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Mar. 19, 2014

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

Gomphidius borealis, Change Islands Ferry Terminal, September 5, 2013. This species was described over 20 years ago, but has not been reported since. The lead article discusses how an analysis of our *Gomphidius* species revealed that this "lost" species is actually the commonest species of *Gomphidius* in Newfoundland and Labrador.

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CONTENT

Message from the Editor

Welcome to spring!

A few days before the equinox, but close enough. It has been a tough winter here with a lot of snow and cold, but now comes the best time of the year. Then, a little mud, and then the morels.

Which reminds us:

VOTE TO NAME OUR TWO UNNAMED MORELS!

We have had some votes, but not nearly as many as we had hoped. This is your chance to name our own mushrooms, so help out! Review the February issue for details about the names and how to vote. Everybody is eligible. We need a lot more votes to make it meaningful.

And when the morels come, please remember to collect some and send us specimens from around the province. One of the advantages of having a club of amateurs interested in mushrooms, is the ability to collect far more and wider than any single individual, to get a much better overview of any species of interest in the province.

We said in the last issue that this issue would outline details of the 2014 Foray. Guess we were a bit too anxious, because a few details remain to be worked out yet. In the past we have announced the Foray and opened up registration in April, and so it shall be this year as well. Therefore, set aside the dates, as shown on the back cover, and be ready to register next month.

Meanwhile, enjoy the story of the rediscovery of *Gomphidius borealis*, our commonest *Gomphidius* species. We are prepared to bet a toonie that the species is common elsewhere as well, and, just as here, has simply been subsumed into a wider concept of *G. glutinosus*.

And another history-making moment: on page 19 you will find the first advertisement in Omphalina. We have not carried ads before, but the increased need for Cognac and other fine industrial oils to lubricate the printing machines in the Editorial Suites has forced our hand in an effort to recoup some of the losses.

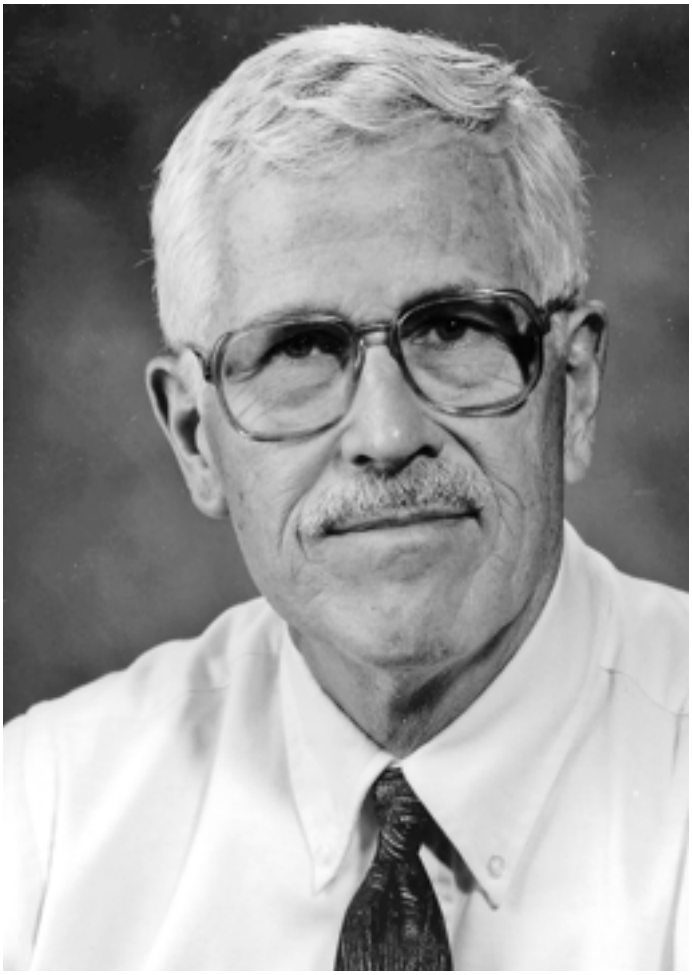
See you at the Foray!

andrus

Gomphidius in Newfoundland and Labrador *with a* redescription of *Gomphidius borealis*

M. Catherine Aime, Andrus Voitk

Dedicated to the memory of Orson Miller (1930-2006), doctoral supervisor to MCA. Since his own doctoral dissertation,[1] Miller repeatedly returned to the genus *Gomphidius*, and together with MCA and Ursula Peintner, first described *Gomphidius borealis* some 20 years ago,[2] a species that has not been reported since—until now.



Our *Gomphidius* collections have caused repeated trouble with visiting faculty at the forays. For one thing, their colour tends to be more pinkish (or at least less dusky blue-gray-purple) than is acceptable for the *G. glutinosus* label we have tried to pin on them. One of us (AV) decided to call the really pinkish ones *G. subroseus*, until Michael Beug told him that he (Michael) knows *G. subroseus* (Figure 1), and this was not it! AV then tried *G. roseus*, but when his grandson introduced him to the real *G. roseus* in Norway (Figure 2), he knew that it did not fit either. He gave up and considered our pinkish ones to represent the pink end of the *G. glutinosus* spectrum. However, this was never accepted by Gro Gulden, who told him this was no *G. glutinosus*!

In desperation AV turned to the senior author, who had done some work on this genus during her postgraduate studies, and asked her whether she would like to study ours to prevent further vexation to our faculty. This turned out to be a most felicitous decision.

Of 33 Newfoundland *Gomphidius* collections studied, 23 were of sufficient material for DNA sequencing, allowing molecular confirmation of three species: 16

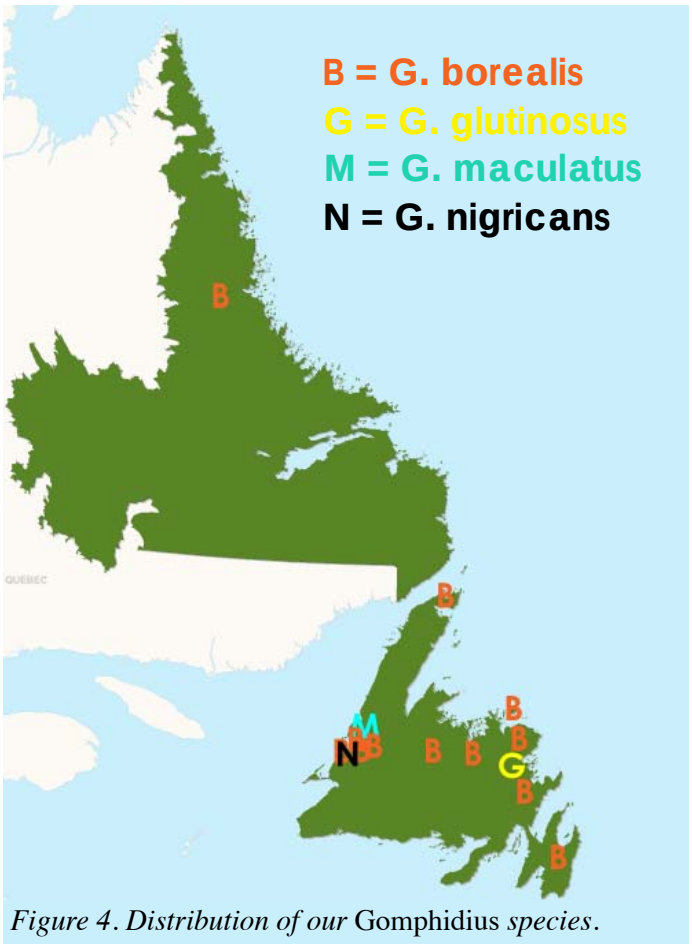


Figure 4. Distribution of our Gomphidius *species.*

Figure 1. Gomphidius subroseus *from Oregon. Beautiful, but definitely not our mushroom. Photo: Michael Beug*

of these were identical to *Gomphidius borealis*, six to *G. glutinosus*, and one to *G. maculatus*. Comparing the photographs of sequenced *G. borealis* and *G. glutinosus* specimens revealed consistent macroscopic identifying characters for each species. For *G. borealis*, these findings were confirmed in vivo on four collections made in 2013. These morphological characters were subsequently used to identify an additional nine collections, seven as *G. borealis* and two as *G. glutinosus*. A tenth collection that had been identified as *G. nigricans* years ago in the field, had, unfortunately, been mislaid. Although this identification must be considered tentative, extant photos of the collection fit well with published descriptions of this taxon. The final tally of our *Gomphidii* is shown in Table 1, and a phylogenetic tree of the ITS locus is shown in Figure 3.

