

PRAIRIE RESEARCH UPDATE

Fire & Feast

The Western Red Lily

By Bonnie Lawrence
and Anna Leighton



Lawrence, Bonnie and Anna Leighton (1999). Fire and Feast: The western red lily. *The Gardener for the Prairies*, Winter 1999, 34-36.

What is the relationship between a vole preparing for winter, a grass fire, and the number of wild lilies you're likely to see one or four years hence?

The Western Red Lily Project is seeking answers to these questions. It began with the simple procedure of tagging flowering plants in wild populations and noting whether they set seed or not and whether they reappeared year after year.

It quickly became obvious that in order to understand this native plant we would have to observe the various vegetative forms over time, examine the growth of the plants through the growing season, and try to understand the structure and function of the underground bulb as well as that of plants started from seed and bulb scales.

We set up field plots to examine the impact of "disturbance events" such as fire and grazing, took note of other biological factors such as animals that ate the plants (and at what stage), competition from other plants, reliance on pollinators, and the importance of environmental conditions such as moisture and soil characteristics.

A Basic Biology

The western red lily (*Lilium philadelphicum*) has upright red flowers and is widely distributed in North America. Both the eastern (*philadelphicum*) and western (*andinum*) varieties of *Lilium philadelphicum*, as well as hybrids of the two, occur in Saskatchewan. Alberta has only the western variety. Manitoba has a mixture of varieties that are probably hybrids.

The two varieties can be distinguished by the arrangement of leaves on the flowering stalk. In the eastern variety, most leaves occur in whorls on the stem. In the western variety, most leaves are scattered singly along the stem, with one to three whorls at the top. The eastern variety has wider leaves, flowers that tend toward orange rather than red, and prefers woods and clearings within woods, earning it the

common names wood lily and red-orange lily.

The western variety has even more common names: western red lily, prairie lily, wood lily, and tiger lily. It also occurs in woods but is more abundant on open prairie habitat, in moist, well-drained sites such as meadows, wetland margins, and ditches. The extensive North American distribution of *Lilium philadelphicum* is largely due to the western variety's tolerance of different habitats, including Canada's boreal forest, the western plains, the Rocky Mountains, along the railway to Churchill, Manitoba, and even coulees in Texas's Guadalupe Mountains.

This lily is a delight to find in the woods, but masses of this species in bloom on the prairie are truly impressive. Nineteenth century botanist John Macoun described lilies at the north end of Last Mountain Lake as "so abundant that they cover an acre of ground bright red." In 1859, the Earl of Southesk, an Englishman who spent that year in western Canada for "travel, sport, and adventure," compared the Saskatchewan prairie covered with blooming *Campanula rotundifolia* and *Lilium philadelphicum* to a "vast oriental carpet thrown upon the plain."

About the turn of the last century, masses of these lilies flowering in Massachusetts caught the eye of Mrs. Norman Henry, a Philadelphia lily grower, who subsequently collected and named over 20 colour varieties.

Pollination and Proliferation

The western red lily forms a walnut-sized bulb, 8 to 10 cm (several inches) beneath the soil surface. In addition to the current year's flower stalk, these bulbs consist of a resting shoot and several dozen bulb scales, many of them jointed. This species is not truly stoloniferous—the new shoot arises along side of the old one.

Lilium philadelphicum is a prolific seed producer. Six of ten pods examined in 1996 contained over 300 viable seeds each, and two had just

over 280. The remaining two contained mostly chaff, with fewer than 50 viable seeds. Plants with multiple heads have tremendous potential as seed producers. However, a plump pod from a lily with five such pods had only 144 filled seeds and 280 chaffy ones. Multiple-headed plants may not reach their full potential as seed producers because of insufficient pollination.

Pollination remains a puzzle. The western red lily is reported to be an "obligate outcrosser": each flower must receive pollen from a different flower for it to produce viable seed. Large butterflies—both swallowtails and monarchs—as well as sweat bees have been observed to carry out pollination in Michigan. In Saskatchewan, we have seen very few pollinators visiting lily flowers and wonder if this species might self-pollinate here or be apomictic (able to produce seed without pollination). Only on two occasions have we observed pollinators: both were swallowtail butterflies, which are quite common when lilies are flowering. The swallowtails knock the tips of their wings against the anthers while walking around the inside of the flower to feed at each of the three nectaries; at the next flower they visit, they knock their wings against the stigma, transferring pollen.

Seed germination, mimicking nature, requires a cold period. Placing the seeds in a freezer for six to eight weeks before sowing them in a greenhouse in December resulted in about 75 percent germination in the first several weeks after sowing. Generally, germination is spread out over many months, and some seeds seem to require complete darkness before they germinate.

