CHAPTER 3: AMPHIBIANS
Northwestern Salamander *(Ambystoma gracile*) is one of Whistler's nine native amphibians. Monitoring amphibians is an important component of biodiversity conservation.

Marsh muhly (blue list)
(Muhlenbergia glomerata)

Upswept moonwort (red list)
(Botrychium ascendens)

CHAPTER 4: PLANTS
Pictured are two rare plants newly-discovered by the Project. A total of 420 native plants have been identified to date from a cross-section of sites across Whistler.

CHAPTER 5: MUSHROOMS
Pine mushroom (T*richoloma magnivelare*), one of 399 species documented so far.

CHAPTER 6: BATS
Little Brown Bat *(Myotis lucifugus)* is one of 10 native species recorded historically in Whistler.

CHAPTER 7: LICHENS
Cabbage lungwort (*Lobaria linita*). Lichens are potential bio-indicators of air quality and forest stage.

CHAPTER 8: DRAGONFLIES
Striped Meadowhawk (*Sympetrum pallipes*) is one of 24 species of dragonflies native to Whistler.

CHAPTER 9: INVASIVE SPECIES
Non-natives such as purple loosestrife (*Lythrum salicaria*) displace native species and threaten biodiversity.

Whistler Biodiversity Project

Progress Report & Provisional Checklists

June 2007

Acknowledgements

Many conservation-minded professionals and volunteers contributed to this project and are acknowledged in the following chapters. Thanks also to others who helped but aren't listed. Support for the project came from the Resort Municipality of Whistler, Community Foundation of Whistler, Association of Whistler-Area Residents for the Environment (AWARE), the Whistler Naturalists, and the Whistler-Blackcomb Employee Environmental Fund. Thanks also for assistance from Nicklaus North Golf Course, the Whistler Museum and Archives, and Whistler-Blackcomb.

Photo credits

Cover photo of *Muhlenbergia glomerata* and *Botrychium ascendens* by Adolf Ceska. Other photos by Bob Brett except where noted.

ISBN 978-0-9783836-0-2

Whistler Biodiversity Project

Progress Report & Provisional Checklists

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Project Sponsors
Resort Municipality of Whistler
Community Foundation of Whistler
Association of Whistler-Area Residents for the Environment
Whistler Naturalists
Whistler-Blackcomb Employee Environmental Fund

June 2007

Executive Summary

Protecting native species is a concern at both global and local levels. Concern at the global level coalesced in 1992 when 150 nations signed the Rio Convention on Biological Diversity. In 2002, the United Nations further intensified its efforts through the "Biodiversity 2010" initiative. Native biodiversity is threatened world-wide and Whistler is no exception.

In Whistler, commitments to protect native species and their habitats are included in Whistler2020 – a long-term, multi-objective strategy involving community members, organizations, and local government. It became increasingly clear in the Whistler2020 process that biodiversity conservation must be guided by a knowledge of Whistler's species and ecosystems, and that this data has often been lacking or incomplete.

To address these knowledge gaps, the Whistler Biodiversity Project was created in 2005 to help protect Whistler's native species through science-based research and public involvement. The Project began surveys of eight species groups in 2005 and 2006. Work to date has resulted in the following products:

- Amphibians: The first broad-scale, cross-valley surveys of occurrence, distribution, and habitat.
- Plants: The first comprehensive survey of plant diversity (420 native species plus 76 non-natives) and discovery of two previously unknown rare plants.
- Mushrooms: The first comprehensive survey of mushroom diversity (399 native species).
- Invasives: The first cross-valley effort to quantify the distribution, diversity, and threat of invasive plants.
- Bats, Lichens, Dragonflies, and Butterflies: Pilot projects and first tentative checklists.
- Cross-Analysis of Other Studies: Data from other studies were collated with this project's results to produce the first attempt to catalogue all known about biodiversity in Whistler.
- Public Involvement: Twelve public events and presentations were organized for the first two years of the project. Future plans are to expand public involvement through: school events, BioBlitz (a 24-hour public event to highlight biodiversity), and expanded hard copy and web-based access to data.

A total of 901 native species and 76 non-native (mostly invasive) species have been confirmed to date by the project. A cross-analysis with other sources (primarily for birds and mammals) raises the confirmed total to 1117 native and 89 non-native species. This is a tentative, conservative total since many species groups (e.g., invertebrates and lichens) and habitat types are under-represented.

The project has helped clarify the status of rare species in Whistler. Two new rare plants were confirmed, neither of which were listed by the BC Conservation Data Centre as potential occurrences in Whistler. Coastal Tailed Frog research provided the first valley-wide quantification of their occurrence by stream and elevational range in the Whistler area. The status of up to 28 additional rare species needs to be clarified. Surveys in 2007 and beyond will target habitat types most likely to support these species.

Amphibian results stress the importance of small, ephemeral wetlands as habitat for a number of Whistler's salamander and frog species. At present, these wetlands are not mapped nor afforded any protection. Future studies will further explore the role played by golf course ponds in local amphibian ecology, including as potential habitat for rare Red-legged Frogs and invasive Bullfrogs.

Amphibian studies are most advanced and are moving towards the establishment and testing of monitoring protocols. Expanded surveys of other native and non-native species groups will help clarify the status of rare and other species and help move these species groups towards the monitoring stage.

Species level data is much more powerful when linked to location and habitat conditions so all data is geo-referenced. Additional work in 2007 and beyond is needed to collate and map this data.

The natural environment is important to Whistler's residents and a key draw for destination tourists. If initiatives such as the Whistler Biodiversity Project are successful, future generations will inherit a Whistler where rare species and habitats have been protected, and common species and habitats remain common.

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Chapter 1: Introduction

Author: Bob Brett

1.1 Biodiversity 2010: The Global and Local Context

> *"Biodiversity is life in all its forms and the habitat and natural processes that support it."*[1]

The loss of native species is a global problem caused mainly by human population growth and development. Attempts to conserve the diversity of native species face challenges such as habitat loss, fragmentation of habitats, and displacement by non-native species.

In the 1980s, global awareness of the need to protect biological diversity (biodiversity) coalesced around images of the burning Amazon rainforest. It led in 1992 to the Rio Earth Summit where 150 governments signed the Convention on Biological Diversity. The treaty, often called the Rio Convention, committed the signatories to:

- Identify and monitor important components of biodiversity.
- Establish protected areas to conserve biodiversity.
- Rehabilitate and restore degraded ecosystems,
- Promote the recovery of threatened species.
- Respect traditional knowledge.
- Prevent and control invasive species.
- Control biotechnology risks.
- Promote public participation.
- Report how biodiversity goals are being met.[2]

In 2002, ten years after the Rio Convention, the United Nation's Secretariat of the Convention on Biological Diversity embarked on the ambitious "Biodiversity 2010" project. Its goal is:

> *"…to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth."*[3]

Biodiversity 2010 is a global effort supported by many agencies. One notable example is the World Conservation Union's (IUCN) Countdown 2010 initiative (Figure 1.1).[4]

The Convention on Biological Diversity is a treaty between nations administered through the United Nations (UN). There are similar initiatives at all levels of government in many of the world's jurisdictions, for example, the species-at-risk and biodiversity initiatives of the Canadian and BC Governments.

At the local level, the Resort Municipality of Whistler (RMOW) has committed to biodiversity conservation through its Whistler2020 process (RMOW 2005b). Whistler2020's biodiversity goals include all components of the Rio Convention above.[5]

Figure 1.1: The Biodiversity 2010 project is spearheaded by the UN (left). The World Conservation Union has embarked on a complementary effort, "Countdown 2010" (right).

[1] Ecosystem Branch, BC Government (http://www.env.gov.bc.ca/wld).
[2] From the Convention on Biological Diversity website (http://www.biodiv.org).
[3] http://www.biodiv.org/2010-target
[4] http://www.countdown2010.net
[5] Although traditional knowledge is not explicitly mentioned, Whistler2020 promotes linkages with First Nations.

The Whistler Biodiversity project was originally conceived to create complementary links between the global Biodiversity 2010 project, the Vancouver 2010 Olympics, and local biodiversity conservation initiatives, including those stated in Whistler2020. The mission of the Whistler Biodiversity Project is:

> ***…to create a science-based, continual learning environment in which the community of Whistler builds its knowledge of native species and habitats to help protect them.***

To date, the Whistler Biodiversity Project has been supported by the:

- Resort Municipality of Whistler (RMOW);
- Community Foundation of Whistler (CFOW)
- Association of Whistler-Area Residents for the Environment (AWARE);
- Whistler Naturalists; and
- Whistler-Blackcomb Employee Environmental Fund.

Additional assistance has been generously provided by Nicklaus North Golf Course, Whistler Museum and Archives, Whistler-Blackcomb Mountain Resorts Ltd., and many community volunteers (most of whom are listed in the following chapters).

1.2 Threats to Native Biodiversity

Human activities around the globe have negatively impacted many native species and habitats. In Whistler, the three main threats to native biodiversity are:

1) Habitat loss;
2) Displacement by other species; and
3) Habitat degradation.

The main causes of these threats are:

1) Human activities;
2) Invasive species; and
3) External stressors, notably climate change.

Humans are certainly the main cause of native species decline. We clear land for our cities and highways (habitat loss). We move into areas and force the exit of some native species, for example, grizzly bears and wolves (displacement). And we change habitat quality by fragmenting ecosystems, polluting the water and air, and occupying the land for recreation and work (habitat degradation).

In a way, humans are the ultimate invasive species since our impacts on habitat are so vast and so fast. Each time we colonize a new area we impact native biodiversity, both by removing original habitat and by continually disturbing ecosystems. We also introduce species, either intentionally or not, to ecosystems which have no natural controls for them. Notable examples include rabbits in Australia, zebra mussels in the Great Lakes, and white pine blister rust (first introduced to Vancouver in 1910 and now spread over much of western North America). Invasive species such as these displace native species and irrevocably alter ecosystems.

Climate change is a newly emerging stressor to native biodiversity. Native species, by definition, are at least somewhat resilient to changing conditions caused by such natural disturbances as fire, insect outbreaks, and small-scale climatic variation. But the fact that climate change is occurring so rapidly at such vast scales (IPCC 2007) poses a new threat for native biodiversity.

Climate change's effects on native species will be far-reaching but unpredictable. One current example is the mountain pine beetle outbreak, apparently made worse by consecutive warm winters. As deforested areas grow back, invasive species will likely benefit due to their ability to rapidly colonize new areas and out-compete native species.

Humans and the choices we make can either expand or contract our ecological footprint. Making the right choices will benefit native biodiversity directly (by reducing habitat loss and degradation), and also indirectly (by reducing the spread of invasive species and reducing our contribution to climate change).

1.3 Addressing the Need for Species-Level Research

Conserving nature is a priority for Whistler residents. Whistler's commitment to nature conservation is shown through initiatives such as the Whistler Environmental Strategy, the Protected Area Network (PAN) strategy, and Whistler2020 (RMOW 2002; 2005a; 2005b).

The Protected Area Network is based on the principle, first adopted by the Whistler Environmental Strategy, that protecting habitats (ecosystems) is the most effective way to protect native species, especially in the absence of fine-scale knowledge about species and their habitat needs. Protecting habitats is a critical aspect of biodiversity conservation which must at some point be bolstered by species-level research. Research at the species level is needed to:

a) Establish which species are native to Whistler, with a special emphasis on rare species.
b) Establish species-habitat relationships to fine-tune conservation efforts, for example, criteria for protection under the PAN.
c) Monitor native biodiversity over time.

Baseline inventories are building blocks for conservation efforts and there are two main types: habitat-based and species-based. Whistler's Terrestrial Ecosystem Mapping (TEM; Green 2004) is a habitat-based inventory. Before this project, however, there have been no comprehensive, valley-wide, species-based inventories in Whistler.[6] Many environmental studies have been conducted for proposed developments, including environmental assessments, but these have been site-specific, time-limited, and generally outdated after site development.

The primary rationale for the Whistler Biodiversity Project is that Whistler cannot protect native species and the habitats that support them without first knowing: (a) which species occur here; and (b) in which habitats. The need to quantify native biodiversity is especially pressing in regards to rare species (species-at-risk). We have some knowledge of which rare species occur or may occur here (e.g., Leigh-Spencer 2004; Green et al. 2005), but much of this information is based on anecdotal evidence and generalized range maps. Field research is therefore needed to verify the occurrence and distribution of rare species.

The Whistler Biodiversity Project will give the Whistler community additional tools to protect the species that make Whistler home, and the habitats those species require. Data from the project will build a framework (like TEM) upon which site-specific data can be effectively linked.

[6] Perhaps the closest analogue to the Whistler Biodiversity Project are the ongoing bird surveys conducted by volunteers with the Whistler Naturalists (Gotz et al. 1996; Ricker et al. 2005).

1.4 Conservation Ranking of Rare and Common Species

Native biodiversity is comprised of both rare and common species. Confirming the presence and distribution of rare species and protecting their habitat are primary focus areas for this project. A second focus is to "keep common species common"[7] by retaining naturally-occurring levels of biodiversity among all species.

The many terms used to describe and rank the relative rarity or commonness of species can cause confusion. This report refers mainly to tracking lists compiled by the BC Government's Conservation Data Centre (CDC) and the Canadian Government's Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The World Conservation Union (IUCN) list is a third, global source. These agencies use different metrics for quantifying rareness and therefore their definitions of terms such as rare, endangered, threatened, and species-at-risk also differs.

To reduce confusion, this report uses the term "rare" to denote a generalized level of rarity. For more precise rankings, consult the tables and checklists compiled by species group which include data from the CDC, COSEWIC, and the IUCN. In this report, the only exception to this rule is the use of the CDC's terms "red-listed" and "blue-listed" (or red list and blue list). For example, Keen's Myotis is a red-listed bat and Coastal Tailed Frog is on the blue list. The CDC defines these terms as follows:[8]

> Red List
> *Includes any ecological community, and indigenous species and subspecies that is extirpated, endangered, or threatened in British Columbia. Extirpated elements no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered elements are facing imminent extirpation or extinction. Threatened elements are likely to become endangered if limiting factors are not reversed. Red-listed species and sub-species have- or are candidates for- official Extirpated, Endangered or Threatened Status in BC. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.*
>
> Blue List:
> *Includes any ecological community, and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia. Elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk, but are not Extirpated, Endangered or Threatened.*

Protection is not automatically afforded to species even on the CDC red list. At the federal level, the only binding protection measures are for COSEWIC-designated species-at-risk, and only on federal land. In BC, the highest level of protection is given to species designated as "endangered" under the Wildlife Act which currently applies to only four species: Vancouver Island Marmot, Sea Otter, White Pelican, and Burrowing Owl.[9] The other, less binding, measure of protection in BC is for Identified Wildlife on Crown Land.[10] Identified Wildlife include such local species as Keen's Myotis and Coastal Tailed Frogs, as well as ecological communities (none of which occur within current RMOW boundaries).[11]

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[7] US Geological Survey Biological Resources Division Gap Analysis Program: http://gapanalysis.nbii.gov.
[8] http://wlapwww.gov.bc.ca/wld/documents/ranking.pdf. As shown, the CDC also includes ecological communities in their tracking. Ecological communities match the general definition of ecosystem used by the RMOW. They are based on plant associations found in similar ecological niches and mapped at the site series level (Green 2004).
[9] http://wlapwww.gov.bc.ca/sir/fwh/wld/atlas/about/about_index.html
[10] http://www.env.gov.bc.ca/wld/documents/identified/IWMS%20Procedures.pdf
[11] http://www.env.gov.bc.ca/wld/frpa/iwms/accounts.html

1.5 Project Objectives, Principles, Priorities, and Personnel

1.5.1 Project Objectives

The Whistler Biodiversity Project is based on an iterative approach with seven interlinking objectives:

1) Inventory and geo-reference[12] all species (plants, animals, fungi, etc.).
2) Identify and protect rare species.
3) Determine species-habitat affinities and identify critical habitat elements.
4) Identify and monitor indicator species.
5) Report data and suggest local Best Management Practices (BMPs) to the RMOW, project sponsors, community members, and other interested people and groups.
6) Engage the community to increase knowledge and appreciation of the natural world.
7) Continually expand knowledge about native species, their habitats, and Best Management Practices (Figure 1.2).

The six objectives shown in the outer part of Figure 1.2 are addressed at each stage of the project with whatever level of knowledge and resources is available at that time. These objectives interlink through the central objective of continually expanding our knowledge of native biodiversity and how to protect it.

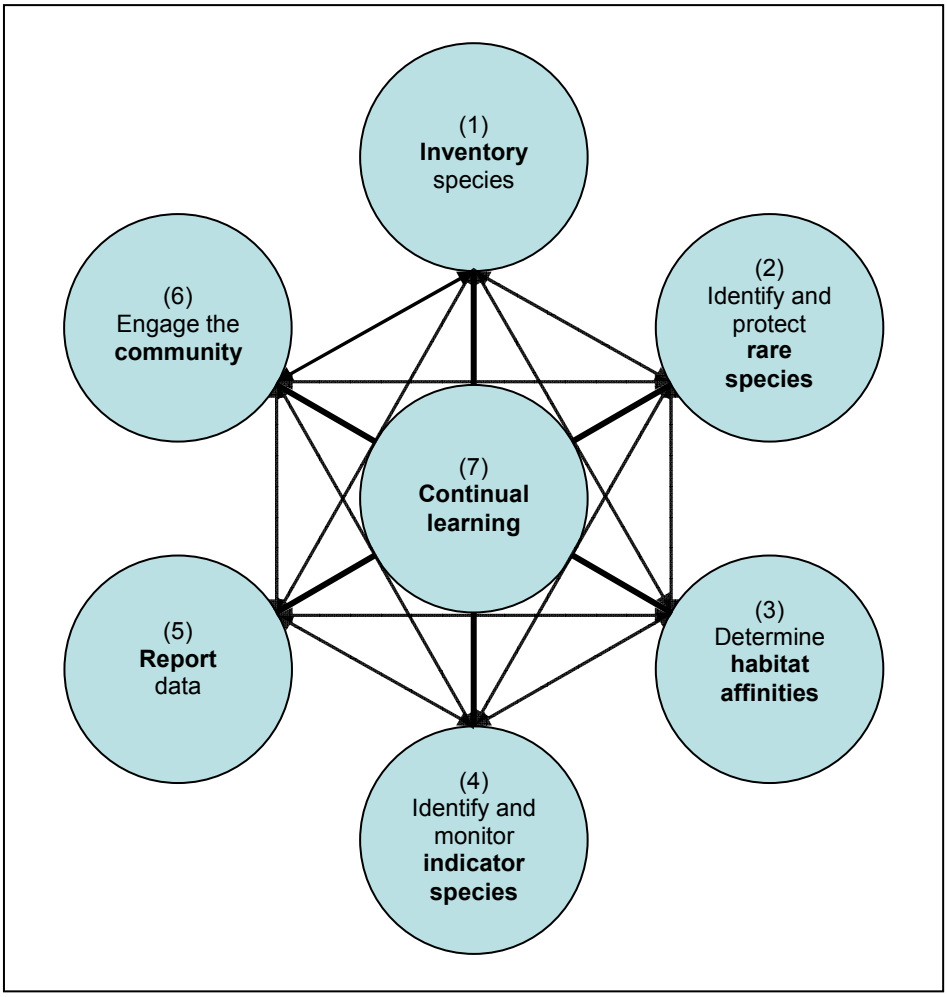

Figure 1.2: Interlinking objectives of the Whistler Biodiversity Project.

[12] Geo-referencing means locating species occurrences on a map through the use of grid coordinates (usually UTM northings and eastings). These coordinates can then used to analyze and monitor data.

1.5.2 Project Principles

Biodiversity conservation can be approached in many ways, as a quick internet search will show. The Whistler Biodiversity Project's approach applies an appropriate level of scientific rigour that conserves scarce resources and engages the community (Figure 1.3). Guiding principles include:

1) Appropriate level of scientific rigour

The project is science-based to ensure effectiveness. We use specialists and replicable methods to ensure data is as accurate and complete as necessary. Rare species surveys, for example, are led by scientists who have the training to verify the presence or absence of species. However, it would be a mistake to make surveys so rigorous they squander scarce resources and exclude public participation. The project therefore strives for an *appropriate* standard of rigour that:

a) provides the most-needed data to guide biodiversity conservation;
b) manages scarce resources so a variety of species groups can be surveyed each year; and
c) leverages the scientific knowledge of the specialist(s) to involve and educate the community.

2) Provide public accessibility

Public accessibility to the data and results is a core principle. All products of the project will be freely available and distributed through the RMOW, AWARE, Naturalists, Museum and Archives, and Library. The data will eventually be mapped on the RMOW, Sea-to-Sky Habitat Atlas, and/or other websites.

3) Forge links with local groups and the RMOW

Many groups and individuals have complementary mandates to this project. The RMOW is the most obvious user of the data as it helps fulfill commitments made in Whistler2020. Linkages with the RMOW include Terrestrial Ecosystem Mapping (TEM), rare species accounts, and contributions to the Protected Area Network (PAN). Other local groups include: the CFOW, Library, Museum, AWARE, Naturalists, Whistler-Blackcomb and their employees; and the local golf courses.

4) Link activities and results to efforts outside of Whistler

Biodiversity conservation initiatives have been started by a growing number of non-governmental organizations and governments at all levels from municipal to global. Many of these initiatives, like this project, stem back to the Rio Convention and its offspring, the global Biodiversity 2010 program (Section 1.1). Since it shares a common provenance and complementary goals, the Whistler Biodiversity Project is a local piece of the broader biodiversity conservation puzzle.

5) Scope each situation before committing resources (look before you leap)

Without proper planning, it is possible to spend enormous resources studying a very narrow slice of biodiversity. In keeping with the principle of low-hanging fruit (Section 1.5.3) and staged implementation (Section 1.5.4), each species group is assessed before committing extensive resources. This process includes an assessment of current knowledge and, where possible, a brief (e.g., one- to three-day) field assessment by one or more specialists.

				
Science-based	Public Access	Local Linkages	Regional, National, Global Linkages	Scope the situation first

Figure 1.3: The project approach is based on five principles.

1.5.3 Project Priorities

Time and resources are limited so each year's activities must be chosen carefully based on clear priorities. To date, the Project has used four main filters to prioritize its activities (Figure 1.4):

1) Low-hanging fruit:
   Subject to the other priority filters, the project focusses on species groups that are relatively easy to sample, that is, provide more useful results for a given investment.

2) Urgency or need:
   There may be situations where the priority to survey or monitor a species or species groups is bumped up because of changing circumstances, for example, impending development of an area or due to a request from an interested agency. Other species groups may be addressed earlier because of gaps in knowledge that need to be filled before biodiversity conservation can properly be addressed. For example, surveying soil organisms or epiphytic lichens may be prioritized if soil or air chemistry is deemed a priority.

3) Rare or threatened species:
   All surveys of species groups will include a focus on rare species that occur or may occur in Whistler. In some cases, the priority of a species or species group might be elevated due to a changing circumstance as described above.

4) Community interest:
   Charismatic species will always engage the community more. For example, frogs and bats generally have more appeal than slugs and other invertebrates. Although all species groups will be eventually be addressed, public involvement will be greater if there is always an opportunity to participate in studies of charismatic, or flagship, species.

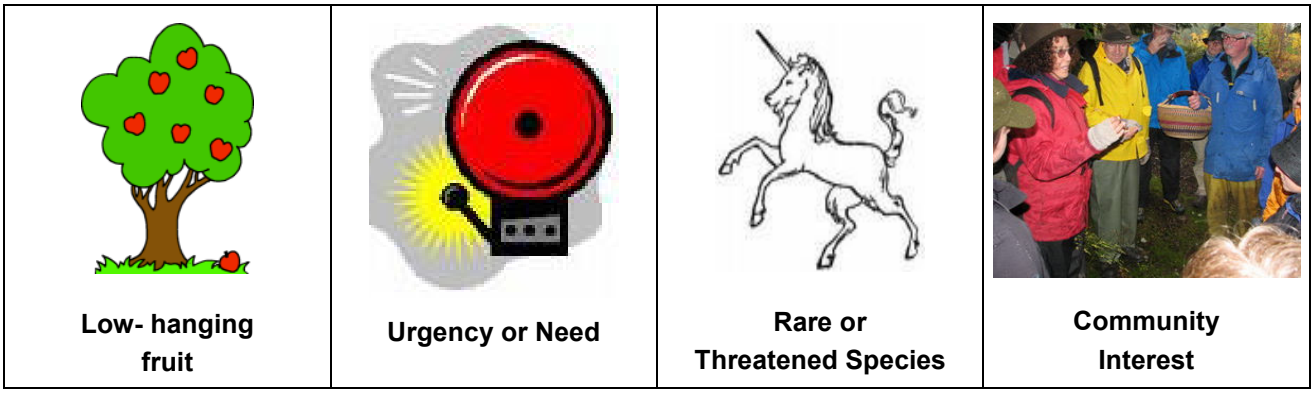

Figure 1.4: Four filters to determine project priorities.

1.5.4 Staged Implementation

The project simultaneously addresses different species groups and advances knowledge in each based on a staged approach. This approach is consistent with the scoping principle mentioned in the previous section, that is, look before you leap. Each subsequent stage builds on knowledge learned in the previous stage and ensures scarce resources are tightly focussed on the best prospects for developing an effective inventory and monitoring program for each species group. The general sequence of stages within each species group include four stages:

Stage 1) Primary Survey:

- Scope existing data
- Pilot field study (~1-3 days)
- Pilot species list (potential occurrences)
- Pilot summary of species-habitat affinities

Stage 2) Secondary Survey:

- Assess results of primary survey(s)
- Secondary field study (~5-20 days)
- First provisional list species list (still incomplete)
- First provisional summary of species-habitat affinities

Stage 3) Comprehensive Surveys.

- Assess results of secondary survey(s)
- Directed field studies to fill knowledge gaps
- Comprehensive species list
- Comprehensive summary of species-habitat affinities
- First suggested indicator/monitoring protocol

Stage 4) Indicator Species and Monitoring

- Choose indicator/focal species for monitoring
- Develop cost-effective monitoring protocols
- Test monitoring protocols by species/species group
- Report findings
- Adapt monitoring as new understanding develops

1.5.5 Project Personnel

Where possible, local knowledge applied over long time periods is preferable to very intensive but brief surveys conducted by out-of-town specialists. The Whistler birding community provides an excellent example of what can be achieved through the cooperative efforts of local specialists and volunteers over many seasons and many years (Ricker et al. 2005; Gotz et al. 1986).

The Whistler Biodiversity Project is based on the principle of using and building local capacity. That is, local knowledge is tapped wherever possible by using local specialists and volunteers. This principle is based on the premise that people who live here have the most interest in their natural environment and most ongoing opportunities to learn about it.

That said, there is also a place for invited specialists when local knowledge needs to be bolstered by outside expertise. The dual goals of inviting non-local specialists are to: (a) bolster scientific rigour when necessary; but also (b) improve local capacity so future studies can be conducted increasingly by locals.

There will always be a role for non-local specialists in the Whistler Biodiversity Project since it is also important to maintain links with biodiversity conservation efforts in other jurisdictions. The out-of-town researchers listed in this progress report exemplify the sort of conservation-minded professionals that fit the goals of the project. They have donated some or all of their time, and are keen proponents of public involvement and capacity building.

Chapter 2: Summary of Key Findings and Progress

Author: Bob Brett

Summary
The Whistler Biodiversity Project began surveys of eight species groups in 2005 and 2006. Work to date has resulted in the following products:

- The first broad-scale survey of Whistler Valley's pond-dwelling amphibians and first comprehensive listing of local amphibians.
- The first cross-valley study of the distribution of Coastal Tailed Frogs, a blue-listed species which inhabits mountain streams.
- The first provisional checklists for plants (420 native species plus 76 non-natives) and mushrooms (399 species).
- The discovery of two previously unknown and unsuspected rare plants.
- Pilot studies of bats, lichens, dragonflies, and butterflies, and the first preliminary checklists for the local diversity of those species groups.
- The first broad-scale effort to document the distribution and threat posed by invasive plants.
- The first cross-study, cross-species analysis of all species groups occurring in Whistler.

A total of 901 native species and 76 non-native species have been confirmed to date by the project. An analysis of other data sources raises the confirmed total of native species to 1117 and non-natives (mostly invasives) to 89 species. This is a tentative, conservative total since many taxa and habitat types are under-represented in the surveys to date, for example, invertebrates and lichens.

The project has helped clarify the status of rare species in Whistler. Two new rare plants were confirmed, neither of which were listed by the BC Conservation Data Centre as potential occurrences in the Whistler area. Coastal Tailed Frog research provided the first valley-wide quantification of their occurrence by stream and elevational range in the Whistler area.

Amphibian studies are the most advanced of all species groups and are moving towards the establishment and testing of monitoring protocols. Expanded surveys of bats, other small mammals, and invasive species will clarify the status of rare and other native species and help move these species groups towards the monitoring stage.

Species level data is much more powerful when linked to geographic location and habitat conditions. All data for the project is geo-referenced though additional work is needed to collate and map this data.

Twelve public events and presentations occurred during 2005 and 2006. Future plans are to expand opportunities for public participation, including the establishment of an annual BioBlitz in which the public is invited to join specialists in recording as many species as possible within a 24-hour period. First attempts towards creating web access to the data will also begin in 2007.

2.1 Key Findings – Species Inventory

To date, the Project has identified a total of 901 native species and 76 non-native[1] species (Table 2.1; Appendices 3 through 9). Plants and mushrooms account for the majority (810 species) of that total. The level of completeness varies by species group (Section 2.3 and appendices). The amphibian list is most complete and the lichen list is likely least complete. Although bat, dragonfly, and butterfly checklists include all potential species for the area, the current status of these species groups remains unclear. Other studies available at the time of writing add another 216 native species for a total of 1117 native species and 89 non-native species. The main species groups under-represented here are insects and other invertebrates.

Table 2.1 Synopsis of known species diversity in Whistler. NT = not tracked.

	Confirmed				Not Yet Confirmed				
		Rare Natives				Rare Natives			
Species Group	Native Species	red list	blue list	Non-Native	Native Species	red list	blue list	Non-Native	Extirpated[2]
Amphibians	8	0	1	0	0	0	1	1	0
Bats	2	0	0	0	8	1	1	0	?
Plants	420	1	1	76	>14	4	10	?	?
Mushrooms – WBP	204	NT	NT	0	?	NT	NT	?	?
– NAMA	195	NT	NT	0	?	NT	NT	?	?
Lichens	38	0	0	0	?	0	0	?	?
Dragonflies	24	0	0	?	16	0	0	?	?
Butterflies	10	0	0	?	46	0	2	?	?
Sub-total: WBP	**901**	**1**	**2**	**76**	**>84**	**5**	**14**	**1 + ?**	**?**
Reptiles	2	0	0	0	1	0	0	0	?
Slugs & Snails	5	0	0	5	?	0	0	?	?
Birds	154	1	2	2	96	1	4	?	3
Mammals	50	0	1	3	?	0	4	?	?
Fish	5	0	1 + 1?	3	0	0	0	?	?
Sub-total: Other Studies	**216**	**1**	**4 + 1?**	**13**	**97**	**1**	**8**	**?**	**3 + ?**
Total	**1117**	**2**	**6 + 1?**	**89**	**> 181**	**6**	**22**	**1 + ?**	**3 + ?**

2.2 Key Findings – Rare Species

Two new rare plant species were discovered: upswept moonwort (*Botrychium ascendens*; red list) and marsh muhly (*Muhlenbergia glomerata*), a blue-listed grass. Neither of these species was previously known or suspected to exist in Whistler. The status of an additional 15 plants need to be confirmed: 12 identified by Green et al. (2005) and three undetermined species from this project.

