Peirson's milkvetch: the saga of a species embroiled in politics and litigation

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Just slightly off the Arizona road in southeastern California is one of the most spectacular sand dune areas in the Southwest. The Algodones Dunes, sometimes called the Imperial Sand Dunes, lie about 20 miles west of Yuma along Interstate 8 and stretch for about 40 miles toward the northwest. The dunes are home to a number of plant and animal species uniquely adapted to withstand extreme summer temperatures, subfreezing winter nights, severe and prolonged droughts, and the abrading effects of blowing sand. It is indeed a land of environmental extremes, and the plants that survive there are tough, having evolved to survive conditions that other species could never withstand. Oh yes, I almost forgot to mention, the Algodones Dunes are the most popular dune area for off-road vehicles in the Southwest, drawing thousands of recreationists each weekend from October to April.

Of the 15 or so plants present (and mostly endemic) in the dunes, only one has been listed by the U.S. Fish and Wildlife Service under the Endangered Species Act. Peirson's milkvetch *(Astragalus magdalenae* var. *peirsonii)* was listed as Threatened in 1998, citing ORV issues as the main threat. An administrative closure of 30% of the dunes was imposed in 2000 by a Federal court judge over BLM's management of the dunes to protect the plant, sparking legal battles between recreationists and environmental groups over the closures that remain unresolved. A wilderness area encompassing about 20% of the dunes has been closed to motorized travel since 1971. More than $3 million has been spent by Federal agencies alone on monitoring and litigation in the past six years, and there is no end to the dispute in sight. How many "millions" have agencies made available to study or monitor YOUR favorite species?

I began working on the biology, demography, and status of Peirson's milkvetch in the spring of 2001. With six seasons now completed, we are learning much about this fascinating plant. The BLM El Centro area office has monitored the plant annually since 2003, and sporadically before that back to 1998.

Our first task was to survey the open areas of the dunes and find as many places where Peirson's milkvetch grew as possible. At each site we located, we counted the plants, determined their age (first-year or older), noted reproductive condition, and mapped the outline of the site with a GPS. We found 126 places, of which 60 were large enough to circumscribe with a GPS, and counted nearly 73,000 plants. About 45% were reproductive, and less than 1% showed evidence of damage by ORVs. Nearly all appeared to be first-year plants, and a check of nearby weather stations confirmed that there had been a major storm in late October 2000. We concluded that the vast majority of plants had germinated as a result of that storm.

Although we were unable to obtain permission from BLM to enter the administrative closures, we were able to obtain the services of a helicopter and fly over the entire dunes area, noting occurrences of Peirson's milkvetch from the air and mapping them with the GPS. When we combined our ground surveys with the aerial points to map distribution, a pattern began to emerge: the plants grow along a narrow corridor that parallels the axis of the dunes, in the western third of the system, where well-developed dunes occur but outside the area of the highest, most active dunes. Moreover, the milkvetch consistently grows with the other plants in the dunes, forming pockets of vegetation on the lee sides of slipfaces and bowls where sand movement is less than elsewhere in the system. We were finding a pattern in the distribution of the plants, and their occurrences were predictable. We were also finding that the ORV'ers preferred the high, unvegetated dunes to the shrubby gentle slopes where vegetation is concentrated, and they largely avoid such places when possible.

The following season, 2001-02, was very dry, and few seedlings germinated. However, timely rains during the summer allowed 21% of the plants we had enumerated in the spring to survive. Milkvetch seedlings quickly grow very long taproots after germination, and their roots may be 5-6 feet long by the end of their first season. This allows them to tap moisture deep in the sand, and makes it possible for robust plants to survive the terrific desiccating heat of summer – temperatures in the dunes regularly reach 115-120^{o} at weather stations, and must be considerably higher at the sand surface.

Even without fall and winter precipitation in 2001-02, the surviving plants grew robustly and reached basketball to beachball size by late fall. Flowering began by December, and for a second season these survivors successfully reproduced. The previous uncertainty about whether Peirsons milkvetch is an annual or a perennial was resolved: it is both! We found that some robust plants can have as many as 800 pods; at ten seeds each, perennial individuals can be quite prolific.

