DRAFT Gastropod Best Management Practices Guidebook

OREGON FORESTSNAIL AND OTHER LAND SNAILS AT RISK IN THE COASTAL LOWLANDS



2007

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BRITISH COLUMBIA
Ministry of Environment

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Preface

British Columbia is recognized globally for its exceptional wildlife, diversity of ecosystems and its rich natural resources. The Ministry of Environment (MOE) works to maintain these valuable natural assets, which are at the heart of many recreational end economic activities enjoyed by British Columbians in all regions of the province.

MOE has responsibility for the protection and stewardship of BC's environment. To achieve this goal, the Ministry develops policy and legislation, regulations, codes of practice, environmental contracts and covenants (legal agreements). In addition, the Ministry sets science- and results-based objectives and standards for activities that affect biodiversity. It monitors and reports on selected species and habitats, and acquires information on habitat and species health.

Clear goals, objectives, meaningful performance measures and science-based tools guide Ministry actions in improving environmental management. Regulatory frameworks allow headquarters and regional staff to set and report on standards for environmental quality, and for discharges and emissions to air, land and water. Regulatory compliance is addressed through policy development, enforcement and publicly reporting the results of compliance monitoring.

An Increasing Role for Stewardship

While the Ministry takes a leading role in the protection of BC's natural resources, species, and habitats, environmental protection and stewardship is the responsibility of all British Columbians. Stewardship of natural resources is key to maintaining and restoring the province's natural diversity, and achieving the Ministry's important environmental mandate. A stewardship approach involves all British Columbians taking responsibility for the well being of the environment by acting to restore or protect a healthy environment.

The Ministry is actively pursuing opportunities for sharing the responsibility of environmental protection. As a Ministry, MOE looks to establish vital partnerships and move forward together to protect the environment and the health of all British Columbians. MOE is listening to and developing partnerships with governments, First Nations, communities, academic institutions, industries, volunteer organizations, and citizens. The involvement of these partners in the shared environmental protection and stewardship of BC's resources is essential because of their local knowledge, resources and expertise. The environment will benefit as a result of an increased level of responsible environmental stewardship ethics, immediate and long-term improvements to environmental health and an increased awareness of ecosystem needs among the partners.

A Changing Process

Over the next several years, the Ministry will be making strategic shifts (changes in business practices) towards:

- Shared stewardship between the Ministry and other stakeholders;
- Clear roles for gathering environmental information and achieving environmental objectives;
- Integrated MOE program delivery based on the best available science and an ecosystem-based approach; and
- Clear, reasonable environmental outcomes, with discretion as to how to achieve these outcomes.

This document is an interim document and may change in the future. Changes to the delivery model of this information are also expected, through the movement towards Internet-based access.

What will this document do for me?

This document exists to help you act as a steward of the environment. The information you will find in this document will help to ensure that your proposed development activities are planned and carried out in compliance with the various legislation, regulations, and policies that apply to your activity. By understanding the standards your activities must meet, you can choose an appropriate set of best practices to help you carry out your activities to achieve the required standards.

This document provides information on management measures that will benefit the Oregon Forestsnail (*Allogona townsendiana*) and associated native terrestrial gastropod fauna (slugs and land snails) found within moist deciduous and mixed-wood forest stands on the Lower Mainland and southern Vancouver Island. The BMPs recommended here will help fulfil requirements towards protection of gastropods at risk but do not replace consultation with a professional biologist who is knowledgeable on the local fauna, who can evaluate needs for a particular situation or site and provide advice on legal requirements. Where multiple species at risk are present, the recommended management measures for each species should be carefully evaluated to identify possible conflicts and opportunities for multi-species management (see South Coast Conservation Program (http://www.sccp.ca/) for framework).

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1 Introduction

This document was initiated by the BC Ministry of Environment in response to the need to protect and manage habitats of the many species at risk that occur in the Lower Fraser Valley. The listing of several species of native terrestrial gastropods (slugs and snails) by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) within the past 5 years has prompted numerous queries to the Ministry on protection requirements and appropriate management, particularly for the Oregon Forestsnail and its habitat, within sites designated for development. The Oregon Forestsnail is a nationally endangered land snail that in Canada is known only from the Lower Fraser Valley and one isolated locality on Vancouver Island (COSEWIC 2002). Its distribution coincides with the most heavily populated parts of the province, where its forest habitats are shrinking as a result of urban development, agriculture, and other human land uses. This document describes approaches and measures to help ensure that the needs of this and other gastropods at risk are met.

2 Purpose/Scope

This document is intended to help urban planners, developers, gardeners, farmers, and other stakeholders to protect native land snails and their habitat and to design appropriate best practices for sites where species at risk are found. The focus is the endangered Oregon Forestsnail, but the recommended measures will also benefit other native slugs and snails that share similar habitats, including other species at risk.

3 Background

3.1 Importance of terrestrial gastropods

Slugs and snails perform important ecological roles and contribute to the health of the ecosystems they occupy. By consuming large quantities of live, dead, and decaying vegetation they facilitate turnover of nutrients and minerals and aid in decomposition (Mason 1970, Richter 1979, 1980). In turn, gastropods are consumed by a variety of invertebrate and vertebrate predators. Snails sequester calcium and other minerals in their shells, which are then released in forms usable by other organisms when the snails die or are consumed by predators. Many gastropods feed on fruits and fungi, aiding seed and spore dispersal (Richter 1980, Gervais et al. 1996). These fungi include species that form essential, symbiotic (or mycorrhizal) associations with tree roots; the fungi help the roots absorb minerals and water from the

soil, so enhancing the plants' ability to withstand environmental stresses. Thus, slugs and snails contribute to the health of the forest ecosystem.

