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FORAY NEWFOUNDLAND AND LABRADOR

is an amateur, volunteer-run, community, not-for-profit organization with a mission to organize enjoyable and informative amateur mushroom forays in Newfoundland and Labrador and disseminate the knowledge gained.

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COVER

Tricholoma dulciolens, photographed by Steve Trudell, Terra Nova National Park, September 30, 2012. The lead article is the first report of this species in North America. In a way. DNA matching had already shown that it grew in North America, but this is the first report of a collection that was identified and subsequently confirmed to be that species.

However, it may turn out that this was only the first time the species was reported from North America under that name. Quite possibly the taxon was first described from North America as a variety of another species some time earlier.

If you think this is confusing, wait until you read what is inside!

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Message from the Editor

Happy Midsummer from one of the famous Red Chairs installed in our National Parks! When you come to our foray in Gros Morne National Park, you will find these Red Chairs in the most likely and most unlikely places. Sit. Take time to contemplate your surroundings—not unlike what you do in an art gallery.

And welcome to our *Tricholoma* issue!

Most *Tricholoma* species are late-season fruiters, so this should be in your hands well ahead of the trich season. The material is essentially the result of a bounteous 2011 *Tricholoma* season, which coincided with the participation of Gro Gulden and Steve Trudell as faculty, so it has taken a bit of time to put together. You can go straight to p. 15 for a description of 11 new species found in 2011. Two are not totally new: we have known and collected *T. terreum* under the name *T. virgatum* in the past. The two have been shown to be genetically synonymous and *T. terreum* is the older name. We have collected *T. luteovirescens* under the name *T. subsejunctum*; in this case, after due consideration, we shall continue to use that name because it is the earlier of the two, as well as a North American name. As you see, lots of room for taxonomic detective work to reconcile European and North American names and species.

As with many other similar articles, do not expect to remember it all. Rather read it and get the general idea. Then file it to use as a reference when coming across our trichs.

The lead articles introduce you to *Tricholoma dulciolens*, one of the species in *Tricholoma* section *Caligatum*. They also confirm that the pine mushroom of Newfoundland and Labrador

is the more desirable (gastronomically speaking) *Tricholoma matsutake*, not *Tricholoma magnivelare*. As you will learn, *Tricholoma* section *Caligatum* in North America offers perhaps the best opportunity for taxonomic detective work. Our review of three of the four species found in on this continent (two in NL), suggests that at present they are participants in the Great Matsutake Masked Ball, where not one of them appears under its real name. Surely the magic hour should fast approach, when the masks are taken off and each identity bared, before other orphic players join the crowded party and totally confuse the scene of recondite merriment. Who will step up to do the unveiling?

As always, first foray matters, then mycology.

See you at the Foray!

andrus



FORAY MATTERS...

1. **INFORMATION, REGISTRATION FORM, HOW TO GET THERE, etc.** Please see *OMPHALINA* V, No 4 (April issue), as well as material stored on our website

nlmushrooms.ca.

Past issues of *OMPHALINA* may be downloaded from our website.

2. **MYCOBLITZ** For those able to make it, join us at Sir Richard Squires Memorial Provincial

Park at 11:00 AM, Fri. Sep. 12, 2014. See April *OMPHALINA* for details.

3. Most unfortunate late-breaking news: Parks, the partner hitherto providing our greatest support, was unable to continue due to decreased budgets during last year's cut backs. We have already scaled back for this year, and you will probably see more. Your Board will deliberate further adjustments and you will be advised.



THE FORESTS OF GROS MORNE

Michael Burzynski

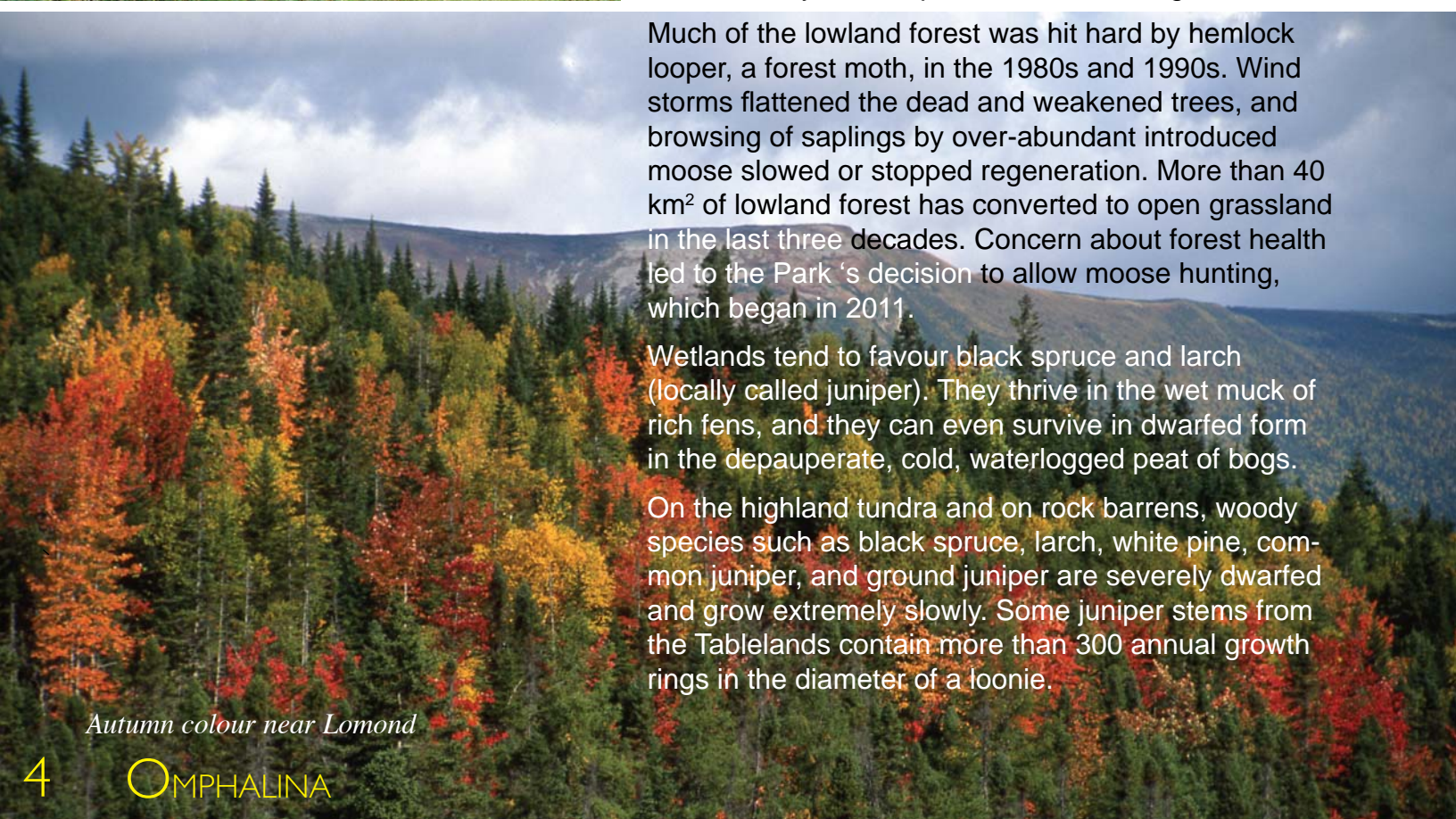
Coniferous and mixed forest cover 44% of Gros Morne's area. Black spruce, white spruce, balsam fir, and white birch dominate the forest throughout in the park, although there are a few more species in the Lomond area. Generally, the more species of trees in the forest, the greater the diversity of fungi.

Mixed forest around Wigwam Pond



Bonne Bay is a climatic divide. South of Bonne Bay, white pine, yellow birch, red maple, black ash, trembling aspen, and a number of shrubs are common forest species. They do not thrive north of the bay because it is slightly cooler. The richest forest in the park area is in the area of the Lomond River valley—probably the most interesting place in the park to search for fungi.

Least diverse—and most picturesque—is the dwarf forest locally called tuckamore. Along the coast, tuckamore is composed of white spruce and balsam fir trees that have been dwarfed and contorted by wind desiccation, salt spray, and ice abrasion. Most pruning takes place in winter when the trees cannot draw water from the soil, and strong onshore winds dry out and kill exposed buds and branches on the windward side of the trees. This causes the trees to grow as though they were leaning inland. At the upper beach the tuckamore is only ankle high. The trees get gradually taller with distance from the shore, forming a dense interwoven hedge that protects trees farther inland. Similar tuckamore forest occurs on the tops of hills, near the treeline. Tuckamore is almost impenetrable for hikers, the only efficient way through is to find a moose or caribou trail. The branches are so densely interwoven that little light reaches the floor, so there are no shrubs, and even few ferns and mosses. This is a very difficult place to look for fungi!



