# A Revision of the *Cinara* Species (Hemiptera: Aphididae) of the United States Pinyon Pines

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ABSTRACT The *Cinara* species (Hemiptera: Aphididae: Lachninae) found on *Pinus edulis* Engelm. and *P. monophylla* Torr. & Frém. are revised and now include eight species. Included are redescriptions of the viviparous apterae and alatae of *C. atra* (Gillette & Palmer), *C. caliente* Hottes, *C. edulis* (Wilson), *C. puerca* Hottes, *C. tanneri* (Knowlton), *C. terminalis* (Gillette & Palmer), and *C. wahtolca* Hottes and a description of *C. anelia* sp. nov. New synonyms are established using discriminant factor analysis and traditional morphological methods: *C. poketa* Hottes becomes *C. atra*, *C. nitidula* Hottes, ecomes *C. terminalis*, and *C. pinona* Hottes, *C. metalica* Hottes, *C. apacheca* Hottes, *C. pinata* Hottes, and *C. rustica* Hottes all become *C. edulis*. The subspecies *C. wahtolca curtiwahtolca* Hottes is also no longer recognized. A key to the viviparae, diagnostic figures, and collection maps are provided.

KEY WORDS Cinara, Aphididae, Pinyon, Pinus edulis, Pinus monophylla

*Cinara* species (Aphididae: Lachninae) are large aphids, up to 1 cm in length, that feed exclusively on conifers in the Cupressaceae and Pinaceae (Eastop 1972). They are one of the most speciose of aphid genera (Remaudière and Remaudière 1997) and are particularly diverse in North America, with 154 described species (Voegtlin and Bridges 1988). Although the European fauna has been divided into subgenera (Eastop 1972), no attempt has been made to divide the fauna of North America except on the basis of host association. Favret and Voegtlin (2004a) showed that host-associated groups of *Cinara* are not monophyletic, but until a full revision of the North American fauna is undertaken, host taxonomy will continue to guide taxonomic treatments of the genus.

The taxonomy of North American *Cinara* is complicated, with many likely synonyms, and in dire need of revision. F. C. Hottes named 78 species of *Cinara*, 16 of which have since been synonymized (Voegtlin and Bridges 1988), and Voegtlin (1976) synonymized four species Hottes had described back to back in one article (Hottes and Essig 1953).

Hottes collected extensively on the Grand Mesa of Colorado (Russell 1971), home to the pinyon pine, *Pinus edulis* Engelm. There are 14 species of *Cinara* recorded from *P. edulis* (Voegtlin and Bridges 1988), 10 of which were described by Hottes (Hottes 1953), 1954b, 1955c, 1956a, c.; Hottes and Butler 1955). There are only five species of Pinaceae that host more *Cinara* species than *P. edulis* (Voegtlin and Bridges 1988), and the *Cinara* associated with them tend to be relatively polyphagous: *Abies, Picea*, and southeastern U.S. *Pinus*. In contrast, the *Cinara* of *P. edulis* are found on it and other pinyon pines exclusively. Pinyon pines constitute the *Pinus* subsection *Cembroides* and are found in semiarid habitats of the southwestern United States and Mexico. There are two principal species in the United States, *P. edulis* and *P. monophylla* Torr. & Frém. The latter hosts a subset of four of the 14 *Cinara* species named from *P. edulis*.

*P. edulis* grows at elevations between 825 and 2,350 m in Arizona, Utah, New Mexico, Colorado, southwestern Texas, far western Oklahoma, and in an isolated population in southern California (Elias 1980). P. monophylla grows at elevations between 650 and 2,350 m in southern and eastern California, Nevada, southwestern Utah, and western Arizona (Elias 1980). These two species of pinyon pine (and hence their concomitant populations of Cinara) are largely allopatric, with a few parapatric areas that also contain hybrids (Trombulak and Cody 1980, Gafney and Lanner 1987). Because of their limited range in elevation, pinyon distribution is scattered and island-like, especially in the Great Basin (Critchfield and Little 1966). Pinyons can form monocultural woodlands, but they are more often found in large stands of pinyon-juniper woodlands, in oak-pinyon scrub, or in mixed stands of other pines, usually Pinus ponderosa Dougl.

The *Cinara* are monophyletic (Heie 1988, Normark 2000), and species are morphologically and biologically similar. However, the similarity between species also means that distinguishing them can be problematic. Due to the relative paucity of discontinuous characters in *Cinara*, morphometric data have been used for the purpose of species description and taxonomic discrimination (Foottit 1992, Watson et al. 1999). Discriminant factor analysis is a mathematical technique whereby many quantifiable characters are pooled in

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	Morph		Setal length	IS		Ant	tennal segment	lengths		Siphunculus	Bodv	Sensoria
Species	(type)	Ant. seg. $3^a$	Tibia <sup>a</sup>	Tergum {	5 Antenn	ia 3 <sup>a</sup> Ante	∋nna 4 <sup>a</sup> Ar	itenna 5ª	Antenna 6	(front to back)	$\operatorname{length}^a$	Ant. seg. 3
C. anelia	Apterae (Holotyne)	0.070-0.139	0.076-0.152	2 0.010-0.17 (0.163) 76	9 0.460-0	.673 0.18 76 /0.95	1-0.285 0.5 29) 75 (0	259-0.394 391) 74	0.114-0.162	0.331-0.676	2.80-4.59 (3.74) 75	0-5 (1) 75
C. atra	Apterae	0.016-0.032	0.045-0.090	10.0-600.0	9 0.354-0	0.160	0-0.213 0.1	190-0.236	0.113-0.133	0.279-0.448	1.96 - 3.25	0
C. caliente	(Lectotype) Anterae	(0.025) 9 0.022-0.035	(0.094) 10 0.034-0.056	(na) 8 (n	(0.377) (0.269-0)	$1.0 \\ 1.0.16 \\ 1.0.10 \\ 1.0.$	(0) 89) 9 (0) 4-0.162 0.1	1.220) 9 169–0.196	(0.138) 9 0.088-0.126	(0.349) 10 0.238-0.463	(1.96) 10 1.96-2.86	(na) 9 0
	(Morphotype)	(0.031) 20	(0.038) 19	(na) 19	(0.295)	1.0) 0.1	19) 19 (0	.176) 19	(0.126) 19	(na) 19	(na) 17	19
C. edulis	Apterae	0.022 - 0.078	0.023-0.118	30.000-0.08	0.305-0	0.130	8-0.331 0.1	179-0.343	0.100 - 0.165	0.166 - 0.701	2.10 - 4.55	0-4
c	(Lectotype)	(0.060) 148	(0.070) 141	1 (0.038) 14	(14) (0.494)	148 (0.2	42) 148 (0	0.281) 147	(0.117) 145	(0.457) 146	(3.05) 148	(3) 148
c. puerca	Apterae (Holotvoe)	(0.057) 14	(0.007) 14	u.uu (na) 13	0.530-0	14 (0.16) 14	56) 14 (0.	241-0.301	(0.208) 14	(0.490) 13 (0.490) 13	3.80-0.49 (4.53) 14	(2) 14
C. tanneri	Aptera	0.057	0.072	0.000	0.49	3	.158	0.271	0.197	0.217	3.79	0
	(Holotype)	0110 2000		0 000 0		210.0		0 0 0 10	01010100			Ċ
C. terminalis	Apterae (Morphotype)	(0.024-0.113)	0.040-0.167 (0.088) 75	71.00000 /	0.339) (0.339)	(0.12) (0.12) (0.12)	26) 70 (0. 26) 70 (0.	167-0.278 .182) 71	0.101-0.163	0.107–0.570 (0.214) 74	1.90-3.35 (2.25) 77	(0) 71
C. wahtolca	Apterae	0.056 - 0.112	0.072 - 0.129	0.000-0.14	0.362-0	0.160	0-0.285 0.1	173 - 0.346	0.089 - 0.153	0.321 - 0.587	1.89-3.85	0-2
-	(Holotype)	(0.104) 32	(0.129) 33	(0.120) 33	(0.603)	32 (0.2)	50) 32 (0	0.285) 31	(0.153) 31	(0.403) 33	(3.53) 33	(2) 32
C. aneta	Alatae	0.077-0.100	361.0-111.0	2 0.089–0.16	0-816.0 00 (002.0/	0.18	20 00,200 0/ 00 00/07	265-0.380	001.0-811.0	0.268-0.479	2.05-4.28	01-6
C. atra	(Morphotype) Alatae	(0.077) 20 0.014-0.038	(0.138) 18 0.059-0.091	0.000-0.03	0 (0.332-0) (3 0.332-0)	0.158 0.158	42) 20 (U $8-0.207$ 0.5	1.346) 20 201-0.225	(0.141) 20 0.105 - 0.157	(0.446) 20 0.215-0.284	(3.53) 20 1.92 $-3.17$	(8) 20 4-6
	(Morphotype)	(0.031) 6	(0.069) 6	(na) 5	(0.371)	6 (0.1	76) 6 (0	(214) 6	(0.132) 6	(0.239) 5	(2.00) 6	(4) 6
C. caliente	Alatae	0.030 - 0.043	0.057-0.083	3 0.025-0.03	5 0.306-0	0.12	7-0.149 0.1	171-0.201	0.086 - 0.105	0.181 - 0.281	1.89 - 2.24	$1^{-3}$
-11-1- 0	(Holotype)	(0.041) 5	(0.075) 5	(0.035) 3	(0.362)	15 (0.1- 1504 0.166	43) 5 (0	0.188) 5 06 0.251	(0.105) 5	(0.233) 5	(2.22) 5 0.65 4.61	(3) 5
C. eautrs	Alatae (Momhotyne)	0.027-0.076	0.028-0.102 (0.050) 86	2 U.UUU-U.UC (na) 77	0.3/3-f	1.594 U.16 83 (0.35	2-0.333 0.2 21) 84 (0	200-0.301	0.176) 82	0.207-0.504 (0.377) 79	2.65–4.61 (4.47) 78	3-7 (6) 82
C. puerca	Alatae	0.051-0.087	0.072-0.111	0.000	0.511-0	0.182	2-0.243 0.5	308-0.378	0.218-0.256	0.482-0.619	3.91-4.09	4-13
	(Morphotype)	(0.051) 2	(0.072) 2	(na) 2	(0.607)	2 (0.18	82) 2 (0	.308) 2	(0.218) 2	(0.619) 2	(4.09) 2	(13) 2
C. terminalis	Alatae	0.031 - 0.095	0.045-0.178	8 0.031-0.13	1 0.325-0	0.130).526 0.130	8-0.246 0.1	193-0.288	0.103 - 0.165	0.221 - 0.473	2.19 - 3.63	1-5
o malatalaa	(Lectotype)	(0.078) 40	0.133) 37	(0.103) 35	(0.499)	140 (0.2) 1503 0.100	(01) 40 (0)	(238) 39 226 0 071	0.141) 40	(na) 36 0 000 0 49€	(2.76) 38 0.26 2.42	(4) 40 6 10
O. wanowa	(Morphotype)	(0.075) 8	(na) 6	(0.063) 8	(0.515)		20) 8 (0	.258) 7	(0.157) 7	(0.390) 8	(3.35) 8	(10) 8
	Morph	Rostra	l segment lengt	hs		Leg segm	ent lengths			Setal	counts	
Species	(type)	Bradley's R	[ 3 <sup>a</sup> ]	Rostrum 4 <sup>a</sup>	$\operatorname{Femur}^a$	Tibia <sup>a</sup>	Tarsus 1 <sup>a</sup>	Tarsus 2 <sup>a</sup>	Ant. 6 base	j <sup>a</sup> URS <sup>a</sup>	Siphunculus	Tergite 8
C. anelia A	pterae	1.37-1.73 0	.194-0.235 (	0.147 - 0.187	1.27 - 2.01	2.31 - 3.32	0.107 - 0.154	0.253-0.328	3 5-11	4-8	28-78	12–38
	Holotype)	(1.58) 20 (	0.216) 76	(0.156)76	(1.79) 72	(2.98) 68 1.60, 9.02	(0.132) 70	0.278) 70	(11) 69	(8) 74	(49) 67 E 1E	(27) 74
	Lectotype)	(na) 8 (na) 8	0.214) 9	(0.176) 10	(0.93) 10	(1.64) 10	(0.107) 10	(0.251) 10	6 (6)	$(12) 10^{-1}$	0-1-0 (na) 8	(na) 9
C. caliente	pterae	0.96-1.28 0	0.136-0.162	0.119 - 0.139	0.69 - 0.96	1.18 - 1.61	0.079 - 0.107	0.183 - 0.221	1 4-7	4-6	7-20	8-12
) oilube o	Morphotype)	(1.02) 12 ( 1 55 2 00 0	0.145) 20	(0.132) 20 0.160 0.055	(0.69) 18 1 00 1 95	(1.26) 18 9.00 2.65	(0.094) 19 0.105 0.150	(0.207) 19	(4) 19	(4) 18 11 00	(na) 14 10 41	(na) 14
C. eumo	Lectotype)	(1.87) 68 (	0.244) 147	(0.180) 149	(1.48) 142	(2.74) 136	(0.117) 140	(0.28) 140	(10) 139	(12) 145	(23) 135	(11) 147
C. puerca	pterae	3.32-3.93 0	.411-0.549	0.538-0.618	0.93-1.38	1.49-2.23	0.107-0.142	0.256-0.361	1 24-37	50-116	11-50	18-88
C. tanneri A	Holotype) ptera	(3.32) 10 2.13	(na) 13 0.343	0.311 0.311	(na) 13 1.16	(1.87) 13 1.73	(0.142) 13 0.109	(0.307) 13 0.280	(32) 14 14	(100) 13 34	(00) 13 9	(00) 14 31
~	$\hat{H}$ olotype)											

C. terminalis	Apterae	1.18 - 1.48	0.167 - 0.211	0.142 - 0.208	0.91 - 1.40	1.40 - 2.41	0.096 - 0.143	0.204 - 0.313	4-10	4-8	11-44	9-18
	(Morphotype)	(na) 25	(0.138) 77	(0.178)76	(0.81)74	(1.44)74	(0.101)74	(0.245)74	(8) 66	(6) 73	(13) 68	(na) 66
C. wahtolca	Apterae	1.28 - 1.60	0.166 - 0.211	0.138 - 0.174	1.04 - 1.70	1.39 - 2.91	0.108 - 0.141	0.228 - 0.288	5-14	4-8	29 - 56	14-31
	(Holotype)	(1.28) 16	(0.194) 33	(0.161) 33	(1.60) 33	(2.68) 33	(0.126) 33	(0.264) 33	(13) 27	(6) 32	(48) 27	(31) 33
5. anelia	Alatae	1.55 - 1.62	0.186 - 0.231	0.151 - 0.170	1.29 - 1.83	2.14 - 3.18	0.124 - 0.144	0.277 - 0.317	6-10	5-8	40-63	22 - 33
	(Morphotype)	(1.55) 4	(0.207) 20	(0.154) 20	(1.68) 18	(2.93) 17	(0.138) 17	(0.302) 17	(8) 19	(6) 20	(55) 17	(29) 18
C. atra	Alatae	1.52 - 1.71	0.186 - 0.218	0.171 - 0.185	0.91 - 1.05	1.59 - 1.74	0.094 - 0.115	0.247 - 0.289	8 - 12	12 - 16	$5^{-9}$	4-9
	(Morphotype)	(na) 4	(0.182) 6	(0.170) 6	(0.99) 6	(1.76) 6	(0.101) 6	(0.283) 6	(10) 6	(13) 5	(na) 4	(na) 5
C. caliente	Alatae	0.93 - 1.04	0.132 - 0.149	0.113 - 0.121	0.70 - 0.91	1.27 - 1.63	0.077 - 0.095	0.190 - 0.213	4-6	4-5	7-12	9 - 12
	(Holotype)	(1.04) 4	(0.145) 5	(0.121)5	(0.85) 5	(1.58) 5	(0.095) 5	(0.208) 5	(6) 5	(4) 4	(7) 2	(12) 3
5. edulis	Alatae	1.65 - 2.01	0.196 - 0.264	0.160 - 0.221	1.12 - 1.87	2.01 - 3.48	0.095 - 0.142	0.216 - 0.311	6-16	10 - 22	8-40	10-26
	(Morphotype)	(na) 33	(0.264) 86	(0.214) 86	(1.87) 85	(3.40) 84	(0.132) 85	(0.264) 83	(na) 79	(10) 85	(na) 78	(na) 81
5. puerca	Alatae	3.52 - 3.62	0.409 - 0.463	0.559 - 0.575	1.34 - 1.45	2.23 - 2.47	0.124 - 0.138	0.316 - 0.345	23 - 30	52 - 89	33	23 - 82
	(Morphotype)	(3.52) 2	(0.463) 2	(0.575) 2	(1.45) 2	(2.47) 2	(0.138) 2	(0.316) 2	(23) 2	(89) 2	(na) 1	(82) 2
C. terminalis	Alatae	1.17 - 1.39	0.166 - 0.202	0.142 - 0.197	0.83 - 1.38	1.39 - 2.31	0.095 - 0.138	0.219 - 0.318	6-10	4-12	11-46	10 - 17
	(Lectotype)	(1.20) 16	(0.178) 40	(0.181) 40	(1.10) 37	(1.98) 36	(0.120) 36	(0.266) 36	(7) 39	(6) 39	(na) 36	(14) 36
<ol> <li>wahtolca</li> </ol>	Alatae	1.50 - 1.52	0.182 - 0.200	0.139 - 0.157	1.04 - 1.50	2.31 - 2.50	0.104 - 0.126	0.220 - 0.268	8-12	2-9	34 - 43	20 - 24
	(Morphotype)	(na) 4	(0.182) 8	(0.157) 8	(1.04) 7	(na) 6	(na) 6	(na) 6	(11) 8	(na) 6	(na) 6	(22) 8
Interested read	ders may contact pri	mary author for	r raw data. na, no	t available.								

