Marine Policy 35 (2011) 477–482

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Shifting baselines in scientific publications: A case study using cetacean research

N.A. Rose [a], D. Janiger [b], E.C.M. Parsons [c,*], M. Stachowitsch [d]

[a] Humane Society International, 2100 L Street NW, Washington, DC, USA
[b] Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA, USA
[c] Department of Environmental Science and Policy, George Mason University, 4400 University Drive, Fairfax, VA 22030-4444, USA
[d] University of Vienna, Department of Marine Biology, Althanstrasse 14, 1090 Vienna, Austria

ARTICLE INFO

Article history:
Received 24 October 2010
Received in revised form
3 November 2010
Accepted 4 November 2010
Available online 7 January 2011

Keywords:
Bibliometric analysis
Cetaceans
Research focus
Marine conservation
Funding
International Whaling Commission

ABSTRACT

The marine sciences have undergone a sequence of historical changes related to new methodologies, approaches and challenges. Most recently, deteriorating natural ecosystems and threatened component species have prompted a renewed change in the focus of scientific research on the marine environment. This study analyzes the scientific literature on cetaceans during the period 2005–2008 to demonstrate that a key focus of modern research is on conservation-related topics, and then compares it to the period 1970–1973 to demonstrate that this new focus represents a shift from basic biological and ecological issues. On average, approximately 46% of papers published on whales, dolphins and porpoises in 2005–2008 were categorized as conservation oriented versus focused on biology or ecology. This contrasts to approximately 10% in 1970–1973. This shift parallels other marine research subjects, such as benthic communities, coral reefs and sea turtles and reflects a general paradigm shift in marine research towards anthropogenic impacts. This is important guidance for institutions and organizations that wish to base their agendas and decisions on state-of-the-art scientific priorities.

1. Introduction

The approach to gaining knowledge about the marine environment has undergone a series of changes. From an historical perspective, four eras of marine research have been distinguished: that of seafarers, of oceanographic expeditions, of marine stations and of field research [1]. This has brought scientists ever closer to the object of their studies, ultimately in the form of scientists using SCUBA and other technology (such as manned and unmanned submersibles, underwater cameras, hydrophones, and ever more sophisticated tags) for in situ observation and experimentation.

A new, fifth era has been recently identified, one that focuses on deteriorating ecosystems and the repercussions of their dysfunction [2]. Accordingly, in response to a deteriorating environment, research efforts have increasingly focused on topics related to describing, preserving, restoring and managing damaged ecosystems and their inhabitants. This new era differs from earlier ones in its underlying aims, the narrower range of topics studied, the reduced validity of its conclusions and the increased urgency for collecting the relevant data. These differences are also reflected in criteria for the selection and funding of research projects.[1]

Bibliometric analysis (quantification of publications) has increasingly been used to investigate the proportion of published research that belongs to a specific field of study [3], or to evaluate environmental trends [4]. For example, Ward and Lafferty [5] evaluated trends in marine disease prevalence using rates of publications as a proxy. Hill and Lackups [6] evaluated published studies focused on cetaceans in an effort to determine, *inter alia*, how often captive cetaceans serve as research subjects and how often free-ranging ones do. On the marine habitat level, Knowlton [7] used bibliometric analysis to investigate the evolution of research on coral reefs. From this, she distinguished three overlapping phases in the recent history of coral reef research, namely research on basic scientific questions, on the decline of corals and the nature of human impacts and on determining how to conserve and restore coral reefs. The most recent phase or era is intimately related to management, whereby explicit recommendations for management measures are being sought and proffered.

This study echoes the work of Knowlton [7], but examines research trends on a taxonomic (i.e., cetaceans) rather than habitat level.

* Corresponding author. Fax: +1703 9931066.
E-mail address: ecm-parsons@earthlink.net (E.C.M. Parsons).

[1] For example, see the program priorities for the Pew Charitable Trusts at http://www.pewtrusts.org/program_investments_guidelines.aspx.

