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ORIGINAL ARTICLE

The top-cited wetland articles in science citation index expanded: characteristics and hotspots

Jiupeng Ma · Hui-Zhen Fu · Yuh-Shan Ho

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Abstract The characteristics of wetland research were investigated by a bibliometric analysis of the top-cited wetland-related articles since 1899 based on the Science Citation Index Expanded database. The analyzed aspects included the distribution of journals, and publications by country, institution, and author, with five indicators including total articles, and independent, collaborative, first-author, and corresponding-author articles. Results showed that 188 articles on wetlands have been cited at least 100 times since their publication year to 2011. The most productive stage was 1991–2000, accounting for approximately seven-tenths of the top-cited articles. The US was the leading country, followed distantly by 25 other countries/territories. The US also held primacy in terms of productive institutions. The US Geological Survey ranked first according to the five indicators. The 188 top-cited articles had 637 authors, among whom W.J. Mitsch published the most first-author and corresponding-author articles. Furthermore, substance circulation (especially of carbon), wetland organisms and vegetation, and modeling methodology were the main focuses of wetland research in the past few years. In 2011, wetland organisms and vegetation were the hottest research topics. These results were coincident with a previous study on total publications, and revealed more-specific characteristics and hotspots of wetland research.

Keywords Wetland · Web of Science · Classic articles · Scientometrics

Introduction

Wetlands research is mainly devoted to the inner operating mechanisms of wetlands and ecological engineering of both natural and constructed wetlands (Vandervalk 1981; Pollock et al. 1998; Mitsch and Gosselink 2007). Research on natural wetlands focused on their restoration and interactions with ambient circumstances, whereas constructed wetlands are usually used to treat wastewaters (Mitsch and Wilson 1996; Rousseau et al. 2004; Kumar and Zhao 2011). Substance circulation, the retention and removal of nutrients and pollutants, capabilities to treat wastewater and maintain biodiversity, ecology, and hydrology, and other aspects of wetlands were reviewed in previous studies (Bartlett and Harriss 1993; Reddy et al. 1999; Deil 2005). Recently, a bibliometric analysis was also used to characterize total publications in 1991–2008 on wetlands (Zhang et al. 2010). An analysis of total publications could show the overall characteristics of wetland research, but it would be unable to distinguish the most popular research. Review papers can reveal detailed progress of processes of research work, but they are restricted to certain topics. A method combining a normal review and a bibliometric analysis could help overcome these shortcomings.

J. Ma
Department of Environmental Engineering,
Peking University, Beijing 100871,
People's Republic of China

H.-Z. Fu · Y.-S. Ho (✉)
Trend Research Centre, Asia University,
Taichung 41354, Taiwan
e-mail: dr_ysho@hotmail.com

H.-Z. Fu · Y.-S. Ho
Department of Environmental Sciences, Peking University,
Beijing 100871, People's Republic of China

Bibliometric analyses are widely used to assess research in multiple disciplines and countries (Pouris 1989; Chiu and Ho 2007; Ponce and Lozano 2011). The distribution characteristics of total publications by document type, country, institution, authors, subject categories, journals, retrieval keywords in the title, author keywords, and abstract are usually used as assessment parameters (Kiara et al. 2009; Brandt et al. 2010; Zhang et al. 2010). There are several indices to describe the characteristics of each aspect according to one's research interests. For example, the publication performance of countries can be estimated by the number of publications, single-country publications, international-collaborative publications, first-author publications, and corresponding-author publications (Zhang et al. 2010). The indices can be adjusted according to one's research goals. The number of times an article is cited indicate its peer recognition and impact in its study area (Garfield 1979; Smith and Rivett 2009). Although some researchers argued that the number of times cited has some defects, such as unnecessary self-citations and citing to argue or oppose, they still could not deny that the number of citations demonstrates the impact of an article in related scientific fields (Seglen 1998; Gisvold 1999). Citation analysis is widely used to assess the characteristics and performance of various articles, journals, disciplines, institutions, and countries (Moed 2005, 2009). Furthermore, top-cited articles are often more typical, because their authors are usually recognized scientists who have insights into the present status and future trends of a discipline (Garfield 1979, 1987; Moed 2009). Therefore, the most frequently cited articles can show research hotspots and trends by themselves. The top-cited 100 articles or articles with over 100 total citations are usually regarded as "classic articles" (Garfield 1987; Dubin et al. 1993; Picknett and Davis 1999). In recent years, analyses of "classic articles" were carried out in many disciplines (Dubin et al. 1993; Picknett and Davis 1999; Chuang et al. 2011).

