



The utility of surfers' wave knowledge for coastal management



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ABSTRACT

In the face of environmental change, managing coastal resources effectively to benefit coastal stakeholders means understanding both complex coastal processes and the needs of stakeholders. Surfers are a culturally and economically significant group of coastal resource users who, in the act of participating in their sport, can acquire deep knowledge about the coastal environment and about wave resources in particular. As the primary users of wave resources, surfers could contribute substantially to both understanding the resources themselves and supplying locally-relevant data to inform their management. This study investigates the local knowledge of surfers through two surveys of more than one thousand California surfers and promulgates, based on survey data, a formal definition of surfers' local knowledge as "wave knowledge." In so doing, this study makes the case that wave knowledge can be used to inform coastal management decision-making in those situations where wave resources, and thus the growing stakeholder group of surfers, could possibly be affected.

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Most of us turn into minor meteorologists. That's what happened to me... That's one of the neat things about surfing... A lot of people don't know what's happening with nature and the weather, but surfers know.

—Skip Frye, surfer and surfboard shaper (quoted in Samuels [1])

[To surf] You have to know about the ocean... not in a technical way, but you have to know it intuitively... [Many surfers] are magical oceanographers.

—Ricky Grigg, oceanographer and big-wave surfing pioneer (quoted in Almond [2])

1. Introduction

In the face of increasing impacts to natural resources from human activities, efforts to protect these resources are proliferating, driven by our improving understanding of the threats themselves and of the costs and benefits of different responses. This is especially the case for marine and coastal systems, whose degradation is a growing focus of research on management and preservation [3–8]. There is a burgeoning recognition that the processes through which we protect and conserve marine and coastal systems (as well as other environments) must better understand and incorporate the

needs and interests of human, in addition to non-human, communities; this is referred to as a social-ecological system (SES) based approach [9–12]. In many cases, the data necessary to understand and manage these complex, coupled SESs comes not from the scientists or managers, but from the stakeholders and resource-user communities who accumulate knowledge of these systems through prolonged use and stewardship [13–15].

This knowledge comes in different forms. Local Ecological Knowledge (LEK) is system-level understanding of relationships between environmental and ecological processes and human activities acquired through individual or community experience [16].¹ Traditional Ecological Knowledge (TEK) is variously defined, but more specific than LEK, incorporating cultural accumulation and transmission of such ecological knowledge and emphasizing human-environment relationships [13].² LEK and TEK have indeed been vital for many resource management efforts, particularly fisheries management [15,17–19].

But fisheries are not the only natural resource whose status could be better understood with the aid of local, context-specific knowledge provided by resource-user communities. In many coasts of the world, wave resources—the ocean waves sought by

¹ "A 'body' and a 'system' of understandings and know-how that arise through time from a variety of individual and shared experiences and observations, mediated by culture, with regard to environmental factors, behavioral attributes, and ecological dynamics" [16].

² "A cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" [13].

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surfers or municipal wave energy projects—will not only be impacted by climate change directly [20–24], but also by the actions communities take on their coasts to adapt to or mitigate the effects of climate change. In other cases, similar actions, including harbor construction, coastal armoring, and beach nourishment, which could also be taken in response to non-climate change-related drivers, can also threaten wave resources, although such impacts have not been well documented in the literature. An example from the 20th century is the construction of Dana Point Harbor (Dana Point, CA) in 1966, which destroyed the surf-spot there known as “Killer Dana” [25].³ A surf-spot is a specific location where local conditions of bathymetry and coastal orientation shape waves in ways surfers favor for riding; surf-spots are the focal points for wave resources for surfing [26].

Although the loss of Killer Dana 50 years ago likely had small social consequence for anyone besides a very small group of dedicated surfers, the same would not likely be true now. Today, surfing is a multibillion dollar, global industry with millions of devoted adherents worldwide and iconic cultural cache [27]. Individual surf-spots have been found to be valuable, sustainable natural resources. Two particular surf-spots in California, Trestles and Mavericks, were found to annually contribute \$8–\$13 million and \$23.8 million, respectively, to the GDPs of their adjacent coastal communities [28,29]. Surfers using the many surf-spots on Australia’s Gold Coast annually spend an estimated \$AUD126–\$AUD233 million (~\$99–180 million USD) directly on surfing activities—an estimate that would likely be higher if multipliers, externalities, and non-market values were included [30]. Given their significance, understanding how surf-spots will be affected by climate change and coastal management actions is of high importance to millions of surfers as well as numerous coastal communities worldwide.

