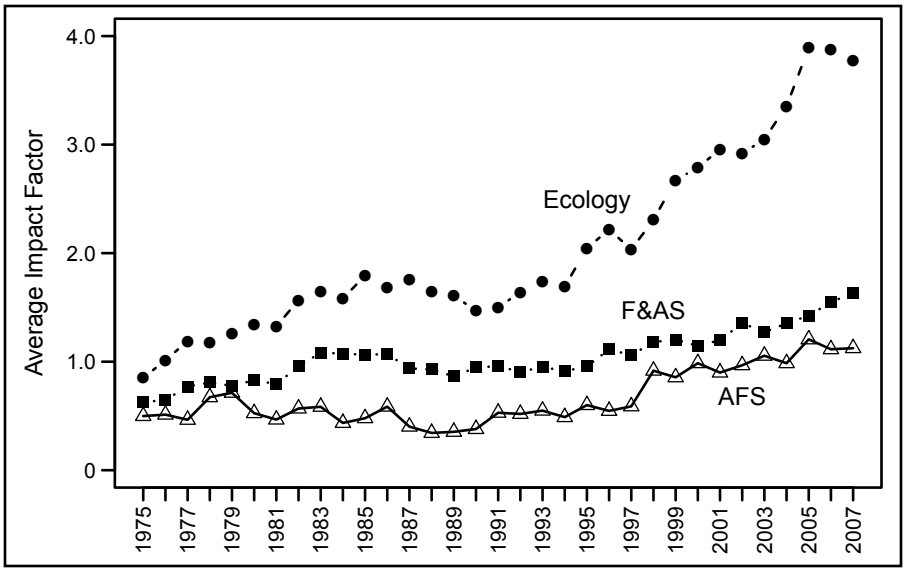
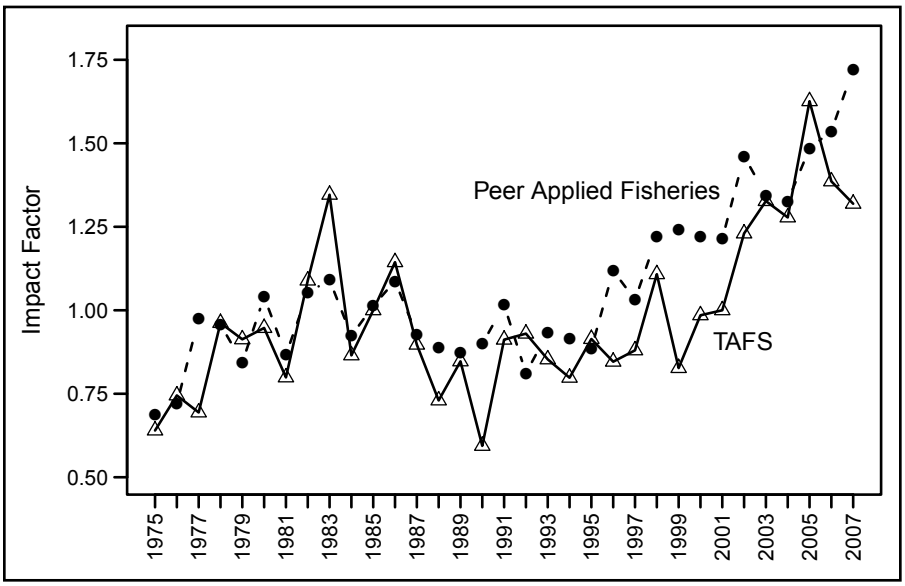


Figure 3. Comparison of the trend in Impact Factor from 1975 to 2007 between *Transactions of the American Fisheries Society* and the average across four peer applied fisheries journals (*Canadian Journal of Fisheries and Aquatic Sciences, Fishery Bulletin, Journal of Fish Biology,* and *ICES Journal of Marine Science*). All of the journals were indexed for the entire time period except *ICES Journal of Marine Science,* which was included beginning in 1992.



Marine Science, and *Fishery Bulletin*. Their position indicates that in comparison to this set of journals they are some of the most cost-effective journals (high influence relative to their subscription cost), but they are not in the top tier of citation-based influence.

