SCIENTIFIC IMPACT OF FISHBASE: A CITATION ANALYSIS[1]

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ABSTRACT

Since its creation in the late 1980s FishBase has evolved into a highly dynamic and versatile ecological tool. A citation analysis based on Scopus, mainly for citations in journals, and Google Books, for citations in books, revealed that it has penetrated into the primary aquatic and general literature, review literature, and aquatic and general books and textbooks. With a cumulative number of citations of 653 during 1995-2006, it belongs to the 0.11 % of the highly-cited items published during 1900-2005, irrespective of discipline.

INTRODUCTION

FishBase (www.fishbase.org) is a global information system on fishes useful for research, for education at all levels, as an information source, and for the sensitization of the public at large (Froese and Pauly, 2000; Stergiou, 2004, 2005; Nauen, 2006). It includes a plethora of data, covering all levels of biological organization, for the known 29,400 fish species (as of August 2006). These data are derived from over 37,000 published sources (gray literature, books, journals, symposia proceedings, reports, etc.). FishBase, which was developed in the late 1980s (Froese and Pauly, 2000), and another ecological tool, Ecopath (www.ecopath.org; Christensen *et al.*, 2000), which was also developed during the same period, widened the scope of fisheries science. This is because these two tools, in a synergetic fashion, led to global studies (e.g., Pauly, 1998; Pauly *et al.*, 1998; Froese and Pauly, 2000; Froese and Binohlan, 2001, 2003; Christensen *et al.*, 2003; Froese *et al.*, 2005; Froese, 2006) in which previously-reported pieces of information on local knowledge were transformed into global knowledge, thus providing the framework for answering 'mega-questions' (i.e., questions pertinent to large spatial and temporal scales, and many species; see Stergiou and Karpouzi, 2002; CIESM, 2003; Stergiou, 2003, 2004).

The success of the FishBase website is demonstrated by the large number of 'hits' (about 30 million hits per month, with number of hits/month increasing exponentially with time), coming from all continents and from a variety of users (i.e., individuals, universities, museums, research institutes, NGOs) (Nauen, 2006; Froese, unpubl. data). In this report, we show that this success is also true in terms of the scientific impact of FishBase, when impact is evaluated based on 'traditional' bibliometric indices (i.e., citation analysis).

SCIENTIFIC IMPACT: ESTABLISHING CRITERIA

Visualizing the scientific impact of a work requires the establishment of measures of impact. "Science employs a knowledge filter that slowly separates the wheat from the chaft" (see Chapter 3 of Bauer, 1992). Such a filter acts at different steps (Bauer, 1992):

- A scientific finding is subjected to peer-review;
- If peers find it useful then it gets published in the primary literature;
- If other scientists also find it useful, it is cited;

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- If it is cited a lot it gets into review articles/monographs/books; and eventually
- It is cited into university textbooks.

In addition, there is a strong gap between terrestrial and aquatic ecologists (Stergiou and Browman, 2005): they read, cite, and publish in different journals. Thus, two other indices of the impact of an ecological work, which measure the exchange of ideas between ecologists and the education of ecologists, are (Stergiou and Browman, 2005):

- Its penetration into the primary 'general ecological' literature; and
- Its penetration into 'general ecology' textbooks (in which the percentage of aquatic references is less than 15%).

SCIENTIFIC IMPACT: THE CITATION SOURCE

Until recently, Thomson's ISI Web of Science was the only citation source available. However, in recent years other bibliographic services have become available, such as the Google Scholar (scholar.google.com) (Butler, 2005) and Scopus (www.scopus.com). These alternative tools perform as well as ISI (e.g., Google Scholar: Pauly and Stergiou, 2005), and moreover they are more flexible in terms of options for analyses that they provide (Scopus). In addition, these alternatives do not distort the scientific output of countries and institutions as ISI does through its limited use of sources, because they cover a much wider range of sources (*sensu* Stergiou and Tsikliras, 2006). For our analysis we selected Scopus for citations in scientific journals and Google Books (http://books.google.com) for locating citations in books.

Scopus is an abstract and citation database covering more than 15,000 peer-reviewed series from more than 4,000 international publishers, including coverage of 500 Open Access journals, 700 Conference Proceedings, 600 Trade Publications, 125 Book Series, 28 million abstract records, and 245 million references (going back to 1996), added to all abstracts, and 200 million quality web sources, with more than 60% of the titles covered being from countries other than the US (copied from http://www.info.scopus.com/detail/what/).

FISHBASE: CITATION ANALYSIS

FishBase was not subjected to formal peer-review in the sense that journal articles do. However, since its development in the late 1980s, it has undergone several reviews by experts and in response is constantly adapted to meet suggestions and new needs (Froese and Pauly, 2000).

