CAN A LEAF WETNESS SENSOR DISTINGUISH FOG FROM DEW?

The Namib Desert on the Southwestern coast of Africa is hyper-arid in terms of rainfall but experiences frequent coastal fog events. The fog has been suggested to provide sufficient water for survival to certain plants which are endemic to the Namib, some of which occur only in the fog zone (up to 60 km inland).

Dr. Keir Soderberg, former researcher at the University of Virginia (now a consultant at S.S. Papadopulos & Associates), wanted to use stable isotopes to measure how much fog water plants were taking up either through surficial roots or their leaves. To enrich his data set, he decided to use METER leaf wetness sensors to show when the fog was occurring. He also wondered if he could use the leaf wetness sensors to distinguish between fog and dew.

PHYTOS 31 leaf wetness sensor

Keir set up five fog monitoring stations along a climate gradient in the central Namib. Each measured leaf wetness, air temperature, and relative humidity measurements along with solar radiation and soil parameters (moisture, temperature, and electrical conductivity). Stable isotope analysis of samples was also used to help quantify the amounts of fog, groundwater, and soil water that plants were using.

DEW OR FOG

Keir says, "We began collecting one-minute data to look at the different patterns of how the water was being deposited on the leaf wetness sensor. The dew tended to be more of a gradual wetting, but with the fog you would see these cyclical waves of steep wetting and then a little bit of a drying on the sensor." Keir says he could look at those patterns and correlate them with visual evidence from his visits to the Namib during fog or dew events, though those wetting patterns may be specific to this location.

Event (n)	Total (mm)	Average (mm)	Average Rate (mm/hr)	Total Wetness Exposure (L*Hr/m²)	Average Wetness Exposure (L*Hr/m²)	Average Hours of Wetness	Average Daylight Hours of Wetness	Annual Hours of Wetness	Annual Daylight Hours of Wetness	Contribution to Annual Daylight Wetness
Fog (69)	4.7	0.07	0.011	41	0.6	7.6	3.5	522	224	23%
Dew (143)	12.3	0.09	0.014	150	1.0	8.2	4.3	1172	618	63%
Rain (30)	57	1.9	0.245			7.8	4.8	233	144	15%
Total (242)	74	0.31	0.038			8.0	4.1	1927	986	

Table 1. Rain, fog, and dew totals (July 2008-June 2009) from the Gobabeb weather station (for rain volume) and a Leaf Wetness Sensor placed near the sand surface on the westward-facing plinth of High Dune 2 km SW of Gobabeb

MEASURING VOLUME

Keir also tried to determine the volume of water deposited on the leaf wetness sensors. He did a calibration in the lab by spraying water on the sensor and then weighing it. He said, "It was sort of a trial and error thing. I found the performance was definitely sensor specific. You have to get an individual calibration, but I felt the uncertainty could be controlled."

In comparing different methods of measuring fog deposition, Keir concluded that it is difficult to compare across measurement methods. "There's a lot of variability between methods, even if you are confident in your own device and its accuracy." This gives the advantage to the most common measurement device, the Standard Fog Collector, since much of the work done through the years has used these instruments. However, the cylindrical-style collectors have the advantage of being insensitive to wind direction.

