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A NEW SPECIES OF *ELASMOSOMA* RUTHE (HYMENOPTERA: BRACONIDAE: NEONEURINAE) FROM THE NORTHWESTERN UNITED STATES ASSOCIATED WITH THE WESTERN THATCHING ANTS, *FORMICA OBSCURIPES* FOREL AND *FORMICA OBSCURIVENTRIS CLIVIA* CREIGHTON (HYMENOPTERA: FORMICIDAE)

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Abstract.—A **new species** of neoneurine braconid, ***Elasmosoma michaeli***, is described from Oregon, Washington, and Wyoming (Yellowstone National Park). The new species is an imagobiont endoparasitoid of adult workers of *Formica obscuripes* Forel in Washington and Wyoming. This species was recorded as a parasitoid of *Formica obscuriventris clivia* Creighton workers in Oregon. This is the first record of *Elasmosoma* attacking *Formica obscuripes*.

Key Words: new species, Neoneurinae, *Elasmosoma*, Oregon, Washington, Wyoming, Yellowstone National Park, ant parasites, *Formica obscuripes* Forel

The braconid subfamily Neoneurinae comprises a small group of relatively rare parasitic wasps that are associated with worker ants of the *Formica fusca* L. and *F. rufa* L. species groups (Shenefelt 1969, Shaw 1997). Little is known about their biology but neoneurine species have long been assumed to be endoparasitoids of adult worker *Formica* ants (Muesebeck 1941, Marsh et al. 1987, Quicke and van Achterberg 1990, Shaw and Huddleston 1991, Poinar and Miller 2002, Poinar 2004, Shaw 2004). The North American species of the neoneurine genus *Elasmosoma* Ruthe were studied by Muesebeck (1922, 1941) and later revised by Huddleston (1976), who recognized five species in the continental United States and Canada. The North American species, their distributions, and known host associations were catalogued by Marsh (1979). Shaw (1985) examined *Elasmosoma petulans* using scanning electron microscopy and illustrated diagnostic features of the head, leg, and metasoma. The legs of *Elasmosoma* are unusual in having vestigial tarsal claws and greatly enlarged pulvilli (Shaw 1985: fig. 6). Egg deposition by neoneurine females into the abdomens of adult worker ants has been observed by numerous authors (Olivier 1893; Pierre 1893; Wasmann 1897; Donisthorpe 1927; Kariya 1932; Shaw 1992, 1993) but the details of larval development have only recently been described (Poinar 2004). The process of oviposition is extremely rapid, requiring only a fraction of a second. Wasmann (1897) reported rearing an adult *Elasmosoma* from a cocoon found attached to the abdomen of a dead worker *Formica* ant, but only recently has any neoneurine

been raised from egg to adult in a laboratory setting (Poinar 2004). Neoneurines fly close to the ground and stay very near nests (Poinar 2004) and raiding trails (Muesebeck 1941) of *Formica* ants. They are usually found hovering over, or near, ant nests and trails, where they can be sampled by aspirator. Although *Formica* ant mounds are quite common in southern Yellowstone National Park (YNP), Wyoming, U.S.A., until recently no neoneurines were known to occur there.

The 1988 fires in YNP burned 400,000 ha or 45% of the park and attracted international attention Christensen et al. (1989). Following that event there was a renewed interest in YNP biotic communities, and new studies of insects were conducted. During the summer of 1990, we operated four Malaise traps in burned and unburned areas of south YNP (Lockwood et al. 1996). Our study found a total of 603 Hymenoptera species, representing 36 families (from a total of 2,331 hymenopteran specimens sampled). Of these, the parasitic wasp family Braconidae was well represented, with 109 species found in south YNP. That study also yielded the first record of the ant-associated subfamily Neoneurinae in YNP: a single (damaged) specimen of *Elasmosoma*, apparently a new species. Although intriguing, the damaged condition of this single specimen prevented further taxonomic study.