Much of the lowland forest was hit hard by hemlock looper, a forest moth, in the 1980s and 1990s. Wind storms flattened the dead and weakened trees, and browsing of saplings by over-abundant introduced moose slowed or stopped regeneration. More than 40 km² of lowland forest has converted to open grassland in the last three decades. Concern about forest health led to the Park's decision to allow moose hunting, which began in 2011.

Wetlands tend to favour black spruce and larch (locally called juniper). They thrive in the wet muck of rich fens, and they can even survive in dwarfed form in the depauperate, cold, waterlogged peat of bogs.

On the highland tundra and on rock barrens, woody species such as black spruce, larch, white pine, common juniper, and ground juniper are severely dwarfed and grow extremely slowly. Some juniper stems from the Tablelands contain more than 300 annual growth rings in the diameter of a loonie.

Autumn colour near Lomond



Species of *Tricholoma* section *Caligatum* in Newfoundland and Labrador

Gro Gulden
Steve Trudell
Tobias Frøslev
Andrus Voitk

Our 2012 foray in Terra Nova National Park took place at the peak of the late-fruiting *Tricholoma* season and was felicitous for tricholomas—to the great satisfaction of those faculty members with a special interest in the genus. The aromatic species of *Tricholoma* sect. *Caligatum* were especially evident, allowing us to recognize and review two species of the highly prized group from our province: *T. matsutake* (Figure 1 and title banner) and *T. dulciolens* (cover photo and Figure 2). This communication describes these two species in our province and allows us to confirm an earlier hypothesis that our matsutake complex mushroom is indeed *T. matsutake* and not the similar *T. magnivelare* found on the west coast of the continent.¹

Tricholoma matsutake is among the highest prized mushrooms in the world in terms of both taste and cost. Its existence in eastern North America has been reported earlier.²

For more than 1,000 years it has been the magic gourmet food of Japanese emperors and priests. Only relatively recently has it become available to 'normal' people in the Far East. The current price of prime button specimens has been reported to be over \$1,000 U.S. a pound on the Japanese market. The most striking feature of the species is a strong and unique odour; once smelled, never forgotten.

Section *Caligatum* belongs to a group of fairly large, mostly brown, scaly tricholomas with a ring on the stem (formerly treated as *Armillaria* species) distributed across the northern hemisphere—most distinguished by a characteristic smell. The first species

to be described in this group was the European *T. caligatum*, known from the Mediterranean region, which is why the group as a whole is known as *Tricholoma* sect. *Caligatum*.

We describe the two section *Caligatum* species in Newfoundland and Labrador. Figure 3 shows a phylogram of our collections among their kin, based on ribosomal internal transcribed spacer (rITS) DNA sequence data, and Table 1 compares their morphological characters.

Methods

Identification was done with the aid of nuclear studies. DNA was extracted with a magnetic kit and the ITS regions were amplified and sequenced, as described elsewhere.³ The phylogenetic analyses were carried out using MAFFT v7 for alignment⁴ and TreeDyn according to established protocol.⁵



Figure 1. *Tricholoma matsutake*, as it appears in Newfoundland and Labrador (see also title banner). Cap diameter about the same as stem length in mature specimens, giving them a stout habitus. The colour is much lighter than elsewhere in the world, but not as whitish as that of *T. magnivelare* on the Pacific coast (Figure 4D).

***Tricholoma matsutake* (S. Ito & S. Imai) Singer** (Figure 1 and title banner).

A fleshy, stubby light coloured mushroom, whose stem length is roughly the same as the cap diameter. **CAP:** 4-35 cm wide, inrolled, dome-shaped, flattens with maturity, initially attached to stem by veil, beige to tan with radial light brown fibrils, browning more with age. **GILLS:** White, crowded, notched. **STEM:** 4-25 x 2-5 cm, tapered toward base, white above ring, concolorous with cap below. **FLESH:** White, with an alluring odor all its own. **SPORES:** Spore print white, size 4.8-6.3 x 4.3-5.3 µm. **ECOLOGY:** Not uncommon its habitat: sandy soil among conifers, usually with pine among them. Peak fruiting at the end of September. **DISTRIBUTION** Eurasia, west to Scandinavia, Scotland⁶ and eastern North America, including Newfoundland (Figure 3). **EDIBILITY:** A desirable edible with a complex taste, of significant commercial value.

Comment

The identification of *T. matsutake* was not straightforward in our province. Our mushrooms were initially thought to be *T. magnivelare*, because their light colour

makes them resemble the whitish *T. magnivelare* of western North America, more than the dark *T. matsutake* found elsewhere, and their spore size overlapped that reported for *T. magnivelare* more than *T. matsutake*. Figure 4 shows the range of colours for Asian, Scandinavian and NL *T. matsutake*, compared to *T. magnivelare* from the Pacific coast. That NL specimens might be *T. matsutake* was first suspected in 2009, after NL collections were studied in a Master's project by Rebecca Bravi.⁷ DNA analyses were not done, but known primers were tested and our mushrooms did not react to *T. magnivelare* reagents. Because *T. matsutake* had been reported from eastern North America,² we hypothesized that our non-reactive collections might represent this taxon.¹

Note that on the phylogram (Figure 3) our collections form a small subclade, not unusual with multi-collection trees, and usually attributed to geographic variation. However, the matsutake clade has the lowest bootstrap support and our particular subclade has about 80% bootstrap support (not shown on the figure), making it conceivable that future multigene analyses could show it to be a distinct species.



Figure 2. Our long-stemmed section *Tricholoma dulciolens*, in situ. Note the elegantly slim stature, with more peaked and darker cap, darker stem about twice the length of the cap diameter.

Tricholoma dulciolens Kytöv. (Figure 2 and cover photo).

A fleshy, long-stemmed mushroom with reddish brown scales covering a whitish background, whose stem length is about twice its cap diameter. **CAP:** 4-12 cm wide, initially inrolled, bluntly but obviously peaked, flattens with maturity but retains a blunt umbo, initially attached to stem by veil, white, covered with reddish brown scales, some browning with age. **GILLS:** White, crowded, notched. **STEM:** 6-20 x 2-4 cm, cylindrical or tapering downwards, white above ring, concolorous with cap ± banded below. **FLESH:** White, with an odour similar to that of *T. matsutake* and *magnivelare*. **SPORES:** Spore print white, size 4.8-6.8 x 4.3-5.8 µm. **ECOLOGY:** Relatively uncommon. Fruits in moss on sandy soil under *Picea*, without pine in NL. Peak fruiting at end of September. **DISTRIBUTION:** Known from Scandinavia, mountainous central Europe and likely across boreal North America, although so far confirmed phylogenetically only from its two sides. **EDIBILITY:** A desirable edible with a complex taste and potential commercial value.

Comment

On the last day of the foray, September 30, 2012, Diane Pelley found three perfect specimens of a new *Tricholoma* in the woods immediately behind the Terra Nova Hospitality Home, close to Terra Nova, NL, growing under *Picea*. GG recognized the species as *T. dulciolens*, a species she knew from her home in Norway. Compared to our *T. matsutake*, this species is more slender and dark, with smaller and scallier caps, and slightly smaller spores, growing with *Picea*, not *Pinus*.

Tricholoma dulciolens was first described from Sweden in 1989.⁸ At the time of our 2012 discovery, it had not been reported from North America. We learned later⁹ that its presence in North America had been deduced (but not published) from genetic matching with sequences deposited in GenBank from a study where the species was identified as *T. caligatum*¹⁰. Very close ITS sequence matches for *T. dulciolens* in North America and Europe have since been published.^{6,11} This is the first time *T. dulciolens* is fully presented and prospectively recognized in North America.