DISCUSSION

Among fisheries and aquatic sciences journals, we found that metrics of influence and cost-effectiveness provide different portrayals of journals relative to their peers. Particularly for the journals published by AFS and other professional societies, evaluations based on cost-effectiveness can be much more positive than those based on influence metrics alone. The ideal journal is both highly influential and cost-effective, but a joint analysis of both metrics is not necessarily conclusive about the success of a journal. Metrics of cost-effectiveness such as PPEF are ratios, so journals with low citation rates can be ranked highly with regard to cost-effectiveness simply because the cost of a subscription is small enough to outweigh the relatively poor influence. Balance is needed between influence and cost-effectiveness when evaluating a journal.

Whereas our evaluation indicates that *TAFS* and *Fisheries* are competitive with highly regarded applied fisheries journals, our evaluation does not provide a conclusive assessment of whether *NAJFM*, *JAAH*, and *NAJA* are successful based only on influence and cost-effectiveness. The degree to which these two factors are weighted in the final analysis of whether a journal is successful depends on the goals that AFS and the editorial board have set for the journal. Nonetheless, the situation for the AFS aquaculture and disease journals (*JAAH* and *NAJA*) within their subdisciplines probably deserves attention.

The applied nature of much of fisheries science means that a substantial measure of the influence of a journal may be hidden from citation-based metrics like Impact Factor and Eigenfactor. For example, an article in *NAJFM* may be read widely by agency biologists and have substantial influence on local or regional fisheries management practices. The article may not garner many citations in the primary literature, but its on-the-ground influence is critically important and serves the purposes of AFS and the journal. Indeed, the history and aims of *NAJFM* make it clear that its primary purpose is to serve the fisheries management community by providing case studies and practical management experience. A similar argument could be made about *NAJA*. Furthermore, citations between basic and applied research journals might not be balanced, in that articles in applied journals are more likely to cite findings in basic

Table 2. Comparisons of influence and cost-effectiveness metrics among aquaculture, disease, and fisheries review journals. The Eigenfactor (EF) and Price per Eigenfactor (PPEF) columns are re-scaled for readability. See Box 1 for abbreviations and details on the metrics. American Fisheries Society journals are highlighted in yellow.

Journal title	EF*100	IF	PPEF/1000	RPI	Value (profit status)
Aquaculture Journals					
Aquaculture	2.84	1.73	138	1.36	Medium (For)
Journal of the World Aquaculture Society	0.23	0.63	158	1.41	Medium (Non)
North American Journal of Aquaculture	0.10	0.53	45	0.23	High (Non)
Disease Journals					
Journal of Fish Diseases	0.55	1.70	321	4.44	Low (For)
Diseases of Aquatic Organisms	1.04	1.49	120	1.89	Medium (For)
Journal of Aquatic Animal Health	0.19	0.95	26	0.28	High (Non)
Review Journals					
Fish and Fisheries	0.44[1]	4.34	169	4.85	Low (For)
Reviews in Fisheries Science	0.10	1.95	1053	11.73	Low (For)
Reviews in Fish Biology and Fisheries	0.26	1.64	362	9.00	Low (For)

1 Only includes data for 2005 and 2006

Table 3. Comparison of influence and cost-effectiveness metrics among the 27 journals considered peers of the AFS general fisheries journals (*TAFS*, *NAJFM*, and *Fisheries*) and the 10 general ecology journals. See Box 1 for abbreviations and details on the metrics. American Fisheries Society journals are highlighted in yellow, and the 14 journals deemed to be the most direct peers of AFS journals based on the citation analysis of McCain (1994) as well as our judgment are highlighted at the top.