In 1999, I was contacted by Jack Longino who kindly sent a nice series of 13 *Elasmosoma*. These were collected on the campus of Evergreen State College (Thurston County, Washington) in association with the western thatching ant, *Formica obscuripes* Forel. He later sent two specimens from Long Beach (Pacific County, Washington), also found attacking workers of *F. obscuripes*. Finally, in 2001, George Poinar sent a series of *Elasmosoma* collected in Lincoln County, Oregon. All of these specimens appeared to be the same as the putative new species from YNP.

During the summer of 2002, I had the opportunity to return to south YNP for braconid sampling, now armed with the knowledge that *F. obscuripes* is the likely host ant for this wasp species. Despite expectations that this wasp species would be rather rare and difficult to locate, it was instead found to be quite common. Within minutes of first arriving in YNP we successfully located and observed *Elasmosoma* hovering by a *F. obscuripes* mound near the South Gate Ranger Station. Over the next two weeks observations were made and samples were obtained for descriptive purposes. The purpose of this paper is to describe and name this new neoneurine species as a contribution to continuing studies of the insect fauna of YNP, and to stimulate and facilitate more detailed biological studies of neoneurine wasps.

Methods and Terminology

Specimens of *Elasmosoma* were sampled using a wet-aspirator and preserved directly into 2 dram vials of 90% ethanol. The wasps are intent on chasing ants and not too difficult to observe or aspirate. The main difficulty with this sampling method is that they fly close to the mound so sand and nest debris is easily aspirated as well. The other hazard is simply working in close proximity to such active and aggressive ants. The samples were moved to clean 90% ethanol, then later into 100% ethanol for 24 hours. Dry specimens were prepared by placing them in fine wire baskets, soaking in chloroform for 20 minutes, and air-drying under a fume hood, prior to point-mounting. This method approximates the results of critical-point-drying at less expense.

Species covered in this paper can be identified as members of the subfamily Neoneurinae using the subfamily key by Sharkey (1997). The definition of *Elasmosoma* follows that of Muesebeck (1922,

1941), Huddleston (1976); Marsh et al. (1987) and Shaw (1997). Specimens can be determined as *Elasmosoma* by using the keys of Marsh et al. (1987) and Shaw (1997). Morphological terminology follows that of Shaw (1992, 1997) and Sharkey and Wharton (1997). Wing vein terminology agrees with the system proposed by Sharkey and Wharton (1997) for the *Manual of the New World Genera of the Family Braconidae*. A labeled diagram of wing veins for *Elasmosoma* was given by (Sharkey and Wharton 1997: 37, fig. 18). The following key to species is modified after Huddleston (1976) and based on examination of the holotypes of all included species. Because of sexual variation, *Elasmosoma* species are most reliably identified based on female specimens.

Key to Females of the Described North American Species of *Elasmosoma*

1 Metasoma elongate, conspicuously longer (1.5–2.0 times) than head and mesosoma combined, strongly compressed; tergite 3 at least as long as wide . . *E. schwarzi* Ashmead

– Metasoma at most equal in length to head and mesosoma combined, not compressed; tergite 3 conspicuously wider than long 2

2(1) Distance between lateral ocellus and eye about twice diameter of lateral ocellus, or slightly less; hypopygium of female folded along midline and compressed . . . . . *E. petulans* Muesebeck

– Distance between lateral ocellus and eye greater than twice diameter of lateral ocellus; hypopygium of female flat, not folded along midline or compressed . . . 3

3(2) Hind tibial spur longer than hind basitarsus; first metasomal tergite wider than long; hypopygium of female arising near middle of metasoma, hypopygium concealed below metasoma . . . . . *E. vigilans* Cockerell

– Hind tibial spur at least slightly shorter than hind basitarsus; first metasomal tergite about as wide as long; hypopygium of female arising in distal 1/3 of metasoma, hypopygium wide and flat, with lateral lobes projecting beyond sides of metasoma 4

4(3) Hind tibial spur relatively short, longer spur just slightly longer than ½ basitarsus length; hypopygium of female densely setose, apical margin of hypopygium narrowly and deeply U-shaped; clypeus pale yellow or white . . . . *E. michaeli*, n.sp.

