

**BLUE-GREY TAILDROPPER SURVEYS AND HABITAT STEWARDSHIP
ON SOUTHERN VANCOUVER ISLAND IN 2016**



Blue-grey Taildropper (*Prophysaon coeruleum*), Matheson Lake, November 2016 (photo by K. Ovaska)

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Blue-grey Taildropper display at the Fernwood Pole Painting event, 10 September 2016, courtesy of Alanah Nasadyk.



EXECUTIVE SUMMARY

Habitat Acquisition Trust (HAT) has conducted surveys and stewardship activities for the federally endangered Blue-grey Taildropper each year since 2010. The overall objectives are to better understand the distribution of the slugs within the fragmented landscape of the Capital Regional District (CRD), monitor the persistence of the species at known localities, better understand habitat requirements and threats, and engage landowners and managers in stewardship. This report presents the results of activities undertaken during the 2016 field season.

The study sites were located on private properties and in regional and municipal parks in the vicinity of known sites of the Blue-grey Taildropper or within potentially suitable habitat. Surveys using artificial cover-objects (ACOs), constructed of corrugated cardboard, were carried out in five CRD regional parks (Francis-King, Matheson Lake, Mt Work at Durrance Lake, Thetis Lake, Witty's Lagoon), two Saanich municipal parks (Calvert, Logan), and ten private residential properties in the Langford, Prospect Lake, West Saanich, and Metchosin areas. In total there were 213 ACOs at 13 sites in CRD parks, 25 ACOs at five sites in Saanich parks, and 135 ACOs at 12 sites on private lands. The ACOs were checked for gastropods multiple times in October – November when Blue-grey Taildroppers are most readily found, resulting in a total of 1390 ACO flips by HAT biologists in the parks and three private properties, and additional flips by landowners on their properties at the remainder of the sites.

The surveys revealed 1016 individual gastropods, representing 25 species, of which eight were introduced species of slugs. Of 17 native species found, there were three species of slugs and 14 of snails. The Blue-grey Taildropper (2 individuals) was only found at a previously known site in Matheson Lake Regional Park, on 10 and 18 November 2016. Landowners participating in the project reported no Blue-grey Taildroppers. Interestingly, the species was not found at known sites surveyed in Thetis Lake, Mt Work (Durrance Lake), and Logan parks, even though survey conditions (mild and wet) were conducive for gastropod activity throughout much of the autumn. The abundance of introduced, invasive slugs and plants, particularly at the Thetis Lake site where the species has not been found since 2010, raise concerns about the persistence of local populations.

Removal of invasive plants, Laurel-leaved Daphne (*Daphne laurealis*) in particular, has been carried out in the vicinity of the Blue-grey Taildropper site in Thetis Lake Regional Park annually since 2014 with the help of CRD Parks and HAT volunteers, and was continued in 2016. A second Blue-grey Taildropper site where invasive plant removal has been carried out is within a conservation covenant in Metchosin. These two sites, Thetis Lake and Metchosin with reference plots containing Daphne at Witty's Lagoon Regional Park, provided an opportunity to examine the effects of dense thickets of Laurel-leaved Daphne on gastropod faunas.

On the Thetis Lake main monitoring plot, surveyed annually since 2012, an increase in the relative abundance of groupings of species and individual species was noted in 2016 when compared to previous years. While the timing of the increase followed the

invasive species removal in 2015, the situation was confounded by a general increase in gastropod abundance in 2016, which appeared to be related to favourable weather conditions, emphasizing the need for reference plots and “before-after” treatment data. Comparisons of relative abundance of individual species and groupings of gastropods between the removal and Daphne plots suggest that introduced slugs, *Arion* and *Deroceras* species, are unaffected by the presence of Daphne. Patterns consistent with adverse effects of Daphne were found for two native snails, Northwest Hesperian and Western Glass-snail, both of which were much more abundant on the removal plots than on the reference plots containing Daphne at Thetis Lake. On the Metchosin study plots, no trends between the removal and Daphne plots could be discerned, but sample sizes for native species were small. The above results should be viewed as preliminary because (a) effects of Daphne removal on gastropods and other macro-invertebrates may be delayed and take several years to manifest, and (b) confounding effects from site-specific factors and year-to-year variability need additional clarification and replication.

Recommendations for future work include the following:

CRD Regional Parks:

- Continue removal of invasive plants in Thetis Lake Regional Park and monitoring of existing study plots to examine the effects of Laurel-leaved Daphne and its removal on gastropod faunas in Thetis Lake and Witty’s Lagoon regional parks.
- Use signage, marking the sides of trails, and/or decommissioning of unauthorized trails to reduce damage to sensitive Blue-grey Taildropper habitat at sites, such as Thetis Lake, Mt. Work, Devonian, and Matheson Lake regional parks.
- Continue Blue-grey Taildropper surveys within CRD Regional Parks and Trails System to better delineate the distribution of this species and to obtain information on patterns of abundance at known sites.

Municipal parks:

- Continue Blue-grey Taildropper surveys in Saanich Parks and other municipal lands with suitable habitat.

Private residential lands:

- Continue working with landowners to expand search effort and protect habitat through stewardship activities.
- Recruit new landowners with suitable habitat to participate in stewardship activities for the Blue-grey Taildropper, especially near known occurrences.
- Continue monitoring effects of invasive plant removal on gastropod faunas at the existing study plots in Metchosin.

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1.0 INTRODUCTION

The Blue-grey Taildropper is a small forest slug that is currently listed in Canada as Endangered under the federal *Species at Risk Act* (SARA). The species has a patchy and localized distribution and is known only from scattered sites on southern Vancouver Island. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2016a) reassessed the status of this species in spring 2016 as Threatened, down-listing it from Endangered, mainly because several new sites have been found as a result of increased survey efforts by HAT and others over the past 10 years. A Threatened species is "...likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction" (COSEWIC 2016b). The range of the Blue-grey Taildropper is heavily fragmented and modified by human development, which tends to isolate populations and makes them more vulnerable to extirpation, and threats from residential development and invasive species, including alien plants, gastropods and other invertebrates, continue. The species occurs mainly within the Coastal Douglas-fir Biogeoclimatic zone, including sensitive ecosystems, such as Garry Oak/Arbutus woodlands.

Surveys for the Blue-grey Taildropper have been conducted on behalf of Habitat Acquisition Trust (HAT) each year since 2010 to better understand the distribution of the slugs, monitor their persistence at known localities, describe habitat requirements, and better understand threats (Ovaska and Sopuck, annual reports 2011 – 2016). In addition, HAT has initiated stewardship projects on private residential and public regional, and municipal lands to protect and enhance important habitats for the species. Stewardship activities include working with landowners to protect suitable habitat, restoration of habitats through removal of invasive plants, and increasing the awareness of the species and its threats through providing outreach and stewardship opportunities. This report presents the results of the 2016 field season.

2.0 OBJECTIVES

The objectives for 2016 were to:

- Survey suitable habitats in regional and municipal parks and on private residential lands for the Blue-grey Taildropper on southern Vancouver Island in an effort to better delineate the distribution of this species and confirm occupancy at known sites.
- Work with private landowners and install artificial cover-objects on properties with potentially suitable habitat for the species, targeting areas near known occurrences.
- Describe habitats and threats at sites where the Blue-grey Taildropper is found, and provide management recommendations.
- Document other species of terrestrial gastropods found during surveys for the Blue-grey Taildropper.

- Enhance habitat where invasive plants and secondary trails may have negatively affected habitat for the species.

3.0 STUDY SITE AND METHODS

3.1 Study sites

The study sites were located on private residential properties and in public regional and municipal parks in the vicinity of known sites of the Blue-grey Taildropper or within potentially suitable habitat (Figure 1; see Appendix 1 for coordinates of sites within parks).

3.2 Sampling methods

The sampling method consisted of using artificial cover-objects (ACOs) constructed of corrugated cardboard (Hawkins *et al.* 1998, Ovaska and Sopuck 2001, 2008). This method is particularly useful in parks and sensitive habitats, as it allows for repeated surveys of the same sites with minimal habitat disturbance. In total, 360 ACOs at 285 sampling stations were checked multiple times for gastropods in autumn 2016 (Tables 1 & 2). Of these, 54 stations (135 ACOs) were on private properties, 25 stations (50 ACOs) in Saanich Parks, and 213 stations (248 ACOs) in CRD regional parks.

In parks, the ACOs were placed along 100 m or 50 m long transects at sampling stations that were 10 m apart (i.e., 5 or 10 sampling stations/transect). Each station had two cardboard ACOs, placed approximately 1 m from each other. On residential properties, the ACOs were set in sites deemed most suitable, depending on the available habitat, size of the property, and convenience for landowners to check them.

