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THE BUTTERFLY FAUNA OF BARTON CREEK CANYON ON THE BALCONES FAULT ZONE, AUSTIN, TEXAS, AND A REGIONAL LIST

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ABSTRACT. Diversity of substrate, topography and water supply, and climate and vegetation account for the occurrence of 74% of the regional fauna along a 1.1 km stretch of Barton Creek. Monthly mean weather records for 40 years are analyzed on a bioclimagram and the modes matched with habitat types. 172 species are listed for the ten counties around Austin, and range, habitat, abundance, and residency are indicated for the 127 found at the study site. Faunal history is interpreted as a sequence of colonization events followed by episodes of habitat restriction. These are related to regional patterns of climatic change inferred from the 22,000-year paleontologic record of sphagnum bogs 70 km to the east and southeast. No species listed is endangered by collecting. Several restricted species of special habitats are threatened by potentially careless land use.

Barton Creek rises in Hays Co. on the Edwards Plateau and flows east into Travis Co. to enter the Colorado River at Austin below the Balcones Fault Zone. Most of the basin contains juniper and live-oak woodland, with cedar-elm more frequent towards the east. Post oak savanna occurs on higher hills near the headwaters, including Shingle Hills at 460 m. Madrone (*Arbutus xalapensis* H.B.K.), associated with sacahuista-grassland (*Nolina lindheimeriana* (Scheele) Wats. and *N. texana* Wats.) is found on the divides. Dwarf palmetto (*Sabal minor* (Jacq.) Pers.) and bald cypress (*Taxodium distichum* (L.) Rich.) are found in the deepest canyon in the middle part of the drainage (Correll & Johnston, 1970). In terms of biotic diversity, the most interesting area is the lowest portion of the canyon where it crosses the spring zone of the Balcones Faults. Here, since 1971, have been taken 127 species and an additional 10 subspecies in overlap. This is 74% of the total butterfly fauna known from the 10-county area around Austin (Llano, Burnet, Blanco, Hays, Travis, Williamson, Lee, Bastrop, Caldwell, and Fayette) or within approximately 90 km (Fig. 1). Factors accounting for this biotic diversity include: features of substrate; topography and water supply; and climate and vegetation.

Substrate. Bedrock is a hard gray Cretaceous limestone (Rodda et al., 1970); the upper three members of the Edwards Formation, with the softer Georgetown Limestone capping hills north and south of the study area. The uppermost member of the Edwards is cavernous with rapid sink-in of rainfall, leading to development of rather xeric microhabitats. Next below is the major cliff-forming member. Residual soils on these limestones are dark-brown and gray-brown granular with limestone fragments and are of the Tarrant soil group (Werchan et al., 1974). On steeper slopes occurs colluvium of broken limestone of the Brackett soil group. At approximately 170 m there are deposits of the Capitol Terrace of reddish-brown chert pebbles and clay on which are developed soils of the Speck group. This terrace was deposited during or before the Yarmouth Interglacial, two to three hundred thousand years ago, when the gradient of the Colorado River and its tributaries was raised in adjustment with the interglacial rise in sea level. At approximately 150 m there is the Sixth Street Terrace of brown-red silty clay on which is developed soils of the Altoga group. This terrace deposit accumulated during the Sangamon Interglacial between 125,000 and 40,000 years ago. Insect microfossils in this deposit indicate a climate as warm as, or warmer than, present. At 140 m there is the First Street Valley Fill of brown fine sandy loam on which is formed soil of the Hardeman group. This deposit, which contains extinct horse and mastodon remains, was formed during the major pluvial stage in the late Wisconsin Glacial between 15,000 and 9000 years ago. Insect microfossils in this deposit indicate a climate cooler and more moist than present. Four lower levels of valley fill occur to the east of the study site, deposited during later Wisconsin and post-glacial pluvial episodes. The present bed load of Barton Creek consists of gray silt with limestone boulders, which are accumulating since the damming and modification of the creek channel at Barton Springs swimming pool.

Topography, land use and water supply. The collecting site extends from 1.2 km above the mouth of Barton Creek at the upper end of the swimming pool at 144 m elevation to 2.3 km SSW of the mouth at 157 m elevation above the rapids above Campbell's Hole. In the channel there is a small perennial spring at 145 m and two usually perennial pools at 147 m, the uppermost of which has been known for 100 years as Campbell's Hole. There is a sloping meadow at 150 to 155 m in the northeastern third of the area, upstream from which the canyon narrows. The top of the bluffs stands at approxi-

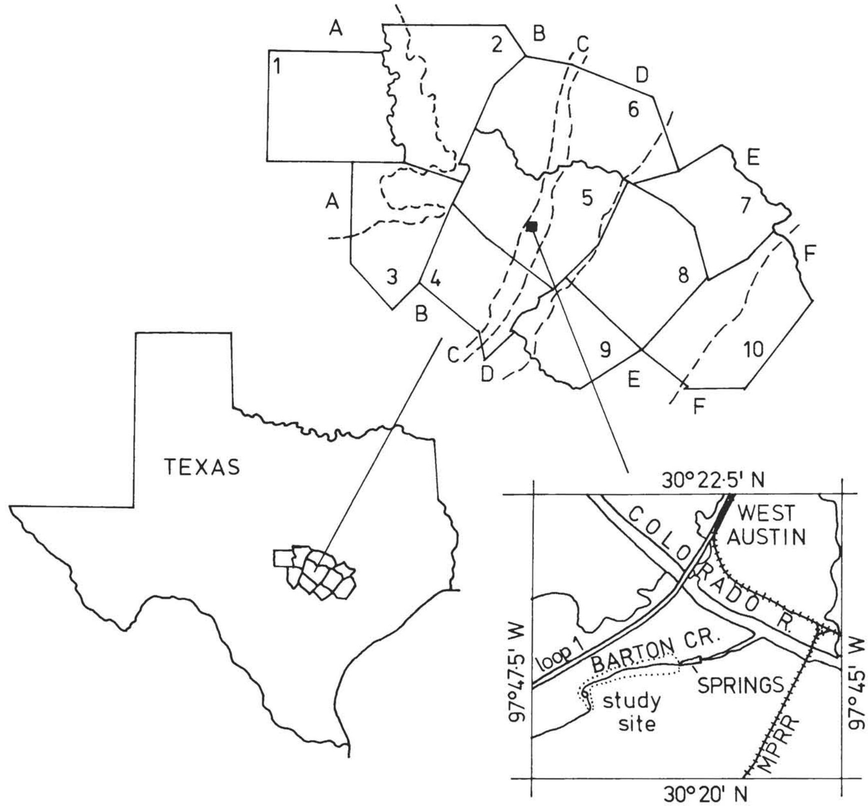

FIG. 1. Location of study site, with counties in the Austin area: 1. Llano, 2. Burnet, 3. Blanco, 4. Hays, 5. Travis, 6. Williamson, 7. Lee, 8. Bastrop, 9. Caldwell, 10. Fayette; and substrate: A. Llano Uplift (Precambrian shield and Paleozoic limestones), B. Lower Cretaceous limestone plateau and canyons, C. Balcones Fault Zone (canyons and springs), D. Upper Cretaceous limestones (with black rendzina soils and prairie), E. Paleogene sandstones and shales (with barren sands, podsols and peat bogs), F. Neogene sands and clays (with coastal plain prairie).