Journal title	EF*100	IF	PPEF/1000	RPI	Value (profit status)
Fisheries and Aquatic Sciences Journals					
Fisheries Oceanography	0.64	2.10	173	3.31	Low (For)
Canadian Journal of Fisheries and Aquatic Sciences (CJFAS)	3.24	1.96	34	0.63	High (Non)
Fisheries	0.34	1.84	26	0.40	High (Non)
ICES Journal of Marine Science	1.46	1.54	78	1.05	High (Non)
Fishery Bulletin	0.65	1.49	11	0.18	High (Non)
Transactions of the American Fisheries Society (TAFS)	0.99	1.44	5	0.06	High (Non)
Journal of Fish Biology	2.20	1.33	146	2.05	Medium (For)
Ecology of Freshwater Fish	0.20	1.25	277	3.06	Low (For)
Fisheries Research	1.01	1.19	220	2.48	Medium (For)
Fisheries Management and Ecology	0.16	1.12	547	4.97	Low (For)
Environmental Biology of Fishes	0.84	0.99	292	3.93	Low (For)
Copeia	0.72	0.98	22	0.30	High (Non)
North American Journal of Fisheries Management (NAJFM)	0.51	0.98	10	0.08	High (Non)
Journal of Applied Ichthyology	0.26	0.68	296	2.49	Medium (For)
Limnology and Oceanography (L&O)	4.93	3.27	8	0.19	High (Non)
Freshwater Biology	2.30	2.65	174	3.37	Low (For)
Marine Ecology Progress Series (MEPS)	7.17	2.38	113	2.06	Medium (For)
Marine Biology	2.81	1.91	254	4.07	Low (For)
Journal of Exp. Marine Biology and Ecology (JEMBE)	2.15	1.78	236	3.36	Low (For)
Estuarine Coastal and Shelf Science	1.71	1.72	137	1.75	Medium (For)
River Research and Applications	0.23	1.54	442	3.57	Low (For)
Marine and Freshwater Research	0.87	1.52	144	2.32	Medium (Non)
Estuaries and Coasts	1.04	1.49	66	0.89	High (Non)
Aquatic Conservation: Marine and Freshwater Ecosystems	0.29	1.47	369	3.06	Low (For)
Hydrobiologia	2.96	1.08	324	3.80	Low (For)
Bulletin of Marine Science	0.77	0.90	80	1.06	High (Non)
Journal of Freshwater Ecology	0.17	0.48	78	0.43	High (For)
Ecology Journals					
Trends in Ecology and Evolution	7.05	14.60	21	1.23	High (For)
Ecology Letters	4.26	6.99	34	1.30	Medium (For)
Ecology	10.37	4.70	7	0.24	High (Non)
Frontiers in Ecology and the Environment	0.51	4.62	29	0.50	High (Non)
Journal of Applied Ecology	2.07	4.45	49	1.04	High (Non)
Conservation Biology	4.41	3.94	16	0.30	High (Non)
Ecological Applications	4.31	3.62	8	0.21	High (Non)
Oikos	5.24	3.28	22	0.55	High (Non)
Oecologia	6.49	3.11	84	2.16	Medium (For)
Biological Conservation	3.29	2.91	76	0.91	High (For)

research journals as foundations for their work than vice versa. For these reasons, we should not expect applied fisheries journals, including AFS journals, to compete with journals such as *Limnology and Oceanography* on the basis of citations. We suggest that AFS supplement future journal evaluations with other approaches to measure the influence of applied journals, such as surveys of agency biologists and managers or detailed summaries of journal article downloads (usage statistics).

Although journals provide important revenue streams for AFS, the fundamental purposes of AFS journals differ from those of commercial publishers. The constitutional objectives of AFS as well as the focus areas of its strategic plan rely on broad and timely dissemination of products related to fisheries science and conservation. As a critical component of these efforts, journals must be affordable and accessible to the global fisheries community, and these objectives will sometimes take precedence over efforts to increase the citation-based influence of AFS journals relative to their peers. For example, if AFS journals become overly selective about manuscripts or otherwise limit the number of journal articles in pursuit of higher citation rates, the dissemination of important information may be impeded. In addition, AFS journals play an important role as outlets for scientific products both by and for a diverse AFS membership. We suggest that there is an intrinsic trade-off between the objectives of AFS journals and efforts to increase citation-based influence metrics. As such, the success of