In addition, ACOs were deployed in systematic grids at experimental plots to obtain information on (a) the abundance of Blue-grey Taildroppers and (b) responses of Blue-grey Taildroppers and other gastropods to habitat restoration consisting of the removal of invasive, introduced plants. The plots were set up as follows:

1) Thetis Lake Regional Park (4 plots):

- One 30 x 30 m grid (with 49 cover-objects) that has been monitored each fall since 2012 and where the initial removal of invasive, introduced Laurel-leaved Daphne (*Daphne laureola*) took place in October–November 2015; one Blue-grey Taildropper was found there in 2010. This plot is referred to as the main grid.
- One 15 x 15 m grid (16 ACOs) where the initial removal of Laurel-leaved Daphne took place in July and October 2014; three Blue-grey Taildroppers were found there (in 2008, 2009, and 2010).
- Two 15 x 15 m grids (16 ACOs each) in adjacent habitat with dense thickets of Daphne (no plants removed); one was setup in 2015 and the other in 2016.

Figure 1. Location of study sites surveyed for terrestrial gastropods in the Capital Region District on southern Vancouver Island in 2016. See Appendix 1 for detailed locations of sites on public lands.

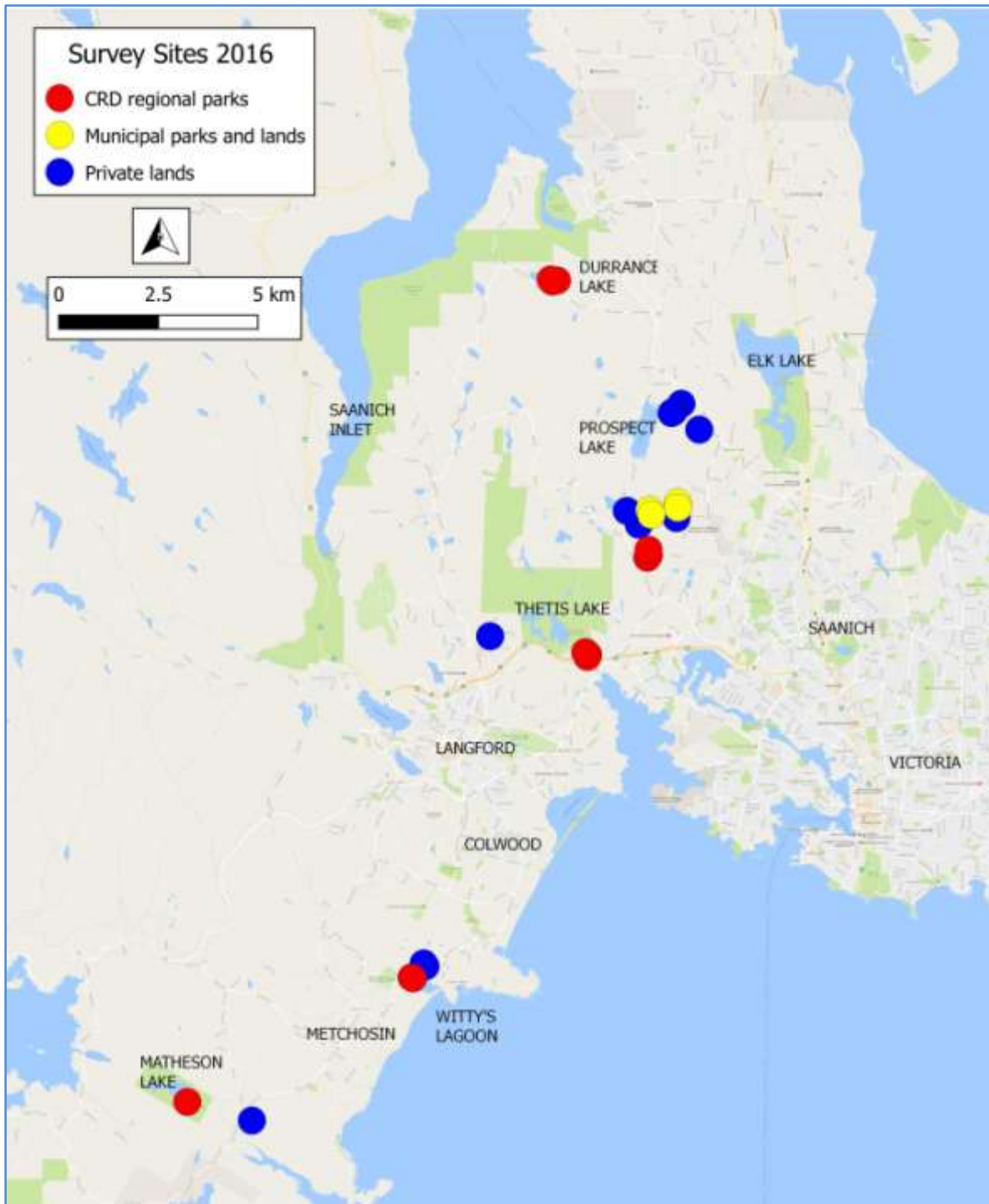


Table 1. Summary of search effort using artificial cover-objects (ACOs) to survey for terrestrial gastropods in autumn 2016.

A. CRD regional parks, Saanich municipal parks, and private properties with ACOs checked by HAT biologists in October and November 2016.

Site Name (Transect or plot ID)	Land ownership	No. of transects and/or grids	# sampling stations	# ACOs ^A	# surveys	# of ACO flips
Francis-King Regional Park	CRD Regional Park	3	15	30	4	120
Matheson Lake Regional Park	CRD Regional Park	1	49	49	4	196
Mt Work Regional Park (Durrance Lake)	CRD Regional Park	3	20	40	4	160
Thetis Lake Regional Park	CRD Regional Park	4	97	97	4	388
Witty's Lagoon Regional Park	CRD Regional Park	2	32	32	4	128
Calvert Park	Saanich municipal park	3	15	30	4	120
Logan Park	Saanich municipal park	2	10	20	4	80
West Saanich Rd (Site 5)	Private (covenant)	2	10	20	3	60
Metchosin Road	Private (covenant)	2	32	32	4	128
Prospect Lake (Site 4)	Private	1	5	10	1	10
Sub-total:		23	285	360	36	1390

B. Residential properties with ACOs checked by landowners in 2016.

Site Name	Initial ACO set up (year)	# ACOs*
Langford (Site 1)	2012	3
West Saanich (Site 1)	2011-2012	20
West Saanich (Site 2)	2012	10
West Saanich (Site 4)	2015	10
Prospect Lake (Site 3)	2014	10
Prospect Lake (Site 4)	2016	10
Metchosin (Site 2)	2015	10
Sub-total:		73
Grand total (A +B):		433

C. Survey effort in 2016 by land status.

Land ownership	# sites	# sampling stations	# ACOs*	# flips
CRD Regional Parks	13	213	248	992
Saanich Parks	5	25	50	200
Private residential	12	54	135	198+flips by landowners
Total:	30	292	433	1390+flips by landowners

Table 2. Dates of artificial cover-object surveys by HAT biologists in 2016.

Site Name (transect of plot)	Check 1	Check 2	Check 3	Check 4
Francis-King Regional Park	17-Oct	30-Oct	14-Nov	21-Nov
Matheson Lake Regional Park	20-Oct	29-Oct	10-Nov	18-Nov
Mt Work Regional Park (Durrance Lake)	17-Oct	30-Oct	11-Nov	23-Nov
Thetis Lake Regional Park	20-Oct	29-Oct	10-Nov	19-Nov
Witty's Lagoon Regional Park	20-Oct	29-Oct	10-Nov	18-Nov
Calvert Park	17-Oct	27-Oct	04-Nov	23-Nov
Logan Park	21-Oct	27-Oct	14-Nov	23-Nov
West Saanich Rd (Site 5)	20-Oct	03-Nov	23-Nov	~
Metchosin Road	20-Oct	29-Oct	10-Nov	18-Nov
Prospect Lake (Site 4)	03-Nov	~	~	~

2) Witty's Lagoon Regional Park and Metchosin Road on private land (4 plots):

- Two 15 x 15 m grids (16 ACOs each) at Metchosin Road site where the removal of Daphne and other invasive plants took place in January 2015; a Blue-grey Taildropper was found there during the removal event; set up in fall 2016.
- Two 15 x 15 m grids (16 ACOs each) with dense thickets of Daphne (no plants removed) Witty's Lagoon Regional Park; set up in fall 2016

3) Matheson Lake Regional Park (1 plot)

- One 30 x 30 m grid (with 49 cover-objects) was set up in September 2016; a total of 15 Blue-grey Taildroppers have been found there in 2011, 2013, and 2014.

In the grids, the sampling stations were 5 m apart with one ACO per station, for a total of 49 ACOs in the 30 x 30 m grid at Thetis Lake and Matheson Lake and 16 ACOs in the other 15 x 15 m grids.

We checked the ACOs in five CRD regional parks, three Saanich municipal parks, and three private properties (Table 2). On the other private properties, landowners checked the ACOs multiple times from October to November and reported their findings to us.