Terrestrial gastropods contribute to the biodiversity of forest ecosystems, and about 40 native species occur on the Lower Mainland and Vancouver Island (Forsyth 2004). Several species reach the northern limits of their distribution in these regions and are found nowhere else in Canada, including the Oregon Forestsnail. Populations at the northern extremity of a species' distribution may possess unique ecological adaptations and provide a reservoir of genetic variability that allows the species to response to changing environmental conditions. The BC red- and blue-lists include several gastropod species that are rare or threatened by habitat loss and other factors (BC Species Explorer: http://www.env.gov.bc.ca/atrisk/toolintro.html), and some are also listed nationally (COSEWIC: http://www.cosewic.gc.ca/). COSEWIC-listed species include: Puget Oregonian Snail (*Cryptomastix devia*) – extirpated; Oregon Forestsnail (*Allogona townsendiana*) - endangered; Blue-grey Taildropper Slug (*Prophysaon coeruleum*) – endangered; Dromedary Jumping-slug (*Hemphillia dromedarius*) – threatened; Warty Jumping-slug (*Hemphillia glandulosa*) – special concern.

3.2 Distribution of the Oregon Forestsnail

The range of the Oregon Forestsnail extends from southwest British Columbia to west-central Oregon. In British Columbia, the species occurs in the Lower Mainland from Surrey east to the Chilliwack River Valley and north to Hope. The species is most frequently encountered in the Abbortsford, Chilliwack, Mission, and Kent areas. The Oregon Forestsnail is known from a single locality on Vancouver Island, near Crofton on the southeast coast of the island.

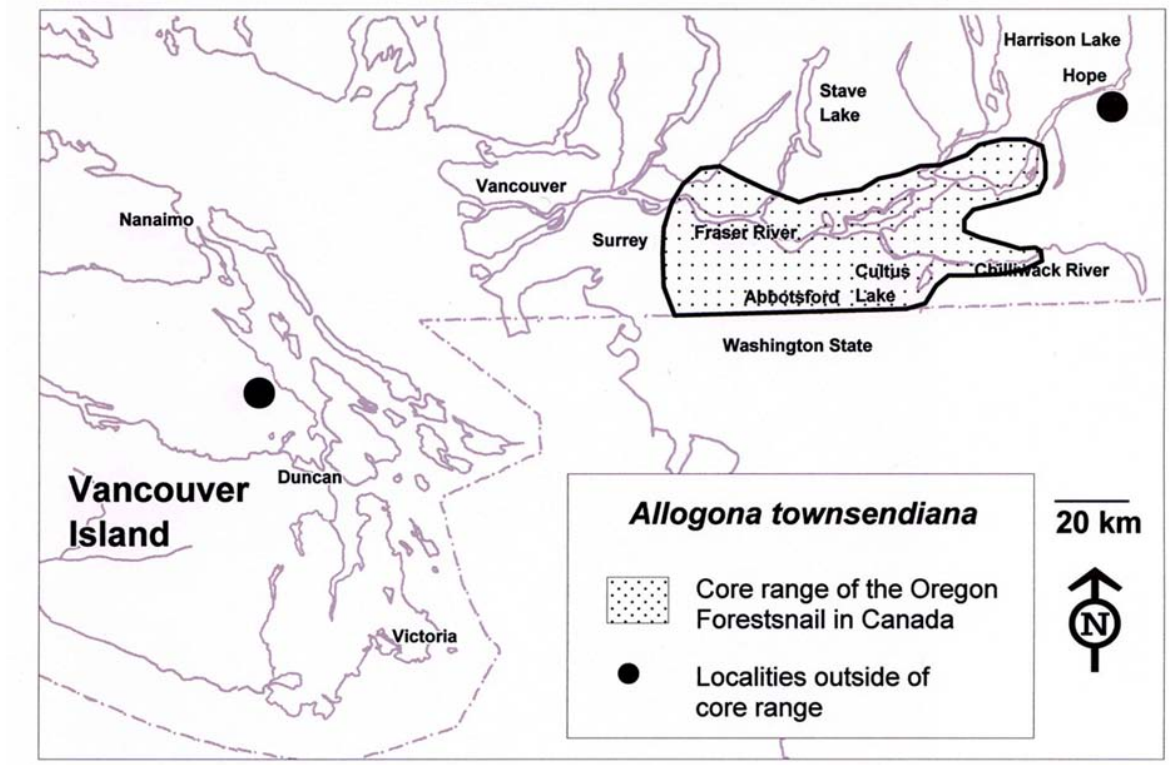

Figure 1: Distribution of Oregon Forestsnail in British Columbia.

3.3 Species description

The Oregon Forestsnail is a large snail with adult shell diameter about 28–35 mm. Diagnostic features include a globular, straw-yellow to light brown shell with fine lines and an opening with a white, thickened rim that flares outward. The outer layer of the shell is often partially worn off, exposing a whitish under-layer. The animal itself is pale brown. Consult guidebooks (e.g., Forsyth 2004) for a detailed description of this and other species of gastropods.

Figure 2: Adult Oregon Forestsnail.