<sup>a</sup> Characters used in discriminant factor analysis.

such a way as to maximize the morphometric distance between groups. One can then add individuals to the analysis to ascertain their morphometric, and hence taxonomic, proximity to the groups. Discriminant factor analysis has been used to discriminate between aphid species (Brown and Blackman 1994), between populations of the same species (Foottit and Mackauer 1990), and to distinguish between holocyclic and anholocyclic aphids of the same species (Hand 1986), and between fundatrices and apterous viviparae of the same species (Favret et al. 2004). It has not been used to associate new aphid material and aphid types as a means to identification. As we began this revision of the Cinara of the pinyon pines, we expected to uncover a number of synonymies (Blackman and Eastop 1994). We used discriminant factor analysis to measure the morphometric differences between otherwise similar species and to confirm taxonomic decisions made using traditional morphological means.

A molecular phylogeny of the polyphyletic pinyon *Cinara* has recently been published (Favret and Voegtlin 2004a). Here, we present a taxonomic revision and description of the *Cinara* species that are found on the pinyon pines *P. edulis* and *P. monophylla*. We do not redescribe the ovipara or male as no new material has been collected of these morphs and many of the types are in poor condition. All the species are fully figured and we provide a key to the apterous and alate viviparous morphs.

Although the taxonomy of the pine-feeding *Cinara* of the southeastern United States is in relatively good shape (Pepper and Tissot 1973), the taxonomy of the rest of the North American fauna suffers from a paucity of museum specimens and an overabundance of names (see above). Unfortunately, many of the *Cinara* specimens housed in museums were not properly cleared before slide-mounting, making morphological examination, especially of types, extremely difficult. To begin to revise the taxonomy of the North American fauna, a large amount of collecting will be necessary, and molecular and morphological techniques will have to be used in tandem. We hope this current study serves as a model for the future revision of the North American *Cinara*.

## Materials and Methods

Collections were made principally during the summers of 1997–2001, with a few collections in the 1970s and 1980s, across the full ranges of *P. edulis* and *P. monophylla*. Extra effort was made to collect at the margins of the ranges. Specimens brought back to the laboratory were cleared in a chloral phenol procedure and mounted to microscope slides in Canada balsam. Unless noted below, all specimens were deposited in the insect collection at the Illinois Natural History Survey (INHS), Champaign, IL. The data associated with these specimens are available in the insect collection database accessible at http://www.inhs.uiuc.edu. We use database catalog numbers for ma-

terial discussed here, which can be used to access all the data via the Internet.

We identified collected specimens using keys of Hottes (1960) and Blackman and Eastop (1994) and found seven species: *C. atra* (Gillette & Palmer), *C. caliente* Hottes, *C. edulis* (Wilson), *C. puerca* Hottes, *C. rustica* Hottes, *C. terminalis* (Gillette & Palmer), and *C. wahtolca* Hottes. Specimens of these and the other seven species, including types, were borrowed from other institutions: the University of Minnesota, Colorado State University, Utah State University, and the U.S. National Museum of Natural History (NMNH).

Measurements were made of collected and type material of pinyon-feeding Cinara. Morphological characters successfully used in previous studies (Bradley 1961, Eastop 1972, Foottit and Mackauer 1990, Foottit 1992, Favret and Voegtlin 2004b) were selected, and measurements and setal counts were made using a Zidas digitizing pad under a compound microscope drawing tube or an ocular micrometer. Measurements were made of maximal lineal distance. In other words, curved structures were measured as straight lines, and projections such as the proximal muscle attachment point of the tibia were included in the measurements. Characters (Table 1) included lengths of: the whole body, from frons to tip of cauda; rostral segments 3 and 4, and Bradley's measure (a proxy for whole rostrum length corresponding to the sclerotized length of the stylet groove; Bradley 1961, Favret and Voegtlin 2004b); antennal segments 3 through 5; the femur, tibia, and first and second tarsal segments of a hind leg; the longest seta on the third antennal segment, the mid-dorsal region of the metatibia, and the fifth abdominal tergum; the siphuncular cone, front to back; and counts of accessory setae on the fourth rostral segment, the basal portion of the sixth antennal segment, the siphuncular cone, and the eighth abdominal tergite.

Because we expected to find synonymies among the species of pinyon *Cinara* (Blackman and Eastop 1994), we used discriminant factor analysis as a means to associate type specimens with newly collected material. Groups of C. anelia, C. atra, C. caliente, C. edulis, C. terminalis, and C. wahtolca, and individual type specimens of other species were analyzed together. If types grouped closely with one of the other species, we would have evidence of a possible synonymy. Conversely, if types were morphometrically distinct from any other species, we would have evidence of the species' validity. We used SYSTAT 10 software (SPSS Inc. 2000) to perform the discriminant factor analyses with equally weighted variables and a matrix inversion tolerance of 0.001. Some of the morphometric characters were omitted from the discriminant factor analysis if they were unavailable for type specimens or for a large number of individuals (Table 1). The second and third canonical variables provided the greatest resolution of species, and we plotted them on twodimensional graphs.

Morphological species concepts have led to the erection of an overabundance of species and cryptic species have not been discerned. The phylogenetic species concept, however, has proven its utility (Wheeler 1999, Goldstein and DeSalle 2000). We used genetic data to circumscribe and clarify taxonomic affinities of pinyon *Cinara*. Mitochondrial cytochrome oxidase 1 (CO-1) sequence data were acquired for 93 pinyon *Cinara* collections, 35 genetic haplotypes were recovered, and phylogenetic analyses were performed (Favret and Voegtlin 2004a). One cannot use cladistic relationships alone to recognize species (Joger et al. 1998, Goldstein and DeSalle 2000), but we made DNAbased taxonomic decisions on a case by case basis, informed by relative sequence divergence, the level of support for clades, and the relative geographic dispersion of genetic haplotypes (see species discussions).

## **Results and Discussion**

# *Cinara anelia* new species (Table 1; Figs. 1a, 2a, 3a, 4a, 5a, 6a, 7a, 8a, 9a)

Apterous Vivipara. In life: Body dark brown to dark gray to black. Extensive wax patterning on the thorax and abdomen, which may be rubbed off, gives the aphid a mottled gray and black appearance (Fig. 1a). Legs and antennae light to dark brown, following same patterning as slide-mounted specimen. Morphology of cleared, slide-mounted specimens: See Table 1 for anatomical measurements. Head: Frons gently rounded with long setae of moderate density. Rostrum typical, segments 1 and 2 mostly clear, with faint sclerotization pattern on segment 2, pattern becoming denser distally (Fig. 2a). Rostral segments 3 and 4 dark (Fig. 3a). Antenna of six segments, smooth, usually with zero to one, sometimes two, and rarely more sensoria on segment 3. Segments 1 and 2 clear, segments 3, 4, and 5 each basally light gradually darkening distally; segment 6 dark throughout (Fig. 4a). Thorax: Pro- and mesofemora slightly darkened and solid, metafemur gradually darkening distally. Pro- and mesotibiae clear, darkened only at knee and distal end. Metatibia long, darkened at knee and on distal portion, slightly less than half the overall length (Fig. 5a). Metatibial setation moderately dense, setae of medium length, and protruding at an angle of  $\approx 45^{\circ}$  (Fig. 6a). Tarsus dark (Fig. 7a). Abdomen: Dorsum smooth with rather dense setae of variable length. Siphunculus well-delimited and sclerotic cones dark. Sclerites of variable size on abdominal terga 6 and 7. Often also on tergum 5, and occasionally on tergum 4, these latter two usually found as aggregations of smaller sclerites (Fig. 8a). The eighth abdominal tergites well developed and with many setae.

Alate Vivipara. As apterous vivipara except for the following (Fig. 9a). *Head:* Antenna three with 5–10 sensoria. Pigmentation of antennal segments 3, 4, and 5, such that they are light basally, and gradually become slightly darker distally. *Thorax:* Metatibia darkened distally for slightly more than half its length. Rs, Cu, and A veins well developed, but M vein, twice-



Fig. 1. Aphids in life, (a) C. anelia, (b) C. edulis, (c) C. terminalis, (d) C. atra tended by ant.

forked, faint and indistinct. *Abdomen:* Tergal sclerites (apart from eighth) absent.

Discussion. Genetic evidence shows that what has previously been considered C. wahtolca is in fact two species, C. wahtolca feeding exclusively on P. edulis and C. anelia feeding on P. monophylla: numerous collections of both species segregate into two clear and well-supported clades based on CO-1 DNA sequence data (Favret and Voegtlin 2004a). Furthermore, the DNA sequence divergence between the two clades (2.1–2.4%) is generally greater than between either of them and other valid species (0.7-2.2%). Although sequence divergence alone is insufficient to delimit species (mitochondrial sequence divergence of 12.9% has been found in a single valid species of snail; Thomaz et al. 1996), the fact that divergence was higher between C. anelia and C. wahtolca than it was between either of them and other valid species is telling. Also, the genetic distinctness of both clades is preserved despite the aphids' apparent high vagility and broad geographic distribution: both clades contain haplotypes that span almost the entire geographic range of their respective hosts (Favret and Voegtlin 2004a). The species is named for Ani Katchova.

**Diagnosis.** Wax patterns in life, usually present, distinguish this species from *C. terminalis*, a species morphologically similar when slide-mounted. The setal count on the ultimate rostral segment (segment 4, URS) is similar to C. terminalis, but the segment is slightly thicker (Fig. 3a and h) and Bradley's measure is usually longer (Table 1). The metatibial hairs are also generally more dense and less erect than in C. terminalis (Fig. 6a and h), but longer, less dense, and more erect than in C. edulis (Fig. 6d). Slide-mounted apterous C. anelia are best distinguished from C. terminalis by the pairs of sclerites on the dorsum of abdominal segments 6 and 7, sometimes also segment 5, and perhaps also segment 4 (Fig. 8a and h). No sclerites have been seen on abdominal segment 3. C. *terminalis* often exhibits paired sclerites on abdominal segments 6 and 7, but these are always considerably smaller than those of *C. anelia*, and those on 6 and 7 are often expressed as a row of scleroites.

Unfortunately, the new species is not reliably differentiated from *C. wahtolca* by morphological means or even discriminant functions (Figs. 11–17), although it is usually larger: almost all length measures are greater in *C. anelia* than they are in *C. wahtolca* (Favret and Voegtlin 2004b). Also, *C. anelia* is more likely than *C. wahtolca* to exhibit paired sclerites on abdominal segments 4 and 5, and all paired sclerites are usually better developed in *C. anelia* (Fig. 8a and h). Finally, *C. anelia* often, but not



Fig. 2. Rostra of apterae, (a) *C. anelia* specimen 19709, (b) *C. atra* specimen 16709, (c) *C. caliente* specimen 43519, (d) *C. edulis* specimen 19760, (e) *C. puerca* specimen 41624, (f) *C. tanneri* immature specimen 43561, (g) *C. terminalis* specimen 16443, (h) *C. wahtolca* specimen 16552. Pictures are to scale with respect to each other, except for *C. puerca* (e) which is one-half size.

always, has a greater number of setae on abdominal tergite 8. The only completely reliable means of differentiating the species is by sequencing the CO-1 gene (Favret and Voegtlin 2004a; GenBank accession nos. AY300205–AY300206, AY302041–AY302053), and short of that, by using host identity.

**Biology.** This aphid is typically found in small to large colonies on needle free or sparsely needled branches, twigs, or trunks of young *P. monophylla*. It can be found in mixed colonies with *C. edulis* or *C. terminalis* and is frequently attended by ants. It is found everywhere *P. monophylla* grows (Fig. 10a).

Type Material Examined. The holotype is an apterous vivipara, INHS insect collection specimen no. 16547, collected in the Piute Mountains of California, Kern County, 6.4 miles north on Sand Canyon Rd. from its junction with Tehachapi Blvd., 1,350-m elevation, 35.184° latitude, -118.340° longitude, 25-VI-1997, C. Favret and S. Favret. We designate specimen no. 16549 as the alate vivipara morphotype, collected in the San Emigdio Mountains of California, Kern County, 0.3 mile north of Forest Route 9N22 from its junction with Cuddy Valley Rd., 1,700-m elevation, 34.850° latitude, -119.061° longitude, 25-VI-1997, C. Favret and S. Favret. Both of these specimens and the following paratypes, deposited at the INHS unless noted otherwise (five-digit numbers preceding the collection data are INHS insect collection catalog



Fig. 3. Ultimate rostral segments of apterae, (a) *C. anelia* specimen 19709, (b) *C. atra* specimen 16710, (c) *C. caliente* specimen 16746, (d) *C. edulis* specimen 19760, (e) *C. puerca* specimen 41624, (f) *C. tanneri* immature specimen 43561, (g) *C. terminalis* specimen 16409, (h) *C. wahtolca* specimen 16517. Pictures are to scale with respect to each other except for *C. puerca* (e) and *C. tanneri* (f) which are one-half size.

numbers retrievable at http://www.inhs.uiuc.edu), are specimens taken from colonies for which we obtained CO-1 DNA sequences: 16530–16531, 19652– 19654, 19949–19952, CA, San Bernardino County, 4.5 miles west on Holcomb Valley Rd. from jxn. w/SR 18, 2,300-m elevation, 34.299° latitude, -116.864° longitude, 23-VI-1997, C. and S. Favret; 16532–16534, 19651, CA, San Bernardino County, 0.5 mile north on SR 18



Fig. 4. Antennae of apterae, (a) *C. anelia* specimen 19709, (b) *C. atra* specimen 16712, (c) *C. caliente* specimen 43519, (d) *C. edulis* specimen 19760, (e) *C. puerca* specimen 41630, (f) *C. tanneri* holotype, (g) *C. terminalis* specimen 16443, (h) *C. wahtolca* specimen 43441. Pictures are to scale with respect to each other.

from jxn. w/Baldwin Lake Rd., 2,000-m elevation, 34.295° latitude, -116.798° longitude, 23-VI-1997, C. and S. Favret; 16535–16539, 16570, CA, San Bernardino County, 0.7 mile west on SR 38 from jxn. w/Lake William Dr., 2,300-m elevation, 34.225° latitude, -116.765° longitude, 23-VI-1997, C. and S. Favret; 16540-16543, 19953-19957, CA, San Bernardino County, 2.1 miles west on SR 38 from jxn. w/Lake William Dr., 2,400-m elevation, 34.215° latitude, -116.750° longitude, 23-VI-1997, C. and S. Favret; 16527 deposited at NMNH, 16528-16529, 16571 deposited at Canadian National Collection, 16572, 19657, CA, Ventura County, jxn. of SR 33 and Pine Mt. Rd., 1,550-m elevation, 34.649° latitude, -119.384° longitude, 25-VI-1997, C. and S. Favret; 16544-16545, 16546 deposited at Utah State University, 19662–19663, 19929 deposited at Colorado State University, 19939–19940, CA, Kern County, 6.4 miles north on Sand Canyon Rd. from jxn. w/Tehachapi Blvd., 1,350-m elevation, 35.184° latitude, -118.340° longitude, 25-VI-1997, C. and S. Favret; 16550 deposited at NMNH, 19661, CA, Kern County, 0.3 mile north of Forest Route 9N22 from jxn. w/Cuddy Valley Rd., 1,700-m elevation, 34.850° latitude, -119.061° longitude, 25-VI-1997, C. and S. Favret; 16526, CA, Inyo County, 10.7 miles west on Horseshoe Meadows Rd. from jxn. w/Whit-



Fig. 5. Metatibiae of apterae, (a) *C. anelia* specimen 16547, (b) *C. atra* specimen 16716, (c) *C. caliente* specimen 43519, (d) *C. edulis* specimen 19760, (e) *C. puerca* specimen 41630, (f) *C. tanneri* holotype, (g) *C. terminalis* specimen 16443, (h) *C. wahtolca* specimen 16552. Pictures are to scale with respect to each other.

ney Portal Rd., 2,000-m elevation, 36.495° latitude, -118.100° longitude, 27-VI-1997, C. and S. Favret; 16523, 19716, NV, White Pine County, Connors Pass on US 50, 2,400-m elevation, 39.039° latitude, -114.647° longitude, 13-VII-1997, C. Favret; 16524-16525, 19708, 19709 deposited at Canadian National Collection, 19710, NV, Eureka County, 6.2 miles east on US 50 from jxn. w/SR 278, 2191-m elevation, 39.473° latitude, -115.947° longitude, 13-VII-1997, C. Favret; 16521-16522, 19846, NV, Elko County, 9.5 miles east on Spruce Mt. Rd. from jxn. w/US 93, 2,362-m elevation, 40.562° latitude, -114.852° longitude, 2-VIII-1998, C. and S. Favret; 16519, NV, White Pine County, 11.5 miles west on Cherry Cr. Rd. from jxn. w/US 93, 2,113-m elevation, 39.911° latitude, -114.930° longitude, 3-VIII-1998, C. and S. Favret; 16553, CA, Mono County, 0.3 mile up dirt Rd. 0.4 mile east Sherwin Summit on US 395, 2,176-m elevation, 37.562° latitude, -118.666° longitude, 6-VII-1999, C. and S. Favret; 16548, 19816-19817, CA, Inyo County, Mahogany Flats, 2,528-m elevation, 36.230° latitude, -117.068° longitude, 7-VII-2001, C. Favret.

