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The Subgenus Compactae of *Russula* in California

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Summary. The subgenus Compactae of the genus *Russula* is characterized primarily by the presence of lamellulae, often of several lengths, which alternate regularly with the lamellae. Within the subgenus are two sections: Nigricantes in which the context, when bruised, changes either to red or black directly or to red and then black, and Lactarioides in which the context either does not change color when bruised or, if so, then not to the colors seen in Nigricantes. There are seven species belonging to Nigricantes and two species plus two varieties belonging to Lactarioides recorded from California. This report represents the first in depth documentation of species of *Russula* in California. Keys and descriptions of all taxa are included.

KEY WORDS: *Russula*, sect. Compactae, sect. Nigricantes, sect. Lactarioides, California.

Introduction

The genus *Russula* (Russulaceae, Agaricales) is widely distributed throughout most of the forested regions of the world and is generally easily recognized at the generic level. It is characterized by the presence of a heteromerous context, absence of a latex and white to ochraceous basidiospores with strongly amyloid ornamentation. *Lactarius* is the only other genus commonly accepted in the family and is easily distinguished by the presence of a latex. *Russula* is a large genus with perhaps as many as two hundred species in the United States and possibly as many as one hundred in California. Species are, in general, difficult to identify. Within the genus two subgenera, Compactae and Russulæ, are recognized. Subgenus Compactae is characterized by basidiocarps which are firm, often white to whitish when young with strongly decurved to incurved margin and numerous lamellulae alternating regularly with the lamellae. Some show conspicuous color changes in the context with age or when bruised. Two sections, Nigricantes and Lactarioides, belong in Compactae. Nigricantes includes those species in which there is a noticeable color change in the basidiocarp when bruised to pink or red or black or to red and then to black. The context of species in Lactarioides either does not change color or changes only slightly to buff or dull yellow when bruised. There is a somewhat

superficial resemblance of some basidiocarps in this section to species of *Lactarius*.

Taxa belonging to both sections are represented in California; seven in Nigricantes and four in Lactarioides. It should be stressed that the *Russula* flora of California is very poorly known. Except for a few short papers by Burlingham (1913, 1936), this is the first report devoted specifically to the genus *Russula* as it occurs in California. All collections, except where specifically stated otherwise, are deposited in the Herbarium at San Francisco State University (SFSU).

Key to Californian species

1. Context changing color when bruised either to red or black or to red and then dark gray or black. Color changes may be slow; if in doubt, wait for at least thirty minutes (sect. Nigricantes) 2
- 1*. Context not changing color as above. If uncertain, allow at least thirty minutes before making final decision (sect. Lactarioides) 8
2. Lamellae changing only to pink to red, reddish brown or reddish purple when bruised; older basidiocarps suffused with these colors
 1. *R. eccentrica*
 - 2*. Lamellae and context when bruised changing to gray or black or to red first and then gray or black 3
 3. Context when bruised changing directly to dark gray or black with no red interphase except for a slight pink or reddish cast in areas in context of *R. adusta* 4
 - 3*. Context when bruised changing to red then to dark gray or black 6
 4. Context when bruised changing slowly to gray or gray-black or black with occasional faint, scattered, reddish or pinkish areas 2. *R. adusta*
 - 4*. Context when bruised changing directly black rather quickly with no red or pink areas 5
 5. Cuticle 200–400 µm or more thick, composed of interwoven hyphae with erect, undifferentiated hyphal tips 3. *R. atrata*
 - 5*. Cuticle from 25–150 µm thick, composed of hyphae generally parallel and horizontally oriented 4. *R. albonigra*
 6. Cuticle more than 150 µm thick; lamellae close to crowded (rarely subdistant) 5. *R. densifolia*
 - 6*. Cuticle less than 150 µm thick, lamellae usually distant to subdistant 7
 7. Lamellae distant to very widely (2–3 mm apart) spaced, very thick; basidiospores 6.3–7×5.3–7 µm; ornamentation usually not more than 0.1–0.4 µm high 6. *R. nigricans*

7*. Lamellae subdistant (rarely close), thin to moderately thick, basidiospores $7.7\text{--}10.8 \times 6.5\text{--}9 \mu\text{m}$; ornamentation up to $0.5\text{--}0.7 \mu\text{m}$ high
7. *R. dissimulans*

