**Comparing influence of ecology journals using citation metrics: or what’s the deal with all those metrics?**

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**Abstract**

**Keywords**

journal influence, impact factor, h-index, Article Importance, Eigenfactor, SNIP, SJR, publishing practices

**Introduction**

Scientists are interested in understanding and quantifying the universe, so the interest in quantifying journal influence is not surprising. The competitive nature of academia and scientific publishing also increases the interest in metrics of influence, impact, and prestige. The perceived importance of journals can influence the choice of publication venue for scientists. Some researchers may even make submission decisions based on a cost-benefit analysis, where financial cost or journal rejection rate compared with the benefit of publishing in highly prestigious or influential journals (ref: aarssen et al 2008). In addition to the general interest in objective metrics of influence, these metrics are increasingly being used for hiring decisions and promotion and tenure evaluation. Metrics are also used by librarians to inform journal subscription decisions, which was one of the primary goals of early metric development. Use by librarians may become increasingly important with the rising number of journals and challenges of funding higher education. Publishers use metrics to promote their journals and understand their influence over time and in relation to other publishers. Citation-based metrics have even been extended to compare the productivity and influence of universities and departments (REF: Fogg 2007 chronicle).

The most widely know metric of journal influence is the Thompson Reuters Journal Impact Factor (JIF). The JIF is published annually in the Journal Citations Report (JCR) and made freely available through Web of Science. The JIF represents the mean number of citations per article for a given journal over a two-year time frame (Table 1). Many publishers highlight the JIF on the websites for their journals, including *Ecology Letters*, which advertises a JIF of 17.557 and a ranking of 1/134 among ecology journals (<http://onlinelibrary.wiley.com>; retrieved 25 May 2013). However, being the most prominent influence metric comes with the cost of frequent and widespread criticisms. Criticisms of the JIF include 1) limitations of the citable materials in the Thompson Reuters ISI Web of Science database (REFS: Harzing year, Pendlebury 2008), 2) free citations from letters and editorials (ref: (Cameron, 2005), 3) insufficient time period biased to rapid production journals (Ref: McGarty (2000:14)), 4) inappropriate distributional representation by using a mean from a skewed distribution (REF: Seglen 1997), 5) excessive influence of review articles for certain journals, 6) inflation of the JIF over time (REF: Nef and Olden), 7) over simplification of journal influence (REF: Pendlebury 2008), 8) difficulty of comparing journals across disciplines and the influence of multidisciplinary journals (REF: Pendlebury 2008), 9) exclusion of many journals from the database (REF: Pendlebury 2008), 10) ease of manipulation by publishers to increase their JIF through altered publication practices (Ref: Falagas M. & Alexiou V. (2008)). Further details regarding criticisms of the JIF can be found in Appendix A and the citations within.

In response to these criticisms, numerous other citation-based metrics have been put forth. These range from slight adjustments to address some of the JIF limitations to metrics based on different conceptual frameworks. All the metrics considered here are still citation based and do not consider other forms of influence or impact. There are alternative metrics (Altmetrics; [www.altmetric.com](http://www.altmetric.com)) that include article downloads, ratings on websites, and Internet links via websites, blog posts, and even Twitter. These Altmetrics are beyond the scope of this paper but may be useful for appreciating the full reach of particular papers and for inclusion in grant reports. Here I compare 11 strictly citation-based metrics for ecology journals: Journal Impact Factor (JIF), 5-year Journal Impact Factor (JIF5), Eigenfactor, Article Influence (AI), h-index, contemporary h-index (hc-index), e-index, g-index, AR-index, Source-Normalized Impact per Paper (SNIP), and SCImago Journal Factor (SJR). Brief definitions are found in Table 1, characteristics are found in Table 2, and more detail on the metrics can be found in Appendix B. Inference related to influence and citation patterns among ecology journals varies by metric. I explore the relationships among these metrics, discuss their interpretation, and make suggestions related to the use of each metric for ecologists.

**Materials and Methods**

I identified 134 ecology-related journals based on the Web of Science (WoS) Journal Citation Reports (JCR) Ecology category. For these journals, I downloaded the Journal Impact Factor, 5-year journal impact factor, EigenfactorTM, Article Importance, number of citations, immediacy, and citation half-life from WoS (retrieved 05 April 2013, <http://admin-apps.webofknowledge.com.libproxy.unh.edu/JCR/JCR?RQ=HOME>). I used Publish or Perish software (ref) to search Google Scholar and calculate the h-index, hc-index, g-index, e-index, and AR-index (reported as AW-index by Publish or Perish). I removed all results where Google Scholar indicated the reference type was a citation and checked for articles with incorrectly identified journals. All metrics of importance were calculated for articles published in the 5-year interval from 2007 – 2011. The metrics derived from Google Scholar include citations from the date of publication until the date of the query (05 – 25 April 2013). I downloaded the 2011 SNIP and SJR metrics from [www.journalmetrics.com](http://www.journalmetrics.com) (retrieved 13 May 2013) for these same journals.

To examine relationships among metrics, I calculated the pairwise correlations among all metrics using Pearson correlations for pairs with linear relationships and Spearman correlations for pairs exhibiting deviations from linearity. Journals with fewer than 50 articles identified in Google Scholar searches were excluded from the analyses, as were any journals with incomplete data (i.e. inability to calculate 1 or more metrics).

