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XANTHORHOE CLARKEATA (GEOMETRIDAE), A NEW SPECIES AND POSSIBLE ENDEMIC OF THE QUEEN CHARLOTTE ISLANDS, BRITISH COLUMBIA

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ABSTRACT. *Xanthorhoe clarkeata*, new species, of which 159 specimens were collected in 2 days in the Alpine Zone on Graham Island, is the first species of Lepidoptera reported only from the Queen Charlotte Islands. It is related to a holarctic species, *X. abrasaria*, but is easily distinguished by its usually reddish-brown coloring, greater color variability, strongly pectinate male antennae, and diurnal flight, as well as by genitalic differences. The new species may be a Pleistocene refugial relict. This aspect is discussed relative to what has been published on other endemic animals and plants of these islands, and on the biological evidence for a refugium there during the last glaciation.

Additional key words: taxonomy, biogeography, relict populations.

On a visit to the Queen Charlotte Islands, British Columbia, in July 1985, J. F. Gates Clarke of the U.S. National Museum of Natural History chartered a helicopter for two flights to the otherwise inaccessible mountains of the interior. His purpose was to investigate the Lepidoptera of the alpine tundra in these isolated ranges where no previous collections are known to have been made. One flight took him to 3100 ft (946 m) on a ridge near Mt. Brown, Graham Island, where he camped overnight. The other flight was a 1-day trip to a 3000 ft (915 m) ridge on Moresby Island. No butterflies and relatively few moths were present, but at the Mt. Brown locality a day-flying moth occurred in abundance. Dr. Clarke recognized it as something unusual, and he netted and pinned 159 specimens. Although virtually swarming above tree line on Graham Island, this species was not seen in similar habitats and under similarly favorable weather conditions on Moresby Island.

Comparison of these moths with all described North American species and subspecies and most palearctic species of *Xanthorhoe*, as well as with superficially similar taxa in other genera, leaves little doubt that it is undescribed. It is not a cryptic species but a distinctive one. I am pleased to name it after Jack Clarke, whose dedicated investigation of the Lepidoptera of the Queen Charlotte Islands led to its discovery and who collected all known specimens. Illustrations are by the author.

***Xanthorhoe clarkeata* Ferguson, new species**
(Figs. 1–11)

Diagnosis. A variable day-flying species found above tree line on the mountains of the Queen Charlotte Islands, British Columbia. The most characteristic feature of the forewing pattern is the banding of the median space, in which the antemedial line is followed and the postmedial line preceded by fairly wide and regular light reddish brown to nearly

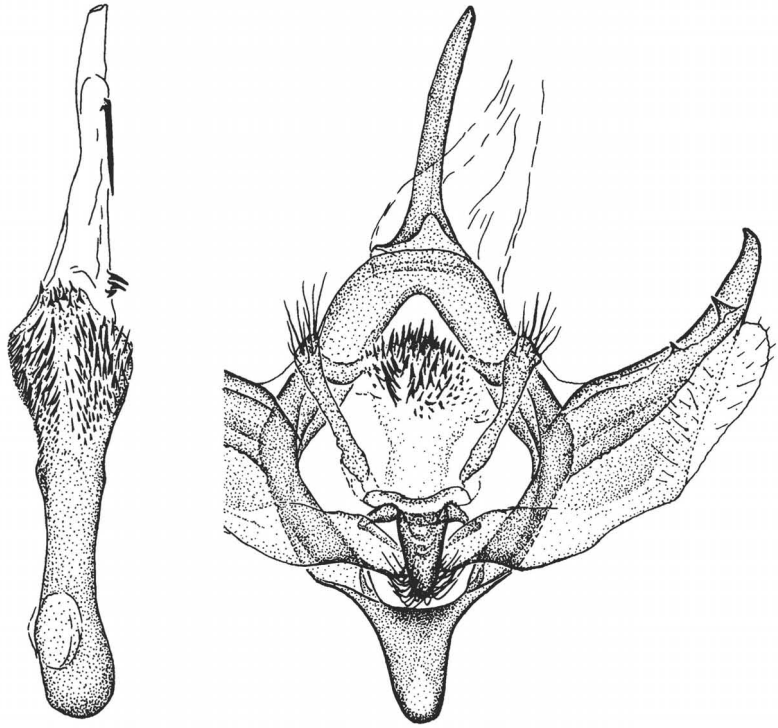


FIG. 1. Male genitalia of *Xanthorhoe clarkeata*. Aedeagus removed and shown in ventral view.