– Hind tibial spur relatively longer, longer spur just slightly shorter than entire basitarsus length; hypopygium of female sparsely setose, apical margin of hypopygium broadly and shallowly V-shaped; clypeus black . . . . . *E. pergandei* Ashmead and *E. bakeri* Ashmead [*E. bakeri* Ashmead is known only from male specimens. It is not certain if it can be maintained as a distinct species from *E. pergandei* Ashmead.]

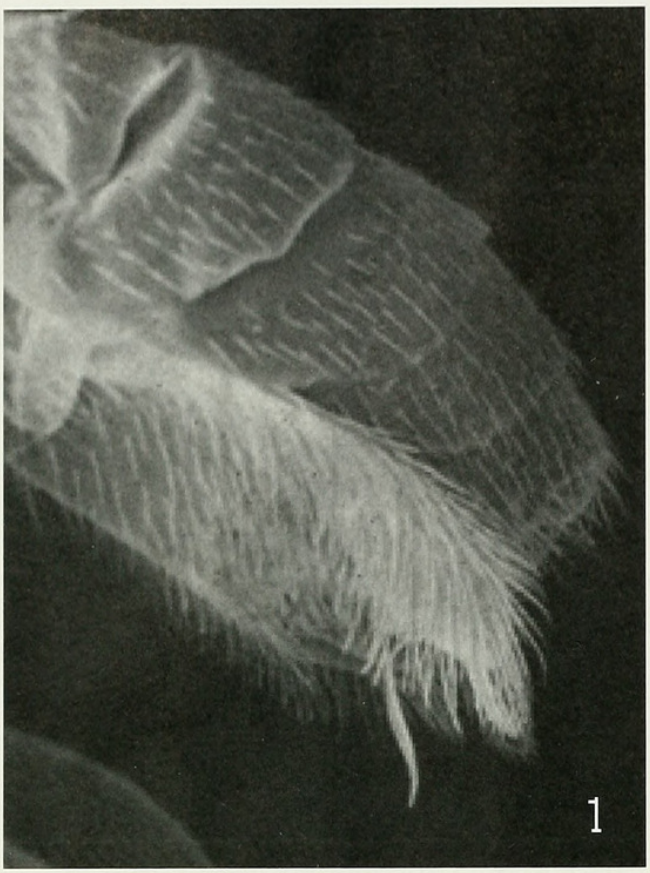
Elasmosoma michaeli Shaw, new species
(Figs. 1–6)

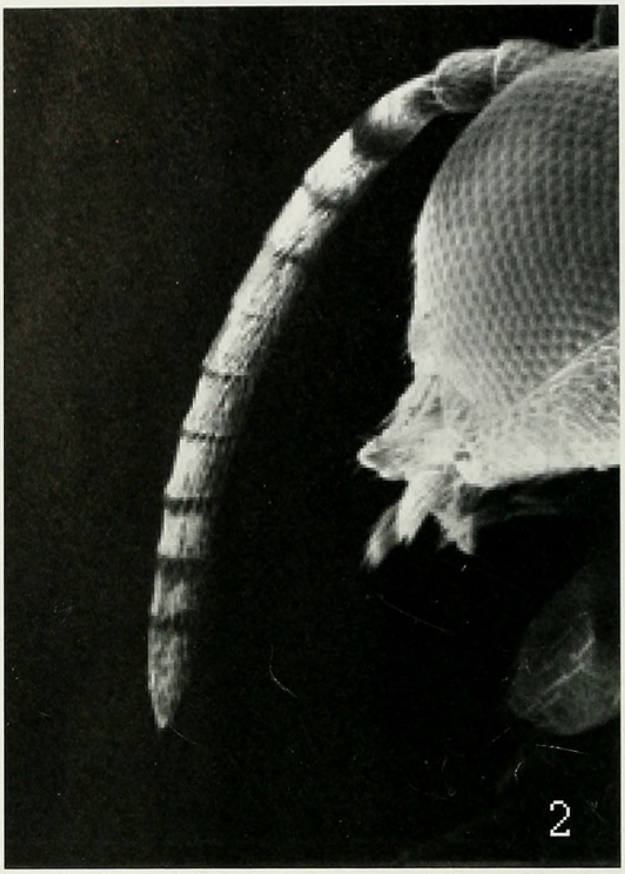
Critical diagnosis.—Clypeus pale yellow or white; distance between lateral ocellus and eye greater than twice the diameter of lateral ocellus; hind tibial spur relatively short, longer spur just slightly longer than ½ basitarsus length; first metasomal tergite about as wide as long; hypopygium of female densely setose, apical margin of hypopygium narrowly and deeply U-shaped; hypopygium of female flat, not folded along midline or compressed.

