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Guide to the Stewardship of Taylor's Checkerspot *Euphydryas editha taylori* on Denman Island

Denman Conservancy Association

2014

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Abbreviations

BC British Columbia
DCA Denman Conservancy Association
CDC Conservation Data Centre
COSEWIC Committee on the Status of Endangered Wildlife in Canada
GOERT Garry Oak Ecosystem Recovery Team

Preface

The overall intent of this report is to provide habitat managers working on Denman with species knowledge, stewardship tools and models for maintaining and enhancing Taylor's checkerspot habitats. The first goal is to present what is currently known about the Taylor's checkerspot butterfly *Euphydryas editha taylori* and a brief description of the few remaining habitats where this butterfly currently exists. The second goal is to review possible habitat enhancement activities for Denman lands that may be managed to extend the survival of this charismatic and endangered species. The third goal is to give examples of current stewardship plans being undertaken by the Denman Conservancy Association and their partners. In addition, the introduction discusses the problems facing butterflies, including the Taylor's checkerspots, and the reasons for action.

Chapter 1 Introduction

1.1 Importance of Butterflies / Population Declines in South-western BC

Taylor's checkerspot *Euphydryas editha taylori* is one of 18 species of butterflies in the coastal Douglas-fir zone in south-western British Columbia that are currently Red or Blue-listed by the provincial government (BC Ministry of Environment 2014). These lists indicate species requiring special attention as conservation priorities Taylor's checkerspot is included by the BC Conservation Data Centre (CDC) on the provincial Red list[1]. The species is also listed as Endangered[2] in the federal government's Species at Risk Act (SARA) having being assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and it is considered "critically imperilled" on the global conservation rating. Thus, successful stewardship of the Taylor's checkerspot on Denman could result in retaining this species in Canada, instead of losing this unique ecological link.

Butterfly species are essential in the interconnected ecological web of species that co-exist in south-western British Columbia. Butterflies fulfill critical life-cycle-linkages with other species. They

- provide a food source for predators and decomposers,
- consume nectar and plant materials, providing pollination services for plants and
- contribute excretion nutrients to the habitat,
- have a role in complex cycles as hosts to various parasites and microorganisms.

Of note, their role in distributing pollen and pollination can be readily appreciated by humans and also, the adult butterflies add an aesthetic element to open-lands, pleasing to humans. In terms of their importance as indicators of the potential health hazards for other species, butterflies respond rapidly to environmental (habitat) and climatic changes and also they occur in a wide range of habitats occupied by many other invertebrate species. Thus, understanding and stewarding butterflies and their habitat requirements may provide avenues to ensuring the security of larger ecosystems and their inhabitants.

Butterflies on the south-western BC coast were described as diverse and abundant in the late 1800's, but butterfly numbers and species declined throughout the 1900's (BC Ministry of Environment, Lands and Parks 1999). During this time, major waves of new human immigrants settled the open-lands that had been previously occupied by First Nations' peoples. The history of open-lands, butterflies and First Nations' settlements are intertwined. After the last ice age of about 15,000 years ago, early post-glacial forests on BC's south-western coast were initially lodgepole pine *Pinus contorta* and red alder *Alnus rubra* (Guppy and Shepard 2001). These forests were gradually replaced about 7500 years ago by Douglas-fir *Pseudotsuga mensiezii* and Garry oak *Quercus garryanna.* First Nations' peoples, arriving on this coast several thousand years ago, kept some coastal areas open, free of forest-growth, and thus retained or even enhanced butterfly habitat for the populations of butterfly species that had previously expanded along ice-free corridors into the ice-cleared, early successional floral habitats.

The overall decline of Taylor's checkerspot populations in BC followed the waves of recent human immigrants in the late 1800-early 1900's. Their decline resembled that of other butterfly species in the coastal open-lands of the southeast Vancouver Island area. The Taylor's checkerspot was once abundant in Victoria and other sites in this area (Danby 1894). But various surveys reported dwindling number of both sites and numbers of butterflies, until the 1990's (Guppy et. al. 1994, Shepard 1995, 2000). By 2000 the last known remaining population of Taylor's checkerspots in Canada, had disappeared from Hornby Island. Then the identification of the Denman Island population in 2005 renewed the possibility for conserving this species in Canada.

[1] **BC red list**: Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.

[2] **ENDANGERED**: A species facing imminent extirpation or extinction.

On Denman, populations of Taylor's checkerspots appeared to expand and then to decline between 2005 and 2013. Indices of the population, determined using flight-season transect-counts, at various sites around Denman, reflect this pattern. In one meadow-habitat that has been open-land since at least 1980, a small population of Taylor's checkerspot butterflies seemed to increase from 2007 to 2009, to decline somewhat in 2011 and then to remain fairly stable through 2013. On two transects within recent clear-cut sites, the counts suggested significant declines in butterfly numbers from 2009 or 2010 to 2013. The checkerspot butterfly population fluctuations on Denman may reflect the effects of local habitat changes, as well as several years of inclement spring weather. The numbers and distribution of Taylor's checkerspot butterflies on Denman Island are discussed in more detail in Chapter 3.

1.2 Threats to Butterfly Populations

Most butterflies require open landscapes and a number of factors could account for declining butterfly populations, many of which are related to open-land changes. Although most of BC's natural coastal prairie meadows of wild flowers and Garry oaks disappeared with human settlement, open non-forested land on the coast persists. In fact the amount of open coastal land has greatly increased, except that now the changes have lead to the overall loss, fragmentation and degradation of butterfly habitat.

To begin with, the uses of open-land have altered:

- Many open spaces are urban or developed landscapes, with dense human activity, interlaced with hard-surfaced busy roads.
- Commercial agriculture has increasingly occupied a large percentage of the open areas, using all the available open space for crop plantations.
- Resource extraction and processing, such as mining, milling and yarding activities take up large areas of rural open space, although when abandoned, the former sites, road systems and logging clear-cuts may offer a form of temporary butterfly habitat.

Also, the physical make-up and structural complexity of open spaces, and thus often their value for butterflies, has changed:

- Invasive species have taken over habitats once occupied by larval and nectar food plants or bare ground. These species often form dense patches, limiting the butterflies' ability to find remaining food and nectar plants. Invasive species include introduced grass species, other herbaceous species and shrubs such as scotch broom. For example, shallow wetlands are being colonized by invasive Reed canarygrass *Phalaris arundinacea*, a grass species that tolerates wet feet, becomes almost a monoculture excluding butterfly food-plant species and butterfly life cycle-activities, such as sheltering or egg-laying.
- Many wet areas have been drained and hydrological patterns have been altered. Previously standing water, even if ephemeral, offered clean aquatic resources and often limited the invasion of other species.
- Fires are no longer a common occurrence in open areas, either as managed fires or as naturally spreading wild fires. Today, fire-fighting controls are quickly applied. Thus many previously fire-dependent openings have regenerated as forests or been taken over by invasive species.
- Varieties of floral species and natural plant-growth patterns in open spaces have been transformed to monocultures or a few varieties of introduced species.
- Plant growth-stages are limited and aspects of general 'untidiness' have been removed through pruning, mowing and clearing, such as seen in lawns and many gardens. Thus the necessary plant debris and moderate vegetative clutter for larval and pupal protection is reduced or absent.
- Sites with other structural complexities such as hummocks, depressions, piles of rocks or large woody debris have been smoothly manicured in preparation for specific human activities or for appearances.

Of major importance has been the declining connectivity of small open habitats that support butterflies. As neighbouring open-spaces continue to be inhospitably transformed or occupied by dominant competing uses, patches of valuable butterfly habitat become fragmented. Butterfly populations that would normally expand, when their populations are plentiful, are restricted by the inaccessibility of adjacent new habitats. Thus, if suitable travel corridors are lacking or any new open habitats are beyond the butterfly's normal dispersal range, few butterflies are likely to successfully disperse, which contributes to the overall decline of the population. Local habitat stress and the inability to disperse are highly significant as, "even a short break in habitat availability can mean local extinction" (Clarke et al 2011 p.6).

Additionally the life and health of butterflies in open areas has been negatively impacted by various factors such as:

- Introduced butterfly species, such as cabbage whites *Pieris rapae* have taken over habitats and plants and potentially disrupted territories, food, activities and available habitat for existing species.
- Changes in overall species composition resulting from the alterations in habitat, affect butterfly population numbers and their ability to make use of the remaining patches. The presence and numbers of various species change over time as populations either increase or decline depending on their ability to adapt to the new habitats and their occupants. Introductions also occur over time, especially of predators, seeking enlarged prey populations.
- Agricultural crops, forestry plantations and linear corridor right-of-ways are often dosed with a series of chemical treatments, including pesticides and other products implicated in hormonal-interactions. Wide-spread chemical treatments, used to protect agriculture and forestry such as spraying with *Bacillus thuringiensis var. kurstaki* (Bt), may also affect butterfly and moth species, (Whaley *et. al.* 1998).
- Introductions of new infectious diseases and parasites, usually unintentional, from contact with domestic plants and animals or species that have invaded wild areas likely have been and continue to be additional stress factors for previously unexposed species.
- Habitat-enhancement activities may inadvertently cause direct damage to butterfly life-stages or may contribute to the introduction of other damaging elements. Recreational activities may also trample life-stages or bring in new threats.

Lastly, global air and water pollution as well as changing climate patterns may be adding further stressors to butterfly survival. Air pollution may not at this time have direct effects on butterfly life stages, but changes have occurred to habitats, such as the reduction or loss of sheltering lichen habitats that were reduced due to excessive atmospheric nitrogen (Clarke *et. al*. 2011). The substantial unpredictable shifts and severity of climate events may affect growth rates or flight periods and may create problems with the synchronicity of life cycle stages and growth stages of critical vegetation, or may alter the numbers of other significant species, such as predators. In general, populations of short-lived butterflies can fluctuate considerably with either supportive or adverse weather patterns.

Table 1.1 summarizes the risks to Taylor's checkerspot populations. Also, to guide possible habitat enhancement, the various impacts can be ranked with respect to those risks most like to be modified by stewardship activities.

1st Local impacts on currently occupied butterfly habitats need to be minimized:
- competing and damaging uses can be avoided or reduced.
- the use of harmful chemicals or other substances can be avoided where their direct effects or spread may be injurious to butterfly life stages.
- structural complexity and essential habitat features can be retained and enhanced. Habitat enhancement activities are discussed in more detail in section 4.3.

2nd Additional open-land habitats and suitable connecting travel corridors adjacent to existing occupied sites can be identified and enhanced for butterfly use:

- competing and damaging uses can be removed or reduced.
- the use of harmful chemicals or other substances can be prevented where their direct effects or spread may be injurious to butterfly life stages.
- structural complexity and essential habitat features can be retained and enhanced. Habitat enhancement activities are discussed in more detail in section 4.3.

Thus, stewardship of checkerspots on Denman requires both an understanding of the butterfly's biology as well as the careful implementation of habitat enhancement activities. Also, consideration of other species' requirements is necessary as open habitats on Denman are occupied by other important species at risk. Habitat enhancement plans need to consider the degree of risk affecting various species and then to aim for an appropriate balance between competing species needs.

Table 1.1 Summary of potential threats to Taylor's checkerspots.

Open-land Habitat Loss, Degradation & Fragmentation	**Competing Uses - Open-habitats Unavailable**	Increasing **human residential density and activities**
		Commercial agricultural use of all available open-land without wild open-habitat buffers.
		Resource extraction and processing activities without wild open-habitat buffers.
	Available Open-habitats Degraded	**Invasive species** replacing butterfly food and other habitat plants.
		Draining wetlands and altering hydrological patterns.
		Active fire suppression, reducing natural open-habitats.
		Plant monocultures limiting food plant variety and habitat-use complexity.
		Plant growth tidied, removing protective habitat.
		Loss of physical habitat complexity
	Habitat Fragmentation	**Isolation of small habitat patches** due to lack of adjacent habitat or suitable, available, safe travel-corridors between patches.
Degraded Butterfly Species Health or Numbers	**Introduced competing butterfly species**, such as cabbage whites *Pieris rapae*	
	Changes in overall species composition, especially increasing predators.	
	Widespread use of **chemical treatments**, including pesticides.	
	Introductions of **new infectious diseases and parasites**.	
	Direct or indirect unintentional negative consequences of **stewardship habitat-enhancement or recreational activities.**	
Global Impacts on Butterflies & Habitats	**Air pollution** affecting species and habitats.	
	Climate change, altering habitats and potential causing asynchrony between life stages and their habitats.	

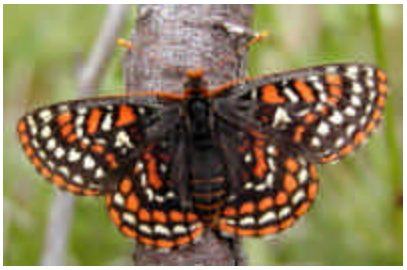
Chapter 2 Taylor's Checkerspot Butterfly Description

This butterfly description depicts the stages and activities of this butterfly through a full calendar year of its life cycle and is included to assist in guiding habitat enhancement activities. To date, some behaviours during the lifecycle, as well as critical habitat features for several life stages remain unknown. Further questions that could assist in directing stewardship activities are included in the life cycle descriptions.

2.1 Species Status and Range

2.1.1 Status

Common Name:	Taylor's Checkerspot
Scientific Name:	*Euphydryas editha taylori*
BC Status:	Red-list[3]
Identified Wildlife Status:	Yes
SARA[4] COSEWIC[5] Status:	Endangered[6]



Taylor's checkerspot, *Euphydryas editha taylori* is listed as Endangered by federal governments in both Canada and the United States of America (SARA, US Fish and Wildlife Service 2013). The butterfly belongs to a group of related coastal subspecies of Edith's checkerspot *Euphydryas editha* that are found from Baja California Norte Mexico, to southeast Vancouver Island BC Canada (Shepard 2000) and other subspecies of Edith's checkerspot are found across western North America. Taylor's checkerspot *E. editha taylori* is considered disjunct from the other subspecies and the genetic relationships among subspecies are currently being studied (pers. comm. C. Guppy and J. Heron 2014). All the coastal subspecies of *E. editha* are rare and disappearing (Shepard 2000).

2.1.2 Range

Range in Canada

Taylor's checkerspots *E. editha taylori*, were collected on Vancouver Island by G.W. Taylor in the late 1880's and described as a new species called *Melitea taylori* in 1888 (Edwards 1888). In Victoria at that time, the species was considered 'plentiful' (Danby 1894). The historical range of *E. editha taylori*, in Canada, was limited to southeast Vancouver Island and some adjacent small islands (Shepard 2000). Museum records indicating the previous distribution data for *E. editha taylori* in BC were originally compiled and published by Shepard (2000) and these data are included in Section 2.6 of this draft guide, as is a list of the last known sightings at BC locations (Stinson 2005). Known sites for Taylor's checkerspots included Hornby Island, Mill Bay, Bright Angel Provincial Park, and ten sites around Victoria. In recent years, various inventories for Taylor's checkerspots were conducted in BC and these demonstrated that the butterfly's distribution was becoming increasingly limited. (Guppy *et. al.* 1994, Shepard 1995, 2000, Miskelly 2003, Guppy and Fischer 2001, Guppy 2007, Page 2007).

Until 2000, Taylor's checkerspots were still considered to be present on Hornby Island, throughout the coastal meadows in Helliwell Provincial Park (Shepard 2000). In 1995 and 1996, the *E. editha taylori* population of these meadows was estimated, using a transect count, at 1100 individuals, (Shepard 1995, 2000). Other small populations existed in the coastal meadow adjacent to this park, in

[3] **BC red list**: List of ecological communities, and indigenous species and subspecies that are extirpated, endangered or threatened in British Columbia. Red-listed species and sub-species may be legally designated as, or may be considered candidates for legal designations as Extirpated, Endangered or Threatened under the Wildlife Act.

[4] **SARA** Species at Risk Act.

[5] **COSEWIC** Committee on the Status of Endangered Wildlife in Canada.

[6] **ENDANGERED**: A species facing imminent extirpation or extinction.

nearby Tribune Bay Provincial Park, and on a powerline right-of-way near Norman Point on southwest Hornby Island. As of 2001, no Taylor's checkerspots were found on Hornby (Guppy and Fischer 2001, Miskelly 2003) and the species was considered extirpated from Canada.

In 2005, at least 20 Taylor's checkerspots were recorded on Denman Island, which, at its closest point, is approximately 1.6 km across Lambert Channel, west of Hornby Island. In 2005, the butterflies on Denman ranged over a distance of least 0.5 km within a 3-5 year old, 64 ha, clear-cut logged area, near the centre of the island. In addition, photographic evidence demonstrates that at least one Taylor's checkerspot was on Denman prior to 2000. Since 2005, Taylor's checkerspots, including breeding populations with larvae, pupae and eggs have been identified in open lands throughout the north and central areas of Denman. In 2008, a single sighting extended the range to the main power line/highway linear corridor on Vancouver Island, which, at its closest point, is approximately 1.6 km across Baynes Sound, west of Denman Island. Population distribution and abundance of the butterfly on Denman is discussed in more detail in Chapter 3 of this draft guide to checkerspot stewardship on Denman.

In summary, the current known Canadian population of Taylor's checkerspot butterflies is on Denman Island in the Strait of Georgia off the mid-eastern coast of Vancouver Island. Denman Island is in the coastal Douglas-fir biogeoclimatic zone, in the Strait of Georgia ecoregion. Most of Denman's non-developed land was in second or third-growth forests, but nearly one third of the island was clear-cut logged at the end of the 1990's. The Taylor's checkerspot population on Denman is found in both the recently clear-cut forested areas and in former agricultural fields of private landowners.

Area:	Denman Island
Ecoprovince:	Georgia Depression
Ecoregions:	Strait of Georgia
Ecosections:	-
BGC Units:	CDFmm

Range in the USA

Taylor's checkerspot populations are also found in Washington and Oregon in the USA, where there is an active recovery program underway. The occupied sites range from isolated openings (balds) on the northern and eastern shoulders of the Olympic mountains and the area's ocean shoreline, through small low hill-slope openings and much larger prairie-lands in the south Puget Sound, down to a few hill-slopes in the Willamette Valley near Corvallis, Oregon.

2.2 Ecological Overview

2.2.1 Background

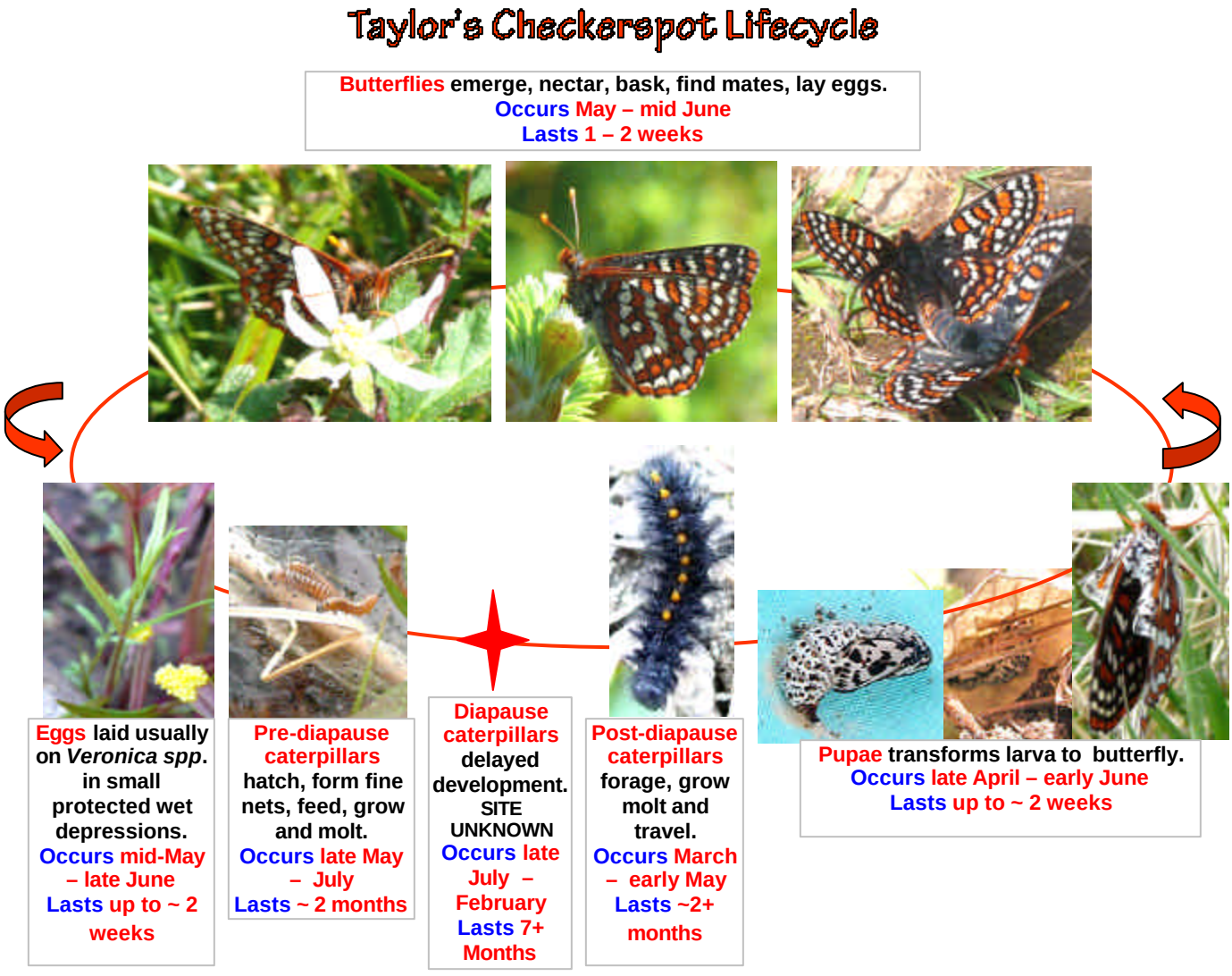
Most of what is known of the ecology of the overall species *E. editha* is due to the work of P.R. Ehrlich and his colleagues (Ehrlich and Hanski 2004). This species is one of the most studied butterflies in North America. As noted above, the subspecies Taylor's checkerspot *E. editha taylori* was observed and collected during various inventories on and around Vancouver Island (Shepard 2000). The population of this subspecies was formally identified in Helliwell Provincial Park on Hornby Island in 1995 and the habitat of Taylor's checkerspot on Hornby was studied in 2002 (Miskelly 2004). *E. editha taylori* has been actively studied for over 10 years in the USA and on Denman since 2005. These studies are on-going.

2.2.2 Lifecycle Summary

This lifecycle summary is presented as the stages occur throughout the year and the information was compiled from the sources listed in the bibliography and from the Denman Conservancy Association's survey data.

Taylor's checkerspots over-winter as larvae and begin the new-year 'sleeping', actually in delayed-development or diapause. The diapause-larval sites are thought to be located near larval spring-food plants and to be sufficiently protected from adverse climatic conditions and predators. The larvae are in diapause for more than seven months, entering diapause in the late summer when food plants dry up and maintaining diapause throughout the cool wet winter and early spring. They emerge as post-diapause larvae when their food plants become available in the spring. In some cases, diapause larvae may continue through a second diapause phase into the next year.

Post-diapause larvae on Denman have been seen foraging as early as February 28, but most often in April and early May. These larvae appear to actively seek out food plants, which on Denman are usually either speedwells (*Veronica*) or plantains (*Plantago*). The larvae continue to grow and then pupate. Pupation usually occurs in late April through May and has been observed to last up to at least 10 days on Denman. Pupae have been observed from May 5 to May 19th. They have been found near the ground and attached in various situations: under leaves, rocks and man-made objects, in the general area of known checkerspot butterfly activity.



Adults may emerge from pupation over a period from early May, occasionally late April, through early June, with males usually emerging one to two weeks before females. The lifespan of adult checkerspots is usually one or two, occasionally up to four weeks and is spent mainly nectaring, mating and egg-laying. Females lay eggs on larval food plants, which on Denman is usually marsh speedwell *Veronica scutellata.*

Taylor's checkerspot eggs are laid in a cluster of joined chains of bright yellow eggs that turn purple-brown with age. They hatch in a few days to two weeks. The pre-diapause larvae emerge, spin protective web nets around their host-plant(s) and begin consuming this plant. As the larvae consume the initial plant, they move off in search of additional food-plants. They must consume sufficient nutrients to grow and molt to the stage of instar 4 or 5 before the food plants dry up. Normally as their food-plants dry up in mid-summer the larvae enter their delayed development stage or diapause to await the following year. One possible reason for fluctuations in the butterfly populations is thought to be due to the lack of available nutrition for the growing pre-diapause larvae. If food-plants dry up early or are unavailable, larvae will not reach a sufficient size or instar-stage to enter diapause.

2.2.3 Habitats

While the habitats of the species *Euphydryas editha* range across a broad landscape from coastal chaparral to alpine tundra, populations of these butterflies tend to have locally adapted behaviours and preferences for only a few plant species at each location (Scott 1986).

The US Federal Register's recent listing for the critical habitat for Taylor's checkerspot describes in detail four components of the "physical or biological features essential to the conservation" of this species in USA sites:

1. site description - patches from <1ac to 100 ac (0.4-40ha) of early seral short-statured perennial bunchgrass plant communities in a topographically diverse landscape, with little to no overstory forest vegetation and with some areas of bare soil for basking. (Bunch grasses: *Festuca roemeri, Danthonia californica, Koeleria cristata Elymus glaucus Agrostis scabra Festuca rubra)*
2. primary larval host plants – *Plantago lanceolata* narrow-leaved plantain;
   Castilleja hispida harsh paintbrush
   secondary annual larval host plants – *Collinsia parviflora* blue-eyed Mary;
   Plectritis congesta seablush;
   Triphysaria pusilla dwarf-leaved owl-clover
   One of several species of speedwell:
   Veronica scutellata marsh speedwell;
   V. beccabunga American speedwell;
   V. serpyllifolia thyme-leaved speedwell.
3. adult nectar sources-
   Achillea millefolium common yarrow;
   Balsamorhiza deltoidea Puget balsamroot;
   Camassia quamash common camas;
   Castilleja hispida harsh paintbrush;
   Cirsium arvense Canada thistle;
   Erigeron speciosus showy fleabane;
   Eriophyllum lanatum wooly sunshine;
   Fragaria virginiana wild strawberry.
   Lomatium triternatum fine-leaved desert parsley/spring gold;
   Lupinus albicaulis sickle-keeled lupine;
   Lupinus lepidus prairie lupine;
   Plantago lanceolata narrow-leaved plantain;
4. aquatic features - permanent, seasonal or ephemeral wetlands, springs, seeps, streams, ponds, lakes and puddles providing moisture in drought periods (US Fish and Wildlife Service 2013).

Thus these essential conservation components can be summarized as:

- appropriate open,-non-forested natural land;
- ample suitable larval-food and adult nectar plants;
- and sufficient water/moisture sources to keep the food plants moist when needed.

Aspects of the species' biology and behaviour also seem to suggest other related supportive habitat characteristics:

- Open-ground - Larval mobility, necessary for larvae to seek for food and shelter, is enhanced by sparsely vegetated habitat that is fairly clear at ground-level, such as bunch-grass open-lands or other sparse herbaceous plants. Examples of good travel habitat for larvae are dry rocky Garry oak sites, drying aquatic sites with bare soil patches or linear coarse woody debris near the ground.
- Protective cover –Habitat features, providing protection to various life stages, may also be important. Egg-laying and newly-laid eggs were observed on Denman and usually females appeared to find suitable host-plants for the eggs that were situated in somewhat protected habitats either under some coarse woody debris or among slightly taller possibly-protective plant species. Although in some cases eggs were laid near the base of plants in completely open areas. Also, post-diapause larvae were thought to be sheltering from predators by seeking out young plantain plants that afforded the larvae shelter under the dead grass of the previous year (Danby 1890). Presumably various life-cycle stages also use protective cover-habitat during inclement weather, at night and during diapause.
- Dispersal corridors - These butterflies are capable of flying over considerable obstacles (Kaye *et. al.* 2011 and DCA observations). But suitable safe travel corridors, perhaps with nectaring opportunities, between nearby good quality habitats, could enhance the chance of dispersal and the successful establishment of additional populations.
- Perch sites – Adult male checkerspots perch on objects within territories and have been shown to use those perches to apparently guard female pupae (Bennett *et. al.* 2011). Preferred perch sites give clear views of their territories and are usually the tallest structure present. Suitable perch-habitat includes tall grasses, flowers, wood twigs and branches, mounds, rocks or man-made objects.
- Basking sites – Both larvae and adults bask in the sun. Sunny warm spots, often bare ground or dark surfaces are used.

Historic habitat of *E. editha bayensis* was once considered to be restricted to "serpentine soils", but later this was considered to be due to the presence of a secondary food plant (Johnson *et. al.* 1968, Ehrlich 1979 – in Shepard 2000). Perhaps however the serpentine soils characterized by naturally open-land with sparse vegetation and wet areas also simply addressed long-established checkerspot habitat feature preferences. To ensure the survival of this species, replicating habitat by providing for the needs and preferences of this species will be critical.

