



HAL
open science

Sesenta años de botánica marina (1946-2006): criterios informacionales y sugerencias

Enrique Wulff

► **To cite this version:**

Enrique Wulff. Sesenta años de botánica marina (1946-2006): criterios informacionales y sugerencias. XII Foro dos Recursos Mariños e da Acuicultura das Rías Galegas., Asociación Cultural do Foro dos Recursos Mariños e da Acuicultura das Rías Galegas, pp.675-689, 2010, 978-84-608-1061-2. hal-01217392

HAL Id: hal-01217392

<https://hal.science/hal-01217392>

Submitted on 19 Oct 2015

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Sixty years in marine botany (1946-2006) : informational criteria and suggestions.**Enrique Wulff**

Instituto de Ciencias Marinas de Andalucía.
Consejo Superior de Investigaciones Científicas.
Campus Universitario Río San Pedro
11510 Cádiz (Spain).
enrique.wulff@icman.csic.es

Abstract

Marine botany appears to contribute to the marine ecological publication system early on the XXth Century. But a pattern of continuance in bibliographical occurrence can be discerned only from 1946. The original aim of this contribution is to determine the significance of the collection 1946-2006 (61 years) of the published material in marine botany, by analysing: (i) the rates of publication, from a cumulative point of view, and after the coverage of sources in the databases scrutinized; (ii) the number of contributions on each ecosystem type and the geographic location of study sites; (iii) the authors scientific community by ranking their countries and institutions after the number of publications produced and citations received and by discriminating low, middle and high incomes; (iv) the aging of the literature throughout indicating its utility and fitting the data to the Weibull distribution; (v) the number and imbalances of the journals employed. The US contribution was below its mean for the complete set of disciplines in marine sciences. The EU affords with 36% of the publication area. The obsolescence is visible in particular in the European case by the explicit visualization of the half-life of this literature.

Keywords: Marine botany; geographic distribution; study sites; journals; bibliometry.

Introduction

From amongst the published production in marine botany two bibliographical databases comprising 38.086 and 38.212 records were compiled for the period 1946 to 2006, from the Web of Knowledge (WOK) and ASFA databases. We wanted to retrieve the evidences supporting marine botany from both automatic frameworks.

A number of words present evidences of interactions resulting cohesive around the term “marine botany”. We have counted the mean of words processed by WOK as significative for the field of “marine botany” and it resulted in 14.460 different terms. What represents a 16% of the total 88.211 words included in a global relevant search under this heading and in this database. Such a few number of inclusions could be linked to the difficulties to finance big scientific research projects for common problems on land and at sea resulting into the provision of information channels to make sea-related researchers accessible to the results of on-land problem research potentially usable to their inquiries [ETO, 1999]. An absence of interest in sea-related topics that also is reflected in the unfortunate fact that no historical account exist on the comparative development of research in the coastal and open oceans [GATTUSO, 2005].

The conceptual cairns around which marine botany is organized by the present contribution are the physiological and community ecology. The information on this wide area of marine botany inside marine biology supposes to include such organisms as microalgae and macroalgae, also sea grasses, coral reefs and salt marshes. Marine fungi and lichens, and marine bacteria are excluded, like in some comprehensive treatise on the subject [DAWES, 1998]. Also taxonomic, physiological, chemical, and ecological aspects of marine plants, and their underlying mechanisms of adaptation and interaction, both through abiotic and biotic forces, conform the frame under consideration.

Methodology

The use of the internet available versions of the databases ASFA (Aquatic Sciences and Fisheries Abstracts) and WOK (World of Knowledge) results in the retrieval of two relevant sets of information. To summarize and describe patterns the search was supported by the employ of the software HistCite [PUDOVKIN, 2004]. Useful in reducing the effective dimensionality of large data sets by generating word, author and journal lists, over all this program displays also flow cartographies of the contributions in the field. The ability of the WOK database to analyze its own results ranking the records by author, country, document type, language, institution name and subject category contributes substantially also.