mately 185 m. The present boundary of Zilker City Park protects the north canyon wall almost to the top, but the south canyon wall lies outside the park, where it is not developed because a city regulation prohibits building on floodplains. Development in the form of apartment complexes and single family houses has, in the past 5 years, used up almost all land bordering the collecting site. In the early 1960's a major sewer line was laid along the northern border of the creek channel. Construction of this line cracked limestone ledges which formerly held ephemeral pools, the habitat of an endemic crustacean, *Eulimnadia antlei* Mackin, known elsewhere only from Okla-

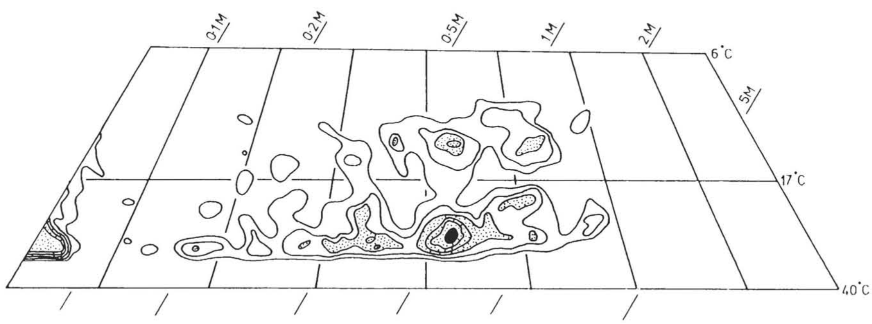

FIG. 2. Bioclimagram for Austin, Texas, based on monthly means of temperature and rainfall from 1931 to 1970, summarized by point density contouring to locate modes. Apparent rainfall is monthly rainfall ×12.

homa. Published plans for future development of the study area include a "Barton Creek Hike and Bikeway" trail over the sewer line and wide enough for a standard patrol car to extend from Barton Springs to a major highway 3.5 km to the southwest.

Climate and vegetation. Monthly rainfall and temperature records for Austin, covering the years 1931 to 1970 were plotted as points on a diagram similar to that of Holdridge et al. (1971). Points were standardized as if for yearly averages and then point density was contoured to locate the positions of climatic modes found throughout the year (Fig. 2). The interpretive overlay of Holdridge was originally calibrated empirically for equatorial climates of small annual amplitude. A new overlay (Fig. 3) has been calibrated empirically for strongly seasonal climates, using as labels the habitats selectively favored under each condition. In order of decreasing frequency of occurrence, our summer (hotter than 16°C, 63°F) bioclimates are for dry forest (sabinal), warm desert, warm arid forest (encinal), with minor modes at warm thorn scrub, warm thorn woodland (including chaparral), warm mesic forest (2 modes), and warm moist forest. Our winter bioclimates are moderate park woodland (2 modes) and moderate groved meadow. Because the annual bioclimate is an oscillation between modes, now one, then another, community best adapted for particular modes is at a selective advantage. The cumulative result of such historical selection is a mosaic or patchy environment in which diverse communities coexist side by side in sharp discontinuity with boundaries maintained by small, but decisive, edaphic and topographic differences. Winter temperatures run some 1.5°C higher, and in summer, some 2.5°C lower in the canyons than the published records from the prairie site at the airport (U.S. Dept. Commerce, NOAA-EDS, 1970).

On Barton Creek there is sabinal or *Juniperus ashei* Buchh. wood-

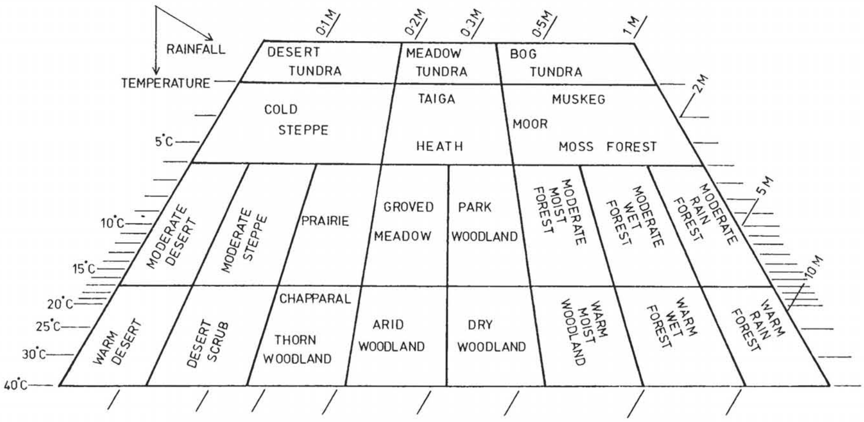

FIG. 3. Key diagram showing optimal community types for various temperatures and apparent rainfall figures based on data from a large number of North American stations.

land on the divides. Oak (*Quercus fusiformis* Small) and elm (*Ulmus crassifolia* Nutt.) woodland occurs on deeper dry soils. Oak (*Q. sinuata* Walt.) and elm (*U. americana* L.) woodland occurs on mesic colluvial pockets. Oak (*Q. texana* Buckl.), redbud (*Cercis canadensis* L.), red buckeye (*Aesculus pavia* L.), hop tree (*Ptelea trifoliata* L.), and monilla (*Ungnadia speciosa* Endl.) woodland occurs on steeper shade slopes. Pecan (*Carya illinoinensis* (Wang.) K. Koch) and ash (*Fraxinus americana* L.) woodland occurs on alluvial soil. Cottonwood (*Populus deltoides* Marsh), willow (*Salix nigra* Marsh), plane tree (*Platanus occidentalis* L.), and indigo bush (*Amorpha fruticosa* L.) occur along the stream channel. On sunslopes there is a chaparral of evergreen sumac (*Rhus virens* Gray), ebony (*Diospyros texana* Scheele), stretch berry (*Forestiera pubescens* Nutt.), oreja de raton (*Bernardia myricaefolia* (Scheele) Wats.), christmas bush (*Eupatorium havanense* H.B.K.), china (*Sapindus saponaria* L.), lotebush (*Ziziphus obtusifolia* (T. & G.) Gray), cenizo (*Leucophyllum frutescens* (Berl.) I. M. Johnst.), granjeno (*Celtis pallida* Torr.), mescal bean (*Sophora secundiflora* (Ort.) DC.), kidney wood (*Eysenhardtia texana* Scheele), catclaw (*Acacia roemeriana* Scheele) and many other shrubs. The grassland of cleared areas is richly herbaceous and is returning rapidly to shrubland under pioneering jara dulce (*Baccharis neglecta* Britt.), mesquite (*Prosopis glandulosa* Torr.), huisache (*Acacia smallii* Isely), and retama (*Parkinsonia aculeata* L.), and to savanna with coma (*Bumelia lanuginosa* (Michx.) Pers.) and hackberry (*Celtis laevigata* Willd. and *C. lindheimeri* Engelm.). The herbaceous and small shrub flora is very rich, particularly on the limestone cliffs where nectar sources are found in all seasons. During moist periods there is a proliferation of herbs and vines on the woodland floor, including suitable larval foodplants for many of our periodic tropical colonists. In cedar thickets in autumn, drying plants of *Heliotropium tenellum* (Nutt.) Torr. are attractants for *Danaus* spp.