Female.—Habitus of adult female as illustrated by (Poinar 2004: fig. 6c). Body length 2.0 mm.

Color: Body mostly black, except metasomal tergum 2 sometimes with yellowish brown along anterior and posterior margins. Clypeus and labrum pale yellow to white. Mandible white except tip reddish brown. Compound eye silvery gray. Front legs mostly white, front femur and tibia infused with pale yellow, apical tarsomere reddish brown. Middle and hind legs with similar color pattern except darker, more extensively infused with pale yellow to yellowish brown. Apex of hypopygium pale yellowish brown to white.

Head: Compound eyes, extremely large and strongly converging anteriorly and ventrally (Fig. 2). Malar space extremely narrow. Width of malar space



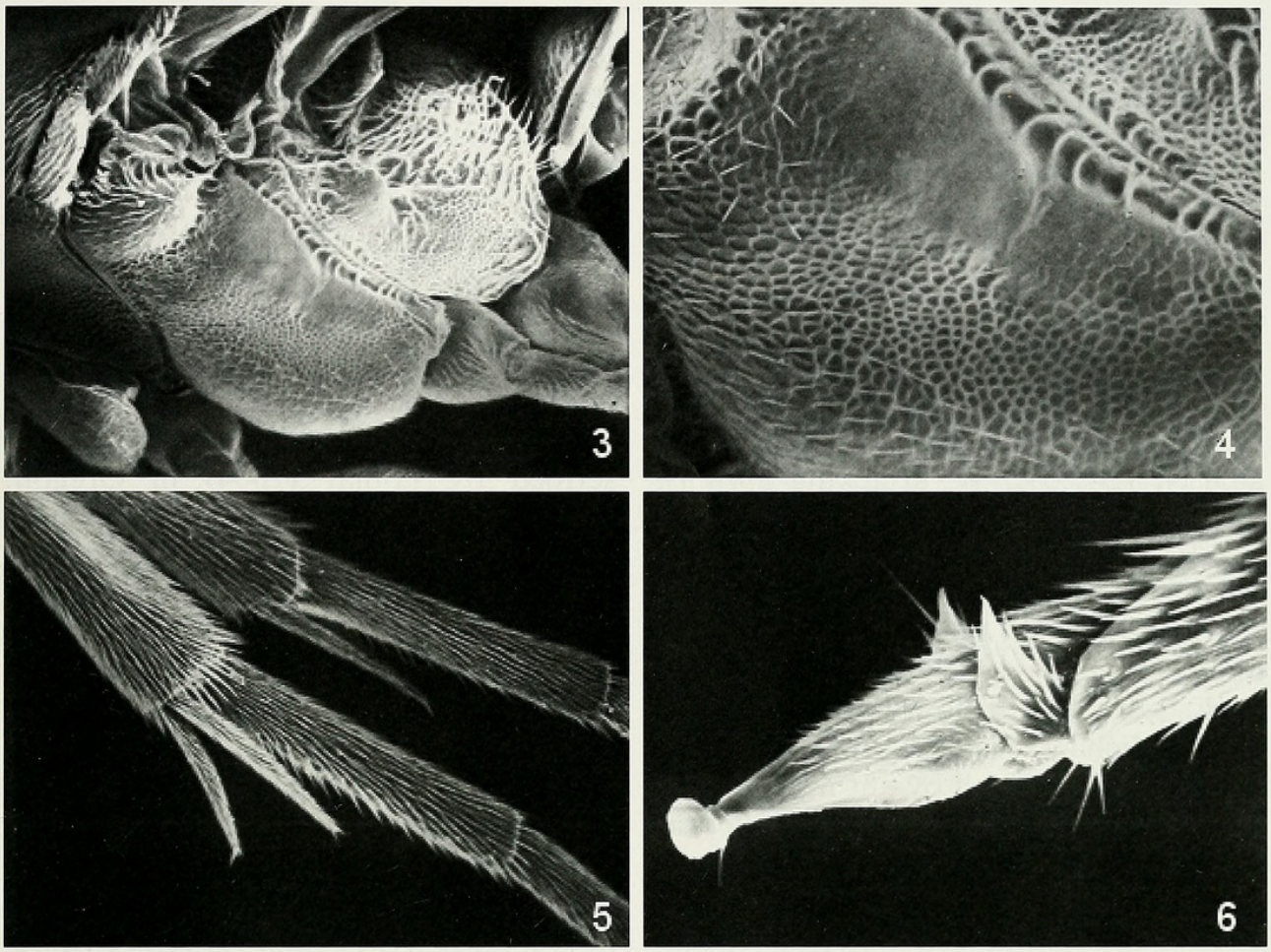


Figs. 1–2. *Elamosoma michaeli*. 1, Metasoma, lateral view showing ovipositor and densely setose hypopygium. 2, Head and antenna, lateral view.

near anterior condyle of mandible slightly less than width of mandible near tip. Face narrow, width of face slightly less than clypeus width. Antenna short (Fig. 2), flagellum length equal to mesosoma length (in lateral profile). Antennal scape short, slightly shorter than first flagellomere. Pedicel ½ length of scape. Flagellum with 10 compact flagellomeres, each of similar size and just slightly longer than wide, except apical (10th) flagellomere about 2× the length of first flagellomere. Apical flagellomere tapers to pointed apex. Apical flagellomere partly divided dorsally, thus appearing to have 11 flagellomeres in dorsal view but only 10 flagellomeres in lateral or ventral view. Ocellar triangle equilateral. Distance between lateral ocellus and eye slightly greater than twice the diameter of lateral ocellus. Surface sculpture of head very finely coriaceous.

Mesosoma: Mesosoma very compact. Mesosoma length in profile about 1.6× head length. Mesonotum finely coriaceous and densely covered with microscopic setae, no trace of notauli. Pronotum finely coriaceous. Dorsoposterior lobe of mesopleuron (Figs. 3–4) smooth and shining, devoid of sculpture and setae. Remainder of mesopleuron with