Biological Conservation 210 (2017) 222–232

Contents lists available at ScienceDirect

Biological Conservation

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

Key players in conservation diffusion: Using social network analysis to identify critical injection points

Emmanuel K. Mbaru[a,b,*], Michele L. Barnes[a,c]

[a] ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Queensland 4811, Australia
[b] Kenya Marine and Fisheries Research Institute (KMFRI), P.O. Box 81651-80100, Mombasa, Kenya
[c] Department of Botany, University of Hawaii at Manoa, Honolulu, HI 96822, United States

ARTICLE INFO

Keywords:
Conservation
Diffusion
Key players
Social network analysis
Social-ecological systems

ABSTRACT

Identifying the right stakeholders to engage with is fundamental to ensuring conservation information and initiatives diffuse through target populations. Yet this process can be challenging, particularly as practitioners and policy makers grapple with different conservation objectives and a diverse landscape of relevant stakeholders. Here we draw on social network theory and methods to develop guidelines for selecting 'key players' better positioned to successfully implement four distinct conservation objectives: (1) rapid diffusion of conservation information, (2) diffusion between disconnected groups, (3) rapid diffusion of complex knowledge or initiatives, or (4) widespread diffusion of conservation information or complex initiatives over a longer time period. Using complete network data among coastal fishers from six villages in Kenya, we apply this approach to select key players for each type of conservation objective. We then draw on key informant interviews from seven resource management and conservation organizations working along the Kenyan coast to investigate whether the socioeconomic attributes of the key players we identified match the ones typically selected to facilitate conservation diffusion (i.e., 'current players'). Our findings show clear discrepancies between current players and key players, highlighting missed opportunities for progressing more effective conservation diffusion. We conclude with specific criteria for selecting key stakeholders to facilitate each distinct conservation objective, thereby helping to mitigate the problem of stakeholder identification in ways that avoid blueprint approaches. These guidelines can also be applied in other research and intervention areas, such as community development studies, participatory research, and community intervention.

1. Introduction

Consensus has emerged on the need to involve local stakeholders in development, implementation, and monitoring of conservation initiatives (Leslie 2005, Lundquist & Granek 2005). This involvement can foster long-term interest in conservation, promote local support, and propel the spread of novel conservation ideas and practices (Ostrom 2007, Armitage et al. 2008). Identifying the right stakeholders that are optimally positioned to diffuse conservation information, knowledge, and practices can therefore be fundamental to successful conservation efforts in social-ecological systems (Mertens et al. 2005, Ostrom 2007, Armitage et al. 2008). However, identifying these key individuals (also referred to as 'opinion leaders' or 'change agents') is becoming more complex as the diversity of stakeholders increases and practitioners and policy makers grapple with increasingly variable conservation objectives (Bottrill et al. 2008, Cohen et al. 2012, Arias 2015). These issues are not unique to the conservation setting, indeed, they are prevalent in many research and intervention areas, such as community development studies, participatory research, and community intervention.

To date, managers and practitioners have consistently relied on local community leaders (hereinafter 'leaders') to diffuse and implement conservation actions at the community level (Olsson et al. 2004, Armitage et al. 2008, McClanahan & Cinner 2008). Such approaches have wide appeal because formal leaders are easily identified and leadership characteristics are known to be important for the initiation and maintenance of many initiatives (Pretty 2003, Olsson et al. 2004, Ostrom 2007). Yet while these leaders may truly be better positioned to implement some conservation and management actions, they are not always the most effective at diffusing and spearheading all types of conservation initiatives (Barnes-Mauthe et al. 2015), and in some cases may struggle to deliver greater than localized conservation outcomes (Berkes 2004, Pajaro et al. 2010). One explanation for this is that communities are inter-sectoral social arenas with networks of social relations between different actors at various levels (Cohen et al. 2012,

* Corresponding author.
E-mail addresses: emmanuel.mbaru@my.jcu.edu.au (E.K. Mbaru), michele.barnes@jcu.edu.au (M.L. Barnes).

http://dx.doi.org/10.1016/j.biocon.2017.03.031
Received 22 November 2016; Received in revised form 20 March 2017; Accepted 25 March 2017

Barnes et al. 2017) that are rarely homogeneous; rather, they tend to be partitioned into complicated subgroups of individuals and stakeholders with different resources, interests, perceptions, affiliations, and amounts of influence (Carlsson & Berkes 2005, Mertens et al. 2005, Nygren 2005). Without an understanding of these complex social structures, even relatively simple, low cost conservation initiatives can suffer from poor rates of success (Mertens et al. 2005, Barnes-Mauthe et al. 2015). At worst, they can result in conflicts (Cumming et al. 2006, Cohen et al. 2012, Ban et al. 2013).

In this paper, we draw on social network theory and methods to present guidelines for selecting key players optimally positioned to successfully implement diffusion-related conservation objectives. Social network analysis (SNA) is an analytical approach that can identify social structures and shed light on the positions of key stakeholders. In the context of conservation, scholars have applied SNA to better understand how social-structural factors relate to processes that facilitate successes and failures in resource management (Bodin & Crona 2009). Critically, social networks have been shown to be important for conservation diffusion (Matous & Todo 2015), having direct implications for environmental outcomes (Barnes et al. 2016). In an effort to combat conflict, marginalization, and unfair representation of diverse interests in conservation, SNA has also been directly employed as a method for stakeholder analysis in order to select relevant stakeholders for participatory conservation initiatives (Prell et al. 2009, Reed et al. 2009). We expand upon this body of work by demonstrating how SNA can be applied to select key players most optimally placed to facilitate conservation diffusion.

