The Chromosomes of Skipper Butterflies From Southwestern North America (Lepidoptera, Hesperiidae)\textsuperscript{1}

Thomas C. Emmel and Houston R. Trew

Department of Zoology, University of Florida
Gainesville, Florida 32601, U.S.A.

Received May 13, 1971

Introduction

The skipper butterflies of the families Hesperiidae and Megathymidae represent about 37 per cent of the United States butterfly fauna (713 species according to the latest list; Heitzman, manuscript), yet are poorly known karyologically. Maeki and Remington (1960) have presented chromosome counts on eleven species of Hesperiidae and three species of Megathymidae, and Freeman (1969) has published chromosome numbers for 29 species and subspecies of Megathymidae. These are the only published counts known to the authors for skipper species in North America north of the tropics. The purpose of the present paper is to report chromosome numbers and karyotypic observations for 22 additional species of Hesperiidae, subfamilies Pyrginae and Hesperiinae, from southwestern North America.

Aside from this series of skippers, we found no meiotic divisions in males of the following species from Texas: one Nastra julia (H. A. Freeman), four Achylodes thraso (Hubner), one Achilarus toxeus (Plotz), three Pyrgus philetas (Edwards), three Thorybes albosuffusa (H. A. Freeman), one Systasea pulvenulenta (R. Felder), one Oarisma edwardsii (Barnes), two Cogia hippalus (Edwards), two Cogia calcahas (Herrich-Schaffer), two Staphylus ceos (Edwards), one Atrytone logan (delaware) lagus (Edwards), one Lerodea eufala (Edwards), one Lerodea dysaules (Godman), one Heliopetes domicella (Erichson), five Urbanus procne (Plotz), four Xenophanes trixus (Stoll), three Phocides polybius lilea (Reakirt), one Atalopedes campestris (Boisduval), one Hylephila phyleus (Drury), one Copaeodes minima (Edwards), five Erynnis horatius (Scudder and Burgess), one Monca telata tyrtaeus (Plotz), and one Calpodes ethilis (Stoll).

This extensive list of specimens examined that lacked dividing cells emphasizes the fact that spermatogenesis is essentially completed or being completed in most hesperiids at the time of eclosion. Wild-caught adult material is commonly not fresh enough to find meiosis. Many of our successful observations were made on specimens whose testes were fixed shortly after eclosion from the pupa.

Material and methods

All material studied in this report was collected by Roy O. Kendall (San Antonio, Texas) in the southern half of the State of Texas, including areas immedi-

\textsuperscript{1} This research has been supported by the National Science Foundation (Grant GB-8442).
ately adjacent to Mexico. Testes of wild-caught males or males reared from pupae were fixed in 3:1 alcohol:acetic acid and stored at -20°C until processing in our Gainesville laboratory. The testes were stained with lacto-aceto-orcein, squashed, and observed under brightfield using a Carl Zeiss Research Microscope Standard WL fitted with 25×, 40×, and 100× plan-apochromatic flatfield objectives and automatic camera (refer to Emmel 1969, for further details). All available metaphase plates (usually one to ten) were counted for each individual. Supplementary observations were made under phase contrast using a Watson Photo-automatic Phase Contrast Microscope “Hilux 70 PH” fitted with 40× Planpara and 90× Fluorite phase contrast objectives and automatic camera.

Results

A. Pyrginae

1. *Chiodes catillus albofasciatus* (Hewitson). \(N=31\).
   
   Counts were made in three nuclei (I) in testes of one male taken at Santa Maria (wildlife refuge), Hidalgo Country, Texas, on 8 November 1969. Thirteen chromosomes are somewhat larger than the remainder.

   This large, long-tailed skipper occurs in southern Texas and south into the Neotropics; it is common in the Rio Grande Valley, flying in every month of the year.

2. *Achalarus casica* (Herrich-Schaffer). \(N=29\).
   
