

## A Tool to Navigate Overlaps in Fragmented Ocean Governance

Julia A. Ekstrom,<sup>1,2\*</sup> Oran R. Young,<sup>2</sup> Steve D. Gaines,<sup>3</sup> Maria Gordon,<sup>2</sup> Bonnie J. McCay<sup>4</sup>

1. Engineering Informatics Group, Department of Civil and Environmental Engineering, 473 Via Ortega, Room 228, m/c 4020, Stanford University, Stanford, CA 94305, USA (current address)

2. Bren School of Environmental Science and Management, U.C. Santa Barbara, Santa Barbara, CA 93106-5131, USA

3. Ecology, Evolution & Marine Biology, U.C. Santa Barbara, Santa Barbara, CA 93106-9610, USA

4. Department of Human Ecology, School of Environmental and Biological Sciences, Rutgers University, New Brunswick, NJ 08901, USA

\* Author for correspondence (present address). E-mail: jekstrom@stanford.edu

### Abstract

Implementation of marine ecosystem-based management requires improved understanding of existing governance, including gaps and overlaps resulting from fragmented management. Focusing on overlaps, this paper presents a technique using text analysis to assist in the identification of agencies and laws involved in overlaps from a system perspective. The overlaps analysis uses term frequency counts on ocean laws and regulations in conjunction with relevant agency authority. Such information delivered in a transparent user-friendly presentation can help policymakers and other constituents of ecosystem-based management to find existing overlaps as a step to facilitate improved coordination.

Keywords: ecosystem-based management; overlap; marine law; jurisdiction

### 1. Introduction

It is well-established that the fragmented approach of sector-based marine management is a major contributor to deteriorating ocean health. Major gaps and overlaps created by this approach impede the achievement of ocean management goals [1, 2]. We focus here on overlaps in the two forms that commonly arise: *jurisdictional overlap* occurs where two or more statutes or regulations govern some aspect of the same resource or activity in the same geographic space [1]; *functional overlap* arises when two or more statutes or regulations separately cover intersecting activities. When ships strike whales in United States waters, for instance, the laws

maintaining shipping routes and speeds unintentionally affect the effectiveness of laws protecting marine mammals [3]. Both types of overlap may occur under a single agency or among agencies within or across scales of management [4]. Strategically developed, overlaps can provide benefits, such as resource sharing or complementary skills [5]. However, without coordination or consistency, overlaps can create obstacles to effective and efficient regulation of the marine environment.

In reaction to the problems caused by fragmented ocean management, public, private and non-profit entities have begun to adopt and implement an ecosystem-based approach to management [6] as a more integrated system that takes into account relationships within ecosystems and the diverse roles of humans [7, 8]. Ecosystem-based management (EBM) includes two key underlying principles: a) increased collaboration between ocean management agencies; and b) participation of stakeholders on behalf of all relevant interests in the target ecosystem [8, 9]. Therefore, to implement EBM, agency personnel, policymakers, and other stakeholders must be able to make decisions from an informed position about ecosystem properties and targets, and current management systems [10, 11]. This creates the need for access to baseline information about overlaps, including what agencies (through what laws) are involved in any piece of the ecosystem.

Traditional qualitative methods to identify overlaps are performed on a case-by-case basis making them time-intensive, particularly as the number of legal documents and authorities increases [4]. Tools that help to rapidly identify problematic overlaps and show paths to mitigation could help meet these challenges and assist the transition into well-informed and well-coordinated EBM [6].

We present a quantitative method that generates quick and easy access to baseline information about the agencies, laws, and regulations involved in any piece of the ecosystem. We show how text analysis, even in a simple form, can systematically provide syntheses of ocean management overlaps. The analysis serves two main purposes for those directly involved in EBM: first, it helps find where overlaps (including redundancies and inconsistencies) exist in the present, and thus assist in resolving conflicting and/or confusing management situations; second, it can identify where proposed policy, regulation, or management practice would create an overlap (and with what agency and law). The latter information is useful in order to facilitate strategic development of proposed policy that could build on existing policy and/or entail collaboration with the relevant agencies or purposeful contradiction of existing policy. The fast, quantitative assessment resulting from the technique in this way contributes two different perspectives on information essential to successful implementation of EBM.