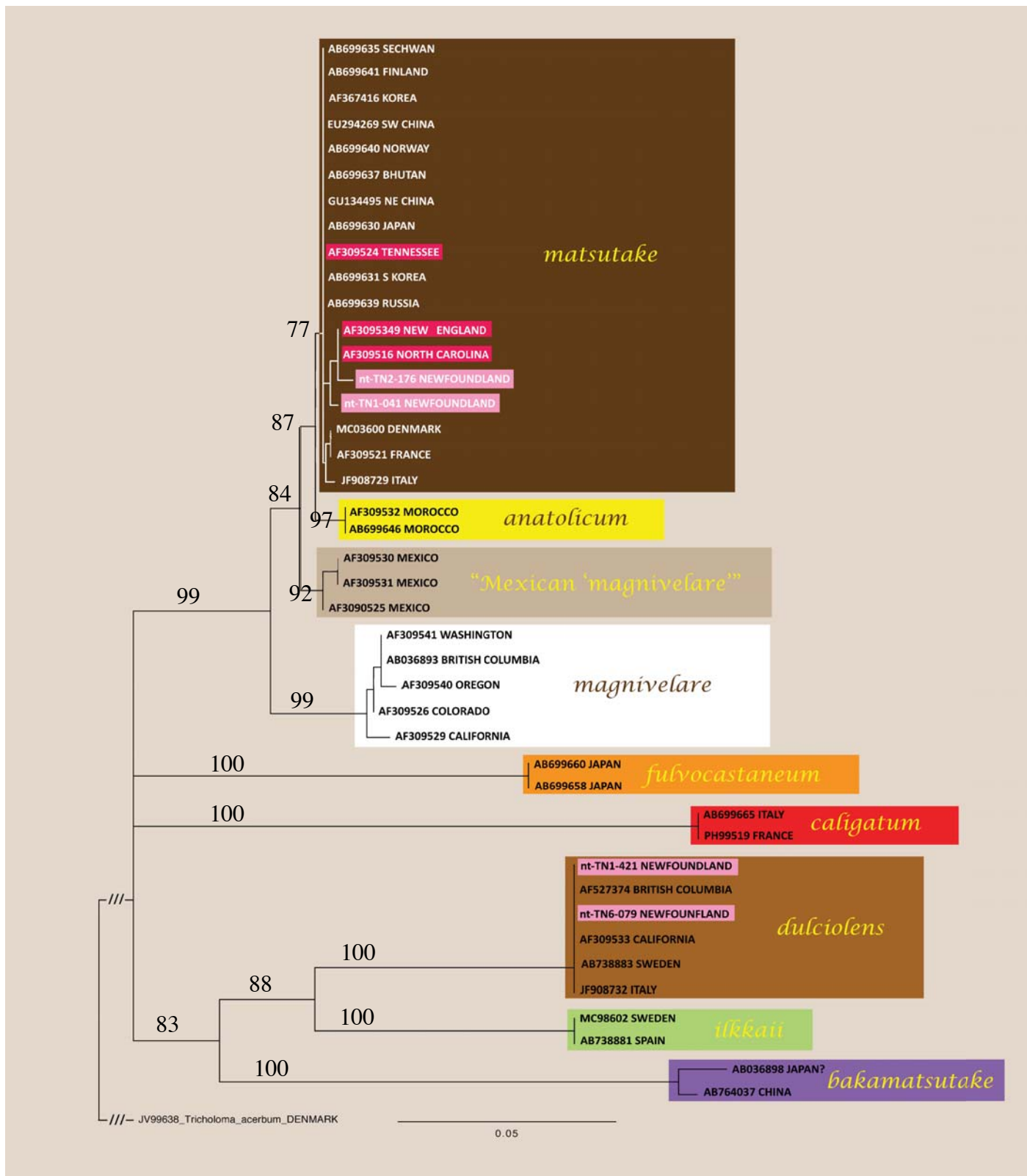


Figure 3. Phylogram of species in sect. *Caligatum* around the world.

Collections are identified by GenBank or other accession numbers, followed by region of origin. Pink background for all NL collections, and red background for all other *T. matsutake* collections from North America. Bootstrap values (%) above node branch.

Our collections nestle in the *Tricholoma matsutake* and *T. dulciolens* clades.

First, a large tree was made from the ITS sequences of all sect. *Caligatum* species listed on the curated UNITE website. To develop the tree shown here, two representatives of each clade were selected, and North American species augmented by

additional collections to show their full geographic extent.

Four species of the section are found in North America: *T. magnivelare* on the Pacific coast, *T. matsutake* in the east, *T. dulciolens* probably across the boreal forest, east to west, and an as yet undescribed species found in Mexico. See also map, Figure 3, next article.

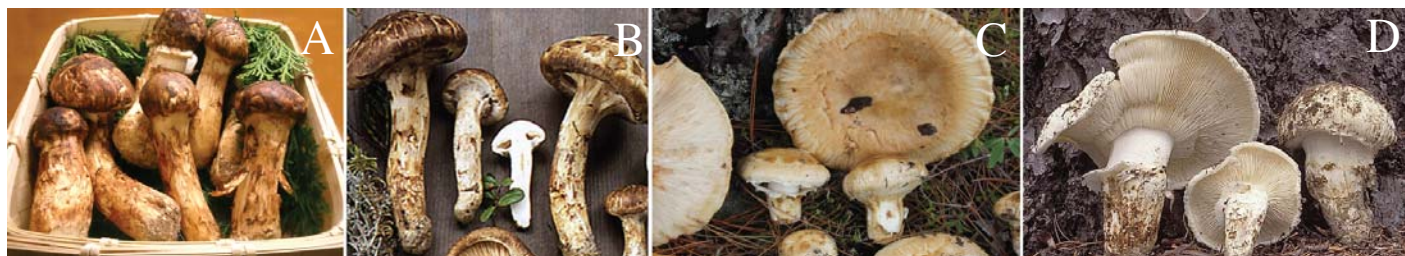


Figure 4. The shades of the *Tricholoma matsutake* cap compared to *T. magnivelare*. A: red brown from Japan (photo: Tomomatsu), B: black-brown from Sweden (photo: H. Marklund), and C: tan-brown from Newfoundland (photo: M. Burzynski), compared to D: the almost pure white *T. magnivelare* cap from the west coast of North America (the brown in the photo is primarily sand, not mushroom colour) (photo: GG). The lighter colour of NL specimens, compared to those found on more easterly continents, is a consistent finding. The difference between the tan mushroom of NL and the white mushroom from the Pacific Coast would be even more obvious here, were the sand brushed off the latter.

		<i>T. matsutake</i>	<i>T. dulciolens</i>
Cap	colour	tan to light brown with medium brown fibrils	red-brown from darker scales on a whitish background
	shape	dome to flat	peaked to flat with umbo
Stem	shape	tapers to base	even or parallel, sometimes tapering
	proportion to cap diameter	approximately equal	longer
Mycorrhizal host		pine ± other conifers	spruce ± other conifers
Spore size (µm)		4.8-6.3 x 4.5-5.3	4.8-6.8 x 4.3-5.8

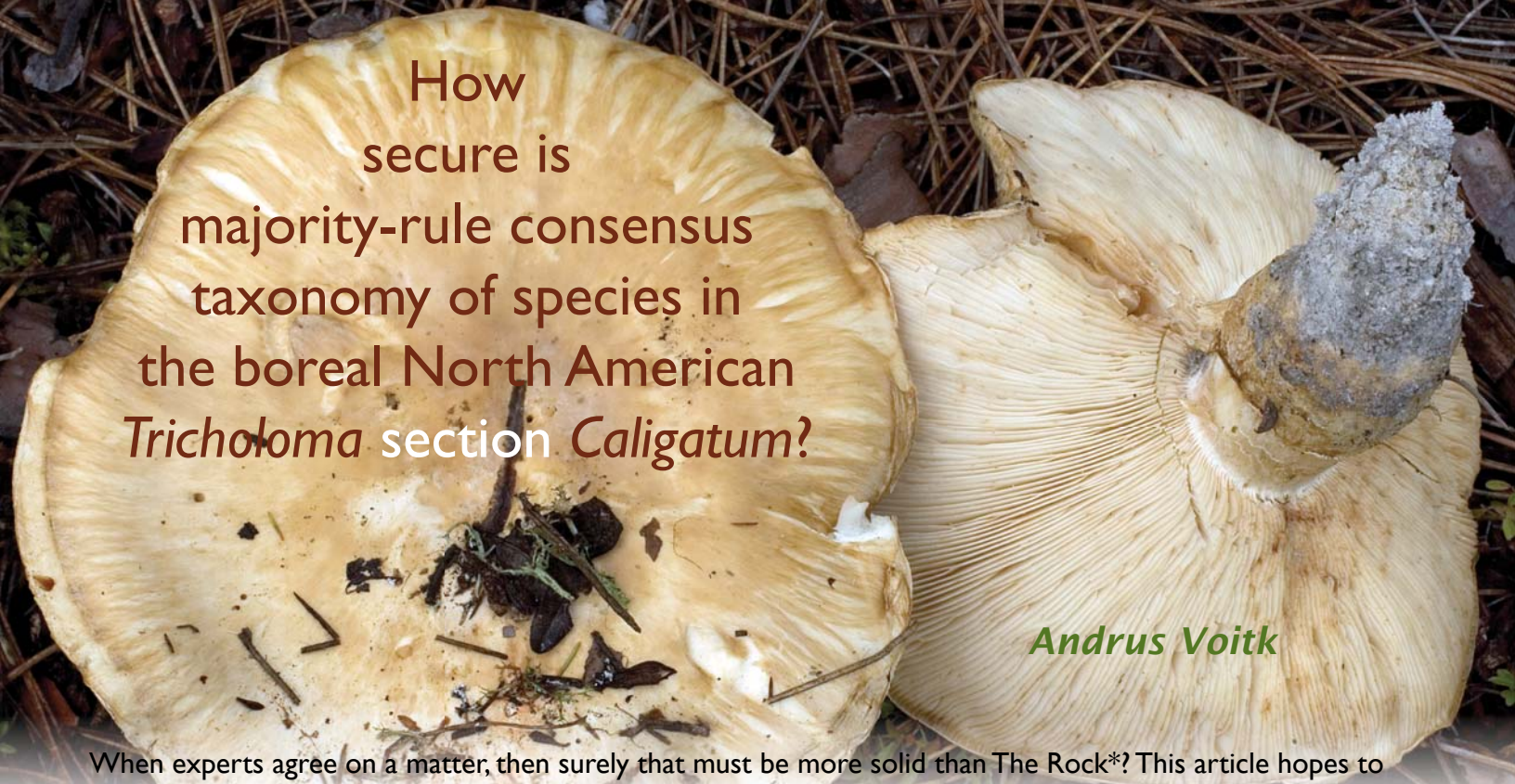
Table 1. Macroscopic identification characters of our sect. *Caligatum* species. Characters listed here refer to the species as they appear in NL, not as they are known elsewhere.

