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The archaeology of fish and fishing on the central coast of California: The case for an under-exploited resource

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ABSTRACT

Decades of systematic archaeological investigations highlight the importance of fish and fishing for prehistoric people along the central coast of California, but to date temporal and spatial trends remain unsynthesized. An evaluation of 202,177 fish remains from 86 sites on the central coast of California yielded a sample of 75,532 NISP from temporally and methodologically controlled contexts. Seventy-nine temporal components demonstrate a 10,000-year history of fishing within estuaries, along the open rocky coast, and on the Monterey Peninsula. Fishes within six taxa dominate the record throughout including New World silversides, small surfperches, and members of the herring family which almost certainly were caught with nets, and rockfish and cabezon which were amenable to individual hook and line capture. The persistent dominance of these fishes suggests that nets and hooks/gorges were employed throughout the sequence along with watercraft. Only very modest changes are apparent between 10,000 and 300 years ago, suggesting continuous harvest of a relatively productive, stable resource that was too abundant to be seriously impacted by pre-European harvesting practices. There is no evidence for gradual or incremental intensification in fishing, rather there are three intervals of change in fish remains and inferred fishing practices that reflect changes in human population and/or environment. There is no compelling evidence for depression of the prehistoric fishery and the record seems to reflect epiphenomenal sustainability related to low human populations and a highly productive, upwelling-fueled, under-exploited fishery. Comparison of the prehistoric record with enormous yields recorded historically further supports this conclusion.

1. Introduction

More than a century ago ethnographers established that fish-dependent hunter-gatherers, like those on the Northwest Coast of North America, were profoundly different from their terrestrial counterparts (see Kelly, 1996; Pálsson, 1988; Plew, 1996), representing what would eventually be classified as "complex foraging." For most of the ensuing century it was often assumed that such adaptations were relatively recent developments—a notion that was supported only by a very limited archaeological record. By the end of the 20th century, however, archaeology demonstrated that such assumptions were unfounded; that coastal adaptations have significant antiquity in North America and beyond, and seem to have facilitated a coastal migration into the New World (Erlandson, 2001, 2002; Erlandson et al., 2007, 2008a, 2011a). In light of such recognition archaeologists have been working in earnest to try to understand the energetics of marine resource acquisition and the use of coastal habitats, often employing optimization concepts with archaeological faunal remains. Such models have repeatedly demonstrated their value in furthering the understanding of coastal resource use, and many have led to arguments that marine resources were overexploited prehistorically (Rick and Erlandson, 2008). In California arguments have been advanced for overexploitation of shellfish (Botkin, 1980; Erlandson et al., 2008b; Jones, 1996), marine mammals (Hildebrandt and Jones, 1992, 2002), marine birds (Broughton, 2004; Jones et al., 2008a; Whitaker, 2010); and fish (Broughton, 1994, 1997; Broughton et al., 2015; Salls, 1992). While many early proposals for marine resource overexploitation and resource depression were largely conjectural (Botkin, 1980; Salls, 1992) more recent cases, especially for shellfish, have been bolstered with meaningful empirical evidence (e.g., Erlandson et al., 2008b, 2011b). Solidly supported cases for overexploitation of marine fish, however, are much less common, although Broughton et al. (2015) recently made a

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convincing argument for depression of sturgeon populations prehistorically in San Francisco Bay, superseding an earlier study by Gobalet and Hardin (2009) who were unable to find support for depletion of sturgeons in that area with a meta-analysis. Sturgeon were enormous fish (individuals can reach over 800 kg) fish that were probably unusually visible and vulnerable, with low populations uniquely susceptible to overexploitation—akin to the flightless duck that was hunted to extinction prehistorically in California (Jones et al., 2008a). In fact with the initiation of a commercial fishery for sturgeon around 1870 by Euroamericans, it took only 30 years before the population of white sturgeon in the San Francisco dropped to the point that they were considered to be on the brink of extinction and the California legislature temporarily abolished the fishery (Skinner, 1962:84). But in terms of prehistoric depression, sturgeon might best be considered the exception, not the rule. In many other instances, the empirical record seems to suggest that fisheries were essentially unaffected by prehistoric human exploitation – as was the case in South Polynesia (Anderson, 2008), Peru (Reitz et al., 2008), and the Northwest Coast of North America (Butler and Campbell, 2004). That fisheries in some parts of the world at least could withstand continued, substantial harvest over time may help explain the development of complex technologies used to exploit them and the perpetuation of fishing-related cultures. Of all of the marine resources associated with intensive hunter-gatherer economies, fish are linked to the most complex technologies and seem most tightly linked to heightened levels of socio-political complexity as can be seen in both southern (Arnold, 1992, 1995, 2001, 2004; Erlandson and Rick, 2002; Gamble, 2008; Kennett, 2005; Pletka, 2001; Rick, 2007, among others) and northwestern California (Hildebrandt, 1984; Kroeber, 1925; Tushingham, 2009).

