INFORME DE DIFUSIÓN
PROGRAMA FORMACION PARA LA PARTICIPACION

1 Nombre de la propuesta :
Charla de difusión del "Tercer Taller Internacional sobre *Hongos Micorrícicos Comestibles: Ecología, Fisiología y Cultivo*", efectuado en Victoria, Canadá

1.1 Modalidad
Exposición oral con apoyo de proyector de multimedia para powerpoint

1.2 Lugar donde se llevo a cabo la formación

Universidad de Victoria, Victoria, British Columbia, Canadá

1.3 Rubro / Area temática de la actividad de formación
Hongos / Ecología, fisiología y cultivo de hongos micorrícicos comestibles

1.4 Fecha en la que se efectúo la actividad de formación:

17.08.2003 al 19.08.2003

1.5 Postulante

Rómulo Santelices Moya

1.6 Entidad Responsable

Universidad católica del Maule

1.7 Coordinador

Rómulo Santelices Moya

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1.8 Identificación de los participantes de la propuesta

NOMBRE	RUT	TELEFONO FAX E-MAIL	DIRECCION POSTAL	ACTIVIDAD PRINCIPAL	FIRMA
Rómulo Santelices Moya		71/203 501 71/203524 rsanteli@hualo.ucm.cl	Universidad católica del Maule, Depto. de Ciencias Forestales, Av. San Miguel Nº 3605, Talca	Académico	

2. ACTIVIDADES DE TRASFERENCIA

2.1. Resumen actividades de transferencia PROPUESTAS

FECHA	ACTIVIDAD	OBJETIVO	LUGAR	Nº y TIPO BENEFICIARIOS
24.10.2003	Charla difusión	Dar a conocer a un público general los resultados del Tercer Taller Internacional sobre *Hongos Micorrícicos Comestibles: Ecología, Fisiología y Cultivo*", efectuado en Victoria, Canadá	Universidad Católica del Maule, Campus San Miguel, Salón Azul, Av. San Miguel Nº 3605, Talca.	70 personas relacionadas con la actividad silvoagrícola (productores, profesionales, académicos e investigadores, y estudiantes universitarios prontos a egresar.
29.10.2003	Charla difusión	Dar a conocer a los productores asociados al proyecto Truficultura los resultados del Tercer Taller Internacional sobre *Hongos Micorrícicos Comestibles: Ecología, Fisiología y Cultivo*", efectuado en Victoria, Canadá, orientado especialmente a su relación con la trufa negra	Universidad Católica del Maule, Campus San Miguel, Sala Nº 9, Av. San Miguel Nº 3605, Talca.	Ocho productores con quienes se está trabajando en el proyecto Truficultura y otros preseleccionados para trabajar con ellos

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2.1. Resumen actividades de trasferencia REALIZADAS

FECHA	ACTIVIDAD	OBJETIVO	LUGAR	Nº y TIPO BENEFICIARIOS
24.10.2003	Charla difusión	Dar a conocer a un público general los resultados del Tercer Taller Internacional sobre *Hongos Micorrícicos Comestibles: Ecología, Fisiología y Cultivo*", efectuado en Victoria, Canadá	Universidad Católica del Maule, Campus San Miguel, Auditórium Nº1 edificio salas de clases sector biblioteca, Av. San Miguel Nº 3605, Talca.	34 personas relacionadas con la actividad silvoagrícola (productores, profesionales, académicos e investigadores, y estudiantes universitarios prontos a egresar.
29.10.2003	Charla difusión	Dar a conocer a los productores asociados al proyecto Truficultura los resultados del Tercer Taller Internacional sobre *Hongos Micorrícicos Comestibles: Ecología, Fisiología y Cultivo*", efectuado en Victoria, Canadá, orientado especialmente a su relación con la trufa negra	Universidad Católica del Maule, Campus San Miguel, Sala de reuniones de la Facultad de Ciencias Agrarias y Forestales, Av. San Miguel Nº 3605, Talca.	Los dos productores con quienes se está trabajando en el proyecto Truficultura

2.2. Detalle por actividad de transferencia REALIZADAS

Fecha 24.10.2003

Lugar (Ciudad e Institución) Talca, Universidad Católica del Maule

Actividad (en este punto explicar con detalle la actividad realizada y mencionar la información entregada) Se realizaron dos charlas expositivas con la ayuda de un proyector de multimedia y del programa powerpoint. La primera de ellas titulada "Hongos micorrícicos comestibles. Importancia y aplicaciones potenciales al sector silvoagrícola nacional", se enmarcó en los principales resultados rescatados del Taller Internacional, desde la óptica de sus aplicaciones en nuestro país. La segunda, titulada "Introducción y cultivo de trufas (*Tuber* spp.) en Chile", se enfocó a las potencialidades del cultivo de trufas en Chile. Se entregó a cada participante un disco compacto con las presentaciones realizadas, más una carpeta con hojas para tomar apuntes.

Fecha 29.10.2003

Lugar (Ciudad e Institución) Talca, Universidad Católica del Maule

Actividad (en este punto explicar con detalle la actividad realizada y mencionar la información entregada) Se efectuó una charla expositiva dirigida a los dos productores que están trabajando asociados al proyecto Truficultura que la Universidad lleva a cabo en forma conjunta con FIA. La charla denominada "Hongos micorrícicos comestibles. Importancia y aplicaciones potenciales al sector silvoagrícola nacional", se enfocó a resaltar las ventajas, de acuerdo a lo observado en el Taller en Canadá, que tiene el cultivo y producción de trufas en el Mundo. Se validó con antecedentes adicionales, que la trufa negra del Périgord es uno de los hongos más valorados a nivel global y sus perspectivas de producción en el Hemisferio sur. A los dos participantes se les entregó una carpeta con hojas para tomar apuntes. A diferencia de la charla a nivel masivo, esta se efectuó en forma interactiva y resaltando algunos puntos de interés para los productores. Se debe señalar que los dos productores asistieron a las dos charlas.

2.2. Especificar el grado de éxito de las actividades propuestas, dando razones de los problemas presentados y sugerencias para mejorar.

En general se tuvo éxito en las actividades realizadas. Se llegó a un público objetivo variado, en el cual se destacan productores, profesionales ligados al sector silvoagrícola, académicos e investigadores, y alumnos de quinto año de las carreras de Agronomía e Ingeniería forestal. No sólo asistieron persona de la VII Región, sino que también lo hicieron algunos de la VIII Región.

Sólo no se cumplió con la cantidad esperada de personas, se esperaba doblar la cantidad de personas que finalmente asistieron (hubo muchos que se excusaron de asistir por falta de tiempo). Quizás se podría mejorar este punto realizando más invitaciones y recordando cada cierto tiempo por correo electrónico. Sin embargo, la interacción que hubo con las personas que asistieron indica que el público tuvo real interés en la propuesta.

En el caso de la presentación para los productores ligados al proyecto Truficultura, sólo manifestaron interés los dos agricultores que ya están seleccionados. Los demás se excusaron por falta de tiempo.

2.3. Listado de documentos o materiales mostrados en las actividades y entregados a los asistentes (escrito y/o visual). (Se debe adjuntar una copia del material)

Tipo de material	Nombre o identificación	Idioma	Cantidad
Disco Compacto	Charla: Programa Formación/Participación "Hongos micorrícicos comestibles"	Español	37

3. ASPECTOS ADMINISTRATIVOS

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Indicar los problemas administrativos que surgieron en la preparación y realización de las actividades de difusión.

No hubo problemas administrativos que dificultaran la actividad de difusión.

Fecha: 28.11.2003

Firma responsable de la ejecución: ____________________

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	5MP				
	1 HP				

FUNDACION PARA LA INNOVACIÓN AGRARIA

PROGRAMA DE FORMACIÓN PARA LA INNOVACIÓN AGRARIA

APOYO A LA PARTICIPACIÓN EN ACTIVIDADES DE FORMACIÓN

FP-V-2003-1-A-027

MATERIAL ASOCIADO

19

3rd International Workshop on Edible Mycorrhizal Mushrooms

August 16 – 22, 2003

University of Victoria

Victoria, British Columbia, Canada

Sponsors:

Natural Resources Canada — Ressources naturelles Canada
Canadian Forest Service — Service canadien des forêts

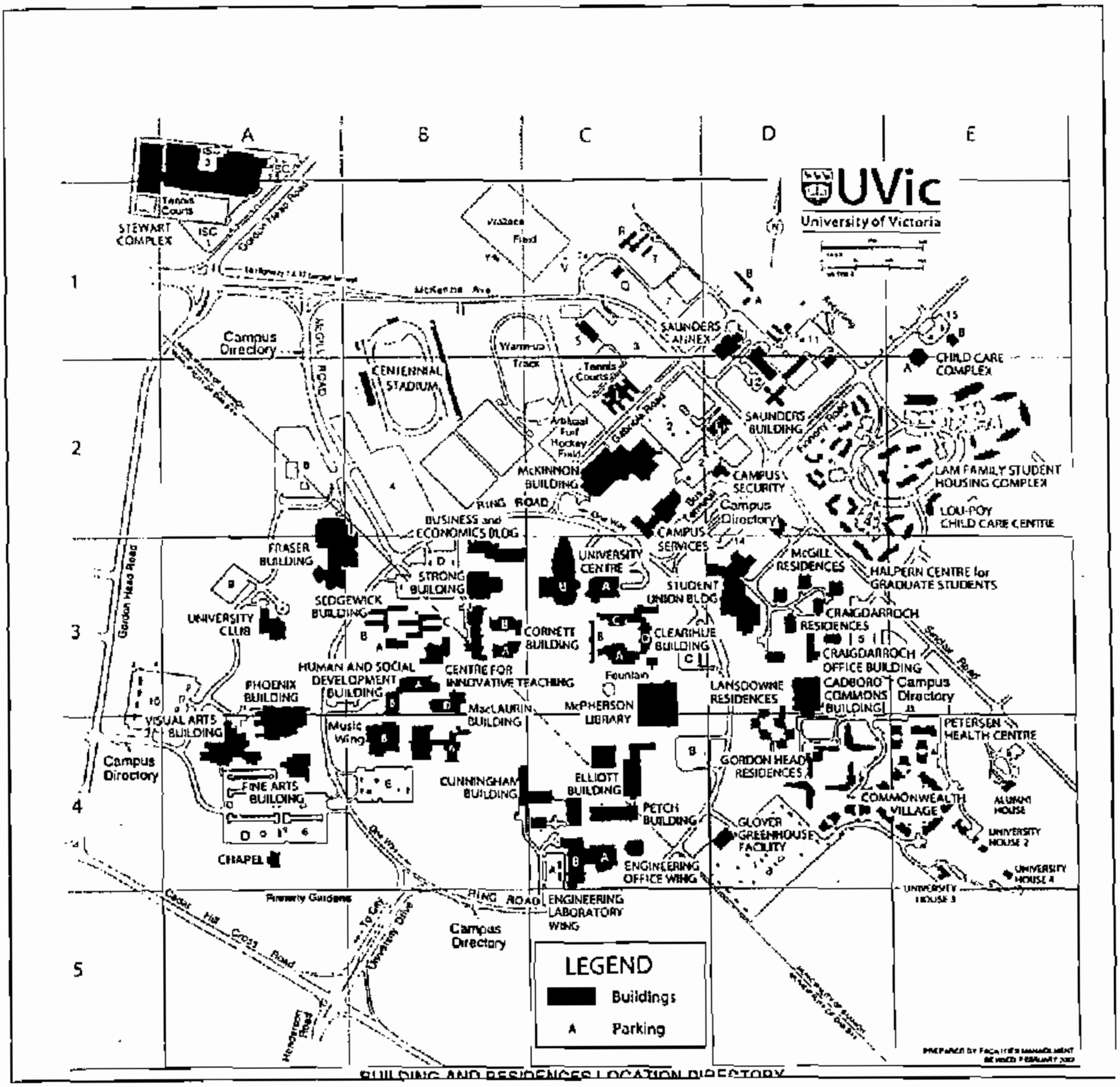
ROYAL ROADS UNIVERSITY

South Vancouver Island Mycological Society

Program overview

Saturday, August 16	
9:30 a.m. - 12:30 p.m.	Workshop on Ecology of fire-associated morels, *David Strong Building, Room C112*
Sunday, August 17	
1:00 p.m. – 4:30 p.m.	Session 1: Public lectures on matsutake, chanterelles, and truffles, *MacLaurin Building Room A144, David Lam Auditorium*
5:00 p.m. – 7:00 p.m.	Evening registration, *Caddys, Cadboro Building* Mixer for Workshop registrants, *Caddys, Cadboro Building* Poster set-up, *MacLaurin Building*
Monday, August 18	
8:30 a.m. – 5:15 p.m.	Session 2: Technical session, *MacLaurin Building Room A144, David Lam Auditorium*
6:30 p.m.	Banquet, *University Club*
Tuesday, August 19	
8:30 a.m. – 4:30 p.m.	Session 3: Technical session, *MacLaurin Building Room A144, David Lam Auditorium*
Wednesday, August 20	
8:30 a.m.	Departure of Field Trip 1: one day in Victoria area, *University Residence*
8:30 a.m.	Departure of Field Trip 2: 3-day to northern Vancouver Island, *University Residence*
5:00 p.m.	Return of Field Trip 1
Friday, August 22	
5:30 p.m.	Return of Field Trip 2

University of Victoria Campus Map



Workshop Activities and Buildings:

All oral and poster presentations: MacLaurin Building
Mixer: Caddy's in Cadboro Commons Building
Sunday Registration: Caddy's in Cadboro Commons Building
Monday Registration: MacLaurin Building
Banquet: University Club

Saturday, August 16

Ecology of fire-associated morels

Time:	Saturday, August 16 9:30 a.m. - 12:30 p.m.
Location:	University of Victoria, David Strong Building, Room C112 http://www.uvic.ca/maps/index.html
Registration:	Open to participants of the 3IWEMM and the general public. There is no fee, simply email: RWinder@pfc.cfs.nrcan.gc.ca (Limited to 60 participants)
Sponsors:	Canadian Forest Service, University of Alaska (Fairbanks)

Abstract: The extensive forests of the Pacific Northwest experience a large number of fires every year, and some of these fires produce plentiful harvests of morel mushrooms (*Morchella* spp.) A large portion of the world supply of this gourmet mushroom comes from this area of the world, where it is a leading non-timber forest product. The popularity of morels has attracted the attention of many mycological researchers, and some interesting questions have surfaced as a result. Morels are typically assigned a saprophytic role, but mycorrhizae-like associations with plants and other interactions hint at the existence of a multi-faceted environmental niche. Underpinning some of the ecological questions, the diversity of morphotypes and apparent hybrids occurring in the Pacific Northwest also hints at a need for a better taxonomic understanding. A burgeoning interest in non-timber forest products underscores the need to understand forest management strategies that will encourage and sustain the development of the commercial morel harvest. This meeting will provide a forum where questions about fire-associated morels can be explored and discussed.

Agenda:

1. Welcome to workshop (5 minutes)
2. **R. Winder** - (Natural Resources Canada / Canadian Forest Service) - "Fire-associated morels and the origin of inoculum."
3. **Nancy Weber** (Oregon State Univ.) – "Diversity in post-fire morels: Is it more than morphological?
4. **Robert Grey** (RWG Consulting) - "Prescribed fire considerations for stimulating black morels."
5. **David Pilz** (OSU) - "Unbiased landscape level estimates of morel productivity in healthy, insect-infested, and wildfire-burned forests of Northeastern Oregon."
6. **Tricia Wurtz** (USDA Forest Serv./ Univ. Alaska - Fairbanks) - "Investigations in the ecology of post-burn morels in boreal Alaska."

The talks will be about 20 min. each, with 5 min. for questions. They will be followed by a round-table discussion that will focus on: 1) Brainstorming ideas for a possible collaborative research proposal on the post-burn morels of western North America; and 2) Discussion concerning fire associated morels, their ecology, management of the resource, market issues, etc. Discussions concerning collaborative research will continue afterwards for interested participants.