The identification of the relevant relationships and the minimization of the effect of random occurrences is controlled through the definition of the bibliographic searches strategies that were formulated along the first week of November 2006. The ASFA search was conditioned by the amount of content retrieved from WOK. A common approach results from considering that the provision from WOK starts in 1946. So although by using ASFA the researcher could come at least until 1938 to obtain no

result from the exploration on marine botany by using our search equation, a decision was taken to equate the temporal basis of the data exploration. Once this decision was made two sets were obtained. And the chronological analysis was restricted to the period 1946-2006. The references published in 2006 were considered also, although their interpretation is just a trend due to their incompleteness.

The set of edges that support this enquiry on marine botany results from two searches. The first one was carried out in the WOK, by using the descriptor 'TS'. 'TS' is the topic keyword which includes the article title, keywords and abstracts. We use also the truncation operator '*' for multiple characters. The boolean operators used were 'AND' and 'OR' useful for searching records containing both groups of keywords or one and the other groups of keywords, in the title, in the keyword field, or in the same sentence of the abstracts. Our account rested on the interaction between a general search for "Sea or Marine" material with four specific independent estimations of the contents on "phytology", "photosynthesis", "plant sciences" and "phycology". We examined these interactions taken together with a general consult on "microalga*" and "algal*". Note that such relevant terms like "seaweeds" and "seagrass*" are covered by this design chaperoned by the truncated "sea*" retrieved edges [WATANABE, 2001].

The second search explores the expected sensitivity of the database ASFA to marine botany. Our strategy was as follows. After the ASFA Thesaurus [GANGEMI, 2002] we provided a framework for integrating all the eleven descriptors related with plant sciences, the three key words explicitly employing the term botany, the set of five homogenized expressions linked to the content "photosynthesis", and any of the eight "algal" targeted descriptors. The keyword history blends these four primary topics with a global search on sea and marine concerns.

The final number of publications present in the WOK database was 38.086 records, and in the ASFA database the number of references was 38.212. For these two sets of information two different kinds of analysis were performed.

Rates of publication

For the comparative purpose, the number of articles on both databases ASFA and WOK were counted regarding a yearly chronological display. It is easy to see a non-linear structure in these strings of data because while the chronological series grows at a constant regular rate of one year, the growth of the quantities of publications is not constant [FERREIRO, 1993]. It is why it makes bibliometrics sense to consider the logarithmic transformation of these data. Thus, improving their visibility (Figure 1).

To estimate the likelihood of the observed data two events must be retained. References published prior to 1971 in the ASFA database face the fact that it was in this year that this database has been incepted [VARLEY, 1995]. Otherwise, from 1991 Science Citation Index (now World of Knowledge) changes its ownership what implies some major switches (like the indexation through descriptors coming from linked articles [CAMBROSIO, 2006]). The specificity of these two cut offs years 1971 in the case of ASFA and 1991 for the WOK, evidence the non-linear limits of both data distributions.

Then from an initial cumulative point of view two different rates of publication must be distinguished. Previous to 1991, 13% of the total cumulative knowledge occurred in the case of WOK. And before 1971, the number of articles retrieved from ASFA was only 0.7% of the records obtained for the period 1946-2006.

The coverage of sources is different in both databases. Only ASFA guarantees the collection of the items grouped per type of document's source. We compiled from ASFA, 30.712 journal articles (vs. 38.086 after WOK), between which 22.127 were published in refereed journals (Figure 2A).

6209 contributions to conference proceedings, 1.771 books or chapters of books, 786 reports, 308 dissertations, 93 patents were also observed (Figure 2B).

The amount of sources indexed by ASFA increased three times in the period 1971-2002 (from 12.143 to 38.892 !), what is evidenced through the high values of the variances obtained. These calculated variances provide a way to interpret how much the changes in the evolution of the ASFA database inertias is worth noting in the case of marine botany. Then by approaching the chronological dispersion of the records, first appear the journal items with an annual mean rate of 832 articles published between 1971 and 2006, while in the previous 25 year 1946-1970 the mean was 8.76 articles. Then we have assembled items in conference proceedings with a mean of 171 annual contributions for the period 1971 and 2006, and a no significant 0.12 annual occurrence between 1946 and 1970. After them we focus on the data for the books and book chapters, and we consider annually the appearance of 45 as a mean between 1971 and 2006, and the publication of an annual average of 1.5 in the period 1946 and 1970. 21 reports appear to be published as a mean from 1971 to 2006 and no valuable data were evidenced previously. 9 dissertations were reported as an annual mean at the time of analysis 1971 to 2006 (the prior time was without records). And finally the patents were computed only for a total of 15 years (1983, and 1989-2002) what makes a mean coefficient of almost 7 patents in marine botany business annually registered as a mean.

