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A Description of a New Subspecies of *Lycaena phlaeas* (Lycaenidae: Lycaeninae) from Montana, United States, With a Comparative Study of Old and New World Populations

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Abstract: The Palaearctic, Oriental and Ethiopian Region subspecies of *Lycaena phlaeas* are briefly discussed. A more detailed account of the North American subspecies is presented, and a new subspecies, *L. p. weberi*, from the Sweet Grass Hills, Montana is described. The possibility that the eastern United States subspecies *hypophlaeas* was introduced from the Old World is discussed; however no conclusion can be reached with certainty. The relationship between Old World and New World subspecies of *L. phlaeas* is discussed. Evidence presented supports the treatment of New World populations as subspecies of *L. phlaeas*.

Additional key words: Polygonaceae, *Rumex acetosella, R. acetosa, R. crispus, Oxyria digyna*.

INTRODUCTION

Lycaena phlaeas (Linnaeus, 1761) is a widespread species with subspecies in Europe, North Africa, Arabia, northern Asia, Japan, North America and tropical Africa. The nominate subspecies occurs in northern Europe (Ackery *et al*., 1995). Shields & Montgomery (1966) mentioned that European texts list Polygonaceae (*Rumex* and *Polygonum*) as larval foodplants for *L. phlaeas* subspecies. Flight period is April to November, in one to four generations, depending on local conditions; over-wintering is in the larval stage (Tuzov, 2000). Bridges (1988) listed 19 subspecies in his catalogue, not including the North American ones. Miller and Brown (1981) listed five subspecies for North America. Ford (1924) attempted to cover the world-wide geographic races of *L. phlaeas*, but the emphasis was on the Old World taxa. He only discussed two taxa from North America, *hypophlaeas* Boisduval and *feildeni* M'Lachlan. Shields & Montgomery (1966) discussed the distribution and bionomics of *L. phlaeas* subspecies in North America, as did Ferris (1974), with the description of a new subspecies, *arctodon*. Two more recent papers also discussed taxa in *L. phlaeas*. Emmel *et al*. (1998) discussed *hypophlaeas*, with lectotype designation and type locality restriction; and Emmel & Pratt (1998) gave a new name, *alpestris*, to the California population. The Palaearctic, Oriental and Ethiopian Region subspecies will be briefly discussed below. The North American subspecies will receive a more detailed accounting and a new subspecies will be described. There has been speculation that the eastern United States populations were introduced from the Old World by human agency. There has also been speculation by some authors that the North American subspecies are not *phlaeas*, but constitute a different species. These theories will be discussed below.

PALAEARCTIC, ORIENTAL AND ETHIOPIAN SUBSPECIES

This section is presented to provide information pertinent to the discussion at the end of this paper and in the hope that more light may be shed on the relationship between the Old World and New World representatives of *L. phlaeas*. It is not intended to be an extensive and complete treatise on the Old World subspecies of *L. phlaeas* and there may be unintended omissions.

***Lycaena phlaeas phlaeas* (Linnaeus, 1761).** TL: Westermannia, central Sweden. The nominate subspecies is widespread and common in Europe from south of the Arctic Circle to all of the larger Mediterranean islands and island groups as well as NW Africa (Tolman & Lewington, 1997, plate. 21). Typical specimens are shown in **Figs. 1-16** of this paper. Probable synomyms of *phlaeas* are *comedarum* (Grum-Grshimailo, 1890) (East Pamirs); *oxiana* (Grum-Grshimailo, 1890) (Bokhara, Pamirs); *stygianus* (Butler, 1880) (West Pamirs, Baluchistan to Chitral and Ladak).
Material Studied: NORWAY: Skjeberg, Grimsoy, 28 July 1990, 1♂; Els 20, Tune, Rakil, 6 June 1990, 1♂, T. J. Olsen Coll. **ROMANIA:** Hagieni Forest nr. Mangalia, 6 June 1984, 7♂♂ 3♀♀, A. Popescu-Gorj Coll. **GERMANY:** R/M Hesse, Rhein Main Air Base, 3 August 1971, 1♂ 1♀, R. L. Hardesty Coll. **FRANCE:** Aveyron: Naucelle Lespinassolle a Chateau d' eau, 5200m, 12 July 1990, 2♂♂, 20 July 1990, 2♂♂, J. Moonen Coll.; Bretagne: Morbihan Arradon, 10 August 1987, 1♂, J. Moonen Coll.; Vaucluse: Luberon, 17 July 1983, 6♂♂ 4♀♀. **SPAIN:** Barcelona, 4 March 1980, 1♂; Sierra Nevada, 1300m, 20 June 1988, 1♀, J. Munoz Sariot Coll.; Madrid: Casa de Campo, 28 July 1984, 1♂, A. Sanchez Conde Coll. **ENGLAND:** Essex, Purfleet, 30 July 1924, 1♀, 6 August 1924, 1♂, 10 August 1926, 1♀; Surrey, 27 July 1924, 1♂. **ITALY:** Vergato, 3 May 1984, 3♂♂, D. Cappelli Coll.

***Lycaena phlaeas abbottii* (Holland, 1892).** TL: "Eastern Africa". It is found in northern Malawi, Tanzania and Kenya (Ackery *et al*., 1995), and was treated as a distinct species by Kielland (1990). It is illustrated in D'Abrera (1980, p. 525).

***Lycaena phlaeas baralacha* (Moore, 1884).** TL: Baralacha Pass, 4875m, Ladak. It occurs in the outer Himalayas (Kashmir-Kumaon) and Nepal (Shields, 1982).

***Lycaena phlaeas coccineus* (Ford, 1924).** TL: Tian-Shan. Illustrated in Ford (1924, pl. LIV, figs. 3-4).

***Lycaena phlaeas chinensis* (C. Felder, 1862).** Central China (Bridges, 1988). This subspecies is illustrated in Ford (1924, pl. LIV, figs. 10-11) and Tuzov (2000, pl. 57, figs. 28-30).

***Lycaena phlaeas daimio* Seitz, 1908.** TL: Japan (Bridges, 1988). Representative specimens are shown in **Figs. 25-28.** Also illustrated in Ford (1924, pl. LIV, fig. 9) and Tuzov (2000, pl. 57, figs. 31-33).
Material Studied: JAPAN: Aomori: Kanagi, 16 August 1973, 2♂, A. Kitagawa Coll.; Hokkaido: Maruszppu, 7 June 1987, 1♂, Y. Yazaki Coll.; Hokkaido: Yudetsu, 27 August 1987, 1♀, Y. Yazaki Coll.; Kuroishi City, 28 July 1991, 1♂, K. Dorbashi Coll.; Miyazaki Omo, 2 June 1979, 1♂, A. Kitagawa Coll.; Nagano: Hotaka, 8 June 1978, 1♀, A. Kitagawa Coll.; Saitama: Koma, 23 April 1977, 5♂♂ 1♀, 3 May 1978, 1♀, A. Kitagawa Coll.; Saitama: Dairokutenjin Iwatsuki, 21 April 1981, 2♂♂ 2♀♀, S. Ohshima Coll.; Tochig: Shiobara, 1 June 1978, 1♀, A. Kitagawa Coll.; Yamanashi: Shibiro, 5 July 1989, 1♀, K. Dorbashi Coll.

***Lycaena phlaeas eleus* (Fabricius, 1798).** A representative male specimen is shown in **Figs. 17-18.**
Material Studied: MALTA: Buckett, June 1987, 1♂, P. Samut, Collector.; Miseb, 26 May 1986, 2♂♂, P. Samut Coll.; San Giljan Valley, 24 May 1986, 1♂, P. Samut Coll.