Sunday, August 17

Session 1: Public Lectures
Location: David Lam Auditorium, MacLaurin Building A144, University of Victoria

Time	Speaker	Title
1:00 – 2:00	Lorelei L Norvell	Ecology and management of commercially harvested edible chanterelles in western North America
2:00 – 3:00	Akiyoshi Yamada	Recent advance in the cultivation study of matsutake mushrooms
3:00 – 3:20	**Break**	
3:20 – 4:20	Charles K. Lefevre	The native and introduced truffles of North America

Location: Caddys, Cadboro Building, University of Victoria

5:00 – 7:00	Workshop registration and mixer

Location: Lobby, MacLaurin Building, University of Victoria

5:00 – 8:00	Poster set up

Monday, August 18

Session 2: Technical session
MacLaurin Building Room A144, David Lam Auditorium

Time	Speaker	Title
8:30 – 8:45	**Registration**	
8:45 – 9:00	Shannon Berch	Welcome
9:00 – 10:00	Scott Redhead	An overview of harvestable Canadian mycorrhizal mushrooms
10:00 – 11:00	**Nutrition break and posters**	
11:00 – 11:20	Faye Murrin	Mushrooms as non-timber forest products in Newfoundland and the Atlantic Region
11:20 – 11:50	Brenda Callan	The biogeography, ecology and taxonomic status of NTFP mushrooms in BC: what we know, and what we don't know
11:50 – 1:00	**Lunch**	
1:00 – 1:20	Patrick Carrier	The effect of rainfall on wild mushroom yield: an experimental test by irrigating forest stands in Yukon
1:20 – 1:50	Daniel Mousain	Detection of polymorphism in two *Lactarius deliciosus* strains by using ISSR primers: application to the morphological and molecular characterization of *Lactarius*-like ectomycorrhizae
1:50 – 2:10	Alison Stringer	The colonial ambitions of *Boletus edulis*: the New Zealand story
2:10 – 2:30	Koji Iwase	Matsutake, true imported and false domestic
2:30 – 3:30	**Nutrition break and posters**	
3:30 – 4:00	Amnon Bustan	Optimizing growing conditions towards intensive cultivation of the black Périgord truffles
4:00 – 4:20	Marcos Morcillo	Open field mycorrhization of adult hazelnut groves with *Tuber melanosporum* Vitt.
4:20 – 4:40	Mariam de Roman	Truffle cultivation in Spain: state of the art and future prospects
4:40 – 5:10	Rómulo Santelices	Introduction and cultivation of *Tuber melanosporum* Vitt. in Chile
5:10 – 5:15	**Announcements**	

Tuesday, August 19

Session 3: Technical session
MacLaurin Building Room A144, David Lam Auditorium

Time	Speaker	Title
8:30 – 9:30	Ian Hall	Why is it so difficult to cultivate edible mycorrhizal mushrooms?
9:30 – 10:00	Nancy Weber	Nutritional modes in true morels: a review and peek at the future
10:00 – 10:20	**Nutrition break**	
10:20 – 10:50	Alexis Guerin-Laguette	Attempts to cultivate matsutake mushroom: two promising approaches
10:50 – 11:10	David Mills	Sterile systems of mycorrhized hairy roots may be used to improve in vitro production of mycorrhized seedlings
11:10 – 11:40	Wang Yun	Potential of cultivation of *Lactarius deliciosus* in NZ
11:40 – 12:00	Sylvain L. Dubé	Vitro truffle mycorrhized hazels and oaks for the establishment of truffle orchards are unrestrained travellers
12:00 – 1:00	**Lunch**	
1:00 – 1:30	David Pilz	Principles of forest management for conserving populations of harvested fungi and sustaining or enhancing their fruit-body production
1:30 – 2:00	Bill Chapman	Five year study of the ecology of pine mushroom in the Anahim Lake area of west central British Columbia
2:00 – 2:20	Marty Kranabetter	Pine mushroom (*Tricholoma magnivelare*) occurrence across age classes of western hemlock forests of northwest British Columbia
2:20 – 2:50	Darcy Mitchell	Many voices, many values: community economic diversification through non-timber forest products in coastal British Columbia
2:50 – 3:20	**Nutrition break**	
3:20 – 3:50	Susan Alexander	Mushrooms, trees, and money: values and theory
3:50 – 4:20	Sinclair Tedder	The non-timber forest product collaborative stewardship project
4:20 – 4:30	**Shannon Berch**	**Closing and announcements**

Wednesday, August 20

Field Trip 1
Departs University of Victoria residence 8:30
Returns to University of Victoria residence at 5:00

Field Trip 2
Departs University of Victoria residence 8:30
Overnight at Montfort House, Oyster River

Thursday, August 21

Field Trip 2
Overnight at Haidaway Motel, Port McNeill

Friday, August 22

Field Trip 2
Returns to Victoria at 5:30 with stops at airport, motels, residence as needed

Abstracts

ORAL PRESENTATION

Mushrooms trees, and money: values and theory

Susan J. Alexander
USDA Forest Service PNW Research Station, 3200 SW Jefferson Way, Corvallis OR 97330
Ph. (541) 745-3911
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Some information exists about the value of commercially harvested wild edible fungi in the Pacific Northwest. Prices for wood products are well documented. Little information exists, however, about the joint production of, and values for, wild edible fungi and other forest resources such as trees. There is also little known about the value of recreational mushroom harvesting. Case studies will be presented to illustrate the information needed to determine production and values for three commercially significant wild mushroom species in various ecoregions in the Pacific Northwest, and present net values for wild edible fungi and timber in different management regimes will be outlined. These values are site specific. In addition, values for recreational harvest of wild edible fungi in south-central Washington state will also be discussed. Economic comparisons of the value of timber and mushrooms are sometimes used as arguments for whether or not forests should be logged. Rarely is the answer obvious from simple comparisons of these two forest products. Production economics is concerned with choices about how much and what to produce, with what resources. Values for joint production of forest resources are sensitive to assumptions about changes in forest management, yields for mushrooms and trees, and costs.

POSTER

Preliminary evaluation of edible mushroom biodiversity and production in the Northeast of Portugal

Paula Baptista[1], Sara Branco[2] and Anabela Martins[1]

[1] Escola Superior Agrária de Bragança. Qta. de Sta. Apolónia, Ap. 172, 5301-855 Bragança, PORTUGAL, pbaptista@ipb.pt

[2] Parque Natural de Montesinho, Apartado 90, 5300 Bragança, PORTUGAL

In the Northeast of Portugal, during the last decade, an increase in the harvesting and commercialisation of edible mushrooms has been verified. In spite of the great diversity of existing mushrooms, the collectors only harvest 5-7 species. The majority of these mushrooms are mycorrhizal of the chestnut (*Castanea sativa* Mill.), oak (*Quercus pyrenaica*) and pine (*Pinus pinaster*) trees, which constitute the principal orchard species in Parque Natural de Montesinho (PNM).

This work intends to evaluate the potential production of the different species of mushrooms in the region and to estimate its economic value. We also intend to clarify the ways mushrooms commercialisation in the region, by making enquiries to collectors and companies. In order to do so, in 2002, we established fixed plots of chestnut and oak trees, in the area of PNM, where all the mushrooms were collected weekly. The fresh mushrooms were weighed and their commercial value estimated taking into account the average current price in the region for that year. The results were allocated to the hectare.

There is a greater abundance of the commercialised species in the chestnut orchards which results in a greater income per ha. In the chestnut trees the following species were found: *Amanita caesarea* (15 Kg/ha; 165,1 euros/ha), *Boletus edulis* (41,1 Kg/ha; 287,6 euros/ha), *Boletus aereus* (3,9 Kg/ha; 19,7 euros/ha), *Cantharellus cibarius* (0,6 Kg/ha; 6,8 euros/ha), *Hydnum rufescens* (2,3 Kg/ha; 19,5 euros/ha) and *Russula cyanoxantha* (1,0 Kg/ha; 8,5 euros/ha). In the areas of oaks trees the follwing species were found: *Amanita caesarea* (0,3 Kg/ha; 3,2 euros/ha), *Hydnum rufescens* (0,4 Kg/ha; 3,4 euros/ha), *Hydnum repandum* (1,5 Kg/ha; 13,1 euros/ha) and *Russula cyanoxantha* (2,6 Kg/ha; 22,5 euros/ha). The results suggest that through this natural resource it is possible to increase the chestnut trees income by at least 507,2 euros/ha and from oak trees by 42,2 euros/ha.

Mushrooms from the region are sold mainly to Spain, France, Italy and Switzerland.

ORAL PRESENTATION

The biogeography, ecology and taxonomic status of NTFP mushrooms in BC: What we know, and what we don't know.

Berch, Shannon[1]; Callan, Brenda[2]; Dennis, John[2]; and Winder, Richard[2]
1. BC Ministry of Forests Research Branch, Victoria, BC
2. Canadian Forest Service, Pacific Forestry Centre, Victoria BC

Early feasibility assessments concerning commercial exploitation of wild mushrooms in BC have listed over 70 species that could be used for nutraceutical or other purposes. Of necessity, selection of these species was largely based on anecdotal evidence from buyers and harvesters, or global research concerning cosmopolitan species. To clarify the status of these species, we have generated distribution maps based on georeferenced collections from herbaria, overlaid with tentative range information derived from expert collectors from BC and adjacent states and provinces. In some cases where there have been extensive surveys for important commercial species, i.e. pine mushrooms, our maps are detailed and even linked to specific biogeoclimatic subzones. Distribution maps for other taxa are largely incomplete. Despite extensive anecdotal evidence of commercial collection, some fungi are under-represented by herbarium specimens. Furthermore, existing distribution data may be confused by taxonomic uncertainties. For example, phenotypically distinct morel populations in BC remain unnamed but are most likely different species with different ecological niches. The abundance of ecological and nutraceutical literature for cosmopolitan mushroom species contrasts sharply with the dearth of information available for species restricted to the Pacific Northwest, making it difficult to assess the nutraceutical potential of many of BC's wild-harvested mushrooms.

POSTER

Seasonal Carbon dynamics of *Corylus avellana* in a commercial truffiére in south-western Australia

Ben P. Bradshaw, Bernie Dell and Nicholas Malajczuk
School of Biological Science and Biotechnology
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Commercial production of the Périgord black truffle (*Tuber melanosporum* Vitt.) in Australia is in its infancy and truffières have been established in the state of Tasmania and the mainland. Little attention has been given to the significance of the host plant in nourishing the truffle mycorrhiza and, importantly, the ascocarp in this species. An initial step was undertaken that examined seasonal changes in carbon translocation, allocation and storage in the host plant (*Corylus avellana*) and related this to the local climate and the proposed life cycle of *T. melanosporum*. Shoot and root material was routinely sampled and analysed for total non-structural carbohydrate (TNC) over the 2001/02 growing season. Phloem sap was collected and sugar levels were monitored during this period. TNC was stored in greatest concentration in shoot tissue, primarily as starch, which varied significantly throughout the season. By comparison, fine root TNC concentrations were lower than those of the shoot suggesting reduced storage capacity in the root. Root insoluble TNC (starch) concentrations showed less seasonal variability compared to shoot starch concentrations, however, soluble TNC of fine roots was more variable across the season. The period of greatest phloem translocation appears to coincide with the expected rapid enlargement of the ascocarp. Sucrose was found to be the major constituent of phloem sap and was in highest concentration in the late summer/early autumn period. These concentrations declined significantly in late autumn/early winter, at which period sap flow ceased. It remains unclear if current photosynthate is utilised for growth by the ascocarp during its growth and maturation phase.

POSTER

Host nutrition and fungal competitor response to applied lime in a commercial truffiere soil of south-western Australia

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A number of ECM fungi are recognised in Australia as competitors of the commercially important Périgord truffle (*Tuber melanosporum* Vitt.) (Dell et al., 2003). Truffières in Australia are generally established on acid soils and are amended with lime, gypsum and dolomite to modify rhizosphere pH to the required level. The influence of lime on infectivity of competitor species of ECM and plant host nutrition has not been examined in an Australian context and data is required to underpin management of nutrients and fungal competitors in Australian truffières. A glasshouse experiment examined the effect of lime application (0, 10, 20 & 40 g $CaCO_3$ kg^{-1} soil) to an acid loam kandosol ($pH_{(H_2O)} = 6.49$) in which seedlings of *Corylus avellana* were planted following inoculation treatment (uninoculated/control, *T. melanosporum*, *Scleroderma* spp., *Hebeloma* spp.). Root colonisation by the competitor species of *Scleroderma* and *Hebeloma* was significantly reduced at higher rates of lime whereas *T. melanosporum* was unaffected by lime treatment. Both lime and fungal treatment had a significant effect on host foliar nutrient concentrations. All treatments had higher foliar Ca levels at high lime rates but this effect was more pronounced in inoculated plants. In contrast, foliar Mn levels declined dramatically with increased lime and was not improved by inoculation. Foliar N & K responded positively to fungal inoculation and interestingly, foliar Fe concentration was unaffected by lime and fungal treatment. Gas exchange of seedlings was not affected by lime but was affected by fungal treatment. These results indicate that high rates of lime application can provide effective control of competitor ECM species most prevalent in truffières of south-western Australia but the use of lime is likely to affect the plant nutritional status on such nutrient poor soils and requires appropriate management.

References

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ORAL PRESENTATION and POSTER

Optimizing growing conditions towards intensive cultivation of the black Périgord truffles

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The high prices commanded by the black Périgord truffle have motivated efforts to develop modern intensive cultivation methods. Our approach was to establish optimal conditions for truffle production in semi-controlled detached media by mimicking natural productive truffle beds. *Cistus incanus*, a Mediterranean shrub, capable of early truffling, served as the host. The identity *of Tuber melanosporum* as the fungus partner was confirmed by molecular analysis. Mycorrhiza development was evaluated by microscopic methods. The composition of the growth medium - polystyrene-foam flakes, perlite, peat, and dolomite powder - provided the coarse and fine porosity required for adequate drainage, the appropriate balance between aeration and moisture, the desired pH (7.5-8.2), and satisfactory support of mycorrhiza development. Optimum root temperatures for mycorrhization and continued mycorrhiza development were 20-25°C. Inoculation with *Tuber*-mycorrhized root fragments proceeded more rapidly than that with a carpophore suspension, particularly at suboptimal growth-medium temperatures. Upon transplantation to bigger containers, canopy development of the host plants was rapid and correlated positively with rhizosphere volume, but spatial expansion of mycorrhiza was slower. *C. incanus* plants grown for two years in temperature-controlled artificial growth media supported remarkable development of mycorrhiza with *T. melanosporum*. Carpophore induction experiments with this system are currently underway.

ORAL PRESENTATION

The effect of rainfall on wild mushroom yield: An experimental test by irrigating forest stands in Yukon

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To determine the effects of climate change on boreal forests, I irrigated three forest stands to simulate increased precipitation from 1995 to 1999 in Yukon. I compared various ecosystem components of the irrigated stands to those on nearby control stands. The reaction of mushrooms (in total mass per m^2) was monitored once a year in August on 126 transects of 20 x 2 m. Mushroom mass per m^2 increased up to 7-fold with irrigation the first year, although the amplitude of increase progressively diminished every year.

Mushroom mass was further monitored an extra two years after the irrigation experiments ended, in order to determine how they would react to the ending of irrigation. The year following the end of the irrigation experiments, mushroom mass on formerly irrigated stands crashed to 30-50% that of control stands. The total mass of mushrooms produced over the five years of irrigation and the two following years was the same for control and treatment stands, i.e. the increased mass the first years because of irrigation was counter-balanced by an equal decrease the next years. The stimulating effect in the short-term seems itself to have caused the crash, perhaps through over usage of resources. I tested this hypothesis using multiple regressions, where the previous year's mass negatively affected the next year's mass – hence low years were followed by bumper crops, and reciprocally, bumper crops were followed by crashes. On control stands, 92% of the year-to-year variations in mushroom mass were explained by the current year's rainfall and the previous year's mushroom mass. This relationship explained 60% of the variations when all stands (irrigated or not) were included in the analysis. Hence a given year's mushroom mass is driven by both that year's rainfall (positive effect) and the previous year's mass (negative effect).

ORAL PRESENTATION

Five Year Study of the Ecology of Pine Mushroom in the Anahim Lake Area of West Central British Columbia

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Pine mushrooms in the Anahim Lake area of West Central British Columbia grow across a wide range of forest types from the Engelman Spruce Sub Alpine Fir Biogeoclimatic zone of Tweedsmuir park, going down in elevation through the Montane Spruce Biogeoclimatic zone, the Sub-Boreal Pine Spruce Biogeoclimatic zone and finally to the lowest elevation forest in the area, the Interior Douglas-fir Biogeoclimatic zone. The entire area is characterized by low rainfall (in the rain shadow of the Coast Mountains), cool dry summers and cold winters.

Soils tend to be coarse textured, with morainal parent material derived from granitic bed rock, though there is some variation in parent material. Forest floors are usually thin and in some good mushroom producing areas, non-existent with bare sand at the soil surface. Trees tend to be small and widely spaced, with a low volume of wood per hectare. The soil water regimes where mushrooms are produced could be considered as drier. Sites tend to be well to very rapidly drained, moderately arid with high to very high hydraulic conductivity, with no free water in the soil profile except immediately after surface soil wetting.