Ecosystems

The growing concern on marine botany present imbalances in the distribution of the studies. In Figure 3A and Figure 3B are graphically depicted tradeoffs between geographical regions and ecosystems and the set of derived research as defined by the set of information retrieved from WOK.

We view in Figure 3A, that the estimation in the European seas represent a major part of the studies, with more than 40% of the total production observed from WOK, that explicitly distinct the Ocean or Sea where the investigations where performed (21.8 of the total WOK set). The geographical distribution of the sites studied during the period from 1946 to 2006 includes two more regions, with at least 10% of the total items; the Antarctic and the Pacific that rank in decreasing order with 18.32% and 13.69%. Apparently, the Indian Ocean absorbs only a 8.59% of the research effort. The Baltic Sea, the Arctic Ocean, and the Black Sea incorporate 7.2%, 4.6% and 2.79% of the results.

At the regional European scale, the distribution of papers is still rather biased, with studies in the Mediterranean (13.26 % of the World Ocean interest on marine botany, although 32% of the European network) dominating those conducted in the North Sea (9.19 % in the World Ocean, and 22% in the European seas context). The Baltic Sea and the Black Sea are also present, with some 17.5% and 6.7% of the European production respectively. Most of the knowledge on eutrophication is derived from studies in the Mediterranean Sea, particularly the Eastern regions [VIDAL & AL., 1999], and that could be the empirical base for such a dominance in the marine botany area. In particular, the Adriatic, Aegean, Ionian and Crete seas are scrutinized by 40% of the Mediterranean focused material.

The Mediterranean marine botany relevance could also be approached through the evidences related to the phosphorus limitation of its coasts. As the opposite to the nitrogen limitation of the Atlantic coastal area. Phosphorus analysis vs. nitrogen analysis assume a percentual relationship of 33 vs. 67. Also it must be remembered that nitrogen and phosphorus increases are a result of fish farming [WATANABE, 2001].

The Antarctic research effort in marine botany is leadered by the USA, Germany and Australia, accounting for 60% of the production.

In Figure 3B we show that the intertidals and shallow are ecosystems with a percentage of 14.55% of the bibliography relevant. It is worth noting that the research performed on these ecosystems, as important players in the carbon cycle, are assumed to be well scaled to the surface that they occupy. Although in this case their place as high raters in primary production makes them specially sensible in terms of publications.

Our assessment of the estuaries and river deltas detect 10.7% of the observations. Modest requirements in terms of ship size and the fact that they can be researched from land-based stations are both factors that can explain this defined attention.

Note that the gulf and bays are the most studied ecosystems, with a share of 18.74% of the interests. This may be partly a result of the keyword indexing of the WOK database, that classifies under these geographic terms a range of diverse coastal oceanographic ecosystems. Such could also be the reason under the annotated visibility of the islands' ecosystems (7.47%).

Coral and reef ecosystems answer some 9.28% of the inquiries, basin ecosystems are investigated in 6% of the occurrences and lagoons provide 4.22% of the issues.

A possible appraisal of the prevalence of lakes (13.4%) and rivers (without considering the deltas, 10.2%) could come from the increasing demand for growing algae in inland culture.

Between the investigated elements (data not shown), carbon is in first position (40%), followed in decreasing ranks by nitrogen (25%), oxygen (14%), phosphorus (13%) and iron (6%). Green algae were used in 61.6% of the occurrences, red algae afford with 24.7% of the experiments and brown algae were studied in 13.6% of the items (data limited to the literature that explicitly declares the typology of the algae

researched). The most studied unicellular algae was 'Diatom', in a factor 4:1 with the second inquired 'Chlorella'. Between the aquatic plants interests were mainly placed on 'Zostera', and 'Posidonia' (with a two-factor difference between both).