8. Spore ornamentation $0.2\text{--}0.7 \mu\text{m}$ high; taste quickly and intensely acrid
8. *R. cascadensis*

8*. Spore ornamentation $0.5\text{--}1.3 \mu\text{m}$ high; taste mild or slowly moderately acrid, if strongly acrid then stipe apex and/or lamellae with green tints 9

9. Basidiospores $8\text{--}10.6 \times 6.7\text{--}8.6 \mu\text{m}$; no green pigments in any part of basidiocarp; taste slowly and moderately acrid, rarely mild
9. *R. brevipes* var. *brevipes*

9*. Basidiospores $9.0\text{--}13.3(-14.1) \times 8\text{--}10(-12) \mu\text{m}$ or basidiocarps with green pigment in stipe apex and/or lamellae; taste usually quickly and strongly acrid 10

10. Basidiocarps with suffused green pigment in lamellae and usually with a green band at apex of stipe 10. *R. brevipes* var. *acrior*

10*. Basidiocarps lacking green pigment; basidiospores $9\text{--}13.3(-14.1) \times 8\text{--}10(12) \mu\text{m}$ 11. *R. brevipes* var. *megaspora*

Description of taxa

1. *Russula eccentrica* Peck N. Y. State Mus. Bull. 150: 61. 1911.

Pileus 6–10 cm broad when mature, convex to plano-convex when young becoming plane to broadly and shallowly depressed with age; margin decurved to incurved, usually somewhat arched and often irregularly lobed with age, occasionally striate, entire; cuticle inseparable or peeling up to 1/4 distance to the disc; surface dry, subviscid when moist, glabrous, sometimes becoming areolate with age; color when young whitish to olive buff to pale yellow to pale pinkish buff, slowly changing to gray brown or umber or blackish with age. Context 0.5–1.5 cm thick, white to pale pinkish buff to pale vinaceous buff, unchanging when exposed or erratically and slowly becoming reddish, not changing to black. Odor usually not distinctive but, according to Bills (1985) may sometimes be fruity or fragrant. Lamellae adnexed to adnate, typically becoming subdecurrent to decurrent with age, subdistant to distant, forking and with some anastomosing, white when young becoming pinkish to pinkish vinaceous at maturity, changing to reddish brown when bruised, not blackening; taste mild to weakly acrid or slightly bitter; lamellulae of several lengths, regularly alternating with lamellae. Stipe 3–7 cm long, 2–3 cm broad at apex, equal or tapering slightly toward the base; usually slightly eccentric; surface glabrous, dry; color white but usually becoming pinkish to gray and eventu-

ally brown with a distinct pinkish overcast; context pink, unchanging when exposed.

Basidiospores white in mass, $6.9\text{--}9.2 \times 5.5\text{--}6.5 \mu\text{m}$, subglobose to subovoid to subellipsoid; ornamentation very weak with scattered to crowded warts often connected by ridges or fine lines to form a partial reticulum, warts $0.1\text{--}0.2 \mu\text{m}$ high. Hymenial cystidia $60\text{--}87 \times 5\text{--}9 \mu\text{m}$, common to crowded, projecting from the hymenium, cylindric with obtuse to elongated, sometimes strangulated apices, usually hyaline. Subhymenium up to $40 \mu\text{m}$ thick, well differentiated. Sphaerocysts abundant and not grouped in well defined clusters in the lamellar trama. Cuticle $230\text{--}280 \mu\text{m}$ thick, embedded in gluten, epicutis interwoven with free hyphal tips, pale yellow in KOH, subcutis interwoven. Pileocystidia present. Pileus trama with discrete clusters of sphaerocysts.

Known from only a single collection found under oaks on the campus of the University of California at Berkeley, Alameda County.

So far as is known this is the first report of this species from the western United States. Shaffer (1962) and others (Weber & Smith 1985) reported the presence of this species in the United States under the epithet of *R. subnigricans* Hongo, but Bills (1985) has shown convincingly that it is *R. eccentrica* of Peck. It is most easily recognized by the somewhat eccentric stipe, the gray to brown color of the pileus and the pink to red to vinaceous color of the lamellae. It is also the only member of this section, so far as is known, which has well defined pileocystidia. It should also be pointed out that *R. subnigricans*, originally reported by Hongo from Japan, is poisonous; however, no data are available regarding this character in *R. eccentrica*.

