CHROMOSOME COUNTS IN SECTION *SIMIOLUS* OF THE GENUS *MIMULUS* (SCROPHULARIACEAE). XI. *M. GLABRATUS* COMPLEX (Cont.)

ROBERT K. VICKERY, JR., FAHIMA RAHMAN, STEVEN R. PACK, and THONG MAC
Department of Biology, University of Utah, Salt Lake City, UT 84112

ABSTRACT

Chromosome counts of $n=15$ were obtained for 5 populations of *Mimulus glabratus* subsp. *fremontii* from southern Canada, central United States and northern Mexico. A count of $n=15$ was obtained for *M. glabratus* subsp. *michiganensis,* a taxon in Category 2 on the Endangered Species list. Counts of $n=31$ were obtained for 5 populations of *M. g.* subsp. *glabratus* from Colombia. A count of $n=46$ was obtained for 1 population of *M. andicolus* from northern Argentina. Counts of $n=46$ were obtained for 9 populations from the eastern slopes of the Andes and 1 population from the western slope—all belonging to *M. pilosiusculus.* The results filled in geographic gaps in the *M. glabratus* complex's north-to-south, mixoploid chromosome series of $n=15 \rightarrow n=30 \rightarrow n=31 \rightarrow n=46$.

RESUMEN

Recuentos de cromosomas de $n=15$ se obtuvieron de 5 poblaciones de *Mimulus glabratus* subsp. *fremontii* del sur de Canadá, el centro de los E.E.U.U., y el norte de México. Un recuento de $n=15$ se obtuvo de *M. glabratus* subsp. *michiganensis,* un taxón en la Categoria 2 de la lista de Especies Peligradas. Recuentos de $n=31$ se obtuvieron de 5 poblaciones de *M. g.* subsp. *glabratus* de Colombia. Un recuento de $n=46$ se obtuvo de un población de *M. andicolus* del norte de Argentina. Recuentos de $n=46$ se obtuvieron de 9 poblaciones de las laderas orientales de los Andes y 1 población de la ladera occidental—todas ellas perteneciendo a *M. pilosiusculus.* Los resultados rellenan los vacios geográficos del complejo de norte a sur en la serie mixoploide de cromosomas de $n=15 \rightarrow n=30 \rightarrow n=31 \rightarrow n=46$.

The *Mimulus glabratus* complex appears to have evolved by wave after wave of adaptive radiations starting from the genus' California center of diversity (Grant 1924), that is, from the probable center of origin (Vavilov 1949/50), and spreading east to Quebec and south to Patagonia (Vickery 1978). The diploids, $n=15$, occur inland in North America from southern Canada to central Mexico. The eutetraploids, $n=30$, are found in the Rio Grande drainage of Texas whereas the aneuploid tetraploids, $n=31$, occur from western Mexico south into Guatemala and then again in the highlands of Colombia. The hexaploids, $n=46$, range from Ecuador south along both sides of the Andes to the Río Santa Cruz, Argentina, that is, almost to Tierra del Fuego. There are some large gaps in our knowledge of these chromosome numbers. The purpose of this research is to im-

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prove our knowledge of the distribution of chromosome numbers by improving our sampling of this widespread complex with its vast, 10,000 km north to south, Western Hemisphere range.

Materials and Methods

A living collection of 22 study populations was assembled in the University of Utah greenhouse. The plants were propagated from seeds collected by the senior author or his collaborators (Table 1). Chromosome counts were made from various stages of microsporogenesis using standard aceto-carmine squash methods as previously described (Vickery et al. 1985). Twenty or more cells were studied from an average of 4 plants of each population. Representative cells were recorded with sketches or camera lucida drawings.

Results and Discussion

At the diploid level, counts of $n=15$ were obtained for 5 widely scattered populations of *M. glabratus* subsp. *fremontii.* They ranged from southern Canada to northern Mexico. Two of the populations, culture numbers *7706* from Epoufette, Upper Peninsula, Michigan, and *10226* from near Amos, western Quebec, had been thought to belong to *M. glabratus* subsp. *michiganensis,* chiefly on geographic grounds. However, they were found to belong to the widespread, polymorphic subsp. *fremontii* instead when grown beside and compared to authentic material of subsp. *michiganensis* kindly sent to us by Margaret Bliss. *Mimulus glabratus* subsp. *michiganensis* is a Category 2 candidate for listing as endangered or threatened under the Endangered Species Act (Fish and Wildlife Service, 1985).

True *M. glabratus* subsp. *michiganensis* (Pennell 1935; Fassett 1939) has larger flowers (18–22 mm long vs. 6–12 mm long) than does subsp. *fremontii.* Also, it has longer pistils (12–20 mm vs. 5–9 mm) and ovaries (8.5–11 mm vs. 3.5–5.5 mm) than subsp. *fremontii* according to Bliss (1986). However, it has $n=15$ chromosomes as does subsp. *fremontii* and subsp. *utahensis* (Table 1).

At the tetraploid level, 5 populations representative of the Colombian geographic race (Table 1) were found to be aneuploid tetraploids with $n=31$ chromosomes like the Guatemalan and Mexican aneuploid tetraploid races. The Colombian aneuploid tetraploids mark the southernmost adaptive radiation of *M. glabratus* subsp. *glabratus* as well as the successful crossing of the tropics of Panama into northern South America.

At the hexaploid level, an $n=46$ chromosome count was obtained for a population of *M. andicolus* from northern Argentina, the center of distribution of that species. Also, $n=46$ chromosome counts were obtained for 9 populations from along the eastern slope of the Andes

TABLE 1. CHROMOSOME COUNTS IN THE *MIMULUS GLABRATUS* COMPLEX OF RELATED SPECIES AND VARIETIES. All populations, except as noted, were collected by R. K. Vickery, Jr., and grown under his culture numbers. Vouchers are in the Garrett Herbarium of the University of Utah (UT).

Mimulus andicolus Kunth. $n = 46$—ARGENTINA: Jujuy, Río Xibi Xibi near Jujuy, culture *11080* (*Lois Arnow* 3635, Oct 1971).

Mimulus glabratus Kunth subsp. *fremontii* (Benth.) A. L. Grant. $n = 15$—MEXICO: Chihuahua, Coyamé, culture *12186*; Temosachic, culture *12191*; USA: Oklahoma, Boiling Springs, culture *7132*; Michigan, Epoufette, culture *7706*; CANADA: Québec, d'Abitibi-Est near Amos, culture *10226* (*A. Asselin et al. s.n.*, 1 Sep 1969).

Mimulus glabratus subsp. *michiganensis* Pennell. $n = 15$—USA: Michigan, Emmet Co., Maple River near Pellston, culture *13263* (*Margaret Bliss s.n.*, Aug 1982).

Mimulus glabratus subsp. *glabratus*. $n = 31$—COLOMBIA: Cundinamarca, Casa Bolivar at edge of Bogotá, culture *11447*; Boyaca, La Capilla near Bucaramonga, culture *13020*; Tibosas near Duitama, culture *13024*; edge of Sagamosa, culture *13025*; Crest of Sagamosa grade, culture *13032*.

Mimulus pilosiusculus Kunth. $n = 46$—BOLIVIA: La Paz, 3 km S of La Paz by La Paz–Oruro highway, culture *11434*; at km 160 along La Paz–Oruro highway, culture *11435*; by Oruro–Cochabamba highway near Caihuasi, culture *11436*; beside Oruro–Cochabamba highway near Challa, culture *11437*; by Oruro–Cochabamba highway, near Sayari, culture *11439*; ARGENTINA: Tucuman, gap in the Tropical Forest along Tucuman–Tafí del Valle highway, culture *13034*; Mendoza, Uspallata in the Mendoza Canyon, culture *13045*; Mina Huemul N of Bardas Blancas, culture *13046*; Río Negro, Lago Gutierrez, culture *13065*; PERU: Arequipa, Hipíco-Militar at Chilina, culture *13072*.

from the alto plano of Bolivia to southern Argentina. In addition, the western Andes population from Arequipa, Peru was found to be a hexaploid, $n=46$. Previous work had suggested to us that the eastern and western Andes populations were partially separated by reproductive isolation taking the form of lower interpopulation seed sets in crosses between the two races (Vickery 1978). Due to the variability and plasticity of these plants (monkey flowers, or *mozzos* as they are called in Bolivia, or *berros* as in Argentina and Mexico), we found it difficult if not impossible to distinguish the eastern and western Andes races morphologically. Therefore, we are taking the conservative approach and are using the older name, *M. pilosiusculus* Kunth (Humboldt et al. 1817) for both races rather than a newer name such as *M. parviflorus* Lindl. or *M. glabratus* var. *parviflorus* (Lindl.) A. L. Grant for one of them as do Reiche (1911) and Grant (1924).

These additional chromosome counts revealed no surprises such as other aneuploids or octoploids. The counts filled in significant gaps, specifically in the Great Lakes area, Colombia, and the eastern Andes in the sampling of the *M. glabratus* complex. These new counts nicely corroborate the unusual, north-to-south mixoploid series of races—$n=15 \rightarrow 30 \rightarrow 31 \rightarrow 46$ (Vickery 1978; Vickery et al. 1985).

Acknowledgments

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NOTEWORTHY COLLECTIONS

Washington

Heribaudiella fluviatilis (Areschoug) Svedelius (Phaeophyta, Ectocarpales, Lithodermataceae). Chelan Co., between mileposts 184 and 185 on Hwy 97 (47°22′N, 120°38′W) in Peshastin Creek, 12 Aug 1989, abundant as discoid to irregular crusts, 100–150 μm thick and 0.5–30 cm diam. on large rocks in fast flowing water (13°C) that was partially shaded, *West s.n.* (UC).

Significance. Brown algae are relatively rare in freshwater habitats. *Heribaudiella fluviatilis* was known previously in Europe, China, Japan, British Columbia, and one locality at Nighthawk, Washington on the Similkameen River, 200 km N of the Peshastin Creek site (Wehr and Stein. J. Phycol. 21:81–92, 1985).—John A. West, Department of Plant Biology, University of California, Berkeley, CA 94720.