Most years have minimum temperature no lower than −5°C (23°F) during the second week of January. New growth of chamaephytes begins in February. The mean last frost date is 3 March with rare chance of near frost as late as mid-April. The first rainy season peaks in May and is separated in most years by a more or less severe dry season in June, July, and August from the second rainy season in September. Rarely the first frost occurs as early as late October or as late as January, with the mean first frost date on 28 November. A few butterfly species are adult only during, just before, or just after the first rainy season. These are *Erynnis juvenalis, Megathymus coloradensis kendalli, Satyrium calanus falacer, Callophrys solatus, Fixsenia ontario autolycus, Megisto cymela,* and *Anthocharis midea annickae,* and all are single brooded. Other numbered species on the list are two or more brooded per year and may be found during or following both rainy seasons, or all year long. Periodic tropical colonists are usually not found before late August in normal years. In years of moist spring, when there is abundant rainfall in the Rio Grande Valley between Sabinas Hidalgo and San Antonio, they may reach our area in May or June. In rare years of exceptionally mild winter, some of these tropical colonists may survive the cold. Neck (1978) has given an introduction to the periodicity of this phenomenon. Empirically, the greatest diversity or number of synchronic species occurs in mid-October, and the greatest population or number of individual butterflies on the wing occurs in late September. There is a smaller diversity peak in June and population peak in May. Diverse collecting often persists well into November and occasionally into December. Taxa of temperate distribution enter hibernation during October, possibly in response to change in day-length. This stops the emergence of new adults of these species, freeing niche space and nectar sources for the periodic tropical colonists. From mid-October through December the greater part of the adult population is composed of species with predominantly tropical distribution, a few endemic taxa, and a few adult hibernators. One species of the sacahuista-grassland association, not yet known from the study site but occurring on the left divide 11 km to the northwest, is *Hesperia woodgatei.* This species has a single autumn brood flying from mid-October into early November. The 27 species indicated (*) may be found during warm weather in mid-winter. In dry years, more species can be found in January than in July.

Biogeographic notes. The subspecies is chosen as the working taxon for biogeographic analysis because it is the primary occupant of the niche (Durden, 1969). Different subspecies have slightly different habitat requirements and accordingly their ranges are determined by the distribution of such habitats. At this locality there are 6 pairs and 2 triplets of syntopic subspecies. These are, however, rarely synchronic or competitive. They have different overall ranges, different habitat requirements, and are only found together during episodes of mutual dispersal.

By habitat preference our butterflies are 53% of woodlands, 26% of desert and grassland, 12% of brushland, and 9% of arid woodland and thorn scrub. Geographically they are 39% in midrange, 41% at or near the northern boundary, 18% near the eastern boundary, 17% at the southern or southwestern boundary, and 7% at the western boundary. Range groups, position within range, frequency, and residency status are indicated in the list by the following symbols:

Range groups. A—wide-ranged in dry disturbed sites (9) in midrange). B—Great Plains (8 in midrange, 4 at southern edge, 4 at eastern edge). C—warm temperate, subtropical and tropical in dry open sites (9 in midrange, 2 at eastern edge). D—subtropical arid thorn forest (1 in midrange, 3 at eastern edge, 3 at northern edge). E—eastern subtropical arid thorn scrub (2 in midrange, 2 at northern edge). F—Tamaulipan arid woodland (2 at northern edge). G—broad-ranged temperate and tropical woodland (1 in midrange). H—eastern deciduous forest and tropical woodland (1 at western edge). I—Gulf Coast and tropical woodland (9 in midrange). J—subtropical and southern Great Plains brushland (3 in midrange, 1 at eastern edge). K—eastern deciduous and subtropical montane woodland (2 in midrange). L—eastern deciduous woodland (5 in midrange, 5 at southwestern edge). M—Appalachian and Mississippi Basin woodland (4 at southern edge, 4 at southwestern edge). N—Gulf Coast woodland (7 at western edge). O—western deciduous and subtropical montane woodland (6 at eastern edge). P—*endemic taxa* of the Sierra Madre Oriental and Balcones Escarpment (4 at northern edge). Q—*endemic taxa* of central Texas and northern Coahuila (1 in midrange, 2 at eastern edge, 4 at northern edge). R—tropical woodland (4 in midrange, 11 within northern part of range, 15 at northern edge).

Position within range. n—at northern edge of range (30). nm—in the northern part of the range, rarely straying farther (11). m—in midrange (54). e—at eastern edge of range (18). w—at western edge of range (8). s—at southern edge of range (8). sw—at southwestern edge of range (9).

Frequency. a—abundant, but may be periodically scarce, although frequently occurring in such abundance that a series may be taken in a day (84). u—uncommon, few specimens have been taken, several years are required to accumulate a series (27). s—scarce, one to five individuals have been taken in 10 years (26).

Residency status. p—periodic, strays appearing in our region after a moist spring or after dispersal by hurricane, usually raising one or more broods or persisting up to 9 years before extermination by severe winter freeze or by summer drought (46). r—permanent residents, known to have survived extreme drought or winter freeze of 25 to 100 year severity.

LIST OF THE BUTTERFLIES FOUND ON BARTON CREEK IN ZILKER PARK, AUSTIN, TEXAS, WITH ADDITIONAL SPECIES FOUND IN THE ADJACENT TEN COUNTIES

(Dates given for scarce species only; author was collector unless noted otherwise; footnotes 1–28 follow the List.)

PYRGINAE (HESPERIIDAE)

1. *Epargyreus clarus* (Cramer, 1775) subsp., O-e-a-r.
2. *Chioides albofasciatus* (Hewitson, 1867), R-n-s-p (14:x:72).
3. *C. zilpa zilpa* (Butler, 1874), R-n-s-p (29:ix:76).
   Urbanus proteus (Linné, 1758), Bastrop Co. (Heiligbrodt, 1870's).
4. *U. dorantes rauterbergi* (Skinner, 1895), R-nm-s-p (1:x:72).
   Achalarus coyote (Skinner, 1892), Travis Co. (Bull Cr.).
5. *Thorybes pylades* (Scudder, 1870), K-m-u-r.
   T. confusis Bell, 1922, Bastrop Co., Travis Co. (Bull Cr.).
   T. bathyllus (Abbot *in* Smith, 1797), Bastrop Co.
   Cogia outis (Skinner, 1894), Travis Co. (Bull Cr.).
6. *Bolla clytius* (Godman & Salvin, 1897), R-n-s-p (2:x:77).
7. *Staphylus hayhurstii* (Edwards, 1870), L-m-u-r.
8. *Systasea pulverulenta* (Felder, 1869), E-n-a-r.
9. *Achlyodes mithridates tamenund* (Edwards, 1871), R-nm-u-p.[1]
   Gesta invisus llano (Dodge, 1903), Llano, Travis, Bastrop Co's.[2]
10. *Erynnis horatius* (Scudder & Burgess, 1870), L-m-a-r.
11. *E. meridianus* Bell, 1927, B-s-s-r (30:ix:76).
12. *E. juvenalis juvenalis* (Fabricius, 1793), M-s-u-r.
    E. martialis (Scudder, 1869), Bastrop Co. (Sandy Cr.).
13. *E. funeralis* (Scudder & Burgess, 1870), C-m-a-r.
    E. zarucco (Lucas, 1857), Travis Co. (Bull Cr.).
    E. baptisiae (Forbes, 1936), Travis Co. (Bull Cr.).
    E. burgessi (Skinner, 1914), Blanco Co. (Round Mt.; F. G. Schaupp).

14a. **Syrichtus* (*Tuttia*) *communis communis* (Grote, 1872), C-m-a-r.[3]
14b. *S.* (*T.*) *communis albescens* (Plötz, 1884), D-n-a-p.[4]
     S. (*T.*) *oileus* (Linné, 1767), Travis Co. (Bull Cr.).
15. *S.* (*T.*) *philetas* (Edwards, 1881), E-m-u-r.[5]
16. *Heliopetes laviana* (Hewitson, 1868), R-n-s-p (13:x:71, 9:xi:72).
17. *Celotes nessus* (Edwards, 1877), E-m-a-r.