   A clear count was made in one nucleus (II) in testes of a male which emerged 28 August 1969 from a larva taken at Musquiz Canyon, Jeff Davis Co., Texas, on 7 July 1969. The chromosomes of this nucleus were not in a uniform plane of focus, and size relationships could not be determined accurately.

3. *Chiomara asychis georgina* (Reakirt). \(N=32\).
   
   Counts were made in two clear nuclei (I) and five additional nuclei (I) in testes of one male with dividing cells (one other male examined lacked meiotic figures) collected at Brownsville, Texas, on 6 November 1969. All chromosomes are notably smaller than those of the preceding species.

   This white-and-brown-patched species occurs from Texas to South America (Holland 1931).

   
   A clear count was made in one nucleus (II) in testes of one male collected at H.O. Canyon, Jeff Davis Co., Texas, on 5 July 1969. Fifteen chromosomes are larger than the remainder.

   This duskywing skipper ranges from Montana, Utah, Arizona, New Mexico, and mountains in western Texas, south through the cordilleras of Mexico and Central America to Colombia. There are at least three generations in Texas (Burns 1964). The nominate subspecies is known only from California (Burns 1964).

5. *Pyrgus albescens* (Plotz). \(N=28\).
   
   A clear count was made in one nucleus (I) in testes of a male collected in the laboratory garden at Lake Corpus Christi Park, San Patricio Co., Texas, on 15 June 1969. No divisions were found in three other males collected elsewhere in Texas; two of these taken in mid June and mid November had many developing sperm,
while one from mid June showed no divisions or sperm. All chromosomes appear similar in size.

This checkered skipper ranges from southern Texas and Arizona south into Mexico.


Counts were made in two excellent nuclei (I) in testes of a male collected at Lake Corpus Christi State Park, San Patricio Co., Texas, on 15 June 1969. The slide preparation deteriorated before a photograph was taken. No divisions were found in four other males collected at the same time and place, though one of these had sperm in its testes.

7. *Heliopetes laviana* (Hewitson). \(N=29\).

Counts were made in three good nuclei (I) in testes of a male collected at Brownsville, Texas, on 6 November 1969. Sperm but no dividing cells were found in testes of three other males taken at other locations in Texas in mid June and early November.

Almost inseparable in dorsal phenotype, this white skipper and the next species, *H. macaira*, range from southern Texas (all months of the year) west to Arizona and south to South America.

8. *Heliopetes macaira* (Reakirt). \(N=29\).

A clear count was made in one nucleus (I) and several additional dividing cells in testes of a male collected at Brownsville, Texas, on 7 November 1969. Sperm but no dividing cells were found in testes of another male from the same locality, and in two males from San Patricio Country, Texas, taken on 15 June 1969, one lacked even sperm.


Counts of \(N=14\) were made in eight good nuclei (I) and counts of \(N=13\) were made in three good nuclei, all in testes of a male collected at San Antonio, Bexar Country, Texas, on 10 August 1969. Sperm but no dividing cells were found in testes of a male taken in San Antonio on 13 June 1970.

This skipper has a streaked pattern and wavy wing margins (the wing is not flat in one plane) and is quite unlike other North American skippers in general phenotype. It is common in southern Texas from April to December, and is found in New Mexico and Arizona as well.

10. *Pholisora alpheus* (Edwards). \(N=34\).

Counts were made in two good nuclei (II) in testes of a newly-emerged male (2 July 1969) reared from an egg collected at Dryden, Terrell County, Texas. No dividing cells or sperm were found in a second male from the same source (emerged 27 June 1969).

One of the many sooty wing skippers in western North America, this species ranges from Colorado south to Mexico and west to California (Brown, Eff, and Rotger, 1955). The unusual hesperiid haploid number of *P. alpheus* will make the karyotypes of the other species in the genus of special interest to investigate.

B. *Hesperiinae*

1. *Lerema accius* (Smith and Abbot). \(N=29\).

Counts were made in eleven nuclei (II) in testes of one male and two nuclei
II) of a second male collected at San Antonio, Texas, on 12 November 1969. Six chromosomes are notably smaller than the others.