To investigate the characteristics and hotspots of wetlands research, top-cited articles in the wetlands field were analyzed in two ways: one included the history, distribution by country and institution, authors, and journals of top-cited articles, and the other covered articles with the most citations to date and articles with the most citations in 2011. The top six articles from their publication year to 2011 and the top-cited seven articles in 2011 are briefly reviewed to demonstrate research processes, the current status, and future trends. The analysis based on these top publications with more-significant influence was also compared to a previous analysis using all publications (Zhang et al. 2010) to reveal more-specific wetland research characteristics and hotspots.

Data sources and methodology

Documents used in this study were located in the Science Citation Index Expanded (SCI-Expanded) database, from Thomson Reuters. According to Journal Citation Reports (JCR), it indexed 8336 journals with citation references across 176 scientific disciplines in 2011. Articles were the only document type considered. Articles from 1899 to 2012 with the keywords, "wetland" or "wetlands", in the title, abstract, keywords, and KeyWords Plus were downloaded using the basic function in the Web of Science (updated 23 May 2012). The numbers of times cited annually of all articles were also downloaded. Articles with at least 100 citations since their publication year to 2011 (TC2011) were identified as top-cited articles. To find papers more directly related to wetlands, articles with only searched keywords in KeyWords Plus were excluded. Therefore, only articles with searched keywords in their title, abstract, and author keywords were considered. In the end, 188 closely related top-cited articles on wetlands were analyzed after applying these filters.

Since total citations from the SCI-Expanded database are updated as time goes on, an invariable parameter, TC2011 (the total number of citations from an article publication year to the end of 2011) (Chuang et al. 2011) was employed. Annual citations were recorded as C + year. For example, C2011 is the total citations in 2011. Articles originating from England, Scotland, Northern Ireland, and Wales were reclassified as being from the United Kingdom (UK) (Chiu and Ho 2005). Articles from Hong Kong were not included in those from China but were separately analyzed as a territory (Li et al. 2009). Contributions of institutions and countries were identified by the appearance of at least one author in a publication. Collaboration type was determined by the addresses of the authors, where the term "single-country article" was assigned if all researchers' addresses were from the same country. The term "international-collaborative article" was assigned to articles coauthored by researchers from multiple countries (Chiu and Ho 2005). The term "single-institution article" was assigned if the researchers' addresses were from the same institution. The term "inter-institution collaborative article" was assigned if authors were from different institutions.

Results and discussion

History of top-cited articles

In the period of 1899–2011, 24,900 wetland-related documents were found in the SCI-Expanded database, including 20,847 articles among which 226 articles had a TC2011 of

≥100. Among the 226 articles, 188 articles could be searched by their title, abstract, or author keywords without KeyWords Plus. Figure 1 shows the distributions of the 226 and 188 articles according to the publication year. These articles could roughly be divided into three stages, 1981–1990, 1991–2000, and 2001–2010. Since the 1950s, worldwide industrialization and urbanization resulted in serious disturbances to natural environments (Falconer 1952; Lubchenco 1998; Drake and Griffen 2010). Wetland research was directly motivated by widespread wetland deterioration and loss, because of water and soil pollution, reclamation from both seas and lakes, and other anthropogenic activities (Holland et al. 1995; Gibbs 2000; Pechmann et al. 2001). The first wetland research-related article was published in 1968 according to the SCI-Expanded database (Niering 1968). However, none of the early articles had a TC2011 of ≥100 until 1981. Actually, publication of the early top-cited articles was closely related to the Ramsar Convention which was held in 1971 and its programs which were implemented in 1975. It established a framework for international cooperation to protect wetlands and became a milestone in wetland research and conservation. After the convention, wetland conservation attracted greater attention around the world. Many countries enacted laws and bylaws to protect wetlands, such as the *Clean Water Act*'s Section 404 program in US and European Water Framework Directive (Grumbles 1991; Janssen et al. 2005). All of these issues pushed forward wetlands research to a more-dynamic state. In 1981–1990, only 20 articles had a TC2011 of ≥100; nevertheless, that represented many more than before. The first top-cited article emerged in 1981 which was about succession in wetlands and had a TC2011 = 382 (Vandervalk 1981). The quantity of top-cited articles per year fluctuated between 0 and 4 and maintained a relatively low level. In this stage, most research focused on natural wetlands (Vandervalk 1981; Smirnoff and Crawford 1983; Kerbes et al. 1990), except for one article, which studied the capability of constructed wetlands to dispose of wastewater using aquatic plants (Gersberg et al. 1986). The second stage delivered most top-cited articles within the studied period. In 1991–2000, top-cited articles boomed and reached an average of 13 articles/year. This was more than sixfold the average amount during 1981–1990 and more than threefold that during 2001–2010. In the third stage, the number of top-cited articles suddenly decreased. A possible reason was that the time span was not long enough that the TC2011 could accumulate beyond 100. In addition, articles published earlier were at an advantage for gaining more citations, compared to those published at a later time (Lefaivre et al. 2010). The same phenomenon was also found in other disciplines on top-cited articles, such as adsorption research (Fu et al. 2012) and chemical engineering (Ho 2012).