**Results**

I compiled a total of 1,084,169 citations for 63,868 articles from 131 ecology journals from Google Scholar searches for articles published from 2007 – 2011. These were combined with data from the 2011 Thompson Reuters Journal Citations Report accessed on the Web of Science, and data from the Scopus database. From these sources, I had sufficient data to estimate all metrics for 110 journals. From the JCR, the mean JIF was 2.93 (range: 0.043 – 17.557), with *Ecology Letters* having the highest JIF. The mean JIF5 was 3.31 (range: 0.134 – 18.007), the Article Influence mean was 1.28 (range: 0.049 – 9.273), and Eigenfactor mean was 0.0148 (range: 0.00026 – 0.09614). From the results of Google Scholar searches, I estimated mean values of 35.1 (range: 5 – 103), 28.3 (range: 5 – 84), 50.3 (range: 6 – 151), 29.2 (range: 3.46 – 91.10), and 37.2 (range: 6.61 – 90.05) for the h-index, hc­-index, g-index, e-index, and AR-index, respectively. I estimated a means of 1.28 (range: 0.094 – 5.483) and 1.48 (range: 0.111 – 8.702) for the SNIP and SJR metrics, respectively.

All five of the influence metrics calculated on a per-article basis (JIF, JIF5, AI, SNIP, SJR) were highly linearly correlated (Pearson’s correlation ≥ 0.90; Figure 1). The Eigenfactor was nonlinearly correlated with all other metrics. The Google-derived indices (h, hc, g, e, AR) were highly linearly correlated to each other and nonlinearly correlated to the other metrics. All metrics had either Pearson (if linear relationship) or Spearman (nonlinear relationship) correlations greater than 0.75 (Figure 1). The distribution of scores among journals was highly skewed, as expected, with most journals having low scores and few journals having very high scores. The Google-based metrics had more evenly distributed scores than the other metrics (Figure 1, diagonal histograms). The SNIP had the most even distribution among the metrics calculated on a per article basis.

**Discussion**

All metrics were highly correlated for ecology journals, but there was still considerable variation in the rank and relative influence of journals among metrics. Rankings of journals in ecology based on the JIF, JIF5, AI, SNIP, and SJR corresponded well. The top 3 journals based all 5 metric rankings are *Annual Review of Ecology, Evolution*, *and Systematics, Trends in Ecology and Evolution*, and *Ecology Letter*s. The first two publish primarily review articles, which tend to be highly cited and hopefully highly synthetic (more synthesis generating novel ideas or tests as opposed to simple summaries of literature). *Ecology Letters* is the highest ranked journal that focuses on primary research, although it does publish reviews and opinion articles as well. The biggest difference among the five metrics in the top 20 journals is *Molecular Ecology*, which is ranked 9th by the JIF5 but only 21st by the AI score and 20th by the SNIP. This suggests that while the average *Molecular Ecology* article is highly cited, the influence of those articles does not spread as much through science as a whole. This may be due to higher than average rates of self-citations (within journal). This pattern may also be related to *Molecular Ecology* being a slightly more specialized than the other ecology journals in the top 20. The *American Naturalist* also differs considerably between the metrics, where is ranked 19th by the JIF5, 11th by AI score, 23rd by SNIP, and 10th by SJR. The AI and SJR, which account for the scientific citation network, both rank the *American Naturalist* higher than the JIF5 or SNIP, which only account for the number of citations to a given journal directly. This suggests a better spread of ideas through science than indicated by single-level citation metrics. Surprisingly, the ISME Journal, with a focus on microbial ecology, was ranked more highly by the JIF5 and AI compared with the SNIP and SJR. This is unexpected because the AI and SJR are more similar in theoretical foundation; therefore, the differences may be more due to differences in the databases than with the metrics.

The ranking of journals shifts considerably when considering total scientific influence rather than influence on a per article basis. The top three journals based on Eigenfactor rank are *Proceedings of the Royal Society B: Biological Sciences, Ecology*, and *Molecular Ecology*. A journal like *Proceedings* might have a higher total influence than other ecology journals because it publishes many papers in more areas of biology than most of the journals on this list, but it is included as it is not as broad as the general science giants, *Nature, Science,* and *Proceedings of the National Academic of Sciences*. Of those journals in the top 20 of the JIF or AI indices, only 12 are also in the top 20 in Eigenfactor rank. One extreme case is the *Bulletin of the American Museum of Natural History*, which is ranked 9th and 10th by AI and JIF, respectively. *The Bulletin* is only ranked 75th by the Eigenfactor and 92nd by the H-index. The discrepancy between the first two metrics and the second two metrics (rank per article and rank on overall scientific influence) is likely a function of the number of articles published, primarily. Journals that publish more articles are likely to have greater total influence on scholarly thought, all else being equal. A publisher may try to maximize total influence by increasing publication output through increased frequency and accepting a greater number of short articles. Similarly, librarians may be interested in the subscription price of journals relative to their total influence rather than on the per article influence. Researchers, in contrast, are likely to be primarily interested in the average article influence and therefore focus on AI and JIF. *Ecology Letters* and *Trends in Ecology and Evolution* are two of the only journals that rank among the top in all metrics. This indicates they publish a large number of highly influential articles. Those articles tend to be highly cited and have influence that spread through scientific thought.

One journal that made a surprise entry into the top ecology journals is the new comer, *Methods in Ecology* *and Evolution*. This is a relatively new journal, particularly in relation to the 2007 – 2011 time period of this study. The rise of a methodological ecology journal reveals the increasing complexity and sophistication of ecological studies and analyses. Increasing use of hierarchical models, Bayesian methods, Random Forests, Network Theory, and similarly complex analyses require a specialty journal where authors can explain challenging mathematics in a form accessible to applied ecologists. This new outlet facilitates the use of novel methods, as evidenced by the high citation metrics, by helping ecologists better understand complex and dynamic aspects of nature that could previously only be examined qualitatively.