Gomphidius borealis	23
Gomphidius glutinosus	8
Gomphidius maculatus	1
Gomphidius nigricans	1

TABLE 1. DISTRIBUTION OF TOTAL STUDIED COLLECTIONS OF *GOMPHIDIUS* IN NL

These results provided a very pleasant surprise to MCA, who had described *G. borealis* with her supervisor some 20 years ago, based on three collections from Siberia.[2] To her knowledge, the species had not been reported or described since, and was presumed to be confined to Russia. The hitherto elusive *G. borealis*, by far the most common species collected in NL, was collected from all over the province (Figure 4). No wonder our faculty was annoyed with our strange *Gomphidius* "glutinosus"! However, a little detective work shows that *G. borealis* had been positively identified from Konrad Brook, Labrador, by Esteri Ohenoja in 2008, with copies deposited at the University of Oulu.[3] Unfortunately this event eluded recognition locally until the present study brought the species to the forefront.

Although *G. glutinosus* makes up 24% of the collections studied, all came from one frequently surveyed site. It is not currently known from elsewhere in the province, and must be considered as uncommon.

The opportunity to examine several collections of *G. borealis* allows us an opportunity to redescribe its characteristics with a broader range of material than permitted by the three collections on which the original description was based. Unless otherwise noted, descriptions are based on local findings.

Figure 2. Gomphidius roseus *under Scots pine in Norway. Again, beautiful, even if overexposed, but definitely not ours.*

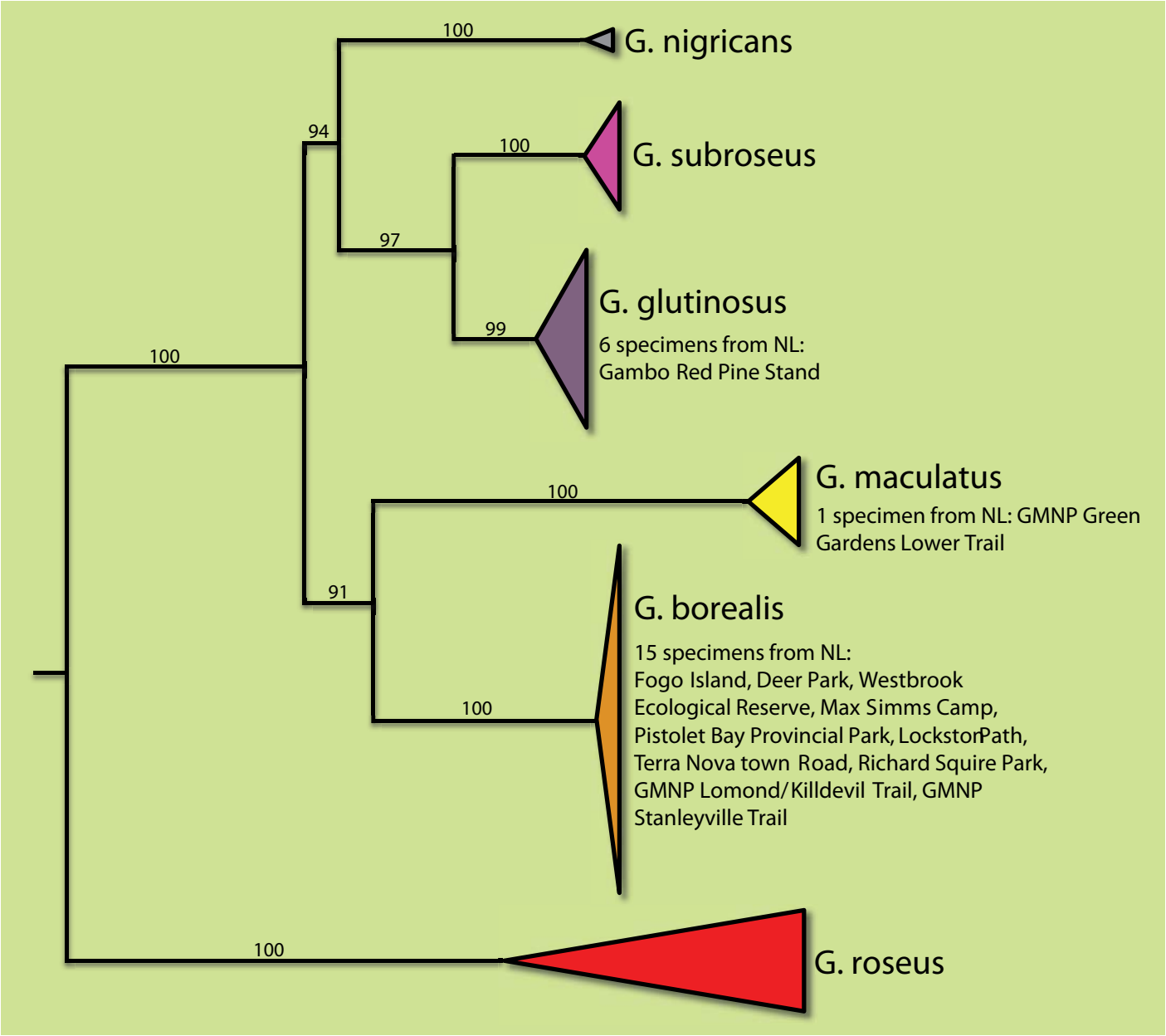


Figure 3. Simplified phylogenetic tree of our Gomphidius *species. This tree has been adapted from a larger tree of the entire Gomphidiaceae family. Only three of our species were available for DNA extraction; the fourth,* Gomphidius nigricans, *is represented by another collection to show its place on the tree. The European* G. roseus *occupies a sister position to the branch leading to all the other species shown. To our knowledge* G. roseus *has not been sequenced from near the site where Fries first reported it; however, one of our representative sequences in this tree is from a collection from Norway (Figure 2), and likely represents Fries's concept for this species.*

Using triangles to represent analyzed collections is a convention you have not encountered before on the pages of Omphalina. *The concept is quite simple: the vertical length of the base of the triangle (the side furthest from the branch) represents the number of collections analyzed: the taller the base, the more collections were studied. The horizontal length of the triangle (the distance from the end of he branch to the base in a straight line) represents the genetic variability of the collections studied: the shorter triangle, the more homogeneous or genetically similar the collections were to each other. At a quick glance you can now see that more* G. borealis *were analyzed than any other species, and they were all very close to each other in their genetic make-up. On the other hand, much fewer* G. roseus *specimens were analyzed, and they showed comparatively extensive variation between them.*

The branch leading to both these species has good support, which means that genetically these are likely very real divisions. The low variability within the G. borealis *cluster suggest that it is likely a good species, and unlikely to contain cryptic species within it. The high variability in the* G. roseus *cluster suggests that these specimens might represent different genetic lineages, and could, on further study, be found to contain other species among them.*

Figure 5, above, and 6, below right. Gomphidius borealis *from Fogo Island. Note the light orange throughout the mushrooms: cap top and underside (between gills), cut flesh, top of stem, and in the yellow at the base of the stem. Orange is unique to this species. Also note the gossamer thin fibrillose veil of the upper middle mushroom, leaving virtually no residual trace in the ring zone of the others.*

Gomphidius borealis Miller, Aime, Peintner

Macroscopic

Cap: 15-70mm diameter, bowl-shaped, with edges inturned for a long time, eventually becoming plane and then flaring out as a shallow funnel. Lubricious, but not overly slimy. Pinkish beige to tan, no bluish purple tones, always some light orange tones, especially seen on the underside, between the gills. Gills: decurrent, close, frequent forking with one or more layers of lamellulae; cream, turning purplish gray, then black, from spores. Veil: thin, fibrillose, whitish, with little to no gluten; does not leave a significant ring; ring zone turns to a black smear from spores. Stem: 8-20 × 25-95mm; may be short or attenuated; cylindric or tapered toward the base; dry to slightly lubricious in moist weather; white to light orange-beige, with lower half orangeish-yellow; stains black on handling. Flesh: cream with light orange shades, orange-yellow at base of stem, does not change colour with exposure; no specific smell.