Here we report the results of our synthesis of a substantial quantity of fish remains data from the central coast of California undertaken with an eye toward identifying temporal variation that could indicate the relative intensity of fishing and possible overexploitation. The ethnographic record from this area, limited to accounts from two centuries ago, constrains our ability to generate meaningful estimates of the pursuit and processing costs associated with indigenous fishing in pre-modern habitats. Nonetheless, general trends do allow us to roughly approximate the profitability of fishing based on the diversity of the fishes caught and the technology required to catch the fish. We evaluate the possibility of overexploitation with an extensive data set resulting from CRM and other investigations in this region that have produced a substantial quantity of fish remains (here we consider a regional NISP of 202,177) representing a 10,000-year record of fishing. To evaluate this sequence we establish methodological and analytical protocols for evaluating a massive fish remains data set in combination with the archaeological record of fishing technology in order to identify possible diachronic variation in fishing patterns. By holding methodological, analytical, and geographic variables constant we aspired to examine the relationship between technological changes and possible shifts in the most abundant species caught in order to determine whether any such changes might reflect overfishing—or whether alternative explanations would be more parsimonious. We conclude that central California fisheries were resilient to overexploitation and that the little diachronic variation that can be identified is better explained with reference to settlement, seasonality and environment. We bolster this assessment with comparison to modern fishing yields that show unequivocally that this regional fishery was one of enormous productivity owing to its position in the western Pacific in a zone of intense upwelling. Unlike Kennett et al. (2008) who found that huge historic changes in the less productive fisheries of southern Mexico were preceded by small-but-noticeable human-induced changes in prehistoric times, we can find no definitive evidence that the fisheries of central coastal California were significantly impacted by humans until the 19th century. These conclusions echo those of Butler and Campbell (2004) who found no evidence for depression of fish resources on the Northwest Coast. Further, at least in the California case, there is no obvious reason to consider this anything other than epiphenomenal sustainability (Smith and Wishnie, 2000) and not a product of deliberate conservation on the part of indigenous fishing people.

2. General working concepts

Recent studies seeking to explain the prehistoric impacts of humans on local fauna typically approach the record from the perspective of historical ecology (e.g., Rick et al., 2008) or behavioral ecology (Kennett, 2005). Both examine how the relative abundance of prey species vary through time as a function of human exploitation, but the latter has the benefit of developing clear predictions about which prey people should prefer and how individuals should respond to local environmental variation (Bird and O'Connell, 2006; Codding and Bird, 2015). This is accomplished through the application of formal models, the most common of which is the prey choice model (e.g., Charnov, 1976). From this perspective, if prehistoric fishing strategies were directed toward maximizing harvest rates, then individuals should preferentially target those species that offer the greatest energetic returns and only acquire prey of lower profitability when these high ranking species decline in abundance (see a detailed review by Codding and Bird, 2015). One potential confound that is particularly important to consider with fish involves technology: gaining the highest possible energetic returns may necessitate specific technologies that require significant investment in manufacture and maintenance, which may only be worth it when people allocate large portions of their subsistence time to fishing (Ugan et al., 2003). Thus, both the aspects of the targeted species and the technology needed to capture them are required to understand the profitability of different fishing strategies. As mentioned in the introduction, understanding fishing profitability along the central California coast is not easy given the lack of local quantitative ethnographic data, but we can make some general rankings based on global patterns that co-vary with known targeted species or technological characteristics. Examining variation in the post-encounter return rates for 25 fish prey types from ethnographic observations in Oceania (Bliege Bird and Bird, 1997; Raven, 1990) and experimental studies in North America (Lindstrom, 1996; Thomas, 2008) show that profitability (1) generally increases with fish size and (2) generally increases when caught en masse (e.g., with nets; Fig. 1). This provides two clear ways to rank the available fish taxa based on their profitability. If human fishing pressure results in overexploitation, then the record should show individuals transitioning to lower profitability size classes or technologies through time. If individuals exploit relatively high ranking fish throughout the sequence, then the record should show only limited diachronic change.

3. Regional working hypotheses

While the importance of fishing to the insular societies of southern California has been investigated extensively in the last few decades (Arnold, 1992, 1995, 2001, 2004; Erlandson and Rick, 2002; Gamble, 2008; Kennett, 2005; Pletka, 2001; Rick, 2007; Turnbull et al., 2015, among others) the relative significance of fish to foraging groups of the central mainland of California has not been systematically evaluated (although see the recent work by Boone, 2012) in spite of the fact that an archaeological study by Greenwood (1972) demonstrated over 40 years ago that fishing has an antiquity of at least 9000 years in this region. At that time,