While journal ranks are interesting, the various metrics show different patterns of dispersion in scores among journals. Most journals have relatively low values across all metrics, whereas a few journals have much high values. The top three ranked journals had scores well above the others for most metrics on a per article basis. The *Annual Review of Ecology, Evolution, and Systematics*, *Trends in Ecology and Evolution*, and *Ecology Letters* had AI, JIF, JIF5, and SJR metrics greater than 50% higher than the 4th ranked journal for each metric. By design, the SNIP does not have this separation due to the normalization process of adjusting the journal citation potential (denominator of the SNIP calculation). Depending on the fields of study covered, journals have different citation potentials. Ecology is an integrative discipline and different journals focus on different aspects of ecology, giving them different citation potential within science as a whole. The SNIP values suggest that *Trends in Ecology and Evolution* has the clear leader in influence once corrected for citation potential of the fields. However, it is unclear if this distinction is precise enough for use among journals that publish papers in similar fields such as the top ecology journals. The Eigenfactor, h-index, hc­-index, g-index, e-index, and AR-index do not show the same clear separation of these, or any, ecology journals. The difference in pattern compared with the AI, JIF, JIF5, and SJR is because they measure influence without correcting for the volume of publications from a journal. Therefore, journals that publish more papers will always increase their scores for these metrics, all else being equal.

Comparing metrics is less about which metric is best, but rather which is the most useful metric or metrics for a specific purpose. Each metric provides particular information about a journal’s influence on the scientific community, or at least on the scientific community’s citation habits (REF: Moed et al 2012). However, given the numerous, valid criticisms of the JIF, I recommend avoiding much inference based on this particular metric. The JIF5 is probably a better metric for most purposes than the JIF, but the AI, SNIP, and SJR all have qualities that are superior to the JIF5. The AI, as well as the Eigenfactor, currently suffer from some of the limitations of the JIF because they are calculated using the same Thompson Reuter’s database; however, in theory they could be calculated from other databases. The SNIP and SJR are calculated from the Scopus database, which is larger and more inclusive than the Thompson Reuter’s database, but these metrics also have their own limitations and therefore appropriate uses. The SNIP is useful for comparing among diverse fields of study. However, the database potential used in the denominator of the SNIP calculation may not match the field of study as accurately as desired, potentially leading to bias for some fields. The weighting of the journals differentiates between the SJR from the AI, but whether increased weighting for citations from similar journals, as done in the SJR, is desirable is unclear. The theory behind closeness weighting is that researchers in the same field are better able to critically choose the papers to cite within that field. The closeness weighting relates more to journal quality than to overall scientific influence. This also creates less intuitive and interpretable values for the SJR compared with the AI.

One appealing aspect of the Eigenfactor, and the associated AI, is the relational interpretation both within and among fields. For example, *Ecology Letters* with an Eigenfactor of 0.06713 can be interpreted to have 32 times the influence on science compared with *Pedobiologia* (Eigenfactor = 0.00209), a smaller more specialized ecology journal. Similarly, *Ecology Letters* (AI: 7.38) has 52 times the influence per article compared with the more specialized *Journal of Freshwater Ecology* (AI: 0.143). That is not to say that *Pedobiologia* and *Journal of Freshwater Ecology* are not good journals, if fact, I selected them for comparison because they are generally high-quality journals, but with a smaller audience and narrower scope. As such, they have less total influence on science (Eigenfactor) and less influence per article (AI).

The h-index has a less clear interpretation than the Eigenfactor or AI. The h-index was designed for evaluation of research influence. While it can be used to evaluate journal influence and has a reasonably high correlation to other influence metrics, it is even more problematic for journals than for researchers. Researchers have limits to the number of articles they can publish. Journals, in contrast, have vastly different publishing capacities and the number of highly cited articles, representing the h-index, is not necessarily representative of the general citation structure of the journal as a whole. For journals, the h-index and its variations may better represent prestige than influence, because they are metrics of the number of highly cited papers, but do not indicate the average influence per article or the total influence on the scientific field. The h-index, hc-index, e-index, g-index, and AR-index can be useful to compliment the other indices and add nuance to the understanding of a journal’s citation patterns. For journals with similar scores based on other metrics of influence, the h-index and g-index can help understand whether a journal’s influence comes from many moderately cited papers or from just a few very highly citated papers. However, these indices are still best suited for examining the influence of individual researchers (with caution). Dividing the h-index by the number of papers published to create the normalized h-index has been proposed to standardize the h-index for journal comparison (REF: same as contemporary h-index). However, the normalized h-index does not have the intuitive interpretation of the JIF or full network inference of the Eigenfactor, AI, or SJR metrics.

All the metrics compared in this paper have limitations and all evaluate slightly different aspects of journal influence. As such, different indices may be more appropriate for different purposes. Librarians and publishers may be interested in the total influence of particular journals, making the Eigenfactor the primary metric of interest. This can help inform decisions regarding subscriptions and purchasing. Of course, librarians listen to faculty member recommendations and make strategic decisions based on costs, database bundles, departmental representation, and other criteria, but citation metrics and journal influence can help further distinguish subscription purchasing decisions. This is increasingly important given the rising costs of higher education outstripping revenue.