This dark skipper ranges from Connecticut to Florida, and west to Texas and south along the Gulf coast in Mexico (Holland 1931).

2. *Polites vibex praeeceps* (Scudder). N = 27.

Counts were made in four excellent nuclei (I) in testes of a male collected at San Antonio, Texas, on 12 November 1969. All chromosomes are about equal-sized.

A member of a large genus, this species occurs from Connecticut south into the tropics, and it is common all year in southern Texas.


Counts were made in eight excellent nuclei (I) and several dozen other dividing cells were observed in testes of a male taken at Brownsville, Texas, on 7 November 1969. The number of chromosomes per nucleus were as follows:

- N = 28 2 cells
- N = 29 4 cells
- N = 30 2 cells

This species occurs throughout eastern North America to Texas (Klots 1951).


Counts were made in four good nuclei (I) in testes of a male collected at San Antonio, Texas, on 6 September 1969. Many other dividing cells were present. Another male, collected 18 September, showed no divisions but contained many sperm in the testes.

This species is closely related to the preceding species and has the same general range (Klots 1951).


Counts were made in three good nuclei (I) and five other nuclei (I) with rather diffuse chromosomes were observed in testes of a male collected at Elbow Creek, Jeff Davis County, Texas, on 6 July 1969.

Five species of this genus have been counted so far (this paper) and all share a haploid number of 29 in the Texas populations (compare *A. aenus*, however). There are fourteen species of *Amblyscirtes* in the eastern half of the United States alone (Klots 1951). They are all small, usually dark brown skippers, and many are extremely similar to one another in phenotype.

---

6. *Amblyscirtes texanae* (Bell). N=29

Counts were made in five good nuclei (I) in testes of a male collected at Fort Davis National Park, Jeff Davis County, Texas, on 4 July 1969.

This species is much paler in color than most of the other species of *Amblyscirtes* and is found in Texas and westward (Klots, 1951).


Counts were made in six good nuclei (I) in testes of one male (H-17) and in five good nuclei (I) in testes of a second male; both males were collected at Lake Corpus Christi State Park, San Patricio County, Texas, on 15 June 1969. All nuclei in the first male gave a clear count of N=29; two nuclei in the second male gave an initial count of N=31 but on checking the photographs these nuclei appeared to contain four single chromosomes (two separated pairs) in addition to 27 standard pairs. A third male, collected on 7 September 1969 at San Antonio, Texas, contained sperm in its testes but no dividing cells.


Counts of N=28 were made in four good nuclei (I) and counts of N=29 were made in five clear nuclei (I) in testes of a male taken at Fort Davis National Park, Jeff Davis County, Texas, on 4 July 1969. A notable feature in each karyotype was one very large chromosomal pair.

This species ranges from Texas north to Kansas and Colorado and westward to Arizona (Brown, Eff, and Rotger 1955).


Counts were made in three clear nuclei (II) and checked in about 20 additional dividing cells (I, II) in testes of a male collected at H.O. Canyon, Jeff Davis County, Texas, on 5 July 1969. Testes of three additional males collected at the same place and date showed abundant sperm and only one showed any remaining meiotic cells (two nuclei in prophase II).

This species ranges from Texas to Arizona and north in the mountains of Colorado (Brown, Eff, and Rotger 1955).


Counts were made in four nuclei (II) in testes of a male collected 16 miles east of Brownsville, Texas, on 10 November 1969. No meiotic activity was found in testes of a second male taken the same date and locality. The counts were possible only under the highest magnification due to tight clumping of the chromosomes; about 12 other dividing cells could not be counted.

A very nondescript small skipper, *P. panoquinoides* occurs in Florida (April to November) and Texas, and south into Central America.


A clear count was made in one nucleus (I) and two other partly obscured nuclei (I) were checked in testes of a male collected at San Antonio, Texas, on 12 November 1969. Few sperm or dividing cells were present. Many sperm but no dividing cells were found in a male collected in Hidalgo County, Texas, on 25 October 1970 and in a male taken in Cameron County, Texas, on 9 November 1969.

