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Stock composition and ocean spatial distribution inference from California recreational Chinook salmon fisheries using genetic stock identification

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ABSTRACT

We apply genetic stock identification (GSI) data and models of the catch and sampling process to describe spatial and temporal patterns in the stock composition and stock-specific catch-per-unit-effort (CPUE) of both tagged and untagged stocks encountered in California recreational ocean Chinook salmon fisheries during the period 1998–2002. Spatial and temporal distributions inferred from GSI sampling of stocks with tagged hatchery components were broadly consistent with those previously inferred from studies of tag recoveries alone, while GSI provided additional insight into untagged stocks of conservation concern. The catch in all times and areas was dominated (typically ≥90%) by the "Central Valley Fall" genetic reporting group, which is comprised primarily of Sacramento River fall run Chinook. Other contributing stocks were more spread out in space and time with the exception of Central Valley winter run Chinook, which were rarely encountered by boats fishing in port areas north of Point Reyes. Localized stock-specific CPUE appeared to increase near a stock's respective natal river while decreasing in other port areas at the time of adult return to freshwater for spawning. We describe methods for quantifying uncertainty in stock proportions, stock-specific catch, and determining the statistical support for proposed management boundaries hypothesized to represent "break points" in the spatial distributions for stocks of concern, and find at most equivocal support for a proposed delineation line at Point Reyes in north-central California.

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1. Introduction

Ocean salmon fisheries on the west coast of North America are generally mixed-stock fisheries, in that fish harvested in any given area usually come from multiple source rivers (Winans et al., 2001; Weitkamp and Neely, 2002; Weitkamp, 2010). While some stocks are usually relatively abundant and productive, their harvest is often constrained to protect less abundant or weaker stocks, including those managed under the U.S. Endangered Species Act (ESA) as "threatened" or "endangered" (Pacific Fishery Management Council [PFMC] 2012, 2013). The goal of "weak stock management," as practiced for these mixed-stock ocean salmon fisheries, is to maximize overall harvest opportunity while simultaneously meeting conservation benchmarks for all managed stocks. The primary tools used in California for implementing weak stock management are (1) allowing fishing only in specific times and areas (i.e., time–area fisheries) to minimize impacts on weak stocks and/or (2) establishing catch quotas. Currently, spatial management of salmon fisheries off the coast of California is accomplished primarily through seasonal openings of fisheries at relatively broad spatial scales, corresponding to the ocean areas delineated in Fig. 1, based on an understanding of stock-specific spatial distributions informed by tag recoveries from stocks of interest or their proxies.

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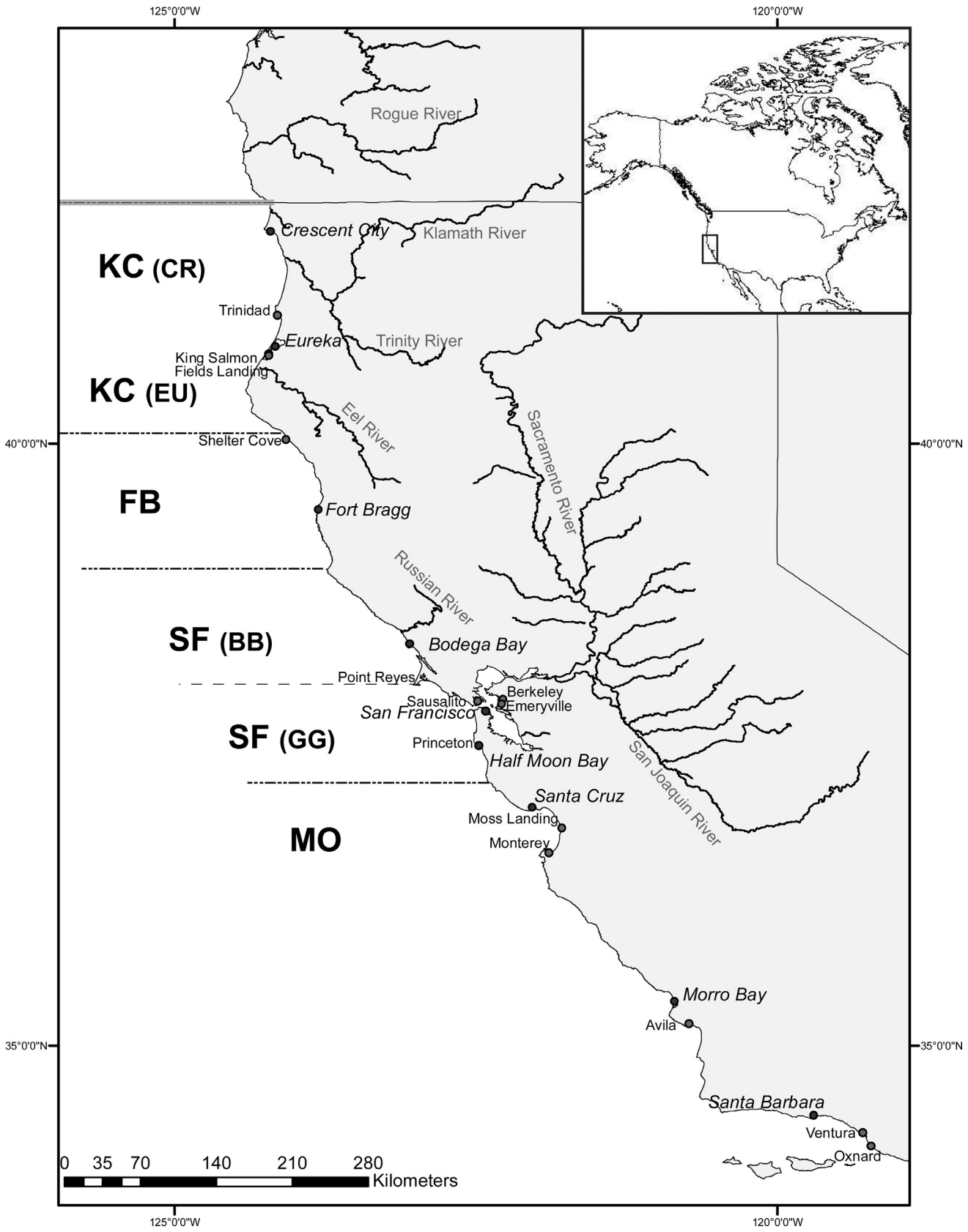

Fig. 1. Map of California salmon fishery management areas (KC, FB, SF, MO), sub-areas defined in this paper (CR, EU, BB, GG), sampled ports, and natal rivers of major Chinook salmon populations.