Denman Habitats

Prior to 2000, the last remaining Taylor's checkerspots known in Canada were on Hornby Island. There, Garry Oak meadows were noted as important habitat for *E. editha taylori* (Guppy *et. al.*, 1994, Shepard 1995). The large Garry oak meadows in Hornby's Helliwell Provincial Park were considered able to support a sustainable population of these butterflies (Shepard 1995, 2000). Use by checkerspots of the small wetlands adjacent to the Helliwell Park meadows was not noted, and moist depressions seem to have been largely ignored as a significant habitat attribute.

Thus, the habitat occupied by Taylor's checkerspot on Denman that was observed in 2005 seemed a complete contrast to the upland Garry oak meadows on adjacent Hornby Island. On Denman, the butterflies were first noticed on logging trails in a complex wet-land, low-bluff regenerating clear-cut, logged 5 to 6 years previously. To date, only one of the known breeding populations on Denman is situated in a fairly stable wet meadow habitat that has remained non-forested for at least 30 years.

The Denman sites occupied by Taylor's checkerspots tend to be relatively flat lowlands <200m in elevation, with complex landscapes of small bluffs or hillocks, diverse vegetation and shallow wetlands with substantial winter-flooding throughout. These shallow wetlands usually dry out in spring and support the host plants for egg-laying and feeding the developing butterfly larvae. The wetlands tend to be situated in areas of thin soils over impermeable ground layers. Adult butterflies are also seen on roadways, drier open-lands and low hill slopes surrounding these wetlands.

Extensive clear-cut logging, around 2000, dramatically altered Denman's natural habitats. The removal of the forest canopy over almost one third of Denman Island occurred within a period of approximately two years. What remained included three significant post-logging features:

1. Log-landings of compacted soil often bare of vegetation other than abundant coarse woody debris.
2. Numerous compacted, shallow equipment tracks that collected rain water or run-off.
3. Large new open-areas of clear-cut forests.

These new clear-cuts provided a sun-exposed, open understory with reduced ground-level vegetation, ample structural coarse woody debris, bare soil areas and exposed natural and man-made moisture-accumulating depressions. Native flowering plants and introduced weedy species flourished. Of note, the natural shallow wetlands and equipment-tracks in the clear-cuts grew an abundance of native marsh speedwell *Veronica scutellata* that has served as a major food source for checkerspot larvae. Plantain species tended to be present initially along roads and tracks and later increased in some bare areas.

The single, fairly stable habitat, occupied by checkerspots on Denman, known as Middle Farm's meadow habitat, consists of a hummocky field of mostly introduced grasses and other herbaceous plants. The grasses surround a shallow sedge wetland along a central drainage ditch. During winter rains, there is standing water across much of the field and the raised hummocks and side-cast spoil pile along the ditch-edge are notable flood-free areas. Considerable structural elements are present at the field margins, including rock piles and coarse woody debris. Other structural elements within the meadow are the isolated shrubs, rocks, occasional trees, woody debris and emergent sedges, primarily slough sedge *Carex obnupta.*

A small portion of this meadow is kept open as a riding ring and a small dug pond adjacent to the ring, that fills in winter, provides at least wet mud-puddling opportunities, usually to early June. The western edge of the meadow is a gravel driveway used for regular access by the owners of this coop-property's six homes. The meadow is surrounded by forests 20 to 30+ m in height, consisting primarily of confers and red alder *Alnus rubra*. The forest edges around the meadow are either open understory of grasses and low shrubs such as Oregon grape *Mahonia nervosa* and salal *Gaultheria shallon,* or relatively dense tall shrub-growth of roses *Rosa nutkana*, other *Rose sp*. and Salmonberry *Rubus spectabilis.*

Draft stewardship plans outline in more detail the site features and proposed stewardship activities of this meadow site, as well as two formerly-occupied clear-cut habitat sites owned by the Denman Conservancy Association. These plans are included in Chapter 7 of this draft stewardship guide.

Dispersal to New Habitats

Before the butterfly's discovery on Denman, it was hoped that smaller coastal grassland habitats of approximately 0.5 ha, with suitable food and nectar plants, surrounding Helliwell Park on Hornby Island, would be able to support small secondary populations of Taylor's checkerspots in good years (*pers. comm*. C. Guppy). Similar to other metapopulations of butterflies, small dispersed populations could help to maintain the species' survival, although the potentially complicated source-sink dynamics of Taylor's checkerspots has not been characterized. Unfortunately, no populations of checkerspots have been found on Hornby Island since 2000 (Page 2007).

Recent studies of Taylor's checkerspots demonstrated that these butterflies were quite capable of flying over numerous potential habitat barriers including roads, shrubs, topographical changes and forests 20-30m high and that the males were observed to disperse more than 100m, often over bands of trees (Kaye *et. al.* 2011). Biologists on Denman have also observed the checkerspots flying over trees up to 30m tall on the edges of meadows and single checkerspots have been observed in many fields some distance from known breeding populations.

The recently described Taylor's checkerspot dispersal-movements are in contrast to those previously recorded for Edith's checkerspot butterflies, in California. The California Edith's were found to be very sedentary, or showed "a remarkable lack of wanderlust" even though there were no apparent barriers to dispersal (Ehrlich 1961). But, a percentage of tagged California butterflies were seen only once, and it was possible that a portion of the population was sedentary and a portion could have been dispersal-prone (Ehrlich 1961). Still Ehrlich (1980) warned that:

> "In Euphydryas absence of insects indicates population extinction and not the temporary removal of groups of individuals to some other site from which they might return when conditions are again favourable"

Overall it appears that checkerspots are more likely to stay in sites where there are other butterflies and leave when numbers are low (Singer *et. al.* 2004). Also, while checkerspots in California seemed more sedentary than their physical capacity for flight would suggest, variability between the sexes was observed. Males tended to stay among other butterflies, possibly to seek mates or to copy the habitat choice of other butterflies, while the females demonstrated a greater variety of dispersal strategies. But a major key to dispersal appeared to be that butterflies tended to disperse when they perceived that their current habitat quality was poor.

2.2.4 Summary of Lifecycle Stage and Habitat Requisites

The essential habitat requirements for Taylor's checkerspot vary throughout the lifecycle and are summarized in Table 2.1.

Table 2.1 Overview of Habitat Requisites by Lifecycle Stages for Taylor's Checkerspots.

Lifecycle Stage	Significant Habitat Requisites
Pre-Diapause Larvae and Post-Diapause Larvae in early summer and spring	Food Security habitat Travel routes / Mobility
Diapause-Larvae in late summer, fall and winter	Security habitat
Pupae in spring and Eggs in early summer	Security habitat
Adults in spring and early summer	Food Egg-laying habitat Security habitat Travel corridors

2.2.5 Sources of Mortality

Possible sources of mortality on the local sites include:

- larvae starve if unable to consume sufficient nutrients to reach 4th instar for diapause period, before host plants senesce.
- eggs consumed by vertebrate or invertebrate predators.
- larvae infected and killed by parasitic wasp.
- adults killed by vertebrate predators, particularly birds.
- adults caught in spider webs.
- indirect mortality of eggs or larvae by foraging vertebrate herbivores consuming vegetation.
- trampling of habitat and inadvertently causing mortality of eggs, larvae, pupae or emerging adults.
- adverse climatic conditions affecting adult flight period, diapause or pupation.
- butterfly-related disease conditions, possibly introduced through fomite-transfer or from migratory species.
- other direct trauma/disturbance of eggs, larvae, pupae or adults, including road-traffic mortality
- other vertebrate-caused mortality of eggs, larvae, pupae or adults.
- other invertebrate-caused mortality of eggs, larvae, pupae or adults.
- various external or general impacts such as pesticide use and severe weather events.

While most of these sources of mortality may account for a very small fraction of deaths in a population, certain habitats may be predisposed to various combinations and varying degrees of these impacts. As noted, dramatic *E. editha* population fluctuations and declining populations have been observed when prediapause larvae were unable to reach sufficient size for diapause before their food plants dried up (Murphy *et. al.* 1983). In addition, inclement weather during the adult flight periods for three years on Denman may have had a significant negative effect on checkerspot numbers on the island.

2.3 Details of Lifecycle, Habitat-use & Stewardship Issues

2.3.1 Diapause Larvae - fall, winter and spring

Degree of Concern: Larvae during diapause → vulnerable

Activities:

During the late summer, Taylor's checkerspot larvae go into diapause, or delayed development in preparation for predictable adverse environmental conditions. These unfavorable conditions begin when the appropriate larval food plants dry up and become unavailable during mid-late summer, and then continue through the cool, wet winter and early spring weather, until food-plants again become available. Eggs taken for captive rearing, from the meadow site on Denman in 2013, went into diapause as 5th stage larvae on July 10, 2013 and emerged for the first time on March 7, 2014 (Peter Karsten pers. comm.). Thus, the diapause period can last more than seven months. Also captive post-diapause larvae have been observed to molt to instar 6 before pupation (P. Karsten, *pers. comm*.).

During diapause larvae usually remain immobile, although if warming occurs, larvae may emerge from diapause to seek food (C. Guppy pers. comm). While in diapause, the larvae are vulnerable to predation, as well as general habitat disturbance. In addition, they are also sensitive to temperature, humidity and fungal infections (Johnson *et. al.* 1967).

Specific Habitat Requisites:

Security Habitat

The specific location and critical habitat characteristics of diapause sites are as yet unknown. But diapause sites are presumably within the open habitat, likely near future food plants. The appropriate conditions are likely to be sheltered, dry, somewhat temperature moderated and

relatively protected from predation and disturbance. Larvae must be able to respond to triggers that will terminate diapause. Sites may include sheltering under plant litter, coarse woody debris or other solid items on or near the ground surface. The diapause sites may be relatively close to egg-laying and early pre-diapause larvae foraging areas, but on Denman these sites are typically under water for all or prolonged periods in winter. Thus diapause sites on Denman may be on higher ground in adjacent habitats, protected from rising winter-water tables, flooded surface depressions and winter storm events. Thus south-facing aspects of small raised areas, may be important as possible diapause sites.

Stewardship Issues:

Although actual habitat characteristics for diapause larvae are unknown, stewardship for habitat to support diapause larvae would include:

- Providing diapause habitat near future food plants that is raised above usual flood levels, has a south-facing aspect, and has some material, such as leaf litter, coarse woody debris or other objects to provide protection and shelter for larvae.
- In general, stewardship for this portion of the life cycle assumes that a suitable overall habitat site is maintained with a long-term commitment to retain open habitat and other essential features, through appropriate management techniques.

Further Questions:

- Where are the actual diapause larvae sites and what are the habitat characteristics?
- Are sites selected due to particular habitat characteristics or randomly?
- Are the larvae alone during diapause? If in groups, what factors influence the composition of groups?
- When sites are known, what are the site-specific risks to this diapause habitat?

2.3.2 Post-diapause Larvae - spring

Degree of Concern: Post-diapause Larvae → somewhat vulnerable

Activities:

Post diapause larvae have been seen on Denman as early as February 28th and at least as late as May 8th. Foraging is a major activity for post diapause larvae as these emerging larvae require sufficient nutrition to continue their growth and eventually to pupate. They have been observed consuming their food plants down to the ground so that the plant is unrecognizable. The larval periods are the "main feeding and growth stage of butterflies" and post diapause larval feeding subsequently provides the nutrition for the first few days of egg production (Nature Conservancy 2008 P. 111). Warmth is necessary for successful digestion and growth, thus larvae spend some of their time immobile, basking in the sun, presumably to absorb heat to assist their metabolism. Occasionally post-diapause larvae may return to the diapause state until the following spring, as has been observed under captive rearing conditions (P. Karsten, *pers. comm*.).

Larvae also travel within the habitat seeking suitable food plants. On Denman, larvae were seen to travel at speeds of 0.2m/min over rough pebbles and 0.7m/min on coarse woody debris, and thus might cover considerable distances in search of appropriate plants. They also may travel in order to find protective shelter for the night and to locate suitable sites to pupate. Larvae are often observed completely immobile as they tend to freeze in place or curl up, often for several minutes when disturbed.

While sheltering at night the larvae are likely immobile and alone or in small groups. Small groups of post-diapause larvae have been observed foraging and basking together. Larvae may also shelter during inclement weather, although in daylight, larvae were observed feeding during moderate wet weather, apparently ignoring the impact of raindrops. In Victoria, larvae were described as avoiding old food plants and feeding solely on younger plants as a strategy to take advantage of the protective

shelter offered by the dried grasses that hid the larvae while they were consuming small young plants (Danby 1890).

Specific Habitat Requisites:

Food

On Denman, post diapause larvae have been observed consuming *Veronica scutellata* and *V. serpylifolia* as well as *Plantago lanceolata* and *P. major* (Table 2.2). A larva eating *Centaurium erythraea* was also observed, and this species was considered as a possible opportunistic choice (Page *et. al.* 2009). The relatively late spring growth of the plantains and the flooding of the depressions containing emergent *V. scutellata* through March and early April may delay and limit the foraging opportunities for post diapause larvae. But as spring advances, Denman habitats contain abundant larval food plants. Thus, while the availability of food resources is one of the determinants of habitat quality (Singer *et. al.* 1988), larval food plants are unlikely to be a limiting factor in the early spring on Denman, unless populations were very large. Miskelly (2004) concluded that the decline and loss of Taylor's checkerspots on adjacent Hornby Island could not be explained by declines in the abundance of larval host plants.

Previously in the USA, plantains were found to be key larval food plants of coastal Edith's Checkerspots (Johnson *et. al.* 1967). Taylor's checkerspot larvae, in Helliwell Park on Hornby Island, were observed feeding on *Plantago maritima* and late stage larvae from Helliwell were also successfully reared on an introduced plantain, *Plantago major* in the laboratory (Shepard 2000). Taylor's Checkerspot, at the Mill Bay site and in Oregon, were observed feeding on *Plantago lanceolata* (Shepard 1995, 2000). In addition in the US, Taylor's checkerspot larvae also are known to eat *Castilleja hispida, C. levisecta, C. attenuata (*formerly *Orthocarpus attenuata), Plectritis congesta, Collinsia parviflora, C. grandiflora, Orthocarpus pusillus* and *Plantago elongata* (Ross, 2009).

Table 2.2 Principal food-plants of Taylor's checkerspot post-diapause larvae on Denman Island.

Latin name	Common name
Veronica scutellata	Marsh speedwell
Veronica serpylifolia	Thyme-leaved speedwell
Plantago lanceolata	English plantain
Plantago major	Broad-leaved plantain

Travel Routes & Mobility

Open ground facilitates larval movement while densely grassed areas impede their travels. Paths and roads may provide travel corridors, especially in areas where introduced grasses have invaded meadowlands. Paths may also provide the weedy food plants that grow in disturbed areas. Taylor's checkerspot larvae were observed moving along heavily-used pedestrian trails at the cliff edge in Helliwell Park (T. Jenzen Hornby Island *pers. comm*.) and also moving and feeding along logging skid roads on Denman.

The need for larvae to travel may be reduced if abundant food plants are available. Larvae tend to move to find new or better food, cover or thermoregulatory environment (C. Guppy *pers. comm.*). They may also move to find suitable habitat for diapause and pupation sites. First and second stage larvae tend to be gregarious, moving and feeding together. Post diapause larvae may be solitary, although they have been seen in what seem like small groups.

Security Habitat

Security cover protects larvae against serious inclement weather, predators and disturbance. Preferred characteristics of larval shelter sites are unknown but presumably habitat complexity with suitable leafy debris, sparse shrubs and coarse woody debris could provide both suitable shelter and to some degree limit the potential disturbance.

While feeding and moving through the habitat, Taylor's checkerspot larvae are vulnerable to trampling by humans and other large animals, as well as exposed to direct predation or infection by parasitic species. Habitat complexity provided by sparse herbaceous or shrub vegetation, coarse wood debris and varied topography, where there is a relatively unobstructed travel surface, may provide structural protection, while still allowing for larval movement. In addition, open patches of habitat that are relatively small and situated away from any buildings may be more secure as they likely have smaller nesting populations of open-land insectivorous birds or bats.

Of note, a level of security is also gained by the checkerspot's consumption of plants in the Scrophulariaceae (figwort) and Plantaginaceae (plantain) families that contain iridoid and other glycosides. The bitter taste of these substances tends to limit the plant's consumption by many herbivores but appears to stimulate larval feeding and egg-layng in some *Euphydryas* butterflies (Ehrlich and Murphy 1987, Kuussaari *et. al.* 2004). Larvae accumulate these chemicals while foraging, making their bodies and those of the later adults unpalatable and even emetic to many predators.

Stewardship Issues:

Stewardship for habitat to support post-diapause larvae would include:

- Ensuring the availability of a healthy, abundant, appropriate food plant population during necessary time period. On Denman - marsh speedwell, other veronicas and plantains, particularly *P. lanceolata.*
- Limiting invasive species growth in larval host plant and travel areas and managing the sites' tree canopy for less than 10-20 % shading (Clarke *et. al.* 2011). Important invasive species in habitats on Denman are:
  - a) Wetland depressions - creeping buttercup, reed canarygrass.
  - b) Meadows – invasive grasses, goldenrod, Scotch broom, other invasive large shrub.
  - c) Tree canopy – various conifers, red alder and big-leaf maple.
- Providing sufficient habitat complexity for suitable cover protection and microclimate in close proximity to a sufficient food supply and without impeding travel between the food supply and shelter.
- Including open micro-sites with sun-exposure to provide basking areas.
- Minimizing physical disturbance particularly in shelter, feeding and travel areas, including controlling and limiting human access.
- Attempting to limit direct predation through providing habitats that do not support large populations of potential predators e.g. maintaining small sites, with no nearby man-made structures to support breeding populations of insectivorous predators, such as nesting birds.
- Reducing indirect predation by attempting to balance the overall positive and negative habitat-impacts of grazing deer populations, and by carefully monitoring any domestic-grazing management activities.
- Observing and if possible monitoring for potential disease agents including parasites, and also assessing the impacts of potential competing species.
- In general, stewardship for this portion of the life cycle assumes that a suitable overall habitat site is maintained with a long-term commitment to retain open habitat and other essential features, through appropriate management techniques.

Further Questions:

- Do larvae select particular habitat characteristics for pupation?
- Are larvae eating any additional plant species on Denman?
- As larvae also move over dead grass thatch at ground level and may use the vegetative debris as shelter habitat, at what percentage of the habitat does grass become limiting?

2.3.3 Pupae - spring

Degree of Concern: Pupae → vulnerable

Activities:

Taylor's checkerspot post-diapause larvae pupate in late April through May on Denman. Cryptically-coloured pupae have been found within a few centimetres of the ground surface, under and attached to leaves (woodland strawberry, *Fragaria vesca*), a small rock, or sheets of man-made materials. Observations occurred from May 5th to May 19th and on one occasion pupation lasted at least 10 days, from first observation to emergence. One butterfly appeared to emerge and function normally after pupation attached under old sail-cloth in a small garden. All observations of pupae occurred within the general area of checkerspot larval and adult activity. During pupation, the animal is immobile and thus vulnerable to disturbance, predation, disease or microclimate influences.

Specific Habitat Requisites:

Security Habitat

As in the diapause-period, security habitat for the pupal stage means suitable cover with a supportive microclimate to protect against inclement temperature and moisture, predators and disturbance. The observed-use of a variety of ground-level objects suggests that some flexibility in habitat selection is possible. Disturbance and exposure are likely the principle threats and a complex habitat with various ground-level features may provide suitable pupation sites.

Stewardship Issues:

Stewardship for habitat where checkerspots can safely pupate would include:

- Providing habitat complexity in non-flooding areas including the growth of leafy plants like strawberry that tend to have a build-up of protective leafy debris at the base, and also structural elements such as coarse-woody debris, rocks etc.
- Minimizing disturbance to the general area of occupied habitat that may support the pupating life stage at the appropriate time period, on Denman: late April through May.
- In general, stewardship for this portion of the life cycle also assumes that a suitable overall habitat site is maintained with a long-term commitment to retain open habitat and other essential features, through appropriate management techniques.

Further Questions:

- What is the most appropriate habitat for successful pupation?
- Can habitat for the pupae be enhanced, for example by providing the preferred habitat close to specific egg-laying or nectaring food plants?

2.3.4 Adults - spring/summer

Degree of Concern: Adult Butterflies → less vulnerable than other life-stages

Activities:

On Denman, Taylor's checkerspots usually emerge from pupation in early May, occasionally late April. Individual butterflies live, on average one to two weeks, although a few may live up to 4 weeks, depending on the temperature; the hotter and sunnier the weather, the shorter the life span (C. Guppy pers. comm.). Adults have been counted on repeated transects over six years on Denman from May 1st to June 21st. The observed length of the flight period on three transect sites has ranged from 21 to 40 days. The peak period of adult activity assessed from these counts was usually May 23 to May 28. But prolonged poor weather conditions at mid-season has occasionally lead to two peaks of first an early and then a late abundance of adults.

Males are thought to emerge one to two weeks ahead of females. Part of the butterflies' activity time, particularly of males, is spent in flight and they exhibit a robust flying ability. These butterflies actively chase other checkerspots and seem to assertively defend territories even against much larger

foes such as large dragonflies. In addition, they often spiral 2 m or more above the ground, either alone or with other butterflies. Also as noted, they have been observed soaring up and over approximately 20-30m high conifers.

Males exhibit both patrolling and perching behaviour in the pursuit of mates (Bennett *et. al.* 2011). Perching males were observed breeding females that had recently emerged from pupae that were near the males' perch sites (Bennett 2011). These males were thought to set up the perch sites as a female-pupa-guarding strategy. Mating occurs soon after females emerge from pupation. If butterflies are numerous, several males may attempt to mate with a female, but once bred, females may be guarded by the initial breeding male while the copulation plug, deposited with the sperm, solidifies (Bennett *et. al.* 2011). These butterflies have seemed relatively unaware of activity around them while mating occurs. Mating behaviour has been observed to last anywhere from 18 minutes to one and a half hours (Bennett *et. al.* 2011).

Egg-laying females have been observed apparently checking out habitats and even individual plants of the preferred larval host plant species. Females may lay over a hundred eggs on the underside of the leaf (leaves) of one or more plants and may take nearly a hour.

Nectaring provides a nutritional source for maintaining butterfly activity levels and for furthering the development of eggs and sperm. *E. editha* adults are capable of producing substantial numbers of eggs without feeding on nectar, but additional eggs are produced later in life based on the availability of nectar sources (Murphy *et. al.* 1983). These later eggs may result in a significant boost to the size of the population, if the late pre-diapause larval can still find food plants and forage to mature sufficiently to enter the diapause period (Miskelly 2004).

Basking and sheltering are also adult butterfly activities. Adults bask with their wings rotated towards the sun, using any available support, such as flowers, branches or plant stems. During inclement weather and at night, butterflies seek shelter in the available habitat area. They have been observed clinging to plant stems within the foliage, but are usually not seen.

Dispersing adult Taylor's checkerspots have been shown to move between habitats divided by bands of trees that were greater than 100m wide (Kaye *et. al.* 2011). These butterflies seemed to move more if the other habitat patches were close, but they also appeared to move to better quality habitats in terms of food resources. As noted, they are robust fliers and seem to have no difficulty flying over tall trees. Despite this, in general checkerspots seem to prefer the company of other butterflies and males tend to stay with other butterflies (Singer *et. al.* 2004). But, some males were also shown to disappear from small patches after they bred with a female (Bennett *et. al.* 2011).

Specific Habitat Requisites

Food

In the clear-cuts and in the meadow habitat on Denman, Taylor's checkrspot butterflies were observed nectaring on ten species of flowering plants as shown in Table 2.3 and in addition they were seen nectaring on many cultivated species in gardens. Probably any nectar-producing flower that is present in the nearby habitat during the adult flight season will be used, both native and introduced species (C. Guppy pers. comm.). Nectar plant location within the habitat may be of some importance to the butterflies, as the related *E. chalcedona* females preferentially laid eggs on host plants situated near nectar sources (Murphy *et. al.* 1984). Overall, nectar plants do not appear to be limiting in Denman habitats. Miskelly (2004) also concluded that the decline and loss of Taylor's checkerspots on adjacent Hornby Island could not be explained by declines in the abundance of nectar sources.

Table 2.3 Nectar plants used by Taylor's checkerspot on Denman Island.

Common Name	*Scientific Name*
American winter cress	*Barbarea orthoceras*
Black raspberry	*Rubus leucodermis*
Buttercup species	*Ranunculus sp.*
Common/European centaury	*Centaurium erythraea*
Dandelion	*Taraxacum officinale*
Evergreen huckleberry	*Vaccinium ovatum*
Hairy cat's ear	*Hypochaeris radicata*
Oxeye Daisy	*Leucanthemum vulgare*
Scouler's popcorn flower	*Plagiobothrys scouleri*
Trailing blackberry	*Rubus ursinus*
White clover	*Trifolium repens*
Other clover sp.	*Trifolium pratense*, *T. hybridum & T. sp..*
Woodland strawberry	*Rubus vesca*

Butterflies were also seen sitting on Black medic *Medicago lupulina* and Scotch broom *Cytisus scoparius.*

Security & Egg-laying Habitat

Adults sheltering at night or in poor weather conditions may select specific protective habitat or may simply occupy any available vegetation. Presumably some elements of habitat complexity may provide both a suitable sheltering-microclimate and a degree of protection against predators or disturbance. On Denman, a large breeding colony of Townsend's big-eared bats *Plecotus townsendii*, that are capable of gleaning insects off vegetation, may limit the checkerspot population in their vicinity. If the bats hadn't learned about or did not mind the butterflies' bad taste, they could consume sheltering butterflies at night.

Female checkerspots on Denman lay eggs primarily on marsh speedwell *V. scutellata*, although they have used *V. serpylifolia.* Page *et. al.*. (2008) also reported eggs on English plantain *Plantago lanceolata.* Specific individual larval host plants seem to be selected by a female for egg-laying and a certain amount of freedom from disturbance is required for the female to perform these tasks. Birds may be an important predator as butterflies were seen on Denman with portions of their wings missing and egg-laying could be a vulnerable period. But both adults and eggs may be consumed by other arthropods or a variety of vertebrates (Stinson 2005). Some egg-laying checkerspots on Denman appeared to select somewhat protected habitat, with either vegetation or coarse woody debris for cover; while others laid eggs on plants that were completely exposed and out in the open. While a certain level of activity in the surrounding area may be tolerated, habitats free from general repeated disturbance, when eggs are being laid, may be more successful and result in more eggs being laid.

Travel Corridors

While Taylor's checkerspot butterflies have been observed crossing various obstacles, males demonstrated an increased frequency of movement between patches located closer together (Kaye *et. al.* 2011). Butterflies generally use open sunny routes for travel and thus movement between sites also may be enhanced if the sites are linked by travel corridors. Additionally butterflies readily use nectar sources along travel routes. Thus the availability of safe, sunny, open travel corridors that have nectar plants and that join patches of quality habitat may enhance the chance of dispersal and increase the species' population throughout the productive habitat.

Stewardship Issues:

Stewardship for habitat to support adult Taylor's checkerspot butterflies would include:

- Providing adequate and varied nectar sources and sufficient larval host plants for egg-laying.
- Providing a complex habitat including:
  a) sheltering opportunities for individual adults,
  b) structural protection over some host plants for shelter while egg-laying, and

c) slightly elevated vantage points for perching and basking, such as branches, shrubs or slightly taller vegetation.

- Limiting invasive species growth in nectar and larval host plant areas and managing the sites' tree canopy for less than 10-20 % shading (Clarke *et. al.* 2011).
- Limiting physical disturbance in the site particularly when females are laying eggs.
- Attempting to limit direct predation through providing habitats that do not support large populations of potential predators e.g. small sites, no man-made structures supporting insectivorous predators such as nesting birds.
- Establishing at least semi-open butterfly travel corridors, preferably containing nectar sources, that link to other reasonably close good quality checkerspot habitats.
- In general, stewardship for this portion of the life cycle assumes that a suitable overall habitat site is maintained with a long-term commitment to retain open habitat and other essential features, through appropriate management techniques.

2.3.5 Eggs - spring/summer

Degree of Concern: Eggs → vulnerable

Activities:

Taylor's checkerspot eggs remain attached on the undersides of host plants selected by the females. The eggs change colour from bright yellow to purplish-brown in approximately three days. Tiny beige caterpillars gradually develop inside. The development period from laying to hatching on Denman has been observed to take as much as 26 days for eggs laid in May, to less than 12 days for eggs laid in mid-June. Eggs taken into captivity on Denman, changed from yellow to purplish brown after seven days and hatched on day 19 (Karsten 2014). During this stationary period the eggs are vulnerable to direct and indirect/accidental damage or predation. One cluster of newly laid yellow eggs on Denman completely disappeared within a day and the observer wondered how much the observational disturbance contributed to the eggs' disappearance.

Specific Habitat Requisites:

Security Habitat

On Denman eggs are usually laid on the undersides of relatively small leaves of marsh speedwell *Veronica scutellata* and occasionally other *Veronicas* or *Plantago lanceolata*. The eggs are virtually invisible from above but exposed from the sides or below. The only additional security cover that could exist might be from the surrounding vegetation or other structural elements, such as pieces of coarse woody debris. Some of the marsh speedwell plants selected for eggs were in depressions, closely surrounded by tall sedge-habitat, but egg-laying was also observed occurring completely in the open, such as on a well-used pathway.

Stewardship Issues:

Stewardship for habitat to support the development of Taylor's checkerspot eggs would include:

- Ensuring abundant larval host-plants are available for the eggs. On Denman the main plant species would be *V. scutellata*, but other veronicas and plantains could be provided in addition.
- Limiting direct physical disturbance in areas where eggs may be present.
- In general, stewardship for this portion of the life cycle assumes that a suitable overall habitat site is maintained with a long-term commitment to retain open habitat and other essential features, through appropriate management techniques.

