Acta Ecologica Sinica 33 (2013) 237–240

Contents lists available at SciVerse ScienceDirect

Acta Ecologica Sinica

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

# Bibliometrical study method on tidal freshwater marshes loss and research orientation

Xi Chen [a,*], Bain Mark [b], Sullivan Patrick [b], Morgan Robertson [c], Kusler Jon [d], Ziyan Wang [a]

[a] School of Humanities and Social Sciences, Dalian University of Technology, Dalian, Liao Ning 116024, PR China
[b] Department of Natural Resources, Cornell University, Ithaca, New York 14853, USA
[c] Department of Geography, University of Wisconsin, Madison, Wisconsin 53706, USA
[d] Association of State Wetland Managers, Berne, New York 12023, USA

ARTICLE INFO

*Article history:*
Received 21 May 2012
Revised 14 December 2012
Accepted 9 May 2013

*Keywords:*
Bibliometrical analysis
Tidal freshwater marsh loss

ABSTRACT

Many studies concerning wetland loss have been conducted in the last two decades. However, tidal freshwater marsh's research topics, mirroring hot points, vary in scientific community and change over time. A bibliometrical analysis method is demonstrated in this paper to describe tidal freshwater marsh research and changes in the research over time. For example, habitat restoration, soil composition, plantation pattern and coastal wetland have drawn increasing attention since 2005. The bibliographic methods described in this paper involved the use of 54 case studies to find critical paths regarding how tidal freshwater wetland loss has been induced by different causes. From case studies, it has been concluded that urbanization is the most important cause of tidal freshwater marsh loss. Critical paths of tidal freshwater marsh loss driving forces have been also demonstrated in this paper.



## 1. Introduction

Wetlands constitute a varied class of aquatic ecosystems across the landscape. Wetlands provide many ecosystem services like ground water recharge, attenuation of nutrient runoff, flood protection through peak flow attenuation, species habitat and pollutant removal [1,2]. Many factors influence the stability or, alternatively, degradation of wetland ecosystems. Based on the scenario simulations in the Millennium Ecosystem Assessment [3], habitat change will be a main driving force for ecosystem service change prior to 2050. Additionally, land use and land cover changes will be vital influences regarding the condition and functions of wetland in most regions [4–6].

An international standard definition for wetlands was developed by the Ramsar Convention in Ramsar, Iran in 1971. Another definition more specific to the United States was provided by Mitsch and Gosselink in their text book on wetlands and demonstrates the variety in the term "wetland" and the reasons for these differences:

> a variety of wetland plant communities and soil types have developed in the United States because of regional differences in hydrologic regimes, climate soil-forming processes, and geologic settings. Consequently, many terms, such as 'marsh', 'bog', 'fen', 'swamp', 'pocosin', 'pothole', 'playa', 'salina', 'vernal pool', 'bottom-land hardwood swamp', 'river bottom', 'lowland', and others are applied to different types of wetlands across the country [7].

Based on the descriptions provided by Mitsch and Gosselink's, the term "tidal freshwater marsh" can be used to describe a kind of wetland that combines the characteristics of salt marshes and freshwater inland marshes. Tidal freshwater marshes are distributed widely along the U.S. eastern and southern coastal areas, and are critical areas of wetland loss in nearly every coastal zone across the world.

In preparing this paper, we performed a bibliometric analysis to identify clusters of scholarly research on tidal freshwater marshes. Furthermore, we identified the critical paths of study relevant to this type wetland loss. Critical path discussion was successfully used by Geist and Lambin in 2002 [12].

## 2. Materials and methods

In a bibliometric analysis the determination of which keywords to use is important to fully capturing the scope of scientific publication on a topic. For the sake of getting accurate search results

* Corresponding author. Tel.: +1 607 279 4714; fax: +1 607 255 0349.
*E-mail addresses:* xc62@cornell.edu (X. Chen), mark.bain@cornell.edu (M. Bain), pjs31@cornell.edu (P. Sullivan), mmrobertson@uky.edu (R. Morgon), jon.kusler@aswm.org (J. Kusler), wziyan22@163.com (Z.Y. Wang).