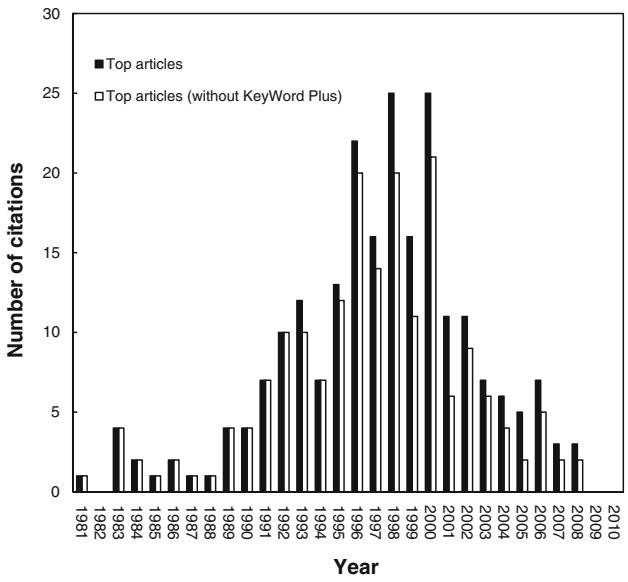

Fig. 1 Distribution of publication year of top-cited articles

Distribution of journals

The 188 top-cited articles were published in 74 journals. The monthly journal, *Ecology*, and *Ecological Applications* were the top two productive journals with more than ten articles, while their respective impact factors (IFs) were 5.073 and 4.276 (Table 1). The IF of a journal was determined from the year 2011 JCR. The journal with the highest IF (36.280) was *Nature* with eight articles. The lowest one was *Photogrammetric Engineering and Remote Sensing* (IF 1.048) with two articles.

Distribution of countries/territories

The 188 top-cited articles were published by 264 institutions in 26 countries/territories. These countries are ranked by the number of total top-cited articles in Table 2. There were 17 (65.4 %) developed countries/territories according to the United Nations Development Programme. These 17 countries contributed 99.5 % of the total top-cited articles, 99.3 % of single-country articles, 100 % of international-collaborative articles, 99.5 % of first-author articles, and 99.5 % of corresponding-author articles. Developed countries had an overwhelming advantage over developing countries, especially the US. It contributed 71.8 % of the total top-cited articles, 71.4 % of single-country articles, 73.2 % of international-collaborative articles, 65.4 % of first-author articles, and 65.9 % of corresponding-author articles. At the same time, the US was the most productive country for total

Table 1 The 11 most productive journals with the number of articles, impact factor (IF), Web of Science categories, and the position of the journal in its category