The surveys in 2016 were carried out in autumn because past experience indicated that Blue-grey Taildroppers are detected most readily at this time (Ovaska and Sopuck 2008, 2009a,b, 2012, 2013, 2014a,b). Conditions during the ACO checks in the autumn were mild (air temperature: mean = 11.5°C; range = 8 – 14°C) and moist, suitable for gastropod activity.

3.3 Identification and data recording

We identified and recorded all gastropods found during the study. Nomenclature follows Forsyth (2004). Identification was done in the field using external characteristics, and all

animals were released after examination. Photos of Blue-grey Taildroppers were taken as vouchers. We also recorded the dominant overstorey and understorey vegetation where this species was found and noted any habitat disturbances and potential threats. At sites monitored by landowners and for opportunistic observations reported to HAT, identification was done based on photos sent to us.

4.0 RESULTS

4.1 Artificial cover-object surveys

The surveys revealed 1016 individual gastropods, representing 25 species, of which eight were introduced species of slugs (Table 3). Of 17 native species, there were three species of slugs and 14 of snails. Small snails (shell width ≤ 5 mm) were under-represented in the samples due to the lateness of the season, which was selected to coincide with the optimal time for detecting slugs and especially the Blue-grey Taildropper. The most frequently encountered species were the introduced Long-necked Fieldslug and Hedgehog Arion, which were very abundant at Thetis Lake and Witty's Lagoon sites, and the native snail Northwest Hesperian, which was found at most sites. Appendix 2 show the breakdown of the numbers of gastropods found by site in CRD and Saanich parks and two conservation covenant lands in 2016 .

Table 3. Terrestrial gastropod species and numbers found during surveys by HAT biologists with artificial cover-objects (ACOs) in October - November 2016.

Gastropods found	Sites (plot) ^	No. of individuals	% of all gastropods (n=1016)
Slugs:			
Pacific Banana-slug, <i>Ariolimax columbianus</i>	Calvert Park (T3); Mt Work RP (T1, T2); Francis-King RP (T2); Logan Park (T1); Matheson Lake RP (Grid); West Saanich Rd (Site 5; T2)	16	1.6
Brown-banded Arion, <i>Arion circumscriptus</i> *	Witty's Lagoon RP (D2)	2	0.2
Darkface Arion, <i>Arion distinctus</i> *	Thetis Lake RP (R1); Witty's Lagoon RP (D1, D2)	4	0.4
Hedgehog Arion, <i>Arion intermedius</i> *	Francis-King RP (T2); Thetis Lake RP (D1, D2, Grid main, R1); Witty's Lagoon RP (D2)	169	16.6
Chocolate Arion, <i>Arion rufus</i> *	Francis-King RP (T2); Witty's Lagoon RP (D2)	2	0.2
Dusky Arion, <i>Arion subfuscus</i> *	Metchosin Rd (R2); Witty's Lagoon RP (D2)	7	0.7
<i>Arion</i> species* (unidentified juveniles)	Logan Park (T1); Thetis Lake RP (R1); Witty's Lagoon RP (D2)	5	0.5
Longneck Fieldslug, <i>Deroceras panormitanum (invadens)</i> *	Metchosin Rd (R1); Thetis Lake RP (D1, D2, Grid main, R1); Witty's Lagoon RP (D2)	322	31.7
Grey Fieldslug, <i>Deroceras reticulatum</i> *	Metchosin Rd (R2); Thetis Lake RP (D1, D2, Grid main, R1); Witty's Lagoon RP (D2)	31	3.1

Gastropods found	Sites (plot) ^	No. of individuals	% of all gastropods (n=1016)
Giant Gardenslug, <i>Limax maximus</i> *	Calvert Park (T1); Logan Park (T1); Matheson Lake RP (Grid); Metchosin Rd (R1, R2); Thetis Lake RP (Grid main); Witty's Lagoon RP (D1, D2)	28	2.8
Blue-grey Taildropper, <i>Prophysaon coeruleum</i>	Matheson Lake RP (Grid)	2	0.2
Reticulate & Yellow-bordered Taildroppers, <i>Prophysaon andersonii</i> & <i>P. foliolatum</i>	Francis-King RP (T1, T2, T3); Metchosin Rd (R1, R2); Mt Work RP (T1, T2); Prospect Lake (Site 5, T1); Thetis Lake RP (Grid main); West Saanich Rd (Site 5, T2); Witty's Lagoon RP (D1, D2)	38	3.7
Snails:			
Glossy Pillar, <i>Cochlicopa lubrica</i>	Thetis Lake RP (D1)	1	0.1
Pygmy Oregonian, <i>Cryptomastix germana</i>	Metchosin Rd (R2); Thetis Lake RP (Grid main, R1)	4	0.4
Brown Hive, <i>Euconulus fulvus</i>	Calvert Park (T1, T2, T3); Logan Park (T1); Prospect Lake (Site 4, T1); Matheson Lake RP (Grid)	27	2.7
Robust Lancetooth, <i>Haplotrema vancouverense</i>	Calvert Park (T1, T2); Francis-King RP (T3); Logan Park (T1, T2); Metchosin Rd (R1, R2); Mt Work RP (T1, T2, T3); Thetis Lake RP (Grid main); West Saanich Rd (Site 5, T1); Witty's Lagoon RP (D1)	25	2.5
Blue Glass, <i>Nesovitrea binneyana</i>	Matheson Lake RP (Grid)	1	0.1
Pacific Sideband, <i>Monadenia fidelis</i>	West Saanich Rd (Site 5, T1); Thetis Lake RP (D2)	4	0.4
Pinhead Spot, <i>Paralaeoma servilis</i>	Thetis Lake RP (D2)	2	0.2
Tightcoil snails, <i>Pristiloma</i> sp. (<i>P. stearnsii</i> and <i>P. lansingii</i>)	Calvert Park (T1, T2, 3); Francis-King RP (T1, T2, T3); Logan Park (T1); Matheson Lake RP (Grid); Mt Work RP (T1, T2); Prospect Lake (Site 4, T1); West Saanich Rd (Site 5; T1, T2)	28	2.8
Conical Spot, <i>Punctum randolphii</i>	Calvert Park (T1, T2); Francis-King RP (T1); Logan Park (T1); Thetis Lake RP (D2)	7	0.7
Northwest Striate, <i>Striatura pugetensis</i>	Mt Work RP (T1)	1	0.1
Vertigo snails, <i>Vertigo</i> species	Logan Park (T1); Thetis Lake RP (R1)	2	0.2
Northwest Hesperian, <i>Vespericola columbianus</i>	Calvert Park (T1, T2, T3); Francis-King RP (T1, T2, T3); Logan Park (T1, T2); Matheson Lake RP (Grid); Metchosin Rd (R1, R2); Mt Work RP (T1, T2, T3); Thetis Lake RP (Grid main); West Saanich Rd (Site 5, T1); Witty's Lagoon RP (D1)	220	21.7
Western Glass-snail, <i>Vitrina pellucida</i>	Metchosin Rd (R1); Thetis Lake RP (Grid main, R1); Witty's Lagoon RP (D2)	53	5.2
Quick Gloss, <i>Zonitoides arboreus</i>	Calvert Park (T2); Francis-King RP (T1); Logan Park (T1); Matheson Lake RP (Grid); Mt Work RP (T3); West Saanich Rd (Site 5; T2)	15	1.5

* denotes introduced species; ^ transect with stations of two ACOs 10 m apart (T#), or grid with ACOs 5 m apart in a grid pattern (R#, D#).

During the gastropod surveys, we opportunistically encountered the following amphibians: Western Red-backed Salamander, under the cardboard cover-objects in Mount Work (Durrance Lake) and Witty's Lagoon regional parks and at the residential property at Prospect Lake (Site 4); Northern Red-legged Frog in Witty's Lagoon Regional Park (Plot D1, 19 November). The Northern Red-legged Frog is listed as Special Concern under the federal *Species At Risk Act*.

4.2 Blue-grey Taildropper

Two Blue-grey Taildroppers were found at the Matheson Lake Regional Park grid in November 2016 (Table 4). The slugs (different individuals based on size) were found about a week apart at cover-objects 11.2 m apart in the upper portion of the study plot and in the vicinity of previous observations. No other Blue-grey Taildroppers were found, although mild and wet conditions during the surveys appeared optimal for slug activity. In contrast, Reticulate and Yellow-bordered taildroppers were found relatively frequently during the autumn 2016 surveys (38 individuals at 7 sites; Table 1).

No observations of Blue-grey Taildroppers were reported to us from the sites checked by landowners.

Table 4. Summary of Blue-grey Taildropper observations during HAT's surveys in autumn 2016.