The following paratype slides do not have corroborating DNA sequence data: At Utah State University, UT, Logan, 13-IX-1937, G. F. Knowlton; at Colorado State University, UT, Logan, U.S.A.C. Campus, 21-VIII-1937, C. F. Smith; at INHS, 43582, CA, Mono



Fig. 6. Tibial setation of apterae, dorsal edge to the right, (a) *C. anelia* specimen 16547, (b) *C. atra* specimen 16716, (c) *C. caliente* specimen 43519, (d) *C. edulis* specimen 19760, (e) *C. puerca* specimen 41630, (f) *C. tanneri* holotype, (g) *C. terminalis* specimen 16443, (h) *C. wahtolca* specimen 16552. Pictures are to scale with respect to each other.

County, Sherwin Summit, 2,134-m elevation, 37.562° latitude, -118.666° longitude, 17-VII-1972, D. J. Voegtlin; 43292-43294, CA, Inyo County, Cedar Flat, White Mts., 18-VII-1973, D. J. Voegtlin; 43295-43299, Grand View Camp, White Mts., 18-VII-1973, D. J. Voegtlin; 19623, AZ, Yavapai County, 6.9 miles east Crown King on FR 259, 1,330-m elevation, 34.258° latitude, -112.291° longitude, 25-V-1997, C. Favret; 19627 deposited at Utah State University, 19975, NV, Lyon County, 5.8 miles south on SR 338 from jxn. w/Risue Rd., 2,051-m elevation, 38.490° latitude, -119.194° longitude, 12-VI-1997, C. Favret; 19628, CA, Mono County, jxn. of 167 and Cemetery Rd., 2,000-m elevation, 38.067° latitude, -119.086° longitude, 13-VI-1997, C. Favret; 19974, NV, Nye County, 8.3 miles east on SR 377 from jxn w/SR 376, 2,325-m elevation, 38.547° latitude, -117.046° longitude, 15-VI-1997, C. Favret; 19972-19973, NV, Lincoln County, 2.5 miles east of pass W of Caliente, 1 mile west dirt Rd. turning north on US 93, 1,896-m elevation, 37.599° latitude, -114.665° longitude, 16-VI-1997, C. Favret; 19969, NV, Clark County, 4.6 miles northeast on SR 156 from jxn. w/SR 158, 2,113-m elevation, 36.372° latitude, -115.628° longitude, 17-VI-1997, C. Favret; 19960, NV, Clark County, 6.9 miles north on Lowell Summit Rd. from jxn. w/SR 160, 1,420-m elevation, 36.073° latitude, -115.586° longitude, 18-VI-1997, C. Favret; 19638, CA, San Bernardino County, 0.5 mile W on Cedar Canyon Rd. from jxn. w/Black Canyon Rd., 1600 m elevation, 35.170° latitude, -115.419° longitude, 19-VI-1997, C. Favret; 19958-19959, CA, San Bernardino Co., 4.9 miles north on New York Mt. Rd. from jxn. w/Cedar Canyon Rd., 1,700-m elevation, 35.218° latitude, -115.307° longitude, 19-VI-1997, C. Favret; 19643-19650, CA, San Bernardino County, 2.1 miles west on SR 38 from jxn. w/Lake William Dr., 2,400-m elevation, 34.215° latitude, -116.750° longitude, 23-VI-1997, C. and S. Favret; 19944-19948, CA, Los Angeles County, 1.7 miles east on N4 from jxn. w/Big Pines elevation, 34.405° Highway, 1,700-m latitude, -117.757° longitude, 24-VI-1997, C. and S. Favret; 19655, CA, San Bernardino County, 1.3 miles southwest on SR two from jxn. w/SR 138, 1,550-m elevation, 34.381° latitude, -117.596° longitude, 24-VI-1997, C. and S. Favret; 16733-16735, 19659-19660, 19941-19942, CA, Ventura County, jxn. of Lockwood Valley Rd. and FR 8N40, 1,300-m elevation, 34.716° latitude, -119.261° longitude, 25-VI-1997, C. and S. Favret; 19664, 19667-19671, 19934 deposited at British Museum of Natural History, 19935-19937, CA, Kern County, 4.7 miles north on Piute Mt. Rd., from jxn. w/Caliente Cr. Rd., 1,950-m elevation, 35.423° latitude, -118.417° longitude, 26-VI-1997, C. and S. Favret; 19672 deposited at NMNH, 19673-19677, 19933, CA, Kern County, 7.0 miles west on Piute Mt. Rd. from jxn. w/Kelso Valley Rd., 2,000-m elevation,



Fig.7. Metatarsi of apterae, (a) *C. anelia* specimen 16547, (b) *C. atra* specimen 16716, (c) *C. caliente* specimen 43519, (d) *C. edulis* specimen 19760, (e) *C. puerca* specimen 41630, (f) *C. tanneri* holotype, (g) *C. terminalis* specimen 16409, (h) *C. wahtolca* specimen 16552. Pictures are to scale with respect to each other.

35.448° latitude, -118.294° longitude, 26-VI-1997, C. and S. Favret; 19678-19679, 19681-19682, 19685, 19928, CA, Tulare County, 4.9 miles east on Sherman Pass Rd. from jxn., w/Sierra Way, 1,700-m elevation, 35.980° latitude, -118.430° longitude, 26-VI-1997, C. and S. Favret; 19686-19687, 19930 deposited at British Museum of Natural History, 19931-19932, CA, Kern County, Walker Pass Campground on SR 178, 1,600-m elevation, 35.662° latitude, -118.037° longitude, 26-VI-1997, C. and S. Favret; 19688-19689, CA, Tulare Co., Nine Mile Canyon Rd. at Inyo County line, 1,900-m elevation, 35.860° latitude, -118.006° longitude, 27-VI-1997, C. and S. Favret; 19691, CA, Tulare County, 6.6 miles west Inyo County line on Kennedy Meadows Rd., 2,150-m elevation, 35.926° latitude, -118.047° longitude, 27-VI-1997, C. and S. Favret; 19692, CA, Inyo County, 16.1 miles on Mazourka Canyon Rd. from jxn. w/US 395, 2,200-m elevation, 36.924° latitude, -118.080° longitude, 27-VI-1997, C. and S. Favret; 19713-19714, NV, White Pine County, 1.2 miles west on US 50 from jxn. w/Thirty Mile Rd., 2,129-m elevation, 39.428° latitude, -115.168° longitude, 13-VII-1997, C. Favret; 19780, 19881–19882, 19883 deposited at Colorado State University, NV, White Pine County, Schellbourne Pass on SSR 2, 2,393-m elevation, 39.806° latitude, -114.649° longitude, 3-VIII-1998, C. and S. Favret; 19784, 19878, NV, Nye County, end of Burley Cr. Rd. (FR 005), 2,486-m elevation, 38.664° latitude, -116.638° longitude, 4-VIII-1998, C. and S. Favret; 19874-19875, NV, Nye County, 0.8 mile west Northumberland Pass on East Northumberland Rd., 2,673-m elevation, 38.960° latitude, -116.849° longitude, 4-VIII-1998, C. and S. Favret.

Other Material Examined. INHS specimens 35865, 43288 – 43291, from *P. aristata* Engelm., are excluded as paratypes due to their unusual host and lack of genetic data: 35865, 43288, CA, Inyo County, Blanco Mt., White Mts., 17-VII-1973, D. J. Voegtlin; 43289 – 43291, CA, Inyo County, Patriarch Grove, White Mts., 1-VIII-1975, P. Rude. Specimens 43593, 43598, 43605, 43609, 43614 from *P. monophylla* are excluded as paratypes because the slides also contain specimens of *C. edulis:* NV, White Pine County, campground 6 miles southwest Ely, 3-VII-1985, D. J. Voegtlin. A discolored slide is at Utah State University: UT, W Duchesne, 27-V-1958, G. F. Knowlton.

## Cinara atra (Gillette & Palmer)

(Table 1; Figs. 1d, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b)

- Lachnus ater Gillette and Palmer 1924: 37–39, plates 12–13, incorrect original spelling.
- *Cinara atra* (Gillette and Palmer 1931: 847–848, Fig. 17); Hottes 1960: 201–202, Fig. 2; Palmer 1952: 23–24, Fig. 15.
- *Cinara poketa* Hottes 1956c: 220–221, Fig. 1; Hottes 1960: 207–209, Fig. 9; new synonymy.

Apterous Vivipara. In *life:* Black and shiny, completely free of wax, with an ant-like appearance (Fig. 1d). Siphunculus concolorous with abdominal dorsum. Appendages light to dark brown, following



Fig. 8. Terminal abdominal segments of apterae, (a) *C. anelia* specimen 16547, (b) *C. atra* specimen 16712, (c) *C. caliente* specimen 43509, (d) *C. edulis* specimen 19760, (e) *C. puerca* specimen 41630, (f) *C. tanneri* holotype, (g) *C. terminalis* specimen 16409, (h) *C. wahtolca* specimen 19861. Pictures are not to scale.



Fig. 9. Alatae (a) *C. anelia* specimen 16549, (b) *C. atra* specimen 16719, (c) *C. caliente* specimen 43520, (d) *C. edulis* specimen 43417, (e) *C. puerca* specimen 41629, (f) *C. terminalis* specimen 43321, (g) *C. wahtolca* specimen 43283. Pictures are not to scale with respect to each other.

same pigmentation pattern as in slide-mounted specimen. Morphology of cleared, slide-mounted specimens: See Table 1 for anatomical measurements. *Head:* Frons gently convex, with short, moderately dense setae. Rostrum moderately long, with light pigmentation pattern along segment 2, becoming more dense distally (Fig. 2b). Segments three and four dark (Fig. 3b). Antenna of six segments short. Segments 1 and 2, distal tips of 3 and 4, distal half of 5, and all of 6 dark (Fig. 4b). Antennal setae relatively short and sparse. No sensoria on segment 3. Thorax: All femora dark except for some lightening basally. Pro- and mesotibiae dark, but darkest at proximal and distal extremes. Metatibia dark at knee and for distal portion just over half the overall length (Fig. 5b). Metatibial setae moderately long and dense, bent at an angle of 30-40°, or just under 45° (Fig. 6b). Tarsus dark. Ventral setae of segment one long, often curved or hooked (Fig. 7b). Abdomen: Dorsum smooth, with short hairs and no sclerites (Fig. 8b). Siphunculus clearly delimited, but sometimes pale, with sparse setae. Few setae on tergite 8.

Alate Vivipara. As apterous vivipara except for following (Fig. 9b). *Head*: Antenna dark except for bases of segments 3, 4, and 5. Segment 3 with 4–6 sensoria. *Thorax*: Metatibia lightly pigmented only on basal onethird, excluding the dark knee. Rs, Cu, and A veins well-developed, but M vein, twice-forked, faint and indistinct.

**Discussion.** Favret and Voegtlin (2004a) established a close genetic relationship between *C. atra* and *C. edulis.* Morphologically, the phylogenetic proximity of the species is seen in the morphology of the rostrum (Table 1; Figs. 2b, 2d, 3b, 3d). Hottes (1960) noted that the setae on the first metatarsal segments were quite long with the "terminal hairs strongly bent or hooked" (Fig. 7b). We also have seen this in more recent collections, and although this character state is common, it is not universal.

**Diagnosis.** The long and curved setae of tarsal segment 1 (Fig. 7b) usually distinguish this species from all the others. The setation of the URS (Fig. 3b) distinguishes it from all others save *C. edulis. C. atra* has setation on the metatibia slightly denser than in other species (Fig. 6b), although not nearly as dense as that of *C. edulis* (Fig. 6d). The abdominal dorsum of the slide-mounted specimen is free of sclerites, in contrast to all the other species save *C. edulis, C. puerca*, and *C. tanneri*, except for relatively small eighth abdominal tergites with short hairs (Fig. 8b). *C. atra* can be distinguished from *C. edulis* in that the setae on the siphuncular cone are similar in size and shape to those on the fifth abdominal tergum, whereas in *C. edulis*, the siphuncular setae are distinctly longer.

**Biology.** It has been found in small colonies on needle free or sparsely needled branches, twigs, or trunks of *P. edulis.* It is usually attended by ants. Recent collections of this species were only in New Mexico and western Arizona, but the type locality is in north central Colorado and the species's range presumably extends everywhere *P. edulis* grows (Fig. 10b).

Type Material Examined. The following material is at the NMNH. Gillette and Palmer (1924) designated a type series: they labeled a "type" for each of four morphs (although they did not mention them as distinct in the description) and labeled the rest of the series as paratypes. Because no single name-bearing type has been designated, all specimens of the type series should be considered syntypes. An alate specimen on a slide with two coverslips has been subsequently labeled a lectotype; an apterous form on the same slide was labeled morphotype. However, this slide has had multiple labels glued over each other, with a bottom "paratype" label under a coverslip, corresponding to the designation by Gillette and Palmer (1924). The types (one for each morph), as labeled by Gillette and Palmer (1924), are on three other slides: an alate and apterous vivipara on one, an ovipara on a second, and a male on the third. To clear up confusion regarding the mislabeling of specimens and misdesignating of types, we hereby designate the apterous vivipara syntype as the true lectotype, all other types and "paratypes" becoming paralectotypes. We single out the other three types as morpholectotypes. The apterous viviparous lectotype, alate viviparous morpholectotype, seven other paralectotypes on one slide, and three other slides of paralectotypes with the same collection data: NMNH#41966, Colo. Agr. Exp. Sta. accession no. 3030, CO, Larimer County, Owl Canyon, 6-VIII-1922, F. C. Hottes and C. A. Bjurman, P. edulis. Oviparous morpholectotype, allolectotype, and 12 other paralectotypes on two slides: same as previous, 27-X-1921, M. A. Palmer.

There are five other paralectotype slides with the same collection data as the lectotype, one at Utah State University and four at Colorado State University. Colorado State University also has an additional three paralectotype slides: same collection locality as the lectotype, 25-IX-1921, C. P. Gillette and M. A Palmer.

Other Material Examined. INHS insect specimens (five-digit numbers are INHS insect collection database catalog numbers, http://www.inhs.uiuc.edu) all from P. edulis: There are five slides labeled as metatypes at Colorado State University, all from Owl Canyon: two slides, 6-XI-1921, J.L.H.; one slide, 19-X-1922, M. A. Palmer; one slide, 27-X-1921, M. A. Palmer; one slide, 6-IX-1922, M. A. Palmer; at the NMNH: CO, Larimer County, Owl Canyon, Fort Collins, 23-VIII-1925, F. C. Hottes; at INHS, 43346-43351, AZ, Sunset Crater, 6-VII-1986, J. H. Cushman; 16709-16710, NM, Santa Fe County, I-25 exit 290 onto U.S. 285, 2,238-m elevation, 35.554° latitude, -105.880° longitude, 12-VII-1998, C. Favret; 16711-16712, NM, Lincoln Co., 1.5 miles south on FR 73 from jxn. w/FR 72A, 2,238-m elevation, 33.855° latitude, -105.654° longitude, 13-VII-1998, C. Favret; 16713, 16715, NM, San Juan County, 5.7 miles west on SR 134 from jxn. w/U.S. 666, 2,207-m elevation, 36.113° latitude, -108.785° longitude, 18-VII-1998, C. Favret; 16716-16720, NM, Union Co., 1 mile north on SR 551 from jxn. w/SR 456, 1,913-m elevation, 36.928° latitude, -103.867° longitude, 3-VII-2001, C. Favret; 16714, AZ, Apache County, 2 miles north Klagetoh, 2,036-m elevation,



Fig. 10. Geographic grid maps of collection localities (type localities have hollow symbols), with elevation range 1,600–2,600 m shaded in gray. (a) *C. anelia* and *C. wahtolca*, (b) *C. atra*, *C. caliente*, *C. puerca*, and *C. tanneri*, (c) *C. edulis*, (d) *C. terminalis*.

 $35.537^\circ$  latitude,  $-109.521^\circ$  longitude, 6-VII-2001, C. Favret.

