Hydrology and Water Quality Monitoring Of The Mora River At Rio Mora National Wildlife Refuge

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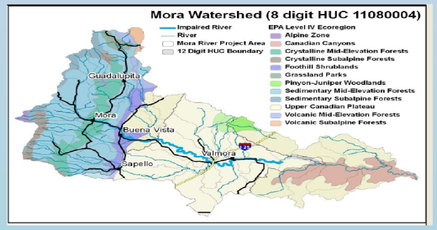
Introduction

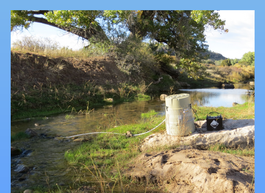
The monitoring projects along the Mora River at Wind River Ranch/Rio Mora National Wildlife Refuge & Conservation Area are ongoing and long-term. Long-term monitoring of any system establishes a base-line of responsiveness and seasonal fluctuation which will allow the investigation of the system's responses to specific events. The purpose of this ongoing and long-term study is to establish baseline levels and trends for the hydrology and water quality of the Mora River at the Rio Mora National Wildlife Refuge. Changes in these levels can be correlated with specific activities that occur within the watershed, on the Refuge, and as a result of climate change. The quality of water in a system sets the basis for the rest of the ecosystem health, and the response of water chemistry to watershed land use & its impact on ecosystems is the subject of many research projects (USEPA, 2013). The specific physical & physiochemical parameters we are monitoring include temperature, dissolved oxygen, specific conductance, pH, turbidity, alkalinity, discharge, and the levels of the nutrients PO_4, NO_3, NO_2, Cl, Br, $S0_4$, & Fl. Monitoring is currently being expanded to include atmospheric levels which would allow development of a partial nutrient budget scheme for the Rio Mora.



Site Description

The Rio Mora is part of the Mora Watershed, which is a subwatershed of the Arkansas Red/White (map courtesy of Hermit's Peak Watershed Alliance). The reach we are sampling is found on the Rio Mora National Wildlife Refuge and Conservation Area. The area formerly known as Wind River Ranch was established in 2012 as Rio Mora as part of the Fish and Wildlife Service Refuge system (USFWS, 2014). The refuge is located approximately 25 miles north of Las Vegas, NM, along Highway 161 west of the town of Watrous, NM.

For our sampling purposes, the "upper" site is located upstream in a broad, shallow area of the river while the "lower" site is located downstream near a marked increase in river depth. The photos below on the left and right are from the "upper" site while the central photo is from the "lower" site. A drainage allows seasonal flow to enter the river at a point between the two sites. Bison grazing and wildlife habitat restoration are the primary land use activities. Bison are prevented by fences from directly entering the riparian area/river.



Methods

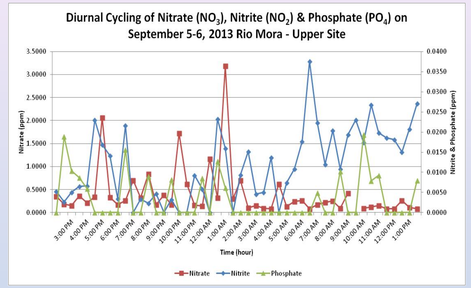
Field Methods

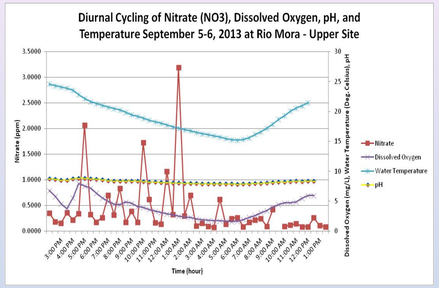
Two water quality sondes have been deployed at two different sites ("upper" and "lower") along the Mora River. These sondes record the temperature, dissolved oxygen, specific conductance, pH, turbidity of the stream every 30 minutes since July 2013, with two periods of disturbance due to memory overload of the sondes in early August & damage to the upper sonde's oxygen sensor in mid-September heavy rains. Using real-time monitoring such as sondes eliminates researcher bias because samples are collected during bad weather, in the night, etc when grab samples would not likely be collected. (Jobs, 2011) In addition to the sondes, ISCO samplers have been used once a month June-October, to collect one sample per hour for a 24 hour period at both sites. During the colder months when the ISCO samplers do not function reliably, grab samples have been collected from both sites approximately twice a month. Snow/rain samples are collected at the time of a precipitation event.