Site name	BEC [^] zone	Method	Date	No. found	Adult/ juvenile	Habitat	Observer(s)
Matheson Lake Regional Park, Metchosin	CWHxm1	Cardboard cover-object	10-Nov-16	1	Adult	Older coniferous forest on gently sloping terrain with sparse understorey; numerous mushrooms & pieces of wood/bark	L. Sopuck & K. Ovaska
Matheson Lake Regional Park, Metchosin	CWHxm1	Cardboard cover-object	18-Nov-16	1	Adult, 19 mm extended	Older coniferous forest on gently sloping terrain with sparse understorey; numerous mushrooms & pieces of wood/bark	L. Sopuck & K. Ovaska

[^]Biogeoclimatic zone variant

4.4 Invasive plant removal

Invasive species removal was carried out at two known Blue-grey Taildropper sites, Thetis Lake Regional Park and a conservation covenant on private land in Metchosin. These activities provided an opportunity to examine the effects of Laurel-leaved Daphne and its removal on gastropods through (a) comparisons of before and after weed removal at the Thetis Lake main monitoring plot that has been surveyed each autumn

from 2012 – 2016, and b) comparisons between the removal¹ and Daphne plots at the Thetis Lake site and in Metchosin, where reference plots within Daphne patches were established in Witty's Lagoon Regional Park.

Thetis Lake main monitoring plot (2012–2016; Figure 2A, B):

- In 2016, an increase in the relative abundance of groupings of species (Figure 2A) and individual species (Figure 2B) was noted when compared to previous years. While the timing of the increase followed the invasive species removal in 2015, the situation was confounded by a general increase in gastropod abundance in 2016, which also occurred in the reference plots containing dense thickets of Daphne (Figure 3A, B), which may related to favourable wet weather conditions.
- Relative abundance of the native snail Northwest Hesperian on the plot has fluctuated greatly over the years, with peaks in 2013 (a dry year) and 2016 (a wet year).
- The native Western Glass-snail was rarely found before 2016 but was relatively abundant that year.

Thetis Lake removal & Daphne plots (2015–2016; Figure 3A, B; see Appendix 3 for breakdown of species and numbers):

- Two introduced species, Long-necked Fieldslug and Hedgehog Arion, increased in 2016 when compared to 2015, both on the removal and Daphne plots.
- Two native snails, Northwest Hesperian and Western Glass-snail, increased only on the removal plots. The Western Glass presents an interesting case: it was relatively abundant only in 2016 and on the removal plots only.
- Introduced slugs, when grouped together or as subgroups (*Arion* or *Deroceras* species) all showed greater abundance in 2016 than in 2015, both on the removal and Daphne plots.
- Large and small snails (all native) increased in 2016 only on the removal plots. These trends are mainly influenced by the two most abundant large and small snail species, Northwest Hesperian and Western Glass-snail, respectively.

Metchosin sites (2016; Figure 4A, B; see Appendix 4 for breakdown of species and numbers):

- Relative abundance of two introduced slugs, Hedgehog Arion and Longneck Fieldslug, and the native snail Northwest Hesperian was much greater on one of the two Daphne plots than on the three other plots. This plot was the closest to the stream in the bottom of the gully and more moist than the other plots, which may have accounted for the difference.

¹ Data from main plot monitored from 2012 to 2016 was also used as one of the weed removal plots for comparisons with Daphne plots in 2015 and 2016.

- No obvious differences in relative abundance of the individual species examined were found between the removal and Daphne plots.
- When species were combined into groups, the trends were similar:
 - abundance was greatest on one of the Daphne plots, except for native slugs and for native small snails (but sample sizes for the latter were very small)
 - No trends between the removal and Daphne plots could be discerned.

Figure 2. Gastropods found during artificial cover-object surveys on the main monitoring plot at Thetis Lake Regional Park, October–November 2012–2016.

Arrow points to invasive species removal.

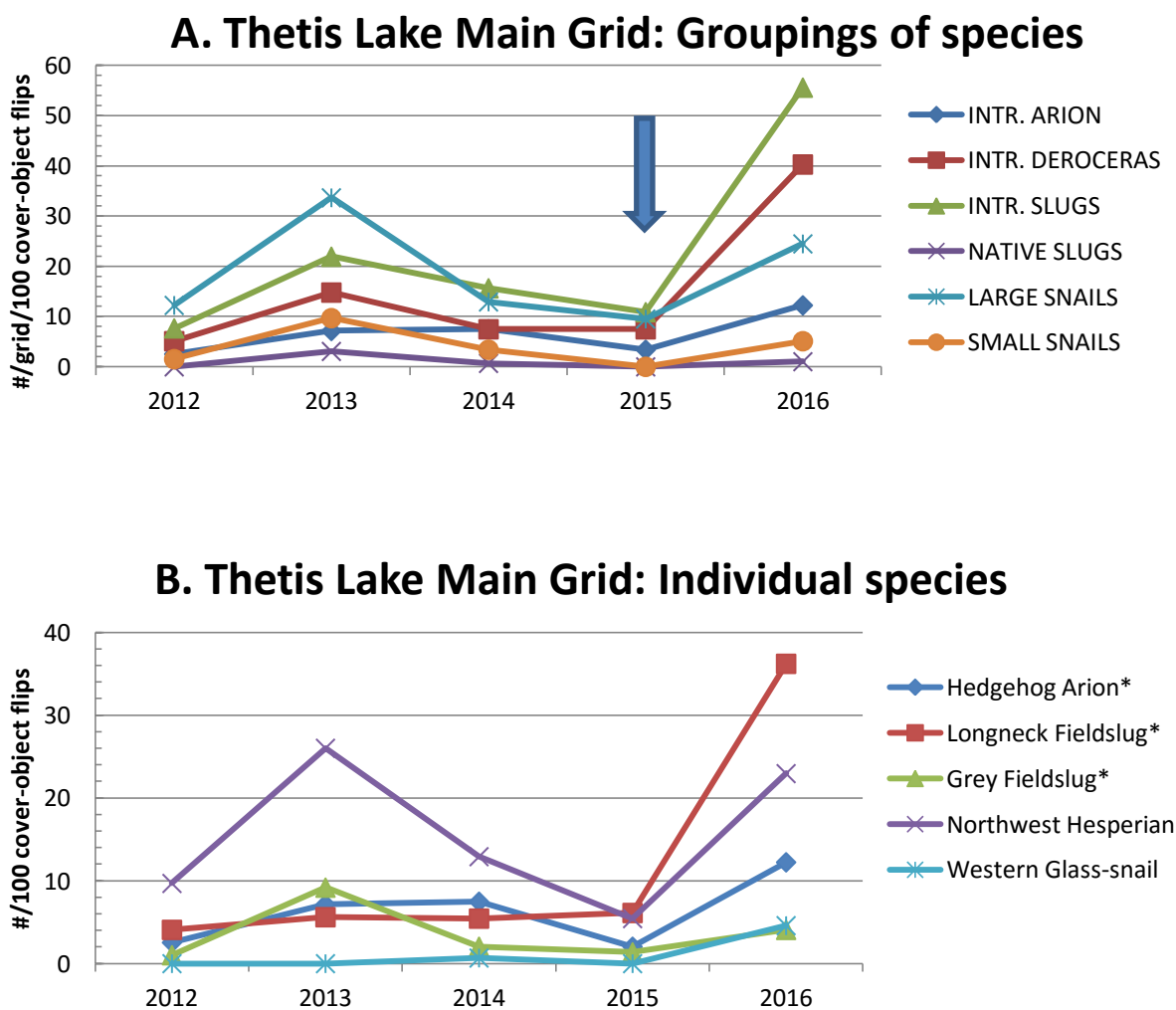


Figure 3. Comparison of groupings (A) and individual species (B) of gastropods at the Laurel-leaved Daphne and removal plots in October–November 2015–2016 at Thetis Lake study sites.

Top of bar - mean; data for two plots combined, except that there was only 1 Daphne plot in 2015.*denotes introduced species.