Cinara poketa Hottes 1956c new synonymy. Discriminant factor analysis was unable to distinguish an apterous specimen of C. poketa determined by Hottes from those of C. atra (Fig. 11a), although the C. poketa alate holotype is slightly removed from the measured specimens of *C. atra* (Fig. 11b). Hottes (1956c, 1960) claimed that C. poketa was very close to C. atra and provided several diagnostic characters (1956c): "In nature this species is suggestive of C. atra G & P from which it may be differentiated at once by the more numerous hairs on the dorsum, the more shallow cornicles, the shorter hairs on the ventral surface of the first tarsal segment, and the dull hairs on the outer margin of the tibiae." Firstly, with respect to dorsal hairs, Hottes (1956c) wrote in his original description of C. poketa, "dorsum of abdomen with comparatively few short rather spine-like hairs," and we cannot see that there is a significant difference between the number of dorsal hairs of the two species. We did not note any difference in the height of the cornicles of these two species, either, although this character is almost always distorted on a slide-mounted specimen. Without photographs of living specimens of C. poketa, a proper comparison of this character with *C. atra* is not possible. Furthermore, although Hottes (1956c) claimed the hairs on the first tarsal segment were shorter than those on *C. atra*, a specimen at the NMNH determined by Hottes clearly exhibits the characteristic tarsal setae of *C. atra*.

In the key of Hottes (1960), the two species are separated based solely on the size of the sclerotized portion of the siphunculus. The siphunculus in the holotype is indeed smaller than that of any alate *C. atra* specimens, but only marginally so. We measured the holotype siphunculus to be 0.19 mm wide, whereas our alate *C. atra* specimens span a range from 0.22 to 0.28 mm (Table 1). All other measurements of *C. poketa* specimens indicate that these are simply individuals on the small end of the range of *C. atra* sizes. All types are at the NMNH.

# Cinara caliente Hottes

(Table 1; Figs. 2c, 3c, 4c, 5c, 6c, 7c, 8c, 9c)

*Cinara caliente* Hottes 1955c: 197–199, Fig. 1; Hottes 1960: 202, Fig. 3.



Fig. 11. Discriminant factor canonical variables plot for C. poketa (a) apterae and (b) alatae.

Apterous Vivipara. In life: Small species with coloration similar to that of the bark on which it feeds (Hottes 1960). Morphology of cleared, slide-mounted specimens: See Table 1 for anatomical measurements. Head: Frons gently convex, with short, sparse setae. Rostrum short, with light pigmentation pattern along segment two (Fig. 2c). Segments 3 and 4 dark, with few setae (Fig. 3c). Antenna of six segments short. Segments 1 and 2, distal tips of 3, 4, and 5, and all of six dark (Fig. 4c). Antennal setae short and sparse. No sensoria on segment 3. *Thorax:* All femora dark except for basal one-fourth of pro- and mesofemora, and basal one-third of metafemur. Tibiae light except for knees and distal one-fourth of pro- and mesotibiae and distal one-third of metatibia (Fig. 5c). Metatibial setae short and sparse, bent at an angle of  $\approx 45^{\circ}$  (Fig. 6c). Tarsus dark (Fig. 7c). *Abdomen:* Dorsum smooth, with slightly scabrous scle-



Fig. 12. Discriminant factor canonical variables plot for C. apacheca (a) apterae and (b) alatae.

rites on all segments (Fig. 8c). Siphunculus clearly delimited and dark with sparse setae. Few setae on irregularly shaped tergite 8.

Alate Vivipara. As apterous vivipara except for following (Fig. 9c). *Thorax:* Rs, Cu, and A veins welldeveloped, but M vein, twice-forked, faint and indistinct. *Abdomen:* No sclerotization on terga.

**Discussion.** This is a rarely collected and small species. All morphometric measurements are smaller than

in other species and the rostrum is particularly reduced (Table 1; Fig. 2c).

**Diagnosis.** There are usually only four or five URS accessory setae (Table 1; Fig. 3c), distinguishing this species from all the others. Also, slide-mounted apterae have sclerites on all or nearly all segments of the abdomen (Fig. 8c). The sclerites on the eighth abdominal tergum are smaller and shaped irregularly compared with other species.



Fig. 13. Discriminant factor canonical variables plot for *C. metalica* aptera.

**Biology.** The few collections of this species were of small colonies on needle-free twigs of both pinyon species. Recent collections have only been in southern California, with the type locality in western Colorado (Fig. 10b).

Type Material Examined. All types were collected by F. C. Hottes at Grand Junction, CO, on *P. edulis*, unless noted otherwise. Holotype at the NMNH: 15-VIII-1955. Designated (Hottes 1955c) but unlabeled morphotype at the NMNH (we added a label): 12-VIII-1955. Allotype (17-IX-1955) and 21 paratype slides at the NMNH: 10 slides, 29-VII-1955; four slides 30-VII-1955; two slides, 22-VII-1955; two slides, 8-VIII-1955; two slides, 2-VIII-1955; one slide, 6-VIII-1955. Colorado State University has six paratype slides: two slides, 12-VIII-1955; one slide each, 8-VIII-1955, 26-IX-1955, 10-VII-1955; and one slide, CO, Delta, 6-VIII-1955.

Other Material Examined. INHS insect specimens (five-digit numbers are INHS insect collection database catalog numbers, http://www.inhs.uiuc.edu) from *P. monophylla*: 16739–16746, CA, San Bernardino County, 0.5 mile north on SR 18 from jxn. w/Baldwin Lake Rd., 2,000-m elevation, 34.295° latitude, -116.798° longitude, 23-VI-1997, C. and S. Favret. From *P. edulis*: 43505–43521, UT, 16 miles west Duchesne on U.S. 40, 11-VII-1985, D. J. Voegtlin. Colorado State University has one slide labeled metatype: CO, Delta, 26-IX-1955, *P edulis*.

#### Cinara edulis (Wilson)

(Table 1; Figs. 1b, 2d, 3d, 4d, 5d, 6d, 7d, 8d, 9d)

Lachniella edulis Wilson 1919: 44–45.

Lachnus edulis (Wilson 1919); Palmer 1926: 314–317, plates 27–28.

- *Cinara edulis* (Wilson 1919); Gillette and Palmer 1931: 851–852, Fig. 21; Hottes 1960: 202, 204, Fig. 4; Palmer 1952: 28–29, Fig. 21.
- *Cinara apacheca* Hottes and Butler 1955: 65–66; Hottes 1955a: Fig. 5; Hottes 1960: 201, Fig. 1; new synonymy.
- *Cinara metalica* Hottes 1956a: 85–87; Hottes 1956c: Fig. 3; Hottes 1960: 204, 206, Fig. 5; new synonymy.
- *Cinara pinata* Hottes 1955c: 199, 201–202, Fig. 2; Hottes 1960: 206–207, Fig. 7; new synonymy.
- *Cinara piñona* Hottes 1953: 153–155; Hottes 1954a: 90–91; name invalid under section 32.5.2 of the ICZN (1999).
- Cinara pinona Hottes 1953; Hottes 1955b: Fig. 5; Hottes 1960: 207: Fig. 8; new synonymy.
- *Cinara rustica* Hottes 1956a: 83–85; Hottes 1956c: Fig. 2; Hottes 1957: Fig. 2; Hottes 1960: 209, Fig. 11; new synonymy.

Apterous Vivipara. In life: Large species dark brown to dark gray to black. Distinct medial abdominal wax stripe and light powdering elsewhere (Fig. 1b), but the wax may be rubbed off. Legs and antennae are light to dark brown. Morphology of cleared, slidemounted specimens: See Table 1 for anatomical measurements. Head: Frons flat to gently convex with short, sparse setae. Rostrum long, with moderate pigmentation pattern along segment two (Fig. 2d). Segments 3 and 4 dark (Fig. 3d). Antenna long. Segment 1, distal tips of 3, 4, and 5, and all of six dark (Fig. 4d). Segment 2 sometimes lighter than 1, but generally darker than the light portions of the other segments. Antennal setae short and moderately sparse. Usually zero to one, often two, and rarely more sensoria on segment 3. Thorax: All femora lightly pigmented, with a gradual distal darkening over the entire length. Pro-





Fig. 15. Discriminant factor canonical variables plot for C. pinona (a) apterae and (b) alatae.

and mesotibiae dark at knees, and then rather abruptly light and gradually darkening for the rest of their lengths. Metatibia dark except for light area after knee and extending for one-third of its length (Fig. 5d). Metatibial setae generally short and quite dense, bent at an acute angle of 15–40° (Fig. 6d). Tarsus dark (Fig. 7d). *Abdomen:* Dorsum smooth, with sclerites only on segment 7. These sclerites may be large and rectangular as to cover most of tergum 7, or reduced to small aggregations of hair-bearing scleroites (Fig. 8d). Tergite 8 well resolved, with setae along the posterior edge only. Siphunculus usually clearly delimited and dark, but occasionally lightly pigmented or with two levels of pigmentation.

Alate Vivipara. As apterous vivipara except for following (Fig. 9d). *Head*: Pigmentation on antennal segments 3, 4, and 5 light basally gradually becoming much darker distally. *Thorax*: Pale area on metatibia reduced, sometimes faint to nonexistent. Rs, Cu, and A veins well-developed, but M vein, twice-forked, faint and indistinct. *Abdomen*: No sclerotization on tergum 7.



Fig. 16. Discriminant factor canonical variables plot for C. rustica (a) apterae and (b) alatae.

**Discussion.** This species is most closely allied with *C. atra* and shares with it a similar rostral morphology (Figs. 2b and d, 3b and d). It exhibits a great amount of variation such that Hottes named many synonyms, detailed below.

**Diagnosis.** *C. edulis* is characterized by a relatively long rostrum (Table 1; Fig. 2d), a URS with 12–20 accessory setae (Table 1; Fig. 3d), and dense, short, and nonerect setae on the relatively thick metatibiae (Fig. 6d). This last character does show some variation, but it rarely overlaps with *C. atra.* The seventh abdominal tergum often has lightly pigmented patches that vary in size from almost encompassing the entire dorsal area of the segment to constituting minute scleroites (Fig. 8d). This species can be differentiated from *C. atra* by the tibial setation (Fig. 6b and d) and by the presence of wax on the living specimen (Fig. 1b). Also, the setae on the siphuncular



Fig. 17. Discriminant factor canonical variables plot for C. nitidula (a) apterae and (b) alatae.

cone are much longer than those on the fifth abdominal tergum, whereas in *C. atra* the setae are similar in size.

**Biology.** *C. edulis* is the most commonly collected species and the first described from pinyons. Its range covers the entirety of the range of both principle pinyon species (Fig. 10c). It can be found in colonies of all sizes, some very large and composed of hundreds of individuals, on needle free areas of branches and small trunks. It has been known to cause serious damage, even killing its host (Palmer 1926). We also col-

lected it on the roots of *P. jeffreyi* Grev. & Balf., where much of the colony had already been decimated by parasites. It is occasionally found in mixed colonies with *C. anelia*, *C. puerca*, *C. tanneri* (Knowlton), *C. terminalis*, or *C. wahtolca*.

Type Material Examined. There are two type slides at the University of Minnesota: CO, Las Animas County, Trinidad, 18-VI-1911, L. C. Bragg. One contains four uncleared specimens. The other contains eight cleared specimens, seven of which are *C. edulis*, including one early instar, and one of which is *C. wahtolca.* To omit the *C. wahtolca* specimen from the type series, we here designate as lectotype the apterous specimen on the lower left of the slide (a slide map was added). The alate morpholectotype is the largest specimen on the left of the slide. The other five specimens of the species on this slide and the four on the other slide become paralectotypes.

Other Material Examined. At the INHS (five-digit numbers refer to INHS insect collection database, http://www.inhs.uiuc.edu), on *P. cembroides*, *P. edulis*, or hybrids of the two: 19598, 19600–19601, 19991, TX, Jeff Davis County, 0.6 mile south on SR 118 from jxn. w/Spur 78, 1,829-m elevation, 30.673° latitude, -104.031° longitude, 19-V-1997, C. Favret; 19863-19865, 19998, TX, Jeff Davis County, 1 mile on spur 78 from jxn. w/SR 118 to southern McDonald Observatory, 1,951-m elevation, 30.674° latitude, -104.021° longitude, 19-V-1997, C. Favret.

On P. edulis: 43300-43302, CO, Larimer County, Fort Collins, 25-IX-1976, W. Brewer; 43440, UT, Iron County, W Cedar City, Summit of Highway 25, 4-VII-1985, D. J. Voegtlin; 43445-43451, AZ, Coconino County, 4 miles northwest Jacob Lake, 5-VII-1985, D. J. Voegtlin; 43459-43461, AZ, Coconino County, E. Flagstaff, 6-VII-1985, D. J. Voegtlin; 43352, 43475-43483, AZ, Apache County, 5 miles west Springerville on Highway 273, 7-VII-1985, D. J. Voegtlin; 43466–43474, AZ, Apache County, 18 miles west Eagar, 2 miles south on Highway 273, 7-VII-1985, D. J. Voegtlin; 43353-43369, CO, Mesa County, 6 miles south Glade Park Campground, 9-VII-1985, D. J. Voegtlin; 43370-43395, 43500-43504, CO, Mesa County, 2 miles east Glade Park on highway to Grand Junction, 10-VII-1985, D. J. Voegtlin; 43396-43415, 43538-43573, UT, Uintah County, 16 miles west Duchesne on U.S. 40, 11-VII-1985, D. J. Voegtlin; 43416-43432, UT, Uintah County, below Starvation Reservoir, 19-V-1986, D. J. Voegtlin; 16558-16562, TX, Jeff Davis Co., 1 mile on spur 78 from jxn. w/SR 118 to southern McDonald Observatory, 1,951-m elevation, 30.674° latitude, -104.021° longitude, 19-V-1997, C. Favret; 16563, 16721–16728, TX, Jeff Davis County, 8.0 miles south on SR 118 from jxn. w/SR 116, 1,865-m elevation, 30.697° latitude, -104.098° longitude, 19-V-С. Favret; 19593-19595, 19859 - 19860, 1997, 19992–19997, TX, Jeff Davis County, 0.6 mile south on SR 118 from jxn. w/Spur 78, 1,829-m elevation, 30.673° latitude, -104.031° longitude, 19-V-1997, C. Favret; 19988, NM, Chaves County, 5.5 miles south of north forest entrance on FR 67, 1,908-m elevation, 32.556° latitude, -105.111° longitude, 20-V-1997, C. Favret; 16705-16708, 19602, 19604, 19606-19607, 19867, 19990, NM, Eddy County, 3.0 miles north on FR 64 from jxn.w/FR 137, 1,920-m elevation, 32.184° latitude, -104.844° longitude, 20-V-1997, C. Favret; 16729-16732, 19982-19984, NM, Chaves County, 5.0 miles east on CR 44 from jxn. w/CR 24, 1,829-m elevation, 32.648° latitude, -105.176° longitude, 20-V-1997, C. Favret; 16586, 19866, UT, Sevier Co., 0.4 mile east on dirt road, 11.8 miles north on SR 24 from jxn. w/SR 62, 2,179-m elevation, 38.669° latitude, 111.831° longitude, 14-VII-1997, C. Favret; 19718, UT, San Juan County, 2.7 miles