Microscopic

Microscopically, the NL collections are consistent with the published description based on Siberian material, with the exception that the spores tend to be slightly wider in our material, measuring (15.5–) 16.5–18.5 (–20) × 6.5–7.5 µm; Q = 2.45

Ecology

Mixed coniferous forest, seemingly with *Abies balsamea*, possibly also *Picea* glauca, consistently associated with *Suillus glandulosus*. Found throughout the province.

Gomphidius glutinosus (Schaeffer) Fries

Macroscopic

Cap: 20–100mm diameter, bowl-shaped, with edges inturned for a long time, eventually becoming plane and then flaring out as a shallow funnel. May be copiously glutinous in moist weather, but this has not been a common character in our province. Dusky brown to tan, with bluish purple tones. Veil: glutinous sheath, leaving a gluten ring, which turns black from spores; here often a thick ring is absent, and only a ring zone may be seen. Gills: decurrent, close, frequent forking with one or more layers of lamellulae; white, turning purplish gray, then black, from spores. Stem: 8–20 × 25–100mm may be short or attenuated; cylindric or tapered toward the base; glutinous to slightly lubricious; white, with lower end light lemon yellow; stains black on handling. Flesh: white, sometimes pinkish purple under cap cuticle, lemon yellow at base of stem, does not change with exposure; no specific smell.

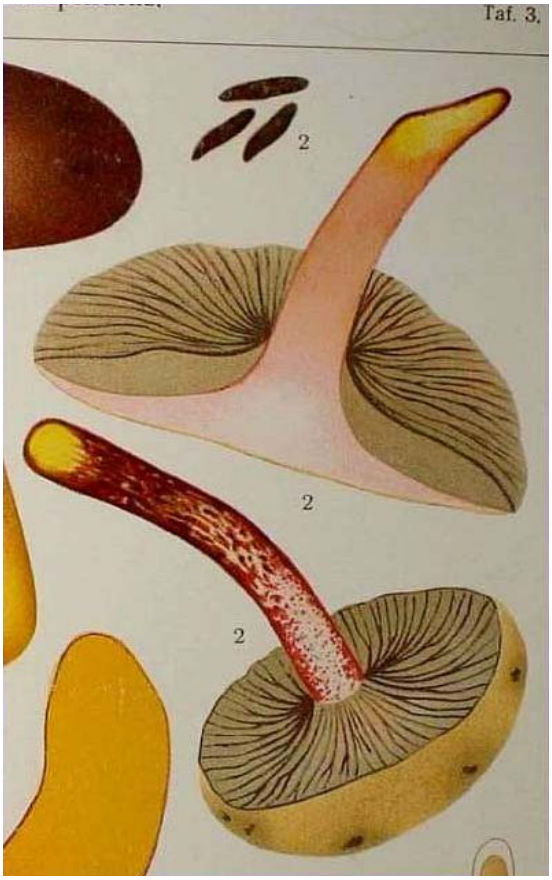
Microscopic

In our material from NL spores are slightly shorter and narrower than published ranges, measuring (15.5–) 16.5–17.5 (–18.5) × 5.5 (–6.5) µm; Q = 3.02.

Ecology

Known from only one site, under red pine in a well drained, sandy soil. *Rhizopogon pseudoroseolus* also known from same site, although association not known. To date, not found in other red pine forests in NL.

Figures 7 and 8. Gomphidius glutinosus *from a small forest of* Pinus resinosus *(note two-needle pine duff). The dusky bluish tones can be appreciated in some caps. Even the palest beige caps do not have any suggestion of the orange tones found in* Gomphidius borealis. *The underside of the cap, seen between gills, is white, and the top of the stem is white. The yellow lower stem is a pale or lemon yellow, not the orange yellow of* Gomphidius borealis. *Although traditionally* G. glutinosus *is described as being very slimy, finding large sheets of dripping gluten is unusual for this species in our province. Often the difference between these two species is not evident by the amount of slime, and a bulky gluten ring is uncommon.*



Gomphidius maculatus (Scopoli) Fries

Our single collection was neither described nor photographed at the time; this description is taken from other sources.

Macroscopic

Cap: 25-90mm diameter, depressed to umbilicate, with edges inturned, eventually becoming plane and then flaring out as a shallow funnel. Glutinous to viscid. Starts ivory, turns yellowish tan, with dark red, brown or black splotches, eventually all black. Veil: glutinous, leaving similar ring. Gills: decurrent, close, frequent forking with one or more layers of lamellulae; white, turning purplish gray, then black, from spores. Stem: 8-20 x 40-80mm; usually tapered toward the base; sticky below ring in youth; white, turning brownish, spotted with red to brown marks, eventually blackening; very tip of base same or light yellow; stains black on handling. Flesh: white, blackening on exposure; no specific smell.

Microscopic

Spores: 14-22 x 5-7 µm; Q=2.9.

Ecology:

Known only from a single collection made during ten years of forays. Larch documented at collection site. A widespread species in the Northern Hemisphere, noted to be only associated with larch. Fungus partner unknown.

Figure 9. Gomphidius maculatus. *We did not take a photo of what has subsequently turned out to be our only collection of this species, so we offer Ricken's 1915 aquarelle.[4] Yes, that is the Ricken after whom* Rickenella *was named.*

Figure 10. Gomphidius nigricans. *Unfortunately our single specimen has been misplaced, limiting our evidence to this photo. However, the fit is rather good, and there are not too many other possibilities. The species is the only known white pine associate (note five-needle pine duff), seemingly limited to northeastern North America.*

Gomphidius nigricans Peck

Based on other sources; our single collection has been misplaced.

Macroscopic

Cap: 20-80mm diameter, bowl-shaped, with edges inturned for a long time, eventually becoming plane and then flaring out as a shallow funnel. Gluten sticky to tacky. Starts white to pale yellow, turns through pink to reddish brown with age. Gluten becomes a shiny, black layer. Veil: none, gluten only or very finely fibrillose, leaving thin ring zone. Gills: decurrent, close, frequent forking with one or more layers of lamellulae; white, turning purplish gray, then black, from spores. Stem: 8-20 x 30-100mm; cylindric or tapered toward the base; gluten sticky in youth, forming a coarse, black, reticulate covering; white, with lower end light lemon yellow; stains black on handling. Flesh: white, light yellow at base of stem; no specific smell. Dries black.

Microscopic

Spores: 14-22 x 5-7 µm; aQ=2.9.

Ecology

Known only from a single collection made during ten years. Collected under white pine. An uncommon species, apparently limited to northeastern North America. Fungus partner unknown.

Discussion

It was a real joy to relocate *Gomphidius borealis* after not hearing of another find since its first description—and in such quantities, being by far the most commonly collected *Gomphidius* species in Newfoundland and Labrador. Given that it is so common here, there are good grounds to suspect that it might be equally common elsewhere in northeastern North America, but thus far escaping detection, having been lumped with the similar *Gomphidius glutinosus*.

Our collections appear to be larger than initially reported from Siberia, and it has also changed its lifestyle in Newfoundland and Labrador. In Siberia it was associated with larch, presumably through an association with a fungus that was a larch partner. Here it seems to have formed a relationship with *Suillus glandulosus*, a balsam fir partner (and/or possibly with white spruce, *Picea glauca*), and is thus found in association with the latter tree(s). Of pertinence are the Conrad Brook collections, where balsam fir was not the prominent conifer species, and collecting sites usually came from areas of *Picea glauca* and some *Larix laricinus*; *Suillus glandulosus* was still the documented fungal associate.

It is interesting to note that *Gomphidius glutinosus* is also behaving a bit differently from its usual behaviour elsewhere. Whereas in Europe and elsewhere it is not a pine associate, here it comes exclusively from an area of red pine. The collection site is not a pure pine forest, with some fir and spruce also present, so that an association with these trees is possible, even if less likely. Interestingly, *G. glutinosus* has not been collected from a second, larger red pine forest, where fir and spruce are even more common. All collections from that second site were *G. borealis*, and *Suillus glandulosus* was common, while *Rhizopogon pseudoroseolus* was not found there.