Coastal Tailed Frog, a blue-listed species, was confirmed in mountain streams on either side of the valley in the first valley-wide survey of their distribution. Local status needs to be confirmed for another blue-listed amphibian, Red-legged Frog, as well as two bats (Keen's Myotis, red list; and Townsend's Big-eared Bat, blue list). Fisher is a red-listed mammal recorded in historic accounts but with only a single recent sighting. Its current status remains unclear. Two blue-listed butterflies which potentially occur in Whistler also have yet to be confirmed. There also needs to be additional clarification of the status of rare species in other studies, notably among birds and mammals.

[1] Most non-natives are invasive, that is, they aggressively spread and displace native species (Chapter 9).
[2] Extirpation is local extinction, defined here as an absence of current sightings for a species previously recorded in Whistler. Spotted Owl is one known example.

2.3 Key Findings – Habitat

The project has made the most progress to date investigating the habitat affinities of amphibians. One of the key findings is that small, ephemeral wetlands provide important habitat. These wetlands are currently unprotected in Whistler (and other jurisdictions). Results from the valley-wide study of Coastal Tailed Frogs suggests elevational and temperature limits for the species. Studies to date were unable to confirm the status of Red-legged Frogs (a blue-listed native) nor Bullfrogs (an invasive species). Future surveys will target golf courses to search further for local occurrences of these species.

2.4 Progress by Species Groups

Eight species groups have been addressed to date (Table 2.2). Details on these eight groups follow in Chapters 3 through 9. Chapter 10 describes other species groups of interest that are candidates for future surveys. It also describes other sources of data describing birds, mammals, and other species groups.

Good progress has been made towards producing the first valley-wide, field-verified (though still provisional) checklists of amphibians, plants, and mushrooms. A good start has been made towards a checklist of invasive species, though the extent and impact of the problem has yet to be fully investigated. Pilot surveys have been completed for bats and dragonflies, while only very preliminary work has been completed for lichens and butterflies. Checklists at varying stages of completeness are included as Appendices 4 through 10.

Amphibian work is best poised to move into a Stage 3 comprehensive survey and then towards monitoring in Stage 4. Targetted plant work should reveal the majority of remaining native species as well as determine the status of 12 rare plants probable or possible in our area (Green et al. 2005).

Table 2.2 Progress by species groups.

Chapter	3	4	5	6	7	8	8	9
1) Primary Survey: Species Group	Amph-ibians	Bats	Plants	Mush-rooms	Lichens	Dragon-flies	Butter-flies	Invasive Species
Scope existing data	■	■	■	■	■	■	■	■
Pilot field study (~1-3 days)	■	■	■	■	■	■		■
Pilot species list (potential occurrences)	■	■	■	■		■	■	■
Pilot summary of species-habitat affinities	■	■	■	■				■
2) Secondary Survey:								
Assess results of primary survey(s)	■	■	■	■				■
Secondary field study (~5-20 days)	■		■	■				
First provisional species list (still incomplete)	■		■	■				
First provisional summary of species-habitat affinities	■							
3) Comprehensive Surveys.								
Assess results of secondary survey(s)	■		■	■				
Directed field studies to fill knowledge gaps								
Comprehensive species list								
Comprehensive summary of species-habitat affinities								
First suggested indicator/monitoring protocol								
4) Indicator Species and Monitoring								
Choose indicator/focal species for monitoring								
Develop cost-effective monitoring protocols								
Test monitoring protocols by species/species group								
Report findings								
Adapt monitoring as new understanding develops								

2.5 Recommended Work Plan for 2007

Amphibians (Stage 3)

- Expand survey of pond-breeding species with an emphasis on confirming the presence of rare Red-legged Frogs and invasive Bullfrogs.
- Further quantify distribution and habitat requirements of Coastal Tailed Frogs and identify potential for future monitoring.
- Identify, map, and survey small (<0.5 ha) wetlands identified in this report as important habitat.
- Conduct preliminary survey of terrestrial salamanders (Western Red-backed Salamanders and Ensatinas).
- Provide map data to the RMOW and other agencies relating species occurrence records and habitat.

Bats (Stage 2)

- Focus on potential habitats for Keen's Myotis (red-listed) and Townsend's Big-eared Bat (blue-listed)
- Describe diversity and habitat relationships of native species and explore potential indicator species..

Invasive Plants (Stage 2)

- Quantify and map distribution of invasives (e.g. knapweed, birds-foot trefoil, Scotch broom, etc.).
- Work with RMOW to test removal success and provide data in support of an invasives control strategy.

Lichens (Stage 1)

- Pilot project to explore indicator value of local lichens as indicators for air quality and ecosystem condition.

Plants (Stage 2/3)

- Continue sampling for rare plants; focus on low-elevations, rock outcrops, and forests.
- Map occurrences by ecosystem type (site units in TEM mapping).

Mushrooms (Stage 2)

- Continue survey (part of annual mushroom festival) and compare results by year and ecosystem type.

Small Mammals (Stage 1)

- Explore options for surveying important but difficult-to-survey indicator species, e.g., e.g. Northern Flying Squirrel and Red-Backed Vole.

Public Events/BioBlitz

- At least one outdoor/indoor event for each species group; articles for Pique; on-line mapping and reports.
- Pilot BioBlitz: 24-hour count of local biodiversity with invited specialists to raise public awareness.

Update June 13, 2007: Funding from the Community Foundation of Whistler was confirmed after the distribution of a final draft which included these goals. Since then, it seems likely bat work will not occur this year due to the unavailability of researchers. Other modifications may be required for this year's work based on the availability of other researchers.

Chapter 3: Amphibians

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Contributing Scientists Connor McGillion
Dr. Leslie Anthony
Bob Brett

Thanks for field assistance to: Betty Rebellato, Veronica Woodruff, Myles Lowcock, Andrea Mead, and Dan McDonald.


a) Northwestern Salamander


b) Long-toed Salamander


c) Rough-skinned Newt


d) Ensatina


e) Western Red-backed Salamander


f) Coastal Tailed Frog


g) Pacific Chorus Frog


h) Western Toad


i) Red-legged Frog (near Pinecrest)


j) Bullfrog

Figure 3.1. Confirmed and potential amphibian species in Whistler. All but Red-Legged Frogs and non-native Bullfrogs have been confirmed.

All photos are from Whistler except (e), (i) and (j). Photo credits: Julie Burrows (Ensatina); Wendy Horan (Western Toad); Elke Wind (Bullfrog); Bob Brett (other photos).

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Summary

Progress on amphibians is the most advanced of all species groups (Section 2.4). A successful pilot study in October 2005 helped plan an efficient strategy for 2006 in which two types of surveys were conducted: (a) for aquatic-breeding species; and (b) for Coastal Tailed Frogs (*Ascaphus truei*), a blue-listed species found in mountain streams.

Aquatic-breeding amphibian surveys were conducted in June and August 2006. The main objectives of the June surveys were to gather distributional data on native pond-breeding amphibian species and determine whether non-native Bullfrogs (*Rana catesbeiana*) and Red-legged Frogs (*Rana aurora*), a blue-listed species, occur within the Valley. Late summer surveys focused on gathering distributional data on Coastal Tailed Frogs in mountain streams. August surveys were also conducted at the Nicklaus North golf course for evidence of pond-breeding amphibians and Bullfrogs.

In winter 2006, museums throughout North America were contacted to obtain information on specimens collected within the RMOW. In June, mesh funnel traps were set overnight in wetlands and ponds to capture all life stages of amphibians. Incidental observations and data from visual surveys at some ponds were recorded, as well as local knowledge of species occurrences. August stream surveys were conducted for all life stages of Tailed Frogs. These consisted of 30-person-minute visual and active searches (e.g., turning cobbles). Habitat characteristics were also recorded at most sites.

Surveys conducted in June at 21 wetlands and ponds confirmed the occurrence of five native species. Breeding was confirmed at 63% of the sites. Northwestern Salamanders (*Ambystoma gracile*) were observed most frequently, followed by Long-toed Salamanders (*Ambystoma macrodactylum*), Pacific Chorus Frogs (*Pseudacris regilla*), and Rough-skinned Newts (*Taricha granulosa*). Western Toad tadpoles (*Bufo boreas*) were observed at only one site.

Two additional species were confirmed outside the study: Ensatinas (*Ensatina eschscholtzii*) from three sites and Western Red-backed Salamander (*Plethodon vehiculum*) from one site. Red-legged frogs and Bullfrogs were not observed at any sites. Museum specimens included only Northwestern Salamanders and Western Toads from two sites (Alta Lake and Nita Lake).

Stream surveys in August confirmed the presence of Tailed Frogs at 47% of sites. Tadpoles, metamorphs, and adults were observed. Tailed Frogs were observed more frequently in streams along the east side of the valley than the west, from the valley bottom up to 1177 m. No clear habitat trends emerged, but Tailed Frogs were observed more frequently at smaller streams below 1177 m that were over 6ºC and contained approximately 50% canopy cover of coniferous or mixed riparian vegetation.

The Whistler Valley contains numerous lentic (still water) and lotic (moving water) sites for amphibian breeding. However, the majority of lentic sites retain water year round, contain fish, and are close to or surrounded by urban development. Few ephemeral wetlands were observed; these are important habitats for many amphibians because they are often highly productive and contain fewer predators (e.g., fish).

Small, ephemeral ponds and headwater streams are protected by riparian buffers or connectivity to upland forest habitat, and they are often difficult to identify on maps and air photos (they usually need to be ground-truthed). All moist microsites and standing water can be utilized by amphibians for breeding, hydration, foraging, and/or cover. Effective management for these species requires a clear understanding of the importance of a variety of aquatic and upland habitat types and connectivity among them. Current legislation regarding the protection of riparian areas is based on size of wetlands and streams and is focused primarily on fisheries management which may do little to protect native amphibian species.

Additional surveys are required to confirm the occurrence of Red-legged Frogs and Bullfrogs, and to create a more accurate database on the distribution of local amphibian populations and their habitats within the RMOW. Volunteer monitoring programs such as FrogWatch would be relatively successful in a community such as Whistler where there is an active naturalists' club, many physically active, outdoor-oriented people, and relatively easy access to numerous water bodies and streams.

3.1 Introduction and Objectives

3.1.1 Amphibian Species in Whistler

The primary goals of the study were to:

i. Confirm which species occur in Whistler;
ii. Assess habitat affinities and distribution of Whistler's amphibians; and
iii. Recommend conservation approaches related to Whistler's amphibians, especially species-at-risk (Coastal Tailed Frog and Red-Legged Frog).

The Whistler area contains as many as 10 species of amphibians (Table 3.1 and Appendix 3). All but two of these species (Ensatinas and Red-backed Salamanders) require water for egg-laying. Six species were confirmed during this study and another two (Ensatina and Western Red-backed Salamander) were confirmed outside this study.[1] Red-legged frogs have not yet been recorded in Whistler though sightings just south of Whistler: at Ransome Lake (835m a.s.l) and at Lucille Lake (ca. 375m a.s.l.; B. Brett and C. McGillion; unpubl. data) suggest they could occur. Non-native Bullfrogs, introduced to the Lower Mainland over 100 years ago, have been expanding their range but have yet to be confirmed in Whistler.

Table 3.1. Amphibian species potentially occurring in the Whistler area and confirmed captures and detections. See Figure 3.1 for photos of each of these species.

Salamanders	Scientific Name	Native?	Confirmed?	Breeding	CDC[2]	Listing COSEWIC[3]	IUCN[4]
Northwestern Salamander	*Ambystoma gracile*	yes	yes	aquatic			
Long-toed Salamander	*Ambystoma macrodactylum*	yes	yes	aquatic			
Rough-skinned Newt	*Taricha granulosa*	yes	yes	aquatic			
Ensatina	*Ensatina eschscholtzii*	yes	yes	terrestrial			
Western Red-backed Salamander	*Plethodon vehiculum*	yes	no	terrestrial			
Frogs and Toads							
Coastal Tailed Frog	*Ascaphus truei*	yes	yes	aquatic	Blue		
Western Toad	*Bufo boreas*	yes	yes	aquatic		Spec. Concern	Red
Pacific Chorus Frog	*Pseudacris regilla*	yes	yes	aquatic			
Red-legged Frog	*Rana aurora*	yes	no	aquatic	Blue		
American Bullfrog	*Rana catesbeiana*	no	no	aquatic			

3.1.2 Objectives

A. Pond Surveys.

Survey a broad range and number of wetlands and ponds throughout the RMOW, including the River of Golden Dreams and valley golf courses in order to:

a) record the distribution of lentic-breeding amphibians in the area;
b) determine whether Bullfrogs are present and breeding in the area (e.g., at golf course ponds); and
c) confirm whether Red-legged Frogs occur in the Valley (range expansion).

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[1] Known locations of Ensatinas include Lost Lake (Horan 2007), Gondola Heights (L. Anthony, pers. comm.), and Emerald (K. Skov photograph). Western Red-backed Salamander has been confirmed at only one site north of Spruce Grove (L. Anthony, pers. comm.).
[2] BC Conservation Data Centre (CDC); http://www.env.gov.bc.ca/cdc/)
[3] Committee on the Status of Endangered Wildlife in Canada (http://www.cosewic.gc.ca/eng/sct5/index_e.cfm).
[4] The World Conservation Union (http://www.iucnredlist.org).

B. Stream Surveys:

Survey a broad range and number of streams for Coastal Tailed Frogs throughout the RMOW in order to:

a) locate and record the distribution of Tailed Frog streams within the Whistler area; and
b) compare streams along the east and west sides of the valley using standard presence/not detected surveys (at a broad, coarse scale).

3.1.3 Public Involvement

Amphibians are typically very popular with young and old nature enthusiasts. This popularity was confirmed when over 50 people of all ages attended an outdoor event at Lost Lake in August, 2006. The event showcased both this general amphibian study and Wendy Horan's Western Toad study at Lost Lake. Results from this study were also presented on March 15, 2007 during a talk hosted by the Whistler Naturalists' Speaker Series.

3.2 Methods

Resources Inventory and Standards Committee (RISC) techniques were employed to conduct rapid assessments for pond-breeding amphibians and Tailed Frogs within the RMOW (RIC 1997, 2000). The data from these standard, coarse-filter assessments provide a foundation upon which more detailed and intensive studies can be developed (e.g., monitoring programs). Knowing the distribution of occupied wetlands, ponds, and streams within the RMOW is key to identifying potential current and future threats to native amphibian populations.

3.2.1 Pond Surveys

Aquatic-breeding amphibians were surveyed between June 19 to 22, 2006 at as many wetlands and ponds as possible that varied in size, depth, hydroperiod, vegetative cover, level of disturbance, water temperature, etc. A total of 17 sites were sampled and additional four were surveyed visually, i.e., without trapping (Figure 3.2; Table 3.2).

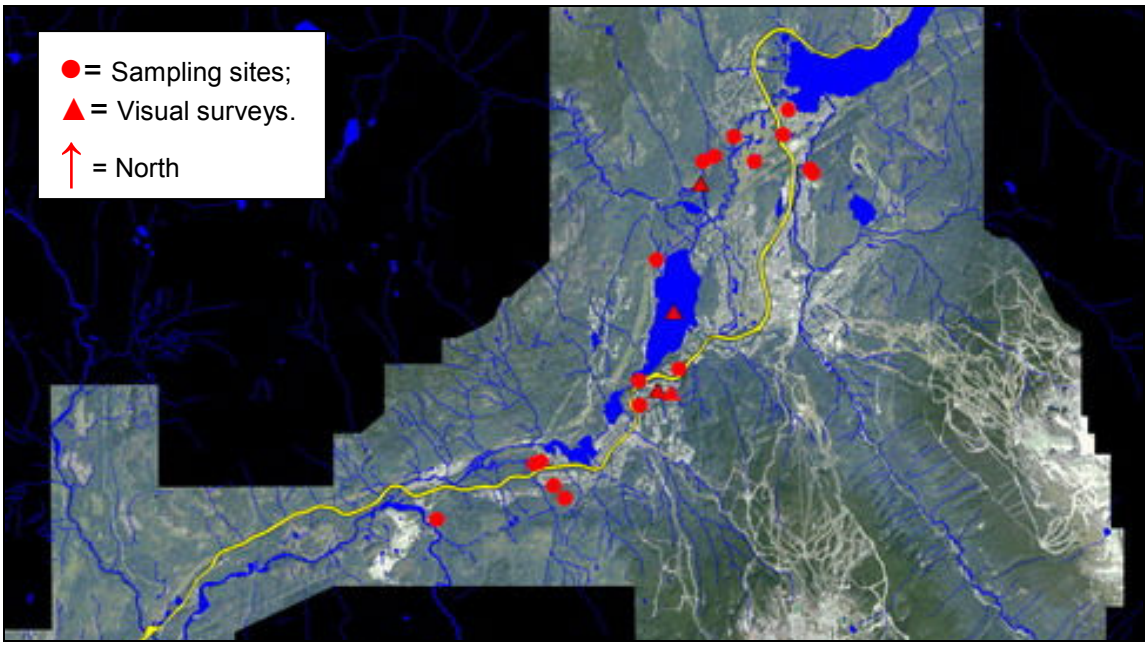

Figure 3.2. Pond sites surveyed for aquatic-breeding amphibians within the RMOW. The yellow line is Highway 99; the large water body in the middle of the figure is Alta Lake

Table 3.2. Pond survey sampling sites.[1]

Site Name	Sampled?	Elev.(m)	Easting	Northing
Bottomless Lake	yes	662	500782	5549694
South Alta Lake	yes	638	500783	5550304
Alta Vista Wetland	yes	646	501442	5550304
Millar's Pond	yes	662	499364	5548358
Connor's Pond (above Millar's Pond)	yes	738	499546	5548151
Spruce Grove Ditch	yes	644	503668	5553550
Spruce Grove Wetland	yes	642	503624	5553616
Buckhorn Drive	yes	636	205355	5554150
Emerald Forest North Pond	yes	652	502038	5553830
Rainbow Park Wetland	yes	642	501069	5552108
Interpretive Forest	yes	618	497433	5547800
Alpha Creek Wetland 1	yes	616	499058	5548723
Alpha Creek Wetland 2	yes	622	499167	5548757
Wildlife Refuge Gravel Pit	yes	644	501849	5553742
Nicklaus North Golf Course - Green 2	yes	636	503179	5554195
Nicklaus North Golf Course - Green 13	yes	636	502699	5553748
Nicklaus North Golf Course - Tee 15	yes	634	503265	5554597
Eva Lake	visual only	676	501095	5549948
Castle Ridge	visual only	692	501320	5549914
Wildlife Refuge	visual only	642	501806	5553380
Alta Lake/Upper River of Golden Dreams	visual only	640	501357	5551267

Unbaited aquatic mesh funnel traps (Figure 3.3) were set at each pond or wetland overnight, including the Nicklaus North golf course ponds. These live traps increase the probability of detecting more secretive species and life stages (e.g., salamander larvae), and amphibians occupying difficult to search habitats (e.g., densely vegetated, or deep, dark water bodies). Traps were placed approximately 5 to 10 metres apart depending on the size of the site and available traps. While the traps were being set and checked, any incidental amphibian observations were also recorded. At some locations, time permitted only a quick visual survey of the site to evaluate the potential for amphibian habitat; incidental observations were recorded during these surveys as well.

Figure 3.3 Aquatic funnel traps were set at numerous ponds and wetlands overnight to capture larval amphibians.

[1] Some stream reaches not recorded in the table were dry when visited in late August including Spring Creek just upstream and downstream of Highway 99 and Gonzales Creek just uphill of Highway 99.

For all individuals captured, the species, life stage (e.g., tadpole or larva, metamorph, and adult), and body size (e.g., snout-vent-length of larva and adults), were recorded. The locations surveyed were recorded using a GPS, the site was photographed, and the habitat was described.

During the spring and late summer surveys, incidental observations offered by locals from wetlands, ponds, and streams throughout the Whistler Valley were recorded. Lastly, museums were contacted during winter 2006 across the Pacific Northwest to obtain information regarding their specimen records for the Whistler area.

3.2 Stream Surveys

During the 8-day, late summer survey period for Tailed Frogs (Aug. 24-31), as many streams and reaches per stream as possible were surveyed throughout the RMOW (Figure 3.4; Table 3.3). A total of two to four surveyors searched each stream reach for Tailed Frogs over a standard 30-person-minute period. Hand nets were held below pebbles, cobbles, and boulders within the stream as they were sifted and lifted in order to catch any tadpoles or frogs attached to or hiding underneath (Figure 3.5). In addition, boulders were hand swept, and pools and shoreline edges were scanned visually.

Captured individuals were retained in a bucket until the end of the survey period. At this time, the species, life stage (e.g., tadpole with or without buds/limbs, metamorph, and adult), average body size (total length of tadpoles and snout-vent-length of metamorphs and adults), and sex (of adults) were recorded.

Habitat characteristics of each reach were also measured or visually estimated based on Department of Fisheries and Oceans standard Stream Site Card (RIC 2000), including elevation, aspect, gradient, percent cover of fines (< 0.2mm), gravels (0.2-0.64mm) pebbles (0.64-6.4mm), cobbles (6.4-25.6mm), and boulders (> 25.6mm), percent canopy cover, riparian vegetation (composition and stage), reach length surveyed, channel and wetted width, current average and annual maximum water depth, water temperature, and turbidity. The UTM was recorded and a photograph taken of each reach.

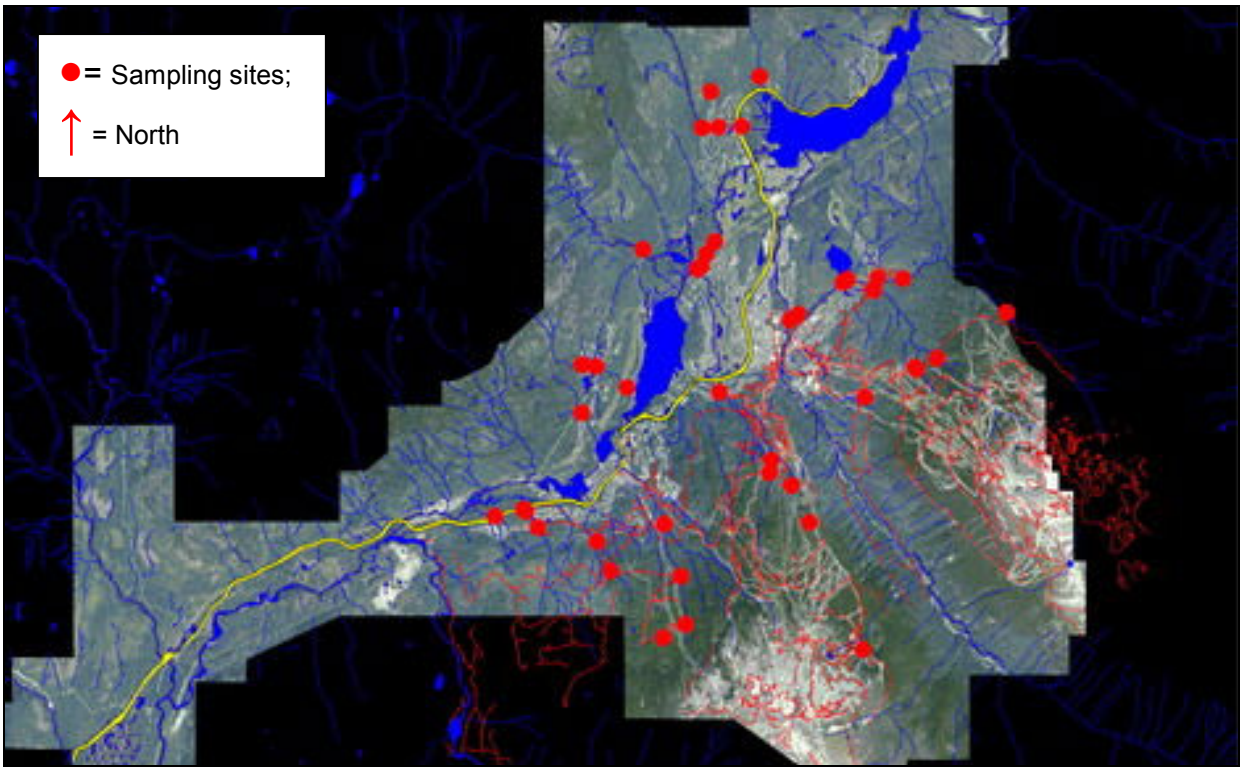

Figure 3.4. Stream sites surveyed for Coastal Tailed Frogs. The yellow line is Highway 99; the large water body in the middle of the figure is Alta Lake.

Table 3.3. Stream survey sampling sites.

Location	Creek Name	# of Reaches	Elevation (m)
west	Gebhart Creek	1	735
west	Scotia Creek	3	668-813
west	21-Mile Creek	1	639
west	19-Mile Creek	3	625-724
west	Unnamed Creek# 3 (Alpine)	1	758
west	Rainbow Housing	1	658
mid	River of Golden Dreams	4	633-635
mid	Fitzsimmons Creek	1	694
Whistler Mt.	Spring Creek	1	635
Whistler Mt.	Alpha Creek	3	635-665
Whistler Mt.	No Name Creek	3	780-1409
Whistler Mt.	Whistler Creek	3	652-1379
Whistler Mt.	Archibald Creek	4	722-1149
Whistler Mt.	Harmony Creek	1	1559
Whistler Mt.	Unnamed Creek#2 (Side Order)	1	1342
Blackcomb Mt.	Unnamed Creek #1 (Cruiser)	1	1010
Blackcomb Mt.	Horstman Creek	4	677-1213
Blackcomb Mt.	Horstman Tributary	2	1137-1177
Blackcomb Mt.	Blackcomb Creek	5	680-1377

Figure 3.5. Tailed Frogs were surveyed visually and manually using hand nets held below overturned cobbles and pebbles. (Elke Wind photo.)

3.3 Results

3.3.1 Pond Surveys

The spring pond surveys confirmed that all potential, pond-breeding, native amphibian species (Table 3.1) occur within the RMOW except Red-legged Frogs; further surveys will be needed to confirm its occurrence within the area.

In total, 17 wetlands and ponds were surveyed for amphibians in spring (June 19-22), and late summer (Aug. 27) for a total of 88 trap nights (Table 3.4). From the trapping, 5 of the potential 8 amphibian species were recorded. Western Toads were not recorded during trapping, but tadpoles were observed visually at Eva Lake on Aug. 22, 2006 (Table 3.5); Horan (2007) also observed breeding at Lost Lake in 2006. No Red-legged Frogs or Bullfrogs were observed from trapping, or from incidental or local observations. Museum amphibian specimen records revealed limited additional species information; of the five museums that had vertebrate specimen records for the Whistler area, only three had amphibian specimens of two species from three sites; Northwestern Salamanders from Alta Lake and Nita Lake, and Western Toads from Alta Lake.

Northwestern Salamanders (Figure 3.6) were the most common species encountered during funnel trapping; they were observed at 7 of the 17 wetlands trapped (41%). Of the 31 Northwestern Salamanders caught, 27 (87%) were larger than 40 mm snout-vent length (SVL) and may have been neotenes (i.e., sexually mature adults with larval characteristics[1]; Matsuda et al. 2006). The largest of these neotenes was 90 mm SVL, which is close to the maximum reached for this species (107 mm; Corkran and Thoms 2006).

Figure 3.6. Northwestern Salamander larvae occupy permanent water bodies throughout the RMOW. (Elke Wind photo.)

Long-toed Salamanders were trapped at 3 wetlands and adults were observed in the surrounding forest at a fourth site (24%). Because small larvae of these two species can be difficult to tell apart, some of the identifications may be incorrect and more than one species may be present (e.g., Connor's Pond and Spruce Grove Wetland)[2]. Only one adult Rough-skinned Newt was observed (at Rainbow Park; Figure 3.1c), and Pacific Chorus Frog tadpoles were only observed at three sites during both trapping and visual surveys (Emerald Forest North Pond, Interpretive Forest, and Castle Ridge; Figure 3.7). Incidental observations by surveyors prior to the study period suggest that some of these sites contain more species than observed in 2006, but additional surveys are required to confirm their presence (e.g., Long-toed Salamanders, Rough-skinned Newts, and Pacific Chorus Frogs have been observed at Connor's Pond and Millar's Pond; C. McGillion, pers. comm.).

[1] Dissection is required to confirm neoteny in this species.
[2] Larvae were confirmed as Northwestern Salamanders if they were larger than 35 mm snout-vent-length (Corkran and Thoms 2006).

Figure 3.7. Small, ephemeral habitats with thin-stemmed emergent vegetation such as this Castle Ridge pond often contain Long-toed Salamander larvae and Pacific Chorus Frog tadpoles.

Trapping at three of the Nicklaus North Golf Course ponds in late August 2006 did not reveal any amphibians. However, many fish (stickleback) were captured in each pond, and the water temperatures were relatively warm (e.g., 15 to 18ºC). Further surveys are required to accurately assess the occurrence of Bullfrogs or other amphibians within the golf course ponds.

Table 3.4. Pond-breeding amphibians and fish trapped during June (various sites) and August (Nicklaus North only).

		AMPHIBIANS										FISH			
		Northwestern Salamander		Long-toed Salamander		Ambystoma sp.[a]		Rough-skinned Newt		Pacific Chorus Frog		Stickleback		Sculpin	
Site	**# trap nights**	**#**	**# / trap night**	**#**	**# / trap night**	**#**	**# / trap night**	**#**	**# / trap night**	**#**	**# / trap night**	**#**	**# / trap night**	**#**	**# / trap night**
Bottomless Lake	8	**1**	**0.13**									203[c]	25.4		
South Alta Lake	4											12			
Alta Vista Wetland	7	**7**	**1.00**									74[c]	10.6		
Millar's Pond	8	**16**	**2.00**												
Connor's Pond	3	**2**	**0.67**	**Incid. A[b]**		**5**	**1.7**								
Spruce Grove Ditch	2	**3**	**1.50**												
Spruce Grove Wetland	2			**1**	**0.5**	**2**	**1.0**								
Buckhorn Drive	5											87	17.4		
Emerald Forest North Pond	4			**13**	**3.3**					**22**	**5.5**				
Rainbow Park Wetland	7	**2**	**0.29**					**1**	**0.1**			144	20.6	1	0.1
Interpretive Forest	4			**12**	**3.0**					**53**	**13.3**				
Alpha Creek Wetland 1	4														
Alpha Creek Wetland 2	4	**1**	**0.25**												
Wildlife Refuge Gravel Pit	4														
Nicklaus North Golf Course - Green 2	5											27	5.4		
Nicklaus North Golf Course - Green 13	10											59	5.9		
Nicklaus North Golf Course - Tee 15	7											72	10.3		
Total # sites		**7**		**3 (4)**		**2**		**1**		**2**		8		1	
Total # captured		**32**		**26**		**7**		**1**		**75**		**401**		**1**	

[a] The larva of the two *Ambystoma* species can be difficult to identify to species so some were left as unknown *Ambystoma* sp.
[b] Adults were found under downed wood in the surrounding forest.
[C] Estimate (not added up from all traps because too many or shortage of time).

Table 3.5. Pond-breeding amphibians observed during visual surveys and by incidental and anecdotal reports.

