PROCEEDINGS

TAYLOR'S CHECKERSPOT WORKSHOP 2008

Natural Resources Building, Room 175
1111 Washington Street SE
Olympia, Washington 98504

January 7 - 8, 2008

sponsored by The Nature Conservancy
with funding support from the Department of Defense Legacy Program
organizing partners:

www.southsoundprairies.org

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WORKSHOP SUMMARY

The Taylor's checkerspot is a Pacific northwestern sub-species of the well known Edith's checkerspot. Taylor's checkerspot is extremely rare throughout its historic range and is an animal in great need of conservation. Its small disconnected populations make it vulnerable to a wide variety of threats. In the past 10 years there have been several large-scale site extirpations that have occurred for unknown reasons.

Working to recover rare species with small population sizes is extremely challenging. Working with rare species that span a variety of similar, yet distinct habitat types across several national and state boundaries adds another layer to that challenge. Even just sharing information about the state of knowledge can be difficult, and lack of information can inhibit successful conservation. To effectively move conservation and recovery actions forward, it is essential that entities share their knowledge, research and expertise, as well as define and work toward achieving common goals. It is through cooperation and coordination that we provide the best opportunity for success.

The January 2008 Taylor's checkerspot workshop convened a wide variety of people who are working on conservation of this rare and declining sub-species to disseminate and discuss integral information. Participants included representatives from local, state, provincial, and federal public agencies; non-governmental organizations; academic institutions; and other interested participants from British Columbia, Washington, and Oregon.

Topics covered by the workshop presentations and discussion sessions included an update to the regulatory and biologic status of the sub-species, the known and unknown habitat requirements, the ongoing efforts to increase the population, the considerable work to enhance habitat through management, as well as survey and monitoring methodology. Finally, and perhaps most importantly, the workshop provided the opportunity and significant time for discussion and conversation among biologists, land managers, and regulators. Through these interactions, entities learn from their regional counterpart's experiences and work together to tackle emergent issues.

Several important outcomes resulted from the workshop. The most apparent were the connections made between the remarkable assemblage of experienced and expert attendees. Partnerships forged and cemented at this event are vital as we move forward on both broad- and fine-scale conservation and recovery actions. This proceedings summary reflects and documents the range-wide state of knowledge for the sub-species including site specific information such as nectaring and oviposition observations, threats to continued existence, and habitat management tools. Finally, the momentum generated and the commitment garnered from invested entities to work together to recover this rare and declining butterfly is essential to its continued survival. A Taylor's checkerspot working group is forming and is charged to identify, prioritize, assign, and implement crucial conservation actions throughout the historic range of the butterfly.

FACT SHEET

Taylor's checkerspot
Euphydryas editha taylori


Photo by Rod Gilbert

Taylor's checkerspot (*Euphydryas editha taylori*), a subspecies of Edith's checkerspot, is a medium-sized prairie-dependent butterfly with a striking checkered pattern of orange to brick red, black and cream; the head and abdomen are black; adult wingspan is < 2″ (60 mm). Unlike the other Washington *Euphydryas* species (*E. chalcedona*, *E. anicia*), Edith's checkerspot can be distinguished by the presence of the "editha-line", a black line that runs through the orange on the ventral side of the hind wing. In Oregon, *taylori* is the darkest of the *E. editha* subspecies. A population of *E. editha taylori* was recently discovered in British Columbia on a small island off of Vancouver Island.

Range
Taylor's checkerspot was historically documented in British Columbia on southeastern Vancouver Island and nearby smaller islands, in Washington around Puget Sound, and in the Willamette Valley in Oregon. The subspecies was thought extinct in British Columbia, but a population was discovered at a previously unknown location in 2005. The historical distribution in British Columbia included Hornby Island and 20 locations on Vancouver Island, including 16 sites in the greater Victoria area. Taylor's checkerspot has been reported to occur at least 37 locales in western Washington, from the San Juan Islands south to the Cowlitz River in Lewis County. It was historically found in San Juan County, Whidbey Island in Island County, on balds, coastal bluffs, and estuarine grasslands along the Straits of Juan de Fuca, and on prairies and balds in south Puget Sound. Several of these populations now appear to be extinct. Taylor's checkerspot is currently known from fewer than ten Washington sites. In Oregon, *E. e. taylori* was formerly found at 13 sites in Benton, Lane, and Polk counties, but is now restricted to two population complexes in Benton County. It is protected under Canada's Species at Risk Act (SARA) and is provincially red-listed in British Columbia. Taylor's checkerspot is a federal candidate under the United States Endangered Species Act. Taylor's checkerspot was listed as state endangered in Washington in 2006.

Habitat
Taylor's checkerspot requires open grasslands and/or woodland edges with rich sources of floral nectar for adults and an abundance of appropriate larval food plants. Larval food plants include members of the figwort or snapdragon (*Scrophulariaceae*), plantain (*Plantaginaceae*), and valerian (*Valerianaceae*) families that contain iridoid glycosides.

Larvae are known to feed on a wider range of host plants than females will choose for oviposition; use and availability of host plants varies between sites.

Natural History

Completion of the checkerspot life cycle generally requires one year, although larvae can reenter diapause in response to unfavorable climatic conditions, thereby postponing the adult life stage. Adult checkerspots emerge between late-March and mid-May depending on their location and produce only one generation each year, deposited as clusters of eggs on the lower leaf or stem of a host plant. After hatching, the larval group forms a web at the base of the host plant, which is thought to deter predators and parasites. Larvae feed until mid-June or early July, and then enter diapause as 4th or 5th instar larvae. Larvae emerge in February to complete their larval development before pupating and completing their life cycle as adults. Pupae are assumed to web themselves among low plants near the ground, or pupate under soil, rocks, twigs or bark. Eclosing adults must find a suitable structure on which to perch to insure proper drying of their wings. Checkerspots bask by perching on shrubs and tall forbs, or on warm soil, moss, or rocks. Primary sources of larval mortality in checkerspots include starvation, parasitism and predation; other sources include desiccation, pathogens, cannibalism and inadvertent consumption by other herbivores.

Conservation

Taylor's checkerspot, a regional endemic subspecies of Edith's checkerspot, was once probably widespread and abundant on west side prairies, but is now the rarest prairie butterfly in the west and its habitat is one of the most endangered ecosystems in North America. Most of the prairie habitat has been lost to residential and commercial development, planted with exotic sod-forming grasses, or has succeeded to Douglas-fir forest. Many remaining sites are being degraded by Scotch broom, exotic grasses, and forbs. Checkerspots have recently gone extinct at several sites for unknown reasons, but human disturbance, habitat degradation, and perhaps the lack of immigration between increasingly isolated sites may all have had a role in the extinction of these populations. Two-thirds of known sites are on public lands, but most are subject to conflicting uses. Military activities disturb vegetation and in some areas result in frequent fires; periodic fires help maintain prairie vegetation, but may threaten butterfly populations. Several sites are subject to recreational impacts that can damage vegetation and result in mortality. Small isolated populations are not likely to persist without restoration of additional sites to facilitate immigration between populations, to allow re-colonization of vacant sites, and to avoid the effects of inbreeding.

Text borrowed from:

Linders, M. 2006. Translocation Methods Development for Taylor's checkerspot (*Euphydryas editha taylori*), South Puget Sound, Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 56 pp.

Stinson, D. W. 2005. Washington State status report for the Mazama pocket gopher, streaked horned lark, and Taylor's checkerspot. Washington Department of Fish and Wildlife, Olympia. 129 + xii pp.


Taylor's Checkerspot
Extant Locations
2007
Denman Island
Clearcut
Clallam County
Estuarine
Clallam County
Balds
Fort Lewis
Lowland Prairie
Bald Hill
Balds
Beazell County Park
Balds
Fitton Green
Balds
N
0 20 40 80 120 160
Kilometers
The Nature
Conservancy
Protecting nature. Preserving life.™

Update of population status by region

Population Update, British Columbia, Canada

Presented by:
Jennifer Heron
Jennifer.heron@gov.bc.ca
BC Ministry of the Environment – Canada

This presentation summarized the historic and current occurrences of Taylor´s checkerspot in southern Vancouver Island, British Columbia, Canada. Museum and sight records show approximately 20 locations from the southeastern lowland open Garry oak ecosystems of Vancouver Island. The most recent known populations were at Duncan (last seen in 1978 and now extirpated); Mill Bay (last seen in 1989 from a power line right of way and now extirpated); Helliwell Provincial Park, Hornby Island (last seen in 1998 within a large open maritime meadow within the park). In 2005, the butterfly was recorded within a young clearcut on Denman Island, and had not previously been recorded from this island. During surveys completed in 2007, the number of observations was 622 individuals.

Population Update
British Columbia, Canada

Presented by Jennifer Heron, B.C. Ministry of Environment
Collaborative project with Parks Canada Agency (Nicole Kroeker, Conan Webb and Brian Reader; B.C. Ministry of Environment (Jennifer Heron), Raincoast Applied Ecology (Nick Page)

Taylor's Checkerspot in BC

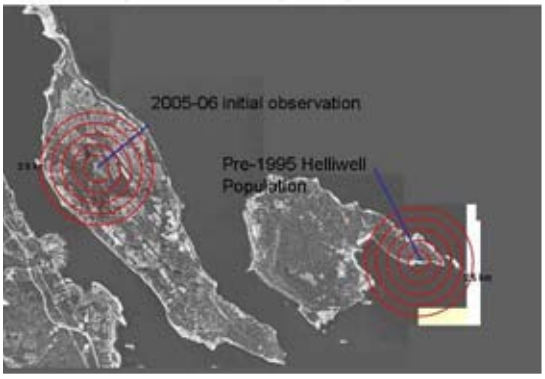
- Historic information
  - collections from approx 20 locations in Victoria area (first collected 1887)
  - 1978 Duncan (extirpated)
  - 1989 Mill Bay (extirpated)
  - 1998 Helliwell Provincial Park (extirpated)
  - 2005 Denman Island (present)

Taylor's Checkerspot in BC

- Historic information
  - collections from approx 20 locations in Victoria area (first collected 1887)
  - 1978 Duncan (extirpated)
  - 1989 Mill Bay (extirpated)
  - 1998 Helliwell Provincial Park (extirpated)
  - 2005 Denman Island (present)

Historic Taylor's Checkerspot Occurrences in BC

Recent Taylor's Checkerspot Populations in BC



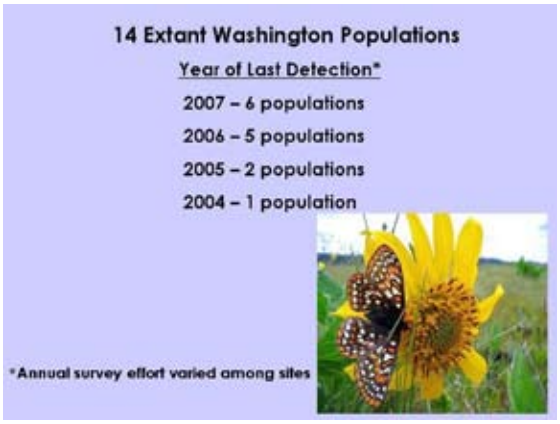
Acknowledgements

- Garry Oak Ecosystems Recovery Team (Shyanne Smith and Chris Junck)
- North Denman Lands (Henning Nielson and Bente Pilgaard)
- Denman Island Conservancy
- Conservancy Hornby
- Invertebrates Recovery Team
- B.C. Parks (Bill Woodhouse and Mike Rody)
- Funding provided by Parks Canada Agency and B.C. Ministry of Environment, Habitat Stewardship Program (Environment Canada).

Taylor's Checkerspot: Status in Washington

Presented by:
Ann Potter
Ann.potter@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA
photo credits to Aaron Barna & Shelly Ament

A brief summary of the population of Taylor's checkerspot butterflies in Washington State is presented. Despite thorough and extensive survey efforts of researchers, the population numbers are low. From 1997 – 1998 there was an obvious drop in populations and subsequent local extinctions at six sites.



14 Extant Washington Populations

How many have >=1 peak annual count of >10 butterflies?

10 populations

How many had butterflies detected in 2007?

6 populations

How many had >10 butterflies detected in 2007?

4 populations

Fort Lewis AIA R74/76 – Lowland Prairie – Pierce County

Graysmarsh – Beach/Estuarine – Clallam County

Eden Valley – Large Bald Complex – Clallam County

Indian Valley – Large Bald Complex – Clallam County

No detection in 2007 of checkerspots at the south Puget Sound, Bald Hill populations, except for 2 observed at 1 bald

2005-2007 Surveys

Over 100 potential sites searched in north Puget Sound: San Juan, Island, Jefferson, and Clallam Counties as a result of multi-agency Island Marble surveys

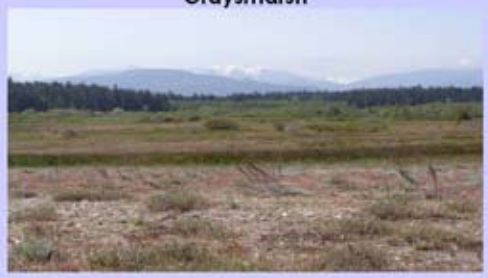
2005-2007 Surveys

Over 80 balds searched in the Bald Hill area by WDFW.
Taylor's checkerspots located in 16.

2005-2007 Surveys

Many potential low and some mid-elevation sites searched in Clallam County WDFW effort.

One new population located, an estuarine beach site:
Graysmarsh



"large numbers"
Barry Bidwell, 1955
McChord Air Force Base

"abundant"
Bob Pyle, 1978
Long Island, San Juan Co

So, what happened???

"common"
Sandra Moore, 1988
Olympia Airport

"estimate 7,000"
WDFW & TNC, 1997
Fort Lewis 13th Div Prairie

"regularly observed strong population"
Bob Pyle, 1974
Mima Mounds NAP

"common on open prairies"
Bob Hardwick, 1980
Fort Lewis

"100+"
Jonathan Pelham, 1983
Rock Prairie

WDFW 2005

Taylor's Checkerspot Status Report

by

Derek Stinson

Estimate ~2% of original prairie grassland remains.
Balds? Beach/estuarine habitat?

Less habitat overall, greater distance between habitat patches, reduced connectivity between habitat patches, loss of habitat quality, and loss of habitat heterogeneity

i.e. greater distance between fewer, poorer quality patches

Impedes 'meta-population function' capability

Across multiple south Puget Sound prairie populations, significant decrease in checkerspot numbers from 1997 to 1998 - and subsequent local extinctions (6 sites).

Also appears to have been a pronounced drop in numbers at Bald Hill, Oregon, and possibly Clallam Co populations between 2005 and 2006.

Insect populations are known to fluctuate due to weather conditions.

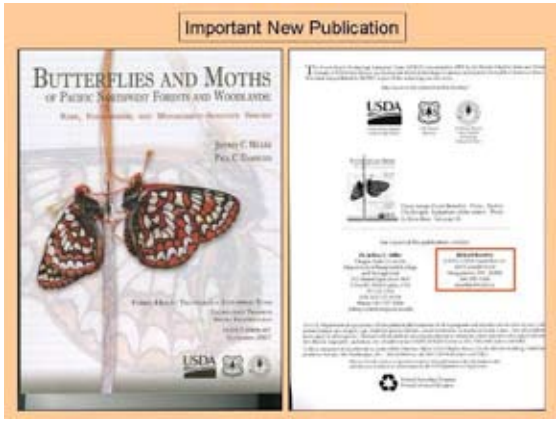
Both time periods identified by climate researchers as tying (aka being in a dead heat) for highest surface temperature in more than a century and for extreme mid-latitude tropospheric warming (Kuman and Wang 2001, Hansen et al. 2005).

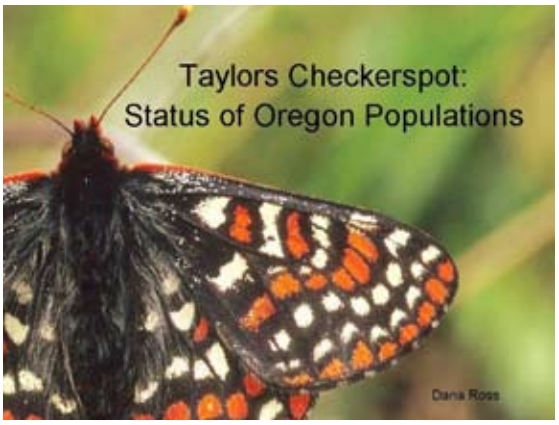
Taylor's Checkerspot: Status in Oregon Populations

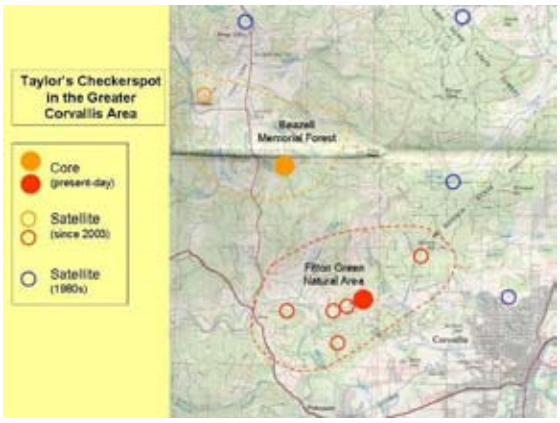
Presented by:
Scott Hoffman Black & Dana Ross
sblack@xerces.org & moreyross@comcast.net
Xerces Society, Oregon

In 2001, the Xerces Society began focusing on Oregon State. In the last five years they have been searching for new Taylor's checkerspot sites in Oregon and monitoring existing occupied sites. A 2007 publication *Butterflies and Moths of Pacific Northwest Forests and Woodlands: Rare, Endangered, and Management-Sensitive Species* by Miller and Hammond includes the Taylor's checkerspot. The document can be downloaded from **www.southsoundprairies.org/documents.htm** (see slide 2).

Dana Ross is an insect conservation consultant specializing in Pacific Northwest butterflies and moths. According to collecting records, Taylor's checkerspot occurred at sites in Benton, Polk, and Lane counties of Oregon's Willamette Valley. Although dozens of potential sites have been surveyed it is now found in only two metapopulations. The Fitton Green site (formally called Cardwell Hill) contains the largest Oregon population with numbers over the years from approximately 600 to over 1,200 individuals. 2005 saw an increase in population but then a crash due to poor weather in 2006. By 2007 the numbers were looking up again and recovering. Bonneville Power had kept an area surrounding their power lines as open meadows and a population was discovered there in 1999. However, the new owner has taken actions that have been detrimental to the habitat. Another important occupied area is Beazell Memorial Forest, considered critical core habitat. There has been a slow degradation of the habitat but with restoration of the oak savannah prairie, it is hoped that the checkerspot numbers will increase. Surveys of these sites are underway. Historically occupied sites have been surveyed, covering most of that area most likely to support checkerspots. A question was asked about whether or not the butterflies can fly over trees to get to their desired habitat. Dana answered that he had seen females flying over 40' conifers.