3.4 Habitat description and use

The Oregon Forestsnail inhabits moist deciduous or mixed-wood forests at low elevations, usually below 350 m. It often occurs in association with bigleaf maple (*Acer macrophyllum*) but is sometimes found in black cottonwood (*Populus balsamifera*) or other deciduous stands (COSEWIC 2002a, Durand 2006). The snails are often found in riparian areas along streams, along forest edges, and in small forest gaps. They prefer sites with abundant moisture-loving herbaceous plants such as stinging nettle (*Urtica dioica*), fringecup (*Tellima grandiflora*), herb-robert (*Geranium robertianum*), or bleeding heart (*Dicentra formosa*;); sword fern (*Polystichum munitum*) is also often present (Ovaska and Sopuck 2003, Durrand 2006). In many areas the snails show a close association with stinging nettle (COSEWIC 2002a, Waldock 2002, Rekers 2006). Soft productive soils, leaf litter, and coarse woody debris are thought to be important for mating, egg-laying, shelter, and hibernation (Cameron 1986, Ovaska and Sopuck 2003). Although the snails often occur in forest edge situations and are sometimes found in wet meadows, shade provided by forest cover is essential as it helps maintain moist conditions.

Movements and seasonal habitat use patterns of the Oregon Forestsnail are poorly known. Limited information suggests that individual snails confine their movements to relatively small areas. The average home-range of 10

snails followed for up to 10 months in high-quality habitat was 32.6 m^2 (range: 3.7 – 71.9 m^2); the greatest width of the home range was about 26 m (Rekers 2006). Although this is quantified as the home range, this is not equivalent to the habitat area necessary to sustain a population of snails. Where seasonal habitats, such as hibernation or egg-laying sites, are widely separated, or where habitat is of lower quality, individual snails may undertake longer movements and maintain larger home ranges. Minimum size of areas that can support a viable population of snails is unknown but must contain habitat features required for all seasonal activities and developmental stages.

3.5 Other native species of gastropods

Many other species of terrestrial gastropods occupy similar habitats as the Oregon Forestsnail and co-occur with this species. In British Columbia, the Puget Oregonian Snail is known from only old records and is presumed to be extirpated (COSEWIC 2000b); however, pockets of this large snail could still exist in the province, and the species should be included in the list of target species in surveys of Oregon Forestsnail habitats. Other large native snails, such as Pacific Sideband (*Monadenia fidelis*), Northwest Hesperian (*Vespericola columbianus*), and lancetooth snails (*Haplotrema* and *Ancotrema* species), and numerous small snails with adult shell diameter less than 5 mm commonly occur in the habitats occupied by the Oregon Forestsnail; of these small snails, the Western Thorn (*Carychium occidentale*) is on the BC blue-list of species at risk. COSEWIC-listed slugs (Dromedary Jumping-slug, Warty Jumping-slug, Blue-grey Taildropper) are known from southern Vancouver Island only and have not been reported from the Lower Mainland to date; these species are not known to co-occur with the Oregon Forestsnail.

Figure 2: Adult Puget Oregonian Snail.

4 Key Issues of Concern

The entire Canadian range of the Oregon Forestsnail is within a densely populated and heavily modified part of British Columbia. Low elevation forest habitats preferred by the snails have been lost and severely fragmented as a result of past land reclamation, agricultural uses, logging, and urbanization. Human activities continue to fragment and degrade habitats. The COSEWIC status report (2002a) and draft Recovery Strategy (MOE 2006) for this species identify the following main threats: (1) habitat loss and fragmentation from urban developments and agricultural land uses; (2) habitat degradation due to land management and recreational activities; (3) interactions with introduced species, particularly exotic gastropods and invasive plants; (4) pollution and pesticides.

5 Objectives

The long-term protection goal for the Oregon Forestsnail is to ensure the persistence of historic, existing, and newly located sites where the species is present in Canada, through habitat securement. The short-term (over the next 5 years) goal is to minimize threats to the Oregon Forestsnail and its habitat at each known location. The following management objectives are intended to help landowners, developers, and other stakeholders to design a management program that is consistent with these goals:

- Ensure that adequate knowledge of the presence and distribution of the species within the study area is obtained before any developments or modifications are made;

- Protect key habitats from land development or modification by stewardship activities;

- Ensure habitat connectivity, process and functionality to allow for movement of snails among habitat patches;

- Manage habitats so that habitat degradation is minimized and the population continues to persist at the site for the long (>100 years) term.

6 Standards

6.1 Legal Requirements

The federal *Species at Risk Act* (SARA) is designed to protect Canada's species at risk and their critical habitat. The Act came into force in June 2004. SARA directly protects listed individual organisms, their residences, and identified critical habitat on federally administered lands and for aquatic species and migratory birds wherever they occur. The B.C. Government agreed in 1996 to provide complementary protection to listed species under its jurisdiction through the national *Accord for the Protection of Species at Risk*, and plans to meet this objective primarily through the use of cooperative stewardship and existing legislation, such as the *Wildlife Act* and its amendments. SARA stresses that cooperative solutions with the involvement of all stakeholders should be attempted before the use of regulated solutions.

The *Canadian Environmental Assessment Act*, as amended by SARA, requires that a formal environmental assessment be conducted for projects that may affect species at risk or their habitat where the federal government has decision-making authority (as defined in the Act if the federal government is acting as a proponent, land manager, source of funding or regulator). Through the 1996 national *Accord for the Protection of Species at Risk*, the B.C. Government agreed to provide a similar process on lands under its jurisdiction. Given that the B.C. Government has responsibility for private, municipal, and regional lands through the *B.C. Local Government Act* and *B.C. Community Charter*, municipalities and regional districts have authority to ensure that species at risk are included in environmental assessments, development permits, and land use planning.