***Lycaena phlaeas ethiopica* (Poulton, 1922).** TL: Uganda: 6000', in the extreme SW of Uganda; high country near Lake Kivu and between it and the northern end of Tanganyika. Distribution includes alpine areas in the Ruwenzori Mountains of the Kigezi District of south-western Uganda, adjoining areas of Zaire, and NW Tanzania (Ackery *et al*., 1995). It is illustrated in D'Abrera (1980, p. 525).

Figs. 1-20. Old World *Lycaena phlaeas* ssp. **Fig. 1.** *L. p. phlaeas*, Hagieni Forest nr. Mangalia, Romania, 6 June 1984, A. Popescu-Gorj Coll., ♂ dorsal. **Fig. 2.** Same, ventral. **Fig. 3.** Same, ♀ dorsal. **Fig. 4.** Same, ventral. **Fig. 5.** *L. p. phlaeas*, Skjeberg, Grimsoy, Norway, 29 July 1990, T.J. Olsen Coll., ♂ dorsal. **Fig. 6.** Same, ventral. **Fig. 7.** *L. p. phlaeas*, Naucelle Lespinassolle a chateau d'eau, 500m, Aveyron, France, 20 July 1990, J. Moonen Coll., ♂ dorsal. **Fig. 8.** Same, ventral. **Fig. 9.** *L. p. phlaeas*, Luberon, Vaucluse, France, 17 July 1983, ♀ dorsal. **Fig. 10.** Same. ventral. **Fig. 11.** *L. p. phlaeas*, Vergato, Italy, 3 May 1984, D. Cappelli Coll., ♂ dorsal. **Fig. 12.** Same, ventral. **Fig. 13.** *L. p. phlaeas*, Barcelona, Spain, 4 March 1980, ♂ dorsal. **Fig. 14.** Same, ventral. **Fig. 15.** *L. p. phlaeas*, Sierra Nevada, 1300m, Spain, 20 June 1988, J. Munoz Sariot Coll., ♀ dorsal. **Fig. 16.** Same, ventral. **Fig. 17.** *L. p. eleus*, Miseb, Malta, 26 May 1986, P. Samut Coll., ♂ dorsal. **Fig. 18.** Same, ventral. **Fig. 19.** *L. p. lusitanicus*, San Roque, Cadiz, Spain, 15 April, 1980, J.L. Torres Mendez Coll., ♂ dorsal. **Fig. 20.** Same, ventral. All figs. approximately 1.3X life size. Photos by Steve Kohler.

***Lycaena phlaeas flavens* (Ford, 1924).** TL: Lhasa, Tibet. The ventral hind wings are of an even shade of lemon-yellow, a unique feature. (Ford, 1924; Bridges 1988).

***Lycaena phlaeas ganalica* P. Gorbunov, 1995.** TL: Kamchatka, Russia (Tuzov, 2000).

***Lycaena phlaeas hibernica* Goodson, 1948.** TL: Ireland (Bridges, 1988).

***Lycaena phlaeas hyperborea* (Ford, 1924).** Arctic Norway (Bridges, 1988). This subspecies is illustrated in Ford (1924, pl. LIV, fig. 6).

***Lycaena phlaeas japonica* (Ford, 1924).** TL: Japan (Bridges, 1988). This subspecies is illustrated in Ford (1924, pl. LIV, figs. 2, 16). The type is in the Tring Zoological Museum.

***Lycaena phlaeas kuriliphlaeas* (Bryk, 1942).** TL: Kurile Island (Bridges, 1988).

***Lycaena phlaeas lusitanicus* (Bryk, 1940).** TL: Portugal (Bridges, 1988). Representative specimens are shown in **Figs. 19-22.**
Material Studied: SPAIN: Cadiz: La Linea, 28 February 1980, 1♂, J.L. Torres Mendez Coll.; Cadiz: San Roque, 16 January 1984, 1♂, 5 March 1982, 1♀, 15 April 1980, 1♂, 18 June 1983, 1♂, J.L. Torres Mendez Coll.; La Coruna: Choren Mellid, 24 May 1986, 1♀, E.H. Fernandez Vidal Coll.

***Lycaena phlaeas matsumuranus* (Bryk, 1946).** TL: Korea (Bridges, 1988). A representative male specimen is shown in **Figs. 23-24.**
Material Studied: KOREA: Seoul, 30 April 1986, 1♂, 3 May 1986, 1♂.

***Lycaena phlaeas phlaeoides* (Staudinger, 1901).** TL: Funchal, Madeira. Found only on Madeira (Tolman & Lewington, 1997). The rich brown, somewhat mottled color and jagged whitish postmedian band of the ventral hind wing on this subspecies are distinctive. It is illustrated in Ford (1924, pl. LIV, figs. 1, 8, 20) and Tolman & Lewington (1997, pl. 21).

***Lycaena phlaeas polaris* Courvoisier, 1911.** TL: Norwegian Lappland. Distribution is Arctic Fennoscandia (Tolman & Lewingson, 1997). It is illustrated on their plate 21. This subspecies is distinguished by the dove grey ventral hind wing ground color and the whitish postmedian band distally bordering the postdiscal series of black spots.

***Lycaena phlaeas pseudophlaeas* (Lucas, 1866).** TL: "Abyssinie". It is found in the Highlands of Ethiopia (Ackery *et al*., 1995). It is illustrated in D'Abrera (1980, p. 525).

***Lycaena phlaeas shima* Gabriel, 1954.** TL: Yemen: "Jebel Masnab, S. W. of Ma'bar, c. 8400 ft." It is found in the Highlands of south-western Arabia (Saudi Arabia and Yemen) according to Ackery *et al*. (1995). It is illustrated in D'Abrera (1980, p. 525).

***Lycaena phlaeas sibiricanus* Kozhanchikov, 1936.** TL: Siberia (Bridges, 1988).

***Lycaena phlaeas timeus* (Cramer, 1777).** TL: North Western Himalaya (Bridges, 1988). The relationship of *comedarum*, *oxiana*, and *stygianus* needs study.

Figs. 21-28. Old World *Lycaena phlaeas* ssp. **Figs. 29-40.** North American *Lycaena phlaeas* ssp. **Fig. 21.** *L. p. lusitanicus*, San Roque, Cadiz, Spain, 5 March 1982, J.L. Torres Mendez Coll., ♀ dorsal. **Fig. 22.** Same, ventral. **Fig. 23.** *L. p. matsumuranus*, Seoul, Korea, 3 May 1986, ♂ dorsal. **Fig. 24.** Same, ventral. **Fig. 25.** *L. p. daimio*, Koma, Saitama, Japan, 23 April 1977, A. Kitagawa Coll., ♂ dorsal. **Fig. 26.** Same, ventral. **Fig. 27.** Same, Iwatsuki, Dairakuteniin, Saitama, Japan, 21 April 1981, S. Ohshima Coll., ♀ dorsal. **Fig. 28.** Same, ventral. **Fig. 29.** *L. p. arctodon*, Beartooth Plateau, Carbon Co., Montana, U.S.A., 15 July 1989, S. Kohler Coll., ♂ dorsal. **Fig. 30.** Same. ventral. **Fig. 31.** Same, ♀ dorsal. **Fig. 32.** Same, ventral. **Fig. 33.** *L.p. arethusa*, Hailstone Butte, Alberta, Canada, 24 July 1980, J. Johnstone Coll. ♂ dorsal. **Fig. 34.** Same, ventral. **Fig. 35.** Same, Plateau Mountain, Alberta, Canada, 26 July 1980, N.G. Kondla Coll., ♀ dorsal. **Fig. 36.** Same, ventral. **Fig. 37.** *L. p. weberi*, Mount Royal, 6300-6900', East Butte, Sweet Grass Hills, Liberty Co., Montana, U.S.A., 30 July 2004, S. Kohler Coll., holotype ♂ dorsal. **Fig. 38.** Same, ventral. **Fig. 39.** Same, 5 August 2003, allotype ♀ dorsal. **Fig. 40.** Same, ventral. All figs. approximately 1.3X life size. Photos by Steve Kohler.