Visual Surveys:

Alta Lake	Canoed shoreline of lake to north end dam June 19, 2006 to look for Bullfrogs and Red-legged frogs - no amphibians observed; lake contains fish (stocked with trout); waters are relatively cold for Bullfrogs; need numerous more surveys to have any confidence in survey results
Eva Lake	Observed Western Toad tadpoles in the lake on Aug. June 22, 2006
Castle Ridge	Observed Long-toed Salamander larvae and Pacific Chorus Frog tadpoles in pond on Aug. 22, 2006
Wildlife Refuge Wetlands	No amphibians observed; fish in wetland

Incidental/Anecdotal Amphibian Observations:

Spruce Grove (Alta Lake School)	Long-toed Salamanders and Western Red-backed Salamanders found terrestrially; Northwestern Salamander egg masses in channel/ditch pond and wetland; Long-toed Salamander adults observed in late April/early May exiting the pond by the disc golf course/hydro cut above the campground and again under logs in fall, also observed alligator lizards and garter snakes; hundreds of toadlets observed in forest - probably originated from above the golf course near Lost Lake (L. Anthony, pers. comm.); toadlets observed by Alta Lake School students emerging in April.
Millar's Pond	Observed Long-toed Salamanders, Northwestern Salamanders, Rough-skinned Newts, and Pacific Chorus Frogs (life stages not recorded; C. McGillion, pers. comm.)
Connor's Pond (above Millar's Pond in forest)	Observed Long-toed salamanders, Rough-skinned Newts, and tadpoles? (wasn't sure) (C. McGillion, pers. comm.)
Gondola Way (Sundance)	Pacific Chorus Frogs heard calling near here in spring (L. Anthony, pers. comm.)
Lakeside Bowl (Blackcomb Mt.)	One northwestern (?) salamander neotene, ca. 35mm long, sighted August 2006 (B. Brett, pers. comm.)
Lucille Lake (outside/south of Whistler)	Observed breeding Western toads (appear to have slower development rates than toads at Lost Lake); and an anuran of some kind (Red-legged frog?) (C. McGillion, pers. comm.)
Black Tusk Village; Ransome Lake (south of Whistler) Emerald Estates	Red-legged Frogs have been observed at both sites (B. Brett, pers. comm.) Kirsten Skov has photographed Ensatinas, Western Toads, and Pacific Chorus Frogs from the small pond in her backyard. She also reports sighting Rough-skinned Newts.

Table 3.6. Macroinvertebrates, snails, and leeches trapped during surveys for pond-breeding amphibians.

	MACROINVERTEBRATES												OTHER	
Site	Water Scorp-ion	Giant Water Bug	Acilius Diving Beetle	Giant Diving Beetle	Scav-enger Beetle	Beetle	Water Boat-man	Back-swimmer	Caddis -fly	Dragonfly (Odonata)	May -fly	Damsel -fly	Snail	Leech
Bottomless Lake	X													
South Alta Lake	X	X								X				X
Alta Vista Wetland										X				
Millar's Pond		X	X				X		X	X				
Connor's Pond			X	X	X				X					
Spruce Grove Ditch														
Spruce Grove Wetland					X			X			X			
Buckhorn Drive						X	X				X		X	
Emerald Forest North Pond				X			X		X			X		
Rainbow Park Wetland	X			X	X				X	X				
Interpretive Forest			X	X				X						
Alpha Creek Wetland 1			X		X				X		X			
Alpha Creek Wetland 2					X			X			X			
Wildlife Refuge Gravel Pit			X	X						X	X			
Nicklaus North Golf Course-Green 2		X					X	X		X				
Nicklaus North Golf Course-Green 13	X	X	X					X	X				X	
Nicklaus North Golf Course-Tee 15	X	X					X		X				X	

3.3.2 Stream Surveys

In total, 19 streams and 43 reaches were surveyed for Tailed Frogs between August 24 to 31, 2006 (Table 3.7). On average, 2.3 reaches were surveyed per stream (range = 1 to 5 reaches). The majority of streams were surveyed on the east side of the Valley, on Whistler and Blackcomb mountains (11) versus the west (6). The emphasis on east slope streams was due to a combination of better access and interest by the Whistler-Blackcomb Employee Environmental Fund (who helped support the study).

Table 3.7.Summary of streams and reaches where Tailed Frogs were observed within the RMOW.

	West side	Mid-Valley	East side		Total
			Whistler	Blackcomb	
Number of Streams	6	1	7	4	19
Number of reaches surveyed	10	5	16	12	43
Number of reaches with Tailed Frogs	4	0	10	3	16
Sampling effort (reaches per stream)	1.7	4	2.3	3	2.3
Streams with Tailed Frogs	1	0	4	2	9
	17%	*0%*	*57%*	*50%*	*47%*

All life stages of Tailed Frogs were observed in streams in the RMOW in late August, except for eggs (Fig. 5). In total, Tailed Frogs were found in 47% of the streams surveyed, with more frequent encounters in east-side streams (54%) versus those surveyed on the west side of the Valley (17%). For streams where multiple reaches were surveyed, Tailed Frogs were observed in at least 50% of the reaches but usually more (82%).

Figure 3.6. Tailed Frog tadpoles, metamorphs, and adults were observed in late August in creeks within the RMOW. (Elke Wind photos.)

No clear trends emerged in terms of the types of streams or habitats where Tailed Frogs were observed. However, exploratory analyses suggest that they were detected more often in streams with (see Table 3 and Fig. 6):

- smaller widths (median wetted width was 1.5 m in streams with frogs versus 3.4 m without detection; range = 0.25 to 6.7 m),
- higher canopy cover (median = 50% cover in streams with frogs versus 12.5% cover without),
- temperatures over 6ºC (range = 7 to 14ºC),
- elevations at or below 1177 m (Tailed frog were not detected in 6 reaches on different streams that were over 1177 m; the range with frogs was 665 to 1177m),
- coniferous or mixed riparian vegetation (more than 40% of streams with frogs) versus deciduous cover (6% of streams with frogs).

Streams where Tailed Frogs were found appeared to require less survey effort in terms of length of stream surveyed (median = 20 m versus 30 m respectively), which likely reflects the amount of suitable and searchable habitat found in streams with frogs.

Figure 3.7. Scotia Creek is an example of a Tailed Frog Creek within the RMOW where tadpoles were observed at all three reaches surveyed.

Table 3.8. Number of streams and reaches where Tailed Frogs were observed within the RMOW.

Location	Creek Name	Reach	Easting	Northing	Elev. (m)	Present	Adults	SVL (cm)	Tad-poles	Meta-morphs	Comments
west	Gebhart Creek	1	499984	5550245	735	Y				1	
west	Scotia Creek	1	499995	5551098	813	Y			5	6	
west	Scotia Creek	2	500222	5551070	754	Y			7		
west	Scotia Creek	3	500764	5550697	668	Y	1	52	4		
west	21-Mile Creek	1	501038	5553117	639	N					fish observed
west	19-Mile Creek	1	502086	5555261	724	N					
west	19-Mile Creek	2	505375	5555275	674	N					has fish
west	19-Mile Creek	3	502785	5555287	625	N					
west	Unnamed Creek# 3 (Alpine)	1	505826	5551052	758	N					
west	Rainbow Housing	1	503092	5556163	658	N					
mid	River of Golden Dreams	1	502067	5552822	635	N					fish observed
mid	River of Golden Dreams (Lorimer)	2	501996	5552766	635	N					fish observed
mid	River of Golden Dreams	3	502147	5553025	634	N					
mid	River of Golden Dreams	4	502307	5553252	633	N					
mid	Fitzsimmons Creek	1	503627	5551873	694	N					
Whistler	Spring Creek	1	498447	5548424	635	N					
Whistler	Alpha Creek	3	499193	5548263	665	Y			7		
Whistler	Alpha Creek	1	499002	5548494	640	Y			6		fish (trout)
Whistler	Alpha Creek	2	499902	5548637	635	Y			14		
Whistler	No Name Creek	2	501400	5546275	1409	Y	1	43	4		
Whistler	No Name Creek	3	500463	5547461	948	N					
Whistler	No Name Creek	1	500231	5547972	780	Y			1		
Whistler	Whistler Creek	2	501785	5546513	1379	Y			12		
Whistler	Whistler Creek	3	501705	5547362	1094	N					
Whistler	Whistler Creek	1	501417	5548276	852	Y	1	36	3		
Whistler	Archibald Creek	1	503654	5548969	1149	N					
Whistler	Archibald Creek	2	503260	5549182	1087	Y	1	51		1 (observed post survey)	
Whistler	Archibald Creek	3	503312	5549408	1037	Y			11		
Whistler	Archibald Creek	4	502387	5550606	722	Y			20		
Whistler	Harmony Creek	1	504916	5546073	1559	N					

Table 3.8 (continued). Number of streams and reaches where Tailed Frogs were observed within the RMOW.

Location	Creek Name	Reach	Easting	Northing	Elev. (m)	Present	Adults	SVL (cm)	Tad-poles	Meta-morphs	Comments
Whistler	Unnamed Creek#2 (Side Order)	1	503980	5548305	1342	N					
Blackcomb	Unnamed Creek #1 (Cruiser)	1	504958	5550528	1010	Y			7		
Blackcomb	Horstman Creek	3	506216	5551201	1213	N					
Blackcomb	Horstman Creek	1	505104	5552394	746	Y			3		
Blackcomb	Horstman Creek	2	505087	5552402	746	N					
Blackcomb	Horstman Creek	4	504565	5552532	677	Y					found outside survey
Blackcomb	Horstman Tributary	2	505862	5551011	1177	Y			12		
Blackcomb	Horstman Tributary	1	502237	5555901	1137	Y			5		
Blackcomb	Blackcomb Creek	5	507447	5552006	1377	N					
Blackcomb	Blackcomb Creek	4	505618	5552600	859	N					
Blackcomb	Blackcomb Creek	2	505173	5552610	771	N					3 small fish observed
Blackcomb	Blackcomb Creek	3	505641	5552586	680	N					
Blackcomb	Blackcomb Creek	1	503787	5551966	663	N					

Table 3.9. Summary of habitat characteristics of streams with and without Tailed Frogs detected.

		Reach Length (m)	Width (m) Channel (m)	Width (m) Wetted (m)	Depth (cm) Aver. (cm)	Depth (cm) Max. (cm)	Grad-ient (%)	Can-opy	Percent Cover Moss	Algae	Fines	Gravel	Pebb-les	Cobb-les	Bould-ers	Temp. (˚C)	Elev. (m)
WITH	**Average**	**25**	**4.0**	**1.8**	**17**	**85**	**20**	**48**	**1**	**0**	**3**	**4**	**20**	**32**	**42**	**10**	**877**
	Median	**20**	**4.0**	**1.5**	**12**	**70**	**18**	**60**	**1**	**0**	**1**	**1**	**15**	**25**	**45**	**10**	**813**
	Count	17	17.0	17.0	17	17	17	17	17	17	17	17	17	17	17	17	17
	SD	12	2.3	1.6	18	62	9	28	2	0	5	4	20	20	25	2	180
	Min	10	1.0	0.3	2	10	4	5	0	0	0	1	1	10	5	7	665
	Max	60	10.3	6.7	80	250	38	85	10	1	20	15	70	75	80	14	1177
WITHOUT	**Average**	**39**	**8.1**	**4.5**	**20**	**114**	**13**	**26**	**5**	**1**	**3**	**6**	**32**	**25**	**36**	**9**	**901**
	Median	**30**	**6.5**	**3.8**	**22**	**75**	**12**	**13**	**1**	**0**	**1**	**5**	**28**	**20**	**30**	**10**	**735**
	Count	22	22.0	21.0	22	22	22	22	21	19	22	22	22	22	21	22	22
	SD	30	6.2	3.2	12	89	12	30	10	2	4	9	24	14	28	2	324
	Min	8	1.0	1.0	0	4	1	1	0	0	0	0	5	5	0	4	625
	Max	120	22.0	12.0	45	290	38	90	40	10	15	40	80	50	85	14	1559

3.4 Discussion

From the coarse-filter surveys conducted in 2006, all of the expected aquatic-breeding amphibians were confirmed to occur within the RMOW in 2006. However, only one to two species were confirmed at any particular site. This may reflect limitations around survey technique and/or effort, and/or differences in habitat preferences among species.

This baseline of information is important for effective management of local populations as occupied sites should not be managed in isolation, and parks and reserves need to be established where they are most effective. Amphibians exist in metapopulations (Gill 1978), dependent upon the occasional dispersal of individuals among sites to maintain genetic fitness (Berven and Grudzien 1990). Keeping the larger landscape context in mind provides greater understanding of the relative importance or sensitivity of each site or population to future development. For example, if a local species is found to be breeding in only a few sites, then the habitat quality of those sites and the distance and habitat composition between sites needs to be managed effectively in order to maintain connectivity among populations.

It was surprising that no amphibians were observed at the Wildlife Refuge during visual surveys as the habitat appears suitable for many species (surveys conducted by B. Beasley in 2002 also did not locate any amphibians at the refuge, B. Brett, pers. comm.). Further repeat surveys should be conducted at the site, especially during the egg laying season to confirm that the area is not used by any native amphibian species for breeding. If no breeding amphibians are found then the area is likely not serving to protect local aquatic-breeding amphibians. Studies should be conducted to determine the potential factors (e.g., water chemistry issues related to the bog iron mining that occurred in the first half of the 1900s; B. Brett, pers. comm.), and/or other areas within the RMOW with high amphibian diversity and habitat quality should be identified to protect native species.

Northwestern Salamanders:

As expected, Northwestern Salamanders were the most common species encountered during the pond surveys. This may be related to a number of factors. First, most sites surveyed were permanent water bodies and contained fish (see Table 1). The larvae of Northwestern Salamanders require more than one year to metamorphose so that they are dependent on permanent water for breeding. In addition, unlike many of our native amphibian species, Northwestern Salamanders can co-exist with some fish species depending on the latter's size and gape width (e.g., stickleback) because their larvae obtain a relatively large size and have toxins in their skin that reduce palatability. In the absence of larger, more predacious fish species (e.g., salmonids; Tyler et al. 1988, Larson and Hoffman 2002), Northwestern Salamanders are likely the major predator within some aquatic systems.

Second, the use of funnel traps to survey the ponds may have biased the species observed. For example, Northwestern Salamander larvae are relatively large, carnivorous predators that are likely attracted to organisms caught in the funnel traps, potentially inflating their relative numbers and reducing those of other species that may have been eaten before the traps were checked. To increase the probability of detecting all species within a site, repeat visual surveys should take place during the breeding season, especially when egg masses are visible.

Lastly, this species may be relatively successful within the RMOW because populations consist of terrestrial and aquatic, reproductively mature individuals. If the surrounding terrestrial environment is threatened or becomes unsuitable, there is the potential for some individuals to survive within the more benign aquatic environment, and vice versa.

Pacific Chorus Frogs and Long-toed Salamanders

Pacific Chorus Frogs and Long-toed Salamanders were observed less frequently than Northwestern Salamander. These species were often observed at small, shallow, and potentially seasonal ponds. Unlike Northwestern Salamanders, the larvae of these two species require only a few months to metamorphose allowing them to exploit and breed in water bodies that do not retain water all year.

Factors beyond hydroperiod may also affect where these species are found. For example, a study in Washington found that Long-toed Salamander sites tended to be smaller, shallower, contain firm sediments low in organic content, and contain a greater occurrence of emergent/aquatic vegetation relative to Northwestern Salamander sites (Hoffman et al. 2003). Related to this, Long-toed Salamanders and Pacific Chorus Frogs are negatively impacted by the presence of fish (e.g., trout) via direct competition and predation (Bull and Marx 2002; see review by Wind 2004). To avoid fish predation, these species may be dependent upon ephemeral or season wetlands and ponds within the RMOW to maintain their populations. However, the conversion of ephemeral wetlands to permanent water bodies within urban and rural areas poses a major threat to many native amphibian species because they are forced to co-exist with non-native fish and Bullfrogs (Adams 1999).

Although ephemeral or seasonal ponds appeared to be less common during our surveys, the location of many sites may be unknown due to limitations in mapping them (Wind 2003). These sites often need to be identified and mapped via ground truthing as they are not identifiable from air photos (Wind 2003). Small wetlands and ponds are some of the most threatened habitats within urban and rural environments because they do not legally require any protection in the form of riparian buffers (i.e., legislation is size- or fish-based), and they have not been identified on regional map bases. Studies have shown that riparian protection based on wetland size likely does little to protect amphibian populations as there is no correlation between wetland size and amphibian species richness (Semlitsch and Brodie 1998).

Rough-skinned Newts

It is unclear why only one Rough-skinned Newt adult was observed at the sites since this species is relatively ubiquitous in other areas of south-western BC (Wind, pers. obs.), and can co-occur with fish due to its high toxicity (see Wind 2004). In some areas, the species commonly associates with lakes (which were not surveyed during this study).

Western Toads

Although Western Toads occur in Whistler, they were not observed at the 17 sites trapped in 2006. Western Toads are listed as Special Concern federally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in part due to dramatic declines observed in parts of the United States and suspected declines in the Lower Mainland and on Vancouver Island (Wind and Dupuis 2002). Of the two confirmed breeding sites for Toads within the RMOW, Lost Lake has many issues associated with recreation that may negatively impact the local population (Horan 2007), and Eva Lake is situated within a housing development that poses numerous threats as well (e.g., road mortality, runoff, etc.).

Western Toads were not observed to breed in small ponds (< 1 ha) during extensive surveys for amphibians on Vancouver Island (Wind 2003), suggesting that this species may often select for larger water bodies for breeding in this area, especially lakes containing sandy shoreline areas (Wind, pers. obs). As with Northwestern Salamanders, Western Toads may be able to co-occur with some fish (Bull and Marx 2002) and as such may take advantage of larger water bodies for breeding. However, due to declines of this species elsewhere, more extensive surveys should be conducted to determine how many breeding sites exist within the RMOW and their distribution in order to effectively manage for this sensitive species and monitor for potential declines.

Red-legged Frogs

Red-legged Frogs were not confirmed within the RMOW despite the fact that they have been observed just south of Whistler at Lucille Lake (C. McGillion, pers comm.), Black Tusk Village, and Ransome Lake (B. Brett, pers. comm.). The range for Red-legged Frogs may be constrained by winter conditions. The latter three sites occur at elevations of 375-835m. Although Red-legged Frogs have been found at elevations over 1,000 m, they are most common at mid to low elevations (e.g., 500 m; Ovaska and Sopuck 2004). Red-legged Frogs have a similar range throughout the Pacific Northwest as Rough-skinned Newts and Northwestern Salamanders. However, both salamander species occur at higher latitudes and elevations, which may be the limiting factor for Red-legged frogs

in Whistler. Unlike Red-legged frogs, which overwinter in terrestrial environments, both salamander species have the ability to overwinter in water which may be advantageous in the colder, winter climate of Whistler and at high elevation sites in general.

American Bullfrogs

American Bullfrogs were not observed within the RMOW in 2006 and there is no confirmed historic record of their presence. There is however an unconfirmed sighting by Pierre Friele from the 1970s and another possible audio identification from Logger's Lake in 2006 (B. Reballato, pers. comm..). The species is likely not present within the RMOW or exists in very low numbers since introductions to an area are obvious due to the large size of Bullfrogs (both adults and tadpoles) and obvious breeding call. However, the potential exists for the species to become established within the area due to the presence of numerous permanent water bodies[1], especially man-made/altered ponds that contain warm water (e.g., golf course ponds), their propensity to prosper in urban/disturbed environments, and the fact that fish can facilitate the survival of Bullfrog tadpoles (Adams 1999, 2000, Adams et al. 2003). Further surveys in the form of regular monitoring are required to confirm whether the species is present and/or to detect its introduction early on in order to implement a rapid control response which is essential to reduce the continued spread of the species.

Coastal Tailed Frogs

Coastal Tailed Frogs were observed in almost half of the streams surveyed but they were not evenly distributed. They appeared to be more common on the east side of the valley than the west, but more surveys on west-side streams are needed. They were also observed more frequently in smaller streams, including ones that were not identified on TRIM maps. Tailed Frogs are associated with small headwater streams (Dupuis and Steventon 1999), which have similar issues to small ponds in terms of their lack of protection and difficulty in mapping. Their distribution within the RMOW may reflect limitations associated with stream size/water flow, water temperature, elevation, and forest cover.

Tailed Frogs were observed in streams that flowed through urban areas within the village. It is unclear whether adults were breeding in these lower reaches, or if the tadpoles observed originated from stream sections of tributaries further upstream and were swept into lower sections of the streams during periods of high flow; the small size of many of the tadpoles suggests that adults may be breeding in some of these lower reaches.

[1] Bullfrog tadpoles require more than one year to metamorphose.

3.5 Recommendations

1. Continue and expand upon amphibian surveys within the RMOW
    a. Increase the number of sites surveyed [try to survey all streams, wetlands, and ponds within the Valley, including man-made sites (e.g., golf-course ponds, etc.) in order to understand the 'context' in which each species is living]
    b. Increase the number of techniques and survey periods or reaches used per site (e.g., at least 3 surveys per site; include visual surveys at ponds in spring during breeding/egg laying to increase the probability of detecting species).

2. Increase efforts to identify and protect small ponds and streams
    a. Begin a program to map all small ponds and streams within the RMOW (e.g., Okanagan Puddle Project – use local volunteers with hand-held GPS's to gather information on the location of all existing ponds and small permanent streams)
    b. Implement legislation that protects small ponds and streams in the form of riparian buffers/setbacks, connective corridors, etc.
    c. Do not manage ponds and streams in isolation – maintain connectivity to surrounding upland and aquatic habitats

3. Evaluate fish management practices within the RMOW to identify potential conflicts with amphibian conservation and protection
    a. Limit accessibility for fish into waterways, especially areas that contain high value for amphibian populations:
        i. do not expand fish access without a thorough investigation into current values for amphibians and other taxa
        ii. protect wetlands from non-native fish introductions (e.g., trout)
    b. Consider eradicating non-native fish from some originally fishless sites that may have high values for amphibian populations

4. Support and promote academic research conducted within the RMOW
    a. Discuss potential research projects and funding sources with experts and professors at local universities
    b. Provide monetary and in-kind support for graduate students

5. Support the implementation of amphibian monitoring and education programs within the RMOW. The program could include surveys of lakeside residents to provide useful information on species occurrences at those sites (e.g., Bullfrogs), and school- or naturalist-based surveys for Tailed Frog tadpoles as indicators of urban health. For example, the existence of Tailed Frog tadpoles in streams within the village provides an excellent opportunity for establishing a monitoring program investigating 'urban' populations due to their occurrence across the valley and ease of sampling (e.g., examine the potential impacts of continued urban development and existing land-use practices, investigate habitat use within both the aquatic and terrestrial environment, etc.).

3.6 Suggested Work Plan for 2007 and 2008

3.6.1 Objective and Research Questions

The main objective of the study is to gather baseline data on amphibian populations that can be used to help direct future planning and development within the RMOW that is compatible with the needs of local species (e.g., maintains biodiversity).

The main research questions for the amphibian study are:

1. Which species of aquatic-breeding amphibians are relatively common versus rare in the RMOW? That is, which species may be at greatest risk from development due to rarity and/or isolation.
2. Which breeding populations are at greatest risk from human development? (i.e., how does current land use potentially hinder or facilitate the movement of individuals among populations in order to maintain genetic fitness):
    a. Which populations are relatively isolated? (e.g., > 1 km away from next population; based on known movement/home range data for these or similar species).
    b. Which breeding sites are currently surrounded by a relatively density of human development, which are protected, and which are at risk of future development? (e.g., % area in impermeable surfaces, density of roads, distance to forest cover – patches versus contiguous, etc.).

3.6.2 Methods/Approach

2007 *– Continue and expand upon amphibian surveys within the RMOW*

To address the research questions above, resurvey 2006 sites and increase the number of sites surveyed in 2007 in an effort to survey all accessible wetlands and ponds within the valley including man-made sites (e.g., golf-course ponds, etc.). This will place each known breeding site within a valley 'context' (e.g., only a few breeding sites versus common throughout the area)

To have confidence in 'known' breeding sites (i.e., increase the probability of detecting each species), surveys should be repeated within each year and a variety of survey techniques should be used. For example, each site should be surveyed at least 3 times using visual surveys—1-2 times in spring during breeding/egg laying (e.g., April/May), and 1-2 times during the larval stage (June/July). As well, the summer survey should include at least 1 night of funnel trapping.

Gather habitat data from each breeding site in the field, and from maps and air photos. Using GIS, estimate which breeding populations may be at greatest risk based on various indicators (see #2 above).

2008 and Beyond *– Support the implementation of amphibian monitoring and education programs*

Based on the results of the surveys, identify suitable long-term monitoring sites that could be repeatedly surveyed by volunteers starting in 2008 (e.g., contain species of concern, are accessible, are at threat from future development, etc.).

To increase efforts to identify and protect small ponds (and streams), begin a training program for volunteers whose objective is to map all small ponds and streams within the RMOW (e.g., Okanagan Puddle Project). Local volunteers use hand-held GPS's to gather information on the location of all existing ponds and small (permanent) streams and the information is submitted to the local planning department.

Surveys lakeside residents and trail users to provide useful historical and current information on amphibian species occurrences throughout the valley (e.g., Bullfrogs). Develop identification cards and species calls to be used during the surveys.

Establish a school-based education program / science module around urban Tailed Frog populations (e.g., as indicators of urban health).The existence of Tailed Frog tadpoles in streams within the village provides an excellent opportunity for establishing an education and monitoring program investigating issues related to wildlife in urban environments (e.g., examine the potential impacts /models of continued urban development and existing land-use practices, investigate habitat use within both the aquatic and terrestrial environment, etc.). Populations can be repeatedly surveyed across the valley using basic survey techniques. Schools or classes could adopt a stream / population and compare results.

3.6.3 Rare Species

1. **Where are Western Toads breeding within the RMOW and how are populations doing?**
    a. Field work to i.d. location and number of sites; GIS work to i.d. proximity to other toad populations, forest cover, roads/urban development
    b. Monitor breeding sites (depending on funding/available resources, look at relative size/number of breeding females per year, location of oviposition microhabitat(s) within the site relative to potential impact areas/issues, survival rate of eggs and larvae (e.g., white eggs; dipnet for tadpoles regularly), i.d. potential issues with recreation/people/pets, dispersal issues with metamorphs – e.g., crossing roads or trails
    c. Work in concert with FrogWatch province-wide toad monitoring program (re: survey techniques, etc.); potential support? (e.g., funding?, in-kind support – e.g., training resources?)

2. **Are Red-legged Frogs breeding in the RMOW?**
    a. Survey locals living and recreating by water bodies using species i.d. cards and calls
    b. Set up hot line to call in with reports (Laura and FrogWatch line?)
    c. Train volunteers who regularly visit certain sites to survey for frogs
    d. Survey south of RMOW northwards into Whistler and locate 'boundary'
    e. Surveys for toads (#1 above) would target all species

3. **How are populations of Coastal Tailed Frog doing?**
    a. Expand survey to include unsampled streams and additional reaches within streams already surveyed.
    b. Use results to hone knowledge of local habitat affinities.
    c. Use results to assess how and whether to monitor Tailed Frogs, especially population trends related to habitat changes.

4. **Are Bullfrogs in the RMOW (in concert with #2)**

5. **Which breeding sites are at greatest risk from urban development related issues?**
    Assess development projects, roads, isolation/fragmentation, non-native species, etc. with the help of GIS work.

Chapter 4: Plants[1]

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Summary

Surveys to date have confirmed 420 native plants in Whistler and an additional 76 non-native species, of which 72 are likely invasive. A provisional checklist of plants is included as Appendix 4. This list presents results of the first documentation of floral diversity throughout Whistler.

Two rare plants were discovered: upswept moonwort (*Botrychium ascendens*; red list) and marsh muhly (*Muhlenbergia glomerata*; blue list). Neither of these species was listed by the BC Conservation Data Centre as potential species in this area. An additional 12 species listed by the Conservation Data Centre and considered as probable or possible inhabitants of Whistler were not recorded during surveys. The discovery of two rare species previously unknown in Whistler is an example of the benefit of field surveys led by specialists.

The provisional checklist is likely close to comprehensive for most plant families. Under-represented taxa include bryophytes (mosses and liverworts), and grass and sedge families. Under-represented ecosystem types include rock outcrops, alpine areas with acidic rock (e.g., Blackcomb Mountain), and additional wetland types. Further survey work on invasive plants is also necessary.

Future work should include additional surveys for rare plants, and under-represented taxa and site types. Current and future data needs to be mapped and incorporated into ecosystem-level planning.

*Figure 4.1. (left) Adolf Ceska in a swamp with alder (*Alnus rubra*) and skunk cabbage (*Lysichiton americanum*). (middle) Adolf and Oluna Ceska survey the Whistler Mountain alpine. (right) Common mare's-tail (*Hippuris montana*) in a wetland in the Whistler Interpretive Forest.*

[1] This report defines plants to include all species of vascular and non-vascular plants. Mushrooms (non-lichenous fungi) are discussed in Chapter 6. Lichens are discussed in Chapter 7.

[2] Contact: Ceska Geobotanical Consulting; P.O. Box 8546, Victoria, BC V8W 3S2; (ph) 250-477-1211; (email) aceska@telus.net.

4.1 Introduction

Plants are critical components of biodiversity conservation in two ways. First, each species contributes to native biodiversity and warrants protection as that individual species. Second, individual plants and combinations of plants provide unique habitat attributes for other native species. The first step towards conserving plants and the other species that rely upon them is to identify an area's floral diversity and distribution. It is especially important when targeting rare species.

Another essential component of biodiversity conservation is at the ecosystem level. Combinations of species and growing conditions result in different plant communities which serve as the basis for BC's biogeoclimatic ecosystem classification (BEC; Meidinger and Pojar 1991). The BEC system underlies the Terrestrial Ecosystem Mapping (TEM; Green 2004) system Whistler uses as base mapping for its Protected Area Network (PAN; 2005a).

The BC Conservation Data Centre[1] tracks both rare species and rare ecosystems. Although this chapter does not discuss plant communities or ecosystems, the species-level surveys it summarizes are an essential first step towards protecting ecosystems. Chapter 10 discusses potential future work towards biodiversity conservation at the ecosystem level.

This chapter summarizes plant research conducted to date at the species level. The goal of the research was to: (a) quantify native plant diversity, including rare species; (b) provide an initial snapshot of the prevalence of invasive species (described more fully in Chapter 9).

4.2 Methods

Three sources of data are included in the results presented in this chapter:

1) Previously unpublished plant data accumulated through 2005 by Bob Brett;
2) A five-day survey in August 2005 of alpine, wetland, and disturbed sites (Figure 4.2) by Dr. Adolf Ceska, Oluna Ceska, and Bob Brett.
3) Additional data collected as part of the Whistler Biodiversity Project by Bob Brett.

*Figure 4.2: The 2005 plant survey focussed on alpine, wetland, and disturbed sites. (left) Moss campion (*Silene acaulis*) grows in the high alpine. (middle)* Verticillate water-milfoil (Myriophyllum verticillatum*) is a native milfoil found in many wetlands and streams. (right) Curly pondweed (*Potamogeton crispus*) is an invasive species found in disturbed wetlands such as the artificial wetland on Blackcomb Way.*

Plant data from Brett is documented in notes and photographs from his personal interest in quantifying Whistler's floral diversity as well as data collected for the Whistler Biodiversity Project (since 2005). The data contain casual and rigorous observations from throughout the Whistler area. Casual observations include photos and notes of species that were not sampled or rigorously field-identified. Field identification generally relied on Pojar and MacKinnon (1994). More difficult species were sampled and later identified using a microscope or magnified digital photograph using technical

[1] Online at: http://www.env.gov.bc.ca/cdc

guides (e.g., Hitchcock and Cronquist 1973; Douglas et al. 1998; Intelsys 2002; Klinkenberg 2007; USDA 2007). All species observations include locations and elevations. Most are also identified to ecosystem type including BEC site series and/or descriptive term such as riparian, wetland, old forest, or alpine. The Brett data lists any potential problems in accuracy, for example, where a field identification is equivocal as in difficult species groups such as grasses, willows, and drabas.

