

Nutrient deposition in the headwaters of streams may impact nitrogen loading in Southern California

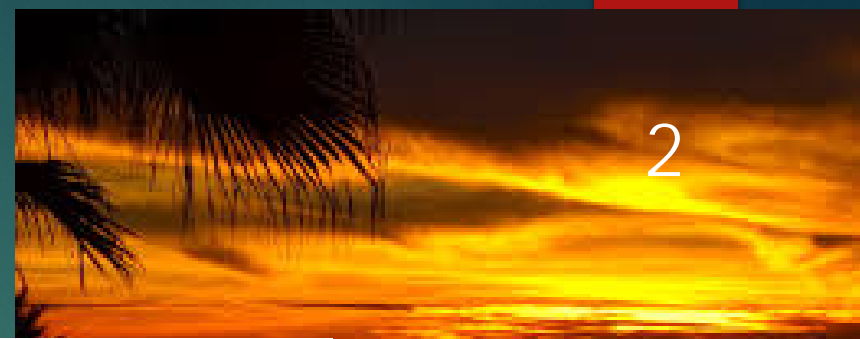
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² SOUTHERN CALIFORNIA COASTAL WATERS RESEARCH PROJECT

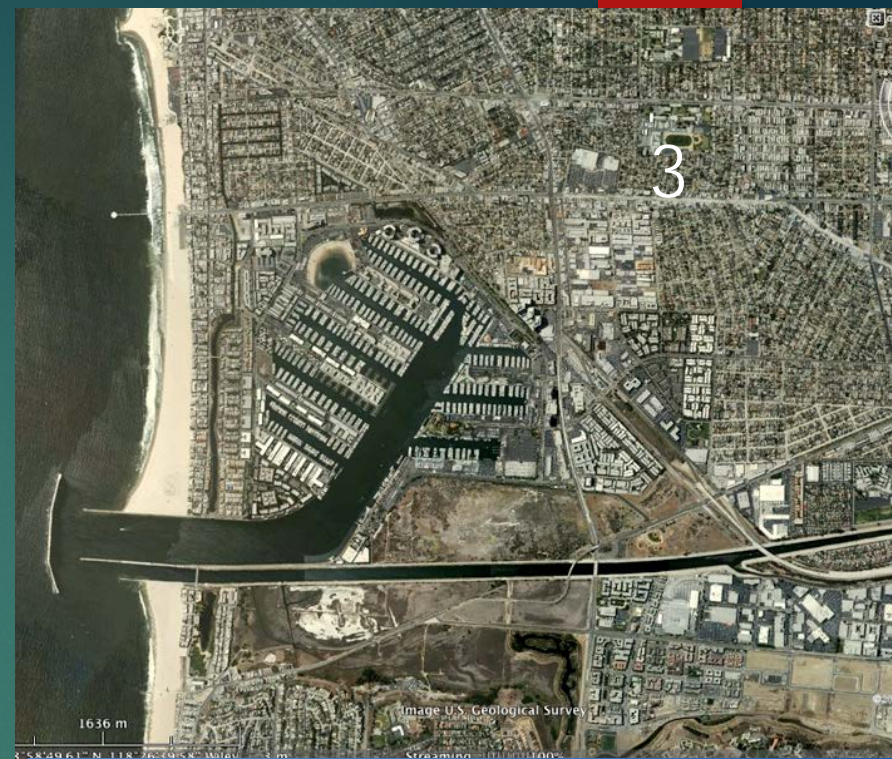


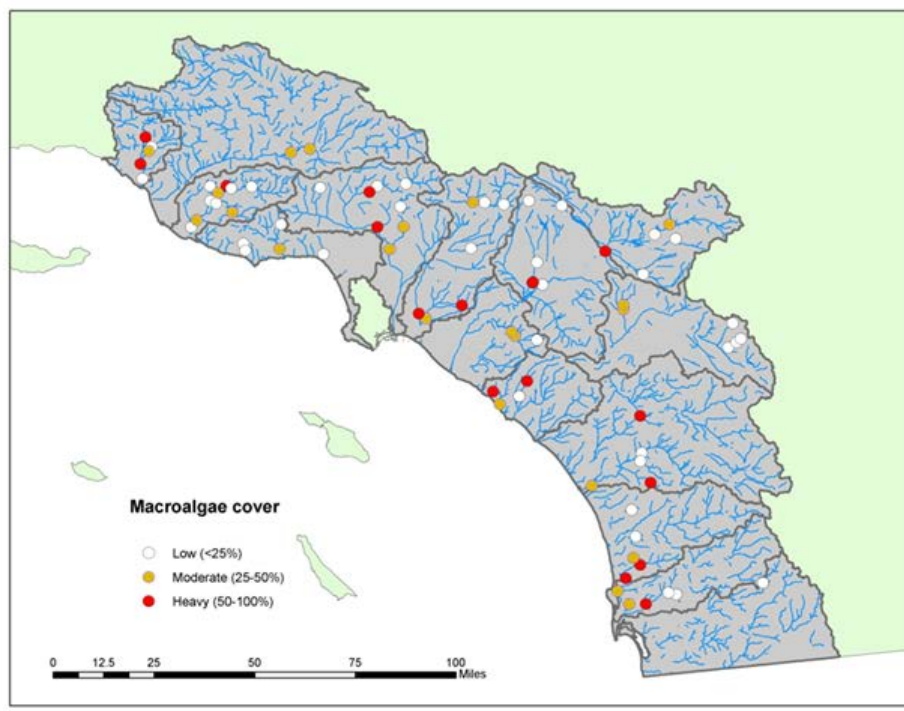
Pacific Southwest Research, Riverside
Funding by EPA Region 9



47% of the natural estuaries in California have been lost, most in the southern half of the state.

- ❑ The combination of the small, somewhat isolated nature of coastal wetlands and intense development pressure has resulted in California experiencing some of the highest rate of loss of coastal wetlands in the United States
- ❑ Most estuaries in the southwest are/were non-navigable.
- ❑ Estuaries in Southern California are more likely to be “closed” due to the Mediterranean climate of wet winters and dry summers.