2. *Russula adusta* Fries
Epicr. Myc. 350. 1838.

Pileus 7–15 cm broad when mature, convex to near plane when young becoming shallowly to moderately depressed with age; margin incurved to decurved, sometimes slightly arched, entire, not striate; cuticle not easily separable from trama; surface viscid, becoming somewhat shiny when dry, glabrous; color white to whitish to buff when young becoming brown to dark gray and eventually blackish with age. Context 2–4 cm thick, white, slowly changing slightly and erratically either to red or reddish to pinkish and then black or directly black with no reddish interphase. Odor mild [some authors (Kibby & Fatto 1990, Knudsen & Stordal 1992) report an odor of empty wine casks, but this odor has not been detected in our material]. Lamellae adnexed to adnate, sometimes subdecurrent in older pilei, close to crowded, occasionally forking and sometimes somewhat intervenose, color white when young usually becoming yellowish or buff with age, eventually black to blackish, staining black when

bruised; taste mild; lamellulae of various lengths, regularly distributed between lamellae. Stipe 3–7 cm long, 1–3 cm broad at apex, equal or tapering slightly toward apex or base; surface dry, glabrous; color white to whitish during all stages, staining black when bruised; context solid, white, blackening when exposed.

Basidiospores white in deposit, $6.5\text{--}10.0 \times 5.7\text{--}7.5 \mu\text{m}$, subglobose to subovoid; ornamentation weak, mostly of isolated warts sometimes joined by heavy lines forming a partial or near complete reticulum, warts $0.2\text{--}0.6 \mu\text{m}$ high. Hymenial cystidia $52\text{--}71 \times 9\text{--}12 \mu\text{m}$, scattered, typically rather deeply embedded in hymenium, clavate to fusoid with a narrow, slightly elongated terminal appendage, hyaline, thin-walled. Subhymenium parenchymatous; cells small. Basidia sometimes 2-spored. Sphaerocysts crowded and not in well defined clusters in the lamellar trama. Cuticle $130\text{--}200 \mu\text{m}$ thick, gelatinous, epicutis a layer of loosely interwoven hyphae with numerous free hyphal tips; subcutis interwoven. No pileocystidia noted. Pileus trama with numerous clusters of sphaerocysts.

Known from only one collection from under conifers (*Abies* and *Pinus*) in the Marble Mountains in Siskiyou County located in the northwestern portion of the state. *Russula adusta* appears to be most closely related to *R. densifolia* but is distinguished from it by the mild taste and slow, erratic, slight reddening of the context when bruised. Shaffer (1962) has also pointed out that *R. adusta* has close rather than crowded lamellae and occurs under conifers rather than deciduous trees.

3. *Russula atrata* Shaffer
Brittonia 14: 262. 1962.

Pileus 6–14 cm broad, broadly convex to plano-convex when young usually becoming broadly and shallowly depressed with age; margin incurved to decurved, entire, often arched when older, not striate; cuticle not easily removed from trama; surface usually dry, sometimes moist but not viscid, matte, glabrous during all stages; color white when young, with age becoming buff to gray and eventually changing entirely to black. Context 1.3–3.5 cm thick, white when first exposed, quickly changing to black when bruised or exposed with no red interphase. Odor not distinctive. Lamellae adnexed to adnate, often subdecurrent when old, close to crowded or subdistant, often forking near base, no anastomosing noted; color white at first but becoming gray then black with age or when bruised, not reddening; taste mild; lamellulae common, of varying lengths, alternating with lamellae. Stipe 4–9 cm long, 3–4 cm thick at apex, equal or enlarging toward base; surface dry, glabrous, dull; color white when young, becoming directly black with age or when bruised; context solid, white, changing as above.