Journal	TP (%)	IF 2011	Web of Science categories	Position
Ecology	12 (6.4)	4.849	Ecology	19/134
Ecological Applications	10 (5.3)	5.102	Ecology	14/134
			Environmental sciences	10/205
Global Biogeochemical Cycles	8 (4.3)	4.785	Environmental sciences	13/205
			Multidisciplinary geosciences	5/170
			Meteorology and atmospheric sciences	4/71
Nature	8 (4.3)	36.280	Multidisciplinary sciences	1/56
Limnology and Oceanography	8 (4.3)	3.416	Limnology	1/19
			Oceanography	2/59
Conservation Biology	8 (4.3)	4.692	Biodiversity conservation	3/37
			Ecology	22/134
			Environmental sciences	15/205
Science	7 (3.7)	31.201	Multidisciplinary sciences	2/56
Environmental Science & Technology	7 (3.7)	5.228	Environmental engineering	3/45
			Environmental sciences	8/205
Ecological Engineering	6 (3.2)	3.106	Ecology	35/134
			Environmental engineering	9/45
			Environmental sciences	34/205
Journal of Geophysical Research-Atmospheres	6 (3.2)	3.021	Multidisciplinary geosciences	21/170
Water Research	5 (2.7)	4.865	Environmental engineering	5/45
			Environmental sciences	11/205
			Water resources	1/78

TP number of total top-cited articles, *IF 2011* impact factor in 2011

Table 2 Publication characteristics by country/territory

Country/territory	Rank (TP)	Rank (SP)	Rank (CP)	Rank (FP)	Rank (RP)	C%
USA	1 (135)	1 (105)	1 (30)	1 (123)	1 (112)	22
Canada	2 (26)	2 (16)	2 (10)	2 (21)	2 (17)	38
UK	3 (12)	3 (6)	4 (6)	3 (7)	4 (6)	50
Netherlands	3 (12)	5 (4)	3 (8)	3 (7)	3 (7)	67
Australia	5 (11)	4 (5)	4 (6)	5 (6)	6 (5)	55
Germany	6 (8)	6 (3)	6 (5)	8 (4)	8 (3)	63
France	7 (7)	8 (2)	6 (5)	5 (6)	4 (6)	71
Sweden	8 (6)	6 (3)	10 (3)	7 (5)	6 (5)	50
New Zealand	9 (4)	8 (2)	13 (2)	9 (3)	8 (3)	50
Switzerland	9 (4)	N/A	8 (4)	10 (1)	10 (1)	100
Russia	9 (4)	N/A	8 (4)	N/A	N/A	100
Italy	12 (3)	N/A	10 (3)	N/A	N/A	100
China	12 (3)	N/A	10 (3)	N/A	N/A	100
Denmark	14 (2)	N/A	13 (2)	10 (1)	10 (1)	100
Belgium	14 (2)	N/A	13 (2)	10 (1)	10 (1)	100
Brazil	14 (2)	N/A	13 (2)	N/A	N/A	100
Tanzania	17 (1)	10 (1)	N/A	10 (1)	10 (1)	N/A
Czech Republic	17 (1)	N/A	17 (1)	10 (1)	10 (1)	100
Hong Kong	17 (1)	N/A	17 (1)	10 (1)	10 (1)	100
Chile	17 (1)	N/A	17 (1)	N/A	N/A	100
South Africa	17 (1)	N/A	17 (1)	N/A	N/A	100
Thailand	17 (1)	N/A	17 (1)	N/A	N/A	100
Iceland	17 (1)	N/A	17 (1)	N/A	N/A	100
Norway	17 (1)	N/A	17 (1)	N/A	N/A	100
Egypt	17 (1)	N/A	17 (1)	N/A	N/A	100
India	17 (1)	N/A	17 (1)	N/A	N/A	100

TP number of total top-cited articles, *SP* single-country articles, *CP* international-collaborative articles, *FP* first-author articles, *RP* corresponding-author articles, *C%* CP/TP, *N/A* not available

wetland publications in the period of 1991–2008 (Zhang et al. 2010). Canada, another important country in wetland research, was ranked 2nd by these five indicators. The results were accordant with a previous analysis of total publications in 1991–2008, that two North American countries, the US and Canada, were the most important countries in the field of wetland research (Zhang et al. 2010). In contrast, Tanzania published one independent-country article with no international collaboration in 2001, which was the only paper that was independently finished by a developing country. This article was a review of the potential for constructed wetlands for wastewater treatment and reuse in developing countries (Kivaisi, 2001). It is worth noting that China had a high output of articles (Zhang et al. 2010), but contributed less to the top-cited articles. Two of China's three top-cited articles had collaborations with the US and other countries (Zhao et al. 1994; Howarth et al. 1996). Furthermore, developed countries, such as the US (22 %) and Canada (38 %), had lower collaborative ratios than developing ones.