The additional source of data is from an intensive survey from August 10 through August 14, 2005. The survey consisted of transects through three main site types: alpine; wetlands, and disturbed urban areas (Figure 4.2). Observations were recorded by location (a GPS waypoint) with photo-documentation where helpful. If field identification was in doubt, a sample was taken. Some voucher specimens from this survey have been forwarded to the UBC herbarium by A. Ceska. The data presented in this progress report is not final since some species identifications need to be clarified.

Scientific names of species are constantly in flux as taxonomists and botanists learn more about plant genetics and relationships. These name changes can make tracking species more difficult, especially for the non-specialist. To reduce confusion as much as possible, the Eflora database[1] (Klinkenberg 2007) is used as the main naming authority for this project. Eflora is consistent with the BC Conservation Data Centre but more suitable for this application.

4.3 Results and Discussion

A total of 420 native species have been identified to date and included in the first provisional checklist (Table 4.1; Appendix 4). Another 76 non-native species were also confirmed which represents approximately 15% of total plant diversity (Chapter 9 and Appendix 4). This list is a first approximation of Whistler's floral diversity and is undoubtedly incomplete. The identification of some species also needs to be clarified; these are noted with a question mark (?) in the checklist.

Table 4.1. Plant species identified to date.

Native Species		
Vascular Plants		396
Unlisted	394	
Red List	1	
Blue List	1	
Non-Vascular Plants		24
Moss	21	
Liverworts	3	
Total Native Species		420
Non-Native Species		76
Invasive Species	72	
Likely Not Invasive	4	
Plant Species Total		496

[1] http://www.eflora.bc.ca/

Rare Species:
Two rare species were found for the first time in the Whistler area. Upswept moonwort (*Botrychium ascendens*) is a red-listed moonwort (a type of fern) found on Whistler Peak (UTM 10U 502877 5545283*)*. Swamp muhly (*Muhlenbergia glomerata*) is a blue-listed grass found in the Whistler Wildlife Refuge *(*UTM 501773E 5553497N*)*. Three additional species await confirmation: a *Senecio* which, though unlikely, may be northern butterweed (*Senecio cymbalaria*, blue-listed), a sample which may be satin grass (*Muhlenbergia racemosa*, red-listed), and another which may be small-fruited willowherb (*Epilobium leptocarpum*; blue-listed).

Figure 4.3: Two newly-discovered rare plants: (left) Upswept moonwort is a red-listed fern found on Whistler Peak. (right) Blue muhly is a blue-listed grass found in the Whistler Wildlife Refuge. Photos by A. Ceska.

The two confirmed rare species were not listed by the BC Conservation Data Centre as present or potentially present in Whistler. Rare plant surveys are exceedingly difficult for non-specialists since rare plants are often difficult to differentiate from more common species. Finding these unexpected rare species is an example of the benefit of field surveys directed by specialists.

Green et al. (2005) assessed Conservation Data Centre records of plants with unconfirmed but potential occurrences in Whistler and concluded 12 species probably or possibly occur in Whistler (Table 4.2). None have been located to date according to our records.[1] Future sampling should target site series and habitats these plants are most likely to occupy.

Table 4.2:Rare plants assessed by Green et al. (2005) as probable or possible in Whistler.

Scientific Name	Common Name	CDC list
Allium geyeri var. tenerum	Geyer's onion	blue
Botrychium simplex	least moonwort	blue
Carex lenticularis var. dolia	Enander's sedge	blue
Castilleja rupicola	cliff paintbrush	red
Ceratophyllum echinatum	spring hornwort	blue
Cheilanthes gracillima	lace fern	blue
Cicuta maculata var. maculata	spotted cowbane	red
Epilobium glaberrimum ssp. fastigiatum	smooth willowherb	blue
Nothochelone nemorosa	woodland penstemon	blue
Pleuropogon refractus	nodding semaphoregrass	blue
Schoenoplectus americanus	Olney's bulrush	blue
Sidalcea hendersonii	Henderson's checker-mallow	red

[1] There is a CDC record of nodding semaphoregrass at Callaghan Lake, just outside the RMOW boundary.

4.4 Suggested Work Plan for 2007

The provisional checklist of 420 native species is likely close to comprehensive for many plant families. Additional surveys need to be conducted for under-represented taxa such as bryophytes (mosses and liverworts), and grass (*Poaceae*) and sedge (*Cyperaceae*) families (Figure 4.4). These surveys should also focus on under-represented ecosystem types such as rock outcrops, alpine areas with acidic rock (e.g., Blackcomb Mountain), montane and subalpine forests, and additional wetland types. Future work should target site types most likely to contain the 12 rare species listed by Green et al. (2005) and also expand the survey of invasive plants.

Some additional work is needed to clarify species sampled to date. The identification of some species (denoted with a question mark in Appendix 4) needs to be confirmed. A complete record of species locations from 2005's intensive survey has yet to fully collated which limits the ability to track distribution. Rare species occurrences also need to be reported to the BC Conservation Data Centre. It would also be helpful to have list of Whistler-area specimens in herbaria such as at the University of BC.

*Figure 4.4: Under-represented taxa include bryophytes, grasses and sedges, for example: step moss (*Hylocomium splendens*), alpine timothy (*Phleum alpinum*), and Sitka sedge (*Carex sitchensis*).*

Chapter 5: Mushrooms

Lead Investigators	Sharmin Gamiet Andy MacKinnon
Contributing Scientists and Naturalists:	Kent Brothers (2006) Dr. Adolf Ceska (2005) Oluna Ceska (2005) Brian Didier (2006) Leanne Gallon (2006) Sharmin Gamiet (2003-2006) Paul Kroeger (2004) Andy MacKinnon (2004-2006) Daryl Thompson (2006)
Author and Data Compiler:	Bob Brett

Summary

This chapter presents Whistler's first provisional checklist of 399 mushrooms. Of these, 204 species have been identified at the annual Fungus Among Us Festival hosted by the Whistler Naturalists, and an additional 195 were recorded at a 1990 conference held in Whistler by the North American Mycological Association.

The total species identified each year has been fairly consistent at about 80, but the composition has varied. Of the total of 135 species in 2004 and 2005, for example, only 35 species were found in both years.

Future surveys will centre on the Fungus Among Us festival and continue to expand our knowledge of local mushrooms. Ideally, it would be help to surveys at other times of the year (e.g., spring) and at different sites (e.g., alpine).

5.1 Introduction

Mushrooms are the fruiting bodies of some larger fungi, or macrofungi.[1] Fungi are particularly important in forests where acidic soils limit the availability of nutrients. They form mutually-beneficial mycorrhizal ("tree root") associations with trees and other plants. Fungi increase a plant's uptake of nutrients while the plant provides sugars from photosynthates. Whistler's ecosystems would be entirely different without these fungal relationships.

Public interest in mushrooms has increased greatly over the past decade, especially with a growing appreciation for edible wild mushrooms such as pines, chanterelles, and morels. Each year since 2003, the Whistler Naturalists have hosted the Fungus Among Us mushroom festival (Figure 5.1). Invited specialists generously volunteer their time to lead the talks, walks, and public displays. A very useful byproduct of the fun and informative weekend is an annual list of mushroom species at a very high level of scientific accuracy.

[1] Lichens, also classed as fungi, are discussed in Chapter 7.

Figure 5.1: (left) Sharmin Gamiet and Andy MacKinnon lead a public walk during the Fungus Among Festival; (middle) Ophra Buckman demonstrates cooking techniques at Millennium Place. (right) One species labelled and displayed at Millennium Place.

It is very difficult to quantify the role fungi play in forested and non-forested ecosystems. It is similarly difficult to fully represent fungal diversity, distribution, abundance, and habitat requirements. Surveys such as these are the first step towards increasing our understanding of local fungal diversity, habitat affinities, and yearly fluctuations in above-ground production. Public events such as the Fungus Among Us festival allow people to enjoy another aspect of the natural world and in the process learn to overcome our culture's fungophobia (Arora 1986).

5.2 Methods

The mushroom survey can best be described as opportunistic. Sites are chosen by:

- proximity to the main venue (Millennium Place or Myrtle Philip Community School);
- diversity and abundance of mushrooms (based on exploratory surveys the previous day); and
- desire to represent a range of sites.

The dry forest in the Emerald Forest (mainly site series CWHms1/03; Green and Klinka, 2004) has been surveyed each year. Other sites have mainly focussed on the Lost Lake area:

- behind Spruce Grove Field House;
- No Horses and Tin Pants trails; and
- the Blackcomb Creek nature trail north from the cross-country ticket booth.

Andy MacKinnon and Sharmin Gamiet have led the surveys each year with the help of other specialists (Table 5.1). They start the weekend with an exploratory survey on Friday and choose sites for public walks in consultation with members of the Whistler Naturalists. During the walks, species are usually sampled for later identification and display at the main venue while others are identified in the field.

Table 5.1. Mycologists (mushroom specialists) at the Fungus Among Us Festival.

Year	Mycologists
2004	Sharmin Gamiet, Andy MacKinnon, Paul Kroeger
2005	Sharmin Gamiet, Andy MacKinnon, Adolf and Oluna Ceska
2006	Sharmin Gamiet, Andy MacKinnon, Kent Brothers, Daryl Thompson, Leanne Gallon, Brian Didier, Trevor Goward

Samples are brought back to the main venue, laid out on a paper-covered table, labelled to species (where possible), and displayed to the public (Figure 5.2). After the event, a list of species is compiled from the labelled paper. Most species nomenclature and common names are from Arora (1986; 1991), and updated where necessary by the specialists based on various technical treatises.

*Figure 5.2: Some local mushrooms are edible, for example, chicken-of-the-woods (left) and "lemony" admirable bolete (middle). Others are not, for example, this huge quinine conk (*Fomitopsis officinalis; *right) from the Comfortably Numb trail (K. Melamed photo).*

5.3 Results and Discussion

The first provisional checklist of Whistler mushrooms (Appendix 5) lists 399 species from two main sources. Fungus Among Us data is the main contributor towards 204 species recorded since 2004.[1] Additional data comes from the 1990 North American Mycological Association meeting which occurred in the Whistler area and listed 269 species (Sharmin Gamiet, pers. comm.[2]). A rough cross-indexing of the lists to combine duplicate records yields 195 additional species and a tentative total of 399 species. Some of these listings are undoubtedly duplicates due to taxonomic changes since 1990; others may represent the same species named two different ways. To ensure accuracy, these lists will need to be properly merged by a mycologist.

One surprise from the Fungus Among Us surveys has been the variability in species composition from year to year. For example, approximately 80 species were recorded in each of 2004 and 2005, but only 35 species occurred in both years. Part of the variability can be explained by year-to-year differences in weather and specialization of the participating mycologists, but a large part of the variability appears to be caused by something else.

No formal protection is offered to mushrooms, and rare species are not formally tracked.[3] Given the critical role fungi play, especially in forests, any additions to local knowledge are welcome. The puzzling year-to-year variability is worth exploring, as is the difference in species diversity and abundance in disturbed and undisturbed sites.

The extensive list of mushrooms is another good example of the reason why specialists are necessary when conducting biodiversity work. Parsing out meaning from the data will require additional surveys which links species presence and abundance to habitat types.

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[1] Some additions have been made outside Fungus Among Us, for example quinine conk (Figure 5.2) and early morel. Details are listed in Appendix 5.

[2] http://www.collectivesource.com/fungi/nama/BC90.html; and the NAMA website at: http://www.namyco.org/. NAMA lists some specimens from the 1990 foray at: http://www.fieldmuseum.org/nama/.

[3] Nonetheless, when Paul Kroeger discovered a rare mushroom (*Tricholoma apium*) which hatled logging on Mt. Elphinstone near Gibsons, BC. In 2004, Paul also recorded this species in the Emerald Forest.

5.4 Suggested Work Plan for 2007

The Fungus Among Us festival (Figure 5.3) will continue to be the main host for mushroom surveys. Where possible, different sites can be added to the ones sampled to date, though travelling time is limiting for this public event. Additional surveys at different times of the year (e.g. spring) and at different site types (e.g., alpine and subalpine) would help expand our knowledge of local mushroom diversity and distribution.

When possible, data from the Fungus Among Us festival and from the 1990 NAMA conference needs to be collated and synchronized. Future BioBlitz data may also expand our knowledge of local mushrooms.

Figure 5.3: (left) Shaggy mane mushrooms (edible!) push up through pavement at the Whistler Skate Park while a Fungus Among Us group examines other mushrooms. According to the event's mushroom specialists, cauliflower mushroom (middle) is "edible and sweet-smelling." Umbrella false morel (middle) is less inviting since it contains the same ingredient as a rocket fuel, monomethylhydrazine (Arora 1986).

Chapter 6: Bats (Pilot Project)

Author and Lead Investigator Tanya Luszcz[1]
Field Assistants: Ruth Joy
Bob Brett

Summary

There are historic records of 10 bat species in Whistler, including one red-listed and one blue-listed species. Recent confirmation of current occurrences of the 10 species is limited. The goal of this pilot survey was to begin to explore current bat diversity and distribution. It was able only to describe some characteristics of Little Brown Bats and Yuma Myotis, and only in two locations. Future work will need to explore the status of local bats, especially of the two rare species. It should also investigate habitat affinities with the goal of contributing to Best Management Practices for bats. In addition, the potential role of bats as indicators of habitat conditions needs to be explored.

6.1 Introduction

Bat diversity and distribution, as well as the structure of local bat communities are all strongly influenced by environmental conditions, prey and roost availability (Findley 1993, Humphrey 1975, Kalko *et al.* 1996), and resource competition (Husar 1976). Latitude largely determines bat species diversity (Willig & Selcer 1989). For example, one island in the Panama Canal is home to at least 66 species of bats (Kalko *et al.* 1996), whereas the whole of Canada is home to only 18 species (Nagorsen and Brigham 1993, van Zyll de Jong 1985).

There are historic records of 10 bat species from the Whistler area (Ricker undated; Table 6.1; Figure 6.1; Appendix 6) though the current status is unclear for at least two reasons: (a) time since last confirmation; and (b) difficulties in identification, especially of Keen's Myotis, *Myotis keenii*. Historic records – especially those before ski area development – can confirm a native to Whistler but do not confirm it still occurs here. Trapping bats aids identification but even then identification in the field is sometimes not possible. For example, skull or DNA samples are required to confirm Keen's Myotis. Sound recordings can help identify other species active in an area but identification to species level is often uncertain.

Table 6.1. Bat species potentially occurring in the Whistler area and confirmed captures and detections.

		CDC	Hist.	2006 Pilot Study	
Common Name	Scientific Name	Listing[2]	Pres.[3]	Captured	Detected
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Blue	yes	no	no
Big Brown Bat	*Eptesicus fuscus*		yes	no	?
Hoary Bat	*Lasiurus cinereus*		yes	no	?
Silver-haired Bat	*Lasionycteris noctivagans*		yes	no	?
Little Brown Bat	*Myotis lucifugus*		yes	yes	yes
Yuma Myotis	*Myotis yumanensis*		yes	yes	yes
Long-legged Myotis	*Myotis volans*		yes	no	no
California Myotis	*Myotis californicus*		yes	no	no
Western Long-eared Myotis	*Myotis evotis*		yes	no	no
Keen's Myotis	*Myotis keenii*	Red	yes	no	no

[1] Box 357, Kaleden, BC V0H 1K0; (ph) 250-497-8650; (email) tluszcz@yahoo.com.
[2] BC Conservation Data Centre (CDC); http://www.env.gov.bc.ca/cdc/
[3] Historic presence data are from a library pamphlet compiled by Karl Ricker (undated).

Figure 6.1. (left) Tanya Luszcz examines a Little Brown Bat; (right) Yuma Myotis.

To determine bat diversity and distribution, capture of individuals, either from a known roost site or via mistnetting and/or harptrapping must occur (Kunz & Kurta 1988, Tuttle 1974). Both netting and trapping are ground-based, and therefore biased towards certain bat species. High-flying species are often under represented, and some species may be able to detect and avoid nets/traps more easily than others (Kunz & Kurta 1988). In addition, pregnant female bats, being less maneuverable, may be more easily captured than other members of a population (Audet 1990).

Studies of bat habitat use often employ acoustic monitoring of bat echolocation activity to make comparisons among habitat types and answer questions about their importance to commuting and foraging bats (Crampton & Barclay 1998, Ekman & de Jong 1996, Erickson & West 1996, Grindal & Brigham 1999) The use of ultrasonic detectors is prone to bias (*e.g.* species are not equally detectable (Parsons *et al.* 2000, Patriquin *et al.* 2003), and the range of detection varies with atmospheric pressure, humidity, temperature, battery voltage and variation among detectors (Livengood *et al.* 2001)). In addition, it is not possible to distinguish between the same individual detected several times versus several individuals each detected once (O'Farrell & Gannon 1999).

It has been suggested that bat activity levels should not be compared across species due to differences in detectability among species (Vaughan *et al.* 1997). When used properly and for the appropriate questions, however, ultrasonic detectors can provide a reasonable index of bat activity and habitat use (Hayes 2000, Murray *et al.* 1999).

6.2 Pilot Study Objectives

The goals of the 2006 pilot study were to:

- Conduct a preliminary inventory of bat species in the Whistler area.
- Determine bat habitat use in certain ecosystems using ultrasonic detectors.
- Increase community awareness and appreciation for bats through a public talk.
- Investigate the potential application of bat habitat needs into local planning and management.

Public involvement was a priority of this pilot study. An outdoor event was offered at Alpha Lake Park on July 29, 2006 (Figure 6.2). Even with minimal notice, 11 youth and adults showed up and stayed until 11:00 pm. The success of this small event confirms that Whistler residents, including young people, are very interested in bats.[1] Any future studies will public involvement including an indoor talk and an expanded outdoor program.

[1] Talks by bat specialist Dr. Mark Brigham at Myrtle Philip Community School and Millennium Place were extremely popular. Over 30 people accompanied Dr. Brigham on a bat walk after his talk.

Figure 6.2. Little Brown Bat (left) and close-up of wing (right) from the public event at Alpha Lake.

6.3 Methodology

All methods in this study were approved by the BC Ministry of Environment Permit and Authorization Service Bureau (Wildlife Act Permit SU06-25173). Bats were captured using mistnets on July 29 and 30, 2006 at two sites (Alpha Lake, 10U 499979 5549125 and Whistler Wildlife Refuge wetland, 10U 501855 5553339; Figure 6.3). Nets were opened at dusk and checked every 10 minutes. All capture and handling methods followed Resource Inventory Standards Committee Inventory Methods for Bats (1998) and the CCAC species-specific recommendations on Bats (CCAC 2003). Captured bats were removed immediately and held in cloth bags for one hour to ensure passage of feces so that an accurate weight measurement could be taken. Measured bats were released from the hand and torpid bats were re-warmed before release.

Figure 6.3. Tanya Luszcz and Ruth Joy setting up mist nets at the Whistler Wildlife Refuge.

A sequence of bat echolocation calls is often divided into phases (Griffin 1958). The search phase has a relatively low pulse repetition rate and is used when a bat is commuting or searching for prey. The approach phase, with increased pulse repetition rate, occurs when the bat reacts to and begins pursuing a prey item. The terminal phase (buzz) is characterized by a high call repetition rate, and indicates that the bat is attempting to capture the prey. As an indicator of activity in this study, a pass is defined as a sequence of two or more individual search phase calls. Buzzes were counted as a measure of foraging activity. Feeding buzzes sound like a buzz and are easily discernible from passes.

Bat activity was monitored using remote ultrasonic detectors at two forested and two wetland habitats at the Emerald Forest and Whistler Wildlife Refuge over two nights. ANABAT II detectors (Titley Electronics, Ballina, N.S.W., Australia) detect the inaudible, ultrasonic echolocation sounds of bats and output them as a fixed proportion of the original call frequency (division ratio), thus making them audible to the human ear. This study used a division ratio of 16 because it is suitable for the frequencies emitted by most North American bats (de Oliveira 1998). The bat detector sensitivity was set to 8 (maximum is 10).

Detectors were coupled with ANABAT II delay switches and tape recorders (RadioShack, Optimus CTR-115), allowing for remote, all-night recordings. With this system (which triggered recording only when there was a detection), a 40 kHz calibration tone and a time stamp were recorded with each detection. The resulting tape contained recordings of bat passes and buzzes with the time between detections removed. A pause of one second or more between sets of calls was used to delineate a new pass because this is the amount of time required for the delay switch on the bat detector to be activated (de Oliveira 1998). If a feeding buzz separated two sets of calls, they were counted as two passes and one buzz.

The detection system was placed in a weatherproof plastic box on the ground, with the microphone facing upward 30° from the horizontal. In forests, the detector faced into a natural gap within a contiguous habitat type. A gap was defined as a natural opening created, for example, by blow-down. In riparian areas, detectors faced the wetland.

6.4 Results

Twenty-two individuals of two species (21 *Myotis lucifugus* and one *M. yumanensis*) were captured in two nights of mistnetting (Table 6.1). Five of the 16 bats captured at the Wildlife Refuge were released at the nets without measurement because too many bats of the same species were captured in the nets at once.

Over two nights of netting, 11 females and 11 males were captured (Table 6.2). A greater proportion of females (83%) were captured at Alpha Lake (Figure 6.4). Males comprised the majority of captures (62.5%) at the Wildlife Refuge. The proportion of reproductive females capture at Alpha Lake (50%) was greater that at the Wildlife Refuge (7%).

Table 6.2. Summary of bat captures at Alpha Lake (July 29, 2006) and Whistler Wildlife Refuge (July 30, 2006), of known sex and reproductive status. All captured bats were adult Myotis lucifugus with the exception of one M. yumanensis. Abbreviations are as follows:

Location	Reproductive Female	Non-reprod. Female	Unknown Female	Male	Total
Alpha Lake	3	2	0	1	6
Whistler Wildlife Refuge	1	3	2	10	16
Total	4	5	2	11	22

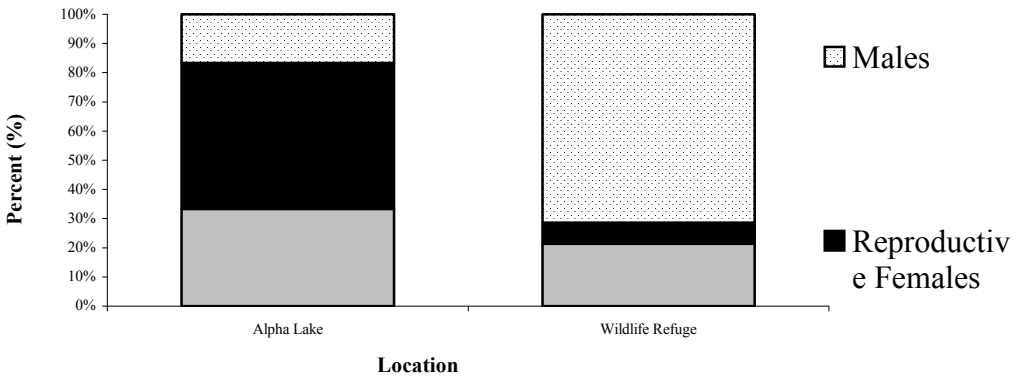

Figure 6.4: Percent composition of reproductive classes of captured bats at Alpha Lake and Whistler Wildlife Refuge, July 29 and 30, 2006.

Both wetland detectors recorded such high activity in the first hour that both tapes ran out shortly after 10:00pm. Therefore, only first hour of activity past sunset could be compared among the four sites. The first bat pass of the evening at the wetland sites was 9:26pm, whereas the first pass at both forest sites was 9:18pm. Bat activity was very high at both wetland sites with 595 and 784 passes recorded in the first hour (Figure 6.4). Foraging activity at these sites was also very high (323 and 417 buzzes respectively), which translates to at least one foraging buzz for every two bat passes. In comparison to the wetland, bat activity at the forest sites was low (Figure 6.5). No foraging buzzes were recorded at the forest sites.

The majority of bat species detected belong to the genus *Myotis*. Their echolocation calls sound like clicks on the detector. In comparison, echolocation calls from species of large bats most often sound like chirps. Species of large bats (most likely *Lasionycteris noctivagans* or *Eptesicus fuscus*) were detected a handful of times at each wetland location. Species of large bats were also detected at one of the Emerald Forest sites.

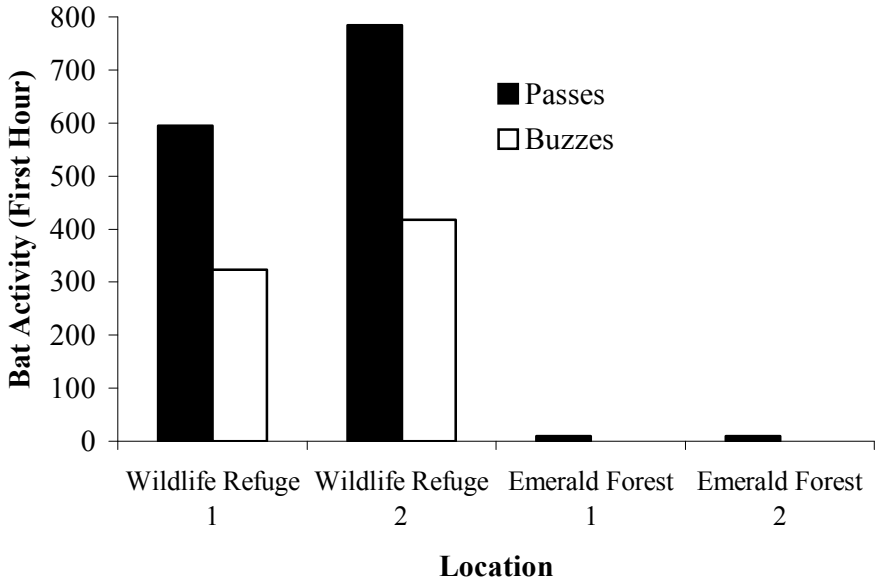

Figure 6.5. Bat activity (number of passes and foraging buzzes) in first hour at remote detection locations in Whistler, BC (July 29 and 30, 2006).

6.5 Discussion

Only two of a possible 10 species of bats were captured in two nights of mistnetting in Whistler. Both netting sites were over water, and *M. lucifugus* and *M. yumanensis* both commonly forage low over water bodies. A greater variety of mistnetting sites (trails, roads, and other flyways), as well as more field days, would probably confirm the presence of additional bat species, especially the larger bats detected but not identified to species.

Although two nights of netting is insufficient to establish trends, the higher proportion of reproductive females captured at Alpha Lake suggests that they may have maternity roosts in buildings, and that they choose to roost and forage in close proximity. Building roosts are usually warmer and less ephemeral than tree roosts. Conversely, there may not be suitable tree roosts in proximity to foraging sites. Male and non-reproductive female bats may be more prevalent at the Wildlife Refuge because they may be choosing nearby cooler tree roosts in trees that allow them to spent more time in torpor. When bats spend more time in torpor, they can better accumulate fat reserves for winter hibernation.

The high foraging activity at the Wildlife Refuge suggests that it holds very high importance to foraging bats, especially bats of the genus *Myotis*. Species of large bats fly very high, so their lack of detection could relate to their height in the air rather than their absence from the site. Future comparisons of this wetland to other foraging sites would be interesting. The remote detection results suggest that bats foraging at the Wildlife Refuge are roosting in the nearby Emerald Forest.

These results are few and preliminary, so caution should be taken in their application. A larger study could further elucidate bat diversity, distribution and habitat use patterns in Whistler.

6.7 Suggested Work Plan for 2007

This two-day preliminary bat inventory provided a tiny snapshot into bat diversity and distribution and habitat use in Whistler, BC. To sufficiently determine species diversity, distribution and community structure, as well as habitat use, I propose a longer study (10 days) that incorporates more components, and includes the help of local volunteers. I also suggest that the Whistler Naturalists or other local group purchase one or two tunable ultrasonic detectors to facilitate long–term monitoring of bats. Other components could include roost searches and exit counts, outreach events and media coverage that increase community awareness, and a plan to ensure that bat habitat needs are addressed in local land-use planning and management.

Bat roost sites are traditionally located using radio-telemetry of radio-tagged bats. This is expensive and time consuming. A cheaper alternative would include canvassing public assistance through local media, coupled with providing bat-friendly alternatives to homeowners who want to exclude bats. Exit counts can be conducted using the help of local volunteers. Potential or suspected bat roosts can be determined through the use of remote detectors and dusk watches by volunteers. Long-term monitoring of roosts could easily occur through annual monitoring by local residents.

Education and outreach are important components of a long-term monitoring plan. An article in the local newspaper could announce the 2007 study and canvass local residents for bat roost locations. I also propose that two of the proposed 10 days of mistnetting could be open to public attendance and could be combined with a slide show. This outreach event would increase community appreciation of bats, and serve to train future volunteers who will be involved in bat monitoring.

Whistler is under heavy development pressure, and it is important to address the needs of wildlife in a place that is known for its natural beauty and wild places. Stewardship and outreach with local governments and local landowners and developers could help to ensure that bat habitat requirements are better met when natural habitat is lost or reduced through urban development. Examples of practices that address bat habitat needs in Whistler include: snag retention, managing for future

snags, and protection of talus slopes, especially for threatened and endangered long-eared bats (*Myotis keenii*, and *Corynorhinus townsendii*). Reducing or curtailing pesticide use also benefits bats. Pesticides reduce prey availability (by killing mosquitoes and other insects). They can also accumulate in tissues and cause sub-lethal or lethal effects on bats.

Summary of Proposed 2007 Work Plan:

- 10 days of mistnetting (in two separate five-day stints) across a wider variety of habitats (e.g. near talus slopes) and flyway types (trails, roads, meadows).
- Precede study with article in local newspaper, canvassing public to obtain information on known human-made and natural bat roosts.
- Conduct evening exit counts at known (and suspected) bats roosts; involve volunteers.
- Set remote detectors at potential bat roosts as needed (snags, caves, talus slopes).
- Increase community awareness and appreciation through a public event.
- Facilitate support from concerned residents to providing direction and alternatives for urban developments.
- Set up a long-term monitoring plan for bats in Whistler with a committed group of volunteers.
- Train local volunteers in the use of remote detectors for monitoring bat activity.

Chapter 7: Lichens (Pilot Project)

Author and Lead Investigator Trevor Goward[1]

Summary

Lichenologist Trevor Goward visited Whistler in October as an invited specialist for the Whistler Naturalists' Fungus Among Us festival. During his stay, Trevor managed to conduct a brief lichen survey. He found a rich flora of nutrient-demanding species brought in with landscaping, including the first occurrence for inland western North America of one species, *Xanthoria parietina*. He also noted that black cottonwood and Alaska yellow-cedar are significant nutrient pumps which add to local lichen diversity. Whistler's acidic soils make lichens sensitive to air pollution which could reduce lichen diversity but, on the other hand, also make these lichens good candidates as inexpensive and effective air quality indicators.

The 38 species confirmed to date represents only a small subset of the native lichen flora, especially since Whistler's location between the Coast and Interior makes it a "release zone" for lichen diversity. The most likely location for rare and endangered lichens are in the remaining old-growth forests, especially those containing Alaska yellow-cedar.

7.1 Introduction

Lichens present a problem for taxonomists because they are actually two lifeforms, an alga and a fungus, joined into one. Lichenologist Trevor Goward describes this relationship as "a fungus that's discovered agriculture." The fungus, which can't photosynthesize, provides shelter for the alga. In return, the alga provides food in the form of photosynthates to the lichen. Lichens grow on many different surfaces including trees, rocks, and soil (Figure 7.1).