## **2. Text Analysis Applied to Ocean Governance Questions**

The rapid growth of digital information has led scientists increasingly to apply a range of information retrieval techniques to a wide variety of complex data analysis problems [12, 13]. Interpretation of satellite data, for example, has revolutionized understanding of the oceans, land, and atmosphere despite its coarse resolution. Can information retrieval also generate overviews

of ocean governance, helping policymakers and EBM program constituents identify and prevent potentially problematic overlaps in governance and move toward ecosystem-based management (EBM)? Text analysis, referred to as text mining in computer science, “seeks to extract useful information from data sources through the identification and exploration of interesting patterns” [12]. Here, we illustrate a use of this tool with an example involving marine mammals and shipping, and discuss its potential in addressing a wide range of marine governance issues. The whale-ship strikes case highlights the challenges of overlaps that need to be addressed to truly integrate ecosystem thinking and approaches into ocean management.

The common approach to text analysis is to count the number of times key terms appear in the texts being reviewed. One apparent limitation of text analysis of laws and regulations is that it does not capture agency responsibility. The need to incorporate agency responsibility into an overlap analysis became clear from feedback provided by managers, ocean users, and researchers who participated in multiple iterations of the tool. Term count data alone produce long lists of laws relating to each topic. Such lists are difficult to synthesize without the context of the responsible agencies. We have therefore gone beyond basic term counting in order to incorporate agency responsibility into the analysis. This shows the existing or potential overlaps results of text analysis in relation to the specific agencies involved [14]. Including agencies also facilitates visualization of the data, giving it the potential to serve as user-friendly tool to a wide variety of ocean stakeholders, policymakers, and marine policy scholars.

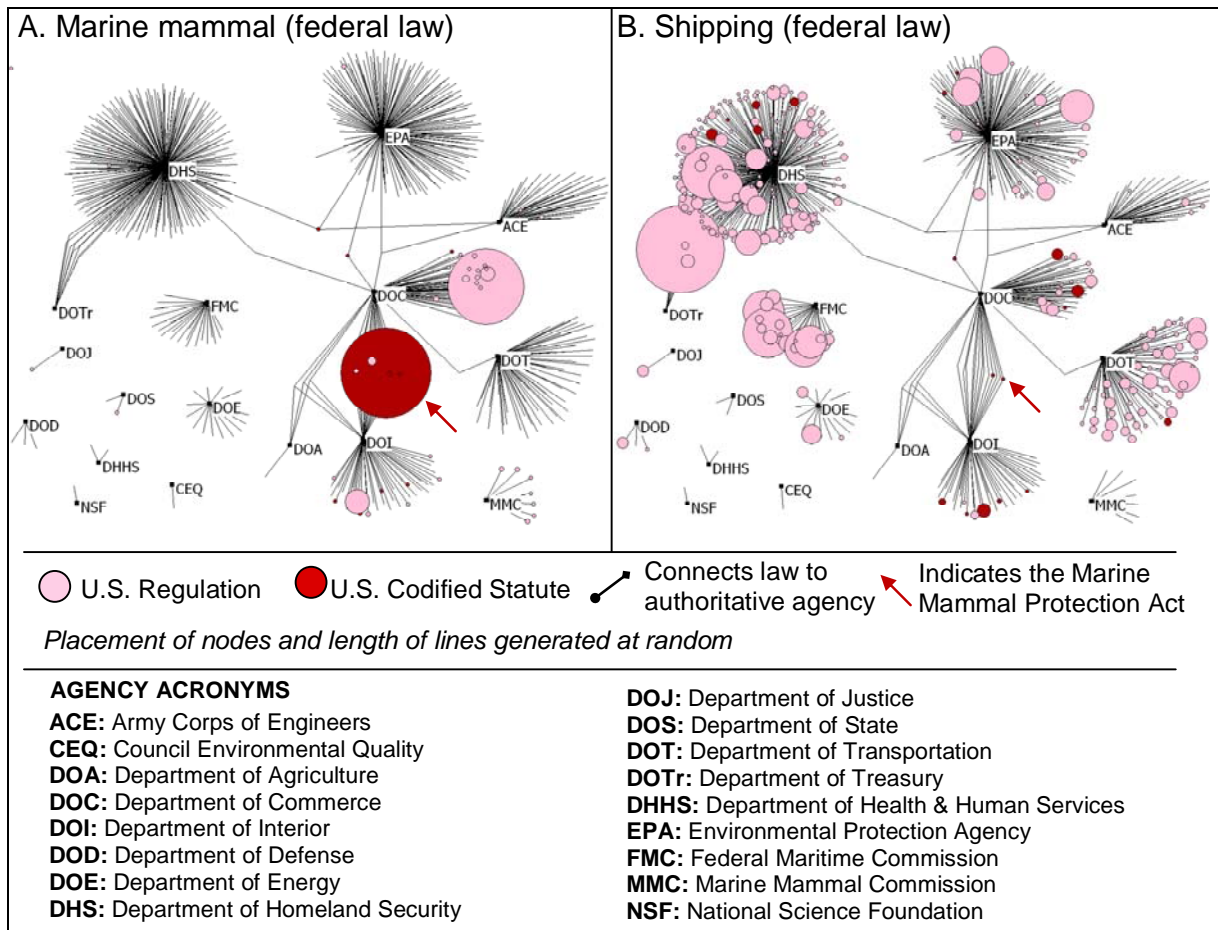
### **3. Mapping Seascapes of Ocean Law**