18. *Pholisora catullus* (Fabricius, 1793), M-s-a-r.
    P. mejicana (Reakirt, 1866), Travis Co. (Bull Cr.).

HESPERIINAE (HESPERIIDAE)

19. *Megathymus coloradensis kendalli* Freeman, 1965, Q-e-u-r.[6]
    M. coloradensis reinthali Freeman, 1963, Caldwell, Williamson, Lee Co's.
    Ancyloxipha numitor (Fabricius, 1793), Travis, Lee Co's.
    A. arene (Edwards, 1871), Llano Co. (Enchanted Rock).
20. *Copaeodes aurantiaca* (Hewitson, 1868), C-e-a-r.
21. **C. minima* (Edwards, 1870), L-m-a-r (with the genitalically distinct winter f. *rayata* Barnes & McDunnough, 1913).
22. **Atalopedes campestris* (Boisduval, 1852), L-m-a-r (with a dark winter f.).
23. *Hesperia viridis* (Edwards, 1883), B-e-u-r.
    H. woodgatei (Williams, 1914), Travis Co. (Fourpoints & U. Barton Cr.).
    H. licinus (Edwards, 1871), Bastrop Co. (Heiligbrodt Cln.).[7]
    H. meskei (Edwards, 1877), Bastrop Co. (Heiligbrodt Cln.).
    H. attalus (Edwards, 1871), Travis Co. (U. Shoal Cr.).
24. *Polites (Polites) vibex brettoides* (Edwards, 1883), L-m-u-r.
    P. (P.) themistocles (Latreille, 1824) subsp., Bastrop Co. (Paige).
25. *P. (Wallengrenia) otho otho* (Abbot *in* Smith, 1797), L-m-a-r.
    Poanes (Poanes) viator viator (Edwards, 1865), Lee Co. (Patschke Bog).
26. *Hylephila phyleus* (Drury, 1773), L-m-a-r.
    Atrytone (Atrytone) arogos iowa (Scudder, 1868), Travis Co.[8]
    A. (A.) arogos arogos (Boisduval & LeConte, 1833), Fayette Co. (Swissalp).
27. *A. (A.) delaware lagus* (Edwards, 1881), B-s-u-r.
    A. (A.) mazai Freeman, 1969, Travis Co. (U. Shoal Cr.).
28. *Euphyes vestris osyka* (Edwards, 1867), L-m-a-r.
29. *Amblyscirtes nysa* Edwards, 1877, B-e-u-r.
    A. aenus aenus Edwards, 1878, Travis Co. (Bull Cr.).
    A. erna Freeman, 1943, Travis Co. (Bull Cr.).
30. *A. eos* (Edwards, 1871), B-e-u-r.
31. *A. celia* Skinner, 1895, F-n-a-r.
    A. alternata (Grote & Robinson, 1867), Bastrop, Lee Co's.
32. *Lerodea eufala* (Edwards, 1869), L-m-a-r.
33. *Calpodes ethlius* (Stoll, 1782), R-m-u-p.
34. *Panoquina ocola* (Edwards, 1863), L-m-a-r.
35. *Nastra julia* (Freeman, 1945), Q-m-a-r.
36. *Lerema accius* (Abbot *in* Smith, 1797), L-m-a-r.

RIODININAE (LYCAENIDAE)

37. *Calephelis nemesis australis* (Edwards, 1877), Q-n-a-r (with a winter form approaching typical nemesis).[9]
38. *C. perditalis* (Barnes & McDunnough, 1918), P-n-u-r (with darker angulate-winged winter form).
39. *C. guadeloupe* (Strecker, 1878), Q-n-a-r (with summer f. *rawsoni* McAlpine, 1939).[10]
40. *C. sinaloensis nuevoleon* McAlpine, 1971, P-n-s-r (16, 21, 28:x:71; 10:ix:72).
    Apodemia mormo mejicanus (Behr, 1865), Bastrop, Travis Co's.[11]

LIPHYRINAE (LYCAENIDAE)

41. *Feniseca tarquinius* (Fabricius, 1793), M-sw-s-r (24:ix:79).

LYCAENINAE (LYCAENIDAE)

    Chlorostrymon simaethis sarita (Skinner, 1895), Williamson Co. (Salado Cr.).
    Phaeostrymon alcestis alcestis (Edwards, 1871), Williamson, Travis Co's.
42. *Satyrium calanus falacer* (Godart, 1824), M-s-u-r.

43. *Calycopis isobeon* (Butler & Druce, 1869), J-m-a-r (with a dimorphic form or possible sibling species).
44. *Callophrys (Mitoura) gryneus gryneus* (Hübner, 1819), L-m-a-r.[12]
    C. (M.) gryneus auburniana (Harris, 1862), Bastrop Co. (Sandy Cr.).
    C. (M.) gryneus × *sweadneri*, Travis Co. (3 in hundreds of the parents).
45. *C. (M.) sweadneri* (Chermock, 1944) subsp., Q-e-a-r.[13]
46. *C. (Incisalia) solatus* (Cook & Watson, 1909), Q-n-a-r (with a var. with green scales ventrally).[14]
    C. (I.) henrici turneri (Clench, 1943), Llano, Travis Co's.
47. **Atlides halesus estesi* Clench, 1942, D-m-a-r.
48. *Fixsenia ontario autolycus* (Edwards, 1871), B-m-a-r.
49. *Panthiades m-album m-album* (Boisduval & LeConte, 1833), L-sw-u-r.
50a. **Strymon melinus franki* Field, 1938, C-e-a-r (with a dark winter f.).[15]
50b. *S. melinus melinus* Hübner, 1818, N-w-u-r.
51a. *S. alea* (Godman & Salvin, 1887), P-n-a-r (with a dark winter f.).[16]
51b. *S. alea* × *columella* (1 in 75 specimens of parent species).
52. *S. columella istapa* (Reakirt, 1866), R-n-s-p (14:x:71; 2:x:72; 7, 9, 10:xi:72).
53. *Hemiargus ceraunus zachaeina* (Butler & Druce, 1872), D-e-u-p.
54. *Echinargus isola alce* (Edwards, 1871), C-m-a-r (with dark winter f.).
55. *Celastrina ladon ladon* (Cramer, 1780), M-s-s-r (6:viii:72).[17]
56. *Zizula cyna* (Edwards, 1881), R-n-s-p (2:xi:71).
57. *Brephidium exilis exilis* (Boisduval, 1852), B-e-s-r (22:x:71; 2, 4:xi:71).
58. *Everes comyntas comyntas* (Godart, 1824), H-w-u-p.
59. *E. texana* Chermock, 1944, Q-n-a-r.[18]
60. *Leptotes cassius striatus* (Edwards, 1877), R-n-s-p (17:v:72).
61. *L. marinus* (Reakirt, 1868), D-e-u-p.

PAPILIONINAE (PAPILIONIDAE)

62. *Papilio polyxenes curvifasci* Skinner, 1902, B-m-a-r.
    P. rudkini f. *clarki* Chermock & Chermock, 1937, Travis Co. (Turkey Bend).[19]
    Pterourus (Pterourus) troilus troilus (Linné, 1758), Travis Co. (Bull Cr.).
63. *P. (Jasoniades) glaucus glaucus* (Linné, 1764), L-sw-u-r.
64. *P. (J.) multicaudatus* (Kirby, 1884), O-e-u-r (with large dark summer f.).
65. *Heraclides (Heraclides) cresphontes* (Cramer, 1777), G-m-a-r.
    H. (H.) thoas autocles (Rothschild & Jordan, 1906), Travis Co. (L. Austin).
66. **Battus philenor philenor* (Linné, 1771), C-m-a-r.
    B. polydamas polydamas (Linné, 1758), Travis Co. (Austin).