*Figure 7.1 Lichens can be found on almost any surface including trees (*Sphaerophorus tuckermanii *on western redcedar), rocks (various lichens including map lichen,* Rhizocarpon geographicum*), and soil (*Solorina crocea*).*

[1] Contact: Enlichened Consulting Ltd.; Edgewood Blue, Box 131, Clearwater, BC V0E 1N0; (ph) 250- 674-2553; (email) tgoward@interchange.ubc.ca.

Lichens have been used extensively as indicators of air quality. Their use in air quality monitoring is based on their sensitivity to small changes in air quality and the cost-effectiveness and simplicity of monitoring lichens.

Lichens can also be used as indicator species of forest stand development (K. Price, pers. comm.). Within wetter forests of the Pacific Northwest, the generalized sequence of epiphytic (tree-dwelling) lichen colonization in younger through older forests moves from rag lichens (e.g., *Platismatia* and *Hypogymnia*), through the hair lichens (e.g. *Alectoria* and *Bryoria*) and, given enough nutrient uptake, to the cyanolichens (e.g., *Lobaria*). If the relationship between lichen types and stand development can be quantified in Whistler, it could prove to be a more effective and accurate proxy of habitat conditions than simple measures currently used such as stand age.

The use of lichens as indicators for air quality and stand development has yet to be explored in Whistler. In October 2006, BC's pre-eminent lichenologist, Trevor Goward, visited Whistler as part of the Whistler Naturalists' Fungus Among Us mushroom weekend (Figure 7.2). His observations have been added to previous records in a very preliminary checklist containing 38 species (Appendix 7).

*Figure 7.2: (left) Trevor Goward at the Ancient Cedars. (middle) Participants at the lichen event during the 2006 Fungus Among Us event. (right) The discovery of snow-loving lichen (*Peltigera chionophila*) Whistler represents a range extension for this species.*

7.2 Summary of Brief Field Visit

The lichens around the immediate town site suggest that Whistler is situated in what is effectively a highly acidic landscape, as would be expected given the predominantly siliceous bedrock geology. The downside of this is that even low levels of air pollution will likely cause reductions in the lichen flora here. The upside is that lichens, especially tree-dwelling, or epiphytic, lichens therefore lend themselves as inexpensive, highly sensitive monitors of air quality in the town site. For example, at the moment they record clear evidence of some sort of overriding dust effect presumably arising from human disturbance of one form or another.

One interesting side note here is that some of the trees planted along the boulevards support remarkably rich, nutrient-demanding lichen floras: a testament to the quality of the soils brought in for landscaping. This flora includes *Xanthoria parietina*: a new species for inland western North America. Another hotspot for lichen diversity in the town site are the old cottonwood trees along Fitzsimmons

Creek. Cottonwoods are nutrient pumps whose roots are capable of uptaking calcium, magnesium and other nutrients from the soil, and transporting them into the canopy. Given the highly acidic background conditions in this portion of the Coast Mountains, such trees act as petri dishes in which nutrient-demanding lichens otherwise unknown in the area are able to take hold. Accordingly, these trees will doubtless prove to be nodes of species diversity in the Whistler town site.

*Figure 7.3: (left) Black cottonwood (*Populus trichocarpa*) is a nutrient pump which promotes the growth of nutrient-demanding lichens such as lungwort (*Lobaria pulmonaria*). (middle) Lungwort with other lichens and moss on black cottonwood and (right) on Pacific willow.*

Concerning the Whistler area in general, this portion of the province is located in what could be terms a kind of "release" zone for coastal lichens. That is, the climate here is rather oceanic, yet tree-dwelling lichens don't have to compete, as in regions closer to salt water, with heavy loadings of epiphytic bryophytes (mosses and hepatics) promoted by marine aerosols. This means that any nodes of nutrient enrichment, should they exist in this area, can be expected to support a rich complement of epiphytic lichens. If and where such nodes overlap with any remaining old-growth forests, there is a strong possibility of finding rare and possibly even endangered lichens. Unfortunately, my time in the Whistler area was too short to explore this possibility.

Finally, I'd like to emphasize that the climate in this regions, being "intermediate" between a coastal climate and an intermontane climate, has permitted the establishment of a wide selection of lichens from both coastal and inland regions. This is likely to result in a rather rich lichen flora.

7.3 Future Work

Future investigations of lichen diversity should include a variety of ecosystems and microhabitats (e.g., tree and rock surfaces). Special focus should be directed towards old-growth forests containing Alaska yellow-cedar since they are the most likely habitat for endangered lichens. The potential role of lichens as bio-indicators of air quality should be explored, as well as the potential use of epiphytic lichens as bio-indictors of the structural stage of forests. All samples should be stored for future analysis since stored lichens retain their chemical composition and therefore provide a record of past air chemistry.

Chapter 8: Dragonflies and Butterflies (Pilot Project)

Lead Investigator: Derrick Marven
Author and Field Assistant: Bob Brett

Summary

A dragonfly survey, conducted by Derrick Marven, was a natural addition to 2005's focus on wetlands, streams, and ponds. Since Derrick is also a butterfly specialist, he added any butterfly sightings during his visit. The first preliminary checklists of dragonflies and butterflies potentially occurring in Whistler are included as appendices. Of 24 dragonflies likely present in Whistler, 10 have been confirmed; of 54 butterflies, 8 have been confirmed. Neither of two rare butterfly species potentially in Whistler have been confirmed to date. Future surveys are needed at a range of sites and times of year to further describe these species groups and confirm the status of the two rare butterflies. The potential indicator role of dragonflies (and other macroinvertebrates) in wetland habitats should also be explored.

8.1 Introduction

Dragonflies are dependent upon wet habitats for their life cycle and occupy an important predatorial niche in all stages of their life (Figure 8.1). The aquatic larvae feed on insects, crustaceans, amphibian tadpoles, and fish. Adults are also efficient predators and mainly eat flying insects. Once sexually mature, they return to water to breed (Cannings 2002).

*Figure 8.1: Variable darner (*Aeshna interrupta*) is a common dragonfly in Whistler: (left) adult; (middle) aquatic larva. (right) A lustrous copper (*Lycanena cuprea*) butterfly pollinates a subalpine daisy (*Erigeron peregrinus*).*

Dragonflies and damselflies are classified in the Order *Odonata*, and are collectively termed Odonates. Odonates include damselflies (Zygoptera; from "joined wing") and the true dragonflies (Anisoptera, from "unequal wing"). Damselflies are generally less robust than dragonflies. They usually rest with their wings upswept while dragonflies rest with their wings outstretched. Wings are another distinguishing feature as reflected in their scientific names: a damselfly's wings are the same size while a dragonfly's back wings are broader than their front wings.

Butterflies and moths are classified in the Order *Lepidoptera* (from "scale wing," which refers to the minute scales on their wings). Lepidopterans form the second largest insect order after beetles (*Coleoptera*) and play a very important ecological role. Moths represent the vast majority of lepidopterans but are difficult to survey, partly due to the small size of many species and tendency to fly at night, but also because of their sheer diversity.[1] A butterfly can be distinguished from a moth by its club-shaped antennae, tendency to be active during the day, resting pose with wings upswept (versus outstretched as in moths; Figure 8.1), and usually thinner body.

[1] There are likely 3000 moth species in the Pacific Northwest, many of which have yet to be identified, and 200 species of butterfly (Miller and Hammond 2000).

8.2 Methods

Dragonfly and butterfly specialist Derrick Marven visited Whistler twice in 2005. An early July visit was aborted on the second day due to torrential rain and minimal activity. The early August visit focussed on sites on the Whistler Mountain alpine and wetland sites (Alpha Lake, Whistler Wildlife Refuge, and Brandywine 4-lanes). Dragonflies were the primary focus. Butterflies sightings were also noted.

Species were identified either through binoculars or by catching them in a net and examining them more closely. The preliminary checklists compiled by Derrick are based on his past observations in Whistler, his site visits in 2005, and from various references. Dragonfly references include Cannings (2002), Dunkel (2000), and Cannings et al. (1977). Butterfly references include Guppy and Shepard (2001), Glassberg (2001), and Layberry et al. (1998).

8.3 Results and Discussion

Whistler's first preliminary checklists for dragonflies and butterflies are included as appendices. The dragonfly list includes 24 species (19 dragonflies and 5 damselflies) likely to occur here, though only eight species have been confirmed (Appendix 8). None of these species are listed by the BC Conservation Data Centre.

A total of 56 butterflies are likely native to Whistler, of which 10 have been confirmed to date (Figure 8.2; Appendix 9). Of these species, two are blue-listed: Western Sulphur (*Colias occidentalis*) and Dun Skipper (*Euphyes vestris*). Derrick Marven has documented Dun Skippers from as close as Mt. Currie. For both dragonfly and butterfly checklists, Derrick Marven notes other species native to Whistler may not be included, and others on the list may prove not to inhabit Whistler.

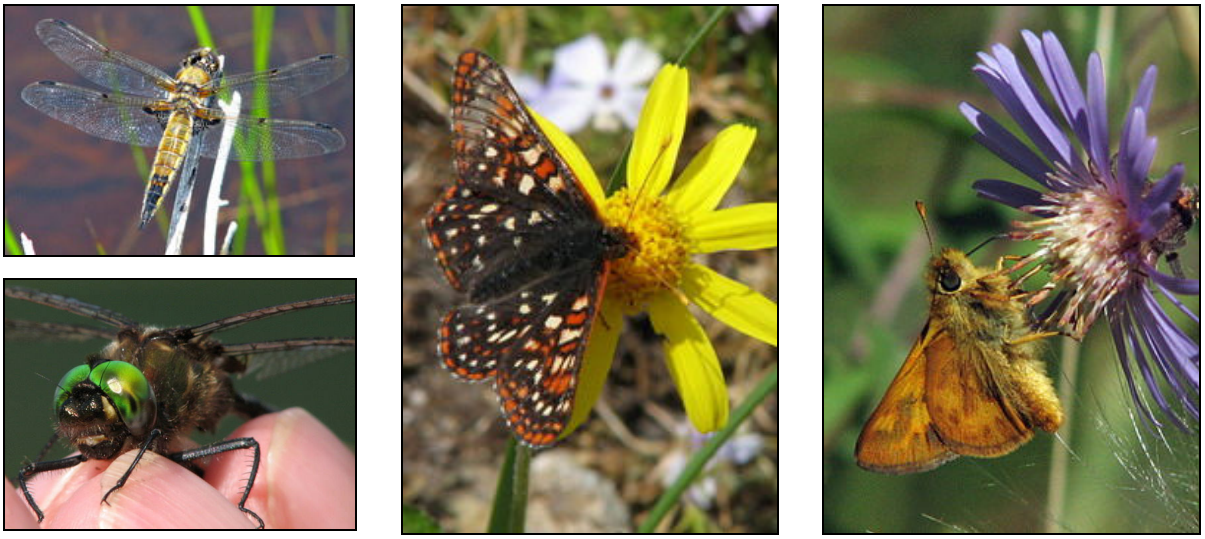

Figure 8.2: (left top) A newly-emerged (teneral) Four-spotted Skimmer. (left bottom.) Ring-tailed Emerald. (middle) A Variable (=Chalcedon) Checkerspot pollinating an arnica in the alpine. (right) A Woodland Skipper pollinating great northern aster.

8.4 Recommendations

Additional research spanning more days and sites will be required to clarify native dragonfly and butterfly diversity. The potential indicator role of dragonflies and other aquatic macroinvertebrates should also be explored in wetland habitats.

Chapter 9: Invasive Species (Pilot Project)

Author: Bob Brett
Contributing Investigators Dr. Adolf Ceska
Oluna Ceska
Karl Ricker
Elke Wind

Summary

Invasive species pose a global threat to native biodiversity. In the past, Whistler has been somewhat shielded from their impacts due to geographic isolation, lower levels of human activities, and a less temperate climate than, for example, Squamish and Vancouver. Now there is no doubt invasives are increasing their impact here as shown by the spread over the past decade of knapweed and Scotch broom. Almost 15% of plants identified so far by the Whistler Biodiversity Project are invasives. Bullfrogs may invade Whistler in the near future to the detriment of local amphibians, and a large proportion of local snails and slugs identified to date are invasive.

Whistler needs a long-term strategy to prevent and control harmful invasions and introductions. In the meantime, there are measures that can help. This chapter lists three species (Scotch broom, purple loosestrife, and yellow flag) for which removal options could be tested in 2007. Bullfrogs are another example of a species that might be prevented from establishing here (so far there are no confirmed records of Bullfrogs). Measures might include Best Management Practices guidelines for golf courses and homeowner education.

The first step towards developing an invasive species strategy for Whistler is to begin to understand the scope of the problem. The results presented in this chapter is a start towards quantifying the diversity, distribution and potential threat of invasives.

9.1 Threats to Biodiversity from Invasive Species

What are invasive species and how do they differ from native, weedy species? Invasive species have three defining characteristics: (i) they are introduced by human activities to an area they didn't naturally inhabit; (ii) they successfully reproduce at that location; and (iii) they are aggressive colonizers of adjacent habitat. In other words, they arrive, survive, and thrive.[1]

Invasives include plants, animals, viruses, algae, and conceivably every form of life. There are invasive species on land, in the water, and in the soil. Invading new areas often allows these species to escape predators and natural controls on their spread. In addition, invasives share a number of characteristics that allow them to out-compete native species, for example, most can:

1) rapidly colonize an area, especially disturbed areas;
2) reproduce quickly, sometimes more than once a year;
3) survive, or even benefit from, further disturbance;
4) withstand removal efforts due to deep roots, dispersal methods spurred by disturbance, tenacious and prolific seeds, continual sources of ingress, etc.; and
5) alter habitat conditions to favour their survival and reproduction.

The three main threats invasive species pose to native biodiversity are: habitat loss, displacement, and habitat degradation (Section 1.2). Another, less obvious threat is the loss of genetic uniqueness when invasive species interbreed with native species. Some common horticultural subjects such as roses, hawthorns, and spruces pose this kind of threat.

[1] http://en.wikipedia.org/wiki/Invasive_species

When invasive species are introduced to an ecosystem, they act as a form of anti-diversity. Each occurrence of an invasive species conceptually means one less occurrence of a native species.

Invasive species can be distinguished from other non-native species in that they spread aggressively beyond their original location. Daffodils and tulips, though non-native, do not expand beyond gardens. Invasive species do expand, including horticultural species such as Japanese knotweed (*Polygonum cuspidatum*[1]) and purple loosestrife (*Lythrum salicaria;* Figure 9.1). Bullfrogs (*Rana catesbeiana*) introduced into BC in the late 1800s are another example of an introduced species still expanding its range.

Figure 9.1: Three examples of invasive threats. A non-native Bullfrog tadpole dwarfs a native Coastal Tailed Frog tadpole (left; E. Wind photo). Japanese knotweed (middle; E. Haug photo). Purple loosestrife in Fitzsimmons Creek wetland (right). All of these species are well-established in the Lower Mainland. Japanese knotweed has recently invaded Squamish.

Wide-scale efforts to control invasive species are relatively recent. Locally, Invasive Plant Councils have started to form in BC in the past few years[2] and invasive animal efforts (e.g., FrogWatch[3]) are also relatively new.

Although there is a growing awareness of the problem and increased resources applied to control invasives, success is often elusive. Once established in an area, invasives are often exceedingly difficult to control especially since they usually benefit from constant disturbance and human activities provide a wealth of such disturbances. Climate change is an additional complication that may confer additional advantages to invasive species, especially over native species with slow dispersal mechanisms or narrow climatic niches.

It seems to me the invasive species problem is just about to mushroom in Whistler as it has already in areas with a more extensive history of human development such as Vancouver and Victoria. To put the Whistler situation in context, eight of the world's 100 worst invasive species as listed by the World Conservation Union (IUCN; Figure 9.2)[4] are already in Whistler:

- Purple loosestrife
- Black rat (Rattus rattus);
- Mouse (Mus musculus);
- Japanese knotweed;
- Leafy spurge (*Euphorbia esula*);
- Rainbow Trout (*Oncorhynchus mykiss*);
- Starling (*Sturmis vulgaris*); and
- Domestic cat (*Felis catus*).

[1] Also known as *Fallopia japonica*.
[2] See the Invasive Plant Council of BC website (http://www.invasiveplantcouncilbc.ca/about.htm).
[3] http://www.env.gov.bc.ca/wld/frogwatch/whoswho/factshts/bullfrog.htm
[4] http://www.issg.org/booklet.pdf..

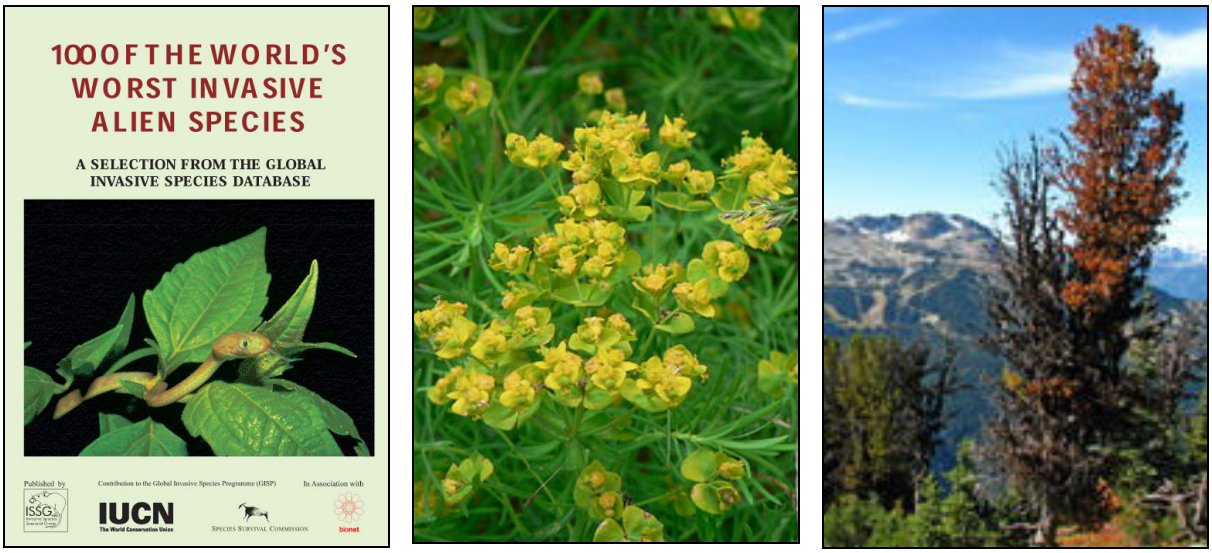

*Figure 9.2: (left) Eight of the world's worst invasives are already in Whistler and at least another seven are spreading towards Whistler. (middle) Leafy spurge has a small foothold at Rainbow Park. (right) White pine blister rust (*Cronartium ribicola*) threatens the existence of whitebark pine, a keystone species at high elevations. This dead whitebark pine is on Blackcomb Mountain.*

A quick scan of the IUCN list shows another seven species (at least) that may invade Whistler in the near future since they are already established nearby:

- Bullfrog;
- Grey squirrel (*Sciurius carolinensis*);
- Carp (*Cyprinus carpio*);
- Frog chytrid fungus (*Batrachochytrium dendrobatidis*);
- Asian tiger mosquito (*Aedes albopicta*), a vector for many non-native viruses; and
- Gypsy moth (*Lymantria dispar*).

The scale of the threat posed by invasive species is just emerging in Whistler. The goal of surveying for invasive species here is from the context of quantifying "anti-diversity." That is, if we know the kind, extent, and scale of species invasions, it will help guide control efforts to benefit native biodiversity.

9.2 Invasive Plants – Extent and Potential Control

Almost 15% of all plants identified to date, 76 of 496 species, are non-native (Appendix 4). The scale of the threat these plants pose to native biodiversity is unclear, but based on experiences elsewhere the following species are of particular concern (in descending order of potential threat to native species and habitat, speed of spread, and difficulty of control):

1. Japanese knotweed;
2. Purple loosestrife;
3. Scotch broom;
4. Knapweed;
5. Yellow flag; and
6. Eurasian milfoil.

Other common invasives, especially along transportation corridors, are a concern but maybe less so because they do not seem to have as much potential to affect Whistler's native species. Such species include orange hawkweed (*Hieracium aurantiacum*) , oxeye daisy (*Leucanthemum vulgare*), bird's-

foot trefoil (*Lotus corniculatus*), many mustard species, and various non-native thistles. The threat of most common ornamentals is likely minor in Whistler. Nonetheless, it would be worthwhile to monitor the spread into natural habitats of such ornamentals as foxglove, oxeye daisy, and leafy spurge (the latter is on the IUCN list but so far does not seem to spread aggressively).

There may still be an opportunity to control the spread of the particularly troublesome six species listed above. The best control measure, of course, is to prevent the introduction of such species but all appear to be in Whistler with the possible exception of Eurasian milfoil.

Even in the absence of an overall control strategy, some control efforts have occurred in Whistler. In 2000, the Whistler-Blackcomb Habitat Improvement Team (HIT) removed a large stand of broom beside Highway 99 in Function Junction. This stand has since re-grown (Table 9.1) which shows successful eradication sometimes requires multiple removals. Another lesson from the HIT experience is that the broom pull proved unpopular among the volunteers who, apparently, did not like to remove plants. If volunteers are used in the future (as in broom pulls on Vancouver Island), it will be necessary to stress the positive benefits of removing invasives.

Paying staff is of course another option. Last year, the RMOW directed approximately 60 person-hours towards removing knapweed and broom in the Nesters area (Paul Beswetherick, pers. comm.). Even with paid staff, however, it is important to communicate the need to control invasives.

No RMOW funds are specifically directed to the control of invasive species (plant or animal) for 2007. Nonetheless, some resources may free up as last year to remove invasives and there is therefore an opportunity to combine control efforts with surveys conducted as part of the Whistler Biodiversity Project. I propose three problem species should be targetted for a pilot control program in 2007: broom, purple loosestrife, and yellow flag (Table 9.1).

Of the three species, purple loosestrife likely poses the highest risk to native biodiversity due to its ability to displace native species in wetlands. Yellow flag similarly displaces native wetland species, but its ability to spread in Whistler is still unclear. Photos of the Fitzsimmons Creek artificial wetland (bio-swale) show it spreading fairly rapidly, while spread in the adjacent, natural wetland appears slower (Figure 9.3). Both species are extremely difficult to remove from wetlands because their rhizomes sprout aggressively when broken (as happens when plants are pulled out).

Figure 9.3: (left) The Fitzsimmons Creek artificial wetland, a.k.a. bio-swale, shortly after planting. (middle) Yellow flag expands into the wetland in 2006. (right) Yellow flag in the adjacent, natural wetland.

Table 9.1 Recorded locations and severity of infestations by three target invasives: Scotch broom, yellow flag, and purple loosestrife. Diffuse and other species of knapweed are also a priority but have not yet been geo-referenced or photo-documented by the Project.

Scientific Name	Common Name	General Location	Urg-ency	Sev-erity	UTM Zone	East	North	Removed
Lythrum salicaria	purple loosestrife	Fitzsimmons Creek wetland	1	C	10	503253	5552513	
Cystisus scoparius	Scotch broom	Blackcomb: Cruiser @ Wood Run	2	C	10	503976	5551394	
Cystisus scoparius	Scotch broom	Blackcomb: Magic Chair @ Pinnacle Ridge	2	B	10	503976	5551394	23-Jun-06
Cystisus scoparius	Scotch broom	Glacier Drive @ Staff Housing, east edge	2	C	10	503727	5550765	23-Jun-06
Cystisus scoparius	Scotch broom	Glacier Drive @ Staff Housing, west edge	2	C	10	503698	5550822	
Cystisus scoparius	Scotch broom	Blackcomb Way @ Glacier Drive, SE side	2	C	10	503637	5551314	
Cystisus scoparius	Scotch broom	Boot Pub, riverside @ Nancy Greene Dr.	2	C	10	503330	5552727	
Cystisus scoparius	Scotch broom	north of Nesters: weather station and berm	2	A	10	503265	5552958	
Cystisus scoparius	Scotch broom	walkway south of Medical Centre	2	C	10	503193	5551928	
Cystisus scoparius	Scotch broom	Lorimer Rd. @ Piccolo Dr. west side	2	B	10	502665	5552638	
Cystisus scoparius	Scotch broom	Rainbow Park west of volleyball courts	2	C	10	501158	5552079	
Cystisus scoparius	Scotch broom	Highland Lodge, Whistler Rd. side	2	B	10	500778	5549643	
Cystisus scoparius	Scotch broom	Eaglecrest road edge	2	B	10	499504	5548510	
Cystisus scoparius	Scotch broom	Spring Creek daycare (planted?)	2	B	10	498617	5548250	
Cystisus scoparius	Scotch broom	Cheakamus Main, S side @ hydro? Building	2	B	10	497362	5548171	
Cystisus scoparius	Scotch broom	Cheakamus Main, N side; W of Cheak. Lk. Rd.	2	C	10	497333	5548908	
Cystisus scoparius	Scotch broom	Highway 99 @ Function Junction, SW side	2	A	10	497320	5548282	
Iris pseudacorus	yellow flag	Fitzsimmons Creek bio-swale	2	A	10	503279	5552414	
Iris pseudacorus	yellow flag	Fitzsimmons Creek wetland	2	A	10	503253	5552513	
Iris pseudacorus	yellow flag	Highway 99 ditch @ Rimrock Restaurant	2	B	10	500725	5549559	
Iris pseudacorus	yellow flag	Green Lake shore @ Valley Trail boardwalk	2	C	10	503412	5554603	

Urgency: Relative measure of potential damage to other species and habitat if left uncontrolled. A = severe; B = very significant; C = lower priority.

Severity key: Approximate measure of size of infestation: A = >10 plants; B = 4-10 plants; C = 1 to 3 plants.

Most significant infestations:

Purple Loosestrife: Fitzsimmons Creek wetland.

Yellow flag: Fitzsimmons Creek wetland and adjacent artificial wetland (bio-swale).

Broom: Function Junction (Hwy. 99 and Cheakamus Mainline).

Knapweed: locations not yet geo-referenced (USDA photo).

I started informally monitoring Scotch broom in the late 1990s and have seen its slow but inexorable spread. Nonetheless, I believe we can knock back broom along Highway 99 and subdivisions, even if continual ingress along hydro and rail corridors poses a challenge. Reports from elsewhere suggest it will be even more difficult to control knapweed, purple loosestrife, and yellow flag.

This list of locations of the three invasive species (Table 9.1) provides a starting point for a pilot project to control invasive plants. The results of removal efforts should be monitored and this requires data such as location, extent of removal, and photo-documentation.

Continued surveys of invasive plants are planned as part of the Whistler Biodiversity Project this year. Two main goals are to: (a) identify the full range of invasive species; and (b) begin to describe the distribution of invasives, especially ones threatening native biodiversity most.

9.3 Other Species

To date, little work has been undertaken to investigate the potential threat other (non-plant) invasives pose to native biodiversity in Whistler. A partial list of potential and known invasives (Table 9.2) gives some indication of the current situation here.

Table 9.2: Partial list of non-plant invasive species confirmed in Whistler or with the potential to invade in the near future. Ext. range = species native to the larger region that have extended their range into Whistler due to human activities.

	Species Group	Common Name	Scientific Name	Confirmed?	Comments
	Amphibians	Bullfrog	*Rana catesbeiana*	no	see Chapter 3
Vertebrates	Mammals	House Mouse	*Mus musculus*	yes	
		Black Rat	*Rattus rattus*	yes	
		Norwegian Rat	*Rattus norvegicus*	yes	
		Coyote	*Canis latrans*	yes	ext. range?
	Birds	European Starling	*Sturnus vulgaris*	yes	
		House Sparrow	*Passer domesticus*	yes	
		Brown-headed Cowbird	*Molothrus ater*	yes	ext. range
	Fish	Goldfish	*Carassius auratus*	yes	
Invertebrates	Gastropods	Arion slug	*Arion sp.*	yes	
		Chinese Mystery Snail	*Cipangopaludina chinensis*	yes	
		Dark-bodied Glass Snail	*Oxychilis daparnaudi*	yes	
		Grove Snail	*Cepaea nemoralis*	yes	
		Waxy Glass Snail	*Aegopinella nitidula*	yes	
	Annelids	exotic earthworms		no	
	Other	other exotic soil fauna		no	
	Insects	Asian Tiger Mosquito	*Aedes albopicta*	no	
Other	Fungi	White Pine Bluster Rust	*Cronartium ribicola*	yes	
		Frog chytrid fungus	*Batrachochytrium dendrobatidis*	no	
	Bacteria	Lyme disease	*Borellia spp.*	no	
	Virus	West Nile Virus	*Flaviviridae*	no?	

9.4 Suggested Work Plan for 2007

All surveys conducted in 2007 and beyond will target invasive as well as native species, that is, the full range of current species diversity will be recorded. The most directed effort in 2007 will be towards a more detailed exploration of the diversity and distribution of invasive plants and the potential occurrence of Bullfrogs.

Chapter 10: Other Species Groups

Author: Bob Brett

Summary

Prior to the Whistler Biodiversity Project, only one species group (birds) and one species (black bear) in Whistler have been the foci of long-term, valley-wide studies. Bird studies provide an excellent example of the usefulness of long-term surveys at different times of the year and covering different sites. The bird work provides extensive information on the occurrence, relative abundance, distribution, and seasonality of common and rare birds. The black bear work applies similar, but species-specific, data towards conservation of that species within Whistler's developed context. It is an example of applying species-habitat knowledge to guide management.

There are many other sources of data, both realized and potential. Before now, these data have never been collated to better present the overall status of native biodiversity. Without an understanding of past work, we cannot properly allocate future resources, nor assess how the status of native species has changed over time (for example, which species no longer occur in Whistler).

This chapter represents the first attempt to collate these various sources of data, combine them with results from the Whistler Biodiversity Project, and analyze what is and is not known. This preliminary work reveals many data gaps. The greatest opportunity to fill these data gaps is to begin pilot studies of such species groups as small mammals, macroinvertebrates, and snails and slugs.

10.1 Other Data Sources

Prior to the Whistler Biodiversity Project, only two long-term, valley-wide studies of species in Whistler have occurred. The bird data is especially comprehensive thanks to volunteer efforts now coordinated through the Whistler Naturalists (Ricker et al. 2005; Gotz et al. 1986). Black bears (*Ursus americanus*) are the single most-studied species due to Michael Allen's extensive research and recent work coordinated through the Black Bear Working Group.

The main sources of other species data are: (a) reports prepared for the RMOW; and (b) government, university, and museum records from outside Whistler. Some Environmental Assessments may also provide useful, site-specific data but the data are often out-dated by the development process, and sometimes not compatible with a comprehensive biodiversity survey due to methodological differences (comprehensiveness, timing and type of survey, etc.).

Older data, especially those pre-dating Whistler Resort (<1965) are of particular interest since they could help define trends in species occurrence and distribution. There are few sources of historic data, but work between about 1922 and 1960 by Ken Racey, Ian McTaggart-Cowan, and J. Bailiff is a rich exception. It has been mined by both Max Gotz and Karl Ricker in their preparation of bird and mammal data (Gotz et al. 1986; Ricker et al. 2005; Ricker undated). It would be worthwhile revisiting these data especially regarding species which are currently rare (for example, Keen's Myotis) or extirpated (for example, Spotted Owl, *Strix occidentalis*).