Further Questions:

- Are there other major deleterious impacts during the egg-development phase?

2.3.6 Pre-diapause Larvae - summer

Degree of Concern: Pre-diapause Larvae → somewhat vulnerable

Activities:

Eggs hatch in June and July on Denman and the tiny beige caterpillars emerge. They begin producing a web or net that encloses the caterpillars and their host plant(s), which is primarily marsh speedwell *Veronica scutellata* on Denman. These nets can be up to 30cm in diameter, and the leaves of other plants and small objects may be included. The caterpillars move within the net, consuming the initial host plant and depositing frass or waste material. When the initial plant has been skeletonized, the larvae move on to eat suitable adjacent plants as necessary and at least initially secondary nets may be spun. If necessary, the larvae move further away from the egg site to find new plants. As they eat, the larvae continue to grow and molt to instar 4 or 5. Then the larvae enter diapause.

Specific Habitat Requisites:

Food

Nutrition during this stage is vital to support growth to the 4th or 5th instar stage. Page *et. al.* (2009) concluded that *Veronica scutellata* was the most frequently used food plant by pre-diapause larvae on Denman, although they also have been observed feeding on *V. serpylifolia, V. becca bunga, Plantago. major* and *P. lanceolata.* Captive-reared larvae on Denman preferred marsh speedwell (Karsten 2014). In other locations, during drought years, when plantain species dried up, coastal *E. editha* larvae were shown to survive by moving to a secondary foodplant, an owl-clover, *Orthocarpus sp*. (Ehrlich *et. al.* 1980). In the BC population, between Mill Bay and Shawnigan Lake (now extirpated) only *Plantago lanceolata* was available for use as a larval food plant, and was used in both the summer and spring (C. Guppy, pers. comm.). On Denman, in significant wetland areas, the primary food sources may remain available even in fairly dry years, but specific sites need to be evaluated. Other possible nutritional sources have not been confirmed.

As noted in the sources of mortality, provision of adequate pre-diapause larval food plants throughout this feeding period may be one of the keys to preventing a population bottle-neck and dramatic subsequent declines. As mentioned, dramatic fluctuations of *E editha* populations followed when larval food plants senesced or dried up during drought years, (Murphy *et. al.* 1983).

Security Habitat

Early in life, these pre-diapause larvae create their own shelter habitat by producing substantial nets or webs around themselves and their immediate environment. These netted-larval-plant sites are still vulnerable to general disturbance and may benefit from protective habitat structure. As the larvae molt, they move off to feed on additional plants. Within 30 days of hatching the now black and spotted larvae with setae (bristles) were observed on plant stems over a metre into the surrounding vegetation, while empty nets and shed skins remained at the egg site. At this stage, they may seek protective shelter in vegetative debris at night. But when feeding or travelling the larvae are vulnerable to disturbance and are apparently only protected from predation due to their incorporated iridoid and other glycosides giving their bodies a bitter taste.

Stewardship Issues:

Stewardship for habitat to support pre-diapause larval Taylor's checkerspots would include:

- Ensuring adequate food plant populations in compact areas that can provide pre-diapause larval nutrition throughout the feeding period, on Denman: marsh speedwell, other veronicas and plantains during June and July.
- Preventing general disturbance of pre-diapause larval feeding sites.

- Attempting to limit direct predation through providing habitats that do not support large populations of potential predators e.g. maintaining small sites, with no nearby man-made structures to support breeding populations of insectivorous predators, such as nesting birds.
- Reducing indirect predation by attempting to balance the overall positive and negative habitat-impacts of grazing deer populations, and by carefully monitoring any domestic-grazing management activities.
- Observing and if possible monitoring for potential disease agents including parasites, and assessing the impacts of potential competing species.
- In general, stewardship for this portion of the life cycle assumes that a suitable overall habitat site is maintained with a long-term commitment to retain open habitat and other essential features, through appropriate management techniques.

Further Questions:

- Are there any survival differences between pre-diapause larvae consuming marsh speedwell and those using other veronicas or plantains?
- Can pre-diapause larvae that start consuming marsh speedwell switch to other species if necessary?
- Are there necessary nutritional elements that enable or promote better net production by larvae?
- How far will larvae successfully move in search of food sources?
- Do larvae seek a certain type of protective shelter or simply stop where they are?
- Are any specific habitat factors important deterrents of disease or predation?
- Are certain factors required in a suitable diapause site to attract or satisfy larva?

2.3.7 Habitat Characteristics and Stewardship Summary

Table 2.4 summarizes the habitat needs and the related stewardship objectives for checkerspot habitat enhancement.

2.4 Wildlife Species In Checkerspot habitats on Denman Island

Less than five percent of BC's original Garry oak meadow ecosystems remain in near natural conditions (Lea 2006) and among the extensive diversity of species in these southwest BC meadow ecosystems, there are already over 100 species at risk (Miskelly 2004). Therefore, conserving remaining populations of these species is an important conservation goal. Yet maintaining open habitats on conserved-lands in the predominantly forested landscape on the southwest BC coast, usually involves reducing forest habitat or limiting natural forest regeneration. These actions reduce the habitat available for forest-dwelling species of this region, whose provincial or national populations also may be at risk. Thus, responsible stewardship necessitates carefully evaluating the overall regional significance of stewardship actions and trying to ensure the survival of groups of significant species wherever possible. In addition, groups of species may benefit from stewardship planning and efforts to coordinate the competing interests of humans and other species within existing open-lands.

Managing open-land habitat for Taylor's checkerspots also includes attempting to provide supportive habitat for other open-land species at risk. On Denman, specific open-land animal species at risk that may share checkerspot habitat are included in Table 2.5. In addition, plant species at risk are found in Taylor's checkerspot habitats, but these have not been assessed on Denman.

Table 2.4 Denman Habitat Needs and Stewardship Objectives for Taylor's Checkerspots

Habitat Requisite	Life-cycle Stage	Time	Habitat Needs	Stewardship Objectives
Food	Pre-diapause larvae	(May) June-July	Abundant accessible healthy food (host) plants *V. scutellata* (other veronicas and plantains) in close proximity during necessary feeding time period. Ease of larval movement between.	* Abundant food plants throughout the season (*V. scutellata* & other veronicas and plantains) * Open-canopy sites with adjacent low-height buffers. * Moist depressions: wet winter spring soils. * Relatively open ground surface or routes for travel.
	Post diapause larvae	(Feb) May-June		
	Adults	(April) May-June	Abundant nectar plants (most easy-access-flower, spring flowering species)	* Abundant spring flowering species e.g. woodland strawberry, popcorn flower, trailing blackberry, hairy-cat's ear. * Open habitats as above.
Security habitat	Diapause larvae	July-March (~7 months)	**Unknown location**. ~*Near food plants/other larval activities. No physical disturbance, disease, flooding, predation. Supportive microclimate.*	* Complex landscape topography with elevated sites near wet depressions supporting food plants. * Vegetative (or other) structure for sheltering. * Free of known disturbance e.g. trampling, flooding, predation,disease.
	Pre-diapause larvae	June-July	Initially in own net/web on food plant. No physical disturbance, disease or predation.	* Food plants - *V. scutellata* ~ other veronicas and plantains * Free of known disturbance.
	Post diapause larvae	(Feb) May-June	*Unknown* ~ Simply shelter where eating. No physical disturbance, disease, flooding, predation. Supportive microclimate?	* Vegetative (other?) structure for sheltering near food plants. * Free of known disturbance.
	Pupae	April-May	Under available shelter objects in area of larval activity. No physical disturbance, disease, flooding, predation. Supportive microclimate.	* Vegetative, rock, other materials as structure for shelter. * Free of known disturbance
	Adults	(April) May-June	*Unknown* ~ Simply shelter in territory / larval food-plant habitat. No disturbance or predation.	* Vegetative (other?) structure for sheltering. * Free of known disturbance, discourage habitat elements supporting known predators.
	Eggs	May-June	Food-plants *V. scutellata* (other veronicas and plantains). No disturbance, predation, or disease.	* Abundant food plants for egg-laying (*V. scutellata* & other veronicas and plantains) * Surrounding vegetative complexity. * Free of known disturbance.
Travel	Pre- & Post-diapause larvae	(Feb) March- July	Easy access to food-plants and shelter.	* Relatively open ground surface or other travel corridors *e.g.* coarse woody debris.
	Adults - dispersal	(April) May-June	Nearby open canopy areas or linking open sunny corridors, preferably with nectar sources.	* Sunny open travel corridors linking available habitat patches.
Other: Perching & Basking	Adults	(April) May-June	Objects slightly raised above average vegetation height in sunny areas and near pupa habitat.	* Slightly raised perch/bask habitat for butterflies, e.g. twigs, branches, taller flower heads or other vegetation. Also bask - open bare (dark) surface.
	Pre- & Post-diapause larvae	(Feb) March- July	Open sunny habitat.	Open bare (dark) surface, ~south/west aspect.

Table 2.5 Animal Species at Risk Using Open-land Habitats on Denman Island.

Species		SARA listing	Provincial Status
Autumn Meadowhawk	*Sympetrum vicinum*		Blue list[7]
Barn Owl	*Tyto alba*	Special concern[8]	Blue list
Blue dasher dragonfly	*Pachydiplax longipennis*		Blue list
Common Nighthawk	*Chordeiles minor*	Threatened[9]	
Common Wood Nymph	*Cercyonis pegala incana*		Red list
Dun Skipper butterfly	*Euphyes vestris*	Threatened	Red list
Red-legged Frog	*Rana aurora*	Special concern	Blue list
Taylor's Checkerspot	*Euphydryas editha taylori*	Endangered	Red list
Townsend's Big-eared Bat	*Corynorhinus townsendii*		Blue list
Western Pine Elfin	*Callophrys eryphon sheltonensis*		Blue list
Western Pondhawk dragonfly	*Erythemis collocata*		Blue list

Butterfly Species Sharing Taylor's Checkerspot Habitat

Butterflies that have been observed in habitat occupied by Taylor's checkerspots on Denman include:

- Anise Swallowtail *Papilio zelicaon*
- Arctic skipper *Carterocephalus palaemon*
- Cabbage White *Pieris rapae*
- Cedar Hairstreak *Mitoura rosneri*
- Common Wood Nymph *Cercyonis pegala*
- Dun Skipper *Euphyes vestries*
- European skipper *Thymelicus lineola*
- Grey Hairstreak *Strymon melinus*
- Hydaspe Fritillary *Speyeria hydaspe*
- Milbert's Tortoiseshell *Aglais milberti*
- Mourning Cloak *Nymphalis antiopa*
- Mylitta Crescent *Phyciodes mylitta*
- Painted Lady *Vanessa carui*
- Pale Tiger Swallowtail *Papilio eurymedon*
- Purplish Copper *Lycaena helloides*
- Roadside Skipper *Amblyscrites vialis*
- Satyr Anglewing *Polygonia satyrus*
- Two Banded Checkered Skipper *Pyrgus ruralis*
- Western Elfin *Incisalia iroides*
- Western Pine Elfin *Incisalia eryphon*
- Western Spring Azure *Celastrina echo*
- Western Tailed Blue *Everes amyntula*
- Western Tiger Swallowtail *Papilio rutulus*
- Woodland Skipper *Ochlodes sylvanoides*

[7] **BC Blue List:** List of ecological communities, and indigenous species and subspecies of special concern (formerly vulnerable) in British Columbia

[8] **Special concern species:** a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

[9] **Threatened species:** a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction

2.6 Historic Taylor's Checkerspot Data

2.6.1 Taylor's Checkerspot Historic Collection Data (Shepard 2000).

Location	Year	Month	Day	Collector	Collection	M	F
Victoria	1887	5	22	J. M*acoun*	CNC	0	2
Beacon Hill Park	1901	5	24	E.M. Anderson	CNC	0	1
Victoria	1902	5	9	And*erson*	CAS	1	1
Victoria	1903	5	3		RBCM	0	2
Victoria	1903	5		E.M. Anderson	CNC	1	1
Victoria	1908	4	20	Gunder Coll.	AMNH	1	0
Victoria	1909	5	6	And*erson*	CAS	1	1
Victoria	1909	5	16	A.J. Croker	CAS	1	0
Victoria	1909	5	23	A.J. Croker	CAS	1	1
Victoria	1909	6	2	G.W. Taylor	JHS	1	0
Victoria	1910	4	30	A.J. Croker	AMNH	1	0
Victoria	1910	4	30		AMNH	0	1
Victoria	1910	5	6	A.J. Croker	AMNH	1	0
Victoria	1910	5	28	A.J. Croker	AMNH	1	0
Victoria	1912	5	4	E.H. Blackmore	RBCM	2	0
Victoria	1916	5	9	W. Downes	CNC	0	1
Victoria	1917	5	17		CNC	1	0
Victoria	1917	5	18		CNC	1	0
Victoria	1919	4	21		CNC	0	1
Victoria	1919	5	6	W. Downes	CNC	1	0
Victoria	1921	5	1	W.R. C*arter*	RBCM	1	0
Victoria	1922	4	18	E.H. Blackmore	AMNH	0	1
Victoria	1922	5	12	W. Downes	CNC	1	0
Victoria	1924	5	3	W. Downes	CNC	5	0
Victoria	1924	5	26	W. Downes	CNC	0	1
Victoria	1926	4	27	W. Downes	CNC	0	1
Victoria	1927	5	20	W. Downes	CNC	1	0
Victoria	1927	6	22	W. Downes	CNC	0	1
Tod Inlet	1928	5	6	W.H.A. Preece	CNC	0	1
Tod Inlet	1928	5	13	W.H.A. Preece	CNC	0	2
Victoria	1929	5	7	Gunder Coll.	AMNH	9	6
Victoria	1929	5	7	Preece	AMNH	0	1
Victoria	1929	5	7	Strenitzky Coll.	AMNH	1	0
Victoria	1929	5	10	Preece	AMNH	0	1
Victoria	1929	5	11	Preece	AMNH	1	4
Victoria	1929	5	13	Preece	AMNH	0	1
Courtenay	1931	5	2	dos Passos Coll.	AMNH	9	1
Courtenay	1931	5	9	dos Passos Coll.	AMNH	4	2
Shawnigan Dist.	1931	5	9	J.R.L. Jones	RBCM	1	0
Cattle Point	1932	5	7	J. Burbridge	RBCM	1	0
Victoria Dist.	1933	5	15	J.R.L. Jones	RBCM	1	0
Chain Is.	1949	5	10	G.I. Guiget	RBCM	0	1
Oak Bay	1951	4	24	R. Guppy	AMNH	2	0
Oak Bay	1951	4	24	Gibbon Coll.	CNC	4	2
Lost Lake	1951	5	9	G.A. Hardy	RBCM	1	0
Shawnigan Dist.	1952	4	13	J.R.L. Jones	RBCM	1	0
Lost Lake	1952	4	24	G.A. Hardy	RBCM	1	0
Victoria	1952	5	1	ex. N.W. Gillman	YPMN	1	0

Taylor's Checkerspot Historic Collection Data (Shepard 2000) continued.

Location	Year	Month	Day	Collector	Collection	M	F
Trial Is.	1952	5	2	G.A. Hardy	RBCM	1	0
Victoria	1952	5	2	ex. N.W. Gillman	YPMN	1	0
Victoria	1952	5	3	ex. N.W. Gillman	YPMN	2	0
Victoria	1952	5	5	ex. N.W. Gillman	YPMN	4	0
Victoria	1952	5	6	ex. N.W. Gillman	YPMN	1	0
Braefoot	1952	5	7	G.A. Hardy	RBCM	1	0
Victoria	1952	5	7	ex. N.W. Gillman	YPMN	7	0
Victoria	1952	5	8	ex. N.W. Gillman	YPMN	1	0
Victoria	1952	5	10	ex. N.W. Gillman	YPMN	1	0
Braefoot	1952	5	11	G.A. Hardy	RBCM	0	1
Lost Lake	1952	5	12	G.A. Hardy	RBCM	1	0
Braefoot	1952	5	15	G.A. Hardy	RBCM	1	0
Cahin Is.	1953	5	1	G.A. Hardy	RBCM	1	0
Lost Lake	1953	5	9	G.A. Hardy	RBCM	1	0
Trial Is.	1953	5	25	G.A. Hardy	RBCM	1	0
Hudson Bay Woods (Oak Bay)	1954	5	3	G.A. Hardy	RBCM	1	0
Brentwood	1954	5	12	G.A. Hardy	RBCM	1	0
Mt. Douglas	1954	5	24	G.A. Hardy	RBCM	1	0
Observatory Hill	1957	5	4	G.A. Hardy	RBCM	1	0
Observatory Hill	1957	5	5	G.A. Hardy	RBCM	1	0
Mt. Finlayson	1957	5	7	G.A. Hardy	RBCM	1	0
Royal Oak	1957	5	18	G.A. Hardy	RBCM	1	0
Mt. Finlayson	1958	5	5	G.A. Hardy	RBCM	0	1
Victoria	1959	5	9	R. Guppy	AMNH	1	1
Duncan, Bright Angel Park	1975			R. Guppy	RG	many	0
Helliwell P.P.	1977	4	25	J.&S. Shepard	JHS	2	11
Duncan, Bright Angel Park	1977	5	1	R. Guppy	NK	3	0
Duncan, Bright Angel Park	1977	5	11	R. Guppy	NK	3	0
Duncan, Bright Angel Park	1978	5	16	R. Guppy	NK	1	0
Duncan, Bright Angel Park	1978	5	18	R. Guppy	NK	2	0
Mill Bay	1988	5	7	C.S. Guppy	RBCM	31	3
Mill Bay, 3 km SW	1988	5	7	C.S. Guppy	CSG	11	1
Mill Bay, 3 km SW	1988	5	7	C.S. Guppy	JHS	4	1
Mill Bay, 3 km SW	1988	5	20	C.S. Guppy	CSG	11	19
Mill Bay, 3 km SW	1988	5	20	C.S. Guppy	JHS	10	2
Mill Bay	1989	4	15	C.S. Guppy	RBCM	1	0
Helliwell P.P.	1995	4	27	J.&S. Shepard	RBCM	10	1
Helliwell P.P.	1995	4	27	J.&S. Shepard	JHS	6	0
Norman Pt nr.	1995	4	28	J.H. Shepard	JHS	3	0
Norman Pt nr.	1995	4	28	J.H. Shepard	RBCM	1	0
Victoria		4	23	Hulst. Coll.	AMNH	1	0
Oak Bay				R. Guppy	Lep. Soc.	common	0
Victoria		4	24	Buchholtz Coll.	AMNH	1	0
Victoria		5	1	Buchholtz Coll.	AMNH	1	3
Beacon Hill Park		5	5	Wood Coll.	AMNH	1	1
Victoria		5	9	Hulst. Coll.	AMNH	1	0
Duncan				A.W. Hanham	CNC	1	0
Vancouver Is				H. Edward	AMNH	0	1

2.6.2 Taylor's Checkerspot Historic Summary Data (Stinson 2005 – *from Shepard*).

Historical populations of Taylor's checkerspot in British Columbia now believed to be extinct

Beacon Hill Park	1901	Last observed
Braefoot	1952	Last observed
Brentwood	1954	Last observed
Cattle Point	1932	Last observed
Central Saanich	1964	Last observed
Chain Island	1953	Last observed
Hudson Bay Woods	1954	Last observed
Lost Lake	1953	Last observed
Mt Douglas	1954	Last observed
Mt Findlayson	1958	Last observed
Oak Bay	1951	Last observed
Observatory Hill	1957	Last observed
Royal Oak	1957	Last observed
Thetis Lake	1950's	Last observed
Tod Inlet	1928	Last observed
Trial Island	1953	Last observed
Courtney	1931	Last observed
Duncan	1978	Last observed
Mill Bay	1989	Last observed
Shawnigan	1952	Last observed
Helliwell Park, Hornby Is.	1996	Last observed*
Norman Point, Hornby Is.	1996	Last observed
Tribune Bay Park, Hornby Is.	1996	Last observed

* Note:Larvae observed to late 1990's by T. Janzen, Hornby Is.

Chapter 3 Taylor's Checkerspot Populations - Denman Island

The following is a brief summary of the DCA's information on the status of the Taylor's checkerspot population on Denman, derived from distribution surveys, monitoring transect counts and general observations from 2005 to 2013. From the initial discovery of at least 20 Taylor's checkerspot butterflies in a Denman clear-cut forest on May 23, 2005, to the first of the 2014-season's Taylor's checkerspot sightings in Washington and Oregon, the DCA has maintained a consistent interest in observing and tracking checkerspot populations.

Early on, little was known about the necessary habitat features of Taylor's checkerspot on Denman, and stewarding the butterfly's existing habitats seemed an important key to assisting the survival of this species. The butterfly may have been on Denman for some time, as a photograph from Denman in the mid 1990's confirmed the species' earlier presence, and some landowners are convinced that the butterfly has been on Denman for decades. But the butterfly's apparent loss from its last known location in Canada, on Hornby Island in the late 1990's, enhanced the significance of understanding and retaining checkerspot habitats on Denman. The expansion of Denman's checkerspot population in 2008-9 occurred at the same time as the DCA's first year of 'meadow stewardship', with the endangered Taylor's checkerspot butterfly as the flagship-species (Balke 2009). Monitoring the population was part of the DCA's stewardship program.

3.1 Population status

3.1.1 Population surveys

Distribution

Subsequent to the discovery of about 20 Taylor's checkerspot adults on Denman in May of 2005, the original site and the surrounding area were explored and further butterflies were found approximately 0.5km from the original sighting. This original site was in the process of being transferred to the Denman Conservancy Association. The following year, on April 11, 2006, post-diapause larvae were confirmed at the original site, 14 butterflies were seen on May 7th and later mating was observed.

In 2007, under the direction of Jennifer Heron for the Ministry of the Environment, comprehensive distribution surveys were undertaken for Taylor's checkerspot on Denman and Hornby Islands (Page 2007). DCA biologists participated in these surveys, under contract to biologist Nick Page, who conducted the survey program. The method involved contacting landowners of suitable open land properties for permission to access their land, then walking through potential habitat, recording the species, location and behaviour of any butterfly observed. In addition, an island-wide poster campaign produced calls from landowners who contributed sighting information for biologists to confirm. From the 2007 surveys, Page (2007) observed that the spring butterfly diversity included 19 species of which Taylor's checkerspots were the most common. Taylor's checkerspots were numerous and widespread over much of north and central Denman, but were not seen on Hornby. Most of the butterflies were seen on private land. The preferred habitat tended to be wet or moist openings, often in recently logged areas. Some of the suggestions for future work included research to confirm host plant use, population monitoring, habitat management and possible reintroduction to other sites.

Also in 2007, Taylor's checkerspot surveys were contracted by the Garry Oak Ecosystem Recovery Team GOERT (Balke and Miskelly 2007). These surveys took place during complementary work by a variety of other biologists. Adult checkerspots were found on four of seven Denman properties, in addition to the DCA's original site. Two of these sites were used for long-term transects to monitor population abundance that were started during 2007.

In 2008, further Ministry of Environment studies were undertaken to examine distribution and habitat-use by Taylor's checkerspots (Page *et. al*. 2009). Post-diapause larval surveys on north Denman and studies of food plant selection and behaviour were conducted. Denman and the Courtenay-Comox area were surveyed for adults and other than the Denman sightings, one butterfly was seen on the BC Hydro/Terasen Gas utility right-of-way on Vancouver Island almost 5 km west of populations on Denman.

The DCA's formal meadow stewardship work began in 2008 and once more the DCA's Taylor's checkerspot poster was used to involve landowners in notifying the DCA if they saw checkerspots on their land. In 2008, sixteen sites with checkerspots were identified, besides the large recently clear-cut development parcel at the north end of Denman. Ten landowners were signed up as rare meadow species-stewards in 2008, including two sites with non-checkerspot rare meadow species. The stewardship project continued in 2009 with further Taylor's checkerspot distribution surveys. Earlier properties were re-checked, and new properties were examined either when landowners requested the DCA to check on butterflies they had seen, or as a result of interest in properties by the DCA biologists. The owners of five additional properties were signed on as rare meadow species stewards. Through to 2013, the program continued on a volunteer basis. Sites where checkerspots had been seen were re-checked each year and any new information about sightings was investigated.

In late 2012, P. Karsten conceived the idea for a Denman Community Checkerspot Group and this idea developed into the Taylor's Checkerspot Community Working Group (TCCWG), chaired by P. Karsten and J. Heron. In the spring of 2013, both larval and adult surveys for checkerspots were encouraged and many islanders participated in checking sites on public lands. Sightings totalled 28 larvae and 16 adults (Bland 2013). Also in 2012, a Taylor's checkerspot reserve was designated in the former clear-cut lands of north Denman. A large portion of these lands on north Denman, 552 ha, including the 10ha checkerspot reserve, has now become Denman Island Provincial Park.

Overall locations of checkerspot sightings on Denman are shown in Figure 3.1. The points include sightings of both adults and larvae from 2005 to 2013. These sightings are the result of all the projects discussed and the data were collected by numerous individuals including the Ministry of Environment, private biologist contractors, the Denman public and the DCA stewardship program.

Larval Surveys – Known Breeding Populations

Over the years larval surveys have been undertaken to establish the locations of known breeding populations, to investigate larval behaviour, including food and habitat preferences, and to confirm that post diapause larvae are present and hopefully will usher in another flight season for this endangered butterfly on Denman. The distribution of larvae in breeding sites in the northern clear-cut lands on Denman was investigated in 2007 and 2008 (Page 2007, Page *et. al*. 2009) and these surveys are continuing by the TCCWG, especially in the Taylor's checkerspot reserve and within the new north Denman Island Provincial Park. The DCA has not conducted detailed larval surveys in the meadow site or on other private lands, since the general checkerspot population decline in 2010 on Denman.

Abundance

In the summer of 2007, Guppy (2007) completed an adult butterfly survey of the 65 ha site where the Taylor's checkerspot butterflies were first identified on Denman. Eighty-eight adult butterflies were observed over four days during the flight season, using modified 'Pollard Walk' transects throughout the habitat and counting butterflies within 3m either side of a central route. An estimate of the overall population was about 350 adults, with the assumptions that the observed number of butterflies represented one half of the adults in flight at that time and that one half of the adults were available during that portion of the flight season.

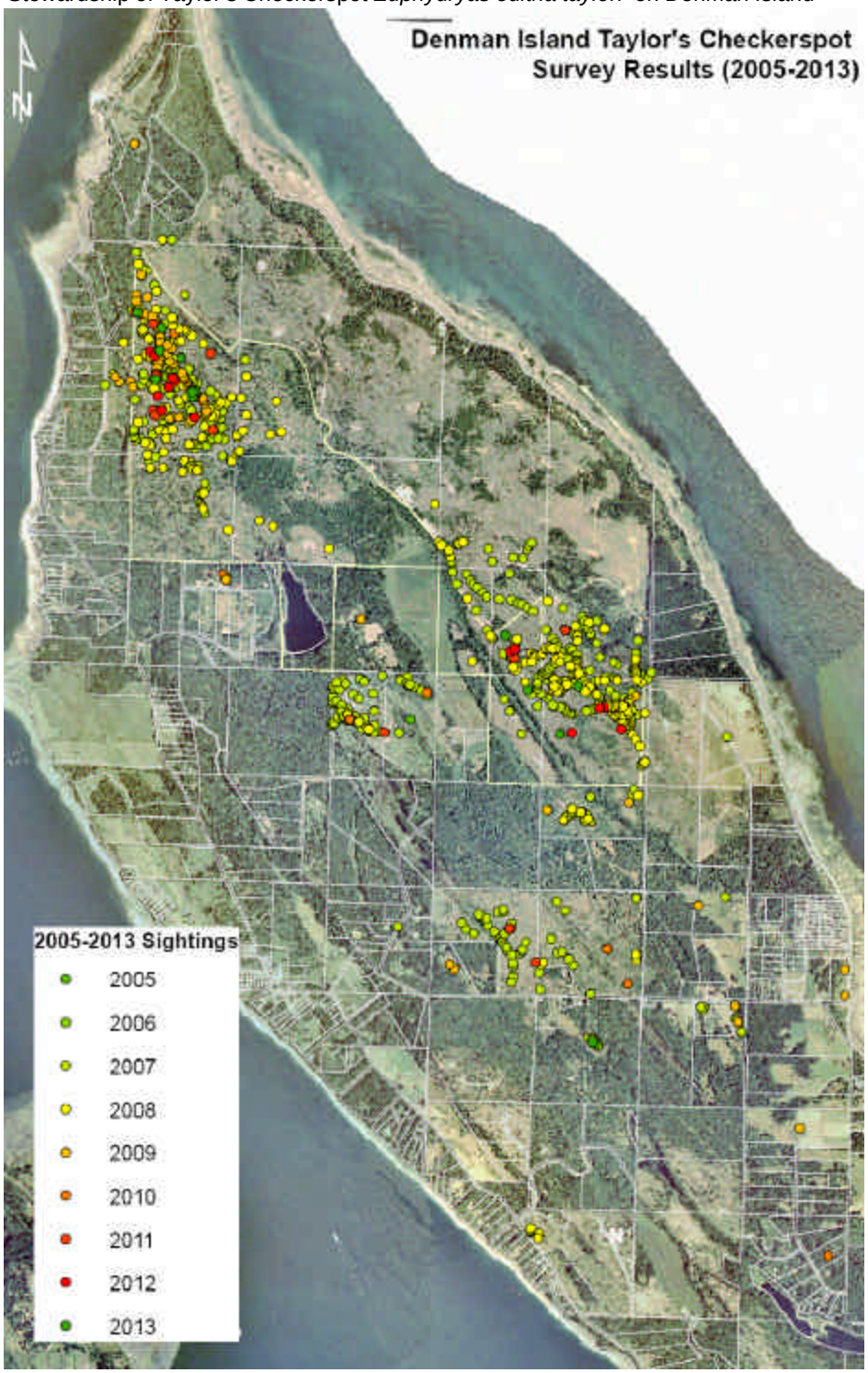


Figure 3.1 Map of Taylor's checkerspot (larva & adult) sightings on Denman Island (by N. Page).