west on SR 95 from jxn. w/Fry Canyon Rd., 1,646-m elevation, 37.648° latitude, -110.169° longitude, 15-VII-1997, C. Favret; 16702–16704, 19845, 19847, NM, Taos County, U.S. 285 at mile 395.5, 2,591-m elevation, 36.836° latitude, -105.972° longitude, 11-VII-1998, C. Favret; 19723, 19921, NM, Bernalillo County, 0.3 mile north Cedro Group Campground, 2,316-m elevation, 35.047° latitude, -106.343° longitude, 12-VII-1998, C. Favret; 19726, NM, Lincoln County, 1.5 miles south on FR 73 from jxn. w/FR 72A, 2,195-m elevation, 33.855° latitude, -105.654° longitude, 13-VII-1998, C. Favret; 19727, NM, Socorro County, 0.7 mile south Water Canyon Campground on Water Canyon Rd., 2,195-m elevation, 34.015° latitude, -107.134° longitude, 13-VII-1998, C. Favret; 16564-16569, NM, Socorro County, 5.0 miles on U.S. 60 from jxn. w/FR 549, mile marker 105.3, 2,164-m elevation, 34.084° latitude, -107.391° longitude, 13-VII-1998, C. Favret; 19728, NM, Catron County, Rest area 1 mile west Red Hill on U.S. 60, 2,225-m elevation, 34.218° latitude, -108.88° longitude, 14-VII-1998, C. Favret; 16556-16557, 19729-19734, 19914-19920, AZ, Apache County, 1.3 miles south on Old McKay Rand Rd. from jxn. w/U.S. 180, 2.316-m elevation, 34.077° latitude, -109.234° longitude, 14-VII-1998, C. Favret; 16573-16574, NM, Catron County, 2.5 miles east Continental Divide on U.S. 60, mile marker 60.4, 2,377-m elevation, 34.288° latitude, -108.079° longitude, 14-VII-1998, C. Favret; 16694–16696, NM, Catron County, FR 66, 1.2 miles from junction with U.S. 60, 2,377-m elevation, 34.176° latitude, -107.903° longitude, 14-VII-1998, C. Favret; 19736, 19913, AZ, Apache County, 1.1 miles east on SR 61 from jxn. w/U.S. 60, 1,951-m elevation, 34.289° latitude, -109.808° longitude, 16-VII-1998, C. Favret; 19737–19738, AZ, Apache County, 0.9 mile south on U.S. 191 from jxn. w/Parker Draw Rd., mile marker 358.4, 1,859-m elevation, 35.089° latitude, -109.31° longitude, 16-VII-1998, C. Favret; 19739, NM, McKinley Co., 5.3 miles on SR 400 from S I-40 exit 33, 2,286-m elevation, 35.446° latitude, -108.55° longitude, 17-VII-1998, C. Favret; 16604–16611, CO, Fremont County, 0.8 mile east of U.S. 50 crossing Arkansas R., Parkdale, 1,829-m elevation, 38.496° latitude, -105.363° longitude, 19-VII-1998, C. Favret; 16697-16699, CO, Eagle County, Eagle, 0.5 mile north of I-70 exit 147, 2,103-m elevation, 39.669° latitude, -106.833° longitude, 20-VII-1998, C. Favret; 16575, CO, Mesa County, 6.4 miles south on Jack's Canvon Rd. from jxn with SR 141, 2,469-m elevation, 38.8° latitude, -108.585° longitude, 21-VII-1998, C. Favret; 16576-16582, 19747, 19906-19907, 19909, CO, Mesa County, 8.0 miles south on 26.10 Jack's Canyon Rd. from jxn. w/SR 141, 0.2 mile east along trail down Rocky Pitch Gulch, 2,438-m elevation, 38.766° latitude, -108.629° longitude, 22-VII-1998, C. Favret; 16636-16642, UT, San Juan County, 0.2 mile south on Ray Mesa Rd. from jxn. w/SR 46, 2,195-m elevation, 38.324° latitude, -109.119° longitude, 23-VII-1998, C. Favret; 19751, 19903-19904, UT, San Juan County, 0.1 mile down CR 160 from jxn. w/U.S. 191, 2,134-m elevation, 37.964° latitude, -109.364° longitude, 23-VII-1998, C. Favret; 16612-16614, 19752-19753, AZ, Navajo County, 5.0 miles north on SR 564 from jxn. w/U.S. 160, 2,134-m elevation, 36.623° latitude, -110.512° longitude, 24-VII-1998, C. Favret; 16583-16584, UT, Iron County, 5.7 miles west on SR 14 from Cedar Canyon Campground, mile marker 6.4, 2,103-m elevation, 37.642° latitude, -112.954° longitude, 26-VII-1998, C. Favret; 16615, 16617-16619, AZ, Coconino County, 8.6 miles north Jacob Lake on U.S. Alt. 89, mile marker 588.4, 2,316-m elevation, 36.758° latitude, -112.268° longitude, 27-VII-1998, C. Favret; 16585, 19767-19768, 19771, 19893-19896, 19898, UT, Sevier County, 0.25 mile west on frontage Rd. from I-70 exit 85, 2,286-m elevation, 38.757° latitude, -111.433° longitude, 28-VII-1998, C. Favret; 19760-19761, 19763, 19766, UT, Iron County, 2.4 miles west on Buckskin Rd. from jxn. w/Lower Bear Valley Rd., 2,560-m elevation, 37.979° latitude, -112.576° longitude, 28-VII-1998, C. Favret; 16747–16749, OK, Cimarron County, 0.9 mile east of jxn. of SR 225 and Black Mesa Rd., 1,368-m elevation, 36.905° latitude, -102.936° longitude, 3-VII-2001, C. Favret; 16643-16645, AZ, Apache County, 2 miles north Klagetoh, 1,996-m elevation, 35.537° latitude, -109.521° longitude, 6-VII-2001, C. Favret.

On *P. jeffreyi*: 19848, CA, Mono County, 7.4 miles east on SR 120 from jxn. w/U.S. 395, mile marker 20.7, 2,073-m elevation, 37.907° latitude, -118.988° longitude, 6-VII-1999, C. and S. Favret.

On P. monophylla: 43590-43632, NV, White Pine Co., Ward Mt. Campground, 6 miles southwest Ely, 3-VII-1985, D. J. Voegtlin; 43633-43635, NV, White Pine County, Connors Pass on U.S. 50, 21-V-1986, D. J. Voegtlin; 19630, NV, Nye Co., 8.3 miles east on SR 377 from jxn. w/SR 376, 2,280-m elevation, 38.547° latitude, –117.046° longitude, 15-VI-1997, C. Favret; 16588– 16591, 16593-16594, 16596, 19631-19635, 19963-19968, 19970, NV, Clark County, 4.6 miles northeast on SR 156 from jxn. w/SR 158, 2,0730m elevation, 36.372° latitude, -115.628° longitude, 17-VI-1997, C. Favret; 16597-16599, NV, Clark County, 0.2 mile east Mt. Springs Summit on 160, 1,667-m elevation, 36.019° latitude, -115.507° longitude, 18-VI-1997, C. Favret; 16601-16603, 19639-19640, CA, San Bernardino County, 0.5 mile west on Cedar Canyon Rd. from jxn. w/Black Canyon Rd., 1,600-m elevation, 35.17° latitude, -115.419° longitude, 19-VI-1997, C. Favret; 16622–16630, CA, Los Angeles County, 1.7 miles east on N4 from jxn. w/Big Pines Highway, 1,700-m elevation, 34.405° latitude, -117.757° longitude, 24-VI-1997, C. and S. Favret; 19938, CA, Kern County, 6.4 miles north on Sand Canyon Rd. from jxn. w/Tehachapi Boulevard, 1,350-m elevation, 35.184° latitude, -118.34° longitude, 25-VI-1997, C. and S. Favret; 16555, 16763, 19658, 19943, CA, Ventura County, jxn. Lockwood Valley Rd. and FR 8N40, 1,300-m elevation, 34.716° latitude, -119.261° longitude, 25-VI-1997, C. and S. Favret; 16631-16635, 19927, CA, Kern County, Walker Pass Campground on SR 178, 1,600-m elevation, 35.662° latitude, -118.037° longitude, 26-VI-1997, C. and S. Favret; 16652–16666, 16678–16679, NV, Churchill County, 0.9 mile west of Carroll Summit on SR 722, 2,195-m elevation, 39.264° latitude, -117.739° longitude, 12-VII-1997, C. Favret; 1969419698, NV, Churchill County, 2.2 miles west Carroll Summit on SR 722, 2,134-m elevation, 39.247° latitude, -117.755° longitude, 12-VII-1997, C. Favret; 19712, NV, Eureka County, 6.2 miles east on U.S. 50 from jxn. w/SR 278, 2,149-m elevation, 39.473° latitude, –115.947° longitude, 13-VII-1997, C. Favret; 16649– 16651, 16684-16685, NV, White Pine County, Sacramento Pass on U.S. 50, 2,181-m elevation, 39.144° latitude, -114.338° longitude, 13-VII-1997, C. Favret; 16680-16683, NV, White Pine County, Little Antelope Summit on U.S. 50, 2,267-m elevation, 39.399° latitude, -115.471° longitude, 13-VII-1997, C. Favret; 16700-16701, 19705-19707, 19925, NV, Lander Countv. 0.5 mile southeast Bob Scotts Summit on U.S. 50, 2,179-m elevation, 39.454° latitude, -116.991° longitude, 13-VII-1997, C. Favret; 16686-16689, 19774-19775, 19887–19891, NV, Elko County, Little Lake Pass, dirt road west of Shafter Siding, 2,012-m elevation, 40.837° latitude, -114.585° longitude, 2-VIII-1998, C. and S. Favret; 16690-16693, NV, Elko County, 9.5 miles east on Spruce Mt. Rd. from jxn. w/U.S. 93, 2316 m elevation, 40.562° latitude, -114.852° longitude, 2-VIII-1998, C. and S. Favret; 19777–19779, 19884–19886, NV, White Pine County, Schellbourne Pass, 2,347-m elevation, 39.806° latitude, -114.649° longitude, 3-VIII-1998, C. and S. Favret; 16646-16648, 19797-19800, NV, Lander County, 0.3 mile south on FR two from confluence of Big Cr. and North Fork Big Cr., 2,195-m elevation, 39.335° latitude, -117.123° longitude, 4-VIII-1998, C. and S. Favret; 16667-16674,19791, 19873, NV, Nye County, 0.8 mile west Northumberland Pass on E Northumberland Rd., 2,621-m elevation, 38.96° latitude, -116.849° longitude, 4-VIII-1998, C. and S. Favret; 19785-19787, 19827, 19877, 19879, NV, Nye County, end of Burley Cr. Rd., 2,438-m elevation, 38.664° latitude, -116.638° longitude, 4-VIII-1998, C. and S. Favret; 19801-19804, NV, Nye County, Ione Summit, 2,281-m elevation, 38.972° latitude, -117.539° longitude, 4-VIII-1998, C. and S. Favret; 16675-16677, 19805-19807, NV, Mineral County, Pass on Powell Canyon Rd., FR 026, 2,499-m elevation, 38.353° latitude, -118.69° longitude, 5-VIII-1998, C. and S. Favret.

On hybrids of *P. edulis* and *P. monophylla*: 16587, 16620–16621, 19818–19820, AZ, Coconino County, 0.5 mile east on SR 260 from jxn. w/FR 142, 1,821-m elevation, 34.507° latitude, -111.565° longitude, 7-VII-2001, C. Favret

At the University of Minnesota, all from *P. edulis:* four slides, CO, Larimer County, Owl Canyon, VIII-1926, O. W. Oestlund; two slides, Owl Canyon, 23-VIII-1925, F. C. Hottes; one slide, CO, Cannon City, 30-XI-1913, E. Bethel.

At Utah State University, all on *P. edulis* unless otherwise noted: one slide, 19770, UT, Sevier County, 0.25 mile west on frontage Rd. from I-70 exit 85, 2,331-m elevation, 38.757° latitude, -111.433° longitude, 28-VII-1998, C. Favret; 2 slides, UT, San Rafael Swell, 12-IX-1937, G. F. Knowlton; one slide, NV, Baker Cr., Baker, 9-VI-1937, G. F. Knowlton, *P. monophylla*; one slide, UT, S Tabiona, 29-VII-1949, M. A. Palmer; one slide, same as previous, 28-VII-1949; one slide, UT, Daggett Co., Flaming Gorge Area, 13-VIII- 1964, G. F. Knowlton, *P. ponderosa*; one slide, stomach of long tailed chicadee, UT, E Fruitland, 18-VII-1941, G. F. Knowlton.

At Colorado State University, all from P. edulis unless otherwise noted: one slide, 16595, NV, Clark County, 4.6 miles northeast on SR 156 from jxn. w/SR 158, 2,113-m elevation, 36.372° latitude, -115.628° longitude, 17-VI-1997, C. Favret, P. monophylla; one slide, CO, Walsenberg, 15-VI-1907, C. P. Gillette; two slides, CO, Trinidad, 18-VI-1911, L. C. Bragg; seven slides, CO, Manitou, 3-VII-1919, L. C. Bragg; five slides, #2897, CO, Larimer County, Owl Canyon, 25-IX-1921, C. P. Gillette and M. A. Palmer; 11 slides, #3027, same as previous, 27-X-1921, C. P. Gillette; two slides, #3034, same as previous 6-XI-1921, J.L.H.; two slides, same as previous, reared in laboratory, 18-IV-1922, J.L.H. and C. P. Gillette; two slides, #3081, CO, Larimer County, Owl Canyon, 27-V-1922, M. A. Palmer; three slides, #3207, CA, Sweetwater Canyon, 5-VIII-1922, E. Bethel, P. monophylla; four slides, #3204, CO, Larimer County, Owl Canyon, 6-VIII-1922, F. C. Hottes, C. A. Bjurman, M. A. Palmer; four slides, #3285, CO, Salida, 1-IX-1922, C. P. Gillette; three slides #3286, same as previous; one slide, #3301, CO, Larimer County, Owl Canyon, 24-IX-1922, F. C. Hottes; one slide, #3337, same as previous, 18-X-1922; three slides, #3353, same as previous 3-XI-1922, M. A. Palmer; one slide, #3371, same as previous, 24-V-1923; one slide, #3373, same as previous, 8-VI-1923; three slides, #3450, CO, Grand Junction, 5-VIII-1923, F. C. Hottes; two slides, #3462, CO, Mt. Garfield, Palisade, 29-VIII-1923, F. C. Hottes; three slides, #3469, CO, Grand Junction, 18-IX-1923, F. C. Hottes; one slide, AZ, Apache NF, Springerville, 30-III-1940.

At the NMNH: one slide, 19735, AZ, Apache County, 1.1 miles east on SR 61 from jxn. w/U.S. 60, 1,989-m elevation, 34.289° latitude, -109.808° longitude, 16-VII-1998, C. Favret, *P. edulis*; one slide, 16600, NV, Clark County, 0.2 mile east Mt. Springs Summit on 160, 1,700-m elevation, 36.019° latitude, -115.507° longitude, 18-VI-1997, C. Favret, *P. monophylla*.

At the British Museum of Natural History: one slide, 16616, AZ, Coconino County, U.S. Alt 89 mile marker 588.4, 8.6 miles north Jacob Lake, 2,362-m elevation, 36.758° latitude, -112.268° longitude, 27-VII-1998, C. Favret, *P. edulis.* 

At the Canadian National Collection: one slide, 16592, NV, Clark County, 4.6 miles northeast on SR 156 from jxn. w/SR 158, 2,113-m elevation, 36.372° latitude, -115.628° longitude, 17-VI-1997, C. Favret.

*Cinara apacheca* Hottes & Butler 1955 new synonymy. Hottes and Butler (1955) described *C. apacheca* as being "most likely taken for *C. schwarzii*" (Wilson). Favret and Voegtlin (2004a) demonstrated the close genetic affinity of *C. schwarzii* and *C. edulis*, and discriminant factor analysis shows *C. apacheca* to be morphologically similar to *C. edulis* (Fig. 12). Hottes had identified an alate specimen on one particular slide at the NMNH as "n. sp. near *C. edulis*," but J. O. Pepper and A. N. Tissot, working together, disagreed on its identity: a note with the slide indicated that Pepper thought it was "probably *C. edulis*," whereas Tissot thought it was "probably *C. apacheca.*" This specimen also resembles *C. edulis* in discriminant factor analysis (Fig. 12).

Hottes and Butler (1955) compared *C. apacheca* to *C. arizonica* (Wilson), *C. curvipes* (Patch), and *C. schwarzii*, but they did not provide a diagnosis to distinguish it from *C. edulis*. In his key to the *Cinara* of *P. edulis*, Hottes (1960) separated *C. apacheca* and *C. edulis* based only on the length of the hairs of metatibia, but there is a smooth gradient of hair length in *C. edulis* that encompasses the lengths of those of the *C. apacheca* types. These data indicate that *C. apacheca* is not distinguishable from *C. edulis* and is in fact its junior synonym. Types are at the NMNH.

Cinara metalica Hottes 1956a new synonymy. The original description (Hottes 1956a) of *C. metalica* was of oviparae and a single male. Hottes (1960) later described a single apterous vivipara as a morphotype. The morphotype, in poor condition, is the only known vivipara of the species, although Hottes (1960) did give ranges for his measurements. There is nothing notable about the morphotype to distinguish it from any apterous vivipara of *C. edulis*, and the second and third canonical variables for the specimen are very close to those of specimens of C. edulis (Fig. 13). The oviparae which comprise the type series of C. metalica also are not distinguishable from those of C. edulis. Unfortunately, the oviparous specimens of *C. edulis* were not cleared and are difficult to examine. However, neither are C. metalica oviparae distinguishable from those of C. pinona, which have been properly cleared, but which we synonymize below with C. edulis. Hottes (1960) noted that C. metalica is often found in mixed colonies with C. rustica, which is also a synonym of *C. edulis* (see below).

The allotype is the only known male of *C. metalica*, although Hottes (1960) did claim to have reared two other males. The allotype has vestigial wings, which seems to be the only character distinguishing it from males of C. edulis (again, poorly cleared) and C. pi*nona*. Although it is possible that the vestigial nature of the male wings is an autapomorphy that could define a species, we believe other explanations are more likely. For example, if collected too soon after a molt, the aphid may not have had the opportunity to strengthen its wings (although the specimen does not seem otherwise teneral). Also, Miyazaki (1987) mentions that males intermediate between alate and apterous are common in aphids. The description of a new aphid species based solely on oviparae or males is questionable. In light of the fact that the oviparous holotype and viviparous morphotype are both C. edu*lis*, we here synonymize *C. metalica* and leave the vestigial wings of the male an open question. Types are at the NMNH.

*Cinara pinata* Hottes 1955c new synonymy. According to the original description (Hottes 1955c), *C. pinata* has a very much shorter rostrum than *C. pinona*, its closest relative. However, we note that although *C. pinata* types did have a shorter Bradley's measure than *C. pinona* types, the range of rostral lengths graded smoothly from one species to the other. Also,

the rostral lengths of both of these putative species are spanned completely by the range of rostrum lengths of *C. edulis.* In his key, Hottes (1960) separated *C. pinata* from *C. rustica* last, based solely on the angles of the hairs on the metatibia. We have observed a large amount of variation in this character within *C. edulis* and have established the synonymy of *C. rustica* and *C. edulis* (below).