Ecological communities (loosely defined here as ecosystems) are also tracked by the BC Conservation Data Centre. The CDC lists three red-listed and six blue-listed ecosystems in the Whistler area (Appendix 10), though this status confers no legislated protection on them. Once adopted, the Protected Area Network (PAN) strategy will be the main mechanism for protecting rare and locally important ecosystems, these are mapped at the site series level through Terrestrial Ecosystem Mapping (TEM, Green 2004). Ongoing plant and other species-based research, reported in earlier chapters of this report, will be linked with ecosystems through TEM to further define species-habitat affinities.

Here is a summary of some realized and potential sources of data:

- Local knowledge from residents and historic anecdotal accounts (Whistler Museum and Archives).
- Other unpublished data from naturalists (e.g. N. Ricker, Vancouver Natural History Society, etc.).
- Federal, Provincial, and Municipal governments (Environmental Assessments and other studies).
- BC Conservation Data Centre (rare and endangered species).
- COSEWIC and federal staff for species-at-risk.
- Royal BC Museum (including collections).
- Other data from the BC Government, e.g., Regional Biologists and Ecologists.
- UBC Vertebrate Museum (and other museums).
- UBC Botanical Garden Herbarium (and other herbaria).
- BC Parks (e.g., Garibaldi Park).
- Whistler Fish Stewardship Group and Whistler Angling Club (freshwater biology).
- RMOW staff, e.g., Fish and Wildlife Technicians and Horticulturists.

10.2 Summary of Data from Other Sources

At least 216 additional species have been recorded in other studies (Table 10.1; Figure 10.1). This is of course a very conservative estimate since some major species groups are not included, notably many insect and other invertebrate groups. Five rare species have been confirmed and another nine may occur.[1] At least three species, all birds, are currently considered extirpated (locally extinct).

Table 10.1 Tentative synopsis of known species for species groups not yet addressed by the Whistler Biodiversity Project. Consult the rest of this section for notes and references.

	Confirmed				Not Yet Confirmed				
		Rare Natives				Rare Natives			
Species Group	Native Species	red list	blue list	Non-Natives	Native Species	red list	blue list	Non-Natives	Extir-pated
Reptiles	2	0	0	0	1	0	0	0	?
Slugs & Snails	5	0	0	5	?	0	0	?	?
Birds	154	1	2	2	96	1	4	?	3
Mammals	50	0	1	3	?	0	4	?	?
Fish	5	0	1 + 1?	3	0	0	0	?	?
Total	**216**	**1**	**4 + 1?**	**13**	**97**	**1**	**8**	**?**	**3 + ?**

*Figure 10.1: Great Blue Heron (*Ardea herodias*; left); Hoary Marmot (*Marmota caligata*; middle); Puget Sound garter snake (*Thamnophis sirtalis pickeringii*; right).*

[1] The bird data is presented differently than the other data. Refer to the section dealing with birds below.

Birds

Whistler bird data is comprehensive, ongoing, and publicly available (Ricker et al. 2005; Gotz et al. 1986). Classifying bird data by native and non-native categories (Table 10.1) presents a bit of a challenge, however. Some birds breed here year-round; others are neo-tropical migrants here just for the warm months; others are migrants travelling to or from breeding grounds in Interior BC or in the North; still others were blown in by strong winds.

The bird lists include number of sightings per year and breeding status. Karl Ricker (pers. comm.) suggested categorizing native status by these criteria:

Native:	Seen every year (Rare to Common) and/or known to breed here.
Non-Native (or not confirmed):	Not seen every year (Accidental or Casual); no breeding record.
Extirpated:	A previously reported species which is now absent in Whistler.

Gray Jay (*Perisoreus canadensis*) is an example of a common native species present year-round. Two blue-listed species are included as natives for different reasons. Band-tailed Pigeons (*Columbia fasciata*) are included because they are sighted more than 10 times per year (=Uncommon). Green Herons (*Butorides virescens*) are not seen every year (=Casual) but are known to breed here.

Short-eared Owl (*Asio flammeus*) is an example of a bird listed as non-native because of its Accidental status (one sighting) and lack of breeding record in Whistler. It too is blue-listed by the CDC. Spotted Owl (*Strix occidentalis*) is a red-listed native species now considered extirpated in Whistler. There are populations relatively nearby, e.g., in the Lillooet Lake area, and they could potential re-occur in Whistler. No known native species in Whistler are extinct.

The other two known extirpated species are Rock Ptarmigan (*Lagopus mutus*) and Willow Ptarmigan (*Lagopus lagopus*). The two recorded invasives are European Starling (*Sturnus vulgaris*) and House Sparrow (*Passer domesticus*).

The definition of unconfirmed native birds (96 of which are listed in Table 10.1) differs from other species groups. As detailed above, these species have been recorded in Whistler but due to lack of repeated sightings or breeding records they are currently considered non-native. This group could eventually break out migratory birds, those which may indeed be native but under-reported, and truly accidental birds, that is, ones which clearly are out of their usual range.

The unconfirmed column contains four rare species in addition to Short-eared Owl. One subspecies of Peregrine Falcon (*Falco peregrinus* subsp. *annatum*) is red-listed and one subspecies of Great Blue Heron (subsp. *fannini*) is blue-listed. Current bird data cannot confirm their occurrence because data are not recorded at the subspecies level. Western Screech Owl (*Otis kennecottii*) and American bittern (*Botaurus lentiginosus*) are blue-listed species listed as accidental sightings.

Mammals

The mammal records summarized in Table 10.1 are from Karl Ricker (undated) and a museum search conducted by Elke Wind for this project. Ricker's data includes historic records, e.g., from Racey, McTaggart-Cowan, and the Royal BC Museum, as well as his personal sightings. Wind's museum data includes known specimens stored in facilities in BC and beyond.

Of 57 mammals recorded in Whistler (Figure 10.1), I have tentatively grouped them as 50 confirmed natives, three confirmed non-natives (invasives), and four unconfirmed natives. This somewhat arbitrary grouping is necessary due to a few challenges. First, the records don't currently include date, location, and other information which would help characterize whether species are native or just passing through. Unlike birds, however, the home range of a wide-ranging species such as Grey Wolf (*Canis lupus*) or Grizzly Bear (*Ursus arctos*) may include Whistler even if they don't actually breed within the boundaries. I would argue they should still be considered native by that measure.

The tentative classing of Grizzly Bears and Wolverines (*Gulo gulo*) as unconfirmed rare natives is meant to be conservative until all data is compiled. A number of other species have a similar status (for example Grey Wolves), but for now I have arbitrarily kept them as confirmed natives for the purposes of generating a snapshot of current, known mammal diversity.

Two rare bats for which there are historic records have not been confirmed recently: Keen's Myotis (Myotis keenii; red-listed) and Townsend's Big-eared Bat (*Corynorhinus townsendii*; blue-listed). They are listed as unconfirmed due to the uncertainty of their current status and (for Keen's Myotis) due to some challenges related to taxonomy and field identification (Chapter 6). Ken Racey and Ian McTaggart-Cowan collected the most recent, known specimens of Keen's Myotis in the early 1940s.[1]

The most recent specimens of Fishers (*Martes pennanti*; blue-listed) are a male and female collected by P.W. Martin in 1956 at Green Lake.[1] Karl Ricker saw one in 2006. Fishers have always been in low abundance, or at least secretive enough to escape detection, so it is difficult to assess their current status. Fishers are included as the only confirmed rare mammal in Whistler though, like the two listed bats, their status should be investigated further. Three invasive rodents inhabit Whistler: house mouse (*Mus musculus*), black rat (*Rattus rattus*), and Norway rat (*Rattus norvegicus*).

Reptiles

Two reptiles have been confirmed in the Whistler area: Northern Alligator Lizard (*Elgaria coerulea*) and Puget Sound Garter Snake (*Thamnophis sirtalis pickeringii*; Figure 10.1).[2] Alligator lizards have been recorded by Leslie Anthony and Whistler residents from various warm aspect, usually rocky sites from across the Whistler area including the Lost Lake disk golf course, Blueberry Hill, Alta Lake Road, and Emerald Estates. Garter snakes are ubiquitous and often found near water. Anthony (pers. comm.) believes Northwestern Garter Snakes (*Thamnophis ordinoides*) may also be in Whistler.

Slugs and Snails

Slugs and especially snails occupy a wide range of habitats. Although not widely appreciated, gastropods ("stomach-feet") are integral components of many ecosystems. We often overlooks these creatures until an issue affecting humans emerges, as happened recently with swimmer's itch in Whistler's lakes. Swimmer's itch is caused by a flatworm whose life cycle alternates between snails and waterfowl. In 2005, the RMOW commissioned a study to test which local snails were associated with the flatworm (Leighton 2005). The study identified five aquatic snails, four natives and one invasive (Table 10.2). The non-native Chinese mystery snail (Figure 10.2) was introduced into a market in San Francisco in the late 1800s and has since made its way here.

Table 10.2 Preliminary checklist of snails and slugs (BL = Leighton 2005; BB = Brett, unpubl. data).

	Scientific Name	**Common Name**	**Native?**	**Habitat**	**Source**
Snails	*Aegopinella nitidula*	Waxy Glass Snail	no	terrestrial	BB
	Cepaea nemoralis	Grove Snail	no	terrestrial	BB
	Cipangopaludina chinensis	Chinese Mystery Snail	no	aquatic	BL/BB
	Ferrissia fragilis	Oval Lake-Limpet	yes	aquatic	BL
	Helisoma trivolvis	Ramshorn Snail	yes	aquatic	BL
	Menetus cooperi		yes	aquatic	BL
	Oxychilis daparnaudi	Dark-bodied Glass Snail	no	terrestrial	BB
	Physa sp.		yes	aquatic	BL
Slugs	*Ariolimax columbianus*	Pacific Bananaslug	yes	terrestrial	BB
	Arion sp.	Arion	no	terrestrial	BB

[1] Stored in the Cowan Vertebrate Museum at the University of BC. Data compiled from a search of collections in BC and Canada by Elke Wind and on file with B. Brett.
[2] Leslie Anthony and Connor McGillion, unpublished data.

Figure 10.2: Chinese mystery snail (Cipangopaludina chinensis) *from the shallow water at Rainbow Park beach. The photo shows this snail at approximately life size (see fingers for reference).*

Another five terrestrial species were collected or photographed in 2006 (B. Brett, unpub. data), only one of which is native (Bananaslug). Snails and slugs are easily imported with landscaping soils and, like earthworms, tend to be dominated by non-natives in landscaped environments.

Fish

The listing of fish in Table 10.1 is tentative since the status of which fish are native to Whistler is in question.[1] Known natives include Threespine Stickleback (*Gasterosteus aculeatus*), Spiny Sculpin (*Cottus asper*), and Bull Trout (*Salvelinus confluentus*), a blue-listed species recently confirmed through DNA analysis. The status of the similar, blue-listed Dolly Varden (*Salvelinus malma*) remains to be clarified. Kokanee (*Oncorhynchus nerka)* and Goldfish (*Carassius auratus*) were introduced, the former to Alta Lake and the latter to Millar's Pond and No-Name Creek.

The main discussion centres on whether the original native game fish was Coastal Cutthroat Trout (*Oncorhynchus clarki clarki*) or Rainbow Trout (*Oncorhynchus mykiss*).[2] Either way, stocking of both species means there is likely no wild stock left in Whistler lakes.

Other:

There are other studies from the Whistler areas not summarized here. One of interest is the RMOW water quality study using macroinvertebrates as bio-indicators (Rebellato 2006) which, with data from the amphibian study (Chapter 3) begins to describe the diversity of these creatures (Figure 10.3).

*Figure 10.3: Invertebrates are currently under-represented in Whistler-area research. Giant Water Bug (*Lethocerus americanus*; left). Stonefly (Pteronarcys californicus?; middle). Unidentified bee on arnica (right).*

[1] Source: Betty Rebellato, Tom Cole, and Eric Crowe, pers. comm.

[2] Eric Crowe has written and presented evidence supporting his position that Cutthroat Trout is the true native, for example, "The Cranbrook Code" (unpublished manuscript).

References

Adams, M. J., C.A. Pearl, and R. B. Bury. 2003. Indirect facilitation of an anuran invasion by non-native fishes. Ecology Letters 6(4):343-351.

Adams, M.J. 1999. Correlated factors in amphibian decline: exotic species and habitat change in western Washington. Journal of Wildlife Management October 63:1132-1171.

Adams, M.J. 2000. Pond permanence and the effects of exotic vertebrates on anurans. Ecological Applications April 10:559-568.

Arora, D. 1986. Mushrooms demystified. Ten Speed Press, Berkeley, CA.

Arora, D. 1991. All the rain promises and more… Ten Speed Press, Berkeley, CA.

Audet, D. 1990. Foraging behavior and habitat use by a gleaning bat, *Myotis myotis* (Chiroptera: Vespertilionidae). Journal of Mammalogy 71:420-427.

Barclay, R. M. R. 1991. Population structure of temperate zone insectivorous bats in relation to foraging behaviour and energy demand. Journal of Animal Ecology 60:165-178. Canadian Council on Animal Care (2003) CCAC species-specific recommendations on Bats, CCAC

Berven, K.A. and T.A. Grudzien. 1990. Dispersal in the wood frog (*Rana sylvatica*): implications for genetic population structure. Evolution 44:2047-2056.

Bull, E.L., and D.B. Marx. 2002. Influence of fish and habitat on amphibian communities in high elevation lakes in northeastern Oregon. Northwest Science 76(3):240-248.

Cannings, R. 2002. Introducing the dragonflies of British Columbia and the Yukon. Royal BC Museum, Victoria, BC.

Cannings, R. and K. Stuart. 1977. The Dragonflies of British Columbia. BC Prov. Museum, Handbook No.35. Victoria, BC.

Components of British Columbia's Biodiversity No. 20. Ministry of Environment, Lands and Parks.

Corkran, C.C., and C. Thoms 2006. Amphibians of Oregon, Washington and British Columbia. 2nd Edition. Lone Pine Publishing. Vancouver BC.

Crampton, L. H., and R. M. R. Barclay. 1998. Selection of roosting and foraging habitat by bats in different-aged aspen mixedwood stands. Conservation Biology 12:1347-1358.

Douglas, G.W., G.B. Straley, D. Meidinger, and J. Pojar (eds.). 1998-2002. Illustrated flora of British Columbia, Vols. 1 to 8. BC Ministry of Env., Lands and Parks. Victoria, BC.

Dunkel, S.W. 2000. A field guide to the dragonflies of North America. Oxford Univ. Press.

Dupuis, L., and D. Steventon. 1999. Riparian management and the tailed frog in northern coastal forests. Forest Ecology and Management 124:35-43.

Ekman, M., and J. de Jong. 1996. Local patterns of distribution and resource utilization of four bat species (*Myotis brandti*, *Eptesicus nilssoni*, *Plecotus auritus* and *Pipistrellus pipistrellus*) in patchy and continuous environments. Journal of Zoology, London 238:571-580.

Erickson, J. L., and S. D. West. 1996. Managed forests in the western Cascades: the effects of seral stage on bat habitat use patterns. Pages 215-227 in R. M. R. Barclay, and R. M. Brigham, editors. Bats and Forests Symposium, Victoria, BC, Canada. BC Ministry of Forests.

Findley, J. S. 1993. Bats: a community perspective. Cambridge University Press, New York.

Gill, D.E. 1978. The metapopulation ecology of the red-spotted newt, *Notophthalmus viridescens* (Rafinesque). Ecological Monographs 48:145-166.

Glassberg, J.2001. Butterflies through binoculars: the West. Oxford Univ. Press, New York.

Gotz, M., N. Ricker, and V. Troup. 1996. Checklist of Whistler Birds. Birdbrain Photography, Whistler, BC.

Green, B. 2004. Terrestrial ecosystem mapping of the Resort Municipality of Whistler. B.A. Blackwell and Associates, North Vancouver, BC.

Green, R.N. and K. Klinka. 1994. A field guide to site identification and interpretation for the Vancouver Forest Region. BC Ministry of Forests, Victoria, BC.

Green, B., S. Leigh-Spencer, and K. Klinka 2005. Identifying habitat for species at risk within the Resort Municipality of Whistler. Contract report for the RMOW. B..A. Blackwell and Assoc., North Vancouver, BC.

Griffin, D. R. 1958. Listening in the dark: the acoustic orientation of bats and men. Dover Publications, Inc., New York.

Grindal, S. D., and R. M. Brigham. 1999. Impacts of forest harvesting on habitat use by foraging insectivorous bats at different spatial scales. Ecoscience 6:25-34.

Grinevitch, L., S. L. Holroyd, and R. M. R. Barclay. 1995. Sex differences in the use of daily torpor and foraging time by big brown bats (*Eptesicus fuscus*) during the reproductive season. Journal of Zoology, London 235:301-309.

Guppy, C. and J. Shepard. 2001. Butterflies of British Columbia. UBC Press, Vancouver, BC.

Hamilton, I. M., and R. M. R. Barclay. 1994. Patterns of daily torpor and day-roost selection by male and female big brown bats (*Eptesicus fuscus*). Canadian Journal of Zoology 72:744-749.

Hayes, J. P. 2000. Assumptions and practical considerations in the design and interpretation of echolocation-monitoring studies. Acta Chiropterologica 2:225-236.

Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. Univ. Washington Press, Seattle, WA.

Horan, W. 2007. Temporal-spatial use of littoral/riparian and upland habitat by the Western Toad (*Bufo boreas*) at Lost Lake, Whistler, BC. Unpubl. M.Sc. Thesis. Royal Roads Univ., Victoria, BC.

Humphrey, S. R. 1975. Nursery roosts and community diversity of nearctic bats. Journal of Mammalogy 56:321-346.

Husar, S. L. 1976. Behavioral character displacement: evidence of food partitioning in insectivorous bats. Journal of Mammalogy 57:331-338.

Intelsys Inc. 2002. Plant keys for British Columbia. Flora ID Northwest. Pendleton, OR (CD version.).

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate change 2007: Summary for policymakers. [on-line] URL: http://www.ipcc.ch/SPM2feb07.pdf.

Kalko, E. K. V., C. O. Handley Jr, and D. Handley. 1996. Organization, diversity, and long-term dynamics of a neotropical bat community. Pages 503-553 in M. L. Cody, and J. A. Smallwood, editors. Vertebrate Communities. Academic Press, Los Angeles.

Klinkenberg, B. (ed.) 2006. E-Flora BC: electronic atlas of the plants of British Columbia (http://www.eflora.bc.ca). Lab for Adv. Spatial Analysis, Univ. BC Dept. Geog., Vancouver, BC.

Kunz, T. H., and A. Kurta. 1988. Capture methods and holding devices. Pages 1-29 in T. H. Kunz, editor. Ecological and Behavioral Methods for the Study of Bats. Smithsonian Institution Press, Washington, DC.

Larson, G.L., and R.L. Hoffman. 2002. Abundances of northwestern salamander larvae in montane lakes with and without fish, Mount Rainier National Park, Washington. Northwestern Science 76(1):35-40.

Layberry, R., P. Hall, and J.D. Lafontaine. 1998. The Butterflies of Canada. Univ. Toronto Press. Toronto, ON.

Leighton, B. 2005. Swimmer's itch at Alta Lake with notes on Lost Lake. Contract report for the Res. Mun. of Whistler.

Livengood, K., R. D. Drobney, C. Corben, and R. L. Clawson. 2001. What will a detector detect? A study of the Anabat's zone of reception. Bat Research News 42:17-18.

Matsuda, B.M., D.M. Green, and P.T. Gregory. 2006. Amphibians and Reptiles of British Columbia. Royal BC Museum. Victoria, BC.

Meidinger, D. and J. Pojar (eds.). 1991. Ecosystems of British Columbia. BC Min. Forests. Victoria, BC.

J.. Miller and P. Hammond. 2000. Macromoths of Northwest Forests and Woodlands. US Forest Service FHTET-98-18. Cooperative Forest Ecosystem Research, Corvallis, Oregon).

Murray, K. L., E. R. Britzke, B. M. Hadley, and L. W. Robbins. 1999. Surveying bat communities: a comparison between mist nets and the Anabat II detector system. Acta Chiropterologica 1:105-112.

Nagorsen, D. W., and R. M. Brigham 1993. Bats of British Columbia. UBC Press, Vancouver.

O'Farrell, M. J., and W. L. Gannon. 1999. A comparison of acoustic versus capture techniques for the inventory of bats. Journal of Mammalogy 80:24-30.

Oliveira de, M. C. 1998. Anabat system practical guide. Queensland Department of Natural Resources, Brisbane, Queensland.

Olson, D.H., W.P. Leonard, and R.B. Bury. 1997. Sampling Amphibians in Lentic Habitats. Northwest Fauna Number 4. Society for Northwestern Vertebrate Biology. Olympia, WA.

Ovaska, K., and L. Sopuck. 2004. Update COSEWIC Status Report on the Red-legged Frog *Rana aurora* in Canada. Resources Inventory Committee. Canadian Wildlife Service, Environment Canada. Ottawa, ON.

Parsons, S., A. M. Boonman, and M. K. Obrist. 2000. Advantages and disadvantages of techniques for transforming and analyzing chiropteran echolocation calls. Journal of Mammalogy 81:927-938.

Patriquin, K. J., L. K. Hogberg, B. J. Chruszcz, and R. M. R. Barclay. 2003. The influence of habitat structure on the ability to detect ultrasound using bat detectors. Wildlife Society Bulletin 31:475-481.

Paulson, D. 1999. Dragonflies of Washington. Seattle Audubon Society, Seattle, WA.

Pojar, J. and A. MacKinnon (eds.). 1994. Plants of coastal British Columbia. Lone Pine, Vancouver, BC.

Racey, P. A. 1973. Environmental factors affecting the length of gestation in heterothermic bats. Journal of Reproduction and Fertility, Supplement 19:175-189.

Reballato, B. 2006. Health of Resort Municipality of Whistler Streams, as determined by benthic macroinvertebrate sampling. RMOW and BC Cons. Fdn., Whistler, BC.

Resources Inventory Committee (1998). Inventory Methods for Bats; Standards for

Resources Inventory Committee (RIC). 1997. Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Pond-breeding Amphibians and Painted Turtle. Version 1.1. Ministry of Environment, Lands and Parks. Victoria, BC.

Resources Inventory Committee (RIC). 2000. Inventory Methods for Tailed Frog and Pacific Giant Salamander. Standards for Components of British Columbia's Biodiversity No. 39. Version 2. Ministry of Environment, Lands and Parks. Victoria, BC.

Ricker, K. Undated. Checklist of Whistler mammals. Flyer prepared for the Whistler Public Library.

Ricker, K., H. Baines, and M. Thompson. 2005. Whistler birds 2005. Whistler Naturalists Society, Whistler, BC.

RMOW. 2002. The Whistler environmental strategy: moving toward environmental sustainability. Resort Municipality of Whistler, BC.

RMOW. 2005a. Protected area network strategy. Resort Municipality of Whistler, BC.

RMOW (Resort Municipality of Whistler). 2005b. Whistler 2020: moving toward a sustainable future – comprehensive sustainability plan. Resort Municipality of Whistler, BC.

Semlitsch, R.D. and J.R. Brodie. 1998. Are small, isolated wetlands expendable? Conservation Biology 12:1129–1133.

Spencer, Leigh-Spencer. 2004. Wildlife "species at risk" within the Resort Municipality of Whistler. BA Blackwell and Assoc. Contract report for the RMOW, Whistler, BC.

Tuttle, M. D. 1974. An improved trap for bats. Journal of Mammalogy 55:474-477.

Tyler, T., W.J. Liss, R.L. Hoffman, and L.M. Ganio. 1998. Experimental analysis of trout effects on survival, growth, and habitat use of two species of Ambystomatid salamanders. Journal of Herpetology 32:345-349.

USDA. 2007. The PLANTS database (http://plants.usda.gov). US Dept. Agric. National Plant Data Center, Baton Rouge, LA.

van Zyll de Jong, C. G. 1985. Handbook of Canadian mammals. 2. Bats. National Museums of Canada, Ottawa, Canada.

Vaughan, N., G. Jones, and S. Harris. 1997. Identification of British bat species by multivariate analysis of echolocation call parameters. Bioacoustics 7:189-207.

Willig, M. R., and K. W. Selcer. 1989. Bat species density gradients in the New World: a statistical assessment. Journal of Biogeography 16:189-195.

Wind, E. 2003. Aquatic-breeding Amphibian Monitoring Program: Analysis of Small Wetland Habitats on Vancouver Island. Annual Progress Report 2002. Unpublished report prepared for Weyerhaeuser Company, Nanaimo, BC.

Wind, E. 2004. Effects of Non-native Predators on Aquatic Ecosystems. Report produced for the Ministry of Water, Lands and Parks. Victoria, BC.

Wind, E., and L.A. Dupuis. 2002. Status Report on the Western Toad, *Bufo boreas*, in Canada. Report written for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Canadian Wildlife Service, Environment Canada. Ottawa, ON.

Appendix 1: Researcher Profiles

DR. LESLIE ANTHONY turned out to be the proverbial snake in the grass when we first encountered him in his current role as journalist and author. It turns out Leslie has a Ph.D. in herpetology (the study of reptiles and amphibians) and is perhaps the only person to ever read *Herpetologica* journal in a Whistler coffee shop. He generously offered his time as part of the 2006 tailed frog study (one of which he has in-hand in the photo).

BOB BRETT, M.SC., RP. BIO. started the Whistler Biodiversity Project in late 2004. Since training in forest ecology and conservation biology, Bob has worked as a research ecologist with Snowline Ecological Research in Whistler. Bob's research includes alpine vegetation classification, a Whistler forest history based on tree rings, tree thinning for wildlife, and traditional plant use with the Lil'wat. He is the founding president and a board member of the Whistler Naturalists. Bob sits on the RMOW Natural Areas Task Force and Forest and Wildland Advisory Committee.

DR. ADOLF CESKA AND OLUNA CESKA, M.SC. are rare plant species specialists based in Victoria, BC. Adolf is a retired botanist from the BC Conservation Data Center, founding member of the Native Plant Society of BC, and contributor to the Eflora website. In addition to her botanical skills, Oluna is a reconized authority on fungi and algae. Together they operate Ceska Geobotanical Consulting in Victoria. The Ceskas like slippery chinese noodles and phantom orchids.

SHARMIN GAMIET, M.SC. is a mycologist and consultant with Mycology Resources in Abbotsford. She has published extensively on mushrooms and recently created a website on BC's mushrooms. Sharmin is active with the Vancouver Mycological Society and President of the (non-chocolate) Truffle Association of BC. Sharmin has led the Naturalists' annual Fungus Among Us Festival from its start in 2003. That first year unfortunately coincided with a 100-year flood and no mushrooms. The event has since improved.

TREVOR GOWARD is a lichenologist based in Clearwater, BC. and curator of the lichens collection at the University of British Columbia Herbarium. He has published extensively in academic and other journals and is currently finishing a new book, *Lichens of Western North America*. His newest research interest are the thousands of species of crust lichens, many of which have yet to be described by science. Trevor likes dark chocolate.

TANYA LUSZCZ, M.SC., RP. BIO. is a bat biologist now working as the Great Basin Program Manager for Partners in Flight in Penticton. In addition to her scientific work she is an excellent natural history educator, as she demonstrated during an outdoor bat event at Alpha Lake last year. She also gives annual bat presentations at the Meadowlark Festival based in Penticton. Tanya prefers telemark to downhill skiing.

ANDY MACKINNON, M.SC., RP. BIO., RPF is a fixture among BC's naturalists and biologists, both for his encyclopaedic knowledge of the natural world and his ability to be enthusiastic about absolutely everything, even jelly fungi. He is co-author of Plants of Coastal British Columbia and has written and contributed to many scientific and technical papers. Andy is the Regional Ecologist with the Ministry of Forests in Nanaimo, BC and unofficial mayor of Metchosin, BC.

DERRICK MARVEN is based in Duncan, BC and is an active member of the Cowichan Valley Naturalists. He is a long-time contributor to the annual Whistler Breeding Bird Count and many other naturalist events on Vancouver Island. Derrick's specialties include birds, dragonflies, and butterflies. Derrick will only drink Guinness if it has a clover inscribed into the head.

CONNOR MCGILLION is a cross between a high school student and local authority on reptiles, amphibians, and invertebrates. He is the youngest known Whistler resident to identify himself as an entomologist (when he was eight). Connor's observations of local species have been an invaluable addition to the project. And that is a snake in his hand.

ELKE WIND, M.SC., RP. BIO. is an amphibian specialist based in Nanaimo, BC. She is co-author of the COSEWIC report on Western Toads and Best Management Practices for BC amphibians, and wrote a book chapter in Amphibians of the Pacific Northwest,. She is active with the Nanaimo Young Naturalists' Club and very committed to public nature education. Elke is also on the board of the Society for Northwestern Vertebrate Biology. Elke spends most of the summer in chest waders and has come to think of it as normal.

Appendix 2: Public Events and Presentations

Date	Event
July 19, 2005	Alpine flora walk to Decker Tarn (16 attendees)
Aug. 10, 2005	Dragonfly and wetland plant outdoor event at the Wildlife Refuge (10 attendees)
Oct. 14-15, 2005	Fungus Among Us mushroom festival walks and talks (55 attendees)
July 29, 2006	Bat outdoor event at Alpha Lake park (12 attendees)
July 29, 2006	Alpine flora walk (10 attendees)
Aug. 28, 2006	Amphibian outdoor event at Lost Lake (55 attendees)
Oct 14-15, 2006	Fungus Among Us mushroom festival walks and talks (30 attendees)
Oct. 16, 2006	Lichen walk to Ancient Cedars (8 participants)
Feb. 21-23, 2007	Poster presentation at the Society for Northwestern Vertebrate Ecology, Victoria
March 15, 2007	Amphibian talk at Millennium Place (45 attendees)
May 2, 2007	PowerPoint presentation to AWARE
May 8, 2007	PowerPoint presentation to Whistler Naturalists
May 15, 2007	PowerPoint presentation to RMOW Forest and Wildlands Advisory Committee
June 9, 2007	Poster presentation at EnviroFest with Whistler Naturalists

Derrick Marven gives participants a close-up view of a dragonfly at the Whistler Wildlife Refuge

Eighty species of local mushroom on display at Millennium Place during the Naturalists' annual Fungus Among Us festival

Elke Wind and Julie Burrows prepare to show a salamander to participants at Lost Lake.

Tanya Luszcz explains a bat wing to participants at Alpha Lake Park.

Appendix 3: Amphibian Checklist (First Provisional)

Notes:
The list is complete except for status confirmation of two species. Red-Legged Frog (*Rana aurora*) is a blue-listed species that likely occurs in Whistler since it occurs at elevations higher than Whistler Valley just south of the RMOW boundary. Bullfrogs (*Rana catesbeiana*) are a potentially dangerous invasive species expanding their range towards Whistler but so far unconfirmed here.

Salamanders	Scientific Name	Native	Con-firmed?	Breeding	CDC	Listing COSEWIC	IUCN
Northwestern Salamander	*Ambystoma gracile*	yes	yes	aquatic			
Long-toed Salamander	*Ambystoma macrodactylum*	yes	yes	aquatic			
Rough-skinned Newt	*Taricha granulosa*	yes	yes	aquatic			
Ensatina	*Ensatina eschscholtzii*	yes	yes	terrestrial			
Western Red-backed Salamander	*Plethodon vehiculum*	yes	no	terrestrial			
Frogs and Toads							
Coastal Tailed Frog	*Ascaphus truei*	yes	yes	aquatic	Blue		
Western Toad	*Bufo boreas*	yes	yes	aquatic		Spec. Concern	Red
Pacific Chorus Frog	*Pseudacris regilla*	yes	yes	aquatic			
Red-legged Frog	*Rana aurora*	yes	no	aquatic	Blue		
American Bullfrog	*Rana catesbeiana*	no	no	aquatic			

Appendix 4: Plant Checklist (First Provisional); page 1 of 12

Notes:
The plant checklist on the following 11 pages is a good first approximation of vascular plant diversity. Non-vascular plants are under-represented, notably mosses and liverworts. Among vascular plants, the most under-represented species are likely in the grass (*Poaceae*) and sedge (*Cyperaceae*) families. There are 12 rare species as yet undetected that Green et al. (2005) consider probable or likely in Whistler. Further investigation of these under-represented and rare species will be the main focus for future surveys.