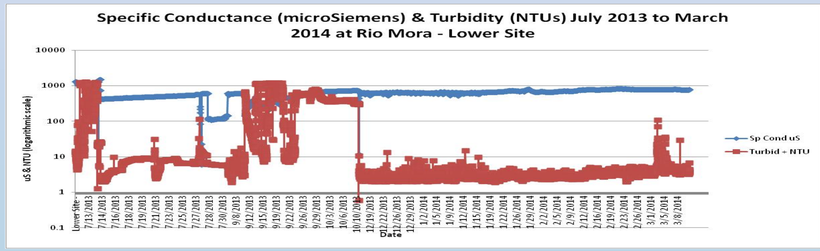
Laboratory Methods

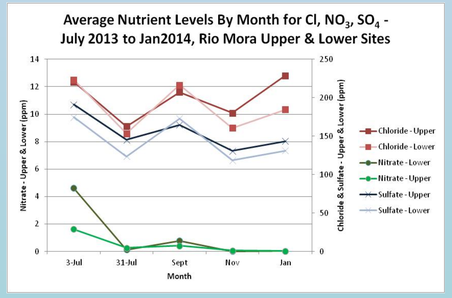
These samples are then analyzed with a Dionex ion chromatograph for nutrient levels, as well as by hand (titration) to determine alkalinity, and with a spectrophotometer to determine dissolved phosphorus (when below detection levels of the Dionex).

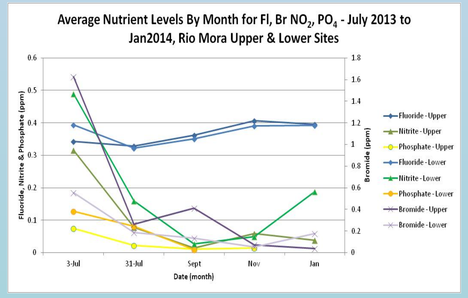
Results

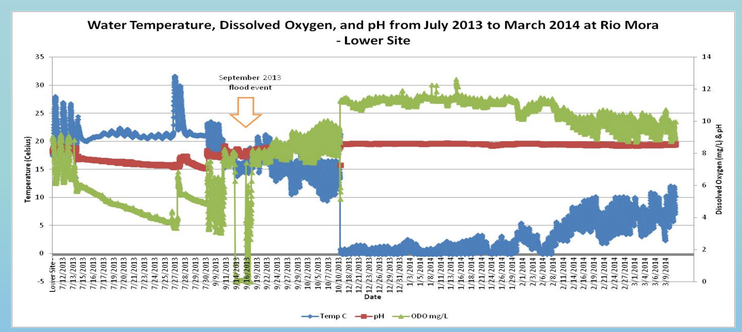












Nutrient (ion)	Recommended	Upper	Lower	Within? (2013)
Fluoride	N/A	0.2061- 0.4358 ppm	0.3310-0.4109 ppm	N/A
Chloride	250 mg/L or less	11.3973- 13.4581 ppm	11.9293- 12.5822 ppm	yes
Nitrite	132 mg/L or less	0.0023- 0.0376 ppm	0.0030 - 0.0576 ppm	yes
Bromide	N/A	0.1114 - 0.1304 ppm	0.1157 - 0.2029 ppm	N/A
Nitrate	10 mg/L or less	0.07878-3.193 ppm	0.1127 - 6.8913 ppm	Yes
Phosphate	N/A	0.0049- 0.0194 ppm	0.0055 - 0.0133 ppm	N/A
Sulfate	500mg/L or less	159.7781-167.1147 ppm	170.9918 - 176.2516 ppm	yes

Parameter	Recommended	Upper	Lower	Within? (2013)
Turbidity	50+-10 NTUs	0.4-1244	0.6-1236	Depends on duration
Conductivity	500 mS/cm or less	0.176-0.928	0.142-0.747	yes
Temperature - Marginal Coldwater	max 29 C	10.77-24.6	9.74-23.1	yes
pH - Marg. Cold.	6.6-9.0	7.35-9.04	7.75-8.47	Upper no; lower yes
DO - Marg. Cold	6 mg/L or greater	0-9.25	0-10.05	no
Diss. Phos.	N/A/<0.1	0-0.06	0-0.07	yes
Alkalinity	N/A	75-113	120-141	N/A

Conclusion

All parameters measured show both diurnal (24-hour) and seasonal fluctuation largely within expected ranges. For example, as illustrated above, as temperature increases, DO generally decreases; turbidity and conductivity seem to be somewhat proportional; nitrate peaks about 6 hours before nitrite levels peak in a diurnal cycle. The September 2013 flood events caused some disturbance in the river, but both sites appear to have returned to pre-flood chemistry in the months following. Even throughout the flood event, the majority of the parameters measured were within normal or recommended ranges. However, the Upper site in particular experienced low pH. (DO levels are not known because of sensor damage.) Continuing monitoring is necessary to develop a more detailed understanding of the river's baseline and response to land use, climatic, and other activities.

References:

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United States Fish & Wildlife Service. (2014, March 12). *Rio Mora*. Retrieved from USFWS Refuge site: http://www.fws.gov/refuge/rio_mora/

Acknowledgements: