

**RHODORA**  
**Journal of the**  
**NEW ENGLAND BOTANICAL CLUB**

**Vol. 89**

**October 1987**

**No. 860**

**CHROMOSOME NUMBERS FROM THE FLORA OF THE  
JUAN FERNANDEZ ISLANDS. II.**

DAVID M. SPOONER, TOD F. STUESSY, DANIEL J. CRAWFORD,  
AND MARIO SILVA O.

**ABSTRACT**

Eighteen chromosome counts are reported from populations in 12 species from the Juan Fernandez Islands, Chile, plus three counts from taxa of the adjacent mainland. First reports are given for *Lobelia tupa* ( $n = 21$ ), *Wahlenbergia masafueriae* ( $n = \text{ca. } 11$ ), and *Raphithamnus spinosus* ( $n = \text{ca. } 18$ ). These data help extend chromosomal information for endemic taxa of the archipelago as part of broad evolutionary studies on the origin and development of its vascular flora.

**Key Words:** chromosome numbers, Juan Fernandez Islands, evolution

**INTRODUCTION**

The Juan Fernandez Islands, located 360 mi W of continental Chile, contain an unusual assemblage of angiosperms of which 69% are endemic (Skottsberg, 1922). Eighteen percent of the genera are also found only in the archipelago, as is one family, the Lactoridaceae (Lammers et al., 1986). Since the discovery of the islands more than 400 years ago, a number of additional angiosperm species has also been introduced there, and the number of weedy taxa now equals that of the native flora (Skottsberg, 1922; Sanders et al., 1982).

Current investigations on the angiosperm flora of the Juan Fernandez Islands have focused on their patterns and processes of evolution (e.g., Stuessy et al., 1984). An important aspect of such studies is to determine chromosomal divergence during speciation. Toward this end, cytological material has been collected routinely during two previous expeditions to the islands in 1980. Results from these collections already have been published (Sanders et al., 1983). During a more recent expedition to the archipelago in 1984, additional

bud materials for cytological analysis were collected whenever possible. Analyses of these new collections have yielded the results reported here.

#### MATERIALS AND METHODS

Materials and methods used in this study are the same as those described by Sanders et al. (1983). Either Snow's stain (Snow, 1963) or acetocarmine were used. Vouchers are on deposit in OS, with duplicates in CONC.

#### RESULTS

The 18 new chromosome counts for taxa of the Juan Fernandez Islands, plus three from taxa of continental Chile, are listed in Table 1. First reports are from *Lobelia tupa*, *Wahlenbergia masafueriae* (both Campanulaceae), and *Raphithamnus spinosus* (Verbenaceae). Other counts confirm previously reported numbers and give cytological information for other conspecific populations in the archipelago. It is most important to document additional populations to determine cytological constancy within taxa before reaching conclusions on evolutionary modes (e.g., Stuessy, 1971). The circa reports are accurate to plus or minus one chromosome. Extreme rarity of some of the taxa precludes the availability of additional material for more extensive examination and perhaps definitive verification.

#### DISCUSSION

Of the taxa reported chromosomally in this study (Table 1), three groups of species exist: (1) endemics, (2) natives, and (3) introduced weeds. Most of the taxa counted chromosomally here are endemics. The only apparently native taxon, so judged by its common occurrence in the higher elevation forests on Masatierra and Masafuera plus being found also on continental Chile, is *Peperomia fernandeziana* (Skottsberg, 1922). *Conium maculatum*, *Galium aparine*, and *Lobelia tupa* are introductions. The former two are originally from the Mediterranean region and from Eurasia, respectively, and the latter is from mainland Chile. Two of the collections reported here chromosomally of *Lobelia tupa*, in fact, have come from the adjacent continent. Detailed comments in this paper focus on taxa reported for the first time. General statements on numbers of species counted within genera and their chromosomal data come from the standard chromosomal indexes (Darlington and Wylie, 1955; Cave, 1958-65; Ornduff, 1967-69; Federov, 1969; Moore, 1970-77; Goldblatt, 1981-85).



The count of  $n = 27$  for *Erigeron* cf. *rupicola* is interesting because of the unusual morphology of the voucher material from which the count was made. The number  $n = 27$  is known (Sanders et al., 1983) from *E. fernandezianus* and *E. rupicola*, both endemic species of the archipelago. This unusual collection was obtained on Masafuera from above 200 m in Quebrada Casas in a zone of natural vegetation. The leaves are larger than in *E. rupicola* and slightly dentate toward the apex, whereas in *E. rupicola* they are smaller and entire. Although our voucher has old receptacles only, it clearly has few flowering heads, similar to the condition commonly found in *E. rupicola* and quite different from that of *E. fernandezianus*, *E. luteoviridis* Skottsbo. and *E. ingae* Skottsbo., also known on Masafuera. A better understanding of the biological significance of this voucher material will have to await completion of cladistic and phenetic studies now underway by Mr. Hugo Valdebenito in our laboratory.