dense, fine, foveolate sculpture (Fig. 4). Sternaulus not clearly differentiated from broad patch of foveolate mesopleural sculpture. Propodeum coarsely rugulose. Hind tibial spur relatively short, longer spur just slightly longer than ½ basitarsus length (Fig. 5). Hind tarsus (Fig. 6) with pulvillus greatly enlarged, tarsal claws greatly reduced and nearly vestigial.

Wings: Venation extremely reduced, as illustrated in (Shaw 1997: fig. 2). Pattern of venation highly distinctive for genus but with little discernable variation be-



Figs. 3–6. *Elamosoma michaeli*. 3, Mesosoma, lateral view. 4, Mesopleuron, lateral view showing detail of surface sculpture. 5, Hind leg, lateral view showing apex of hind tibia and length of tibial spurs relative to basitarsus. 6, Apex of hind tarsus showing vestigial tarsal claws and modified pulvillus.

tween species. Forewing length 1.0 mm. Costa and pterostigma dark brown to black. Remaining veins light brown.

Metasoma: Metasoma about equal in length to head and mesosoma combined, not compressed. Tergite 3 conspicuously wider than long. Metasomal terga finely coriaceous, sparsely setose, setae not obscuring surface sculpture. Hypopygium of female densely setose, flat, not folded along mid-line or compressed. Apical margin of hypopygium narrowly and deeply U-shaped. Lateral lobes of hypopygium extensively desclerotized and thin, nearly transparent. Ovipositor (Fig. 1) about as long as apical tergite, thin, sharply pointed, and flexible.

Male.—Similar to female except more extensively black, lacking light colors on clypeus and metasoma, and hind coxa black. Antenna longer, thicker, and more densely setose than in female, with 12 flagellomeres. Each flagellomere about 2× longer than wide, and densely setose. Flagellum tapering gradually from base to apex, apical flagellomere (12th) only about ½ as thick as first flagellomere. Compound eye smaller than in females, and malar space broader. Width of malar space about equal to length of antennal scape. Male genitalia mostly retracted into metasoma and not visible, except for small narrow parameres, about equal in size to apical hind tarsomere.

