Fisheries Research 108 (2011) 268–276

Contents lists available at ScienceDirect

Fisheries Research

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

The increasing importance of marine recreational fishing in the US: Challenges for management

Thomas F. Ihde*, Michael J. Wilberg, David A. Loewensteiner, David H. Secor, Thomas J. Miller

University of Maryland Center for Environmental Science Chesapeake Biological Laboratory, Solomons, MD 20688, USA

ARTICLE INFO

Article history:
Received 14 May 2010
Received in revised form 7 December 2010
Accepted 11 December 2010

Keywords:
Fishery management goals
Harvest policy
Life history analysis
Marine fisheries management
Recreational fisheries

ABSTRACT

Harvests from recreational fishing are increasingly as important as commercial harvest to populations of popularly fished marine recreational species. However, it has yet to be determined whether the increasing importance of recreational fishing is a general trend of marine fisheries in the US or whether such a trend is limited to only those species recognized as popular recreational fishes. 71% of marine species in the US have experienced an increase in the proportion of total harvest from the recreational sector during the time harvest data are available for both sectors. Species demonstrating an increase in the proportion of harvests by the recreational sector included those generally regarded as commercial, bait, and bycatch species, as well as those considered recreational species. Marine species categorized as overfished could not be predicted from either fishery characteristics or life history characteristics in a PCA analysis of available data for fished species in the US. Consequently, there appears to be little to predict vulnerability of populations to fishing efforts save that all fished species can be made vulnerable to overexploitation. Well-developed yield-based strategies, designed for commercial fisheries, are not likely to be effective in managing populations as the diverse recreational fishing sector continues to increase in its importance. Thus, new management strategies for US marine fisheries are needed. Some possible alternative strategies are discussed.

1. Introduction

Recreational fishing is an increasingly important consideration in the management of marine fisheries in terms of the economic impact (Steinback et al., 2004), the number of participants (Kearney, 2002; Marine Recreational Fisheries Statistical Survey [MRFSS], National Marine Fisheries Service [NMFS], Fisheries Statistics Division, Silver Spring, MD; http://www.st.nmfs.noaa.gov/st1/recreational/queries data retrieved 20 March, 2009), and the magnitude of the catches (Coleman et al., 2004; Cooke and Cowx, 2004; NRC, 2006; Post et al., 2002; Schroeder and Love, 2002). The high value of recreational fisheries is commonly recognized in developed countries and, though largely unassessed in developing countries, recreational fisheries appear to be of similar importance there as well (Pitcher and Hollingworth, 2002). The recreational sector has become increasingly important over the past 50 years for many marine species (Coleman et al., 2004; Cooke and Cowx, 2006; NRC, 2006), compared to the commercial sector, and this sector has dominated the harvest for some marine fisheries in the United States (US) since at least the early to mid-1960s (DeSylva, 1969). A similar rise in the recreational sector has occurred in the European Union where some recreational fisheries are now on a par with that of their commercial counterparts (Pawson et al., 2008). However, whether the increasing importance of the recreational sector has been limited to only popular, high-profile recreational fisheries, or whether such change is a general trend for marine fisheries remains unclear.

Research on the economic, ecological and social impacts of recreational fisheries has lagged behind similar research on commercial sector fisheries (Pitcher and Hollingworth, 2002). Furthermore, Kearney (2002) asserted that the mainstream scientific literature contains few assessments of recreational fisheries. He interpreted this deficiency as a lack of recognition by fisheries scientists of the potential importance of recreational harvests.

If recreational fisheries are increasing in their importance, trends indicating such change should be evident in trends of harvests estimated from landings statistics. Researchers have previously used recreational harvest data to document the importance of recreational harvests for popular species (Coleman et al., 2004; Cooke and Cowx, 2004). Although these studies show that marine recreational harvests can be of similar magnitude as commercial harvests, such approaches do not identify whether the recreational harvest relative to the commercial harvest has changed over time.

* Corresponding author. Present address: NOAA Fisheries, Chesapeake Bay Office, 410 Severn Ave. Suite 107A, Annapolis, MD 21403, USA.
Tel.: +1 443 975 3736; fax: +1 410 267 5666.
E-mail address: Tom.Ihde@noaa.gov (T.F. Ihde).

0165-7836/$ – see front matter
doi:10.1016/j.fishres.2010.12.016

Nor do such analyses focus on whether individual fisheries exhibit trends in recreational or commercial harvests over time. A direct comparison of the change of the harvest of each sector is required to answer these questions. For example, consider a stock subject to commercial and recreational exploitation, both of which harvest in proportion to stock abundance. In this case, if the stock abundance changes both the commercial and recreational harvests would exhibit the same proportional change over time. In a second scenario, the recreational fishery expands over time while the commercial sector does not. In this instance, only the recreational sector would exhibit a positive proportional change in harvest over time. Here, we examine harvest trends over time for all US marine stocks for which data were available for both the recreational and commercial sectors and test whether there is a general trend for increasing proportional change in the recreational sector.