Taylors Checkerspot:
Status of Oregon Populations
Dana Ross


Taylor's Checkerspot in the Greater Corvallis Area
Core (present-day)
Satellite (since 2003)
Satellite (1980s)
Beazell Memorial Forest
Fitton Green Natural Area
Corvallis


Fitton Green Natural Area (aka Cardwell Hill)

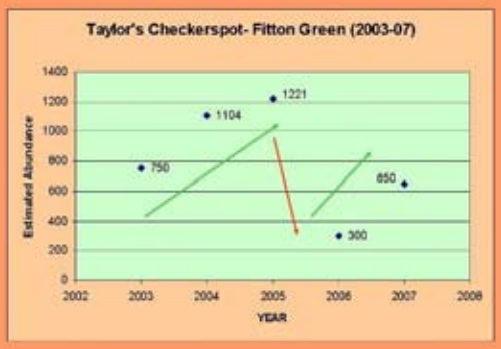

Fitton Green Natural Area - Critical Core Habitat


Discovery in 1999
Regional Importance by 2004


Fitton Green - 2005

Fitton Green - 2007

Population Estimates



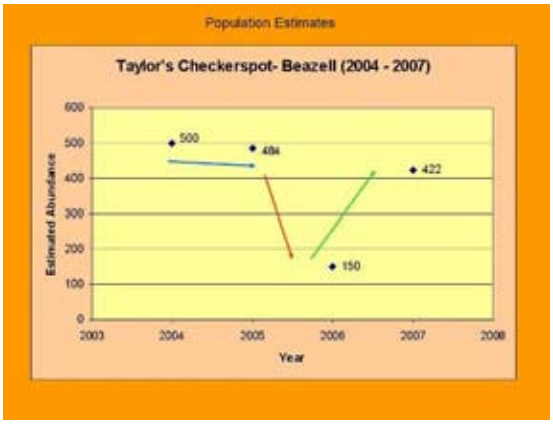
Beazell Memorial Forest

Beazell Memorial Forest - Critical Core Habitat

Discovered 2004 / Increased interest in 2007

Duncan Thomas

Paul Severns



THE BOTTOM LINE

Oregon populations are *hanging on* and appear to be rebounding from the "Crash of 2006".

Many threats persist:
Habitat degradation,
Habitat loss,
Population isolation,
Small population size.

?

Positive actions are taking place:
Habitat restoration
(On-site weed abatement & restoration of adjacent areas)
Benton County Habitat Conservation Plan

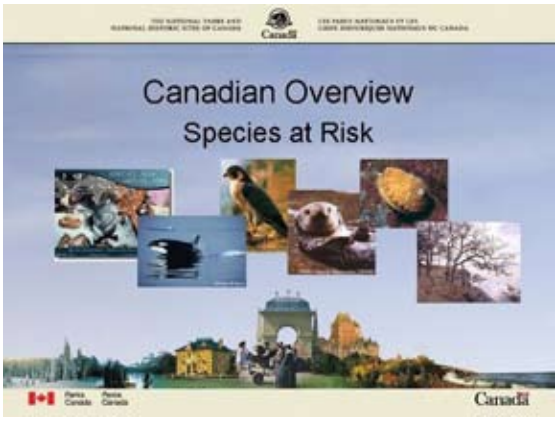
"Only immediate & well-implemented conservation & restoration efforts will keep our Oregon populations of Taylor's checkerspot from disappearing within 5-10 years."

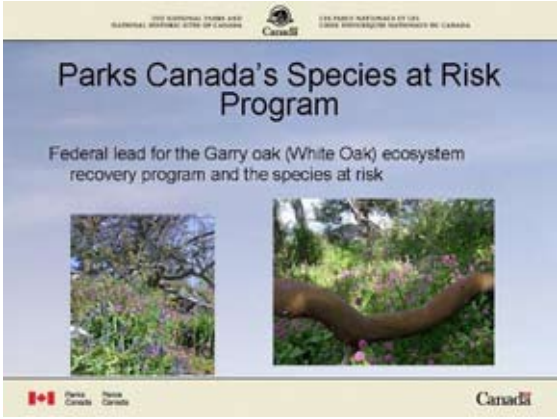
Policies, agreements and incentives

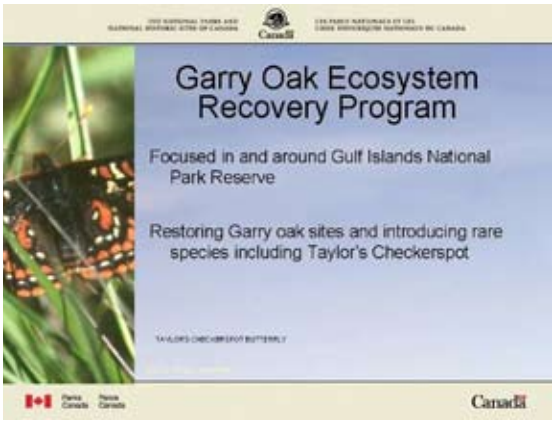
Canadian Overview: Species at Risk

Presented by:
Brian Reader
Brian.reader@pc.gc.ca
Parks Canada Agency

This talk summarized the Species at Risk Act (SARA) and how it protects species and habitats in Canada. Three federal agencies in Canada work together to allocate funds for research: Department of Environment, Department of Fisheries and Oceans, and Parks Canada. Following the presentation, he was asked if Canada focuses not only on species, but habitats and ecosystems and how this is different from the United States. Brian answered that the Canada Species at Risk Act only lists species but that they are encouraged to take a multi-species or ecosystem-based approach to recovery planning and recovery. Parks Canada is the Federal lead for up to 15% of SARA-listed species and their focus is on natural areas conservation as well as ecosystem management.



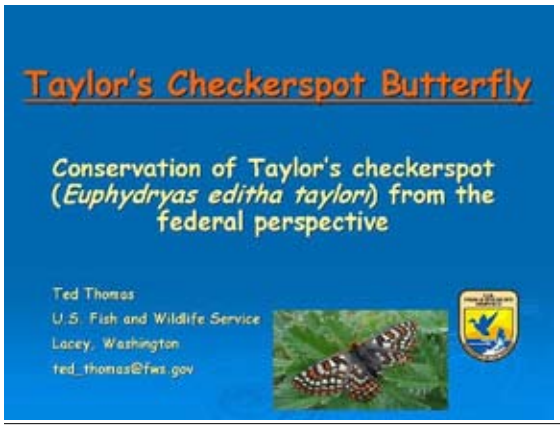



Garry Oak Ecosystem Recovery Program
Focused in and around Gulf Islands National Park Reserve
Restoring Garry oak sites and introducing rare species including Taylor's Checkerspot

Conservation of Taylor's Checkerspot from the U.S. Federal Perspective

Presented by:
Ted Thomas
Ted_thomas@fws.gov
U.S. Fish and Wildlife Service, Lacey, WA

This talk illustrates the range wide distribution of Taylor's checkerspot butterflies in the northwest (see slide 3, this presentation or page 4 of this document) and outlines the steps the US Federal government is taking to conserve the butterfly.



Highlights-what, where and when for Taylor's Checkerspots

- Historically known from >70 locations. 34 in WA, 13 in Oregon and 23 from VI (Xerces2002, Shepard 2000)
- 1989--Identified as Species of Critical Conservation Concern (Robert Michael Pyle)
- Documented extirpation from several Fort Lewis Training Areas during 1990's
- 1997--Bald Hills NAP, WA site identified
- 2003--Eden Valley, WA site identified
- 2003--Beazell Complex, OR site identified
- 2006--Denman Island, Canada site identified
- 2004-2007--Robust counts of Taylor's on Fort Lewis AIA. Max of 1,300 detected on May 4, 2006
- 2007--Translocated larvae take flight at SCWA, WA

Programs and Planning Efforts to conserve Taylor's checkerspot

- Fort Lewis Sustainability Program
- Area Compatible Use Buffer Program (ACUB)
- Benton County (OR) HCP
- BPA Right-of-Way Management Plan (OR)
- Candidate Conservation Agreement (SPS, WA)
- Butterfly Habitat Enhancement Experiments
- FWS Recovery Program funding to Agencies, NGOs and Universities
- Section 6 Funding (OR and WA)
- Recovery Land acquisition Program

What does the future hold for Taylor's checkerspot butterfly

- FWS is negotiating a settlement agreement with Center for Biological Diversity for all federal candidate species.
- OUTCOME -- All candidates will be proposed for listing or withdrawn from candidate status by 2012.
- WWFWO will allocate annually approximately 20% of Recovery Budget to on-the-ground projects.

Summary

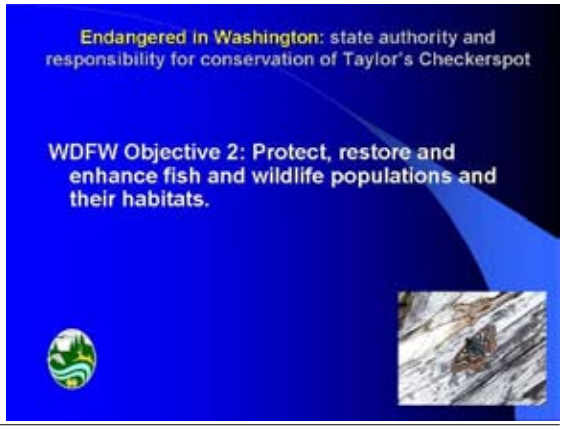
- In cooperation with all partners
  - The Nature Conservancy of WA
  - WDFW
  - WDNR
  - Fort Lewis
  - Xerces Society
  - Thurston County
  - Wolf Haven
  - Caveness Family
  - Ports, Olympia and Tacoma

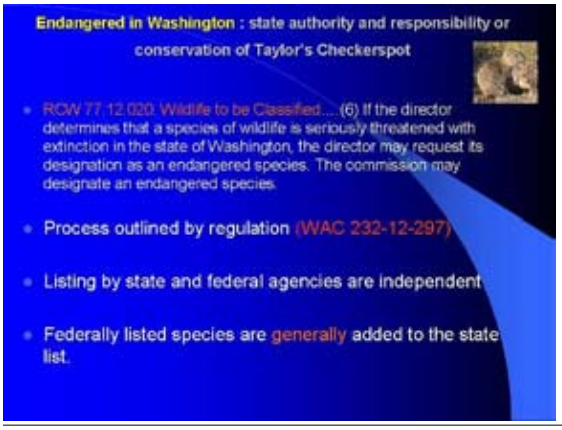
OBJECTIVE -- Improve the numbers and distribution of Taylor's checkerspot and the quality of prairie habitat throughout the species range.

Endangered in Washington:
State Authority and Responsibility
for Conservation of Taylor's Checkerspot

Presented by:
Derek Stinson
Derek.stinson@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA

Derek Stinson outlined the authorities and responsibilities of Washington State in the conservation of the Taylor's checkerspot butterfly. He explained the process a species goes through in order to be listed as endangered by the State. Now that the checkerspot is considered by the State to be endangered and listed as a candidate species by the Federal government, examples were given as to what conservation steps are being taken by agencies locally. Also, the shortcomings of this process were discussed, explaining the holes in the system that limits the State's ability to protect this species.





State Listing: what effect does it have ?

- State listed species are protected by RCW primarily protects from direct killing.
- Habitat of forest species often become regulated by critical habitat rule in the Forest Practices WAC.

- Once listed, a state recovery plan is prepared

(cont'd)

State Listing: what effect does it have (cont'd)?

- Increases species priority for WDFW resources
- Listed species are recognized by most county and city governments.
- Washington's Growth Management Act requires counties and cities to identify and protect important wildlife resources.
- Habitat receives some protection (review; avoid, minimize, mitigate) by count/city critical area ordinances.

Species Listing: what effect does it have (cont'd)?

- State-listed species gain some recognition by other agencies, (example: Fort Lewis, USFWS, etc.) for protection and funding.
- State listing may instigate evaluation for recognition as fed species of concern or a status review for federal listing.

Federal ESA Candidates

- The species will be listed at some point in the future when USFWS gets around to it, unless conservation actions preclude the need to list*.
- Not protected from 'take'
- No protection of habitat on private or state lands

*Threat of listing can be a good motivator for land managers

Taylor's Checkerspot Conservation: who does what, where?

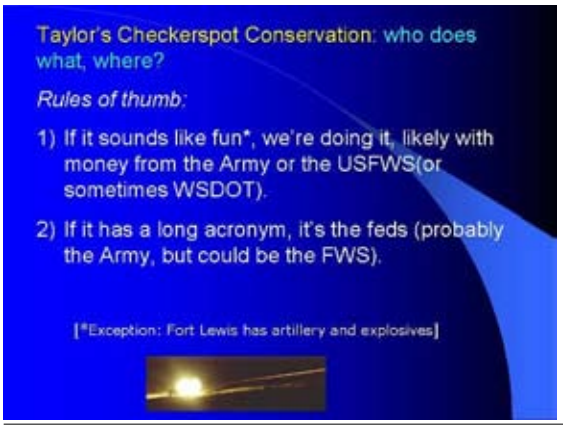
- WDFW (in cooperation from Ft. Lewis, TNC, and landowners) does much of the survey and research on the ground.
- Ft. Lewis has crews that monitor veg/soil condition and they have done veg survey work on many prairie sites.

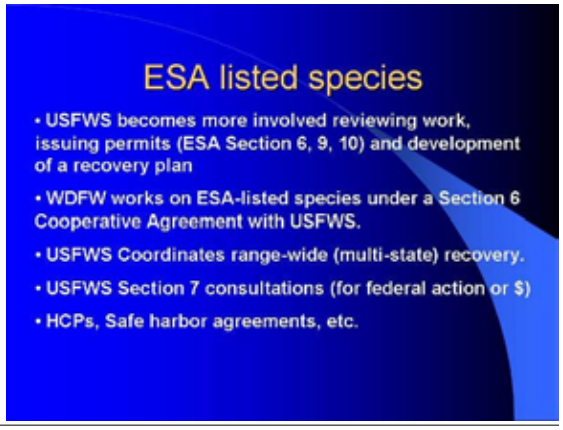
Taylor's Checkerspot Conservation: who does what, where?

- Much of the checkerspot work is funded by the US Army/DOD/Ft. Lewis.
- Much conservation work (for other species) funded through USFWS (SWGS, Section 6, etc.)


Taylor's Checkerspot Conservation: who does what, where?


Taylor's Checkerspot Conservation: who does what, where?
•The Nature Conservancy is doing lots of prairie habitat management and restoration on Ft Lewis and other TNC managed properties.
•Habitat management/restoration on WDFW lands increasing


Taylor's Checkerspot Conservation: who does what, where?
Rules of thumb:
1) If it sounds like fun*, we're doing it, likely with money from the Army or the USFWS(or sometimes WSDOT).
2) If it has a long acronym, it's the feds (probably the Army, but could be the FWS).
[*Exception: Fort Lewis has artillery and explosives]


ESA listed species
• USFWS becomes more involved reviewing work, issuing permits (ESA Section 6, 9, 10) and development of a recovery plan
• WDFW works on ESA-listed species under a Section 6 Cooperative Agreement with USFWS.
• USFWS Coordinates range-wide (multi-state) recovery.
• USFWS Section 7 consultations (for federal action or $)
• HCPs, Safe harbor agreements, etc.

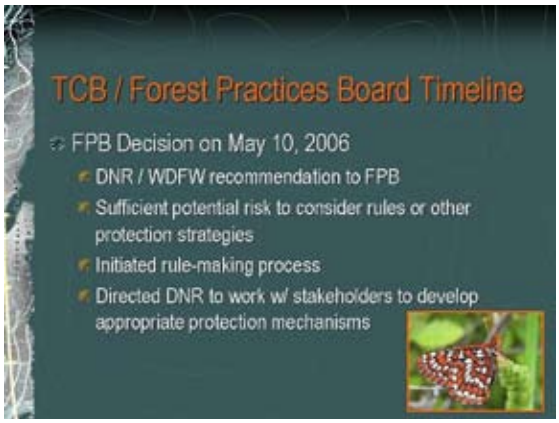

Holes in the safety net
• Little protection of habitat in state law (except for Forest Practices)
• County and city ordinances vary in coverage and application
• State and county laws do not protect habitat that is 'unoccupied' ---problematic for species that exist as metapopulations.


Holes in the safety net
•State and county laws do not protect habitat that is 'unoccupied' --- problematic for species that exist as metapopulations.
•Prairie habitat needs to be maintained, or it becomes unsuitable (Scotch broom, turf grasses, etc.) and unoccupied. Landowners may only need to wait and the 'problem' goes away.

Washington State Forest Practices Board Action

Presented by:
David Whipple
David.whipple@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA

This talk explained the approach taken by the Washington State Forest Practices Board to protect habitat occupied by the Taylor's checkerspot butterfly. Instead of adopting a regulatory approach of forest practices rules to protect the occupied sites, the Board will rely on habitat management plans developed between the landowners and WDFW. Landowners will work with agencies to develop a management plan that attempts to meet landowner goals but also protects the species. Even if all landowners do not develop a management plan, the Department of Natural Resources (DNR) will use its authority, in consultation with WDFW, to condition Forest Practices Applications to protect the species. A question was asked about what happens when a new site is discovered. David answered that once it has been identified it is then entered into the system and eligible for consideration within the context of an existing management plan, if applicable. Other outcomes could be that a new plan is developed for the site, or that they rely on DNR's conditioning authority to protect the site.



TCB / Forest Practices Board Timeline

- Stakeholder work April 2006 – August 2007
  - TCB life history
  - Habitat requirements
  - Potential effects of forest practices
  - Stakeholder issues & concerns

Stakeholder Positions

- Landowner Views
  - Collaborative protection approach desired
  - More willing to participate in restoration, research & monitoring if no formal Forest Practices Rule (some was currently on-going)
- Other Positions
  - Need rule for protection
  - Non-rule approach OK

Landowner Commitments

- One developing TCB management plan & working w/ WDFW on research & monitoring program
- Three other private landowners willing to develop site-specific management plants, & provide access & possibly participate in site restoration activities
- DNR State Lands committed to notification process & management plan development

TCB Protection Approach

TCB Non-Rule Approach ~ Rationale

- 13 currently known occupied sites
- Total area of occupied sites is small
- 13 known sites owned by 8 landowners
- ~ 25 landowners within ¼ mile of known sites
  - Not all land is managed forestland
- Little forest management expected in near future
- Commercial timber value around sites can be low
- Need site-specific protection / management

TCB Non-Rule Approach ~ Rationale

- Non-rule approach more likely to foster cooperation
- All 5 industrial forest landowners committed to planning, & may participate in restoration, monitoring, etc.
- 3 SFLOs own small portions of 2 of the 4 occupied sites in Clallam Co.
- 1 SFLO may own 1 Thurston Co. site
- Assume SFLOs likely won't be aerially applying chemicals
- DNR can use conditioning authority to protect public resources
- Protection can be achieved w/o formal rule

TCB Non-Rule Approach

- DNR & WDFW screen FPAs w/in 1 mile of TCB sites
- DNR Region contacts WDFW
- WDFW evaluates for potential impacts & consistency w/ TCB management plan
- If possible impact, WDFW works w/ DNR & landowner to modify or withdraw FPA
- WDFW "material damage" letter / DNR conditioning possible
- WDFW may request & DNR may condition for 2-day operation notification

Forest Practices Board Action

- September 11, 2007
- DNR & WDFW recommendation to FPB
- FPB voted to "adopt" non-rule approach
- DNR / WDFW report annually

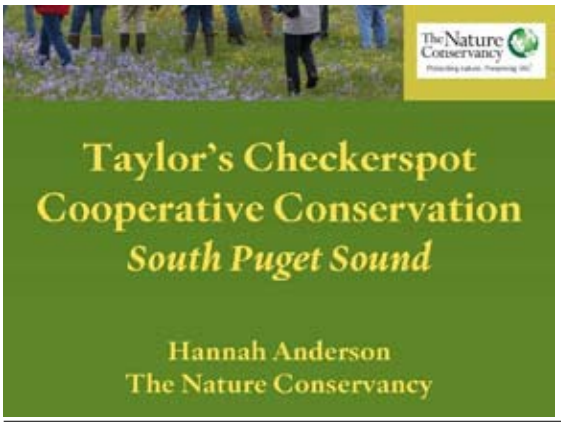
Implementation

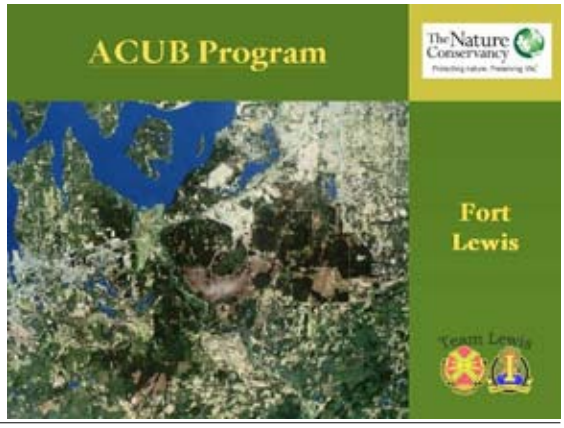
- DNR & WDFW developed implementation plan
- Providing co-agency training to regional staffs

Taylor's Checkerspot: Cooperative Conservation South Puget Sound

Presented by:
Hannah Anderson
handerson@tnc.org
The Nature Conservancy, Olympia, WA

This talk gave a brief description of programs and projects that incorporate conservation work for the Taylor's checkerspot butterfly in the South Puget Sound including: The Rare Species Project, The Fort Lewis Army Compatible Use Buffer (ACUB) program and the multi-partner and multi-species Prairie Candidate Conservation Agreement (CCA). All these projects aim to reduce the likelihood that the four prairie Candidates, one of which is the Taylor's checkerspot, become listed under the ESA. The highly collaborative nature of these programs allows for significant interchange among partners, thereby increasing the effectiveness and efficiencies of the programs and individual projects they contain. The atmosphere of cooperation that is created by these programs may provide the best opportunity to recover these rare animals.