In contrast, researchers may be interested in the chance of their article being highly influential (read and cited). When choosing among journals as an outlet for research and scientific ideas, researchers consider numerous factors. These include overall fit, intended audience, cost, publishing speed, novelty of research, open-access options, and perceived journal quality or influence. Although, I frequently hear colleagues criticize impact factors and other metrics as irrelevant, these metrics do play some role in how many scientists select journals for manuscript submission. As such, the AI score may be of most interest because it is a per article representation of the Eigenfactor score. In ecology, the JIF5 is highly correlated with the AI score and could be used as an accurate estimate of a journal’s per article influence. However, this is not always true. In economics, mathematics, and medicine, the relationship between the JIF5 and AI score is different than for ecology ([www.eigenfactor.org](http://www.eigenfactor.org) - see if can get reprint permission). It is possible that the relationship between the two metrics will change within ecology over time or for particular journals. The AI score currently suffers from some of the same limitations as the JIF5, including a limited, albeit large, database of journals, limited inclusion of citations from books, and free citations because not all communications are included in the number of published articles. However, given the conceptually superior calculation of influence throughout scholarly publications, I recommend scholars focus on the AI score rather than either the 2-year or 5-year impact factors.

Additionally, citations and scholarly influence play a part in promotion and tenure decisions. While adjustments to these metrics and new metrics are proposed regularly, there has recently been pushback in opposition to the increasing use of these metrics (REFS: ). In response to what is viewed as misuse of citation-based metrics, researchers recently put forth the San Francisco Declaration on Research Assessment calling for an end to the use of these metrics for evaluating researchers (<http://am.ascb.org/dora/>). The signatories of this declaration call for researchers, publishers, administrators, and granting agencies to apply a more holistic approach to evaluating research outputs. Furthermore, they call on organizations supplying metrics to be more open in sharing the methods and data used, and specifically to, “Provide the data under a licence [sic] that allows unrestricted reuse, and provide computational access to data, where possible” (REF: San Francisco Declaration: <http://am.ascb.org/dora/files/SFDeclarationFINAL.pdf>). The grievances highlighted in this Declaration cannot be ignored. Citation-based metrics provide valuable information about the publishing and citation patterns among researchers, journals, research fields, and publishers. While useful, this information should not be weighted excessively when considering publishing research or evaluating researchers for hiring, promotion, tenor, or funding. A more inclusive approach in evaluating subscription decisions, publishing outlets, and researchers is necessary.

Familiarity, complexity, and scale are the biggest challenges for moving scientists away from the JIF and to other metrics, particularly the Eigenfactors and AI scores. The Journal Impact Factor has been part of the scientific lexicon for decades and most scholars are aware of its use even if they do not consider it as part of their publication process. The JIF is so ingrained in the scientific community that it is possible that the view of journal hierarchy within ecology is based as much on JIFs as it is on the content of the journal. Separating the two is impossible at this point. Even those scholars frustrated with the limitations of JIFs might have trouble with a paradigm shift to Eigenfactors because of the complexity of Eigenfactor calculation. Most researchers are not experts in network theory and may be confused by the calculation of Eigenfactors, making researchers dubious of the metric. Finally, the JIF is on a scale that is easy to remember and talk about. Journals with JIFs below 1 are generally smaller, specialty journals with lower reach and readership. Many good journals in the field of ecology fall in the range of 3-6 and the very top ecology journals are between 10 and 20. Eigenfactors for ecology journals, in contrast, range from 0.00014 - 0.08167. Although they represent the percent influence on scientific citations as a whole (i.e. all Eigenfactor scores sum to 100), these are not numbers that are easy to remember or discuss in casual conversations. Using a scaled Eigenfactor value might enable Eigenfactors to gain greater traction in the ecological community. Eigenfactors have a greater relative range than JIFs, allowing for greater separation of journals by network influence. Multiplying Eigenfactors by 100 to create and Eigenfactor index would allow ecology journals to range from 0.014 to 8.167, and top scientific journals such as Nature, PNAS, and Science would have an Eigenfactor-index of 165.5, 160.2, and 141.2, respectively. These are numeric values that would help increase the use of Eigenfactors by the scientific community. This is equivalent to all Eigenfactor scores summing to 10,000.

In summary, citations served as a link to previously published materials and provide credit for original ideas (REF: Davis 2008). Citation-based metrics can indicate the influence ideas from particular papers and in aggregation reveal the influence of specific scholars and journals. The process of citing previous research creates a massive network scientific documents. As such, network-based metrics (Eigenfactor, AI, SJR) are best suited for understanding the flow of ideas through science and the influence of particular journals. All metrics were positively correlated among ecology journals; however, there was still considerable variation among metrics and these correlations can change over time as publishing practices change. Each influence metric has its own strengths and weaknesses, and therefore its own uses regardless of current correlations. Researchers interested in the average influence of articles in a journal would be best served by referring to AI scores or possible SJR values. The h-index and related indices (hc, e, g, AR) are better suited for evaluating individual influence than journal influence, but in combination may be useful for differentiating citation patterns among journals with similar AI or SJR scores. Publishers and librarians interested in the total influence of a journal on science should use Eigenfactor scores. The SNIP may be useful for comparing the relative influence of journals across very disparate fields of study. Despite the usefulness of citation-based metrics for understanding the flow of scientific ideas and influence, they have limitations and should not be over emphasized by publishers or by researchers looking for manuscript outlets, and especially not for personnel decisions. A holistic view of a journal including audience, publishing speed, cost, type of articles, length of articles, and overall fit is needed when making publishing decisions. Finally, citation-based metrics only capture one aspect of scientific influence, they do not consider the influence on legislation, land-use practices, public perception, or other effects outside of the publishing network.