The following season, 2002-03, lacked fall rain but a storm in mid-February resulted in a germination event that rivaled that of 2000-01. We waited to see if these seedlings would flower, but they didn't! Another twist in the reproductive strategy of the milkvetch had been revealed: plants that germinate in the fall can reproduce their first year, but those that germinate in late winter must survive a summer before flowering the next season. There simply would not be enough time for them to flower and produce seed before the onset of summer dormancy. The summer of 2003 was very dry, and more than 99% of the February seedlings died. This is a small return for a big investment, made feasible by the prolific seed production of second-year plants.

How long do the plants live? As figure 1 shows, between 80% and 99% fail to survive beyond their initial growing season, making them annuals. By the third season, 99.9% of the plants in a given cohort have died. Thus only a few plants survive to become short-lived perennials.

The 2004-05 season began with heavy rainfall in late October that continued at regular intervals through the winter. Germination began within days and continued

unabated for weeks. By March there were twice as many plants as in 2001. Nearly two-thirds of these first-year plants flowered. In addition, the 1200 survivors from previous years produced copious amounts of seeds. It was a banner year for Peirson's milkvetch.

By comparing rainfall events with germination, we can easily see how storms influence germination. We find that summer rains may enhance survival, but there is no germination during the hot time of year. This is a good survival strategy, as seedlings adapted for cool season growth would never make it in summer. By mid-October the weather is usually cool enough for successful germination. In spring, rains occurring after mid-April do not result in any germination. Figure 2 shows the relationship between rainfall and germination between 2002 and 2005.

Obviously, dormant seeds must be available in the sand to germinate quickly when conditions are right. We conducted studies of the seed bank in 2001-02 and 2005-06. By pushing frames into the sand, scooping it out, and running it through a soil sieve we were able to capture and count the seeds in a known volume of sand. We extrapolated these counts to determine the number of seeds at a site and in all of our sites. Both times, the numbers came out between 2.3 and 3 million seeds and were statistically identical. The seed bank appears to be a much more constant measure of size and status of the population than living plants.

There is an important lesson here for those who study the status of rare short-lived plants in arid climates: you must study the seed bank to determine the true health of the species. The vagaries of weather events result in tremendous variation in the number of living plants from year to year, while the seed bank provides a more consistent and accurate measure of the status of the species.

Peirson's milkvetch provides an excellent opportunity to gain insight into the interface among biology, management, politics, and litigation. All play a role in the ongoing saga of this species, and all are likely to be invoked in the decision-making process in any situation where controversy or conflicting interests arise in the management of rare plants and their habitat.