Authorship patterns

The current investigation derived the different authorship patterns in the marine botany [BIRD, 1997]. 51898 was the total number of authors between 1946 and 2006, and they were affiliated to 9923 different institutions within 171 different countries. As illustrated in Figure 4 USA authors included 30.9% of the total bibliographical set measured for marine botany. This meets 61.8% of the mean USA contribution to marine sciences for all subdisciplines (Dastidar 2004). The east coast authors produced 25.8% of the marine botany literature, and the west coast authors justified 21% of the research efforts. Alaska was involved in 1.22% of the total literature. The largest amount of contributions come from institutions located in Massachusetts, Virginia, California and Washington. This prominence of the east coast is to be contrasted with the largest number of labs coming from California (21) vs Florida (14), as these two states have the longest coastlines of all US states (respectively, 1350 and 2170 kms).

The incumbency of the authors from the EU countries is also important, at least affording with 36% of the publication area. The Spanish Council for Scientific Research and the Alfred-Wegener Institute for Polar & Marine Research are the institutions where authors produce a maximum number of articles (respectively 603 and 504, 1.6% and 1.3% of the global rate); and two Spanish scientists and a British contributor are between the top ten of authors when scaled by the number of publications (all the other been from the Canada, US and Australia). In terms of the citations top ten also Spain and UK are the European representatives although in reverse sense, one Spaniard scientist (world-ranked in the second position with 3917 citations) and two British researchers (2587, 2576 citations). Otherwise the Russian Academy of Science appears as the first network for the marine botany students when reckoning publications exclusively falling into this field without sharing any content with other scientific disciplines. All this occur although Russian authors afford with just 1.6% of the world production (Spain, Australia, Canada, Germany, UK and USA represent 5.4%, 6.8%, 7.4%, 8.6% and 30.9% each one).

Descriptive statistics for the diverse authors' countries are established by discriminating between the authors from the low and middle income countries (less than 5.500 US dollars), and the authors coming from the high income countries (5.500 and above US dollars) [TEITEL, 1994]. The authorship mean for the group of authors coming from the low and middle income countries is 82, whereas for those from the high income countries it is 887, i.e. more than 10 times as large. All countries mean is 303.

Analysis of the aging function

To estimate the shape of the marine botany literature loss of relevance along the years we exploited the negative exponential law of obsolescence (aging) [BROOKES, 1970]. The citation activity (Figure 5) is a function of the fact that each time an author refers to

another article he not only contributes to the size of the citation network but also acts as an integrator, contributing to the self-regulation of the citation system. This mechanism expresses the aging of the literature. It results that both the utility factor and the half-time (the time in which 50% of the bibliography has been used) are just issues of the aging factor 'a(t)'.

For the collection on marine botany extracted from WOK, that spans between the 62 years 1945 – 2006, the total global citation score is 584 498. As a confidence interval to test the strength of the mechanisms of self-regulation inside the bibliographical set studied we have derived which were the citation scores expressing the intensity of the inner relationship in this collection at the beginning and at the end of the period. This way the time series could be splitted into those articles cited before 1993, 20.15% of the items, and those cited since 2004, 20.68%. We considered that the cohesiveness of this area has grown with a factor of 12, between 1946 and 2006. We apply this measure to the marine botany network and it resulted in 252.479 eigen-interactions through citations inside this set. Also the global number of citations mean when obtained from the total WOK database was 15.35, but the local citations mean rate extracted after our little set of 38.086 marine botany records was 6.63. As we see the probability of obtaining a local citation is of 0.43. Such is a weak interaction. The biases introduced in the WOK database that can explain its different efficiencies to return relevant papers are a conventional explanation of this fact. Nevertheless, a consequent paucity of relevance through citations is detected in what concerns marine botany inside WOK.

Once exposed the experiment evidences about self-regulation, we contribute by a study of the time-dependent phenomena of aging in the general case of marine botany. For validation, we used a subset of the European seas marine botany, also we have established the general pattern of utility for the general bibliography on marine botany.