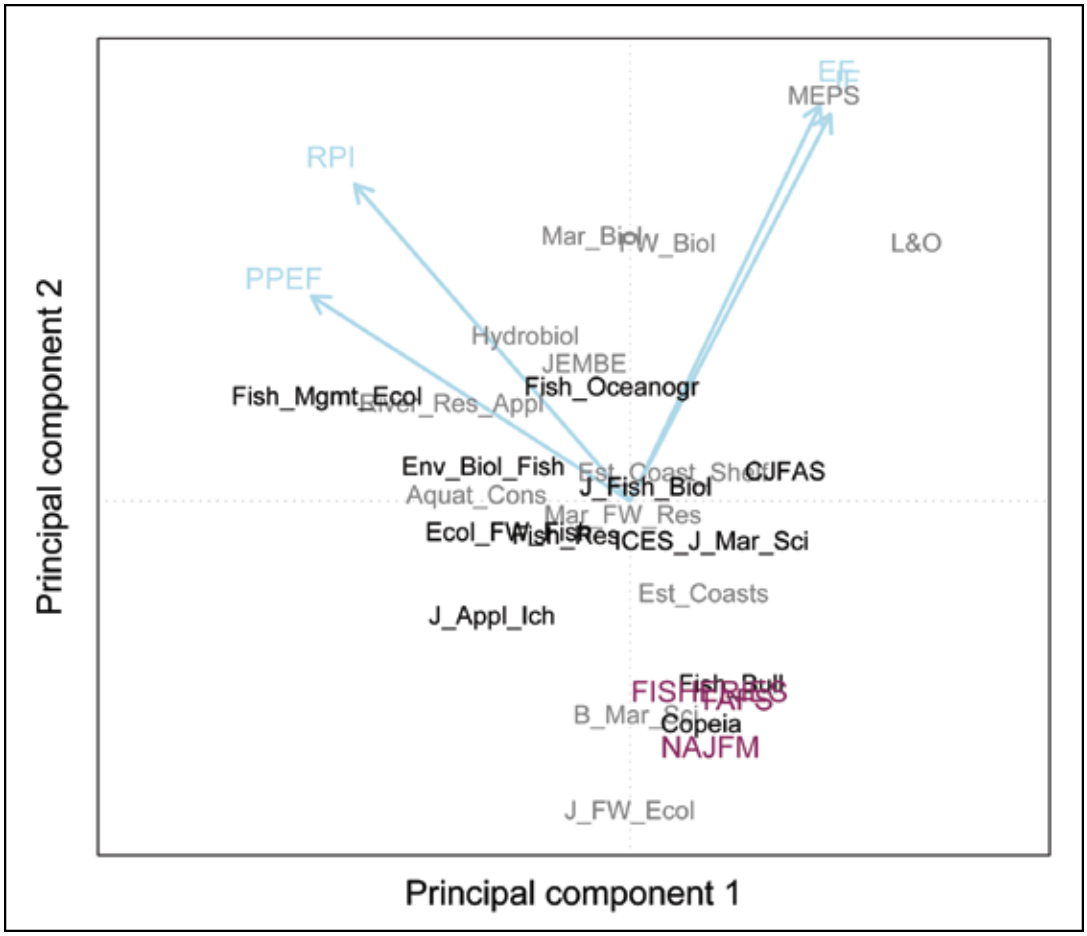


Figure 4. Biplot resulting from a principal components analysis (PCA) for the subset of journals included in Table 3. The most recent data for influence and cost-effectiveness metrics (IF [2007]; EF, PPEF, RPI [2006]) were scaled prior to analysis and the PCA was performed using singular value decomposition with the `rda` function in the `vegan` package for R (Okansen et al. 2009; R Development Core Team 2009). The first component (x-axis) explains mostly variation in cost-effectiveness metrics and the second component (y-axis) explains mostly variation in influence metrics. For readability, the abbreviations of the AFS journal names are written larger and in maroon, the abbreviations for the most direct peer journals (those at the top of Table 3) are written in black, and the abbreviations for less direct peers are written in gray. The most influential journals are toward the top right (e.g., *MEPS* and *L&O*) and the most cost-effective are toward the bottom right, where the AFS journals lie.

AFS journals might be better judged on the basis of cost-effectiveness and other criteria.

