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Influence of climate change and urbanization on coastal water quality in southern California

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INTRODUCTION

Southern California beaches are visited more than 129 million times a year (60% of all U.S. beach visits)

An important concern is how will future changes in climate impact the quality of recreational beach waters.

Previous research has reported water quality decreases with urbanization of the watersheds.

Previous research has reported precipitation is associated with beach water quality impairments.
Studies were limited in scope either by time or geography.
This study investigated the entire southern California coastline for an extended period of time.

OBJECTIVES

To study the effects of variable precipitation on southern California's recreational coastal water quality.

To examine how developed and undeveloped watersheds respond to changes in precipitation, and to measure the effect on coastal water quality.

METHODS

Six years of daily data (2000-2005) for southern California

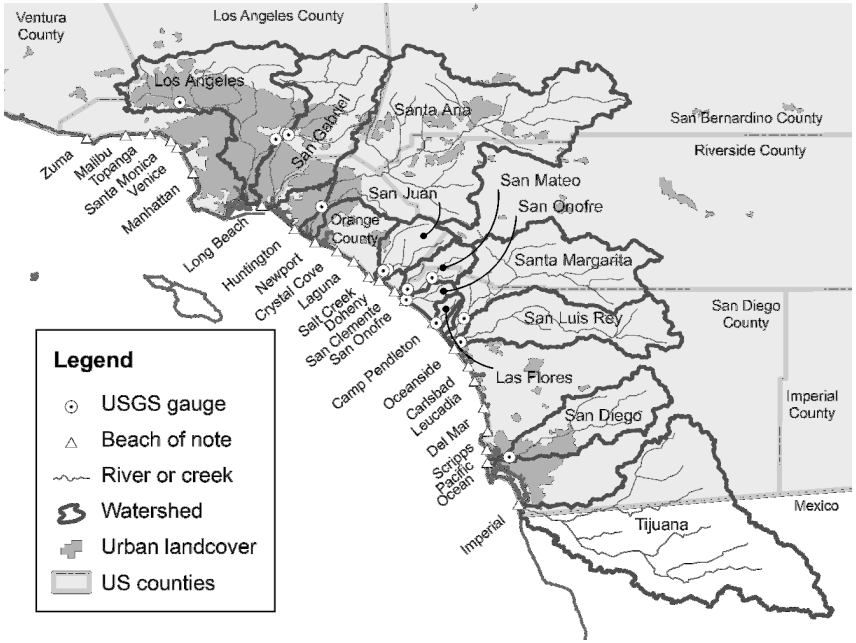
1) Precipitation levels for 10 watersheds [2002 = drought year; 2005 = record wet year]

2) Discharge rates for 10 rivers and creeks

3) Bacteria concentrations for 285 monitoring stations representing 78 recreational beaches

Multi-analysis Investigation

Data analyzed over time and by individual location
Correlations and regressions were run between sets of data
Time series analysis conducted



Watershed	**Land Use**	**Urban**	**Size** (m^2)	**Discharge** (c/f/s)		**Enterococcus** (cfu)	
Los Angeles	Urban	61%	871	5,478	High	27	Medium
San Gabriel	Urban	38%	640	2,605	High	186	High
San Diego	Urban	19%	440	253	Medium	35	Medium
Santa Ana	Urban	14%	2800	26	Low	31	Low
Tijuana	Urban	na	1750	2	Low	52	High
San Juan	Mixed	4%	176	50	Low	3240	High
San Mateo	Undeveloped	0%	139	7	Low	23	Low
San Onofre	Undeveloped	0%	42	0	Low	4	Low
Santa Margarita	Undeveloped	0%	750	405	Medium	10	Low
San Luis Rey	Undeveloped	0%	558	287	Medium	47	Medium

RESULTS

1 Precipitation was significantly correlated with discharge for all 10 rivers and creeks. (A to B)

2 Discharge was significantly correlated with coastal water bacteria concentrations for all ten beaches near river/creek mouths. (B to C)

3 Precipitation was significantly correlated with coastal water bacteria concentrations for all ten beaches near river/creek mouths. (A to C)

4 Regressions: Bacteria concentrations in coastal waters significantly increased with higher levels of precipitation across 95% of the 78 beaches investigated.