At times distinguishing between *G. borealis* and *G. glutinosus* can be difficult. Both have a wide colour range, with considerable overlap. *Gomphidius glutinosus* is consistently the larger of the two, but the differences are so small that most specimens overlap entirely, making size a poor help to identification. Spore size and shape (the Q value) are a bit better, but again there is so much overlap that except for extremes, this character will be unlikely to help identify a sollitary specimen.

The amount of gluten may be a bit more helpful. However, in wet weather the "dry" *G. borealis* can

Figure 11. Veils. Gomphidius glutinosus *from Norway on the left, with a transparent glutinous veil. Characteristic of the species elsewhere, this veil has been an uncommon finding in our specimens.* Gomphidius borealis *on the right with typical white fibrillose veil.*

Figure 12. Colour. Collections of Gomphidius glutinosus *on the left, and* Gomphidius borealis *on the right. Looking at several collections, the difference between lemon yellow and orange yellow in the foot of the two species is obvious even from afar. Photos: Roger Smith.*

		GOMPHIDIUS			
		borealis	***glutinosus***	***maculatus***	***nigricans***
Cap	**colour**	orange-pink tan	dusky gray-purple tones in most caps	light yellow-beige, dark red-brown spots	off-white to light tan, becoming brown and blackening
	gluten	sparse to moderate	moderate to copious	sparse	sparse to moderate, sticky
Veil / ring		fibrillose	only gluten	fibrillose	none to fibrillose
Stem	**gluten**	dry to sticky	sticky to slimy	dry to sticky	sticky
	colour, upper	cream to light orange beige	white	covered with yellow spots, stains purlpe	white, gluten superimposing a black, reticular pattern
	colour, base	orange yellow	lemon yellow	base not yellow, or only at the very tip	light yellow, staining dark purple and eventually black on handling
spores, *µ*m		(15.5) 16.5–18.5 (20) × 6.5–7.5; aQ=2.5	(15.5) 16.5–17.5 (18.5) × 5.5 (6.5); aQ=3.7	14–22 × 5–7; aQ=2.9	14–22 × 5–7; aQ=2.9
Host mushroom		*Suillus glandulosus*	*Rhizopogon pseudoroseolus?*	unknown	unknown
Host tree		balsam fir, white spruce?	red pine	larch	white pine

Table 2. Differentiating characters of our Gomphidius *species.*

feel quite slippery, and in dry weather the slimy *G. glutinosus* may be completely dry. One good area to check is the veil, if you have a young specimen (Figure 11). We have also found that the colour of the base of the stem is consistently lemon yellow for *G. glutinosus* and orange-yellow for *G. borealis*. Unfortunately the shades are so close that the difference is best appreciated viewing several species of each side by side (Figure 12); it may be considerably more difficult to differentiate with only a single specimen. However, the presence of orange tones seems to be a good and consistent character exclusively seen in *G. borealis*. Voucher photos taken under standardized light, white balance and exposure conditions by the same photographer, using the same camera, bring out the shade differences much better than one may hope to do in the field with different lighting conditions and differing camera settings.

An association with *Suillus glandulosus* will help tip the scales in favour of *Gomphidius borealis*. If you are still puzzled, fall back on the statistical odds revealed by this study: a *Gomphidius* species in this province is most likely *G. borealis*, by a far margin. Table 2 lists the characters that taken together should aid your identification.

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The three-way life of *Gomphidius*

Andrus Voitk

For the mycophile, whose prime interest is to learn mushrooms she can eat with her moose steak, the previous article on *Gomphidius* may or may not be of interest. Of our four species, at least *G. glutinosus* is considered edible, and odds are they all are. Some people advise that you peel off the glutinous skin of the cap before preparation to eliminate the slimy quality. The disappointing part is that these species are not common enough to provide a meal, but at best contribute additions to a mushroom mix. If you do decide to eat them, though, make sure you know where they come from. They concentrate Cesium and other heavy metals many thousand times more than in the ambient environment, so if your specimens come from Chernobyl or Fukushima, you may prefer them for nightlamps rather than vittles.

To the naturalist, whose curiosity about mushrooms extends beyond their suitability as table fare, each new encounter opens up questions that can be pursued as far as you care to go. For example, the article stated that *G. borealis* was always found with *Suillus glandulosus*—illustrated in our title banner: three dark *Suillus* caps and one *G. borealis*, the balsam fir needles indicating the third partner. Is this a chance association, or is it because both like the same habitat, or perhaps even the same host? Or could they possibly have a more intimate relationship?

To gain some insight into these questions, let us first turn to what is known about the relationships of *Gomphidius*. The classic association is that of *Gomphidius roseus* and *Suillus bovinus*, observed for decades in northern Europe. Apparently *S. bovinus* can grow alone, but not *G. roseus*—the latter is only found if *S. bovinus* is present. Study of this association has revealed a three-way relationship between these two mushrooms and *Pinus sylvestris*.[1] It seems that the *Suillus* has a traditional ectomycorrhizal relationship with scots pine. *G. roseus*, which was thought to be another mycorrhizal partner of scots pine, has never (or at least very rarely) been found to form a direct relationship with this tree host. Instead, its relationship seems to be formed with *Suillus bovinus*. Current urban legend has it that *G. roseus* is a parasite on *S. bovinus*, tapping into the *Pinus-Suillus* system for a free meal. The truth is that what exactly goes on is unknown. The *Suillus* is never found alone, without its tree partner, yet nobody goes around accusing it of being a pine parasite. In other words, obligate association is not necessarily parasitism. Yes, the *Gomphidius* seems to get food from the *Suillus*. But whether it brings a present in return to its host or what they do for each other remains, for the nonce, a confidential matter between consenting partners.

Can this evidence of an intimate association between these two fungi be extended to our observations?

Figure 1. *Rhizopogon pseudoroseolus*, in the same red pine forest as our *Gomphidius glutinosus*. Since the latter is know to form partnerships with species of the former, could this be the partner of ours? Truffle sequenced and identified by Jeremy Hayward.

In all likelihood the answer is, yes. The association of *G. borealis* and *S. glandulosus* is too consistent to be dismissed as a casual preference for similar habitat. In view of similar "parasitic" reltionships of other *Gomphidius* species, current opinion is that they all share a similar lifestyle. There is some evidence that these organisms are quite specific in their choice of partners, so that recognizing the partner is a good way to identify the *Gomphidius*. This is quite helpful, because as the last article demonstrated, differentiating between our species in the field is not always as easy as on the pages of a book.

If *S. glandulosus* is the mushroom partner of *G. borealis*, who is the partner of *G. glutinosus*? After all, this species is far better known over a much longer time and wider distribution, so surely its partner must have been documented? Strangely, such is not the case: descriptions in European or North American books do not mention a partner. Why? The potential answer is not obvious to us adults, but a child would probably blurt it out in a trice: maybe it's invisible? Indeed, this may be exactly the case. Investigations have revealed that *G. glutinosus* partners with species of *Rhizopogon*,[3] a false truffle usually not visible because it grows underground. In this regard, it is interesting to note that all our collections of *G. glutinosus* come from a red pine (*Pinus resinosa*) site which also produces *Rhizopogon pseudoroseolus* (Figure 1).[4] I am willing to bet a toonie that investigation will reveal that this is not merely a random observation. Odds are we have two other three-way relationships:

1. *Gomphidius glutinosus-Rhizopogon pseudoroseolus-Pinus resinosa,*

2. *Gomphidius borealis-Suillus glandulosus-Abies balsamea* (and/or *Picea galuca*, or, remotely, *Larix laricis*).

Why did the original description of *G. borealis* state that it was a larch associate? Well, the real associate is another fungus, not a tree. The tree is determined by the other mushroom. Hence, *G. borealis* may associate with a larch-partnering *Suillus* in Siberia, but a fir-associating *Suillus* here. This seems to be the case for *G. glutinosus*: in Europe it is found with non-pine species of the Pinaceae, but here it was only collected from a red pine forest.