Pine mushroom producing stands tend to be old and low in vigour with a high incidence of blister rust, mistletoe and mountain pine beetle in pine forests. Pine mushroom production is seriously jeopardised by mountain pine beetle. Pine mushroom mycorrhizae form the characteristic witches broom pattern with the appearance of being parasitic.

POSTER

The Role of the Ectomycorrhizal Community in *Tuber melanosporum* truffiéres in Northern Spain

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Since 1993 we have been monitoring the mycorrhizal state of different tree species previously inoculated with *Tuber melanosporum* and then planted in several truffières in Navarra (northern Spain). The aim of our research is to confirm the presence of black truffle ectomycorrhizae on the roots of the inoculated trees over a long period of time, studying also the occurrence of other competing ectomycorrhizae.

Root samples have been taken under three different tree species, *Quercus ilex* L. subsp. *ballota* (Desf.) Samp., *Q. faginea* Lam. and *Corylus avellana* L., after which the samples were analysed in the laboratory in order to describe the ectomycorrhizal morphotypes.

This paper provides data on the monitoring of three truffières during two years (2001-2002), and the results obtained show there is a high percentage of tomentelloid morphotypes within the ectomycorrhizal community of the truffières, i.e., morphotypes belonging to the genus *Tomentella* or closely related to it, among which we can *cite Tomentella galzinii, Quercirhiza cumulosa, Q. stellata* and *Q. squamosa.*

Detailed figures on the frequency of each ectomycorrhizal morphotype occurring in each tree species are given, as well as further comments on their ecological implications in the truffières.

ORAL PRESENTATION

Vitro truffle mycorrhized hazels and oaks for the establishment of truffle orchards are unrestrained travellers

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The Canadian Food Inspection Agency imposes directives to control importation from the United States (U.S.) and domestic movement of plants for planting of all *Corylus spp.* (filbert, hazelnut) to prevent the entry and spread of Eastern filbert blight (*Anisogramma anomala* (Pk.) Muller) into British Columbia. As this disease is a quarantine pest to B.C., all propagative *Corylus spp.* materials originating in the infested areas are prohibited entry to B.C. However, the pest risk analysis concluded that the risk of introducing Eastern Filbert Blight into Canada with tissue-cultured *Corylus* is low, tissue-cultured *Corylus* plantlets are admissible into B.C. Similar restrictions apply to oaks to prevent the entry and spread of the pathogen that causes sudden oak death, a fungus-like organism *Phytophthora ramorum*. Since oaks and hazels are the most planted species for the establishment of truffières, especially for hosting the black truffle, *Tuber melanosporum*, an innovative approach had to be used to circumvent those restrictions.

We have developed a process for establishing truffle mycorrhiza on *in* vitro propagated plantlets. Our technique, based on a root culture system, allows rapid and protected colonization of rooting plantlets under an *in vitro* acclimatization scheme. Since rooting, colonization and acclimatization are realized under aseptic conditions, the mycorrhized plant material can thus be exported to nearly any country without phytosanitary restrictions.

Parts of Canada appear to posses the climate that somewhat match the desirable climatic conditions found in the European truffle production areas. The recent New Zealand and Tasmanian break-throughs in terms of establishing successful truffle productions on non-calcareous soils provide guidelines to developing a Canadian truffle growing industry.

We are now launching our first commercial products for the establishment of truffières: a series of Hazelnut hybrids selected for their nut size and high disease resistance to Eastern Filbert Blight, and compatible with truffle growing climatic zones. Within the next year, *in vitro* propagated oaks, including Gary Oak, will also become available for truffière plantations.

The presentation will also be focussing on the difficulties of establishing truffières in Canada.

POSTER

Pine Mushroom (*Tricholoma magnivelare*) ecology and management in the West Kootenay Region of British Columbia

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This project was initiated to address public concerns about potential loss of pine mushroom (*Tricholoma magnivelare*) and other commercial mushroom harvesting opportunities resulting from logging planned within the Arrow Forest District by the British Columbia Ministry of Forests (B.C. MoF). Logging plans for forests administered by the BC MoF are detailed in Forest Development Plans which show all proposed timber harvesting within an area for the next 5 years and are subject to public review. People expressed concern about proposed logging in a highly popular mushroom picking area near the town of Nakusp in the West Kootenay region of southeastern British Columbia. The B.C. MoF initiated this study in 1998 to gather information needed to include pine mushrooms in their forest management planning.

The study was conducted over 5 years. Our approach was to gather anecdotal and survey information to map productive pine mushroom habitat within the study areas. We analyzed logging plans to identify potential conflicts with productive pine mushroom habitat and developed recommendations to sustain pine mushroom production within forest development plans. We described and characterized the ecological, stand and vegetation characteristics from 25 pine mushroom fruiting sites and explored a method to identify productive pine mushroom habitat throughout the West Kootenay region using our data and available forest inventory information.

POSTER

Ectomycorrhizal Mushrooms from Old-growth CWHvm Forests in British Columbia.

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Old-growth *Tsuga heterophylla* and *Abies amabilis* forests in the Coastal Western Hemlock biogeoclimatic zone were sampled for ectomycorrhizal mushrooms. Forests were divided into montane and submontane variants, which were further classified into site series based on soil nutrient and moisture status. Forest types were replicated 3 times and sampled for ectomycorrhizal mushroom species richness and frequency. Sampling occurred along a 250 X 10 meter transect divided into 25 10 X 10 meter plots. Species richness and frequencies were determined for each year and for the combined 3 years. Around 200 species were collected from 9,000 m^2 over the 3 years. Forests in the montane variant had higher species richness and frequency (p=0.05) compared to the submontane forests. There were significant differences in species richness and frequency between the 2 site series for the driest of the 3 years only. Ordination shows that, while the r^2 value was lower than 0.5, trends indicate that different site series have different ectomycorrhizal mushroom communities.

POSTER

British Columbia's Non-Timber Forest Products: Mushrooms

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Forests in British Columbia, Canada are increasingly being used for timber and non-timber forest products (NTFP) and services. Wild mushrooms, one NTFP, are harvested or potentially can be harvested throughout the province for culinary, nutraceutical and natural dyeing purposes. We selected 12 major culinary species harvested commercially; *Cantharellus cibarius* var. *roseocanus*, *C. formosus*, *C. subalbidus*, *Craterellus tubaeformis*, *Polyozellus multiplex*, *Hydnum repandum*, *Hydnum umbilicatum*, *Clitocybe nuda*, *Lyophyllum decastes*, *Tricholoma magnivelare*, *Sparassis crispa*, and *Hypomyces lactifluorum* and described their macro and micro features, ecology and habitat. We included distribution maps, some interesting facts and synonyms for each species. These descriptions are posted onto the World Wide Web: URL http://bcmushrooms.forrex.org/ntfp. Over the next two years the remaining species will be included.

ORAL PRESENTATION

Attempts to cultivate Matsutake mushroom: two promising approaches

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Despite massive attempts, the cultivation of *T. matsutake* (Matsutake) is not achieved yet. While seedlings can be infected in vitro, the infection fails to spread after transplantation in nursery or forest sites. Using progress obtained in Matsutake ecology and physiology, we initiated two kinds of cultivation experiments based on different approaches. In the first one, we developed highly protected environment in order to limit the effect of microbial competitors onto the development of Matsutake mycorrhizas and to co-cultivate the mycorrhizal association Pine/Matsutake over long period of time (more than 1 yr.). We aim to initiate thus large fungal biomass, including Shiro-like mycelial structures. In the second one, we assume that inoculating aged trees with Matsutake directly in forest should be a straightforward way to provide a suitable rhizosphere environment for inducing Shiro development. We therefore set up a protocol to inoculate mycorrhiza-free short roots generated from root systems of 50 year-old *Pinus densiflora* trees.

In the present communication, we describe encouraging results obtained with each method. We demonstrate in particular for the first time that the roots of mature pine trees can be inoculated with a symbiotic ectomycorrhizal fungus, here the valuable Matsutake mushroom.

ORAL PRESENTATION

Why is it so difficult to cultivate edible mycorrhizal mushrooms?

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The decline in harvests of some edible ectomycorrhizal mushrooms over the past century and the sometimes obscene prices paid for some species has been the driving force for research into devising methods for their cultivation. Plants infected following inoculation with sporal suspensions or pure cultures prepared either from fruiting bodies or mycorrhizal root tips have led to fruiting body formation in the field by *Lactarius deliciosus* (saffron milk cap), *Rhizopogon rubescens* (shoro) and *Suillus granulatus* and various species of truffle including Tuber borchii (bianchetto), *Tuber melanosporum* (Périgord black truffle), *Tuber uncinatum* (Burgundy truffle) and *Terfezia* (desert truffle). There has also been some progress in the cultivation of a few other species such as *Cantharellus cibarius* (chanterelle).

However, fewer than a dozen of the many hundreds of edible mycorrhizal mushrooms have ever been cultivated with any degree of success including many important commercial species such as *Tricholoma matsutake* (matsutake) and *Tuber magnatum* (Italian white truffle). For these we are left to speculate why it has not been possible to establish viable infections on a suitable host plant or why what appear to be adequate infections subsequently fail, are displaced by other ectomycorrhizal fungi, or simply fail to produce fruiting bodies. Until we begin to understand the problems presented by these apparently intractable species it is possible that further attempts to cultivate them will be stillborn. Our paper will attempt to trigger discussion on what these problems may be and how they might be circumvented. Our pigeon-hole attitude towards classifying fungi as symbionts, saprobes and pathogens; the complex interactions some ectomycorrhizal fungi have with other soil organisms including bacteria and other ectomycorrhizal fungi; and the edaphic requirements of ectomycorrhizal fungi seem profitable areas to explore.

POSTER

The Truffle-Bed Plantation "Los Quejigares" (Soria, Spain): Study of their Ectomycorrhizae

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Introduction:

This study describes and quantified the ectomycorrhizae occurring in 16 thirty years old seedlings of evergreen oak (*Quercus ilex* L. subsp. *ballota* (Desf.) Samp.), in four areas of a 600 ha plot that produces black truffle (*Tuber melanosporum* Vitt.). It is situated in Villaciervos (Soria, Spain) and it is manage by AROTZ-CATESA.

During two springs and two autumns, between 1999 and 2001, 12 evergreen oaks that produces black truffle and 4 non-producers were sampled. The aim was know the evolution of the fungal inoculum introduced in the plot 30 years ago and compare the mycorrhizal species that appears in the trees.

This study is included in the project LIFE 99 ENV E 000356 "Truffled Mediterranean forest improvement: an example of sustainable management".

Key Words: ectomycorrhizae, truffle-growing, *Quercus ilex* L., *Tuber melanosporum* Vitt.

Materials And Methods:

Following the global method (VERLHAC *et al.*, 1990), two samples of each tree were taken in opposite orientations, preferly in South-North position, in the superficial area of the soil (10-20 cm) near to the evergreen oak without damage it. After the extraction, the samples were cleaned in an ultrasound bath, and if it was necessary, the wash process was completed with brushes and needles. Under the dissecting microscope the root apex were counted, and separating by non-mycorrhizated and mycorrhizated, and this, between *Tuber melanosporum* mycorrhizae and non-identificated mycorrhizae. The non-identificated ectomycorrhizae were preserved with lactoglycerol for their later characterization and identification.

Results

It is remarkable the presence of *Tuber melanosporum* mycorrhizae in all the studied trees, producers and non-producers of black truffle. It is also important the high percentage of this mycorrhiza, always over 45% of the total of found mycorrhizae.

It was also found a lot of competitors ectomycorrhizae morphotypes, the most importants are two species of the *Tuber* genus (*Tuber aestivum* Vitt. and *Tuber brumale* Vitt.), *Cenococcum geophilum* Fr. and *Hebeloma*-like and *Scleroderma*-like morphotypes. In tables 1 and 2 mycorrhizae percentages are summarized.

ORAL PRESENTATION

Matsutake, true imported and false domestic

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Matsutake (*Tricholoma matsutake*) is an incomparably special mushroom to Japanese people. In fact, matsutake is exclusively consumed in Japan with additional consumption in Japanese community all over the world. In Japan, substantial quantities of articles or reports on matsutake are shown on TV or newspaper especially in autumn. This paper will describe the recent matsutake related topics not only from the scientific but also the economical point of view.

A large quantity of so-called matsutake consisting of several different but closely related species is imported and sold at auction in Japan. Those imported matsutake,consists of at least 3' different species, *T. matsutake* (= *T. nauseosum*?), *T. magnivelare* and *T. caligatum*, but they are all accepted as matsutake in Japanese market, which implies those are true matsutake from the economical view point.

News of the successful cultivation of matsutake has been repeatedly released in Japan. . The Yugo-matsutake, literally means 'matsutake produced by cell fusion' was on the market this year. This affair is more precisely discussed.

Matsutake is now listed in Red data book as a near threatened species determined by Kyoto Prefecture in 2002. We will face the situation that the market is exclusively filled with imported true or domestic false matsutake in the near future.

ORAL PRESENTATION

The native and introduced truffles of North America

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European truffles are revered by North American chefs even without the history, tradition and lore that accompany truffles in Southern Europe. North America is also blessed with at least six native species harvested for culinary use. The best known of the native truffles is the Oregon white truffle, which comprises three species. Oregon white truffles are found along the west coast of North America from just north of San Francisco, California through Vancouver and Victoria, British Colombia. They appear to be specific associates of the coastal variety of Douglas fir and occur in greatest abundance beneath young plantations established on converted pasture or farmlands. The name *Tuber gibbosum* is correctly applied to Oregon white truffles collected in late winter through late spring. *Tuber gibbosum* makes up a small portion of the overall harvest. The bulk of the Oregon white truffle harvest occurs between December and February and primarily consists of a species provisionally named *Tuber oregonense*. A small part of the winter harvest also consists of the third species provisionally named *Tuber wheeleri*. Two other native truffles occurring in similar habitats within the same geographic range are the Oregon black truffle, *Leucangium carthusianum* and an undescribed and fairly uncommon *Leucangium* species often sold as Oregon black truffles, but occasionally called Oregon brown truffles. The truffle species most recently introduced to commerce in North America is *Tuber lyonii*, the Texas truffle or pecan truffle. It occurs in abundance beneath commercial pecan orchards in the southeast U.S., but is found occasionally beneath a variety of host trees from the southwest U.S. north through the eastern third of the U.S.

Because the native North American species are relatively new to gastronomy, they continue to be received with some skepticism by chefs, but the Oregon white and black truffles have also received praise ranking them among the best European species. Chefs that praise them have likely experienced fully mature truffles, whereas overall quality is often poor. The use of rakes to harvest all of the truffles in an area at once rather than using pigs or trained dogs harms quality in two ways: it leads inevitably to harvest of immature truffles and because the first harvester to arrive gets everything, there is competitive pressure to harvest truffle patches early when the proportion of mature specimens is low. Poor knowledge of differences between winter and spring white truffle species also leads to inclusion of immature spring truffles in batches of otherwise good quality winter truffles. Thus, despite praise from some of the best known chefs in North America, the Oregon truffles have developed a poor reputation, which is reflected in prices approximately a factor of ten lower than prices for French black truffles. With greater attention to quality control and education of everyone from harvesters through chefs, it may be possible to repair the reputation of Oregon truffles. *Tuber lyonii* is well received by the chefs that have served it, but it is still relatively undiscovered and has not suffered from the quality issues facing the Oregon truffles.

In the early 1980's, *Tuber melanosporum*, the French black or Perigord truffle was introduced to North America on inoculated seedlings imported from France, and the first farm began production five years after planting. Truffle farming experienced a slow start on this continent, however, after the first local company established to produce inoculated seedlings failed. Despite large areas of the continent with potentially suitable climates and soils that can be modified to meet the needs of *Tuber melanosporum*, there are still relatively few established farms with more than a few trees and only three that have produced truffles. Currently at least three companies produce seedlings inoculated with *Tuber melanosporum* and other species including *T. magnatum*, *T. oregonense* nom. prov. and *T. aestivum* syn. *uncinatum* in North America. Research is underway to develop inoculation methodologies for several other European and North American truffle species. As more plantations reach the age when truffle production can be expected we will learn more of the range of climates and soils on this continent that are capable of supporting *Tuber melanosporum* and other truffle species.

POSTER

Is the Booted Tricholoma in British Columbia really Japanese Matsutake?