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Table 1. Definitions of journal influence metrics

|  |  |  |
| --- | --- | --- |
| **Influence Metric** | **Basic Definition** | **Reference** |
| Journal Impact Factor (JIF) | Number of citations divided by number of articles publisher over 2 year time frame | Ref |
| Five-year Journal Impact Factor (JIF5) | Same as the JIF but calculated using a 5 year time frame | Ref |
| Eigenfactor | Percent of citations across all journals linked to each journal through network using eigenvector centrality methods | Bergstrom (ref: 2007) |
| Article Influence (AI) | Eigenfactor divided by number of articles published by the journal, scaled by multiplying by 0.01 | Ref |
| Source Normalized Impact per Paper (SNIP) | Corrects for differences in publications characteristics across fields by dividing the impact factor by the database citation potential within each field of study | Refs: Colledge et al. 2010, Waltman et al 2013, Moed 2010 |
| SCImago Journal Rank (SJR)\* | Influence of journals based on network of citations on a per article basis, weighing citations from prestigious and similar journals | Ref: Guerrero-Bote and Moya-Anegon 2012 |
| h-index | Number of papers that have at least h citations | Refs: Hirsch 2005, Harzing and van der Wal 2007 |
| Contemporary h-index (hc-index)\*\* | Age-adjusted version of the h-index\*\* | Ref: Sidiropoulos et al 2007 |
| e-index | Square-root of the number of citations above the h-index | Ref: Zhang 2009 |
| g-index | Number of papers that have at least g^2 citations | Egghe 2006 |
| AR-index\*\*\* | Square-root of the sum of citations divided by the age of the article for all articles contributing to the h-index | Jin 2007 |
| \*Adjustment to the original SJR sometimes referred to as SJR2 | |  |
| \*\*I used gamma=4 and delta=1 for this study. | |  |
| \*\*\*Reported as AW-index by Publish or Perish Software | |  |

Table 2. Characteristics of journal influence metrics

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Influence Metric** | **Database** | **Time Frame** | **Adjusted per Article** | **Age-adjusted** | **Network Weighting** | **Closeness weight** | **Journal Self Citations** | **Background Trend** |
| JIF | Web of Science | 2 years | ✓ |  |  |  | Included | Increasing |
| JIF5 | Web of Science | 5 years | ✓ |  |  |  | Included | Increasing |
| AI | Web of Science | 5 years | ✓ |  | ✓ |  | Excluded | ? |
| Eigenfactor | Web of Science | 5 years |  |  | ✓ |  | Excluded | ? |
| SNIP | Scopus | 3 years | ✓ |  |  |  | Included | Increasing |
| SJR | Scopus | 3 years | ✓ (rate) |  | ✓ | ✓ | Limited | Stable |
| h-index | Google Scholar | 5 years |  |  |  |  | Included | Increasing |
| hc-index | Google Scholar | 5 years |  | ✓ |  |  | Included | Increasing |
| e-index | Google Scholar | 5 years |  |  |  |  | Included | Increasing |
| g-index | Google Scholar | 5 years |  |  |  |  | Included | Increasing |
| AR-index | Google Scholar | 5 years |  | ✓ |  |  | Included | Increasing |

Table 1. Journal influence per article based on 5 metrics for the top 20 journals using the Article Influence score.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Abbrev\_Journal | AI | JIF | JIF\_5yr | SNIP | SJR |
| ANNU REV ECOL EVOL S | 9.273 | 14.373 | 18.007 | 3.932 | 6.901 |
| TRENDS ECOL EVOL | 7.913 | 15.748 | 16.981 | 5.483 | 8.702 |
| ECOL LETT | 7.38 | 17.557 | 15.389 | 3.701 | 7.898 |
| FRONT ECOL ENVIRON | 4.085 | 9.113 | 9.023 | 3.383 | 3.664 |
| ECOL MONOGR | 3.745 | 7.433 | 7.75 | 2.966 | 4.292 |
| GLOBAL CHANGE BIOL | 3.188 | 6.862 | 8.036 | 2.233 | 3.557 |
| ISME J | 2.812 | 7.375 | 7.85 | 1.778 | 2.851 |
| GLOBAL ECOL BIOGEOGR | 2.729 | 5.145 | 6.629 | 1.915 | 3.009 |
| B AM MUS NAT HIST | 2.722 | 2.905 | 6.281 | 2.694 | 1.909 |
| ECOLOGY | 2.637 | 4.849 | 6.007 | 1.941 | 3.336 |
| AM NAT | 2.61 | 4.725 | 5.28 | 1.677 | 3.098 |
| P ROY SOC B-BIOL SCI | 2.454 | 5.415 | 5.67 | 1.744 | 2.668 |
| EVOLUTION | 2.431 | 5.146 | 5.613 | 1.589 | 3.111 |
| J ECOL | 2.385 | 5.044 | 6.02 | 2.198 | 3.537 |
| CONSERV BIOL | 2.293 | 4.692 | 5.94 | 2.026 | 2.529 |
| ECOL APPL | 2.234 | 5.102 | 5.38 | 1.994 | 2.615 |
| METHODS ECOL EVOL | 2.205 | 5.093 | 5.093 | NA | NA |
| J APPL ECOL | 2.171 | 5.045 | 5.804 | 2.239 | 2.851 |
| ECOGRAPHY | 2.165 | 4.188 | 5.535 | 1.603 | 2.395 |
| PERSPECT PLANT ECOL | 2.112 | 3.208 | 5.229 | 2.806 | 1.634 |