black bands that tend to constrict the much paler grayish central space between them. A small dark discal spot usually marks the center of what remains of the pale median space. Genitalia most resemble those of *X. abrasaria* (Herrich-Schaeffer) in general configuration, differing mainly in the shape or proportions of components, although one would hardly guess from external appearances that the two species were closely related. The usually reddish brown *clarkeata* has narrower, more pointed wings than the predominantly gray and black *abrasaria*, and its male antennae are bipectinate (heavily setose but not bipectinate in *abrasaria*). *Xanthorhoe clarkeata* is about the size of northeastern American *abrasaria* (subspecies *congregata* Walker). The forewing pattern, as well as the pectinate antennae, at first led me to compare *clarkeata* with the European *Scotopteryx peribolata* Hübner, but the genitalia are in no way similar.

Further description. Male antenna bipectinate, with black branches; longest branches about equal in length to 2½ antennal segments; ventral branches twice length of dorsal ones; branches conspicuously setose, shaft covered with brown scales to tip; female antenna simple, slender. Palpus rough scaled, light brown, exceeding front for about half its length, somewhat decumbent toward end. Front slightly convex, rough scaled, matching color of palpi; gena unscaled. Eye reduced to ⅓ width of front in male, ¾ width of front in female (width of eye equal to or greater than width of front in both sexes of *abrasaria*); eye finely and sparsely setose in both sexes. Chaetosemata large but not meeting mesially. Tongue well developed, dark brown, nearly black. Legs normal, fairly slender, with two pairs of hindtibial spurs in both sexes. Vestiture of legs and body a nearly uniform mixture of pale and darker gray-brown scales.

Wings appearing narrower than those of *abrasaria* because forewing is apically more

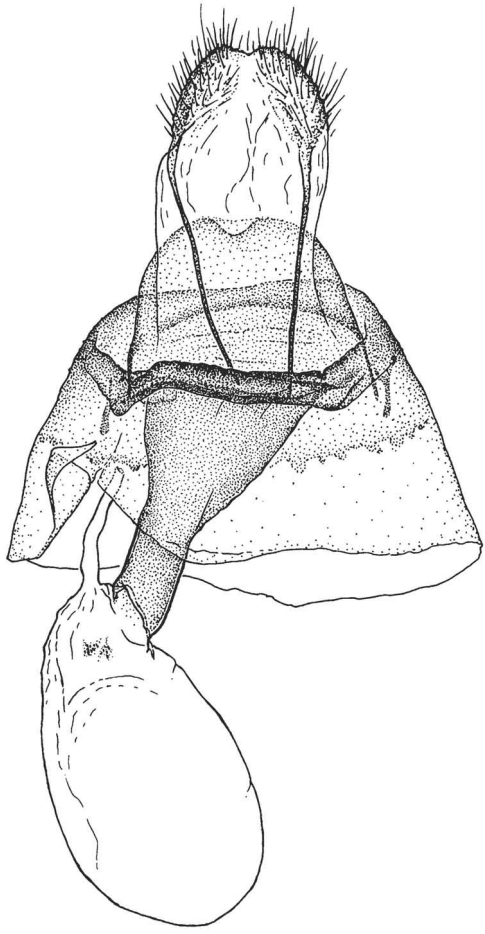
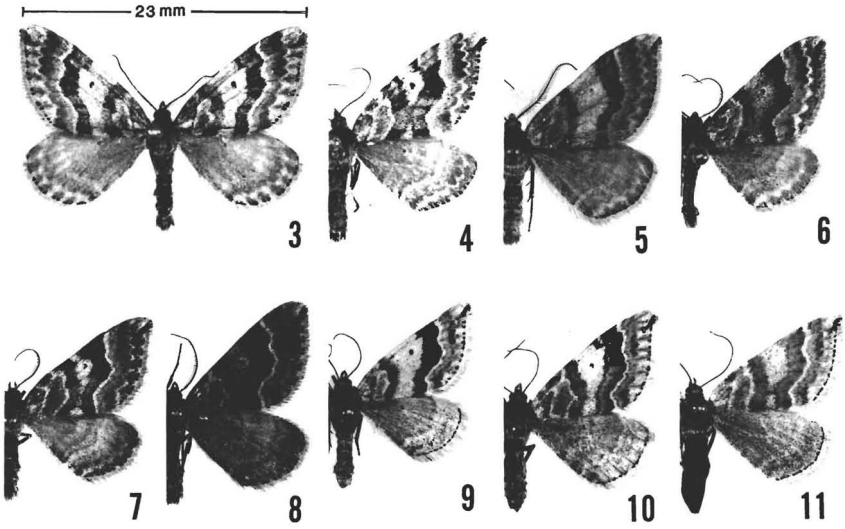