LIBYTHEIDAE

67a. *Libytheana bachmanni bachmanni* (Kirtland, 1851), L-sw-u-p (with wet season f. *kirtlandi* (Field, 1938)).[20]
67b. **L. bachmanni larvata* (Strecker, 1878), D-n-a-r (with wet season f. *streckeri* (Field, 1938)).
68. *L. carinenta mexicana* Michener, 1943, R-n-s-p (3:v:73; 24:ix:79; 2:x:80; 11:xi:80).

NYMPHALINAE (NYMPHALIDAE)

69. **Euptoieta claudia claudia* (Cramer, 1776), C-m-a-r (with winter dwarfs).
70. *E. hegesia hoffmanni* Comstock, 1944, R-n-s-p (16, 21:x:71).
71. *Polygonia (Polygonia) interrogationis* (Fabricius, 1869), K-m-a-r (with summer f. *umbrosa* (Lintner, 1869)).
72. *P. (Grapta) comma* (Harris, 1842), M-sw-s-r (with summer f. *dryas* (Edwards, 1870)), (24, 26:ix:79).
73. *Nymphalis (Euvanessa) antiopa lintnerii* (Fitch, 1856), O-e-s-r (6:ix:76).
74. **Vanessa (Vanessa) atalanta rubria* (Fruhstorfer, 1916), A-m-a-r.
75. **V. (Cynthia) cardui* (Linné, 1758), A-m-a-p.
76. **V. (C.) virginiensis* (Drury, 1773), A-m-a-r (with winter f. *fulvia* (Dodge, 1900)).

77. **Precis (Junonia) coenia coenia* (Hübner, 1822), C-m-a-r (with dark wet season f., and winter f. *rubrosuffusa* Field, 1936).
78. *P. (J.) nigrosuffusa* (Barnes & McDunnough, 1916), D-n-u-p.[21]
79a. *P. (J.) genoveva genoveva* (Stoll, 1782), R-n-u-p.
79b. *P. (J.) genoveva zonalis* (Felder & Felder, 1867), R-n-s-p (2:x:71; 2:xi:71; 1:vii:72).
80. *Anartia jatrophae jatrophae* (Johansson, 1763), R-nm-s-p (18:x:71).
Siproeta (Victorina) stelenes biplagiata (Fruhstorfer, 1907), Travis Co. (Austin; R. Neck).
81. *Heliconius charitonius vazquezae* Comstock & Brown, 1950, R-nm-a-p (with var. with orange scaled disc).
Eueides isabellae zorcaon (Reakirt, 1866), Travis Co. (Austin, R. Neck).
82. *Dryas iulia moderata* (Riley, 1926), R-nm-a-p (with dark wet season f.).
Dione (Dione) moneta poeyi (Butler, 1873), Travis Co. (Bull Cr.; P. Horde).
83. **D. (Agraulis) vanillae incarnata* (Riley, 1926), B-m-a-r (with winter dwarfs).
84. *Mestra hypermnestra amymone* (Ménétriés, 1857), R-m-a-p (with wet season dark f.).
Biblis hyperia aganisa Boisduval, 1836, Travis Co. (Austin).
Chlosyne (Chlosyne) janais (Drury, 1782), Travis Co. (Bull Cr.).
85. *C. (C.) lacinia adjutrix* Scudder, 1875, J-m-a-r (with dry season light f. cf. *saundersi* (Doubleday, 1848), and var. black, var. black and white).
86. *C. (Charidryas) gorgone carlota* (Reakirt, 1866), B-s-s-p (5:iv:78; 29:ix:79).
87. *C. (C.) nycteis* (Doubleday, 1848), M-sw-a-r (with wet season f. cf. *drusius* (Edwards, 1884)).
Thessalia theona bollii (Edwards, 1877), Burnet Co. (Pangle).
88. *Texola elada ulrica* (Edwards, 1877), E-n-a-r (with wet season f. *senrabii* (Barnes, 1900)).
89. **Phyciodes phaon* (Edwards, 1864), L-m-a-r (with summer f. *aestiva* (Edwards, 1878)).
90. **P. tharos distincta* Bauer, 1975, O-e-a-r (with winter f. ventrally brown).
91. **P. vesta* (Edwards, 1869), J-e-a-r (with winter f. *boucardi* Godman & Salvin, 1878).
92. **Anthanassa texana texana* (Edwards, 1863), J-m-a-r (with summer f. *smerdis* (Hewitson, 1864), and var. black & white).
93. *Marpesia (Euglyphus) chiron* (Fabricius, 1775), R-nm-s-p (29:ix:75).
94. *Limenitis (Limenitis) bredowii eulalia* (Doubleday, 1848), O-e-a-p.[22]
95a. *L. (Basilarchia) archippus archippus* (Cramer, 1776), B-s-a-p.
95b. *L. (B.) archippus watsoni* (dos Passos, 1938), N-w-a-r (with var. orange, a Batesian mimic of *Danaus eresimus* v. orange).[23]
96. *L. (B.) astyanax astyanax* (Fabricius, 1775), L-sw-u-r.
Dynamine dyonis Geyer, 1837, Travis Co. (Bull. Cr.).

APATURINAE (NYMPHALIDAE)

97. *Asterocampa celtis alicia* (Edwards, 1868), N-w-a-r.
98. *A. antonia antonia* (Edwards, 1877), B-m-a-r.
99. *A. leila cocles* (Lintner, 1884), F-n-a-p.
100. *A. clyton texana* (Skinner, 1911), B-m-a-r (with light dry season f.).
101. *A. louisa* Stallings & Turner, 1947, P-n-u-r.
102. **Anaea (Anaea) andria andria* Scudder, 1875, L-m-a-r (with winter f. *andriaesta* Johnson & Comstock, 1941).
103. **A. (A.) aidea* (Guerin, 1844), R-nm-a-p (with winter f. *morrisonii* (Edwards, 1883)).

SATYRINAE (NYMPHALIDAE)

104. *Cercyonis pegala texana* (Edwards, 1880), B-m-a-r (with var. dark).
Cyllopsis gemma gemma (Hübner, 1808), Lee Co. (Patschke Bog).
Neonympha (Hermeuptychia) hermes (Fabricius, 1775), Travis Co.

105. *N.* (*H.*) *sosybius* (Fabricius, 1793), N-w-a-r.[24]
106. *Megisto cymela cymela* (Cramer, 1777), B-m-a-r (with var. smeared silver).
107. *M. rubricata rubricata* (Edwards, 1871), B-m-a-r (with var. obsolescent eyespots).

DANAINAE (NYMPHALIDAE)

108. *Danaus* (*Danaus*) *plexippus plexippus* (Linné, 1758), A-m-a-p (with var. dark apex forewing).
109. **D.* (*Anosia*) *gilippus strigosus* (Bates, 1864), C-m-a-r (with var. cf. *berenice* (Cramer, 1780), var. *gilippina* Hoffmann, 1940, and var. orange Müllerian mimic of *D. eresimus* var. orange).
110. *D.* (*A.*) *eresimus montezuma* Talbot, 1943, R-n-a-p (with var. dark maculate, and var. orange).