The utility factor, $1/(1-a(t))$, arises in the analysis of obsolescence because the sum of the geometric series that it defines decreases as 'a(t)', the annual aging factor, increases. Then it happens that those research contributions with short live have a total utility more reduced than the items on which interests decline slowly. We can calculate this score 'a' in the age 't', by extracting the t-root of the fraction between the residual number of citations received after 't' years and the initial number of citations.

By using the data provided by the citation reports of the 'Web of Knowledge' we have plotted the Figures 6A and 6B. We commence by note the steady decrease of the European site literature, in Figure 6A, followed by an increase for the papers contributed when the bibliography attained its 5 years old (a typical half life of 5.5 is expected for WOK), after what a long tail of less useful material is displayed. Looking for curve fitting distribution models we have tested with success a polynomial fit for the European seas data, with correlation coefficient 0.9872 (Weibull, 0.9613). In Figure 6B, by adjusting the remaining utility at age 't' attributable to the whole marine botany literature, we show that the data behave by converging to a Weibull model with a correlation coefficient of 0.9914.

Journals

Journal articles represent 91.4% of the marine botany literature analysed in this contribution. It comprises 2242 journals, which percentual distribution is shown in Figure 7A. The view affords with a model very asymmetric where journals publishing more than 100 papers represent simply 4.1% of the total set. Such a dispersion can be the reflect of the importance of local ecosystems studies and it has suggested the elaboration of Figure 7B.

We specify in Figure 7B the number of review articles involved on marine botany every year. The optimal detection of relevant bibliographic material is own to the scope of review articles. In particular we consider two repeatedly recognized years, 2005 and 2003, for the tied distributed publications. The degree of fragmentation presented in Figure 7A, is tantamount to this challenging competition for initial recognition through prompted released synthesis.

The 10 more productive journals were: Marine Ecology-Progress Series (30809 (marine botany citations, 51574 (WOK citations), 2316 (number of publications)), Hydrobiologia (3721 m.b.cit., 9893 WOK cit., 1287 pub.), Limnology and Oceanography (22421 m.b.cit., 43332 WOK cit., 1249 pub.), Journal of Phycology (10145 m.b.cit., 18662 WOK cit., 1026 pub.), Journal of Experimental Marine Biology and Ecology (8973 m.b.cit., 16309 WOK cit., 899 pub.), Marine Biology (9450 m.b.cit., 19001 WOK cit., 846 pub.), Journal of Plankton Research (5805 m.b.cit., 10510 WOK cit., 729 pub.), Deep-Sea Research Part II-Topical Studies in Oceanography (7701 m.b.cit., 12951 WOK cit., 605 pub.), Estuarine Coastal and Shelf Science (3444 m.b.cit., 6533 WOK cit., 556 pub.), Aquatic Botany (6943 m.b.cit., 9121 WOK cit., 540 pub.).

All ten sources of literature are focused aquatic science journals, and they absorb 26% of the total production on marine botany. When considering the top ten cited journals the sources are the same except 'Estuarine Coastal and Shelf Science', and 'Aquatic Botany', that are substituted by the multidisciplinary scoped 'Nature' and 'Science'. The German journal 'Marine Ecology-Progress Series' is both the most productive and the most cited journal in this area.

Conclusions

From a cumulative point of view the scientific literature on marine botany is non-linear, this property is true both in WOK and in ASFA. The changes in the ownership of WOK and the ASFA inertias derived from its inceptional year are elements that necessarily affect this question. It is not surprising that although the cohesiveness of marine botany grow quickly, the self-regulation identity of this field does not guarantee a consequent rhythm of growth in terms of relevance. The general pattern of utility of this bibliography is a Weibull distribution, as a model in terms of the age of the publications. Quick interaction networks integrates into prompted released reviews, but the fragmentation of the information channels used shows large imbalances.

Acknowledgment. To Quentin Burrell because of his science.