Certain ecosystem types have been under-sampled, for example, rock outcrops, granitic alpine sites (e.g., Blackcomb Mountain), subalpine parkland, and additional types of wetlands.

Some confirmation to exact species is still required for some plants. Where questions remain, a question mark (?) is inserted after the scientific name.

The list of invasive plants, especially those from disturbed transportation corridors, is likely fairly complete, at least in terms of biomass. There are likely many more species, especially in the mustard family (*Brassicaceae*), now present in Whistler but with lesser abundance and therefore likely less risk to native species. These mustards and other invasive plants appear to moving into Whistler from both directions along transportation corridors such as the highway, railway, and to a lesser degree, hydro corridors. They out-compete native vegetation especially on bare, disturbed soil. Future studies can clarify the spread of these and other invasive species.

(See the next 11 pages for the provisional plant checklist.)

Appendix 4: Plant Checklist (First Provisional); page 2 of 12

CDC list	Invasive	*Scientific Name*	Common Name
		Abies amabilis	Pacific silver fir
		Abies lasiocarpa	subalpine fir
		Acer glabrum	Douglas maple
		Achillea millefolium	yarrow
		Actaea rubra	baneberry
		Adenocaulon bicolor	pathfinder
		Adiantum pedatum	maidenhair fern
		Agoseris aurantiaca	orange agoseris
	yes	*Agrostis capillaris*	colonial bentgrass
		Agrostis exarata	spike bentgrass
		Agrostis exarata var. *monolepis*	spike bentgrass variety
	yes	*Agrostis gigantea*	redtop
		Agrostis scabra	hair bentgrass
	yes	*Agrostis stolonifera*	creeping bentgrass
	yes?	*Allium sp.*	horticultural onion
		Alnus rubra	red alder
		Alnus viridis ssp. sinuata	Sitka alder
		Alnus viridis subsp. *crispa*	green alder
		Amelanchier alnifolia	saskatoon
		Anaphalis margaritacea	pearly everlasting
		Anemone occidentalis	western anemone
		Angelica genuflexa	kneeling angelica
		Antennaria alpina	alpine pussytoes
		Antennaria umbrinella	umber pussytoes
	yes	*Anthoxanthum odoratum*	sweet vernal grass
		Apocynum androsaemifolium	spreading dogbane
		Aquilegia formosa	red columbine
		Arabis drummondii	Drummond's rockcress
		Arabis lyallii	Lyall's rockcress
		Arabis microphylla	littleleaf rockcress
		Aralia nudicaulis	wild sarsaparilla
		Arceuthobium tsugense	hemlock dwarf mistletoe
	yes	*Arctium minus*	common burdock
		Arctostaphylos uva-ursi	kinnikinnick
		Arnica amplexicaulis	streambank arnica
		Arnica angustifolia ssp. angustifolia	alpine arnica
		Arnica cordifolia	heart-leaved arnica
		Arnica latifolia	mountain arnica
		Arnica mollis?	hairy arnica
		Aruncus dioicus	goat'sbeard
		Asarum caudatum	wild ginger
		Aster alpigenus	alpine aster
		Aster foliaceus	leafy aster
		Aster or Erigeron	unidentified daisy
		Athyrium filix-femina	lady fern
		Aulacomnium palustre	ribbed bog moss

Appendix 4: Plant Checklist (First Provisional); page 3 of 12

CDC list	Invasive	*Scientific Name*	Common Name
	yes	*Bellis perennis*	English daisy
		Betula papyrifera	paper birch
		Blechnum spicant	deer fern
red		*Botrychium ascendens*	upswept moonwort
		Botrychium virginianum	rattlesnake fern
		Boykinia elata	coast boykinia
	yes	*Brassica campestris*	field mustard
	yes	*Bromus erectus*	erect brome
		Bromus sitchensis	Alaska brome
		Bryum pseudotriquetrum	tall clustered thread moss
		Calamagrostis canadensis	bluejoint
		Caltha leptosepala	alpine white marsh-marigold
		Calypso bulbosa	fairyslipper
	yes	*Campanula rapunculoides*	creeping bellflower
		Canadanthus (=Aster) modestus	great northern aster
	yes	*Capsella busra-pastoris*	shepherd's purse
		Cardamine bellidifolia	alpine bitter-cress
		Cardamine oligosperma	few-seeded bitter-cress
		Cardamine umbellata	Siberian bitter-cress
		Carex buxbaumii	Buxbaum`s sedge
		Carex canescens	grey sedge
		Carex cusickii	Cusick`s sedge
		Carex deweyana	Dewey`s sedge
		Carex echinata	star sedge
		Carex exsiccata	inflated sedge
		Carex gynocrates	yellow bog sedge
		Carex interior	inland sedge
		Carex laeviculmis	smooth-stemmed sedge
		Carex lasiocarpa	slender sedge
		Carex limosa	shore sedge
		Carex magellanica	poor sedge
		Carex mertensii	Merten`s sedge
		Carex nardina	spikenard sedge
		Carex nigricans	black alpine sedge
		Carex obtusata	blunt sedge
		Carex pauciflora	few-flowered sedge
		Carex phaeocephala	dunhead sedge
		Carex pyrenaica	Pyrenean sedge
		Carex rossii	Ross' sedge
		Carex sitchensis	Sitka sedge
		Carex spectabilis	showy sedge
		Carex viridula	green sedge
		Cassiope mertensiana	white mountain-heather
		Castilleja miniata	common red paintbrush
		Castilleja parviflora?	small-flowered paintbrush
		Ceanothus sanguineus	red-stemmed ceanothus

Appendix 4: Plant Checklist (First Provisional); page 4 of 12

CDC list	Invasive	*Scientific Name*	Common Name
	yes	*Centaurea cyanus*	bachelor's button
	yes	*Centaurea diffusa*	diffuse knapweed
		Cerastium beeringianum	Bering chickweed
	yes	*Cerastium fontanum*	mouse-ear chickweed
		Cerastrium arvense	field chickweed
		Chamaecyparis nootkatensis	Alaska yellow-cedar
		Chimaphila menziesii	Menzies' pipsissewa
		Chimaphila umbellata	prince's-pine
		Cicuta douglasii	Douglas' water-hemlock
		Cinna latifolia	wood reedgrass
		Circaea alpina	enchanter's-nightshade
	yes	*Cirsium arvense*	Canada thistle
		Cirsium edule	edible thistle
	yes	*Cirsium vulgare*	bull thistle
		Claytonia lanceolata	western spring-beauty
		Claytonia sibirica	Siberian miner's-lettuce
		Clintonia uniflora	queen's cup
		Comarum palustre (=Potentilla palustris)	marsh cinquefoil
		Corallorhiza maculata?	spotted coralroot
		Corallorhiza mertensiana	western coralroot
		Cornus canadensis	bunchberry
		Cornus stolonifera	red-osier dogwood
		Cornus unalaschkensis (=*C. canadensis*)	bunchberry
		Corydalis sempervirens	pink corydalis
		Corylus cornuta var. californica?	beaked hazelnut
		Crataegus douglasii	black hawthorn
		Crepis capillaris	smooth hawksbeard
		Crepis nana	dwarf hawksbeard
		Cryptogramma acrostichoides (=C. crispa)	parsley fern
		Cystopteris fragilis	fragile fern
	yes	*Cytisus scoparius*	Scotch broom
	yes	*Dactylis glomerata*	orchard grass
		Danthonia intermedia	timber oat-grass
		Danthonia spicata	spike trisetum
		Dasyphora fruticosa (=*Potentilla fruticosa*)	shrubby cinquefoil
		Deschampsia elongata	slender hairgrass
		Dicentra formosa	Pacific bleeding heart
		Dicranum scoparium	broom moss
		Dicranum spp.	Dicranum spp.
	yes	*Digitalis purpurea*	foxglove
		Diphasiastrum (=Lycopodium) sitchense	Sitka clubmoss
		Diphasiastrum alpinum (=Lycopodium alpinum)	alpine clubmoss
		Disporum hookeri (=Prosartes hookeri)	Hooker's fairybells
		Draba sp. (34099)	unidentified draba
		Draba sp. (34117)	unidentified draba
		Draba sp. (34127)	unidentified draba

Appendix 4: Plant Checklist (First Provisional); page 5 of 12

CDC list	Invasive	*Scientific Name*	Common Name
		Drosera anglica	great sundew
		Drosera rotundifolia	round-leaved sundew
		Dryopteris expansa	spiny wood fern
		Dryopteris filix-mas	male fern
		Eleocharis obtusa?	blunt spike-rush
		Eleocharis palustris	common spike-rush
		Elymus glaucus	blue wildrye
		Elymus hirsutus	hairy wildrye
		Elymus repens	quackgrass
		Empetrum nigrum	crowberry
		Epilobium anagallidifolium?	alpine willowherb
		Epilobium angustifolium	fireweed
		Epilobium brachycarpum	tall annual willowherb
		Epilobium ciliatium	purple-leaved willowherb
		Epilobium clavatum	club-fruited willowherb
		Epilobium glandulosum (E. ciliatum complex)	Epilobium ciliatum complex
		Epilobium latifolium	broad-leaved willowherb
blue		*Epilobium leptocarpum?*	small-fruited willowherb
		Epilobium luteum	yellow willowherb
		Equisetum arvense	common horsetail
		Equisetum fluviatile	swamp horsetail
		Equisetum hyemale? (=E. variegatum?)	scouring rush
		Equisetum variegatum	northern scouring-rush
		Erigeron compositus	cut-leaved daisy
		Erigeron humilis	Arctic daisy
		Erigeron peregrinus	subalpine daisy
		Erigeron sp.	unidentified daisy
		Eriophorum angustifolium	narrow-leaved cotton-grass
		Eriophorum chamissonis	Chamisso's cotton-grass
	yes	*Erysium sp.*	wallflower
		Erythronium grandiflorum	yellow glacier lily
	yes	*Euphorbia esula?*	leafy spurge
	yes	*Euphrasia nemorosa*	eastern eyebright
		Euthamia (=Solidago) graminifolia	fragrant goldenrod
		Festuca brachyphylla	alpine fescue
		Festuca brachyphylla (ovina var. brevifolia)	alpine fescue
		Festuca nigrescens (=*Festuca rubra*)	red fescue
	yes	*Festuca ovina*	sheep fescue
		Festuca spp.(idahoensis?)	fescue spp.
		Fontinalis antipyretica	common water moss
		Fragaria virginiana	wild strawberry
		Fritillaria camschatcensis	northern rice root
		Fritillaria lanceolata?	chocolate lily
	yes	*Galeopsis tetrahit (*=Galeopsis pubescens?*)*	hemp-nettle
		Galium trifidum	small bedstraw
		Galium triflorum (=G. trifidum?)	sweet-scented bedstraw

Appendix 4: Plant Checklist (First Provisional); page 6 of 12

CDC list	Invasive	*Scientific Name*	Common Name
		Gaultheria ovatifolia	western tea-berry
		Gaultheria shallon	salal
		Geocaulon lividum	bastard toadflax
		Geum macrophyllum	large-leaved avens
		Glyceria borealis	northern mannagrass
		Glyceria elata	tall mannagrass
	yes	*Gnaphalium uliginosum*	marsh cudweed
		Goodyera oblongifolia	rattlesnake plantain
		Gymnocarpium disjunctum	western oak fern
		Gymnocarpium dryopteris	oak fern
		Hemitomes congestum	gnome-plant
		Heracleum maximum (=H. lanatum)	cow-parsnip
	yes	*Hesperis matronalis*	dame's rocket
		Heuchera micrantha	small-flowered alumroot
		Hieracium albiflorum	white-flowered hawkweed
	yes	*Hieracium aurantiacum*	orange hawkweed
		Hieracium gracile (=H. triste?)	slender hawkweed
		Hieracium triste	wooly hawkweed
	yes	*Hieracium umbellatum*	narrow-leaved hawkweed
		Hippuris vulgaris	common mare's-tail
		Holodiscus discolor	ocean spray
	yes	*Hordeum jubatum*	foxtail barley
		Hylocomium splendens	step moss
	yes	*Hypericum perforatum*	common St. John's-wort
	yes	*Hypochaeris radicata*	hairy cat's ear
		Iris (missouriensis?)	western blue iris (?)
	yes	*Iris pseudacorus*	yellow flag
		Juncus acuminatus	tapered rush
		Juncus alpinoarticulatus	alpine rush
		Juncus drummondii	Drummond's rush
		Juncus effusus	common rush
		Juncus ensifolius	dagger-leaf rush
		Juncus mertensianus	Mertens' rush
		Juncus parryi	Parry's rush
		Juncus supiniformis	spreading rush
		Juncus tenuis	slender rush
		Juniperus communis	common juniper
		Kalmia microphylla ssp. occidentalis	western bog-laurel
		Kindbergia oregana	Oregon beaked moss
	yes	*Lactuca muralis (=Mycelis muralis)*	wall lettuce
		Ledum groenlandicum	Labrador tea
		Lemna minor	common duckweed
	yes	*Lepidum campetre*	(field?) pepper-grass
		Leptarrhena pyrolifolia	leatherleaf saxifrage
	yes	*Leucanthemum vulgare*	oxeye daisy
		Lilium columbianum	tiger lily
	yes	*Linaria vulgaris*	butter-and-eggs

Appendix 4: Plant Checklist (First Provisional); page 7 of 12

CDC list	Invasive	*Scientific Name*	Common Name
		Linnaea borealis	twinflower
		Listera cordata	heart-leaved twayblade
		Lonicera ciliosa	western trumpet honeysuckle
		Lonicera involucrata	black twinberry
		Lonicera utahensis	Utah honeysuckle
	yes	*Lotus corniculatus*	bird's-foot trefoil
		Luetkea pectinata	partridgefoot
		Lupinus arcticus	Arctic lupine
		Lupinus nootkatensis	Nootka lupine
		Lupinus polyphyllus	large-leaved lupine
		Luzula hitchcockii	Hitchcock's wood-rush
		Luzula parviflora	small-flowered wood-rush
		Luzula piperi	Piper's wood-rush
		Luzula spicata	spiked wood-rush
		Lycopodiella inundata (=Lycopodium inundatum)	bog clubmoss
		Lycopodium annotinum	stiff clubmoss
		Lycopodium clavatum	running clubmoss
		Lycopodium dendroideum	ground-pine
		Lycopodium selago	fir clubmoss
		Lysichiton americanum	skunk cabbage
	yes	*Lythrum salicaria*	purple loosestrife
	yes	*Madia sativa?*	tarweed?
		Mahonia aquifolium	tall Oregon-grape
		Mahonia nervosa?	dull Oregon-grape
		Maianthemum (=Smilacina) racemosum	false lily-of-the-valley
		Maianthemum (=Smilacina) stellatum	star-flowered Solomon's-seal
		Maianthemum dilatatum	false lily-of-the-valley
		Malus fusca	Pacific crab apple
		Marsupella brevissima	snow liverwort
	yes	*Matricaria discoidea*	pineapple weed
	yes	*Medicago alba*	white sweet-clover
		Melampyrum lineare	cow-wheat
		Menyanthes trifoliata	buckbean
		Menziesia ferruginea	false azalea
		Microsteris gracilis	pink microsteris
		Mimulus lewisii	pink monkey-flower
		Mimulus tilingii	mountain monkey-flower
		Mitella breweri	Brewer's mitrewort
		Mitella pentandra	five-stamened mitrewort
		Mnium spinulosum	Menzies' red-mouthed mnium
		Moneses uniflora	single delight
		Monotropa hypopithys (=Hypopitys monotropa)	pinesap
blue		*Muhlenbergia glomerata*	marsh muhly
red		*Muhlenbergia racemosa? UNCONFIRMED*	satin grass
	yes	*Myosotis laxa*	small-flowered forget-me-not
		Myrica gale	sweet gale

Appendix 4: Plant Checklist (First Provisional); page 8 of 12

CDC list	Invasive	*Scientific Name*	Common Name
		Myriophyllum verticillatum	verticillate water-milfoil
		Nuphar lutea subsp. polysepala (=N. poysepalum)	yellow pond-lily
		Oemleria cerasiformis	Indian-plum
		Oplopanax horridus	devil's club
		Orthilia secunda	one-sided wintergreen
		Osmorhiza chilensis	mountain sweet-cicely
		Osmorhiza long style?	sweet-cicely
		Osmorhiza purpurea	purple sweet-cicely
		Oxycoccos oxycoccos (=Vaccinium oxycoccos)	bog cranberry
		Oxyria digyna	mountain sorrel
		Parnassia fimbriata	fringed grass-of-Parnassus
		Paxistima myrsinites	falsebox
		Pedicularis bracteosa	bracted lousewort
		Pedicularis racemosa	sickletop lousewort
		Penstemon cardwellii	Cardwell's(?) penstemon
		Penstemon davidsonii	Davidson's penstemon
		Penstemon procerus	small-flowered penstemon
		Petasites frigidus hyperboreus (=P.f. var. nivalis)	sweet coltsfoot
		Phacelia sericea	sky pilot
		Philonotis fontana	swamp moss
		Phleum alpinum	alpine timothy
	yes	*Phleum pratense*	timothy
		Phlox diffusa	spreading phlox
		Phlox hoodii	spiny phlox
		Phyllodoce empetriformis	pink mountain-heather
		Phyllodoce glanduliflora	yellow mountain-heather
		Physocarpus capitatus	Pacific ninebark
		Picea engelmannii	Engelmann spruce
		Picea glauca	planted?
		Picea sitchensis (x engelmannii?)	Whistler hybrid spruce
		Pinguicula vulgaris	common butterwort
		Pinus albicaulis	whitebark pine
		Pinus contorta	lodgepole pine
		Pinus monticola	western white pine
		Plagiomnium insigne	badge moss
	yes	*Plantago lanceolata*	ribwort
	yes	*Plantago major*	common plantain
		Platanthera dilatata	white bog-orchid
		Platanthera orbiculata	round-leaved rein-orchid
		Platanthera stricta	slender bog-orchid
		Pleurozium schreberi	red-stemmed feathermoss
		Poa alpina	alpine bluegrass
	yes	*Poa annua*	annual bluegrass
		Poa arctica	arctic bluegrass
	yes	*Poa compressa*	Canada bluegrass
		Poa cusickii	Cusick`s bluegrass

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CDC list	Invasive	*Scientific Name*	Common Name
		Poa leptocoma	bog bluegrass
	yes	*Poa pratensis*	Kentucky bluegrass
	yes	*Poa trivialis*	rough bluebrass
	yes	*Polygonum aviculare*	common knotweed
	yes	*Polygonum cuspidatum?*	Japanese knotweed
		Polypodium glycrrhiza	licorice fern
		Polypodium hesperium	western polypodium
		Polystichum brauni	Braun's fern
		Polystichum lonchitis	mountain holly fern
		Polystichum munitum	sword fern
		Polytrichum juniperinum	juniper haircap moss
		Polytrichum piliferum	awned haircap moss
		Populus trichocarpa	black cottonwood
	yes	*Potamogeton crispus*	curled pondweed
		Potamogeton epihydrus	ribbon-leaved pondweed
		Potamogeton foliosus	close-leaved pondweed
		Potamogeton gramineus	grass-leaved pondweed
		Potamogeton natans	floating-leaved pondweed
		Potamogeton praelongus	long-stalked pondweed
		Potentilla diversifolia	diverse-leaved cinquefoil
		Potentilla flabellifolia	fan-leaved cinquefoil
		Potentilla norvegica	Norwegian cinquefoil
		Potentilla villosula (=Potentilla villosa*)*	villous cinquefoil
	yes?	*Prunella vulgaris*	self-heal
		Prunella vulgaris subsp. lanceolata	lance self-heal
		Prunus emarginata	bitter cherry
		Pseudotsuga menziesii	Douglas fir
		Pteridium aquilinum	bracken fern
		Ptilium crista-castrensis	knight's plume
		Pyrola asarifolia	pink wintergreen
		Pyrola minor (maybe chlorantha)?	lesser wintergreen
		Pyrola minor? chlorantha?	lesser? (or green?) wintergreen
		Pyrola picta	white-veined wintergreen
		Racomitrium elongatum	long rock moss
	yes	*Ranunculus acris*	meadow buttercup
		Ranunculus aquatilis	white water-buttercup
		Ranunculus eschscholtzii	subalpine buttercup
		Ranunculus repens	creeping buttercup
		Ranunculus uncinatus	little buttercup
		Ranunuculs flabellaris?	yellow water-buttercup
		Rhacomitrium canascens	rockside road moss
		Rhamnus purshiana	cascara
		Rhinanthus minor	yellow rattle
		Rhizomnium glabrescens	fan moss
		Rhododendron albiflorum	white-flowered rhododendron
		Rhynchospora alba	white beak-rush

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CDC list	Invasive	*Scientific Name*	Common Name
		Rhytidiadelphus loreus	lanky moss
		Rhytidiadelphus triquetrus	electrified cat's-tail moss
		Rhytidiopsis robusta	pipecleaner moss
		Ribes bracteosum	stink currant
		Ribes howellii?	maple-leaved currant
		Ribes lacustre	black gooseberry
		Ribes sanguineum	red-flowering currant
		Romanzoffia sitchensis	Sitka mistmaiden
		Rosa gymnocarpa	baldhip rose
		Rosa nutkana	Nootka rose
		Rosa pisocarpa	clustered wild rose
		Rubus idaeus	red raspberry
		Rubus leucodermis	black raspberry
		Rubus parviflorus	thimbleberry
		Rubus pedatus	five-leaved bramble
		Rubus spectabilis	salmonberry
		Rubus ursinus	trailing blackberry
	yes	*Rumex acetosella*	sheep sorrel
	yes	*Rumex obtusifolius?*	bitter dock?
	yes	*Rumex sanguineus*	redvein dock
	yes	*Sagina procumbens*	bird's-eye pearlwort
		Sagina saginoides	Arctic pearlwort
		Salix commutata	variable willow
		Salix lucida subsp. *lasiandra*	Pacific willow
		Salix myrtillifolia	bilberry willow
		Salix scouleriana	Scouler's willow
		Salix sitchensis	Sitka willow
		Sambucus racemosa	red elderberry
		Saxifraga bronchialis	spotted saxifrage
		Saxifraga caespitosa	tufted saxifrage
		Saxifraga ferruginea	Alaska saxifrage
		Saxifraga lyallii	red-stemmed saxifrage
		Saxifraga nelsoniana	heart-leaved saxifrage
		Saxifraga nelsoniana?	heart-leaved (?) saxifrage
		Saxifraga oppositifolia	purple mountain saxifrage
		Saxifraga tolmiei	Tolmie's saxifrage
		Scapania bolanderi	yellow-ladle liverwort
		Schoenoplectus subterminalis	swaying clubrush
		Schoenoplectus tabernaemontani (=Scirpus lacustris ssp. validus)	soft-stemmed bulrush (tule)
		Scirpus microcarpus	small-flowered bulrush
		Sedum divergens	spreading stonecrop
		Sedum lanceolatum	lance-leaved stonecrop
		Selaginella wallacei	Wallace's selaginella
blue		*Senecio cymbalarioides?* UNCONFIRMED	northern butterweed
		Senecio fremontii	dwarf mountain butterweed
		Senecio pauciflorus	rayless alpine butterweed

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CDC list	Invasive	*Scientific Name*	Common Name
		Senecio triangularis	arrow-leaved groundsel
	yes	*Senecio viscosus*	sticky ragwort
		Shepherdia canadensis	soopolallie (soapberry)
		Sibbaldia procumbens	sibbaldia
		Silene acaulis	moss campion
		Silene parryi	Parry's campion
	yes	*Sisymbrium looselii*	Loesel's tumble-mustard
		Solidago canadensis	Canada goldenrod
		Solidago multiradiata	northern goldenrod
	yes	*Sonchus oleraceus*?	common (?) sow-thistle
		Sorbus scopulina	western mountain-ash
		Sorbus sitchensis	Sitka mountain-ash
		Sparganium angustifolium	narrow-leaved bur-reed
		Sparganium emersum	emersed bur-reed
		Sparganium natans	small bur-reed
	yes	*Spergularia rubra*	red sand-spurry
		Sphagnum spp.	Sphagnum spp.
		Spiraea densiflora	subalpine spiraea
		Spiraea douglasii subsp. *douglasii*	hardhack
		Spiraea douglasii subsp. *menziesii*	hardhack
		Spiranthes romanzoffiana	ladies' tresses
		Stellaria calycantha	northern starwort
		Stellaria humifusa	salt marsh starwort
		Stellaria longipes	long-stalked starwort
		Stellaria nitens	shining starwort
		Streptopus amplexifolius	clasping twistedstalk
		Streptopus lanceolatus (=S. roseus)	rosy twistedstalk
		Suksdorfia ranunculifolia	buttercup-leaved suksdorfia
		Symphoricarpos albus	common snowberry
		Syringa vulgaris	common lilac
	yes	*Tanacetum vulgare*	common tansy
		Taraxacum ceratophorum	horned dandelion
	yes	*Taraxacum officinale*	common dandelion
		Taxus brevifolia	western yew
		Tellima grandiflora	fringecup
		Thalictrum occidentalis	western meadowrue
		Thuja plicata	western redcedar
		Tiarella trifoliata subsp. *unifoliata*	foamflower
		Tonestus lyallii (=Haplopappus lyallii)	Lyall's goldenweed
		Torreyochloa pauciflora	weak alkali grass
		Trachybryum megaptilum	trachybryum moss
	yes	*Tragopogon dubius*	yellow salsify
		Triantha glutinosa (=Tofieldia glutinosa)?	sticky false asphodel
		Triantha occidentalis (=Tofieldia occidentalis)	western false asphodel
		Trichophorum alpinum	Hudson Bay clubrush
		Trientalis arctica	northern starflower

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CDC list	Invasive	*Scientific Name*	Common Name
		Trientalis latifolia?	western starflower
	yes	*Trifolium hybridum*	alsike clover
	yes	*Trifolium pratense*	red clover
	yes	*Trifolium repens*	white clover
		Triglochin palustris	marsh arow-grass
	yes	*Tripleurospermum (=Matricaria) perforata?*	scentless mayweed?
		Trisetum cernuum	nodding trisetum
		Trisetum spicatum	spike trisetum
		Tsuga heterophylla	western hemlock
		Tsuga mertensiana	mountain hemlock
		Typha latifolia	cattail
		Urtica dioica	stinging nettle
		Utricularia intermedia	flat-leaved bladderwort
		Utricularia macrorhiza	greater bladderwort
		Vaccinium alaskaense	Alaskan blueberry
		Vaccinium caespitosum	dwarf blueberry
		Vaccinium membranaceum	black huckleberry
		Vaccinium ovalifolium	oval-leaved blueberry
		Vaccinium parvifolium	red huckleberry
		Vahlodea atropurpurea	mountain hairgrass
		Valeriana sitchensis	Sitka valerian
		Veratrum viride	Indian hellebore
	yes	*Verbascum thapsus*	great mullein
		Veronica americana	American brooklime
	yes	*Veronica serpyllifolia*	thyme-leaved speedwell
		Veronica wormskjoldii	alpine speedwell
		Viburnum edule	highbush cranberry
		Viburnum with blue calyx?	unidentified highbush cranberry
		Vicia americana	American vetch
	yes?	*Vicia hirsuta*	hairy vetch
		Viola adunca	early blue violet
		Viola glabella	stream violet
		Viola orbiculata	round-leaved violet
		Viola palustris	marsh violet
		Viola sempervirens	trailing yellow violet

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Notes:
The mushroom checklist grows each year as different species emerge on the same sites (due to different growing conditions or cycles?) and probably also because invited mycologists have different levels of experience with the difficult genera. The list is relatively complete for the sites sampled most often, in the Emerald Forest and Lost Lake dry forests, at least for the macrofungi that emerge in fall. Additional sampling is needed at different times of the year, especially spring, and also at higher elevations. Species identified at the North American Mycological Association's Whistler foray in 1990[1] are included but some additional work is necessary to synchronize and verify the lists.

The checklists follow on the next eight pages.

Edibility Rough Guide

C = choice
D = dyeing
E = edible (check each; may vary from choice to bland to mildly toxic for some)
H = hallucinogenic
SP = may cause toxic reaction
P = poisonous
L = lethal
N = not edible
U = unknown/too small/disputed/may be poisonous/no-one cares

N.B. The usual disclaimers apply. Consult technical references or accompany a knowledgeable mushroomer before rashly ingesting any species.

[1] http://www.collectivesource.com/fungi/nama/BC90.html; and the NAMA website at: http://www.namyco.org/. NAMA lists some specimens from the 1990 foray at: http://www.fieldmuseum.org/nama/.