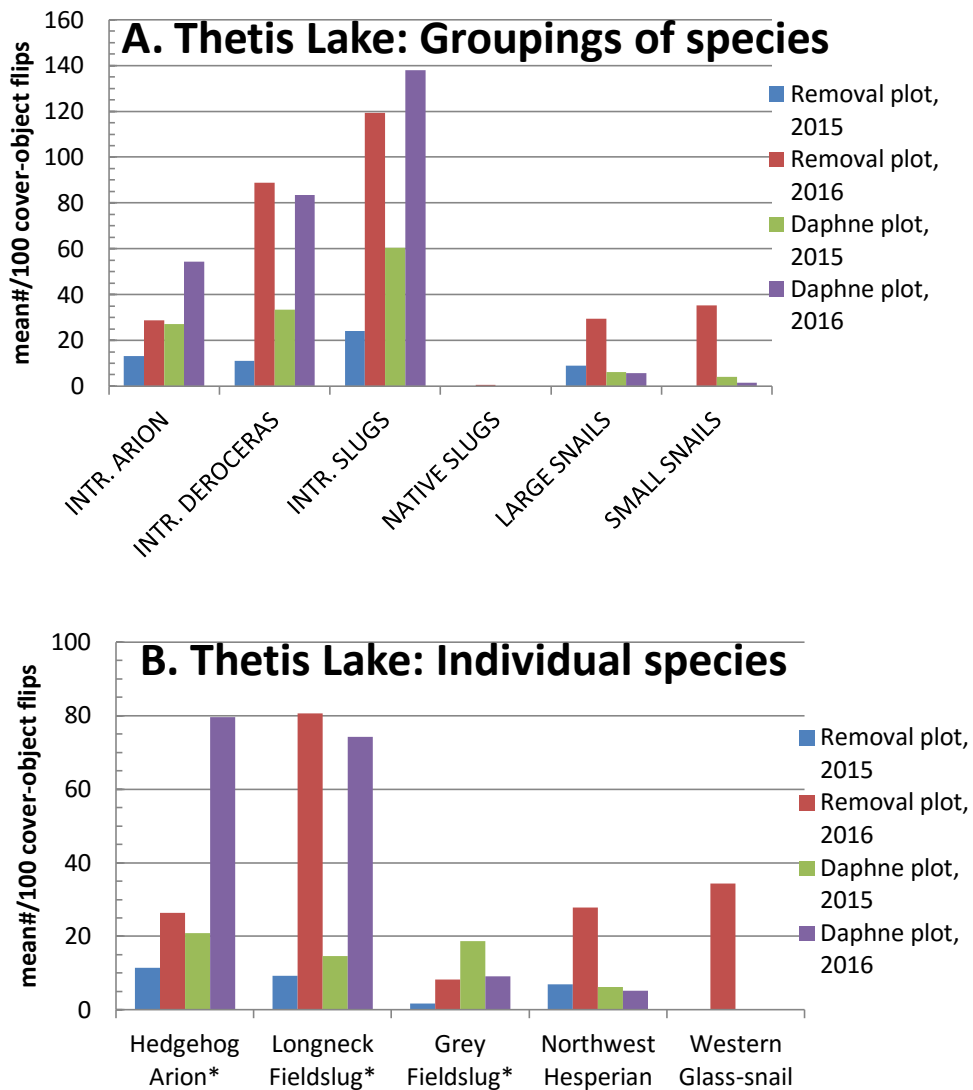
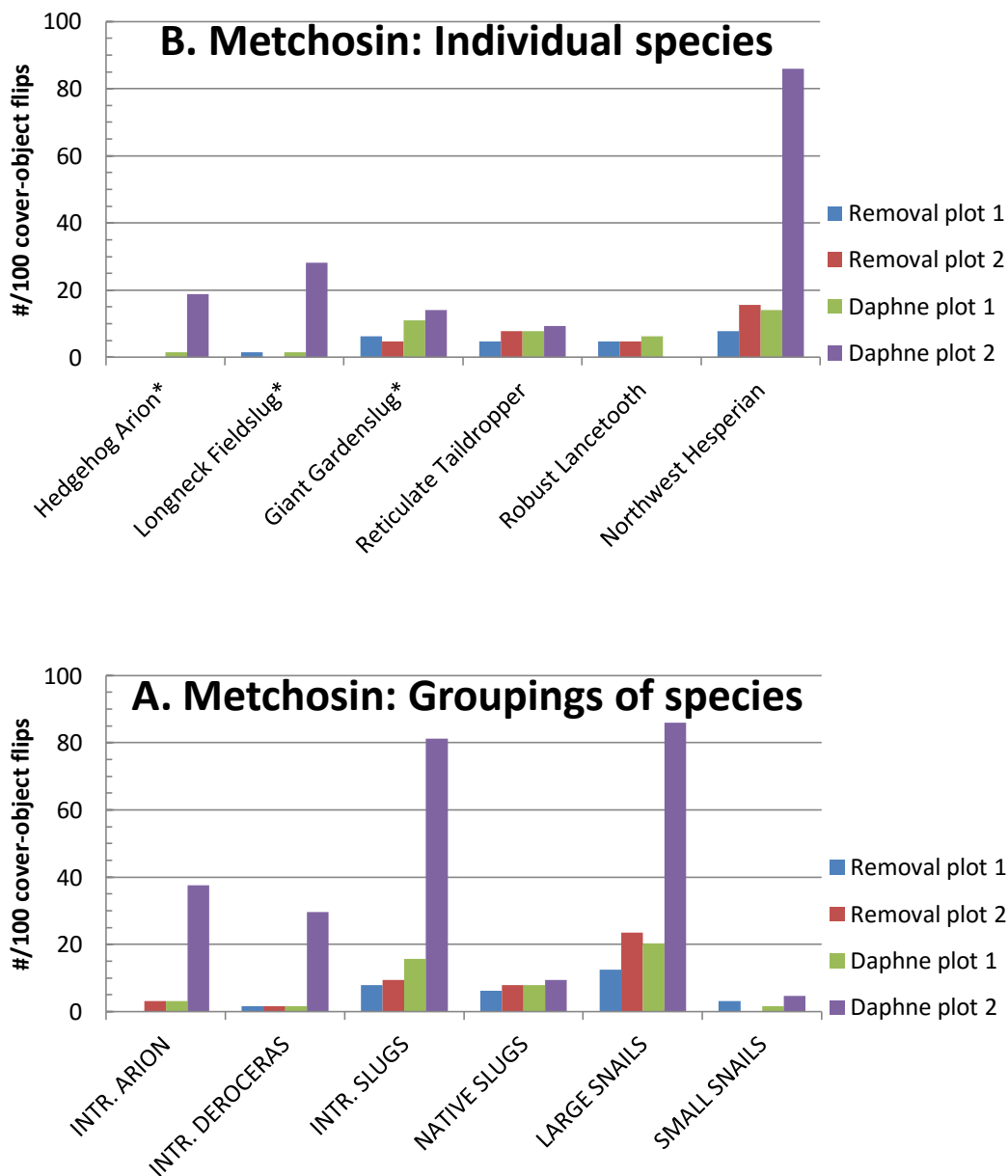


Figure 4. Comparison of groupings (A) and individual species (B) of gastropods at the Laurel-leaved Daphne and removal plots in October–November 2016 at Metchosin study sites.

Top of bar - mean; data for two plots shown side by side. *denotes introduced species.



5.0 DISCUSSION

5.1 Blue-grey Taildropper

The Blue-grey Taildropper was found only in Matheson Lake Regional Park during the surveys, even though mild and wet conditions throughout much of autumn 2016 were conducive for gastropod activity. The species was not found at known sites surveyed in Thetis Lake, Mt Work (Durrance Lake), and Logan parks. At Thetis Lake, the last

observation was in 2010 raising concerns that the population might have disappeared. The site is riddled with introduced slugs, which may be contributing to their disappearance. At Durrance Lake, small numbers of Blue-grey Taildroppers have been found several times since 2007, most recently in 2014. At Logan Park, the species has been found only once, in 2010, and it is unknown whether it still persists there.

Several previous observations are from CRD Regional Parks, and parks and other green spaces form important refuges for the Blue-grey Taildropper and other wildlife within the heavily altered and fragmented Capital Regional District. Surveys carried in CRD parks since 2003 have contributed towards elucidating the species' distribution and habitats (see Appendix 5 for a history of survey effort within CRD Regional Parks). The Blue-grey Taildropper inhabits a variety of forest types within the Coastal Douglas-fir zone and its fringes. Many observations are from Arbutus/Garry Oak/Douglas-fir woodlands. Features deemed important for the species have been described in the proposed Critical Habitat description (Environment and Climate Change Canada 2016), but the detailed habitat requirements of the species remain incompletely known.

5.2 Invasive species removal experiment

Habitat restoration was started at a known Blue-grey Taildropper site in Thetis Lake Regional Park in 2014, when CRD Parks and HAT volunteers manually removed introduced plants during two occasions (29 July, 15 October). The activity was continued in 2015 (24 October, 12 November) and again in 2016 (28 January, 19 November) with the aim of expanding the restored area and removing any weed seedlings that had sprouted in the previously treated areas. The action was prompted by lack of observations of Blue-grey Taildroppers at the site for several years and by an increase in the spread and abundance of Laurel-leaved Daphne, which tends to form dense thickets, crowding out native understorey plants. Laurel-leaved Daphne produces toxic, volatile secretions that are poisonous to vertebrate browsers, and skin contact and fumes cause adverse reactions in some people (Natural Resources Canada 2003). It is possible that the plants may also be toxic to gastropods and soil organisms either directly or indirectly through ecosystem processes. Dense patches of Daphne are likely to alter soil processes and chemistry, potentially creating unfavourable conditions for gastropods.