Fort Lewis ACUB is Unique

- Partners provide acquisition funds and enroll lands
- DoD provides management funds
- 5-year program 2006-2011
- Up to $2.2 million on DoD funds
- $984,000 currently allocated to on-the-ground projects

Fort Lewis ACUB Cooperators

- Fort Lewis Military Installation
- The Nature Conservancy of WA
- Washington Dept. of Fish and Wildlife
- Washington Dept. of Natural Resources
- Wolf Haven International

Fort Lewis ACUB Goals

- Avoid future training restrictions if species were listed under ESA
- Recover candidate species regionally
- Prevent incompatible development along installation boundary
- Provide suitable non-training lands to share burden of species recovery

Fort Lewis ACUB Objectives:

- Acquire native prairie parcels in the southern Puget lowlands
- Manage those parcels for the recovery of candidate species
- Accomplish the above two objectives through partnerships with other regional landowners

Fort Lewis ACUB Actions:

- Land acquisition
- Habitat restoration & maintenance
- Increase the size and numbers of populations
- Monitoring
- Planning & research

ACUB Lands

Habitat Restoration & Maintenance

Increase the size and numbers of populations

Monitoring

Planning and Research

Candidate Conservation Agreement (with Assurances)

Voluntary agreement between partners and the US Fish and Wildlife Service to implement actions on enrolled lands that reduce or minimize potential effects to enrolled species

South Puget Sound CCA(A) Partners

Fort Lewis
TNC
WDFW
WDNR
Thurston County
Wolf Haven Int'l
Otis & Arline Cavness

The Nature Conservancy

Butterflies

Taylor's checkerspot
Mardon skipper
Valley silverspot
Puget blue

Birds

Streaked horned lark
Slender-billed white-breasted nuthatch
Vesper sparrow

Mammals

Western gray squirrel
Mazama pocket gopher

Amphibians

Oregon spotted frog
Western pond turtle
Western toad

CCA(A) Enrolled Lands

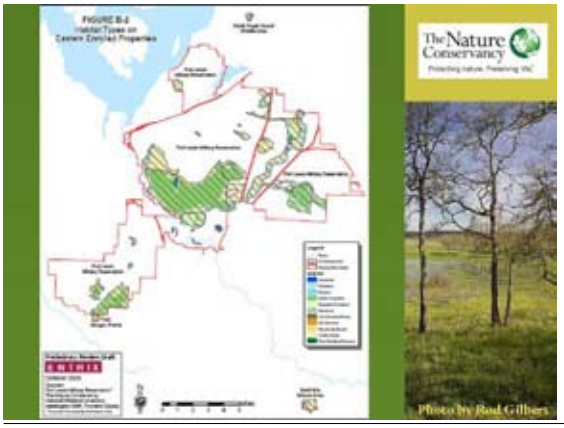


Photo by Rod Gilbert

CCA(A) Covered Activities

- Military Training
- Recreation
- Transportation
- Utilities
- Land Use

CCA(A) Conservation Measures

- Minimization and Avoidance
- Habitat Management
- Habitat Restoration

NRCS Natural Resources Conservation Service

Audubon

WOLF HAVEN

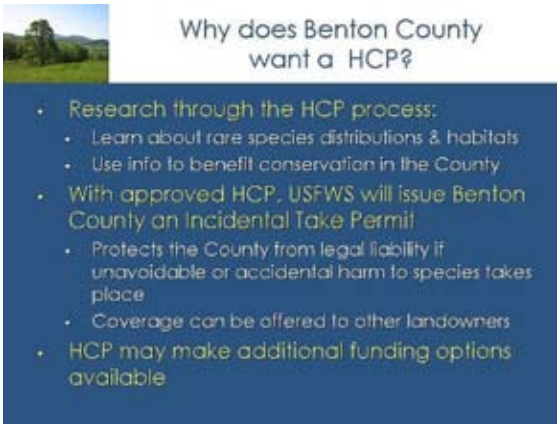
McChord Air Force Base

Port of Olympia

Benton County Prairie Species Habitat Conservation Plan

Presented by:
Lori Wisehart
lwisehart@parks.ca.gov
Institute for Applied Ecology, Corvallis, OR

This talk gave a summary of the Habitat Conservation Plan (HCP) being developed for prairie species in Benton County in Oregon. The HCP development process involves identifying activities of the County and other cooperating entities that are likely to cause harm to threatened or endangered species as well as potential mechanisms for avoiding, reducing and mitigating those stressors. The HCP may also allow for protection of a species on county land as if it were federally listed. Candidate species that are included in the HCP, would essentially be treated as listed species by the County and cooperating entities. The Benton County Prairie Species HCP is currently in draft form with public and agency review expected for winter 2008-2009.



Benton County:

- 7% of the Willamette Valley Ecoregion
- 12% of the remaining prairie and oak savanna
- Significant rare species populations

Species Covered by the HCP


Streaked Horned Lark


Taylor's checkerspot butterfly


Fender's blue butterfly

Current status: **Candidates**
Not protected

Current status: **Endangered**
Protected on all lands

With HCP: **Protected** on **County lands** and other non-federal **public lands**

Species Covered by the HCP


Bradshaw's lomatium | Peacock larkspur | Nelson's checkermallow | Willamette daisy | Kincaid's lupine

Current Status:
Protected on non-federal public lands by State ESA

With HCP: **Protected** on **County lands** and other non-federal **public lands**

The HCP process/timeline

2006
- Field Surveys
- Advisory Committee meetings

2007
- Field Surveys
- Advisory Committee meetings
- Public Meetings
- Draft HCP Document

2008
- Field Surveys
- Advisory Committee meetings
- Public Meetings
- Draft NEPA document
- Finalize HCP

2009
- Final NEPA documentation
- Incidental Take Permit Issued

Draft Species Management Goals

Increase the amount of protected native prairie habitat

Develop Prairie Reserve System

Increase Population Connectivity

Support long term species survival & conservation

Promote conservation by other public entities

Reduce/manage threats to species

Increase public Awareness

Taylor's checkerspot and the HCP

Development of Management plans:

- County properties
- Voluntary participation by private landowners

Goals: Enhance existing habitat and minimize impacts from other management activities.

Prairie Conservation Strategy

A conservation measure for the HCP that will contribute to species recovery

- Coordination tool:
  - *where populations are*
  - *where protected sites are*
  - *how they interact*
  - *where actions will provide the most positive effects*
    - Increasing connectivity and enhancing existing populations

Public and Private Landowner Agreements for Taylor's Checkerspot

Presented by:
Scott Hoffman Black
sblack@xerces.org
Xerces Society, Oregon

This talk gave an overview of the Xerces Society and how the organization works to conserve habitat for Taylor's checkerspot. There is no wildlife agency in the state of Oregon that is charged with the conservation of invertebrates which is why the Xerces Society has focused on butterfly conservation in the state(see slide 2). Xerces worked with Benton County Parks Department on a search strategy for the Taylor's checkerspot. Working with Dana Ross, a new metapopulation was found at Beazell County Park (see slide 4). Xerces also developed a management plan for Bonneville Power Administration power line right of way (see slide 5-6). The largest Oregon population is found on private land. The landowner was reticent about working with the federal government but was willing to work with the county and Xerces. Xerces worked with Benton County Parks Department to develop an MOU (Memorandum of Understanding) with this landowner. The landowners have allowed management for invasive plants and placement of a barbed-wire fence around the property (see slide 7-8), which allows for deer passage but prevents trespass from horses and ATVs.

Landowner agreements for prairie obligate butterflies

- Populations are found on both private and public lands
- Areas need active management

Benton County Parks Department

- Provided aerial photos to help with search effort
- Worked with adjacent landowners on MOU
- Control of invasive plant species at extant sites

Bonneville Power Administration

- Xerces worked with the BPA to develop a right-of-way (ROW) specialized management plan


Final

Right-of-Way
Specialized Management Plan

For the
Taylor's Checkerspot Butterfly

Santiam-Toledo 230 kV
Transmission Line Corridor

Located on Cardwell Hill, near Corvallis OR
Between Wood Pole Structures
Mile/Structure: 38/3 to 40/6

Bonneville Power Administration
Eugene Region

October 25, 2005

Bonneville Power Administration

- Develop specific strategies for preserving and restoring native grassland beneath the ROW.
- Develop and provide training to BPA planning and maintenance personnel.
- Minimize impacts to the butterfly and it's habitat through the implementation and timing of conservation measures.

Private landowner agreement

- Xerces worked with Benton County Parks staff to develop an MOU for the largest Oregon population.

Private landowner agreement

- Allowed for:
- Continued inventory of the population.
- Management to control invasive plants and encroaching trees.
- Placement of a fence to keep out motor vehicles and horses.


Photo by Benjamin Benschneider/Seattle Times

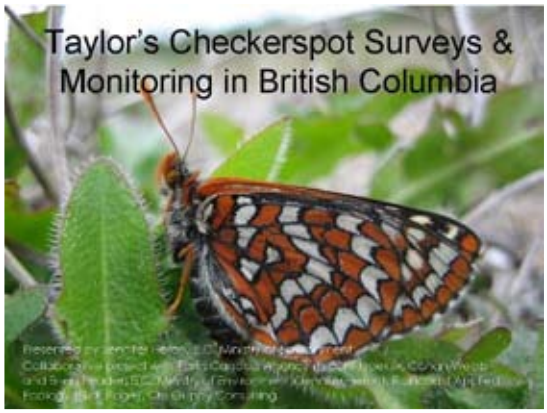
Meaningful measurement

Taylor's Checkerspot Surveys & Monitoring in British Columbia

Presented by:
Jennifer Heron
Jennifer.heron@gov.bc.ca
BC Ministry of the Environment

This presentation summarized surveys for Taylor's checkerspot over the past 10 years in British Columbia. Many of the surveys have been carried out by independent researchers and naturalists. Many of the habitats where Taylor´s checkerspot could occur are private so permission was sought from landowners. Much of the surveyed land has been logged. Results imply that there is probably a single interconnected population.

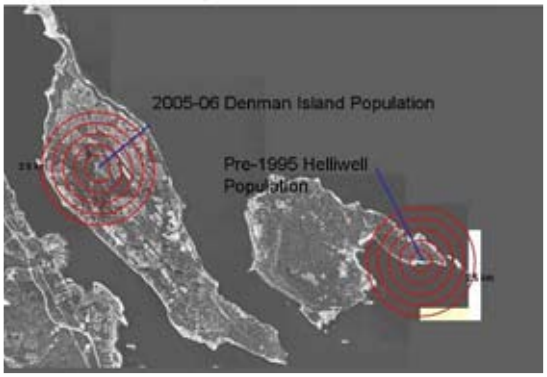
Questions and discussion followed with the clarification that the map of Denman Island illustrates the approximate 2K diameter of the island (slide 3). Also participants wanted to know more about the methodology and if anyone was surveying the coast. Jennifer answered that they are in the initial phases of creating the survey techniques but would like to align with practices in Washington and Oregon. The coast sites, although possible habitat, are steep non-meadows, which are difficult to survey. It was also asked how the public has responded to the surveys. Jennifer answered that people either seem very open to participating or not interested at all. Some landowners are interested in developing their property but are also willing to identify habitat and protect sections for species at risk, including Taylor´s checkerspot.

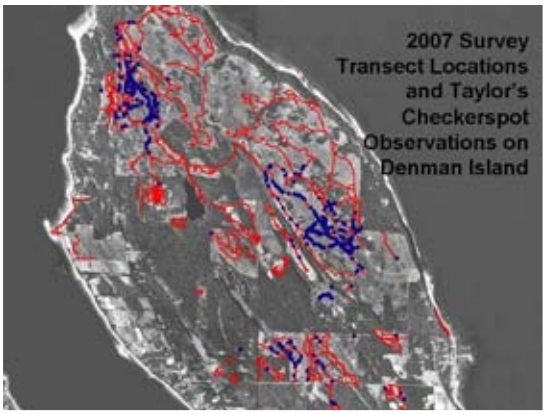


Surveys within the past 10 years

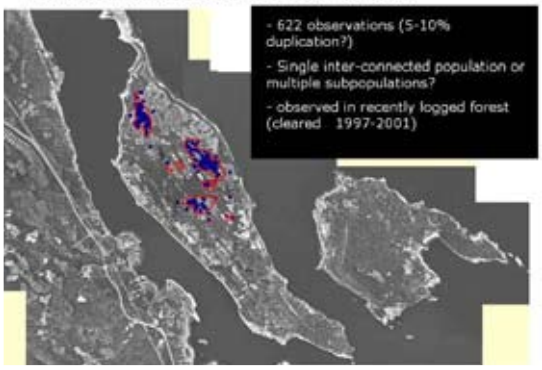
- 1999 BC MOE contract to Guppy and Fisher
- 2003 BC MOE contract to James Miskelly to monitor Helliwell while doing his MSc research
- 2000-2007 general butterfly surveys BC MOE, Parks Canada, municipal - Victoria area
- 2007 Parks Canada/BC MOE contract to Raincoast Applied Ecology (Nick Page)
- 2007 Parks Canada contract to Cris Guppy to complete surveys on conservancy property on Denman Island
- Many naturalists looking for the species

Recent Known Populations in British Columbia





Taylor's Checkerspot Observations (2007)



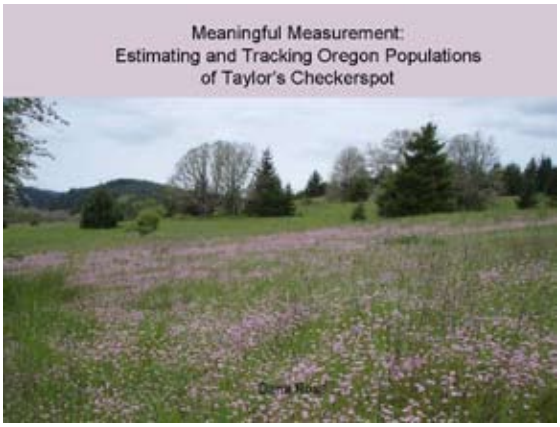
Acknowledgements

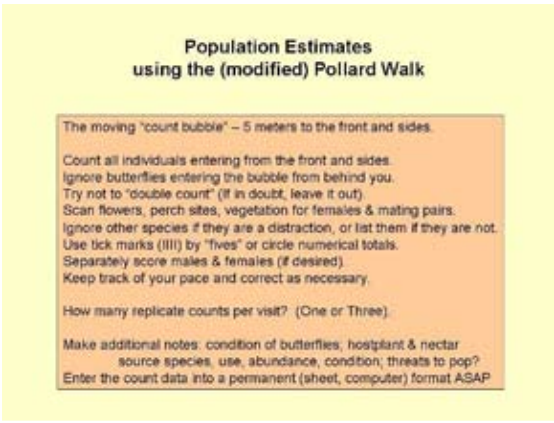
- Garry Oak Ecosystems Recovery Team (Shyanne Smith and Chris Junck)
- North Denman Lands (Henning Nielson and Bente Pilgaard)
- Denman Island Conservancy
- Conservancy Hornby
- Invertebrates Recovery Team
- B.C. Parks (Bill Woodhouse and Mike Rody)
- Funding provided by Parks Canada Agency and B.C. Ministry of Environment, Habitat Stewardship Program (Environment Canada).

Estimating and Tracking Oregon Populations of Taylor's Checkerspot

Presented by:
Dana Ross
moreyross@comcast.net
Corvallis, Oregon

This presentation explained the methods employed in surveying for Taylor's checkerspot butterflies in Oregon. Dana covered the questions that must be answered before monitoring begins, such as, "how familiar are you with the physical site?" and "have adjacent areas been searched well enough or at all?" Also important before beginning monitoring is defining the geographical boundaries of the area to be measured and locating larval host plants and nectar sources. He uses the Pollard-Yates Walk method to estimate the butterfly population. Moving through the area, you only count butterflies that enter your "count bubble" which is 5 meters to the front and side. While walking, it is important to scan flowers and perch sites for butterflies. Dana also outlined how to time the population counts as well as how to read the data for population estimates.





TIMING & FREQUENCY OF COUNTS FOR POPULATION ESTIMATES

Monitor the population for the onset of adult activity.

At a minimum, attempt to estimate 3 times: pre-peak, peak and post-peak.

A good frequency is 5 – 7 (10) days over the entire flight period.

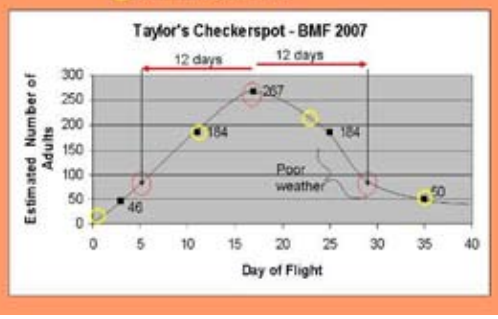
Once every 5 days during periods of consistent good weather is ideal.

Average adult life span (10 – 14 days) used to calculate population estimate.
Assume 10 days if extended periods of unseasonable weather: hot or cold.
Assume 12 days under most conditions (a typical spring).
Assume 14 days as an absolute maximum lifespan for estimates.