Given the diversity of goals associated with conservation initiatives, we focus on four distinct diffusion-related conservation objectives: (1) rapid diffusion of conservation information; (2) brokering of conservation information and initiatives between disconnected or fragmented communities; (3) rapid diffusion of complex knowledge or conservation initiatives; and (4) widespread diffusion of conservation information or complex conservation initiatives over a longer time period. We distinguish between spreading conservation information (simple spreading; typically associated with conservation objectives 1, 2, and 4) and complex knowledge or complex conservation initiatives (complex contagions; typically associated with conservation objectives 3 and 4) because the role of influential actors, the rate of spread, and the effects of network structure on spreading processes differ between the two (Granovetter 1978, Karsai et al. 2014), as discussed in Section 1.1.

Drawing on social network theory, we begin by demonstrating how different conservation information and behaviors associated with the four objectives can be expected to diffuse in a community, and provide guidelines for using SNA to identify key individuals to spearhead these conservation actions. We then empirically demonstrate how these guidelines can be used to identify key individuals to act as critical injection points in the diffusion of each conservation objective (i.e., key players) to show that different types of people are likely to be more effective depending on the conservation goal. Finally, we compare the types of individuals identified as key players for diffusion with the individuals that are currently selected for engagement by conservation organizations and resource management agencies (i.e., current players) to highlight missed opportunities for progressing more effective conservation diffusion. We accomplish this by leveraging comprehensive data on social networks and information on conservation diffusion strategies currently being applied along the Kenyan coast.

The Kenyan coast provides a unique case to demonstrate the utility of our approach due to the strong parallels between the local coral reef fishery conservation context and the four conservation objectives described above. With almost 23,000 fishers catching over 16,000 tonnes of fish annually and providing monetary income and animal protein to about 70% of the coastal communities (Glaesel 1997, Tuda et al. 2008), the local fishery grapples with a number of management challenges including an increasing number of small-scale fishers (Ochiewo 2004), and excessive and destructive fishing (McClanahan & Shafir 1990, McClanahan & Obura 1995, McClanahan et al. 2008). To deal with these problems, Kenya has prioritized a number of participatory measures to conserve and manage natural resources. For example, nine marine protected areas (MPAs) have been established, beach management units (BMUs) delegating responsibility of natural resources to local stakeholders have been set up (McClanahan & Mangi 2004), gear-based management approaches that relieve pressure on reproductively immature fish have been implemented (McClanahan & Mangi 2004, McClanahan 2010, Mbaru & McClanahan 2013, Gomes et al. 2014), and 24 Locally Managed Marine Areas (LMMAs) have been established. Although these initiatives have been implemented in a participatory manner, little success has been made in terms of reversing resource depletion and stemming management conflicts (Alidina 2005, Cinner et al. 2012), which calls into question whether greater success might be achieved if stakeholders more optimally placed to facilitate conservation diffusion are involved.

1.1. Identifying key stakeholders for specific conservation goals

A large body of work in sociology has demonstrated how actors' position in a social network determines how effective they are at acting as a conduit for the spread of information and whether or not they have the power to influence others either directly or indirectly (Freeman 1979, Valente 1996b). Based on their closeness to others, network position, level of connectedness, direct interactions, or nominations, certain well-connected individuals are typically referred to as 'central' in social network theory (Freeman 1979, Valente 1996b). These central positions have often been equated with opinion leadership, change agency, prominence or popularity, all of which are associated with diffusion and adoption behaviors (Valente 1996a, Valente & Davis 1999). There are a range of different centrality metrics which emphasize different structural aspects of complex social systems. We focus on four: (1) closeness centrality (Rochat 2009, Newman 2010), (2) betweenness centrality (Freeman 1979), (3) degree centrality (Wasserman & Faust 1994), and (4) eigenvector centrality (Bonacich 1972); each of which captures different types of prominence or influence relevant for facilitating the four conservation objectives included here (see Table 1). We discuss these measures in turn.

Spreading of conservation information quickly is often necessary, especially when rapid awareness creation is needed to protect and safeguard certain species or habitats under emergency threat (Kapucu 2008, Haddow et al. 2013). *Closeness centrality* takes into account how close an actor is located to all other actors in a network (Gil-Mendieta & Schmidt 1996). Closeness centrality is important in identifying persons who are best positioned to spread novel information quickly and efficiently throughout a network (Beauchamp, 1965, Costenbader & Valente 2003) – people who would therefore be most appropriate to efficiently transmit novel conservation ideas and information more quickly and rapidly to many others across a social-ecological system.

Social-ecological systems are typically comprised of disjointed social structures, so there is often a need to identify brokers who can bridge conservation ideas and practices among disconnected groups (Barnes et al. 2016). *Betweenness centrality* identifies actors who sit between many other actors in a social network (Butts 2008, Stephenson & Zelen, 1989) – people who are often referred to as 'brokers'. The measure specifically identifies the extent to which a node falls between others on the shortest path length, thereby allowing it to act as transmitter of resources and information between disconnected actors (Borgatti et al. 1998, Barnes-Mauthe et al. 2015).

Conservation information or initiatives can sometimes be highly complex, and are not likely to spread as easily from person-to-person as simple information (Wejnert 2002, Hill et al. 2010). In social network theory, 'complex contagions' refer to information or behaviors that a node has to be exposed to through multiple contacts before it