1872-2032/$ - see front matter © 2013 Ecological Society of China. Published by Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.chnaes.2013.05.001

while excluding studies on unrelated sites such as inland freshwater wetlands, the term "tidal freshwater marsh" was used to guide keyword selection based on the definition of wetland from Mitsch and Gosselink. The terms "tidal", "freshwater", "marsh" and "estuary" to formulate retrieval query in Web of Science (WOS) (Table 1). WOS offers search results from fields as diverse as ecology to engineering management. The initial search generates a pool from which will be selected papers cited a very large number of times and which are central to study of tidal freshwater marshes.

According to the principle and methods above, 181 high-impact tidal freshwater marsh research papers were selected, representing a collection of authoritative and pioneering viewpoints in every field related to wetland research.

**Table 1**
Query formation of literature in Web of Science.

| | Query formation | Language | Document type | Time span | results |
|---|---|---|---|---|---|
| #1 | TS = tidal | English | Article | All year | 39,738 |
| #2 | TS = freshwater | English | Article | All year | 39,605 |
| #3 | TS = marsh | English | Article | All year | 16,321 |
| #4 | TS = estuary | English | Article | All year | 27,536 |
| #8 | #1 and #2 and #3 and #4 | English | Article | All year | 181 |

These 181 papers were then further analyzed as data sources using Citespace downloaded from WOS [8,9]. The papers were published in English from 1990 to 2011. Thus, a 22-year research period is used to produce "knowledge maps" which demonstrate the study characteristics and track changes in scholarly concerns during this period (Fig. 1).

## 3. Results

We selected a subset of the 181 cases, identifying 54 papers as the key papers or cases to analyze.

The bibliometric visualization tool was used to focus on these 54 papers to produce a co-keyword analysis map. This is a map that shows the research topic change with the timeline change. The resulting clusters are presented in Fig. 2. Across time, the research topics become more concerned with ecological relationships and interconnections. We can see that during 1990s, research on tidal freshwater marsh focuses on particular elements, such as nitrogen or phosphorus (Cluster B). After 2005, the research tends to be more systematic and focused on holistic issues such as habitat restoration.

Based upon the 54 high impact factor selected papers, primary driving forces for tidal freshwater marsh loss are urban expansion and agricultural activities. However, urban factors are exerting increasingly stronger influences in the cases studies over the past

