Instream flows for anadromous fish passage on the intermittent and partly regulated Santa Maria River, coastal southern California

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EAN PROTECTION COUNCIL

- **1.** Why the Santa Maria River?
- 2. Reconstruction of pre- and post-dam hydrology
- **3.** Recovery of a "natural" flow regime

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 "NMFS included the Santa Maria in its listing of southern California Steelhead as endangered in 1997, and reaffirmed in 2005 (62 FR 43937; reaffirmed 71 FR 834)..."

 "These are NMFS most fundamental, and most formal determinations regarding the status of steelhead in the Santa Maria River..."

 "The Santa Maria River is the highest ranked watershed in the Category 2 Basins (i.e., basins with irregular flows to the ocean)..."

SOUTHERN CALIFORNIA STEELHEAD RECOVERY PLAN

Public Review Draft Version: July 2009





January 2012

Table 6-1. Preliminary designation of Core 1, 2, and 3 O. *mykiss* populations within the Southern California Steelhead DPS.

BPG	POPULATION	FOCUS FOR RECOVERY
Monte Arido Highlands	Santa Maria River	Core 1
	Santa Ynez River	Core 1
	Ventura River	Core 1
	Santa Clara River	Core 1
	Jalama Creek	Core 3
	Canada de Santa Anita	Core 3
	Canada de la Gaviota	Core 2
	Agua Caliente	Core 3
	Canada San Onofre	Core 3
	Arroyo Hondo	Core 3



Instream Flow Study Objective

"The primary objective is to provide the Water Board with flow recommendations as to what <u>the</u> <u>minimum amount of water flow is needed</u> to ensure salmonid survival." (CALIFORNIA OCEAN PROTECTION COUNCIL, Staff Recommendation, November 20-21, 2008).



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AS REVISED:

To identify the <u>flows needed</u> to allow for passage of steelhead through the Santa Maria River, to and from the Pacific Ocean and upstream spawning and rearing habitats in the upper watershed.







Study Area









"Transmission loss" from the confluence to the mainstem Guadalupe gage is about <u>350 cfs</u>

Mainstem Santa Maria River at the Guadalupe gage (site), 0 cfs

≥USGS





Water Year 1952 Gage 11141000 Santa Maria near Guadalupe

Date



Water Year 1956 Gage 11141000 Santa Maria near Guadalupe



Water Year 1951 Gage 11141000 Santa Maria near Guadalupe

≊USGS



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How have flows changed, pre/post dam?



How have flows changed, pre/post dam?



How have flows changed, pre/post dam?



Sisquoc vs. Cuyama flows: pre-dam



Sisquoc vs. Cuyama flows: post-dam



Juvenile migration: does u/s flow = d/s passage?



Juvenile migration: does u/s flow = d/s passage?









Summary of key changes in the flow regime

- 1. Increased number of days with upstream steelhead-passable flows that are *not* followed by at least two additional steelhead-passable flow days.
- 2. Reduced frequency of long-duration upstream steelheadpassable intervals (mitigated in part by the increased frequency of short-duration migration intervals).
- 3. Reduced overall frequency of downstream steelheadpassable conditions.
- 4. Increased frequency of "false positives" in the flow of the Sisquoc River (i.e., discharges in the Sisquoc River that historically correlated with upstream- or downstream-passable conditions from or to the estuary, but no longer do).

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FLOW RECOMMENDATIONS

Targets and constraints, based on historic patterns:

- As a result of any operational changes at Twitchell Dam, the increase in the number of upstream steelhead-passable days should be on the order of 2 days/year, as averaged over periods of about a decade or more.
- Upstream steelhead-passable conditions of substantial duration (i.e., substantially more than 3 days) should not be anticipated in more than one or two years per decade, given historical climatic conditions.
- 3. Flow conditions suitable for **downstream steelhead passage should occur in about one-half of all years**, on average.

Net "cost" of implementing flow recommendations: For 1962-1987, 1,500 ac-ft per year (3% of total GW recharge) For 1988-2011, 1,020 ac-ft per year (2% of total GW recharge)

FLOW RECOMMENDATIONS: testing the results



FLOW RECOMMENDATIONS: testing the results



FLOW RECOMMENDATIONS: testing the results



CONCLUSIONS

- Standard metrics for determining "adequate" instream flows are not useful in intermittent rivers with naturally episodic flow.
- The magnitude, frequency, and duration of the unmodified flow regime is a credible benchmark for evaluating alternative mitigation scenarios for fish passage.
- Climate change will likely (but indeterminately) affect future outcomes.
- On the Santa Maria River, mitigation is hydrologically feasible (but socially challenging).

Determining appropriate instream flows for anadromous fish passage on an intermittent mainstem river, coastal southern California, USA

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ABSTRACT

Setting instream flows to protect aquatic resources is required by California state law, but this task is not straightforward for an intermittent river that is naturally dry six or more months of every year. The Santa Maria River, 200 km northwest of the Los Angeles metropolitan area, lies within the northern range of the federally endangered southern California steelhead (*Oncorhynchus mykiss*) and is a logical candidate for instream flow protection: the watershed historically supported the anadromous life history of this species, but fish must navigate the lowermost 39 km of the commonly dry mainstem river to move between the ocean and freshwater habitats in the upper watershed. Mainstem flows are partly controlled by Twitchell Dam, constructed across one of the Santa Maria River's two main tributaries in 1962. The dam is operated to maximize groundwater recharge through the bed of the mainstem Santa Maria River, thus minimizing discharge to the Pacific Ocean and so reducing already limited steelhead passage opportunities. Conventional criteria for determining suitable instream flows for steelhead passage are ill-suited to intermittent, Mediterranean-type rivers because they ignore the dynamic channel morphology and critical importance of headwater flows in providing cues that once presaged passage-adequate mainstem discharges but no longer do so. Hydrologic analysis of pre-dam flows, coupled with established criteria for successful *O. mykiss* migration, provides an objective basis for evaluating alternative dam-management scenarios for enhancing steelhead passage, although their implementation would redirect some water that for the past half-century has exclusively supported irrigated agriculture and municipal water supplies. Copyright © 2013 John Wiley & Sons, Ltd.

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