References

- BIRD, J.E. (1997), Authorship patterns in marine mammals science, 1985-1993. *Scientometrics*. 39 (1): 99-105.
- BROOKES, B.C. (1970), The optimum p% library of scientific periodicals. In: *Proceedings of the meeting of the study committee of International Federation for Documentation "Research on the theoretical basis of information"*. FID, Moscow. pp. 144.
- CAMBROSIO, A. (2006), Personal communication.
- DASTIDAR, P.G. (2004), Ocean science and technology research across the countries : a global scenario. *Scientometrics*. 59: 15-27.
- DAWES, C.J. (1998), Marine botany. 2nd ed. John Wiley & Sons, New York. pp. 480.
- ETO, H. (1999), The interest of scientific communities in sea-related research topics. *Scientometrics*. 45 (2): 167-178.
- FERREIRO, L. (1993), Bibliometría : análisis bivariante. Eypasa, Madrid. pp. 480.
- GANGEMI, A., F. FISSEHA, J. KEIZER, I. PETTMAN AND M. TACONET. (2002), *Development of an integrated formal ontology and an ontology service for semantic interoperability in the fishery domain*. FAO, Rome. pp.14.
- GATTUSO, J.P., DAWSON, N.A., DUARTE, C.M., MIDDELBURG, J.J.. (2005), Patterns of publication effort in coastal biogeochemistry : a bibliometrics survey (1971 to 2003). *Mar. Ecol.-Prog. Ser.* 294: 9-22.
- PUDOVKIN, A.I., GARFIELD, E. (2002). Algorithmic procedure for finding semantically related journals. *J. Am. Soc. Inf. Sci. Tec.* 53 (13): 1113-1119.
- TEITEL, S. (1994). Scientific publications, R&D expenditures, country size, and per capita income. A cross section analysis. *Technological forecasting and social change* 46: 175-187.
- VARLEY, A. (1995). *ASFA : The first twenty years. History of Aquatic Sciences and Fisheries Abstracts, 1971-1990*. Unesco, Paris. pp. 70.
- VIDAL, M., DUARTE, C.M., SANCHEZ, M., CARMEN, M. (1999), Coastal eutrophication research in Europe: progress and imbalances. *Mar. Pollut. Bull.* 38(10): 851-854.
- WATANABE, M.E. (2001), Algal research. *The Scientist*. 15 (21): 1.

Figure 1 N° of publications (log). 1946-2006.

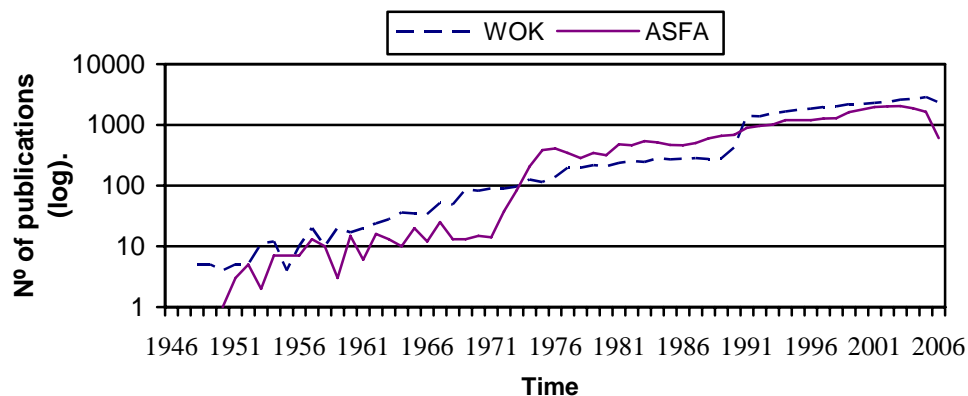


Figure 2A. N° of publications on marine botany published between 1946 and 2006 as occurred in journals vs refereed journals

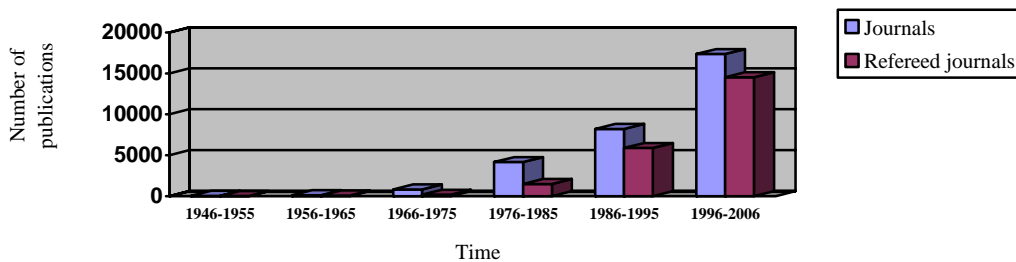


Figure 2B. N° of publications on marine botany published between 1946 and 2006 in books, conference proceedings, reports, patents, dissertations