Basidiospores white in mass, $7.2\text{--}10.8 \times 7\text{--}8 \mu\text{m}$, ellipsoid to subellipsoid to subovoid; ornamentation very weak, composed of isolated warts, sometimes connected by fine lines to form a partial or near complete reticulum, warts $0.1\text{--}0.2 \mu\text{m}$ high. Hymenial cystidia $30\text{--}74 \times 6\text{--}9 \mu\text{m}$, common, often crowded, projecting slightly, terete to subfusoid with tapered, obtuse to narrowly elongated, often strangulated, terminal appendage, hyaline or with diffused brown pigments. Subhymenium strongly developed, compact, cellular. Basidia sometimes 2-spored. Sphaerocysts in lamellar trama scarce, apparently absent in some lamellae, hyaline or sometimes with diffused brown pigment. Cuticle $200\text{--}450 \mu\text{m}$ thick, appearing somewhat gelatinous, numerous hyphae with brown contents; epicutis interwoven, often with free hyphal tips; subcutis interwoven. Pileocystidia absent. Pileus trama with numerous, often small, clusters of sphaerocysts.

Solitary to gregarious in mixed conifer-hardwood forests.

Apparently most abundant in the northern coastal forests in the state but also occurs in the foothills in the central part of the state.

This species appears quite similar to *R. albonigra* and can only be distinguished from it with certainty by an examination of the cuticle. *R. atrata* has a broad cuticle that is composed of interwoven hyphae with numerous free hyphal tips and varies from $200\text{--}450 \mu\text{m}$ in thickness, whereas that of *R. albonigra* is composed mostly of parallel hyphae with few free hyphal tips and is rarely thicker than $150 \mu\text{m}$. The absence of a red interphase in the color changes in the context and the very weak ornamentation of the spores distinguish this species from *R. nigricans*, *R. dissimulans* and *R. densifolia*.

4. *Russula albonigra* (Krombh.) Fries Mon. Hymen. Suec. 2: 324. 1863.

Pileus 5–12 cm broad at maturity, broadly convex to plano-convex when young becoming shallowly to rather deeply depressed with an arched margin with age; margin decurved to incurved, entire, not striate; cuticle not easily separable from context; surface subviscid to moist at first, quickly becoming dry, dull, glabrous or, rarely, obscurely tomentose when old, sometimes aerolate or partially so with age; color whitish when young becoming brown to fuscous and eventually black with age. Context 1–3 cm thick, white when first exposed but quickly changing directly to black with no red interphase. Odor mild. Lamellae adnexed to adnate becoming subdecurrent with age, close to subdistant, occasionally crowded, forking often common, sometimes intervenose; color white at first becoming pale yellow and eventually black, blackening when bruised, no red interphase; taste mild to slightly bitter, sometimes mildly of menthol; lamellulae numerous, of several lengths, alternating regularly with

lamellae. Stipe 3–9 cm long, 2–3.5 cm broad at apex, equal or tapering toward apex or base; surface dry, glabrous, white at first darkening as in pileus with age or when bruised; context solid, white at first changing to black when bruised.

Basidiospores white in deposit, $7.0\text{--}10.5 \times 5.5\text{--}6.5 \mu\text{m}$, subovoid to subellipsoid, occasionally subglobose; ornamentation very weak and faint, composed of short warts or spines which are sometimes joined by fine lines to form a broken reticulum; warts and spines $0.1\text{--}0.2 \mu\text{m}$ high. Hymenial cystidia common to abundant, projecting well beyond hymenium, fusoid to terete with a narrow, elongated, often strangulated, terminal appendage, hyaline to pale brown in KOH. Subhymenium moderately to strongly developed. Basidia 2- and 4-spored. Sphaerocysts numerous in lamellar trama. Cuticle usually $100\text{--}150 \mu\text{m}$ thick, epicutis of more or less parallel, horizontally attached hyphae with scattered free hyphal tips, not gelatinous or only slightly so; subcutis interwoven. Pileocystidia not noted. Pileus trama with numerous discrete clusters of sphaerocysts.

Solitary to gregarious in soil in mixed conifers or in mixed conifer-hardwood forests. Found only in the coastal and foothill areas within the state, but probably also occurs in the mountains.

Russula albonigra is characterized by the rapid blackening of the context with no red interphase, spores with very weak ornamentation and a cuticle that rarely exceeds $150 \mu\text{m}$ in thickness. *R. atrata* is similar but has a gelatinous and interwoven cuticle. *R. densifolia*, *R. nigricans* and *R. dissimilans* have flesh that turns red before blackening.