0308-597X/$ - see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.marpol.2010.11.002

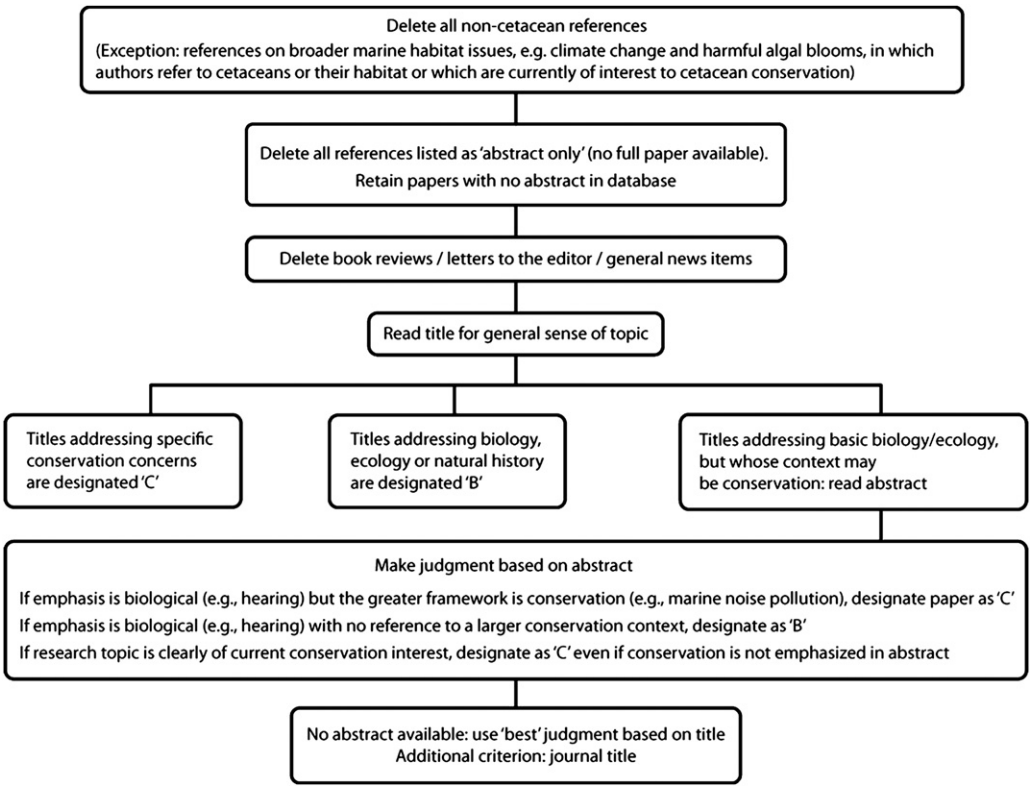

Fig. 1. Decision-making flowchart for designating cetacean research papers into 'biology' (B) versus 'conservation' (C) categories for the Natural History Museum of Los Angeles County database on marine mammal publications. The BIOSIS database did not contain abstracts.

Whales, dolphins and porpoises were chosen for a case study primarily because of their role as keystone, or flagship, species for the marine environment. The hypothesis is that a considerable body of research is available on such species and that, due to the known major declines in many species,[2] a conservation-related focus in the recent scientific literature will be recognizable for this group.

This issue is of eminent practical interest, especially for the orientation of institutions and organizations that deal with these organisms, their respective animal communities and their habitats. A case in point with regard to cetaceans is the International Whaling Commission (IWC), the internationally recognized body responsible for the conservation and management of large whales. The IWC has a Scientific Committee, whose annual research and computing budget is allocated and approved according to priorities set by the national delegations. There is a debate among the delegations on the emphasis that should be placed on conservation-related issues versus more traditional management (e.g., quota-setting for hunts). The IWC strives to set its agenda and make its decisions based on sound scientific advice.[3] This calls for determining the current focus of cetacean research and for adjusting agendas and decisions to reflect these scientific priorities.