NORTH AMERICAN SUBSPECIES

Five subspecies of *L. phlaeas* occurring in North America are recognized. A sixth from the Sweet Grass Hills of Montana is designated below. Each of the subspecies is discussed, and material examined for this study is listed. Forewing length measurements (from the junction with the thorax to the wing apex) are given in millimeters. Ferris (1974, p. 6) used a table to enumerate the differences among the named subspecies, with the characters of dorsal forewing and ventral hind wing black spots; forewing black borders; dorsal and ventral hind wing orange borders; and ground color of dorsal forewing and ventral hind wing. This table was also referred to by Emmel & Pratt (1998). The table of Ferris is reproduced with revisions here as **Table 1.**

***Lycaena phlaeas hypophlaeas* (Boisduval, 1852).** TL: "Nord de la Californie. Il se retrouve dans tout le nord des Etats-Unis". It was restricted by Shields (1967) to northern California. It was further restricted to vicinity of Boston, Massachusetts by Emmel *et al*. (1998). The lone syntype specimen is in the U.S. National Museum (Emmel *et al*., 1998). The name *americana* Harris, 1862 is a junior synonym of *hypophlaeas* Boisduval. This non arctic-alpine subspecies was known for many years by the name a*mericana*; however, the work of several authors has clarified the correct name. Shields & Montgomery (1966) gave the English translation from Boisduval's description of *hypophlaeas* in French, which was first given by Wolley Dod (1907) as "North of California. It is found in all the northern United States". Thus they concluded the type locality is not "California" as listed by Klots (1951) and Comstock & Huntington (1960), and said they did not know of a precise locality for *hypophlaeas,* nor where the type specimen(s) were located. Shields (1967) then said that "north of California" should instead be translated "Northern California". He also said the probable type locality was "the Sierra Nevada Mountains, California". Ferris (1974) accepted the reasoning by Shields, and stated, "Boisduval's type of *hypophlaeas* is in the collection of the United States National Museum. The type was collected by J.M. Lorquin but does not bear exact locality information". Emmel *et al*. (1998) questioned the likelihood of *hypophlaeas* being from California. They reasoned: (1) The lone syntype in the U. S. National Museum collection is typical of the eastern United States phenotype and does not resemble any of the high-elevation California populations of *L. phlaeas*; and (2) Even if the type specimen was purported to represent an atypical variant of a California population, it is extremely unlikely that Lorquin collected in any of the current arctic-alpine habitats of this insect. Further, they reasoned that since Boisduval was aware of the presence of this insect in the eastern United States, he undoubtedly already had material from that region and may have assumed that the species occurred in northern California, without any Lorquin specimens to support this assumption. Thus, they concluded that the name *hypophlaeas* was applicable to the *L. phlaeas* populations of the eastern U.S., but not the ones from California. They designated the sole syntype as the lectotype and restricted the type locality to the vicinity of Boston, Massachusetts, an area known to have populations with a phenotype matching the *hypophlaeas* type, and an area which was, at the time, easily accessible to collectors providing material to European lepidopterists. Thus the name *americana* Harris, 1862 becomes a junior synonym of *hypophlaeas* Boisduval.

The subspecies *hypophlaeas* is widely distributed in eastern North America. Ferris (1974) gave its range (as *americana*) as Nova Scotia and The Gaspe west through Canada to central Ontario and Minnesota, south to Virginia and montane northern Georgia, Missouri and Kansas. One historical Cass County, North Dakota record exists (Royer, 2003). It is generally rare or temporary on the Great Plains westward. Marrone (2002) reported only three widely scattered South Dakota records. Layberry *et al*. (1998) show a record for southern Manitoba. Hooper (1973) mentions one record near Regina, Saskatchewan. Elrod (1906) said that C. A. Wiley found it not rare at Miles City, Montana. It has also been taken in eastern Colorado near Colorado Springs (Ferris & Brown, 1981). Habitat where *hypophlaeas* is most often found is disturbed areas, including vacant lots, weedy pastures, roadsides and lake shorelines.

Figs. 41-49. North American *Lycaena phlaeas* ssp. **Fig. 41.** *L. p .hypophlaeas*, Springdale, Sussex Co., New Jersey, U.S.A., 18 July 1978, W.B. Wright Coll., ♂ dorsal. **Fig. 42.** Same, ventral. **Fig. 43.** Same, ♀ dorsal. **Fig. 44.** Same, ventral. **Fig. 45.** *L. p. alpestris*, N. Slope Mount Dana, 11500', Mono Co., California, U.S.A., 6 August 1991, M. Grinnell Coll. ♂ dorsal. **Fig. 46.** Same, ventral. **Fig. 47.** Variation of some *L. p. weberi* paratypes from Mount Royal, East Butte, Sweet Grass Hills, Liberty Co., Montana, U.S.A. Left two columns ♂♂, right two columns ♀♀. **Fig. 48.** Variation of *L. p. arctodon* series from Beartooth Plateau, Carbon Co., Montana, U.S.A. Left two columns ♂♂, right two columns ♀♀. **Fig. 49.** Variation of *L. p. arethusa* series from Hailstone Butte and Plateau Mountain, Alberta, Canada. Left two columns ♂♂, right column upper one ♂, two lower ones ♀♀. Figs. 41-46 approxmately 1.3X life size, figs. 47-49 approximately 2/3 life size. Photos by Steve Kohler.

Klots (1951) reported the larval foodplants *Rumex acetosella* L. (Sheep Sorrel), *R. acetosa* L. and *R. crispus* L. (Curled Dock). Opler & Krizek (1984) described the life history. The pale-green eggs are laid singly on host leaves or stems. The young caterpillars chew holes in the underside of young host leaves and later make longitudinal channels. Development takes about three weeks and pupation is under leaves or rocks. Winter is spent as pupae. The caterpillars are covered with short hairs and are variably colored rose-red to green. There is a red dorsal stripe on some caterpillars. The chrysalis is light brown, tinged with pale yellow-green and spotted with black.

Allen (1997, pl. 33, p. 312) shows a photograph of the larva (as a*mericana*). In the northern parts of its range, *hypophlaeas* is bivoltine (June-early July and August-September) and probably has three broods everywhere to the south (mid-April through May, mid-June through July and mid-August through September). The ground color of the dorsal forewing of *hypophlaeas* is bright coppery red-orange, not brassy or brassy-red like the arctic-alpine subspecies (**Table 1**). Typical adults are shown in **Figs. 41-44.** Thirty-two males and 25 females were examined. Average forewing length of males was 12.3 mm, with a range of 11.5 to 14.5 mm. Average forewing length of females was 13.5 mm, with a range of 11.5 to 14.5 mm.