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We use evidence from ribosomal repeat DNA sequences to suggest that the North American Booted Tricholoma (*Tricholoma caligatum*) and Pine Mushroom (*Tricholoma magnivelare*) are separate species and that both North American species are distinct from the Japanese Matsutake (*Tricholoma matsutake*). We determined the ribosomal ITS and 5' 28S gene sequences from three collections of the Booted Tricholoma and from four collections of the Pine Mushroom. In our analysis, we included previously determined sequences from additional 23 collections of Pine Mushrooms and allies. Sequences from all six Booted Tricholoma collections clustered together with 100% bootstrap support. Sequences from 16 Pine Mushroom collections clustered together with 98% bootstrap support. Finally, sequences from collections from Mexico labelled *'T. nauseosum'* and *'T. magnivelare'* clustered with the Japanese Matsutake with 98% bootstrap support. Mushroom buyers do not distinguish between the British Columbia species and they purchase the Booted Tricholoma as 'Pine Mushrooms.' However, similar species may have different ecological optima. The ecological requirements of the two British Columbia species should be compared. Ultimately, this comparison may lead to different management strategies appropriate for the highest value species at each forest site.

ORAL PRESENTATION

Detection of polymorphism in two *Lactarius deliciosus* strains by using ISSR primers : application to the morphological and molecular characterization of Lactarius-like ectomycorrhizae

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It has been shown that only two rDNA ITS-RFLP types were present in the INRA-Montpellier bank of about sixty *Lactarius deliciosus* strains. In particular, the two selected L.d. strains M 4-5-25 and M 4-5-34 belong to the ITS type A (Guérin-Laguette, 1998). So, their genetic diversity was investigated by using inter-simple-sequence repeat (ISSR) markers. The use of (GACA)4 primer has yielded specifically two distinct bands, each characterizing one of the two strains. Cloning and sequencing of these two DNA fragments were then performed in order to design two pairs of primers, each being specific of one of the two strains. These primers were used to characterize Lactarius-like ectomycorrhizae, sampled on nursery-seedlings inoculated with L.d. M 4-5-25 and M 4-5-34 or not inoculated and outplanted on acid soils of an experimental plantation in the Basses Cévennes (south-eastern France). Most of the sampled ectomycorrhizae showed the morphological characters of the Lactarius mycorrhizae (smooth bright orange mantle with laticifers). Using PCR assisted by the two specific selected primers, it has been showed that the two L.d. strains introduced in the plantation two years before, highly survived under mycorrhizal association with *Pinus nigra* ssp. *salzmannii*.

ORAL PRESENTATION

Pine mushroom (*Tricholoma magnivelare*) occurrence across age classes of western hemlock forests of northwest British Columbia

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1. Northern Interior Forest Region, Smithers, BC

Forest harvesting on productive pine mushroom (*Tricholoma magnivelare*) areas in northwest British Columbia could eliminate commercial mushroom harvests for many years. We examined mushroom communities over 12 stands covering a chronosequence of young, immature, mature and oldgrowth forests to estimate when reestablishment of species, including the pine mushroom, occurred. The sites were western hemlock/lodgepole pine forests on coarse-textured, well-drained sites in the Interior Cedar Hemlock zone of northwest British Columbia. We found clear differences in mushroom communities across stand ages, demonstrating the slower dispersal by many late-stage fungi species. The pine mushroom was not found in young or immature stands, and we would estimate reestablishment of this species occurs generally between 75 and 100 years. A list of indicator mushroom species for mature and oldgrowth stands were determined to evaluate the reestablishment of late-stage communities.

ORAL PRESENTATION

Many Voices, Many Values: Community Economic Diversification through Non-Timber Forest Products in Coastal British Columbia, Canada

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This presentation will review some of the issues and opportunities that have been identified in the sustainable development of Non-Timber Forest Products (NTFPs) in coastal British Columbia, Canada. The project is led by Royal Roads University, Victoria, British Columbia. The presentation will address issues in policy, research, business and employment development, and education and training as they relate to increasing community capacity to benefit from a more diverse forest-based economy. The complexity of the project reflects the complexity of identifying and responding to the challenges of sustainable development (not to mention the ever shifting landscape of funding opportunities).

The current project, which represents a continuation of several years of research and extension activity in the region led by several organizations, has been formulated and implemented in collaboration with the forest industry, non-timber forest businesses, the federal, provincial, and local levels of government, regional economic development agencies, and First Nations (indigenous populations).

Experience with the North Island Integrated Project has confirmed the need for support to be paid simultaneously to the ecological, economic and social aspects of sustainable development of NTFPs.

Lessons from previous projects in the region and from the first sixteen months of the current project include the following:

- local applied projects cannot flourish without specialized expertise and research support and without appropriate policy and industrial infrastructure that can only be implemented at the provincial or national level, or both;
- Provincial, federal or international research centres or agencies cannot be effective without the efficient extension, practical application, and "buy in" possible only through local projects that are genuinely supported and implemented by local communities;
- regional strategies, linking rural production and urban and international markets, are essential for efficient coordination of local, provincial and national initiatives.

ORAL PRESENTATION

Open Field Mycorrhization of Adult Hazelnut Groves with *Tuber melanosporum* Vitt.

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The hazelnut tree has a great socioeconomic value in the NE of Spain that nowadays is sunk in an economic crisis. Most of these fields lays on potential truffle producing areas. Our aim is to coordinate the truffle and hazelnut cultivation, trying to get an added value to the traditional harvest. In this work, inoculations with *Tuber melanosporum*'s sporal inocula has been carried out in mature hazel trees (from 11 to 30 years old). Previous to the inoculation some hazels received different treatments: desmycorrhization + plough for ones and phosphorus fertilization for others.

Two inoculations were carried out in all the treatments (spring-fall). Two years later the mycorrhization qualitative analysis reflects the presence of *T. melanosporum* among 51-69% of the hazel trees inoculated with the treatment of desmycorrhization + plough, 71% with phosphorus fertilization, and 77% of the hazels inoculated without any previous treatment.

Waiting for some truffles to grow, we think direct inoculation on mature hazel trees could be a viable way as it is less expensive, and it could reduce the waiting time for productions to come. In account of these results, mycorrhized seedlings offer great advantages but they shouldn't be considered the only way for truffle production.

ORAL PRESENTATION

Mushrooms as non-timber forest products in Newfoundland and the Atlantic Region

Faye Murrin
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The Atlantic region of eastern Canada consists of four provinces. The smallest is the highly agricultural Prince Edward Island where forested area is limited. Nova Scotia and New Brunswick are dominated by Acadian Forest and it is here that the use of mushrooms as non-timber forest products is greatest. The boreal forest and tundra covers the largest province of Newfoundland and Labrador where the exploitation of the rich mushroom flora is in its infancy. Despite differences in forest cover, the major ectomycorrhizal basidiomycetes harvested for private or commercial use are common to these provinces and shared with the rest of Canada. They include the abundant golden chanterelle, *Cantharellus cibarius*, the King Bolete, *Boletus edulis*, and the Pine Mushroom, *Tricholoma magnivelare*. Others include the Black Trumpet, *Craterellus cornucopoides*, the Winter Chanterelle, *Craterellus tubaeformis*, and *Hydnum* spp. Markets include central Canada, the United States and Europe. While accurate statistics are unavailable, the potential for commercial harvesting is generally seen as underexploited in the Atlantic Provinces. However problems with summer drought, particularly in Nova Scotia in recent years, interfere with consistent market supply, and regulation of picking is non-existent. The emphasis of this presentation is on the mushrooms of the island of Newfoundland.

ORAL PRESENTATION

Ecology and Management of Commercially Harvested Edible Chanterelles in Western North America

Lorelei L Norvell
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Chanterelles! The Pacific Golden (*Cantharellus formosus*). The White (*C. subalbidus*). The Rainbow (*C. cibarius* var. *roseocanus*). The Blue (*Polyozellus multiplex*). Plus the pig's ear (*Gomphus clavatus*), the winter craterelle (*Craterellus neotubaeformis*), and the horn of plenty (*Cr. cornucopioides*).

To the initiated, this cadence of names evokes visions of verdant moist forests, delectable repasts, or money in the pocket. But what do we know, really know, about these fascinating denizens of the fungal kingdom? How do they grow? Where do we find them? Can we grow them ourselves? Does picking them harm them? And how do we ensure a sustainable harvest for years to come?

The "chanterelle" that we pick is the fruitbody of a soil-dwelling fungus that forms a symbiotic mycorrhizal association with tree roots. The term "chanterelle", derived from a Greek word meaning cup or goblet, is used for a variety of edible, and highly prized, funnel-shaped mushrooms with ridges (instead of gills) on the undersides of their caps. In the Pacific Northwest, *Cantharellus, Craterellus, Gomphus,* and *Polyozellus* comprise the four genera producing fruitbodies with such diagnostic ridges or folds on their spore-bearing surfaces.

Chanterelles are globally renowned as one of the best edible forest mushrooms, and their annual estimated international market value may well exceed a billion dollars. A variety of species fruits plentifully in Alaska, British Columbia, California, Idaho, Oregon, and Washington forests, and during the last two decades their abundance has spawned a significant commercial harvest industry. The rise of this oft-robust regional chanterelle economy has prompted both litigation to protect chanterelle habitat as well as sociological studies of those who hunt or cook them and biological research of the beasties themselves.

Because chanterelles grow symbiotically with the roots of forest trees such as Douglas-fir, hemlock, spruce, fir, pine, and (in California) oak, managing the mushrooms for sustainable harvest also means managing forest habitats. The speaker will summarize some of what is currently known about chanterelles, craterelles, and other edible cantharelloid mushrooms, including guidelines for joint forest and chanterelle management, field keys to and photos of choice edibles (along with indifferent or poisonous look-alikes), and results from selected taxonomic, biological, and ecological scientific research. Also presented will be the story of the finding and naming of the Pacific Golden (the official Oregon state mushroom since 1999) and Rainbow chanterelles, whose ³type² specimens were collected right here on Vancouver Island.. Recipes are optional!

More detailed information, including a comprehensive bibliography of scientific papers (for the specialist) and field guides (for the neophyte), is provided in the newly published research handbook, *Ecology and Management of Commercially Harvested Chanterelle Mushrooms* by David Pilz, Lorelei Norvell, Eric Danell, & Randy Molina (2003, PNW-GTR-576). PDF files of this publication can be downloaded via the internet at http://www.fs.fed.us/pnw. Hardcopies are available without cost from the USDA-FS Pacific Northwest Research Station (PNW-RS Publications distribution, PO Box 3890, Portland, OR 97208-3890, USA. Some copies will be also available at the lecture.)

POSTER

Ectomycorrhizal mushrooms, including *Cantharellus formosus*, produced under different conifer species

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and
Shannon M. Berch
Research Branch, British Columbia Ministry of Forests

The impact of 35 year-old conifer monocultures of Sitka spruce - *Picea sitchensis* (Bong.) Carr., Douglas-fir -*Pseudotsuga menziesii* (Mirb.) Franco, western red cedar -*Thuja plicata* Donn ex D. Don in Lamb., and western hemlock -*Tsuga heterophylla* (Raf.) Sarg., on species composition, diversity and abundance of ectomycorrhizal macrofungi was researched at three locations on the west-coast of Vancouver Island. Western red cedar was shown to support some fruiting of ectomycorrhizal fungi, with juvenile rogue western hemlock in the understory. No statistically significant differences were found in diversity and abundance of sporocarps among the other three conifers, though species composition varied. Western hemlock and Sitka spruce ranked the highest and the lowest, respectively, in sporocarp production of chanterelles (*Cantharellus formosus*), the second most frequently observed mushroom in our survey. Analyses of site preferences of individual ectomycorrhizal fungi suggests that different species show affinities for different environmental conditions. For example, *C. formosus* fruited most abundantly in plots with low nitrogen, phosphorus and organic matter, while *Lactarius hepaticus* var. *laetus* preferred the opposite. Overall, communities of ectomycorrhizal fungi appear to show great resilience, adaptability, and efficiency in sharing resources, independently of conifer species.

POSTER

Chanterelle productivity on burned and unburned regeneration sites, scheduled and not-scheduled for timber harvesting in the vicinity of Skidegate Lake on Moresby Island

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Commercial harvesting of chanterelle mushrooms on the Queen Charlotte Islands is estimated at 45,000-115,000 Kg annually. Four study sites were established around Skidegate Lake on Moresby Island to determine whether chanterelle productivity on sites burned prior to regeneration, differs from sites having no fire history. All chanterelle sporocarps were sampled from within each of three parallel, 8x100 m plots. Site 1 had been burned and consisted of a 50 year old stand of Sitka spruce. Site 2 was on an unburned site and consisted of a 50 year old stand of Sitka spruce mixed with western hemlock. Site 3 was on a burned site and consisted of a younger, mixed Sitka spruce and western hemlock stand, age unknown. Site 4 was unburned and consisted of mixed western hemlock and Sitka spruce. Greatest chanterelle productivity was observed on each of the burned (1, 3) compared to unburned (2, 4) sites. The largest chanterelles were observed on site 3 with an average dry weight/fruit body of 0.52 g. Chanterelles on sites 1, 2 and 4 had average dry weights/fruit body of 0.34, 0.27 and 0.25 g respectively. In addition to chanterelles sampled from each site, 34, 33, 32 and 26 other mushroom species were noted to occur on sites 2, 3, 1 and 4 respectively. Chanterelle productivity appeared to be greatest on sites with a previous fire history and having regenerated to a mixed, 66% Sitka spruce and 33% western hemlock stand.

ORAL PRESENTATION

Principles of forest management for conserving populations of harvested forest fungi and sustaining or enhancing their fruit-body production

David Pilz[1], Eric Jones[2], Becky Kerns[3] and Randy Molina[3]

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A Non-Timber Forest Product database hosted by the Institute for Culture and Ecology (http://www.ifcae.org/) now lists 104 edible, 19 medicinal, and 191 decorative fungus species that are commercially-harvested in US forests. Many more species are likely collected for personal or recreational use. Forest managers are increasingly aware that their choices influence the occurrence and abundance of these fungi, but they often lack understanding of how such fungi respond to collection, or to forest conditions, disturbances, and management. We discuss how the mode of nutrition, growth substrate, forest habitat, and reproductive strategies of each fungus species can be used to derive general principles about how mushroom harvesting and forest management are likely to affect them. Such principles will be presented for ectomycorrhizal, soil-saprobic, and wood-saprobic fungi and their responses to (1) forest conditions such as stand age, stand density, tree species composition, presence of snags, and coarse woody debris; (2) forest disturbances such as fire, wind-throw, or pollution; (3) forest management activities such as clearcut harvesting, tree planting, thinning, yarding, slash disposal, prescribed fire, fertilization, or snag creation; and (4) harvesting impacts such as picking, raking, or trampling.

ORAL PRESENTATION

Introduction and cultivation of *Tuber melanosporum* Vitt. in Chile

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The climatic conditions of some areas in Chile are very similar to the best truffle producing areas in Europe. These areas are located primarily in the central valley between 35° and 40° S latitude and in the colder locations of the Andes foothills between 33° and 35° S. However, contrary to Europe where soils commonly present a high pH (7.5 to 8.5) most of the appropriate soils in Chile have a pH ranging from 5.5 to 7.0. This discrepancy in pH can be corrected by means of lime application.

To investigate the field behaviour and growth of *Tuber melanosporum* in Chile several agricultural sites under different environmental conditions have been selected in the VII Region where experimental truffières will be established.

Currently we are implementing mycorrhizal plant production under greenhouse conditions. In November 2002, seedlings of *Quercus ilex*, *Q. robur* and *Corylus avellana* were inoculated using dried spore inoculum of *T. melanosporum* imported from "Castellón" Spain, which was mixed with inert talcum powder as a coadjutant. Seedlings were produced in a greenhouse using local seed provenances which provide eco-types best adapted to the study area. We have also inoculated seedlings of the native species *Nothofagus obliqua* and *Nothofagus glauca* that are well adapted to the Mediterranean region in Chile.

Based on preliminary data and analyses of mycorrhizal morphotypes, the presence of *Tuber melanosporum* has been confirmed in all species 5 months after inoculation. Definitive mycorrhizal analysis will be conducted in September 2003 after ten months of greenhouse incubation.

In this paper we present our technical and experimental work to date, and we also discuss the mycorrhization levels obtained.