PIERINAE (PIERIDAE)

111. *Anthocharis* (*Paramidea*) *midea annickae* dos Passos & Klots, 1969, M-sw-a-r.
112. *Artogeia rapae rapae* (Linné, 1758), A-m-a-p (exotic introduction).
113. **Pontia protodice* (Boisduval & LeConte, 1829), A-m-a-r (with winter f. *vernalis* (Edwards, 1864)).
114. *Ascia* (*Ascia*) *phileta phileta* (Fabricius, 1775), R-nm-s-p (16:x:71).[25]
115. *Appias* (*Glutophrissa*) *drusilla poeyi* (Butler, 1872), R-nm-s-p (13, 18:x:71).
116. **Colias* (*Colias*) *eurytheme eurytheme* Boisduval, 1852, A-m-a-r (with summer f. *amphidusa* Boisduval, 1852, and female var. *alba* Strecker, 1878).
C. (*C.*) *philodice philodice* Godart, 1819, Bastrop Co. (H. Duval Cln.).
117. **Zerene cesonia cesonia* (Stoll, 1790), A-m-a-r (with winter f. *rosa* (M'Neill, 1889), and var. *stainkeae* Field, 1936).
Anteos maerula lacordairei (Boisduval, 1836), Travis Co. (N. Austin).
118a. **Kricogonia lyside lyside* (Godart, 1819), D-e-a-p (with winter f. *unicolor* Godman & Salvin, 1889).[26]
118b. *K. lyside terissa* (Lucas, 1852), R-nm-a-p (with f. *lanice* Lintner, 1885).
118c. *K. lyside fantasia* Butler, 1871, R-n-u-p.
119. *Eurema* (*Eurema*) *mexicana* (Boisduval, 1836), O-e-a-r (with winter f. *rosa* Whittaker & Stallings, 1944).
E. (*E.*) *daira daira* (Godart, 1819), Travis Co. (Austin).
120. *E.* (*Pyrisitia*) *proterpia* (Fabricius, 1775), R-n-a-p (with winter f. *gundlachia* (Poey, 1851)).
121. *E.* (*P.*) *lisa* Boisduval & LeConte, 1829, C-m-a-r (with summer f. *immaculata* Whittaker & Stallings, 1944, and female var. *alba* Strecker, 1878).
122. *E.* (*P.*) *nise nelphe* (Felder, 1869), R-n-s-p (14:x:76; 11:xi:80).
123a. **E.* (*Abaeis*) *nicippe nicippe* (Cramer, 1780), C-m-a-r (with winter f. ventrally orange, and female var. pale orange).
123b. *E.* (*A.*) *nicippe flava* (Strecker, 1878), N-w-s-r (19:x:71).[27]
124a. *Phoebis* (*Callidryas*) *sennae eubule* (Linné, 1767), L-sw-a-p (with female var. *browni* Field, 1936).
124b. *P.* (*C.*) *sennae sennae* (Linné, 1758), N-w-a-p.
124c. *P.* (*C.*) *sennae marcellina* (Cramer, 1777), R-nm-a-p (with female var. *yamana* Reakirt, 1863).[28]
125. *P.* (*C.*) *philea* (Johansson, 1763), R-m-s-p (10:x:71; L. Gilbert).
126. *P.* (*Phoebis*) *agarithe maxima* (Neumoegen, 1891), R-m-a-p (with female var. *albarithe* Brown, 1929).
Aphrissa statira statira (Cramer, 1777), Travis Co. (Northwest Hills).
127. **Nathalis iole* Boisduval, 1836, A-m-a-r (with winter f. *viridis* Whittaker & Stallings, 1944).

FOOTNOTES TO LIST OF BUTTERFLIES ON BARTON CREEK

[1] *Hesperia tamenund* Edwards has been treated as a subspecies of *Papilio thraso* Jung, 1792 which is a junior homonym. *Papilio mithridates* Fabricius, 1793 is the oldest name for the species (H. Ebert, 1969, J. Lepid. Soc. 23, Suppl. 3: 38).

[2] *Nisoniades llano* Dodge, described from Llano Co., refers to the Central Texas populations which are subspecifically distinct from *Thanaos invisus* Butler & Druce, 1872 which ranges north to Tamaulipas and strays into the Rio Grande Valley.

[3] Species allied to *Papilio oileus* Linné, fall outside the genus *Pyrgus* as revised by B. C. S. Warren (1926, Trans. Entomol. Soc. London, 74: 152). By genitalic structure they fit best in *Tuttia* Warren, 1926. This genus was sunk in *Muschampia* Tutt, 1906 (e.g., C. G. Higgins & N. D. Riley, 1970, Field Guide to the Butterflies of Britain & Europe. Boston) for which F. Hemming (1967, Bull. British Museum Nat. Hist., Entomology, Suppl. 9: 300) has shown the correct name is *Syrichtus* Boisduval, 1834.

[4] *Pyrgus albescens* Plötz is distinguished genitalically from *Syrichthus communis* Grote, as are occasional intermediates interpreted as hybrids. Genitalic determination of males is made in the field using a 20× Seibert emoskop. A. W. Lindsey, E. L. Bell & R. C. Williams (1932, J. Sci. Lab., Denison Univ., 26: 46) are followed in recognizing subspecific status.

[5] Specific distinctness of *Papilio oileus* Linné and *Pyrgus philetas* Edwards has been supported on structural, ecological and geographic grounds by J. M. Burns & R. O. Kendall (1969, Psyche, 76: 453).

[6] H. A. Freeman (1969, J. Lepid. Soc. 23, Suppl. 1) reports different chromosome numbers (27) for *Megathymus coloradensis* (Riley, 1877) and (26) for *M. yuccae* (Boisduval & LeConte, 1833) and places *M. y. reinthali* Freeman, 1963 with *coloradensis* rather than with *yuccae*.

[7] *Pamphila licinus* Edwards, 1871, described from Waco (Belfrage clr.) although recently treated subspecifically under *Hesperia metea* Scudder, 1863 by MacNeill (*in* Howe et al., 1975, Butterflies of North America. New York) is considered distinct following Lindsey, Bell & Williams (loc. cit.) until data is available from connecting localities.

[8] This subspecies occurs on southern extensions of tall grass prairie developed as glades on fluvial terraces on and west of the Balcones Fault Zone. The next subspecies occurs on Fayette prairie, a facies of the Southeastern Coastal Plain prairies. The first is identified with *Hesperia iowa* Scudder (type locality: Denison, Iowa); the second with *H. arogos* Boisduval & LeConte (type locality: "North America," probably Georgia), determination and subspecific ranking following A. B. Klots (1951, Field Guide to the Butterflies. Boston) rather than MacNeill (loc. cit.).

[9] Subspecific recognition follows W. S. McAlpine (1971, J. Res. Lepid., 10: 28) rather than the lumping of J. A. Powell (*in* Howe et al., loc. cit.). The allolectotype, fig. 6 of F. M. Brown (1968, Trans. American Entomol. Soc., 94: 130) is of the summer form.

[10] Here the synonymy of Powell (loc. cit.) is followed with added recognition that *guadeloupe* was based on the winter form more easily confused with the summer form of *C. nemesis*. *C. rawsoni* McAlpine, 1939 was based on the distinctive summer form of this species. Although convenient labels for ecologically important phenotypes, these names, when used for seasonal forms, are infraspecific and outside present zoological nomenclature.

[11] Specimens collected by Morgan Hebard, 23 miles east of Austin (Carnegie Museum Cln.) fall close to *mejicanus* and are the basis for this determination. One sight record (Travis Co., Austin, Northwest Hills, 13:x:68) resembled the Hebard specimens.