Also in 2007, the first two long-term transects were established on two central Denman properties, a regenerating clear-cut and a meadow-site. In 2008 and then in 2010, two more were set up so that populations in NE and NW Denman were being tracked. Transects on each property ranged in overall length from 500 m to 1750 m. Counts of adult butterflies during the flight season were totalled over each 100m section and each of these sections was timed to take two-minutes. Additional data collected included, checkerspot behaviours, other animal species, vegetative species in bloom, and overall temperature and humidity on the site. Combined yearly counts of adults on these transects for each property are shown in this section. These counts give an index of the population abundance and can be used to indicate trends as discussed in 3.1.2, but are not a measure of overall population

abundance or density. Survey grid techniques are being used in the Washington State to obtain more accurate overall estimates of population abundance (Linders and Lewis 2013).

In 2009, J. Heron, BC Ministry of Environment, undertook a mark-recapture study of Taylor's checkerspot butterflies on Denman Island (COSEWIC 2011). From May 19 to June 6, 1220 butterflies were marked within a suitable habitat area of approximately 4.8 km^2. Recaptures included 45 butterflies and 950 additional un-marked butterflies were seen. The population was estimated as 13,000 adults.

Figure 3.2 Combined Yearly Counts of Adult Taylor's Checkerspots during the Flight Season NE Denman Clear-cut (1000m transect)

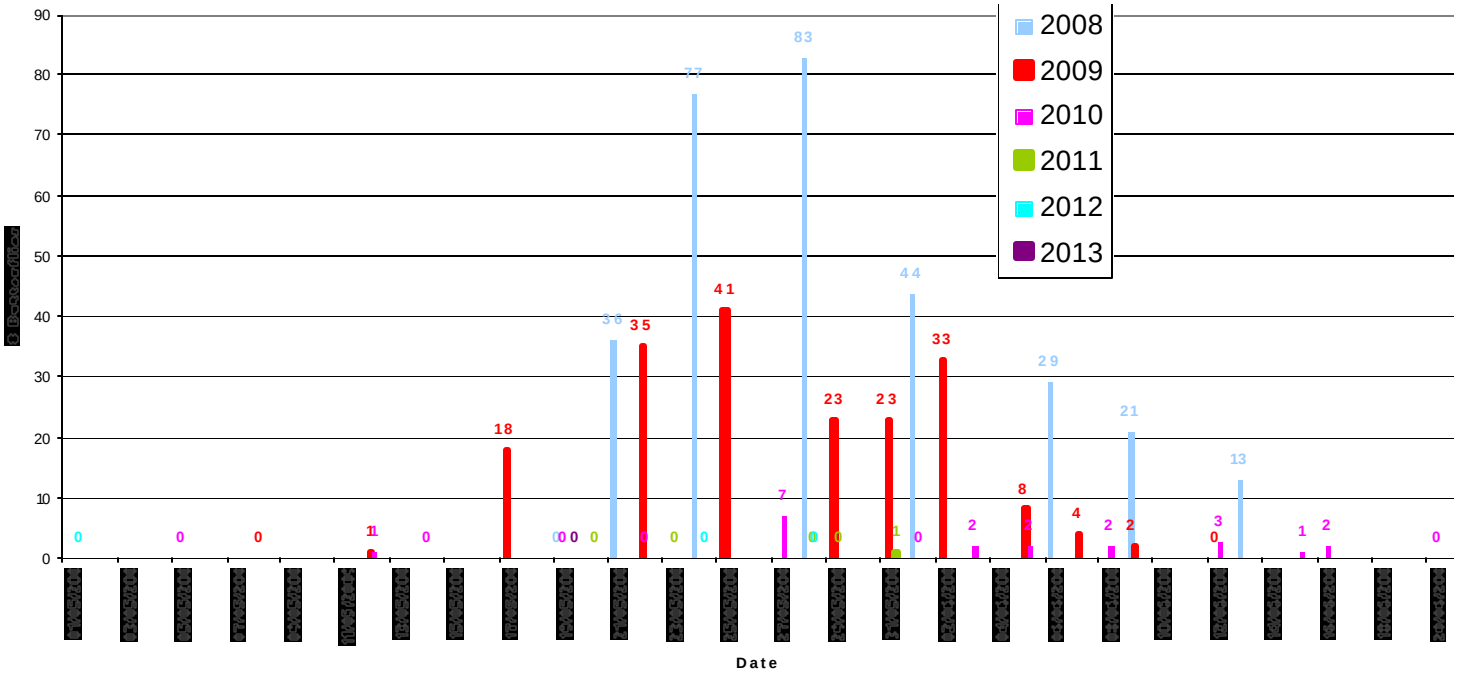


Figure 3.3 Combined Yearly Counts of Adult Taylor's Checkerspots during the Flight Season Central Denman Clear-cut

The count in 2007 was in 3 parts A,B,C each ~500m, in 2010 Part A was lengthend to 750, these results are only for the complete 1750m transect.

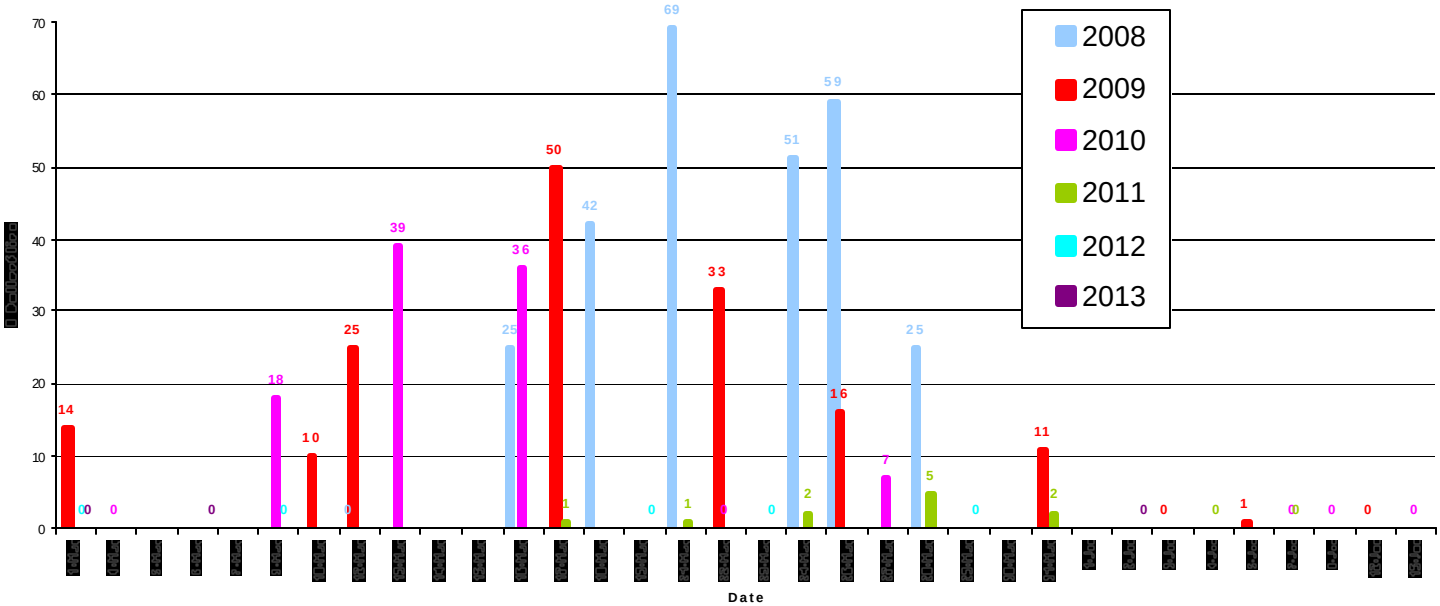


Figure 3.4 Combined Yearly Counts of Adult Taylor's Checkerspots during the Flight Season

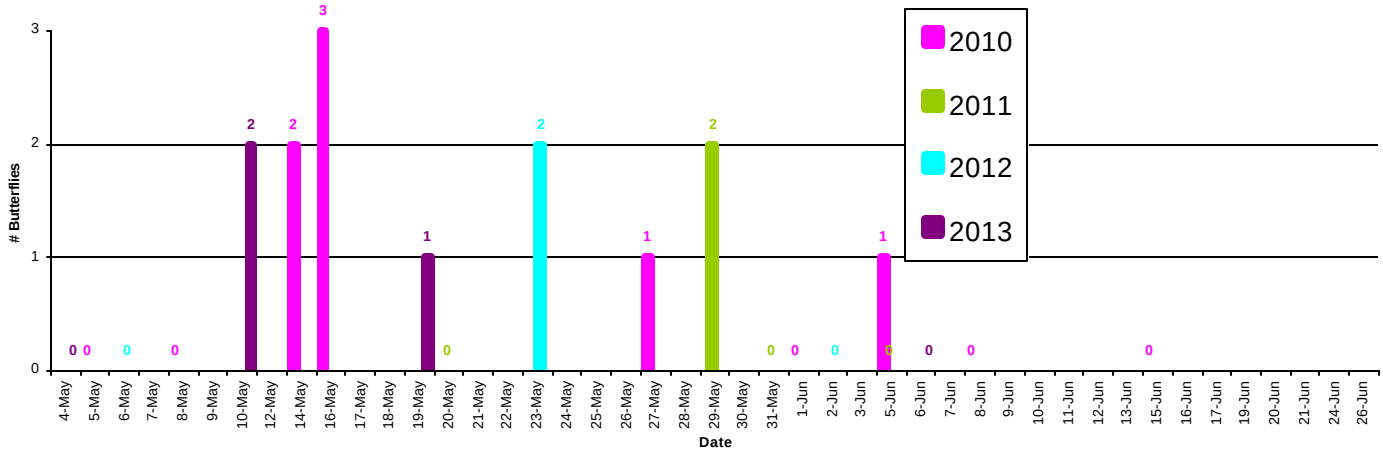
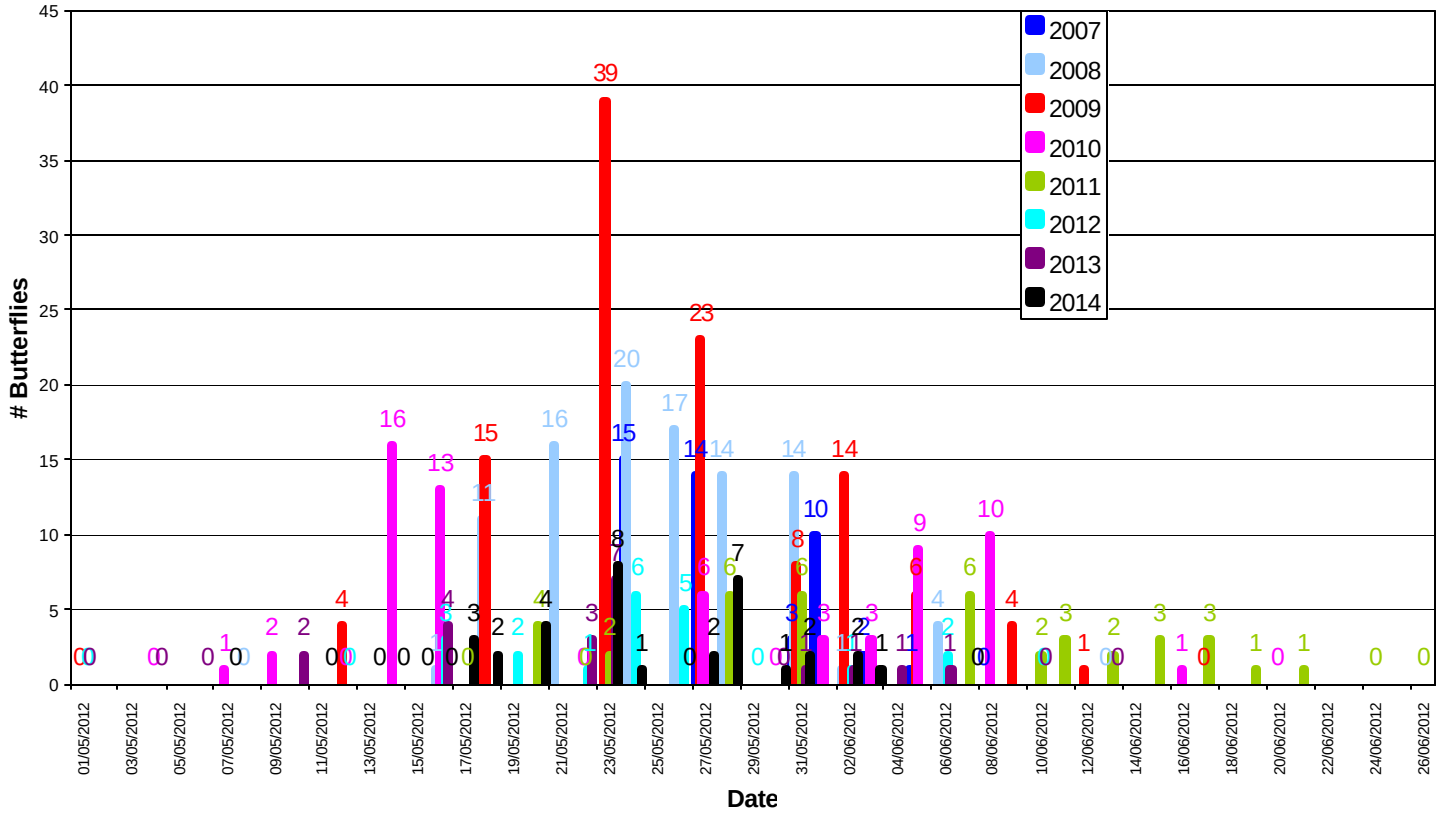


Figure 3.5 Combined Yearly Counts of Adult Taylor's Checkerspots during the Flight Season



3.1.2 Population Trends

Checkerspot butterflies are short-lived, with a one year generation cycle. Thus while this gives the population the chance to expand quickly in response to favourable conditions, it also means that populations could drop substantially with one year of bad weather or poor habitat resources. On Denman, mild, relatively-sunny springs (April to June) for a number of years (particularly 2007-9) combined with over two thousand acres of recently clear-cut former-forest habitat, and abundant potential food and nectar plant resources was a 'perfect storm' combination of factors favouring the expansion of the Taylor's checkerspot population. Occupied sites prior to 2005 are unknown, but it is clear that the population dispersed after 2005 over much of the north and north-central parts of the island. Thus, while

the clear-cut logging removed the habitat of coastal Douglas-fir forest species, the habitat was supportive for Taylor's checkerspots and other open-land species.

Transect counts were useful in monitoring and assessing general trends in the population numbers and also activities on different sites around the island. Observed times of first flights, peaks and the overall lengths of flight seasons varied at the different sites, as shown below. The highest counts on two of the sites were in 2008 and on the third site, the highest count was in 2009, yet all three longer-term sites declined in 2010. The northwest transect was set up just prior to the 2010 flight season.

Figure 3.6 Flight Season Dates & Length (days) in Different Sites

YEAR	NE (1000m)	Central (1750m)	Meadow (500m)
2007	-	- June 5	- June 5
2008	M' 21-J" 13	M16-M28	M16-J6
	23	12	21
2009	M12-J9	M1-J5	M12-J12
	28	35	31
2010	M12-J16	M9-M27	M7-J16
	35	18	40
2011	*	M17-M31	M20-J21
		14	31
2012	*	*	M16-J6
			21
2013	*	*	M10-J6
			27

'M=May, "J=June * = insufficient butterflies

Figure 3.7 Date of Peak Number of Adults In Different Sites.

YEAR	NE (1000m)	Central (1750m)	Meadow (500m)
2008	M' 28	M21	M24
2009	M25	M17-M31	M23
2010	M27	M13 (16)	M14 & J" 8
2011	~M31	M28	M28
2012	*	*	M24
2013	*	*	M23

'M=May, "J=June * = insufficient butterflies

The reason for the marked declines at some of the sites, particularly in the northeast in 2010 is unknown. Certainly weather conditions in 2010 were less conducive to adult butterfly breeding activity and a detailed analysis of several years of daily weather temperatures and hours of sunlight on north-central Denman, during May and June, would be valuable. The decline was marked, from an apparently abundant population observed in flight in 2009's good weather season to almost none in flight in less supportive weather in 2010. The northeast site's peak count dropped over 80 % in 2010. The central site's count (2) dropped slightly in 2010, but count numbers were up until the bad weather began, after which the peak count dropped 22% below the previous year. Then in 2011, the numbers crashed in the central site with the peak count 95% lower in 2011 than 2010. The meadow site's counts were highest in 2009, with the peak count in 2010 almost 60 % lower and again about 60% lower in 2011. Of note, Mylitta crescent observations also declined throughout this period.

May spring weather on Denman has continued to be predominantly cool and damp, although 2013 and particularly 2014 were drier and warmer with a number of sunny days. Checkerspot counts on the

northeast site did not recover. By 2013, it is likely that the healthy forest regeneration at this site has become unsupportive of extensive activity by open-land butterflies. Yet, while the central site retains considerable open habitat, checkerspots were not observed in this site in 2013. The meadow site has retained low but steady counts throughout this period, perhaps reflecting a higher quality of habitat resources available and possibly fewer expanding populations of open-land predators.

The significant population fluctuations in butterfly populations point out the need to protect substantial areas of high quality habitat. With abundant and diverse habitat resources small populations may be sustained throughout periods of stress from weather or other negative impacts on the population. Support for habitat enhancement is necessary for the maintenance of sufficient high quality checkerspot habitat.

3.2 Overall Conservation Project Success

The DCA's Rare Meadow Species Stewardship Project demonstrated that significant community interest and support exists for habitat stewardship and that this support can lead to commitment and action with a strong community outreach program. The program was able to bring both species biology and conservation land-use issues into the homes of the island. Stewards willingly signed up, hoping to do what they could for species at risk. This year's project took the next step, investigating the best current habitat enhancement techniques and beginning the long-term adaptive management involving the design of plans for specific habitats and conducting initial enhancement activities. Through investigative trials and adequate monitoring and maintenance, the success of current stewardship actions can be evaluated and techniques adaptive both to suit what works on the individual site and to adjust to new knowledge about the species at risk. In addition to the DCA's work, other groups have now become very involved in conserving the checkerspot butterfly on Denman and their actions, particularly those of the privately managed captive- rearing project by P. Karsten, as well as the TCCWG will make a major contribution to stewardship. Habitat stewardship is a long-term project with many steps along the way and this year's stewardship work has made considerable progress towards future success.

What was learned overall:

1. Many landowners would willingly offer portions of their land for the creation/restoration of specific species' habitat.
2. What is needed to enable stewardship is the availability of the necessary supportive direction, adequate labour and materials to create and maintain quality habitats, particularly for species such as checkerspots.
3. Regular local hands-on direction and assistance for landowners is successful in achieving active habitat stewardship, as demonstrated for example by the meadow site project this year.
4. Long-term consistent support is necessary. Manipulating habitat is a multi-year project that doesn't stop at a fixed point but constantly changes over time.
5. Monitoring of both habitats and the recovery of focal species is necessary to assess if habitat stewardship continues to be successful and if some actions are better suited than others in certain situations.

Recommendations:

1. A valuable solution for Canada to enable local communities to be responsible for maintaining rare species would be to establish a fund for the long-term regular yearly maintenance of successful habitat stewardship programs, particularly those for endangered and threatened species, as these habitats will also support many other species.
2. A variety of methods could be set up to encourage the regular sharing of recovery data and methods between habitat stewardship programs, e.g. annual on-line conference, website interactive communication, etc.

Chapter 4 Stewarding Habitats for Taylor's Checkerspots - Denman Island

4.1 Introduction / Rationale

Denman's landscape has been continually modified by land use activities. For several thousand years, waves of First Nations' peoples opened-up or maintained open coastal areas for their settlements and farming activities. By the early 1900's these open areas were either abandoned to regenerate as dense coniferous forests or further opened-up by new immigrants for housing, agriculture and natural resource extraction. The latest wave of settlement together with the accompanying draining, ditching, stream-modifications, trapping, hunting and frequent travelling radically changed the vegetative and wildlife species composition and abundance that had existed with the First Nations. Irregular cycles and varying degrees of recent clearing activities and active use have occurred across Denman. A few sites may have remained as open space with minimal impacts and over time these probably functioned as natural refugia for the early (native) open-land species.

The present spectrum of species of flora and fauna on Denman's landscape reflects the balance/blend of what has survived and what has been introduced with the land-use modifications. Unfortunately the rapid rate and extent of landscape change continues to be dramatic. The new conditions and the competing interests may be beyond the adaptation ability of various species. Maintaining any particular species or group of species into the future is likely to require stewardship decisions and actions that enhance or protect specific habitat features.

Currently Denman's 'wild' habitats consist mainly of forests (recently clear-cut to old-growth), lakes, wetlands and a few rocky herbaceous openings. Much of the human-used areas are open fields with woodlands or small treed-patches. Many butterflies, such as checkerspots, rely on cleared openings, edges and sunny open woodland habitats. Maintaining a variety of species and human uses in the open spaces will require minimizing the negative impacts of competing interests and integrating the supportive habitat-features for as many species as possible. Usually choices will be required. Species may be rated based on their rarity and potential for stewardship assistance. Increasingly more attention will be needed to identify and manage essential habitat features for both single, as well as suites of species, particularly for those species in critical need such as the Taylor's checkerspot.

4.2 General Habitat Stewardship Objectives

General stewardship objectives for Taylor's checkerspot can be summarized as:

1. Enhancing HABITAT features:
    - Open land, minimal shading.
    - Food and nectar plant abundance and diversity.
    - Habitat heterogeneity including a range of bare land, water features, moist and dry plant assemblages, topographic variation.
    - Structural complexity with appropriate structural components.
2. Accepting the TIME frame:
    - Planning into the future for sites that may be permanent and those that may need to added or changed.
    - Recognizing that habitats are dynamic and constantly changing over short periods. For open lands may mean working through cycles of forest succession, in a landscape where there is a "continuity of short-lived habitats" (Clarke et al 2011).
    - Having a commitment to future generations of stewardship.

3. Appreciating the SCALE of planning:
    - Managing across landscape or connectivity as "populations of many if not most butterflies and moths function as metapopulations", which is a "collection of local populations which occupy discrete habitat patches but which are connected by occasional dispersal of individuals" and "each habitat patch is likely to undergo regular local extinctions and regular re-colonizations." (Clarke et al, 2011, p. 15).
    - Recognizing the span of landscape inclusion with climate changes, and corridors to other habitats.
    - Integrating and coordinating collaborative human efforts at all levels.
4. Defining Stewardship Priorities and Aims using clear principles and taking a landscape view (Clarke et al 2011):
    - Assessing what is there (habitats, species in local & regional context).
    - Deciding objectives, priorities - incorporating needs of butterfly species alongside other interests.
    - Refining how to achieve objectives – assess time scale, resources, legal requirements etc.
    - Monitoring progress of vegetative habitat and butterfly population
    - Being flexible, revising as necessary, trial managing only a portion of habitat at a time.

4.3 Specific Habitat Features and Enhancement Activities

4.3.1 Introduction

Habitat Terms

Taylor's checkerspot habitat = area of stewardship activity for checkerspots.
Core habitat = area occupied by major checkerspot life cycle activities.
Buffer habitat = zone around core habitat.
Connectivity corridors = area between habitat stewardship areas.

Possible Population Bottlenecks

Habitat needs and enhancement opportunities could be based on an assessment of the individual site and could involve a review of possible core habitat-related bottle-necks for Taylor's checkerspot populations, such as:.

- Insufficient nectar plants,
- Insufficient oviposition plants (=future larval food plants),
- Inadequate persistance of pre-diapause larvae food plants through the season,
- Insufficient or unavailable (growing too late in spring) post-diapause larval plants,
- Unavailable, unsuitable or disturbed diapause sites,
- Unavailable, unsuitable or disturbed pupal sites,
- Excessive disturbance, predation, disease during mating, egg-laying, egg-maturation or larval feeding and development.

Timing and Scale of Enhancement Activities in Occupied Habitats

How Much Impact

Some of the activities aimed at improving checkerspot habitat in the middle to long-term, may be detrimental to existing populations of butterfly life stages currently on the site. Thus, for site treatments involving intrusive activities, only portions of the site are impacted in any one year. For potentially harmful enhancement activities such as burns, a maximum of 10 % or in some cases 1/3 of the occupied habitat could be treated in any one season (*pers. comm*. Kitzman 2014, Wilderman and Davenport 2011). In the case of Bald Hill Natural Area Preserve, in Washington the plan is to "plan necessary activities (invasive control, burning, seeding, planting, etc.) so they affect <10% of occupied habitat annually" (Wilderman and Davenport 2011).

When to Work

The somewhat intrusive activities can be timed to minimize impacts on butterfly life stages. In general, while some enhancement activities may be possible to a very limited extent during the butterfly flight season, the consensus appear to be that conducting intrusive activities in the late fall and winter, when the larvae of Taylor's checkerspot are in diapause, is likely to have the minimum effect (*pers. comm.* R. Gilbert, D. Wilderman, A. Kitzman, 2014). Determining the location of diapause sites would enhance the ability to reduce possible impacts of any habitat activities on Taylor's checkerspot populations during this period. This question remains one of the unknown keys to understanding and protecting the species.

4.3.2 Summary of Specific Habitat Stewardship Objectives

1. Ensure core habitat is open and sunny with less than 10% shaded.
2. Maintain a variety and adequate number of host and nectar plants in core and overall stewardship habitat areas.
3. Keep sufficient habitat complexity to include habitat features for all life cycle requirements of checkerspots.
4. Develop suitable connectivity travel corridors for checkerspots between possible stewarded habitats.
5. Establish sites where the level of possible disturbance, predation and disease is minimized.
6. Over the long-term, monitor habitat characteristics and Taylor's butterfly populations and use adaptive management to evaluate and adjust to new knowledge and changes.
   - Establish rating criteria for attributes of quality checkerspot habitats.
   - Set targets for achieving desired attribute ratings.
   - Determine the action steps to achieve these targets.

   This will allow managers to work towards specific goals and also provide a method for evaluating the success (Wilderman and Davenport 2011).

4.3.3 Detailed Habitat Objectives – What to do & How[10]

1. Open Habitats

Maintaining the open habitats, required for Taylor's checkerspots, in Denman's regenerating forests demands continual on-going management. Mason (1997) described the term "plagioclimax" as applying to a plant community where natural succession is continually interrupted by management activities including fires, mowing, tree-cutting or grazing. He described these early successional communities that support butterflies as having "a mosaic of microhabitats and microclimates".

Open Habitat Characteristics

Reduced Shading For most butterfly species, recommended habitat stewardship involves maintaining the overall habitat, particularly the core habitat, as a sunny open area with minimal shading, usually <10-20% of canopy cover (Clarke *et. al*. 2011). Taylor's checkerspots are known from very large open areas of several hundred acres at Joint Base Lewis McCord, Wa, USA, as well as many smaller predominantly openings such as the meadows in association with oak woodlands in Helliwell Provincial Park, Hornby Is, BC. Thus, an appropriate goal for Denman habitats is to maintain at least the core habitat as primarily open meadowland with up to 10-15% primarily Garry oak or other deciduous cover such as red alder or possibly big-leaf maple. In order to supply abundant host and nectar plants, the preferred ground cover of the core habitat is primarily herbaceous with some structural shrub and other elements as discussed in 4.3.3. Thus, the necessary habitat is early successional with very limited shading from within or from surrounding vegetation.

[10] References to Taylor's checkerspot habitat characteristics and enhancement activities are based on observations and written materials from checkerspot sites, habitat-managers and activities in BC, Washington and Oregon.

Physical Habitat Variations Current and previously occupied Taylor's checkerspot butterfly sites are found in a variety of physical habitats, usually either on flat land, or on south to predominantly south facing slopes. Slopes of occupied meadows or rocky outcrops, referred to as balds, can be steep, to over 50%. The highest resource use in these steep sites may be in the upper slope and slope-crest or bench areas. The size of core habitats may ranges from less than a hectare to over 100 acres. In addition, sites exist at elevations from sea level to over 1000m in northern Washington, USA. The variability of physical conditions in habitats occupied by Taylor's checkerspots is profound, from sandy ocean-beach shorelines to wet-meadow pockets; extensive oak-prairie meadows to small steep rocky outcrops along mountain rivers. In addition, large portions of some sites are regularly and extensively disturbed, particularly by fire.

Open land for these butterflies refers not only to open at the tree canopy level, but also a certain amount of ground level openness is necessary both for food plant growth and for larval movement between food plants and to shelter sites. Thus open-land enhancement techniques are necessary at all vertical habitat levels.

Other than "open", non-shaded core habitats, the recommendations for specific physical site characteristics are perhaps best developed from the local conditions that may suit adaptations of the local butterflies. On Denman, while some larger 50+ ha wide-open areas with abundant host and nectar plants are available, the butterflies seem to have maintained in much smaller patches of habitat, <1ha surrounded by messy clear-cut tree-patches or solid forests, and they have not expanded into these larger areas. One hypothesis was that the larger areas had structures that supported large numbers of predators such as a very large maternal colony of Townsend's big-eared bats *Corynorhinus townsendii*, also large numbers of nesting birds, including various swallow species.

Buffer Habitats Buffer habitats around the core are significant in terms of managing the negative effects of potential shading but also the positive effects of retaining moisture and possibly allowing some of the more shade tolerant food and nectar plants to survive and produce seed in dry years. Buffer habitats of 15-30m in these forest-regenerating areas may be maintained as less dense, lower height, treed areas adjacent to forests. Stewardship of buffer habitat could involve particular attention to reducing the shading of core-habitat especially on the south and west sides, as well as to cultivating areas of food plants and preventing the invaision of un-desireable species.

Invasive Species on Denman Checkerspot Sites One of the aspects of maintaining open lands, particularly at the shrub and herbaceous plant layers, is invasive species control and removal. A variety of specific undesirable invasive plants are present in Denman's checkerspot habitats. The first two species listed below are particularly worrisome as they invade and become monocultures in the wetland habitat currently occupied by the principal oviposition plant species of Taylor's checkerspot, *Veronica scutellata.* Scotch broom is a major problem in previously-forested, disturbed habitats.

- **Reed canarygrass** This species is advancing throughout Denman's wet seasonally flooded habitats and on wetland edges. It is currently increasing in three small areas of the Middle Farm meadow habitat and control is necessary.
- **Creeping buttercup** This buttercup is a general problem, more prevalent in disturbed habitats but needs to be watched, particularly in shallow ephemeral wetlands.
- **Rhizomatous grass species** A variety of non-native rhizomatous grasses are present in Denman's openings and particularly in the meadow habitat. Specific identification is necessary.

- **Scotch Broom** Broom is not present in Denman's meadow site but is abundant and maturing in the clearcut sites.
- **Bracken** Bracken fern *Pteridium aquilinum* has rapidly become dominant in many early transitional and wetland edge habitats on Denman. Bracken sites are recognized as supplying useful butterfly features, such as the suppression of ground vegetation, including coarse grasses, and also the creation of protective micro-climates of standing and slowly-decaying leaf litter (Clarke *et. al* 2011). But it is advised not to allow bracken to become dominant. As yet bracken is relatively minor in Denman's meadow site, but it is increasingly in some of the recovering clear-cut sites and in general should be monitored and controlled.
- **Other common roadside invasive species** Dandelions, daises, goldenrod and others need to be monitored and if possible at least prevented from seeding, as they may become increasingly problematic over time.

Techniques to Maintain Open Land

Various problems exist in keeping the land open on each site. They vary from forest regeneration to the growth of a host of different invasive species. Treatments will usually involve a variety of techniques and approaches that are adjusted over time to suit the site. The following are some of the techniques for dealing with the various issues.

a) Working with Existing Site Opportunities

Sites with compacted or shallow soils on clay or rocky substrates tend to remain open (non-treed) for longer periods and may not support the growth of large trees, thus these sites may be easier to maintain in an open state.

b) Individual Tree Management

Trees, particularly larger conifers can be cut and removed, girdled, topped or high-limbed. A combination may be used to create the habitat character over a prescribed time period and to supply habitat for other meadowland species of interest.

- **Removal**: Falling and removing large conifers is recommended in the core habitat. If mowing is planned for the entire site, stumps must be cut low and preferably ground down to allow safe-passage for the mower. Best to fall away from heavily occupied areas, towards areas of least impact. Trees can be limbed and either pulled off site with equipment that does not enter or that minimally enters the site, or trunks can cut up and removed in pieces. Removal of the tree-debris from the core habitat is preferred, although large pieces may be left for possible shelter habitat if this habitat feature is lacking, and if mowing of this portion is not performed. Limbs and debris from the cutting can be used for small-scale burns, see discussion below.
- **Girdling**: Various girdling techniques can be used. Chain saw cuts, such as three passes around the trunk through the cambium. If deemed necessary, the initial chain saw cut can be enlarged to include removing a wide strip of bark. The usual objectives are to kill the tree quickly to diminish the shading effects, but also to have it decay slowly remaining upright, providing habitat for other species and not falling onto the meadow.
- **Topping**: Where girdling may result in weakened trees falling and doing damage to the meadow, topping may be preferred although the cost is usually much greater. Limbing and topping usually kills the tree, but the undamaged trunk is less prone to falling. Usually 1-2 green branches are left but occasionally these trees will form new leaders that may grow and repeatedly crack off, although keeping the tree alive. Again debris from topping can be used in small-scale burns, see discussion below.
- **High-limbing**: If tree removal is not immediately possible, cutting the limbs high up on the trunk can reduce the immediate ground-shading. This debris also may be used for small-scale burns, see discussion below.
- **Other Options**: One strategy, used in Britain to retain an open understory habitat for butterflies in large sites, is to repeatedly open small forest patches of at least 0.5ha, while

allowing others to re-grow (Clarke *et. al.* 2011). The forest canopy closure causes the understory plants to decline while re-opening the canopy allows the herbaceous vegetation to flourish. The openings provide butterfly habitat for several years before they move to another re-opened area. Coppicing methods (trees cut to stumps that re-grow) can be used for this and the small coppice patches are repeatedly used for small scale forestry products, while the ground surface is largely undisturbed.

c) Shrub, Thatch and Undesirable or Invasive Species Management:

Keeping the site sunny and the vegetation low is important for supporting the growth of food and nectar plants, as well as for enabling the butterflies to make use of the available resources. Of additional significance is the suitability of the habitat for larval movement within the site, enabling the larvae to find food plants and suitable shelter sites. Larval movement may be facilitated by an open structure at ground level and may be impeded by dense stands of grasses or other vegetation. Thatch and the build up of other organic debris may also limit germination sites of some food plants or cause undue shading. Management of specific significant invasive species may be attempted using various techniques such as those listed below, but no site on Denman has agreed to consider the use of herbicides.

- **Mowing**

  Mowing may be used where burning is not possible, in order to reduce the standing vegetation and the litter layer, and also to prevent some plants, such as grasses, from going to seed. Mowing can be used as a stage in other processes such as pulling or covering. Some of the general principles of mowing include:

  - Use equipment with least ground impact.
  - Mow fairly high so as not to disturb butterfly life stage activities.
  - Timing of mowing should be after any food plants have gone to seed, when the checkerspots will suffer the least disturbance and when there will be the least impact on soil (wet-compaction). This translates to late summer to early fall, when checkerspots are in early diapause and the winter rains have not saturated the soil. This may not be early enough to reduce the seeding by invasive grasses.
  - Seeding following mowing may be advantageous.
  - Use clean equipment to prevent the spread of invasive species.
  - Consider all the species on the site and their possible responses, prior to mowing.
  - Many tools may be used for mowing (GOERT 2013).

- **Selective cutting, pruning, pulling, raking**

  If the extent of the undesirable species is small or there is a limited number, individual manual plant treatments, such as cutting or pulling, may be successful. Raking is useful in combination with mowing or cutting, in order to remove the thatch and vegetative debris from the site. Often conservation-oriented volunteers have been employed in these tasks. Other manual treatments, such as bruising and whipping with sticks, has been used for bracken control.

- **Burning**

  The main reasons to burn are to reduce surface vegetation and to burn at least some of the seed bank, depending on the degree and duration of heat. On a large scale it is particularly useful for Scotch broom. Burning also has been used to remove bracken and to reduce the overall thatch layer or to expose mineral soil and allow improved germination of nectar species such as *Collinsia* and *Castilleja.* Burning also produces a dark surface layer that warms and advances plant phenology in the spring and thus stimulates food plant growth. The first rains after burning may elicit a vegetative flush, often of non-native species, which will have to be managed.

  Large scale The burning of whole fields and other large areas requires intensive professional fire-fighting management, including training and preparation fire breaks and water resources. Burning may be repeated every 2-4 years. As noted above only a

maximum of 10 to 33% of occupied habitat should be burned in any one year. The best time to burn large areas is in late summer/fall before the fall/winter rains,

Small scale Small low branch piles, approximately 3m in diameter and less than 1m high, can be made from trimmed tree debris and then covered with tarps through the early fall rains. These can be burned in winter, the ashes spread and then 7-10 days later, seeds of nectar and food plants can be applied to the small burned sites. Seeds and seedlings may need some cover to prevent damage by seed eaters or inquisitive herbivores.

- **Application of cardboard, clear plastic or shade cloth**

  Small areas of invasive species can cut or mowed first and then covered. Possible cover materials include cardboard, clear or black plastic or a variety of shade cloth materials. Note: covering, if effective, will kill all of the vegetative species beneath the cover. Cardboard covering can be left to decay in place and desirable plant plugs can be added through the cardboard. But the use of clear plastic or shade-cloth may be simpler and may more effectively cover the surface when the terrain is undulating and uneven. Landscape staples can be used to keep the cover material in place and wood chips can also be added to the cover to help to anchor it.

  Reed canarygrass has very persistent rhizomatous and can reproduce vegetatively as well as sexually but can be controlled with diligent covering. The goals are to kill the existing plant and the rhizome system, to exhaust the seed bank and to keep new seeds or stem fragments from the site (Tu 2004). Often the cover over invasive species is left for at least 2 seasons, but effective treatments of reed canarygrass have been obtained with one season of effective covering (Tu 2004). The area will require re-vegetation with desirable species such as checkerspot food and nectar plants.

- **Small scale machine disturbance**

  Small disturbed soil patches can be created by scraping or digging/tilling with small machines. Very small areas could be dug by hand. These patches can be planted as with small scale burns and managed for weed growth.

- **Grazing** Although grazing has been shown to have limited desirable effects on enhancing butterfly habitats (*pers. comm.* Kitzman 2014), grazing animals if carefully controlled in specific areas may reduce the annual grass cover. Unfortunately many grazing species also prefer the important food and nectar plants, reducing the growth and subsequent seed production of these plants. Cattle and sheep have been used for controlled grazing and chickens in chicken-tractors could also be used to remove thatch and open the soil surface. Of note, however, chickens may also actively consume invertebrates including butterfly life stages.

- **Herbicides**

  Managers of large scale prairie recovery projects involving restoring checkerspot habitats in Washington and Oregon are using various herbicides including broadleaf products such as glyphosate and Triclopyr and targeted grass-herbicides such as Fusilade. Boom spraying, spot application and hack and squirt treatments have been used with specific objectives for certain species and at various times during the year. Herbicides have been used effectively after cutting to remove large scale broom populations, specific individual plants and especially extensive coverage by rhizomatous grasses. They are also used after burning to kill the first flush of largely invasive broadleaf species, prior to planting with checkerspot food plants. A number of herbicide protocols have proven effective for habitat treatments while maintaining checkerspot populations. A few US sites are being managed, where herbicide use is not possible, and these may provide larger scale models for Denman sites into the future.

2. Food, Host and Prairie Plant Populations

Plans for the establishing Taylor's checkerspot food and host plants, as well as other meadow plants need to be flexible. They need to be able to adapt to the continual dynamic aspects of habitats that will change over the season and over the years, depending on light, moisture, other nutritional elements, other species presence and disturbance. Changes will occur not only in the plant species, spatial locations and numbers, but also in animal species populations and even in the habitat's small scale physical features. Stewardship actions may influence existing development or cause new development to occur. As a result plant stewardship is necessarily adaptive.

Specific Checkerspot-use Plants

Many specific plant species used by checkerspot butterflies on Denman are known; however, additional plant species, used by Taylor's checkerspots in other regions, may also be acceptable to Denman checkerspots. Providing a variety of potential checkerspot plant species, may increase the likelihood of overall butterfly survival under a variety of conditions. In addition, enhancing meadow habitats with a variety of native meadow species may also support a range of other meadow species.

Checkerspot food plants may be seeded or planted as seedlings or 'plugs'. Planting resource pockets of food/host and nectar plants together enhances the habitat. When seeding after a burn, the addition of clean soil or covering at least a portion of the seed with mulch may help with germination and survival. Detailed instructions for seeding or planting seedlings of various species can be found at the GOERT site for Native Plant Propagation www.goert.cs/propagation.

A list of additional plant species that could planted for checkerspots on Denman sites is included in Section 6.2.

- **Larval food plants** Denman larval food plants include the primary *Veronica scutellata,* and secondary *Veronica serpylifolia, Veronica beccabunga , Plantago lanceolata* and *Plantago major.* Food plants in the US sites include: *Castilleja hispida, C. attenuata, C. levisecta* (planted in restoration), *Plectritis congesta, Collinsia parviflora, C. grandiflora, Plantago lanceolata, P. elongata and Orthocarpus pusillus* (Ross 2009).
- **Nectar sources** As noted in Part 2, adult butterflies will nectar at almost any available flowering species. Certain species may be preferred or contain more nutritious nectar, although this is not known for species on Denman. See list in Section 6.2.

Meadow Plant Species

Native bunch-grasses are important additions to restoration sites for checkerspots. *Festuca roemeri* is one of the native prairie grass species that is being used extensively in US checkerspot recovery sites. This grass will also perform as a necessary host plant for the hemi-parasitic *Castilleja* food plant species. Other grasses noted in the US designation of critical habitat include *Danthonia californica* California oatgrass, *Koeleria cristata* prairie dunegrass, *Elymus glaucus* blue wild rye, *Agrostis scabra* rough bentgrass, *Festuca rubra* red fescue. Some of the other Garry oak meadow grasses for Denman include *Hordeum brachyantherum, Deschampsia cespitosa, Achnatherum nelsonii Danthonia spicata, Dicanthelium ologosanthes Koeleria macrantha* (*pers. comm.* J. Miskelly 2013).

Techniques for Enhancing Food and Nectar Sources

a) General

- Recording the phenology range for food and nectar plant species on Denman will assist in understanding the plants availability and use by checkerspots, as well as their potential propagation methods.
- Developing sources for both seeds and plants to use in enhancement is necessary.

- Denman sites could be enhanced by the addition not only of other additional checkerspot-use plants but also of additional prairie plant species, native to this area. Note: if *Castilleja* species are planted, they are hemi-parasitic and in order to thrive they usually require the presence of host plants such as for *C. levisecta: Eriophyllum lanatum or Festuca roemeri.*
- The best time for enhancing habitats with plants or seeds corresponds to moist weather, usually in the fall or winter, when rains begin.

b) Food and Nectar Plant Gardens

Small garden-type beds of plants can be grown in a few small areas within the core habitat. The beds can be created with soil disturbance and the removal of competing surface vegetation in various ways such as:

- by digging by hand or using a small machine,
- after covering materials are removed or
- after small scale burns.

While *Plectritis congesta* will seed through moss, some species, such as *Collinsia* and other annuals require bare or almost bare soil to germinate effectively. Weeding will be necessary, as the rhizomatous grasses, if present, will re-sprout. Some sites or areas of sites may be best suited to developing plant gardens, depending on moisture, competing vegetation etc. Of note, removal of the biological soil crust, that is made up of varying amounts of fungi, lichens, cyanobacteria, bryophytes, and algae, can lead to problems as this layer performs assorted functions depending on its composition, such as stabilizing soil, fixing nitrogen, inhibiting many invasive species, increasing nutrient levels in plants.

c) Distributing Plant Species Throughout Habitats

Generalized enhancement of prairie and checkerspot-use plants can be managed through seeding or planting plugs of seedling plants. Certain species in certain sites will propagate better with one or other of the two methods. Seeds can be spread by broadcast or by using a mechanical spreader. Seed mixes can be adapted to suit each site. In specific areas, it may be necessary to cover seeds or seedlings to prevent damage by seed or vegetation foragers.

3. Habitat Complexity Features

An important quality for any supportive habitat is an appropriate degree of structural complexity. Large successful checkerspot sites in the US appear to have limited large structural features. Sites are cleared and often regularly burned every few years or mowed, so the meadows appear devoid of complexity. On the other hand, the soil surface in these sites is often disturbed at an insect scale by the activities of both moles and the pocket gophers. The creation of burrows and small soil and rock mounds may provide both some shelter opportunities, as well as basking sites. Also, recent vegetative debris also may provide some shelter. In addition, unlike the Denman sites, most US sites are quite dry.

Specific Features

Inclusion of the following features in checkerspots sites may add to their habitat quality and increase their ability to support checkerspot populations.

a) Basking Sites

Basking sites for larvae and adults may be any bare, often dark surface. These may be paths, pieces of coarse woody debris, bare soil patches, exposed rocky surfaces, or artificial substrates such as wood chips or garden beds or other materials. These can be created by providing a suitable surface, as simply as exposing some bare soil in sunny areas of the site. Exposed soil would need to be monitored for weed growth.

b) Shelter Objects

Various physical or vegetative structures may provide some degree of the necessary shelter for the different life stages. The diapause stage, particularly requires a protected location for over eight months. In the Denman meadow, butterflies regularly fly into sedge and low shrub patches and

they lay eggs on *Veronica scutellata* in ditches that are surrounded by taller vegetation. The butterflies also have been observed crawling under coarse woody debris and selecting partially-covered plants for egg-laying. Thus habitats with taller herbaceous or low shrub vegetation or coarse woody debris may enhance the security of checkerspots. Perhaps on the much clearer US sites, the taller prairie plants and disturbed soil surface supply the necessary security needs. On Denman's small habitats, if lacking structure, enhancement could include some adding security cover using rocks, coarse woody debris or by planting some tall herbaceous or low shrub species, for example *Carex sp*., *Symphoricarpos albus* or *Rosa gymnocarpa).*

c) Perching sites

Checkerspot butterflies perch to bask and also to monitor and defend territories. Perch sites may be any slightly raised site, such as leaves or seed heads of growing vegetation that is slightly taller than the surrounding plants, twigs or other coarse woody debris.

d) Wetlands

On Denman, small ephemeral wetlands are particularly important, as this is the habitat for the principle checkerspot food plant species. Eggs are laid predominantly on marsh speedwell that grows in many seasonally wet areas. These wet areas include depressions made by logging-equipment, those created in seasonally flooded fields by differential debris build-up of debris and those formed as natural drainage courses in shallow soils on impermeable substrates. Moist soils also support food plants later into the season. In addition, water features are used as a water source by adult butterflies.

4. Connectivity

A landscape view of checkerspot stewardship includes facilitating the dispersal of butterflies to additional quality habitats. Thus, stewardship involves including additional habitats surrounding existing sites as well as the necessity not only to evaluate new habitats, but also to envision and if possible enhance the travel corridors between habitats. The habitat requirements for these travel corridors resemble the open sunny qualities of the core habitat. In addition, the provision of abundant nectar plants is considered to enhance the possibility of successful butterfly dispersal. In this way a network of connected quality habitats could be created. The corridor widths, aspects, slopes and routes depend on the existing landscape. The goal is to provide a minimally obstructed, least shaded and nectar-supportive linkage between butterfly breeding areas.

5. Disturbance, Predation, Disease

Achieving and maintaining prairie-like conditions in a naturally forested environment requires a considerable amount of initial and on-going habitat-disturbance. In addition, many of the checkerspot-use plants thrive in disturbed soil conditions. Thus, a certain level of habitat disturbance is necessary in habitat-enhancement. In general, principles for habitat disturbance that may affect butterfly life-stages are that disturbance

1. is minimized by using the least invasive techniques,
2. is planned to occur at the least invasive time period for the butterfly life stages and
3. if major, impacts a maximum of one third of the occupied habitat over one life cycle.

The goal is that sufficient numbers of checkerspots will remain on the site and able to multiply in the newly 'disturbed'/ enhanced habitat.

The significance of the negative impacts of predation and disease on checkerspot populations is unknown. Predation of checkerspot larvae and butterflies by insectivorous birds has been observed in the field. Additionally, checkerspot butterflies have been observed caught in spider webs and a variety of other potential predators exist within the habitats. The cumulative impact of low levels of predation on small checkerspot populations may be more significant than in large occupied sites.

Certain diseases and parasitic organisms have been investigated by the checkerspot captive breeding program, but the wider effects of pathogenic micro-organisms in checkerspot habitats are unknown.

Miller and Hammond (2000 p. 6) noted that "many pathogens cause fatal diseases in Lepidoptera. Some of the most important pathogens are viruses, bacteria, protozoa, microsporidia and fungi." Thus it is conceivable that disease organisms of varying virulence and having a range of effects on populations may exist in wild populations and may be inadvertently spread between populations. Many animal management systems now routinely involve biosecurity provisions to decrease exposure to pathogenic organisms. Natural area enhancement programs may wish to evaluate possible biosecurity options for butterfly habitats.

Other general, non-enhancement-related disturbance, or additional negative impacts on the checkerspot habitat need to be evaluated. Recreation, livestock grazing or other human uses of the core habitat may pose too great a risk to checkerspot populations, but each site will vary. Landscape changes such as ditching, draining, or other machine or vehicle use is likely to be unwarranted, as is the application of any chemical substances, such as agricultural or garden sprays, other than those known to not effect butterfly life stages.

6. Long-term Habitat and Butterfly Monitoring

Monitoring both the habitat response to enhancement actions, as well as the butterfly population within the enhanced-habitats is critical to evaluating the progress and success of checkerspot stewardship. Unfortunately, other factors, such as climatic conditions, influence year-to-year variation in butterfly populations and thus data from monitoring must be evaluated in a comprehensive context.

Techniques used for monitoring checkerspot populations include both larval and adult evaluations. During the flight season, butterfly counts have been made using random pollard-walk inventories, simple transect counts repeated throughout the flight season and distance sampling measures over a transect grid covering the habitat. Random-walk sampling indicates the presence-absence of the butterflies and if carefully controlled may, as in simple transects, offer an index of population abundance. The distance sampling techniques are used to estimate population density. Larval surveys principally have been used to determine the location of breeding populations, to confirm winter survival of the species and to study larval behaviours and habitat requirements.

The Benton County Prairie Species Habitat Conservation Plan (2010) stated that direct counts of butterflies were not required for monitoring the success of the conservation program. As butterfly numbers fluctuate yearly due to a variety of different conditions, an abundance for Taylor's checkerspot was determined on the basis of square meters of host plants (primarily English plantain) and native nectar plants present.

Simple repeated adult transect counts were used at multiple sites on Denman to monitor trends in the checkerspot butterfly population year to year. A review of the data is in progress. A brief summary of Denman's population is included in Part 3.

4.4 Description of Occupied and Enhanced Habitats in USA

Nine managed Taylor's checkerspot sites were toured in Washington and Oregon in April 2014 in the company of biologists and land managers from the respective jurisdictions. In addition, two Washington sites on central Whidbey Island were visited without accompanying local personnel. Observing enhancement sites, discussing methods and activities and reviewing several management plans for the sites has been invaluable in assisting with designing checkerspot habitat enhancement plans for sites on Denman Island. A brief summary of significant enhancement feature observations is included in Chapter 8.

Chapter 5 Landowner Involvement

Private landowners on Denman could potentially play a very significant role in long-term checkerspot conservation for a number of reasons:

- Most of the habitat maintained in open meadow-like conditions is on private lands.
- Taylor's checkerspot food plants are ubiquitous and weedy in Denman Island open areas.
- Currently identified checkerspot breeding sites on Denman have been in poorly-drained, shallow soil, non-productive areas, thus checkerspots pose no direct threat to crops or other species.
- Overall, although more remains to be understood, active management for the checkerspots may be minimal, other than avoidance of direct impacts within occupied habitats or the use of pesticides in the area.
- Dispersal of the checkerspots has occurred over a wide area of private lands on Denman in open human-use areas.

Benton County in the USA hoped to involve landowners and allay fears of the impacts of federal regulation of endangered species by:

- "clearly explaining the regulations that may impact landowners,
- increasing community appreciation of prairie habitats,
- enhancing positive community engagement, and
- demonstrating the success of voluntary actions and programs to promote prairie conservation." (Benton County 2010 p9)

Authorities responsible for managing open-land species on protected land in natural forest-ecosystems face an on-going habitat-management challenge. On the other hand, most landowners have busy lives and would need continual long-term assistance and coordination to recognize, plan and conduct stewardship activities for conserving wild species on their open-lands.

In Benton County, for conservation of the USA endangered Fender's Blue butterfly, landowners receive assistance and guidance in activities such as:

- Mowing, haying or grazing in specific sites or ways,
- Planting native prairie species,
- Installing, maintaining or replacing fencing (Benton County 2010).

Similar support may be established if the Taylor's checkerspot is listed as endangered in the USA in the future.

A possible program where personnel from jurisdictional authorities or contracted managers work with landowners and are continuously involved in hands-on open-land species conservation on private land may be more cost effective and successful long term across the landscape. Direct landowner contact, organization and assistance for conservation of the Taylor's checkerspot (and other species at risk) on Denman could be effectively achieved by local contracted managers by staff from the authorities with jurisdiction, such as Environment Canada, BC Ministry of Environment or other governing authorities such as the Islands Trust, Comox Valley Regional District.

Chapter 6 Resource Information

6.1 Useful Sources for Assistance

The following are a few useful checkerspot resources to assist with habitat enhancement.
For creating and managing a small Garry oak meadow:

- Garry Oak Ecosystem Recovery Team's 2013 'Best management practices for Garry oak and associated ecosystems'.

And propagating plants:

- Garry Oak Ecosystem Recovery Team's web site for 'Native Plant Propagation Guidelines'.

For more details of Taylor's checkerspot biology:

- Derek Stinson's 2005 'Washington State Status Report for the Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot.'

For designing a stewardship plan with appropriate objectives, strategies and actions:

- David Wilderman and Roberta Davenport's 'Bald Hill Natural Area Preserve Restoration Plan.'

For managing invasive Reed canarygrass:

- Martin Tu's 2004 'Reed canarygrass Control and Management in the Pacific Northwest.'

6.2 Plant Species Suitable Checkerspot Enhancement Sites

6.2.1. Checkerspot Plants – Denman

The following are species that could be added to Denman checkerspot enhancement sites. ***Note***: native bunch grasses are also included in the second list.

Armeria maritima N*
Aster subspicatus blm time?
Balsamorihiza deltoidea N
Camassia quamash N
Castilleja hispida F
Castilleja. attenuata (Othocarpus attenuata) F
Castilleja. levisecta F
Cerastium arvense N
Collinsia grandiflora FN
Collinsia parviflora FN
Crocdium multicaule N
Dodecatheon pulchellum ?
Erigeron philadelphieus blm time?
Eriophylum lanatum N
Frillaria lanceolata N
Orthocarpus pusillus F
Plectritis congesta FN

Native Oak prairie grasses / bunch grasses:

Festuca roemeri Roemer's fescue (grass of choice in US enhancement – possibly due to herbicide use)
Achnatherum nelsonii Columbia needlegrass
Agrostis scabra rough bentgrass
Danthonia californica California oatgrass
Danthonia spicata poverty oat grass
Deschampsia cespitosa tufted hairgrass
Dicanthelium oligosanthes Scriber's witchgrass
Elymus glaucus blue wild rye
Festuca rubra red fescue
Koeleria cristata prairie dunegrass

Koeleria macrocantha junegrass

Note: various rushes and sedges are also possible for wet sites.

* N= butterfly nectar source F=larval food plant species.

6.2.2 Checkerspot Plants Oregon

Scientific Name	Common Name	Native/Introduced
Armeria maritima	thrift	Native
Balsamorhiza deltoidea	deltoid balsamroot	Native
Berberis spp.	Oregon grape	Native
Calochortus tolmiei	Tolmie's mariposa lily	Native
Camassia quamash	common camas	Native
Cerastium arvense	field chickweed	Native
Eriophyllum lanatum	woolly sunflower	Native
Fragaria spp.	strawberry	Native
Linanthus bicolor	bicolored flaxflower	Native
Lomatium triternatum	nineleaf biscuitroot	Native
Lomatium utriculatum	common lomatium	Native
Malus sp.	apple	Cultivated
Mimulus spp.	monkey-flower	
Plectritis congesta	shortspur seablush	Native
Potentilla anserina	silverweed	Native
*Ranunculus occidentalis**	western buttercup	Native
Sedum sp.	stonecrop	
Taraxacum officinale	common dandelion	Introduced
Zigadenus venenosus	meadow death-camas	Native

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Chapter 7 Draft Stewardship Plans for Taylor's Checkerspots on Denman

The following drafts of stewardship plans have been compiled for private lands, either owned by or having stewardship agreements with the Denman Conservancy Association. The process for implementation of these plans includes discussion and negotiations with the landowners and the active management groups. Various activities on these lands are or have been in progress for several years but organized restoration and enhancement activities are just beginning. These plans are included below.

7.1 Middle Farm Draft Taylor's Checkerspot Stewardship Plan

7.1.1 Introduction

Property Location & Land-use Description

Middle Farm is located in the centre of Denman Island, Figure 7.1. The land is Lot B of Section 17. The zoning of the local land use jurisdiction, the Islands Trust, is approximately 1/3 Rural Residential "2" and the remainder Agriculture "4". Approximately two thirds of the land is in the provincial Agricultural Land Reserve (ALR), including the checkerspot stewardship area, Figure 7.2. The property is situated central to several other parcels where Taylor's checkerspot butterflies have been identified, as shown in Figure 7.3.