The response of the development proponent or regulator to the findings of an environmental assessment (i.e., whether to protect habitat or establish buffers) is not directly mandated by legislation. The process instead emphasizes the importance of cooperative stewardship by government, industry, private landowners, and non-governmental organizations to ensure that sufficient habitat is protected and /or rehabilitated for this species. This document describes actions that municipalities, regional districts and developers can take to ensure the recovery of Oregon Forestsnail and other gastropod species at risk. Following these guidelines helps demonstrate due diligence towards protection and recovery of this species.

The most up-to-date information on species at risk in Canada is available at Environment Canada's website: http://www.speciesatrisk.gc.ca/; or at the SARA Public Registry: http://www.sararegistry.gc.ca/. For information on species at risk in British Columbia, visit: http://wlapwww.gov.bc.ca/wld/.

7 Best Management Practices

7.1 Methodologies for obtaining data on presence and distribution of gastropods

7.1.1 Existing information

The first step is to find out whether the Oregon Forestsnail or other species at risk occur or are likely to occur within the study area, using existing information and field surveys. Sources for existing distribution records of gastropods include BC Ministry of Environment Species and Ecosystems Explorer (http://srmapps.gov.bc.ca/apps/eswp), BC Conservation Data Centre (http://www.env.gov.bc.ca/cdc), South Coast Conservation Program (http://www.sccp.ca/), and BC Ministry of Environment species at risk biologists and species specialists. The distributions of most gastropods in the province, including the Oregon Forestsnail, are incompletely known. Therefore, if a site contains potentially suitable habitat and is within the range of the target species, it is appropriate to proceed with field surveys regardless of whether previous records of the species from the vicinity of the study site are available.

7.1.2 Survey Methods

The first step is to find out what habitats are present within the study area and assess their suitability for the Oregon Forestsnail. Resources for habitat assessment include orthophotos, satellite imagery, forest cover maps, and biophysical mapping. For example, low elevation mixed-wood or deciduous forest with bigleaf maple and riparian areas all form good habitat for the Oregon Forestsnail and often can be located from maps. Ground visits are required to locate key microhabitat features, such as patches of stinging nettle and small forest gaps favoured by the snails.

The second step is to select an appropriate design for field surveys. Detailed protocols have been developed for locating rare species of terrestrial gastropods under the Northwest Forest Plan in the United States (Duncan et al. 2003); the methods presented here are modified from this protocol. Polygons are selected for surveys based on habitat mapping, and tentative survey routes are plotted on maps. If the study area is small, the entire area should be searched systematically, for example along parallel transects. If the study area is large, suitable habitats will have to be sampled (i.e., only a portion of the habitats are searched), using stratified sampling designs (see Krebs 1989 for methodologies). It is important to search all habitats that potentially harbour snails and to ensure that preferred habitats, including patches of stinging nettle, receive adequate coverage.

The third step is to conduct field surveys at an appropriate time of the year and under suitable conditions. Surveys are best conducted when the Oregon

Forestsnail is most likely to be encountered on the forest floor, although empty shells can be found throughout the year. Both the Oregon Forestsnail and Puget Oregonian Snail are active during the day and often can be located visually on the surface of the ground. In British Columbia, the snails are most active from late March or early April to the end of June during periods when the ground is moist and temperatures are moderate. Therefore, spring – early summer is optimal for surveys. The snails hibernate during cold periods in the winter (November – mid-March) and aestivate during dry periods in the summer (July – August); surveys during these times are inappropriate. Multiple surveys per year are recommended to increase chances of detecting rare species.

To obtain "presence/not detected"[1] type of data, the recommended search method consists of a combination of opportunistic point searches along survey routes and intensive, time-constrained surveys of smaller sample areas where concentrations of key habitat features for the target species are present (Duncan et al. 2003). One or more observers walk slowly along pre-determined survey routes through each habitat of interest while examining the ground surface for gastropods, paying particular attention to patches of stinging nettle and other herbaceous vegetation, and opportunistically investigating other key habitat features, such as decaying logs, piles of sloughed-off bark, bases of sword ferns, and accumulations of leaf litter at bases of large bigleaf maples, as they are encountered. The emphasis will be on searching a large number of points along the route, covering all potential microhabitats. Along the survey routes, the observers will select patches of stinging nettle, dense herbaceous vegetation with fringecup or other moisture-loving plants, riparian areas, or other suitable moist sites for intensive time-constrained surveys. Within these areas, the observers will intensively search 5 m-radius sampling areas. Opportunistic point searches should constitute about one-third and intensive time-constrained searches of sample areas about two-thirds of the total search time. The searches should be conducted carefully, avoiding trampling of vegetation and disturbance to soils; all cover-objects searched should be carefully replaced.

Placing artificial cover-objects constructed of cardboard or other materials on the ground in suitable habitats enhances the chances of locating many species of gastropods (Boag 1990, Hawkins et al. 1998). However, visual searches of the surface and natural cover are more suitable for the Oregon Forestsnail.

The search effort should be quantified by recording the time spent searching, area searched, and number of people engaged in searches. It is beneficial to seek the advice of a professional biologist who is familiar with both the species and methodology to design an appropriate survey strategy.