Material Studied: ILLINOIS: Palos Park, McMahon Woods, 23 May 1965, 8♂♂ 3♀♀, R. Arnold Coll.; **IOWA: Polk Co.:** Des Moines, 850', 9 July 1929, 1♀, 21 July 1929, 1♂ 1♀, 7 August 1932, 2♂♂, 21 August 1932, 1♂, 4 September 1927, 1♂, O. E. Booth Coll.; **MAINE: Penobscot Co.:** Passadumkeag, 10 June 1976, 1♂ 1♀, L.P. Grey Coll.; **MARYLAND: Alegheny Co.:** 6 mi. E. Flinstone, 12 May 1983, 1♀, T.A. Greager Coll.; **NEW JERSEY: Ocean Co.:** Lakehurst, 11 May 1978, 2♂♂ 6♀♀, W. B. Wright Coll.; **Sussex Co.:** Springdale, 16 July 1978, 2♂♂ 1♀, 18 July 1978, 4♂♂ 3♀♀, W.B. Wright Coll.; **PENNSYLVANIA: Elk Co.:** 3 mi. W. Dent's Run, 19 July 1983, 2♂♂, T.A. Greager Coll.; **Indiana Co.:** 1 mi. S. Clarksburg, 14 May 1977, 1♀, 2 mi. N. Shelocta, 5 July 1981, 1♀, 5 June 1983, 1♂ , 21 July 1983, 1♂, T.A. Greager Coll.; **Westmoreland Co.:** 1.5 mi. W. Greensburgh, 14 May 1979, 1♀, 22 May 1981, 1♀, 8 July 1977, 1♂, 2 August 1983, 1♂, T.A. Greager Coll.; **WEST VIRGINIA: Pendleton Co.:** Franklin, 24 July 1978, 1♂, 16 August 1976, 2♂♂, J.E. Dewey Coll.; **WISCONSIN: Juneau Co.:** Necedah Township, 5 June 1979, 2♀♀, 30 July 1979, 1♂ 1♀, T. Kral Coll.

***Lycaena phlaeas feildeni* (M'Lachlan, 1878).** TL: Grant Land, Northwest Territories, according to Miller & Brown (1981), who claimed the location of the type was unknown. However, Shields & Montgomery (1966) referencing Tite (1957), stated, "M'Lachlan (1878) described *L. p. feildeni* from two males and one female from 'Lat. 81° 45'. The British Museum of Natural History contains these three specimens which bear the label 'Grinell Land west side of Smith Sound, Arctic America 78-83 Lat. (81-45) Capt. Feilden R. N. 77-101' ". They also referenced Wolff (1964) stating that these were collected in 1875 or 1876. Ferris (1974) placed the type locality of *feildeni* as "Ellesmere Island, Lat. 81° 45'N". He showed the distribution of this subspecies to be the Hayes Peninsula of western Greenland; Ellesmere Island, Banks Island, Baffin Island, Simpson Peninsula, South Hampton Island and District of Keewatin, Northwest Territories, Canada. He also stated that the insect is poorly represented in collections with the few extant specimens placed primarily in the Canadian National Collection and the Natural History Museum (London). Layberry *et al*. (1998) included the arctic coast of Yukon Territories and Alaska in the distribution of *feildeni*, while Ferris (1974) considered these populations undescribed. The habitat of *feildeni* is tundra and the larval foodplant is *Oxyria digyna* (L.) Hill (Mountain Sorrel) (Ferris, 1974; Layberry *et al*., 1998). The subspecies *feildeni* is illustrated in Shields & Montgomery (1966, figs. 1 and 2, pp. 232-233); in Ferris (1974, figs. 10-16, p. 12); in Layberry *et al*. (1998, pl. 10, fig. 1). There is one generation per year. The dull brassy color of the dorsal forewing with smoky washed out aspect and the very small sometimes indistinct ventral hind wing black spots characterize this subspecies (**Table 1**). No specimens were examined in this study.

***Lycaena phlaeas arethusa* (Wolley Dod, 1907).** TL: "nr. Calgary, Alberta" in Miller & Brown (1981). Restricted to the head of Fish Creek, Alberta by Kondla (1996). After giving reasons for restricting the type locality, Kondla (1996) stated, "the locality was near Billings Lumber Mill as evidenced by label data on additional paratypes in the Canadian National Collection, collected on 19 and 20 July 1903. In a brief discussion about *L. phlaeas*, Wolley Dod (1904) stated, 'About fifteen specimens of this were captured near the spruce bush at the head of Fish Creek in southern Alberta' ". Kondla (pers. com., 2007) has offered new information concerning the types and type locality of *arethusa*. The statement by Shields & Montgomery (1966), "The holotype and allotype are in the U. S. National Museum and six paratypes are in the Canadian National Collection" is not correct, nor is "HT in USNM" in Miller & Brown (1981). Wolley Dod in the original description stated, "Described from five males and eight females. . . . Types, ♂ and ♀ in U.S. National Museum, the rest co-types." Wolley Dod did not designate one specimen as the name bearing type and so all extant specimens in the type series are syntypes. Also, since one of the syntypes

came from the "south fork of Sheep Creek", then the type locality should be amended to "the head of Fish Creek and the south fork of Sheep Creek, Alberta". Syntypes are in the U.S. National Museum and the Canadian National Collection. Layberry *et al*. (1998) gave the distribution of *arethusa* as from the Rocky Mountains of Alberta northward to Boreal Zone habitat in southern and central Yukon. A record by James Scott from 1962 (pers. corresp., Scott, 1975)—Logan Pass, Glacier National Park, Flathead/Glacier Counties, Montana is probably referable to this subspecies. Ferris (1974) in discussing the habitat and larval foodplant of *arethusa* according to J.A. Legge, Jr. and C.D. Bird, stated that "on Plateau Mountain south of Banff, Alberta, it flies in small grassy meadows at 8200' in association with *Oxyria digyna* and *Rumex alpestris* (Scop.)". The flight period is typically the first two weeks in August. The dull, red-brassy with smoky or dusky cast of the dorsal forewings in most males and the very small ventral hind wing black spots characterize this subspecies (**Table 1**). Typical adults are shown in **Figs. 33-36.** A range of phenotypic variation is shown in **Fig. 49.** For this study, seven males and two females were examined. Average forewing length of males was 13.1 mm, with a range of 12.5 to 14.0 mm. Average forewing length of females was 14.5 mm, with a range of 14.0 to 15.0 mm.

Material Studied: CANADA: ALBERTA: Hailstone Butte, 24 July 1980, 2♂♂, J. Johnstone Coll.; Plateau Mountain, 26 July 1980, 3♂♂ 2♀♀, 6 August 1979, 1♂, N.G. Kondla Coll.; Plateau Mountain, 8000', 14 August 1973, 1♂, L.P. Grey Coll.