Table 3 Characteristics of the eight most-productive institutions

Institution	Rank (TP)	Rank (SP)	Rank (CP)	Rank (FP)	Rank (RP)	C%
US Geological Survey, USA	1 (14)	1 (5)	1 (9)	1 (7)	1 (7)	64
McGill University, Canada	2 (9)	18 (1)	2 (8)	15 (2)	34 (1)	89
University of California, Berkeley, USA	3 (8)	18 (1)	3 (7)	2 (6)	2 (6)	88
University of Minnesota, USA	4 (6)	2 (4)	32 (2)	4 (4)	4 (4)	33
Louisiana State University, USA	4 (6)	3 (3)	11 (3)	4 (4)	11 (2)	50
University of Wisconsin, USA	4 (6)	6 (2)	5 (4)	2 (6)	3 (5)	67
Duke University, USA	4 (6)	6 (2)	5 (4)	4 (4)	4 (4)	67
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	4 (6)	6 (2)	5 (4)	15 (2)	34 (1)	67

TP number of total top-cited articles, *SP* single-institution articles, *CP* inter-institutional-collaborative articles, *FP* first-author articles, *RP* corresponding-author articles, *C%* CP/TP, *N/A* not available

Distribution of institutions

The eight most productive institutions which had at least six top-cited articles are shown in Table 3. The productivity of institutions in developed countries was much higher than those of developing countries. No institution from developing countries was found in the top 77 productive institutions with more than one article. Among the 264 contributing institutions, 249 (94.3 %) were from developed countries. Institutions in the US played the most important roles in wetland research. There were six US institutions among the top eight productive institutions, and 136 in the total 264 institutions. The US Geological Survey (USGS) in the US and McGill University in Canada were the top two institutions. The most impressive institution was the USGS which is funded by the US government. It ranked first in all five indicators, and produced the most wetland-related articles (549) in 1991–2008 (Zhang et al. 2010). McGill University published nine top-cited articles with a relatively low total production, which meant Canada had a higher proportion of top-cited articles to total publications (Zhang et al. 2010). Institutions in nine developing countries contributed 13 top-cited articles, including three for each from Russia and China, two each from Brazil and Thailand, and one each from India, South Africa, Chile, Egypt, and Tanzania.

Table 4 Characteristics of the 21 most-productive authors

Author	Rank (TP)	Rank (FP)	Rank (RP)
Moore, TR	1 (6)	9 (1)	9 (1)
Chanton, JP	2 (4)	9 (1)	9 (1)
Roulet, NT	2 (4)	9 (1)	9 (1)
Keddy, PA	2 (4)	N/A	N/A
Mitsch, WJ	5 (3)	1 (2)	1 (3)
Chapin, FS	5 (3)	1 (2)	3 (2)
Roden, EE	5 (3)	1 (2)	3 (2)
Semlitsch, RD	5 (3)	1 (2)	3 (2)
Stlouis, VL	5 (3)	1 (2)	3 (2)
Zedler, JB	5 (3)	1 (2)	3 (2)
Galatowitsch, SM	5 (3)	1 (2)	9 (1)
Bubier, JL	5 (3)	1 (2)	9 (1)
Chappellaz, J	5 (3)	9 (1)	3 (2)
Kelly, CA	5 (3)	9 (1)	9 (1)
Blunier, T	5 (3)	9 (1)	9 (1)
Zayed, A	5 (3)	9 (1)	N/A
Terry, N	5 (3)	N/A	1 (3)
Raynaud, D	5 (3)	N/A	N/A
Rastetter, EB	5 (3)	N/A	N/A
Heimann, M	5 (3)	N/A	N/A
Rudd, JWM	5 (3)	N/A	N/A

TP number of total top-cited articles, *FP* first-author articles, *RP* corresponding-author articles, *N/A* not available

Distribution of authors

Altogether, 637 authors contributed to the 188 top-cited articles. The top 21 productive authors who had at least three top-cited articles were successively ranked by the numbers of total top-cited articles, first-author articles, and corresponding-author articles (Table 4). Fifty-two authors (8.2 %) contributed to two articles in each category, and 564 authors (89 %) published only one article in each category. Moore, from McGill University, Canada, was the most productive author (six articles), while Mitsch, from Ohio State University, USA, published the most with respect to first-author articles (two articles) and corresponding-author articles (three articles).

