

ABSTRACT

In the first decade of the 21st Century commercial harvesting of the medicinal forest fungus *Inonotus obliquus* expanded dramatically in the Russian Far East as export markets emerged in China and Japan. This parasitic fungus infects birch trees, producing a sterile mycelial conk that is harvested and marketed as “chaga,” a traditional Russian folk remedy. Dried and powdered, chaga teas or other water-extract beverages are sold for relieving stomach ailments, treating skin problems and for reputed anti-cancer and immune-system enhancing properties. Established retail markets in Russia face increased harvest levels and export sales, raising issues of sustainability and local availability. In 2004, USAID and Winrock International collaborated with the Khabarovsk and Primorsky Krai, through the auspices of the “FOREST” Project, to address the issue of sustainable chaga harvesting.

Key words: *Inonotus obliquus*, medicinal fungi, nontimber forest products, Russian Far East, sustainable harvesting

CHAGA HARVESTING IN THE LAND OF THE SIBERIAN TIGER

by David Pilz

BACKGROUND

In April of 2004, as I was winging my way into the Seoul Incheon International Airport, I reflected on never having previously heard of my destination, the city of Khabarovsk in the Russian Far East. I had been retained to determine the sustainability of harvesting the medicinal fungus called chaga, because I had a research background in the study of whether commercial-scale wild edible mushroom harvesting is sustainable and how to manage forests for future wild mushroom crops. But I had never studied commercial harvesting of a wild medicinal fungus, nor was I familiar with eastern Russia. So let me step back a bit and describe the context of my visit.

Humans have been harvesting natural products from the steppes and forests of Eurasia since distant ancestors first chased big game and woolly mammoths through the boreal forests and across the tundra. Russians have been harvesting a diverse array of forest products

for domestic markets for as long as archaeological and historical records recount. With the advent of the Soviet Union, trade in what we now call nontimber forest products (NTFPs) became highly regulated state enterprises with collection networks feeding large, centralized processing and distribution centers. With the collapse of the Soviet Union in 1991, the privatization of Russian businesses, and the devaluation of the ruble in 1998, individuals involved in collection of forest products were suddenly faced with becoming independent entrepreneurs and finding new distribution networks and markets for their products.

The US Agency for International Development (USAID) and Russia introduced the Russian Far East Regional Initiative in 1997 to help build new institutions that would support capitalism and democracy. The Russian Forest Resources and Technologies (FOREST) Project (2000-2006) was one

of the endeavors. Winrock International held the USAID contract to conduct the project at headquarters in Khabarovsk, Russia. The Project's primary goals included education about forest fire prevention, pest monitoring through pheromone traps, promotion of sustainable non-timber forest product and secondary wood processing associations and businesses, and renewable energy alternatives such as biomass utilization.

About this time, demand for natural medicinal products grew dramatically in Japan and among the increasingly wealthy Chinese populace. One such product, chaga, had a long history of traditional medicinal use in Russia. It was brewed as a tea to relieve stomach distress, applied as a cleansing skin treatment, or the smoke was inhaled to relieve bronchial problems. (See the article in this issue by Robert Dale Rogers for more information on the traditional uses and reputed medicinal

KHABAROVSK AND PRIMORSKY KRAIS

Krais are one of several types of administrative units in Russia. Our closest equivalent would be states. Russia is huge. Stretching across nine time zones, the country is nearly twice as big as the United States including Alaska. The Forest Project focused on the Khabarovsk and Primorsky Krai of far southeastern Russia. Combined, these two Krai are ten percent larger than California, Oregon, and Washington combined, but only five percent of Russia's territory. In the south, Primorsky Krai borders northeastern China and is connected globally by the port of Vladivostok, just north of North Korea. Khabarovsk Krai is by far the larger of the two, extending north along the Sea of Okhotsk for another 1,100 miles. Its capital, Khabarovsk, is located on the mighty Amur River where it flows across the border into China. The two Krai stretch from 43 to 62 North Latitude, the equivalent of mid-Oregon northwards further than Anchorage, Alaska. The climate of the Russian Far East is far more continental and colder than the Pacific Northwest, however, because the North Pacific Current does not warm it. Biomes range from boreal spruce and birch forests in the south to tundra and taiga in the North. The two Krai contain about 40,000 square miles of birch forests. Newell (2004) is an informative reference guide to resource conservation issues in the Russian Far East.



Figure 1. Location of the Khabarovsk and Primorsky Krai of far southeastern Russia

properties of chaga.) Reports that it had cancer curing properties and boosted the immune system led to burgeoning demand by Asian pharmaceutical companies for the raw product and chaga was rapidly becoming a major export from the Khabarovsk and Primorsky Krai of the Russian Far East adjacent to China (Fig.1).

Was the dramatic increase in chaga harvesting sufficiently sustainable that the FOREST Project should be promoting it? I was retained by Winrock to help make that determination, partly in response to a critical article in the press that raised this question.