FIG. 2. Female genitalia of *Xanthorhoe clarkeata*.

produced, that of female ending in slightly acute apex. Ground color of forewing pale bluish gray, but in nearly all males and some females this shade mostly obscured by darker gray-brown to bright reddish brown suffusion; pale basal and antemedial lines roughly parallel, convex, angled or bending inward toward costa, usually enclosing a grayish to rust-colored band contrastingly paler than basal band or proximal dark band in median space beyond; median space with its light-gray central area variably constricted by dark-brown to reddish-brown transverse bands that closely follow antemedial and postmedial lines; pale central area may remain a continuous medial gray band from costa to inner margin (Figs. 3, 9), be pinched off to form separate gray areas near costa and inner margin (Fig. 4) or one discal patch bearing the dark discal spot in middle (Fig. 7); postmedial line whitish, regular or slightly irregular but not as sinuous as that of *X. abrasaria*, convex near middle; dusky to rust-brown distal third of forewing often almost evenly divided by crenulate or dentate gray subterminal line parallel to outer margin; terminal line a series of double dark dots, one on each side of each vein; apex marked by small, oblique blackish dash directed toward or just behind apex. Hindwing darkened



FIGS. 3–11. *Xanthorhoe clarkeata*. **3,** Holotype; **4, 5,** Male paratypes, 28 July 1985; **6, 7,** Male paratypes, 27 July 1985; **8,** Male paratype, 28 July 1985; **9–11,** Female paratypes, 27 July 1985.

by dusky suffusion, marked by faint discal spot, by diffuse pale postmedial and subterminal bands paralleling outer margin, and series of terminal dots like those of forewing. Fringes of both wings dusky to light gray or pale yellowish brown. Females usually much paler and more extensively grayish than males, although some are predominantly brown, and they usually have the light-gray median band of forewing unconstricted and much wider. Undersides of both wings dusky to reddish brown, with diffuse, darker postmedial bands with paler shading beyond, and often a diffuse subterminal, also pale-shaded outwardly. Length of forewing: holotype, 12.0 mm; other males, 11.0–14.0 mm (N = 144); females, 11.5–13.0 mm (N = 12).

Male genitalia (Fig. 1) (N = 2). Closest to those of *X. abrasaria* but with several conspicuous and numerous lesser differences; most notably: costa of valve with one or two dentate, subapical processes on inner side; membranous lobe of valve less ample, more flattened; costa of valve stouter, more heavily developed; large papillate process of juxta erect, recurved, not recumbent; saccus knoblike, rounded, not acuminate and pointed; manica more heavily spined than that of *abrasaria*; and vesica with similar two groups of cornuti, but distal ones longer than proximal ones, the reverse of *abrasaria*.