Articles with the most citations in their article life

The total citation analysis (TC2011) and review of top-cited articles reflect research progression and trends for the future. The history of the top-cited articles demonstrated the overall distribution characteristics of the top-cited articles. The top six articles with a TC2011 $\geq$400 were investigated to identify specific wetland research hotspots. Their citation lives are shown in Fig. 2. Five of the six articles were published in the second stage. Only

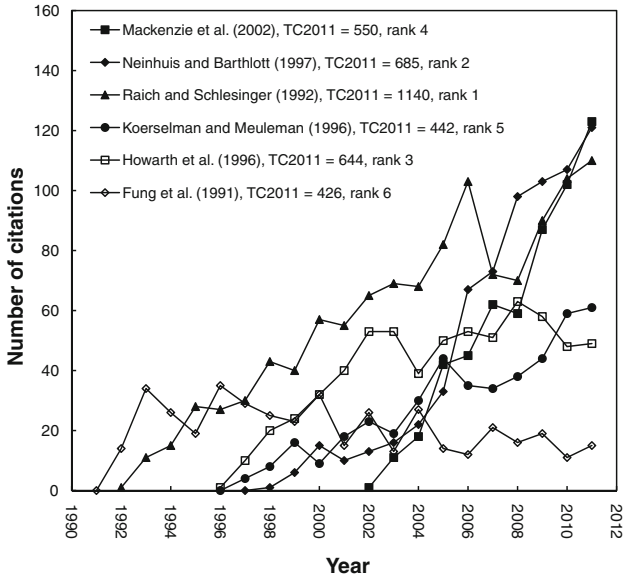

Fig. 2 Citation lives of the top six articles (with a TC2011 of ≥400)

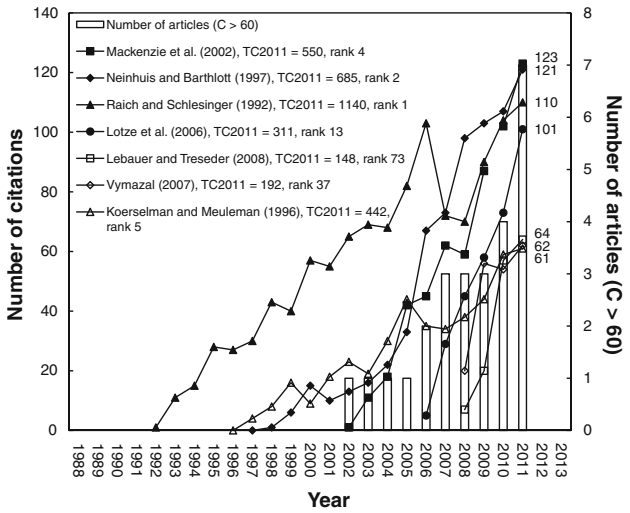

Fig. 3 Number of articles (with a C of ≥60) and top seven articles (with a C2011 of ≥60)

one was published in the third stage, but it had a TC2011 of 550, which reached fourth place within a relatively short time span. The most-often cited article was published in 1992 with a TC2011 of 1140 and a C2011 of 110, and was first among all top-cited wetland-related articles (Raich and Schlesinger 1992). From 1992 on, the number of times the article was cited continued growing, and remained at a high level compared to the others each year, especially during 1998–2006. Although the articles' C2007 and C2008 values decreased temporarily, the increasing trend was not reversed. The article studied the global carbon dioxide flux in both terrestrial and wetland

Table 5 Top seven articles (with a C2011 of ≥60)

References	C2011	TC2011
MacKenzie et al. (2002)	123	550
Neinhuis and Barthlott (1997)	121	685
Raich and Schlesinger (1992)	110	1,140
Lotze et al. (2006)	101	311
LeBauer and Treseder (2008)	64	148
Vymazal (2007)	62	192
Koerselman and Meuleman (1996)	61	442

soil respiration, and its relationship to vegetation and global climate change. Wetland drainage was also considered in this paper, because it could improve soil respiration rates. It was published by Raich from the Department of Botany, Iowa State University, and Schlesinger, from the Departments of Botany and Geology at the Duke University, both in the US. Actually, global carbon dioxide flux and global climate change, especially global warming, have been key research fields by scientists worldwide in recent years (Rasool and Schneide 1971; Sarmiento and LeQuere 1996; Florides and Christodoulides 2009). Wetlands have been an indispensable studied ecosystem.