Another site where Laurel-leaved Daphne appears to degrade habitat for the Blue-grey Taildropper was on a conservation covenant property in Metchosin. A Blue-grey Taildropper was found there on 23 January 2016 during an invasive plant removal event. Experimental plots were set up at this site, with reference plots with thickets of Daphne at another site in Metchosin in Witty's Lagoon Regional Park, and at Thetis Lake Regional Park to obtain information on the effectiveness of weed removal as a restoration tool for the Blue-grey Taildropper and other gastropods.

Invasive plant removal was also carried out at a third site, on a conservation covenant property in West Saanich in 2015 (Matthews 2015). Targeted surveys in both 2015 and 2016 failed to locate the Blue-grey Taildropper; furthermore, the invasive plant removal

focused mainly on a Garry Oak meadow rather than the surrounding forest. Therefore, this site was not included in the experiment.

At the Thetis Lake main monitoring plot, there was an increase in relative abundance of individual species and groupings of species in 2016 when compared to previous years since 2012. Removal of Laurel-leaved *Daphne* took place in 2015 on this plot, and at first glance the increase might be attributed to the treatment. However, this may not necessarily be the case, as similar increases were also noted in the reference plots containing *Daphne* in 2016. Instead, weather conditions might have been particularly suitable for gastropods that year due to a wet autumn (see monthly summary of weather data in Appendix 6). Rainfall in summer and autumn 2013 was much below average. Interestingly, the lowest relative abundance of gastropods was not recorded that year but in the two following years, recovering only in 2016. It is possible that the effect of prolonged drought conditions in 2013 was delayed, and populations required time to build up.

Comparisons of relative abundance of individual species and groupings of gastropods between removal and *Daphne* plots suggests that the presence of dense tickets of *Daphne* have no adverse impacts on introduced slugs, particularly *Arion* and *Deroceras* species, which presumably also occurs in their native habitats in Europe. Only a few native species of gastropods were found in sufficient numbers to allow for comparisons. Patterns consistent with adverse effects of *Daphne* were found for two snails, Northwest Hesperian and Western Glass-snail, at Thetis Lake, both of which were much more abundant on the removal plots than on the reference plots containing *Daphne*. However, a similar pattern for the Northwest Hesperian was not observed on the Metchosin plots, even when confounding effects of high abundance on one of the *Daphne* plots at Witty's Lagoon were removed; the very low numbers of the Western Glass-snail on the Metchosin plots precluded comparisons. It is possible that factors other than *Daphne* removal were responsible for the elevated abundance of the Northwest Hesperian at the Thetis Lake site; data from the plot monitored since 2012 show large multi-year fluctuations of unknown causes. The Western Glass-snail was observed only infrequently at the Thetis Lake site before 2016, when it appeared in relatively high numbers on both plots where *Daphne* had been removed. This species occupies seasonally dry/moist habitats in openings, such as rockslides and meadows, but according to Forsyth (2004) is never found in the forest. Removal of *Daphne* may have opened the habitat sufficiently to allow for a population increase.

The above preliminary results from the invasive species removal experiment should be viewed with extreme caution because (a) effects of *Daphne* removal on gastropods and other macro-invertebrates may be delayed and take several years to manifest, requiring recovery of soil organisms and processes; and (b) confounding effects from site-specific factors and year-to-year variability need additional clarification and replication. Additionally, sufficient sample sizes were obtained for only a few native species. Longer-term data for the experimental plots are desirable. For new sites, data should be obtained both before and after removal at treatment and reference sites to account for site-specific and annual variability.

6.0 RECOMMENDATIONS FOR 2017

Recommendations for future work include the following:

CRD Regional Parks:

- In collaboration with CRD Regional Parks, continue removal of invasive plants in Thetis Lake Regional Park and continue monitoring of existing study plots to examine the effects of Laurel-leaved Daphne and its removal on gastropod faunas in Thetis Lake and Witty's Lagoon regional parks; establish additional replicate plots in these and other parks (e.g., Devonian) as deemed necessary.
- Use signage, marking the sides of trails, and/or decommissioning of unauthorized trails to reduce damage to sensitive Blue-grey Taildropper habitat at sites, such as Thetis Lake, Mt. Work, Devonian, and Matheson Lake regional parks, where these actions are deemed beneficial.
- Continue Blue-grey Taildropper surveys within CRD Regional Parks and Trails System to better delineate the distribution of this species and to obtain information on patterns of abundance at known sites.

Municipal parks:

- Continue Blue-grey Taildropper surveys in Saanich Parks and other municipal lands with suitable habitat.

Private residential lands:

- Continue working with landowners to expand search effort and protect habitat through stewardship activities.
- Recruit new landowners with suitable habitat to participate in stewardship activities for the Blue-grey Taildropper, especially near known occurrences.
- Continue monitoring effects of invasive plant removal on gastropod faunas at the existing study plots in Metchosin.

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APPENDICES

Appendix 1. Sites surveyed for terrestrial gastropods with artificial cover-objects in CRD regional parks and Saanich municipal parks in October–November 2016.

UTM coordinates: Zone 10; NAD 83; measured at start and end of transect with a hand-held Garmin GPS unit or obtained from maps.

Site name	Transect or Plot ID	Land ownership	Elevation (m)	UTM Easting (start)	UTM Northing (start)	UTM Easting (end)	UTM Northing (end)	No. stations 2016	No. ACOs 2016
Francis-King Regional Park	T1	CRD Regional Park	140	467333	5370358	467293	5370388	5	10
Francis-King Regional Park	T2	CRD Regional Park	129	467372	5370415	467351	5370449	5	10
Francis-King Regional Park	T3	CRD Regional Park	132	467366	5370556	467321	5370571	5	10
Matheson Lake Regional Park	Grid	CRD Regional Park	48	455715	5356822	455696	5356864	49	49
Mt Work Regional Park (Durrance Lake)	T1	CRD Regional Park	155	465001	5377271	465045	5377305	5	10
Mt Work Regional Park (Durrance Lake)	T2	CRD Regional Park	160	465117	5377295	465075	5377223	10	20
Mt Work Regional Park (Durrance Lake)	T3	CRD Regional Park	160	464959	5377321	465006	5377290	5	10
Thetis Lake Regional Park	Grid (main)	CRD Regional Park	70	465835	5367939	465852	5367962	49	49
Thetis Lake Regional Park	D1 (grid)	CRD Regional Park	102	465805	5367939	~	~	16	16
Thetis Lake Regional Park	D2 (grid)	CRD Regional Park	85	465767	5368005	~	~	16	16
Thetis Lake Regional Park	R1 (grid)	CRD Regional Park	89	465818	5367889	~	~	16	16
Witty's Lagoon Regional Park	D1 (grid)	CRD Regional Park	45	461366	5359899	~	~	16	16
Witty's Lagoon Regional Park	D2 (grid)	CRD Regional Park	42	461396	5359877	~	~	16	16
Calvert Park	T1	Saanich municipal park	95	467349	5371576	467358	5371616	5	10
Calvert Park	T2	Saanich municipal park	98	467394	5371549	467380	5371502	5	10
Calvert Park	T3	Saanich municipal park	95	467441	5371430	467449	5371474	5	10
Logan Park	T1	Saanich municipal park	87	468100	5371720	468126	5371689	5	10
Logan Park	T2	Saanich municipal park	88	468104	5371605	468059	5371584	5	10

Appendix 2. Terrestrial gastropod species and numbers found per site during surveys with artificial cover-objects in CRD regional and Saanich municipal parks, and on private conservation covenant lands, from October–November 2016.

* denotes introduced species; RP - CRD Regional Park; n=# of cardboard cover-objects (ACOs)

Gastropods found	Francis-King RP (n=30)	Matheson Lake RP (n=49)	Mt Work RP (Durrance) (n=40)	Thetis Lake RP (n=97)	Witty's Lagoon RP (n=32)	Calvert Park (n=30)	Logan Park (n=20)	West Saanich Rd (Site 5) (n=20)	Metchosin Road (n=32)
Slugs:									
Pacific Banana-slug, <i>Ariolimax columbianus</i>	1	5	5	0	0	2	1	1	1
Brown-banded Arion, <i>Arion circumscriptus</i> *	0	0	0	0	2	0	0	0	0
Darkface Arion, <i>Arion distinctus</i> *	0	0	0	2	2	0	0	0	0
Hedgehog Arion, <i>Arion intermedius</i> *	2	0	0	152	13	0	0	2	0
Chocolate Arion, <i>Arion rufus</i> *	1	0	0	0	1	0	0	0	0
Dusky Arion, <i>Arion subfuscus</i> *	0	0	0	0	5	0	0	0	2
<i>Arion</i> species* (unidentified juveniles)	0	0	0	1	3	0	1	0	0
Longneck Fieldslug, <i>Deroceras panormitanum (invadens)</i> *	0	0	0	302	19	0	0	0	1
Grey Fieldslug, <i>Deroceras reticulatum</i> *	0	0	0	29	1	0	0	0	1
Giant Gardenslug, <i>Limax maximus</i> *	0	7	0	6	16	1	1	0	7