5. *Russula densifolia* Gill. Champ. Fr. 231. 1876.

Pileus 5–12 cm broad, broadly convex to plano-convex usually becoming shallowly depressed to infundibuliform with age; margin incurved becoming decurved with age, entire, not striate; cuticle not separable or peeling $1/2\text{--}2/3$ distance to disc; surface viscid, shining when dry, glabrous; color white to pale buff when young, slowly changing to shades of brown and eventually black when old. Context 2.5–4 cm thick, white when first exposed slowly changing to red and eventually becoming black. Odor mild. Lamellae adnexed to adnate becoming subdecurrent to decurrent with age, close to crowded or occasionally somewhat subdistant, with scattered forking, sometimes intervenose, whitish to pale yellow or pale buff, slowly becoming gray and then black with age, staining red then black when bruised; taste somewhat variable, most often acrid to very acrid but apparently mild in some basidiocarps; lamellulae of varying lengths, alternating with lamellae. Stipe 3–9 cm long, 1.5–3.5 cm

broad, equal or tapering toward base or apex; surface dry, glabrous or rarely furfuraceous, often rugulose; white becoming gray to brown and then black with age, changing to red then black when bruised; context solid, hard, brittle, white changing as above when bruised.

Basidiospores white to pale yellow in deposit, (6.9–)7.6–9.5(–11.5) × 6.7–7.5 μm , subellipsoid to subovoid to sometimes near subglobose; ornamentation composed of isolated warts which may be joined by heavy lines to form a broken reticulum, warts 0.2–0.5 μm high. Hymenial cystidia 30–80 × 5–10 μm , common, projecting slightly from hymenium, clavate with obtuse apices to fusoid with short, narrowed, terminal appendage, hyaline, thin-walled. Subhymenium strongly differentiated. Sphaerocysts abundant in lamellar trama with few connective hyphae. Cuticle 125–200(–312) μm thick, embedded in gelatinous matrix, epicutis interwoven with few free hyphal tips; subcutis well differentiated, interwoven. No pileocystidia noted. Pileus trama with numerous distinct clusters of sphaerocysts.

Gregarious to solitary in soil in mixed conifer-hardwood forests. Widely distributed in the state and found in the coastal forests, foothills and mountains; often quite common.

Russula densifolia is characterized by the red then black color changes in the context when bruised and a cuticle that is rarely less than 150 μm thick. The lamellae are usually close or crowded, rarely subdistant. It is most likely to be confused with *R. dissimilans* or *R. nigricans* but in both of these species the cuticle is less than 150 μm thick. In addition, the lamellae are distant to subdistant in *R. nigricans* and usually subdistant in *R. dissimilans*, but are typically close to crowded in *R. densifolia*.

Shaffer (1962) has described three forms of this species from the Pacific Northwest: fa. *dilatoria* in which the basidiocarps darken only to lavender gray to brownish gray, fa. *fragrans* which has a fragrant odor and widely spaced lamellae and fa. *cremeispora* which has light yellow spores in deposit and an obscurely two-layered cuticle. So far as is known none of these forms has been found in California.

6. *Russula nigricans* (Bull.) Fries Epicr. Myc. 350. 1838.

Pileus 8–15 cm broad when mature, broadly convex to plano-convex when young, plane to broadly and deeply depressed at maturity; surface dull, moist to subviscid when wet, glabrous but sometimes obscurely tomentose, particularly on the disc; margin decurved to incurved, often becoming arched with age, entire, frequently highly eroded when old, not striate; cuticle not easily separable from context; color white to buff when young darkening to dark gray