This small species is widespread in the southern United States from Florida to Texas and is found north to New York, Ohio, and Indiana (Klots 1951).

Counts were made in three good nuclei (I) in testes of a male collected at San Antonio, Texas, on 12 November 1969. As with the other two species of *Panoquina*, the chromosomes are small and equal-sized. Many other cells in this specimen were in metaphase I, with tightly-bunched plates.

Found in Florida and Texas, this is another medium-to-small sized dark species of this primarily tropical genus.

**Discussion**

The chromosome numbers of 22 species of Nearctic Hesperiidae for which counts were previously lacking are shown in Table 1. Counts on an additional 11 species of North American Hesperiidae were reported by Maeki and Remington (1960), and chromosome numbers for 11 species from southern Mexico and Guatemala were recently reported by de Lesse (1970). One of the counts reported here for a Texas population of *Chiodes catillus albofasciatus* (Hewitson) matches de Lesse's count (N=31) for a male of this subspecies from Tuxtla Gutierrez, Chiapas, Mexico. Our count for *Chiomara asychis georgina* (Reakirt) from Texas (N=32) differs, however, from the count (N=31) for a male of this subspecies from Chiapas, Mexico (Lesse 1970).

With chromosome numbers available now for 43 North American species of the skipper family Hesperiidae, it is apparent that certain genera where several species have been counted have a characteristic haploid number:

- **Amblyscirtes**: 5 species, N=29 (Present paper)
- **Chiodes**: 2 species, N=31 (Present paper; Maeki and Remington 1960, Lesse 1970)
- **Erynnis**: 5 species, N=31 (Present paper; Maeki and Remington)
- **(2 species)**, N=30 (Maeki and Remington)
- **Heliopetes**: 2 species, N=29 (Present paper)
- **(1 species)**, N=30 (Lesse 1970)
- **Panoquina**: 3 species, N=29 (Present paper)
- **Wallengrenia**: 2 species, N=28 (Present paper)

(to 30)

Those genera that have species with considerably different numbers are:

- **Pyrgus**: 2 species, N=28, 32 (Present paper)
- **Achalarus**: 2 species, N=16, 29 (Present paper; Maeki and Remington)

The lowest number of chromosomes yet reported (present paper) for the Hesperiidae is the haploid count of 13-14 for *Celotes nessus* (Edwards). This species is unique in other phenotypic characters from the bulk of the Pyrginae, and seems to represent an older, specialized offshoot from the chromosomal evidence.

It is notable that many of the counts reported here are for species which are wide-ranging in geographic distribution and that are adapted to both temperate and tropical conditions. No correlation in this limited sample has been detected
between extent of geographic range and chromosome number in the Hesperiidae, nor is there any correlation between chromosome number and adult size or intraspecific variability of phenotype.

