Correlating personal weather station data with *Allogona townsendiana* activity observations at Crystal Springs Park, Tukwila, Washington.

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Over the years I have taken my dogs on walks nearly everyday to Crystal Springs Park, Tukwila, about 0.5 mile from my house (**Figure 1**). I casually observed in this 11 acre (0.04 km^2) city park the seasonal activity of a colony of *Allogona townsendiana* (Oregon forestsnail) and appearances of other native land mollusks such as *Ariolimax columbianus* (Pacific banana slug) with occasional appearances of *Monadenia fidelis* (Pacific sideband), *Ancotrema sportella* (beaded lancetooth), *Haplotrema vancouverense* (robust lancetooth), *Prophysaon andersoni* (reticulate taildropper), much more rarely *Cryptomastix devia* (Puget Oregonian) and, so far, long dead shells only of *Vespericola columbiana* (northwest hesperian). They are found occurring on the top of a seepy, well-vegetated forested slope above Crystal Springs. In addition to the land mollusks, Crystal Springs is the north-most site for *Pristinicola hemphilli* (pristine pyrg) in the Puget Sound basin. Occurrence of this springsnail is an anomaly in a once heavily glaciated region. It was during surveys for the pristine pyrg that I found additional sites for the Oregon forestsnail in the Puget Sound region including Crystal Springs (Johannes, 2016).

Figure 1. Crystal Springs Park with locations of transect site (CSP and PWS (KWASEATT324)

Recently, I decided that *Allogona townsendiana* (**Figure 2**) would be a good candidate to study the relationship between seasonal weather conditions and the activity of land snails. This snail is usually found in isolated, relatively densely populated colonies that are associated with *Urtica* (stinging nettles) typically near springs and seeps (pers. obs.; Waldock, 2002; Steensma et al., 2009; Edworthy et al., 2012). This makes locating and censuses of them much easier than other native land snails, which occur more widely dispersed in very low densities in Pacific Northwest forested habitats.

Considering that A*llogona townsendiana* has a restricted habitat preference, I suspect this snail is a climate relict, as is possibly the co-occurring *Cryptomastix devia*. The Committee on the Status of Endangered Wildlife in Canada assessed both of these mollusks (COSEWIC; for background see Lepitzki & Mackie, 2013). *Allogona townsendiana* was designated as Endangered and *Cryptomastix devia* as extinct in Canada (COSEWIC, 2002a, b, 2013a, b). In the U.S. *Cryptomastix devia* is currently a federal Survey and Manage species under the Northwest Forest Plan and is also being considered for listing under the Endangered Species Act, this determination is long overdue (USDA & USDI, 1994; Johannes, 2012, 2013; USFWS, 2012). Due to its limited range (from extreme southern British Columbia, Canada to the Willamette Valley, Oregon), fragmented occurrence, low dispersal ability and restricted habitat preference it is possible *Allogona townsendiana* should also be considered for listing as well in the U.S. (Steensma et al., 2009; Edworthy et al., 2012).

To methodically survey the daily absence or presence and numbers of *Allogona townsendiana* I set up a 1 m X 10 m transect through the center of the snail colony designated site CSP (**Fig. 1**; 47.461° N -122.273° W; elev. 90 m). The corners of the transect are marked by wooden stakes used to stretch a 50 ft. (15.24 m), 0.25 inch (0.625 cm) diameter shock cord (bungee) around them to define the boundaries (**Figure 3**). This shock cord does not remain at the site but is only set up during observations when snails are found to be actively present. The *Allogona* colony has a paved path cutting through part of it (**Figure 3**). It is also being encroached by invasive *Hedera helix* (English ivy) that has taken over the parts of the ground cover of the park, excluding native plants including *Urtica*. This could possibly threaten the continued existence of this *Allogona* colony.

Biological studies in the past requiring continuous weather data used either the closest National Weather Service (NWS) station or a weather station placed on site. Setting

Figure 2. *Allogona townsendiana,* found associated with a spring and *Urtica* on E. side of Waldrick Road SE near Silver Spring, Deschutes River drainage, Thurston County, Washington. Snails about 27 mm wide.
Photo Bert Bartleson

Figure 3. Transect site along paved path in CSP under a Bigleaf maple {*Acer macrophyllum*) dominated forest with sword fern (*Polystichum munitum*) and stinging nettles (*Urtica* dead stalks) understory. Max with front paws next to the right corner stake of a 1 m x 10 m transect area bordered by a yellow shock cord.

up a weather station on site entails the possible risk of expensive equipment being vandalized or stolen; this could potentially cut short a project. Constraints on placement of a weather station at a site are also possible due to accessibility or that it is not permissible, as in Crystal Springs Park. The dependence on NWS stations restricted where such studies could be conducted, the data less likely to show local conditions the further away the site is from the station. The nearest NWS station to site CSP is 3.6 km away at Seattle-Tacoma International Airport (Sea-Tac Airport) (KSEA at 47.445° N -122.314° W; elev. 132 m). As shown on **Table 1**, this weather station and a personal weather station (PWS) closer to site CSP differ in the rainfall amounts measured. The advent of PWS streaming to the web has made it possible to use a nearby station that more closely reflects the weather conditions found at a biological study site at little or no cost. The proliferation of PWS has resulted in wide spread coverage of local weather conditions that are stored on web sites like the Weather Underground and MesoWest, making real-time and historic information very accessible to the public. Real-time and historic data from NWS stations are posted at both web sites as well. The nearest PWS to site CSP is just 0.4 km away (**Figure 1**; KWASEATT324 at 47.457° N -122.275° W; elev. 131 m). This station started operating on January 15th, 2015 and is streaming weather data to the Weather Underground site.