***Lycaena phlaeas arctodon* Ferris, 1974.** TL: E. side Beartooth Pass, Carbon Co., Montana. The holotype is in the Allyn Museum of Entomology, now part of the McGuire Center for Lepidoptera & Biodiversity, Gainsville, Florida. Ferris (1974) gave the distribution of *arctodon* as "the Beartooth Plateau on the Park Co., Wyoming-Carbon Co., Montana border; the Teton Mountains, Teton Co., Wyoming; Yellowstone National Park on Mt. Washburn; and from the Lemhi Range, Lemhi Co., Idaho". He also referred specimens from Sweet Grass Co., Montana to this subspecies, and tentatively assigned a single male *phlaeas* from the Wallowa Mountains, Wallowa Co., Oregon to *arctodon*. Warren (2005) notes that the original Oregon record was a single male from Matterhorn Mountain and that additional Oregon populations have been found in similar habitats in other parts of the high Wallowas in Wallowa County referencing Pyle (2002). Here the butterfly flies over rockslides and talus slopes above 7500'. Since the description of *arctodon* by Ferris in 1974, it has been collected in the Wind River Mountains, Sublette Co. and Fremont Co., Wyoming (Harry, 1981), and the Big Horn Mountains, Big Horn Co., Wyoming. New localities in Carbon, Judith Basin, Silver Bow, Gallatin and Stillwater Counties, Montana have also been documented (**Fig. 56**). Records also exist for the Delano Peak area, Beaver and Piute Counties, Utah (Clyde Gillette, pers. com., 2007). Subspecies *arctodon* is found in lush moist alpine meadow habitat near or above treeline where the presumed foodplant, *Rumex acetosa* is found. At the type locality the plants grow in depressions in open meadows where some moisture remains from the spring snow melt. Harry (1981) described the habitat in the Wind River Mountains, Fremont Co., Wyoming as quite different from Beartooth Pass, "Here, the butterfly lives among the rocky slopes like that preferred by *Erebia magdalena*. This type of habitat is typical of where *Oxyria digyna* exists". Harry documented Mountain Sorrel as a larval foodplant at this location on the Bear's Ears Trail, collecting four larvae from it, and was able to rear one to adult. Later at the same location, he obtained 38 ova from an adult female and reared them to pupa on *O. digyna* from the Wasatch Mountains, Utah. The suspected foodplant, *R. acetosa*, at the Beartooth Pass type locality has subsequently been verified by Clyde Gillette (pers. com., 2007). The subspecies closest to *arctodon* in appearance is *arethusa*, but *arctodon* does not have the wide dark dorsal forewing borders exhibited by *arethusa* nor the smoky cast of the forewings of the males. The appearance of *arctodon* is much brighter than *arethusa*, and the dorsal hind wing blue spots are also more prominent. The black spots on the ventral hind wing of *arctodon* are more distinct than on *arethusa* (**Table 1**). Typical adults are shown in **Figs. 29-32.** A range of phenotypic variation is shown in **Fig. 48.** Scott (1986), p. 387) applied the subspecies name *polaris* Courvoisier, 1911 (TL: Norwegian Lappland) to all of the western United States populations, including California, ignoring the name *arctodon*. This should not be followed, as *polaris* represents Old World populations distributed in Arctic Fennoscandia that differ from any North

American populations in having extensive whitish spaces on the ventral hind wing distally from the postdiscal series of black spots (Tolman & Lewington, 1997, pl. 21). For this study, 50 males and 29 females of *arctodon* were examined. Average forewing length of males was 12.8 mm, with a range of 11.0 to 14.5 mm. Average forewing length of females was 13.5 mm, with a range of 12.0 to 14.5 mm.
Material Studied: MONTANA: Carbon Co.: nr. Beartooth Pass, 1 August 1973, 4♂♂ 5♀♀, 1 August 1974, 4♂♂ 2♀♀, S. Kohler Coll.; Beartooth Plateau, 13 July 2006, 8♂♂ 1♀, 14 July 2000, 3♂♂ 2♀♀, 14 July 2006, 15♂♂ 5♀♀, 15 July 1989, 7♂♂ 3♀♀, 16 July 1985, 1♂, 28 July 1976, 1♀, S. Kohler Coll.; Hellroaring Plateau, 31 July 1974, 1♀, S. Kohler Coll.; **Gallatin Co.:** above Fairy Lake, Bridger Mountains, 11 August 1986, 1♀, S. Kohler Coll.; **Silver Bow Co.:** Table Mountain, Highland Mountains, 24 July 1986, 1♀, S. Kohler Coll.; **Stillwater Co.:** Benbow Mine Rd., 17 mi. SW Fishtail, 9000', 18 July 1989, 4♂♂ 1♀, B. Vogel Coll.; above Mystic Lake, 15 August 1986, 4♂♂ 6♀♀, S. Kohler Coll.

***Lycaena phlaeas alpestris* J. Emmel & Pratt, 1998.** TL: north slope of Mt. Dana, 11,200-11,800', Mono Co., California. The holotype, allotype and nine paratypes are in the collection of the Natural History Museum of Los Angeles County, California. For a long time this subspecies was known as *hypophlaeas*, but as pointed out by Emmel *et al*. (1998), the lectotype of *Polyommatus hypophlaeas* in the U.S. National Museum does not resemble any California specimens and appears to be a typical example of *L. phlaeas* populations of the northeastern United States (see discussion of *hypophlaeas* above). They restricted the *hypophlaeas* lectotype to eastern U.S. populations of *L. phlaeas* and sunk a*mericana* Harris, the name those populations were long known as, to a junior synonym. This left the California populations of *L. phlaeas* without a name, which led to the description of *alpestris* by Emmel & Pratt (1998). The distribution of *alpestris* given by them is "the higher elevations of the Sierra Nevada from Fresno County and Inyo County on the south, north to Sonora Pass on the Tuolumne-Mono County line". They reference Shields & Montgomery (1966); D. Bauer & K. Davenport (pers. com.). Emmel and Pratt (1998) also recently discovered a population in the White Mountains along the California-Nevada border. This subspecies flies in a single brood from mid-July to mid-August, and the larval foodplant is *O. digyna*. Emmel & Pratt (1998) referred to the table by Ferris (1974) in summarizing the distinguishing characters of *alpestris*. The dorsal forewing ground color is a pale brassy red, often with a dusky aspect. The dorsal forewing spots are prominent and well developed and the outer margin borders tend to be narrow. A typical adult male is shown in **Figs. 45-46.** For this study, five males were examined. Average forewing length was 13.4 mm, with a range of 11.5 to 14.5 mm.
Material Studied: CALIFORNIA: Mono Co.: N. Slope Mt. Dana, 11,500', 6 August 1991, 5♂♂, M. Grinnell Coll.

Lycaena phlaeas weberi Kohler, new subspecies

During the winter of 2002-2003, Byron Weber of Missoula, Montana brought to my home a number of pinned butterfly specimens that he had collected in the area of the Sweet Grass Hills in Toole and Liberty Counties, north-central Montana. Looking through this material, I was very surprised to see two male *phlaeas* specimens that Byron had collected on the East Butte, Sweet Grass Hills, Liberty County. My experience with *L. phlaeas* in Montana prior to this had been in high elevation alpine habitats near or above timberline. Needless to say, the two large, very dusky specimens from below 7000' elevation Canadian Zone habitat on a Prairie Island Range mountain grabbed my attention. Plans were made to return to the area to obtain more specimens and study the population, which Byron and I did in August 2003. I made two additional trips to the area in 2004 and 2005 to accumulate an adequate study series.
Definition: Besides the larger size, the most striking characteristic of *weberi* dorsally is the extremely dark, dusky appearance. In many males, the copper ground color of the forewing is almost completely obscured by dark brown, which often obliterates the inner margin of the dark wing border. The dusky brown is also present in many of the females, causing them to appear much more dark and dusky than any *arethusa* females. The dark border of the forewings of both males and females of *weberi* is very wide, more so than any of the other subspecies (excepting possibly *hypophlaeas*), as a percentage of total wing

length (**Table 1**). The pattern of dorsal forewing blackish spots is also very distinct and heavy (**Figs. 37-40**). **Fig. 47** shows a range of phenotypic variation. Ventrally the ground color of the hind wing of *weberi* is a darker shade of warm gray than *arethusa*. This color is continued on the ventral forewing border and wing apex, where it is considerably darker than on *arethusa*, as well as the orange of the discal portion of the ventral forewing being brighter and more intense than on *arethusa*. The black spots on the ventral hind wing of *weberi* are as in *arethusa*, being very small with distal whitish edging present. However, further distally from these whitish spaces there are spaces that are darker than the rest of the gray ground color of the hind wing of *weberi*, forming an indistinct darker band and giving somewhat the impression of a two-toned hind wing. There is also darker gray-black in the hind wing tornus area of *weberi*, being fairly distinct and obvious, but only vaguely present on *arethusa*. The orange crenulate submarginal line on the ventral hind wing is bright, narrow and distinct on *weberi* (**Figs. 38, 40**), but is narrower and sometimes faint on *arethusa* (**Fig. 34**). The main differences between this new subspecies and the other named subspecies from North America are outlined in **Table 1**. Of the North American subspecies, *weberi* is most similar to *arethusa*, but larger. Forewing length of male *arethusa* studied averaged 13.1 mm, with a range of 12.5 to 14.0 mm, while *weberi* males averaged 14.5 mm, with a range of 12.5 to 15.5 mm. Forewing length of the male holotype is 15.0 mm. Forewing length of female *arethusa* studied averaged 14.5 mm, with a range of 14.0 to 15.0 mm, while *weberi* females averaged 15.2 mm, with a range of 13.5 to 16.0 mm. Forewing length of the allotype female is 15.5 mm.