2. Material and methods

The present bibliometric analysis evaluated two separate literature databases. A database maintained at the Natural History Museum of Los Angeles County (NHMLAC)[4] was used for the period 2005–2008. For 2005, the NHMLAC database contained 1023 document records, 1500 for 2006, 1389 for 2007 and 2310 for 2008; these included books, theses, technical reports and articles from over 300 peer-reviewed journals. These document records covered a wide range of topics on marine mammal (and marine mammal-related) biology, evolution, ecology, habitat, conservation and policy. This appears to be a reasonably inclusive database for peer-reviewed and technical publications on marine mammal-related topics in the literature; for example, searching 'Google Scholar' using the search term 'cetaceans' and '2005' yielded 1830 hits, but many of these listings were abstracts from conference proceedings, popular science articles, web articles, obituaries, or otherwise not appropriate to include in the current analysis. A random selection of approximately two dozen hits (of peer-reviewed articles only) from this Google Scholar search was also present in the NHMLAC database. Thus, the peer-reviewed articles identified by Google Scholar were, by and large, contained in the NHMLAC database as well, while the NHMLAC database contained only a fraction of the non-peer-reviewed records listed in the Google Scholar search.

A keyword search of the BIOSIS database was conducted for the period 1970–1973. Keywords used were: cetacean, Cetacea, whale, dolphin, porpoise, marine mammal, marine conservation, marine pollution, marine policy, marine ecology and marine habitat. The BIOSIS database contained 234 document records for 1970, 240 for 1971, 221 for 1972, and 180 for 1973. The BIOSIS database may have under-represented documents from sources other than peer-reviewed journals (i.e., books, theses and technical reports); nevertheless, more than 200 journals, books, reviews and report series were represented. No abstracts were available for the BIOSIS documents, so the categorization was based entirely on the title of the document and/or the journal/publication. This may have led to an underestimation of studies that addressed cetacean conservation issues, as documents on topics such as marine pollution that

[2] For example, see Clapham PJ, Young SB, Brownell RL. Baleen whales: conservation issues and the status of the most endangered populations. Mammal Review 1999; 29: 35–60.

[3] See the 45th Annual Meeting of the International Whaling Commission, Resolution 1993–12, http://www.iwcoffice.org/Meetings/Resolutions/IWCRES45_1993.pdf.

[4] This database is maintained by author DJ.

did not specifically mention cetaceans in the title were deleted. However, the number of such document records was very small for each year, making the effect of this on the final result minimal.

The databases were examined, document by document, according to a decision flowchart (Fig. 1). The primary analysis was done by author NAR. For both databases, all records that focused on pinnipeds or other marine animals—or on aspects of marine organisms, habitats or ecosystems not immediately relevant to cetaceans—were deleted. The analysis involved almost exclusively primary literature in peer-reviewed journals; book reviews, letters-to-the-editor and similar publications (e.g., short news pieces) were not considered (however, invited papers in conference proceedings were retained for analysis). The remaining records were then classified into two categories as follows:

- B ('basic biology'): primary focus on basic biology (e.g., evolution, behavior, physiology, anatomy, or taxonomy), ecology (e.g., distribution, habitat preference, habitat partitioning, or stock structure), or new research methods;
- C ('conservation'): primary focus on environmental threats, conservation, management, or policy.

For many records in the NHMLAC database (and all of those in the BIOSIS database), this decision was made based on title alone. For the remainder, the abstract was reviewed.

If an abstract did not generally refer to any larger conservation context, then the paper was designated 'B.' Studies that presented basic biological or ecological information on a species and included a mention of management implications only as a 'general framework' were also typically categorized as 'basic biology.' If management or conservation implications were the primary motivations for undertaking a study (even if the study treated basic aspects of cetacean biology or ecology), however, then the paper was generally categorized as 'conservation.' This designation was also given if the research topic was clearly of current conservation interest, even if this interest was not emphasized in the abstract.

Most decisions were clear-cut. Those that presented more difficulty can be illustrated using hearing in cetaceans as an example. Studies with a purely physiological/anatomical focus were typically designated 'B'. Research on hearing in beaked whales, however, which are the most commonly affected species in sonar-related strandings, was generally classified 'C'. If the emphasis was biological, but the motivation for the study was management or conservation (e.g., marine noise pollution), the designation was also 'C'.