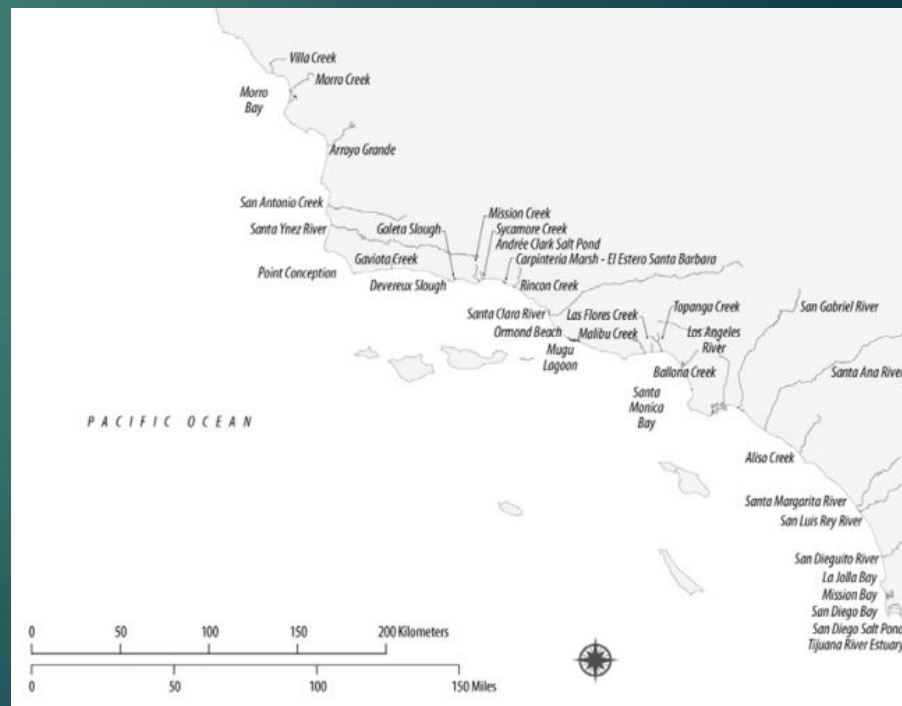




Assessment of water quality concentration and loads from natural landscapes. Eric D. Stein and Vada Kyonga Yoon, Southern California Coastal Water Research Project, February 2007 Technical Report 500

Nitrogen deposition on coastal watersheds in the Los Angeles region. Rong Lu, Kenneth C. Schiff and Keith D. Stolzenbach Southern California Coastal Water Project Annual Report, 2003-2004

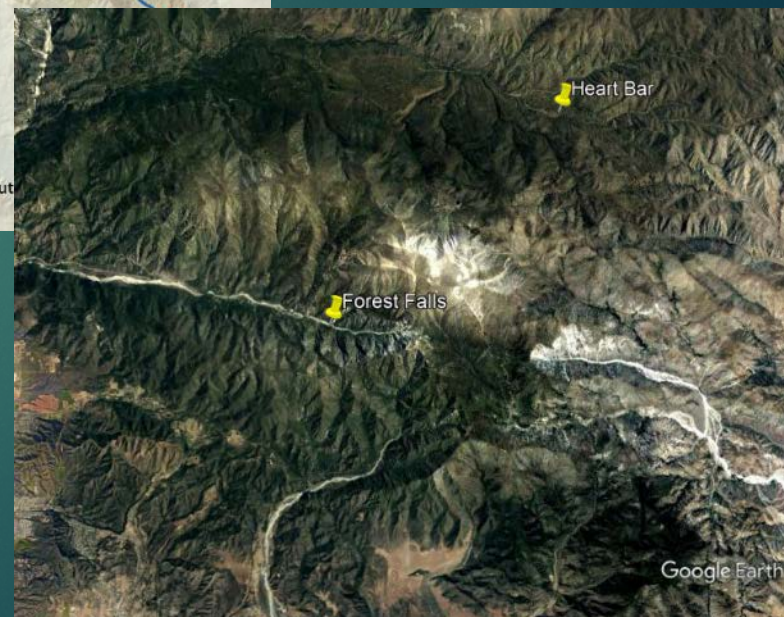
Southern California Coastal Water Research Project (SCCWRP).
Mission: *To enhance the scientific foundation for management of Southern California's ocean and coastal watersheds.*