The resulting diagrams, as shown in Figure 1 for the topics ‘marine mammal’ and ‘shipping,’ display multiple dimensions of the legal information simultaneously. Each document in the collection of federal United States ocean and coastal related laws<sup>1</sup> (red) and regulations (pink) is represented in the network diagrams by a circular node. A line from each of these nodes links it to a small square node representing its authoritative agency or agencies. Document nodes resize according to the frequency of term counts for each topic [14]. Large nodes indicate laws with a high frequency of topic references. The nodes representing laws and regulations that do not reference the selected term or phrase disappear from the diagram, but document-agency connecting lines remain in place. The diagrams create a graphical portrayal or “seascape” of legal and agency involvement for the marine-related topic(s) under study. Interpretation of such legislative seascapes produces baseline governance overviews helpful in identifying key legal and agency involvement.

---

<sup>1</sup> Federal United States statutes and regulations relevant to the ocean and coastal region along the West Coast of the U.S. for the year 2006 were used in this analysis. The full collection is available for searching and viewing at <http://www.cclme.org>.

**Figure 1.** Mapping seascapes of U.S. federal laws and agencies directly involved in management of marine mammals (A) and shipping (B). Laws (red circular nodes) linked with lines to their statutory implementing agencies. Regulations (pink circular nodes) link to their author agency. Relative frequency of a term in each law is represented by varying node size. Arrow indicates Marine Mammal Protection Act in A and B under the shared primary authority of the U.S. Department of Commerce and the U.S. Department of Interior. Diagrams generated in NetDraw [27] using a table of agency authority for each law combined with term frequency data.



### 3.1 Jurisdictional overlap

The network diagrams reveal relational patterns and multiple dimensions not captured by other types of representation [14]. The diagrams reflect, for instance, that the key statute

involved in the topic ‘marine mammal’ is the Marine Mammal Protection Act, which is under the dual regulatory authority of the Departments of Commerce and Interior (arrow Fig. 1a). The diagram also shows multiple regulations for the topic. If a key statute covering all the regulating agencies were not in place, these regulations would carry a high potential for problematic jurisdictional overlap. The existence, however, of one key statute assigning dual authority has likely prevented the development and promulgation of inconsistent regulations. Thus, for this topic, jurisdictional overlap seems “positive,” producing low potential for inconsistent regulation (Fig.1a). However, widening the scope by including the term ‘whale,’ would make the diagram change to reflect the significance of the Endangered Species Act and other documents. A picture of much more complicated jurisdictional overlap would then emerge because the number of statutes and regulations increases.