However, in discriminant factor analysis, C. pinata types are fairly distinct from *C. edulis*, particularly in the third canonical variable (Figs. 14a and b). All of that separation can be attributed to a greater number of setae on the ultimate rostral segment (URS) and the base of the sixth antennal segment (A6B) of C. pinata (apterae: URS, 19-26; A6B, 17-24; N = 12), compared with C. edulis (apterae: URS, 10-22; A6B, 6-16; N =145). When these two characters are removed from the analysis, the C. pinata types fall well within the cloud of C. edulis specimens (Fig. 14c and d). Hottes (1960) also noted that "the most outstanding feature of this species is the abundance of hairs on the antennal segments," although he did not mention the rostrum. Setal counts are rarely correlated with other morphological characters, in most cases being independent of overall aphid size (Foottit and Mackauer 1990). Favret and Voegtlin (2004b) also found that setal characters, both counts and lengths, contribute to morphometric principal components in very different ways than other characters.

In this particular case, are differences in setation alone sufficient for confirming the validity of C. pinata? Apart from the greater setation on the rostrum and antennae, all other morphological characters in C. pinata agree with those of C. edulis. C. pinata also possesses the occasional rectangular seventh tergal sclerites characteristic of C. edulis (Fig. 8d). The types are the only known specimens of C. pinata (notwithstanding the Hottes 1960 assertion that the species is "rather common in its type locality") and all of them were taken from the same mature tree where "the branches have a yellowish bark and large scales" (Hottes 1955c, 1960). We consider it likely that the extra setation on the antennae and rostra of the C. pinata types is an aberration. Because the species has not been seen since its description in 1955, despite extensive recent collecting, we here consider it a synonym of C. edulis. Types are at the NMNH.

*Cinara pinona* Hottes 1953 new synonymy. Hottes (1953, 1960) claimed that *C. pinona* was much smaller than *C. edulis*. However, the difference in size between apterae of the two species is minimal, and is not at all reflected in the first (not figured), second or third canonical variables in discriminant factor analysis (Fig. 15). Hottes (1960) claimed that *C. pinona* was "allied to *C. schwarzii*," but his main argument was based on size. He separated *C. pinona* from *C. edulis* based on the width of the base of the cornicle: the base of the *C. edulis* cornicle measured "up to 0.6 mm" and that of *C. pinona*"<0.4 mm." This character is closely tied to the overall size of the aphid and also shows a considerable degree of variation, not only in its objective measurement but also with regard to distortion

under the pressure of a coverslip. Also, the range of siphuncular diameters of *C. edulis* is much greater and encompasses that of *C. pinona* (Table 1). It seems that *C. pinona* represents small *C. edulis*. Types are at the NMNH.

*Cinara rustica* Hottes 1956a new synonymy. Favret and Voegtlin (2004a) have provided genetic evidence that *C. rustica* is a junior synonym of *C. edulis*, the former having the same CO-1 haplotype as the latter species. Although it is possible to have different species share the same DNA sequence for a particular gene, this is not known for aphid CO-1 DNA sequences. Also, *Cinara* that are clearly the same species can have considerable CO-1 DNA sequence divergence (Favret and Voegtlin 2004a), so it seems highly unlikely that two separate species would share the same haplotype. Because the CO-1 haplotype for our collected *C. rustica* was identical to that of *C. edulis* (Favret and Voegtlin 2004a), we conclude that *C. rustica* is a synonym of *C. edulis*.

Despite CO-1 genetic identity, the fact that we were able to identify some individuals as *C. rustica* by using the key of Hottes (1960), morphological differentiation of some specimens does show that a fair amount of variation can exist within *C. edulis*. However, in discriminant factor analysis, both the types and specimens we determined as *C. rustica* fell squarely within or close to the cloud of *C. edulis* (Fig. 16). This fact is particularly interesting in light of the Hottes (1960) statement that: "*C. rustica* is a very distinct species. Specimens are easily identified in the field or mounted." It seems as though *C. rustica* is a (sometimes) recognizable morphological variant of *C. edulis*. Types are at the NMNH.

#### Cinara puerca Hottes

(Table 1; Figs. 2e, 3e, 4e, 5e, 6e, 7e, 8e, 9e)

*Cinara puerca* Hottes 1954b: 251–253; Hottes 1955a: 69, 71, 73; Fig. 2; Hottes 1960: 209, Fig. 10.

Apterous Vivipara. In life: Large species dark gray to black, free of wax. Morphology of cleared, slidemounted specimens: See Table 1 for anatomical measurements. Head: Frons with medial suture strongly indented, forming two convex lobes. Rostrum extremely long, with dense and dark pigmentation pattern along segment 2 (Fig. 2e). Segments 3 and 4 very long, with many setae (Fig. 3e). Antenna long, segments 3, 4, 5, and 6 all dark with paleness basal grading to dark distally (Fig. 4e). Antennal setae dense. Thorax: Femora and tibiae of all legs mostly dark, with a slight lightening just distal of the knee and darkening distally (Fig. 5e). Metatibial setae of moderate length, erect up to 80° (Fig. 6e). Tarsus dark, with erect setae on segment two (Fig. 7e). Abdomen: Dorsum smooth and clear (Fig. 8e). Tergite 8 and subgenital plate well-resolved. Siphunculus usually poorly delimited, with sclerotic areas irregular.

Alate Vivipara. As apterous vivipara except for following (Fig. 9e). *Thorax:* Wings dusky. Rs, Cu, and A veins well-developed, but M vein, twice-forked, faint, indistinct, and visible as pale lines. **Discussion**. Published comparisons of *C. tanneri* and *C. puerca* (Hottes 1954b, 1955a, 1960) mentioned short third and fourth rostral segments of *C. tanneri* in comparison with those of *C. puerca* (Figs. 3e and f). Specifically, Hottes (1954b) asserted that in *C. tanneri* the rostral segments are shorter than the third antennal but that they are longer in *C. puerca*. However, the assertion is incorrect, as we note several *C. puerca* specimens where the third antennal segment was longer than the third rostral segment (e.g., specimens 41627–41629).

We have noticed an interesting difference between the first collections of this species and the two collections made more recently. The type specimens, adults and nymphs from Colorado, all have a large number of setae on the eighth abdominal tergite, especially clumped as groups on the lateral ventral edges of the tergite. Specimens of more recent collections from Arizona and California have a number of setae on the tergite more typical of other *Cinara*. This morphological difference is undoubtedly significant, but until we collect more specimens and get genetic data for the original form, we cannot properly evaluate it.

**Diagnosis.** *C. puerca* is easily recognized as there is little similarity in the length and structure of its rostrum with that of any other species (Figs. 2e and 3e). It also has a particularly setose antenna (Fig. 4e), erect tibial setae (Fig. 6e), and the dorsal setae of the second tarsal segment are more erect than in other species, one or more setae even being perpendicular to the tarsus (Fig. 7e).

**Biology.** This species has been collected in crevices in the trunk bark and on the roots of mature *P. edulis. C. puerca* also has been collected as part of the type series of *C. tanneri* on *P. monophylla*, as well as on the shoots of *P. monophylla* (specimen 16768). This last collection consisted of nymphs and was probably a spurious find. Only a few collections have been made, but they span a great geographic range (Fig. 10b).

Type Material Examined. All on *P. edulis*. The holotype (CO, Fruita, 2-VII-1954, F. C. Hottes) and morphotype (CO, Grand Junction, 29-XII-1954) are at the NMNH. Paratypes at the NMNH: two slides, CO, Fruita, 10-IX-1954, F. C. Hottes; one slide, same as previous, 2-VII-1959. Paratype at Utah State University: one slide, same as previous, 22-X-1954.

Other Material Examined. INHS specimen 16738 from *P. monophylla*: CA, San Bernardino County, 0.5 mile west on Cedar Canyon Rd. from jxn. w/Black Canyon Rd., 1,600-m elevation, 35.170° latitude, -115.419° longitude, 18-VI-1997, C. Favret; and 41620-41631 from *P. edulis*: AZ: Apache County, 18 miles west Eagar, 2 miles south on Hwy 273, 7-VII-1985, D. J. Voegtlin. Apterous Vivipara. Morphology of cleared, slidemounted specimen: See Table 1 for anatomical measurements. Head: Frons with strong medial suture. Rostrum very long, with dense and dark pigmentation pattern along segment 2 (Fig. 2f). Segments 3 and 4 very long, with many setae (Fig. 3f). All antennal segments largely concolorous (Fig. 4f). Antennal setae moderately dense. *Thorax*: All segments of all legs largely concolorous, with base and tip of tibiae slightly darker (Fig. 5f). Metatibial setae of moderate length, erect up to 60° (Fig. 6f). Tarsus dark (Fig. 7f). *Abdomen*: Dorsum smooth and clear (Fig. 8f). Tergite 8 and subgenital plate well resolved. Siphunculus poorly delimited, with sclerotic areas small.

**Discussion.** This species is known only from one apterous adult and four nymphal specimens. The description of Knowlton (1930) of the alate vivipara was actually of *C. edulis* (see Type Material below). Knowlton (1930) claimed that the fourth antennal segment of *C. tanneri* was significantly shorter than that of *C. edulis*, but we note the difference to be unexceptional (Table 1).

**Diagnosis.** The ultimate rostral segment of *C. tanneri* (Fig. 3f) is shorter and less setose than that of *C. puerca* (Fig. 3e) but longer and more setose than that of any other species. *C. tanneri* has particularly small siphuncular cones (Fig. 8f).

**Biology.** We have made only one collection of *C. tanneri* since its description (Fig. 10b), and the two specimens unfortunately are nymphs. Rostrum morphology is conserved across instars, so we were able to accurately identify the nymphs. We have at least confirmed the existence of the species and documented its host range to include both *P. monophylla* (the original collection) and *P. edulis* (the more recent collection). Its original collection was made in a mixed colony with *C. edulis* and *C. puerca*.

Type Material Examined. The apterous holotype (UT, Reservoir Creek, Raft River Mountains, 19-VI-1928, V. M. Tanner, on *P. monophylla*), at the NMNH, is the only adult specimen bearing the name *C. tanneri*. The holotype slide also contains a misidentified alate *C. edulis* specimen. A paratype nymph of the same collection is at Colorado State University. Another paratype slide of the same collection, at Utah State University, contains a nymphal *C. tanneri* and an apterous *C. edulis*. Another slide of specimens at Utah State University from the same colony as the type has *C. puerca* nymphs: their ultimate rostral segments are longer than those of the adult *C. tanneri*, and have the more setose antenna and URS characteristic of *C. puerca*.

Other Material Examined. INHS specimen 43561, nymphs from *P. edulis*: UT, Duchesne County, 16 miles west Duchesne, 19-V-1986, D. J. Voegtlin.

# *Cinara tanneri* (Knowlton) (Table 1; Figs. 2f, 3f, 4f, 5f, 6f, 7f, 8f)

Lachnus edulis tanneri Knowlton 1930: 155–156.

*Cinara tanneri* (Knowlton 1930); Palmer 1952: 49. Hottes 1955a; Fig. 3; Hottes 1960: 211, Fig. 12.

# Cinara terminalis (Gillette & Palmer)

(Table 1; Figs. 1c, 2g, 3g, 4g, 5g, 6g, 7g, 8g, 9f)

Lachnus terminalis Gillette & Palmer 1924: 19–21, plates 6–7.

- *Cinara terminalis* (Gillette and Palmer 1924); Gillette and Palmer 1931: 873–874, Fig. 43; Hottes 1960: 211, 213, Fig. 13; Palmer 1952: 49–50, Fig. 46.
- *Cinara nitidula* Hottes 1954b: 256–258; Hottes 1955a: Fig. 9; Hottes 1956b: 91–92; Hottes 1956c: Fig. 5; Hottes 1960: 206, Fig. 6; new synonymy.

Apterous Vivipara. In life: Usually amber in color, sometimes shading to green. Siphunculi darker and distinct (Fig. 1c). Thorax with some wax, especially ventrally, abdomen with little wax. Morphology of cleared, slide-mounted specimens: See Table 1 for anatomical measurements. *Head:* Frons broadly convex, with average setation. Rostrum typical with faint pigmentation pattern along segment two (Fig. 2g). Segments 3 and 4 dark (Fig. 3g). Antenna short. Segments 1 and 6 dark, 2, 3, 4, and 5 pale, small dark area on distal portion of 3, 4, and 5 (Fig. 4g). Antennal setae moderately sparse. Thorax: Pro- and mesofemora pale, metafemur pale with slight gradual darkening distally. Tibiae mostly pale with dark knees, pro- and mesotibiae darker in distal one-fourth and metatibia darker in distal one-half (Fig. 5g). Metatibial setae short to long, erect from 45 to 90° (Fig. 6g). Tarsus dark (Fig. 7g). Abdomen: Dorsum smooth, usually with small sclerites on segments 6 and 7, often broken into patches of scleroites (Fig. 8g). Tergite 8 small. Siphunculus well defined and dark.

Alate Vivipara. As apterous vivipara except for following (Fig. 9f). *Thorax:* Rs, Cu, and A veins welldeveloped, but M vein, twice-forked, faint and indistinct. *Abdomen:* Dorsum free of sclerites.

**Discussion.** The amber color of this species is distinct, but on occasion the amber color is darker than usual, and sometimes takes on a green tone. Hottes (1960) observed two forms of the species with respect to color and tibial seta length, but we note that there are enough specimens with intermediate character states as to create a smooth gradient between extremes. Favret and Voegtlin (2004a) demonstrated two geographically based clades of *C. terminalis* but were unable to corroborate their findings sufficiently to erect a new species. Favret and Voegtlin (2004b) also showed interesting patterns of host-based morphological variation: rostrum length can be independent of overall aphid size.

**Diagnosis.** In life, this species is easily recognized by its amber (to green) coloration. Slide-mounted specimens of C. terminalis are sometimes difficult to differentiate from those of C. anelia and C. wahtolca. The small sclerites of the seventh abdominal tergum (Fig. 8g), in contrast to the larger ones of C. anelia (Fig. 8a) and C. wahtolca (Fig. 8h), serve to distinguish C. terminalis. However, the sclerites are reduced or absent in alatae of all three species (Figs. 9a, f, and g). The tibial setation also may distinguish the species, as the setae of C. terminalis are generally more erect than those of C. anelia and C. wahtolca (Fig. 6a, g, and h). However, there is enough overlap between extremes of both species to occasionally confuse them. Finally, the URS of C. terminalis is somewhat narrower than in C. anelia and C. wahtolca (Fig. 3a, g, and h).

**Biology.** Adult *C. terminalis* are normally found singly or with young nymphs on the shoots of young trees. However, we have frequently collected the species in larger colonies of several dozen adults, and in mixed colonies with *C. anelia*, *C. edulis*, or *C. wahtolca*. It has been collected throughout pinyon territory, including on *P. discolor* Bailey & Hawksw. in southeastern Arizona (Fig. 10a).

Type Material Examined. Gillette and Palmer (1924) simply designated a type series but labeled five syntypes (a type for each morph) and many paratypes. Hottes (1960), apparently quoting M. A. Palmer, designated an alate viviparous specimen at the NMNH as lectotype (NMNH#41958, Colo. Agr. Exp. Sta. accession no. 3321, CO, Larimer County, Owl Canyon, 5-X-1922, C. P. Gillette, P. edulis). All other labeled types and paratypes thus become paralectotypes, including one apterous vivipara on the same slide as the lectotype. At the NMNH: male allolectotype, ovipara morpholectotype, and five other paralectotypes, same as previous, NMNH#41958, Colo. Agr. Exp. Sta. accession no. 3338, 18-X-1922, F. C. Hottes; "fundatrix" (the specimen is actually an apterous viviparous nymph) four other paralectotypes, NMNH#41958, Colo. Agr. Exp. Sta. accession no. 6-15-07, CO, Walsenburg, 15-VI-1907, C. P. Gillette; apterous vivipara morpholectotype one other paralectotype, and NMNH#41958, Colo. Agr. Exp. Sta. accession no. 2896, CO, Larimer County, Owl Canyon, 25-IX-1921, C. P. Gillette, P. edulis.

Other paralectotypes are at Colorado State University, all from *P. edulis*: one slide, CO, Walsenburg, 15-VI-1907, C. P. Gillette; four slides, #2896, CO, Larimer County, Owl Canyon, 25-IX-1921, C. P. Gillette; two slides, same a previous, 6-VIII-1922, one numbered 3206 collected by F. C. Hottes, the other numbered 3203 collected by F. C. Hottes and M. A. Palmer; one slide, same as previous, 13-X-1922, F. C. Hottes; one slide, same as previous, 18-X-1922; one slide, same as previous, 18-X-1922; one slide, same as previous, 27-X-1922, C. P. Gillette. One slide of specimens, #3302 collected in Owl Canyon on 24-IX-1922 by F. C. Hottes, is incorrectly labeled paratype, as it is not mentioned by Gillette and Palmer (1924).

Other Material Examined. At the INHS (five-digit numbers refer to catalog numbers in the insect collection database, http://www.inhs.uiuc.edu), on *P. cembroides*: 16422–16425, AZ, Cochise County, 0.2 miles on FR 356 from jxn. w/FR 42, 1,798-m elevation, 31.969° latitude, -109.317° longitude, 22-V-1997, C. Favret; 16428–16438, AZ, Cochise County, just west Mule Pass Tunnel on SR 80, 1,676-m elevation, 31.459° latitude, -109.944° longitude, 23-V-1997, C. Favret.