Table 2. Ecology journal influence for six citation-based metrics. These metrics do not correct for the number of articles published by each journal.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Abbrev\_Journal | Eigenfactor | h\_index | hc\_index | e\_index | g\_index | AR\_index |
| P ROY SOC B-BIOL SCI | 0.09614 | 85 | 67 | 63.55 | 117 | 78.31 |
| ECOLOGY | 0.08167 | 78 | 59 | 62.81 | 111 | 82.37 |
| MOL ECOL | 0.07334 | 79 | 67 | 80.15 | 126 | 90.05 |
| ECOL LETT | 0.06713 | 94 | 76 | 84.81 | 140 | 81.56 |
| GLOBAL CHANGE BIOL | 0.06455 | 87 | 69 | 62.8 | 119 | 89.42 |
| TRENDS ECOL EVOL | 0.06008 | 103 | 84 | 91.1 | 151 | 77.42 |
| EVOLUTION | 0.05569 | 64 | 50 | 47.86 | 89 | 72.78 |
| MAR ECOL-PROG SER | 0.05428 | 54 | 40 | 38.64 | 73 | 63.42 |
| BIOL CONSERV | 0.04727 | 67 | 52 | 53.8 | 95 | 75.23 |
| AM NAT | 0.04448 | 61 | 46 | 37.74 | 78 | 63.21 |
| OECOLOGIA | 0.04034 | 52 | 39 | 39.85 | 72 | 64.73 |
| ECOL APPL | 0.03761 | 59 | 46 | 53.59 | 89 | 67.11 |
| CONSERV BIOL | 0.0344 | 71 | 55 | 59.26 | 102 | 66.82 |
| J EVOLUTION BIOL | 0.03224 | 49 | 37 | 43.97 | 73 | 59.29 |
| OIKOS | 0.03049 | 49 | 37 | 39.96 | 70 | 57.54 |
| BIOL LETTERS | 0.02992 | 51 | 40 | 36.91 | 69 | 59.9 |
| ECOL MODEL | 0.02928 | 48 | 37 | 43.93 | 72 | 60.39 |
| J APPL ECOL | 0.02866 | 63 | 46 | 48.58 | 87 | 63.86 |
| J ECOL | 0.02782 | 58 | 45 | 42.56 | 79 | 59.11 |
| J BIOGEOGR | 0.02782 | 53 | 44 | 45.46 | 77 | 60.41 |

Table 3. Ranks of top 10 journals on a per article basis as indicated by the 5-year Journal Impact Factor, Article Influence score, SNIP, and SJR.

OR ordered by AI because that’s what I’m suggesting (but JIF more well known)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Journal | JIF5 Rank | AI Rank | SNIP Rank | SJR Rank |
| ANNU REV ECOL EVOL S | 1 | 1 | 2 | 3 |
| TRENDS ECOL EVOL | 2 | 2 | 1 | 1 |
| ECOL LETT | 3 | 3 | 3 | 2 |
| FRONT ECOL ENVIRON | 4 | 4 | 4 | 5 |
| GLOBAL CHANGE BIOL | 5 | 6 | 9 | 6 |
| ISME J | 6 | 7 | 19 | 13 |
| ECOL MONOGR | 7 | 5 | 5 | 4 |
| GLOBAL ECOL BIOGEOGR | 8 | 8 | 14 | 11 |
| MOL ECOL | 9 | 21 | 20 | 14 |
| B AM MUS NAT HIST | 10 | 9 | 7 | 28 |
| J ECOL | 11 | 14 | 10 | 7 |
| ECOLOGY | 12 | 10 | 13 | 8 |
| CONSERV BIOL | 13 | 15 | 11 | 18 |
| J APPL ECOL | 14 | 18 | 8 | 12 |
| P ROY SOC B-BIOL SCI | 15 | 12 | 21 | 16 |
| EVOLUTION | 16 | 13 | 27 | 9 |
| ECOGRAPHY | 17 | 19 | 26 | 19 |
| ECOL APPL | 18 | 16 | 12 | 17 |
| AM NAT | 19 | 11 | 23 | 10 |