[1] Whereas finding an animal confirms presence, absence is difficult to ascertain as the species could be present although not detected.

7.1.3 Identification and vouchers

Adults of the Oregon Forestsnail can be readily identified from shell characteristics (see Forsyth 2004). Good-quality photographs of the top and underside of the shell should be taken. If empty snail shells are found, 1-2 shells per site should be collected as vouchers. Avoid collecting live snails inadvertently; hibernating snails are often in an upside-down position (with the aperture facing up) and are withdrawn deep within the shell. Confirmation of identification should be sought from an expert. Photographs may be sent to the BC Conservation Data Centre for this purpose.

7.2 BMPs for land development and clearing

The best option is to locate developments away from high-quality habitats in low-elevation deciduous and mixed-wood forests where the Oregon Forestsnail is found. Where avoidance is not feasible, adoption of the following practices will help mitigate deleterious effects.

Buffers and Management Areas:

- Set aside from development habitat patches where the Oregon Forestsnail occurs or where the habitat is deemed to be of high quality. These management areas should be as large as possible, as accurate estimates of minimum patch size for viable populations are unavailable. Conservation covenants or Stewardship Agreements are an excellent way to ensure that these areas remain protected over the long term.
- Using results of habitat assessment and surveys, set boundaries for protected areas. Establish a buffer zone of undisturbed forest around groups of snail observations (see Figure 3). Use signage and/or fencing to control human access to the area, as appropriate.
- Promote habitat connectivity both within the development area and within the landscape beyond this area through riparian buffer zones (see below), greenways, and other habitat protection initiatives; a habitat patch that is in close proximity or connected to other patches, larger forest stands, riparian buffer zones, or other greenways is much more likely to support viable populations of snails than patches that are isolated in midst of unfavourable habitat.
- Leave buffers of undisturbed habitat along both sides of streams and around wet areas or around the occurrence as they may occurs beyond a wet area; such buffers should be at least 50 m wide or 1 ½ times the length of the tallest bigleaf maple tree within the habitat patch, whichever distance is largest. Buffers wider than this are preferred and provide adequate shade and retain moist forest floor conditions. Where multiple species at risk occur, use the widest buffer width recommended. On very

small sites, even buffers of this size may not sustain the micro-climatic habitat characteristics of shade and moisture necessary for a population.

- Retain bigleaf maples, especially large diameter trees, wherever possible; even a large maples at the edges of a forested area can provide valuable habitat for the Oregon Forestsnail, especially if dense herbaceous vegetation is also maintained.
- An assessment of water supply to an area, including water sources, springs, ponds, drainage patterns, draws, creeks (dry and with water) should take place as part of the planning process. Water contributes to soil moisture, vegetation and micro-habitat conditions.

Management of activities during construction:

- Avoid altering natural patterns of drainage and ground water levels, both adjacent and within habitat patch. Drainage and groundwater maintenance is essential for maintaining moist forest floor conditions and herbaceous vegetation required by the snails and other wildlife.
- Restrict heavy machinery and vehicles to development areas; mark clearly and fence off sensitive areas that are to be left undisturbed.
- In areas free of exotic species, avoid inadvertently introducing and spreading exotic gastropods and other non-native species into snail habitat; this could be accomplished by cleaning soil adhering to machinery and workers' boots before entering the worksite. For example, the spread of exotic and invasive plant species such as English Ivy (*Hedera helix*), Himalayan Blackberry (*Rubus discolo*r) and brome (*Bromus spp.*) can negatively affect native vegetation.
- Avoid compaction of soil, disturbance of herbaceous plants and removal of coarse woody debris. Course woody debris acts as cover during dry periods, and may hold eggs and act as residences for the species.
- Strictly manage construction waste and pollutants so that snail habitats are not contaminated.

Management of activities after construction is complete:

- Within riparian buffers and management areas set aside for the Oregon Forestsnail, maintain a multi-layered canopy with natural forest gaps and undisturbed forest edge habitats; avoid conversion of deciduous and mixed-wood forests into dense conifer-dominated stands.
- Retain coarse woody debris, including large-diameter downed logs, on the forest floor; these provide shelter for gastropods and are thought to be important during the mating period and as residences of the Oregon Forestsnail.
- Avoid disturbance to areas containing soft, loamy soils as such sites are used for egg-laying by the Oregon Forestsnail.

- Avoid brush burning, as snail populations are usually intolerant of burning.
- Avoid stormwater run off from entering or running into the management areas for the Oregon Forestsnail. The flow of excess storm water carries pollutants, debris, garbage, and other substances that may be deleterious to the species. Keep stormwater channels from entering snail habitats.
- Manage habitat along roadsides, greenways and trails as described in Sections 8.3, 8.4, and 8.5.

7.3 BMPs for roadside and right-of-way maintenance

The Oregon Forestsnail is frequently found along rights-of ways in locations where roads, railways, powerlines, or other transportation or utility corridors intersect low-elevation, deciduous or mixed-wood forest stands, especially stands with bigleaf maple (Ovaska et al. 2001, COSEWIC 2002a, Ovaska and Sopuck 2003, 2006)). A number of observations of snails depositing eggs in shallow depressions that they dig in the ground are from these habitats, including mowed road edges (Ovaska et al. 2001). The only known population on Vancouver Island occupies a railway right-of-way and adjacent forest habitat (COSEWIC 2002a, Ovaska and Sopuck 2003). It is recommended that a professional biologist be consulted before maintenance activities are carried out.