A citation analysis with Scopus (on 5 July 2006) using 'FishBase' as the keyword in all fields revealed 580 citations for 1995-2006, whereas a search in Google Books revealed citations in 73 books. This adds up to 653 citations and implies an annual mean rate of about 57. A cumulative citation rate of 653 puts FishBase into a very small group of highly-cited published items. This is because from the *ca* 38 million items that have been published since 1900, half have not been cited at all. From the remaining half that has been cited at least once, only 21,200 items (0.11%) have been cited more than 500 times (Garfield, 2005).

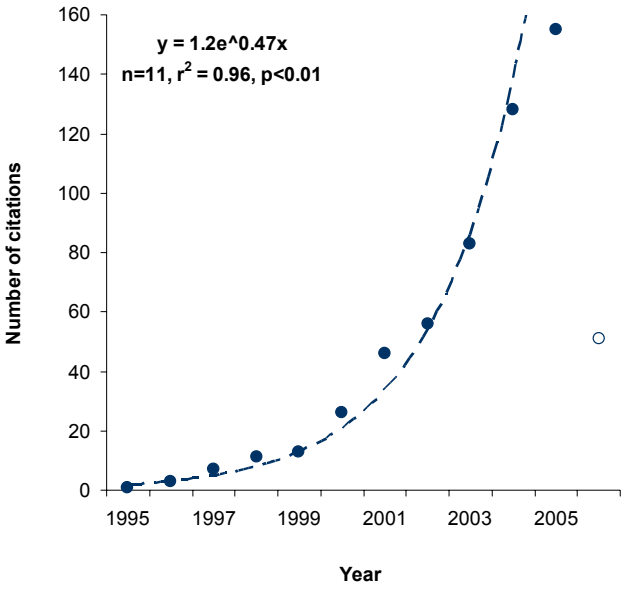

Figure 1 Annual number of citations to FishBase (source: Scopus, www.scopus.com, accessed on 5 July 2006).

The number of Scopus citations per year increased exponentially during this period from 1 in 1995 to 155 citations in 2005 and 51 for the first half of 2006 (Figure 1). The 580 Scopus citations occurred in 199

different journals. Fourteen out of the 199 journals (i.e., *Systematic Parasitology*, *Journal of Fish Biology*, *Folia Parasitologica*, *Marine Ecology Progress Series*, *Fisheries Research*, *Acta Parasitologica*, *Journal of Parasitology*, *Journal of Applied Ichthyology*, *ICES Journal of Marine Science*, *Reviews in Fish Biology and Fisheries, Canadian Journal of Fisheries and Aquatic Sciences, Aquatic Living Resources*, *Bulletin of Marine Science*, and *Ecological Modelling*), covering parasitology, fish and fisheries, and aquatic ecology, each cited FishBase more than 9 times and cumulatively accounted for 223 citations (38.4%). The 199 journals covered different fields, from agricultural and biological sciences to energy, business management and accounting (Figure 2).