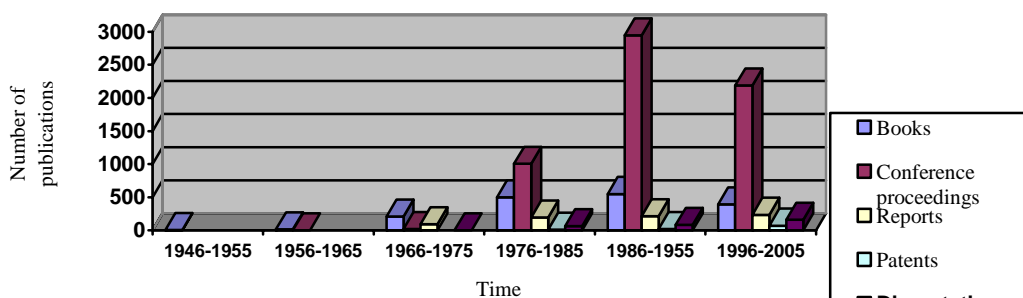


Figure 3A. Specification of the studies linked to seas and oceans
(source: 8.299 WOK records)

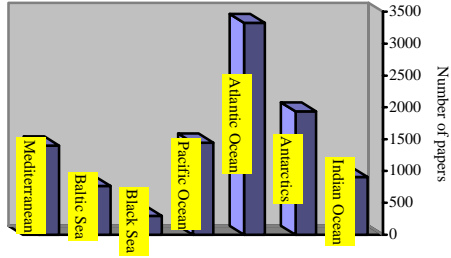


Figure 3B. Main magnitudes of the diverse ecosystems present in the literature on marine botany
(source: 16.963 WOK records)

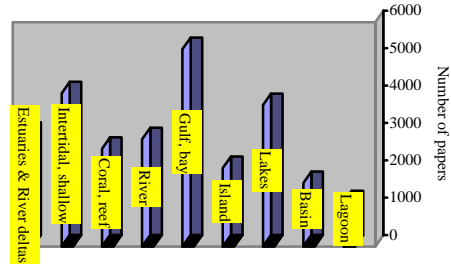


Figure 4. Authorship by geographical distribution.

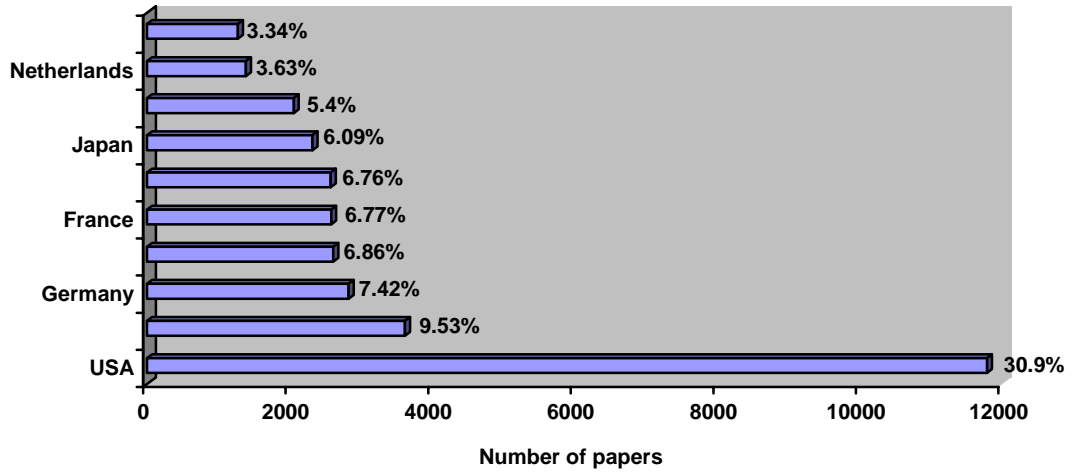


Figure 5. Articles distribution after the citation flow.

