

### Distribution of Diploid and Tetraploid Species of Gray Tree Frogs (*Hyla chrysoscelis* and *Hyla versicolor*) in Kansas

**ABSTRACT:** Cytological identification of diploid and tetraploid members of the *Hyla versicolor* complex from throughout the range of these frogs in Kansas revealed the presence of both *H. chrysoscelis* ( $2n = 24$ ) and *H. versicolor* ( $4n = 48$ ). The diploid species, *H. chrysoscelis*, is found throughout the eastern third of the state. The tetraploid species, *H. versicolor*, is sympatric with *H. chrysoscelis* along the eastern border of Kansas (roughly the area of eastern hardwood forests) and penetrates westward along two forested river bottoms (Kansas and Marais des Cygnes rivers). In addition, isolated populations of *H. versicolor* are found in the forested Chautauqua Hills of Elk and Greenwood counties, approximately 150 km W of the closest known populations of this species.

#### INTRODUCTION

Sound spectrographic analyses of gray tree frogs by Blair (1958) demonstrated two distinct call types within the nominal species *Hyla versicolor*. Progeny of experimental crosses between the call types had greatly increased mortality compared to crosses within a call type, which led to the recognition of two distinct species, *H. versicolor* and *H. chrysoscelis* (Johnson, 1959, 1963; Ralin, 1968). Subsequently, it has been demonstrated that *H. versicolor* is tetraploid ( $4n = 48$ ), whereas *H. chrysoscelis* is diploid ( $2n = 24$ ) (Wasserman, 1970), thus confirming the existence of two species.

Morphological differentiation between the two species of gray tree frogs generally is insufficient for specific identifications, although statistically significant differences in size, shape and several adult pattern characteristics exist (Jaslow and Vogt, 1977; Ralin and Rogers, 1979). As a result, information on the distribution of *Hyla versicolor* and *H. chrysoscelis* has been slow to accumulate. Ralin (1968, 1977) presented a map of the distributions of these species showing them to be essentially parapatric throughout eastern and central North America. This map has been greatly modified by Jaslow and Vogt (1977), Gerhardt (1978), Bogart and Jaslow (1979) and Bogart (1980), and it is now evident that *H. versicolor* and *H. chrysoscelis* are sympatric over a large portion of E-central North America.

Gray tree frogs range westward to the forest-grassland ecotone along the eastern border of the Great Plains, although the distribution of the two species remains largely unresolved in this area. In Kansas, *Hyla versicolor* and/or *H. chrysoscelis* have been recorded from throughout the eastern third of the state (Collins, 1982), although specific identifications are unavailable. Ralin (1968, 1977) indicated that *H. versicolor* was restricted to the southeastern corner of Kansas and that *H. chrysoscelis* was found elsewhere in the state. Bogart (1980) plotted three records for *H. versicolor* along the eastern border of Kansas and five records of *H. chrysoscelis* in northern Kansas, thereby indicating a different pattern of distribution of these species than that reported by Ralin (1968, 1977) for this area. We undertook the present study in order to clarify the distribution of *H. versicolor* and *H. chrysoscelis* in the zone of contact in Kansas.

#### MATERIALS AND METHODS

Gray tree frogs were collected throughout the known range of the species complex in Kansas. All specimens were identified by cytological examination. Mitotic metaphase chromosome preparations were obtained from either culture of leucocytes (Hungerford, 1965) or acetic acid squashes of intestinal tissue. Meiotic bivalent preparations were obtained from acetic acid squashes of testes. In addition, 25 preserved museum specimens were examined for cell size and nucleoli number by the technique of Fernandez-Gomez *et al.* (1969), as described by Cash and Bogart (1978). Voucher specimens were deposited in the herpetological collections of the Museum of Natural History, University of Kansas. Voucher numbers of specimens examined are given in Appendix I.

#### RESULTS

Examination of mitotic preparations revealed the expected chromosome complements of  $4n = 48$  for *Hyla versicolor* and  $2n = 24$  for *H. chrysoscelis*. Karyotypes did not differ significantly from those published by Bogart and Wasserman (1972). Specimens of *H. chrysoscelis* exhibited the expected number of meiotic bivalents (12). However, as noted by Bogart and Wasserman (1972) and Danzmann and Bogart (1982), some quadrivalents form during meiosis in *H. versi-*

color, thereby reducing the number of pairings observed from the expected bivalent count of 24. However, meiotic preparations of *H. versicolor* were easily distinguishable from those of *H. chrysoscelis* as specimens of the former always exhibited at least 20 bivalents plus quadrivalents, whereas specimens of the latter always exhibited 12 bivalents.

Cytological identifications were obtained for 108 specimens of gray tree frogs from 54 localities in Kansas (Appendix I). These localities are located throughout the combined ranges of *Hyla chrysoscelis* and *H. versicolor* in Kansas (Collins, 1982). Of the 108 specimens, 85 were *H. chrysoscelis* and 23 were *H. versicolor*.

*Hyla chrysoscelis* was found at 38 of the 54 localities; *H. versicolor* was found at 19 of the 54 localities (Fig. 1). The two species were collected syntopically at localities in three different counties, and were found at adjacent localities in four additional counties.

Seventy-one of 73 tree frogs collected during 1985 were found in breeding choruses. However, no differences were apparent in the breeding seasons of the two species. Choruses of *Hyla chrysoscelis* were found from 11 April to 26 June, and choruses of *H. versicolor* were found from 11 April to 22 June. The breeding season of both species peaks in late May and early June in Kansas.