On *P. discolor*: 19978, AZ, Cochise County, 0.2 miles on FR 356 from jxn. w/FR 42, 1,798-m elevation,  $31.969^{\circ}$  latitude,  $-109.317^{\circ}$  longitude, 22-V-1997, C. Favret; 19612–19613, 19979–19980, AZ, Cochise County, FR 42 at mile marker 14.8, 2,091-m elevation,  $31.916^{\circ}$  latitude,  $-109.251^{\circ}$  longitude, 22-V-1997, C. Favret; 16426–16427, AZ, Cochise County, 2.2 miles east Montezuma Pass on FR 61, 1,737-m elevation,  $31.35^\circ$ latitude,  $-110.273^\circ$ longitude, 23-V-1997, C. Favret; 19617–19622, 19976–19977, AZ, Cochise County, Montezuma Pass on FR 61, 2,006-m elevation, 31.351° latitude,  $-110.286^\circ$ longitude, 23-V-1997, C. Favret.

On P. edulis: 43326, CO, Larimer County, Owl Canyon, 23-VII-1923, F. C. Hottes; 43436-43439, CO, Chaffee County, Salida, 3-VI-1977, W. Brewer; 43442, UT, Iron County, 5 miles east Cedar City on Highway 14, 5-VII-1985, D. J. Voegtlin; 43452-43453, AZ, Coconino County, 4 mil northwest Jacob Lake, 5-VII-1985, D. J. Voegtlin; 43454-43458, AZ, Coconino County, 7 miles east Jacob Lake, 6-VII-1985, D. J. Voegtlin; 43462-43465, AZ, Coconino County, E Flagstaff, 6-VII-1985, D. J. Voegtlin; 43323-43324, AZ, Apache County, 18 miles west Eagar, 2 miles south on Highway 273, 7-VII-1985, D. J. Voegtlin; 43486–43493, CO, Ouray County, Ouray, 9-VII-1985, D. J. Voegtlin; 43496-43497, 43499, CO, Mesa County, 6 miles south Glade Park Campground, 9-VII-1985, D. J. Voegtlin; 43523, 43526-43532, 43535, 43550, 43562-43564, 43567, UT, Uintah County, 16 miles west Duchesne on U.S. 40, 11-VII-1985, D. J. Voegtlin; 19849-19851, 19857, TX, Jeff Davis County, 8.0 miles south on SR 118 from jxn. w/SR 116, 1,865-m elevation, 30.697° latitude, -104.098° longitude, 19-V-1997, C. Favret; 16454-16455, 19603, NM, Eddy County, 3.0 miles north on FR 64 from jxn. w/FR 137, 1,920-m elevation, 32.185° latitude, -104.845° longitude, 20-V-1997, C. Favret; 19642, CA, San Bernardino County, 4.9 miles north on New York Mt. Rd. from jxn. w/Cedar Canyon Rd., 1700 m elevation, 35.218° latitude, -115.307° longitude, 19-VI-1997, C. Favret; 19717, UT, Sevier County, 0.4 mile east on dirt road, 11.8 miles north on SR 24 from jxn. w/SR 62, 2,179-m elevation, 38.669° latitude, 111.831° longitude, 14-VII-1997, C. Favret; 16449-16452, 19719-19720, 19924, CO, Alamosa County, Pinyon Flats Campground, 2,499-m elevation, 37.748° latitude, -105.503° longitude, 9-VII-1998, C. Favret; 19721-19722, 19922, NM, Rio Arriba County, 0.8 mile west on FR 83 from jxn. w/WU.S. 285, 2,591-m elevation, 36.68° latitude, -105.993° longitude, 11-VII-1998, C. Favret; 19724-19725, NM, Torrance Co., 1.2 miles northwest on SR 42 from jxn. w/U.S. 54, 2,073-m elevation, 34.268° latitude, -105.608° longitude, 12-VII-1998, C. Favret; 16439, NM, Catron County, 2.5 miles east Continental Divide on U.S. 60, mile marker 60.4, 2,377-m elevation, 34.288° latitude, -108.079° longitude, 14-VII-1998, C. Favret; 16453, AZ, Apache County, 1.3 miles south on Old McKay Rand Rd. from jxn. w/U.S. 180, 2,316-m elevation, 34.077° latitude, -109.234° longitude, 14-VII-1998, C. Favret; 16408, 19745-19746, CO, Mesa County, 6.4 miles south on Jack's Canyon Rd. from jxn with SR 141, 2,469-m elevation, 38.8° latitude, -108.585° longitude, 21-VII-1998, C. Favret; 16406-16407, CO, Montrose County, 8.0 miles north on FR 50 from jxn. w/Fifth St. in Nucla, 2,103-m elevation, 38.336° latitude, -108.474° longitude, 22-VII-1998, C. Favret; 19748, 19905, CO, Mesa County, 8.0 miles south on 26.10 Jack's Canyon Rd. from jxn. w/SR 141, 0.2 mile east along trail down Rocky Pitch Gulch,

2,438-m elevation, 38.766° latitude, -108.629° longitude, 22-VII-1998, C. Favret; 16405, UT, San Juan County, 0.1 mile down CR 160 from jxn. w/U.S. 191, 2,134-m elevation, 37.964° latitude, -109.364° longitude, 23-VII-1998, C. Favret; 19749, UT, San Juan County, 0.2 mile south on SR 46 from jxn. w/CR 163, 1,829-m elevation, 38.273° latitude, -109.375° longitude, 23-VII-1998, C. Favret; 19750, UT, San Juan County, north jxn. of U.S. 191 and CR 179, 1,829-m elevation, 38.273° latitude, -109.375° longitude, 23-VII-1998, C. Favret; 16447–16448, AZ, Navajo County, 5.0 miles north on SR 564 from jxn. w/U.S. 160, 2,134-m elevation, 36.623° latitude, -110.512° longitude, 24-VII-1998, C. Favret; 19757, UT, Garfield County, 6.5 miles on SR 12 from jxn. w/U.S. 89, 2,316-m elevation, 37.739° latitude, -112.296° longitude, 27-VII-1998, C. Favret; 16403-16404, AZ, Coconino County, 8.6 miles north Jacob Lake on U.S. Alt 89, mile marker 588, 2,316-m elevation, 36.768° latitude, -112.261° longitude, 27-VII-1998, C. Favret; 19755-19756, UT, Garfield County, SR 12 mile marker 17, 0.35 mile north Paria River, 2,134-m elevation, 37.667° latitude, -112.111° longitude, 27-VII-1998, C. Favret; 16401-16402, 19899, UT, Iron County, 2.4 miles west on Buckskin Rd. from jxn. w/Lower Bear Valley Rd., 2,560-m elevation, 37.979° latitude, -112.576° longitude, 28-VII-1998, C. Favret; 19769, 19892, 19897, UT, Sevier County, 0.25 mile west on frontage Rd. from I-70 exit 85, 2,286-m elevation, 38.757° latitude, -111.433° longitude, 28-VII-1998, C. Favret; 19773, UT, Carbon County, 5.1 miles north on U.S. 191 from jxn. w/U.S. 6, mile marker 162.6, 2,103-m elevation, 39.758° latitude, -110.82° longitude, 29-VII-1998, C. Favret.

On P. monophylla: 43325, CA, Mono County, Sherwin Summit, 17-VII-1972, D. J. Voegtlin; 43581, 43583-43589, NV, Elko County, 4 miles south Wells, 3-VII-1985, D. J. Voegtlin; 43615, 43626, NV, White Pine County, Ward Mt. Campground, 6 miles southwest Ely, 3-VII-1985, D. J. Voegtlin; 41940, 43322, 43616-43619, NV, White Pine County, Connors Pass on U.S. 50, 21-V-1986, D. Voegtlin; 43317–43321, NV, Lander County, Austin Summit near U.S. Highway 50, 22-V-1986, D. J. Voegtlin; 19624, AZ, Yavapai County, 3.2 miles east Crown King on FR 259, 1,646-m elevation, 34.225° latitude, -112.314° longitude, 25-V-1997, C. Favret; 19625, NV, Douglas County, 5.9 miles east Sunrise Pass on Sunrise Pass Rd., 1,768-m elevation, 39.05° latitude, -119.438° longitude, 12-VI-1997, C. Favret; 19626, NV, Lyon County, 5.8 miles south on SR 338 from jxn. w/Risue Rd., 2,012-m elevation, 38.49° latitude, -119.194° longitude, 12-VI-1997, C. Favret; 16416, 16418–16421, NV, Lyon County, 1.1 miles west Sunrise Pass on Sunrise Pass Rd., 2,042-m elevation, 39.094° latitude, -119.505° longitude, 12-VI-1997, C. Favret; 16440, CA, Mono County, jxn. of 167 and Cemetery Rd., 2,000-m elevation, 38.067° latitude, -119.086° longitude, 13-VI-1997, C. Favret; 19629, NV, Nye County, 8.3 miles east on SR 377 from jxn. w/SR 376, 2,280-m elevation, 38.547° latitude, -117.046° longitude, 15-VI-1997, C. Favret; 19971, NV, Lincoln County, 2.5 miles east of pass west of Caliente, 1 mile west dirt road turning north on U.S. 93, 1,859-m elevation, 37.599° latitude, -114.665° longitude, 16-VI-1997, C. Favret; 19961-19962, NV, Clark County, Willow Spring Picnic Area, 0.3 mile on Red Rock Canon Rd. from jxn. w/Moenkopi Loop Rd., 1,737-m elevation, 36.157° latitude, -115.491° longitude, 17-VI-1997, C. Favret; 19636, NV, Clark County, 6.9 miles north SR 160 on Lowell Summit Rd., 1,420-m elevation, 36.073° latitude, -115.586° longitude, 18-VI-1997, C. Favret; 19641, CA, San Bernardino County, 0.5 mile west on Cedar Canyon Rd. from jxn. w/Black Canyon Rd., 1,600-m elevation, 35.17° latitude, -115.419° longitude, 19-VI-1997, C. Favret; 16441, 19656, CA, Ventura County, jxn. of SR 33 and Pine Mt. Rd., 1,550-m elevation, 34.649° latitude, -119.384° longitude, 25-VI-1997, C. and S. Favret; 16443, 16445, CA, Kern County, 0.3 mile north on FR 9N22 from jxn. w/Cuddy Valley Rd., 1,700-m elevation, 34.85° latitude, -119.061° longitude, 25-VI-1997, C. and S. Favret; 19665–19666, CA, Kern County, 4.7 miles north on Piute Mt. Rd. from jxn. w/Caliente Cr. Rd., 1,950-m elevation, 35.423° latitude, -118.417° longitude, 26-VI-1997, C. and S. Favret; 19680, 19683, CA, Tulare County, 4.9 miles east on Sherman Pass Rd. from jxn. w/Sierra Way, 1,700-m elevation, 35.98° latitude, -118.43° longitude, 26-VI-1997, C. and S. Favret; 19690, CA, Tulare County, 6.6 miles west on Kennedy Meadows Rd. from Inyo County line, 2,150-m elevation, 35.926° latitude, -118.047° longitude, 27-VI-1997, C. and S. Favret; 19693, NV, Churchill County, 4.7 miles west Carroll Summit on SR 722, 1,951-m elevation, 39.24° latitude, -117.78° longitude, 12-VII-1997, C. Favret; 19699, NV, Churchill County, 2.2 miles west Carroll Summit on SR 722, 2,134-m elevation, 39.247° latitude, -117.755° longitude, 12-VII-1997, C. Favret; 16409, 19852, NV, Churchill County, 0.9 mile west of Carroll Summit on SR 722, 2,195-m elevation, 39.264° latitude, -117.739° longitude, 12-VII-1997, C. Favret; 19700, NV, Lander County, Bob Scotts Summit on U.S. 50, 2,193-m elevation, 39.459° latitude, -116.997° longitude, 13-VII-1997, C. Favret; 19715, NV, White Pine County, Connors Pass on U.S. 50, 2,354-m elevation, 39.039° latitude, -114.647° longitude, 13-VII-1997, C. Favret; 16412-16415, NV, White Pine County, Sacramento Pass on U.S. 50, 2,181-m elevation, 39.144° latitude, -114.338° longitude, 13-VII-1997, C. Favret; 19701-19704, 19926, NV, Lander County, 0.5 mile southeast Bob Scotts Summit on U.S. 50, 2,179-m elevation, 39.454° latitude, -116.991° longitude, 13-VII-1997, C. Favret; 19844, NV, Elko County, Little Lake Pass, dirt road west of Shafter Siding, 2,012-m elevation, 40.837° latitude, -114.585° longitude, 2-VIII-1998, C. and S. Favret; 19783, NV, White Pine County, FR 405 Cordorov Mt. Pass, 2,438-m elevation, 38.977° latitude.  $-115.396^{\circ}$ longitude, 3-VIII-1998, C. and S. Favret; 16410-16411, 19776, NV, White Pine County, 11.5 miles west on Cherry Cr. Rd. from jxn. w/U.S. 93, 2,073-m elevation, 39.911° latitude, -114.93° longitude, 3-VIII-1998, C. and S. Favret; 19781–19782, 19880, NV, White Pine County, 1.4 miles up dirt road 0.3 mile east Ward Mt. Campground Rd. on U.S. 6, 2,213-m elevation, 39.215° latitude, -114.956° longitude, 3-VIII-1998, C. and S. Favret; 19788–19789, 19876, NV, Nye County, end of Burley Cr. Rd., 2,438-m elevation, 38.664° latitude, -116.638° longitude, 4-VIII-1998, C. and S. Favret; 19792–19793, NV, Nye County, 0.8 mile west Northumberland Pass on E Northumberland Rd., 2,621-m elevation, 38.96° latitude, -116.849° longitude, 4-VIII-1998, C. and S. Favret; 19794–19796, NV, Lander County, 0.3 mile south on FR two from confluence of Big Cr. and North Fork Big Cr., 2,195-m elevation, 39.335° latitude, -117.123° longitude, 4-VIII-1998, C. and S. Favret.

At Colorado State University, all from *P. edulis:* one slide, 19605, NM, Eddy County, 3.0 miles north on FR 67 from jxn. w/FR 137, 1,880-m elevation, 32.183° latitude, -104.844° longitude, 20-V-1997, C. Favret; 1 slide, CO, Walsenburg, 15-VI-1907, C. P. Gillette; one slide, CO, Manitou, 3-VII-1919, L. C. Bragg; one slide, #3029, CO, Larimer County, Owl Canyon, C. P. Gillette; one slide, #3274, same as previous, 6-III-1922, M. A. Palmer; two slides, #3226, same as previous 19-VIII-1922; one slide, #3226, same as previous, 24-VIII-1922; three slides, #3425, same as previous, 23-VII-1923; one slide, same as previous, 10-IX-1957, J.A.Q.

At Utah State University: one slide, 19684, CA, Tulare County, 4.9 miles east on Sherman Pass Rd. from jxn. w/Sierra Way, 1,700-m elevation, 35.980° latitude, -118.430° longitude, 26-VI-1997, C. and S. Favret, *P. monophylla*; 1 slide, #3203, same as previous, 6-VIII-1922, F. C. Hottes and M. A. Palmer; one slide, UT, Kanab, 19-VI-1949, G. F. Knowlton, *P. edulis*.

At the NMNH, both on *P. monophylla:* one slide, 16417, NV, Lyon County, 1.1 miles west Sunrise Pass on Sunrise Pass Rd., 2,082-m elevation, 39.094° latitude, -119.505° longitude, 12-VI-1997, C. Favret; 1 slide, 16444, CA, Kern County, 0.3 mile north on FR 9N22 from jxn. w/Cuddy Valley Rd., 1,700-m elevation, 34.850° latitude, -119.061° longitude, 25-VI-1997, C. Favret and S. Favret.

At the British Museum of Natural History: one slide, 16446, same as previous.

At the Canadian National Collection: one slide, 16442, CA, Ventura County, Los Padres NF, Sierra Madre, jxn. of SR 33 and Pine Mt. Rd., 1,550-m elevation, 34.649° latitude, -119.384° long, 25-VI-1997, C. and S. Favret, *P. monophylla*.

Cinara nitidula Hottes 1954b new synonymy. C. nitidula types fall squarely within a cloud of C. terminalis specimens in discriminant factor analysis (Fig. 17), suggesting that there is little or no morphological variation between the two species. Hottes (1954b) compared C. nitidula and C. terminalis at length. He noted that the former was smaller, which we also have observed in univariate morphometrics. We therefore concur with the claim of Hottes (1954b) that C. nitidula has shorter tarsi, adding that it also has shorter metatibiae and metafemora. However, we note significant overlap with respect to tibial seta length and erectness, the presence/absence of antennal sensoria, and rostral lengths. The comparative assertion of Hottes (1954b) that C. nitidula is found in colonies misrepresents C. terminalis's occasional to frequent propensity to aggregate as well. Also, his descriptions of the wax patterns of the two species are actually similar.