Figure 7.1 Middle Farm location.

Figure 7.2 Middle Farm Core Checkerspot Habitat (purple) and Agricultural Land Reserve (yellow).

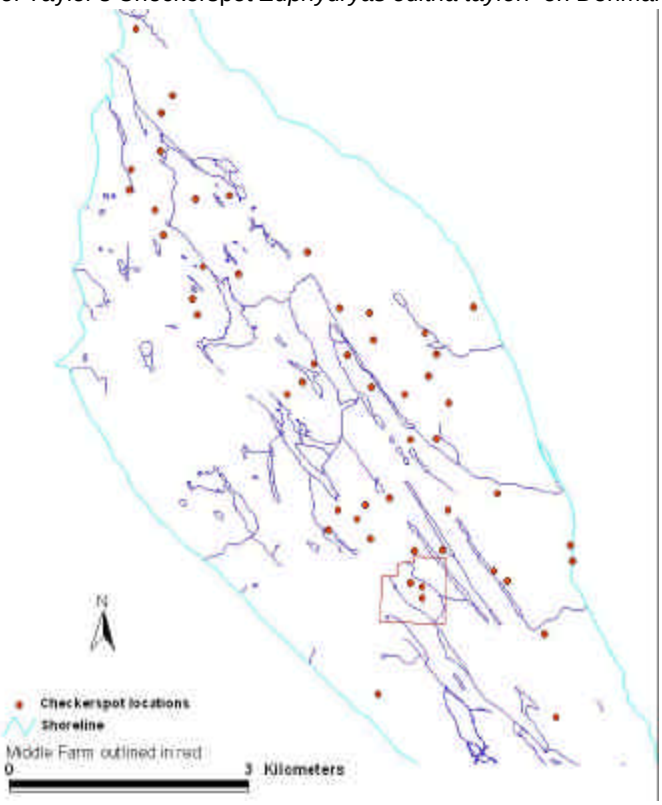

Figure 7.3 Middle Farm and other general areas on Denman where checkerspot butterflies have been seen.

Known land use of this property includes historic logging of the original timber at about the time of the First World War. The owner at this time conducted a mixture of logging and farming but found the property generally unsuitable for farming. Portions of the second growth forest were logged periodically. There are remnants of an old sawmill and logging truck on the property. The land was purchased by another owner and then a developer who clear-cut logged and high-graded the property in the mid-1980's. Logging equipment was driven across the meadow (core habitat, see below) leaving deep ruts.

In 1991, the property was purchased by the current owner-families who have built residences and made personal gardens and domestic animal-use areas. The forested portions of the property supply firewood and some timber needs for the owners. A small pond was made in the centre of the property (core habitat area) to supply a potential adjacent garden site. This site was fenced but later converted into a small riding ring that is currently used in the dry season. Small trails exist through the property, but other than these uses, the rest of the property has remained largely un-changed by the current owners. The forested areas are gradually regenerating.

Taylor's Checkerspot Butterflies on Middle Farm

In 2007, Taylor's checkerspot butterflies *Euphydras editha taylori* were identified by landowners on their "Middle Farm" property. The identification was the result of an island-wide poster-notification, seeking information about this butterfly from the community. In 2007, an open area of Middle Farm, approximately 1.8 ha, shown in Figure 3, had at least 10 checkerspot butterflies flying at one time. The population numbers have fluctuated over the years, but the butterfly has persisted in this meadow, through the 2013 flight season. Eggs collected in 2013 from the meadow formed the founding stock for Denman's checkerspot captive breeding program.

In 2007, a 500m monitoring transect was set up in the meadow area and butterfly counts have been made throughout the flight season each year. These transect counts are reported in Chapter 3 of this draft stewardship guide. Also, presence of pre-diapause larvae in their nets on *Veronica scutellata*,

growing in small moist depressions throughout the meadow confirmed oviposition and that there was a breeding population. Subsequently, post-diapause larvae have been seen mainly in the meadow, but also crossing the road and in the adjacent small field. During the abundant years for the checkerspots on in this meadow site, 2007-2010, butterflies were also seen in the household gardens on Middle Farm and in nearby open-land properties.

Taylor's Checkerspot Habitat Description

The Middle Farm core checkerspot habitat is a 1.8 ha flat open area, situated roughly in the centre of this property. The entrance to the property for the six residences is a gravel driveway running along the western border of the core habitat and this driveway connects the households' small clearings and the core habitat with Denman's main east-west travel corridor, Denman Road. A narrow ditch bisects the habitat longitudinally and old grassed-in tracks circle around the meadow near the south, east and north edges. Recent human use-features include a small riding ring, a dug pond, a small pile of wood milling debris, the butterfly monitoring transect-route, marked with small metal stakes every 100m, and a small 2x2m fenced Garry oak project area.

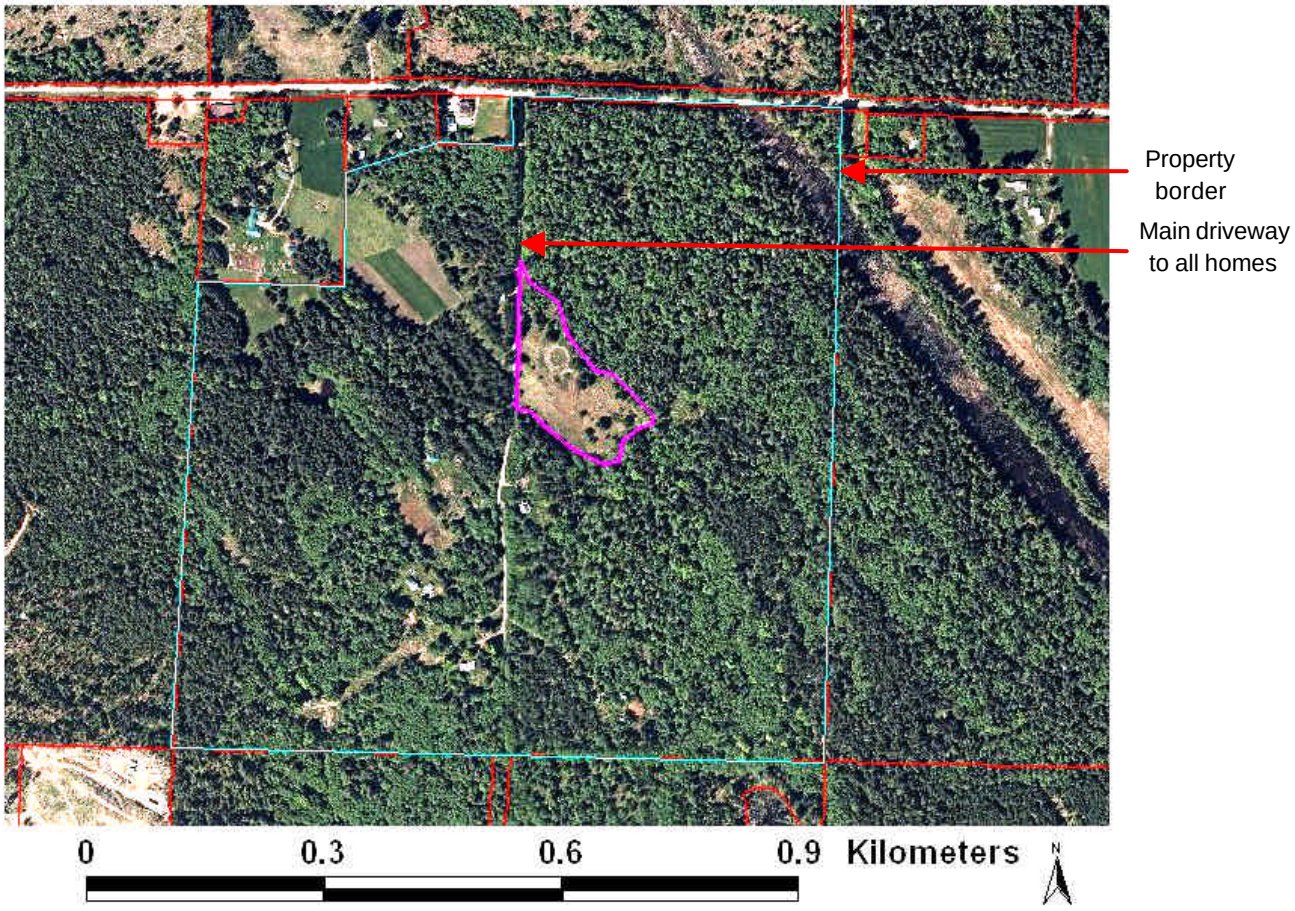

Figure 3. Middle Farm and core habitat (pink border) for the Taylor's checkerspot.

The vegetation of the core habitat is primarily herbaceous, spilt nearly equally between sedges and grasses. The majority of the soil surface tends to be wet and flooded throughout the winter. Thus many of the species are shallow-rooted or can tolerate "wet-feet" over the winter. The surface is irregularly-mounded with soil and vegetative-debris so that small wet-depressions supporting marsh speedwell are found across the meadow. A few conifers, mainly Douglas-fir, are growing in the meadow, although apparently they often blow-down before reaching any substantial height. Trees along the edge of the core habitat include both conifers, surrounding the meadow, and red alders, mainly along the eastern edge. These trees are increasingly shading the perimeter. In addition, there are a few shrub species, such as red elderberry, salmonberry, snowberry, and Nootka rose, within the

meadow and along the edge. While some of these shrubs are a nectar resource, they are also gradually occupying more herbaceous habitat.

Meadow species of interest, that were identified in the grass-areas of the core-habitat, included California oat grass, early blue and/or Alaska violet, Scouler's popcorn flower, Gairdner's yampah and blue-eyed grass. The last three are very uncommon on Denman. The presence of these species suggests that the area has retained some open meadowland attributes and may have been open for sometime, possibly from when additional open-land surrounded the property. Comprehensive inventories of the vegetation are part of the enhancement activities.

Structural features to support aspects of the checkerspot life cycle, other than the living vegetation, include rock-piles, soil mounds and pieces of coarse woody debris. At least four piles of rocks are present in or at the edge of the meadow and these may provide shelter, potentially diapause sites. Some of these piles contain large glacial erratics as well as gathered and piled stones. The largest rock-pile, ~7m by 3m, is on the northeast side and would be in full sun except for two 15m high trees on the west side of the pile. Other rock-piles, at least 2x2m, are in the south end of habitat and on the west side, near the driveway. In addition, a few large rocks, >20cm in diameter, are located in the grassy areas. A side-cast earth mound, alongside the ditch, about one metre wide, that was probably from the ditches' construction, runs at varying heights up to ~30cm above the ditch-edge and is covered by mostly sedges and invasive grasses. Lastly, a few downed-rotting tree trunks provide some woody debris within the habitat.

The major problematic invasive species at this time is reed canarygrass. Currently three small patches are in the core habitat, two along the central ditch near the riding ring and one in the ditch at the south end. The reed canarygrass has been cut in the past and a plan for future control and hopefully elimination of this species is included in section 2.3. Some of the other introduced species include various other rhizomatous grasses, goldenrod, dandelions, oxeye daisies, small hop clover and/or black medic and other clovers.

7.1.2 Goals, Objectives & Methods for Stewardship On Middle Farm

Habitat Planning Background

General Habitat Needs:

1. Open sunny non-shaded habitat – overall habitat & small wetland areas.
2. Diverse meadow plant community with invasive species control.
3. Complex habitat available for butterfly life-cycle needs – including newly disturbed areas, available wetland features supporting food plants, and also perching / basking, diapause and sheltering sites.
4. Connectivity to other high quality habitats.
5. Monitoring of habitat conditions and butterfly populations.

General Habitat-related Threats:

Some potential habitat-related threats to existing populations:

1. Insufficient nectar plants.
2. Insufficient oviposition (host) plants (=future larval food plants).
3. Insufficient duration (senesce too early) of pre-diapause larvae food plants.
4. Unavailable (begin to grow too late) post-diapause larval plants.
5. Unavailable, unsuitable or disturbed diapause sites.
6. Unavailable, unsuitable or disturbed pupal sites.

Other possible habitat or direct threats:

7. Disturbance, predation, disease during mating, egg-laying, egg-maturation, larval feeding and development.
8. Yearly unfavourable climatic conditions.

9. Toxic chemical drift.

Planning Steps

The initial step in this process is a review of the draft plan by the landowners with revision as necessary and to achieve landowner support for the initiatives. Following that the plan will be shared with the checkerspot RIG and also with the checkerspot US contacts in order to incorporate as much helpful advice and suggestions as possible. Due to the timing of this document, enhancement activities, approved by landowners will begin in May 2014.

Goals, Objectives & Methods for Habitat Stewardship 2014

1. Goal: Create open sunny habitat for checkerspots **(Need #1)**

Objectives:

1. To identify the trees for removal.
2. To remove small trees and high-limb or girdle larger trees.
3. To remove larger trees by felling or topping.
4. To identify and time the major areas of the meadow used by adult butterflies, as well as shade patterns within the meadow.

Method:

(1) Trees will be marked with flagging tape or paint for removal.

(2) While best done in the fall and winter, this year in late April, with minimum impact on the core habitat, some of smaller trees and the lower limbs of some larger trees will be removed. Two or three small piles (~4'x 8'x 1-2'high) of debris, intended for burning in the winter, will be made at selected locations. These piles will be covered with tarps before the rains in the fall and then burnt in November. The remainder of the debris will be spread in surrounding forest. Also some shrubs may be pruned during the flight season. Some selected trees may be girdled.

(3) In the fall (Sept), with minimum impact on core habitat, selected trees will be felled or topped, limbed and cut-up for firewood. The wood will be removed and the debris will be used to create the burn piles mentioned above and any excess will be spread in the surrounding forest. If tree-topping is possible, all but 1 or 2 limbs will be cut off as well as the tops and the debris will be disposed of as above.

(4) Locations of butterflies within meadow will be recorded at 10:30 am, 1 pm and 4 pm, on at least 5 sunny days, spread out during the flight season, using the transect path for counting and viewing. The shaded areas of meadow will also be recorded at these times.

2. Goal: Create diverse meadow plant community with problem invasive species controlled. **(Need #2)**

Objectives:

5. To identify and map species within the major plant communities, as well as problem invasive species in the meadow.
6. To enhance the diversity of checkerspot-use plants in the meadow.
7. To make progress towards controlling/eliminating the reed canarygrass *Phalaris arundinacea* patches and other invasive species.

Method:

(5) General vegetation communities will be mapped using GPS and GIS techniques and a species list for each identified community will be created. Invasive species locations will be identified using GPS and documented.

(6) Seedling plants (plugs) of species selected from list in the stewardship guide, section 6.3, will be planted in the small Garry oak garden project area. Species will be selected and plugs or seeds sourced for planting in the fall/winter.

One of the diversity techniques is to open up the mineral soil for enhancing those species that thrive in these conditions. In the late fall (after first rains), 2 or 3 small piles of tree-debris

will be burned. After 10 days to 2 weeks. These small areas will be planted with selected species and weeded as necessary.

In addition, a portion of the meadow, 1/10 to 1/3, will be mowed in late August as another technique to assist in opening the meadow and reducing grass cover for a greater diversity of checkerspot-supporting plant species and for larval movement. If seeds or plugs are available these will be planted with the fall rains.

(7) The reed canarygrass will be cut by hand and the debris removed. Card board, shade cloth or clear plastic will be used to cover the cut reed canarygrass and this will be stapled down with wood-chip mulch applied over the cardboard or shade cloth covering. If shade cloth is used this will be removed in two years. If cardboard, it may be left to rot in place and planted through with plugs. Plastic may be used to "solarize" or cook the reed canarygrass. It may be possible to try portions of the grass with all three methods. Some of the other species will be controlled by hand-pulling or cutting and prevented from seeding.

3. **Goal:** Provide complex habitat for butterfly life-cycle needs **(Need #3)**
   Objective: 8**.** To identify and locate habitat complexity features within the meadow.
   Method: All structural features will be described and mapped during the flight season, using the transect route**.**

4. **Goal:** Establish/enhance connectivity routes for checkerspots from Middle Farm **(Need #4)**
   Objective: 9**.** To identify connecting corridors to other nearby high quality checkerspot habitats.
   Method: Any potential butterfly travel corridors that at least partially open, will be identified on maps and air photos. Where corridors are on private land, a discussion with owners will begin regarding their willingness to engage in checkerspot habitat enhancement, such as opening the routes or planting suitable nectar species within the corridors.

5. **Goal:** Monitor butterfly populations **(Need #5)**
   Objective: 10**.** To complete this flight season's repeated transect counts of adult butterflies
   Method: The existing 500m transect will continue to be used to monitor adult population throughout flight season and counts will be made, if possible, every other good weather-day as previously conducted.

6. **Goal:** Provide habitat with abundant checkerspot nectar and food plants **(Need 5 & Threats #1&2).**
   Objective: 11. To estimate abundance of checkerspot food and nectar plants.
   Method: During the flight season, with a minimum of impact, at least three 1x 1 m plots in representative-habitat areas throughout the meadow, will be used to identify and count the numbers of checkerspot food and nectar plants by species.

7. **Goal:** Establish whether the early senescence of pre-diapause food plant is a significant bottleneck for checkerspot populations at this site **(Threat # 3).**
   Objective: 12. To determine duration of availability of *V. scutellata* throughout pre-diapause larval feeding period.
   Method: In the meadow, at least 3, sites of *Veronica scutellata,* preferably occupied by larvae, will be checked weekly through June and July. If identified the larvae will be observed to see if they shift to secondary food plants.

8. **Goal:** Climatic conditions **(Threat # 8)**
   Objective: 13. To record general temperature and relative humidity conditions in core habitat.
   Method: A remote, continuous-read temperature and relative humidity monitor will be installed in the meadow to record conditions in the central occupied habitat. In addition a marked gauge (metal post) could be put in the dug pond and read during transect counts in order to monitor the water table fluctuation and obtain an annual index of the rate and timing of surface drying.

9. Goal: Create a suitable buffer area around the core checkerspot habitat.

Objective: 14. To retain the meadow as a valuable asset to Middle Farm and to maximize the value of the core habitat for checkerspot butterfly survival.

Method: Begin a discussion with the landowners regarding their interests in using the meadow and the surrounding area. Discuss if they have any interest in opening and using some of the surrounding former farmed/grassy areas and in general how they what they would envisage as a suitable buffer.

7.1.3 Habitat Stewardship Schedule

Schedule of Activities

The following table indicates the timing of the activities for the objectives given in section 2.3.

May	June	July	August	September	October	November
1*						
2						
			3			
4	4					
5	5					
6			6			6
7						
8						
				9	9	9
10	10					
11	11					
	12	12				
13						
				14	14	14

* number of objective from section 2.3.

Monthly reports of the checkerspot stewardship activities will be presented to the Denman Conservancy Lands Committee meetings throughout 2014 by the assisting biologist. A final written report of the activities and data collected will be completed and submitted to the Lands Committee by December 31, 2014.

7.1.4 Future Stewardship Recommendations

Short-term goals

The stewardship plan lays the foundation for current and further short-term work, based on the present understanding of checkerspot needs, habitat conditions and the suggested enhancement methods outlined in the stewardship guide. Subsequent years can continue this model and use adaptive management to adjust methods to suit the apparent response of the site, as well to adjust due to new knowledge concerning the needs of the butterfly or other related species within the habitat. Two and five year progress assessments are recommended.

Long-term goals

In five years, a Taylor's checkerspot population status review is recommended, together with an assessment of the quality of current and future habitat areas. Obviously, open-land species will require continuous maintenance in this naturally forested ecosystem, thus understanding and using the best techniques efficiently will help to sustain the program. The conservation success of maintaining these species on private lands can be determined over time and this assessment would indicate the priorities for allocating time and funding into the future.

7.1.5 Appendix

Middle Farm Habitat Feature Photographs

Available on request from the authors.

7.2 Denman Conservancy Association's Settlement Lands Draft Taylor's Checkerspot Stewardship Plan

7.2.1 Introduction

Guppy (2007) wrote the following: "The moderate abundance of Taylor's checkerspot on the Settlement Lands, and Denman Island in general, is apparently a temporary phenomenon resulting from recent large-scale clear-cuts. There is a narrow window of opportunity, over the next 5 years or so, to use that abundance for research, development of management strategies, and for re-locating live larvae and/or adults to establish new populations elsewhere. Once the clear-cut populations decline as a result of forest regeneration, such activities will become increasingly difficult and perhaps impossible." It is now nearly 7 years since that was written and an opportunity has now arisen to establish a Butterfly Reserve on the Settlement Lands as well as on other private properties on Denman and the newly establish Denman Island Provincial Park.

Location and Description

The legal description of the property

1) W ½ of NE ¼ Section 21
   PID 006-657-656 except part in Plan VIP 78186 (20 meter strip along the west side for new access road)
   80 acres
   Zoned: Silviculture
2) E ½ of NE ¼ Section 21
   PID 006 - 639 - 771
   80 acres
   Zoned: Silviculture and Site specific agriculture

The Settlement Lands is located in the north-central part of Denman Island, south of Chickadee Lake and north and east of a forest and wetland area including parts of the new Denman Island Provincial Park and the Inner Island Nature Reserve a conservation zone area owned by the Islands Trust Fund and managed by the DCA. To the east is an area of farmland which provides an open corridor to other areas of the provincial park where Taylor's checkerspot continue to live (Page, 2014).

The Settlement Lands property became the property of Denman Conservancy Association in 2007. This recently clear cut area (in 1999) is being documented and a Management Plan for its protection and possible recreational use will be developed soon. There is an ecological overview of the property (Balke, 2007). The following text is from the summary of that document and provides a concise picture of the property at that time:

> "This ecologically complex site is situated in the Coastal Douglas-fir moist maritime biogeoclimatic subzone, (CDFmm). The site consists of a large area of residual and regenerating forests, major wetland complexes, and pronounced slopes with rock outcrops. The forest on this site was one of Denman's most significant old-growth Douglas-fir *Pseudotsuga menziesii* forest remnants. Most of the old growth Douglas-fir trees remain; however, the majority of second-growth forest cover was removed during "messy" clear-cut logging in 1999-2000 and the current forest is regenerating. Skid roads and landings are left from the recent logging and an orchard of old apples trees and sections of split rail fence remain from the original homestead.
>
> The wetlands are many and varied. The two large wetlands, Pickles Beaver Pond and the swale are components of the headwaters of Denman's largest Class A salmon stream, Beadnell Creek. Smaller sedge wetlands are isolated pockets in the Uplands and other areas. The slopes are NE and SW facing and range from approximately 5 to 30 m in height. Rock outcrops and their unique flora are found on the slopes, particularly the ridge crests in several locations.

A nationally significant COSEWIC[11] endangered butterfly, the Taylor's checkerspot *Euphydryas editha taylori* is found on this site. Provincially important wildlife species include the blue-listed Cutthroat trout *Oncorhynchus clarki clarki* and Red-legged frog *Rana aurora*. Locally uncommon plant species for Denman that reflect the site diversity include Falsebox *Pachistima myrsinites*, Sitka spruce *Picea sitchensis* and Red osier dogwood *Cornus stolonifera.*

Minimizing disturbance, particularly to the habitat and survival of the endangered butterfly is of primary concern. Monitoring the survival and investigating the food requirements of this butterfly is needed. Other significant issues include the removal of introduced species such as broom and St. John's Wort, monitoring and protecting water levels and quality, and removing dumped material.

This site provides a key link in a network of protected areas on north Denman by connecting seven other important properties into a continuous corridor. The site also contributes a substantial area of land in diverse habitat types."

Since that report was written, the blue listed butterfly, the Dun skipper (*Euphyes vestris*) has been observed on the property (Guppy, 2007) as has the BC, blue listed dragonfly the Western pondhawk (*Erythemis collocata*) (Fyson, unpublished observations) which is a COSEWIC threatened species. In all, Guppy (2007) found 17 butterfly species on the Settlement Lands, listed in Table 1. The Woodland skipper (*Ochlodes sylvanoides*) is also found on the property but flies later in the summer than Guppy's visits.

Table 1. Butterfly species reported by Guppy (2007) for the Settlement Lands

Common Name	**Latin Name**
Anise swallowtail	*Papilio zelicaon*
Arctic skipper	*Carterocephalos palaemon*
Cedar hairstreak	*Mitoura rosneri*
Dun skipper	*Euphyes vestris*
Grey hairstreak	*Strymon melinus*
Hydaspe fritillary	*Speyeria hydaspe*
Lorquin's admiral	*Limenitis lorquini*
Margined white	*Pieris marginalis*
Mylitta crescent	*Phyciodes mylitta*
Silvery blue	*Glaucopsyche lygdamus*
Pale swallowtail	*Papilio eurymedon*
Roadside skipper	*Amblyscirtes vialis*
Spring azure	*Celastrina echo*
Two-banded checkered skipper	*Pyrgus ruralis*
Taylor's checkerspot	*Euphydrys editha taylori*
Western elfin	*Incisalia iroides*
Western tiger swallowtail	*Papilio rutulus*

The fauna list from Balke (2007) and a list of plants found in the Settlement Lands (Fyson, unpublished data as part of a baseline study (2009)) are found in Appendix 2 and 3 respectively.

[11] COSEWIC Committee on the Status of Endangered Wildlife in Canada.

Taylor's Checkerspot on the Settlement Lands

The Taylor's checkerspot butterfly was first seen on Denman on this property by Jenny Balke in 2005, 5 years after its declared extinction on neighbouring Hornby Island. Denman Island remains the only known breeding area for this species in Canada.

Larvae and adults were found in 2006. A survey of breeding sites and adult Taylor's checkerspots were carried out by Guppy in 2007. This was a very good year for the species and young larvae, indicative of local breeding, were found in 5 separate areas of the property. Adult checkerspots were also surveyed and were common in the north-western quarter and the north eastern corner in the same general areas as the larvae.

The authors of the current report monitored the property for Taylor's checkerspot in subsequent years. The breeding sites mentioned by Guppy (2007) were occupied in 2008 and some in 2009. There was a dramatic decline in Taylor's checkerspot numbers all over the Denman Island known distribution from 2008 to 2009 and numbers have remained low up to the present (see Map x, Page, 2014). No breeding sites have been found on the Settlement Lands since 2009.

The presence of breeding population of Taylor's checkerspot on the Settlement Lands continued in 2008 when post-diapause larvae and adult butterflies eggs and young larvae. Post diapause larvae were observed in March and April, feeding on Ribwort plantain on sunny old skid roads. Oviposition and the feeding of young larvae (to instar 4) was observed on Marsh speedwell in a wetland area. Larval nests (young larval colonies) were also observed in other wetlands on the property in 2008.

Breeding was confirmed again in 2009. Thereafter, no larval nests or post diapause larvae have been observed on the Settlement Lands. One or two adults were observed on the Settlement Lands (north west area) in 2010 and one individual in the north east corner in 2012.

Among other recommendations by Guppy (2007) was that a management plan for Taylor's checkerspot be made for the butterfly on the Settlement Lands involving "two stable population centres"
Guppy recommended the following for Taylor's checkerspot and Dun skipper conservation on the Settlement Lands

RECOMMENDATIONS

1. Develop a management plan for Taylor's checkerspot on the Settlement Lands – the area is large enough for at least two stable population centres, one in the orchard area and one in the Central Road area. Management should be on a "progressive improvement" model, and incorporate monitoring of management impacts. Appendix 1 provides some initial suggestions to consider when developing the management plan, and will undoubtedly need further work.

2. Research – Taylor's checkerspot diapause larvae: Determine the state of the ribboned larval sites through fall and winter, especially with respect to flooding and the condition of the larval foodplants.

3. Research – Taylor's checkerspot post-diapause larvae: Determine the state of the ribboned larval sites in the spring, especially with respect to flooding and the condition of the larval foodplants. Document the activities of post-diapause larvae.

4. Research – Taylor's checkerspot oviposition: Determine the nature of oviposition behaviour, and any apparent characteristics of preferred oviposition micro-sites. This should be possible now that the reproductive areas have been determined.

5. Research – Dun Skipper: Conduct a basic research project, similar to the present project, for the Dun Skipper. Field research should be limited to adults, with the option to rear in captivity one or

more larvae should oviposition be observed (larvae are probably too difficult to locate in the field). Adult field time will need to be greater than was needed for Taylor's checkerspot, because Dun Skippers have low density populations and are difficult to visually locate and follow.

6. Inventory – Dun Skipper: Conduct a basic inventory project on Denman Island focussed on the Dun skipper. Field time will need to be greater than was needed for Taylor's checkerspot and needs to be very species-focussed, because Dun Skippers have low density populations and are difficult to visually locate.

7. Inventory – Taylor's Checkerspot and its habitat: Conduct an intensive inventory project on the east coast of central Vancouver Island (Nanaimo to Campbell River) for Taylor's checkerspot and its habitat. The objective should be to (1) determine if the checkerspot occurs in that area; and (2) identify areas of potentially suitable habitat, as potential introduction sites.

The current report marks the start of implementation of some of these recommendations.

Selection of the Butterfly Reserve Area

Searches were undertaken in 2013 to find potential areas of Settlement Lands for a reserve for sustainable maintenance of conditions favourable for Taylor's checkerspot as recommended by Guppy (2007).