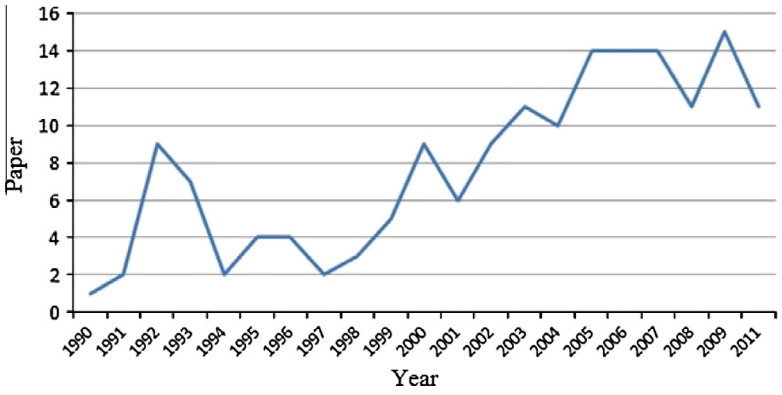


**Fig. 1.** Publication increase with timeline.

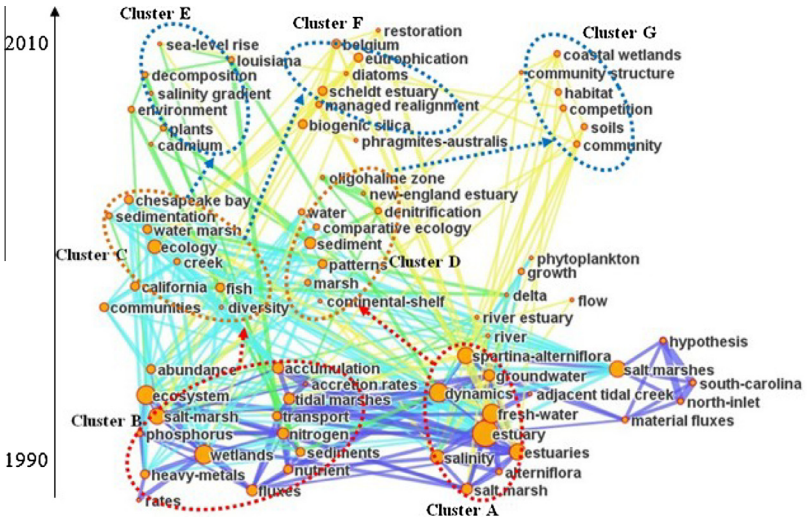


**Fig. 2.** Co-keyword analysis map.

**Table 2**
Time distribution of driving forces analysis.

| Timeline | Agriculture | Urbanization | Nature | Others |
|---|---|---|---|---|
| Time unknown | 10 | 8 | 6 | 1 |
| Before 1900s | 1 | 1 | – | – |
| From 1950s to 1990s | 3 | 3 | 1 | 3 |
| From 1990s to now | 9 | 14 | 6 | 9 |
| Overall | 23 | 26 | 13 | 13 |

decade. These findings are consistent with Tiner and Dahl's status and trend studies in 1984 and 1996 [10,11].

As one can see, 23 and 26 papers from all of the (54) support the impacts of Urbanization and Agriculture over time. Further, 22 of them agree that channelization and dam and reservoir construction are important causes of tidal freshwater marsh loss. This part worked with water issues (13) together led further influence: 14 (plant adaptation and species change) and 9 (sediment change and eutrophication). The black and red lines represent the transmit routine: the power of wetland loss between varied underlying causes and proximate causes. Of which, the red line roads could be regarded as a critical routine because of more supports based on literature analysis. The end rectangles, such as Bird or Fish Adaptation, could be regarded as phenomena. From all of these chains of causation, it is clear that urbanization factors (26) are exerting the most powerful influence via channelization. Next most influential (22) is plant adaptation, and following that (14) sediment change (22), and fish (10) and bird (3) species change. Agricultural factors (23) and natural factors (13) are less important in affecting tidal freshwater marsh loss (Table 2 and Fig. 3).

## 4. Conclusions

A bibliometric visualization technique was used to discover broad research themes in tidal freshwater wetland research. We used bibliometric analysis and 54 key papers to further discern the major causes of loss of tidal freshwater marshes involved in academic study, and to discover the trends in current threats to these wetlands. We found strong support for identifying urbanization as the primary threat to tidal freshwater marsh loss. Urbanization activities threaten tidal freshwater marshes by channelization and dam and reservoir construction. Recent surveys in the series of "status and trends" reports on wetlands issued by the US government have made it clear that agricultural impacts to wetlands are declining relative to historic trends, but agricultural uses also pose a significant threat to tidal freshwater marshes. It is of course true that natural factors and other factors including sea-level rise and salinity change, are threatening biodiversity. However, coastal wetlands across the world are threatened environments and our analysis not only confirms that urban development is one of the leading, if not the primary, driver of degradation, but also confirms that this has been documented in the scholarly literature. There is