ORAL PRESENTATION

An overview of Harvestable Canadian Mycorrhizal Mushrooms

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Canada is the world's 2nd largest country (near 10 million sq km), spanning 6 time zones, and encompassing arctic tundra to Carolinian mixed forest, prairies, cordilleran, boreal and maritime climates. In this vast area, the number of mushroom species (>5,000) is unknown and many areas of the country remain inaccessible to commercial harvesting. Commercial harvesting of wild Canadian mushrooms takes place in most provinces and territories, serving 3 major markets: Japanese, European, American. *Tricholoma magnivelare* (Pine mushroom /American matsutake) is predominantly shipped to Japan while chanterelles, boletes, morels, and other edibles are shipped to Europe, the USA, or marketed locally. The largest harvest of chanterelles in Canada is from British Columbia, where the endemic Pacific Golden Chanterelle (*Cantharellus formosus*) is the most abundant species. North American *Cantharellus cibarius* is otherwise known from the boreal forests. Several *Boletus* spp. occur under the name *B.* edulis. *Sarcodon squamosus* is commercially harvested locally in boreal Quebec. These and other mushrooms are discussed.

ORAL PRESENTATION

Truffle Cultivation in Spain: State of the Art and Future Prospects

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The aim of this work is to provide a history of the cultivation of black truffle in Spain from its beginning in the 1950s to the present, considering also its prospects for the future. At the moment, truffle cultivation in Spain is a reality. More and more farmers decide to introduce trees mycorrhized with *Tuber melanosporum* in their land. Researchers from several universities and research centres are undertaking a pioneer investigation on a wide range of topics, such as mycorrhization in nurseries, certification of mycorrhized plants, cultivation and monitoring of truffle plantations, ecology of truffles, molecular taxonomy of truffles, reclamation of wild truffle stands or forestry practices for the improvement of truffle production. The government is also providing an increasing support for any practice related with the cultivation of truffles, because it is regarded as an activity of high economic, social and ecological interest, especially for areas which traditionally have very limited agricultural and forestry opportunities, falling thus within the concept of sustainable development.

This paper provides data on collection areas, truffle plantations, production, prices, markets and research advances, including a brief final summary of future prospects in order to establish common criteria for the truffle sector in Spain.

POSTER

Macrofungi of Six Habitats over Five Years in Clayoquot Sound, Vancouver Island

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Over five years, macrofungi from six habitats in Clayoquot Sound, Vancouver Island were documented. Habitats were categorized as: dune, spruce fringe, old growth rainforest, second growth forest, bog, and estuarine. All but the second growth forest are natural ecosystems. A total of 660 taxa of macrofungi were recorded. Between 19% and 40% of the species in any one habitat were found only in that habitat. The most frequently encountered and ubiquitous species was *Craterellus tubaeformis*, found in all years, habitats and sites. Of the 660 taxa, only 37 were found every year, and 412 found only in one year. Rare species recorded include: *Cordyceps ravenelii*, *Tricholoma apium* and *Hygrophorus inocybiformis*, in the dunes; and *Stereopsis humphreyi*, in the spruce fringe. Similarity coefficients based on fungal species in common showed that bog and estuarine habitats had only 8 to 15% in common with each other and the other habitats, whereas dune, spruce fringe and two forest types shared 19 to 27% of their species. Old growth rainforest yielded approximately 4 times as many species as bog and estuarine habitats, and approximately 1.5 times as many as the other 3 habitats.

ORAL PRESENTATION

The Colonial Ambitions of *Boletus edulis*: the New Zealand Story

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A study was undertaken to determine the taxonomic identity of *Boletus edulis* Bull.:Fr sensu lato fruiting bodies that are found in the city of Christchurch, New Zealand, and had first come to the attention of New Zealand scientists in 1993 (Wang et al., 1995). The study also endeavoured to determine how many introductions of B. edulis there had been into New Zealand.

The internal transcribed spacer (ITS) region of ribosomal DNA was sequenced in order to examine the interspecific relationship between the New Zealand samples of B. edulis and samples from Sweden, Scotland and other northern hemisphere countries.

The random amplified microsatellites (RAMS) technique was used to examine the intraspecific population dynamics of the New Zealand *B. edulis*. The New Zealand population was then compared with established populations from Uppsala and Gotland in Sweden.

The New Zealand samples of *B. edulis* seems most closely related to northern hemisphere samples of *B. edulis* sensu stricto, supported by a phylogenetic analysis of the ITS sequences. The RAMS analyses suggest that there is sufficient intraspecific variation for multiple introductions to have occurred, or that a single introduction encompassed a range of genotypes.

Wang, Y., Sinclair, L., Hall, I.R. and Cole, A.L.J. (1995) *Boletus edulis* sensu lato: a new record for New Zealand. New Zealand Journal of Crop and Horticultural Science 23: 227-231.

ORAL PRESENTATION

The non-timber forest product collaborative stewardship project

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In the province of British Columbia, Canada, thousands of people harvest non-timber forest products (NTFPs) for recreational, subsistence, traditional and commercial purposes. The most intensely harvested products include salal (*Gaultheria shallon*), boughs (e.g. *Thuja plicata*, *Abies spp*, and *Pinus spp.*), and a variety of edible wild mushrooms (e.g. *Tricholoma magnivelare* and *Cantharellus formosus*. NTFPs on Crown or public land have been managed as "open access" resources, which means that while harvesting these resources is not a "public right," government has chosen not to regulate their use, thus allowing for the free and unfettered access to forest resources other than timber. For over a decade this intensity of commercial use has created concerns about the sustainability of these species and an interest in resource management, not only within the provincial government, but also more increasingly among the harvesters and buyers themselves.

While some interest in management is clear, what that management regime will look like and do is much less clear. There are several questions concerning how to manage the NTFP resource in such a way as to ensure the long-term availability of these products and overcome a variety of resource related issues. Any management regime must balance the need to maintain a vibrant commercial sector, while protecting traditional rights and ensuring recreational access. Perhaps the most significant characteristic influencing management is the size of the area in question. British Columbia covers an area of about 95 million hectares. About 92% of this area is Crown, or public land. The British Columbia, Ministry of Forests manages 81.9 million hectares, and 48.8 million hectares of that are considered productive forest, from a timber perspective.

In an effort to understand the management challenges and to design a management regime, a collaborative relationship has been established between, Royal Roads University (RRU) in Victoria, British Columbia, and the British Columbia Ministry of Forests (BCMOF). This partnership led to an examination of the resource and management characteristics of NTFPs and now the design of a collaborative stewardship project with the aim of testing a variety of management options.

The basis for this project was a report released in 2002 by Tedder, Mitchell and Hillyer, "*Property rights and the sustainable management of non-timber forest products.*" BC Ministry of Forests, Forest Renewal BC (www.for.gov.bc.ca/het/). The report concludes that given the heterogeneity of non-timber forest product characteristics and the uncertainty of how to design an effective, efficient and equitable stewardship regime, a pilot project would provide some answers to the management question. The pilot concept has developed into the NTFP Collaborative Stewardship Project. The key element in the pilot is how to structure property rights in NTFPs that will encourage sustainable resource use and resource investment, and maintain or enhance a vibrant commercial sector while protecting traditional and recreational uses. The models currently being considered include the following: the enhancement of existing rights in forest resources (e.g., more private type systems such as expanding the comprehensiveness of existing timber tenure rights to include NTFPs); establishing a new form of property rights in NTFPs exclusive of existing timber tenure rights (e.g., common property systems such as local user associations, or First Nations management); and a blending of the two models (e.g., a First Nations / forest company joint rights).

The purpose of each stewardship approach is to test the ability and desire to manage and benefit from the NTFP resource, create incentives to invest in the NTFP resource, look for synergies between timber and NTFP management, and test whether creating property rights in NTFPs can lead to a sustainable commercial harvest and the long-term provision of resources for personal, subsistence and cultural or traditional purposes.

Sterile systems of mycorrhized hairy roots may be used to improve in vitro production of mycorrhized seedlings

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Our objectives were 1) to evaluate the ability of *Cistus incanus* hairy roots, mycorrhized with *T. melanosporum*, to inoculate *C. incanus* seedlings, and 2) to determine the appropriate growth media for this in vitro system. Two growth media, M and N5, were compared on Phytagel®. Medium M was tested also with Perlite. N5 promoted intensive growth of the hairy roots culture but inhibited mycelium growth whereas medium M had opposite results. N5 enhanced all parameters of seedlings' development excluding root growth. Nevertheless, mycorrhization degree was much higher in medium M (35%) than in N5 (0.2%). In addition, the fraction of mycorrhized plants in Phytagel® varied from 100% on M to 10% on N5. Comparing to Phytagel®, Perlite reduced root length by 53%, only 50% of the plants were mycorrhized, but no change was observed in mycorrhization degree. It is evident that mycorrhized hairy roots provide an efficient tool to induce in vitro mycorrhization between *T. melanosporum* and *C. incanus* seedlings, especially when the combination of medium M and Phytagel® is used.

POSTER

Laboratory and field inoculation of Norway spruce and Scots pine with two edible ectomycorrhizal fungi

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Several strains of the edible mushrooms *Boletus badius* and *Boletus edulis* were isolated from fresh fruit-bodies growing in the Norway spruce forest near Průhonice, Czech Republic. After three months of cultivation on agar media in Petri dish, three strains of *B. badius* started to produce small fruit-bodies. Vegetative mycelium of all fungal isolates was grown in axenic conditions for field inoculations. All strains were tested in the split Petri dish system for the ability to form ectomycorrhizas with Norway spruce and Scots pine. Both host species formed ectomycorrhizal root tips while inoculated with all tested strains. In March 2003, a field trial was started with inoculations of individual strains or different combinations of fungal strains. A total of 20000 bare root seedlings of Norway spruce and Scots pine were inoculated at transplantation from nursery to the soil. Presence of ectomycorrhizas, growth response and occurrence of mushrooms of the used fungal species are being evaluated on the inoculated plots and compared with the uninoculated controls.

ORAL PRESENTATION

Nutritional Modes in True Morels: A Review and Peek at the Future

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Morels have been thought to be parasitic, saprobic, or mycorrhizal depending on the type of data collected and the kind of morel involved. Recent work supports the hypothesis that within the genus *Morchella* both saprobic and biotrophic (ranging from facultatively to obligately mycorrhizal) nutritional strategies occur. Through pure culture synthesis, including extensive microscopic and physiological studies, and field studies of carbon isotopes (C-13 and C-14), evidence is mounting that some species may be capable of following both strategies but at different stages of development or under different conditions. Radiocarbon measurements are a promising new tool to assess the age of fungal carbon and thereby infer mycorrhizal status.

ORAL PRESENTATION

Recent advance in the cultivation study of matsutake mushrooms

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Matsutake mushrooms consist of two major species, i.e. *Tricholoma matsutake* (syn. *T. nauseosum, T. caligatum*) and *T. magnivelare* (syn. *T. ponderosm*). Although recent taxonomic outcomes provide various discussions in the species name of *T. matsutake* population, here I accept the broader sense of the specie name. The American matsutake (*T. magnivelare*) can be distinguished from Japanese matsutake (*T. matsutake*) based on the morphology of fruit bodies and DNA fingerprints. Here I talk about recent advance in the cultivation study of matsutake mushrooms, especially in *T. matsutake*.

Tricholoma magnivelare has been popular in the Japanese market since last decade. It costs 1,000 – 2,000 yen/100g fresh weight, which is generally the same with that of *T. matsutake* imported from several Eurasian and African countries. Sum of the matsutake mushrooms imported annually to Japan exceeds several thousand tons. Most Japanese people can enjoy only these matsutake fruit bodies, because the domestic harvest of *T. matsutake* is quite limited (at most a few hundred ton) and expensive (5,000 - 50,000 yen/100g). Annual whole sale of matsutake mushrooms in the Japanese market is estimated at around 30 - 40 billion yen. The domestic harvests of *T. matsutake* in Japan have been decreasing since the peak (twelve thousand ton per year) in 1930's. The reasons for the decrease have been described elsewhere[1,2]. Some also fear to decrease the matsutake mushroom harvests outside Japan in the near future. Anyway, the reason for studying cultivation of matsutake mushrooms is not only sustaining the natural production but also increasing it.

The mycorrhizal status of *T. matsutake* at the microscopic revel was revised in the recent year as to be ectomycorrhizal[3,4]. The fungus form relatively slender mycorrhizal tips, thin fungal mantle, and typical Hartig net mycelium on the roots of *P. densiflora*, which is similar to the *T. magnivelare-P. contorta* var. *latifolia* association[5]. The *T. matsutake* is known to distribute under various coniferous forests in Japan, i.e. *Pinus*, *Picea*, *Tsuga*, and *Abies*[1,6], where microscopic studies of the mycorrhizal associations are desired. The known specific characteristics of matsutake-pine association other than the above description are bleached soil called "shiro" around the mycorrhizal tips, chlamydospore-like structure, and carbonization of older mycorrhizas, which may support the idea that the fungus is ecophysiologically different from the general mycorrhizal mushrooms[1].

As well as under natural field conditions, *T. matsutake* forms ectomycorrhizas with *P. densiflora* under in vitro conditions[7,8,9,10]. The symbiotic effect of *T. matsutake* defined as the growth promotion of host in not yet well studied, the mycorrhizal association can be maintained over a year. Under such situation, plant height reaches 10-15cm, and shiro-like structure develops, but no sign of fruiting is observed. Host specificity of the matsutake mushrooms is comparable among fungal species through the experiment of mycorrhiza synthesis. The *T. matsutake* isolates from Japan form ectomycorrhizas with some conifers in Japan but not with others[11]. Interestingly, European red pine, *P. sylvestris*, is also susceptible with Japanese isolate of *T. matsutake*. In addition, *T. matsutake* isolates from Asia, Africa, and Europe, and *T. magnivelare* from Canada, all forms ectomycorrhizas with Japanese red pine, *P. densiflora*. Within these associations, *T. magnivelare* develops the largest amount of mycorrhizas. The latest objectives of this kind of study are to enlarge the scale of mycorrhization experiment (soil volume, incubation period, etc.) and screen the suitable fungus-plant combinations.

Another technique to inoculate the cultured *T. matsutake* mycelium to the root of *P. densiflora* has been recently conducted under field forest conditions. Before inoculating mycelium, mycorrhiza-free roots must be induced from the root cutting on the root system of mature tree. This method is rather preliminary, but only one to have been proven microscopically the success of artificial ectomycorrhization of *T. matsutake* in the field conditions[12].

Molecular biological techniques have enable fruitful but complicated discussion in the taxonomy and phylogeny of matsutake mushrooms[13, 14, 15]. This at least indicates the need for further study of fungal specimen not yet well analyzed. Mexican matsutake, *Tricholoma* sp.[2], is required for the precise species identification from the economical point of view in Japan. To understand the *T. matsutake* population throughout the Eurasian continent, specimen from Western Asia and Siberia may be the key. Some *T. matsutake* populations in the southwestern China have been observed in oak forests[16], which suggests the importance of synthetic experiments with such hosts. Genome analyses of matsutake mushrooms[17, 18, 19], that are rather new techniques, may be powerful for the mycelial manipulation. The finding of retroelements that consist of retrotransposon genes from *T. matsutake* is expected as the target for transformation of mushrooms[18]. This molecular technique also suggest the importance of classical ecophysiological studies such as mycorrhizal synthesis to understand and estimate the function of genes based on the established phenotype of matsutake.

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ORAL PRESENTATION

Potential of cultivation of *Lactarius deliciosus* (saffron milk cap) in NZ

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Isolates of *Lactarius deliciosus* (saffron milk cap) were made from European fruiting bodies, imported into New Zealand and used to infect *Pinus radiata* seedlings. When these were 12 to 26 months old they were used to establish experimental plantations in both North and South Island. Within 6 to 12 months *L. deliciosus* had extended onto the new host roots. The first saffron milk cap fruiting body was produced after 1½ years in a North Otago plantation. A year later this plantation produced the equivalent of 50 kg/ha of fruiting bodies. The production of fruiting bodies was affected by the infections on the seedlings, soil conditions and management.