to black, sometimes paler gray on disc, typically black with age. Context 2.5–4 cm thick, white when first exposed changing to red and eventually black. Odor not distinctive. Lamellae adnexed to adnate becoming subdecurrent to decurrent with age, subdistant to distant, more commonly distant with 2–3 mm between lamellae, some forking and anastomosing, fragile, very thick and broad, white when young gradually changing color as in the pileus; taste mild to weakly acrid; lamellulae of several lengths, alternating with lamellae. Stipe 4–8 cm long, 2–4 cm broad at apex, equal to tapering toward the base or apex; surface dry, glabrous; color gray at first becoming black when old; stuffed often becoming hollow with age; context white changing to red then black when exposed or bruised. Basidiospores white in deposit, $5.7\text{--}7.6 \times 4.8\text{--}6.2 \mu\text{m}$, subglobose to subellipsoid; ornamentation weak, composed of isolated warts often connected to form short lines or a partial reticulum, warts $0.1\text{--}0.3 \mu\text{m}$ high. Hymenial cystidia $53\text{--}60 \times 7\text{--}9 \mu\text{m}$, common, projecting from hymenium, cylindric with a narrow, elongated, often strangulated, terminal appendage, hyaline or nearly so. Subhymenium strongly developed, up to $90 \mu\text{m}$ thick, cellular. Sphaerocysts crowded in lamellar trama with no connective hyphae apparent. Cuticle $115\text{--}165 \mu\text{m}$ thick, somewhat embedded in gelatinous matrix, some hyphae with occasional brown contents and some with scattered, nodulose enlargements, epicutis interwoven, sometimes with free hyphal tips; subcutis interwoven. No pileocystidia noted. Pileus trama with discrete clusters of sphaerocysts.

Solitary to gregarious and often abundant in soil in mixed conifer-hardwood forests. Apparently more common in the coastal forests and foothills up to an elevation of 4,000 feet. Probably occurs throughout the state.

Russula nigricans is distinguished by the widely spaced, notably thickened lamellae, relatively small spores with weak ornamentation and a viscid to weakly viscid pileus. Shaffer (1962) has stated that this species does not occur in the United States, but Smith (1985) reported its presence in the Pacific Northwest and the California specimens reported here match the description very satisfactorily. *R. dissimilans* appears to be very similar but differs in having slightly larger spores with a slightly heavier ornamentation, usually subdistant lamellae, and a dry cuticle.

7. *Russula dissimilans* Shaffer *Brittonia* **14**: 267. 1962.

Pileus 6–15 cm broad at maturity, plane to plano-convex when young, shallowly and broadly depressed to infundibuliform at maturity; margin incurved to decurved, usually becoming arched with age, entire but often eroded when old, not striate; cuticle not easily separable from context; surface dry, rarely

subviscid when wet, glabrous or somewhat tomentose on the disc, occasionally becoming areolate with age; when young color white to buff, soon changing to gray to gray brown to brown and eventually fuscous to black. Context 1.5–3 cm thick, white when first exposed changing to red and eventually black. Odor not distinctive. Lamellae adnexed to adnate becoming subdecurrent to decurrent, usually subdistant (rarely close or distant), intervenose, occasional forking, white to pale yellow, showing a similar series of color changes as in pileus; numerous lengths of lamellulae, alternating with lamellae; taste mild or weakly acrid. Stipe 5–8 cm long, 2–4 cm broad at apex, equal or tapering toward base or apex; surface dry, unpolished; color white when young becoming black to blackish with age, staining red then black when bruised; context solid, white when exposed or bruised, soon changing to red then black.

Basidiospores white in deposit, 7–11×6.5–7.2 μm , subellipsoid to subovoid to sometimes near subglobose, ornamentation of isolated warts often connected by dark lines to form a partial reticulum, warts 0.2–0.7 μm high. Hymenial cystidia 30–41×4–7 μm , often obscure, usually embedded in hymenium or projecting only slightly, mostly clavate to fusoid, hyaline, thin-walled. Subhymenium well developed. Mostly sphaerocysts in lamellar trama. Cuticle 115–200 μm thick, hyphae not embedded in gelatinous layer, epicutis interwoven with some free hyphal tips; subcutis interwoven. No pileocystidia noted. Pileus trama with many discrete clusters of sphaerocysts.

Solitary to gregarious in soil in mixed conifer-hardwood forests. Known from the coastal areas, foothills and mountains. Widely distributed and often common.

This species has the same color changes in the context as *R. densifolia* and *R. nigricans*. It is distinguished from *R. densifolia* by having a much thicker cuticle which is embedded in a strongly developed gelatinous matrix, and lamellae which are usually subdistant to distant. It is easily confused with *R. nigricans*, and there appears to be considerable intergradation. The major differences are the thick, widely spaced lamellae and smaller spores of *R. nigricans* Singer (1986) has suggested that *R. dissimilans* might be better placed as a variety of *R. nigricans*.