The second and fourth top articles both soared from 2002. Regardless of whether one examined the TC2011 or the number of times cited every year, both of them maintained a high level. The paper in second place was about the characterization and distribution of water-repellent, self-cleaning plant surfaces, which is in the category of botany. It is claimed that wetlands areas have more species with water-repellent leaves (Neinhuis and Barthlott 1997). The paper in fourth place proposed a model to estimate site occupancy rates, in which 32 wetland sites were taken as pilot sites (Mackenzie et al. 2002). After 1996, the article in the sixth position kept decreasing by an average of 20 times per year. This article exploited three-dimensional models to simulate the global methane cycle (Fung et al. 1991). The decrease in citations was attributed to the new model's invention, which was used to deduce information on methane sources and sinks from temporal and spatial variations in atmospheric methane mixing ratios (Hein et al. 1997). The two other articles have continued to increase or remained steady since their publication. One was the second most frequently cited article that assessed influences of natural and human drainages on the North Atlantic. The balance of regional nitrogen, riverine nitrogen, and phosphorous fluxes were the main thrust (Howarth et al. 1996). The other article was about the N:P ratio of vegetation (Koerselman and Meuleman 1996).

Of the six most frequently cited articles, four articles studied wetland organisms or vegetation; three discussed substance circulation; and two were about modeling methodology. The distribution of research interests of the six most-often cited articles is in accord with the analysis of total publications of wetland articles (Zhang et al. 2010).

Articles with the most citations in 2011

The single-year citation analysis (C2011) and review of the top articles describe the characteristics and hot points of that year. The TC2011 is an accumulative number which can reach a high value if the time span is sufficiently long. Although one articles as a newcomer, for example, published in 2009, had great potential, it did not have a high TC2011. Therefore, it is necessary to study the number of times an article was cited every single year to interpret the research focus in that year. The seven most-often cited articles in 2011 are listed in Table 5. Figure 3 shows the top seven articles which had a C2011 of $\geq$60, and the numbers of articles that had a C $\geq$60 every single year. In 2011, four articles overlapped in Figs. 2 and 3. These four articles had both a TC2011 of $\geq$400 and a C2011 of $\geq$60. They were the most influential articles in their disciplines. The other three had a C2011 of $\geq$60, but a TC2011 of $<$360. They were, respectively, published in 2006 (Lotze et al. 2006), 2007 (Vymazal 2007), and 2008 (LeBauer and Treseder 2008). There was insufficient enough time to accumulate citations, but all of them rapidly increase since publication with great potential. Lotze et al. (2006) reported on estuarine and coastal sea depletion, degradation, and recovery potential under human impacts from a historical view in the journal *Science*, which was frequently cited all along because of its significance to science. Loss of wetland habitats is discussed in the article. Vymazal (2007) reviewed the removal capability of nutrients (mainly nitrogen and phosphorus) in various types of constructed wetlands. Nitrogen and phosphorus removal/retention mechanisms are also discussed. Constructed wetlands were surely becoming very attractive research areas (Brix 1997; Coleman et al. 2001; Rousseau et al. 2004). LeBauer and Treseder (2008) studied nitrogen limitation of net primary production in terrestrial ecosystems. In 2011, five of the top seven articles focused on wetland organisms or vegetation. Four topics (substance circulation (carbon-dioxide flux), wetland habitats, constructed wetlands, and modeling methodology) were, respectively, studied in one of the top seven articles. This indicated that wetland organisms or vegetation were the principal fields of wetland research in 2011. A similar analysis can be applied to the other years to identify the hottest research topics.

Conclusions

Since 1899, there were 188 top-cited articles with at least 100 citations that had wetland or wetlands in the title, abstract, or author keywords. They were written by 637 authors and published in 74 journals. The publication year of articles was divided into three stages of 1980–1990, 1991–2000, and 2001–2010. The decade 1991–2000 was the most productive period, during which more than three-fifths of the top articles were published. Developed countries accounted for the overwhelming majority of top-cited articles, and the US held the leading position. Most of the most-productive institutions were also from the US. Moore was the most-productive author of top-cited articles overall, while Mitsch published the most first- and corresponding-author articles. According to the citation lives of top articles, it was concluded that wetland organisms and vegetation were the most recent research emphases. Moreover, wetland organisms and vegetation, and modeling methodology were traditional research hotspots and will continue to be emphasized in the foreseeable future.

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