I cheated and purposely delayed relating that the legendary Nova Scotia mycologists, Grund and Harrison, documented an association between *Gomphidius glutinosus* and *Suillus sinuspaulianus* over 30 years ago.[2] How could we explain that, if *G. glutinosus* forms a relationship with *Rhizopogon*? An adaptation to the different flora of Nova Scotia is one possible explanation. However, in view of the difficulty we had separating *G. glutinosus* from *G. borealis*, and given that *G. borealis* had not been described then, is it possible that despite their experience and sharp observation skills, the species Grund and Harrison really observed was what we now know as *G. borealis*? *S. sinuspaulianus* is very similar to *S. glandulosus* (another difficult distinction in the field), so that association with either offers an attractive explanation.

If your questions have taken you this far, you might wonder how these mushrooms that seem to feed off or with each other are related? Here you get another surprise. They are all close relatives, all boletes, and specifically, all on the *Suillus* branch of the bolete family. How could it be? *Suillus* is a pored bolete, *Rhizopogon* is a truffle, and *Gomphidius* is a gilled mushroom. How can they be close relatives? Well, it seems boletes arose from some ancestors that split away from the Euagarics (the cap and stem mushrooms with gills). Some of them "reinvented" gills again. This is called

parallel evolution, when different evolutionary lineages seem to invent the same features. The mechanism is probably totipotentiality, that is they never lost the ability to form gills, and when it seemed to offer an evolutionary advantage, reverted to that form again, while others went along different lines that suited their circumstances better. But genetically they all remain closely related, no matter how far apart they stray in looks.

Figure 2 is adapted, with permission, from an article by Binder and Hibbett,[5] laying out the lineage of the bolete clade (Boletales). The earliest members along this branch were wood rotters, like *Tapinella*, *Serpula*, and *Hygrophoropsis*. As they evolved, they discovered the benefits of a mutualistic association with trees, using the mycorrhizal mechanism. From here on, they evolved hand-in-hand with their tree partners, a process called coevolution. How did some switch from trees to relatives? Binder and Hibbett offer an attractive explanation. As more and more fungi learned to partner with trees, related species tended to specialize to the same tree species. It became increasingly more difficult to fight for some root tip real estate, and some found that it might be easier to tap into nearby relatives than fight them for root space. As mentioned, whether this is a parasitic relationship or whether there is an exchange, we do not know.

There you have it. Edible, but possibly too slimy and uncommon to be worth the effort. If your interest in mushrooms extends beyond the dinnerplate, they provide a lot of fodder for the mind, making their study a fascinating pursuit.

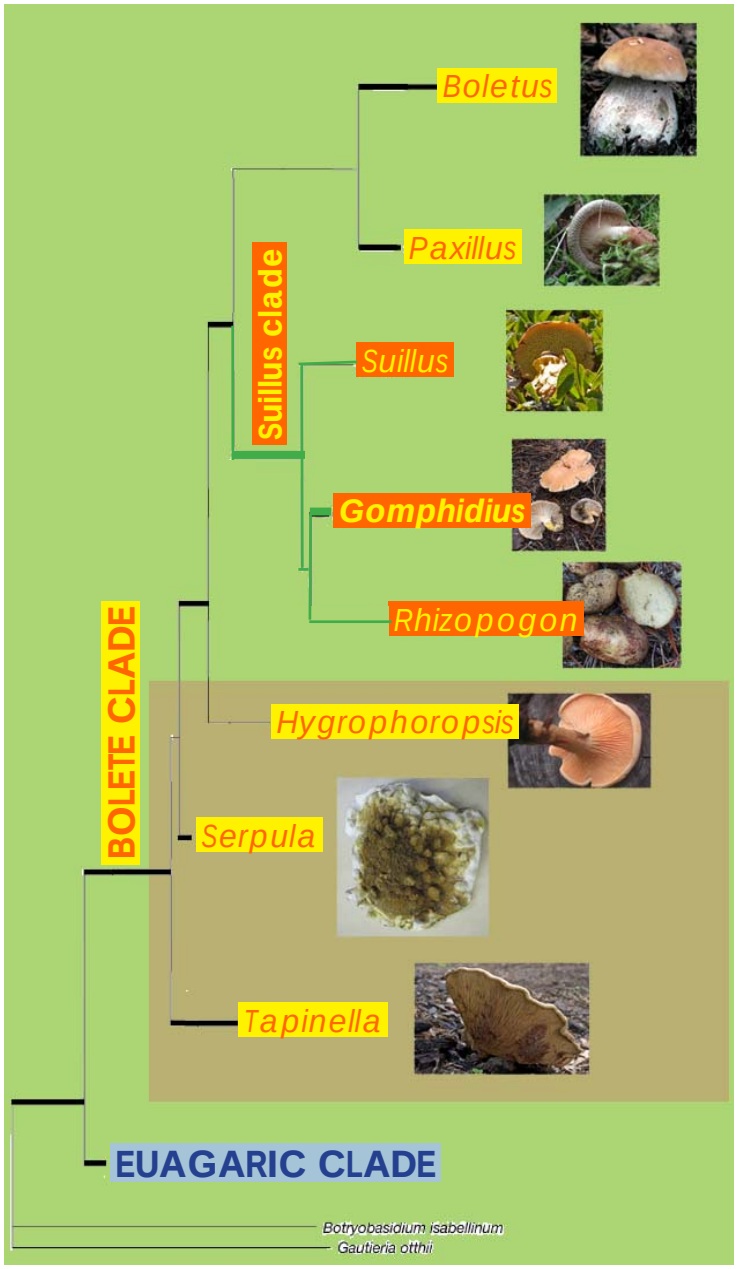

Figure 2. Phylogeny of the bolete clade, showing the suillus clade (green branches) containing the genera *Suillus*, *Gomphidius* and *Rhizopogon*, all close relatives, despite their differing looks. Note that the earlier bolete clade genera, on the brown panel, are saprobes, woodrotters to a man. They digest cellulose, leaving behind the brown lignin, and are thus named agents of brown rot. Later groups evolved to become partners to the same trees that their ancestors rotted—their idea of a better way. As they all narrowed down on the same hosts, the situation became so crowded that our *Gomphidius* decided to tap into his relatives, instead of competing with them. Whether *Gomphidius* is a mooching uncle, or makes equal contributions in this three-way partnership of *Gomphidius*, fungal relative and tree, remains to be discovered.

Note: Tree pruned of many branches for this discussion.

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The Bishop's Sketchbook

Out of focus shots? Great!
Take more!

Walt Endicott

As any product catalog photographer will tell you, all their best shots are out of focus. Seriously. What professional photographers don't tell you, are the real tricks of their trade like HDR, focus stacking, and other masking and layering techniques. If you've ever opened a serious image editor like those supplied by Adobe you might jump outta your chair and club the monitor to death. I know, I got 50 shades of grey from that torture, trying to emulate a 16 year old! The learning curve for this stuff is never ending, and quietly, behind the scenes, my internationally known photojournalist friends are struggling to keep up.

So, let's cheat. First let's get some robust but free slightly simpler software. Not garbage. Something even pros use but won't admit. It's called Gimp. It's the ever developing Open Source version of Adobe Photoshop. A team of caffeine addicted monkeys and ex-Adobe employees scattered throughout the world secretly slave away in their basements developing and improving it. Then, like some communist do-gooders, give it away for the betterment of mankind while throwing terracotta coloured powder and beating tambourines. So go scoop up your free $700 software at <http://www.gimp.org/downloads/>, and while you are at it, save another $100, and get a free RAW converter and manipulator at ufRAW <http://sourceforge.net/projects/ufraw/files/ufraw/ufraw-0.19.2-2-setup.exe/download>.

Canon fans can get a free firmware update for their old Canon "point and shoot" at <http://chdk.com> to turn it into a $1000 DSLR. For the DSLR people with older Canon cameras like the T1,2,3, D-whatever, go to Magic Lantern <http://www.magiclantern.fm/> and enjoy the massive upgrade for free. Seems the people at Canon were hiding what your camera can truly do and then charging you money to "release" locked features as each new model was unveiled annually. Wish you had a free $55,000 Red One camera? Just tweak your 5Dii and in many ways your old 5Dii will be better than the Red One!

Now you know a possible explanation as to why Canon suddenly released so many new features all at once and made $700 cameras better than $5000 cameras from the year before. They couldn't beat the monkeys so they joined them. All of this is Open Source thanks to the basement monkeys trying to clean the world. Cavendish bananas welcome.