Hottes (1954b) does describe C. nitidula as generally being darker than C. terminalis, but we have found many instances of dark specimens of the latter species. Therefore, besides size, the only real difference we have noted between the two species is the usually larger seventh abdominal tergal sclerites in the C. nitidula types. However, this character is not entirely reliable, because some of the paratypes do have the small sclerites typical of *C. terminalis*. The sclerites are entirely absent from the alatae of both species. The type series of C. nitidula was collected on terminal twigs of mature trees. We believe the specimens of the type series of C. nitidula are in fact C. terminalis collected at atypical feeding locations. The fact that no known specimens of *C. nitidula* have been collected apart from the original types supports our position.

The one caveat to this synonymy is the apterous *C. nitidula* male designated as allotype (Hottes 1956b), the C. terminalis allotype being alate (Gillette and Palmer 1924). However, males of *Cinara* are fairly vagile and because the *C. nitidul*a allotype was collected alone, we have cause to question its identity. Also, there is evidence of phenotypic plasticity with regard to the wings of male Cinara. Both C. pinata and C. rustica were described as having apterous males (Hottes 1955c, 1960), but the male of their senior synonym (this article), C. edulis, is described as being alate (Palmer 1926). Furthermore, the C. edulis junior synonym C. metalica (this article) male is described as having vestigial wings (Hottes 1956a). Bradley (1961) notes that C. lyallii Bradley has both apterous and alate males, and "both alate and apterous males can occur in one species, and an intermediate state between apterous and alate is also common" (Miyazaki 1987). The types are at the NMNH.

#### Cinara wahtolca Hottes

(Table 1; Figs. 2h, 3h, 4h, 5h, 6h, 7h, 8h, 9g)

Cinara wahtolca Hottes 1953: 155–157; Hottes 1954a: 90; Hottes 1955b: Fig. 4; Hottes 1956b: 91; Hottes 1956c: Fig. 6; Hottes 1960: 213, Fig. 14.

*Cinara wahtolca curtiwahtolca* Hottes 1955b: 101–102; new synonymy.

Apterous Vivipara. In life: Body dark brown to dark gray to black. Extensive wax patterning on the thorax and abdomen, which may be rubbed off, gives the aphid a mottled gray and black appearance. Morphology of cleared, slide-mounted specimens: See Table 1 for anatomical measurements. Head: Frons broadly convex, with moderately long setae. Rostrum typical with faint pigmentation pattern along segment two (Fig. 2h). Segments three and four dark (Fig. 3h). Antenna with moderately long setae of typical density. Segments 1 and 6 and distal portion of 3, 4, and 5 dark (Fig. 4h). Thorax: Pro- and mesofemora pale, metafemur pale with gradual darkening distally. Tibiae mostly pale with dark knees, pro- and mesotibiae darker in distal one-fourth and metatibia darker in distal one-half (Fig. 5h). Metatibial setation moderately dense, setae of medium length, erect to an angle of  $\approx$ 45° (Fig. 6h). Tarsus dark (Fig. 7h). *Abdomen:* Dorsum smooth with rather dense setae of variable length. Siphunculus well delimited and sclerotic cones dark. Sclerites of variable size on abdominal terga 6 and 7, often also on tergum 5, and occasionally on tergum 4, these latter two usually found as aggregations of smaller sclerites (Fig. 8h). The eighth abdominal tergites well developed and usually with many setae.

Alate Vivipara. As apterous vivipara except for following. *Head*: Antenna three with six to nine sensoria. Pigmentation of antennal segments 3, 4, and 5 such that they are light basally, and gradually become slightly darker distally. *Thorax*: Metatibia darkened distally for slightly more than half its length. Rs, Cu, and A veins well-developed, but M vein, twice-forked, faint and indistinct. *Abdomen*: Tergal sclerites absent.

Discussion. See *C. anelia* above for discussion of both species.

Diagnosis. See *C. anelia* above for diagnosis of both species. GenBank accession nos. AY300202–AY300204, AY302035–AY302039.

**Biology.** This aphid is typically found in small to large colonies on needle free or sparsely needled branches, twigs, or trunks of young *P. edulis.* It presumably occurs everywhere its principal host grows and has also been collected on *P. discolor* in southeastern Arizona (Fig. 10a). It is occasionally found in mixed colonies with *C. edulis* or *C. terminalis.* 

Type Material Examined. All types were collected on *P. edulis* at Glade Park, CO, by F. C. Hottes. At the NMNH: apterous viviparous holotype, 8-VII-1953; alate viviparous morphotype, 18-VII-1953; oviparous morphotype, 20-X-1953; alate allotype, 22-X-1955. Paratypes: two slides, no dates; one slide, 12-VII-1953; three slides, 15-VII-1953; one slide, 18-VII-1953; four slides, 20-VII-1953; one slide, 25-VII-1953; one slide 26-VII-1953. one paratype slide at Utah State University: 1-VIII-1953. Three paratype slides at Colorado Sate University: two from 19-VII-1953 and one from 26-VII-1953.

Other Material Examined. At the INHS (five-digit numbers are catalog numbers in the insect collection database, http://www.inhs.uiuc.edu), on *P. cembroides:* 19616, AZ, Cochise County, just west Mule Pass Tunnel on SR 80, 1,676-m elevation, 31.459° latitude, -109.944° longitude, 23-V-1997, C. Favret.

On *P. cembroides*, *P. edulis*, or hybrids of the two: 19591–19592, TX, Jeff Davis Co., 1 mile on spur 78 from jxn. w/SR 118 to southern McDonald Observatory, 1,951-m elevation, 30.674° latitude, -104.021° longitude, 18-V-1997, C. Favret; 19599, TX, Jeff Davis County, 0.6 mile south on SR 118 from jxn. w/Spur 78, 1,829-m elevation, 30.673° latitude, -104.031° longitude, 19-V-1997, C. Favret.

On *P. discolor:* 19614–19615, AZ, Cochise County, Cochise Stronghold East Campground, 1,524-m elevation, 31.923° latitude, -109.968° longitude, 22-V-1997, C. Favret.

On *P. edulis*: 43433–43435, CO, Larimer County, VA Dale, 29-VI-1973, D. Schutz; 43441, UT, Iron County,

west Cedar City, Summit of Highway 25, 4-VII-1985, D. J. Voegtlin; 43443-43444, UT, Iron County, 5 miles east Cedar City on Highway 14, 5-VII-1985, D. J. Voegtlin; 43286, AZ, Coconino County, 7 miles east Jacob Lake, 6-VII-1985, D. J. Voegtlin; 43282-43285, 43484-43485, CO, Ouray County, Ouray, 9-VII-1985, D. J. Voegtlin; 43303-43316, 43494-43495, 43498, CO, Mesa County, 6 miles south Glade Park Campground, 9-VII-1985, D. J. Voegtlin; 43522, 43524-43525, 43533-43534, 43536 - 43537, 43545, 43548, 43551, 43555 - 43560, 43565, 43568-43572, 43574-43580, UT, Uintah County, 16 miles west Duchesne on U.S. 40, 11-VII-1985, D. J. Voegtlin; 43422, UT, Uintah County, below Starvation Reservoir, 19-V-1986, D. J. Voegtlin; 19837-19840, 19842-19843, TX, Jeff Davis County, 8.0 miles south on SR 118 from jxn. w/SR 116, 1,865-m elevation, 30.697° latitude, -104.098° longitude, 19-V-1997, C. Favret; 19981, NM, Chaves County, 5.0 miles east on CR 44 from jxn. w/CR 24, 1,829-m elevation, 32.648° latitude, -105.176° longitude, 20-V-1997, C. Favret; 19608, 19985-19987, 19989, NM, Chaves County, 5.5 miles south of north forest entrance on FR 67, 1,908-m elevation, 32.556° latitude, -105.111° longitude, 20-V-1997, C. Favret; 16515, 16517, 19958-19959, CA, San Bernardino County, 4.9 miles north on New York Mt. Rd. from jxn. w/Cedar Canyon Rd., 1,700-m elevation, 35.218° latitude, -115.307° longitude, 19-VI-1997, C. Favret; 19923, NM, Rio Arriba County, 0.8 mile west on FR 83 from jxn. w/W U.S. 285, 2,591-m elevation, 36.68° latitude, -105.993° longitude, 11-VII-1998, C. Favret; 16512-16514, 16551, NM, Taos County, U.S. 285 at mile 395.5, 2,591-m elevation, 36.836° latitude, -105.972° longitude, 11-VII-1998, C. Favret; 16511, AZ, Apache County, 0.9 mile south on U.S. 191 from jxn. w/Parker Draw Rd., mile marker 358.4, 1,859-m elevation, 35.089° latitude, -109.31° longitude, 16-VII-1998, C. Favret; 16554, 19861-19862, 19911, CO, Mesa County, 6.4 miles south on Jack's Canyon Rd. from jxn with SR 141, 2,469-m elevation, 38.8° latitude, -108.585° longitude, 21-VII-1998, C. Favret; 19825, 19908, 19910, CO, Mesa County, 8.0 miles south on 26.10 Jack's Canvon Rd. from jxn. w/SR 141, 0.2 mile east along trail down Rocky Pitch Gulch, 2,438-m elevation, 38.766° latitude, -108.629° longitude, 22-VII-1998, C. Favret; 19754, 19901-19902, AZ, Coconino County, mile marker 430 on U.S. 89, FR 418, 2,134-m elevation, 35.4° latitude, -111.576° longitude, 24-VII-1998, C. Favret; 19758, 19900, UT, Garfield County, 6.5 miles on SR 12 from jxn. w/U.S. 89, 2,316-m elevation, 37.739° latitude, -112.296° longitude, 27-VII-1998, C. Favret; 16518, NM, Union Co., 1 mile north on SR 551 from jxn. w/SR 456, 1,876-m elevation, 36.928° latitude, -103.867° longitude, 3-VII-2001, C. Favret; 16510, AZ, Coconino County, U.S. 180 north of Flagstaff, 2,253-m elevation, 35.47° latitude, -111.789° longitude, 7-VII-2001, C. Favret.

On hybrids of P. edulis and P. monophylla: 19826, AZ, Coconino County, 0.5 mile east on SR 260 from jxn. w/FR 142, 1,821-m elevation, 34.507° latitude, -111.565° longitude, 7-VII-2001, C. Favret.

At Colorado State University: two slides labeled metatypes collected in Grand Junction, CO, on 20-X- 1955 and 23-X-1955 by F. C. Hottes, P. edulis; one slide, 16516, CA, San Bernardino County, 4.9 miles north on New York Mt. Rd., from jxn. w/Cedar Canyon Rd., 1,700-m elevation, 35.218° latitude, -115.307° longitude, 19-VI-1997, C. Favret, P. monophylla.

At Utah State University: one slide, 19759, UT, Garfield Co., 6.5 miles on SR 12 from jxn. w/U.S. 89, 2,362-m elevation, 37.739° latitude, -112.296° longitude, 27-VII-1998, C. Favret, P. edulis.

At British Museum of Natural History: one slide, 16552, NM, Taos County, U.S. 285 at mile marker 395.5, SE San Antonio Mt., 2,642-m elevation, 36.836° latitude, -105.972° longitude, 11-VII-1998, C. Favret, P. edulis.

At the NMNH, both from P. cembroides, P. edulis, or hybrids of the two: one slide, 19841, TX, Jeff Davis County, 8.0 miles south on SR 118 from jxn. w/SR 116, 1,902-m elevation, 30.697° latitude, -104.098° longitude, 19-V-1997, C. Favret; one slide, 19589, TX, Jeff Davis County, Davis Mts., 1 mile on spur 78 from SR 118 to southern McDonald Observatory, 1,989-m elevation, 30.674° latitude, -104.021° longitude, 18-V-1997, C. Favret.

At the Canadian National Collection: one slide, 19590, same as previous.

Cinara wahtolca curtiwahtolca Hottes 1955b new synonymy. There is no true distinction between typical and short-haired forms of C. wahtolca. There is a smooth gradient in dorsal abdomen setal length among specimens of the species and paratypes of C. wahtolca also occur intermittently along this gradient. Furthermore, setal length is variable even within colonies, and five individuals from the same colony have dorsal abdomen setal lengths from 0.010 to 0.141 mm (specimens 19837, 19838, 19840, 19841, and 19843). This form is therefore not a taxonomically relevant subspecies of C. wahtolca. C. wahtolca curtiwahtolca also was collected on P. monophylla (Hottes 1955b) and hence is actually C. anelia, but the same gradient of setal length also is observable in this species. The holotype is at the NMNH.

# Key to Cinara Viviparae Feeding on Pinus edulis and P. monophylla

1A.	Ultimate rostral segment (fourth segment,
	URS) 0.3–0.65 mm, with 30–100+ accessory
	setae (Figs. 3e-f)
1B.	URS 0.1–0.25 mm, with 4–25 accessory setae
	(Figs. 3a-d, 3g and h) 3
2A.	URS 0.5–0.65 mm, with 50–100+ accessory
	setae (Figs. 3e). Bradley's measure 3–4 mm
	(Fig. 2e) C. puerca Hottes
2 <b>B</b> .	URS 0.3-0.4 mm, with 30-40 accessory setae
	(Fig. 3f). Bradley's measure 1.8–2.5 mm
	(Fig. 2f) C. tanneri (Knowlton)
3A.	Aptera 4
3 <b>B</b> .	Alate
4A.	URS with 10–25 accessory setae (Figs. 3b, 3d).
	Abdominal tergum six free of sclerites (Figs.
	8b. 8d), although tergum seven may have
	pale sclerites of any size 5
	pare selectives of any since the territer of

- 4B. URS with 4-8 accessory setae (Figs. 3a, 3c, 3 g-h). Abdominal tergum six usually with sclerites, although these can be very reduced or absent (Figs. 8a, 8c, 8 g-h) . . . 6
- 5A. Abdomen with wax in life (Fig. 1b), although this may be rubbed off. Setae of metatarsus one short and straight (Fig. 7d). Setae of metatibia dense (Fig. 6d). Siphuncular cones with 10-41 setae (mean = 24) scattered over surface. Setae on cone much longer than the short setae on abdominal tergite 5 . . . . . . . . C. edulis (Wilson)
- 5B. Abdomen free of wax in life (Fig. 1d). Setae of metatarsus one long, usually with some curved at the end (Fig. 7b). Setae of metatibia moderately dense (Fig. 6b). Siphuncular cone with five to none setae (mean = 7) located around basal edge of cone and near pore. Setae on cone similar in size and shape to setae on abdominal tergite 5. . . . . . .
- 6A. Large sclerites on all abdominal terga (Fig.
- 8c). URS usually with only four to five accessory setae (Fig. 3c) . . C. caliente Hottes
- 7A. Color in life amber, possibly with some green, mostly free of wax, almost always feeding on shoots of young trees (Fig. 1c). Sclerotization on abdominal tergites 6 and 7 most often in the form of scleroites each with a single seta on it. Setae of tergite 8 in a single row usually along posterior edge of sclerites. (Fig. 8g). Setae of metatibia erect, extending 45° or more from plane of leg (Fig. 6g). Sides of URS straight, forming a narrow cone (Fig. 3g). Mesosternal tubercle a shallow oval, wider than deep . . . . . . . . .
- 7B. Color in life gray to black, with extensive wax
- giving it a mottled appearance (although this may be rubbed off), usually feeding on twigs or branches with few or no needles (Fig. 1a). Sclerotization on abdominal tergites six and seven most often consisting of four large sclerites each with several setae. Setae on tergite 8 in irregular row on posterior half of sclerites and usually additional setae on anterior of sclerites (Fig. 8a and h). Setae of metatibia usually 45° or less from plane of leg (Fig. 6a and h). URS somewhat parallel-sided basally, with more abrupt tapering distally (Fig. 3a and h). Mesosternal tubercle large, round to oval, deeper than 8A. On P. edulis .... C. wahtolca Hottes 8B. On P. monophylla . . . . . . C. anelia sp. nov. 9A. URS with 10-25 accessory setae (Fig. 3b

- 9B. URS with four to eight accessory setae (Fig. 3a,
- this may be rubbed off. Setae of tarsus 1 short and straight (Fig. 7d). Setae of metatibia dense (Fig. 6d). Siphuncular cones with 8–40 setae (mean = 28) scattered over surface. Setae on cone much longer than the short setae on abdominal tergite 5 . . . . . . . . C. edulis (Wilson)
- 10B. Abdomen free of wax in life (Fig. 1d). Setae of tarsus one long, usually with some curved at the end (Fig. 7b). Setae of metatibia moderately dense (Fig. 6b). Siphuncular cone with 5–15 setae (mean = 9) located around basal edge of cone and near pore. Setae on cone similar in size and shape to setae on abdominal tergite 5 . . . . C. atra (Gillette & Palmer)
- 11A. URS usually with only four to five accessory setae . . . . . . . . . . . . . . . C. caliente Hottes
- 12A. Color in life amber, possibly with some green, mostly free of wax, almost always feeding on shoots of young trees (Fig. 1c). Setae of metatibia erect, extending 45° or more from plane of leg (Fig. 6g). Sides of URS straight, forming a narrow cone (Fig. 3g). Mesosternal tubercle a shallow oval, wider than deep.

.... C. terminalis (Gillette & Palmer)

- 13A. On *P. edulis* ..... *C. wahtolca* Hottes 13B. On *P. monophylla* .... *C. anelia* sp. nov.

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