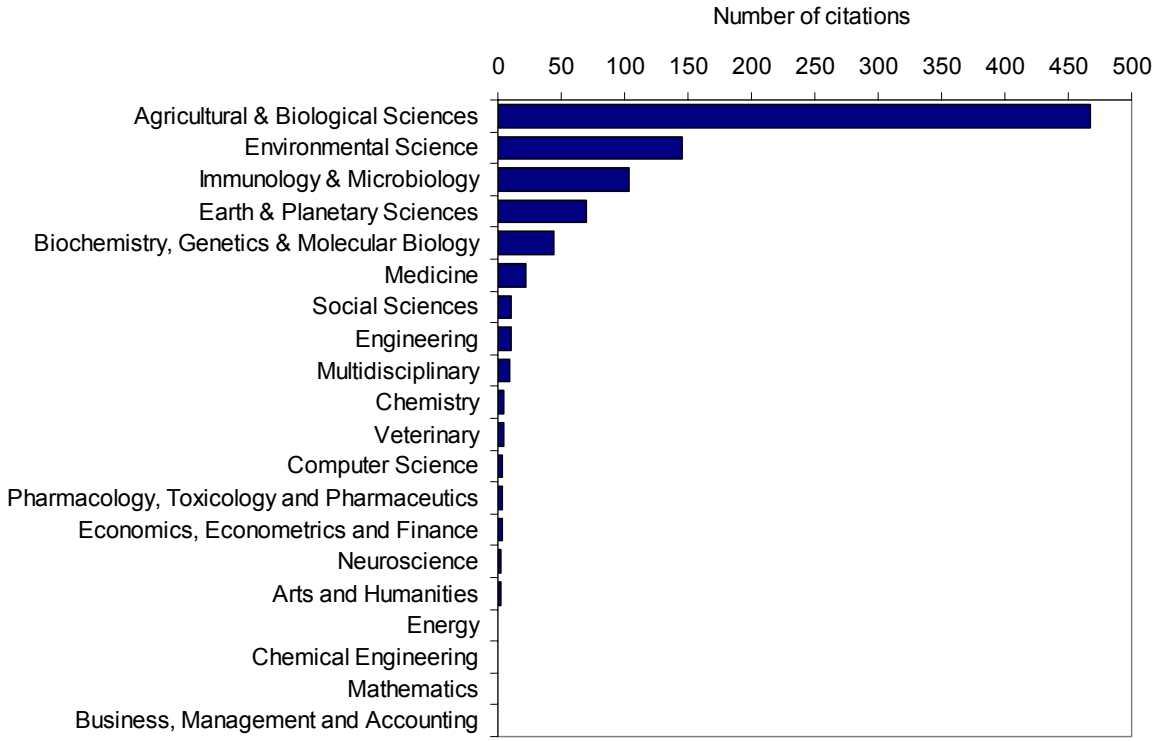

Figure 2 Number of citations to FishBase per field of journals (many journals cover more than one field) (source: Scopus, www.scopus.com, accessed on the 5 July 2006).

In total, 121 (60.8%) out of the 199 journals were general journals and 74 (37.2%) were aquatic journals (there were also 4, 2%, conference proceedings). In terms of citations, 299 (51.6%) out of the 580 citations occurred in general journals and 276 citations (47.6%) in aquatic journals (there were also 5 citations in conference proceedings). Thus, more than half of the citations to FishBase and of the sources of such citations were in 'general' journals. This clearly indicates that FishBase had a very good penetration into the primary 'ecological' (and other general) literature. FishBase also had a good penetration into the review literature: 46 (8%) out of the 580 citations were in journals specializing in reviews.

FishBase was also cited in 48 aquatic and 18 general books as well as in three general (e.g., Lévêque and Mounolou, 2003) and four aquatic textbooks (e.g., Jennings *et al.*, 2001; Walters and Martell, 2003) (Figure 3). However, it is not yet cited in recent general ecology textbooks (e.g., Smith and Smith, 2003; Townsend *et al.*, 2003; Odum and Barrett, 2005; Begon *et al.*, 2006).

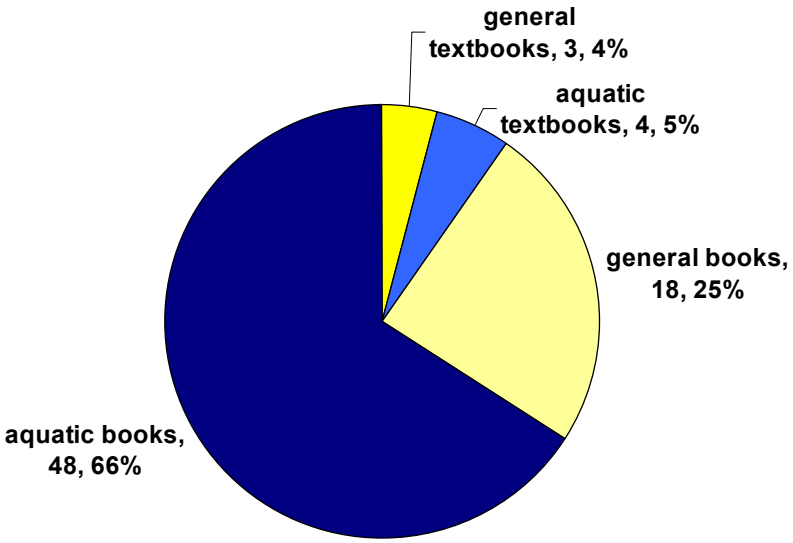

Figure 3 Number of citations (left) and percentages (right) of citations in books (source: Google Books, accessed 7 July 2006).

To sum up, the analysis presented here shows that FishBase is also very successful in terms of scientific impact, when the latter is evaluated based on 'traditional' bibliometric indices. Naturally, the number of citations to FishBase is much larger than the one presented here, since it is most probably cited in many other scholarly publication types not covered by Scopus, some of which are covered by Google Scholar (e.g., theses, technical reports, and technical papers, if online). In addition, the analyses of citations especially in non-peer reviewed, 'popular' items (e.g., general public publications, newsletters, newspaper articles, thematic maps, websites) will also be useful for measuring whether FishBase has become such a part of the public knowledge infrastructure that people from all walks of life refer to it (Cornelia Nauen, European Commission, Brussels, pers. comm.).

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