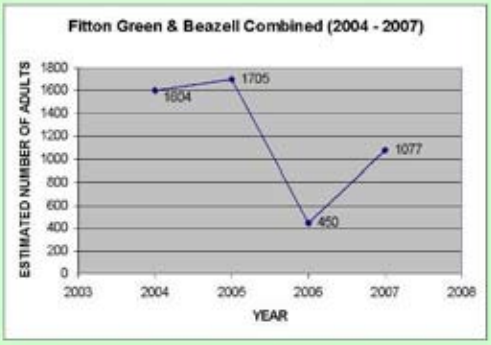
No need to oversample the post-peak, post-decline tail.
Populations tend to peak fairly fast and decline a bit more slowly.

READING THE DATA FOR AN ANNUAL POPUALTION ESTIMATE

Pre-peak + Peak + Post-peak
Either side of peak + tails



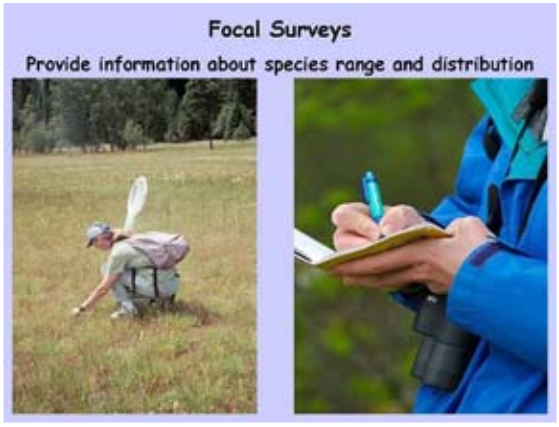
Provides a reasonable **estimate** for year to year comparisons

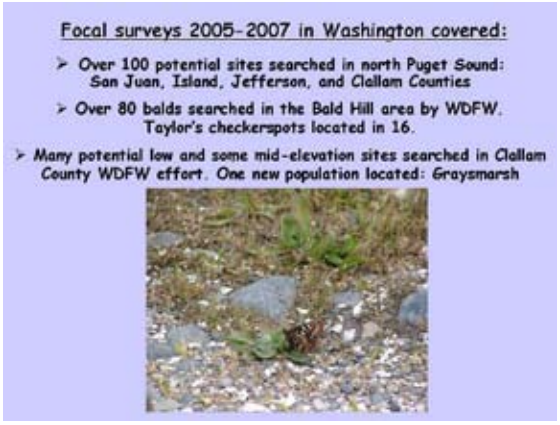


Taylor's Checkerspot: Surveys and Monitoring in Washington

Presented by:
Ann Potter
Ann.potter@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA
photo credits to Aaron Barna & Shelly Ament

This talk summarized the efforts to survey and monitor Taylor's checkerspot butterflies in Washington State. The focal surveys provide information as to the range and distribution of the species. Once occupied locations were identified, monitoring began to provide information about species abundance. The methods used were a combination of counting visible butterflies along a transect and employing the distance sampling method. Over 100 sites were searched in San Juan Island, Jefferson, and Clallam counties. Of the over 80 balds surveyed, Taylor's checkerspot were found at 16 sites. A new population was also discovered at Graysmarsh.





Monitoring Methods

Count butterflies

- Using repeatable transect(s) (w/standardized length & width)
- Using single or multiple observers, walking 5-10 meter spaced transects, and moving across entire site

Distance Sampling Method

- 2007-2008 study @ 14 Bald Hill sites
- 2007 Data collected @ Fort Lewis R74/76 site

Distance Sampling 101: What is it? Why Use it?

Presented by:
Gail Olson
Gail.olson@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA

This presentation explained the distance sampling method and how it can be used to estimate abundance of butterflies. The advantages of distance sampling over more traditional butterfly survey methods were reviewed, including that it provides unbiased estimates of density with explicit estimates of uncertainty (variance), accounts for imperfect and variable detectability, and is more efficient in its use of sample observations. The premise of distance sampling estimation is the intuitive principle that detectability of objects declines with distance from the observer, providing the basis for an estimation equation. Other factors affecting detectability can also be accounted for in the analyses, thus making it possible to compare estimates taken by different observers, in different places, and at different times, without making the assumption that detectability was always the same.

During the question and discussion session, Dana Ross (independent consultant) asked whether these methods could be used for high density populations. Mary Linders (WDFW) said that they haven't encountered any problems using the method with the dense population on Fort Lewis. Gail added that in dense populations, clusters of butterflies could be recorded rather than single individuals. Scott Hoffman Black (Xerces Society) asked if this method has been tested against other methods to know how well it works for butterflies. Gail answered that the more appropriate test of the method is on a population of known size, but such a thing is unlikely to exist. Someone asked about the possibility of using mark-recapture methods. Because mark-recapture method requires handling of animals, it may be more appropriate in some situations but not in others. A type of distance sampling that uses multiple observers and is based on mark-recapture principles could also be used. Ann Potter (WDFW) warned that research shows that mark-recapture can be a contributing factor to extinction because it also requires a lot of trampling and the return is low. It was then asked how distance sampling can work when surveying a cliff. Ann answered that you can use the information you have to account for these variables. Gail also added that this method allows for variation in transect width.

DISTANCE Sampling 101

What is it?

Why use it?

Line Transect Sampling

WHY?

Advantages of distance sampling*

- Statistically based methodology
- Accounts for imperfect AND variable detectability
- Increased efficiency

*Includes both line transect and point transect surveys

Statistically based methodology

- Assumptions are explicitly stated
- Estimates are unbiased
- Variance estimates
  - Uncertainty due to sampling process
  - Variation due to natural processes
- Results are comparable

Imperfect Detectability

- Probability of detection < 1.0
- Variable: Probability changes
- Examples of reasons:
  - Weather
  - Vegetation
  - Observer
  - Time of day
  - Number of individuals

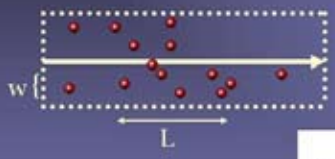
Imperfect ability to see objects

Why distance data?

Detectability generally declines with distance

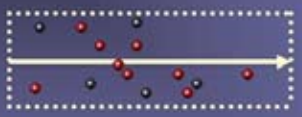
Density estimation

Density = Number per unit Area



$$\hat{D} = \frac{n}{2wL}$$

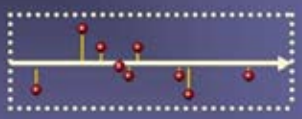
Density estimation with imperfect detectability



$$\hat{D} = \frac{n}{2wL\hat{P}_a}$$

Where P_a is the proportion of detected objects

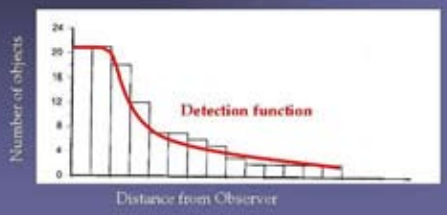
Distance data



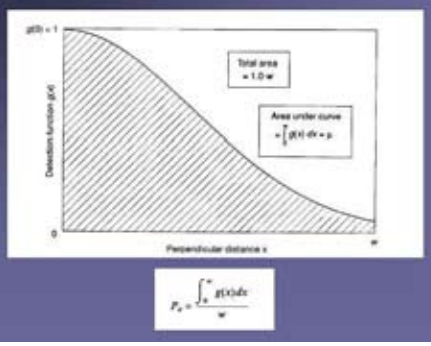
Using distance data

- Assumes:
  - P(detected) = 1.0 at Distance = 0.0
  - P(detected) changes from 1.0 to <1.0 over some distance
  - Function (curve) can be found to model this change in P, based on data collected

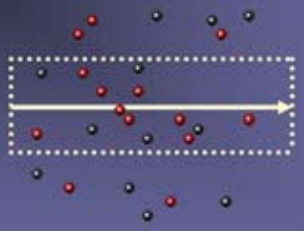
Distance data



Oops, some calculus!



Thinking outside the box



Increased efficiency

- Sample greater area
- Use more sighting data
- Can accommodate less experienced observers
- May be able to relax sampling restrictions

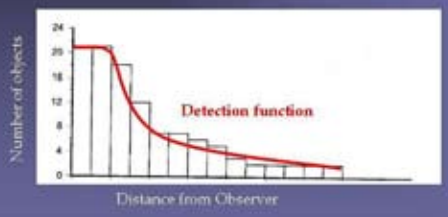
Other methods

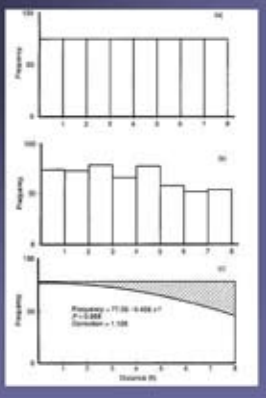
- Double observer surveys (mark-recapture)
- Quadrat sampling (presence/absence)
- Double sampling

Assumptions

- Objects on the line are detected with certainty
- Objects are detected at their initial location
- Measurements are "exact"

Distance data





Legacy Prairie Quality Monitoring Project

Presented by:
Gail Olson
Gail.olson@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA

This talk gave an update of the latest prairie quality monitoring projects. The goal of the project is to identify the vegetative and soil characteristics of remnant prairie sites in the South Puget Sound. The research is ongoing and Gail presented the preliminary results. Soon a data framework will be available on a WDFW secure website. This information will be useful to prairies managers and researchers from all cooperating groups.

Project Goals

Identify characteristics of "occupied" prairie sites
Assess potential of unoccupied sites

Species of interest:
- Mazama pocket gopher
- Streaked horned lark
- Mardon skipper
- Taylor's checkerspot
- Western gray squirrel

Site characteristics

- Plants (native and invasive)
- Soils
- Other:
  - Land use (historic and present)
  - Size
  - Vegetation structure
  - Etc., etc.

Project Objectives - Plants

Provide wall to wall mapping of plant species of interest (invasive and native)
Identify plant species occurrence and measure diversity
Allow monitoring of changes through time
Enable assessment of management efforts

Methods – Plant sampling

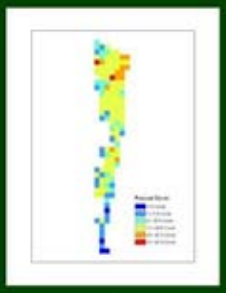
- Assess cover and abundance of selected species in 25m plots
- Estimate cover of all species in 1m plots
- 2007: Mima Mounds and Rocky Prairie

Plant Metrics

- Cover classes (%)
  0, <1, 1-5, 6-10, 11-20, 21-30,.., 91-100
  Festuca roemeri, Carex inops, Pteridium aquilinum, Cystisus scoparius, Arrhenatherum elatius
- Abundance classes (criteria dependent on species)
  None, Light, Moderate, Dense
  Castilleja hispida, Viola adunca, Balsamorrhiza deltoidea, Plantago spp., Lupinus spp.
- Presence/absence
  Vicia spp., Hieracium pilosella, Pontentilla recta, Centaurea spp., Quercus garryana, Pseudotsuga menziesii

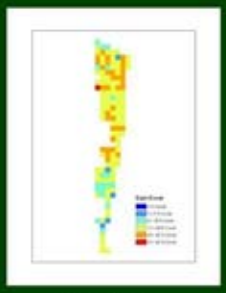
Festuca roemeri Cover


Mima Mounds


Rocky Prairie

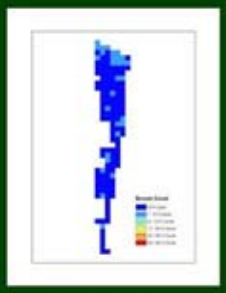
Carex inops Cover


Mima Mounds

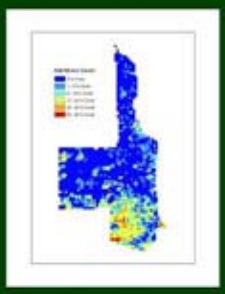

Rocky Prairie

Scotch Broom Cover

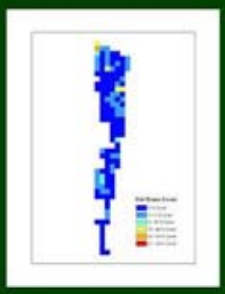

Mima Mounds


Rocky Prairie

Tall Oatgrass Cover

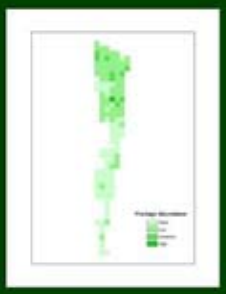


Mima Mounds



Rocky Prairie

Plantago spp. Abundance



Lupinus spp. Abundance

Mima Mounds

Rocky Prairie

Viola spp. Abundance

Mima Mounds

Rocky Prairie

Methods - Other

- Legacy Prairie Data Framework

Legacy Prairie Data Framework Objectives

- Compile all available prairie related information, including:
  - Spatial data
  - Tabular data
  - Imagery
  - Reports/Publications
- Enable easy access to prairie managers and researchers from all cooperating groups
- Allow updating of information
- Accomplished via a secured web site

Legacy Prairie Data Framework

- Secured Web site portal
- Contains links to:
  - Spatial data (biotic and abiotic)
  - Imagery
  - Tables
  - Documents

Examples

- Biotic spatial data
  - Taylor's checkerspot locations
- Abiotic spatial data
  - Thurston County soils
- Imagery
  - Pierce County Aerial Photographs
- Documents
  - State status reports

Taylor's Checkerspot Habitat Enhancements at Unoccupied Sites in South Puget Sound

Presented by:
Hannah Anderson
handerson@tnc.org
The Nature Conservancy, Olympia, WA

This presentation covered a habitat enhancement project for Taylor's checkerspot at currently unoccupied sites in South Puget Sound in anticipation of reintroduction of the butterflies. The goal of the project is to move the eight sites closer to the conditions necessary for reintroduction and resulting long-term occupation of captive-reared butterflies. The first step was to convene a multi-disciplinary team, followed by field visits to each site to evaluate current conditions. Density and diversity of target plant species was taken into consideration, level of and management actions for invasives, as well as heterogeneity of habitat features such as trees and mounds/swales. Management units were selected for each site and prioritized among sites. Management actions to control invasive species are in process. Future 2008 actions will include extensive nectar surveys within the management units to guide the spatial distribution and density of larval food and nectar plant enhancements, and the plantings themselves. The sites include both north and south units of Scatter Creek Wildlife Area, Mima Mounds NAP, Glacial Heritage Preserve, Rocky Prairie NAP, Tenalquot Preserve, Wolf Haven, and West Rocky Wildlife Area.

ACUB Sites

Project Goal

Efficiently move habitat condition closer to appropriate level for Taylor's Checkerspot in preparation for reintroduction of captive-reared animals

Project Objectives

- Based on best available knowledge, evaluate and identify management units at sites that contain potentially appropriate habitat
- Assign, prioritize and implement restoration activities to management units
- Enhance nursery capacity to ensure sufficient propagation for enhancement activities
- Develop methodology to fulfill assigned management unit activities
- Monitor efficacy of treatments

Activities to date:

- Cooperative, interdisciplinary butterfly habitat enhancement team convened
- Habitat evaluation factors developed highlighting important habitat features
- Site visits to 8 sites conducted

Activities to date:

- Habitat enhancement opportunities within and among sites prioritized
- Priority plant species identified for 2008 restoration plantings
- Site-specific work plans developed by land managers outlining proposed activities

Evaluation Factors:

- density and diversity of nectar plants , availability of host plants
- presence and density of invasive plants
- heterogeneity in habitat features
- adjacency to other potentially suitable habitat patches / sites
- planned management activities

Ranking:

- Management units were ranked based on the evaluated factors
- Management units closest to "ready" for reintroduction were selected as first-year priorities
- Example: Glacial Heritage Preserve, management unit #2

Glacial ACUB Butterfly enhancement areas

Glacial Heritage Management Unit #2 selected as priority for Taylor's checkerspot habitat enhancement

Host and Nectar Plants:

Plantago lanceolata - 2
Castilleja hispida - 0
Plectritus congesta - 0
Collinsia parviflora - 0
Balsamorhiza deltoidia - 0
Lomatium triternatum - 3
Lomatium ultriculatum - 3
Cammasia quamash - 2
Others: *Fragaria, Ranunculus* - 2

0 – none , 1 – a few, 2 – moderate, 3 – high

Invasive Plants:

- low density of Scotch broom present in unit
- rigorous treatments of tall oatgrass since 2004 resulting in low density
- exotic forbs present, particularly *Hypochaeris radicata*

Habitat Heterogeneity:

- scattered conifers present in management unit
- mounded topography and a large swale creates a diversity of microhabitats

Adjacency:

Future Activities:

- Continued control of invasive plants in management units
- Spring Nectar Surveys at all sites – protocol to be developed
- propagation of target butterfly plants – develop new methods if necessary, utilize experimental approach
- enhancement plantings of target butterfly plants

Funding provided by:

Butterfly Habitat Enhancement Team :

Dave Hays
Ann Potter
Mary Linders

David Wilderman
Birdie Davenport

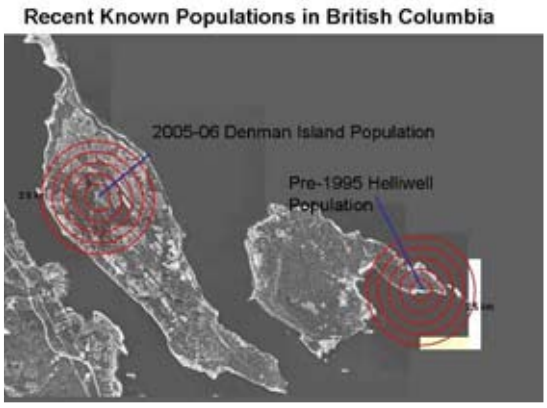
Eric Delvin
Cheryl Fimbel
Hannah Anderson
Carri Marschner

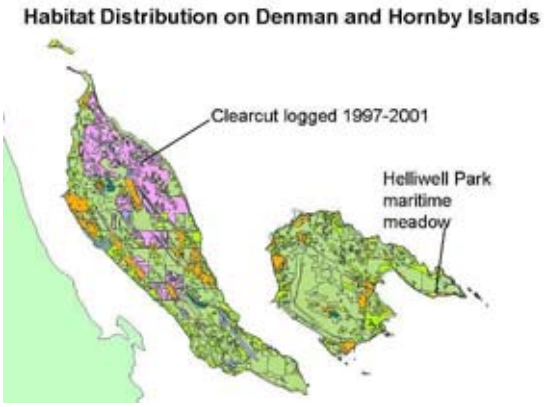
Habitat requirements

Taylor's Checkerspot Foodplants and Habitat in British Columbia

Presented by:
Jennifer Heron & Conan Webb
Jennifer.heron@gov.bc.ca
BC Ministry of the Environment

Food sources and habitat for Taylor's checkerspot butterflies in British Columbia were the topic of this presentation. Known population and habitat distribution information was summarized and then followed by examples of typical habitat types. Studies found that the three habitats preferred were roads and landings, dry meadows, and wet meadows. Soil and rock composition was also explained in detail as well as vegetation found at these sites. Larval host plants were surveyed and the results indicated that *Veronica serpyllifolia* and *Veronica beccabunga* ssp. *americana* are the important larval host plants for this butterfly in British Columbia.





Taylor's Checkerspot Habitat Characteristics

Found in three habitats:

1. Sparsely vegetated roads and landings;
2. Dry meadows dominated by sweet vernalgrass and hairy-cat's ear with varying amounts of tree and shrub cover.
3. Most abundant in wet meadows with common rush slough sedge, and other wetland plants including *Veronica* species.