Etymology: This subspecies is named for Byron Weber of Missoula, Montana, who discovered the population at the type locality, and whose interest in the Sweet Grass Hills and energy expended in exploring them are inspiring. Byron's grandfather, Harry Demarest, came to the Sweet Grass Hills from Nebraska around the turn of the 20th century. He worked on ranches and hauled freight with a team of 12 horses and homesteaded in 1910 just north of the town of Whitlash. Today the ranch spreads from East Butte to Middle Butte to the original homestead. As a child and young man, Byron spent his summers on the ranch in the hay fields, but his favorite times were spent alone along the willows of Breed Creek and on the native prairie, identifying wildflowers and birds and quietly observing the mammals. In 1995, he began to seriously study the butterflies of the area and now has several drawers of pinned butterfly specimens.

Distribution and Phenology: To date, this subspecies is known only from the type locality (**Fig. 56**). It flies in a single brood from late-July to mid-August. The adults are found in close association with *Rumex acetosa*, which is the presumed larval foodplant. A preferred nectar source is *Solidago multiradiata* Ait. (Goldenrod). In late July 2004, Byron Weber and I climbed the West Butte, Sweet Grass Hills, Toole County, which is similar in elevation to the East Butte, but much more of the terrain is dominated by rockslides. We did not find *weberi*, nor did we find the larval foodplant. There is some controversy about whether *R. acetosa* is native to North America. Moss (1983) discussed two subspecies of *R. acetosa* L., ssp. *acetosa*—gardens and waste places, introduced; and ssp. *alpestris* (Scop.) Löve—moist banks and meadows to alpine elevations, native, more or less circumpolar, Alaska, Yukon to Wyoming. This was confirmed by Lesica (2002) discussing *R. acetosa* in Glacier National Park, Montana,"Uncommon in moist meadows and talus slopes, upper montane to alpine; East, West. Our plants are ssp. *alpestris* (Scop.) Löve. Circumboreal south to OR, WY. A closely related ssp. is introduced from Europe and grown as a garden herb". Thompson & Kuijt (1976) reporting a study of the montane and subalpine plants of the Sweet Grass Hills stated of *R. acetosa*, "Collected from only one area, on the moist north-facing slope of Mount Royal where outcrops of Madison limestone have produced calcareous soils. Although this arctic-alpine species, native to the American Arctic, has been naturalized from Eurasia in the eastern United States, it is believed to occur as a relict in the Sweetgrass Hills rather than as a garden escapee, since it has been reported in the vicinity of Montana only from alpine or subalpine areas in Glacier Park, the Bear Paw Mountains, and the Beartooth Plateau". They also pointed out that arctic-alpine disjunctions are often correlated with calcareous substrates, and the close association of *R. acetosa* with soils derived from limestone in East Butte suggests its persistence there as an arctic relict.

Types: Holotype male: **MONTANA: Liberty County:** Mount Royal, 6300-6900', East Butte, Sweet Grass Hills, 30 July 2004, S. Kohler Coll. (**Figs. 39-40**). Allotype female: **MONTANA: Liberty Co.:** Mount Royal, 6300-6900', East Butte, Sweet Grass Hills, 5 August 2003, S. Kohler Coll. (**Figs. 41-42**). Paratypes (55♂♂ 33♀♀): **MONTANA: Liberty Co.:** nr. summit of East Butte, 6800', Sweet Grass Hills, 15 August 1996, 2♂♂, B. Weber Coll.; Mount Royal, 6300-6900', East Butte, Sweet Grass Hills, 5 August 2003, 6♂♂ 13♀♀, 30 July 2004, 24♂♂ 4♀♀, 28 July 2005, 28♂♂ 8♀♀, S. Kohler Coll.; 5 August 2003, 1♂ 7♀♀, B. Weber Coll.

Deposition of Types: The holotype male, allotype female, two male and two female paratypes will be deposited in the Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah. Three male and seven female paratypes are in the Weber collection, and the remaining paratypes are in the Kohler collection.

Type Locality: MONTANA: Liberty County: north slope of Mount Royal, East Butte, Sweet Grass Hills, from the summit (6914') down slope (north) to the saddle (6300') between Mount Royal and Mount Brown. The upper part is forested with spruce (*Picea glauca* × *engelamnnii*), whitebark pine (*Pinus albicaulis*), limber pine (*P. flexilis*) and lodgepole pine (*P. contorta*) (Thompson & Kuijt, 1976), and is fairly steep and rocky in places, but the lower slope towards the saddle is more gentle and open and supports open lush meadow (**Figs. 51-53**). The north-facing aspect of the slope allows the *R. acetosa* to grow on the upper parts (**Fig. 55**). The Sweet Grass Hills in the northern part of Liberty County near the Alberta-Montana border in north-central Montana are unique in that they are the highest isolated peaks in the United States. Of volcanic origin, the Sweet Grass Hills are prominent landmarks, rising nearly 3000' above the surrounding prairie with rolling hills extending to the north almost to the Alberta-Montana border. They are visible for more than 50 miles and consist of three distinct butte complexes with scattered grassy hills connecting them. The three buttes are West Butte (elevation 6983', on left); Middle or Gold Butte (elevation 6512'); and East Butte (elevation 6958', on right) with two smaller features (on far right), Grassy and Haystack Buttes (**Fig. 50**).

GENITALIC STUDY

Male genitalia of the following subspecies were dissected and subjected to microscopic examination: *L. p. phlaeas* (Romania: Hagieni Forest near Mangalia, 6 June 1984, A. Popescu-Gorj Coll., 1; France: Aveyron: Naucelle Lespinassolle a Chateau d' eau, 520m, 12 July 1990, J. Moonen Coll., 1); *L. p. eleus* (Malta: Miseb, 26 May 1986, P. Samut Coll., 1); *L. p. lusitanicus* (Spain: Cadiz, La Linea, 28 February 1980, J.L. Torres Mendez Coll., 1); *L. p. daimio* (Japan: Saitama, Koma, 23 April 1977, A. Kitagawa Coll., 1); *L. p. hypophlaeas* (Pennsylvania: Indiana Co., 2 mi. N. Shelocta, 5 June 1983, T.A. Greager Coll., 1); *L. p. alpestris* (California: Mono Co., N. slope Mt. Dana, 11500', 6 August 1991, M. Grinnell Coll., 1); *L. p. weberi* (Montana: Liberty Co., Mount Royal, 6300-6900', East Butte, Sweet Grass Hills, 30 July 2004, S. Kohler Coll., 1); *L. p. arctodon* (Montana: Carbon Co., Beartooth Plateau, 16 July 1989, S. Kohler Coll., 1); *L. p. arethusa* (Canada: Alberta, Plateau Mountain, 26 July 1980, N.G. Kondla Coll., 1). After careful examination, I found no genitalic characters that were useful in separating these taxa in this limited study. I concluded the male genitalia of these subspecies were virtually identical.