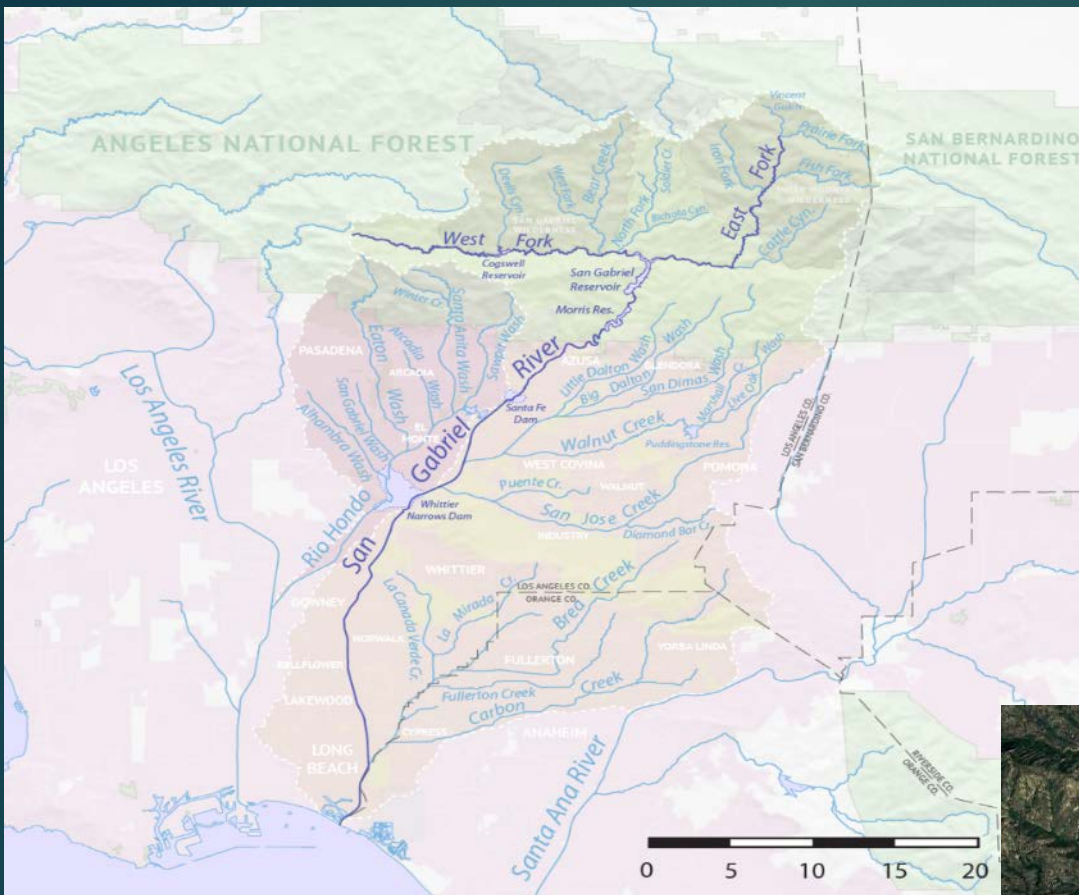


| Site | Latitude | Longitude | Elevation | Stream | Watershed |
|--------------|---------------|----------------|-----------|-----------------|--------------------|
| Bear Creek | N 34° 14.520' | W 117° 53.202' | 1688 feet | Bear Creek | San Gabriel River |
| Cattle Creek | N 34° 13.661' | W 117° 45.829' | 1941 feet | Cattle Creek | |
| Forest Falls | N 34° 04.734' | W 116° 52.911' | 6404 feet | Mill Creek | Santa Ana River |
| Heart Bar | N 34° 09.288' | W 116° 47.040' | 6858 feet | Santa Ana River | |
| Palomar | N 33° 20.774' | W 116° 54.402' | 4560 feet | French Creek | San Luis Rey River |

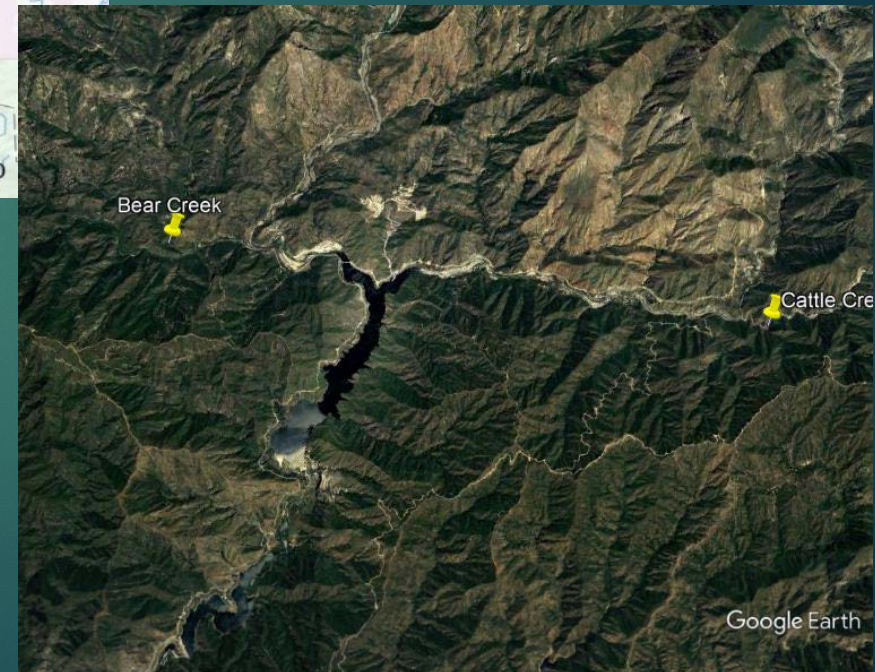
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

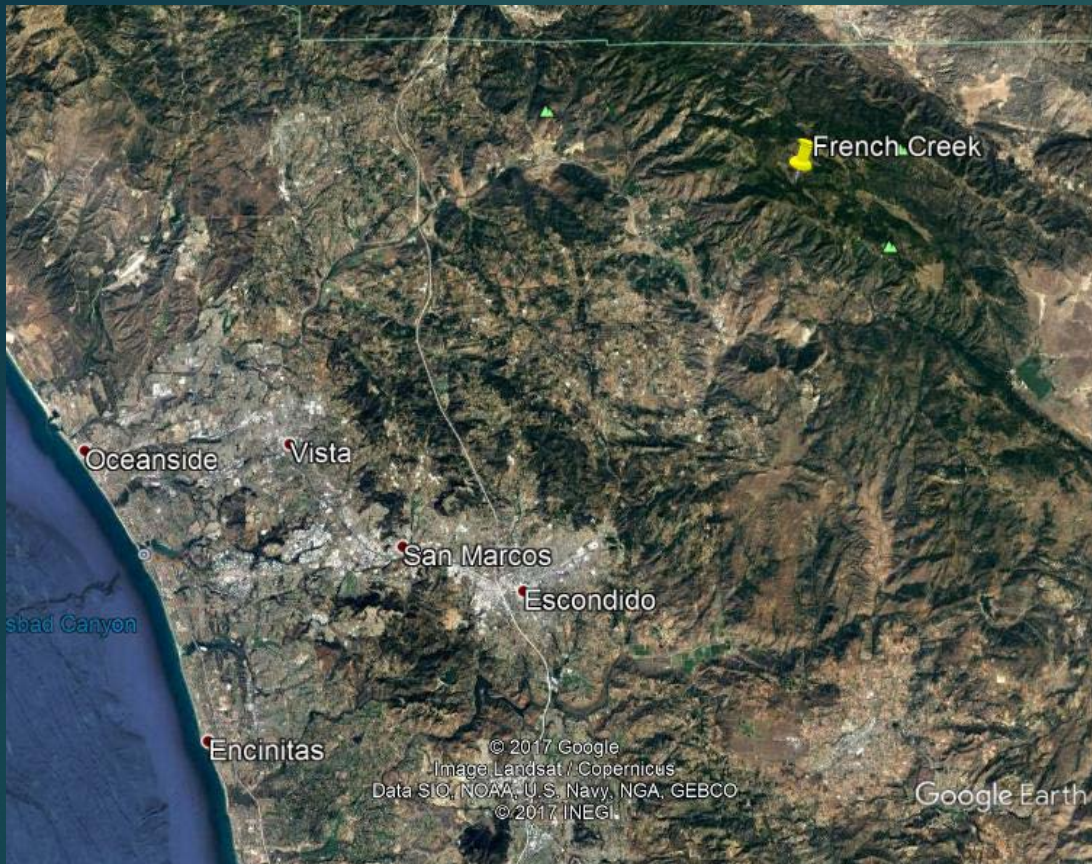


Santa Ana Watershed
 Headwaters in the San Bernardino
 National Forest
 Discharge: Small tidal lagoon
 between Huntington Beach and Costa
 Mesa, near Huntington Beach



San Gabriel watershed
 Headwaters: Angeles National Forest
 Discharge to Alamitos Bay near Long Beach.