[12] W. T. M. Forbes (1960, Cornell Univ. Agric. Expt. Sta., Mem. 371: 133) is followed in recognition of subspecific distinctness of the northeastern entity associated with red cedar. Bastrop Co. material (associated with *Juniperus virginiana* var. *crebra* Fern. & Grisc.) was compared with series from Connecticut, New Jersey and North Carolina. This is distinct in color facies from the southern subspecies *gryneus* which is synonymous with *smilacis* Boisduval & LeConte, 1833. Texas material of this complex is routinely referred to *castalis* Edwards, 1871 (type locality: Waco) but the type seems indistinguishable from the summer form of southeastern *gryneus*. Our *gryneus* is associated both with *Juniperus silicicola* (Small) Bailey and with *J. ashei* Buchh. in lowland sites, perhaps favoring hybrid stands of these species.

[13] Our other species of *C.* (*Mitoura*) is associated with the upland phenotype of *J. ashei* which resembles *J. monticola* Martinez. Specimens were compared with the type series of *C. sweadneri* with which our winter brood is in close agreement. One specimen of our summer brood at Carnegie Museum (Austin, an old collection, possibly by C. T. Brues or J. F. McClendon) was placed under *C. siva* which it superficially resembles. K. Johnson (1978, J. Lepid. Soc., 32: 3–19) has not recognized three taxa in Central Texas.

[14] *Incisalia henrici* var. *solatus* Cook & Watson (type locality: Blanco Co., Texas) originally proposed as a "geographic variety" and formally accorded subspecific status by W. Barnes & J. H. McDunnough (1917, Checklist of the Lepidoptera of Boreal America. Decatur, Ill.) is here broadly sympatric, and often syntopic and synchronic with *C. henrici turneri* (Clench, 1943). The former normally utilizes buds, flowers and early pods of *Sophora secundiflora* as larval food, but when these are destroyed by late frost, it shifts to *Diospyros texanum*; the latter utilizes flowers and fruit of *Cercis canadensis* as larval food, with populations in Llano and Burnet Co. using *Lupinus texensis* Hook. Specific distinction is inferred from these differences and the lack of clearly intermediate individuals.

[15] As well as obviously seasonal variation, a suite of apparently genetically determined phenotypes occurs in our area. The most frequent of these is identified as *S. m. franki* (type locality: Lawrence, Kansas), and the next most frequent as *S. m. melinus* (type locality: coastal Georgia). The former is associated with drier and prairie sites; the latter with streamside herbaceous stands, particularly with *Hypericum* sp.

[16] H. K. Clench (1966, J. Lepid. Soc., 20: 65–66) is followed for treatment of our material. There is still not enough west Mexico topotypical material to resolve the need or not for recognition of *Callicista laceyi* Barnes & McDunnough, 1910 as eastern subspecies, queried by Clench.

[17] The correct name for this entity, formerly known as *Argus pseudargiolus* Boisduval & LeConte, 1833 has been clarified by H. K. Clench & L. D. Miller (1980, J. Lepid. Soc., 34: 103–119) who resurrect the same opinion of A. G. Butler (1900, Canadian Entom., 32: 91).

[18] This entity is not a subspecies of *E. comyntas* which also occurs this far and farther south. It is probably conspecific with *E. herri* (Grinnell, 1901) but not with *E. amyntula* (Boisduval, 1852) but this remains to be properly demonstrated.

[19] The correct name for this entity is uncertain. Edwards (1877, Trans. American Entomol. Soc., 6: 10) was probably correct in considering Arizona material conspecific with *P. americus* Kollar, 1850. *P. coloro* Wright, 1906 may refer to the California subspecies currently called *P. rudkini* J. A. Comstock, 1935. All material seen from east of the continental divide and north of latitude 30° is of f. *clarki*. *P. americus stabilis* Rothschild & Jordan, 1906, which more closely resembles *P. coloro*, ranges north from eastern Mexico to Bexar and Comal Co's. in Texas. Brown's (1942) f. *pseudoamericus* is an aberrant *P. polyxenes asterius* quite unrelated to the entity in question.

[20] These three *Libytheana* taxa have been frequently confused (e.g., Howe, 1975, loc. cit.: 258, pl. 47, f. 14, 15,

presents *L. bachmanni larvata* as *L. carinenta mexicana*). Heitzman & Heitzman (1972, J. Res. Lepid., 10: 284) give good figures for determination of the North American mainland species.

[21] Thorne (1971, J. Res. Lepid., 9: 101) is followed in treatment of the *P. coenia* complex and all males were genitalically determined. Work by Clench, continued by Harvey suggests that *P. evarete* (Cramer, 1780) is an additional species distinct from our three. Infrequent intermediates between *P. g. genoveva* and *P. g. zonalis* suggest conspecificity; *genoveva* occurs south of, and *zonalis* east of our area. De Lesse (1952, Bull. Soc. Ent. France, 57: 74) is followed in recognition of *Junonia* but only at the subgeneric level.

[22] By genitalia and venation *L. bredowii eulalia* is close to the type species of *Limenitis*, *L. populi* (Linné, 1758). As demonstrated by G. D. H. Carpenter & B. M. Hobby (1944, Trans. Royal Entomol. Soc. London, 94: 311–346) it is not an *Adelpha*, that genus being closer to *Parthenos*. Species related to *L. astyanax* (Fabricius, 1775) have been separated generically from *L. bredowii* (e.g., dos Passos, 1964, Lepid. Soc. Mem. 1) but the available name *Basilarchia* Scudder, 1872 is here used subgenerically.

[23] *L. a. archippus* is the plains and northeastern subspecies which ranges south to the Rio Grande in West Texas. *L. a. watsoni* is the Gulf Coast subspecies which ranges west to the Rio Grande, meeting *archippus* in Travis and Zapata Co's. Here populations of one or the other wax and wane with little intergradation.

[24] *Neonympha* Hübner, 1818: 8 (type species: *Papilio areolatus* Abbot *in* Smith, 1797) is senior by page to *Euptychia* Hübner, 1818: 20 (type species: *E. mollina* Hübner, 1818). W. Forster (1964, Veröffentlichungen der Zoologischen Staatssammlung, München, 8: 88–89) is followed in specific distinction of *hermes* and *sosybius*, although his genus *Hermeuptychia* seems no more than subgenerically distinct from *Neonympha*.

[25] G. Talbot (1928, Bull. Hill. Museum, 2: 195) pointed out that *Papilio monuste* Linné, with which our species has been identified, is actually *Udaina cycnis* Hewitson. *Papilio phileta* Fabricius, 1775 is the oldest available name.

[26] The entities *lyside*, *terissa*, and *fantasia* have geographically recognizable ranges that overlap only in northeast Mexico and Texas, and then only during migration. N. D. Riley (1972, J. Lepid. Soc., 26: 228) determined that *Papilio castalia* Fabricius, 1793 is a junior synonym of *P. drusilla* Cramer, 1777, and the entity that has been known as *castalia* (e.g., J. L. de la Torre y Callejas, 1958, Univ. de Oriente (Cuba), Dept. Ext. y Relac. Cult., 42: 24) should be referred to the appropriate senior available name, *Gonepteryx terissa* Lucas, 1852.

[27] Holland (1932, The Butterfly Book. New York) figures a male of this entity (pl. 37, f. 5). L. Harris (1972, Butterflies of Georgia. Norman, Oklahoma) reports three collections from Georgia, including three males and two females. Originally described as a species, in recent usage (e.g., C. P. Kimball, 1965, Lepidoptera of Florida. Gainesville) this name has been erroneously applied to the light var. of the orange female from which the true *flava* may be distinguished by the cold yellow tone resembling *E. boisduvaliana* Felder & Felder, 1865 with which it may be confused on the wing.