- During roadside and right-of-way maintenance within habitat occupied by the Oregon Forestsnail, leave undisturbed patches of stinging nettle and other herbaceous vegetation where concentrations of snails or patches of high-quality habitat occur.
- Check for snail presence prior to clearing of vegetation. Use hand clearing methods (e.g. clippers, axes) and mechanical clearing of roadside and right-of-way vegetation rather than herbicides; avoid clearing during the spring-early summer (March – June) when snails are most active on the surface and depositing eggs.
- Confine vehicles and machinery to the road itself at all times to avoid compacting soil and crushing snails within roadside vegetation; avoid turning or parking vehicles and machinery on right-of-ways occupied by snails.
- Where mortality of snails along roads or trails is a problem, use barrier fencing to deflect movements of snails away from these hazardous areas.
- Avoid inadvertently introducing and spreading exotic gastropods and other non-native species into snail habitat; this could be accomplished by inspecting and cleaning any building materials brought into the area, such as bricks and lumber stored outside, and avoiding bringing in plants from other areas. These measures are particularly important in areas that are free of exotic species.

7.4 BMPs for pest management

- Avoid using chemical pesticides and herbicides that are harmful to wildlife and natural ecosystems; some municipalities prohibit pesticide use in urban/rural environments and encourage the use of integrated and green pest control strategies. Check the municipal bylaws.
- Where needed, use hand clearing (e.g. clippers, axes) mechanical clearing of vegetation rather than herbicides, which effectively destroy cover and food and may increase mortality of snails through toxic effects.
- Avoid using chemical pesticides near or within habitats occupied by the Oregon Forestsnail; establish a pesticide-free buffer zone where gardens, lawns, and agricultural fields occur adjacent to occupied habitat, such as forest edges.
- Use alternative measures to control garden pests, such as exotic slugs and snails; such methods include placement of susceptible crops in driest areas of the garden, use of copper barrier fences around individual plants or groups of plants, and hand-picking of pest slugs at night (for other ideas, see University of California website http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7427.html)

7.5 BMPs for recreational activities

- Avoid constructing recreational facilities, such as picnic sites or new trails, through areas occupied by the Oregon Forestsnail.
- Avoid developing facilities for high-intensity recreational activities, such as mountain biking, use of all-terrain vehicles, or other activities that compact soil, in occupied snail habitats.
- Confine recreational trails in snail habitat to clearly defined paths; for example, use chip trails to encourage trail users to remain on paths.
- Use fencing to discourage off-trail access where concentrations of snails or patches of high-quality habitat occur; consider rerouting paths to avoid concentrations of snails.
- When possible, construct elevated boardwalks through snail habitat; boardwalks encourage people to remain on paths and reduce trampling of vegetation.
- Minimize removal of stinging nettle patches, which provide important cover and forage for the Oregon Forestsnail.
- During trail maintenance, avoid using herbicides and excessive removal of trailside herbaceous vegetation (see section 8.3 for details).
- Avoid inadvertently introducing and spreading exotic gastropods and other non-native species into snail habitat; this could be accomplished by inspecting and cleaning any building materials brought into the area, such as bricks and lumber stored outside, and avoiding bringing in plants from

other areas. These measures are particularly important in areas that are free of exotic species.

7.6 Additional Guidelines

The land manager or developer is responsible for collecting available information on previous records of the Oregon Forestsnail from the vicinity of the study area and, where suitable habitat exists, for conducting surveys for this and other species at risk in an appropriate manner. Section 8.1 covers recommendations for collecting existing information and carrying out field surveys; these recommendations should be consulted and followed whenever possible. Careful records should be kept of all tasks undertaken and their outcomes. These records can be used to demonstrate that the manager or developer has shown due diligence and made every effort to follow recommended standards and procedures.

8 Salvage and translocation

Measures other than or additional to the above BMPs may be used in particular situations, provided that they conform to the recovery objectives for the Oregon Forestsnail. Usually, such measures are best developed in consultation with a professional biologist with expertise on gastropods and their habitat requirements. If in doubt about particular measures or approaches, contact the BC Ministry of Environment or the BC Conservation Data Centre.

Salvage of snails from sites deemed for construction is not usually an appropriate conservation measure and is never a substitute for habitat protection and stewardship. Translocation and salvage of snails as a mitigation measure is discouraged for two reasons: It does nothing to prevent habitat loss and fragmentation, and snails introduced to new sites are usually unlikely to establish populations that are viable over the long term. Snails introduced to new sites may not survive either because the habitat is sub-optimal or already saturated and cannot support additional snails. The absence of the species from a site suggests that the habitat might be unsuitable. At sites already occupied by the Oregon Forestsnail, snails from another location may carry diseases or parasites that are detrimental to the resident population. SARA prohibits the collection of the Oregon Forestsnail without special permits. Any planned relocation of snails should be discussed with the BC Ministry of Environment Species At Risk Biologists.

9 Monitoring and Reporting

Land managers and developers are strongly advised to monitor the results of habitat protection and other mitigation measures they have applied for the Oregon Forestsnail and other target species. Monitoring can demonstrate that the manager or developer has followed the prescribed BMPs; it will also help improve these practices if problems are encountered. The following steps should be reviewed and followed as appropriate:

1. Document all measures taken during planning, construction and maintenance of the development area, including maps showing the boundaries of natural areas retained. Use a qualified resource professional.