Observation

The names used here correspond with the majority-rule consensus taxonomy, as demonstrated by the naming of sequences in GenBank and UNITE databases and the application of names by Christensen & Heilmann-Clausen.⁶ In other words, there is a general consensus or agreement among taxonomists, mycologists, phylogeneticists and other interested parties that the names we apply to the species we have identified and their relatives, are the “correct” or currently accepted names for these organisms. But see the following article for different views.

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How
secure is
majority-rule consensus
taxonomy of species in
the boreal North American
Tricholoma section *Caligatum*?

Andrus Voitk

When experts agree on a matter, then surely that must be more solid than The Rock*? This article hopes to demonstrate why a respectful irreverence toward authority is a good life philosophy. Or, as Socrates said**, “The unexamined taxonomy is not worth naming.”

The previous article stated that it used majority-rule consensus taxonomy for the North American species in sect. *Caligatum*, as found in UNITE and a recent book, to wit, *Tricholoma matsutake* in eastern North America, *T. dulciolens* across the boreal forest, and *T. magnivelare* on the Pacific Coast. These groups form three well-supported clades on phylogenetic analysis, but are the names currently applied to them by experts*** equally secure? Let us examine them one at a time.

Tricholoma matsutake

One would think that such a highly prized mushroom would have its name well worked out, secure forever. However, one need not delve too deeply into its recent taxonomic past to discover weakness. According to the rules of nomenclature, the first legitimately described name of an organism has precedence. Names given at subsequent descriptions are considered synonyms and subsumed under the original. The first valid description of this mushroom was *Armillaria nauseosa* by A. Blytt in 1905,¹ and later transferred to *Tricholoma* by Kytövuori as *T. nauseosum*.² The mushroom in Asia was described twenty years later as *Armillaria matsutake* by S. Ito and S. Imai,³ and transferred to *Tricholoma* as *T. matsutake* by Singer.⁴ Their synonymy was discovered some years later, and confirmed by nuclear

studies. According to the rules, the later name should be considered a synonym of the earlier one and the species be correctly named *T. nauseosum*. However, in view of the major commercial importance of this mushroom, an appeal to conserve the more appealing name *T. matsutake* was made and adopted. Economics is as nefariously influential in science as it is in other aspects of life.

There is a risk that at a later time more puritanical taxonomists may decide to revert to more strict observance of the scientific rules. An argument from a highly respected senior mycologist might convince the Nomenclature Committee for Fungi that such change is desirable. Authority is almost as nefariously

influential in science as economics—just as it is in other aspects of life.

This minor threat to its name is rather unlikely. But read under *T. magnivelare* to learn why both names, *T. nauseosum* and *T. matsutake*, could disappear altogether!

Tricholoma dulciolens

Our recent find may also come under close scrutiny by the rules of nomenclature, although chances are that it will escape unscathed. It was first described from Sweden by Kytövuori as *Tricholoma dulciolens* in 1988.² However, nine years earlier Smith had described a similar North American taxon, *Armillaria caligata* var. *occidentalis*.⁵ Kytövuori was aware of these earlier descriptions and stated that his *T. dulciolens* “greatly

*Term by which Newfoundlanders and Labradorians refer to Newfoundland.

**He did no such thing.

***Majority-rule consensus nomenclature for this group by non-specialists differs: most people in North America refer to all matsutake-like mushrooms in North America as *T. magnivelare*, and all dulciolens-like mushrooms as *T. caligatum*. Because non-specialists outnumber specialists, true majority-rule consensus nomenclature for this group would be determined by the former.

resembles the American taxon *Armillaria caligata* var. *occidentalis*." Noting some differences between dried material, he declared, "I have thought it best to describe the European material as a new species. Its relationship to var. *occidentalis* needs further research with more material."

Our collections match *Tricholoma dulciolens* from Europe, as well as collections initially identified as "T. caligatum" from California and British Columbia. This increases the likelihood that Smith's var. *occidentalis* will also match *T. dulciolens*. What happens then? Does *T. dulciolens* become a synonym for the earlier taxon? Well, no. The rules give the first validly described species name priority over an earlier variety name. Therefore, even if Smith's taxon were transferred from *Armillaria* to *Tricholoma* and raised to species level, the mushroom first described by Smith will continue to be known as *T. dulciolens*.

We found only a single clade of "Tricholoma caligatum" in North America, but Ovrebo, Hughes and Halling, using material not available from UNITE/GenBak, reported two clades, one from each side of the Continental Divide.⁶ The collections from California and BC are the same as in our series, with which our and the European *T. dulciolens* match. The identity of their eastern clade is of interest, in view of other earlier descriptions of "T. caligatum" taxa in North America, and that of a provisional new caligatoid species in Europe.

Tricholoma magnivelare

At last! Here is a species with a very securely applied name! After all, it is a species exclusive to North America, and all authorities are agreed that this is the species that grows on the Pacific coast. All nuclear studies show that organism to be a good species, distinct from others on the continent. So, its name must be safe, right?

Not so. Note the distribution of

	<i>T. matsutake</i>	<i>T. magnivelare</i>
total	168	28
from NA	5	28
origin known	5	15
west NA	0	15
East NA	5	0

Table 1. Tricholoma matsutake and T. magnivelare collections from the UNITE database, with our 2 T. matsutake added. 5 and 28 collections, respectively, came from North America. We were able to trace the origin of 5 and 15 of these, respectively. All 5 T. matsutake came from eastern NA and all 15 T. magnivelare from the west. The difference in distribution of the two species, as seen with these collections, is statistically extremely significant (p=0.0001). This means that it is extremely unlikely that the difference in observed distribution is due to chance. In other words, it is extremely unlikely that if one of these species is found in the east, it will also be found in the west. Therefore, if Peck described an eastern species as T. magnivelare, it is extremely likely (9,999 to 1) that a similar mushroom in the west is a different species.

these collections on Figure 3. The odds are good that the name, *Tricholoma magnivelare*, currently used for the species of the Pacific coast is misapplied. Charles Horton Peck described a new mushroom species from Copake, NY, as *Agaricus (Armillaria) ponderosus* in 1874,⁷ and corrected that to *Agaricus (Armillaria) magnivelaris* in 1878, because the previous name was taken.⁸ It was transferred to *Tricholoma* as *T. magnivelare* by Redhead.⁹

Data in Table 1 shows that statistically it is extremely unlikely that Peck's species, found in eastern North America, is the same as the species in the west. Rather, it is highly likely that Peck collected a typical eastern North American pale *T. matsutake*. If this were to be confirmed, discussion



Figure 1. Alexander Hanchett Smith, who first described Armillaria caligata var. occidentalis. He may wonder whether Kytövuori's Tricholoma dulciolens will turn out to be the same species. Probably it will.