The variability in chromosome number (N=28, 29, or 30) in *Wallengrenia*

<table>
<thead>
<tr>
<th>Species</th>
<th>Number(n)</th>
<th>Division</th>
<th>Reference no.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A. Subfamily PYRGINAE</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choides catillus albofasciatus (Hewitson)</td>
<td>31</td>
<td>I</td>
<td>(H-320)</td>
</tr>
<tr>
<td>Achilarus castica (Herrich-Schaffer)</td>
<td>29</td>
<td>II</td>
<td>(H-148)</td>
</tr>
<tr>
<td>Chionara asychis georgina (Reakirt)</td>
<td>32</td>
<td>I</td>
<td>(H-282)</td>
</tr>
<tr>
<td>Erynnis tristis tattus (Edwards)</td>
<td>31</td>
<td>II</td>
<td>(H-107)</td>
</tr>
<tr>
<td>Pyrgus albecens (Plötz)</td>
<td>28</td>
<td>I</td>
<td>(H-9)</td>
</tr>
<tr>
<td>Pyrgus oileus (Linnaeus)</td>
<td>32</td>
<td>I</td>
<td>(H-81)</td>
</tr>
<tr>
<td>Heliopetes laviana (Hewitson)</td>
<td>29</td>
<td>I</td>
<td>(H-50)</td>
</tr>
<tr>
<td>Heliopetes macaira (Reakirt)</td>
<td>29</td>
<td>I</td>
<td>(H-39)</td>
</tr>
<tr>
<td>Celotes nessus (Edwards)</td>
<td>14, 13</td>
<td>I</td>
<td>(H-216)</td>
</tr>
<tr>
<td>Pholisora alphea (Edwards)</td>
<td>34</td>
<td>II</td>
<td>(H-97)</td>
</tr>
<tr>
<td><em>B. Subfamily HESPERIINAE</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lorina accius (Smith and Abbot)</td>
<td>29</td>
<td>II</td>
<td>(H-370, H-371)</td>
</tr>
<tr>
<td>Polites vibex praeceps (Scudder)</td>
<td>27</td>
<td>I</td>
<td>(H-247)</td>
</tr>
<tr>
<td>Wallengrenia otho curassavica (Snellen)</td>
<td>28, 29, 30</td>
<td>I</td>
<td>(H-311)</td>
</tr>
<tr>
<td>Wallengrenia egeremet (Scudder)</td>
<td>28</td>
<td>I</td>
<td>(H-256)</td>
</tr>
<tr>
<td>Amblyscirtes cassus (Edwards)</td>
<td>29</td>
<td>I</td>
<td>(H-196)</td>
</tr>
<tr>
<td>Amblyscirtes texanae (Bell)</td>
<td>29</td>
<td>I</td>
<td>(H-206)</td>
</tr>
<tr>
<td>Amblyscirtes cela (Skinner)</td>
<td>29</td>
<td>I</td>
<td>(H-17, H-18)</td>
</tr>
<tr>
<td>Amblyscirtes aenus (Edwards)</td>
<td>28, 29</td>
<td>I</td>
<td>(H-186)</td>
</tr>
<tr>
<td>Amblyscirtes phylace (Edwards)</td>
<td>29</td>
<td>II</td>
<td>(H-118)</td>
</tr>
<tr>
<td>Panoquina panosquinoides (Skinner)</td>
<td>29</td>
<td>II</td>
<td>(H-350)</td>
</tr>
<tr>
<td>Panoquina ocola (Edwards)</td>
<td>29</td>
<td>I</td>
<td>(H-331)</td>
</tr>
<tr>
<td>Panoquina hecebolus (Scudder)</td>
<td>29</td>
<td>I</td>
<td>(H-400)</td>
</tr>
</tbody>
</table>
otho curassavica is probably due to fragmentation of one of the holokineti
chomosomes; the causes and selective advantages of numerical heterozy
osity in this and other butterfly species will be discussed elsewhere
(Emmel and Trew in preparation).

Summary

Chromosome numbers and karyotypic observations are reported for 22 species
of Hesperiidae (Pyrginae and Hesperiinae) found in southwestern North America.
Characteristic haploid numbers for certain genera are found: Amblyscirtes
(N = 29), Chiodes (N = 31), Erynnis (N = 30 or 31), Heliopetes
(N = 29 or 30), Panoquina (N = 29), and Wallengrenia (N = 28, 29, 30).
Two genera with widely varying chromosome numbers are Achalarus
(N = 16, 29) and Pyrgus (N = 28, 32). The phenotypically unusual
Celotes nessus (Edwards) is shown to be cytogenetically distinct
from all other Pyrginae with a haploid number of 13–14, the lowest number reported
to date for the family Hesperiidae.

References

History, Denver, 368 pp., illustr.
Entomol. 37: 1–214.
Lepid. 7: 23–28 (“1968”).
Revised edition.
40 pls.
Lesse, H. de, 1970. Les nombres de chromosomes chez les Lépidoptères Rhopalocères en Amérique