*Lobelia tupa* belongs to a complex of seven species endemic to mainland Chile, which were treated by Wimmer (1953) as an unnamed series within subg. *Tupa* sect. *Tupa*. Our determination of  $n = 21$  is the first count for the complex\*, and is the first report of the hexaploid level in sect. *Tupa*. Six of the 69 species of this section have been counted as  $n = 7$  and  $n = 14$ . Other hexaploid counts are known from subg. *Lobelia* sect. *Lobelia* (Bowden, 1959) and subg. *Tupa* sect. *Isolobus* (Lee, 1972).

The first report of  $n = \text{ca. } 11$  for *Wahlenbergia masafuerae* is significant. Five species of the genus are endemic in the archipelago with four of them restricted to Masatierra. *Wahlenbergia fernandeziana* was counted earlier (Sanders et al., 1982) as  $n = 11$ , as well as again here, but the other three taxa on Masatierra (*W. berteroi* H. & A., *W. grahamae* Hemsl., and *W. larraini* [Bert. ex Colla] A. DC.) have not yet been counted. The first count for *W. masafuerae* is for the only endemic species on the younger island, Masafuera.

---

\*Note added in proof: No chromosome count is listed for *Lobelia tupa* in any of the available indexes. However, in the course of monographic studies on Lobelioideae in our laboratory by Mr. Thomas Lammers, an incidental mention of a count for *L. tupa* of  $2n = 42$  was discovered in Mabberley (1974, Kew Bull. 29: 554) with neither voucher citation nor literature reference. In examining Fedorov (1969) once more, a citation (1927, Vilmorin and Simonet, Compt. Rend. Soc. Biol. Paris 96: 166) is listed for *L. trapa* L., which is now known to be an orthographic variant of *L. tupa* (Wimmer, 1953; T. Lammers, pers. comm.). In this early paper an  $n = 21$  count is given for this taxon, and our meiotic count therefore confirms this report.

Table 1. Chromosome numbers of taxa from the Juan Fernandez Islands and adjacent mainland Chile.

Taxon	Gametic chromosome number <sup>a</sup>	Voucher <sup>b</sup>
<b>APIACEAE</b>		
<i>Conium maculatum</i> L.	11	MASATIERRA: Pangal Gorge, SCRL 6204.
<b>ASTERACEAE</b>		
<i>Dendroseris neriifolia</i> (Dcne.) H. & A.	18	MASATIERRA: up main valley from Puerto Frances, SCVL 6624, VL 6661; La Pascua, at S end of island, SC 6655.
<i>Erigeron fernandezianus</i> (Colla) Solbrig	27	MASATIERRA: trail from Mirador Selkirk to Valle Villagra, SCPVRL 6238, V 6542.
<i>Erigeron</i> cf. <i>rupicola</i> Phil.	27	MASAFUERA: Quebrada Las Casas, PR 6401
<i>Gnaphalium viravira</i> Mol	14	MAINLAND CHILE: CONCEPCIÓN: San Pedro, near Concepción, SCPL 6697.
<b>CAMPANULACEAE</b>		
* <i>Lobelia tupa</i> L.	21	MASATIERRA: path to Quebrada Pangal, SCRL 6200.
	ca. 21	MASATIERRA: path from La Hosteria to San Juan Bautista, SC 6310; MAINLAND CHILE: CONCEPCIÓN: San Pedro, near Concepción, SCPL 6681.
<i>Wahlenbergia fernandeziana</i> Skottsbo.	11	MASATIERRA: path from Mirador Selkirk to Valle Villagra, SC 6489.
* <i>Wahlenbergia masafuerae</i> (Phil.) Skottsbo.	ca. 11	MASAFUERA: Quebrada Las Casas, PR 6408.
<b>FLACOURTIACEAE</b>		
<i>Azara serrata</i> R. & P. var. <i>fernandeziana</i> (Gay) Reiche	9	MASATIERRA: path from Mirador Selkirk to Valle Villagra, SC 6485.
<b>PIPERACEAE</b>		
<i>Peperomia berteriana</i> Miq.	ca. 22	MASATIERRA: Valle Villagra, LRV 6527; Valle Ingles, SCVL 6550.
<i>Peperomia fernandeziana</i> Miq.	23 + 2	MASATIERRA: path from Valle Villagra to Mirador Selkirk, SC 6498.

Table 1. (Continued.)

Taxon	Gametic chromosome number <sup>a</sup>	Voucher <sup>b</sup>
	ca. 22	MASATIERRA: Valle Ingles, SC 6579.
<i>Peperomia skottsbergii</i> C. DC.	ca. 23	MASAFUERA: Quebrada Las Casas, PR 6399.
RUBIACEAE		
<i>Galium aparine</i> L.	32	MASAFUERA: Quebrada Las Casas, PR 6394.
VERBENACEAE		
* <i>Rhaphithamnus spinosus</i> (A. Juss.) Moldenke	ca. 18	MAINLAND CHILE: CON- CEPCIÓN: 7.7 km E of Fundo San José, SCPL 6699.