8. *Russula cascadensis* Shaffer *Mycologia* 56: 212. 1964.

Pileus (4) 5–12 cm broad when mature, plano-convex to plane becoming depressed to relatively deeply infundibuliform with age; margin incurved to decurved, usually arched and sometimes irregularly undulating, entire, not striate; cuticle not easily separable from trama; surface dry, subviscid when wet, glabrous but may be weakly fibrillose or subtomentose, dull; color white

but with ochraceous to tan or buff stains when older, sometimes becoming entirely buff or tan with age. Context 8–17 mm thick, white, unchanging or slowly changing to buff to yellowish but not reddening or blackening when exposed. Odor slight or mild. Lamellae adnate or adnexed, typically becoming decurrent to subdecurrent with age, close to subdistant or crowded, rarely subdistant, some forking near stipe, no anastomosing noted; color white when young, usually becoming buff to brownish or developing spots of these colors with age; taste strongly and quickly acrid; numerous lengths of lamellulae alternating with lamellae. Stipe 3–6 cm long, 2–3 cm broad at apex, equal or tapering toward the base; surface dry, dull, glabrous; white during all stages, no discolorations noted; context solid, white, unchanging in color when bruised.

Basidiospores whitish to pale yellow in mass, $6.5–8.2 \times 5.5–6.5 \mu\text{m}$, typically subglobose, sometimes subovoid or subellipsoid; ornamentation of isolated warts often connected by heavy lines forming a partial to near complete reticulum, warts $0.6–1 \mu\text{m}$ high. Hymenial cystidia $48–87 \times 5–9 \mu\text{m}$, often abundant, conspicuous and either projecting well beyond the hymenium or partially or rather deeply embedded and projecting only slightly, fusoid to cylindric, often with an elongated, tapered, sometimes strangulated, terminal appendage. Subhymenium not strongly differentiated. Sphaerocysts closely packed in lamellar trama. Cuticle $92–140 \mu\text{m}$ thick, epicutis differentiated as a layer of tangled to interwoven hyphae usually with somewhat erect hyphal tips; subcutis interwoven. No pileocystidia noted. Pileus trama with scattered, discrete clusters of sphaerocysts.

Solitary to gregarious under conifers. Found only in the northern coastal areas of the state and relatively few collections have been made.

Russula cascadensis differs from other taxa in the Lactarioideae in California by having slightly smaller spores with weaker ornamentation, an apparent restriction to conifers and an acrid taste that develops quickly and becomes rather intense. It is obviously closely related to *R. brevipes* and is easily confused with it. *R. brevipes* has spores with stronger ornamentation, an acrid taste that develops slowly and occurs in mixed forests. *Russula vesicatoria* Burl., an east coast species, and one which Shaffer (1964) believes to be most closely related to *R. cascadensis* has a bitter as well as an acrid taste. Furthermore, according to the protologue, the acridity is such that blisters often develop on the tissues of the mouth and lips.

9. *Russula brevipes* var. *brevipes* Peck
N. Y. St. Mus. Ann. Rept. 43: 20. 1890.

Pileus (4–)6–12(–20) cm broad at maturity, broadly convex to plane to depressed becoming depressed to infundibuliform with age; margin plane to de-

curved, occasionally becoming undulating to irregular, entire, not striate; cuticle not easily separable from trama; surface dry but in wet weather may become subviscid to viscid, glabrous but with age may appear somewhat fibrillose or subtomentose; color white but sometimes becoming buff to brown with age or developing spots of these colors. Context 10–21 mm thick, white or occasionally brown to brownish with age, not changing color when bruised or exposed. Odor mild. Lamellae adnate to adnexed becoming decurrent with age, typically close or rarely subdistant, typically forking and sometimes anastomosing; color white but often becoming pale yellow or pale buff with age, usually with buff to brown or ochraceous stains with age; taste mild at first but becoming acrid; lamellulae common and regularly alternating with lamellae. Stipe (2–)4–6.5(–8) cm long, (1.5–)2–3.5(–4) cm broad at apex, equal or tapering toward base; surface dry, dull, glabrous; white with ochraceous to brown to cinnamon stains when old; context solid, white, unchanging when bruised.