Table 1. Comparison of some daily precipitation amounts between two weather stations. KSEA at Sea-Tac Airport and PWS KWASEATT324 near CSP.

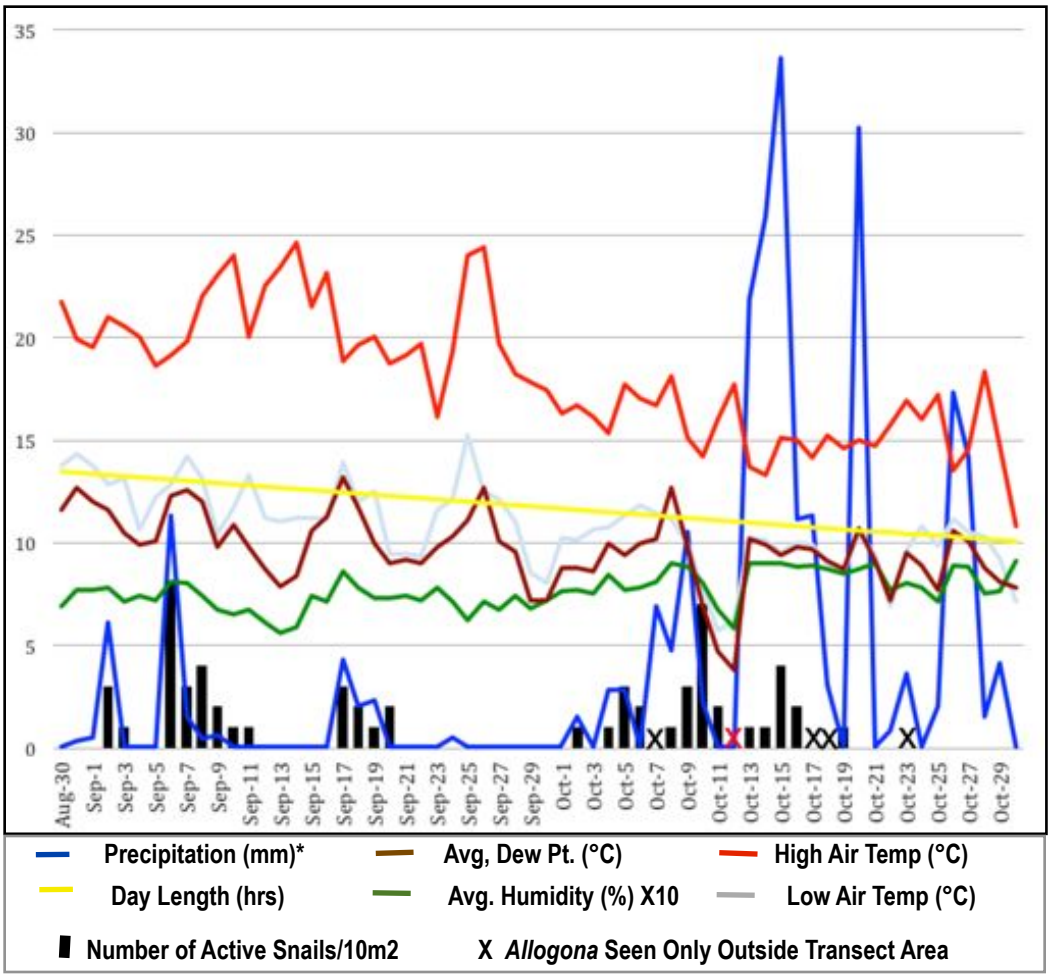
DATES	PRECIPITATION (mm)	
	KSEA	KWASEATT324
Sep. 1	4.3	4.1
Sep. 2	1.3	2.5
Sep. 6	10.7	10.7
Sep. 7	1.0	1.5
Sep. 8	0.8	1.0
Sep. 17	4.1	6.3
Sep. 23	0.3	0.5
Oct. 1	1.3	1.5
Oct. 4	3.3	4.3
Oct. 6	7.9	4.6
Oct. 7	2.8	4.1
Oct. 8	15.5	14.0
Oct. 9	1.5	2.5

Initial results of this study at site CSP show unsurprisingly a close correlation between precipitation and the appearance of active *Allogona townsendiana*, at least initially (**Figure 4**). During the sixty-two days of observations from August 30th (the start of seasonal rainfall) to October 30th. 2016, the snails were active for a total of only twenty-six days. Snails were seen during five active periods with lengths of one to sixteen days. With the onset of dry periods between rains the snails completely disappear, usually within a couple of days or less. Two days occurred with 0.5 mm of rainfall amount that resulted in no snails appearing, but it does seem that at least 1.5 mm of precipitation is enough to rouse the snails from their slumbers. A sudden cold snap (5.7ºC or 42.3ºF) resulted in a few *Allogona* being found aestivating on the surface of the leaf litter (**Figure 4**). I also observed this behavior at a second nearby *Allogona* site on the same day. It was as if they had been caught out by the rapid air temperature change and were unable to crawl back to their usual hiding spots. All revived with warmer temperatures in the following days, but despite regional record-breaking rainfall for October all land mollusks essentially disappeared not to reemerge until the following spring.

PWS are another useful tool now available for the conservation management of sensitive or endangered species, especially projects with limited budgets. I hope to continue this project for several years to assess the response of *Allogona townsendiana* to daylight length, seasonal weather conditions and, more importantly, climate change.

Figure 4. Snail observations and weather data from PWS KWASEATT324 recorded from August 30th to October 30th, 2016.

***** = Total rainfall amounts calculated between snail observations.
X = Snails found aestivating on the litter surface.



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