THE MEDICINAL FOREST PATHOGEN

To understand sustainability issues regarding chaga harvesting, one must understand the biology of the fungus and its context in forest management. Chaga is unlike edible ectomycorrhizal mushrooms (e.g. chanterelles, boletes, matsutake) that derive their nutrition for fruiting from long-lived mycelial colonies associated with the roots of trees that provide annual supplies of carbohydrate. The fungus *Inonotus obliquus* (Pers. : Fr.) Pilát 1942 (Minnis et al., 2012) that produces chaga is a pathogen in the truest sense. It actively attacks the living cambium of trees (mostly birches) and they respond with a variety of physiological responses in an attempt to compartmentalize and thereby isolate the fungus (See Blanchette, 1982 and Rahman et al., 2008 for more information about tree defense mechanisms.) Each spring and summer, during active tree growth, the birch tries to seal off the fungal infection, but each year the fungus also spreads from the

infection site in a dense mycelial wedge that re-damages the surrounding cambial tissue and sustains the infection. The fungus usually prevails in the long run, and eventually either the tree is girdled and dies, or

the interior rot weakens the bole of the tree and it topples. The period from initial infection to tree death varies with the number of infection sites and tree resistance, but is typically two decades.

Chaga, the harvested part of the fungus, is a dense mass of thick-walled mycelium that produces this wedge and erupts on the outside of the bark. The most common term for this mycelial mass is "sterile conk," because unlike most conks, it has no reproductive tissues, structures, or functions. (See the article by Lawrence Millman in this issue regarding the interesting reproductive biology of this fungus.) When the term "canker" is used, it refers to the swollen tree tissues surrounding the infection (Fig. 2). The chaga conk



Figure 2. The sterile conk harvested as chaga. Photo by Anatoly Boyarinov.

begins growing within a year or two near the site of infection and is large enough to harvest within three to five years. As the infection spreads up and down the bole of the tree, or from multiple sites of initial infection, several chaga conks may develop on the same tree, but usually only on the bole of the tree, not the limbs. After harvesting, chaga can regrow to harvestable size again in three to 10 years, and can be repeatedly harvested until the tree dies. Infection

rates in natural birch stands in Russia vary widely, but typically from 1-20% of the trees show signs of infection (Kuzmichev et al., 2001).

RUSSIAN CHAGA HARVESTING

When I arrived in Khabarovsk, the ice was just breaking up on the Amur River. On the weekend, the entire city, from grade school classes to soldiers were participating in a spring litter cleanup. Although wealthy corporations were sponsoring civic projects such as restoring the main cathedral, revitalizing the riverfront, and building a performing arts center, I was struck by the extent of poverty apparent throughout the city. Clearly the citizens were still struggling to maintain and restore their civil institutions and cultural heritage in the wake of communism’s demise. In my off time, I had the opportunity to explore a major World War II memorial, the cathedral, and two nature museums. Vera Kharberger, my translator, made much of my visit possible. I thought of her as my “Russian mother bear” because she was quite protective too.

Evgeniy P. Kuzmichev, a forest pathologist and mycologist, and Patrick Perner, the Project Director, ensured arrangements that allowed me to obtain the information I needed for my consultation. During my visit, I was able to meet a variety of knowledgeable individuals to discuss the chaga industry. These included scientists, foresters, nature museum staff, business owners, and government officials (Fig. 3). Unfortunately, I did not have the



Figure 3. Forest Pathologist and photographer Anatoly Boyarinov (left), resting in classic birch forest habitat for both chaga and tigers. Photo by Anatoly Boyarinov.

opportunity to talk with chaga harvesters or conservationists. April also is a bad time of year to visit the birch forests to see chaga harvesting methods. The melting boggy soils make transportation difficult, and the woods are full of ticks.

In addition to sustainability concerns, large scale export of raw chaga was also critiqued by some as not capturing local economic benefits derived from further processing into secondary



Figure 4b. Interior of dried chaga.



Figure 4a. Harvested dried chaga. Photo 4a.-4c. courtesy of David Pilz.



Figure 4c. Vacuum-packed chunks of chaga for export.

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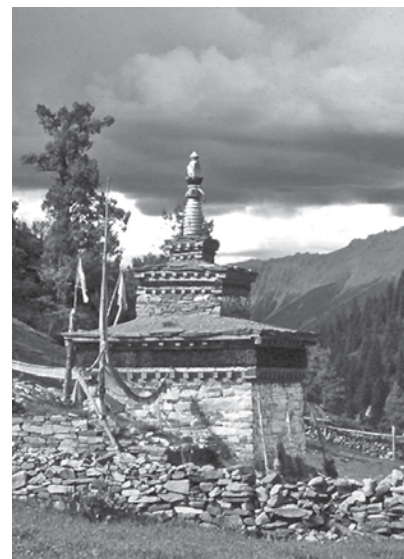
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products (Fig. 4). Most of my visits were in Khabarovsk, but I also made a side trip to Vladivostok where my guide, Elena Begunkova, and I visited a company that produced chaga teas and soft drinks for domestic and export markets.