Gastropods found	Francis-King RP (n=30)	Matheson Lake RP (n=49)	Mt Work RP (Durrance) (n=40)	Thetis Lake RP (n=97)	Witty's Lagoon RP (n=32)	Calvert Park (n=30)	Logan Park (n=20)	West Saanich Rd (Site 5) (n=20)	Metchosin Road (n=32)
Blue-grey Taildropper, <i>Prophysaon coeruleum</i>	0	2	0	0	0	0	0	0	0
Reticulate & Yellow-bordered Taildroppers, <i>Prophysaon andersonii</i> & <i>P. foliolatum</i>	16	0	1	2	11	0	0	0	8
Snails:									
Glossy Pillar, <i>Cochlicopa lubrica</i>	0	0	0	1	0	0	0	0	0
Pygmy Oregonian, <i>Cryptomastix germana</i>	0	0	0	2	0	0	0	0	2
Brown Hive, <i>Euconulus fulvus</i>	0	1	0	0	0	22	1	0	0
Robust Lancetooth, <i>Haplotrema vancouverense</i>	1	1	4	2	4	3	2	1	7
Pacific Sideband, <i>Monadenia fidelis</i>	0	0	0	2	0	0	0	2	0
Blue Glass, <i>Nesovitrea binneyana</i>	0	1	0	0	0	0	0	0	0
Pinhead Spot, <i>Paralaeoma servilis</i>	0	0	0	2	0	0	0	3	0
Tightcoil snails, <i>Pristiloma</i> sp. (<i>P. steamsii</i> and <i>P. lansingii</i>)	5	6	2	1	3	5	0	0	0
Conical Spot, <i>Punctum randolphii</i>	2	0	1	1	0	2	1	0	0
Northwest Striate, <i>Striatura pugetensis</i>	0	0	1	0	0	0	0	0	0

Gastropods found	Francis-King RP (n=30)	Matheson Lake RP (n=49)	Mt Work RP (Durrance) (n=40)	Thetis Lake RP (n=97)	Witty's Lagoon RP (n=32)	Calvert Park (n=30)	Logan Park (n=20)	West Saanich Rd (Site 5) (n=20)	Metchosin Road (n=32)
Vertigo snails, <i>Vertigo</i> species	0	0	0	1	0	0	1	0	0
Northwest Hesperian, <i>Vespericola columbianus</i>	15	23	4	80	64	12	5	1	15
Western Glass-snail, <i>Vitrina pellucida</i>	0	0	0	50	1	0	0	0	2
Quick Gloss, <i>Zonitoides arboreus</i>	7	1	2	0	0	3	1	1	0

Appendix 3. Gastropods found during surveys of artificial cover-object (ACO) grids at Thetis Lake Regional Park experimental sites, October–November 2012–2016.

n=# of ACO; s= # of surveys by year; blue shading – species with sufficient numbers of observations (≥ 10) for analysis

Species	Grid main (n=49)					Grid R1 (n=16)		Grid D1 (n=16)		Grid D2 (n=16)		Total	
	2012 [^] (s=4)	2013 (s=4)	2014 (s=3)	2015 (s=3)	2016 (s=4)	2015 (s=3)	2016 (s=4)	2015 (s=3)	2016 (s=4)	2015 (s=3)	2016 (s=4)	2015	2016
Slugs:													
Hedgehog Arion, <i>Arion intermedius</i> *	5	14	11	3	24	10	26	10	54	~	48	23	152
Brown-banded Arion, <i>Arion circumscriptus</i> *	0	0	0	0	0	0	0	0	0	~	0	0	0
Darkface Arion, <i>Arion distinctus</i> *	0	0	0	0	0	0	2	0	0	~	0	0	2
Chocolate Arion, <i>Arion rufus</i> *	0	0	0										
Dusky Arion, <i>Arion subfuscus</i> *	0	0	0	1	0	1	0	3	0	~	0	5	0
<i>Arion</i> species* (unidentified juveniles)	0	0	0	1	0	0	1	0	0	~	0	1	1
INTRODUCED ARION (total)	5	14	11	5	24	11	29	13	54	~	48	29	155
Longneck Fieldslug, <i>Deroceras panormitanum (invadens)</i> *	8	11	8	9	71	6	80	7	68	~	83	22	302
Grey Fieldslug, <i>Deroceras reticulatum</i> *	2	18	3	2	8	1	8	9	11	~	2	12	29
INTRODUCED DEROCERAS (total)	10	29	11	11	79	7	88	16	79	~	85	34	331
Giant Gardenslug, <i>Limax maximus</i> *	0	0	1	0	6	0	0	0	0	~	0	0	6
INTRODUCED SLUGS (total)	15	43	23	16	109	18	117	29	133	~	133	63	492
Pacific Banana-slug, <i>Ariolimax columbianus</i>	0	0	1	0	0	0	0	0	0	~	0	0	0
Reticulate & Yellow-bordered Taildroppers, <i>Prophysaon andersonii</i> & <i>P. foliolatum</i>	0	6	0	0	2	0	0	0	0	~	0	0	2
NATIVE SLUGS (total)	0	6	1	0	2	0	0	0	0	~	0	0	2
Snails:										~	0	0	0
Lancetooth species, <i>Ancotrema</i> sp.	0	1	0	0	0	0	0	0	0	~	0	0	0
Pygmy Oregonian, <i>Cryptomastix germana</i>	1	9	0	0	1	0	1	0	0	~	0	0	2
Robust Lancetooth, <i>Haplotrema vancouverense</i>	4	4	0	6	2	0	0	0	0	~	0	6	2

Species	Grid main (n=49)					Grid R1 (n=16)		Grid D1 (n=16)		Grid D2 (n=16)		Total	
	2012 [^] (s=4)	2013 (s=4)	2014 (s=3)	2015 (s=3)	2016 (s=4)	2015 (s=3)	2016 (s=4)	2015 (s=3)	2016 (s=4)	2015 (s=3)	2016 (s=4)	2015	2016
Pacific Sideband, <i>Monadenia fidelis</i>	0	1	0	0	0	0	0	0	0	~	2	0	2
Northwest Hesperian, <i>Vespericola columbianus</i>	19	51	19	8	45	4	21	3	3	~	11	15	80
LARGE SNAILS (total)	24	66	19	14	48	4	22	3	3	~	13	21	86
Glossy Pillar, <i>Cochlicopa lubrica</i>	0	0	0	0	0	0	0	1	1	~	0	1	1
Blue Glass, <i>Nesovitrea binneyana</i>	0	1											
Pinhead Spot, <i>Paralaeoma servilis</i>	1	8	3	0	0	0	0	1	0	~	2	1	2
Western Flat-whorl, <i>Planogyra clappi</i>	2	1	0	0	0	0	0	0	0	~	0	0	0
Tightcoil snails, <i>Pristiloma</i> sp. (<i>P. stearnsii</i> and <i>P. lansingii</i>)	0	3	1	0	1	0	0	0	0	~	0	0	1
Conical Spot, <i>Punctum randolphii</i>	0	4		0	0	0	0	0	0	~	1	0	1
Vertigo snails, <i>Vertigo</i> species	0	1	0	0	0	0	1	0	0	~		0	1
Western Glass-snail, <i>Vitrina pellucida</i>	0	0	1	0	9	0	41	0	0	~	0	0	50
Quick Gloss, <i>Zonitoides arboreus</i>	0	1	0	0	0	0	0	0	0	~	0	0	0
SMALL SNAILS (total)	3	19	5	0	10	0	42	2	1	~	3	2	56
Total				76	422	62	396	95	406	~	428	233	1652

*introduced species; ^grid established on 15 Oct 2012

Appendix 4. Gastropods found during surveys of artificial cover-object (ACO) grids at Metchosin experimental sites (Witty's Lagoon and Metchosin Rd), October–November 2016.

n=# of ACO; s= # of surveys by year; blue shading – species with sufficient numbers of observations (≥ 10) for analysis