A few beaches were clean regardless and a few were polluted regardless.

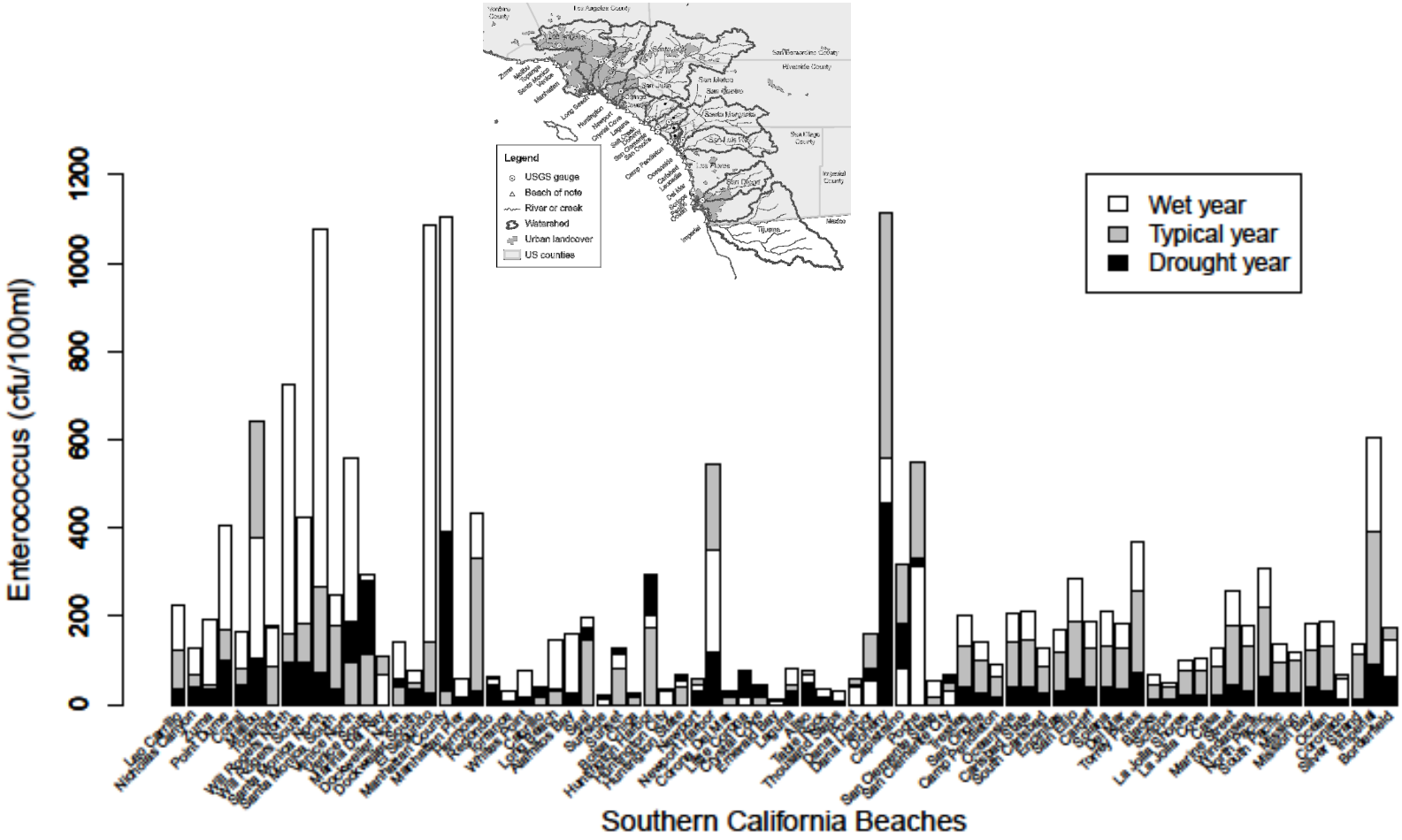
5 Bacteria concentrations in coastal waters near a heavily developed watershed were higher (186 cfu) compared to waters near an undeveloped watershed (10 cfu) of similar size.