2. Conduct repeated surveys of the property to determine the areas occupied by the Oregon Forestsnail and compare distribution patterns before and after development.

3. Assess the quality of retained habitats by measuring contaminants and their effects, soil compaction, and disturbances to natural vegetation and key habitat features such as coarse woody debris; also

assess whether the habitats continue to be used by the Oregon Forestsnail or other target species.

4. Where protection measures have been found to be deficient, document what improvements were made to rectify the problems.

A monitoring plan should be part of each project to ensure that mitigation measures taken are working as intended. Such monitoring provides valuable feedback to managers and allows activities and mitigation measures to be adjusted through adaptive management as new information becomes available. Monitoring both habitat features and populations of target organisms is often a useful approach. The results of monitoring efforts should be summarized at regular intervals, such as yearly, through a reporting schedule to ensure that the results become available to managers in a timely fashion.

Example check-list for habitat features to be monitored:

- Soil compaction, erosion, and disturbance
    - Condition of soils, especially on slopes
    - Amount of erosion
    - Amount of human disturbance, including various infrastructures, number of visitors, length and density of trails/roads
- Vegetation composition and structure at different layers
    - Herbaceous vegetation (type and abundance)
    - Deciduous component, particularly of bigleaf maple (type, abundance, and age/size)
- Canopy closure and forest edges
    - Measure of canopy closure or openness of forest
    - Size and pattern of openings in the forest
    - Amount of forest edge
- Forest floor structure
    - Coarse woody debris (amount and state of decay)
    - Depth and type of litter layer
- Wind-throw
    - New wind-throw, particularly around edges of retained forest patches and riparian buffer zones
- Drainage pattern
    - Are natural or pre-disturbance water-flow and drainage patterns maintained? Have temporary water bodies been converted to permanent water bodies or vice versa?
    - Is stormwater draining into an area? Are pools forming where once they were not present?
- Connectivity

  - Measures of degree of isolation for habitat patches, e.g., distance to nearest areas with suitable habitat
  - Measures of fragmentation, e.g., length of roads of different types within the study area; proportion of paved surfaces

- Presence and/or effects of contaminants

- Prevalence of introduced, invasive species
  - Introduced species of gastropods
  - Invasive plants
  - Other invasive species of significance to gastropods, such as new predators

Example check-list for population/distribution characteristics to be monitored over time:

- Changes in distribution patterns of the Oregon Forestsnail or other target species within the study area
- Continued presence of the Oregon Forestsnail or other target species within designated buffer zones, protected habitat areas, or other sites within the study area
- Continued use of key habitat features by the Oregon Forestsnail or other target species within the study area; such key features may be patches of stinging nettle for foraging or areas with soft soils for nesting
- Population trends (stable, increasing, declining) of the Oregon Forestsnail or other target species within the study area

The first three measures require the least effort and are often adequate. "Presence/not detected" type of data needed for these monitoring measures should be collected through surveys at appropriate times of the year using appropriate methods (see Section 8.1.2). Information on relative abundance or population size/density over many years is needed to determine whether a population is declining, increasing, or stable. Ideally, population trend data most accurately indicates whether mitigation is successful. However, accurate information on population size is usually difficult to obtain and requires much effort. The objectives of the monitoring program should be carefully examined to evaluate whether information on population trends is needed for particular purposes or projects.

10 Compliance and Enforcement

Best management practices (BMPs) are approaches based on known science that, if followed, allows the client to meet the standard or achieve desired objectives. Clients may follow the BMPs suggested in this document, or they may opt to follow different practices with or without the advice of an

appropriately qualified professional. If the objective is not met, but the client can clearly demonstrate that they have followed the prescribed BMPs, they may not be held responsible for non-compliance with the objective. If the objective is not met, the client (and the professional) can be responsible for demonstrating that the alternative practices were an appropriate choice. If this cannot be demonstrated, the client (and professional) will be held accountable for any environmental damage.

11 Case Studies

At present no case studies have been completed.. Opportunities exist for collaborative research to investigative effectiveness of the BMPs described in this document. More information on such collaboration can be obtained from the Ministry of Environment Conservation Data Centre.

12 Glossary

Audit (noun): a single set of tests, analyses and confirmations to verify the acceptability and quality of work or data. Audits are usually comprehensive, complex and spatially/temporally discrete. Audits can be considered a type of compliance monitoring. (Quayle 2003).

BC Conservation Data Centre: need to add definition

Best management practices: methods, measures, or practices designed to prevent or reduce water pollution. Not limited to structural and non-structural controls, and procedures for operations and maintenance. Usually, BMPs are applied as a system of practices rather than a single practice. (Dunster and Dunster 1996).

Biodiversity (biological diversity): the diversity of plants, animals, and other living organisms in all their forms and levels of organization, including genes, species, ecosystems, and the evolutionary and functional processes that link them. (MOF Web Glossary). (MELP 1999).

Compliance monitoring: Measures performance against some environmental standard to establish a compliance record. May include audits, assessments, and reviews. Legal Defn: measurement of performance against practices required by law (e.g. regulations under the Fish Protection Act, Wildlife Act, etc.). Practices Defn: Measurement of performance against environmental standards, policies, best management practices or plans that are recommended but not required by law. CAUTION: Insome BC ministries, the term "compliance" refers exclusively to performance against legal standards. (Quayle 2003).