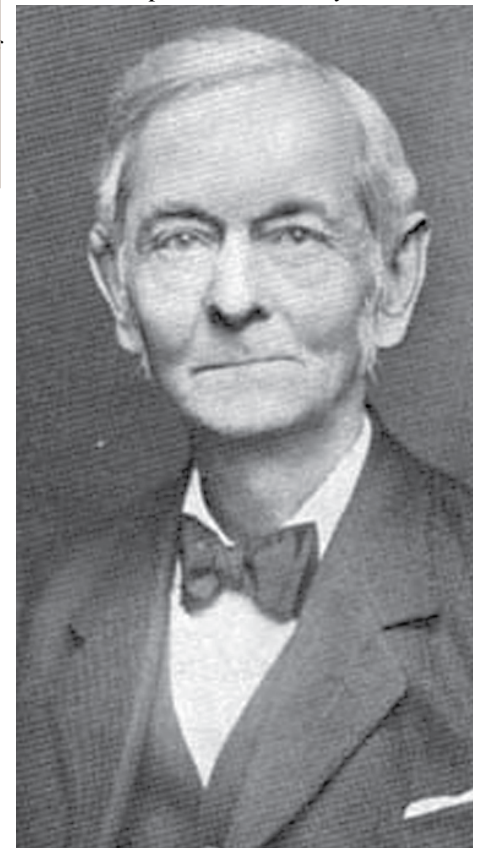


Figure 2. Charles Horton Peck might wonder whether he really found a North American Pacific coast mushroom in New York State. Probably he did not.

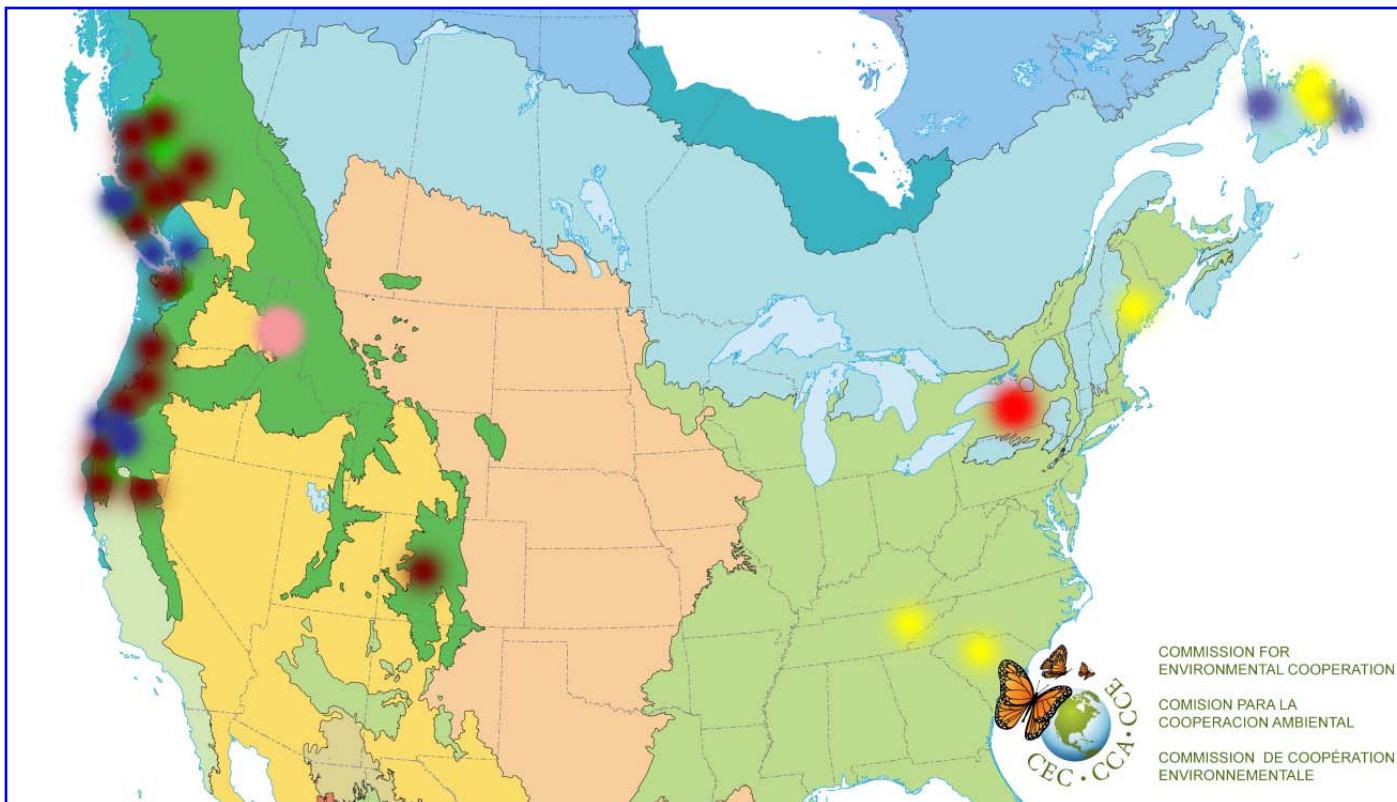


Figure 3. NA distribution of the three boreal species of *Tricholoma* section *Caligatum* in our phylogram, using their current majority-rule consensus names. Map (adapted) of the primary ecoregions of North America courtesy of the Commission for Environmental Cooperation.

Purplish splashes represent the approximate locations of collections of *Tricholoma dulciolens*. The species has been confirmed by sequencing from the east and west

coasts of the continent. Pink splash represents approximate location of Smith's *Armillaria caligatum* var. *occidentalis* type collection.

Brown splashes indicate approximate locations of the species in section *Caligatum* that is limited to the North American west (currently named *Tricholoma magnivelare*). All but one were to the west of the Continental Divide. The exception came from Colorado in a disjunct segment of similar ecoregion (North-

west forested mountain).

Yellow splashes indicate the approximate locations of all known North American collections of the species that matches what is currently known as *Tricholoma matsutake*. All are from the east, with no records west of (or even near) the Mississippi River. Although the number of records is low, it is significant that not one of the very many collections made in the west were of this entity.

The red splash indicates the approximate location of Peck's collection that he named *Armillaria ponderosum*, corrected to *A. magnivelaris*, whose taxonomically correct name is now accepted to be *Tricholoma magnivelare*. What are the odds that study of Peck's type specimen will show it to match the yellow rather than the brown splashes?

I am willing to wager a toonie (a Canadian coin of variable value) that this is so. Any takers?

about the merits of *nauseosum* vs. *matsutake* becomes moot. Peck's description predates all other descriptions of the species, and according to the rules, the tasty and lucrative mushroom of Eurasia and eastern North America, including our fair province, should then become known as *T. magnivelare*. Were that to happen, the similar mushroom in western North America that has up to then also used the name *T. magnivelare*, would now become nominally orphaned, hoping for adoption by an epithet with longer

staying power. Fortunately, there is at least one waiting in the wings.

In 1912 William Alphonso Murrill (Figure 4) reported a new mushroom, *Armillaria arenicola*, on the Pacific coast.¹⁰ Assistant director of the New York Botanical Gardens at the time, Murrill knew Peck's *Armillaria magnivelaris*, and remarked on the similarity of that species to his new sand-dwelling (=arenicola) species. By the time it was recognized to be a *Tricholoma*, the name *T. arenicola* was no longer available. Rolf Singer (Figure 5) transferred

it to *Tricholoma* with a new name, *Tricholoma murrillianum*, to make sure that history recognized that the species was first described by Murrill, not him.¹¹ As we say in NL, "proper thing."

Conclusions

If these suspicions are right, the revised taxonomic landscape could look like this:

1. There is a good likelihood that *Tricholoma dulciolens* will prove to be the same species as Smith's *Armillaria caligata* var. *occidentalis*.

This can be confirmed by examining Smith's type species. If it matches *T. dulciolens*, Smith would be recognized as the first to describe the species. A new combination to *Tricholoma* (as *T. caligatum* var. *occidentalis*) and elevation to species level (as *T. occidentalis*), with a special appeal to reinstate Smith's epithet may bring about a change in name. The best chance for such an appeal to succeed, would be its proposal by Ilkka Kytövuori. Barring that, the name *T. dulciolens* is likely to remain, and due to a technicality the man who first described it will not be associated with its name.

The nature, placement and relationship of the second (eastern) *caligatum* clade reported by Ovrebo and coworkers⁶ remains to be seen.

