



Angler travel distances: Implications for spatial approaches to marine recreational fisheries governance



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ABSTRACT

Increasingly recreational fisheries are being managed as socioecological systems using spatially explicit and participatory place based approaches. Such approaches require considering the spatial dynamics of a resource (fish) as well as its users (anglers). While the former is comparatively well studied, very little empirical information exists regarding the spatial ranges of angler travel to fishing locations. To address this and ultimately inform spatial and place based management approaches, the statistical properties of angler travel were assessed in six popular marine recreational fisheries in Florida, USA. Expected angler travel distances differed among species, regions, and years, with most trips in certain fisheries (e.g., common snook) made by anglers residing in close proximity to the fishing site (< 30 km), while anglers targeting other species (e.g., red snapper) usually traveled more than 200 km from their residence to fish. In concert with literature, these results suggest that some fisheries may be better suited than others for more spatially explicit or place based approaches to management. More broadly, these results can be used to better identify and engage stakeholders in management, anticipate effects of spatially explicit management decisions, and assess relative importance of different fisheries for attracting out-of-region or state trips, which may be important for local economies.

1. Introduction

Recreational fisheries are increasingly recognized as integrated socioecological systems, in which ecological, environmental, socio-economic, and governance institution dynamics interact to affect the outcomes of conservation and management objectives [1–3]. In practice, these systems are even more complex. The spatial context of a socioecological system contributes additional challenges related to spatially and politically nested jurisdiction of management and governance systems, multiple and sometimes conflicting uses for the same resources among heterogeneous stakeholder groups, and potential mismatches between the spatial scales pertinent to ecological resources and those relevant to stakeholders [4–7]. These spatial challenges may be particularly pronounced in marine recreational fisheries systems [8–10]. In North America, these systems are often characterized as relatively “open” in two important ways. Local or even state-level fish population abundances are often influenced by processes defined at broader spatial scales, such as fishing mortality, recruitment, or environmental variation. Second, anglers are generally free to fish as much as they want and wherever they choose, since recreational fishing effort is rarely limited in magnitude or spatially restricted. These largely open systems, however, are typically punctuated by abrupt federal,

state and local jurisdictional boundaries that may not align with spatial dynamics of fish populations or stakeholders [11,12]. This creates governance challenges. For example, fisheries whose stocks span jurisdictional boundaries (e.g., migratory or benthic species) require coordinating regulations across management areas to simultaneously satisfy possibly diverse stakeholder groups while preserving healthy fish populations at a greater spatial scale. Other fish whose populations are biologically discrete at lesser spatial scales such as bays (e.g., inshore or estuarine species) may benefit from finer spatial scale management actions attuned to local biological status and stakeholder needs. The challenge of reconciling spatial dimensions of marine recreational fisheries to produce effective governance across scales may be best addressed by an emerging transdisciplinary paradigm referred to as place based management [6,7].

Formal definitions of place based approaches to management can be broad [13]. Young et al. [6] described it as “integrated management of the full suite of human activities occurring in spatially demarcated areas identified through a procedure that takes into account biophysical, socioeconomic, and jurisdictional considerations”. Place based approaches can be considered to encompass other spatially explicit management strategies, such as marine spatial planning or zoning that seek to designate different locales for different competitive uses

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[14–17]. Place based approaches also compliment ecosystem-based fisheries management ideas, by considering how management effects reverberate throughout the ecosystem and influence non-target species, habitats and non-market ecosystem services and co-benefits [7,15,18,19]. Additionally, place based approaches seek to better incorporate stakeholders in the management process, including co-management arrangements [20–23]. Finally, in emphasizing “place” rather than simply “space”, place based approaches recognize that stakeholder socially-constructed meanings and psychological attachments regarding a physical space are meaningful and worth considering with respect to management, per “sense of place” research [24–26]. In practice, it may be most useful to consider a continuum between more place-based management and traditional North America marine fisheries management—the latter being characterized by single-species management plans implemented at federal and state spatial scales through regulatory actions determined largely by fisheries experts (scientists and managers). Here, more place based approaches might include more locally specified (e.g., county, estuary, or user-defined “place”) governance initiatives arising from more stakeholder-inclusive collaborative processes, would include more explicitly acknowledge psychological and emotional relevance of an area, and would be developed with greater consideration of alternative (non-fishery) uses of the spatial area considered.

Implementing place based approaches to marine fisheries management, especially for recreational fisheries, remains practically demanding [6,7,13]. Even if place based approaches are to be applied to the current single-species framework, a recognized knowledge gap is the lack of empirical assessment of the spatial scales at which human resource users interact with the resource [6–24]. In recreational fisheries, these scales may be described by angler travel dynamics—the distances traveled, origins, and destinations of fishing trips. Angler travel distances have traditionally been used by economists and human dimensions researchers to value recreational fisheries and to understand the importance of elements of the fishing experience [27–29], or to make phenomenological assessments of the effects of fishing across landscapes [30–32]. However, there are almost no direct descriptions of the dynamics themselves.