By comparison, Figure 1b shows a high degree of potentially problematic jurisdictional overlap for ‘shipping’ as this topic appears in the regulations of many agencies without an apparent key statute. This absence of a lead agency or bridging statute sets the stage for regulatory conflict over management of shipping. In addition, transaction costs of interagency coordination often rise with the number of bargaining players [10]. Therefore, the overall high number of agencies and regulations involved in shipping may indicate its management suffers from a lack of coordination, as confirmed by the U.S. Commission on Ocean Policy (2004). Beyond the exposure of potential problematic jurisdictional overlap, identification of the responsible agencies can help direct efforts to coordinate and so avoid conflict.

### *3.2 Functional overlap*

Viewed together, the two network diagrams also facilitate examination of a problematic functional overlap produced by sector-based decision-making. They show how mining text of laws can reveal which federal laws and regulations govern two intersecting issues - shipping and marine mammals – and, again significantly, through which agencies. The graphical results (Fig.1a) display the highest concentration of marine mammal related regulation and statutory authority by the Departments of Commerce and Interior. This contrasts with prominent overlapping jurisdiction of shipping through regulations stemming from several agencies (Fig.1b). This overview could assist policymakers and managers in deciding which agency or suite of agencies should be involved in resolving the problem at this scale of management. Functional overlap analysis of the same kind could apply to laws at the state and international levels for the continued crisis of Right Whales in the North Atlantic [3, 15], as well as the emerging problem of ship strikes on whales in the Southern California Bight [16]. Thus, generating baseline legislative and agency data about functional overlap could help facilitate strategic management decisions necessary at different policy levels to alleviate impacts on threatened cetacean populations.

## **4. Discussion**

### *4.1 Applications*

Text analysis of management related documents can help direct efforts to improve coordination both within and across levels of management assisting ecosystem-based efforts, such as marine protected area designation, marine spatial planning, and others. The redesign of marine protected areas (MPAs) off California presently managed by several agencies, for example, requires identification of existing management and human uses in the State's waters [17]. An overview of jurisdictional overlap among these agencies on selected MPA issues and goals could prove useful to managers and policymakers. Mapping of laws to agencies involved in functional overlap for topics linked ecologically may also help improve agency coordination in the MPA process.

Marine spatial planning involves even more comprehensive cross-sector evaluation of existing management than marine protected area planning. It must go beyond living marine resource protection to incorporate the full suite of interest groups, human uses, and existing management systems [18]. Accessible, interpretable, and transparent legal and agency jurisdiction information combined with ecosystem data is critical to the marine spatial planning process [11].

#### *4.2 Limitations and strengths of technique*

We recognize limitations exist to the use of a text analysis tool to understand ocean management issues. It does not:

- analyze all elements of governance (e.g., indigenous practices; non-governmental and community organizations) unless associated documents are included to represent such elements
- replace valuable legal knowledge or management experience and interpretation of law

Baseline overviews of extant laws and regulations could help the transition toward EBM by:

- providing a fast, quantitative method to supplement, complement, and help direct expert management assessment
- identifying potentially incompatible and inconsistent statutes and regulations
- identifying where coordination should exist between or among agencies
- tracking feedbacks between governance and ecosystem services (given baseline ecosystem information) to improve understanding of complex interdependencies within socio-ecological systems

#### *4.3 Opportunities for a deeper understanding of ocean governance*

Given the potential benefits, further development is underway [14]. Advances in information retrieval provide opportunities to design tools that go beyond simple analysis of the pattern and frequency of terms and phrases [12]. Developments will likely include:

- Use of text analysis with geographic information system (GIS) tools to address how laws and regulations vary by season and in geographic scope.<sup>2</sup>
- Aligning spatial legal data with spatial ecological layers
- Using hierarchical synonyms and term groupings [19] to develop a system where an analysis of federal law and agencies incorporates multiple terms to represent a single concept. For example, using the term 'marine mammal,' a more advanced text mining tool would show that whales fall under the statute and regulations of the U.S. Marine Mammal Protection Act, as well as the U.S. Endangered Species Act.