Concerns about journal value and cost-effectiveness are relatively new, but they have important implications for the progress of science and are relevant to the mission of AFS. Scientists are both the primary producers and consumers of journal articles, and contribute free peer review services, so authors and volunteer editors must exert some influence on the economics of the publication process. Some commercial publishers control hundreds or thousands of journals and devote so much effort to maximizing profits that they impede the exchange of peer-reviewed information (Rosenzweig 2000; Bergstrom and Bergstrom 2004). Given the recent profusion of journals and ongoing increases in subscription costs, even large academic libraries are fiscally challenged to provide continued and comprehensive access to researchers in the varied disciplines at their institutions (McGuigan 2004; Moghaddam 2007). As a result, journal circulation is strongly positively related to journal cost-effectiveness, and circulation can be expected to feed back on citation rates (Bergstrom and Bergstrom 2006; Evans and Reimer 2009).

The success of open access publications, such as those of the Public Library of Science (PLoS; www.plos.org), have demonstrated that the results of highly influential research can be made available to a wide readership at low cost (e.g., PLoS Biology: 2006 EF*100 = 8.9, 2007 IF = 13.5). We found that scientists publishing in fisheries and aquatic sciences journals have options from non-profit publishers like AFS that strike a reasonable balance between influence and cost-effectiveness, similar to findings for ecology (e.g., the journals of the Ecological Society of America; Bergstrom and Bergstrom 2006). Review journals specifically for fisheries are an exception, and we suggest that AFS journals, including the new open access *Marine and Coastal Fisheries* journal, may be able to help fill this gap in the marketplace.

As an extension of our assessment, we offer some suggestions that might help increase the influence of AFS journals without unduly compromising their accessibility and affordability:

1. The AFS journals web site could more prominently display the aims and scopes of the journals, and potentially other information. This type of information is currently buried in the Guides to Authors, in contrast to the practices of other professional societies (e.g., CERF, www.erf.org/journal).
2. Although all AFS journals occasionally publish review articles, editors could more vigorously solicit timely, synthetic reviews on emerging or contentious topics. Such contributions are likely to be cited more frequently than regular articles, but are also especially useful in guiding scientific inquiry. Special sections including multiple articles could also be more often organized or solicited for a journal.
3. AFS could take further steps to reduce time-to-publication, including:
   a. Encouraging editors and associate editors to more aggressively screen manuscripts prior to peer review, in order to better match manuscripts to journals and more effectively allocate effort from volunteer reviewers and editors; and
   b. Reducing the amount of time given to authors to make revisions on accepted manuscripts (currently six months).
4. AFS could encourage editors to be more involved in developing and revising the aims and scopes of the journals, in collaboration

with the Publications Overview Committee. If revisions were made annually, they would help keep the journals current, provide a "vision" for the journals, and provide a basis for editors to actively solicit high quality manuscripts from colleagues or presenters at scientific meetings that contribute to the vision (e.g., articles on emerging or contentious topics).

5. AFS could consider expanding the content of the journals to include more international coverage, at the same time potentially changing the name of the journals *NAJFM* and *NAJA*.
6. AFS could consider expanding the content of the journals to include topics related to other trophic levels and aquatic processes, but still directly related to fisheries. We can envision a place for some articles that are now more often directed to journals like *Canadian Journal of Fisheries and Aquatic Sciences*, *Limnology and Oceanography*, and *Marine Ecology Progress Series*.

In conclusion, we argue that AFS journals serve the purposes of the Society and its membership well by publishing a balance of high quality articles that are influential in the literature as well as contribute to the applied aspects of fisheries research and management, and by being some of the most accessible and affordable journals in the marketplace. We feel that most of the AFS journals are competitive based on these criteria, and that the citation-based influence of *TAFS*, *NAJFM*, and *Fisheries* are reasonable. Nonetheless, we encourage continuous efforts to increase the influence (of any kind) of AFS journals, particularly *NAJA* and *JAAH*, and to adapt them to the changing landscape of scientific publishing. Given the recent pace of change in publishing practices, maintaining the competitiveness of the AFS journals will require more frequent evaluations of the type we have conducted here, as well as continued attention to the methods used to judge the success of the journals (particularly for *NAJFM*). Such evaluations will allow AFS to stay abreast of how the journals are doing and identify strategies to improve them.

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