6 Variable precipitation generated a greater response in bacteria concentrations at beaches near urbanized watersheds compared to undeveloped watersheds.

RESULTS

Bacteria concentrations significantly increased with higher precipitation for 95% of 78 beaches.

Drought year: 56% of 78 beaches had annual mean bacterial concentrations (< 50 cfu.)
Typical year: 26% of beaches had annual mean bacterial concentrations (< 50 cfu.)
Wet year: 13% of beaches had annual mean bacterial concentrations (< 50 cfu.)



RESULTS

Developed vs. Undeveloped Watersheds:

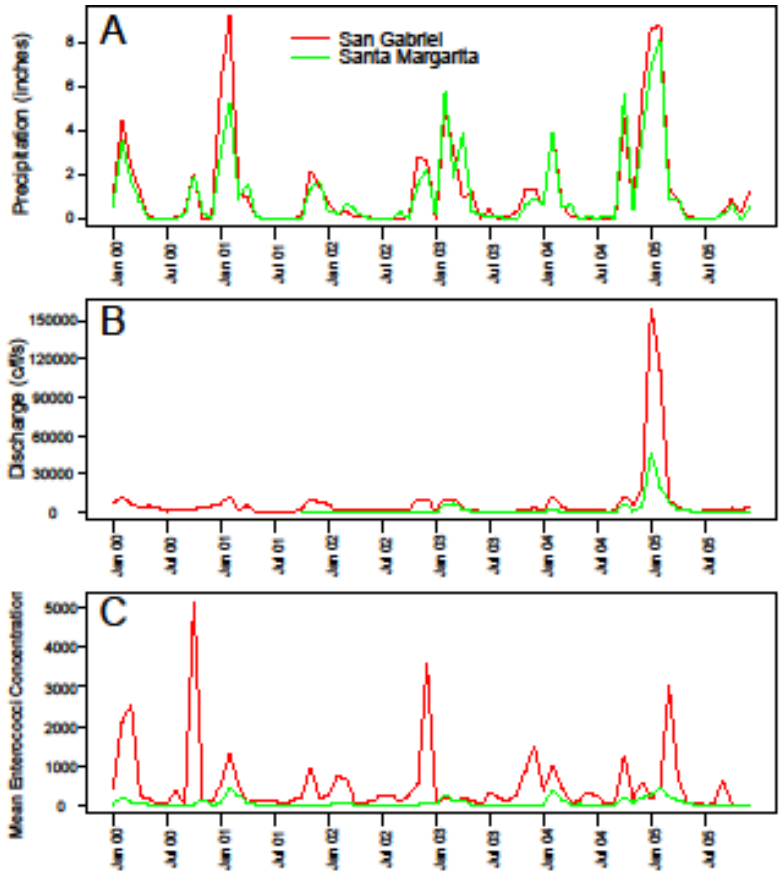
Mean bacteria concentrations in coastal waters near an urbanized watershed were much higher (186 cfu) compared to waters near an undeveloped watershed (10 cfu) of similar size.

San Gabriel River

- 38% urbanized
- 640 square miles
- 2,605 cubic feet per second flow
- 186 cfu monthly mean bacteria concentrations

Santa Margarita River

- 0% urbanized
- 750 square miles
- 405 cubic feet per second flow
- 10 cfu monthly mean bacteria concentrations



CONCLUSIONS

- Precipitation and ensuing runoff is the strongest determinate of pollution levels for most beaches in southern California.

Most climate models predict southern California will experience decreased precipitation as a consequence of climate change.

- *If predictions are correct….* decreased precipitation would result in less coastal water pollution.
    - Most beaches would experience water quality similar to a drought year.
    - Less water pollution would reduce risk of water associated illnesses.

- Variable precipitation generates a greater response in coastal water bacteria concentrations for developed compared to undeveloped watersheds.

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