In order to participate successfully in their sport—*i.e.*, to find, catch, and ride waves, and thereby generate its multifold contributions to society—surfers develop knowledge about waves and the behavior of waves under different conditions and in different locations. As the primary users of wave resources, surfers could contribute substantially to both understanding these resources themselves and supplying locally relevant data to inform their management. This study investigates the local knowledge of surfers through two surveys of California surfers and, based on results and other sources, it (1) promulgates a formal definition of surfers’ local knowledge as “wave knowledge,” (2) describes wave knowledge as a unique form of knowledge analogous to other recognized, described forms of local knowledge, and (3) makes the case that wave knowledge can be used to inform coastal management decision-making.⁴

2. Methods

In the spring of 2014, an online survey (Survey 1) was deployed to collect data on various aspects of surfer local knowledge; a second, follow-up survey (Survey 2) was sent to respondents of Survey 1 who indicated lengthy experience with specific surf-spots. Both surveys were deployed online using Qualtrics Survey Software (Qualtrics, LLC; <http://www.qualtrics.com>).

³ “Locals there still talk reverently about [Killer Dana], and the trauma of losing their local break. ‘Killer Dana’ remains a sort of shorthand for surfers: a reminder that coastal engineering can claim waves” [25].

⁴ Wave knowledge is a not a novel term: it is used colloquially among surfers and throughout surf culture (*personal observation*).

2.1. Survey 1: local knowledge

This survey instrument was developed iteratively and through piloting with 10 surfers to address multiple research questions. A battery of questions pertinent to investigating local experience with, knowledge of, and preferences for waves comprised the first 18 questions and generated 48 categorical and short response variables. These included general demographics of the respondent, information about his or her participation in surfing, and specific details about a single surf-spot chosen by the respondent in an open ended question. (Respondents who indicated that they been surfing this surf-spot for 35 years or longer were provided the option to enter their email address for participation in a follow-up survey; see Section 2.2 below.) The survey was disseminated to various surf-oriented business and organizations, including surf shops and surf clubs, NGOs, and through various professional networks. An approved IRB protocol restricted participation to adults aged 18 or older. This study only reports results from respondents who chose to describe a surf-spot in California; however the survey instrument did not favor any specific location and was available online to any consenting adult. This study utilizes responses submitted between March 10, 2014 and May 12, 2014 (inclusive).

2.2. Survey 2: expert follow-up

A second survey instrument was sent via email to respondents of Survey 1 who indicated that they had been surfing for 35 years or longer at one surf-spot and who volunteered to provide their email address and participate in the follow-up survey. Previous work has found that U.S. surfers are, on average, 34 years old and have been surfing for, on average, 16 years [31]; 35 years was chosen as the cutoff age here to ensure that respondents had been surfing for twice as many years as the national average or more. Survey 2 was designed to solicit in-depth, qualitative descriptions of surf-spots and to define and describe local knowledge of waves. The instrument contained 12 open-ended questions and three short-answer questions. Respondents were encouraged to provide as much detail as possible. It was disseminated via email using the Qualtrics Panel function, with reminders sent after two weeks and three months. The long-form, open-ended items were inductively coded using NVivo 10 qualitative analysis software (QSR International).

2.3. Data quality assessment, control, and analysis

Responses to Survey 1 that were from minors, not complete, duplicate based on IP address, or were erroneous or indicative of non-responsiveness [32] were eliminated. Responses for non-California surf-spots were not included in analyses. California surf-spots were vetted against published guides [*e.g.*, 33–35] and online databases (see *e.g.*, <http://www.surflines.com>, <http://www.magicseaweed.com>). For more complete details on the cleaning and verification processes, see [24].

3. Results

According to response data collected by Qualtrics, Survey 1 was initiated 3240 times. (Clicking once on the survey URL link from a webpage, email, or other source initiates a new response in Qualtrics.) Of those, 1057 responses were complete (1542 responses did not evaluate California surf-spots and 641 were eliminated for the reasons explicated in Section 2.3). From the completed responses, 74 indicated that they had 35 years or more experience at their response-spot and, thus, were offered the

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