The Santa Margarita is the only remaining free-flowing river in coastal Southern California. All the others have been dammed, diverted, or passed into underground tunnels. Headwaters: Riverside County
Discharge: the Gulf of Santa Catalina on the Pacific approximately 3 miles (4.8 km) northwest of Oceanside.



Evaluation of passive techniques for monitoring dry deposition using knife-edge platforms.

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Dr. Thomas Holsen, Clarkson University

Passive water sampler
250 ml Nano-pure water



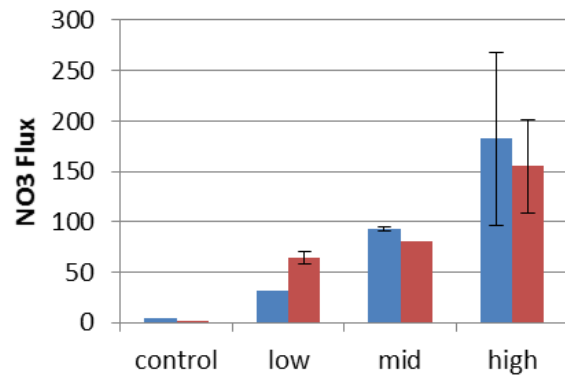
Passive filter sampler
Nylasorb (HNO_3)
Acid treated glass filters (NH_3)



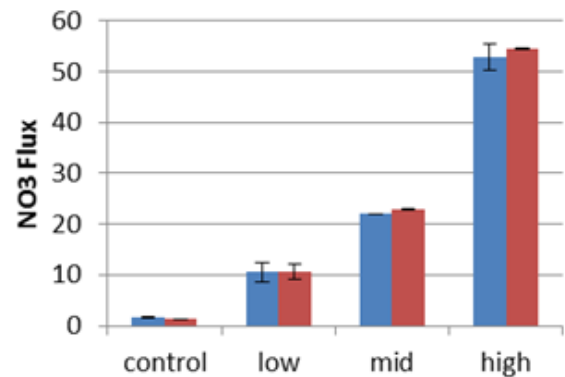
Chamber studies:

8 CSTR (2 per HNO₃ level)
5 replicates per chamber

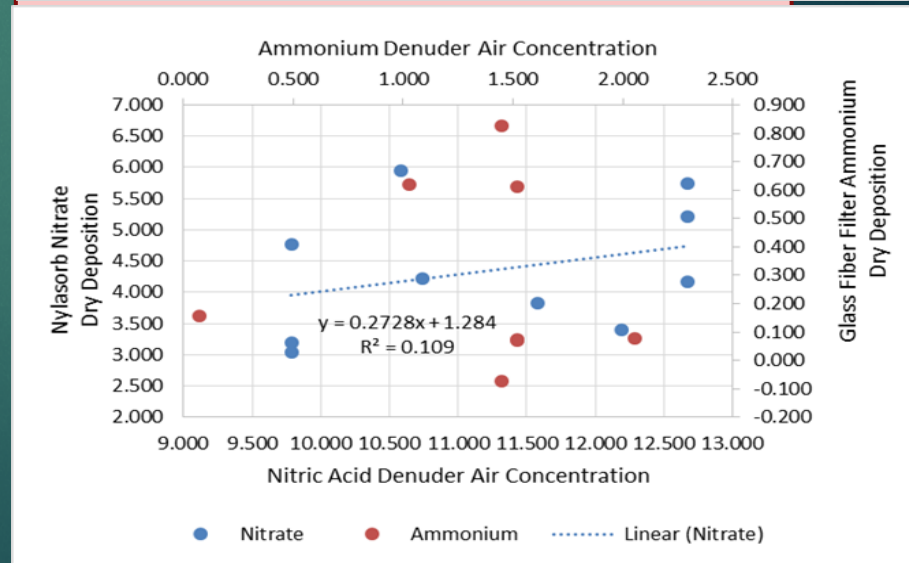
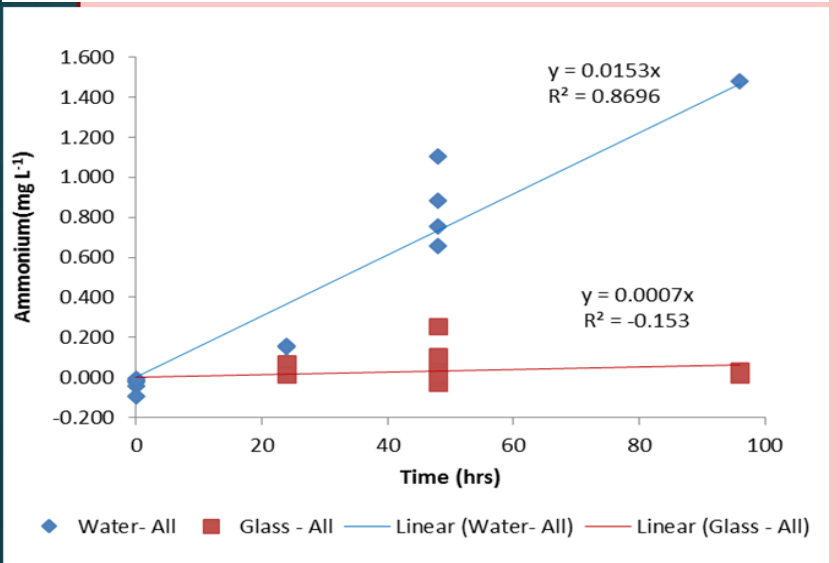
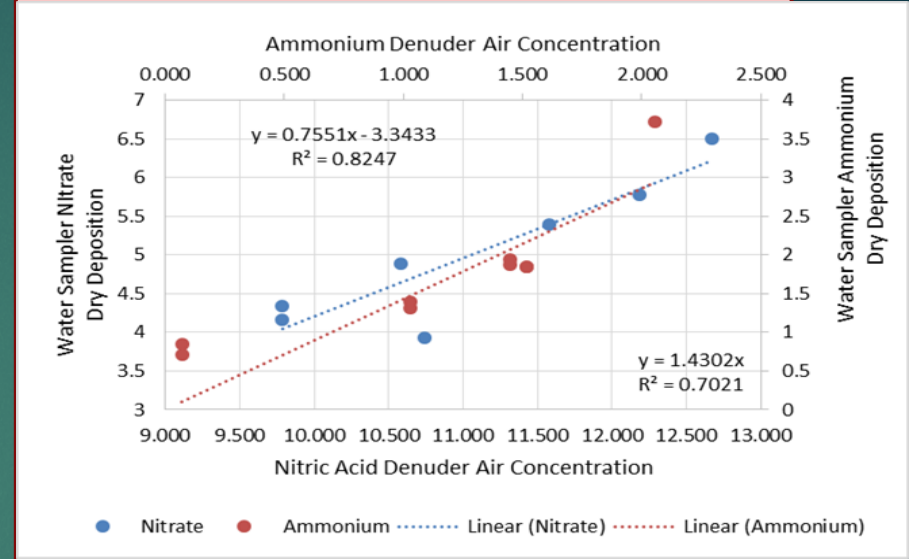
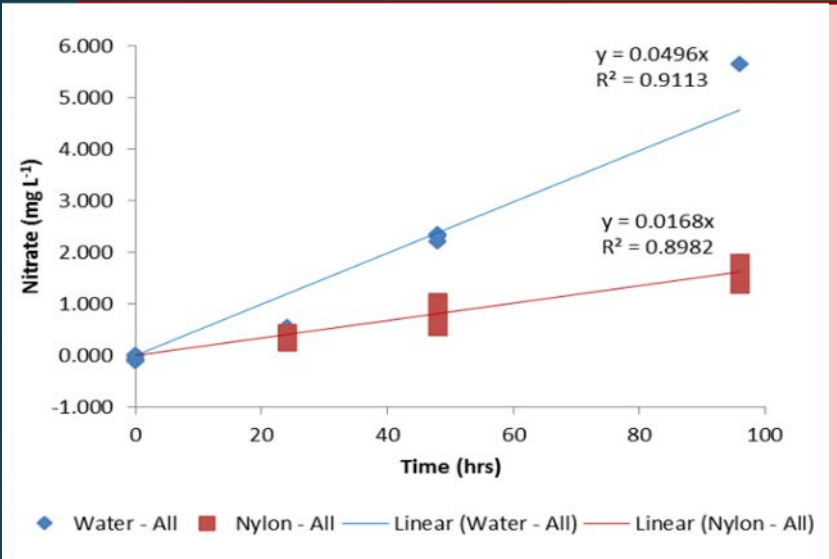
Water Sampler