Field trips

Field Trip 1

Wednesday, August 20	8:30 Leave University of Victoria 8:45 – 9:15 Stop at Mount Douglas Park, *Bob Maxwell and Del Meidinger* 9:45 – 10:15 Stop at Goldstream Park, *Bob Maxwell and Del Meidinger* 10:45 – 11:15 Stop at possible future truffiere, Shincliffe Farm, David and Joan Lestock-Kay, *Wayne Haddow* 11:15 – 11:45 Drive to Duncan 12:00 Lunch at Riverwalk Café, *Cowichan FN* 1:00 – 1:30 Tzinqwa Dance, *Cowichan FN* 1:30 – 2:00 Great Deeds video, *Cowichan FN* 2:00 – 2:30 Totem pole tour, *Cowichan FN* 3:00 – 3:25 Mill Bay ferry to Brentwood Bay 3:45 – 4:15 Stop at possible future truffiere, Field Stone Garlic Farm, *Bob Maxwell and Wayne Haddow*

Field Trip 2

Wednesday, August 20	8:30 Leave University of Victoria 8:45 – 9:15 Stop at Mount Douglas Park, *Bob Maxwell and Del Meidinger* 9:45 – 10:15 Stop at Goldstream Park, *Bob Maxwell and Del Meidinger* 10:45 – 11:15 Stop at future truffiere, Shincliffe Farm, David and Joan Lestock-Kay, *Wayne Haddow* 11:15 Drive to Nanaimo, Maffeo/Sutton Park 12:15 – 1:00 Lunch 1:00 – 2:00 Drive to Courtenay 2:00 – 3:30 Stop at wild mushroom buyer station and mushroom habitat, Courtenay, *Rick Ross, Western Evergreens* 3:30 - 4:00 Drive to Montfort House, Oyster River 6:00 Dinner at Salmon Point Pub 8:00 – 8:30 Presentation on agroforestry and big leaf maple wine tasting, *Harold Macy*
Thursday, August 21	7:30 Drive to Campbell River 7:45 – 8:30 Breakfast at Beehive Restaurant 8:30 Leave for Woss 9:30 – 9:45 Keta Lake Rest Stop 9:45 - 10:30 – Drive to Woss Stop 1 beyond Hoomak Lake Rest Area 10:30 – 10:50 Chanterelle habitat and research, Woss Stop 1, *Tyson Ehlers* 10:50 – 11:00 Drive to Woss Stop 2 11:00 – 11:20 Pine mushroom habitat, Woss Stop 2 11:20 –11:30 Drive to Woss Stop 3 11:30 – 11:50 Old Growth trail 11:50 – 12:00 Drive to Mine Lake 12:00 –12:30 Lunch at Mine Lake 12:30 – 1:00 Drive to Port McNeill 1:00 Arrive Haidaway Motel, Port McNeill 1:00 – 1:45 Check in to motel 1:45 Leave to catch ferry 2:10 – 3:00 Ferry from Port McNeill to Alert Bay, Cormorant Island 3:30 – 4:30 Tour of U'Mista Cultural Centre, *Andrea Sanborn* 5:00 – 6:00 Tour of Gater Gardens and CMTs, *Harry Alfred* 6:30 – 8:00 First Nations banquet, *Nam'gis First Nation* 8:20 – 9:20 Ferry from Alert Bay to Port McNeill
Friday, August 22	7:30 – 8:30 Breakfast in Port McNeill 8:30 – 10:30 Drive to Campbell River 10:30 – 10:45 Rest Stop at Esso Station on 16th 10:45 – 11:15 Drive to next stop 11:15 – 11:25 Stop on Hwy 19, south of Hamm Road and just north of Millar Creek 11:25 – 12:45 Drive to Englishman River Fall Provincial Park 12:45 – 1:30 Lunch 1:30 – 2:15 Drive to Morden Colliery Provincial Park, south of Nanaimo 2:15 – 2:45 Walk in Morden Colliery Provincial Park 2:45 – 5:00 Drive to Victoria

Site potential for Périgord Black Truffle production, Southern Vancouver Island
Information for France, Italy, NZ taken from *The Black Truffle* by I Hall, G Brown and J Byars

Climatic conditions for truffiéres in Europe and New Zealand:

	France/Italy	NZ	Duncan	Saanich
Annual rainfall (mm)	600-1500	1058	992	695
Mean daily temperature summer (C)	17.5 – 22	18.7	16.7[1]	15.6[2]
Mean daily temperature winter (C)	1 – 8	9.1	3.3	4.0
Annual sunshine hours	1900-2800	2204	1803	1985
Summer sunshine hours (April – Sept)	1200-1800	1319	1352	1454
Approximate degree days (10 C)	900-1900	1430	*1158[3]	*957[4]

Soil conditions for truffiéres:

pH	• minimum 7.5 • optimum 7.9 • not to exceed 8.0 especially for oak (induces Fe deficiency)	•[5]
Depth	• 40 cm	•
Surface OM	• 8%	•
Plant available Ca, Mg	• High	•
Plant available P	• Moderate	•
Na	• Low	•
Drainage	• Free	•[6]
Texture	• Loam, granular	•
Aeration	• Good	•

[1] July, August, September 1941 to 1970 average, from Environment Canada. Ministry of Forests site in Duncan & Agriculture Canada's Saanichton Research station. A second reference indicates a summer temperature of 17.4 for Duncan.
[2] July, August, September 1941 to 1970 average, from Environment Canada. Ministry of Forests site in Duncan & Agriculture Canada's Saanichton Research station. A second reference indicates a summer temperature of 17.4 for Duncan.
[3] Effective Growing degree days above 5 degrees C: Climate Capability Classification for Agriculture in B.C. –BC. Environment 1978 More work is needed to calculate GDD on a 10 degree C base.
[4] Effective Growing degree days above 5 degrees C: Climate Capability Classification for Agriculture in B.C. –BC. Environment 1978 More work is needed to calculate GDD on a 10 degree C base.
[5] pH can be adjusted via application of lime, does the pH have to be uniform throughout the top 40-50 cm of the soil profile?
[6] Some site selection work will be needed to find a southern exposure site (for heat units and sunshine hours- if these criteria are not critical then maybe other aspects could be considered), free drainage and good aeration. A higher sand content towards sandy loam would be needed to facilitate winter harvest and tillage in Feb or March in most years.

Site conditions:

History	• Site free of ectomycorrhizal* plants for over 5 years
Location	• Not down hill from ectomycorrhizal trees • More than 100m from ectomycorrhizal trees

*Ectomycorrhizal species include all Pinaceae and most temperate hardwoods.

Establishing and maintaining truffiéres:

Planting density	• 800/ha (100 – 1250) Europe • 400 – 500/ha NZ
Irrigation	• Required if spring, summer, fall rains are not adequate
Fencing	• Protection from browsing
Windbreaks	• Protection from desiccation
Host trees	• Hazel, Oak
Soil cultivation for soil aeration and weed control	• Once in spring (Feb – March in France)
Weed control	• Early cultivation and mowing
Pruning	• Single trunk preferred but up to 2 for oak and 3 for hazel permitted
Double cropping of hazel for truffles and nuts	• For maximum truffle production, plants and rows should be relatively close and root zone (Brulé) must not be compacted, so nuts are NOT harvested.
Fertilizer application	• Usually composted organic matter is added to keep %OM up

Harvesting the truffles:

Onset and duration of truffle formation	• Hazel produces years 4 – 25 • Oak produces years 10 – 100
Where formed	• In brulé from soil surface down to 50 cm
How harvested	• Found by truffle dog • Carefully hand dug
Yield	• 25 - 30 (-300) kg/ha after a decade • Not really well documented
Value	• $6,000CAN/kg retail • Volatile, speculative, etc.

The Four-Story Forest: A Model for Coastal Agroforestry

Harold Macy
University of British Columbia, Oyster River Farm

There are many agroforestry practices that combine trees with other crops using innovative combinations. Generally speaking, however, most agroforestry techniques are designed to integrate trees or woody shrubs into a primarily agricultural environment that may be lacking in the structural diversity afforded by trees.

However, on the coast of British Columbia, keeping the inexorable pressure of forest succession from encroaching into cleared agricultural land is more the task. Many ancestors of local farmers spent thousands of back-breaking hours digging, blasting, burning and pulling stumps out of their land. To propose the re-establishment of trees on those lands may not receive popular support if not outright derision.

Instead of introducing trees into an agricultural setting, a prime concept for coastal agroforestry is to bring agricultural technology, practices and intensity into our vibrant and dynamic forests. This is commonly termed "Forest Farming".

To successfully introduce agroforestry knowledge into coastal sites, two obstacles must be overcome: the reluctance to re-establish trees on cleared land, and the perceived long-term commitment of forest management. Practices such as Alley Cropping, Windbreaks, Timberbelts, and Silvopasture may address the first concern. Forest Farming, with short-term crops, speaks to the second.

It will require some adjustment of standard operating procedures or techniques in both agriculture and forestry to make full advantage of these practices. However, the immediate and future benefits hold great promise. Practitioners will require an open mind and a creative approach. It will be necessary to "read the landscape" and follow nature's lead, to work within the natural patterns of ecological succession.

Checklist of the larger fungi of Vancouver Island
October 2002
Prepared by Ian Gibson and the South Vancouver Island Mycological Society

Agaricus
[] albolutescens r
[] arvensis C
[] augustus a
[] bisporus r
[] bitorquis r
[] californicus r
[] campestris c
[] diminutivus gr. r
[] hondensis C
[] micromegathus r
[] osecanus r
[] praeclare-squamosus C
[] purpurellus r
[] semotus R
[] silvaticus R
[] silvicola c
[] smithii C
[] subrufescens *C*
[] subrutilescens c
Agrocybe
[] dura C
[] erebia r
[] pediades r
[] praecox R
[] sororia r
Albatrellus
[] ovinus C
Aleuria
[] aurantia A
Alpova
[] diplophloeus c
Amanita
[] aprica nom. prov. c
[] constricta r
[] farinosa r
[] franchetii c
[] gemmata c
[] muscaria A
[] novinupta r
[] pachycolea *R*
[] pantherina C
[] phalloides R
[] porphyria c
[] silvicola c
[] smithiana C
[] vaginata C
[] virosa r
Antrodia
[] xantha r
Arcangeliella r
Armillaria
[] gallica r
[] mellea group C
[] nabsnona R
[] ostoyae C
Ascocoryne
[] sarcoides C
Asterophora
[] lycoperdoides r
[] parasitica r
Astraeus
[] hygrometricus R
Auriscalpium
[] vulgare C
Baeospora
[] myosura r
Bisporella
[] citrina C
Bjerkandera
[] adusta R
Bolbitius
[] vitellinus c
Boletopsis
[] subsquamosa c
Boletus
[] barrowsii R
[] chrysenteron C
[] coniferarum u
[] edulis C
[] flaviporus r
[] luridiformis r
[] mirabilis A
[] piperatoides r
[] piperatus a
[] pulcherrimus r
[] subtomentosus *U*
[] zelleri C
Bondarzewia
[] montana C
Botryobasidium
[] croceum r
[] obtusisporum r
Bovista
[] plumbea c
Callistosporium
[] luteo-olivaceum r
Calocera
[] cornea R
[] viscosa U
Calocybe
[] onychina r
Cantharellula
[] umbonata r
Cantharellus A
[] cibarius u
[] formosus A
infundibuliformis = Craterellus tubaeformis
[] subalbidus A
Catathelasma
[] ventricosa r
Caulorhiza
[] umbonata r
Chamonixia
[] caudata r
Chlorociboria
[] aeruginascens C
Chondrostereum
[] purpureum r
Chromosera
[] cyanophylla r
Chroogomphus
[] rutilus r
[] tomentosus *A*
[] vinicolor r
Chrysomphalina
[] aurantiaca u
[] chrysophylla u
Ciboria
[] rufofusca R
Clavaria
[] purpurea u
[] rubicundula r
[] vermicularis U
Clavariadelphus
[] ligulus R
[] truncatus R
Claudopus
[] byssisedus r
Claviceps
[] purpurea R
Clavicorona
[] taxophila R
Clavulina
[] cinerea R
[] cristata *A*
[] ornatipes r
[] rugosa r
Clavulinopsis
[] corniculata r
[] fusiformis R
[] laeticolor r
[] subtilis r
Clitocybe
[] albirhiza r
[] avellaneialba r
[] clavipes c
[] dealbata c
[] deceptiva r
[] dilatata c
[] epichysium r
[] fellea r
[] fragrans r
[] gigantea r
[] harperi r
[] incomis r
[] odora C
[] sclerotoidea R
[] sinopica R or *R*
Clitocybula
[] atrialba C
Clitopilus
[] prunulus r
Collybia
[] cirrhata r
[] tuberosa u

Coltricia
[] cinnamomea c
[] perennis c
Conocybe
[] filaris gr u
[] lactea r
[] tenera r
Coprinus
[] atramentarius C
[] comatus A
[] lagopus c
[] micaceus c
[] plicatilis r
Cordyceps
[] capitata r
[] militaris R
[] ophioglossoides r
[] myrmecophila r
Cortinarius
[] acutus r
[] alboviolaceus c
[] allutus r
[] anomalus r
[] azureus r
[] bicolor r
[] brunneus gr. r
[] californicus r
[] callisteus *R*
[] camphoratus u
[] cinnamomeus R
[] clandestinus r
[] collinitus gr r
[] croceofolius gr. c
[] croceus *R*
[] cyanites r
[] delibutus r
[] duracinus r
[] fasciatus r
[] fulvescens r
[] gentilis r

[] glaucopus r
[] infractus r
[] mucosus r
[] mutabilis U
[] obtusus r
[] obtusus group r
[] olympianus r
[] percomis r
[] phoeniceus var. occidentalis c
[] porphyropus r
[] renidens r
[] sanguineus c
[] scaurus group r
[] semisangineus c
[] subfoetidus r
[] superbus r
[] traganus u
[] vanduzerensis u
[] vibratilis c
[] violaceus *C*
Craterellus
[] tubaeformis A
Crepidotus
[] applanatus c
[] herbarum R
[] mollis *C*
Cristinia
[] helvetica r
Crucibulum
[] laeve A
Cryptoporus
[] volvatus U
Cudonia
[] circinans R
[] grisea r
[] monticola *R*
Cyathus
[] olla r
[] striatus r
Cyphellostereum
[] laeve r
Cystoderma
[] amianthinum C
[] cinnabarinum r
[] fallax c
[] granulosum c
[] gruberianum r
Cystolepiota
[] seminuda r
Dacrymyces
[] alpinus C
[] chrysocomus R
[] chrysospermus A
deliquescens = stillatus
[] minor r
palmatus = chrysospermus
[] stillatus R
Daldinia
[] concentrica R
Dasyscyphus
[] virgineus U
Dendrocollybia
[] racemosa r
Dentinum
See Hydnum
Dermocybe
See Cortinarius
Discina
[] ancilis U
perlata = ancilis
Elaphomyces
[] granulatus R
[] muricatus R
Entoloma C
[] bloxami r
[] rhodopolium r
Flammulina
[] velutipes C
Floccularia
[] albolanaripes r
Flocculina
[] granulosa r
Fomitopsis
[] cajanderi C
[] officinalis R
[] pinicola A
Galerina
[] atkinsoniana r
[] autumnalis c
[] badipes r
[] fallax r
[] heterocystis r
[] mammillata r
[] stylifera r
[] tibiicystis r
[] vittaeformis r
Ganoderma
[] applanatum A
[] browni R
[] oregonense C
[] tsugae *C*
Geastrum
[] quadrifidum r
[] saccatum u
[] triplex R
Geoglossum
[] glabrum r
Geopetalum
[] porrigens A
Geopyxis
[] carbonaria r
[] vulcanalis r
Gloeophyllum
[] saepiarium C
Gomphidius
[] glutinosus R
[] oregonensis A
[] smithii c
[] subroseus A
Gomphus
[] clavatus C
[] floccosus C
Gymnopilus
[] aeruginosus r
[] bellulus r
[] flavidellus r
[] penetrans r
[] picreus *R*
[] punctifolius u
[] sapineus group r
[] spectabilis group C
Gymnopus
[] acervatus *C*
[] alkalivirens r
[] confluens U
[] dryophilus u
[] fuscopurpureus r
Gyromitra
[] californica R
[] esculenta C
[] montana r
[] infula U
Hapalopilus
[] nidulans R
Hebeloma
[] crustuliniforme a
[] mesophaeum group c
[] sacchariolens r
[] sinapizans group C
Helvella
[] acetabulum U
[] compressa r
[] crispa r
[] elastica R
[] lacunosa A
[] leucomelaena r
[] stevensii R
Hemimycena
[] delicatella r
Hericium
[] abietis C
[] erinaceus r
[] ramosum R
Heterobasidion
[] annosum R
Heterotextus
[] alpinus C
Heyderia
[] abietis r
Hohenbuehelia
[] petaloides C
Humaria
[] hemispherica R
Hydnellum
[] aurantiacum C
[] caeruleum *C*
[] conigenum r
[] peckii C
[] scrobiculatum C
[] suaveolens *C*
Hydnum
[] repandum C
[] umbilicatum C
Hydropus
[] marginellus r
Hygrocybe
[] acutoconica R
[] cantharella r
[] chlorophana r
[] coccinea r
[] conica C
[] flavescens r
[] laeta r
[] miniata u
[] parvula r
[] psittacina r
[] punicea r
[] reai r
[] subminutula r
[] turunda r
[] unguinosa r
Hygrophoropsis
[] aurantiaca A
[] olida u
Hygrophorus
[] agathosmus u
[] bakerensis r
[] borealis r
[] camarophyllus r
[] chrysodon r
[] eburneus r
[] erubescens r
[] foetens r
[] gliocyclus r
[] hypothejus r
[] inocybiformis r
[] laetus r
[] niveus r
[] olivaceoalbus r
[] pacificus r
[] piceae c
[] pratensis r
[] pudorinus *R*
[] pusillus r
[] russocoriaceus r
[] saxatilis u
[] subalpinus r
[] virgineus r