3. Results

Of the total number of cetacean-related document records examined for 2005–2008, 54.1% ($n=1521$) was focused on basic biology and 45.9% ($n=1291$) on conservation. For 1970–1973, the distribution was 89.5% ($n=485$) and 10.5% ($n=57$), respectively (Fig. 2(a)). The proportion of the BIOSIS database categorized as 'conservation' ranged from 4.5% to 14.6% (Fig. 2(b)). For 2005–2008, the proportion increased slightly over the four year period (Fig. 2(c)), from 43.6% to 50.4%.

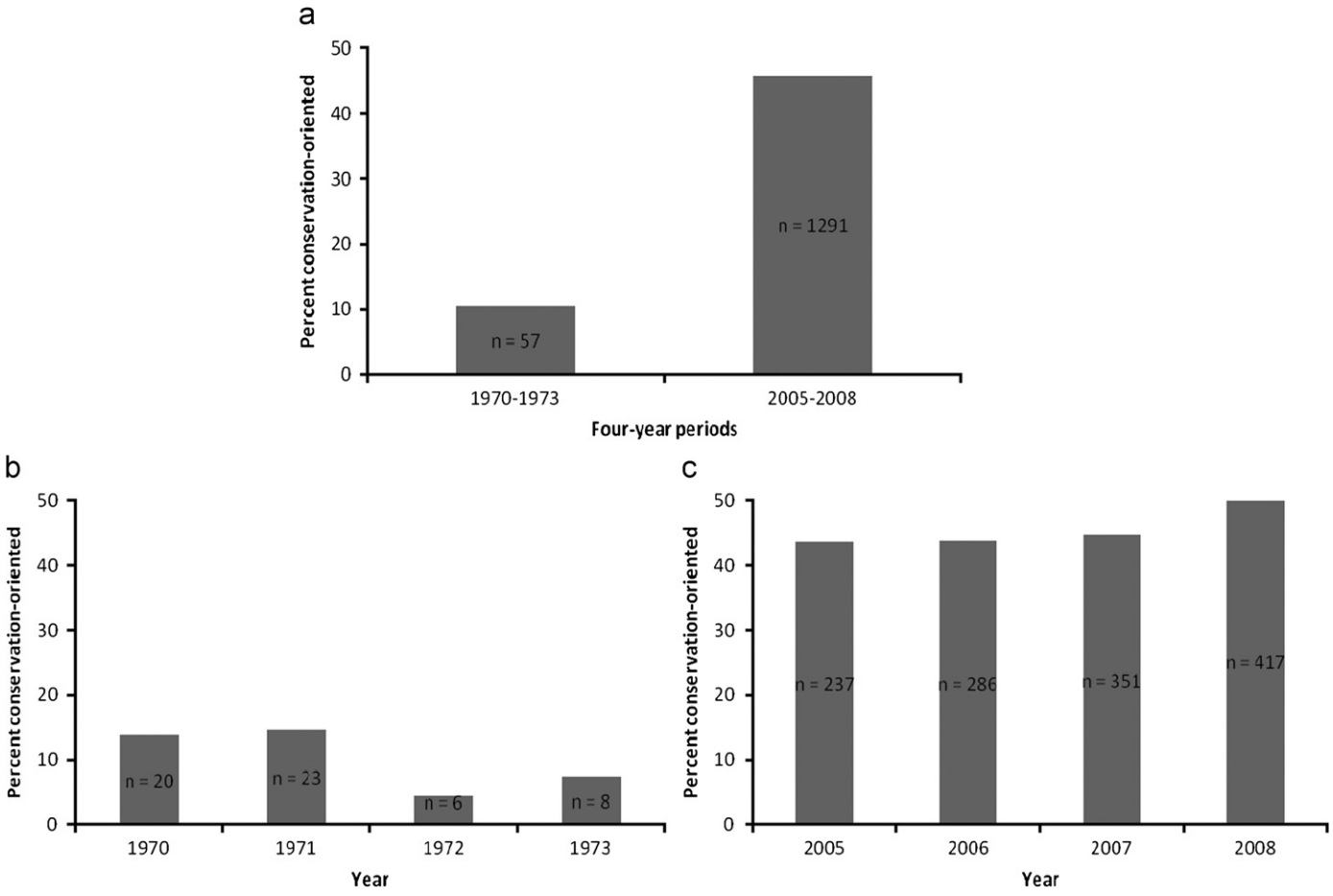

Fig. 2. (a) Comparison of the total percent of records categorized as conservation oriented for each four-year period; percent of records categorized as conservation oriented in (b) BIOSIS database for each year 1970–1973 and (c) the NHMLAC database for each year 2005–2008.