Compared to other countries, I was impressed by the fact that Russia has a longer history of, and experience with, regulating the harvest of NTFPs. Their permitting process is more thorough and detailed, and harvest methods are often specified in greater detail. On the flip side, obtaining harvest permits was cumbersome, time-consuming, and expensive. Enforcement was sporadic and consisted only of penalties. I did not find any evidence of harvest quantities being monitored and collaboration among stakeholders was a nascent concept.

SUSTAINABLE?

Sustainable harvesting of NTFPs becomes complicated when it is considered in context; some of the overlapping salient factors are biological, ecological, environmental, economic, social, cultural, traditional, historical, political, regulatory, legal, land tenure, aboriginal rights, poaching, enforcement, harvest methods, multiple resource co-management, cultivation, markets (local, national, international), rural economic development, small versus large companies, commodity export versus value-added product retailing, and equitable profits.

For this project, I focused on biological and economic sustainability. Sometimes it just comes down to counting the beans. I created an Excel spreadsheet for calculations and populated it with the following information:

- The hectares of pure birch stands in Khabarovsk and Primorsky Krai
- The number of birch trees per hectare
- A multiplicative factor for the number of birch trees in mixed stands
- The fraction of birch trees infected
- An average weight of chaga conks that can be harvested per tree
- Years until equivalent re-harvest on same tree
- A multiplicative factor for the Russian resource
- The current legal harvest level
- A multiplicative factor for personal

use and poaching

- An adjustment factor for economic accessibility (nearness to settlements or roads)

Because little of this information was precise, and I had to make many assumptions, I conducted the calculations with all low estimates, all medium estimates, and all high estimates, each separated by 1 order of magnitude.

I did calculations for three geographical extents: the combined area of the Khabarovsk and Primorsky Krai, the boreal forest of Russia, and the global boreal forest. Output values were the total chaga resource in metric tons, the accessible annual harvestable amount in metric tons, and the percent of economically and biologically

sustainable chaga resource currently being harvested.

The upshot? The chaga resource in Russia is so immense, that even under the most pessimistic estimates, it will likely never be biologically threatened. The same cannot be said about economic sustainability. It worked out to be quite possible that chaga could be so heavily harvested near the few communities in the Khabarovsk and Primorsky Krai, that it would no longer be economically viable to go deeper and deeper into the forest to obtain chaga for large scale export. Even though these Krai are located close to Asian markets, other parts of Russia also harvest and export chaga, so there is competition for cost-effective harvesting.

Solutions? I offered several to my Russian hosts. One, of course, is shifting to value added products. Marketing approaches could include emphases on “natural” products, “traditional” use, “pollution-free” environments, “certified sustainable” harvesting, quality control, and product labels that have vibrant, humorous images that reflect Russian culture (Fig. 5).

Another approach I suggested was increasing the chaga resource near communities where it is harvested. Inoculation of uninfected trees would be easy. Doing so might even fit into forest management goals. Birches are short-lived pioneer species and Russian foresters encourage more valuable spruces to become established and grow in the sheltered understory of birch stands. Chaga could be harvested as the more valuable spruces grow up through the decaying birch stand. Unfortunately, most classically trained foresters dislike tree pathogens and this idea was not well received.

HENCEFORTH

My original report included additional recommendations addressing saprobic cultivation, trials to isolate superior strains, education, monitoring, management, regulations, etc. Contact me if you would like a copy of the original project report or the sustainable-harvest Excel spreadsheet.

The FOREST project has concluded. None of the businesses for which I compiled contact information now have functional web sites, so I don't know their fate. I have no doubt that chaga



Figure 5. Chaga soft drink. Photo by Anatoly Boyarinov.



Figure 6. Denizen of the southeastern Russian birch forest.

harvesting is still an important forest product industry in the Russian Far East, but I have no idea if it is being better regulated for sustainability. Resources for managing chaga or the conservation of Siberian tigers often get short shrift when more valuable resources like animal furs, timber, minerals, and fossil fuels compete for attention. And concerning the tigers, after seeing a stuffed one in the Khabarovsk Forest Museum, if I was forced to choose, I think I would rather encounter a grizzly while harvesting forest fungi in the boreal forests!

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THE SIBERIAN TIGER

Siberian tigers are the world's largest cat, up to 13 feet long and 700 pounds. Poaching reduced their numbers to only 40 individuals in the 1940s, but concerted conservation efforts have allowed their population to rebound to around 400 now. Their reduced range currently consists of the extensive birch forests of the Sikhote-Alin Mountains east of the Amur River in Khabarovsk and Primorsky Krai. They are still threatened by habitat loss due to logging and new logging roads that allow poachers (and presumably chaga harvesters) to access formerly remote areas. Only six instances of Siberian tigers eating humans were documented in the 20th Century. 🐾