There have been few comparative studies of *L. phlaeas* subspecies in the literature. In Russia, Gorbunov (2001) noted the apical part of the valve of *chinensis* (C. Felder) was wider than in subspecies *phlaeas* and *ganalica*. Ford (1924) in reviewing Ethiopian populations, *abbottii* (Holland), *ethiopica* (Poulton) and *pseudophlaeas* (Lucas) concluded from the genitalic descriptions of T.A. Chapman that "the genitalia of these Ethiopian forms . . . do not differ from those of *H. phlaeas phlaeas* save in a slight diminution in size, most noticeable in the aedoeagus", signs of geographical variation. Ford (1924) also agreed with Chapman's conclusions regarding the genitalia of "*hypophlaeas* (Lapland and N. America) as specifically identical with *phlaeas*."

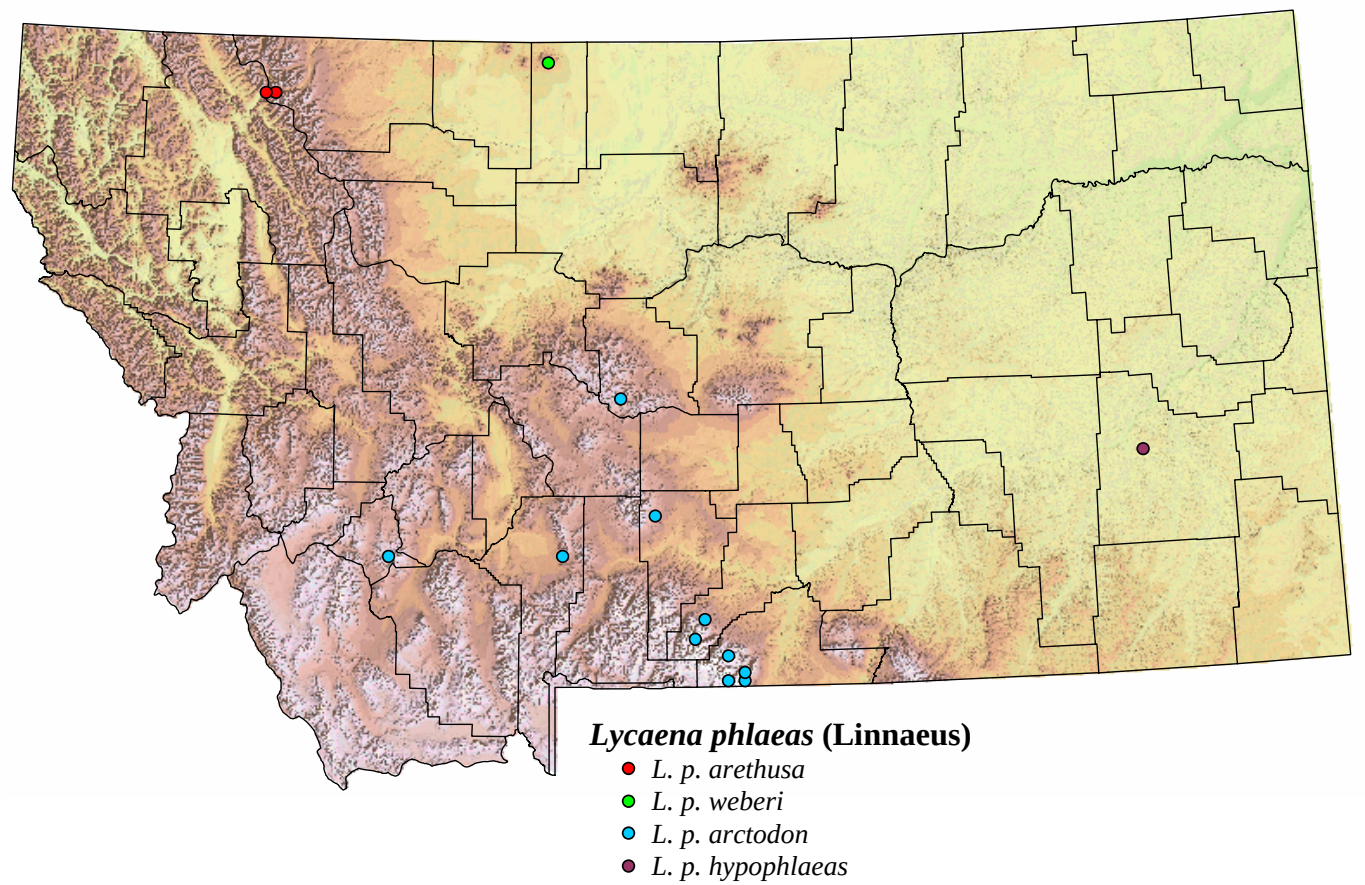
Table 1. Characteristics of North American *Lycaena phlaeas* (revised from Ferris, 1974)

Subspecies	FW Length		Black Spots		Black Borders	Orange Borders - HW		Color	
	males	females	Dorsal FW	Ventral HW	DFW	Dorsal	Ventral	DFW	VHW
hypophlaeas	12.3	13.5	Distinct. CS frequently fused, CES 1-1.5 mm wide.	Distinct. Postmedian row distally edged in white.	Wide, up to 15.5 % of wing width, measured along vein Cu1.	Wide & distinct.	Narrow, bright & strongly crenulate.	Bright red-orange copper.	Warm gray with suggestion of tan or light brown.
alpestris	13.4	-	Distinct. CS double or only slightly fused. CES 1 mm wide.	Distinct. Postmedian row with only suggestion of white edging distally.	Moderately narrow, 7.7% of wing width maximum.	Wide & distinct.	Very narrow, strongly crenulate & bright.	Pale brassy copper, dusky aspect especially in males.	Ashy-gray.
feildeni	-	-	Delicate. CS double, small & concave. 1♀ fused. CES less than 1 mm wide.	Very small & sometimes indistinct; distal white edging present.	Narrow, 7.2% of wing width maximum.	Relatively narrow but distinct.	Very narrow and frequently indistinct.	Dull brassy copper, smoky but washed out aspect.	Dark ashy-gray.
arethusa	13.1	14.5	Distinct. CS double & distinct. Generally concave out if fused. CES 1 mm wide.	Very small; distal white edging present.	Wide, up to 14.3% of wing width.	Wide & distinct.	Narrow & rather faint in some specimens.	Dull, red-brassy copper, very smoky or dusky cast in most males.	Warm ashy-gray, lighter areas in postdiscal cell spaces
arctodon	12.8	13.5	Distinct. CS varies; concave inward, outward or double. CES 1 mm wide.	Distinct; white edging nearly obsolete in most specimens.	Moderately wide, up to 10.6% of wing width.	Wide & distinct.	Very narrow, delicate, but distinct.	Bright red-brassy copper tending to coppery-red in females, dusky cast in many males.	Cool pale gray.
weberi	14.5	15.2	Distinct & heavy. CS sometimes double, frequently fused. CES 1.5-2 mm wide.	Very small; distal white edging present, often with dark spaces distally.	Wide, up to 21.2% of wing width.	Wide & distinct.	Narrow & distinct.	Dull, red-brassy copper, extensive dark suffusion in most males, considerable in many females.	Darker shade of warm ashy-gray
Northern Alaska & western NWT			Northern populations are like *feildeni*. Specimens tend to become larger, more heavily and brightly marked in south central Alaska (McKinley National Park). Orange band on both surfaces of the hind wing becomes quite wide and very distinct in McKinley National Park specimens. At least two populations are undescribed (Meade River and Fairbanks, Alaska).						