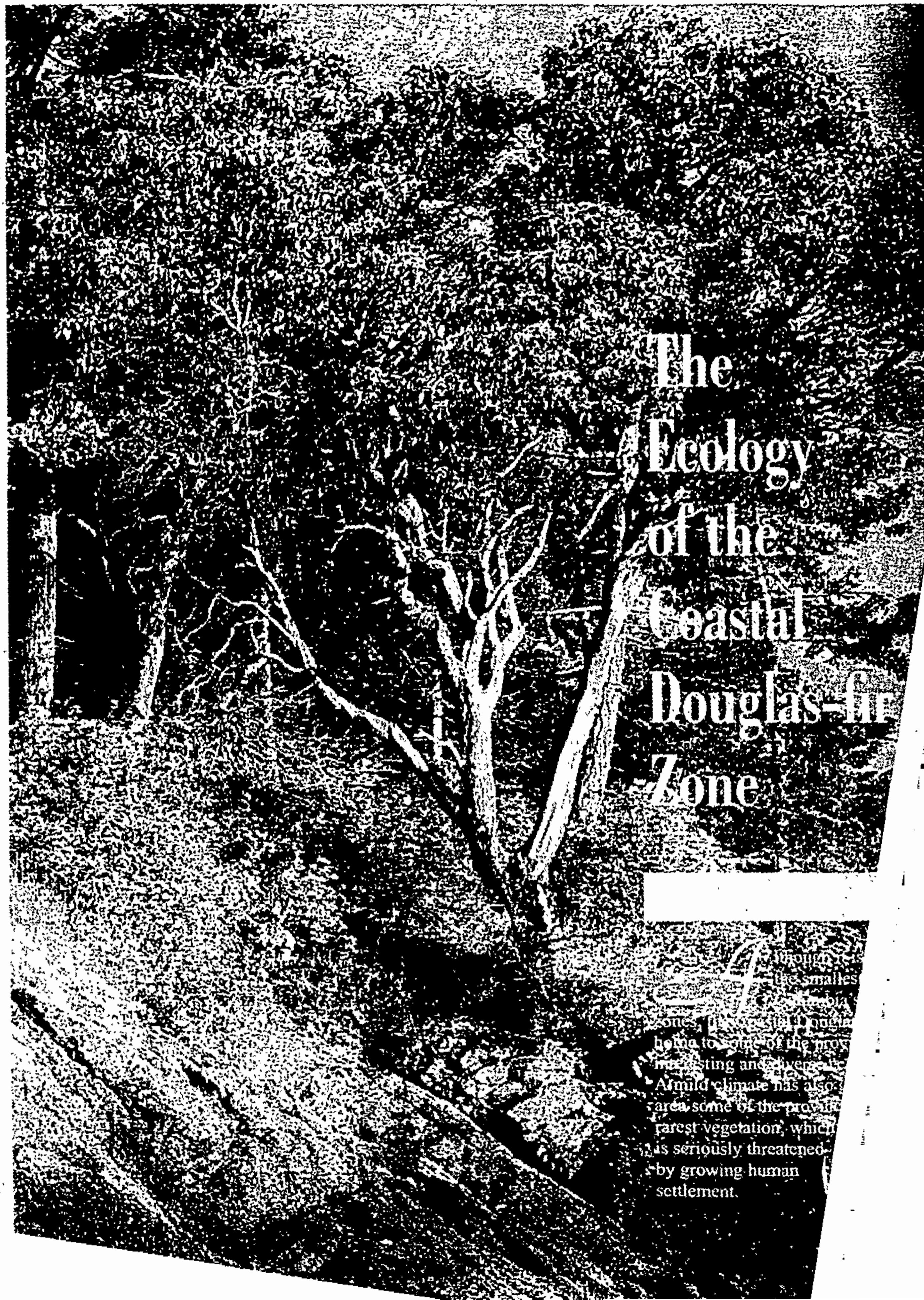
Hymenochaete
[] rubiginosa R
[] tabacina r
Hyphodontia
[] sambuci r
Hypholoma
[] aurantiacum R

[] capnoides C
[] dispersum *U*
[] elongatum r
[] fasciculare A
Hypomyces
[] aurantius R
[] cervinigenus r
[] chrysospermus c
[] lactifluorum A
[] lateritius r
[] luteovirens r
Hypoxylon
[] fuscum R
[] multiforme R
[] rubiginosum R
Hysterangium
[] darkeri r
Inocybe A
[] albodisca r
[] calamistrata r
[] cincinnata r
[] fastigiata U
[] fuscodisca r
[] geophylla a
[] griseolilacina r
[] jacobi r
[] lacera r
[] lanuginosa r
[] lilacina a
[] mixtilis r
[] napipes r
[] oblectabilis r
[] ovatocystis r
[] praetervisa r
[] pudica r
[] sororia c
[] umbratica r
[] umbrina r
Inonotus
[] tomentosus C
Jahnoporus
[] hirtus C
Kuehneromyces
see Pholiota
Laccaria
[] amethysteo-occidentalis a
[] bicolor c
[] laccata A
Lachnellula
[] occidentalis r
Lactarius
[] alnicola r
[] controversus r
[] deliciosus A
[] deterrimus r
[] fallax r
[] fragilis r
[] cf. hepaticus r
[] kauffmanii r
[] cf. luculentus r
[] mucidus r
[] olivaceoumbrinus r
[] olympianus r
[] pallescens c
[] pseudomucidus c
[] pubescens c
[] representaneus r
[] rubrilacteus A
[] scrobiculatus U
[] subtorminosus r
[] torminosus var. nordmanensis r
[] uvidus C
Laetiporus
[] sulphureus C
Leccinum
[] aurantiacum gr *R*
[] manzanitae r
[] ponderosum r
[] scabrum *C*
Lentaria
[] delicata r
Lentinellus
[] omphalodes r

Lentinus
kauffmanii
= Neolentinus kauffmanii
Lepiota
[] atrodisca c
[] castanea r
[] clypeolaria A
[] clypeolarioides r
[] cristata C
[] flammeatincta r
[] roseilivida r
[] rubrotincta c
Lepista
[] inversa c
[] nebularis C
[] nuda a
[] tarda r
Leptonia
[] asprella R
[] formosa r
[] fuligineomarginata r
[] cf. parva r
[] cf. serratula r
Leptoporus
[] mollis R
Leucoagaricus
[] naucinus C
Leucocoprinus
[] birnbaumii U
luteus
= birnbaumii
Leucogaster
[] rubescens r
Leucopaxillus
[] albissimus C
[] amarus c
Limacella
[] glioderma r
Lycoperdon
[] foetidum r
[] perlatum A
[] pyriforme C
Lyophyllum
[] decastes group C
[] loricatum r
[] semitale r
Lysurus
[] cruciatus R
Macowanites
[] chlorinosmus r
Macrocystidia
[] cucumis r
Macrolepiota
[] rachodes A
Macrotyphula
[] fistulosa R
Marasmiellus
[] candidus C
Marasmius
[] androsaceus r
[] capillaris r
[] oreades A
[] pallidocephalus r
[] plicatulus C
[] salalis *C*
[] scorodonius r
[] umbilicatus r
[] Marcelleina sp r
Melanoleuca
[] graminicola r
[] melaleuca r
Melanotus
[] horizontalis *R*
textilis = horizontalis
Meruliopsis
[] corium r
Merulius
[] tremellosus R
Micromphale
[] foetidum r
[] perforans r
Mitrula
[] elegans r
Morchella
[] angusticeps R
[] deliciosa R
[] elata r
[] esculenta R
[] Mucronella r
Mycena A
[] acicula r
[] adonis U
[] adscendens r
[] 'alcalina' C
amabilissima
= adonis
[] amicta r
[] aurantiidisca a
[] aurantiomarginata r
brownii
= cinerella
[] capillaripes r
[] cinerella r
[] citrinomarginata r
[] elegantula r
[] epipterygia c
epipterygiodes
= epipterygia var. epipterygioides
[] filopes r
[] flavoalba r
[] galericulata r
[] galopus r
[] haematopus c
[] lohwagii r
[] longiseta r
[] maculata r
[] metata r
[] murina r
[] oregonensis r
[] piceicola r
[] parabolica r
[] pura a
[] purpureofusca r
[] rorida c
[] rosella u
[] rubromarginata r
[] sanguinolenta r
[] strobilinoides R
[] tenax r
tenella
= lohwagii
tenerrima
= adscendens
[] vulgaris c
[] Mycenella sp r
Mycoacia
[] aurea r
Mycocalia
[] duriaena r
[] Naucoria r
Neolecta
[] irregularis r
Neolentinus
[] kauffmanii *R*
Neournula
[] pouchetti r
Nidula
[] candida C
[] niveotomentosa R

Nolanea
[] cetrata r
[] fructufragrans r
[] hebes r
[] hirtipes r
[] holoconiota u
[] sericea r
[] staurospora r
Oligoporus
[] balsameus r
[] caesius C
chioneus
= Tyromyces
chioneus
[] fragilis R or *R*
[] leucospongia r
[] perdelicatus r
[] tephroleucus r
Omphalina
chlorocyanea
= viridis
epichysium
= Clitocybe
epichysium
[] ericetorum A
luteicolor
= Chrys-
omphalina
aurantiaca
[] oniscus r
[] viridis R
Osteina
[] obducta R
Otidea
[] alutacea u
[] leporina R
[] onotica R
[] smithii r
Oxyporus
[] cuneatus r
Panellus
[] longinquus R
[] mitis R
[] serotinus C
[] stipticus R
Panus
[] torulosus r
Paraeccilia
[] sericeonitida r
Paxillus
[] atrotomentosus C
[] involutus A
[] panuoides C
Paxina
[] recurvum r
Peniophora
[] incarnata r
Perenniporia
[] medulla-panis r
Peziza
[] badia R
Phaeocollybia
[] attenuata r
[] carmanahensis r
[] fallax r
[] kauffmanii gr r
[] piceae r
[] pseudofestiva r
Phaeolepiota
[] aurea R
Phaeolus
[] schweinitzii A
Phaeomarasmius
[] erinaceellus r
Phanerochaete
[] carnosa r
[] sanguinea r
Phellinus
[] ferruginosus R
[] pini C
Phellodon
[] atratus R
[] tomentosus R
Phlebia
[] radiata R
Phlogiotis
helvelloides
= Tremiscus
helvelloides
Pholiota
[] astragalina u
[] aurivella gr. R
[] decorata R
[] flavida r
[] highlandensis r
[] lignicola R
[] malicola R
[] mutabilis *C*
[] scamba r
[] squarrosa R
[] terrestris u
Phylloporus
[] rhodoxanthus R
Phytoconis - See
Omphalina
Pisolithus
[] tinctorius R
Plectania
[] melastoma R
[] nannfeldtii *R*
Pleurocybella
porrigens
= Geopetalum
porrigens
Pleurotus
[] dryinus R
[] ostreatus A
Plicatura
[] nivea r
Pluteus
[] cervinus C
[] granularis r
[] longistriatus r
[] lutescens r
Polyporus
[] badius C
[] elegans C
[] melanopus R
[] varius R
[] Poria R
Psathyrella
[] candolleana c
[] gracilis group r
[] hydrophila r
[] longipes r
[] longistriata c
[] multipedata r
[] velutina r
Pseudoarmillariella
[] ectypoides R
Pseudohydnum
[] gelatinosum A
Pseudoplectania
[] melaena R
[] nigrella R
Psilocybe
[] atrobrunnea r
[] baeocystis R
[] corneipes r
[] crobula R
[] cyanescens R
[] inquilina r
[] montana u
[] pelliculosa r
[] rhombispora r
[] semilanceata r
[] stuntzii r
Pulcherricium
[] caeruleum r
Pycnoporus
[] cinnabar-
inus R or *R*
Ramaria
[] apiculata r
[] araiospora r
[] flavobrun-
nescens R
[] formosa group c
[] gelatinosa r
[] myceliosa r
[] rasilispora r
[] stricta R
Ramariopsis
[] kunzei r
Resinicium
[] furfuraceum r
Resinomycena
[] saccharifera r
Resupinatus
[] applicatus r
Rhizopogon
[] occidentalis r
[] parksii c
Rhodocollybia
[] butyracea c
[] maculata U
[] oregonensis R
Rhodocybe
[] nitellina r
Rickenella
[] fibula c
[] setipes r
Rozites
[] caperata *C*
Russula
[] aeruginea *R*
[] albonigra r
[] bicolor r
[] brevipes a
[] cascadensis r
[] crassotunicata r
[] cremoricolor r
[] cyanoxantha r
[] decolorans
group *R*
[] densifolia r
[] emetica *R*
[] farinipes r
[] foetens r
[] fragilis U
[] fragrantissima r
[] granulata r
[] laurocerasi *R*
[] nigricans r
[] occidentalis r
[] olivaceovio-
lascens r
[] placita R
[] queletii r
[] sanguinea c
[] sororia r
[] stuntzii r
[] subnigricans r
[] veternosa r
[] virescens *R*
[] xerampelina A
Sarcodon
[] adustus r
[] fennicus r
[] fuligineo-vio-
laceus r
[] fuscoindicus R
[] imbricatsm R
[] cf. indurescens r
[] scabrosus r
Sarcosoma
[] mexicana r
Sarcosphaera
coronaria
= crassa
[] crassa U
eximia = crassa
Schizophyllum
[] commune R

Schizopora
[] radula r
Scleroderma
[] cepa C
[] citrinum r
Scutellinia
[] scutellata U
Scutiger
hirtus = Jahno-
porus hirtus
Scytinostroma
[] ochroleucum r
Scytinostromella
[] arachnoidea r
Sparassis
[] crispa C
Spathularia
[] flavida C
Sphaerobolus
[] stellatus R
Stagnicola
[] perplexa r
Steccherinum
[] ochraceum r
Stereopsis
[] humphreyi r
Stereum
[] hirsutum C
[] striatum r
Strobilurus
[] albipilatus R
[] occidentalis r
[] trullisatus a
Stropharia
[] aeruginosa r
[] albonitens r
[] ambigua A
[] hornemannii *R*
[] pseudocyanea r
[] riparia r
[] rugoso-annu-
lata R
[] semiglobata r
Suillus
[] borealis r
[] brevipes r
[] caerulescens A
[] granulatus C
[] lakei A
[] luteus a
[] placidus r
[] punctatipes r
[] sibiricus c
[] subolivaceus r
[] tomentosus *C*
[] umbonatus r
Tapinella
panuoides
= Paxillus
panuoides
Tarzetta
[] cupularis r
[] Tetrapyrgos r
Tephrocybe
[] atrata r
Thaxterogaster
[] pingue r
Thelephora
[] mollissima r
[] palmata r
[] terrestris C
Tomentella
[] stuposa r
[] sublilacina r
Trametes
[] hirsuta group r
[] versicolor A
Tremella
[] encephala R or *R*
[] mesenterica C
Tremellodendropsis
[] tuberosa r
Tremiscus
[] helvelloides U
Trichaptum
[] abietinum A
Trichoglossum
[] hirsutum R
Tricholoma
[] albobrunneum r
[] apium *R*
[] aurantium R
[] cf. bufonium r
[] caligatum R
[] flavovirens c
[] focale *C*
[] imbricatum c
[] inamoenum r
[] magnivelare C
[] pardinum *R*
[] pessundatum C
[] platyphyllum *R*
[] populinum C
[] portentosum c
[] saponaceum c
[] sejunctum c
[] sulphureum c
[] terreum group c
[] vaccinum *U*
zelleri = focale
[] virgatum c
Tricholomopsis
[] decora u
[] platyphylla r
[] rutilans U
Trichopilus
[] jubatus r
[] plebeoides r
Truncolumella
[] citrina R
Tubaria
[] furfuracea r
[] tenuis r
[] Tulostoma sp. r
Tylopilus
[] pseudoscaber r
Tyromyces
caesius
= Oligoporus
caesius
[] chioneus gr C
fragilis
= Oligoporus
fragilis
lacteus
= Oligoporus
tephroleucus
tephroleucus
= Oligoporus
tephroleucus
Ustulina
[] deusta R
Vascellum
[] pratense c
Verpa
[] conica R
Xeromphalina
[] campanella A
[] campanelloides r
[] cauticinalis r
[] cirris r
[] fulvipes r
Xylaria
[] hypoxylon A

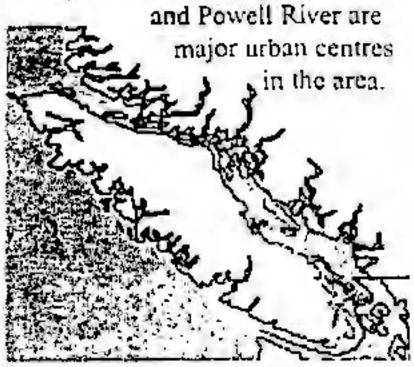


The Ecology of the Coastal Douglas-fir Zone

Although it is the smalles[t] ... zones, the Coastal Douglas[-fir Zone is] home to some of the prov[ince's most] interesting and diverse ... A mild climate has also ... area some of the provin[ce's] rarest vegetation, which is seriously threatened by growing human settlement.