To confirm the objectivity in the decision-making process, 100 out of the 785 records analyzed in 2007 were randomly chosen, using a random numbers table, and independently evaluated by authors NAR, ECMP and MS. This independent categorization showed a very high degree of agreement for the absolute number of records designated as 'conservation' (37/37/38 out of 100). There was, however, some disagreement over which individual records constituted which category, with some co-authors designating documents as 'C' that others did not and vice-versa. This means that, overall, an even greater number of records was deemed conservation-related by the authors as a group. The categorization of document records in the databases for both periods of this study was therefore conservative and was unlikely to have over-represented the level of conservation-related research.

For 1970–1973, the total number of cetacean papers fluctuated, from 145 in 1970 to 107 in 1973, peaking at 157 in 1971. The number of conservation oriented papers also fluctuated, as low as 6 in 1972 and as high as 23 in 1971 (Fig. 2(b)). The total number of papers addressing cetacean issues increased from 544 in 2005 to 828 in 2008. In parallel, the number of conservation papers increased from 237 to 417 during this period (Fig. 2(c)). The steady increase in absolute numbers of documents in the 2005–2008 period is probably as much a reflection of increased search effort by the database manager as it was of increased research effort by the scientific community over those years: the keywords used and the number of journals searched has been augmented over the past decade.

4. Discussion

Scientific knowledge is subject to highly dynamic processes that have led to a tremendous increase in information, constantly shifting priorities and paradigms within individual disciplines, and ever new fields of inquiry. This evolution can be driven by new technologies and analytical processes[5] or by the recognition of new challenges. This clearly also pertains to the biological sciences and, in the present case, to marine sciences. In marine biology and ecology, the trends have been governed not only by the general accumulation of data inherent in scientific inquiry and increasingly sophisticated technology, but also by the rapid, anthropogenically driven changes that the systems are undergoing: all the data and methods of analysis point to drastic and increasingly rapid degradation of marine ecosystems due to the synergistic effects of overfishing, biological, toxic, noise and nutrient pollution, habitat loss, and global climate change.[6]

Over the last decades, research in the field of marine sciences has therefore undergone a corresponding paradigm shift [2,7, this study]. In response to a deteriorating environment, research efforts have increasingly focused on topics related to describing, preserving, restoring and managing damaged ecosystems and their inhabitants. This analysis shows that this development is also valid for cetacean research. Almost half of all publications on cetacean biology and ecology today have a direct conservation focus. This is in contrast to 35–40 years ago, when research was almost entirely focused on basic questions of biology and ecology (see Fig. 2(a)), in the then relatively new science of cetology [8]. Moreover, the bibliometric analysis from 2005 to 2008 probably underestimates the number of studies undertaken to inform cetacean management or conservation policies, given the generally

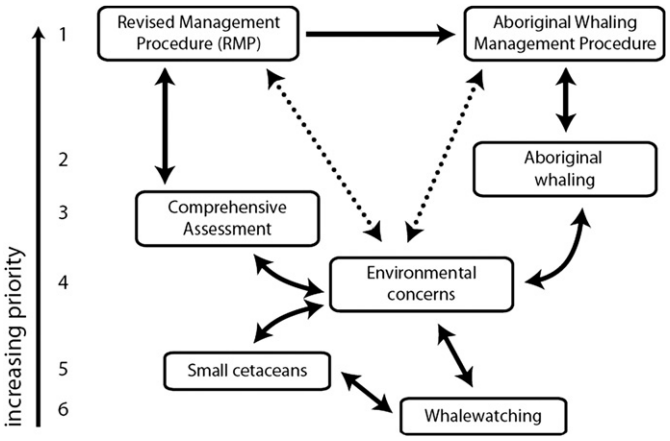

Fig. 3. Schematic representation of the relative importance in 1998 of environmental concerns in the IWC's Scientific Committee tasks, including perceived links (based on Fig. 1 in IWC, 1999, p. 5, used with permission).

conservative criteria for categorizing papers: some papers designated as 'basic biology,' were no doubt inspired by on-going conservation or policy debates and could arguably be considered as part of this paradigm shift.