A typical habitat had 29% soil or rock; 8% wood debris and was vegetated with 23% grass, 20% forbs, 16% sedges or rushes, 8% shrubs, and 7% trees.

All butterflies by habitat type on Denman Island 2007

- Butterflies were much more common in modified ecosystems (1,160 observations; 95% in total) rather than natural ecosystems (67; 5%).
- Of the natural ecosystems, herbaceous (24; 2%) and woodland ecosystems (28; 2%) had the most butterfly observations.
- Of the developed, open logged (649; 53%) and moderately open logged (165; 13%), had the most butterflies.
- 565 (91%) of checkerspot observation were made in logged areas, particularly open logged areas (408; 66%).

Taylor's Checkerspot Larval Host Plants

- Observations indicate that lance-leaved plantain *(Plantago lanceolata)* is not the primary host plant for the checkerspot population on Denman Island.
- Thyme-leave speedwell *(Veronica serpyllifolia)* and American speedwell *(Veronica beccabunga* spp. *americana)* are suggested as more important larval host plants and would explain the prevalence of Taylor's checkerspot in moist, disturbed habitats.
- Monkeyflower (*Mimulus* species) may also be used, although it is unlikely.

Food plant observations on Denman Island

Acknowledgements

- Garry Oak Ecosystems Recovery Team (Shyanne Smith and Chris Junck)
- North Denman Lands (Henning Nielson and Bente Pilgaard)
- Denman Island Conservancy
- Conservancy Hornby
- Invertebrates Recovery Team
- B.C. Parks (Bill Woodhouse and Mike Rody)
- Funding provided by Parks Canada Agency and B.C. Ministry of Environment, Habitat Stewardship Program (Environment Canada).

Habitat Requirements

Presented by:
Mary Linders
Mary.linders@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA

This presentation covered the habitat requirements of the Taylor's checkerspot butterfly, which are defined by climate and vegetation. Common places to find the butterfly are on grassy balds, prairies, and coastal meadows. Discussion and questions continued throughout the presentation; threats and population issues were discussed at length.

Microclimates affect food plant distribution and thus the distribution of larvae and adults. Climate change can affect the microclimates where larval communities occur. Perennial plants combined with annual plants are considered good for Taylor's checkerspot larvae. Females lay clusters of eggs, requiring that sufficient food be available within a small area. Mary explained the difference between the Oregon and Washington balds. Oregon balds have deeper soil that is more moist and occur at approximately 500 ft in elevation. The balds in Washington have very shallow soils overlaid on bedrock. Lack of management on balds as well as climatic perturbations affect the germination of annual host plants. Climatic perturbations appear to have significantly altered bald habitat.

Habitat quality is determined by availability of key food sources and food and nectar plants provide key nutrients for adults and larvae. Besides the balds, another important site for Taylor's checkerspot is the Artillery Impact Area on Fort Lewis, where bunch grasses are interspersed with forbs in a native prairie setting. The foods table on pages 113-116 in this document, and slide 10 in this presentation list host plants by site. When asked if there is an indication of preferences for nectaring plants, Mary answered that although there is not enough data at this time, it is known that adults seem to prefer certain nectar plants but will use a variety of available sources. Checkerspots at Fort Lewis use *Balsamorhiza deltoidea* extensively, while those on balds in Thurston County nectar heavily on *Plectritis congesta*. Locating, identifying and making accommodations for diapause sites are all part of restoring habitat. Rocks and downed logs are examples of potential diapause sites that shouldn't be disturbed. Scott Hoffman Black (Xerces Society) suggested that a study is needed of how these butterflies determine their diapause location. Mary answered that captive breeding and using enclosures at a zoo would be a good place to begin such a study.

Habitat Requirements

- Habitat conditions that support Taylor's checkerspot are defined by climate and vegetation
- Balds, prairies, and coastal meadows may contain checkerspot habitat among others
- Microclimate affects food plant distribution and thus the distribution of larvae and adults
- Habitat quality is determined by the availability of key food resources
- Food and nectar plants provide key nutrients
- Adults seem to prefer certain nectar plants, but will use a variety of available sources

Clearcut - Denman Island, BC

Coastal - BC

Helliwell Provincial Park
Hornby Island

East Point, Gulf Islands

Coastal – Clallam County, WA

Balds – Clallam County, WA

Balds – Thurston County, WA

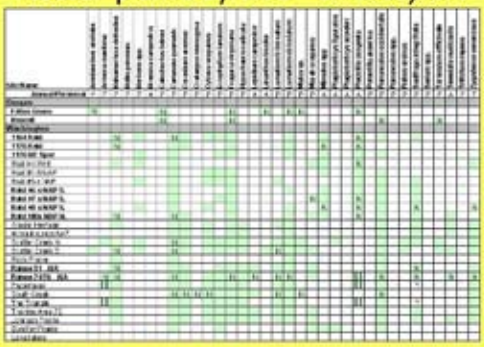
Balds - Oregon

Lowland prairie - WA

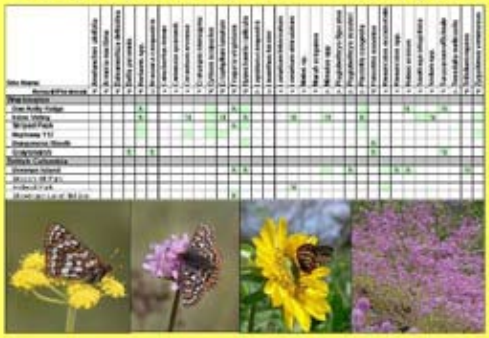
Lowland prairie - WA

Taylor's checkerspot host plants by site

Nectar plants by site - *E. e. taylori*



Nectar plants by site - *E. e. taylori*



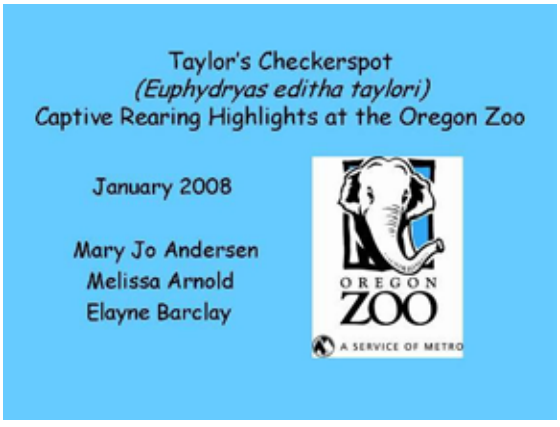
Taylor's Checkerspot: Captive Rearing Highlights at the Oregon Zoo

Presented by:
Mary Jo Andersen, Melissa Arnold, Elayne Barclay
Maryjo.andersen@oregonzoo.org & Melissa.arnold@oregonzoo.org
Oregon Zoo, Portland, Or

The history of the Oregon Zoo's involvement in captive rearing of Taylor's checkerspot butterflies was summarized in this presentation. A total of 757 larvae have been released since 2004 as a result of the Zoo's efforts and as of 2007 the Zoo has been successful in rearing the species to adulthood. Factors contributing to the success of the program were addressed including type of prediapause rearing container and substrate; host plant species used; diapause housing; presence of parasitoids; and type of postdiapause rearing container and need for basking opportunities. Information gained to date about second diapause larvae, pupation, eclosion, and adult care was presented. The current census of larvae in diapause at the Zoo (600) and future plans to attempt mating of captive-reared adults was reviewed.

Information from discussion that followed presentation:

- Larvae could be monitored during diapause without disturbing them by shining a flashlight under or behind the container to back light the clusters of larvae webbed in the paper towel folds.
- The most successful results occur when there is consistency in care, with one worker dedicated exclusively to working with the species.



Important aspects of successful rearing methods

- Prediapause care
- Host plant care
- Diapause care
- Post diapause care
- Parasitism
- Pupae and adult care

Prediapause care

- Unsuccessful:
  - petri dishes of different sizes
  - jars of different sizes
  - deli containers with sphagnum moss
  - netted flats of potted host plants
- Successful:
  - Dannon yogurt cups (6oz) and lids, lined with kitchen paper towels ("diapers")
  - Thanks to Gordon Pratt!

Factors relating to success

Yogurt cups!

- Provide vertical substrate for larvae to climb away from frass and cluster in groups
- Provide traction for proper molting
- Lids provide proper ventilation so larvae do not desiccate or mold

Host plant

- Larvae raised on a variety of host plants:
  - *Castilleja hispida*
  - *Plantago lanceolata*
  - *Collinsia* and *Plectritis*
- Best results with Plantago
  - Larvae fed plantago weighed significantly more before entering diapause than those fed Castilleja (average weight for Plantago eaters was 0.0408g versus 0.0250g for Castilleja)
  - Survivorship was high for both, with no significant difference between host plant (average cohort % survival 94.3% for Castilleja and 97.0% for Plantago)
  - Convenience, quality of leaves, and quantity of leaves higher with Plantago

Diapause care

- Larvae survival is higher when housed outdoors than in fridge
- Micro-environment provided by inverted clay pots very successful
  - Pots watered weekly to supply humidity
- Ability to check larvae without disturbance better when outdoors
  - Weekly checks to assess state of dessiccation/mold and to monitor movement of larvae

Postdiapause care

- Monitored activity level to determine when to remove larvae from diapause
- Low mortality using clear plastic Sterilite bins to house groups of larvae
- Low mortality using yogurt cups for housing individual larvae

Postdiapause care

- Provided a moisture gradient with partially dampened lining (disposable "shop" towels), screened top during day and solid lid overnight
- Provided basking opportunities with "mima mounds" and incandescent lights

Parasitism!

Since eggs are collected in the field, they are susceptible to parasitoids.

2006-2007 Parasitism

- Three cohorts were parasitized by a species of Braconid wasp
- First observed 17 days postdiapause. These cohorts were kept in the lab rather than be released.
- Parasitized larvae stopped eating, but some survived for weeks before dying
- An estimated 29% of the individuals from each parasitized cohort were effected
- 15 individuals from the parasitized cohorts pupated and eclosed

Pupation

- Of the 77 larvae that remained in the lab, 31 went into a second diapause and 21 pupated
- Larvae provided with "teepee" of Plantago stalks to pupate on (none used it)
- Larvae pupated on "mima mounds", sides or tops of enclosures
- 15 of the pupae were from parasitized cohorts
- Average time from breaking diapause until pupation was 36.8 days (one individual took 64 days)

Eclosion

- Pupae housed in temperature controlled lab in a variety of enclosures: aquarium, jewel box, netted sterilite bin
- Average time from pupation to eclosion was 20.1 days
- 17 out of 21 pupae eclosed successfully

Adult Butterflies

- Housed in a variety of enclosures: aquarium, jewel box, netted sterilite bin, pop-up tent
- Fed gatorade and given a variety of nectar plants, observed feeding on both
- Minimal handling, moved with cotton swabs
- No flying or breeding behavior observed
- Survived up to 36 days with and average of 24.5 days
- Gender ratio 11:7 (3 unknown gender)
- One female laid infertile eggs

Current year: 2007-2008

- All 611 individuals the zoo received in 2007 were reared in yogurt cups and fed plantago
- Survivorship to diapause was 98% (600)
- All larvae known to be in 5th instar when entering the diapause stage
- A subset of larvae will be kept to attempt breeding adults

Taylor's Checkerspot Partners

- Washington State Department of Fish & Wildlife
- The Nature Conservancy
- Xerces Society
- Thurston County
- Parks Canada
- American Zoological Association, Butterfly Conservation Initiative

Acknowledgements

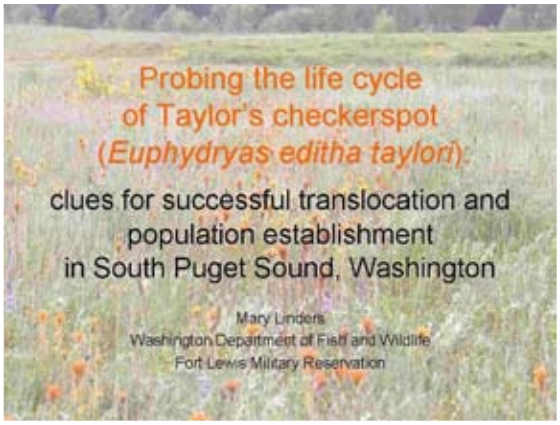
Thanks to: Our partners, the staff, volunteers and interns at the Oregon Zoo, Dr. David Shepherdson, Mary Linders, Dr Gordon Pratt, and Dr Mike Singer

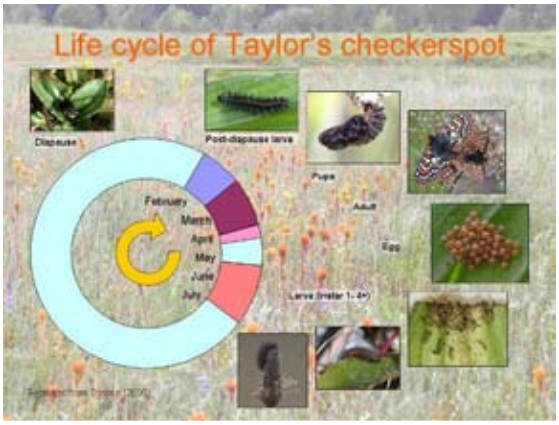
Probing the Life Cycle of the Taylor's Checkerspot

Presented by:
Mary Linders
Mary.linders@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA

This presentation focused on the lifecycle of the Taylor's checkerspot and how it relates to successful translocation and population establishment. The goal of translocation is to reduce the chances of extinction of the butterfly in South Puget Sound. Mary discussed the captive rearing and translocation efforts for 2006 and 2007, and explained what is planned for the 2008 field season.

During the discussion and question session, Mary was asked about the 2008 strategy and was she planning to use the same sites. She answered that they were planning to use the same areas so that restoration can take place at other sites. A new method they would like to try this year is putting up ribbon barriers, to mimic trees at the edge of a prairie. Ann Potter (WDFW) suggested releasing butterflies in an area that is already surrounded on three sides by trees. Mary answered that there are time constraints and they need to see the sites when they are in full bloom. Gordon Pratt (University of California, Riverside) inquired as to the quality of the nectar in these areas and Mary said that the sites did have nectar plants available to the butterflies. Gordon followed up by suggesting that even the right plant could produce little or no nectar if the site wasn't appropriate. Lisa Randolph (Ft. Lewis) wanted to know if they are tracking preferences and Mary answered that oviposition preferences are genetic. Currently *Plantago lanceolata* is the only host plant available at the release site; nectar preference can vary between years and is also based on availability in any given year.





Captive rearing and translocation
justification for intervention

- Isolation – distance between populations exceeds dispersal distance
- Size – Wild populations are too small to support direct translocation for reintroduction
- Rate of loss – 4 populations were lost in South Puget Sound from 1998 to 2000
- Risk – potential benefits outweigh risks associated with captive propagation
- Net benefit – an increase in the number of healthy individuals and populations
- Safety net – augmenting populations may prevent them from going extinct

Translocation
goal and objectives

Goal: Reduce the probability of extinction in south Puget Sound

Objectives

- Develop translocation and release techniques
- Use releases to learn about rates and sources of mortality, habitat use and suitability, and other potential limiting factors
- Provide basis for a translocation plan for Taylor's checkerspot in south Puget Sound

Translocation
3 strategies tested

Stages

- Contain females on release site to capture eggs
- Release late prediapause larvae
- Release postdiapause larvae

Rationale

- Translocated adults would likely be disoriented
- Prediapause larvae can seek diapause site, may survive better in the field than in lab
- Postdiapause larvae highly mobile and may benefit from the increased light exposure in the field

Methods
capture of eggs via wild females

Results
capture of eggs via wild females

- Females will lay eggs in a controlled setting
- 3-4 of 8 females laid eggs on *Castilleja*; but only *Plantago* available in quantity at the source site
- Minimum egg production averaged about 142 eggs per female (projected range was 120-300)
- Minimum life span = 12.9 + 4.9 d (SD); range 5-19 d
- Females lived several to many days after egg production stopped
- Egg to diapause survival in the wild = 0.8% (5 of 639); egg to diapause at the Zoo = 91.4 % (412 of 451)

Methods
prediapause larval release: 27 June 2006

Results

prediapause larval release

- 608 larvae (527 captive, 81 wild)
- Sites were similar with respect to cover of *Plantago* and stems of *Castilleja* per plot
- 3 days post-release:
  - 5 larvae on Site 1, 34 larvae on Site 2;
  - plants on Site 1 were notably more desiccated than on Site 2
- Postdiapause:
  - 3 wild larvae in 2 visits to plot on Site FL1; 2 larvae were observed on a 2nd plot
  - 1 larva was observed on Site FL2
  - No adults observed
- Desiccating winds at time of release and placing larvae singly are believed to account for these results

Methods

postdiapause larval release

$n_1 = 30$; $n_2 = 199$

2006 Results

postdiapause larval release

- Released mid-March due to inclement weather
- Larvae diapausing outdoors were larger and more active than those kept in fridge
- 9 individuals were relocated a total of 20 times
- Outdoor larvae accounted for most individuals (7 of 9) and sightings (17 of 20)
- 58 percent (7 of 12) of outdoor larvae were observed; 14 percent (2 of 14) of indoor larvae
- 4 larvae found dead at release location, likely from hail immediately after release
- No adults were observed in 2006 and 2007 surveys

2007 Results

postdiapause larval release

- 199 unmarked larvae were placed in 2 plots that were 50 m apart
- Released 6th (Plot A) and 16th (Plot B) March due to inclement weather
- Post-release surveys:
  - 18 March: 15 larvae on Plot A and 22 on Plot B
  - 27 March: 5 larvae on Plot A and 4 on Plot B
  - 11 observations of adults during 10 flight season surveys (7 suitable weather)
- Unknown number of individuals
- Initially adults were observed in close proximity to the release plots, but moved away shortly thereafter

Expectations for 2008

would 2 strategies be best?

- Harrison (1989) translocated 100 postdiapause larvae per site, which resulted in 0-3 adults.
- We observed ±11 adults (n = 199 postdiapause larvae)
- Postdiapause survival estimates from Moore (1989) for an established population:

	% larval survival	# larvae (n=100)	58 % pupal survival	93 % pupal survival
with parasitism				
larval survival – lo	3	3	1	2
larval survival – hi	88	88	51	81
without parasitism				
larval survival – lo	36	36	20	33
larval survival – hi	93	93	53	86

Next steps

- Relative eclosion rates for postdiapause larvae vs. pupae. Mark adults emerging from captive pupae.
- Are adults more likely to remain at the release site if other adults are present? Observe adult behavior.
- Can we encourage adults to remain with barriers? Set up ribbon fences.
- Are adults are successfully reproducing at the release site? Monitor adult behavior and search for eggs/larvae.
- How many adults are needed to establish a population?
- Test hand-mating techniques for adults in captivity.
- What is the egg-laying potential of female *taylori* in captivity?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• Technical expertise: Gordon Pratt, Scott Hoffman-Black, Dan Grosboll, Ann Potter, Scott Pearson, Debbie Pickering, Ted Thomas, Cheryl Schultz, John Fleckenstein
• Reviewers: Mary Chramiec, Lisa Randolph, Derek Stinson, John Weller
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Questions?