Nylon Filters



Performance of passive sampler in fumigation chambers over time



Field experiment at 5 headwater streams

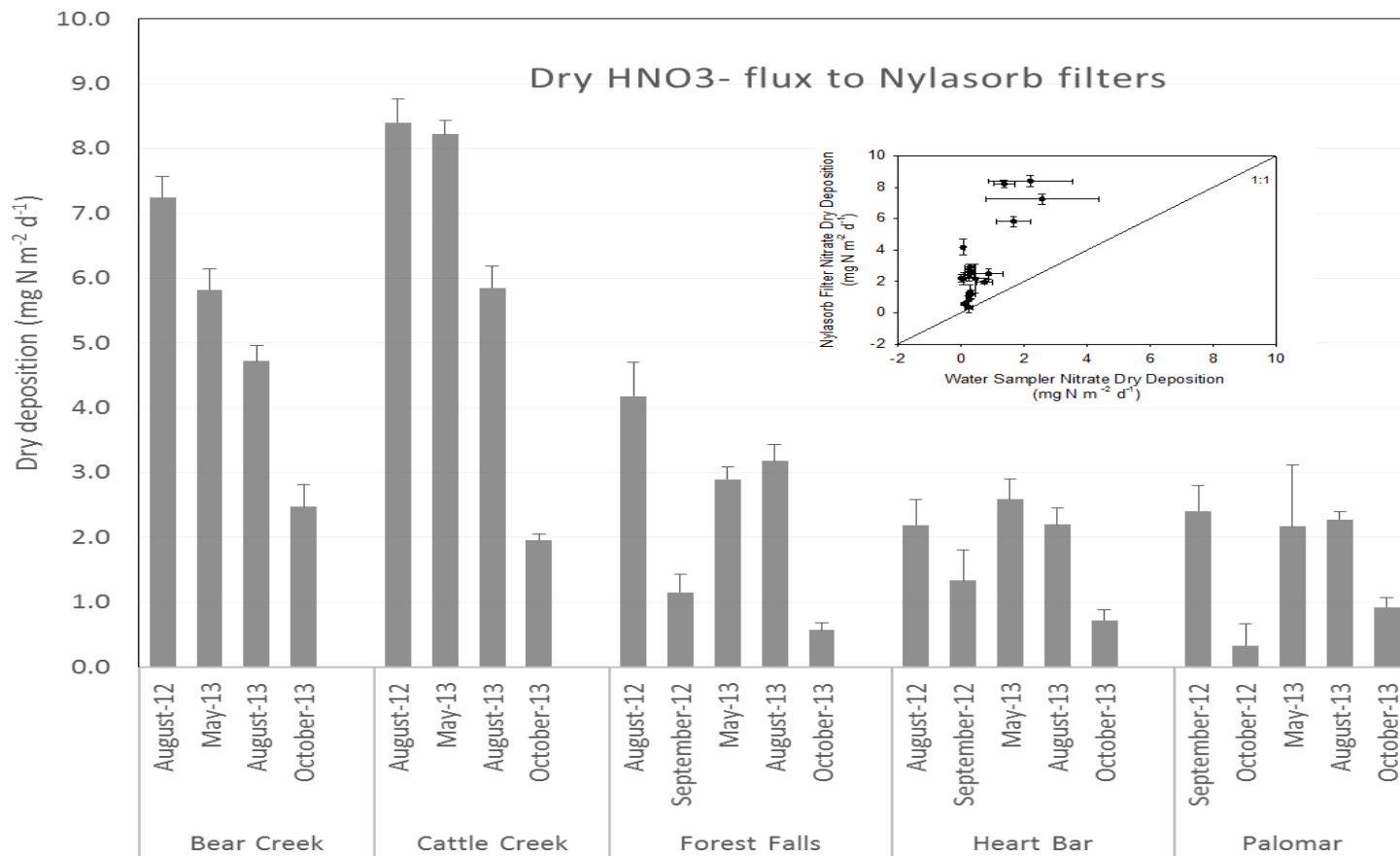
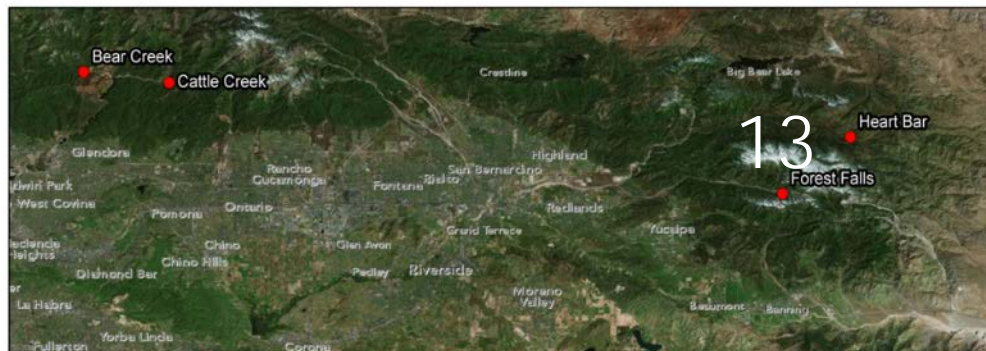
Wet deposition: Mixed bed resin collectors, 5 replicates per site, 6 month exposures, wet and dry season.