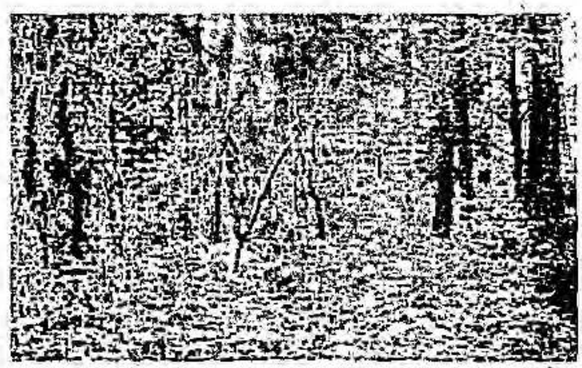
Location

The Coastal Douglas-fir Zone covers a small area of British Columbia's south coast, including a band of lower elevation along southeastern Vancouver Island, the Gulf Islands, and a fringe of mainland along Georgia Strait. Victoria, Nanaimo, and Powell River are major urban centres in the area.



Environment

This small corner of the province enjoys perhaps the finest climate in Canada. Sheltered by the rainshadow of the Vancouver Island and Olympic mountains and warmed by air from the Pacific, the area basks in a Mediterranean-like environment of warm, sunny summers and mild, wet winters. Unlike more exposed coastal areas such as the west coast of Vancouver Island, this zone experiences long dry summers, which are a major factor in its ecology.

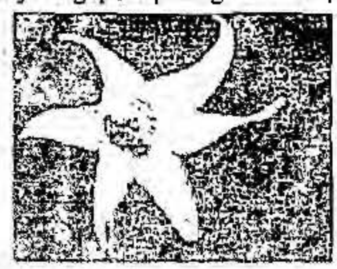


Alex Inselberg

Ecosystems

Here the majestic Douglas-fir reigns supreme, occurring in a wide range of sites from dry rock outcrops to moist valley bottoms. In upland Douglas-fir forests, salal and Oregon grape are common understorey plants; in rock outcrop areas, arbutus, Garry oak, and occasionally lodgepole pine grow alongside Douglas-fir. Wild rose, snowberry, and ocean spray are well adapted to these open, dry ecosystems.

In moister forest areas, Douglas-fir, grand fir, western redcedar, bigleaf maple, and western flowering dogwood flourish together with understorey plants such as sword fern, salmonberry, and trillium. Skunk cabbage and red alder are typical of wet swampy areas, along with Indian plum, salmonberry, and red elderberry.



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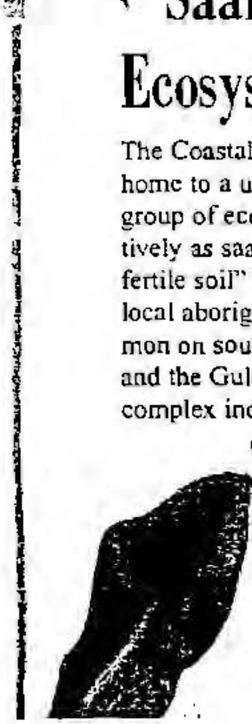
White Fawn Lily
Erythronium oregonum

Saanich Ecosystems

The Coastal Douglas-fir Zone is also home to a unique and sensitive group of ecosystems known collectively as saanich, meaning "place of fertile soil" in the language of the local aboriginal people. Most common on southeast Vancouver Island and the Gulf Islands, the saanich complex includes seaside parkland, dry forest, rock outcrop, and wetland habitats and contains many rare plants. Two common trees here, Garry oak and arbutus, are found nowhere else in Canada.

Garry oak parkland is perhaps the most unusual ecosystem in the saanich group. In dry sites with deep soils, Garry oaks form an open tree cover above a carpet of grasses and colourful spring flowers, including blue camas, shooting star, easter lily, chocolate lily, and satin flower. These habitats may also harbour rare, endangered plants such as golden Indian paintbrush and deltoid balsamroot.



Susan Ferguson

Shooting Star
Dodecatheon hendersonii

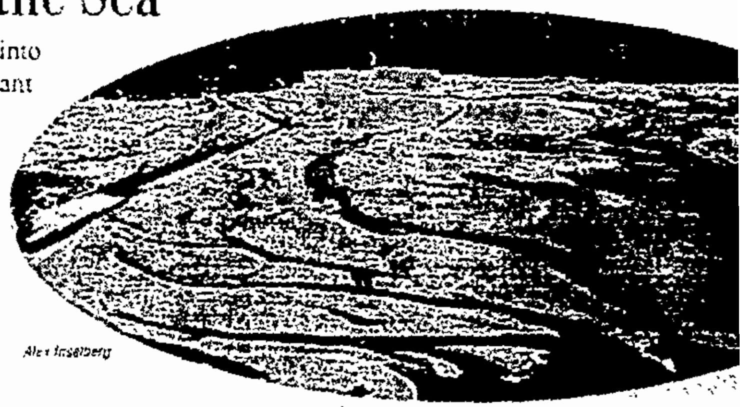
Jim Pojar

Golden Paintbrush
Castilleja levisecta

Cover photo : Alex Inselberg

Where Rivers Meet the Sea

Estuaries, where rivers and streams flow into the sea, are highly productive and important ecosystems, providing habitat for a wide variety of life. The nutrient-rich, protected waters of estuaries are an ideal environment for overwintering birds, for example, and serve as excellent nurseries for young fish.



Alex Inselberg

Douglas-fir and Fire

Wildfires were once common in the Coastal Douglas-fir Zone and played an important role in shaping its ecosystems. For example, there is evidence that 300 or 400 years ago, large fires burned away much of the forest on Vancouver Island's east coast, from Victoria to Campbell River. Today, forest fires are suppressed and play a lesser role in the area's ecology.

One reason Douglas-fir dominate many of this zone's ecosystems is that they are well adapted to living with

Alison Nicholson

fire. Old Douglas-fir have thick, f resistant bark that protects them from all but the hottest flames. Many large old trees show areas charred bark and fire scars at th base. After a fire, young Dougl seedlings quickly colonize the ened area. As fires kill off oth fire-resistant species, they hel lish and maintain the Dougla the dominant tree in the area

Garry oak parklands are al adapted to surviving fires.

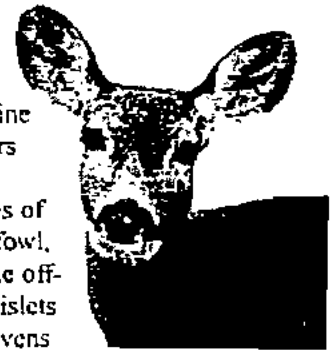
Wildlife

Historically, the Coastal Douglas-fir Zone has teemed with animal life. Black-tailed deer, Roosevelt elk, black bear, cougar, and many other species freely roamed its forests and coasts. Today, humans are the dominant animal, and their cities, towns, industries, and agricultural operations have transformed this former wilderness.

MOF

Animals that conflict with human interests, such as bears, cougars, and elk, are being increasingly displaced by a growing human population.

Despite this expansion, many animal species continue to flourish here. Black-tailed deer and many smaller mammals are common. Some animals, such as raccoons, and barn swallows, have seized the advantages of cohabiting with people by feeding off gardens and garbage, or nesting in buildings. The remaining old forests still provide important habitat for native birds.

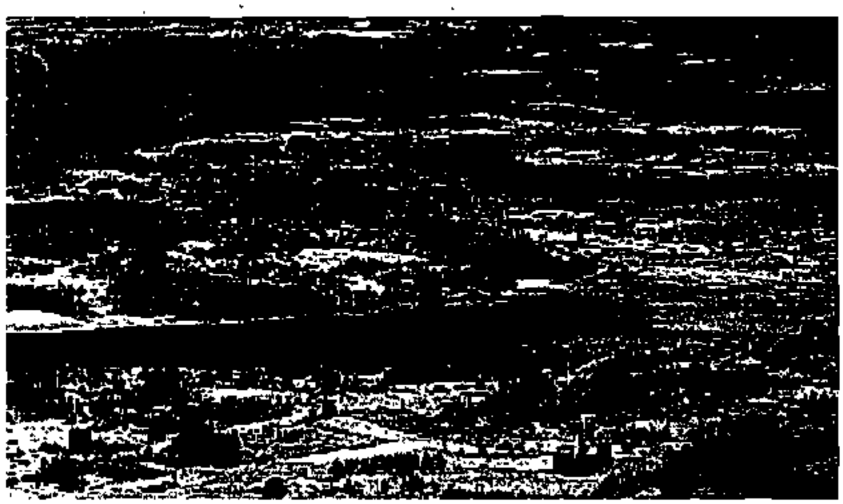


MOF

The coastline shelters many species of waterfowl, and the offshore islets are havens for colony-nesting species such as the glaucous-winged gull and Brandt's cormorant. This zone is home to the greatest diversity of wintering birds found anywhere in Canada.

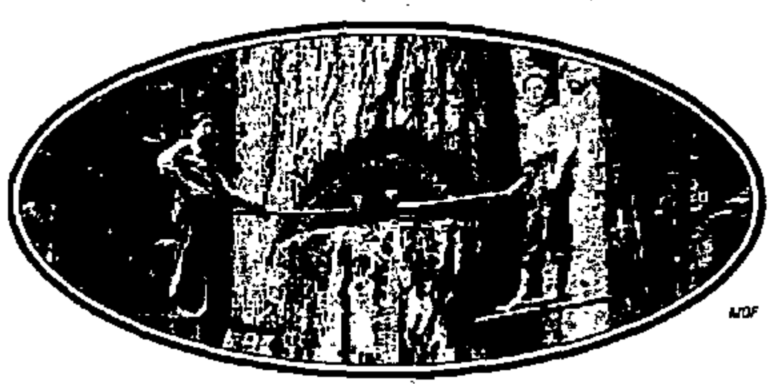
Resources

Much of the Coastal Douglas-fir Zone has been developed as residential or industrial land. The most important industries are agriculture, small-scale forestry, pulp mills, and tourism. Because of the area's long dry summers, soil-water conservation is a significant management concern.



Don Baum

Logging History



MOF

When the first European settlers arrived in the area, old forests of massive Douglas-fir covered much of the land. Recognizing the economic value of these forests, the settlers soon launched a coastal logging industry.

The Douglas-fir was the most highly prized timber tree. In the early logging days it might take two men, using axes and crosscut saws, three or four hours to fell one of these giants. Oxen would then drag the log to a nearby beach, from where is was floated to the nearest sawmill. The introduction of steam donkeys, logging railways, chainsaws, and other technologies greatly enhanced production, allowing workers to cut many more trees and log in areas farther and farther from the water.

Today, very little old forest remains; most of it has been converted to farms, residences, or second-growth forests.

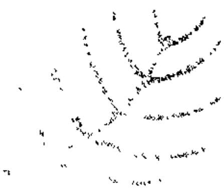
Exotic Invaders

Alex Inselberg

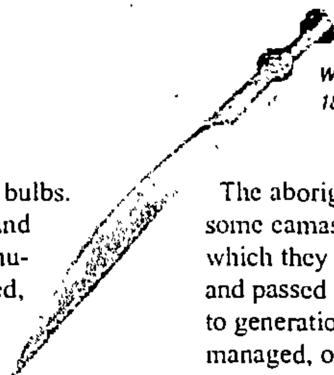
Travellers to a new land often bring something to remind them of home. When the reminder is a living plant or animal, it can create havoc with the local flora or fauna. Several exotic species introduced into the Coastal Douglas-fir Zone have had this unfortunate effect.

Scotch broom, for example, brought to Sooke in 1849 by a Scot named Captain Walter C. Grant, soon escaped captivity and spread rapidly. Today, the bright yellow flowers of this hardy plant are a familiar sight throughout the zone where it is considered a pest and a threat to native vegetation, including many rare plants from the saanich ecosystems.

Other well-known plant species introduced into this zone are gorse and purple loosestrife; animal species include starlings, house sparrows, bullfrogs, grey squirrels, and Norway rats.



Camas



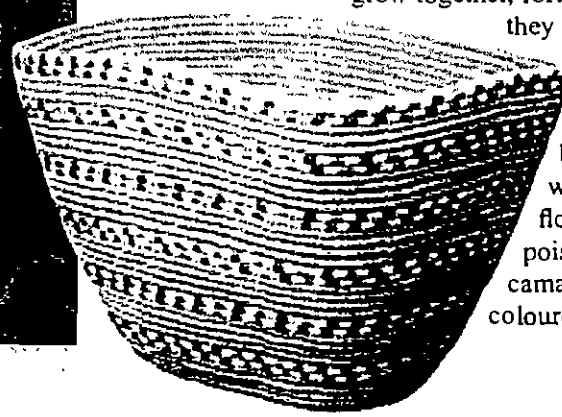
Women's spade 1893

The blue camas grows in Garry oak meadows and grassy bluffs on south-east Vancouver Island and the Gulf Islands. The bulbs are rich in carbohydrates and were a staple food for the area's aboriginal people. Every summer these people would travel to fields where camas grew in abundance and harvest the bulbs. These were steamed and often eaten in a communal feast. When cooked, the bulbs are soft and sweet and were sometimes used to sweeten other foods.

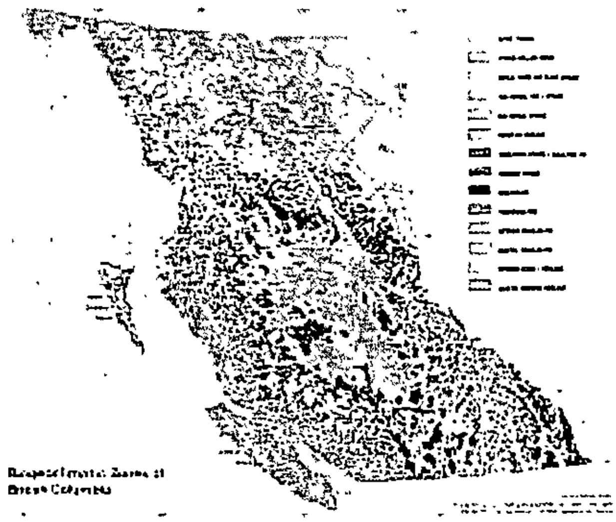
The aboriginal people divided up some camas-rich areas into plots, which they owned individually and passed down from generation to generation. These beds were managed, often by controlled burning, to keep them free of weeds and brush.

The blue camas should not be confused with the closely related and poisonous death camas. Although the two species often grow together, fortunately they are easy to distinguish: the edible camas has blue flowers, while the flowers of the poisonous death camas are cream-coloured.

Alex Inselberg



Salish type basket



The Coastal Douglas-fir Zone is just one of the fourteen biogeoclimatic or ecological zones within British Columbia. These zones are large geographic areas that share a similar climate within the province. Future brochures in this series will explore each zone.

BRITISH COLUMBIA

Ministry of Forests
March 1999

For further information contact:

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P.O. Box 9519 Stn Prov Govt
Victoria, B.C. V8W 9C2

Detail on British Columbia's Biogeoclimatic Zones is available in:

Ecosystems of British Columbia
Special Report Series #6
D. Meidinger and J. Pojar
Ministry of Forests Research Branch,
Victoria, B.C.

Text: Brian Egan
Design: Susan Fergusson
Basket & spade (CPN 17664, CPN 496) – Courtesy of the Royal British Columbia Museum, Victoria, B.C.