[28] Some years *eubule*, *sennae*, and *marcellina* are all absent. In other years a combination of one to rarely three are present. The low frequency of intermediates between *eubule* and the other two denies a clinal relationship and may ultimately prove specific distinction.

Faunal history. Micropaleoentomological studies in progress indicate that in this region, pluvial and interpluvial climates were out of phase with glacial and interglacial climates of the north. River terrace deposits (largely gravel) appear to represent interpluvial time. They were deposited when sea level stood higher than today and river gradients were adjusted upward. Accumulation took place during infrequent severe storms in a period of semiarid climate during later interglacial and early glacial times. Interpluvial times appear to have occupied much more of the Pleistocene Epoch than did pluvial times. The former were times of plains and desert communities in our area and of isolation of relict pockets of woodland biota. Pluvial times were brief episodes of dispersal between relict woodlands and influx of Sierra Madre montane and eastern deciduous forest elements during cool pluvial time, and tropical forest elements during warm pluvial time. Periodic colonists are of course in a state of flux, dependent upon minor climatic fluctuations of the recent past. Our resident species may be analyzed in terms of a tentative schedule of late Pleistocene episodes based on data published for Hershop, North Soefje, and Rutledge Bogs in Gonzales Co., Boriack and Patschke Bogs in Lee Co., South Gause and North Gause Bogs in Milam Co., and Franklin Marsh in Robertson Co. (Durden, 1979).

For the last 4000 years our regional fauna has probably been much the same as present under moderate and dry climate with reduction of periodic colonists from the south during the "Little Ice Age". From 6000 to 4000 years ago the climate was moderate and not quite so dry. A few periodic colonists may have assumed resident status. From 8000 to 6000 years ago the climate was moderate and nearly as dry as present, with presumably almost the same fauna. From 9200 to 8000 years ago the climate was moderate and moist, with probable resident status for a few of our southern and eastern periodics. From 9700 to 9200 years ago the climate appears to have been hot and dry. The Austin regional fauna at this time probably resembled that of the lower Rio Grande Valley with 270 or more species of butterflies. Our relict populations of species with Tamaulipan (Durden, 1974) affinities probably date from this time. These include *Systasea pulverulenta, Ancyloxipha arene, Apodemia mormo mejicana, Strymon alea, Thessalia theona bollii, Texola elada ulrica, Phyciodes vesta, Asterocampa louisa*, and *Neonympha hermes*. The Travis Co. (Turkey Bend) population of *Papilio rudkini* f. "clarki" probably arrived from the Chihuahuan and Sonoran Deserts at the same time. From 11,500 to 9700 years ago the climate was warm and arid, and some of the previously mentioned species may have established residency this early. From 12,800 to 11,500 years ago the climate was cooler than the present and dry. Our resident species of Gulf Coastal prairie and savanna distribution probably date from this episode. These include *Thorybes confusis, T. bathyllus, Erynnis zarucco, Hesperia meskei, Atrytone arogos arogos, Amblyscirtes alternata* and *Cyllopsis gemma gemma*. Species of Great Plains distribution probably date largely from this time also. These include *Pholisora catullus, Copaeodes aurantiaca, Hesperia viridis, H. attalus, Atrytone arogos iowa, A. delaware lagus, Amblyscirtes nysa, A. eos, Phaeostrymon alcestis, Strymon melinus franki*, and *Brephidium exilis exilis*. From 14,000 to 12,800 years ago the climate was warm and very wet. We appear to have no tropical species surviving here from this episode, but some of the Gulf Coast swamp-woodland species may go back this far. These include *Syrichtus oileus, Strymon melinus melinus, Limenitis archippus watsoni, Asterocampa celtis alicia*, and *Eurema nicippe flava*. At this time dwarf palmetto reached Barton Creek where it is now disjunct some 100 km from the nearest Coastal Plain stand down river. From 15,000 to 14,000 years ago the climate was moderate and wet. From 16,000 to 15,000 years ago and possibly as early as 22,000 years ago the climate was cool and moist. This appears to be the episode from which date both our relicts of Virginian distribution and of Sierra Madre montane distribution. The former include *Thorybes pylades*, *Erynnis meridianus*, *E. juvenalis juvenalis*, *E. martialis*, *E. baptisiae*, *Ancyloxipha numitor*, *Polites themistocles*, *Poanes viator*, *Feniseca tarquinius*, *Satyrium calanus falacer*, *Callophrys gryneus auburniana*, *C. henrici turneri*, *Panthiades m-album*, *Celastrina ladon*, *Pterourus troilus*, *P. glaucus*, *Polygonia comma*, *Chlosyne nycteis*, *Limenitis astyanax*, *Neonympha sosybius* and *Anthocharis midea annickae*. The latter include *Epargyreus clarus* subsp., *Achalarus coyote*, *Cogia outis*, *Gesta invisus llano*, *Hesperia woodgatei* subsp., *Amblyscirtes aenus*, *A. erna*, *A. celia*, *Calephelis guadeloupe*, *C. sinaloensis nuevoleon*, *Callophrys sweadneri* subsp., *C. solatus*, *Pterourus multicaudatus*, *Nymphalis antiopa lintneri*, *Siproeta stelenes biplagiata*, *Phyciodes tharos distincta* and *Eurema mexicana*. However, many of these appear to have persisted in our area over several interglacials, as have such species of similar affinities as *Megathymus coloradensis kendalli*, *M. c. reinthali*, *Hesperia licinus*, *Calephelis nemesis australis*, *C. perditalis* and *Everes texana*. Before 22,000 years ago there appear to have been long episodes of climate much cooler than present and rather arid. Some of our species of Great Plains affinities may go back this far, but the only one that certainly dates from this time is the Blanco Co. (Round Mountain) population of *Erynnis burgessi*. Our fauna at that early and mid-glacial time must have been impoverished, resembling that of the Davis or Guadalupe Mountains with their montane endemic elements represented by our own canyon relicts.

The butterfly fauna of the Austin area is the result of opportunistic colonization under each changed climate, with the persistence of relict populations in reduced habitats through subsequent unfavorable climatic episodes. Our endemic taxa, most of which are shared with the mountains of northern Coahuila, Mexico, are the few lineages that have persisted through much of the Pleistocene and probably longer. The community to which they belong includes relict plants such as *Berberis swaseyi* Buckl. which find their roots in the Oligocene biota of Florissant, Colorado.

Potentially threatened or endangered taxa. None of the species that occur in the study area appear to be threatened by normal collecting for scientific or recreational purposes. The greatest hazard to all species of exacting habitat requirements is destruction of habitat. One of the six known stations for *Calephelis sinaloensis nuevoleon* in the United States is now an apartment complex and parking lot with no butterflies. This species with only two known additional stations in Mexico should be watched closely. The study site on Barton Creek is a protected station that should be preserved by nondevelopment of the brush and chaparral where *Eupatorium hava-*

nense, the presumed larval food plant, grows. *Bernardia myricaefolia*, the larval foodplant of *Strymon alea*, is equally vulnerable to habitat destruction. The grassland species, *Hesperia woodgatei* and *Everes texana*, are susceptible to loss of foodplant through grazing. One colony of the latter in Travis Co. (Bull Creek) is gone through overgrazing by horses.

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EPILOGUE. Since May 1980 *Thessalia theona* has been taken at the study site and *Pterourus palamedes* (Drury, 1770) has been seen in Austin, raising the known local fauna to 128 species and the regional fauna to 173 species. Development adjacent to the study site has caused silting of the waterholes, massive bacterial contamination of the springs, and loss of cliff habitat replaced by condominium projects.