Dry deposition: Static water samplers 2 day exposures, 2 replicates per site.

Nylasorb filters (HNO_3) and oxalic acid treated glass filters (NH_3), 5 replicates per site, 4 day exposures.

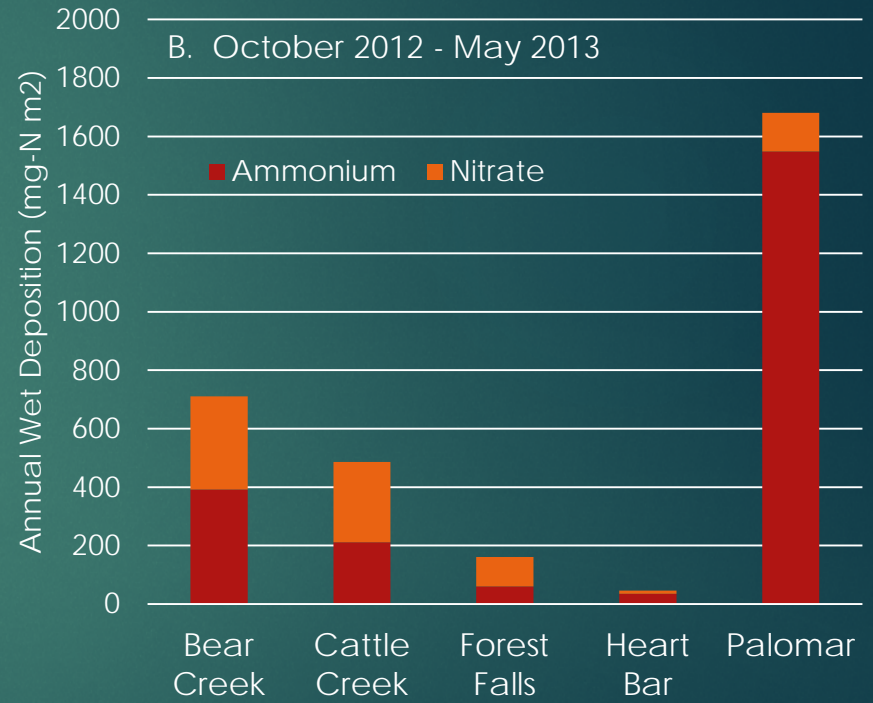
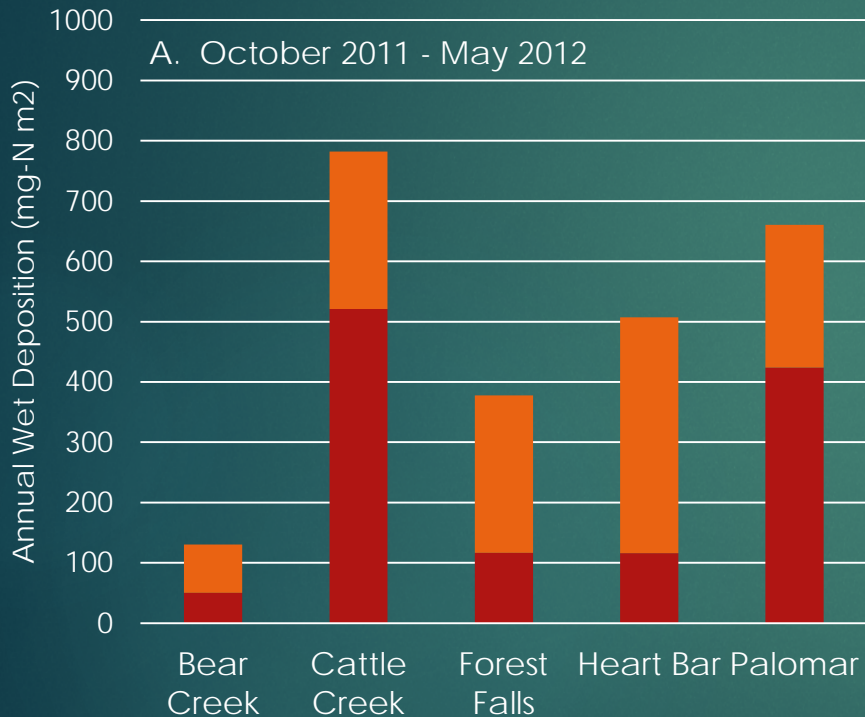
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SA, Lockheed, San Bernardino Geographic, CRISM/Alamos, D37, RDA, UOBA, I, FBI, and the 600 User Community (1991, NPS/2, Caltrans, and the 600 User Community)