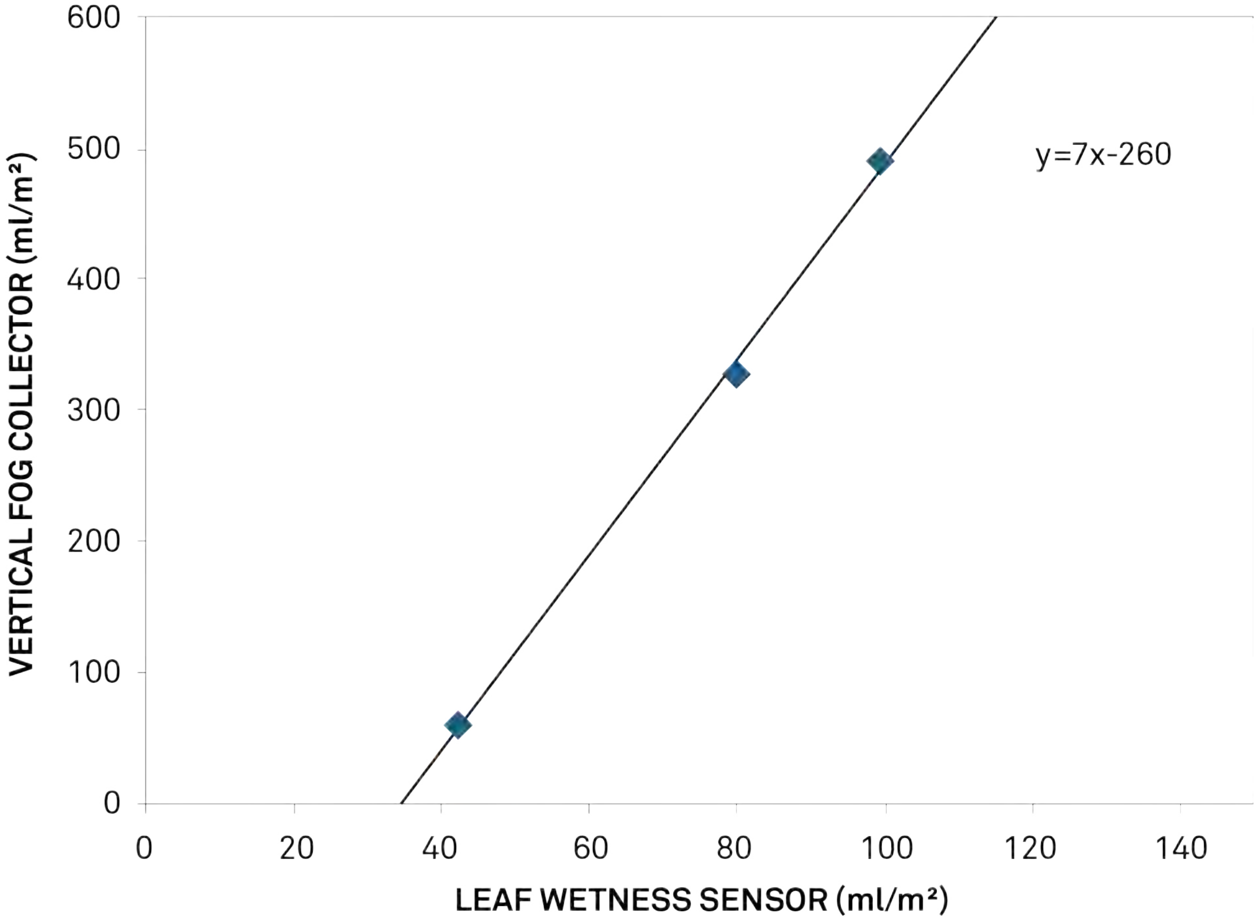

Figure 1. Volume of water deposited for 3 fog events on a vertical collector (X-harp) and a PHYTOS 31 Leaf Wetness Sensor

FUTURE DATA

In spite of this, Keir admits he's still interested in seeing if he can get good dew collection data from leaf wetness sensors. He says, "I went on from Namibia to a research station in Kenya where we had an eddy covariance flux tower. Though there is no fog in Kenya, I convinced them to put leaf wetness sensors up and down the tower to collect data on dew deposition. We left the sensors out there and have been collecting one-minute data for a while. There's this massive dataset out there that we still need to look at."

Keir collaborated on a paper for *The Journal of Arid Environments*, called "The Nature of Moisture at Gobabeb, in the Central Namib Desert," a compilation of different fog and dew collection techniques over the years, including leaf wetness sensors, for automating the identification of fog events. You can find it here.

Discover the PHYTOS 31 leaf wetness sensor