Captive Breeding of the *Euphydras* Checkerspots

Presented by:
Gordon F. Pratt
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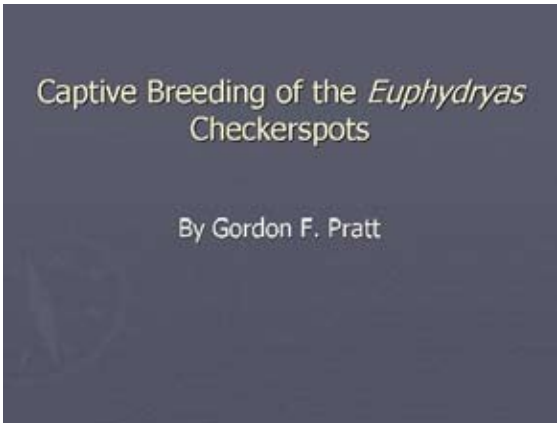
University of California, Riverside

Gordon's talk centered on his experience in the captive rearing of *Euphydras* checkerspots. He explained the Quino checkerspot, *Euphydryas editha quino*, was listed under the ESA in 1997 and at that time he began developing a captive breeding method for these butterflies. He has used this method successfully with other butterflies as well– other Nymphalids, blues, coppers, etc. One of the problematic differences working with checkerspots is that they tend to return to diapause and many species have a multiple year diapause. He explained his methods in detail and mentioned that it is also necessary to maintain excess food plants as well as keeping a backup food plant species just in case something happens. During the discussion following his talk, he was asked if they released the butterflies in California. Gordon answered that they do not, and he attributes this to the US Fish & Wildlife Service in California having conservative policies. Someone asked for a further explanation of the second diapause and Gordon answered that if the conditions are not right, they will just go back into diapause and can do this multiple times. This behavior is also used by these butterflies as bet hedging since some years' weather conditions can change drastically in a very short period, which will mean there will be no successful progeny from the adults that eclosed that year. In these cases the population will only continue by the larvae that returned to diapause.



Synopsis of Steps in Checkerspot Captive Breeding

Maintain Diapause larvae

- Stored in plastic containers with dry paper toweling at room temperature from spring to winter
- Quino larvae stored in plastic containers are not chilled (unlike required by many other Edith's Checkerspot populations)
- Checkerspots from high elevation (>4,000 feet) or populations that are exposed to cold winter conditions, should be placed in the refrigerator in mid October and brought out when food plant becomes available

Breaking Diapause

- Breaking diapause for most checkerspots requires four months of cold, which simulates winter, followed by warmer conditions
- Larvae are placed in gladlock containers with wet paper towels and *Penstemon* branches
- Within 5-10 days in gladlock containers the larvae begin feeding on the *Penstemon* branches
- Containers are opened twice daily, preferably at 12 hour intervals, often when I first arrive at the facility and just before I leave
- After 10 days the larvae are placed out in tanks with the food plants which can be *Castilleja* species, *Plantago erecta*, *Penstemon* species, etc.


Penstemon added to container


Larvae move onto *Penstemon* branches


After 10 days larvae are transferred to tanks with lights


Young fresh post diapause larvae


Larval Room


Penstemon cuttings in yogurt containers placed within the tanks

Advantages of *Penstemon*

- *Penstemon* is used as a secondary food source for the Quino Checkerspot and as a back up if *Plantago*, the food plant for Quino, does not do well or is eaten by herbivores.
- Usually mammals and birds at Murrieta will not feed upon the *Penstemon* and they rarely disturb the pots.
- Used as oviposition substrate for the adult females.
- Reduces work load since prediapause larvae will feed upon this plant in yogurt containers. So larvae can be left inside the containers and reared to diapause or wandering stage without having to change them to new plants.


Larvae reared to pupae


Post diapause larvae are also reared in a cage in the fenced enclosure


Adult Room


Adult Collection
Pupae are collected by cross or specific female line, put inside cages, and the cages are labeled as to the cross or specific line
Males are kept in the cages after eclosion, while females are removed immediately after wing drying and placed in the refrigerator in labeled yogurt containers
Males need to mature three days on average – some can mate the first day, but most take at least three days
During the period females are being mated the males are fed daily
Females can be kept in the refrigerator for at least two months before mating – if chilled longer than a few days the females must be fed

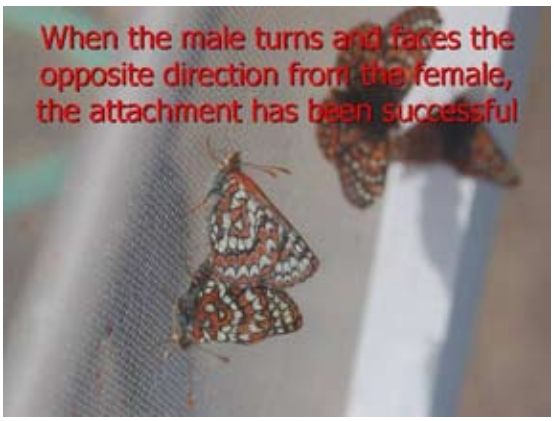

Adult Cage

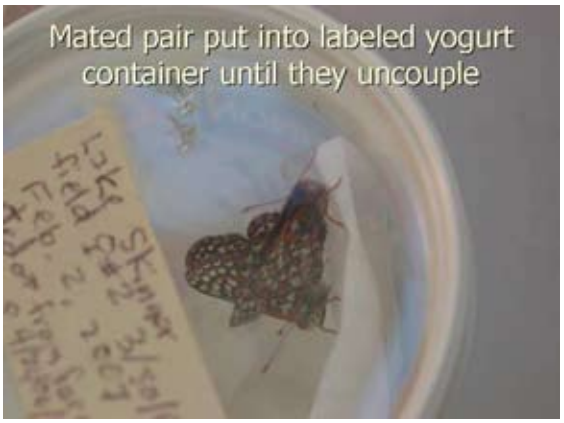

Pupae are kept in yogurt containers with paper toweling

Mating of Checkerspots

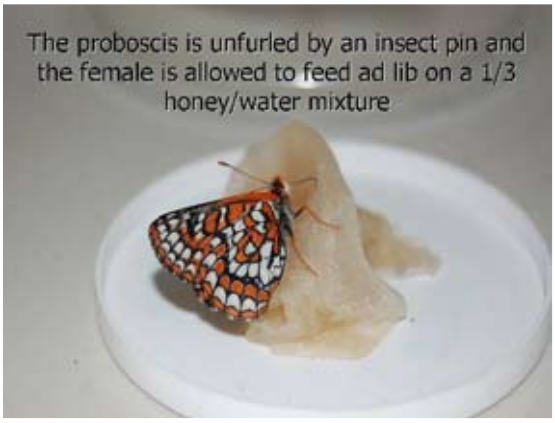
- Amount of light is extremely important – sometimes it can be done indoors, but it is easiest outside
- Females are kept in refrigerator (or in the field in a cooler) for at least 15 minutes before mating
- Mating can be done in the field with field collected males and they are released back after mating
- Females are placed on the netting of the inside of the cage
- Lab reared males are grabbed by the forewings and their antennae are rubbed against the abdomens of the females until the males react
- With field collected males to reduce wing damage, the female is grabbed by the forewings and her abdomen is rubbed against his antennae
- Once the male starts turning its abdomen and trying to attaching its abdomen to the female, I often hold the female to prevent her from falling or trying to escape
- Male begins attaching by facing the same direction, turning its abdomen, and when the attachment is successful he turns around and faces away from the female


Show male abdomen is connected to the female abdomen


When the male turns and faces the opposite direction from the female, the attachment has been successful


Mated pair put into labeled yogurt container until they uncouple


Adults are fed a 1/3 honey water mixture
PURE
HONEY


The proboscis is unfurled by an insect pin and the female is allowed to feed ad lib on a 1/3 honey/water mixture


Oviposition Container with a female


Potted Penstemons with mated
Quino Checkerspot females


Paper toweling at the branch base prevents
larvae and female from leaving the container


Eggs that are around a day old


Eggs that are a couple of days old

Prediapause larvae

- Larvae are reared in these oviposition containers until they reach diapause or they have eaten most of the *Penstemon* leaves within them
- If they have not completed development into diapause in the oviposition containers then the larva are transferred to either yogurt or new oviposition containers
- Once the larvae have entered diapause they can be left in the yogurt containers on shelves until the following winter

Problems with Captive Breeding

Growing food plants
- a) crowi, rabbits, and squirrels, and insect herbivores damage *Plantago* flats
- b) spiders, insect predators, and parasitoids kill Checkerspot larvae
- c) balance of organic and inorganic components can reduce mold yet affect the time the soil remains moist –larvae can drown yet return to diapause if plants dry out to quickly
- d) need enough *Plantago* or *Penstemon* at proper stage and quality to rear all larvae

Long term Diapause
- a) encourage larvae to complete development and make sure those larvae that return to diapause are as healthy as possible
- b) high male numbers with first year larvae and high female numbers with second and third year larvae, may need to release both into the field

High quality adults
- a) large size – small males and small females are difficult to mate
- b) fully formed structures, particularly antennae and wings – mating cues

Crosses between different female lines
- a) goal >20 adults for each female line – this give about 10 males per cage which is necessary since male to male interaction seems to be important in the maturation process
- b) reduce potential selection on captive bred colony by indirectly maintaining as much genetic variability as possible

Habitat restoration and maintenance

Taylor's Checkerspot in the Greater Corvallis Area

Presented by:
Scott Hoffman Black, Xerces Society
and Al Kitzman, Benton County
sblack@xerces.org & al.a.kitzman@co.benton.or.us
Moderated by:
Dave Hays, Washington Department of Fish & Wildlife

This talk was a group discussion about habitat restoration and maintenance in the greater Corvallis area. Current "restoration" is really the staving off of invasives without hurting the butterfly. A question was posed to the group as to how they can go further into restoration within their critical core habitats of Fitton Green Natural Area and Beazell Memorial Forest. The 586 acres are worth $6 million. Fitton Green Natural Area is also known locally as Cardwell Hill. The main part of this property is privately owned and an MOU between the County and the landowner exists. This area is adjacent to park land but the landowner is working with the county to protect the Taylor's checkerspot on their land. The 2.4 acres of private land is the largest of two critical core habitats next to a 300+ acre county park. One neighboring landowner mistakenly assumed that trees were inherently good. Working under that assumption, glyphosate was sprayed from a helicopter and tree seedlings were planted. Luckily for the butterfly, the trees did not take. The butterflies need that corridor open to connect to the other area. Xerces wants to maintain the habitat to encourage Taylor´s checkerspot to travel through the corridor. Another landowner in the complex is absentee and doesn't have plans to develop the land. Xerces showed his family the butterflies and they were excited. The landowner was also educated about the invasive *Brachypodium* encroaching into his meadow. Discussion followed about the lifecycle of the butterfly. Xerces will put together a habitat enhancement plan for these areas.

Al Kitzman led the next section of the talk specific to Benton County Natural Areas and Parks. *Brachypodium sylvaticum*, a Eurasian grass, showed up in Oregon in the 1940s near Eugene. These bunch grasses will completely occupy an area, quickly crowding out nectar and host species. The good news is that the seeds are short-lived, with only a two year window of viability. If the plants are treated two years in a row, there is a good chance of eradication. This plant can thrive in full shade or full sun and creates a carpet under forest canopies. Up to 60% of the occupied site at Fitton Green was *Brachypodium* and no butterflies were found in that area. Glyphosate had been used with some success to control *Brachypodium* at Beazell. The goal is to minimize impact to butterflies on the occupied sites, while continuing to control the plant. The strategy is to treat during periods of time that the butterflies are least sensitive such as diapause. *Brachypodium* was mowed first before the plant fully seeded, then glyphosate was used during diapause. Mowing reduced seeding by 75%. If no treatment was initiated, *Brachypodium* would have totally occupied the prairie in 5-7 years. After the first spraying over dense *Brachypodium*, some suppressed native forbs emerged. Additional treatments of germinating *Brachypodium*, will be with a broadleaf grass specific

herbicide such as Poast, to minimize native forb mortality. The landowner recently logged fir from the oak forest close to the Taylor's occupied prairie. The majority of prairies occupied by Taylor's in Oregon have tall vertical structure along the edge, creating some protection from the wind. Trees immediately adjacent the prairie were left in place to maintain this structure. An area between two occupied meadows was cut more heavily to provide a dispersal corridor.

The butterfly population has increased after this latest treatment, is there a correlation? They can't say with certainty that the treatment caused the increase, but at least the population didn't decrease. Smaller seedlings will be left for perching sites, medium-sized trees will be removed, and then the area will be reseeded with native grasses and nectar forbs.

Question and discussion followed.

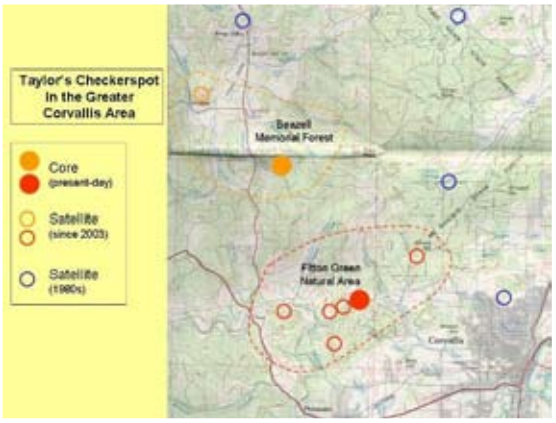
- What is the host plant at these sites?. Scott answered that it is not *Castilleja.* Most sites had *Plantago lanceolata* as host.

- What were the butterflies feeding on before and what historically, pre-Oregon trail, did occupied sites look like?
  Scott answered that they think it would have been an open oak savannah because the huge fir trees have big lower limbs that spread out. Scott goes on to say that they didn't want to affect the microclimate so they leave trees at the edge. Over half the butterflies in Oregon are in this one site.

- A question was raised as to what they are going to do next and Scott answered that the next five years will be spot-treating and maintenance. Al added that the good thing about logging practices in this area is they try to treat *Brachypodium* two years prior to logging to minimize seed transfer.

- Derek Stinson (WDFW) asked for clarification regarding the lack of host plants, except maybe *Plantago.* If there weren't any there, did this mean that this might not have been an historical habitat? Dana Ross (independent consultant) answered that they have records from 1950s – 1970s of a viable population. Ann Potter (WDFW) continued that *Plantago* has been there since the 1800s in some form. She also mentioned Paul Severns' work with Kincaid's lupine, a food source for Fender's Blue butterfly, as a graduate student at Oregon State University. When he studied the Taylor's occupied meadow he wanted to know what females were looking for when selecting for oviposition. He looked at *Plantago* density, *Fragaria* density, and grass height. He found that they wouldn't oviposit where there was tall or dense grass. *Fragaria* density and shorter stature of grass was adequate and they selected for this. This oviposition information will be used to inform and guide restoration efforts.

The talk ended with Scott announcing that their strategy is available and Ann added that Paul should also be able to have his research available to the group.



Taylor's Checkerspot Management on Fort Lewis

Presented by:
Rod Gilbert, Fort Lewis, Washington and
Cheryl Fimbel, The Nature Conservancy
Roderick.gilbert1@us.army.mil & cfimbel@tnc.org

This joint talk presented the efforts underway to manage Taylor's checkerspot habitat on Fort Lewis. Rod began his talk by explaining how the 20,000 acres of prairie land on the Fort requires a good deal of seed for restoration and that many of these plants are difficult to propagate. Currently there are five sites on the Fort that are in preparation for the butterflies' release. Each site has its own set of issues, with different threats. At this point in the presentation, Cheryl asked that further clarification be given to the participants as to what sort of training goes on in these areas of the Fort. John Weller (Ft. Lewis Range Control) gave a brief explanation of the training. Soldiers travel through Range 51 and 76 in combat formation and engage in artillery fire. When the troops reach the point in training where they need more room, they transfer to Yakima. John indicates that butterflies are attracted to the most violent places on the Fort and that training appears to be good for butterflies and their habitat. Much of this is attributed to the fact that they do not put out training-caused fires and areas are allowed to burn, mimicking natural processes on the prairies. Rod continued that the nicest prairies in the South Sound are on the Fort but due to the dangers in the impact area, plugs cannot be used, so plants are propagated primarily through seeding. John also adds that monitoring of these areas is not possible because it is too dangerous. Ironically, due to the restricted nature of many of these areas, the biggest threat would be illegal trespass by civilians disturbing the relative natural setting.

A discussion followed about the plants that are being put out at the Fort. Ann Potter (WDFW) offered that *Plantago* should be put out as a larval source. Cheryl replied that they are not putting any *Plantago* plants out, but instead *Castilleja* and they are working to promote both larval hosts through site maintenance and seeding of both species. Ann warned that by planting only one species, you could be selecting for a plant specific butterfly and that there is a risk in genetic bottleneck as a result.

Taylor's Checkerspot Management on Fort Lewis

Rod Gilbert
Contract Biologist, Versar Inc., Fort Lewis Fish and Wildlife Program
Cheryl Fimbel
Biologist, The Nature Conservancy

Seed Production

- TNC's Shotwell's Landing nursery (focus on rare plants, plugs, annuals, spp. with hard to collect seed)
- Fort Lewis' seedbed nursery (common forbs)
- Fort Lewis' Roemer's fescue nursery? (ITAM and F&W)

Plug Production

- Primarily for Federal Candidates
- Adaptive management
  - Develop stratification and germination protocols
  - Soil mix
  - Pathogens
  - Time to mature (in cells & seed set)
  - Available seed?
  - Survivability (in cells & on site)
- Range Control greenhouse

Extant and Historic Locations

- Management focus on 1 extant, 4 historic sites
- Preparing release sites AQAP due to release pressure
- Each site is very different:
  - Larval hosts
  - Nectar hosts
  - Weeds
  - Site treatments
  - Threats

Extant Sites: Range 76, AIA

Current Condition:
- Ample nectar hosts
- Limited larval hosts?

Potential Threats:
- If maneuver activities extend into occupied habitat
- Early fires
- Noxious weeds
- Access

Management:
- Spot treat weeds
- Fire break?
- Needs more larval hosts
  - Can't use plugs - needs annual and perennial seed mix

Historic/Extant Sites: Range 51, AIA

Current Condition:
- Ready for release
- Ample nectar hosts
- Sufficient larval hosts?

Potential Threats:
- Early fires

Management:
- Spot treat weeds
- More larval hosts
  - Can't use plugs - needs annual and perennial seed mix

Historic Sites: TA 14, Pacemaker

Current Condition:

Ready for release
Ample larval hosts
Adequate nectar hosts

Potential Threats:

Unauthorized entry
(siber-staked)

Management

Burned '05; Scot's broom spot treatment '06 & '07
13 enhancement plots established & treated '07;
Plugged '08
Planted nectar hosts '07 (*Armeria, Lomatium spp.)*
POAST '08?

Historic Sites: TA 7 South

Current Condition:

Ready for release '08?
Ample nectar hosts
Adequate larval hosts?

Potential Threats:

Unauthorized access
Fire restrictions
Weeds

Management:

Burned in '05; Spot-treated '06 and '07; Boomed tall oat grass in '07
14 enhancement plots treated '07; Plugged in '08
Needs more larval hosts
POAST '08?; Treat tall oat grass; Spot treat weeds

Historic Sites: TA 15, Triangle

Current Condition:

Not ready for release
Limited nectar hosts
Limited larval hosts

Potential Threats:

Unauthorized access
Weeds / Thatch / Moss
Fire restrictions

Management:

Spot treated weeds in '06 & '07
Planted nectar and larval hosts in resource plots in '07
On going *Castilleja* planting since '05
POAST '08

Taylor's Checkerspot Management on Fort Lewis (continued)

Cheryl Fimbel continued with the next section of the talk. She explained the focused habitat work being done at Training Area 15. There had been a previous population there so it would be a good place to release butterflies. After working in the area for the last 15 years, The Nature Conservancy has made major progress in ridding the prairies of Scotch broom. Their current goal is to support the release of Taylor's checkerspots. The approach is to create concentrated resource plots, using published literature and Paul Severns' recent work to guide the habitat characteristics. They put a lot of host plants out but never know which ones will be correct for the butterfly and they increase diversity of plant species to ensure proliferation despite fluctuating weather. The main techniques in preparing a site for planting have been to de-thatch, burn, and then apply herbicide. The planting techniques have been direct seeding and planting forbs plugs (11,500 plugs), half the plot would be seeded and half would be plugs.

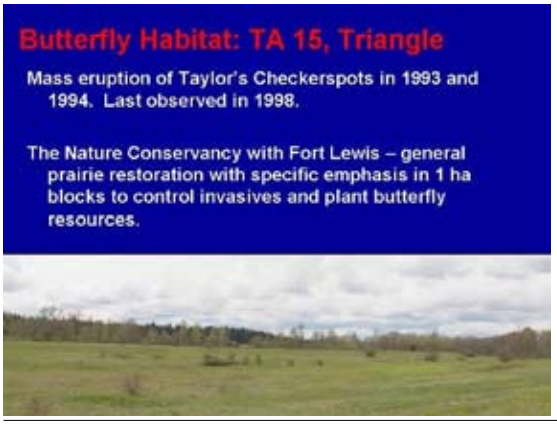
During the discussion and question session that followed her talk, Scott Hoffman Black (Xerces Society) raised the question about the possible detrimental effects of de-thatching in mossy areas. Cheryl answered that this could be a risk but their sites don't have a lot of forbs and in order to get them established, they want to try to get rid of the moss initially in order to seed. She also commented they are not ridding the entire prairie of moss, just planting areas. Mary Linders (WDFW) added that moss does reform quickly. Rod continued that moss is great for retaining moisture for plants but seed germination is very difficult for most plants in that environment. However, Mary countered that *Plectritis* is an example of a plant that seeds well into moss. Ann Potter (WDFW) offered that annuals typically do seed well into mosses and that moss is great for preventing the seeding and growing of non-natives.

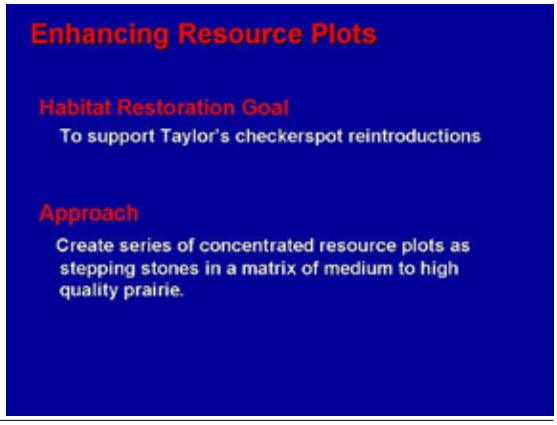
Scott then turned the conversation to herbicides, mentioning Cheryl Schultz's work (Washington State University, Vancouver). Her students are studying the impact of herbicide on caterpillars. Even though this was not included in this workshop, it is an important topic. Cheryl Fimbel offered that it might not be the actual chemical that they react to but the method of delivery and the scale of treatment.

A question was then asked about the original historical conditions of Washington prairies as opposed to Oregon prairies. Ann answered that there are a huge variety of conditions. From there, the next question was whether management is focused on maintaining what prairie components that remain or only preventing it from becoming something else through succession and invasion. Cheryl answered that this area used to be a much more extensive prairie with coniferous forest and she thinks these sites have come a long way. Bill Yake (Butterfly Associates) wanted to know how much effort has been put into researching historical records and speaking with native informants when trying to recreate fire management methods. Cheryl referred to the work that Linda

Storm, an ethnobotonist, is doing at the University of Washington. Pat Dunn (TNC) then offered that the appropriate infrastructure is lacking with the burning method, not that there is a lack of interest or lack of information on how to use it. Ann reminded everyone that the fuel loads are different now and one can't compare fires of yesterday to fires of today. Rod indicated that it takes multiple fires to burn these areas and the fires burn hotter. They can burn all the way through if there are plants like Scotch broom but if mostly fescue, the fires burn cooler and this is more of the way it was historically. There is a concern that the intense heat might do a lot of damage to the habitat. Ann then said that they have aerial photos and survey records of what the prairies used to look like but that they are limited in knowledge as to what they want to create.

Pat brought up the decline of butterfly populations and wondered if this has been documented with species other than Taylor's checkerspot. Barry Bidwell (long time Nature Conservancy volunteer) remarked that at Glacial Heritage Preserve, Taylor's declined somewhat after other more common butterflies saw a drop in numbers. He also thought that the butterflies that don't require prairies are also declining. Rod said that he has seen a huge decline in two species and thinks the only cause for this could be mowing. Ann points out that butterfly diversity has to be linked to plant diversity and all these management and maintenance techniques have an impact on butterflies. Gordon Pratt (University of California, Riverside) added that in the east, Pennsylvania couldn't afford to mow more than once a year. The result was that the state with the least amount of mowing had the largest population of butterflies. He also offered that possibly mowing later in the year may not be good for seeds but better for butterflies.





Target Habitat Characteristics

1. ***Dense concentrations*** and ***interspersions*** of nectar and larval host resources.

Target Habitat Characteristics

2. ***Multiple species assemblages*** of nectar and host resources in close proximity

Host: *Plantago lanceolata* (non-native), *Castilleja hispida, Plectritis congesta, Collinsia* spp.,

Nectar: *Balsamorhiza deltoidea, Armeria maritima, Camassia quamash, Plectritis congesta, Lomatium* spp., *Fragaria virginiana*

Target Habitat Characteristics

3. ***Mixture of low and tall*** grass and forb vegetation height

Tall vegetation - shelter for larval and adult stages of butterflies,

Low vegetation & thatch - access to base of plants for oviposition.

Target Habitat Characteristics

4. Resource patches occurring on ***different moisture and temperature regimes*** or gradients to provide a variety of habitat conditions and plant phenologies to promote or sustain larval development.

Experimental Resource Plots

Site Preparation Techniques

- de-thatching
- burning
- herbicide

Planting Techniques

- direct seeding
- forb plugs
  40 plugs / m^2

Habitat Restoration Challenges

- **Site Preparation**
  May require multiple years to control invasives
- **Site Maintenance**
  Unique challenge of maintaining native forbs and discouraging invasives with butterflies on site
- **Habitat Characteristic Targets**
  Hard to know exactly what to 'fix' without specific information on factors of decline

Taylor's Checkerspot Habitat Restoration in BC

Presented by:
Jennifer Heron
Jennifer.heron@gov.bc.ca
BC Ministry of the Environment

Habitat restoration and maintenance in British Columbia has been focused on Helliwell Provincial Park on Hornby Island. In preparation, vegetation assessments were completed and information was gathered on food plants, conifers and oaks. The plan for restoration is to gradually remove conifers from the area. They are in the clearing-land phase currently. They hope to involve the community as much as possible and keep them informed to garner support as well as prevent the spread of misinformation. The question to the group was if they do translocate a population of Taylor's checkerspot to Helliwell, will that negatively impact the population on Denman Island?

Jennifer was asked about the removal of trees using the girdling method. She replied that they are starting with the removal of smaller trees, under a meter, and waiting for public reaction. Once the public is more comfortable with the idea of losing trees on the landscape, they can begin working on the larger trees (up to 2.5 meters tall). There is no intention to move large diameter, older growth trees, as the habitat in which these trees occur is predominantly forest and not likely previously occupied by Taylor´s checkerspot in Helliwell Provincial Park. It was suggested that snags could also be created as habitat enhancement for other species at risk within the park (e.g. birds).

There was discussion about the need for range-wide translocation guidelines (for B.C., WA and OR), and an interim strategy is needed prior to translocation. Jennifer closed with the reminder that butterflies don't have legal protection provincially and local naturalists might move butterflies themselves anyway, thinking they were doing good for the conservation of Taylor´s checkerspot.

Taylor's Checkerspot Habitat Restoration in BC

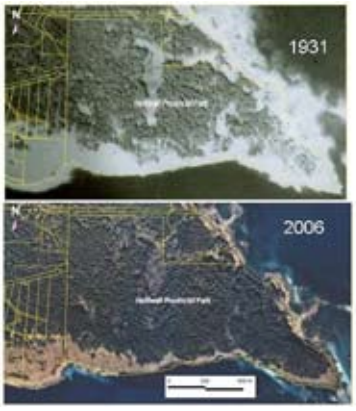
Presented by Jennifer Heron, B.C. Ministry of Environment
Collaborative project with Parks Canada Agency (Nicole Koehler, Conan Webb and Brian Rooder; B.C. Ministry of Environment (Jennifer Heron), Raincoast Applied Ecology (Nick Page)

Most Recent Locations of Taylor's Checkerspot in BC

- 1989 Shawnigan Lake/Mill Bay
  - Power line right of way, with Scotch broom
  - Likely extirpated b/c hydro company stopped clearing vegetation, and broom moved in
- 1998 Helliwell Provincial Park
  - Likely extirpated due to forest encroachment, small/isolated pop'n, early foodplant senescence???
- 2005 Denman Island clearcut (present)
  - Forest succession, vehicle traffic, land development (private land)

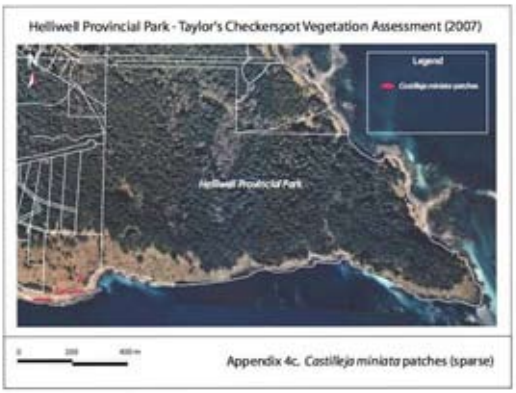
Clearcut vs. Maritime Meadow

Conifer Encroachment

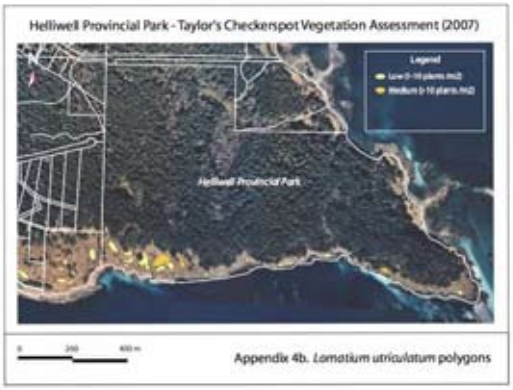


Appendix 2. Garry oak and isolated Douglas-fir trees

Appendix 4a. *Plantago lanceolata* polygons



Appendix 4c. *Castilleja miniata* patches (sparse)



Appendix 4b. *Lomatium utriculatum* polygons

Restoration and Translocation

- Conifer removal within open meadows at Helliwell using hand tools
- Supplement habitat with foodplants?
- Larval release?
- Adult release?
- Enclosures?
- Looking for guidance and this workshop has been great!

Checkerspot Translocations

- Pros
  - Forest succession in Denman clearcuts
  - Denman property - development pressure
- Cons
  - Larval/adult survival and success?
  - Is the habitat suitable in Helliwell?
  - Locating larvae in Denman clearcuts?
  - What impact will removal have to the population?
- Other considerations
  - Translocations to other areas?

Acknowledgements

- Garry Oak Ecosystems Recovery Team (Shyanne Smith and Chris Junck)
- North Denman Lands (Henning Nielson and Bente Pilgaard)
- Denman Island Conservancy
- Conservancy Hornby
- Invertebrates Recovery Team
- B.C. Parks (Bill Woodhouse and Mike Rody)
- Funding provided by Parks Canada Agency and B.C. Ministry of Environment, Habitat Stewardship Program (Environment Canada).

Garry Oak Ecosystems Restoration and Species at Risk Recovery Project

Presented by:
Nicole Kroeker
Nicole.kroeker@pc.gc.ca
Parks Canada Agency

This talk explained Parks Canada's efforts to restore Garry oak and associated ecosystems in Gulf Islands National Park Reserve, British Columbia, Canada. The project objectives include restoring degraded Garry oak ecosystems as well as recovering rare and endangered butterfly and plant species associated with these areas. The presentation also outlined 2007 project activities as well as upcoming activities that include continuing butterfly surveys in the park and Taylor's checkerspot research and surveys on Denman Island, an island off central Vancouver Island supporting the only known extant Taylor's checkerspot population in Canada. Reintroduction of two rare plants species (purple sanicle and golden paintbrush) is planned for two separate sites in the park. Deer were mentioned as a threat to restoration efforts because they heavily graze native forbs and grasses including many butterfly food plants. However, deer do not appear to heavily graze ribwort plantain, a Taylor's checkerspot larval host plant. The restoration questions posed to the group included identifying at what life stage it is appropriate to translocate individuals and what type of host plant density is required to sustain a healthy population. A question was asked about surveying in the estuarine areas along the Straits of Juan de Fuca and Nicole answered that this is planned for the future.

Gulf Islands National Park Reserve (GINPR), BC

2007 Project Activities

1) Taylor's checkerspot research and inventory on Denman Island, BC.
   - Larval host plant preferences, adult nectar sources and preliminary habitat parameter data were recorded.
2) Vegetation mapping was conducted at several potential rare butterfly recovery sites in Gulf Islands National Park Reserve, BC.
3) Butterfly inventory in GINPR.

2007 Project Activities (continued)

4) Restoration plans were developed for two Garry oak ecosystem sites on small islands in the park.
5) Translocation plans were developed for two rare plant species (purple sanicle and golden paintbrush).

2008-09 Anticipated Activities

1) Taylor's checkerspot surveys on Denman and Hornby islands and the Courtenay-Comox area.
2) Taylor's checkerspot research: a) estimate population distribution/size; b) larval host plant, adult nectar source and oviposition site preferences; and c) identify habitat parameters.
3) Second round of butterfly surveys in GINPR.
4) A butterfly habitat assessment study in GINPR to identify rare butterfly recovery sites in the park.

Taylor's Checkerspot Habitat Restoration

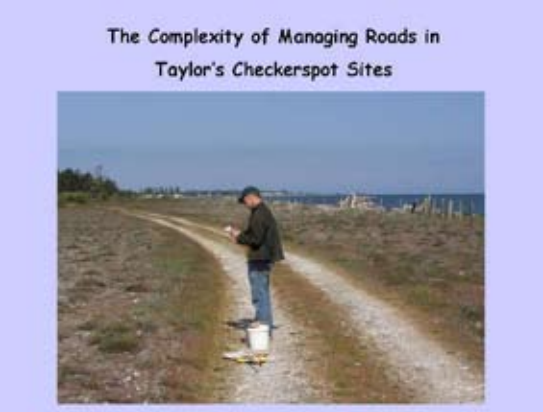
Restoration questions??

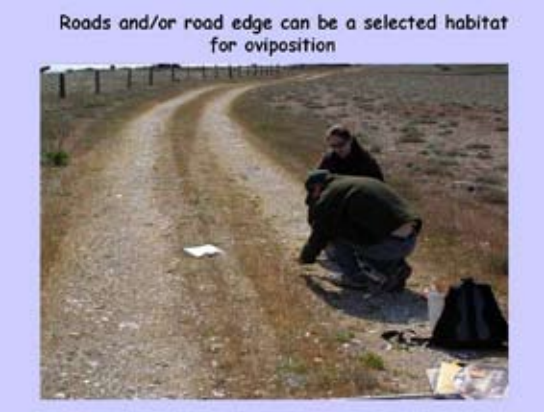
- Site suitability - number of sites, size, connectivity and proximity
- Food plant density/percent cover (nectar/larval)
- Timing of translocation (which life stage?)

The Complexity of Managing Roads in Taylor's Checkerspot Sites

Presented by:
Ann Potter & Anita McMillan
Ann.potter@dfw.wa.gov & anita.mcmillan@dfw.wa.gov
Washington Department of Fish & Wildlife, Olympia, WA
photo credits to Aaron Barna & Shelly Ament

This presentation covered the challenges in managing habitat for the Taylor's checkerspot along roads and road edges. Roads and road edges are important habitats in several Taylor's checkerspot populations. *Plantago* densities can be high in these areas as the plant loves compacted soil, creating the warm, open, and short habitat preferred by the butterfly. However among other threats, vehicle and foot traffic on roads can cause direct negative impacts to the butterfly populations. This situation presents unique management challenges that require innovative solutions. One possibility is creating a parallel habitat, a road that would not actually be used by anyone except for the butterflies; the same characteristics without the risks. In the presentation that followed, examples of road use by Taylor's checkerspots at Indian Valley were discussed.





Graysmarsh Farm oviposition locations

Indian Valley

Roads and/or road edge can also be habitat selected for nectaring and basking

Indian Valley

What else happens in and/or along roads?

- Direct loss of habitat – footprint of road
- Fragmentation of habitat (crossing the road)
- Variety of vehicle use
- Recreation (walking, horseback riding, etc.)
- Maintenance, including road edge
- Weeds – and accompanying weed control
- Road abandonment
- Changes in local hydrology
- Compaction of soil
- Vehicle related chemicals – petroleum, anti-freeze, etc.

One management option is:

Creating habitat at these 'road habitat sites' that the butterflies select for – that is not within the road footprint.

Let's discuss other options…

Anita McNillan, Wildlife Biologist with WDFW, is going to share a few examples of what has happened roads in checkerspot habitat.

Taylor's Checkerspot Habitat Restoration: Bald Hill Natural Area Preserve

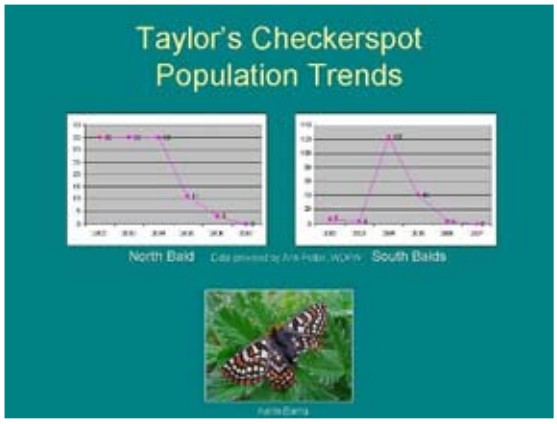
Presented by:
David Wilderman
David.wilderman@dnr.wa.gov
Washington Department of Natural Resources, Olympia, WA

This presentation covered habitat restoration for Taylor's checkerspot at Bald Hill Natural Area Preserve (NAP), located near Yelm, Washington. The southern group of balds on the site is dominated by Roemer's fescue, common velvetgrass, and mosses. The balds also have areas of shallow soils and rock outcroppings, with Douglas-fir, Garry oak, and dense shrubs on the edges and in occasional "islands" within the balds. Although less is known about the role of fire in bald habitats than in lowland prairies, there is significant evidence of recurrent fire in the past at this site (Douglas-firs with multiple fire scars). Woody species (primarily Douglas-fir, snowberry, ocean spray, and poison oak) are encroaching on the grassland habitat and appear to have reduced open-habitat connections between the balds (see slide 12), which likely reduces their connectivity for Taylor's checkerspot.