Hill and Lackups [6] came to a different conclusion, noting that conservation topics in their cetacean literature sample were 'under-represented'.[7] Indeed, they found that only 3.2% of the papers analyzed covered conservation, ecology or environmental topics, which was substantially lower than even the 1970s sample in this current study. This may be reflective of a difference in their definition of what constituted a conservation topic; for example, they separated acoustic topics from conservation topics, whereas this analysis considered many acoustic papers to fall within the conservation category because, for example, they were the direct result of, and addressed, concerns over the impacts of underwater noise and military sonar on cetaceans.[8] In addition, their sample covered papers published during the time period 1950 to 2009, which would mask the temporal trends noted in this analysis. However, and perhaps most importantly, they also excluded a large number of publications from their sample, as they only focused on cetacean species 'cared for by humans at some point during captivity's documented history'.[9] This would exclude an enormous number of conservation studies done on free-ranging cetaceans (including all baleen whales and beaked whales) and would also suggest that captive research does not generally focus on conservation topics.

Organizations and institutions that wish their actions to remain in synch with new research priorities need to fully consider research trends. In the case of cetaceans, a key body—the International Whaling Commission—is highly divided as to the relative amount of effort it should devote to the two parts of its mandate, to wit: "to provide for *the proper conservation of whale stocks* and thus make possible *the orderly development of the whaling industry*"[10] (emphasis added). Over the years, environmental issues have gained increasing importance at the IWC. This was reflected in the establishment of a Standing Working Group on Environmental

[5] For example, see Loscalzo J. The evolution of the discipline of vascular biology. Circulation Research 2003;93:583–585.

[6] For a synthesis, see Jackson JBC. Ecological extinction and evolution in the brave new ocean. Proceedings of the National Academy of Sciences 2008;105 (Suppl. 1):11458–11465.

[7] Page 435 in Hill H, Lackups M. Journal publication trends regarding cetaceans found in both wild and captive environments: what do we study and where do we publish? International Journal of Comparative Psychology 2010;23:414–534.

[8] See Parsons ECM, Dolman S, Wright AJ, Rose NA, Burns WCG. Navy sonar and cetaceans: just how much does the gun need to smoke before we act? Marine Pollution Bulletin 2008;56:1248–1257.

[9] Page 416 in Hill and Lackups, *supra* at 7.

[10] International Convention on the Regulation of Whaling 1946, http://www.iwcoffice.org/commission/convention.htm.

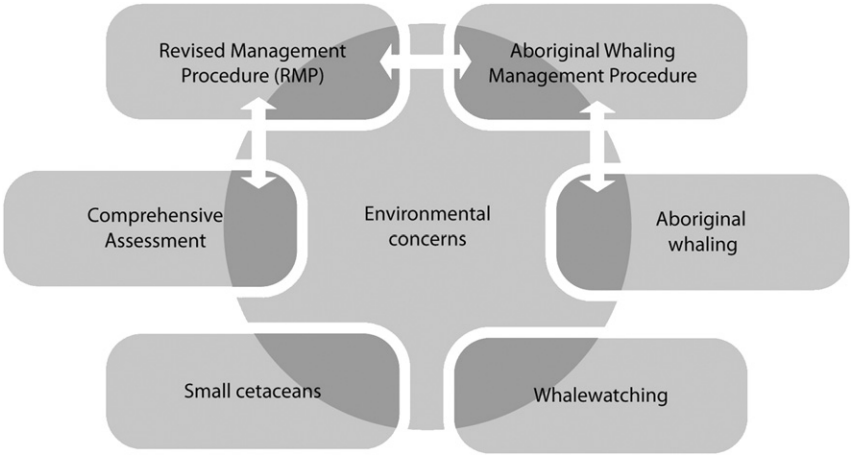

Fig. 4. Conceptual representation of the current overlap of environmental concerns with the various IWC Scientific Committee tasks.

Concerns in the Scientific Committee in 1992. This group identified five core issues that merit IWC attention: habitat degradation (which includes fisheries interactions, marine debris and ship strikes), noise impacts, chemical pollution, climate change and disease and mortality events.

An increasing number of workshops has been devoted to these topics in recent years.[11] In 2000, the Scientific Committee responded to an IWC resolution request "to provide regular updates to the Commission on environmental matters that affect cetaceans"[12] by producing a prototype State of the Cetacean Environment Report (SOCER) [9], which addressed the above priority issues for the world's major oceans. The IWC Commissioners then requested the Scientific Committee to produce the SOCER annually thereafter;[13] after subsequent deliberations on the format and content within the Scientific Committee [10], the SOCER has been produced annually since 2003 [11–16].

In 1998, environmental concerns had already assumed a middle ranking of importance within the framework of the Scientific Committee's main tasks, which include development of the Revised Management Procedure and the Aboriginal Whaling Management Procedure,[14] addressing so-called small cetacean issues, and addressing the impacts of whale watching on whales (Fig. 3). Nonetheless, considering that several of these tasks are not recognized as being within the competence of the IWC by many member states,[15] the ranking of environmental concerns within the Scientific Committee was inappropriately low.

In 2003, conservation issues reached a higher level of importance within the Commission itself, when it established the Conservation Committee, in what continues to be a contentious decision.[16] The results of the present analysis can inform this situation by pointing out the major focus on conservation in current cetacean research. Environmental concerns are not only a separate item in the IWC's Scientific Committee, but also have been incorporated in all six topics identified in Fig. 3 (Fig. 4). Thus, in the context of the Revised Management Procedure (RMP) environmental variability is being taken into account in the estimation of population growth rates and sustainable catch levels. The robustness of the RMP and the Aboriginal Whaling Management Procedure with respect to environmentally caused population changes has also been investigated. Environmental issues are further included, for example, in IWC whale watching discussions in the context of noise pollution, and in discussions on small cetaceans in the context of chemical pollution, climate change and habitat degradation. Moreover, many other important IWC agenda items, such as ship strikes and bycatch, are in a broad sense related to the degradation of cetacean habitat.

Accordingly, the IWC is accurately reflecting the current trend in scientific endeavor by dealing with environmental and conservation matters in its Scientific Committee and within the Commission itself. Recognizing and reacting in a timely manner to shifting baselines and shifting timelines in ecological status [17] are prerequisites for addressing and solving the problems facing cetaceans and the marine environment in general. The ultimate result is the generation of new concepts, changes of opinion and political movements culminating in new agreements, treaties and conventions—fueled by dramatic changes in electronic data documentation and internationally oriented information systems [18]. The shift in the focus of scientific publications is an excellent mirror of this process.

[11] For example, see International Whaling Commission. Report of the Scientific Committee: Annex K, Review of the report of the habitat degradation workshop. Journal of Cetacean Research and Management 2006;8(Suppl.):186–188.

[12] The 49th Annual Meeting of the International Whaling Commission, Resolution 1997-7, http://www.iwcoffice.org/Meetings/Resolutions/IWCRES49_1997.pdf.

[13] The 52nd Annual Meeting of the International Whaling Commission, Resolution 2000–7, http://www.iwcoffice.org/Meetings/Resolutions/resolution2000.htm#7.

[14] The Revised Management Procedure and the Aboriginal Whaling Management Procedure use algorithms for calculating commercial and aboriginal whaling quotas respectively.

[15] For example, whale watching and small cetaceans. For a detailed statement see International Whaling Commission. Statement on the Agenda. Journal of Cetacean Research and Management 2007;9 (Suppl.):403.