Increased sophistication will also stem from techniques developed by researchers specifically investigating problems in the automatic generation of information from laws [20-22]. The quantitative, systematic techniques of text analysis under development can be applied to a broad set of management scenarios involving jurisdictional and functional overlaps. They can help navigate governance and help identify overlaps in different domains as seen already in application development for construction and water quality law [21].

## 5. Conclusion

Although the methods of implementing EBM vary widely and are still being developed [23], it necessarily entails working with extant governance [10, 24] and therefore resolution of problematic overlaps [25, 26]. Whether and how to address overlaps in management remains guided by societal and political values, and management tradeoffs. A widely accessible synthesis tool, however, could serve as a starting point for decision-makers and the full suite of stakeholders within and across scales of management to glean baseline governance information about any topic or set of topics in ocean management. Text analysis to find potential overlaps could be incorporated on a website with a simple interface to access and analyze updated legal information and produce overviews desired for any topic, as recommended in the U.S. Joint Ocean Commission report [6]. Using the results, policymakers, ocean managers, and other stakeholders could strategically enhance efforts to resolve problematic overlaps, thus reducing conflicts and redundancies. Thus, text analysis could provide fast, practical help in the move toward coordinated ocean governance achieved through EBM.

---

<sup>2</sup> The National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center's Digital Coast: Legislative Atlas program provides a natural opportunity for collaborative developments (<http://www.csc.noaa.gov/legislativeatlas/>). The Atlas provides geospatial boundaries of ocean and coastal laws, which could then be integrated with text analysis so a user can easily distinguish the functionality of laws based on the text.

## **Acknowledgements**

This research was funded by the University of California Marine Council Coastal Environmental Quality Initiative, California Sea Grant and Ocean Protection Council, the National Center for Ecological Analysis and Synthesis (NCEAS), and the David and Lucile Packard Foundation (Ecosystem-Based Management Tools Initiative Fund).

## **References**

- [1] Crowder L, Osherenko G, Young O, Airame S, Norse EA, Baron N, Day JC, Douvère F, Ehler CN, Halpern BS, Langdon SJ, McLeod KL, Ogden JC, Peach RE, Rosenberg AA, Wilson JA. Resolving Mismatches in U.S. Ocean Governance. *Science* 2006; 313: 617-18.
- [2] United States Commission on Ocean Policy (USCOP). *An Ocean Blueprint for the 21st Century Final Report of the U.S. Commission on Ocean Policy* 2004.
- [3] Kraus SD, Brown MW, Caswell H, Clark CW, Fujiwara M, Hamilton PK, Kenney RD, Knowlton AR, Landry S, Mayo CA, McLellan WA, Moore MJ, Nowacek DP, Pabst DA, Read AJ, Rolland RM. North Atlantic Right Whales in Crisis. *Science* 2005; 309: 561-62.
- [4] Young OR. *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*. Cambridge: MIT Press; 2002.
- [5] Folke C, Hahn T, Olsson P, Norberg J. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 2005; 30: 441-73.
- [6] Joint Ocean Commission Initiative (JOCI), Monterey Bay Aquarium (MBA). *Regional Ocean Governance: An Agenda for Action*. Washington, D.C., 2007.
- [7] McLeod KL, Lubchenco J, Palumbi SR, Rosenberg AA. *Scientific Consensus Statement on Marine Ecosystem-Based Management Communication Partnership for Science and the Sea*, 2005.
- [8] Christensen NL, Bartuska AM, Brown JH, Carpenter S, D'Antonio C, Francis R, Franklin JF, MacHahon JA, Noss RF, Parsons DJ, Peterson CH, Turner MG, Woodmansee RG. *The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management*. *Ecological Applications* 1996; 6: 665-91.