Species	Grid R1 (n=16)	Grid R2 (n=16)	Grid D1 (n=16)	Grid D2 (n=16)	Total
	2016 (s=4)	2016(s=4)	2016(s=4)	2016(s=4)	2016(s=4)
Slugs:					
Hedgehog Arion, <i>Arion intermedius</i> *	0	0	1	12	13
Brown-banded Arion, <i>Arion circumscriptus</i> *	0	0	0	2	2
Darkface Arion, <i>Arion distinctus</i> *	0	0	1	1	2
Chocolate Arion, <i>Arion rufus</i> *	0	0	0	1	1
Dusky Arion, <i>Arion subfuscus</i> *	0	2	0	5	7
<i>Arion</i> species* (unidentified juveniles)	0	0	0	3	3
INTRODUCED ARION (total)	0	2	2	24	28
Longneck Fieldslug, <i>Deroceras panormitanum (invadens)</i> *	1	0	1	18	20
Grey Fieldslug, <i>Deroceras reticulatum</i> *	0	1	0	1	2
INTRODUCED DEROCERAS (total)	1	1	1	19	22
Giant Gardenslug, <i>Limax maximus</i> *	4	3	7	9	23
INTRODUCED SLUGS (total)	5	6	10	52	73
Pacific Banana-slug, <i>Ariolimax columbianus</i>	1	0	0	0	1
Reticulate & Yellow-bordered Taildroppers, <i>Prophysaon andersonii</i> & <i>P. foliolatum</i>	3	5	5	6	19
NATIVE SLUGS (total)	4	5	5	6	20
Snails:					
Lancetooth species, <i>Ancotrema</i> sp.	0	0	0	0	0
Pygmy Oregonian, <i>Cryptomastix germana</i>	0	2	0	0	2
Robust Lancetooth, <i>Haplotrema vancouverense</i>	3	3	4	0	10
Pacific Sideband, <i>Monadenia fidelis</i>	0	0	0	0	0
Northwest Hesperian, <i>Vespericola columbianus</i>	5	10	9	55	79
LARGE SNAILS (total)	8	15	13	55	91

Species	Grid R1 (n=16)	Grid R2 (n=16)	Grid D1 (n=16)	Grid D2 (n=16)	Total
	2016 (s=4)	2016(s=4)	2016(s=4)	2016(s=4)	2016(s=4)
Glossy Pillar, <i>Cochlicopa lubrica</i>	0	0	0	0	0
Blue Glass, <i>Nesovitrea binneyana</i>	0	0	0	0	0
Pinhead Spot, <i>Paralaeoma servilis</i>	0	0	0	0	0
Western Flat-whorl, <i>Planogyra clappi</i>	0	0	0	0	0
Tightcoil snails, <i>Pristiloma</i> sp. (<i>P. stearnsii</i> and <i>P. lansingii</i>)	0	0	1	2	3
Conical Spot, <i>Punctum randolphii</i>	0	0	0	0	0
Vertigo snails, <i>Vertigo</i> species	0	0	0	0	0
Western Glass-snail, <i>Vitrina pellucida</i>	2	0	0	1	3
Quick Gloss, <i>Zonitoides arboreus</i>	0	0	0	0	0
SMALL SNAILS (total)	2	0	1	3	6
Total	19	28	31	140	218

*introduced species

Appendix 5. History of terrestrial gastropod surveys in CRD Regional Parks and Trails System, 2003–2016, by Biolinx Environmental Research Ltd. (2003–2009) and Habitat Acquisition Trust (2010–2016).

Red text indicates sites where the Blue-grey Taildropper has been found. Note: Additional surveys were conducted in Matheson Lake as part of Metchosin Bioblitz in May 2011, during which the Blue-grey Taildropper was found.

Park or Trail	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bear Hill						Oct-Nov		Oct-Dec						
Coles Bay									Oct-Nov					
Devonian		Sep-Nov		Oct-Nov	Nov	Apr-June; Oct-Nov	Oct-Dec					Nov	Oct-Nov	
East Sooke	Oct	Sep-Nov					Oct-Nov		Oct-Nov					
Elk/Beaver Lake										Oct-Nov				
Francis/King		Sep-Nov					Oct-Nov			Oct-Nov		Oct-Nov	Oct-Nov	Oct-Nov
Galloping Goose Trail at Sooke River		Nov		Oct-Nov	Nov	May-Jun; Oct-Nov								
Horth Hill									Oct-Nov					
Lone Tree Hill		Sep-Nov												
Matheson Lake		Sep-Nov							Oct-Nov	Oct-Nov	Oct-Nov	Nov	Oct	Oct-Nov
Mill Hill				Nov						Oct-Nov				
Mount Wells						Oct-Nov	Oct-Nov	Oct-Dec						
Mount Work		Sep-Nov		Oct-Nov	Nov-Dec	Apr-Jun; Oct-Nov	Oct-Nov	Oct-Dec	Oct-Nov			Oct-Nov	Oct-Nov	Oct-Nov
Roche Cove									Oct-Nov	Oct-Nov				

Park or Trail	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sooke Hills Wilderness				Oct-Nov			Oct-Nov	Oct-Dec						
Thetis Lake						Oct-Nov	Oct-Nov	Oct-Dec	Oct-Nov	Oct-Nov		Oct-Nov		Oct-Nov
Witty's Lagoon		Sep-Nov												Oct-Nov
Survey effort (search of forest floor; person-minutes)	160	54*			160						60**	426***	160^	
Survey effort (# ACO flips)		660		1390	260	2360	1620	1460	860	1076	805	387	663	992

* At Galloping Goose Trail, where there were no ACOs

**At Matheson Lake

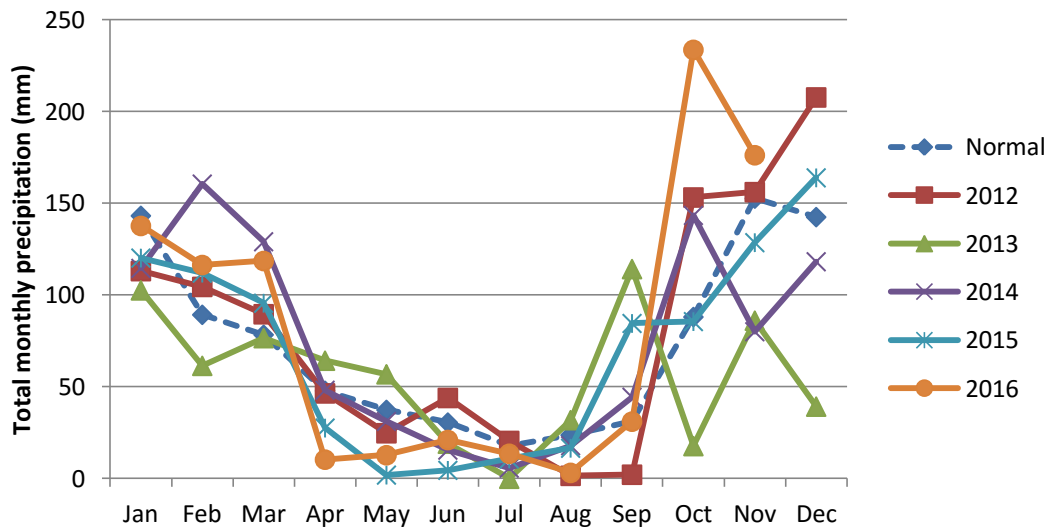
***At Matheson Lake and Devonian, where there were no ACOs

^At Matheson Lake, where there were no ACOs

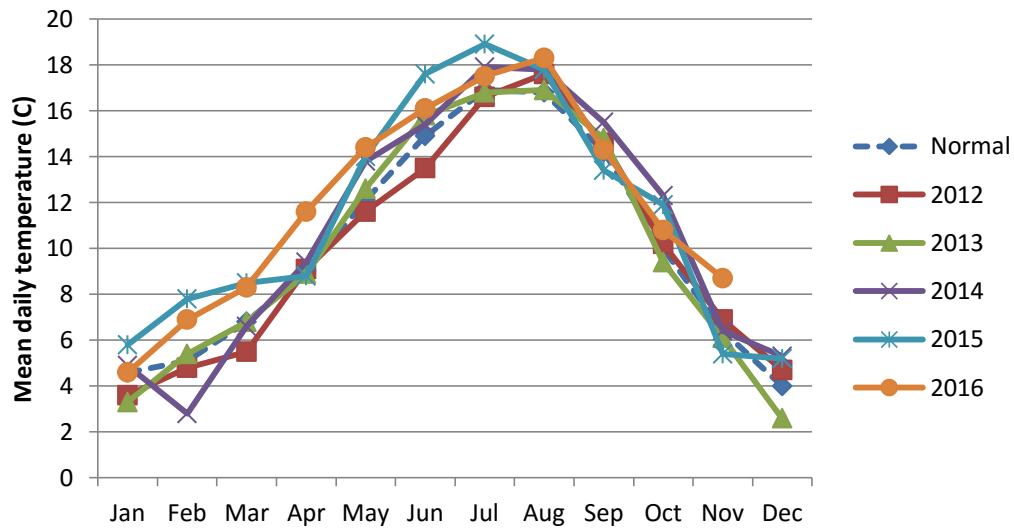
Appendix 6. Mean monthly temperature, monthly total precipitation, and number of days with precipitation per month in 2012–2016 compared to normals (1981–2010).

Data compiled from Environment Canada Climate data online:
http://www.climate.weatheroffice.gc.ca/climateData/canada_e.html (accessed December 2016)

Precipitation: Total



Temperature



Precipitation: Frequency