It usually takes at least four years for the western red lily to flower when started from seed or bulb scales in a greenhouse and subsequently planted back into the wild. In the first year, they produce small, oval leaves less than 2.5 cm (1 in.) long; in the second, the leaves

are 5 cm (2 in.) long and strap-shaped; in the third, the plants produce an upright stem about 10 cm (4 in.) long; they may flower in the fourth year. Depending on growing conditions, each of the vegetative stages may last more than one year.

Flowers bloom at the earliest sites in mid June and at the later ones by mid July. Mature plants do not necessarily flower every year; they may revert to a vegetative form or show no growth above ground at all for a year or two. Flower production of a particular plant can increase or decrease from one year to the next, and it seems that any sequence is possible: a three-headed lily may become a single flower, a two-headed lily producing five. Or the stalk may bear a tiny, underdeveloped or aborted flower bud. These are common in some years, such as 1998, which had unusually hot, dry spring weather.

Fire

The prairie landscape was a fire-adapted environment before an extensive road system and settlement precluded natural fires. Fires probably occurred every three to five years in many grassland habitats, started by lightning or Native peoples as a means of managing herds of bison.

To study the effect of fire on wild lily populations, we established a number of research plots at the north end of Last Mountain Lake National Wildlife Area, where the Canadian Wildlife Service has been using prescribed burning since 1982. We have observed several general trends of the effect of fire on lily populations. A spring fire that removes thatch facilitates lily growth as measured by the total number of plants in the plots. There is a significant increase in the number of plants that produce a flowering bud after a spring burn. The number is also high, if not higher, the year following the burn. Seed set may be significantly higher following a burn.

One of the obvious effects of fire is a subsequent decrease in the eating

of lilies by small mammals, who have lost their protective plant litter. Vegetative regrowth is influenced by the intensity of the fire, moisture availability, and competition among plants.

Feast

The western red lily is completely edible at all stages of its growth. As the young shoots emerge in spring, they are chewed by small mammals. This phenomenon was particularly noted in 1997 when meadow vole populations peaked dramatically.

Deer target plants when the mature, coloured buds are about to or have just burst open. Other small mammals such as pocket gophers and voles may begin gathering at this time but seem to show a greater appetite for the mature, plump, but still green pods. Typically, we have found a 5 to 10 cm (2–4 in.) stalk base and a number of stalk pieces chewed to about matchstick lengths left at the base of the plant. The bulbs are harvested in the fall by the subterranean activities of pocket gophers and voles. The fragile jointed scales are often broken off and dispersed along the foraging route.

Herbivore browsing can significantly decrease seed production, but do lilies that were chewed off after they flowered reflower the following year? Our study showed that approximately 30 percent of chewed plants reappeared as flowering or aborted plants, 25 percent as clusters of plants, and 21 percent as vegetative plants. In contrast, 65 percent of flowering plants that were not chewed reappeared as flowering or aborted plants, 3 percent as clusters and 9 percent as vegetative plants.

In the fall of 1993, at one of our study sites east of Saskatoon, a pocket gopher tunnelled extensively throughout a plot of tagged lilies. In 1994, none of the tagged lilies flowered again, although other flowering lilies did appear in the plot. By 1995, there was an explosion of vegetative and small flowering

lilies, with density per square meter increasing from 1 in 1994 to 7.3 in 1995. Four years later we are still tagging new plants in this plot. The effect of the disturbance by tunnelling thus appears to be a tremendous production of young plants. We speculate that the pocket gopher, in the process of eating and transporting the bulbs underground, managed to detach and disperse bulb scales that, once separated from the main bulb, grew into new plants. These same small mammals that dine on lily buds and pods also have a role as gardeners.

What can be concluded about the effects of fire and small mammals on reproduction within wild lily populations? Fire is important for maintaining genetic diversity through release of dormant bulbs and enhancing seed set by lowering competition with other plants and removing cover for small mammals. Sexual reproduction by cross-pollination is very critical to maintaining species diversity within a population. Small mammal activity is important in dispersing vegetative propagules and stimulating production of clusters of young plants by chewing. Conversely, eating flowering stalks also decreases the number of potential seeds available for future population regeneration and therefore acts against genetic diversity.

The Western Red Lily Project has received funding from Nature Saskatchewan, Friends of the Environment, and the Saskatchewan Heritage Foundation. The University of Saskatchewan and the Canadian Wildlife Service (Last Mountain Lake National Wildlife Area) provide logistical support.

Bonnie Lawrence is a biologist who lives and gardens east of Saskatoon. Curiosity about the abundance and distribution of the wild lilies that grow on the family homestead initiated this study.

Anna Leighton is a plant taxonomist with an interest in wildflower ecology.