A statistical understanding of angler travel dynamics is probably critical for implementing place based approaches to recreational fisheries management, and should be equally useful to traditional (e.g., less place-based) approaches. Angler travel spatial range information is needed to gauge the spatial size, extent and boundaries of the areas considered for implementing place based approaches [33]. Identifying spatial origins of anglers fishing certain locations also promotes efficient allocation of governance resources to facilitate stakeholder involvement through extension and outreach [23] and even to promote co-management [34]. Fisheries with high proportions of non-local anglers may require different approaches to engage these resources users and facilitate their involvement in place based management [35]. Non-local anglers may also be of particular interest to state governance institutions desiring to attract out-of-state dollars and the jobs they support, since the distances anglers travel to fish affect the allocation of market activity throughout space [36]. Finally, angler travel dynamics ought to influence how fishing effort redistributes across landscapes following management changes or ecosystem perturbations. The statistical properties of angler travel dynamics may well differ substantially among species targeted, across regions, or over time, but this has not been well studied.

The goal of this work is to (1) improve understanding of angler travel dynamics by describing how they may differ across species, regions, time, and to (2) consider how this information may be useful for place-based or other spatial management approaches. To achieve this, the statistical properties were assessed of empirically observed distances that anglers traveled to target popular marine fish species along the coast of Florida, USA. Recreational fishing is considered a dominant component of Florida's tourism industry, and fisheries management that

promotes satisfied stakeholders—both local and non-local—is critical. The economic importance of recreational fishing, coupled with the relatively great diversity of species-specific fisheries has motivated recent interest in exploring application of place-based approaches to single-species management. Here the goal is to both allow efficient, spatially explicit regulations that consider local place conditions and multiple water uses, while also promoting stakeholder engagement and investment in the management process.

2. Methods

2.1. Study system

The marine recreational fisheries in Florida, U.S.A. were considered as a case study for this work. Here there are a diversity of species that anglers can and do target from shore and vessels year-round. These attributes make Florida's marine fisheries popular with Florida residents as well as out-of-state visitors, and there are no restrictions on individual or aggregate private recreational fishing trips. This work focuses on six of the most commonly targeted species: *Cynoscion nebulosus* (spotted sea trout), *Sciaenops ocellatus* (red drum), *Centropomus undecimalis* (common snook), *Mycteroperca microlepis* (gag grouper), *Lutjanus campechanus* (red snapper) and *Megalops atlanticus* (Atlantic tarpon). Some of these species are targeted commonly throughout the entirety of the state (e.g., red drum, spotted seatrout) whereas other are primarily targeted in northern (e.g., red snapper) or southern (e.g., common snook) regions. As there is no absolute definition of North versus South Florida, the latitude of 29.001 was used as a boundary, which corresponds roughly with the northern extent of common snook. The species considered span a diversity of life histories, fisheries, and management approaches. Spotted seatrout and common snook live almost exclusively in estuarine and inshore areas, are expected to have more local population dynamics and are managed at a state level. Red drum juveniles and sub-adults also inhabit and are targeted in inshore areas, where their harvest is regulated at the state level, but adults populations live offshore where fisheries are managed federally but not often targeted by anglers and where commercial harvest is prohibited. Gag and red snapper similarly recruit in state waters, but most fisheries exist in federally managed offshore areas where they are fished recreationally and commercially. Atlantic tarpon are not a commercial target, and are almost never harvested recreationally, but are pursued by anglers throughout the Gulf of Mexico as they seasonally migrate. Details of each species-specific fishery, particularly with respect to spatial scales of population dynamics and management, are given in Table 1.

2.2. Data

Assessing angler travel dynamics required data describing spatial locations of angler trip origins and destinations. This information is routinely collected by the National Oceanic and Atmospheric Administration (NOAA), Marine Recreational Information Program (MRIP). This includes a nationally implemented, in-person, Access Point Angler Intercept Survey (APAIS) (example survey form available for download at <http://www.st.nmfs.noaa.gov/recreational-fisheries/Surveys/survey-details>) to collect trip and catch information from anglers interviewed at coastal access points, such as boat ramps, piers and shore-based fishing areas [37]. The APAIS survey specifies for each interviewed angler the fishing access point (site of survey), the primary species targeted and the angler state and county of residence. These interview data are referred to as “trip” data within the MRIP data system, and are freely available for download at <http://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/downloads>. For this study these data were organized via SAS (PROC SORT) to subset for interviews recorded in Florida from 2004 through 2015 for all modes of fishing where the primary target species included any of

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