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Scientific Name	Common Name	Edibility*	NAMA 1990*
Agaricus augustus	prince	C	yes
Agaricus campestris	meadow mushroom	C	yes
Agaricus silvicola	woodland agaricus	C	yes
Agaricus sp.		some	
Albatrellus flettei	blue knight	E	yes
Aleuria aurantia	orange peel fungus	E	yes
Amanita franchetii			yes
Amanita muscaria	fly agaric	P, H	
Amanita muscaria var. *flavivolvata*			yes
Amanita muscaria var. *formosa*			yes
Amanita porphyria			yes
Amanita silvicola	western woodland amanita	U	
Amanita silvivola			yes
Amanita smithiana		U	
Armillaria albolanaripes			yes
Armillaria luteovirens			yes
Armillaria sp.		some	
Astraeus hygrometricus	hygroscopic earthstar	N	yes
Auricularia auricula	wood ear	E	yes
Auriscalpium vulgare	ear pick fungus	N	yes
Baeomyces sp.			
Baeospora myriadophylla		U	yes
Bisporella citrina		U	
Bolbitius sp.		U	
Boletopsis leucomelaena			yes
Boletopsis subsquamosa	Kurokawa	E	yes
Boletus coniferarum		N	yes
Boletus edulis	king bolete	C	yes
Boletus mirabilis	admirable bolete	C	yes
Boletus piperatus	peppery bolete	U	yes
Boletus rubripes	red-stemmed bitter bolete	N	yes
Boletus smithii		U	yes
Boletus zelleri	Zeller's bolete	E	
Bovista plumbea	tumbling puffball	E	
Calocera cornea	jelly fungus	U	
Calocera viscosa		U	yes
Cantharellula umbonata	= Clitocybe/Hygrophoropsis umb.?		yes
Cantharellus formosus	chanterelle (= C. cibarius? cf. NAMA)	C	yes
Cantharellus infundibuliformis	(aka Craterellus) winter chanterelle	E	yes
Cantharellus subalbidus	white chanterelle	C	yes
Cantharellus tubaeformis			yes
Chondrostereum purpureum			yes
Chroogomphus nutilans	pine spike	E	
Chroogomphus rutilus	pine spike	E	
Chroogomphus tomentosus	wooly pine spike	E	
Clavariadelphus ligula			yes
Clavariadelphus truncatus			yes
Claveriadelphus sachalinensis	club coral	U	
Clavulina cinerea			yes
Clavulina cristata	crested coral	E	yes
Clitocybe clavipes			yes
Clitocybe dealbata	sweat-producing clitocybe	P	
Clitocybe deceptiva	anise mushroom	E	

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Scientific Name	Common Name	Edibility*	NAMA 1990*
Clitocybe dilitata		P?	yes
Clitocybe ectypoides			yes
Clitocybe geotropa			yes
Clitocybe gibba	funnel-shaped clitocybe	E	
Clitocybe gigantea	giant clitocybe	E/U	
Clitocybe nebularis	cloudy clitocybe	E	yes
Clitocybe odora	blue-green anise mushroom	E	yes
Clitocybe sinopica			yes
Clitocybe sp.			
Collybia acervata	clustered collybia	N	yes
Collybia badialba			yes
Collybia butyracea			yes
Collybia cirrhata			yes
Collybia confluens			yes
Collybia cookei			yes
Collybia longispora			yes
Collybia maculata var. *scordonia*			yes
Collybia tuberosa			yes
Coltrichia perennis		N	yes
Coprinus atramentarius	inky cap	E, SP	
Coprinus comatus	shaggy mane	C	
Coprinus micaceus	glistening inky cap	E	
Coprinus sp.	inky caps	some	
Coriolus versicolor			yes
Cortinarius allutus (group)			
Cortinarius calocrus			
Cortinarius collinitus (group)	belted slimy cortinarius	E/U	
Cortinarius croceus			
Cortinarius eburneus			
Cortinarius iodioides (group)			
Cortinarius ionosmus			
Cortinarius laniger	brown cortinarius	U	
Cortinarius maxacium (?)			
Cortinarius multiformis		U	
Cortinarius muscigenus			
Cortinarius mutabilis	purple-staining cortinarius	U	
Cortinarius occidentalis	(=C phoeniceus var. occidentalis?)	N/D	
Cortinarius phlegmacium			
Cortinarius pinetorum			
Cortinarius purpurescens group			
Cortinarius pyriodes			
Cortinarius semisanguineus			
Cortinarius telemonia			
Cortinarius traganus	lilac conifer cortinarius	N/P	
Cortinarius vibratilus		N	
Cortinarius volvatus			
Crepidotus? sp.		N	
Cudonia ciranans			yes
Cysterderma amianthinum			yes
Cystoderma amianthinum var. *rugosoreticulatum*			yes
Cystoderma cinnabarinum			yes
Cystoderma fallax			yes

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Scientific Name	Common Name	Edibility*	NAMA 1990*
Dacrynum palmatus			yes
Daedaleopsis confragosa			yes
Dermocybe semisanguinea	= Cortinarius?		
Echinodontium tinctorium	Indian paint fungus	N/D	yes
Entoloma rhodopolium		P	
Fomes fomentarius			yes
Fomitopsis officinalis	quinine conk (K. Melamed; Comfortably Numb)	?	yes
Fomitopsis pinicola			yes
Fomitopsis pinicola	red-belted conk	N	
Fuscoboletinus sp.	larch boletes	E	
Galerina sp.		P	
Ganoderma applanatum			yes
Ganoderma oregonense			yes
Ganoderma tsugae	varnished conk	N	
Geastrum saccatum			yes
Geastrum triplex			yes
Gerronema chrysophyllum			yes
Gleophyllum saepiarium	Rusty Gilled Polypore	N	yes
Gomphidius glutinosis	gluteus gomphidius	E	
Gomphidius roseus	(MD lists as not in N. Am.; = G. subroseus?		
Gomphidius sp.			
Gomphidius subroseus	rosy gomphidius	E	
Gomphus floccossus	wooly chanterelle	U	yes
Gomphus kauffmanii			yes
Gyromitra californica	umbrella false morel	P	
Gyromitra infula			yes
Hebeloma crustiliniforme	poison pie	P	
Hebeloma leucosarx	(or should this be with H. crustiliniforme?)	P?	
Hebeloma sinapizans	scaly-stalked hebeloma	P	
Hebeloma sp.			
Helvella lacunosa	fluted black elfin saddle	E	yes
Hericium abietis			yes
Hericium ramosum			yes
Hydnellum aurantiacum			yes
Hydnellum caeruleum			yes
Hydnellum peckii	strawberries and cream (bleeding hyndellum)	N	yes
Hydnellum regium			yes
Hydnum (Dentinium) repandum	hedgehog mushroom	C	
Hydnum repandum			yes
Hydnum umbilicatum			yes
Hydropus marginellus			yes
Hygrocybe coccinea	righteous red waxy cap	U	
Hygrocybe conica	witch's hat	N	
Hygrocybe miniata	miniature waxy cap	E	
Hygrophoropsis aurantiaca	false chanterelle	SP	yes
Hygrophorus agathosmus	grey almond waxy cap	E	
Hygrophorus bakerensis	brown almond waxy cap	E	
Hygrophorus camarophyllus	grey-brown waxy cap		
Hygrophorus piceae			
Hygrophorus sp.?			
Hypholoma (=Naematoloma) capnoides	conifer tuft	E	
Hypholoma (=Naematoloma) dispersum	dispersed naematoloma	U	
Hypholoma fasciculare	clustered woodlover	P	

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Scientific Name	Common Name	Edibility*	NAMA 1990*
Hypholoma (=Naematoloma) fasciculare	sulfur tuft	P	yes
Hypomyces lactifluorum			yes
Hypoxylon fuscum			yes
Hypoxylon serpens			yes
Hypsizygus tesselatus			yes
Inocybe fastigata	unsure ID		
Inocybe geophylla	little white inocybe	P	
Inocybe lanugimosa	wooly inocybe	U	
Inocybe sp.			
Inonotus tomentosus		U	yes
Jahnoporus hirtus			yes
Laccaria amethysteo-occidentalis	western amethyst laccaria	E	yes
Laccaria bicolor			yes
Laccaria laccata	lacklustre laccaria	E	yes
Lactarius affinis var. *viridilactis*			yes
Lactarius alpinus var. *mitis*			yes
Lactarius circellatus var. *borealis*			yes
Lactarius controversus			yes
Lactarius deliciosus	delicious milk cap	E	yes
Lactarius deterrimus			
Lactarius fragilis	candy cap	E	
Lactarius glyciosmus			yes
Lactarius kauffmannii			yes
Lactarius luculentis			
Lactarius obscuratus			
Lactarius olympianus			yes
Lactarius pseudormucidus	slimy milk cap	U	yes
Lactarius pubescens var. *pubescens*			yes
Lactarius repraesentaneus			yes
Lactarius resimus			yes
Lactarius rubrilacteus			yes
Lactarius rufus	red hot milky cap	U	yes
Lactarius sanguifluus (L. rubrilacteus)	bleeding milk cap	E	
Lactarius scrobiculatus	scrobiculate milk cap	N	yes
Lactarius uvidus var. *montana*			yes
Laetiporus sulphureus	chicken-of-the-woods	C	yes
Leccinum aurantiacum			yes
Leccinum manzanitae	manzanita bolete	E	
Leccinum scabrum			yes
Lentaria pinicola			yes
Lentinellus micheneri			yes
Lentinellus ursinus			yes
Lenzites betulina			yes
Lepiota acutesquamosa			yes
Lepiota atrodisca			yes
Lepiota clypeolaria			yes
Lepiota cristata			yes
Lepiota naucina			yes
Lepiota rhacodes			yes
Lepiota sp.		some	
Lepista (=Clitocybe) nuda	blewit	C	yes
Leucopaxillus albissimus	large white leucopaxillus	N	yes
Leucopaxillus amarus	bitter brown leucopaxillus	N	yes
Lycoperdon marginatum			yes

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Scientific Name	Common Name	Edibility*	NAMA 1990*
Lycoperdon perlatum	common puffball	E	yes
Lycoperdon pyriforme	pear-shaped puffball	E	yes
Lycophyllum spp.			
Lyophyllum descastes	fried chicken mushroom	E	yes
Lyophyllum semitale			
Macrolepiota (=Lepiota) rachodes	shaggy parasol	C	
Marasmiellus papillatus			yes
Marasmiellus pluvius			yes
Marasmiellus tremullosus			yes
Marasmius epiphyllus			yes
Marasmius oreades			yes
Marasmius scorodonius			yes
Melanoleuca melaleuca			yes
Melanomma pulvis-pyrius			yes
Micromphale perforans			yes
Mycena alcalina	alkaline mycena	U	
Mycena algeriensis			
Mycena amabillissima			yes
Mycena aurantidisca			
Mycena epipterygia	yellow-stemmed mycena	U	yes
Mycena flavoalba			yes
Mycena galericulata			yes
Mycena haematopus	bleeding mycena	E	yes
Mycena oregonensis			yes
Mycena pterigena			yes
Mycena pura			yes
Mycena rorida			yes
Mycena rosella			
Mycena sp.			
Mycena strobilinoides	flame mycena	U	yes
Mycena vulgaris			yes
Myxomphalia maura			yes
Naematoloma capnoides	= Hypholoma?		yes
Naematoloma dispersum	= Hypholoma?		yes
Naematoloma elongatipes	= Hypholoma?		yes
Naematoloma polytrichi	= Hypholoma?		yes
Nectria episphaeria			yes
Nidula candida			yes
Nidula niveo-tomentosa			yes
Nidula sp.	bird's nest fungi		
Nolanea sp.			
Oligoporus obductus			yes
Omphalina ericetorum			yes
Omphalina luteicolor			yes
Panellus longinquus			
Panellus serotinus	late oyster	E	yes
Panellus stypticus			yes
Paxillus atratomentosus	velvet pax	N	
Paxillus atrotomentosus			yes
Paxillus involutus	poison pax	P	yes
Paxillus panuoides			yes
Paxillus tomentosus			
Peniophora aurantiaca			yes
Phaeocollybia sp.		U	

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Scientific Name	Common Name	Edibility*	NAMA 1990*
Phaeolepiota aurea			yes
Phaeolus schweinitzii	dyer's polypore (velvet-topped fungus)	N/D	yes
Phaeomarasmius erinaceus			yes
Phellodon tomentosus	zoned phellodon	U	
Phlebia tremellosa			yes
Phlegmacium sp. (group)			
Phlogiotis helvelloides			yes
Pholiota destruens	destructive pholiota	E	yes
Pholiota limonella			yes
Pholiota lubrica			yes
Pholiota malicola			yes
Pholiota myosotis			yes
Pholiota sp.			
Pholiota spumosa			yes
Pholiota squarrosoides			yes
Pholiota terrestris			yes
Phylloporus rhodoxanthus	gilled bolete	E	yes
Phyllotopsis nidulans			yes
Pleurocybella porrigens	angel wings	E	yes
Pleurotus dryinus			yes
Pleurotus ostreatus			yes
Plicatura nivea			
Pluteurs cervinus	deer mushroom	E	
Pluteus atromarginatus			yes
Pluteus cervinus			yes
Polyporus arcularius			yes
Polyporus badius	black-leg	N	yes
Polyporus elegans			yes
Polyporus melanopus			yes
Polyporus radicatus			yes
Psathyrella sp.			
Pseudoarmillaria (=Clitocybe) ectypoides	wood clitocybe		
Pseudohydnum galatinosum	toothed jelly fungus (spirit gummy bear?)	E	yes
Psilocybe montana			yes
Psilocybe sp.			
Psilocybe stuntzii			yes
Pucciniastrum goeppertianum			
Pycnoporellus albolutescens			yes
Pycnoporellus fulgens			yes
Pycnoporus cinnabarinus			yes
Ramaria apiculata			yes
Ramaria botrytis var. *aurantiiramosa*			yes
Ramaria cystidiophora var. *citronella*			yes
Ramaria longeiflora			yes
Ramaria rasilispora			yes
Ramaria rubella			yes
Ramaria sp. (yellow)	coral fungi		
Ramaria stricta	strict coral mushroom	N	
Ramaria testaceoflava			yes
Ramaria velocimutans			yes
Rhizinia undulata			yes
Rhizopogon parksii			yes
Rhizopogon sp.	false truffles	E/U	
Rhodocollybia oregonensis			yes

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Scientific Name	Common Name	Edibility*	NAMA 1990*
Rhytisma punctata			yes
Rickenella fibula			yes
Rozites caperata	gypsy mushroom	E/C	
Russula aeruginea	green russula	E	yes
Russula albidula			yes
Russula albonigra			yes
Russula bicolor			yes
Russula brevipes	short-stemmed russula	E	yes
Russula cascadensis		N	
Russula densifolia	reddening russula	N	yes
Russula flaviceps			yes
Russula heterophylla			yes
Russula nigricans			yes
Russula occidentalis			yes
Russula olicacea			yes
Russula pectinata			yes
Russula pelargonia			yes
Russula rosacea			yes
Russula rosacea	rosy russula	N	yes
Russula sylvicatus (or silvicola?)			
Russula veternosa			yes
Russula xerampelina	shrimp russula	C	yes
Sarcodon imbricatum	shingled hedgehog	E	yes
Sarcodon/Hydnum (?) fuscoindicum	(orig ID; Hydnellum) violet hedgehog	N	
Schizophyllum commune			yes
Sparassis crispa	cauliflower mushroom	C	yes
Spathularia spathulata			yes
Stereum ostrea [near]			yes
Stereum sp.	turkey tail	N	
Strobilurus trullisatus	on Douglas-fir cones	U	yes
Strobilurus albipilatus			yes
Stropharia aeruginosa			yes
Stropharia ambigua	questionable stropharia	E	yes
Stropharia hornemannii		U	yes
Suillus brevipes	short-stemmed slippery jack	E	yes
Suillus brunnescens			yes
Suillus caerulescens			yes
Suillus granulatus	granulated slippery jack	E	
Suillus grevillei	tamarach jack	E	
Suillus lakei	western painted suillus	E	yes
Suillus luteus			yes
Suillus ponderosus		E	
Suillus punctatipes			yes
Suillus subolivaceus			yes
Suillus tomentosus	bule-staining slippery jack	E	yes
Suillus umbonatus			yes
Telamonia sp. (group)			
Trechispora confluens			yes
Tremella fuciformis			yes
Tremella lutescens			yes
Tremella mesenterica	witch's butter	E	
Tricholoma apium	rare		
Tricholoma caligatum	brown matsutake	E	
Tricholoma flavovirens	man on horseback	E	yes

Appendix 5: Mushroom Checklist (First Provisional); Page 9 of 9

Scientific Name	Common Name	Edibility*	NAMA 1990*
Tricholoma focale			
Tricholoma imbricatum		N	
Tricholoma inamoenum		N	
Tricholoma magnivelare	pine mushroom	C	yes
Tricholoma odora			yes
Tricholoma pardinum			yes
Tricholoma pessundatum			yes
Tricholoma populinum			yes
Tricholoma saponaceum			yes
Tricholoma sejunctum		U	yes
Tricholoma vaccinum		N	yes
Tricholoma virgatum		U	
Tricholoma zelleri	Zeller's tricholoma	N	yes
Tricholomopsis aurantiacum			
Tricholomopsis decora			yes
Tricholomopsis platyphylla			yes
Tricholomopsis rutilans			yes
Tricholomopsis tomentosus			
Tyromyces chioneus			yes
Verpa bohemica?	early morel (B. Brett; Fitz. Cr. riverside)	E/SP	
Xeromphalina campanella		N	yes
Xeromphalina cornui			yes
Xeromphalina fulvipes			yes
Xylaria hypoxylum	candlesnuff fungus	N	
Xylaria sp.		N	

Appendix 6: Bat Checklist (Comprehensive?)

Notes:
The list of probable species compiled independently by Tanya Luszcz as part of this project is identical to the list of historic and current occurrences of native species compiled by Karl Ricker (undated). The present status of all species listed by Ricker needs to be explored by date of last sighting given the extensive alterations to habitat in Whistler especially over the past three decades. Ricker's list is an example of how historic studies provide an important baseline to track trends over time.

Confirming the status of the two rare species, Keen's Myotis (*Myotis keenii*) and Townsend's Big-eared Bat (*Corynorhinus townsendii*), should have the highest priority. Keen's Myotis is a difficult species to identify since distinguishing it from Western Long-eared Bat (*Myotis evotis*) relies either on cranial examination (which is unacceptable due to its endangered status) or DNA samples. At the time of writing, the most recent sighting for Keen's Myotis and Townsend's Big-eared Bat were unknown. As discussed in Chapter 10, the only known specimens of either species were two female Keen's Myotis collected in the early 1940s by Ken Racey and Ian McTaggart-Cowan.[1] Even these records should be verified through DNA or cranial analysis to ensure identification to current taxonomy.

Karl Ricker's sightings data is the best available source of information for sites to sample in the future, assuming exact or near coordinates are recorded. Some sampling possibilities include gaps in old forests and near cliffs with potential roosting habitat (possible Keen's Myotis habitat), and foraging areas near buildings where many species may roost, including Townsend's Big-eared Bat.

		CDC	Historic	2006 Pilot Study	
Common Name	Scientific Name	Listing[2]	Presence*	Captured	Detected
Little Brown Bat	*Myotis lucifugus*		yes	yes	yes
Yuma Myotis	*Myotis yumanensis*		yes	yes	yes
Long-legged Myotis	*Myotis volans*		yes	no	no
California Myotis	*Myotis californicus*		yes	no	no
Western Long-eared Myotis	*Myotis evotis*		yes	no	no
Keen's Myotis	*Myotis keenii*	Red	yes	no	no
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Blue	yes	no	no
Big Brown Bat	*Eptesicus fuscus*		yes	no	?
Hoary Bat	*Lasiurus cinereus*		yes	no	?
Silver-haired Bat	*Lasionycteris noctivagans*		yes	no	?

[1] Stored in the Cowan Vertebrate Museum at the University of BC. Data compiled from a search of collections in BC and Canada by Elke Wind and on file with B. Brett.
[2] BC Conservation Data Centre (CDC); http://www.env.gov.bc.ca/cdc/

Appendix 7: Lichen Checklist (Basic)

Notes:
The lichen list is extremely sparse (only 38 of potentially thousands of species), though some of the common and "charismatic" lichens are included. We will likely never come close to documenting the full diversity of lichens in Whistler, but many of the larger lichens (for example, the many species of Cladonia, Platismatia, and Hypogymnia) can be added with relatively little sampling effort. At present, no rare lichens are included in this list.

Scientific Name	**Common Name**
Alectoria sarmentosa	common witch's hair
Alectoria vancouverensis	
Bryoria capillaris	
Bryoria fuscescens?	speckled horsehair
Cladina mitis	
Cladina rangerifina	reindeer lichen
Cladonia macilenta?	lipstick cladonia
Cladonia chlorophaea	false pixie cup
Cladonia scabriuscula	
Hypogymnia enteromorpha	beaded bone
Hypogymnia imshaugii	forking tube lichen
Hypogymnia inactiva	forking bone
Letharia vulpina	wolf lichen
Lobaria linita	
Lobaria pulmonaria	lungwort
Mycoblastus sanguineus	
Peltigera aphthosa	
Peltigera britannica	freckle pelt
Peltigera chionophila	
Peltigera collina	
Peltigera membranacea	
Peltigera neopolydactyla	frog pelt
Peltigera ponojensis	
Pertusaria ophthalmiza	
Physia aipolia	
Physia ascendens	hooded rosette
Pilophorus aciculari	devil's matchstick
Platismatia glauca	ragbag
Platismatia herrei	tattered rag
Ramalina sp.	undescribed
Rhizocarpon geographicum	green map
Solorina crocea	
Sphaerophorus tuckermanii	other Christmas-tree
Stereocaulon grande	
Usnea longissima	Methuselah's beard
Xanthoria parietina	
Xanthoparmelia cumberlandia?	questionable rock-frog
Umbillicaria torrefacta	punctured rocktripe

Appendix 8: Dragonfly Checklist (Preliminary)

Notes:
Ten of 24 potential species have been confirmed to date on the pilot checklist. Verifying species occurrences simply requires additional sampling days, at different sites and different times of the year. Luckily, dragonflies and butterflies are species of interest to many people and photographic records from non-scientists may extend the sampling effort.

Key:
C = Common
Unc = Uncommon
R = Rare

Scientific Name	Common Name	Habitat	Flight Dates (good weather)	Sighted	Status
Enallagma boreale	Boreal Bluet	Lakes and ponds to 1500m	Early May to mid October	yes	C
Enallagma carunculatum	Tule Bluet	Lakes and ponds to 600m	Early May to mid October		Unc
Enallagma cyathigerum	Northern Bluet	Lakes and slow streams 1350m	Mid May to mid October		Unc
Ischnura cervula	Pacific Forktail	Lakes and ponds to 1700m	April through October	yes	C
Ischnura perparva	Western Forktail	Lakes, ponds and slow streams to 1700m	Early May to mid October		Unc
Aeshna californica	California Darner	Lakes, ponds and in town to 1700m	Mid April to mid August	yes	C
Aeshna canadensis	Canada Darner	Lakes and ponds to 1050m	Late July to early October		R
Aeshna eremita	Lake Darner	Lakes to 1200m	Mid July to ealry October		Unc
Aeshna juncea	Sedge Darner	Small lakes and ponds to 1700m	Mid July late September		Unc
Aeshna multicolor	Blue-eyed Darner	Lakes, ponds and in town to 1200m	Mid May to mid October	yes	C
Aeshna palmata	Paddle-tailed Darner	Lakes, ponds and in town to 1700m	Late June to late October		C
Aeshna umbrosa	Shadow Darner	Lakes. Ponds and slow streams to 1700m	Late June to early November		Unc
Cordulia shurtleffi	American Emerald	Lakes and ponds to 1700m	Late May through to early Sept.		C
Somatochlora albicincta	Ringed Emerald	Lakes and ponds to 1700m	Late July to mid October		Unc
Somatochlora semicircularis	Mountain Emerald	Bogs and fens	Early June to mid October		Unc
Libellula forensis	Eight-spotted Skimmer	Lakes, ponds and in town to 900m	Early May to mid September	yes	C
Libellula julia	Chalk-fronted Corporal	Lakes, ponds and bogs	Late May to mid August		R
Libellula lydia	Common Whitetail	Lakes, ponds and slow streams, muddy areas to 900m	Mid May to late September	yes	C
Libellula quadrimaculata	Four-spotted Skimmer	Lakes, ponds, slow streams w abundant vegetation to 1200m	Early May to late September	yes	C
Sympetrum danae	Black Meadowhawk	Lakes and ponds with emergent vegetation to 1700m	Mid July to mid October		R
Sympetrum madidum	Red-veined Meadowhawk	Temporary ponds away from major water bodies to 1200m	Mid June to mid September		R
Sympetrum pallipes	Striped Meadowhawk	Lakes, ponds, meadows and in town to 1050m	Mid June to mid October		C
Leucorrhinia glacialis	Crimson-ringed Whiteface	Lakes and ponds with dense vegetation to 1700m	Mid June to early August		Unc
Leucorrhinia hudsonica	Hudsonian Whiteface	Ponds and bogs with dense vegetation to 1950m	Early May to early October	yes	C

Appendix 9: Butterfly Checklist (Preliminary); Page 1 of 2

Notes:
Only eight of 54 butterfly species have been confirmed to date. The situation here is very similar to that for dragonflies and confirming species simply requires more sampling effort. As with dragonflies, non-scientists may be able to provide considerable help. Abundance: C = common; Unc. = uncommon; R= rare (tentative rankings).

CDC	Scientific Name	Common Name	Habitat	Flight Times (Good Weather)	Sight-ed?	Abund.
	Erynnis icelus	Dreamy Dusky wing	Logging roads and open forest	June/July		C
	Erynnis persius	Persius Dusky wing	Logging roads and open forest, burnt areas	June/July		Unc
	Pyrgus ruralis	Two-Banded Checkered Skipper	Logging roads and open forested paths	Late May		Unc
	Carterocephalus palaemon	Arctic Skipper	Open grassy areas	June		Unc
	Thymelicus lineola	European Skipper	Cultivated grassy areas with sedges near	July/August		R
	Hesperia comma	Common Branded Skipper	Grassy ski slopes and adjacent meadows	August		Unc
	Ochlodes sylvanoides	Woodland Skipper	All lower elevation areas	July/August		C
blue	*Euphyes vestris*	Dun Skipper	Forest areas with grassy areas	July August		R
	Amblyscirtes vialis	Roadside Skipper	Logging roads and open forest	June/July		C
	Parnassia clodius	Clodius Apollo	Logging roads and open forest	July/August		C
	Parnassia smintheus	Rocky Mountain Apollo	Alpine areas	August/September		Unc
	Papilio zelicaon	Anise Swallowtail	Most lower elevations	May through August		Unc
	Papilio rutilus	Western Tiger Swallowtail	Most lower elevations	May through August	yes	C
	Papilio eurymedon	Pale Swallowtail	Most lower elevations	May through August	yes	C
	Neophasia menapia	Pine White	Around the village in trees	Late July/August		Unc
	Pontia occidentalis	Western White	Dry meadows and forest clearings	July/September	yes	Unc
	Pieris marginalis	Margined (Veined) White	Moist areas ad. to willow/alder habitat	May/June		Unc
	Pieris rapae	Cabbage White	In town, urban areas	May through September		C
	Euchloe ausonides	Large Marble	Meadows at all elevations	July/August		R
	Anthocaris sara	Sara's Orangetip	Lower elevations too just below alpine	May through July		C
	Colias philodice	Clouded Sulphur	Lower elevations with cultivated fields	July/September		Unc
	Colias eurhytheme	Orange Sulphur	Lower elevations with cultivated fields	August/September		Unc
blue	*Colias occidentalis*	Western Sulphur	Forested logging roads, open subalpine	June/September		R
	Lycaena cuprea	Lustrous Copper	Alpine	Mid July/Mid August		R
	Lycaena helloides	Purplish Copper	Right of ways, railroad edges	June through September		Unc
	Lycaena mariposa	Reakirt's Copper	Bogs at all elevations	July through September		C
	Satyrium sylvinum	Sylvan Hairstreak	Areas with lots of willows	July/August		R
	Mitoura rosneri	Cedar (Rosner's) Hairstreak	Rights-of-way, railroad edges with cedar	Late May/June		Unc
	Incisalia augustina	Western Elfin (Brown Eifin)	Rights-of-way, railroad edges	May/June		Unc
	Incisalia eryphon	Western Pine Elfin	Pines to 6m tall	May/June		R
	Strymon melinus	Gray Hairstreak	Around the village and gardens	May through August		Unc
	Everes amyntula	Western Tailed Blue	Open meadows/forested roads	May/June		C
	Celastrina ladon	Western Spring Azure	Open meadows/forested roads	May/June		C
	Glaucopsyche lygdamus	Silvery Blue	Open meadows/forested roads with clover	May/June		C
	Plebejus shasta	Greenish Blue	Open meadows/forested roads	June/July		R
	Icaricia icarioides	Boisduval's Blue	Higher elevation meadows and dirt roads	July		R

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CDC	Scientific Name	Common Name	Habitat	Flight Times (Good Weather)	Conf.	Abund.
	Agriades franlinii	Arctic Blue	Above timberline in meadows	Late July/August		Unc
	Speyeria hydaspe	Hydaspe Fritillary	Edges of forest roads	Late June/July		Unc
	Clossiana epithore	Western Meadow Fritillary	Wet meadows and adjacent roads	Late May/July		C
	Phycoiodes mylitta	Pearl Crescent	Old fields and meadows	June/August		C
	Phycoiodes tharos	Mylitta Crescent	Old right of ways, disturbed ares	June/September		Unc
	Euphydryas chalcedona	Variable (Chalcedon) Checkerspot	Open meadows on hillsides	June/August		Unc
	Polygonia satyrus	Satyr Anglewing	Forest edges and along dirt roads	May through September	yes	C
	Polygonia faunus	Green Comma	Forest edges and along dirt roads	May through September	yes	C
	Polygonia zephyrus	Zephyr Anglewing	Sub-alpine areas	May through September		Unc
	Nymphalis antiopa	Mourning Cloak	Forested openings with adjacent willow sp.	May through September	yes	C
	Aglais milberti	Milbert's Tortoiseshell	All areas below alpine	May through September		C
	Vanessa cardui	Painted Lady	Open areas, road edges below alpine	May through August	yes	Unc
	Vanessa atalanta	Red Admiral	In town and forested roads	May through August		Unc
	Liminitis lorquini	Lorquin's Admiral	Forested roads and gardens	June/August	yes	C
	Cercyonis pegala	Common Wood Nymph	Clearcuts and forest openings	July/September		Unc
	Erebia vidleri	Vidler's Alpine	Open forests and alpine	July/August	yes	R
	Erebia epipsodea	Common Alpine	found on Disease Ridge by Amber	02-Aug-06	yes	??
	Oeneis nevadensis	Great Arctic	Rocky forested outcroppings	July/August		R
	Oeneis chryxus	Chryxus (olympic) Arctic	Forest openings and alpine	August		R
	Oeneis melissa	Melissa Arctic	Alpine habitat	July/August		R

Appendix 10: Red- and Blue-Listed Ecosystems in Whistler

Notes:
Three red-listed and six blue-listed ecosystems are currently tracked by the BC Conservation Data Centre.[1] None of these ecosystems have formal protection under current legislation. Only 15 ecosystems in BC currently have Identified Wildlife status (Section 1.4), and some of these occur just to the north and south of Whistler in the Southern Dry Submaritime variant of the Coastal Western Hemlock Zone (CWHds1). Identified Wildlife status nonetheless affords only limited protection, for example, any impact on the timber supply of such protection must be less than one percent (Andy MacKinnon, pers. comm.).

Eight of nine of the tracked ecosystems in Whistler are in forests at lower elevations (generally<1300m), in the Southern Moist Maritime variant of the Coastal Western Hemlock zone (CWHms1). One occurs at treeline in the Mountain Hemlock Moist Maritime parkland (MHmmp). One further note about the CDC listings is that their data is incomplete for non-forested ecosystems since Biogeoclimatic Ecosystem Classification (BEC) mapping has been mainly applied to forested ecosystems. The result is that non-forested ecosystems (such as rare wetland or rock outcrop communities) may be under-represented in the data.

For definitions and descriptions of site series and the BEC system, see Green and Klinka (2004) and Meidinger and Pojar (1991).

Site Series	Scientific Name	Common Name	BC Status
CMA;MHmmp/00	*Calamagrostis purpurascens* Herbaceous Vegetation	purple reedgrass Herbaceous Vegetation	Red
CWHms1/02	*Pseudotsuga menziesii - Pinus contorta / Arctostaphylos uva-ursi* Moist Submaritime	Douglas-fir - lodgepole pine / kinnikinnick Moist Submaritime	Blue
CWHms1/03	*Pseudotsuga menziesii - Tsuga heterophylla / Paxistima myrsinites*	Douglas-fir - western hemlock / falsebox	Blue
CWHms1/04	*Abies amabilis - Thuja plicata / Gymnocarpium dryopteris*	amabilis fir - western redcedar / oak fern	Blue
CWHms1/06	*Abies amabilis - Thuja plicata / Oplopanax horridus* Moist Submaritime	amabilis fir - western redcedar / devil's club Moist Submaritime	Blue
CWHms1/07	*Picea sitchensis / Rubus spectabilis* Moist Submaritime	Sitka spruce / salmonberry Moist Submaritime	Red
CWHms1/08	*Populus balsamifera* ssp. *trichocarpa - Alnus rubra / Rubus spectabilis*	black cottonwood - red alder / salmonberry	Blue
CWHms1/09	*Populus balsamifera* ssp. *trichocarpa / Salix sitchensis - Rubus parviflorus*	black cottonwood / Sitka willow - thimbleberry	Red
CWHms1/11	*Thuja plicata - Picea sitchensis / Lysichiton americanus*	western redcedar - Sitka spruce / skunk cabbage	Blue

[1] http://www.env.gov.bc.ca/cdc/