Basidiospores white to pale yellow in mass, $8–10.5 \times 6.5–9 \mu\text{m}$, subglobose to subovoid to subellipsoid; ornamentation of isolated warts and heavy lines that sometimes join to form an obscure partial reticulum, warts $0.7–1.7 \mu\text{m}$ high. Hymenial cystidia $50–72 \times 7–12 \mu\text{m}$, often common, conspicuously projecting or sometimes embedded in hymenium, occasionally with yellow contents in KOH, clavate to fusoid to terete with obtuse apices or with a short, narrowed terminal branch. Subhymenium not strongly differentiated. Sphaerocysts crowded in gill trama. Cuticle $70–140 \mu\text{m}$ thick, epicutis interwoven to somewhat horizontally appressed, often with more or less solitary to clustered, free hyphal tips, not gelatinous; subcutis interwoven. No pileocystidia noted. Pileus trama with discrete, scattered clusters of sphaerocysts surrounded by narrow connective hyphae.

Solitary to gregarious in soil in mixed conifer-hardwood forests. Very common in California and occurs in coast al, foothill and mountainous areas.

Russula brevipes is readily recognized by the white pileus usually with brown to ochraceous spots or stains, the more or less infundibuliform shape with a noticeable incurved margin at least when old, the unchanging color of the context when bruised and the somewhat slowly developing acrid taste. The only other species in subsect. Lactarioideae in California is *R. cascadensis* which is similar in appearance but has smaller spores, with slightly weaker ornamentation and an intensely acrid taste which develops immediately.

Russula brevipes is obviously closely related to *R. delica* Fries of Europe, and Singer (1986) has stated that it should be reduced to a variety of *R. delica* Shaffer (1964), however, notes that there has not always been complete accord on the concept of *R. delica* in Europe and that no holotype exists. He has, therefore, accepted Peck's *R. brevipes* for the North American taxon, especially since a holotype is available for comparison.

10. *Russula brevipes* var. *acrior* Shaffer
***Mycologia* 56: 223. 1964.**

This variety is distinguished by the dull greenish to somewhat blue-green discoloration of the lamellae and a more conspicuous similarly colored band around the apex of the stipe. These colors may be rather faint and sometimes seem to disappear with age. In addition the taste is usually more intensely acrid than that of the typical variety, but in rare cases it may be mild or only weakly acrid.

This variety occupies the same type of habitat as var. *brevipes*, shows a similar fruiting habit and has been found in the coastal and mountainous regions of California. *Russula brevipes* var. *acrior* is obviously similar to *R. chloroides* Krombh. of Europe and, indeed, may be synonymous with it. Shaffer (1964) pointed out in the protologue that the basis for erecting this variety rather than calling it *R. chloroides* stems from the fact that originally *R. chloroides* was thought to be a *Lactarius*, however it now appears to be universally accepted as a *Russula*. The Europeans with whom I have collected in this country immediately identified var. *acrior* as *R. chloroides*. Singer (1986) suggested that it be made a variety of *R. chloroides* rather than a variety of *R. brevipes*.

11. *Russula brevipes* var. *megaspora* Shaffer
***Mycologia* 56: 226. 1964.**

Macroscopically this variety appears very similar to the typical variety. The distinguishing feature is found in the larger size of the basidiospores. In the protologue the spores are $9.3\text{--}14.1 \times 8\text{--}12 \mu\text{m}$, but in my collection the spore size is $9\text{--}13.3 \times 8\text{--}10 \mu\text{m}$. No other significant differences have been noted except that the pileus is notably smaller than that of var. *brevipes*.

So far as can be determined this variety is known only from the holotype and the collection reported here. It is, however, probably more widely distributed within the state since the holotype was collected in Butte County and the above collection was made in Santa Barbara County which is several hundred miles farther south.

Acknowledgment

It is a pleasure to dedicate this paper to Prof. M. Moser not only because of his outstanding contribution to our knowledge of the agarics but, in addition, as a means of expressing my deep appreciation for the many very pleasant hours spent with him in the field and for the assistance he so generously gave in determining numerous collections, especially those belonging to the genus *Cor-tinarius*.

This contribution is dedicated to Prof. Dr. M. Moser (Innsbruck, Austria),
on occasion of his 70th birthday.

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