The original site to the west of Central Road is now much shaded by young Red alder trees. Although the food plant, Marsh speedwell is still present in small quantities in the wetland here, this and the neighbouring grassy area are now shaded and it is unlikely that even with extreme management measures (Cutting trees etc) conditions suitable for the butterfly will be recovered. An area in the north west of the Settlement Lands where Guppy (2007) reported breeding colonies of Taylor's checkerspot are also now too shady for the species.

An area in the north east near an old abandoned orchard remains largely open but there is little suitable breeding habitat here and the site is relatively difficult to get to for management and monitoring activities.

The area to the east of Central Road (Figures 1 and 2) contains two wetlands identified as breeding sites in Guppy's study (Guppy, 2007). The author considered this area as a suitable site to "Manage as vernal pool/wetland reproductive habitat." The 2 small wetlands have remained little changed since that study. They remain open and sunny. Along their edges are both mature but small trees (Red alder, Western red Cedar, Douglas fir) and also a few young Red alder trees. Between the two wetlands is an area with many young trees which have grown since the clear cutting of 1999-2000 and are generally less than 5 m in height. There is an extensive shrub layer of salal and bracken fern. There remain several logging roads in the area which maintain an open grassy character and would provide nectaring area for adult butterflies. An area was chosen containing the 2 wetlands and open areas in between as a butterfly reserve. As suitable nectaring areas, the reserve contains logging roads which without active management will provide nectaring areas for 5-10 years. Some ribwort plantain (*Plantago lanceolata*) is present which may provide a larval foodplant in addition to the Marsh speedwell in the wetlands. Post diapause larvae are usually observed feeding on this species in the spring. It is possible that this species requires the presence of both marsh speedwell and Ribwort plantain in fairly close proximity to survive. The chosen area meets this criterion.

A suitable area was marked out by GPS and the boundaries marked with flagging tape. The chosen area is shown in Figures 1 and 2 and the UTM coordinates of the boundary in Appendix 3. The boundaries were chosen such that the reserve contained

- Suitable breeding areas with Marsh speedwell and not too wet in summer for oviposition and feeding by larvae.
- Suitable sheltered habitat for pupation, overnight survival and survival of larvae through diapause from July to April.

- Areas with food plants available for post diapause larvae in the spring when the Marsh speedwell is generally under water
- Open grassy nectaring and sunning area for adult butterflies in May and early June. The area has Woodland strawberry (*Fragaria vesca*) and Trailing blackberry (*Rubus ursinus*) for early season nectaring. It also has Hairy cat's ear (*Hypochaeris radicata*) and Oxeye daisy (*Leucanthemum vulgare*) among other species for late season nectaring

The total area of the reserve is 2.24 ha.

Photographs of the selected Butterfly Reserve are shown in Figure 3-14.

Description of wetland areas

Northern Wetland

The northern wetland has an area of approximately 540 m^2. The vegetation is dominated by Slough sedge (*Carex obnupta*). At the time or the survey (February-March, 2014), there was much standing water with a depth mostly of 15-30 cm. There is no standing water here in summer. During the survey, Marsh speedwell was found to be abundant and completely underwater. The presence of Pacific water parsley (*Oenanthe sarmentosa*) was also noted. There is much wood waste scattered across the wetland which provides ideal location for sunning and resting of Taylor's checkerspot larvae.

The edges of the wetland were marked by a sharp transition from Slough sedge to Salal. A number of mature Western red cedars, Douglas firs and Red alders (i.e dating from before the clear cutting of 1999) grow around the edge of the wetland. A number of young Red alders, dating from after the clear cutting are also present.

Southern Wetland

The southern wetland has an area of approximately 240 m^2. The vegetation is dominated by Slough sedge. At the time of the survey (February-March, 2014), there was standing water to a depth of 15 cm, i.e. less deep than the northern wetland. There is usually no standing water here in summer. There is much wood waste scattered in the wetland.

On the south, west and north sides of the wetland are a number of young Red alders which will likely continue to grow and pose a threat of shading the wetland and altering its hydrology.

The Butterfly Reserve will provide protection for threatened and endangered species in addition to the Taylor's checkerspot. These include the Red legged frog (*Rana aurora*), the Western pondhawk (*Erythemis collocata*) and the Dun skipper (*Euthyes vestris*), all of which have been seen on the Settlement Lands and may find suitable and sustainable breeding habitat in the Butterfly Reserve wetlands. The BC yellow listed (threatened) Common nighthawk (*Chordeiles minor*) has bred in the landing area to the south of the Butterfly Reserve in recent years.

Connectivity

A key to the long-term success in providing a sustainable home for the Taylor's checkerspot butterfly may be the presence of connecting corridors which enable the insects to fly from one breeding and nectaring area to another. Such corridors need to be sunny and therefore fairly wide as well as sustainable. The butterflies are able to fly over tall trees but how far is unknown and unlikely more than a few hundred meters.

The area between the reserve and Central Road is not included in the reserve because of ongoing disturbance through road-related activities. However this area has few young trees and will remain a corridor for butterflies for many years. Central Road itself is a non-gazetted gravel road and a popular sunning area for Taylor's checkerspot butterflies in the past. It also provides a connector to the large, open wetland area to the south which in turn connect to Taylor's checkerspot breeding sites and potential breeding sites to the south including the Butterfly Reserves of Central Park and Middle Farm.

To the east of the Settlement Lands Butterfly Reserve (Figure 1) is a bluff and beyond that a corridor of wetland, and grassy meadow area connecting to the pasture lands and meadows of the Swale, a corner of which is just within the Settlement Lands property. These grassy area in turn connect to the clear-cut areas of the Denman Island Provincial Park which retains Taylor's checkerspot breeding sites.

7.2.2 Management Plan

This management plan provides guidance for the documentation, monitoring and maintenance of habitat for the Taylor's checkerspot butterfly and associated rare and threatened species. It will be in accordance with the accompanying document "Guide to Stewardship of Taylor's checkerspot, *Euphydryas editha taylori* on Denman Island" A Management Plan for the Settlement Lands will be prepared in the coming months. The plan for the reserve will be incorporated into that larger plan. Before it is implemented it will require the consent of the local DCA Settlement Lands committee, the DCA board and input from the public through a public meeting.

The following actions will be carried out in the Butterfly Reserve areas. In the following management proposal, the action items are followed by the timing of the activity: whether the action needs to be done *e.g.* in 2014 = *URGENT* and whether the action needs to be done every year or only once.

Documentation

- A detailed map will be made of physical features and habitats of the reserve. *To be carried out by DCA Lands Manager and other knowledgeable local biologists. MIDDLE-TERM*
- An inventory of biota will be carried out (in particular, butterflies, dragonflies, birds, amphibians, reptiles, mammals, flowering plants, gymnosperms and ferns). *To be carried out in March and April by DCA Lands Manager and other knowledgeable local biologists. MIDDLE TERM*
- The trees will be mapped and classified by age (pre and post 1999 clear cutting etc.). *To be carried out in March and April by DCA Lands Manager and other knowledgeable local biologists. MIDDLE TERM*

Monitoring activities

- Annual monitoring of open grassy areas for post diapause Taylor's checkerspot larvae. *To be carried out in March and April by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*
- Annual survey of Taylor's checkerspot and other butterflies. *To be carried out in May and early June by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*
- Annual survey of wetlands for Taylor's checkerspot pre-diapause larval (larval webs). *To be carried out in June and July by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*
- Annual survey for invasive alien plants. *To be carried out by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*

Removal of Undesirable Plants which may be detrimental to Taylor's checkerspot population

- Control of invasive aliens-Scotch broom will be removed through pulling and cutting to ground level. *Surveys will be carried out every other year and Scotch broom plants removed by supervised,volunteer work parties, preferably in May when the plants are most easily killed and there is the least likelihood of Taylor's Checkerspot larvae on the ground. URGENT, ANNUAL*
- Holly (*Ilex aquifolium*) will be removed through cutting and pulling. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT, ANNUAL*
- Reed canarygrass appearing in the reserve will be removed. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT, ANNUAL.*
- Bracken fern will be pulled from grassy, potential butterfly-nectaring areas. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT ANNUAL.*
- Tree saplings will be cut in grassy, potential butterfly-nectaring areas. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT, ANNUAL*

Enhancement of Taylor's checkerspot habitat

- Spreading seeds and plants of Ribwort plantain, a Taylor's checkerspot foodplant, in open sunny areas. *Seed will be collected locally and plants grown in pots in gardens by volunteers. MIDDLE-TERM*
- Spreading seeds/planting native nectaring plants such as Woodland strawberry and Creeping blackberry in open sunny area *Seed will be collected locally and plants grown in pots in gardens by volunteers. MIDDLE-TERM*
- Planting Marsh speedwell in the wetlands to provide greater oviposition and larval feeding potential. *Plants will be grown in pots from locally collected cuttings by volunteers. MIDDLE-TERM*

Signage and boundary markers

- No boundary markers will be used as these will encourage hikers to enter the site to the detriment of the Taylor's checkerspot (trampling of larvae, food plants etc)
- An information sign about Taylor's checkerspots, their life cycle, history and conservation measures on Denman Island should be erected at the parking site at the bend in Central Road to the south of the Butterfly Reserve. *The sign will be designed and erected by local craftsmen. MIDDLE-TERM*

Education and research

- *In conjunction with other Taylor's checkerspot reserves described in this report and in conjunction with the DCA outreach committee, nature walks and talks will be conducted by local experts explaining the importance of conserving the Taylor's checkerspot and other threatened and endangered species and how the creation of protected area within the DCA and other private lands. URGENT, ANNUAL*
- There is already some expertise in the culture and transplanting of Taylor's checkerspot food and nectaring plants on Denman Island. *Further development of horticultural techniques and the possible establishment of a small native plant nursery by the DCA will be undertaken. MIDDLE-TERM*

Recreational activities

- No trails will run through or near the Butterfly Reserve as this would be detrimental to Taylor's checkerspot survival.

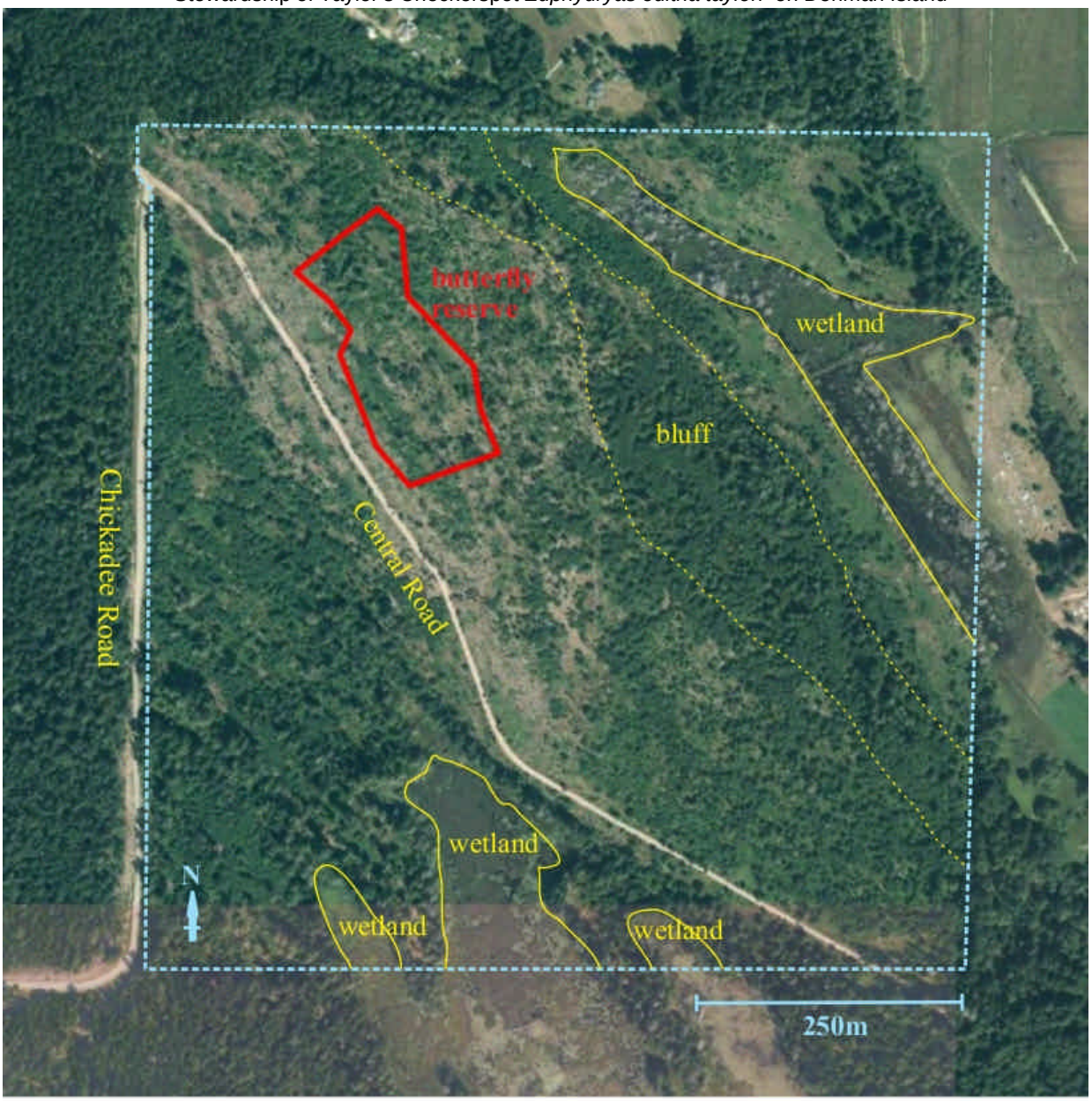

Figure 1.The Settlement Lands
Location of the Butterfly Reserve, roads, bluff and major wetlands. The Butterfly Reserve has an area of 2.24 ha

Figure 2. Settlement Lands Butterfly Reserve
Location of wetlands and other habitat features

Appendix 1. Fauna of the Settlement Lands from Balke (2007). Inner Forest Marsh Reserve was an earlier name applied to the property.

Fauna Identified on Inner Forest Marsh Reserve			
FAMILY	**GENUS & SPECIES**		**RARITY**
	Latin Name	Common Name	
MAMMALS			
INSECTIVORES - undoubtedly present but unrecorded			
BATS - undoubtedly present but unrecorded			
RODENTS			
Small mammal burrows seen - probably voles			
Castoridae - Beavers	*Castor canadensis*	Beaver	
Sciuridae - Squirrels	*Tamiasciurus hudsonicus*	Red squirrel	
CARNIVORES			
Unknown carnivore scats with hair seen on several occassions			
Mustelidae - Mustelids	*Lutra canadensis*	River otter	
EVEN-TOED UNGULATES			
Cervidae - Cervids	*Odocoileus hemionus columbianus*	Black-tailed deer	
BIRDS			
Podicipedidae - Grebes	*Podilymbus podiceps*	Pied-billed Grebe	
Anatidae - Swan, geese, Ducks	*Cygnus buccinator*	Trumpeter Swan	
	Branta canadensis	Canada Goose	
	Aix sponsa	Wood Duck	
	Anas platyrhynchos	Mallard	
	Anas clypeata	Northern Shoveler	
	Aythya collaris	Ring-necked Duck	
	Bucephala albeola	Bufflehead	
	Lophodytes cucullatus	Hooded Merganser	
Cathartidae - New World Vultures	*Cathartes aura*	Turkey Vulture	
Accipitridae - Kites, Eagles, Harriers	*Haliaeetus leucocephalus*	Bald Eagle	
	Buteo jamaicensis	Red-tailed Hawk	
Phasianidae - Pheasants, Grouse, Turkeys	*Phasianus colchicus*	Ring-necked Pheasant	introduced
Strigidae - Typical Owls	*Strix varia*	Barred Owl	
Trochilidae - Hummingbirds	*Selasphorus rufus*	Rufous Hummingbird	
Alcedinidae - Kingfishers	*Ceryle alcyon*	Belted Kingfisher	
Picidae - Woodpeckers	*Sphyrapicus ruber*	Red-breasted Sapsucker	
	Picoides pubescens	Downy Woodpecker	
	Picoides villosus	Hairy Woodpecker	
	Colaptes auratus	Northern Flicker	
	Dryocopus pileatus	Pileated Woodpecker	
Tyrannidae - New World Flycatchers	*Contopus borealis*	Olive-sided Flycatcher	
	Empidonax hammondii	Hammond's Flycatcher	
	Empidonax difficilis	Pacific-slope Flycatcher	
Hirundinidae - Swallows	*Tachycineta bicolor*	Tree Swallow	
	Tachycineta thalassina	Violet-green Swallow	
Corvidae - Crows, Jays	*Corvus caurinus*	Northwestern Crow	
	Corvus corax	Common Raven	

Paridae - Chickadees, Bushtits	*Parus rufescens*	Chestnut-backed Chickadee	
	Psaltriparus minimus	Bushtit	
Sittidae - Nuthatches	*Sitta canadensis*	Red-breasted Nuthatch	
Certhiidae - Creepers	*Certhia americana*	Brown Creeper	
Troglodytidae	*Thryomanes bewickii*	Bewick's Wren	
	Troglodytes troglodytes	Winter Wren	
	Cistothorus palustris	Marsh Wren	
Muscicapidae - Kinglets, Thrushes	*Catharus ustulatus*	Swainson's Thrush	
	Ixoreus naevius	Varied Thrush	
	Regulus satrapa	Golden-crowned Kinglet	
	Turdus migratorius	American Robin	
Bombycillidae - Waxwings	*Bombycilla cedrorum*	Cedar Waxwing	
Sturnidae - Starlings	*Sturnus vulgaris*	European Starling	introduced
Vireonidae - Vireos	*Vireo gilvus*	Warbling Vireo	
Parulinae - Wood Warblers	*Vermivora celata*	Orange-crowned Warbler	
	Dendroica coronata	Yellow-rumped Warbler	
	Geothlypis trichas	Common Yellowthroat	
Thraupinae - Tanagers	*Piranga ludoviciana*	Western Tanager	
Emberizinae - Towhees, Sparrows	*Pipilo erythrophthalmus*	Spotted Towhee	
	Spizella passerina	Chipping Sparrow	
	Passerella iliaca	Fox Sparrow	
	Melospiza melodia	Song Sparrow	
	Zonotrichia atricapilla	Golden-crowned Sparrow	
	Zonotrichia leucophrys	White-crowned Sparrow	
	Junco hyemalis	Dark-eyed Junco	
	Agelaius phoeniceus	Red-winged Blackbird	
	Carduelis pinus	Pine Siskin	
AMPHIBIANS			
Salamandridae - Newts	*Taricha granulosa*	Rough-skinned Newt	
Ambystomidae - Mole salamanders	*Ambystoma gracile*	Northwestern Salamander	
Hylidae - Treefrogs	*Pseudacris regilla*	Pacific Treefrog	
Ranidae - Frogs	*Rana aurora*	Red-legged Frog	BLUE-listed
FISH fresh water & anadramous			
Salmonidae - Salmon & Trout	*Oncorhynchus clarki clarki*	Coastal Cutthroat Trout	BLUE-listed
Gasterosteidae - Sticklebacks	*Gasterosteus aculeatus*	Three-spined Stickle Back	
INVERTEBRATES - only a few known butterfly species included here			
BUTTERFLIES			
Hesperiidae - Skippers	*Pyrgus ruralis*	Two Banded Checkered Skipper	
	Phyciodes mylitta.	Mylitta Crescent	
Nymphalidae	*Euphydryas editha taylori*	Taylor's Checkerspot	**COSEWIC: Endangered**
	Nymphalis antiopa	Mourning Cloak	
Lycaenidae	*Incisalia iroides*	Western Elfin	
	Mitoura rosneri	Cedar Hairstreak	

Appendix 2. Settlement Lands Plant Species - June 2009

Abies grandis	Grand fir	**Cytisus scoparius*	Scotch broom
Acer macrophyllum	Big-leaf maple	**Dactylis glomerata*	Cock'sfoot grass
Achillea millifolium	Yarrow	*Dicentra formosa*	Pacific bleeding-heart
Achlys triphylla	Vanilla leaf	*Dryopteris expansa*	Spiny wood fern
Adenocaulon bicolor	Pathfinder	*Eleocharis palustris*	Common spike-rush
**Agrostis stolonifera*	Creeping bentgrass	*Epilobium angustifolium*	Fireweed
**Aira caryophyllea*	Silver hair grass	*Epilobium ciliatum*	Purple-leaved willowherb
**Aira praecox*	Spring hair grass	*Epilobium sp.*	Willowherb
Alnus rubra	Red alder	*Equisetum arvense*	Common horsetail
Anaphalis margaritacea	Pearly everlasting	*Equisetum telmateia*	Giant horsetail
Anemone lyallii	Lyall's anemone	*Festuca pratensis*	Meadow fescue
**Anthoxanthum odoratum*	Sweet vernal grass	*Festuca rubra*	Red fescue
Aquilegia formosa	Sitka columbine	*Fragaria vesca*	Wild strawberry
Arbutus menziesii	Arbutus	*Galium aparine*	Cleavers
Asarum caudatum	Wild ginger	*Galium triflorum*	Sweet-scented bedstraw
Athyrium filix-femina	Lady fern	*Gaultheria shallon*	Salal
Boschniakia hookeri	Vancouver groundcone	*Geranium molle*	Dove's foot cranesbill
**Bromus inermis*	Smooth brome	*Geranium robertianum*	Herb robert
**Bromus hordeaceus*	Soft brome	*Geum macrophyllum*	Large-leaved avens
Bromus vulgaris	Columbia brome	*Glyceria sp.*	Mannagrass
Bromus sitchensis	Alaska brome	*Gnaphalium palustre*	Lowland cudweed
Campanula scouleri	Scouler's harebell	*Heuchera micrantha*	Small-flowered alumroot
Cardamine oligosperma	Little western bitter-cress	*Hieracium albiflorum*	White hawkweed
Carex deweyana	Dewey's sedge	**Holcus lanatus*	Yorkshire fog
Carex exsiccata	Inflated sedge	*Holodiscus discolor*	Oceanspray
Carex obnupta	Slough sedge	*Hypochaeris radicata*	Hairy cat's ear
Carex spp. (6 species)		**Ilex aquifolium*	Holly
Cerastium fontanum	Mouse-ear chickweed	*Juncus effusus*	Common rush
Chimaphila umbellata	Pipsissewa	*Juncus ensifolius*	Dagger-leaf rush
**Cirsium arvense*	Canada thistle	**Lactuca muralis*	Wall lettuce
Cirsium brevistylum	Short-styled thistle	**Lathyrus sylvestris*	Everlasting pea
**Cirsium vulgare*	Bull thistle	*Lemna minor*	Common duckweed
Claytonia perfoliata	Miner's lettuce	**Leucanthemum vulgare*	Oxeye daisy
Claytonia sibirica	Siberian miner's lettuce	*Linnaea borealis*	Twinflower
**Digitalis purpurea*	Foxglove	*Lonicera ciliosa*	Orange honeysuckle
Collomia heterophylla	Vari-leaved collomia	**Lapsana communis*	Nipplewort
Cornus nuttallii	Pacific dogwood	*Luzula multiflora*	Many-flowered woodrush
**Crataegus monogyna*	Hawthorn	*Luzula parviflora*	Small-flowered woodrush
**Crepis capillaris*	Smooth hawksbeard	*Lysichiton americanum*	Skunk cabbage

*Non-native species

Appendix 2. Settlement Lands Plant Species June 2009 continued.

Mahonia aquifolium	Tall Oregon grape	*Ranunculus acris*	Field buttercup
Mahonia nervosa	Dull Oregon grape	*Ranunculus repens*	Creeping buttercup
Malus fusca	Pacific crab apple	*Ranunculus uncinatus*	Small-flowered buttercup
**Matricaria matricarioides*	Pineapple weed	*Ribes divaricatum*	Coastal black gooseberry
Mentha arvensis	Field mint	*Sambucus racemosa*	Red elderberry
Microsteris gracilis	Pink twink	*Sanicula crassicaulis*	Pacific sanicle
Mimulus moschatus	Monkey flower	*Satureja douglasii*	Yerba buena
Moehringia macrophylla	Big-leaved sandwort	*Schoenoplectus tabernaemontani*	Soft-stemmed bulrush
**Myosotis discolor*	Common forget-me-not	*Scutellaria galericulata*	Marsh skullcap
**Myosotis scorpioides*	European forget-me-not	**Senecio sylvaticus*	Wood groundsel
Nemophila parviflora	Small-flowered nemophila	*Solidago canadensis*	Canada goldenrod
Nuphar polysepalum	Yellow water lily	**Sonchus asper*	Prickly sow-thistle
Oenanthe sarmentosa	Pacific water parsley	*Sparganium angustifolium*	Narrow-leaved bur-reed
Osmorhiza berteroi	Mountain sweet cicely	*Spiraea douglasii*	Hardhack
**Phalaris arundinacea*	Reed canarygrass	*Stachys chamissonis*	Cooley's hedgenettle
Pinus monticola	Western white pine	*Stellaria calycantha*	Northern starwort
**Plantago lanceolata*	Ribwort plantain	*Stellaria crispa*	Crisp starwort
**Plantago major*	Broad-leaved plantain	*Symphoricarpos mollis*	Common snowberry
Poa palustris	Fowl bluegrass	*Symphoricarpus hesperius*	Creeping snowberry
**Poa pratensis*	Kentucky bluegrass	**Tanacetum vulgare*	Tansy
Polystichum munitum	Sword fern	**Taraxacum officinale*	Dandelion
Potamogeton natans	Floating pondweed	*Thuja plicata*	Western red cedar
Potamogeton richardsonii	Richardson's pondweed	*Tiarella trifoliata*	Three-leaved foamflower
Prunella vulgaris	Self-heal	*Trientalis latifolia*	Northern starflower
Prunus sp.	Plum	**Trifolium dubium*	Small hop-clover
Pseudotsuga menziesii	Douglas fir	**Trifolium repens*	White clover
Ribes lobbii	Gummy gooseberry	*Tsuga heterophylla*	Western hemlock
Ribes sanguineum	Red flowering current	*Typha latifolia*	Cat-tail
Rosa gymnocarpa	Baldhip rose	*Urtica dioica*	Stinging nettle
Rosa nutkana	Nootka rose	*Utricularia vulgaris*	Bladderwort
**Rubus armeniacus*	Himalayan blackberry	*Vaccinium parviflorum*	Red huckleberry
**Rubus laciniata*	Evergreen blackberry	*Vaccinium ovatum*	Evergreen huckleberry
Rubus leucodermis	Black raspberry	*Veronica beccabunga*	American brooklime
Rubus parviflorum	Thimbleberry	*Veronica scutellata*	Marsh speedwell
Rubus spectabilis	Salmonberrry	*Veronica serpyllifolia*	Thyme-leaved speedwell
Rubus ursinus	Trailing blackberry	**Vicia hirsuta*	Hairy vetch
**Rumex acetosella*	Sheep's sorrel	**Vicia lathyroides*	Spring vetch
Rumex aquaticus	Western dock	**Vicia sativa*	Common vetch
Salix sp.	Willow	**Vinca major*	Greater periwinkle
Pteridium aquifolium	Bracken	*Viola sempervirens*	Trailing yellow violet

*Non-native species

Appendix 3. GPS (UTM) coordinates of the Settlement Lands Butterfly Reserve

Waypoint	Time of logging	UTM coordinates
SL01	07-MAR-14 14:14:00	10 U 369237 5490681
SL02	07-MAR-14 14:19:42	10 U 369216 5490708
SL03	07-MAR-14 14:22:39	10 U 369185 5490735
SL04	07-MAR-14 14:33:53	10 U 369231 5490772
SL05	07-MAR-14 14:40:18	10 U 369273 5490794
SL06	07-MAR-14 14:45:13	10 U 369284 5490776
SL07	07-MAR-14 14:51:59	10 U 369289 5490712
SL08	07-MAR-14 14:58:45	10 U 369351 5490647
SL09	07-MAR-14 15:01:00	10 U 369358 5490607
SL10	07-MAR-14 15:02:59	10 U 369374 5490566
SL11	11-MAR-14 12:22:32	10 U 369325 5490544
SL12	07-MAR-14 15:10:10	10 U 369291 5490536
SL13	07-MAR-14 15:15:39	10 U 369260 5490573
SL14	07-MAR-14 15:18:08	10 U 369244 5490612
SL15	07-MAR-14 15:20:56	10 U 369226 5490658

7.3 Denman Conservancy Association's Central Park Draft Taylor's Checkerspot Stewardship Plan

7.3.1 Introduction

The Taylor's checkerspot (*Euphydryas editha taylori*) butterfly was first found on Denman Island in 2005. Surveys in 2007 (Guppy, 2007) and 2008 (Page, 2008) found the species to be widespread and frequent in one meadow area and in open regenerating forest areas (clear cut in 1997-2000). From 2009 on there has been a dramatic decline in numbers and distribution. Efforts are under way to protect this species both in the newly designated Denman Island Provincial Park and in private lands including lands owned and managed by the Denman Conservancy Association. On two such lands, Central Park and Settlement Lands, areas are being set aside for the stewardship of habitat that has supported Taylor's checkerspot in the past and have characteristics to sustain breeding populations of the butterfly. A Management Plan for 3 areas in Central Park is described below.