- [9] Pomeroy R, Douvere F. The engagement of stakeholders in the marine spatial planning process. *Marine Policy* 2008; 32: 816-22.
- [10] Imperial MT. Institutional Analysis and Ecosystem-Based Management: The Institutional Analysis and Development Framework. *Environmental Management* 1999; 24: 449-65.
- [11] Crowder L, Norse E. Essential ecological insights for marine ecosystem-based management and marine spatial planning. *Marine Policy* 2008; 32: 772-78.
- [12] Feldman R, Sanger J. *The Text Mining Handbook: Advanced Approaches to Analyzing Unstructured Data*. Cambridge: Cambridge University Press; 2007.
- [13] National Research Council. *Finding the Forest in the Trees*. Washington, D.C.: National Academy Press; 1995.
- [14] Ekstrom J, Lau G. Exploratory text mining of ocean law to measure overlapping agency and jurisdictional authority. *Proceedings of the Digital Government Research Conference, Montreal, Canada, 2008*.
- [15] Jensen AS, Silber GK. Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum 2003; NMFS-OPR.
- [16] Channel Islands National Marine Sanctuary Advisory Council. *Reducing Ship Strikes on Large Cetaceans in the Santa Barbara Channel and Channel Islands National Marine Sanctuary*. CINMS 2008.
- [17] Scholz A, Bonzon K, Fujita R, Benjamin N, Woodling N, Black P, Steinback C. Participatory socioeconomic analysis: drawing on fishermen's knowledge for marine protected area planning in California. *Marine Policy* 2004; 28: 335-49.
- [18] Douvere F. The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine Policy* 2008; 32: 762-71.
- [19] Cheng CP, Pan J, Lau G, Law K, Jones A. *Relating Taxonomies with Regulations* Proceedings of the Digital Government Research Conference. Montreal, Canada, 2008.
- [20] Rissland EL, Ashley KD, Loui RP. AI and Law: A fruitful synergy. *Artificial Intelligence* 2003; 150: 1-15.
- [21] Lau GT, Law K, Wiederhold G. A Relatedness Analysis of Government Regulations using Domain Knowledge and Structural Organization. *Information Retrieval* 2006; 9: 657-80.

- [22] Cheng CP, Pan J, Lau GT, Law KH, Jones A. Relating Taxonomies with Regulations Proceedings of the 9th Annual International Conference on Digital Government Research (dg.o2008). Montreal, Canada, 2008.
- [23] Young OR, Osherenko G, Ekstrom J, Crowder L, Ogden J, Wilson J, Day J, Douvère F, Ehler C, McLeod K, Halpern B, Peach R. Solving the Crisis in Ocean Governance: Place-Based Management of Marine Ecosystems. *Environment* 2007; 49: 8-19.
- [24] Cortner HJ, Wallace MG, Burke S, Moote MA. Institutions matter: the need to address the institutional challenges of ecosystem management. *Landscape and Urban Planning* 1998: 159-66.
- [25] Juda L, Hennessey T. Governance profiles and the management of the uses of large marine ecosystems. *Ocean Development and International Law* 2001; 32: 43-69.
- [26] Sutinen JG, Clay P, Dyer CL, Edwards SF, Gates J, Grigalunas TA, Hennessey TM, Juda L, Kitts AW, Logan PN, Poggie JJ, Rountree BP, Steinback S, Thunberg EM, Upton HF, Walden JB. A Framework for Monitoring and Assessing Socioeconomics and Governance of Large Marine Ecosystems. In: NMFS-NE-158. NTM NOAA Technical Memorandum NMFS-NE-158. Northeast Fisheries Science Center: Northeast Fisheries Science Center, Woods Hole, MA, 2000.
- [27] Borgatti SP. NetDraw: Graph Visualization Software. Harvard, Massachusetts: Analytic Technologies, Inc., 2002.