2. There is a good likelihood that *Tricholoma magnivelare*, described by Peck, will prove to be the eastern North American species of sect. *Caligatum* that we now know as a pale *T. matsutake*. This can be confirmed by examining Peck's type species. More analyses with a multigene technique should show whether it is *T. matsutake* or a species derived from *T. matsutake*. If the former, the species hitherto known as *Tricholoma matsutake* (= *T. nauseosum*) should be corrected to *T. magnivelare*, and the Pacific coast species hitherto known as *T. magnivelare* should be renamed. If it turns out to be a derived species, the same applies, except that the Eurasian *T. matsutake* will be able to keep its name.
3. There is a good likelihood that the species described by Murrill as *Armillaria arenicola*, and subsequently renamed by Singer as *Tricholoma murillianum*, is the sect. *Caligatum* species of the Pacific coast, presently erroneously known

as *T. magnivelare*. This can be confirmed by examining Murrill's type specimen. If it matches the Pacific coast species (and differs from Peck's type species), what has hitherto been called *T. magnivelare* should be corrected to *T. murillianum*.

Acknowledgments

These speculations would not be possible without the work of my coauthors in the previous article. Especially vital to this speculation is the work of Tobias Frøslev, who created a phylogeny for section *Caligatum* from all sequences available in UNITE. Tobias also contributed the concept of majority-rule nomenclature to the results of the previous article. I am indebted to all my previous coauthors for spirited discussion of this article. While recognizing their contribution to the present speculations, should my speculations prove erroneous, the responsibility rests with the speculator, not those whose work provided the seed.

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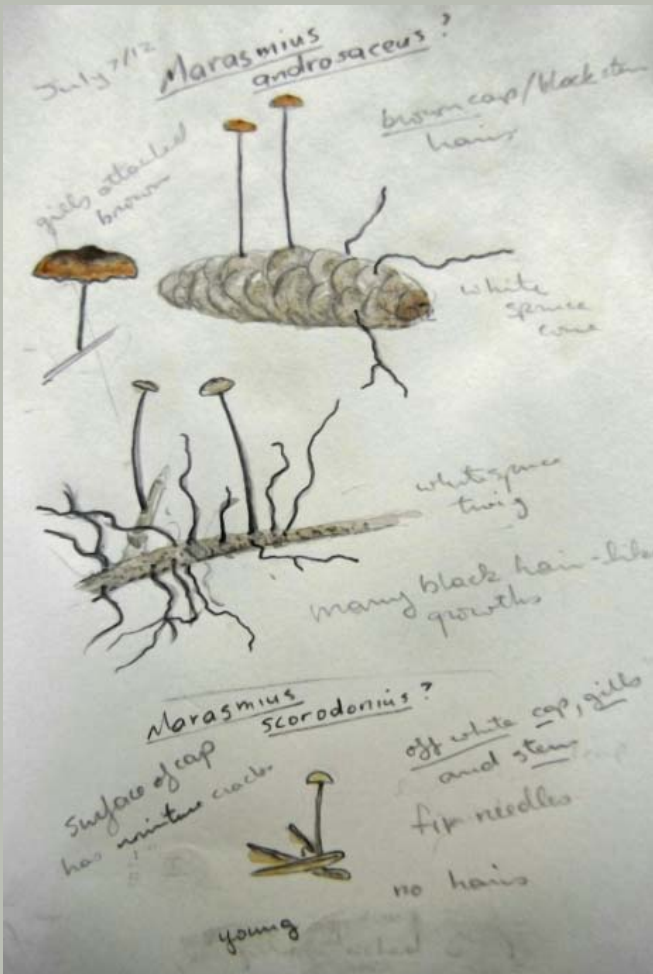
Figure 4. William Alphonso Murrill. Public domain photo from the internet. Murrill described the sand-dwelling *Armillaria arenicola* on the Pacific coast and thought it different from the similar *Armillaria magnivelaris* described by Peck. He should be greatly pleased at the honourable way Rolf Singer solved the taxonomic problems presented by the name.



Figure 5. Rolf Singer, grinning over a bouquet of shimeji. Photo courtesy of Gary Lincoff. When he learned that Murrill's *Armillaria arenicola* was a *Tricholoma*, but that the name *T. arenarium* had already been used, Singer renamed it *Tricholoma murillianum*, to ensure Murrill be recognized as the first to describe the species.



The Bishop's Sketchbook





New trichs for Newfoundland

Steve Trudell, Gro Gulden

The 2012 Foray Newfoundland-Labrador (FNL) was notable for the welcome abundance of mushrooms in and around Terra Nova National Park [Foray Report: *OMPHALINA* 3(12)]. With the event occurring a bit later than normal, the well-stocked display tables contained quite a number of species that fruit toward the end of the season, including an abundance of tricholomas—about 30 different ones, in fact (Table 1). This is particularly impressive when one considers that the cumulative FNL list for 2003 through 2011 contained only 28 species of *Tricholoma*.

Unfortunately, *Tricholoma* is one of many genera that have not been sufficiently studied in North America, even though most tricholomas are relatively large conspicuous mushrooms. Thus, many *Tricholoma* species concepts are not well defined or widely understood, and so many of the species are not well known. This is due in large part to the fact that most of the features used to define the species are gradational ones, and often rather subtle ones. For instance, one important character in many groups of *Tricholoma* is whether the cap surface is shiny (e.g. *T. portentosum*) or matte (e.g. *T. terreum*). In moist weather the shiny species are viscid while the matte ones are not. In addition, until recently, readily available literature and images for North America have been lacking, so identifying tricholomas has often been difficult and sometimes impossible.

Since the foray, the situation has been improved by the appearance of three new *Tricholoma* books. Two are European (*The Genus Tricholoma*

by Christensen & Heilmann-Clausen, and *The Genus Tricholoma in Britain* by Kibby) and one is North American (*Tricholomas of North America: A Mushroom Field Guide* by Bessette, Bessette, Roody and Trudell).

Even with these valuable new resources, it still is hard to know whether the North American fungi to which we apply European names really ought to carry those names. Perhaps our species are different and deserve names of their own. Molecular methods have begun to address this problem, and some results, including a preliminary phylogenetic tree for *Tricholoma* based on ITS data, are provided in the book by Christensen & Heilmann-Clausen. However, until expanded molecular data are available for a wider range of species, we stick to a more pragmatic grouping of the species. In this and the accompanying articles about the local matsutake complex, we will deal with the tricholomas, or *Tricholoma* names, that were recorded for the first time during the 2012 foray. Our

approach will be to refer each new species name on the list to one of the following five groups within *Tricholoma*—the “gray ones,” “brown ones,” “colorful ones,” “whitish ones,” and a “miscellaneous” group—highlighting features that characterize the new species for the group. These informal, or “artificial,” groups are often used for convenience in *Tricholoma* literature but, in many cases they do not reflect the likely evolutionary relationships among the species. But first, let’s briefly review what makes a tricholoma a tricholoma.

The current concept of *Tricholoma* differs little from Elias Fries’s 1820’s view of it—fleshy terrestrial mushrooms with a white spore-print and (mostly) notched (or sinuate or emarginate) gill attachment (Figure 1). However, many species that Fries would have considered to belong in *Tricholoma* have been moved to other genera based largely on microscopic features. Thus, all remaining trichs have smooth, non-amyloid spores and parallel gill trama. The typical

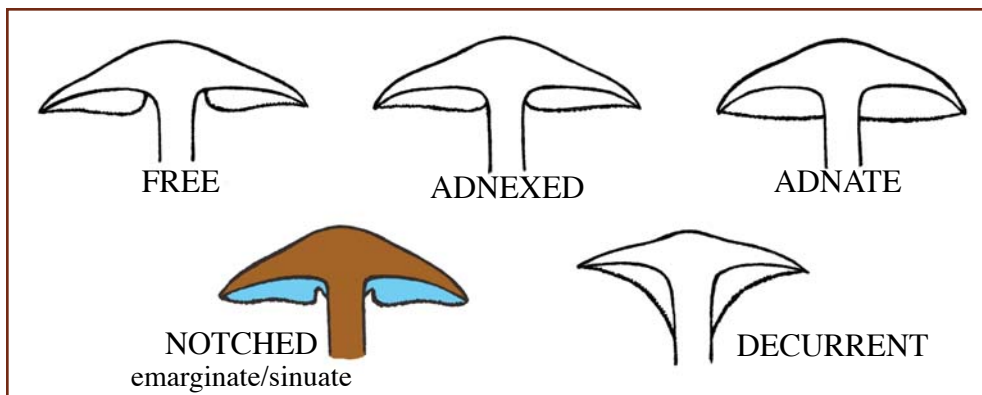


Figure 1. Examples of gill attachment types.