OK, now what? Now you can take your soon to be worthless 8 megapixel dinosaur from 2006 and shoot in RAW, twist your bad auto white balance shots into something useful with ufRAW and make it perform focus stacking like a $6000 Canon 5Diii with a Pro grade lens! These newly unlocked features are 1000 times more powerful than even that—enjoy exploring the new features.

The new cameras do a lot of photo editing with a series of clicking shutters and some behind the scene internal grinding. We are going to have to work it out in software. If you shoot in the RAW file format and play with the options and sliders after looking at what a color/temperature curve should look like, you will throw out a lot less photos. Instead of writing out the RAW and white balance explanation, I direct you to <http://www.youtube.com/watch?v=AD1kEbsYW8M>

So, what is focus stacking? Its magic. Some depth of field photography techniques were previously described by Jim Cornish in Omphalina 3(5):6. To recap, depth of field describes how deep one can look "into" an image and still see a sharp focus. There are many ways to achieve a deeper depth of field, but having 1/3 of a subject in focus in a photo that was taken while the lens was very close to the subject is tough—having it all in focus is impossible. Pulling the camera away from the subject and zooming in will increase the depth of field but at the cost of light which is a precious commodity in a dark mushroom-laden forest.

Instead, we will cheat and take 2, 3, or more photos that focus on progressively further parts of the subject, without moving the camera. A tripod is a must. Next, we will make one image by blending the sharp sections from each photo into one super sharp image with otherwise impossible super depth of field. We do this by stacking each photo on top of the other in order: of back to front or front to back. Just don't mix up the order. When you open the images as layers, they stack up like perfectly aligned transparencies because you didn't move the camera while changing the focus, right? You can select and deselect the tiny eyeball icon square next to each thumbnail in the right pane thus adding the ability to see, or not see, each layer. A common slip is forgetting to select the top layer. Another is forgetting to switch the paint brush from black on top (erase) or white on top (undo erase) in the color selections squares in the center of the left pane. You will also notice a black square that gets white sections as you paint/erase on the masked layer. This shows your work. Adding a removing the selected "eyes" until only the mask is selected will show what you've erased. This will generate white sections as you erase the masking layer. Clear as mud?

For a clear demonstration of stacking with Gimp, go to <http://www.youtube.com/watch?v=271n4yFigfY>. The title banner was made from these instructions. The photos on the right were taken on a tripod, focussing on the fore, middle and background (of the mushrooms, not fence). The bottom image is a blend of back and midground photos, and the title banner of this with the foreground shot.

Now you can make an image of a pool cue with the Made in China sticker on the butt and the chalk on the tip, all in focus, with the rest of the image a non-distracting blur. Mushrooms will be a breeze! So will that amazing landscape with the daisies at your feet and the far-off hills as sharp as tacks.

Try it! Experiment!

Rhytisma andromedae
—a very common fungus of NL bogs

Andrus Voitk

During the Wildflower Society's annual field trip to the Great Northern Peninsula in June, 2013, to the shock and horror of some participants, some of us also collected the few fungi that were in evidence—mainly a wide variety of orange rusts on various leaves. One of the few non-rust fungi was the specimen shown in the title banner, collected by President Burzynski and entrusted to my care. That would be our President, not the Wildflower Society's.

Once home, all my treasures were carefully labelled, entered in the database, and laid out on several screens to dry. Then the fun of identification began. I had no idea what the tar-like black stuff coating one leaf of *Andromeda polifolia* (bog rosemary) could be, or even if it was a fungus. However, an avid reader of Omphalina, I vaguely remembered pictures of tar spot on dwarf willow, so I looked it up: *Rhytisma salicinum*, Omphalina, 3(8):8-9, 2012. Next, I looked up *Rhytisma*, and noted that one species grows on *Andromea*, aptly named *Rhytisma andromedae*. Looking this one up, it was clear that it was our species.

Of course, this was a valuable collection: our first record of the species in the province, plucked up by the presidential hand. Needless to say, it got the premium spot on the best drying screen. Sometimes, when you do things too right, the gods pounce. Imagine my horror on tipping over this, the best of my three screens, spilling into one pile some 20-25 collections of various fungus bedecked dried leaves! A huge, crumbly, mixed mess, among which, alas, the small, black presidential rosemary leaf!

Well, I sorted through this mess the best I could, hoping against hope that I could match leaf shards to their correct labels. Most leaves had to be discarded as unidentifiable mulch, but surprisingly, with the aid of photos and some visible leaf shapes, parts of 18 collections were restored. But no trace of the little black rosemary leaf. I sifted through all the dross several times, but could not find it.

No choice now, but to replace the collection quickly, before the mandatory Report to the President. Off to a bog we went, an hour's drive from home. Every *Andromeda polifolia* sprig came under close scrutiny. Do you know what I discovered? This is a very common fungus! If you start to look at each potential host critically, it does not take long for the first "Here's one!" And once the search image is fixed, the fungus is everywhere. Everywhere. The reason we are not aware of it is that we overlook it. We do not go looking for fungi in bogs very much. When we do, it sure is not to look for small spots on small leaves of small plants. So, we walk past it unawares. It is not showy and gorgeous, has no magnificent shape or proportions, is neither a revered gustatory delight, nor a feared dramatic killer. There is nothing about it to draw attention to it, and therefore all field guides give it a miss.

Most places where mushroom book authors live may not have 20-30% surface area as bog or fen. We do, and these fungi are a unique and very common part of our natural heritage. It is something we can introduce to others with pride, so it behooves us to know *Rhytisma andromedae*. And, as so often happens, once you get to know this organism a bit, it becomes

very fascinating. Its life cycle is not as complicated as that of the rusts we found. Rusts go through several stages and several hosts. This one has only the one host and one stage. But the way it has worked out its cycle is very clever.

It is an ascomycete, whose spores land on an *Andromeda* leaf and start to grow. The organism lives happily inside the leaf (endophytic) until it comes time to procreate. It forms a fruiting body (stroma) with cavities (apothecia) inside. Inside the apothecia are the asci and inside the asci are the spores. These need to be discharged to infect the next leaf, for the cycle to begin anew.

But things are not that simple. The organism grows most of the warm season, before it gets big, strong and mature enough to do the procreation thing. But by the time it has all things in place, the season is over, leaves are falling and there is no place for the spores to go. Even though *Andromeda* is an "evergreen", spores can make little headway growing or colonizing in the cold of winter, under the snow. So, spores do not mature that season. Instead, the infected leaves die and fall off, and the stroma is covered by the tar to protect the asci over winter.

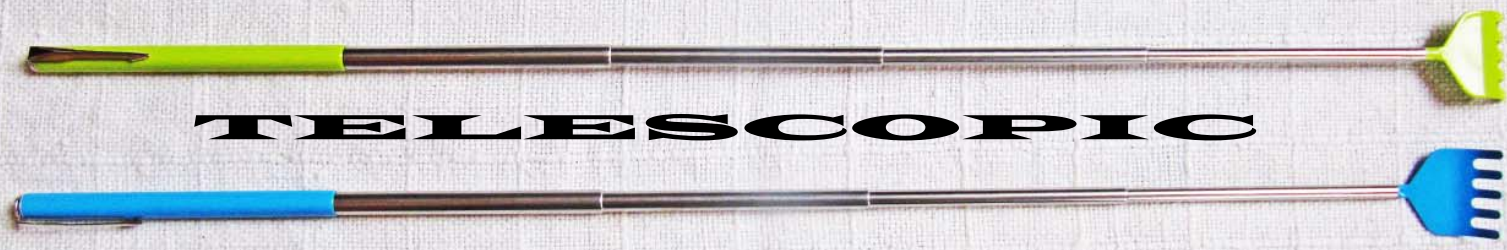
Spores begin to mature once winter is over. The tar cracks by the expansion-contraction of the freeze-thaw cycle, augmented later by the wet-dry cycle with alternating rain and sun. Spores are discharged from the asci to the outside through the cracks, which connect the apothecia to the open air. Probably mostly driven by wind on the exposed bogs, spores find new homes in new *Andromeda* leaves. Thus, the fungus cycles from fallen leaves to attached new leaves and back again.