If harvests from marine recreational fishing are indeed increasing in importance, then identifying the characteristics of exploited species and their fisheries that make species vulnerable to recreational fishing pressure would be particularly useful for management. For example, recreationally targeted species might share a suite of life history characteristics, and some of these characteristics may make certain species more vulnerable to recreational fishing than others. Similarly, the characteristics of a fishery may contribute to the inherent vulnerability of a species to recreational fishing pressure. Multivariate ordination techniques have often been used to identify species that possess suites of characteristics that confer resilience or susceptibility to exploitation (King and McFarlane, 2003; Winemiller and Rose, 1992). We apply these techniques to better understand how combinations of life history and fisheries characteristics relate to the vulnerability of fished species.

Our goals for this study were to use available data to test the hypothesis that marine recreational harvests are increasing compared to commercial harvests in the US and to evaluate whether certain sets of species are more likely to be vulnerable to recreational fishing pressure. To evaluate our hypothesis, we examined trends in harvest data from commercial and recreational marine fisheries in the US. We applied principal components analysis to identify the life history and fisheries characteristics that make species particularly vulnerable to recreational fishing.

2. Methods

2.1. Analysis of harvest data

We analyzed harvest data from US marine fisheries to determine if trends were detectable in the harvest of the recreational sector relative to that of the commercial sector during a recent 25-year period. Analysis included only those fisheries for which both commercial and recreational harvest data were available concurrently; consequently, the period examined varied by species. In general, for Atlantic coast species, recreational data were available from 1981 to 2006 from the Marine Recreational Fisheries Statistical Survey (MRFSS, NMFS-FSD, Silver Spring, MD, data retrieved 22 June, 2008). Data for Pacific species were available for 1993–2006 from the Recreational Fisheries Information Network (RecFIN, Pacific States Marine Fisheries Commission, www.recfin.org data retrieved 22 June, 2008). RecFIN data were available prior to 1993, but to minimize the effect of survey design changes, analyses included only RecFIN data from 1993 forward. The RecFIN data set also underwent a survey design change that could affect harvest estimates beginning in 2004; however, plots of the time series of recreational harvests for RecFIN species revealed very little to no change in trends of harvest estimates prior to 2004 when compared to those from 2004 forward. Consequently, we included RecFIN data from the years after the design changes (i.e., 2004, 2005, and 2006) in the analysis. Commercial data for all species came from the NMFS commercial statistics (NMFS-FSD, Silver Spring, MD).

Both recreational and commercial harvest data were normalized (Zar, 1996) and given a standard score based on the available data for each sector prior to analysis. Data were standardized to account for the vast differences in the scale of catch for different US fisheries, and to ensure measures were comparable in our analyses. Thus, the term "harvest" henceforth refers to standardized harvest.

We analyzed the proportional change in harvest for each species over the period for which data were available. We used average harvests of the first and last five years of each time series to define the relative proportional change in recreational and commercial harvests in each species. To allow direct comparisons among species, we expressed these data as trend vectors in Cartesian coordinates. The origin of each trend vector was defined as the (0, 0) point, and the end point of each vector was

$$\left(\frac{(Com_2 - Com_1)}{Com_1}, \frac{(Rec_2 - Rec_1)}{Rec_1}\right), \tag{1}$$

where *Com* and *Rec* are the commercial and recreational harvests and subscripts indicate average harvests for the first (1) or final (2) five years of the time series. When fewer than 11 years of data were available in the time series, the endpoints of the trend vector were calculated from three years of data. To ensure the same year was not included in the calculation of both endpoints, a minimum of one year separated the endpoints. Thus, all species required at least seven years of harvest data from both sectors for corresponding years. Years in which data were unavailable for either sector were excluded from analysis.

The trend vectors of relative harvest change for each species provide two pieces of information: their angle θ, and their length. The angle of the trend vector indicates the relative change in harvest between the sectors. Based on possible values of θ, we defined four quadrants of response (Table 1; Fig. 1). If there is no consistent trend among all species included in the analysis, one would expect equal numbers of trend vectors terminating in each of the four quadrants. This expectation was tested with a χ^2 test. We also compared counts of trend vectors terminating in quadrants II and IV with a χ^2 test. This comparison was intended to include only species demonstrating trends that strongly favor one sector or the other; thus, species showing similar harvest trends for both sectors, i.e., those with trend vectors terminating in quadrants I and III, were excluded from consideration.

To refine the analysis of harvest change between the fishing sectors further, we created a binary classification by defining vectors whose directions were $45^\circ < \theta < 225^\circ$ as evidence for increasing importance of recreational fishing and vectors with direction $0^\circ < \theta < 45^\circ$ and $225^\circ < \theta < 360^\circ$ as indicative of an increasing commercial importance. This categorization was also examined using a χ^2 test of the null expectation of an even division between the two categories. In addition, we conducted a series of *post hoc* comparisons to examine patterns in trend vectors based on geographic, ecological or fishery factors. In all tests of significance, we used $\alpha = 0.05$.

The length of the trend vector indicates the magnitude of the relative change in harvest. Trend vectors of different species would be comparable to one another if the number of years of data included in each were equal. However, the total number of years of data available for and included in our analysis varied by species (Table 1). Consequently, vector lengths were expressed on a per year basis before trend vectors for all species were plotted together for direct comparison.