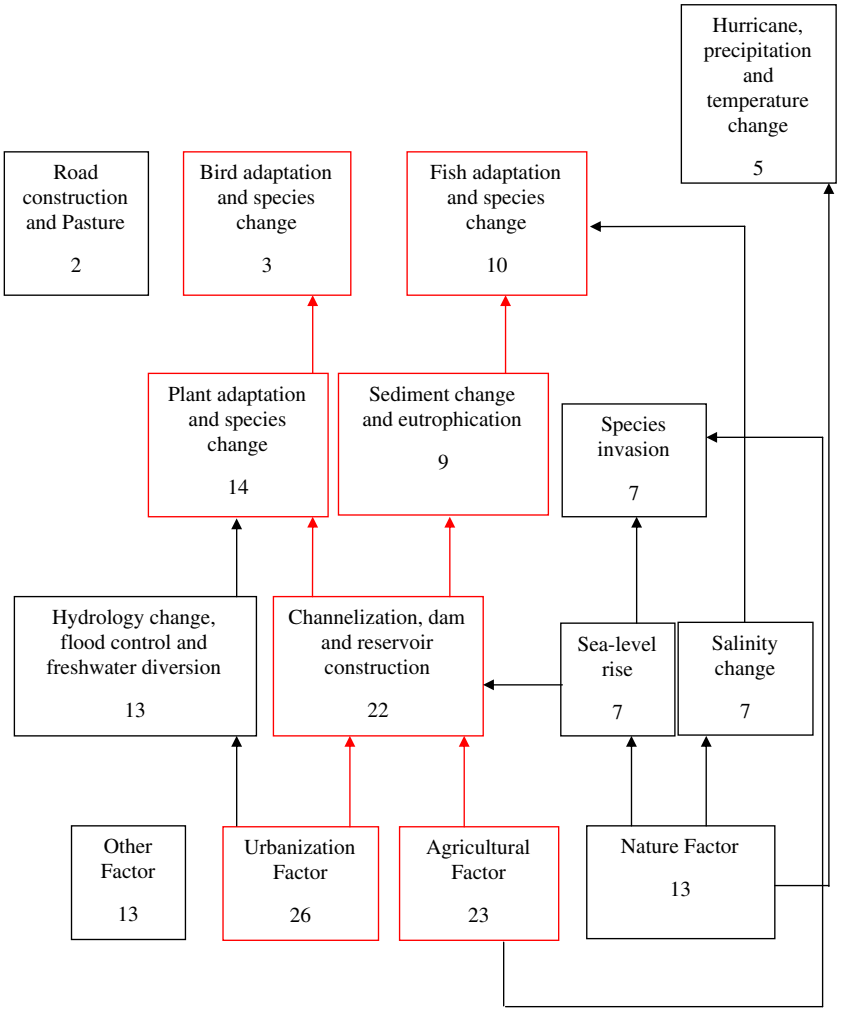


**Fig. 3.** Critical path of tidal freshwater marsh loss based on varied driving forces.

no shortage of evidence in the academic literature that urbanization threatens coastal wetlands, and policymakers should not delay action on the basis of scientific uncertainty.

## Acknowledgments

This research is partly funded by Chinese Scholarship Council, China and Jeffrey Sean Lehman Fund in Cornell, USA.

## References

[1] R. Costanza, R. d'Arge, R. de Groot, et al., The value of the world's ecosystem services and natural capital, Nature 387 (1997) 253–260.
[2] W.J. Mitsch, J.G. Gosselink, Wetlands, second ed., John Wiley & Sons, New York, 1993. pp. 31–32.
[3] Millennium Ecosystem Assessment. Ecosystems and Human Well-Being: Wetlands and Water. World Resources Institute, Washington DC, USA 2005. pp. 3–15.
[4] W. Steffen, A. Sanderson, P.D. Tyson, et al., Global Change and the Earth System: A Planet under Pressure, Springer, Verlag Press, Berlin, Germany, 2004.
[5] J.J. Feddema, K.W. Oleson, G.B. Bonan, et al., The importance of land-cover change in simulating future climates, Science 310 (2005) 1674–1678.
[6] E. Lambin, X. Baulies, N. Bockstael, et al., Land use and Land Cover Change: Implementation Strategy, IGBP Report No. 48, Stockholm, Sweden and IHDP Report No. 10:Bonn, Germany, 1999, p. 145.
[7] R.W. Tiner, Wetland definitions and classifications in the United States, in: J.D. Fretwell, J.S. Williams, P.J. Redman (Eds.), National Water Summary on Wetland Reournces, USGS Water-Supply Paper 2425, USDI, U.S. Geological Survey. Washington DC, USA, 1996, pp. 27–34.
[8] C.M. Chen, Detecting and visualizing emerging trends and transient patterns in scientific literature, J. Am. Soc. Inf. Sci. Technol. 57 (2006) 359–377.
[9] C.M. Chen, Measuring the movement of a research paradigm, Proc. SPIEIS&T: Visual. Data Anal. 5669 (2005) 63–76.
[10] R.W. Tiner, Wetlands in the United States: current status and recent trends, US Fish and Wildlife Service, Washington, DC, 1984.
[11] T.E. Dahl, G.J. Allord, History of Wetlands in the Conterminous United States, USGS, National Water Summary on Wetland Resources, 1996. p. 2425.
[12] H.G. Geist, E. Lambin, Proximate causes and underlying driving forces of tropical deforestation, Bioscience 52 (2) (2002) 143–150.