Female genitalia (Fig. 2) (N = 1). Differ from those of *abrasaria* in having larger, fully sclerotized ductus bursae about as long as bursa copulatrix, and with straight, transverse rim at ostium; a small signum only ¼ the size of that in *abrasaria*; better developed anterior apophyses 2 or 3 times as long as those of *abrasaria*; with integument of segments 7 and 8 dark pigmented, a difference often affecting the entire exoskeleton of diurnal moths.

Types. Holotype ♂, Ridge W of Mt. Brown, 3100′ [946 m], Graham Island, Queen Charlotte Islands, British Columbia, 27 July 1985, J. F. G. Clarke. Paratypes: 106 ♂, 12 ♀, same data; 38 ♂, 1 ♀, same locality and collector but taken 28 July 1985. Holotype and most paratypes in U.S. National Museum of Natural History; some paratypes distributed to American Museum of Natural History, Canadian National Collection, British Museum (Natural History), Los Angeles County Museum of Natural History, Queen Charlotte Islands Museum at Skidegate Mission, Graham Island, and other collections.

Remarks. In the description I compared *Xanthorhoe clarkeata* with *X. abrasaria*, a widespread, holarctic species with some obvious similarities in structure and wing pattern. The two are so easily distinguished by superficial features that I did not think it necessary to include figures of *abrasaria*. Illustrations of it may be found in Ferguson (1954:pl. 15, fig. 7), Morris (1980:pl. 29, fig. 10), and in many European works. An outline drawing of the male valve of *X. abrasaria* was given by Forbes (1948:148, fig. 158).

BIOGEOGRAPHY

Xanthorhoe clarkeata is the first species of Lepidoptera to be recorded only from the Queen Charlotte Islands. Such a restricted distribution is unusual because most alpine and subalpine Lepidoptera in northern North America are more widespread. Many are holarctic. Although this species might still prove to occur elsewhere, it seems equally likely to be a local endemic or relict.

A few taxa endemic to the Queen Charlotte Islands have been recognized in other groups such as Coleoptera (Lindroth 1962:67), amphipod crustaceans (Bousfield 1958:64), and plants (Calder & Taylor 1968:102, 103, Schofield 1969:174). Endemism in the plants is regarded as surprisingly high, with four endemic species and seven well-differentiated subspecies, and all but one are limited to about the same alpine habitat as *X. clarkeata*. Although geological evidence has not been reassuring, biologists have long maintained that a Pleistocene refugium must have existed in the Queen Charlotte Islands (Calder & Taylor 1968:113, Schofield 1969, Randhawa & Beamish 1972). The concept that such a refugium persisted throughout the last (late Wisconsin) glaciation received new impetus from recent radiocarbon dating and analysis of plant remains in sediments and peat deposits by Warner et al. (1982), who showed that a diverse flora did exist near sea level on the E side of Graham Island 15,000 to 16,000 years ago and continuously thereafter. That was around the climax of the last glaciation, when the British Columbia mainland coast is believed to have been fully covered by glacial ice. The plant fossil deposits revealed the presence in the late Pleistocene of many of the same species that grow on the islands today, but some of them now only at higher elevations.

Considering the growing biological evidence for a refugium in the Queen Charlotte Islands, a few endemic species or subspecies of Lepidoptera were to be expected in addition to the previously known lycaenid, *Lycaena mariposa charlottensis* (Holland). Such an abundant and mobile species as *X. clarkeata* also might have spread back to the mainland in post-Pleistocene times, and I urge collectors to look for it elsewhere in the mountains of the N Pacific coast. The apparently endemic carabid beetle, *Nebria charlottae* (Lindroth 1962), has a close sister species in the Aleutians. Nothing comparably similar to *clarkeata* has yet appeared among the described and undescribed species of

Xanthorhoe from Alaska or the Aleutians, but those vast regions could hardly be described as well collected.

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