Holotype.—Female, United States of America: Washington, Thurston County, Evergreen State College, 20 September 1999, Jack Longino, #4191, at *Formica obscuripes* nest. Deposited in

University of Wyoming Insect Museum, Laramie, Wyoming.

Paratypes.—Oregon: 16 ♀, Lincoln County, between Newport and Waldport, 8 September 2001, aspirated near ant nest, George Poinar, coll.; 2 ♀, 1 ♂, Waldport, 7 August 2001, George Poinar, coll. Washington: 8 ♀, 5 ♂, Thurston County, Evergreen State College, 20 September 1999, Jack Longino, #4191, at *Formica obscuripes* nests; 2 ♀, Pacific County, Long Beach, #4160, 46° 20.8′N, 124° 03.7′W, attacking *Formica obscuripes*; 9 ♀, Yakima County, Pleasant Valley Campground, Highway 410, 46° 57′N, 121° 20′W, 1,000 m, 30 August 2003, J. Longino, #5136. Wyoming: 21 ♀, 1 ♂, Yellowstone National Park, near South Entrance, 1 August 2002, Michael J. Shaw and Scott R. Shaw coll., aspirated by ant nest, USDI-NPS YNP Scientific Research Permit Number YELL-2002-SCI-5310; 20 ♀, same data except collected 30 July 2002. Deposited in University of Wyoming Insect Museum, Laramie, Wyoming and National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Etymology.—This species is named for my son, Michael Joseph Shaw, for his assistance during the 2002 field season in Yellowstone and Grand Teton.

Biology.—The egg-laying behavior, embryonic development, larval development, and cocoon-forming behavior of this species was described by Poinar (2004) as "an undescribed species of *Elasmosoma* near *pergandei* Ashmead." Poinar reported this species as attacking workers of *Formica obscuriventris clivia* Creighton workers in Oregon. In Washington and Wyoming it was found attacking workers of *Formica obscuripes*. According to Jack Longino, the majority of ants in the YNP samples are *F. obscuripes* but a few individuals from the same mound resembled *F. propinqua* Wheeler. There were other ant mounds in the vicinity. It is possible that some workers of *F. propinqua* wandered near the *F. obscuripes* mound. Another possibility is that *F. propinqua* were temporary social parasites in nests of *F. obscuripes* and that YNP mounds were mixed nests. In all three cases the ants usually make similar, very large, thatched dome nests. It seems likely that the parasitoid attacks any of these host ants with similar behavior. The behavior of adult *E. michaeli* in YNP was the same as described by Poinar (2004) in Oregon. *Elasmosoma michaeli* adults were quite active on sunny mornings between 9am and 11am, with activity tapering off at midday.

Discussion.—*Elasmosoma michaeli* is most similar to *E. pergandei*. Females of both species have a broad, flat hypopygium that projects beyond the sides and apex of the metasoma. The lateral lobes of the hypopygium are extensively desclerotized and thin. When viewed from above these hypopygial lobes are rather transparent and windowlike. *Elasmosoma michaeli* can be distinguished by the hypopygium of the female being more densely setose (Fig. 1), and the apical margin of the hypopygium being narrowly and deeply U-shaped. The hypopygium of *E. pergandei* is less densely setose, with the apical margin more broadly V-shaped, and having a distinct sharp notch at the midline where the hypopygium margin meets the ovipositor base. *Elasmosoma michaeli* is also similar to *E. bakeri* (a species known only from male specimens). *Elasmosoma michaeli* can be distinguished from both *E. pergandei* and *E. bakeri* by the shorter tibial spurs (Fig. 5). The tibial spurs are much longer in *E. pergandei* and *E. bakeri* (nearly as long as the entire basitarsus). *Elasmosoma michaeli* females can be distinguished from those of *E. pergandei* by the pale yellow or white clypeus. The clypeus is black in females of *E. pergandei*. The cly-

peus color of *E. bakeri* females is not known.

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