CS=Critical Spot. Character from Ford (1924). This is the spot which appears dorsally in space Cu2 of the forewings.
CES=Cell-End Spot. This is the spot at the end of the cell of the dorsal forewings.
FW=Forewing
HW=Hind Wing
DFW=Dorsal Forewing
VHW=Ventral Hind Wing

Figs. 50-55. Habitat of *Lycaena phlaeas weberi* at type locality. **Fig. 50.** Sweet Grass Hills, Montana, from the southwest, looking north toward Canada; from left, West Butte, Middle Butte (Gold Butte), East Butte, Grassy Butte, Haystack Butte. **Fig. 51.** Near the summit of Mount Royal, East Butte. **Fig. 52.** From the summit of Mount Royal looking north to the saddle and Mount Brown. **Fig. 53.** Looking back toward Mount Royal from the saddle. **Fig. 54.** *L. p. weberi* ♂ taking nectar from a preferred source, *Solidago multiradiata* (Goldenrod). **Fig. 55.** *Rumex acetosa*, presumed larval foodplant of *L. p. weberi*. Photos by Steve Kohler.

Fig. 56. Distribution of *Lycaena phlaeas* ssp. in Montana.



DISCUSSION

Opler & Krizek (1984) and Opler & Malikul (1992) suggested that the eastern United States population of *Lyaena phlaeas hypophlaeas* was introduced from Europe in Colonial times, reasoning that it is associated with waste places and introduced foodplants, *Rumex acetosella* (Sheep Sorrel) and occasionally *R. crispus* (Curled Dock) and it resembled European material. Other authors (Ehrlich & Ehrlich, 1961) have also put forth this theory. Layberry *et al*. (1998) pointed out, however, that unlike European specimens, subspecies *hypophlaeas* (as a*mericana*) has a pale gray rather than brown ventral hind wing, with larger more sharply defined black spots. They also stated that in Europe second-generation *phlaeas* tends to be duskier in color and have longer tails unlike subspecies *hypophlaeas*. I was not able to find illustrations or specimens of Old World *phlaeas* that completely matched *hypophlaeas* in appearance. Nominate *phlaeas* from Sweden is quite similar, as is subspecies *polaris* as figured by Tolman & Lewington (1997, pl. 21), except that *polaris* has extensive whitish spaces distally from the postmedian series of black spots on the ventral hind wing. Tuzov (2000) figures specimens on pl. 57, p. 337, from the Chita Region and Altais, Russia under the name *L. p. hypophlaeas*, both spring and summer generations. This is a very strange location for something conspecific with the eastern North American population. There are no intermediate populations. Perhaps it represents convergence rather than conspecificity (per. corresp., David Wright, 2007). From the dorsal aspect, these Russian specimens look similar to eastern United States *hypophlaeas*, and the forewings are not dusky in the 2nd generation, nor is there any evidence of long hind wing tails. Ventrally, the hind wing ground color is gray, very similar to Nearctic

hypophlaeas, though the black spots are not quite as large or distinct as in U.S. *hypophlaeas*. There are Old World populations of *L. phlaeas* that are similar-enough appearing to U.S. *hypophlaeas*, that this name has been applied by some authors (Tuzov, 2000), as well as by Wolly Dod (1907), who stated that "In the Staudinger Catalogue, Lapland, northern Scandinavia, Sajan-Geibel (Siberia), Amur and North America are quoted as localities for 'var. *hypophlaeas*', and some that I have bearing labels of some of those Old World localities would pass anywhere as North American specimens, amongst which there is also an occasional tendency to lose the spots, and so assimilate the typical European form". Some of the driving force for theories that eastern North American populations were introduced is the use of the name *hypophlaeas* for Old World populations that has persisted through the years. Ford (1924) in discussing *hypophlaeas* said, "Not only does it occur throughout the Nearctic Region, but it has an extended range in Arctic Europe and Asia. There is a specimen from Siberia in the Hill Museum, Witley, and two from Amurland in the Natural History Museum, South Kensington, while Staudinger also refers to specimens from the later country. There can be little doubt that this form will ultimately be found distributed along the north coast of Asiatic and European Russia, for it is known to occur in Lapland; there is a specimen from this locality in the Tring Zoological Museum (Plate LIV, fig. 21), another in the Hill Museum, together with one labeled 'Norway',which although it has no other data, must almost certainly have come from the extreme north-east of that country". Ford (1924, p. 739) then described subspecies *hyperborea* from arctic Norway and Lapland, saying that it was not found in Siberia or North America. He stated that specimens of *hyperborea* are far more frequent in collections than are Palaearctic examples of *hypophlaeas*, and that some confusion exists in the literature dealing with the Far Northern races of *phlaeas*. Although some individuals of some Old World populations of *L. phlaeas* are quite similar to North American *hypophlaeas*, none match completely the description as translated from the French [from Boisduval 1852] by Ford (1924), "Very near *phlaeas*, but smaller, with the spots more distinct, the wings more rounded. The under side of secondaries of an ashy whiteness, with the fulvous marginal band well marked". I am of the opinion that the name *hypophlaeas* should not be used for any of the Old World populations of *L. phlaeas*, and that currently there is no conclusive evidence that the North American populations were introduced from Europe. Pratt & Wright (2002) presented an alternate hypothesis to an introduction, positing that the eastern North American populations of *hypophlaeas* existed endemically in the high elevations of the White Mountains in New England and expanded their range with the introduction of *Rumex acetosella*. They said, "An expansion of this sort has been observed with alpine populations of *L. cupreus* and *L. editha*. Both of these species have broadened their range with the introduction of *Rumex acetosella* into western North America. Also high altitude California *L. phlaeas* from 12,000 feet elevation can be experimentally reared on *Rumex crispus* at 800 feet elevation (and lower), suggesting that the species has the ability to rapidly adapt to lowland conditions. *Oxyria digyna* is the primary host plant of arctic-alpine *L. phlaeas* in North America. This plant occurs locally at high elevations on Mount Washington in New Hampshire; the possible existence of high altitude *L. phlaeas* colonies there and elsewhere in New England has not been studied". If in the future, such colonies are discovered, it will certainly be a valuable key in solving the introduction question. For the present, I am not able to answer this question with certainty.

Do North American populations of *Lycaena phlaeas* represent a separate species? Evidence to support a single widespread *phlaeas* species in the Old and New World is available in the literature. Maeki & Remington (1960) showed the haploid chromosome number (n = 24) is the same for three subspecies of *L. phlaeas* from the Palaearctic (Japan, Finland) and the Nearctic (United States). There is at least as much adult phenotypic diversity among Old World subspecies as there is between the nominate *phlaeas* and New World subspecies. Even the most phenotypically divergent Old World subspecies, *phlaeoides*, *chinensis*, *matsumuranus*, and *daimio* are still generally treated as *phlaeas* subspecies. Genitalic studies also suggest conspecificity between Old and New World populations. Yet these facts may be inconclusive. Many lycaenid complexes have multiple species with identical genitalia and chromosome numbers (pers. com., David Wright, 2007). Keilland (1990) in his recent treatment of the three east African taxa elevated

abbottii from a subspecies of *phlaeas* to full species. The conclusion reached in the present study is that no real evidence exists to contradict the traditional placement of North American subspecies with Old World *phlaeas*. Perhaps future molecular studies will shed more light on how many species are involved.

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