[16] See International Whaling Commission Annual Report of the International Whaling Commission. 2008. International Whaling Commission, Cambridge.

Acknowledgements

We wish to thank Marcie Berry for her assistance in searching the BIOSIS database. We also thank Douglas DeMaster, then Chairman of the Scientific Committee of the International Whaling Commission, who urged us, within the framework of the State of the Cetacean Environment Reports, to undertake this bibliometric analysis of the cetacean-related literature and Sue Moore for helpful comments on the manuscript. Lastly, we thank Harald Gruber for preparing the final versions of Figs. 1, 3 and 4.

References

[1] Riedl R. Marine ecology—a century of changes. Marine Ecology 1980;1:3–46.
[2] Stachowitsch M. Viewpoint: research on natural marine ecosystems: a lost era. Marine Pollution Bulletin 2003;46:801–5.
[3] Kochin BF, Levin PS. Publication of marine conservation papers: is conservation biology too dry? Conservation Biology 2004;18:1160–2.

[4] Bini LM, Diniz-Filho JAF, Carvalho P, Pinto MP, Rangel TFLVB. Lomborg and the litany of biodiversity crisis: what the peer-reviewed literature says. Conservation Biology 2005;19:1301–5.
[5] Ward JR, Lafferty KD. The elusive baseline of marine disease: are diseases in ocean ecosystems increasing? PLOS Biology 2004;2:542–7.
[6] Hill H, Lackups M. Journal publication trends regarding cetaceans found in both wild and captive environments: what do we study and where do we publish? International Journal of Comparative Psychology 2010;23:414–534.
[7] Knowlton N. Coral reef coda: what can we hope for? In: Côté IM, Reynolds JD, editors. Coral reef conservation. Cambridge: Cambridge University Press; 2006. p. 538–49.
[8] Forestell P. Public attitudes and popular culture. In: Perrin WF, Würsig B, Thewissen JGM, editors. The encyclopedia of marine mammals. 2nd ed. New York City: Academic Press; 2009. p. 898–913.
[9] Simmonds MP, Perry C, Dolman SJ. Reporting the 'State of the Cetacean Environment': ideas and examples. Paper presented to the scientific committee at the 52nd meeting of the international whaling commission. 11–28 June 2000, Australia; SC/52/E12.
[10] Perry C, Stachowitsch M. Second state of the cetacean environment report. Paper presented to the scientific committee at the 53rd meeting of the international whaling commission. 3–16 July 2001, London; SC/53/E21.
[11] Stachowitsch, M, Rose NA, Parsons ECM. State of the cetacean environment report (SOCER). Paper presented to the scientific committee at the 55th meeting of the international whaling commission, 26 May–6 June 2003, Berlin, Germany; SC/55/E7.
[12] Stachowitsch M, Rose NA, Parsons ECM. State of the cetacean environment report (SOCER) 2004. Journal of Cetacean Research and Management 2005;7(Suppl.):290–301.
[13] Stachowitsch M, Rose NA, Parsons ECM. State of the cetacean environment report (SOCER) 2005. Journal of Cetacean Research and Management 2006;8(Suppl.):198–217.
[14] Stachowitsch M, Rose NA, Parsons ECM. State of the cetacean environment report (SOCER) 2006. Journal of Cetacean Research and Management 2007;9(Suppl.):275–93.
[15] Stachowitsch M, Rose NA, Parsons ECM. State of the cetacean environment report (SOCER) 2007. Journal of Cetacean Research and Management 2008;10(Suppl.):279–92.
[16] Stachowitsch M, Rose NA, Parsons ECM. State of the cetacean environment report (SOCER) 2008. Journal of Cetacean Research and Management 2009;11(Suppl.):288–302.
[17] Erlandson JM, Rick TC. Archaeology, marine ecology and human impacts on marine environments. In: Rick TC, Erlandson JM, editors. Human impacts on ancient marine ecosystems. Berkeley: University of California Press; 2008. p. 1–19.
[18] Hammer K. A paradigm shift in the discipline of plant genetic resources. Genetic Resources and Crop Evolution 2003;50:3–10.