A smart parasite, it does not do major damage to the host, and its major impact is cosmetic—brown and black spots on the leaves. If you do not like these black spots on the otherwise perfect *Andromeda* leaves in your bog, the solution is simple. You need not destroy alternate hosts, or spray toxic fungicidal or other chemicals. The way to eradicate the infection from your bog, is to rake up and burn all dead *Andromeda* leaves in the fall, year after year. Remember, burn, not compost, as composting is not hot enough to destroy the spores. Within a few years, you should notice a big difference: your bog will have the prettiest, most spotless and perfect *Andromeda* plants around.

See advertisement, next page, for tiny rakes, specially designed for raking bog leaves, without damaging the *Spahgnum* or other plants. Not cheap, but well worth it.

Meanwhile, I need to cook up my Report to the President a bit.

Andromeda



Telescopic

Bog Rake

WARNING: Vendor, distributor and manufacturer not responsible for careless use. If you wear it in your shirt pocket and go through thickets where it gets caught and rips your shirt--it is YOUR fault.

Be the first on your block to own the fantastic telescopic

Andromeda Bog Rake

As advertised on National TV! **Used by thousands!**

Small enough to fit in your pocket, yet extends to under 1,000 mm.

Prevent Andromeda Tar Spot on the spot! Clean your Sphagnum of fallen and infected Andromeda leaves in no time! Look good with your decorator colour coordinated **ABR**.

On the bog, extend the **ABR** to its fullest, make raking a breeze, and avoid the backache seen with common, non-extensile bog rakes.

Off the bog, line up several **ABR**-s in your shirt pocket and look like an important executive or a computer genius! Better than pens: Guaranteed to leave no ink stains.

THE choice conversation piece for sophisticates. At your next cocktail party, take out your **ABR**, stir your drink, and watch envy swirl in the eyes of your rivals, as you move with ease among the illuminati on the A-list.

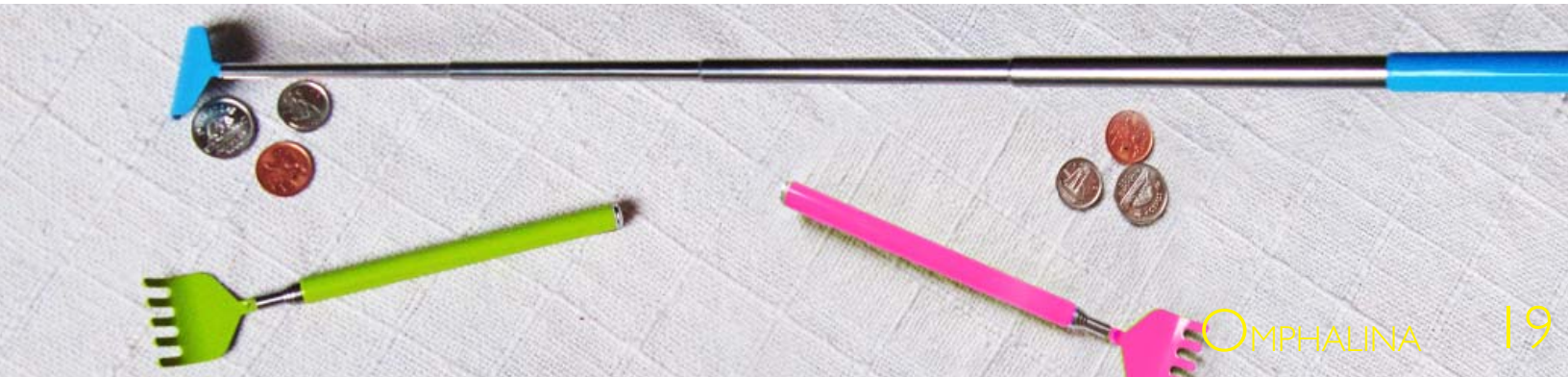
Versatile! Use in a similar way to clean up your bog bilberry (*Vaccinium uliginosum*) patch of ugly bilberry tar spot (*Rhytisma vaccinia*).

Limited Time Offer: send $95.00 in unmarked bills per rake, (add $37.50 pink surcharge for **hot pink** model) along with your mailing address, to:

ABR c/o Omphalina at the address marked on the inside front cover of this magazine.

Special price includes shipping, batteries and 25-year warranty on all hydraulic components.

HURRY! Quantities limited—while supplies last! This one is bound to go fast.



The XEROPHILIA of *BISCOGNIAUXIA REPANDA* —preliminary enquiry

Andrus & Maria Voitk

*Figure 1. Experimental tree, an old mountain ash (*Sorbus decora*), mostly dead, with some live branches and leaves aloft and live shoots from the root, seen below. Dead experimental branches resting in the Y-crooks of two major limbs are seen. Other dead branches are beside the trunk on the ground.*

Fruit bodies of Biscogniauxia repanda *on a dead part of the trunk before the experiment shown (sideways) in the title banner.*

Dead branches of living trees have no water supply through normally active vascular channels, and aloft in the crown, exposed to sun and wind, dry out readily. Not many lignicolous (wood dwelling) fungi can survive in such sere environments, giving those that evolve a coping mechanism a definite advantage over competitors in this specialized habitat. Organisms able to survive in dry conditions are called xerophilic (xero = dry, philos = love); they are actually just as dependent on water as all other organisms, but have developed alternate coping mechanisms. The minimal requirement in such an environment is an ability to survive dry periods and revive with renewed moisture, make the most of external water during wet periods, all the while utilizing water produced as a byproduct of wood catabolism. Many lignicolous xerophiles seem to thrive only if their deadwood substrate remains attached to a living tree, and do not seem to grow on fallen deadwood. An explanation offered for this observation is that once the branch falls to the ground, it constantly absorbs water, and in this moist environment the xerophile loses its advantage over other competitors: more aggressive fungi take over. However, many xerophiles do not seem to grow on seemingly dry branches, once their continuity with living wood has been severed. Does the intact tree provide water or other nutrients?

An intact tree may be a water bank, with the ability of some water to move into upper dead branches by capillary action. An alternate mechanism is for the xerophile to develop a sufficiently large mycelium in the host (Figure 2), to allow the

Figure 2. Cross section of small branch with B. repanda. *Black lines formed by pseudosclerotial plates stake out its property, outside the bounded area. It is easy to imagine the extension of mycelia down the branch to live wood for water and nutrients.*

translocation of water and/or other nutrients from living tree tissue to the dead branch. The first situation describes a pure saprobe, an organism living on and digesting dead organic matter. The second describes a parasite, an organism feeding on or removing vital materials from living tissue.

Biscogniauxia repanda[1] is one of several fungi that seem to fruit exclusively on dead wood only if it is attached to live wood, usually on dead branches in the crown of living trees. A simple study was designed to explore these mechanisms in the case of *B. repanda*.

Materials and methods

An old *Sorbus decora* (Figure 1) with actively fruiting *B. repanda* (identified both macro- and microscopically) on dead trunks and branches, was selected near Humber Village, NL, in a mature birch forest grown after logging of an original coniferous forest. The approximate tree composition was 60% *Betula papyrifera*, 15% *B. allagheniensis* and 20% other trees (*Acer rubrum* and *spicatum*, *Amelanchier* spp., *Corylus cornuta*, *Fraxinus nigra*, *Prunus pensylvanicus*, *Sorbus americanus* and *decora*, few *Abies balsamea* and occasional *Picea* sp.). In March, 2012, six dead branches (at least 5 cm diameter at the proximal end, and at least 50 cm in length) with actively fruiting *B. repanda*, and no macroscopic evidence of other fungi, were broken from the tree. All fruit bodies were removed. Three branches were placed securely between other branches in the crown of the tree, at the same height as similar branches harbouring *B. repanda*, (Figures 1, 3, 4) and three branches on the ground beside the tree (Figure 3). Lastly, all fruit bodies of *B. repanda* were removed from the tree. The site was visited 2, 4, 6, 8, 9, 11 and 13 months later, noting regenerated *B. repanda* fruit bodies on the tree, broken branches placed in the crown, and on the ground.