Conservation covenant: Add

COSEWIC: Add

Effectiveness monitoring: Measures environmental condition in the context of a program, policy, plan or activity to gauge progress towards its desired outcomes or effects. Different from compliance monitoring in that rather than addressing whether people are complying with environmental standards, effectiveness monitoring attempts to uncover whether those standards are having an effect in the environment. (Quayle 2003).

Goal: goals provide general purpose and direction. They are the end result of ultimate accomplishment toward which an effort is directed. They generally should reflect perceived present and future need. They must be capable of being effectively pursued. (MOF Web Glossary). An ideal; a desired endpoint; frequently defined in abstract terms. Goals are qualitative and are achieved by means of objectives. (Dunster and Dunster 1996).

Guidelines: a set of recommended or suggested methods or actions that should be followed in most circumstances to assist administrative and planning decisions, and their implementation in the field. Guidelines may consist of policy statements, procedures, or checklists. They are provided as a broad framework of recommended actions to be taken and, therefore, provide some flexibility for decision making. Note that guidelines cannot, by definition, be mandatory; such actions are prescribed by regulations or rules. (Dunster and Dunster 1996).

Impact assessment: A study of the potential future effects of resource development on other resources and on social, economic and/or environmental conditions. (MOF Web Glossary).

Inventory: a single enumeration of an ecological system; generally carried either as a basis for estimating potential yield or to establish a benchmark. An inventory may act as one point in time in a monitoring program. Ecological inventories may be more comprehensive and spatially/temporally discrete than monitoring activities. (Quayle 2003).

Mitigation: measures implemented to control, reduce or eliminate a potential adverse impact of a project, including restorative measures. (EAO 2003).

Monitoring: repeated, systematic measurements done with a specific purpose in mind. Monitoring is focused on measurements over time in order to detect the change toward, or away from, a stated standard or objective. Monitoring is part of the cycle of assessment and evaluation that is linked to management activities. (Quayle 2003).

Objective: a quantifiable, measurable and defined target, capable of attainment within a defined period of time. Objectives are the means by which goals are achieved and should include four main components: 1. They must state the desired outcome (i.e., what is to be accomplished.); 2. They must indicate the time period within which the expected outcome is to be achieved; 3. They must include measurement factors, such as quantity,

quality, or cost, so that the fulfilment of the objective can be verified; 4. They must indicate who is responsible for achieving the indicated result. Desirable (but not absolutely essential) elements of objectives are a description of how they will be achieved and an indication of who will determine whether the results have been achieved. Objectives are typically narrower and shorter in range than goals, and serve as milestones toward goal achievement. (Dunster and Dunster 1996).

Referral: the process by which applications for permits, licences, leases, etc., made to one government agency by an individual or industry are given to another agency for review and comment. (MOF Web Glossary).

Rehabilitation: the restoration of ecosystem functions and processes in a degraded system or habitat. (Dunster and Dunster 1996).

Reporting: the process of effectively communicating the results of monitoring and their potential implications to a target audience. (Quayle 2003).

Restoration: a process of returning ecosystems or habitats to their original structure and species composition. Restoration requires a detailed knowledge of the (original) species, ecosystem functions, and interacting processes involved. (Dunster and Dunster 1996).

Results-based performance standards: Typically define a maximum permissible disposal or impact threshold. For example, the concentration of a particular chemical in waste water discharge or a receiving environment; minimum in-stream flow levels; forest age class distribution within a defined zone. Requiring users of the environment to stay within the established threshold is presumed will achieve the environmental goal that the standard relates to. Results-based performance standards must be scientifically supported, as locally-relevant as possible, accepted by the public and stakeholders, enforceable by being capable of being measured, and affordable and feasible to implement (Brown, 2002)

Risk: the probability that an undesirable event will or will not occur. It is the product of the probability of the event taking place, the probability of being exposed to the event, and the probability of certain outcomes occurring if exposure did take place. Risk can be statistically quantified in a risk assessment. (Dunster and Dunster 1996).

Standard: quantifiable and measurable thresholds that are typically defined in law or regulation, and are mandatory. A statement that outlines how well something should be done, rather than how it should be done. A standard does not necessarily imply fairness or equity, nor an absolute knowledge of cause-and-effect linkages. Standards are typically established using a combination of best available scientific knowledge, tempered by cautious use of an established safety (caution) factor. (Dunster and Dunster 1996).

Stewardship: caring for the land and associated resources so that healthy ecosystems can be passed on to future generations. (Dunster and Dunster 1996).

Stewardship Agreement: Add

Sustainability: the ability of an ecosystem to maintain ecological processes and functions, biological diversity, and productivity over time. (Dunster and Dunster 1996).

Sustainable development: a conceptual ideal where development (in whatever form that might be) meets the needs of the present generations without compromising the ability of future generations to meet their own needs…(Dunster and Dunster 1996).

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14 Additional Information Sources

British Columbia Conservation Data Centre Species and Ecosystems Explorer (http://www.env.gov.bc.ca/atrisk/toolintro.html)

South Coast Conservation Program (www.sccp.ca)

Species At Risk Public Registry (www.SARAregistry.gc.ca)

Environment Canada SAR website

Committee On Status of Endangered Wildlife In Canada (COSEWIC) http://www.cosewic.gc.ca/

University of California. Pests in gardens and landscapes. http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7427.html)

Greater Vancouver Regional District

Photographic atlases

Other information from eg., City of Abbotsford, Langley, Aldergrove, etc.

Lower Mainland Regional Species At Risk Biologist

Invertebrate Species At Risk Biologist