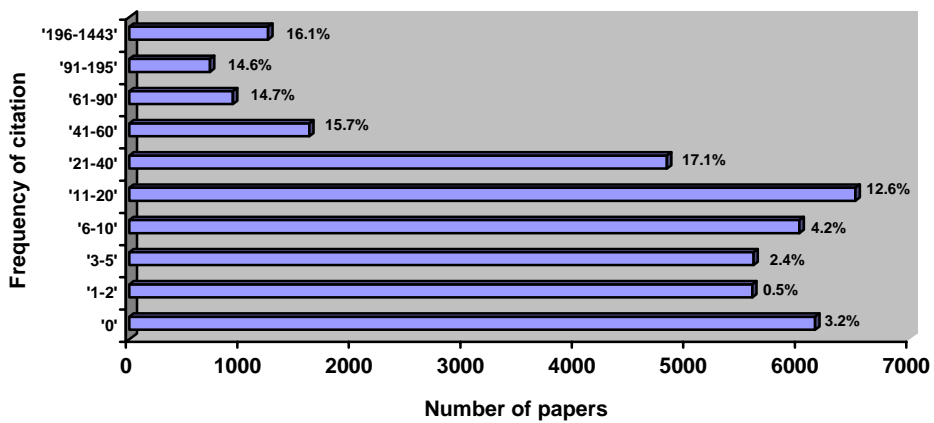


Figure 6A. Utility factor European seas bibliography

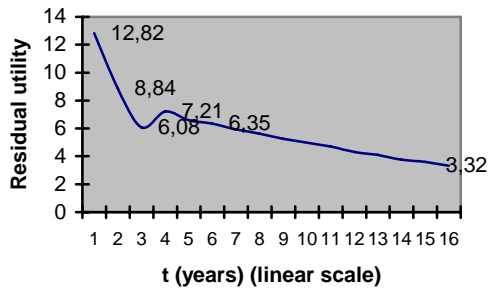


Figure 6B. Utility factor general bibliography

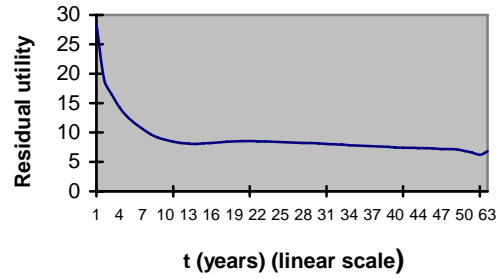


Figure 7A. Distribution of the number of journal articles.

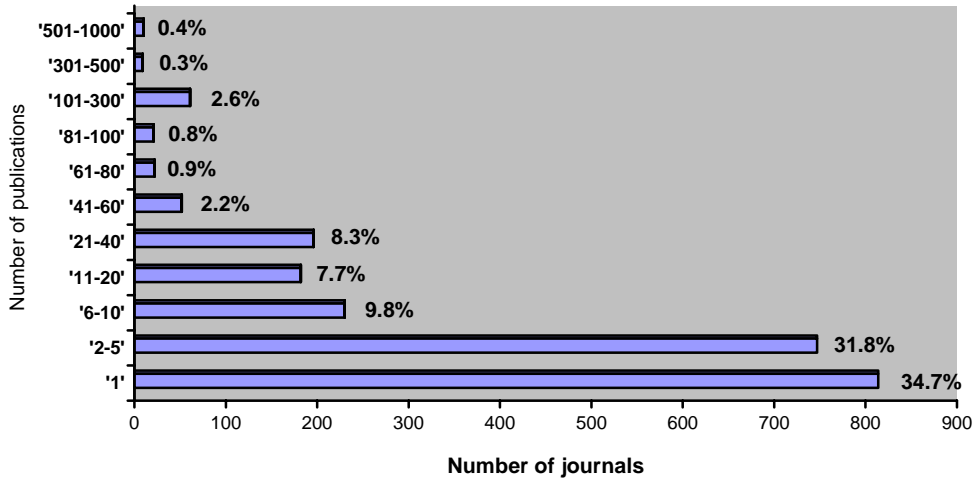


Figure 7B. Number of review articles in the field of marine botany