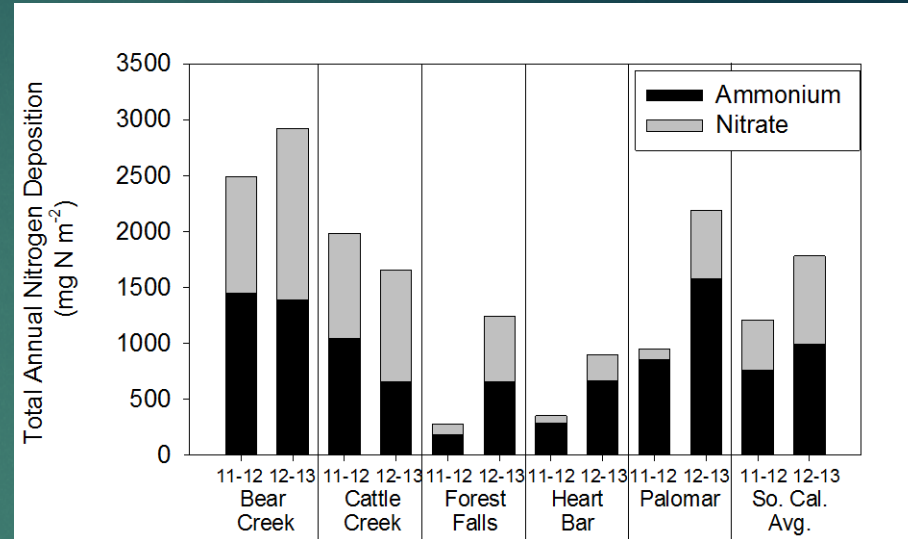
Wet deposition: Two years, two different rainy seasons.



■ Ammonium ■ Nitrate

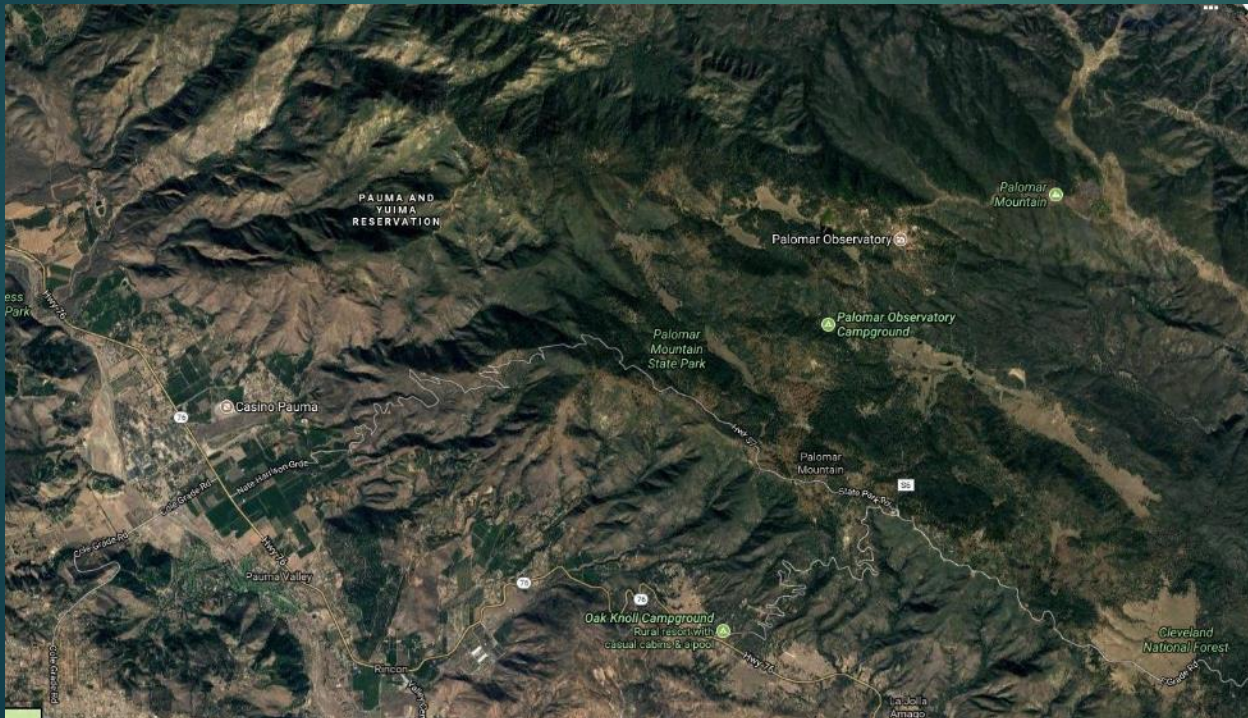
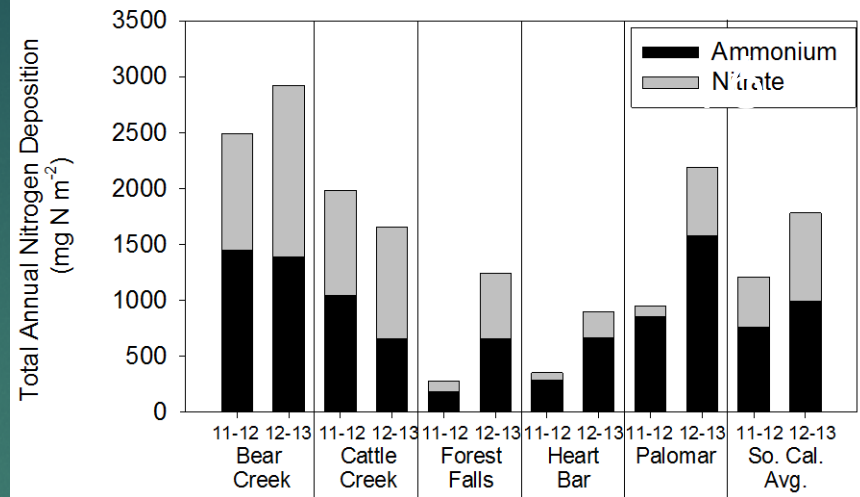
Wet vs. dry deposition in the headwaters of the San Gabriel, Santa Ana, and Santa Margarita watersheds.