Results

By four months, 2 cm diameter fruit bodies had regenerated on dead parts of the lower trunk of the standing tree. At six months these were nearly 3 cm in diameter and small fruit bodies were beginning to develop on attached dead branches. At eight months fruit bodies on the trunk approached 4 cm, and those on attached dead branches, above the level of the broken branches resting in the crown, were nearly 2 cm. No fruit bodies were seen on any broken branches. At nine months the fruit bodies on the tree were bigger and a few 1 cm diameter fruit bodies were seen on one of the three broken branches resting in the crown, under the bark,

Figure 3. Above: Three dead branches suspended in the canopy. Below: Three dead branches on the ground by the tree. All had B. repanda *fruit bodies, which were removed at the beginning of the experiment.*

Figure 4. Tree at 9 months after beginning. The loose branches in the crown obviously enjoy all the benefits of ambient precipitation.

Figure 5. Above: Three experimental branches numbered. At 9 months, small fruit bodies of B. reapanda *(yellow oval) appeared on one of the loose branches in the crown, in a place where it was in contact with the other two loose branches as well as both arms of the Y-crook where they nestled. Note the multiple and larger fruit bodies on the supporting branches (red circles).*

Below: Branch 2, same place, at 13 months, blown down by a storm. The fruit bodies were of the same size. No other fruit bodies had appeared on this or the other loose limbs. More and larger fruit bodies had appeared on the attached dead branches in the same time, and these had increased in size between 9 and 13 months.

in an area where the broken branch was resting in the crook of larger tree branches, in contact with both limbs of the tree and with the other broken branches (Figure 5). No other fruit bodies on any of the broken branches, whether in the crown or on the ground, were seen. The branches on the ground were not examined during snow-covered months. At all other times they were moist to wet. No macroscopically obvious fruit bodies of any fungus developed on any branch on the ground.

Thirteen months after the original intervention the experiment was terminated by nature. The previous week the area was hit by a storm with winds just shy of 200 Km/hr. Many of the attached dead branches were broken off and strewn on the ground, as were the broken branches placed in the crown. The latter had no fruit bodies, apart from those seen in one site at nine months, without increase in size.

Discussion

After removal of all fruit bodies, both attached and severed dead branches contained residual mycelium of *B. repanda* (Figure 2). Because fruit bodies did not develop in any dry area of the severed branches, it would seem that *B. repanda* needs water in addition to precipitation, dew and fog to thrive. Attachment of dead wood to the tree gave *B. repanda* a clear edge in regenerating fruit bodies, which appeared progressively from the lower levels upwards: dead parts of the trunk first and progressing higher with time. Fruit body size decreased in size with distance from living wood. This would be compatible with getting vital water or nutrients either through capillary action or a mycelial network originating in live wood.

Because fruit bodies developed in a severed branch, a mycelial network extending to live tree tissue is not a sine qua non, although its presence elsewhere has not been excluded. The appearance of fruit bodies in a small area of increased local moisture suggests *B. repanda* needs additional water, not some other nutrients, to fruit.

Observations on branches placed on the ground neither confirm nor exclude the influx of more aggressive competitors.

Conclusions

B. repanda has zero tolerance for true xerophilia. For regeneration of fruit bodies, access to some moisture beyond that supplied externally seems required. This seems best supplied by continuity with a larger wood mass, although such continuity is not a sine qua non.

Acknowledgments

We thank Lynn Boddy and Dave Malloch for critical review of the manuscript.

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The empty skillet

WILD MUSHROOM RISOTTO

Robin McGrath

Risotto is a dish that deserves really good ingredients. Use the best quality Calrose or Arborio rice you can find, high-quality fresh-grated parmesan (not the cardboard stuff you find on the shelf), homemade stock and your favourite wild mushrooms. For this recipe, we used the last of the 2012 Labrador Foray mushrooms prepared for the freezer by Maria Voitk. Edibles found at Goose Bay included *Cantharellus roseocanus*, *Craterellus tuabaeformis*, *Cortinarius caperatus*, *Leccinum vulpinum* and allies, *Leccinum holopus*, *Leccinum scabrum*, *Hydnum repandum*, *Russula paludosa*, *Tylopilus chromapes*.

INGREDIENTS

1 small onion, finely chopped
2-3 tablespoons olive oil
1 $^{1}/_{3}$ cup of Italian medium grain rice
$^{2}/_{3}$ cup of white wine
4 cups heated buillon
½ cup grated Parmesan
Salt and pepper
2 cups of sautéed wild mushrooms

PROCEDURE

If using fresh mushrooms, sauté them briefly at a high heat in a little olive oil and set to one side. If using frozen, sautéed mushrooms, thaw to room temperature. In a heavy-bottomed pan, sauté the onion in the olive oil until just translucent over a slow to medium heat. Add the rice and stir so it is covered with the oil and takes on a slightly yellow cast. Add the white wine, stirring continually. When the rice has taken up the wine, start adding the buillon a few ounces at a time, stirring until the liquid is absorbed by the rice before adding more. Cook for about 20 to 22 minutes, until the rice is soft and creamy but with a bit of bite in the middle. When the rice is cooked, stir in the Parmesan and (optional) a knob of butter, then fold the mushrooms into the rice. Add salt and pepper, perhaps a sprinkle of parsley if you have it. Serve immediately as a side dish or plat principal according to taste.

THE MAIL BAG

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

Morel issue—a tour de force! Congratulations on the wonderful assortment of articles on morels in Newfoundland and Labrador.

JL

To celebrate the nice morel issue, we could all sing with gusto the following chorus adapted from the old WW II song, "Tramp, tramp, tramp, the boys are marching…

Mulch, mulch, mulch, *Morchella's* popping.
Cheer up, 'shroomers, they will come.
And beneath the springtime skies
We shall see morels arise
Not too far from our Pasadena home!

HEM

Attached are my votes for morel names from the available list. If you wanted to be truly democratic, shouldn't you let readers propose their own names, rather than limit them to your choices?
MMJ

Ed response: Thank you for voting.

Letting readers propose names was our first thought. However, the more clever members of the Editorial Board pointed out that doing so, likely we'd get a 60-way tie, each name with only the vote of its proponent. To break it would need setting up a panel of judges to make selections and then offer the narrowed list to a general vote. This would be quite time consuming and unnecessarily complicated. We opted for this way as more efficient and practical.

Last year I almost missed out on the foray. Although I registered over 4 months in advance, I ended up low down on the waiting list! I got in only because you were able to secure more lodging at the end. Please register me now and I'll send the form and cheque as soon as they come out.

CB

Ed response: Thank you for your great interest!!!

We have had some members "register" in advance the last few years. The Board decided that to create an even playing field, registrations would not be accepted until the foray has been announced open. A hard copy of the signed **Registration Form** together with the **cheque** must be physically in the hands of the Treasurer/Registrar to be considered registered. Registrations are dated and taken on a first-come-first-served basis. E-mail registrations or declarations of intent will be considered fully registered only **after** the signed Form and cheque arrive.

Because we have a limited number of faculty this year, the cap will be strictly observed, to 1) avoid overloading the identifiers, and 2) allow participants ready access to the faculty.

Please register as soon as the next issue comes out—it should have the Form in it.

OUR PARTNER ORGANIZATIONS

- People of Newfoundland and Labrador, through
  - Department of Environment and Conservation
    - Parks and Natural Areas Division
    - Wildlife Division
  - Department of Natural Resources
    - Center for Forest Science and Innovation
- People of Canada, through
  - Parks Canada
    - Terra Nova National Park
    - Gros Morne National Park
- Model Forest of Newfoundland and Labrador
- Memorial University of Newfoundland
  - St. John's Campus
  - Grenfell Campus
- Tuckamore Lodge
- Quidi Vidi Brewing Company
- Shorefast Foundation

FORAY NEWFOUNDLAND AND LABRADOR

2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014 2014

The second decade

GROS MORNE NATIONAL PARK

A UNESCO WORLD HERITAGE SITE

Headquarters: *Killdevil Camp, Lomond, NL*

September 12-14, 2014

Get to know our MUSHROOMS & LICHENS!

GUEST FACULTY

Teuvo Ahti
Renée Lebeuf
Dave Malloch
Michele Piercey-Normore
Roger Smith
Greg Thorn

Look on our website at the end of April, 2014, for Registration Forms & Information:

<www.nlmushrooms.ca>