Table. Journal ranks based on their total influence on scholarly thought as indicated by the citation-based metrics: Eigenfactor, H-index, AR-index, and total citations. The top 20 ecology journals based on Eigenfactor and H-index are shown.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Journal | EF\_Rank | H\_Rank | AR\_Rank | Cites\_google\_rank |
| P ROY SOC B-BIOL SCI | 1 | 5 | 6 | 6 |
| ECOLOGY | 2 | 7 | 4 | 3 |
| MOL ECOL | 3 | 6 | 1 | 1 |
| ECOL LETT | 4 | 2 | 5 | 5 |
| GLOBAL CHANGE BIOL | 5 | 3 | 2 | 2 |
| TRENDS ECOL EVOL | 6 | 1 | 7 | 7 |
| EVOLUTION | 7 | 11 | 9 | 9 |
| MAR ECOL-PROG SER | 8 | 18 | 15 | 11 |
| BIOL CONSERV | 9 | 9 | 8 | 8 |
| AM NAT | 10 | 13 | 16 | 15 |
| OECOLOGIA | 11 | 20 | 13 | 13 |
| ECOL APPL | 12 | 15 | 11 | 12 |
| CONSERV BIOL | 13 | 8 | 12 | 10 |
| J EVOLUTION BIOL | 14 | 27 | 20 | 20 |
| OIKOS | 15 | 28 | 23 | 22 |
| BIOL LETTERS | 16 | 25 | 19 | 19 |
| ECOL MODEL | 17 | 30 | 18 | 17 |
| J APPL ECOL | 18 | 12 | 14 | 16 |
| J ECOL | 19 | 16 | 21 | 21 |
| J BIOGEOGR | 20 | 19 | 17 | 18 |
| ECOL ECON | 21 | 4 | 3 | 4 |
| J ANIM ECOL | 22 | 26 | 26 | 26 |
| BIOGEOSCIENCES | 23 | 32 | 24 | 23 |
| FUNCT ECOL | 24 | 22 | 25 | 24 |
| ISME J | 25 | 10 | 10 | 14 |
| ANNU REV ECOL EVOL S | 26 | 34 | 52 | 52 |
| BEHAV ECOL | 27 | 45 | 36 | 36 |
| J EXP MAR BIOL ECOL | 28 | 41 | 28 | 27 |
| FRONT ECOL ENVIRON | 29 | 14 | 34 | 31 |
| BEHAV ECOL SOCIOBIOL | 30 | 46 | 33 | 34 |
| ECOGRAPHY | 31 | 40 | 38 | 39 |
| BIODIVERS CONSERV | 32 | 36 | 29 | 28 |
| ECOSYSTEMS | 33 | 29 | 42 | 41 |
| HEREDITY | 34 | 35 | 39 | 38 |
| GLOBAL ECOL BIOGEOGR | 35 | 17 | 37 | 37 |

<http://jcn.sagepub.com/content/24/3/260.long>

<http://community.thomsonreuters.com/t5/Citation-Impact-Center/Thomson-Scientific-Corrects-Inaccuracies-In-Editorial/ba-p/717/message-uid/717>

<http://jgp.rupress.org/content/131/2/183>

<http://www.plosmedicine.org/article/info:doi/10.1371/journal.pmed.0030291>

<http://arxiv.org/abs/1010.0278>

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2140038/?tool=pubmed>

SJR Maps and subject areas and subject categories

**SCImago. (2007). SJR — SCImago Journal & Country Rank.  
Retrieved May 16, 2013, from** <http://www.scimagojr.com>

03 May 2013: (Scopus Ecology Category) <http://www.scimagojr.com/journalrank.php/journalrank.php?area=0&category=2303&country=all&year=2011&order=sjr&min=0&min_type=cd>

Figure 1. Scatterplot and correlation matrix of journal influence metrics with histograms on the diagonal. The top half of the panels are scatterplots showing the relationship between each pair of influence metrics with a smoothing spline through the points to help review linear and nonlinear patterns. The bottom half of the panels are correlations. Pearson correlations were used for linear relationships (p in upper right) and Spearman correlations were used when any nonlinearity was observed (s in upper right).

Figure 1.



Appendix A.

While the purpose here is not to evaluate the criticisms of the JIF, I outline many of the common concerns below:

([Colquhoun 2003](#_ENREF_5); [Walter *et al.* 2003](#_ENREF_15); [Monastersky 2005](#_ENREF_9); [Fuyuno & Cyranoski 2006](#_ENREF_7); [The 2006](#_ENREF_14); [Rossner *et al.* 2007](#_ENREF_10); [Browman & Stergiou 2008](#_ENREF_1); [Brumback 2008](#_ENREF_2); [Campbell 2008](#_ENREF_4); [Falagas & Alexiou 2008](#_ENREF_6); [Rossner *et al.* 2008](#_ENREF_11); [Russ-Eft 2008](#_ENREF_12); [Smith 2008](#_ENREF_13); [Wilcox 2008](#_ENREF_16); [Brumback 2009](#_ENREF_3))

* **Citable Materials:** As calculated by the Thompson Reuters and reported in the JCR, citations outside the ISI database are not included and many citations in books are not included (refs - Harzing). This is expected to be a large problem in the humanities because much of the scholarly work is in the form of books (REF: Pendlebury 2008)
* **Free Citations:** Letters and editorials do not count towards the number of papers published but the citations to these materials (i.e. increase numerator citations but not denominator publication number). Therefore, journals with lively discussion through letters and editorials have inflated JIFs (ref: (Cameron, 2005)
* **Insufficient Time Period:** For the standard 2-year JIF, the spread of information and rate of journal publication is often not sufficient to allow for citations from outside scholars; therefore, the 2-year JIF is overly influenced by self citations (Ref: McGarty (2000:14))
* **Distributional Representation:** The JIF is also calculated as using the mean citations per article but the distribution of citations among articles in generally highly skewed (REF: Seglen 1997), making the mean and inappropriate measure of the impact of a journal as a whole. The use of the arithmetic mean is also potentially sensitive to outliers.
* **Review Articles:** The JIF is also influenced by the publication of review articles, which tend to be highly read and cited, but potentially in disproportion to their influence compared with original research papers.
* **Inflation:** The average JIF across all journals tends to increase over time as more articles are published with more citations (although many journals are now limiting the number of citations to save print space). Therefore, journals that have increasing JIFs might appear to be increasing in influence, but if their JIF could be increasing slower than the rate of inflation. These journals may be decreasing in influence compared with others in the field (REF: Nef and Olden).
* **Over simplification:** Many consider the JIF to be overly simplistic; therefore, it does not sufficiently represent the full, multi-dimensional scope of a journal’s influence (REF: Pendlebury 2008)
* **Multidisciplinary journals:** It can be difficult to interpret which fields of study contribute to the journal influence if many fields of study are published in one journal (REF: Pendlebury 2008)
* **Journal Exclusion:** Not all journals are indexed by Thompson Reuters and there is bias in relation to nation and languages (REF: Pendlebury 2008)
* **Manipulation:** The JIF can be manipulated through publishing practices. Increasing the rate of publication, soliciting review articles, and encouraging self-citation can enhance a journal’s impact factor.