#### DISCUSSION

*Hyla chrysoscelis* is distributed throughout the eastern third of Kansas, in the Cherokee Plain, Osage Cuestas, Glaciated Region and eastern portions of the Flint Hills physiographic provinces (Kuchler, 1974). In contrast, *H. versicolor* is restricted to the forested eastern border of Kansas, extending W along the wooded Kansas and Marais des Cygnes river valleys into Douglas, Franklin and Jefferson counties. The only exception to this pattern is the presence of isolated populations of *H. versicolor* from Elk and extreme southeastern Greenwood counties in the forested Chautauqua Hills region (Fig. 1).

This study reveals a markedly different pattern of distribution for *Hyla chrysoscelis* and *H. versicolor* in Kansas than has been suggested previously (Ralin, 1968, 1977). Rather than being distributed in a parapatric fashion, the two species are sympatric over a large portion of eastern Kansas. Furthermore, the range of *H. versicolor* is discontinuous in this region. The isolated populations of *H. versicolor* in the Chautauqua Hills, approximately 150 km W of the nearest known populations of this species, are enigmatic. These populations may be relics of a once

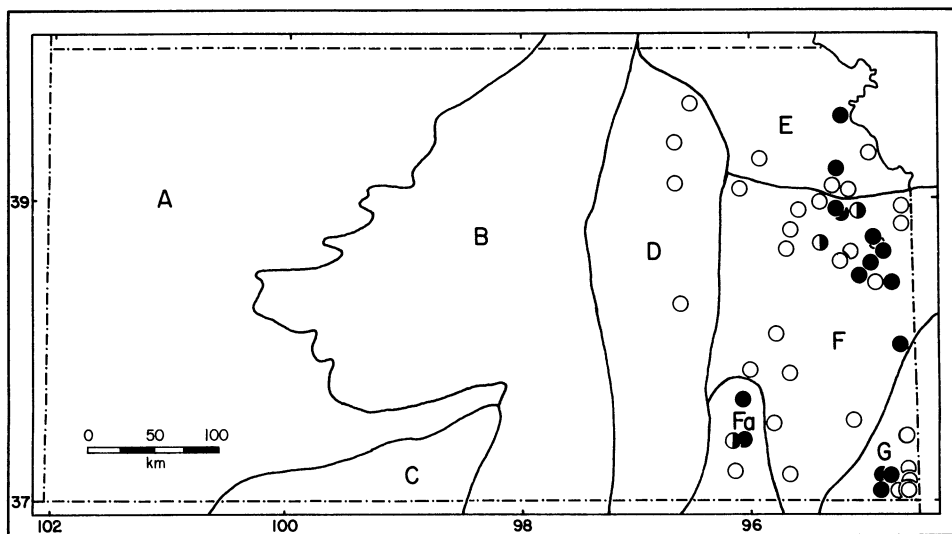


Fig. 1—Distribution of *Hyla chrysoscelis* (open circles) and *Hyla versicolor* (solid dots) in Kansas. Letters refer to the principal physiographic regions of the area (A: High Plains; B: Low Plains; C: Red Hills; D: Flint Hills; E: Glaciated Region; F: Osage Cuestas, and G: Cherokee Plain; adapted from Kuchler, 1974). F<sub>a</sub> identifies the Chautauqua Hills of the Osage Cuestas Region

larger range of *H. versicolor*. Alternatively, these populations may be the result of an independent polyploidy event. The possibility of multiple origins of tetraploidy in gray tree frogs needs investigation (Maxson *et al.*, 1977; Ralin and Selander, 1979). Isolated populations of *H. versicolor* such as those in the Chautauqua Hills are logical focal points of such investigations.

#### APPENDIX I.

Specimens examined. All localities are in Kansas and are listed alphabetically by county.

*Hyla chrysoscelis*: Chase Co.: KU 203673; Chautauqua Co.: KU 203710; Cherokee Co.: KU 33490, 203665-68, 203706-07, 203720-22; Coffey Co.: KU 203705; Crawford Co.: KU 203718-19; Douglas Co.: KU 16371, 16373-381, 203995-96, 203991-92, 203993-94, 203676-79, 203712-714; Elk Co.: KU 203711; Franklin Co.: KU 203669-671, 204038; Greenwood Co.: KU 203701; Jackson Co.: KU 203690-94; Jefferson Co.: KU 17398; Johnson Co.: KU 203723-24; Leavenworth Co.: KU 21145; Marshall Co.: KU 49182-84; Miami Co.: KU 203672, 204037; Montgomery Co.: KU 203708-09; Neosho Co.: KU 203715-17; Osage Co.: KU 17681, 203689; Pottawatomie Co.: KU 203674-75; Riley Co.: KU 203698-700; Shawnee Co.: KU 203688; Wabaunsee Co.: KU 203695-97; Wilson Co.: KU 203680-87; Woodson Co.: KU 203702-04

*Hyla versicolor*: Atchison Co.: KU 203740-41; Bourbon Co.: KU 28672; Cherokee Co.: KU 28671, 31099, 203746; Douglas Co.: KU 8122, 22013, 203745; Elk Co.: KU 203742-44; Franklin Co.: KU 203735; Greenwood Co.: KU 22931; Jefferson Co.: KU 203732-34; Miami Co.: KU 21833, 22112, 203736-39

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