| Site | Water Year | Total Annual Deposition (mg m ⁻²) | | | |
|-----------------------------|-----------------|---|---------|---------|-----------|
| | | Ammonium | Nitrate | Total N | Phosphate |
| Bear Creek | Oct 11 - Sep 12 | 1453 | 1038 | 2491 | 111 |
| | Oct 12 - Sep 13 | 1388 | 1536 | 2924 | 423 |
| Cattle Creek | Oct 11 - Sep 12 | 1043 | 945 | 1988 | 79 |
| | Oct 12 - Sep 13 | 656 | 1001 | 1657 | 43 |
| Forest Falls | Oct 11 - Sep 12 | 184 | 95 | 278 | 20 |
| | Oct 12 - Sep 13 | 661 | 582 | 1242 | 37 |
| Heart Bar | Oct 11 - Sep 12 | 284 | 69 | 353 | 48 |
| | Oct 12 - Sep 13 | 662 | 232 | 895 | 46 |
| Palomar | Oct 11 - Sep 12 | 854 | 94 | 948 | 260 |
| | Oct 12 - Sep 13 | 1579 | 607 | 2186 | 1141 |
| Southern California Average | Oct 11 - Sep 12 | 764 | 448 | 1212 | 103 |
| | Oct 12 - Sep 13 | 989 | 792 | 1781 | 338 |



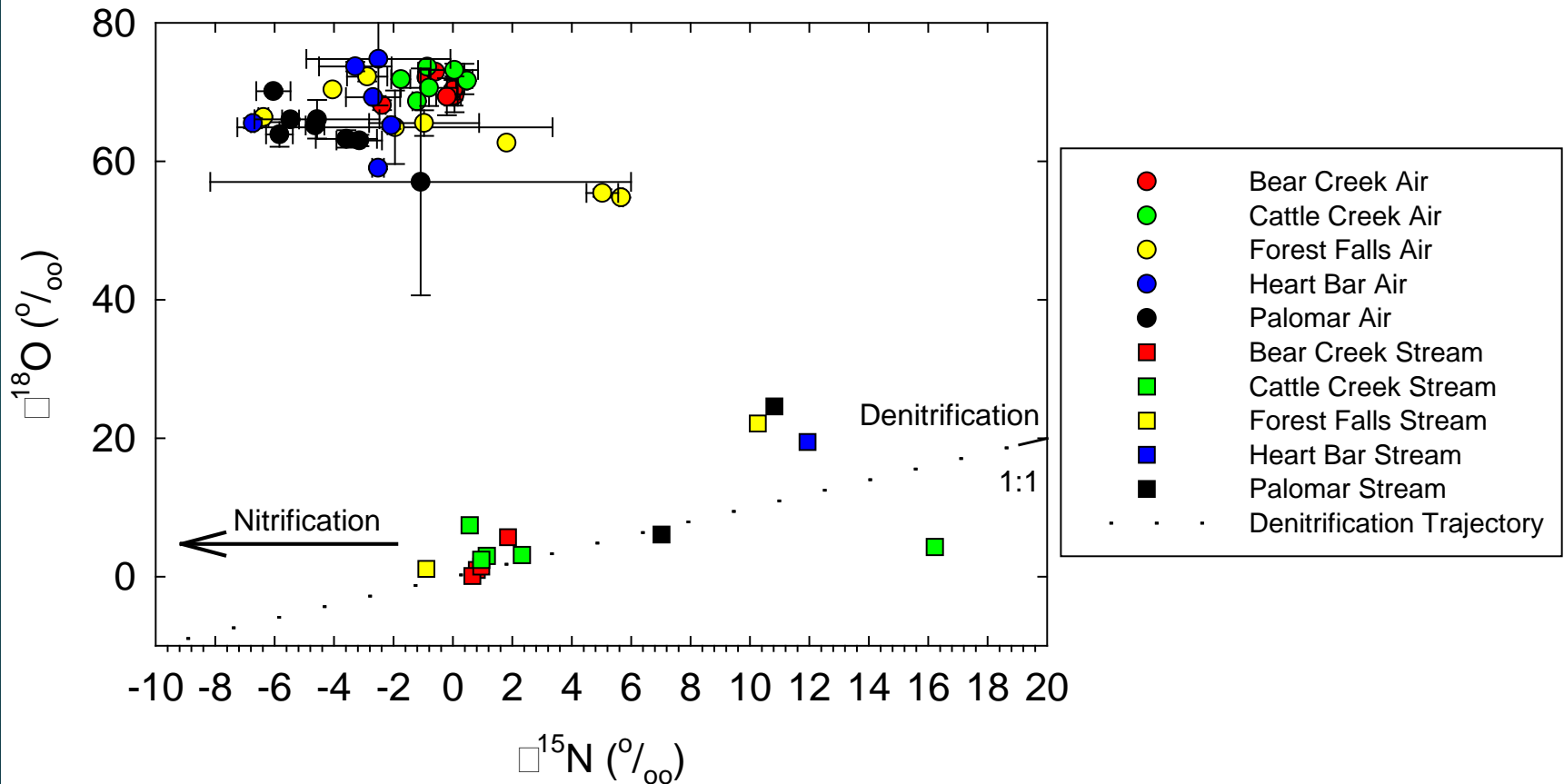
| Site | Water Year | Total Annual Deposition (mg m ⁻²) | |
|-----------------------------|-----------------|---|-----------------------|
| | | % N as dry deposition | % P as dry deposition |
| Bear Creek | Oct 11 - Sep 12 | 90 | 37 |
| | Oct 12 - Sep 13 | 71 | 9 |
| Cattle Creek | Oct 11 - Sep 12 | 86 | 21 |
| | Oct 12 - Sep 13 | 62 | 39 |
| Forest Falls | Oct 11 - Sep 12 | 86 | 68 |
| | Oct 12 - Sep 13 | 82 | 98 |
| Heart Bar | Oct 11 - Sep 12 | 64 | 7 |
| | Oct 12 - Sep 13 | 96 | 72 |
| Palomar | Oct 11 - Sep 12 | 30 | 1 |
| | Oct 12 - Sep 13 | 46 | 11 |
| Southern California Average | Oct 11 - Sep 12 | 71 | 27 |
| | Oct 12 - Sep 13 | 71 | 46 |

Palomar Mountain has substantial agricultural activities to the west. Mostly plant nurseries and citrus production



Can we identify nitrogen deposition in stream water?

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What have we learned?

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- ▶ Still looking for suitable methods for direct determination of dry deposition.
- ▶ Especially ammonia
- ▶ Dry deposition is a substantial contributor to nitrogen loading in Southern California stream water.
- ▶ But direct quantification will require both additional monitoring and modeling.

Questions?

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