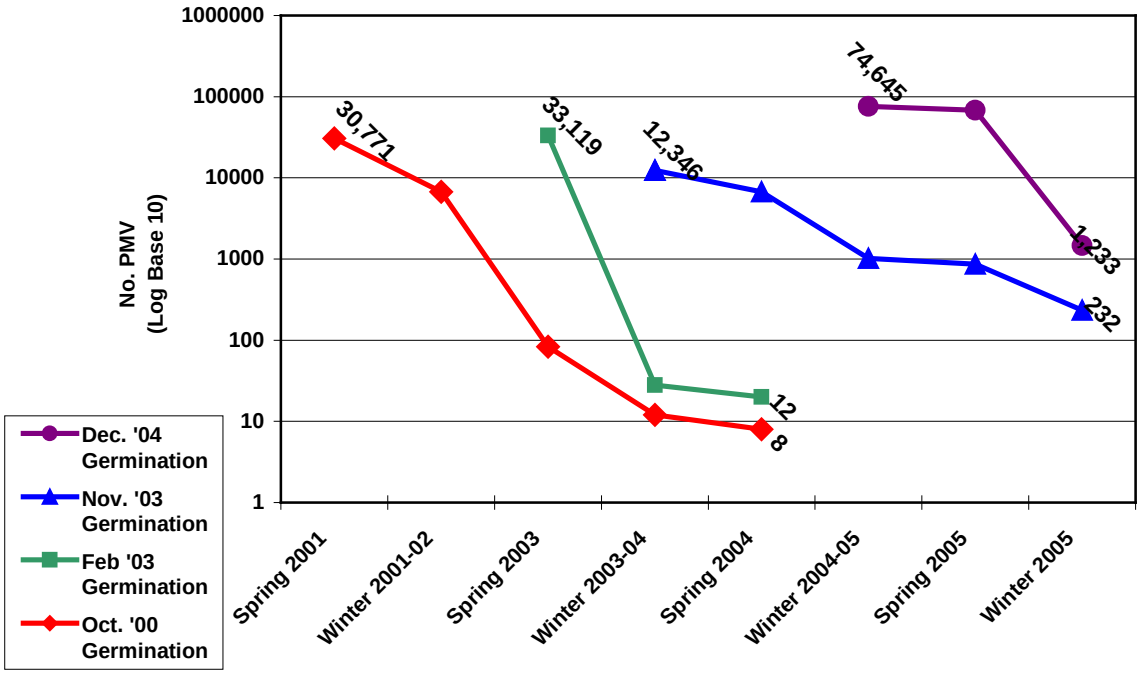

Figure 1. Yearly counts of Peirson's milkvetch cohorts at 25 sites in the Algodones Dunes. Vertical axis is on a log-base 10 scale. Maximum age of 99.9% of plants is about 3 years.

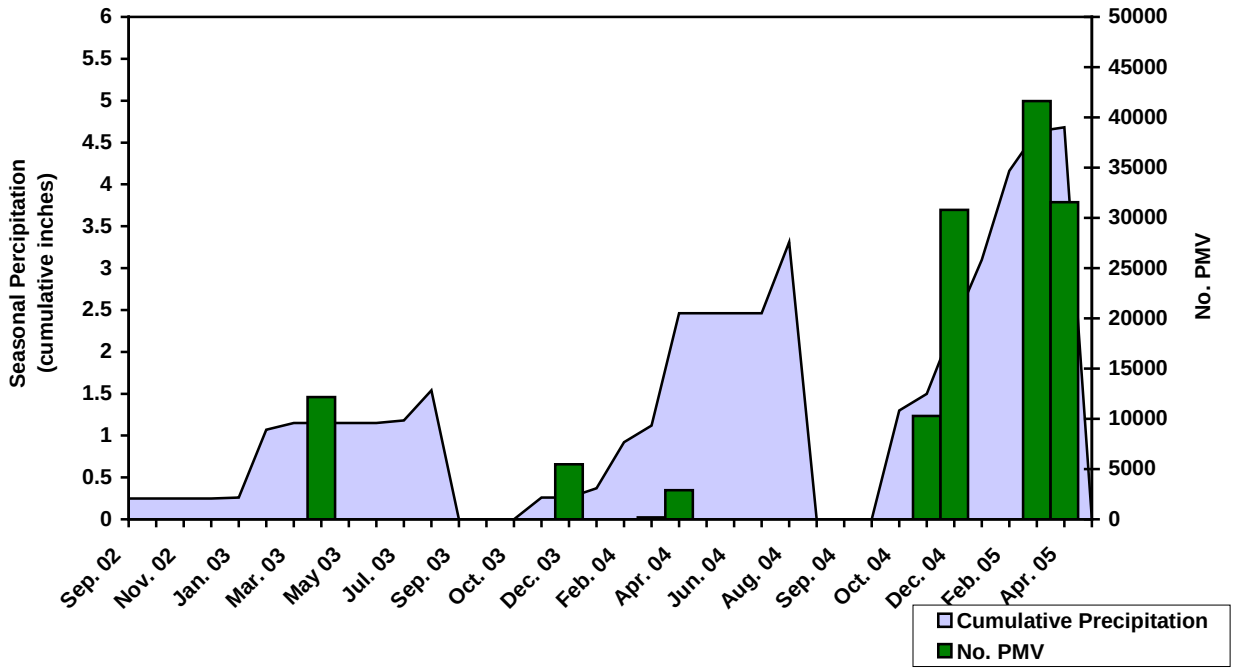

Figure 2. Relationship between precipitation and Person's milkvetch germination. Precipitation graphs are cumulative for the year, reset on October 1. Steep slopes indicate precipitation events, while plateaus are dry periods.

Figure 2.