<sup>a</sup>All bivalents<sup>b</sup>C = Crawford; L = Landero; P = Pacheco; R = Ruiz; S = Stuessy;  
V = Valdebenito.

\*First report for the taxon

This finding indicates that there has been little or no change in chromosome number in the evolution of this species from relatives on the older island.

*Raphithamnus* is a genus of only two species, with one taxon (*R. spinosus*) in central and southern Chile, and the other (*R. venustus* (Phil.) Skotts.) in the Juan Fernandez Islands on Masatierra and Masafuera. Because of the young age of the archipelago and the occurrence of generic relatives in the Neotropics (such as *Citharexylum* L.), it is almost certain that *R. venustus* evolved from the former (or at least from a taxon similar to it). The previous count of  $n = \text{ca. } 18$  for *R. venustus* (Sanders et al., 1982) and now  $n = \text{ca. } 18$  for *R. spinosus* indicates that there apparently has been no change in chromosome number in the evolution of the island taxon from that on the mainland. This idea was first suggested by Sanders et al. (1983), and is supported by this new count.

## ACKNOWLEDGMENTS

We are pleased to acknowledge: CONAF of Chile for permission to collect in the Juan Fernandez archipelago and for facilitating our work generally; Gaston Gonzalez, former Chief of the Robinson Crusoe National Park, for his help, support, and kindness during our field studies there; Thomas Lammers for helpful information on



*Lobelia tupa* and its relatives; the National Science Foundation for support to TFS and DJC under grant BSR-8306436; and to CONICYT of Chile, OEA, and the Universidad de Concepción, for support to MSO.

## LITERATURE CITED

- BOWDEN, W. M. 1959. Phylogenetic relationships of twenty-one species of *Lobelia* L. section *Lobelia*. Bull. Torrey Bot. Club. 86: 94-108.
- CAVE, M. S., Ed. 1958-1965. Index to plant chromosome numbers, 1956-1964 & Suppl. Univ. North Carolina Press, Chapel Hill.
- DARLINGTON, C. D., AND A. P. WYLIE. 1955. Chromosome Atlas of Flowering Plants, ed. 2, George Allen and Unwin, Ltd., London.
- FEDEROV, A. A., Ed. 1969. Khromosomnye chisla tsvetkovykh rasteny [Chromosome numbers of flowering plants]. Acad. Sci. U.S.S.R., Leningrad.
- GOLDBLATT, P. 1981-1985. Index to plant chromosome numbers 1975-1983. Missouri Botanical Garden, St. Louis.
- LAMMERS, T. G., T. F. STUESSY, AND M. SILVA O. 1986. Systematic relationships of the Lactoridaceae, an endemic family of the Juan Fernandez Islands, Chile. Pl. Syst. Evol. 152: 243-266.
- LEE, Y. N. 1972. Chromosome numbers of flowering plants in Korea (4). J. Korean Res. Inst. Better Living 8: 41-51.
- MOORE, R. J., Ed. 1970-1977. Index to plant chromosome numbers for 1968-1974. Regnum Veg. 68: 1-115; 77: 1-112; 84: 1-134; 91: 1-108; 96: 1-257.
- ORNDUFF, R., Ed. 1967-1969. Index to plant chromosome numbers for 1965-1967. Regnum Veg. 50: 1-128; 55: 1-126; 59: 1-129.
- SANDERS, R. W., T. F. STUESSY, AND C. MARTICORENA. 1982. Recent changes in the flora of the Juan Fernandez Islands, Chile. Taxon 31: 284-289.
- , T. F. STUESSY, AND R. RODRIGUEZ. 1983. Chromosome numbers from the flora of the Juan Fernandez Islands. Amer. J. Bot. 70: 799-810.
- SKOTTSBERG, C. 1922. The phanerogams of the Juan Fernandez Islands. Nat. Hist. Juan Fernandez and Easter Is. 2: 95-240.
- SNOW, R. 1963. Alcoholic hydrochloric acid-carmin as a stain for chromosomes in squash preparations. Stain Tech. 38: 9-13.
- STUESSY, T. F. 1971. Chromosome numbers and phylogeny in *Melampodium* (Compositae). Amer. J. Bot. 58: 732-736.
- , R. W. SANDERS, AND M. SILVA. 1984. Phytogeography and evolution of the flora of the Juan Fernandez Islands: a progress report. 59-69. In: F. J. Radvosky, P. H. Raven, and S. H. Sohmer, Eds. Biogeography of the Tropical Pacific. Assoc. Syst. Coll. and B. P. Bishop Museum; Lawrence, Kansas.
- WIMMER, F. E. 1953. Campanulaceae-Lobelioideae. II. Pflanzenr. IV. 276b (107): 261-813.

D.M.S., T. F. S. AND D. J. C.  
DEPARTMENT OF BOTANY  
THE OHIO STATE UNIVERSITY  
COLUMBUS, OHIO 43210

M. S. O.  
DEPARTAMENTO DE BOTÁNICA  
UNIVERSIDAD DE CONCEPCIÓN  
CONCEPCIÓN, CHILE