Illustration: Marsha Mello.

tricholoma stature features a broadly umbonate cap that is often quite wide relative to the length of the stem, and a “gutter” around the stem formed by the notched gills. While most trichs lack rings and veils, some do have a well developed ring and others have a thin partial veil (cortina), at least when young. Many have a distinct border between a white zone at the top of the stem and the more or less cap-colored lower part, indicating that a continuous coating of cap and stem existed in young fruitbodies. Because the genus concept now is based in part on microscopic features (mostly their absence), sometimes it is necessary to use a microscope to be certain that you have a species of *Tricholoma* and not a species of *Tricholomopsis*, *Melanoleuca*, or another similar genus.

Now, let’s look at the new-for-Newfoundland trichs. As Table 1 shows, there were 11 new species identified in 2012:

- Tricholoma albobrunneum*
- T. apium*
- T. arvernense*
- T. atrodiscum*
- T. columbetta*
- T. dulciolens*
- T. guldeniae*
- T. cf. nigrum*
- T. roseoacereum*
- T. terreum*
- T. viridilutescens*.

As you will see, not all of them may actually represent new species for the province.

Table 1. *Tricholomas* identified to date by Foray Newfoundland & Labrador. Species new to the cumulative list are marked with a pink X. These are the species described in this article.

Species	Authority	FNL 2003-2011	FNL 2012
Gray Group			
<i>Tricholoma atrodiscum</i>	Ovrebo		X
<i>Tricholoma atosquamosum</i>	(Chevalier) Saccardo	X	
<i>Tricholoma myomyces</i>	(Persoon) J.E. Lange	X	
<i>Tricholoma cf. nigrum</i>	Shanks & Ovrebo		X
<i>Tricholoma pardinum</i>	(Persoon) Quélet	X	
<i>Tricholoma portentosum</i>	(Fries) Quélet	X	
<i>Tricholoma sculpturatum</i>	(Fries) Quélet	X	
<i>Tricholoma terreum</i>	(Schaeffer) P. Kummer		X
<i>Tricholoma</i> sp. “unearthly”		X	X
<i>Tricholoma virgatum</i>	(Fries) P. Kummer	X	X
Brown Group			
<i>Tricholoma albobrunneum</i>	(Persoon) P. Kummer		X
<i>Tricholoma caligatum</i>	(Viviani) Ricken	X	
<i>Tricholoma dulciolens</i>	Kytövuori		X
<i>Tricholoma flavobrunneum</i>	(Fries) P. Kummer	X	
<i>Tricholoma focale</i>	(Fries) Ricken	X	X
<i>Tricholoma fulvum</i>	(Bulliard) Saccardo	X	X
<i>Tricholoma imbricatum</i>	(Fries) P. Kummer	X	X
<i>Tricholoma inodermeum</i>	(Fries) Gillet	X	
<i>Tricholoma matsutake</i>	(S. Ito & S. Imai) Singer	X	X
<i>Tricholoma pessundatum</i>	(Fries) Quélet	X	X
<i>Tricholoma stans</i>	(Fries) Saccardo	X	X
<i>Tricholoma transmutans</i>	Peck	X	X
<i>Tricholoma ustale</i>	(Fries) P. Kummer	X	
<i>Tricholoma vaccinum</i>	(Schaeffer) P. Kummer	X	X
Colorful Group			
<i>Tricholoma arvernense</i>	Bon		X
<i>Tricholoma davisiae</i>	Peck	X	X
<i>Tricholoma equestre</i>	(Linnaeus) P. Kummer	X	X
<i>Tricholoma flavum</i>	P. Kummer	X	
<i>Tricholoma fumosoluteum</i>	Peck	X	X
<i>Tricholoma guldeniae</i>	Mort. Christensen		X
<i>Tricholoma intermedium</i>	Peck	X	
<i>Tricholoma leucophyllum</i>	Ovrebo & Tylutki	X	
<i>Tricholoma luridum</i>	(Schaeffer) P. Kummer	X	
<i>Tricholoma subsejunctum</i>	Peck	X	X
<i>Tricholoma viridilutescens</i>	Moser		X
White Group			
<i>Tricholoma columbetta</i>	(Fries) P. Kummer		X
<i>Tricholoma inamoenum</i>	(Fries) Quélet	X	X
Miscellaneous Group			
<i>Tricholoma apium</i>	Jül. Schaffer		X
<i>Tricholoma roseoacereum</i>	A. Riva		X
<i>Tricholoma saponaceum</i>	(Fries) P. Kummer	X	X

Gray Group

The following species of the gray group had been reported prior to the 2012 foray: *T. atosquamosum*, *T. myomyces*, *T. pardinum*, *T. portentosum*, *T. scalpturatum*, *Tricholoma* sp. "unearthly" and *T. virgatum*. The newly added names are *T. atrodiscum*, *T. cf. nigrum*, and *T. terreum*.

Tricholoma atrodiscum

T. atrodiscum is a little-known dark scaly species that occurs in eastern Canada and perhaps beyond, primarily with conifers. Its gills often have a somewhat pinkish cast and its taste is very bitter.

FNL collection
TNI-265. Photo:
Roger Smith, #9301.



Tricholoma cf. nigrum

The name, *T. nigrum*, was applied to our several collections of this mushroom based on ST's West Coast familiarity with that species. The cap of *T. nigrum* usually starts out nearly black and becomes lighter as it expands. The surface is usually a bit scaly and can also be a bit streaky, but not nearly as much as in *T. virgatum*. The stem and gills lack the yellowish discolorations typical of *T. portentosum*.

Its odor and taste are strongly farinaceous (mealy or somewhat like watermelon rind or cucumber). Microscopically it has a distinctive layer of more or less



soap-bubble-like cells that underlies the cap cuticle. It is a conifer associate, so far only found on nutrient-poor, often sandy, soils. Originally described from Oregon, it has also been found in California and Washington. Thus, finding it in Newfoundland would extend its range from one side of North America to the other. Quite a leap!

However, further post-foray microscopic examination of some of the FNL specimens showed that the spores were not quite right for *T. nigrum* so, for the time being,

we are qualifying our identification with a "cf.," which stands for the Latin "confer" here meaning "compare with." This could be the same species that has been called "unearthly trich" on the FNL list and/or "*T. pseudoterreum*" in Québec.

We hope to continue working on this apparently common mushroom to confirm our tentative identification or provide a proper name for it.

Photo: ST, FNL collection TN2-241.



Tricholoma terreum

Here we are cheating a little. European mycologists hold differing opinions about the taxonomy of the trichs with a gray to brown, somewhat wooly-scaly cap, and grayish gills, including *T. terreum* and *T. myomyces*. Some feel there are two (or more) species whereas others, like the authors of the latest *Tricholoma* monograph (Christensen & Heilmann-Clausen) think there is only one. Those who believe that *T. terreum* and *T. myomyces* are separate species claim that the latter has a cobwebby partial veil (cortina) when young, whereas the former lacks a partial veil at all stages. All of the mushrooms in this bunch have

mild to slightly farinaceous odor and taste, and some are considered a delicacy in Europe. *Tricholoma terreum* occurs with conifers whereas other similar species, mostly those with white gills that stain yellow, occur with broadleaved trees.

The reason we are cheating is that in 2003-2011 this species was listed as *T. myomyces*, and, in 2012 we used *T. terreum* for (what is likely) the same species. The foray list has been updated, now calling all of them *T. terreum*.

Photo: A. Voitk, Stuckless Pond trail, Gros Morne National Park, 22 Oct, 2012.

Brown Group

The following species of the brown group had been reported prior to the 2012 foray: *T. caligatum*, *T. flavobrunneum*, *T. focale*, *T. fulvum*, *T. imbricatum*, *T. inodermeum*, *T. matsutake*, *T. pessundatum*, *T. stans*, *T. transmutans*, *T. ustale*, and *T. vaccinum*. The newly added species are *T. albobrunneum* and *T. dulciolens*.



Tricholoma albobrunneum

T. albobrunneum is one of a number of reddish-brown-capped species with more or less viscid caps. The species is best recognized by its radially fibrillose cap, the white zone at stem apex compared to the rest of the stem, which is brown fibrillose, and its occurrence with pines. Often it gets confused with other brown pine-associated species like *T. pessundatum* and *T. stans*, but the caps of these species are larger, not fibrillose, and are of a paler, more pinkish brown (note the reliance on gradational characters for telling them apart). In addition, the stems

of the latter two species are predominantly white with delicate brown fibrils. Still another brown pine-lover is *T. batschii*, called *T. fracticum* in the new North American book. It differs from the other three by having a partial veil, which can form a thin membranous ring when young. All of these have white or whitish flesh, which distinguishes them from species such as *T. fulvum* in which the flesh is at least somewhat yellowish.