Appendix B.

JIF – The journal impact factor is defined as the number of citations to all articles in a journal published in the previous 2 years divided by the number of articles published by that journal in that time frame.

JIF5 – The 5-year journal impact factor is calculated the same way as the JIF but over 5 years rather than the previous 2 years

Eigenfactor – Scholarly interactions exist in a network connected by citations among articles. The influence of an article does not necessarily stop with the publications that cite the original article but extends through the network of scholarly work citing those secondary publications. The Eigenfactor uses network theory in an algorithm, similar to Google PageRank, to iteratively resample the network to determine the influence of journals in the network. It uses a modified version of eigenvector centrality methods to overcome problems of dangling nodes at the edges of the network. The details of the algorithm are beyond the scope of this paper, but more information including the code used can be found at (<http://www.eigenfactor.org>) and the Eigenfactor is originally described in Bergstrom (REF 2007) (provide in appendix? - http://www.eigenfactor.org/methods.pdf). Of note, the Eigenfactor reported in the JCR does not include self citations and the sum the Eigenfactors for all journals in the database sums to 100. Therefore, the Eigenfactor score of a journal can be interpreted as the total influence of the journal on scholarly thought as identified through citations.

Article Influence (AI) – the citation influence of a journal on a per citation basis. It is calculated as

where EF is the Eigenfactor value and *a* is the number of articles over a 5 year time period. As with the Eigenfactor, the AI does not include self citations. The article influence score is intended to be comparable to the JIF because the EF measures the entire influence of a journal whereas the JIF and AI calculate the influence on a per-article basis.

H-index – the number of papers that have at least H citations (Hirsch ref). While originally intended as a metric of author influence, Harzing and van der Wal (REF: 2007) showed that it can be used as a metric for journal influence. Although the H-index can be calculated over any timeframe, it is often calculated over the previous 5 years when comparing current influence.

Hc-index – the contemporary H-index is an age-adjusted version of the H-index. It is calculated using gamma=4 and delta=1 by Publish or Perish software (Antonis Sidiropoulos, Dimitrios Katsaros, and Yannis Manolopoulos in their paper **Generalized h-index for disclosing latent facts in citation networks**, *[arXiv:cs.DL/0607066](http://arxiv.org/abs/cs.DL/0607066" \t "_blank) v1 13 Jul 2006*.) – now in Scientometrics 2007

e-index – the square root of the number of citations above the H-index. It is intended to complement the H-index by differentiating between authors or journals with different citation patters but similar H-indices (Chun-Ting Zhang in his paper **The e-index, complementing the h-index for excess citations**, *PLoS ONE*, Vol 5, Issue 5 (May 2009), e5429.)

g-index – similar to the H-index but represents the number of papers such that g papers have at least g2 citations (by Leo Egghe in his paper **Theory and practice of the g-index**, *Scientometrics, Vol. 69, No 1 (2006), pp. 131-152)*

AR-index - The AR-index stands for the age-dependent index calculated using square-root. It is calculated as

where *Hcore* are the publications constituting the H-index, *Citp* is the number of citations for publication *p* in the H-index, and *ap* is the age of publication *p*. The AR-index is intended to adjust the H-index for age and allow the index to decrease over time, unlike the H-index which can only increase over time ([Jin 2007](#_ENREF_8)). However, for the purpose of understanding journal influence, I calculated the AR-index including all publications found for each journal during 2007-2011. As it is age-adjusted, this should more accurately reflect the total scientific influence of each journal, at least with respect to citations (see Altmetrics for limitations).

SNIP – The Source Normalized Impact per Paper is intended to correct for differences in publication characteristics across fields of study. Some fields of study publish more quickly, allow more citations per paper, and have a greater total volume of publications than other fields. These characteristics lead to differences in most citation metrics unrelated to the influence of papers within a discipline. This may be a concern even within journals publishing ecologically-oriented papers because ecology spans a variety of disciplines including evolution, genetics, physiology, conservation, and behavior. To calculate the SNIP, the raw impact per paper is divided by the database citation potential, which adjusts for differing publication characteristics across fields of study. The SNIP is calculated over 3-year periods using Elsevier’s Scopus database and is freely available at [www.journalmetrics.com](http://www.journalmetrics.com). Greater detail on SNIP methodology can be found in REFS xxxxxxxxxxxxx (Refs: Colledge et al. 2010, Waltman et al 2013, Moed 2010)

SJR – The SCImago Journal Rank is similar to the Article Influence, in that it measures the influence of journals based on their network of citations on a per article basis. However, it differs from the AI by weighting citations based on the influence of the citing journal. Journals that act as larger hubs in the citation network receiving higher weights. Weighting is calculated iteratively. Again, the details of the SJR are beyond the scope of this paper but details can be found in Guerrero-Bote and Moya-Anegon (Ref: 2012). Of note for the purposes of this paper, the SJR is calculating using the Scopus database over a 3-year window and only citations from and to scholarly papers are used, excluding books and technical reports.

Appendix C. – All journals, all metrics (won’t fit in word document but would work as a supplement or link to online database)