Location and Description

PID 006-639-411
The NE ¼ of Section 17, Denman Island, Nanaimo District except those parts in Plans 14174 and 17286 adjoining Denman Road and North Central Road on Denman Island.
Zoned agricultural

The DCA acquired Central Park in September of 2006 through the efforts of Denise and Boyd MacKean and many generous donations. The 60 ha property in the middle of Denman Island on Denman Road was clear-cut in 1997-2000. It has been naturally regenerating since then. The description here and much more background information is found in the Ecological Overview (Balke, 2006) and the Management Plan (DCA, 2009) and on the DCA website (www.denmanconservancy.org) . The local Central Park committee was consulted on choosing area suitable for a butterfly reserve and offered suggestion with respect to management. An update of the Management Plan incorporating the Butterfly Reserve will be produced in the coming year.

Central Park is strategically located within a protected corridor of wetlands and forest habitat. The parcel has three narrow wetlands aligned north-west to south-east across the property (Figure 1). The most westerly, Graveyard Marsh is bounded on its east side by a bluff (Beaufort Lookout). The areas adjacent to Logging roads and the landings from the 1990s logging operations are colonized by Red alders (*Alnus rubra*). The logging roads are now used as trails. Other areas of the property are being gradually reforested through natural generation mostly conifers. Some open sunny areas remain with remnant woodland vegetation, mostly Salal (*Gaultheria shallon*) and grassy areas, many colonized by Bracken fern (*Pteridium aquilinum*).

Taylor's Checkerspot Butterfly in Central Park

The Taylor's checkerspot butterfly was first seen on Denman on the nearby Settlement Lands by Jenny Balke in 2005, 5 years after its declared extinction on neighbouring Hornby Island. Denman Island remains the only known breeding area for this species in Canada. After three years of relative abundance (2006-2009) numbers of Taylor's Checkerspots have declined dramatically. In 2013, this species was only observed in a few locations in the northern, clear-cut section of Denman Island Provincial Park and on Middle Farm, a property south of Central Park on the opposite side of Denman Road.

In Central Park, no larval nests of Taylor's Checkerspots a definitive indicator of breeding sites, have been found. Post diapause larvae were observed in 2006 and 2007 the north east and south-east corners of the property on trails in the spring. Breeding sites have been confirmed on properties

immediately to the north, south and west of Central Park. Adult Taylor's checkerspots have been observed in open area throughout the park. The last observation was in 2010.

Other Rare, Threatened and Endangered Species in Central Park

The Dun skipper (*Euphyes vestris*) butterfly a BC blue-listed (threatened) species has been observed in the wetland at the north-east corner of the property. The monitoring of and conservation measures for this species are an integral part of the management plan presented below. The larvae of this species are known to feed on sedges (*Carex* spp.) but little in general is known of this species' habitat requirements.

The Red-legged frog BC Blue-listed, is common on Denman Island and has been seen in several wetland areas of Central Park.

The Western pondhawk is a BC Blue-listed (threatened) dragonfly that has been observed in Central Park.

Selection of Butterfly Reserve Areas

Reconnaissance was carried out in February 2014 to find an area suitable for a butterfly reserve providing ideal conditions for a sustainable population of the Taylor's checkerspot.

In the absence of confirmed breeding sites in the past (although they were likely present) areas were sought containing:

- Suitable breeding areas with Marsh speedwell and not too wet in summer for oviposition and feeding by larvae.
- Suitable sheltered habitat for pupation, overnight survival and survival of larvae through diapause from July to April.
- Areas with food plants (Ribwort plantain) available for post diapause larvae in the spring when the Marsh speedwell is generally under water.
- Open grassy nectaring and sunning area for adult butterflies in May and early June. The area has Woodland strawberry (*Fragaria vesca*) and Trailing blackberry (*Rubus ursinus*) for early season nectaring. (first half of May) It also has Hairy cat's ear (*Hypochaeris radicata*) and Oxeye daisy (*Leucanthemum vulgare*) among other species for late season nectaring (Second half of May and early June).
- Connectivity to other breeding and potential breeding sites

Three such areas were found, small in size and in three different parts of Central Park. Following discussion with the DCA Central Park and Lands Committees, it was decided to develop a management plan based on all three areas.

The selected areas are shown in Figure 1 and each in more detail in Figure 2. The boundary was recorded as UTM coordinates by GPS (Garmin 76 smx) and marked with flagging tape. The UTM coordinates are shown in Appendix 1.

The Butterfly Reserve NW is the largest of the areas at 1.24 ha and is bounded on the north side by Long Log Path which is named after the long cedar log which acts as a trail through a wetland area, dominated by Slough sedge (*Carex obnupta*) and with the Taylor's checkerspot foodplant, Marsh speedwell. The Log Path enables hikers to walk through the wetland without damaging the ecosystem or getting their feet wet. For the reserve, it provides an ideal viewing platform. Long Log Path continues along the base of the bluff, within the reserve. The east side of the reserve is on the top of the bluff. The south side cuts through a Salal (*Gaultheria shallon*) area with trees and wetland. The western boundary is the Pickles Road trail. Photographs of this area are available from the authors.

The Butterfly Reserve NE has an area of 0.58 ha and is bounded on the east side by North Central Road, a gravel road with little traffic. The area comprises a grassy meadow, a wetland and an area of Bracken (*Pteridium aquilinum*) , Salal (*Gaultheria shallon*) and Sword fern (*Polystichum munitum*) in between. There are a few trees dating from before the clear cutting of 1999-2000 and younger trees, mainly around the edges of the meadow. There is a small quantity of Scotch broom (*Cytisus scoparius*) and Holly (*Ilex aquifolium*) in the area.

The Butterfly Reserve SW has an area of 0.38 ha and is bounded by other private properties on the south and west sides. To the north and east are more forested areas of Central Park. This Butterfly Reserve area is mostly open meadow with some trees including a group in the centre dating from before the clear-cutting of 1997-2000 and young trees, particularly Douglas fir (*Pseudotsuga menziesii*) and Grand fir (*Abies grandis*), which are mostly around the edges. There is much Dull Oregon grape (*Mahonia nervosa*), which has likely survived since the clear-cutting and does not appear to displacing the sun-loving grasses and other flowering plants of the meadow. There are also patches of Scotch broom and at least one Holly. In the SW corner of the reserve is a wetland which extends into the neighbouring property. This wetland is dominated by Slough sedge and has much Marsh speedwell. There are no footpaths in the Butterfly Reserve SW.

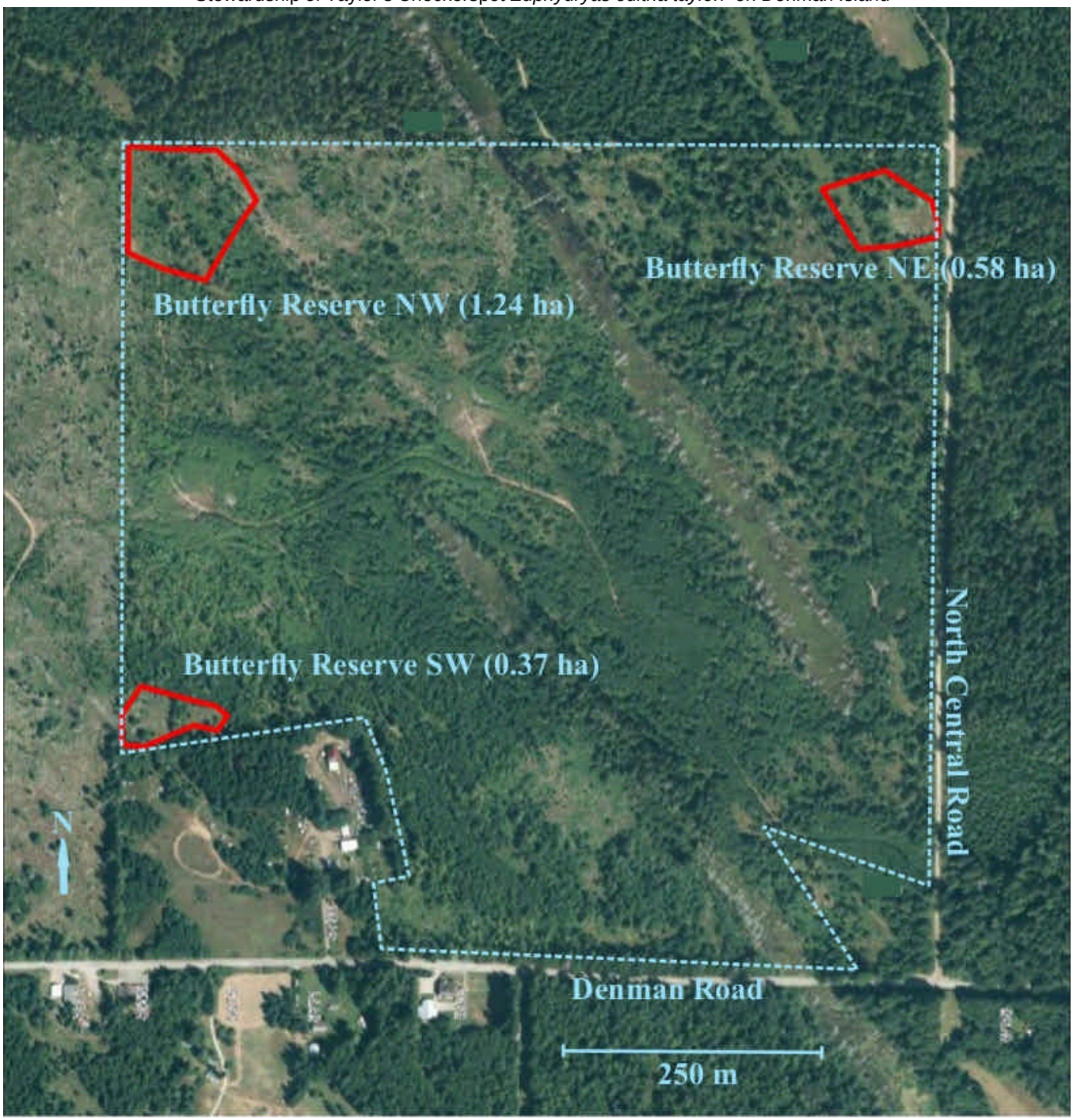

Figure 1. Central Park with Butterfly Reserve Areas
The property boundary is the blue dotted line

Central Park - Butterfly Reserve NW

Area 1.23 ha.
Bounded on west side by Pickles Road Trail and on the north side by Long Log Path which also runs along the foot of the bluff.
A mostly sunny wetland runs from the north west through the south east of the area.
On either side of the wetland are areas of bracken and salal with young trees and some small wetlands.
The bluff slope and the south west corner are grassy meadows.

Central Park - Butterfly Reserve NE

Area 0.58 ha
Bounded on the east by North Central Road, this area includes an open grassy area largely devoid of young trees. Bracken fern, Salal and tree saplings are apparently growing in from the edges.
On the west side is a wetland dominated by Slough sedge and partly shaded by mature trees (pre 1999 clear cutting) on both sides.

Central Park - Butterfly Reserve W

Area 0.37 ha
Mostly open grassy area with some young trees.
In the south west corner is the south eastern end of a wetland which extends north west across the neighbouring property.

Figure 2. Central Park Butterfly Reserve areas

7.3.2 Management Plan

This management plan provides guidance for the documentation, monitoring and maintenance of habitat for the Taylor's checkerspot butterfly and associated rare and threatened species. It will be in accordance with the accompanying document "Guide to Stewardship of Taylor's checkerspot, *Euphydryas editha taylori* on Denman Island" A Management Plan for Central Park will be prepared in the coming months. The plan for the reserve will be incorporated into that larger plan. Before it is implemented it will require the consent of the local DCA Central Park committee, the DCA board and input from the public through a public meeting.

The following actions will be carried out in the Butterfly Reserve areas. In the following management proposal, the action items are followed by the timing of the activity: whether the action needs to be done *e.g.* in 2014 = *URGENT* and whether the action needs to be done every year or only once.

Documentation

- A detailed map will be made of physical features and habitats. *To be carried out by DCA Lands Manager and other knowledgeable local biologists. MIDDLE-TERM*
- An inventory of biota will be carried out (in particular, butterflies, dragonflies, birds, amphibians, reptiles, mammals, flowering plants, gymnosperms and ferns). *To be carried out in March and April by DCA Lands Manager and other knowledgeable local biologists. MIDDLE-TERM*
- The trees will be mapped and classified by age (pre and post 1999 clear cutting etc.). *To be carried out in March and April by DCA Lands Manager and other knowledgeable local biologists. MIDDLE-TERM*

Monitoring activities

- Annual monitoring of open grassy areas for post diapause Taylor's checkerspot larvae. *To be carried out in March and April by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*
- Annual survey of Taylor's checkerspot and other butterflies. *To be carried out in May to July by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*
- Annual survey of wetlands for Taylor's checkerspot pre-diapause larval (larval webs). *To be carried out in June and July by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*
- Annual survey for invasive alien plants. *To be carried out by DCA Lands Manager and other knowledgeable local biologists. URGENT, ANNUAL*

Removal of Undesirable Plants which may be detrimental to Taylor's checkerspot population

- Control of invasive aliens-Scotch broom will be removed through pulling and cutting to ground level. *Surveys will be carried out every other year and Scotch broom plants removed by supervised,volunteer work parties, preferably in May when the plants are most easily killed and there is the least likelihood of Taylor's checkerspot larvae on the ground. URGENT, ANNUAL*
- Holly (*Ilex aquifolium*) will be removed through cutting and pulling. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT, ANNUAL*
- Reed canarygrass appearing in the reserve will be removed. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT, ANNUAL*
- Bracken fern will be pulled from grassy, potential butterfly-nectaring areas. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT, ANNUAL*
- Tree saplings will be cut in grassy, potential butterfly-nectaring areas. *This could be carried out by volunteers in May at the same time as Scotch broom removal. URGENT, ANNUAL*

Enhancement of Taylor's checkerspot habitat

- Spreading seeds and plants of Ribwort plantain, a Taylor's checkerspot foodplant, in open sunny areas. *Seed will be collected locally and plants grown in pots in gardens by volunteers. MIDDLE-TERM*
- Spreading seeds/planting native nectaring plants such as Woodland strawberry and Creeping blackberry in open sunny area *Seed will be collected locally and plants grown in pots in gardens by volunteers. MIDDLE-TERM*
- Planting Marsh speedwell in the wetlands to provide greater oviposition and larval feeding potential. *Plants will be grown in pots from locally collected cuttings by volunteers. MIDDLE-TERM*
- No boundary markers will be used as these will encourage hikers to enter the site to the detriment of the Taylor's checkerspot (trampling of larvae, food plants etc)
- Information sign about Taylor's checkerspots, their life cycle, history and conservation measures on Denman Island will be placed on the information kiosk at the entrance to Central Park on Denman Road. *The sign will be designed and erected by local craftsmen. MIDDLE-TERM*

Education and research

- *In conjunction with other Taylor's checkerspot reserves described in this report and in conjunction with the DCA outreach committee, nature walks and talks will be conducted by local experts explaining the importance of conserving the Taylor's checkerspot and other threatened and endangered species and how the creation of protected area within the DCA and other private lands. URGENT, ANNUAL*
- There is already some expertise in the culture and transplanting of Taylor's checkerspot food and nectaring plants on Denman Island. *Further development of horticultural techniques and the possible establishment of a small native plant nursery by the DCA will be undertaken. MIDDLE-TERM*

Recreational activities

- There are trails on three sides of the NW reserve. The Pickles Road Trail on the west side is a 'multi-use trail allowing use by horseriders and bicycles in addition to hikers. The other trails are for hikers only. *Signage warning people to keep on the path will be posted. URGENT, ONE-OFF*

7.3.3 Appendix

VASCULAR PLANTS OF CENTRAL PARK

FAMILY	Latin Name	Common Name
FERNS CLUBMOSSES HORSETAILS		
Polypodiaceae -Common fern	*Athyrium felix-femina*	Lady fern
	Blechnum spicant	Deer-fern
	Polystichum munitum	Sword fern
	Pteridium aquilinum	Bracken fern
Ophioglossaceae -Adders tongue	*Botrychium multifidum*	Leathery grape fern
GYMNOSPERMS		
Cupressaceae – Cypress	*Thuja plicata*	Western red cedar
Pinaceae – Pine	*Abies grandis*	Grand fir
	Pinus contorta	Lodgepole pine
	Pinus monticola	Western white pine
	Pseudotsuga menziesii	Douglas fir
	Tsuga heterophylla	Western hemlock
MONOCOTYLEDONS		
Alismataceae – Water-plantain	*Alisma plantago-aquatica*	Water-plantain
Araceae – Arum or Calla-lily	*Lysichitum americanum*	Skunk cabbage

Cyperaceae – Sedge	*Carex obnupta*	Slough sedge
Juncaceae – Rush	*Juncus effusus*	Common rush
Lemnaceae – Duckweed	*Lemna minor*	Water duckweed
Poaceae/Gramineae – Grass	*Agrostis stolonifera*	Creeping bentgrass introduced
	Aira caryophyllea	Silver hairgrass introduced
	Aira praecox	Early hairgrass introduced
	Anthoxanthemum odoratum	Sweet vernalgrass introduced
	Dactylis glomerata	Orchardgrass introduced
	Festuca occidentalis	Western fescue
	Holcus lanatus	Yorkshire fog introduced
	Phalaris arundinacea	Reed canarygrass
	Poa annua	Annual bluegrass introduced
Sparganiaceae - Bur-reed	*Sparganium angustifolium*	Narrow-leaved bur-reed
Typhaceae – Cat-tail	*Typha latifolia*	Cat-tail

DICOTYLEDONS

Aceraceae - Maple	*Acer macrophyllum*	Big leaf maple
Apiaceae/Umbelliferae - Carrot	*Daucus carota*	Queen Anne's lace introduced
	Oenanthe sarmentosa	Pacific water-parsley
	Sanicula crassicaulis	Pacific sanicle
Aquifoliaceae – Holly	*Ilex aquifolium*	English holly introduced
Asteraceae – Sunflower	*Achillea millifolium*	Yarrow
	Anaphalis margaritacea	Pearly everlasting
	Bellis perennis	English daisy introduced
	Cirsium arvense	Canada thistle introduced
	Cirsium vulgaris	Bull thistle introduced
	Hypochaeris radicata	Hairy cat's-ear introduced
	Lactuca muralis	Wall lettuce introduced
	Lapsana communis	Nipplewort introduced
	Leucanthemum vulgare	Oxeye daisy introduced
	Solidago canadensis	Canada goldenrod
	Tanacetum vulgare	Common tansy introduced
	Taraxacum officinale	Common dandelion introduced
Berberidaceae - Barberry	*Achlys triphyhla*	Vanilla-leaf
	Mahonia nervosa	Dull Oregon-grape
Betulaceae – Birch/Hazel	*Alnus rubra*	Red alder
Brassicaceae – Mustard	*Cardamine oligosperma*	Little western/Few-seeded bitter-cress
Campanulaceae-Bellflower	*Campanula scouleri*	Scouler's harebell
Caprifoliaceae-Honeysuckle	*Linnaea borealis*	Twin flower
	Sambucus racemosa	Red elderberry
Caryophyllaceae-Pink	*Cerastium glomeratum*	Sticky chickweed introduced
	Moehringia macrophylla	Big-leaved sandwort
Cornaceae-Dogwood	*Cornus nuttallii*	Pacific dogwood
Ericaceae-Heath	*Vaccinium parvifolium*	Red huckleberry
	Gaultheria shallon	Salal
Fabaceae-Pea	*Cytisus scoparius*	Scotch broom introduced
	Lotus corniculatus	Bird's-foot trefoil introduced
	Medicago lupulina	Black medic introduced
	Trifolium pratense	Red clover introduced
	Trifolium repens	White clover introduced
	Vicia hirsuta	Tiny /Hairy vetch introduced
	Vicia sativa	Common vetch introduced
Geraniaceae-Geranium	*Erodium cicutarium*	Common stork's bill introduced
	Geranium robertianum	Herb Robert introduced
Grossulariaceae -Currant & Gooseberry	*Ribes lobbii*	Gummy gooseberry
Hypericaceae-St. John's-wort	*Hypericum perforatum*	Common St. John's wort introduced
Lamiaceae – Mint	*Mentha arvensis*	Field mint
	Prunella vulgaris	Self heal
	Satureja douglasii	Yerba buena
	Scutellaria lateriflora	Blue skull cap

Malvaceae-Mallow	*Malva moschata*	Musk mallow introduced
Nymphaeaceae-Water-lily	*Nuphar lutea* spp. *polysepala*	Yellow pond-lily
Plantaginaceae-Plantain	*Plantago lanceolata*	Ribwort plantain introduced
	Plantago major	Common plantain introduced
Portulacaceae-Purslane	*Claytonia sibirica*	Siberian miner's lettuce
Primulaceae-Primrose	*Trientalis latifolia*	Western starflower
Ranunculaceae- Buttercup	*Ranunculus acris*	Field buttercup introduced
	Ranunculus repens	Creeping buttercup introduced
Rosaceae-Rose	*Fragaria virginiana*	Wild strawberry
	Malus fusca	Pacific crab apple
	Rosa gymnocarpa	Baldhip rose
	Rosa nutkana	Nootka rose
	Rubus discolor	Himalayan blackberry introduced
	Rubus laciniatus	Cut-leaved evergreen blackberry introduced
	Rubus leucodermis	Black raspberry
	Rubus spectabilis	Salmonberry
	Rubus ursinus	Trailing blackberry
	Spiraea douglasii	Hardhack
Rubiaceae-Madder	*Galium aparine*	Cleavers introduced
	Galium triflorum	Sweet-scented bedstraw
Scrophulariaceae-Snapdragon/Figwort	*Digitalis purpurea*	Common foxglove introduced
	Euphrasia nemorosa	Eastern eyebright introduced
	Veronica beccabunga	American brooklime
	Veronica scutellata	Marsh speedwell
	Veronica serpyllifolia	Thyme-leaved speedwell
Uricaceae-Nettle	*Urtica dioica*	Stinging nettle
Violoaceae -Violet	*Viola adunca*	Early blue violet
	Viola sempervirens	Evergreen/Trailing violet

Chapter 8 Appendix

8.1 List of Scientific and Common Plant Names

Achnatherum nelsonii	Columbia needlegrass
Agrostis scabra	rough bentgrass
Alnus rubra	red alder
Armeria maritima	thrift (sea pink)
Aster subspicatus	Douglas aster
Balsamorihiza deltoidea	deltoid balsamroot
Camassia quamash	common camas
Carex obnupta	slough sedge
Catilleja attenuata *(Othocarpus attenuata)*	narrow-leaved owl-clover
Castilleja hispida	harsh paintbrush
Castilleja levisecta	golden paintbrush
Collinsia grandiflora	blue-eyed mary
Collinsia parviflora	small-flowered blue-eyed mary
Crocdium multicaule	gold star
Cytisus scoparius	Scotch broom
Danthonia californica	California oatgrass
Danthonia spicata	poverty oat grass
Deschampsia cespitosa	tufted hairgrass
Dicanthelium oligosanthes	Scriber's witchgrass
Dodecatheon pulchellum	few-flowered shooting star
Elymus glaucus	blue wild rye,
Erigeron philadelphieus	Philadelphia fleabane
Eriophylum lanatum	wooly eriophyllum / Oregon sunshine
Festuca roemeri	Roemer's fescue
Festuca rubra	red fescue
Fragaria vesca	woodland strawberry
Fragaria virginiana	wild strawberry
Frillaria lanceolata	chocolate lily
Fritillaria lanceolata	chocolate lily
Gaultheria shallon	salal
Hypochaeris radicata	hairy cat's ear
Koeleria cristata	prairie dunegrass
Koeleria macrocantha	junegrass
Leucanthemum vulgare	oxeye daisy
Lomatium nudicaule	Indian consumption plant
Lomatium utriculatum	spring gold
Mahonia aquifolium	tall Oregon grape
Mahonia nervosa	dull Oregon-grape
Medicago lupulina	black medic
Mimulus alsinoides	chickweed monkey-flower
Mimulus guttatus	yellow monkey flower
Orthocarpus pusillus	dwarf owl-clover
Perideridia gairdneri	Gairdner's yampah
Plagiobothrys scouleri	Scouler's popcorn flower
Phalaris arundinacea	reed canarygrass
Plantago elongata	

Plantago lanceolata	English plantain
Plantago major	common plantain
Plectritis congesta	sea blush
Pseudotsuga menziesii	Douglas-fir
Pteridium aquilinum	bracken fern
Quercus garryana	Garry oak
Ranunculus repens	creeping buttercup
Rosa gymnocarpa	dwarf rose
Rubus discolor	Himalayan blackberry
Rubus lanciniatus	Evergreen blackberry
Rubus spectabilis	salmonberry
Sambucus racemosa	red elderberry
Symphoricarpos albus	common snowberry
Sisrynchium sp	blue-eyed grass
Taraxacum officinale	dandelion
Trifolium dubium	small hop clover
Vaccinium parvifolium	red huckleberry
Veronica beccabunga	American brooklime
Veronica scutellata	marsh speedwell
Veronica serpylifolia	thyme-leaved speedwell
Viola adjunca	blue violet, early
Viola langsdorfii	Alaska violet
Centaurium erythraea	European centaury

8.2 Some of Enhancement-related Features of USA Sites

Area & Site	Size category	Features
Olympic Penninsula, Wa		
3 Oclock Ridge	small	Balds + old clear-cuts mainly S & SE facing Very steep, exposed rock, trees slow re-growth in cuts Enhancement tree-girdling, high-limbing, shrub-trimming Food plants - *Plantago lanceolata, Castilleja* sp., larva eating *Collinsia* Nectar plants Spring gold, manzanita, sedum Checkerspot larvae on road Anglewings and Mourning Cloak butterflies seen
Upper Dungeness	larger strip of openings	Strip of balds and old clear cuts below road, mainly S & SE facing Very steep, exposed rock, trees slow re-growth in cuts Only one areas with enhancement tree-cutting, girdling, shrub trimming Checkerspot larvae on road Anglewings and Mourning Cloak butterflies seen
Beach - shoreline	small	similar to Denman's cable beach site flat ocean shoreline
Puget Sound, Wa.		
JBLM	very large	Various sites, flat, open Broom problem, burn repeatedly every 2-3 years in July-Sept Treat first flush of weeds when rains with herbicide glyphosate In past, checkerspot introduced larvae were seen to be eaten by birds Burn gives black surface, higher winter temperatures to advance plant phenology for larval food plant growth Balsam root, *Plectritis, Collinsia*, thrift, blue-eyed grass, Roemer's fescue Rhizomatous grasses also a problem - use grass specific Fusilade on mature tall grass before flowering, also spot spray specific plants Annuals need germination space - open continually - seed and weed!
Bald Hill	small	Typical Garry oak meadow sites, rocky (called balds) hill slopes, shallow soils with pockets of deeper soils Broom an issue mow and treat with Triclopyr herbicide Conifers removed in middle and around edge, large by helicopter *Castilleja* primary host plant, usually on edges and in deeper soil pockets Plan for connectivity Invasive grasses *Eryiophylum* also host species for *Castilleja* Small burns of brush piles, cover with plastic, burn in winter then seed annuals by Nov. Also use propane torch to burn off litter and open mineral soil Shrub incursion, paint stems with herbicide Temperature relative humidity monitoring using Hobo device Reed canarygrass, heavy duty shade cloth, for 2 seasons then plant plugs See Mourning cloaks, Western spring azures

Area & Site	Size category	Features
Olympic Penninsula, Wa		
Tenalquot Prairie	large	Flat open prairie Issues similar to JBLM Broom - burn every 3-8 yrs, cut, herbicide Seed post fire, plugs as resource pockets host and nectar plants together, for sowing the drop seeder worked better for them than the drill seeder Pocket gophers are soil surface movers
Benton County, Or.		
Beazell Memorial Forest	small	S & SW facing meadows on slopes, oak savannah surrounded by conifer forest Aim for sun on the ground in corridors Had 'old-growth' broom 6-8" trunks, 8' high: Mowed trunks > 1" in diameter, left 6" above ground. Old did not re-grow. Burn every 3-4 years for seed bank, spot spray young broom Plant plugs of *Castilleja,* broadcast Roemer's fescue seed, also 1000's of *Fragaria* plugs Mow meadows with tracked skid steer machine, most years Removed conifers from meadows and around shading edges Some areas not use grass-specific herb, but wipe with glyphosate, other areas Fusilade Burn, let sit 1wk 10 days, seed, cover 1/2 with mulch False Brome a serious problem, grows in forest and meadows - intensive spray Snowberry a problem in one meadow - mowed carpet of it Overall 2006-2010 population crash, now holding Seed every year, collect seed, grow out on contract, except grow own *Castilleja*, better success with drilled seed over broadcast seed. Tree toping, tree girdling Tested flush grazing - concl. More negs than pos. Checkerspots in flight.
Loomis Winery	small/ medium	private land managed for Fender's blue without herbicides, former cattle range remove trees & grind stumps, hand-de-limb, haul off lumber, cover big debris piles with plastic and burn in fall, seed after burn Broom burn 2 yrs in row. Survey nectar and host plants ever 3 years For grass, mow, burn occasionally in 1/3rds, rake in 1/3rds
Fitton Green	small/ medium	one of meadows burn at 4 yr intervals, hawthorn is problem, herbicide, sow after False Brome treated individually with glyphosate spot spray & have created an FB- free buffer area on meadow perimeter with forest that has FB -deer transport. Hack and squirt brush, fruit trees, hawthorn, spray poison oak. Conifers removed around oaks to release them Plant plugs for *Castilleja* and others