FNL collection TNI-082. Photo: Roger Smith, #8380.

Tricholoma dulciolens

T. dulciolens is a slender-statured member of the matsutake group that was found quite near our lodgings on the final day of the foray. Given the great interest in matsutakes, we dealt with this species in a separate article on p. 5. Here is a small picture as a reminder.

FNL collection TN6-079. Photo: Roger Smith, #9902.



Colourful Group

The following species of the colourful group had been reported prior to the 2012 foray: *T. davisiae*, *T. equestre*, *T. flavum*, *T. fumosoluteum*, *T. intermedium*, *T. leucophyllum*, *T. luridum*, and *T. subsejunctum*. The newly added names are *T. arvernense*, *T. guldeniae* and *T. viridilutescens*.



and now, in a leap across the continent, Newfoundland. It is a conifer associate in the group of species similar to *T. sejunctum*, a species that occurs with broadleaved trees in southern Europe. The deep golden cap with brownish, not blackish, fibrils and a stem that often is enlarged in the middle and may be reddish stained at the base, distinguish *T. arvernense* from other species in the group.

Tricholoma arvernense

T. arvernense is a European species that only recently has become recognized in North America. Initially identified through DNA analysis of a collection made in Idaho, it has since been found in Alaska, Washington, California,

Upper photo: ST, Alaska;
lower: Roger Smith, #9827, FNL collection TN3-063.



Tricholoma guldeniae

This is another case where we are adding a name, but, again, probably not increasing the species count. *T. guldeniae* is another member of the *T. sejunctum* group and is somewhat similar to *T. arvernense* (see above) but paler yellowish, with grayish fibrils. It is more slender and sometimes develops small, bright violet stains (as on the stem of the specimen to the right). Named in honour of one of 2012's guest foray mycologists and co-author of this article, it would have been wonderful to

add this species to the FNL list. Unfortunately, although the material (one old battered mushroom) seemed to represent *T. guldeniae*, its condition made it too risky to add the name to the official list. Thus, this is a good candidate for FNL's most-wanted list. Previously *T. guldeniae* was known as *T. luridum*, a name that is already on the list, so chances are great that the species does occur in Newfoundland and all we have done is correct a name.

Photo: GG, Norway.

Tricholoma viridilutescens

T. viridilutescens is another member of the *T. sejunctum* group. Described from Europe, it grows with conifers and has a viscid-shiny cap that is almost black at the center, black fibrillose over the rest, with bright yellow shades towards the margin. The gills are often serrate and stain yellowish near the cap margin. This name must be considered tentative as detailed comparisons between North American and European material have not been done. This is another case of a new name, not a new species: on the FNL list it has appeared with an earlier North American name, *T. subsejunctum*.

Photo: ST, Alaska



Whitish Group

Only one species in the whitish group had been reported prior to 2012, *T. inamoenum*, and only one new species, *T. columbetta*, was added.



Tricholoma columbetta

T. columbetta is a medium-sized, all-white European species with a distinct farinaceous odor and taste. It is usually found with oaks, beech, or birch and occasionally develops bright bluish or greenish stains at the base of the stem. Although it has often been reported from North America, this is one of many cases where a European name has been applied without careful comparison of material from the two continents. However, preliminary DNA analysis of a collection identified as the all-white, eastern North American

T. subresplendens, found it to be extremely similar to *T. columbetta* collections from Europe. So, for now, it appears we are justified in calling the NL mushroom *T. columbetta* as it is the earlier name.

Apart from the pale colour, *T. columbetta* has little in common with the other reported species of the whitish group, the stinking *T. inamoenum*.

Photo: ST, North Carolina.

Miscellaneous Group

Only one species in the miscellaneous group had been reported prior to 2012: *T. saponaceum*. The newly added species are *T. apium* and *T. roseoacereum*.

Tricholoma apium

T. apium is little known in North America, although it is very distinctive and occurs widely across the northern part of the continent. Again, this is a European name and we need a confirmation of the identity of North American and European species. Its distinguishing characteristics are the yellowish brown, woolly cap surface that cracks like dried mud and the strong celery- or curry-like odor. Young specimens erupt from the ground almost white, then discolor yellow, and finally turn brown. In Europe, it occurs mainly in dry heath forest under pine. In North America, it has been found with various conifers in British Columbia, Washington, Michigan, Massachusetts, and now Newfoundland.

Upper photo: ST, Washington State. Lower photo: Roger Smith, #9205, FNL coll. TN2-222.



Tricholoma roseoacereum

T. roseoacereum is a more pinkish-capped version of *T. acereum*, both of which were described from Europe. Except for a bitter taste, it is a fairly nondescript conifer associate whose more distinctive characteristics are its very crowded gills, short stocky stature with the cap wider than the height of the stem, and the margin of the cap, which remains inrolled well into maturity. These characters are all shared with *T. acereum* which, however, most often has a ribbed cap margin and occurs with hardwood.

Photo: ST, FNL coll. TN1-014.



THE MAIL BAG

OR WHY THE PASSENGER PIGEONS ASSIGNED TO SERVE THE
LAVISH CORPORATE AND EDITORIAL OFFICES OF *OMPHALINA* GET HERNIAS

Thank you for the *Gymnopus* issue and congratulations on the new species. Very beautiful photos and informative content. Very. Your foray dates were not the best for us this year and we had planned to give it a miss. But seeing that Gros Morne was one of the few places where the new species was collected at foray time, we have rescheduled our activities and signed up, hoping to see this new species in its home grounds.

Ed comment: That is the sort of dedication we like to see! A beacon and shining example to others you are. And, yes, the odds are good that you could meet this new species this year, introduced by somebody familiar with its good, if somewhat retiring, looks.

I missed meeting the famous Newfoundlandian naturalists Crow, Moose and Vixen while at your foray in 2012, and only came upon their article about lady's-slippers and fungi now (*OMPHALINA*, 4(6):4). I was unable to find their e-mail addresses and I don't do Facebook, so perhaps you can pass a message along ...

I applaud their efforts to understand what in the world is going on among fungi and plants. But I caution them not to jump too quickly onto the "ash trees supporting orchid plants" notion. Now, it could well be true (and that would please me). But having the same fungus present in the roots of orchids and ashes is necessary, but not sufficient to conclude that the fungus is providing a functional link. That requires additional work (which the critters somewhat acknowledged, but still their dialogue left the impression that a link had been found).

First, the finding of an AM fungus in the orchid is unusual—not sure if I have heard of it before. So I would first make sure the field collectors had the proper roots. Assuming they did, then next question would be whether said roots exhibited the features of AM, such as arbuscules. Ditto for the ash roots.

Second, the orchid has green leaves and so is capable of photosynthesis. So one would question whether it needs support from fungi after the germination and establishment phases. It's not obvious that it would need support, but current thought is that many of the green species are likely to be mixotrophic, with a portion of their carbon coming from associated fungi—which to date have been found to be predominantly (exclusively???) ectomycorrhizal species. Presumably they change their fungi from Rhizoctonia types during germination and establishment to ecto types as they mature (or at least add the latter ones).

Third, even if a connection can be verified, then one would need to demonstrate that it is functionally important to the plants, another not-so-easy thing to do.

Hopefully their friend the Perfesser and Zoe the student will tackle this daunting challenge and add another example to the list of fungus networks in nature.

Cheers!

Steve Trudell, the Seattle Skeptic

Yes, the finding of AMF in orchid roots was indeed a surprise, but was supported with microscopic observations of what appear to vesicles (which, I agree, could be ???), but not arbuscules, in both sets of roots. But wait, it gets worse. Both roots also had sequences of ECTOMYCORRHIZAL fungi, which as you say is no surprise for the orchid, but was unsettling regarding the ash, which has been discounted by authorities greater than me as non-ecto, AMF only. What we cannot say is that any of these fungi were FORMING their mycorrhizae in said roots, only that their sequences were present in DNA extracts of washed roots, carefully collected and packaged and extracted separately.

Is one plant supporting the other? Maybe not as an adult, as you say, but support in youth may also help explain the distribution of these orchid plants in the field—conspicuously surrounding black ash trees as Vixen pointed out.

As with many stories, it is an interesting one but one that I would hesitate to announce as solved just yet.

Perfesser Greg Thorn

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