Currently Washington Department of Natural Resources (WDNR) is carrying out various habitat restoration and enhancement treatments to attempt to improve Taylor's checkerspot habitat on the NAP. These treatments include removing encroaching conifers and controlling encroaching shrubs, both within balds and in areas that appear to have historically connected the balds. Smaller conifers that can be removed by hand have been cut and piled in adjacent forest areas, while shrubs have been cut and stem-treated with herbicide. In a second phase of conifer removal, to take place in 2009 or 2010, larger trees will be removed by helicopter. In addition, WDNR is developing a plan to treat orchard grass (*Dactylis glomerata*), a tall introduced grass that is increasing within the balds. Bare areas created by these various treatments will be planted and/or seeded with native grassland plants propagated from site-specific seed. Planting will focus on augmenting populations of larval host and nectar species, including *Castilleja hispida, Plectritis congesta, Collinsia parviflora, Lomatium utriculatum, Balsamorhiza deltoidea*, and *Fragaria virginiana*. One of the goals in removing dense shrubs is to create partially shaded nooks, a microhabitat that is particularly suitable for *Castilleja hispida.* Habitat work at this site is largely being funded through the Ft. Lewis ACUB program, as well as funding from USFWS and NRCS.

During the discussion section following David's talk, Gordon Pratt (University of California, Riverside) asked for clarification regarding the removal of snowberry since post-diapause larvae in California like a similar plant. David explains that there isn't much to remove, just in the deeper soil areas. Someone asked about collecting seeds and propagating, and David answered that these efforts are being conducted at Shotwell's Landing Nursery. It was then asked why there hasn't been a discussion about fire restoration techniques for the balds. Ann Potter (WDFW) answered that it

is mostly a question of scale and Pat Dunn (TNC) added it is being pursued at other sites, but it is unknown how fire will affect butterflies. Dave Hays (WDFW) also explained that sometimes invasives thrive after a fire and about every 30 years the numbers of invasives double. He suggests that there are other tools with less risk. Gordon was concerned about research on the effects of herbicides on larvae. Cheryl Fimbel (TNC) responded that WSU is studying Poast and Puget blues. Pat added that herbicides are very selectively used and not on inhabited sites.



Threats/Concerns

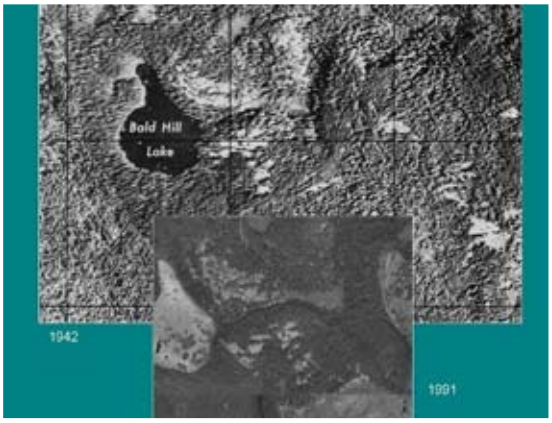
- Low host & nectar plant abundance and/or diversity
- Successional changes
  - Shrub & tree encroachment, shading, habitat loss
  - Reduced host and nectar sources(?)
- Loss of habitat connectivity
- Introduced species
  - Scotch broom
  - Orchard grass
  - Others?

Host plants

Bald	Host Plants
1	CAAT, CAHI, COPA, COGR, PLCO, PLLA
2	COPA, PLCO
2a	PLCO
3	CAHI, COPA, COGR, PLCO
4	PLCO
5	PLCO
6	CAAT, PAVI, PLCO, TRPU
7	CAAT, CAHI, COPA, PAVI, PLCO, PLLA, TRPU
8	CAHI, COPA, COGR, PLCO, PLLA, TRPU

CAAT=Castilleja attenuata; CAHI=Castilleja hispida; COPA=Collinsia parviflora; COGR=Collinsia grandiflora; PAVI=Parentucellia viscosa; PLCO=Plectritis congesta; PLLA=Plantago lanceolata; TRPU=Triphysaria pussila. **Data provided by Mary Linders and Ann Potter, WDFW.**

Successional changes



Introduced Species

Orchard grass (Dactylis glomerata) 2007

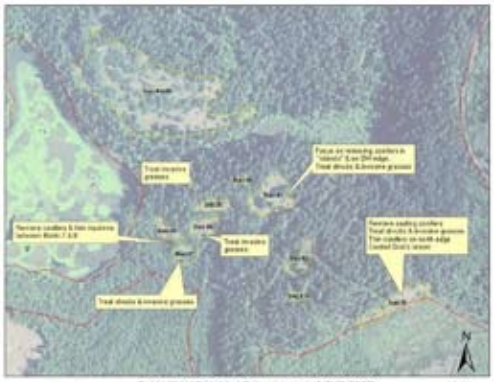
Scotch broom (Cytisus scoparius)

Dogtail (Cynosurus echinatus)

Cotoneaster (Cotoneaster sp.)

Planning

- Prioritized balds based on:
  - Host & nectar plant abundance/diversity
  - Size and aspect
  - Proximity to recently occupied bald
  - Level of effort required for enhancement
  - Avoid activity in occupied bald(s) -- #8



Bald Hill NAP Habitat Enhancement (ACUB 2007)

2007 Activities

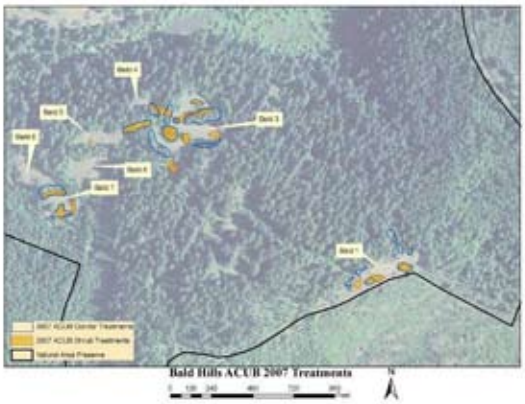
- Orchard grass (North Bald)
- Shrub control
  - Poison oak
  - Ocean spray
  - Snowberry
- Small tree removal (<6" dbh)
- Seed collection

Orchard grass

- Sethoxydim (Poast) late April
  - Excellent control except in shade (?)
    - 75% overall reduction
  - No apparent damage to native plants
- Glyphosate (Round Up)
  - Excellent control
  - Significant mortality of natives

Shrub Control

- Cut/paint 50% triclopyr (Garlon 3A)
  - Mid June through late August
- Wipe-on application of 5% triclopyr (Garlon 3A) – poison oak only
  - Early through late August (fruiting/foliage turning red)



Seed Collection

- Larval hosts:
  - Castilleja hispida
  - Plectritis congesta
  - *Collinsia parviflora/ grandiflora**

- Nectar sources:
  - Lomatium utriculatum
  - *Balsamorhiza deltoidea**

** = not collected in 2007, but priority for future collecting*

- Other species
  - Achillea millefolium
  - Festuca roemeri
  - Elymus glaucus
  - Danthonia californica
  - Clarkia amoena
  - Eriophyllum lanatum

Next Steps

- Completing site restoration plan
- 2008 – planting/seeding a portion of areas treated in 2007
- Continued shrub and grass treatments
- Continued seed collection
- Planning for removal of larger trees (helicopter)

Acknowledgements

- Ft. Lewis ACUB
- Natural Resource Conservation Service
- Mary Linders & Ann Potter, WDFW
- Liesl Plomski
- Washington Conservation Corps

SUPPLEMENTAL INFORMATION

Presenter Biographies

Mary Jo Andersen is a zookeeper at the Oregon Zoo and has worked with animals throughout the zoo. She has studied penguins in Peru, worked as a foreign fisheries observer on the Bering Sea, and taught many science classes in the Portland area. She has worked on the Zoo's butterfly projects since 1999 and is continually astounded at these complex animals.

Hannah Anderson is the Rare Species Project Manager with The Nature Conservancy of Washington, South Puget Sound Program. She holds a Masters in Environmental Studies from The Evergreen State College and a Bachelor's in Bio-Anthropology from the University of Washington. She has considerable experience working with rare and endangered species, having held positions in this capacity at both Federal and Washington State agencies. Her work with The Nature Conservancy is aimed at promoting the regional recovery of federal candidate species occurring on the grasslands of the Willamette Valley/Puget Trough/Georgia Basin ecoregion. Her project promotes this agenda by working beyond political and geographic barriers and with all organizations and individuals who can assist in the recovery process. This regional cooperative approach provides the best chance for proactive, successful conservation, restoration, and recovery of target species and habitats.

Elayne Barclay is with the Oregon Zoo in Portland, OR.

Cheryl Fimbel, a rare species biologist with The Nature Conservancy in Washington, has an academic background in wildlife ecology and nearly 30 years of applied wildlife conservation research and management experience. Presently, Cheryl is working to improve habitat conditions for rare butterflies in western Washington prairies.

Rod Gilbert is a field biologist with the Fort Lewis Fish and Wildlife Program. He works on prairie restoration for federal candidate species and other rare flora and fauna, developing a prairie seed nursery for large scale prairie restoration efforts, and conducts surveys for federally listed flora and fauna. He has worked at Fort Lewis on prairie related projects since 1995. He received a BA in Environmental Studies from The Evergreen State College in 1994.

Jennifer Heron works for B.C. Ministry of Environment Wildlife Science Section. She heads the provincial program for invertebrate conservation and is involved in numerous recovery programs for invertebrate species at risk in B.C.

Scott Hoffman Black is Executive Director of the Xerces Society, the international organization dedicated to protecting biological diversity through invertebrate conservation. He is an ecologist and entomologist. He has extensive experience in native pollinator and endangered species conservation. As a researcher, conservationist

and teacher he has worked for over 25 years advocating science based conservation. Scott has authored many scientific and popular publications and his work has been featured in newspaper, magazines and books and on radio and TV.

Al Kitzman is Superintendent for Benton County Natural Areas and Parks, based in Corvallis, Oregon. Responsible for 1400+ acres of natural areas and parks, Al has been crafting and implementing conservation strategies for over 25 years. Discovery of approximately 500 Taylor´s checkerspot by Dana Ross in 2004 at Beazell Memorial Forest, lead to the conservation of the species. Within a year, another 1000+ Taylor´s Checkerspot on private land came under management by Benton County. A Habitat Conservation Plan for Benton County is being developed that would provide Taylor´s checkerspot with levels of protection similar to those under the Endangered Species Act.

Nicole Kroeker is an ecosystem scientist with Parks Canada Agency. She is currently working on a Garry oak ecosystems and species at risk recovery project on Parks Canada land located on southern Vancouver Island and the Gulf Islands. As the project manager, Ms. Kroeker is responsible for developing and implementing various ecosystem restoration plans and working towards the recovery of several plant and butterfly species at risk (including Taylor´s checkerspot) in Garry oak and associated ecosystems. From 2002 to 2006, Ms. Kroeker was a Natural Resource Management Specialist with the Department of Natural Resources Canada, where she was responsible for exotic species management, species at risk conservation and ecosystem health on military lands located in southern British Columbia. Ms. Kroeker holds an M.Sc. in Geography from the University of Ottawa, Canada.

Mary Linders is an endangered species recovery biologist for the Washington Department of Fish and Wildlife (WDFW) on a joint assignment with Fort Lewis Military Installation. She works on restoration and recovery of five prairie and oak woodland-associated species in South Puget Sound including Taylor's checkerspot and mardon skipper butterflies, streaked horned lark, Mazama pocket gopher and western gray squirrel. Mary has worked for WDFW since 1994 on projects related to the conservation of rare species. She received a master's degree in Wildlife Science from the University of Washington in 2000 and a bachelor's degree in Anthropology from the University of Wisconsin-Madison in 1987.

Anita McMillan has worked for Washington Department of Fish and Wildlife as the District Wildlife Biologist in Port Angeles since 1986. She filled a newly created position including both game and nongame assignments. WDFW began training District Biologists about butterflies approximately 15 years ago. Ten years ago Anita recruited a few local volunteers from the Audubon group to begin a butterfly focus group. Kristi Knowles led this effort and has since written a book on local butterflies. Due to Kristi´s diligence WDFW made connections with a local entomologist that gave them leads on two of their Clallam County Taylor's checkerspot butterfly sites.

Gail Olson is currently a Research Scientist at the Washington Department of Fish and Wildlife (WDFW), where her primary research responsibilities are prairie wildlife species in western Washington. She is the project leader for the Prairie Quality Monitoring/Assessment study, jointly funded by ACUB and the Department of Defense Legacy Program, and serves as a statistical consultant and analyst on several other studies including butterfly projects for both Mardon skipper and Taylor's checkerspot aimed at developing monitoring methods based on distance sampling. Gail has a PhD. in Wildlife Biology from Colorado State University, an M.S. in Ecology (with Statistics minor) from North Carolina State University, and a B.S. in Zoology from the University of Rhode Island. Before being hired by WDFW, she was a Research Assistant Professor at Oregon State University, where her main research projects were on population dynamics of Northern Spotted Owls.

Ann Potter is a wildlife biologist for the Washington State Department of Fish and Wildlife, with an expertise in butterflies. She has been working on prairie butterflies for over 13 years.

Gordon Pratt did his Ph.D. on the systematics of the *Euphilotes enoptes* and *Euphilotes battoides* complexes. From his research several papers were written on the taxonomy and evolution of these butterflies in association with their wild buckwheat food plants. Pratt is very interested in conservation, evolution, and behavioral biology of North American butterflies. He has a strong interest in the symbiotic relationship between ants and lycaenid larvae. He has written several papers on these topics. He has surveyed for butterflies and other insects on many of the military bases of southern California. Pratt received his B.S. in Biology from Northeastern University of Boston, Massachusetts, his M.S. from Queen's University in Kingston Ontario (Canada) in Molecular Biology, his Ph.D. in Insect Systematics with a minor in Plant/Insect Interactions at the University of California at Riverside, and a postdoc on sympatric speciation in *Enchenopa binotata* treehoppers in Entomology at the University of Delaware. He presently is a research scientist at the University of California at Riverside and runs a captive breeding program for federally endangered butterflies. Pratt has been captive breeding the quino checkerspot, *Euphydryas editha quino*, since 1997.

Brian Reader graduated with a Master's degree in Natural Resources Management in 1984 and has worked for the Parks Canada Agency for the past eighteen years. Brian has served as the Chair of the Garry Oak Ecosystems Recovery Team for the past five years and currently works for Parks Canada as a Species at Risk Ecologist. Brian maintains an active role in restoration and species at risk recovery through various Garry oak ecosystem field projects in Gulf Islands National Park Reserve and Fort Rodd Hill National Historic Site. He also chairs the Seaside Centipede Lichen Recovery Team, serves on the Killer Whale Recovery Team and is a Director of the Invasive Plant Council of British Columbia.

Dana Ross is an independent contract entomologist from Corvallis, Oregon, specializing in the documentation and conservation of Pacific Northwest insects, especially butterflies. An avid insect collector since the age of 4, Dana went on to earn a Master's Degree in entomology from Oregon State University under Dr. Jeffrey Miller. His current and recent clients include The Xerces Society, The Nature Conservancy, Oregon State University, U.S. Fish & Wildlife Service, U.S. Forest Service, Bureau of Land Management, Bonneville Power Administration, Benton County (Oregon), Salix Associates and The Institute for Applied Ecology. Dana is a curatorial associate at the Oregon State Arthropod Collection (OSAC), a technical advisor for the Benton County Prairie Species Habitat Conservation Plan and oversees Oregon butterfly records for the Northwest Lepidopterists' Association and Butterflies and Moths of North America website. Dana has tracked Oregon populations of Taylor's checkerspot since 2003 and is involved in the conservation of Seaside Hoary Elfin, Mardon Skipper, Johnson's Hairstreak, Coastal Greenish Blue and Leona's Little Blue. Finally, he is conducting insect inventories at several Oregon sites.

Derek Stinson wrote the 2005 state status report for Taylor's checkerspot. He has worked on wildlife species conservation for 20 years, including four years in the Mariana Islands, two years working on forest issues for the Yakama Nation and WDFW, and the last nine in the Threatened and Endangered Species Section in the Wildlife Program of WDFW. He has a BS from Framingham State College and an MS in zoology from Washington State University.

Theodore B. Thomas works in the Division of Listing and Recovery, in the Washington US Fish and Wildlife Office, Lacey, Washington. His major responsibilities include developing conservation partnerships for recovery planning and implementation actions with State and Federal agencies and private landowners, including several land trusts and NGOs. He joined the FWS in 1994, after several years with Forest Service Research Station and as a Research Associate with the University of Washington, primarily working on Forest and Wildlife relationships, including early work on promoting the development of late-successional forest habitat in managed forests for the northern spotted owl. In Ted's early years with FWS he authored several listing rules, critical habitat designations and co-authored recovery plans for regionally endemic plants. His primary interest is the conservation of the prairie ecosystem and its importance to plant and butterfly conservation. He is also the FWS lead for the Columbia River Distinct Population of the Columbian white-tailed deer. Ted received his B.S. from the University of Michigan School of Natural Resources and Environment; and his M.Sc. from Oregon State University Forest Science Department with a focus on Forestry, Botany, and Entomology.

David Whipple was born in Michigan, obtained a B.S. in Wildlife Management from Michigan State University and also worked as an intern on numerous wildlife research projects in both Upper & Northern Lower Michigan. His graduate research at Utah State University was on elk habitat utilization relative to various livestock grazing regimes. He then spent 2½ years as a wildlife biologist for the USFS in Gold Beach &

LaGrande, Oregon before coming to WDFW. His work with WDFW over the past 16 years has focused on Forest Practices Rules development, implementation and policy issues associated with forest habitat protection within the Timber, Fish and Wildlife context. Work has been centered in the realm of forest practices relative to upland wildlife and aquatic habitat (Forests & Fish), federal habitat conservation planning, state landscape planning, state & federal forest management, small forest landowner issues, etc.

Dave Wilderman is a Natural Areas Ecologist for the Washington Department of Natural Resources, Natural Areas Program. He earned his B.S. in Biology at the University of Illinois and his Master's in Forest Resources from the University of Washington. Dave has worked as a botanist and ecologist in eastern Washington, western Oregon and western Washington since 1989. His primary interests are restoration ecology, rare plants, fire ecology, and, more recently, butterflies.

Lori Wisehart is a botanist with an M.S. in Environmental Science from Oregon State University (2006) and a B.S. in Botany from Humboldt State University (2003). Lori worked as part of a team to develop a Habitat Conservation Plan for the prairie species of Benton County but now works for California State Parks out of the North Coast Redwoods District. More information about the Benton County Prairie Species Habitat Conservation Plan can be found here:
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Extant Taylor's Checkerspot Sites: Status Updated December 2007

State / Province	Site Group	ID#	Site Name	Distance/ nearest neighbors	# of sites w/in ~1mi	Site comment	Acres habitat	Habitat type	Year found	Survey history
British Columbia		19	Denman Island	N/A	0	Sparsely vegetated roads and landings; Dry meadows dominated by sweet vernalgrass and hairy-cat's ear with varying amounts of tree and shrub cover.		clearcut/bald	2005	2007: April 28 to July 13, 2007 - 288.1 km of field transects - 171.9 hrs of field time (60.8 hrs on Hornby; 111.1 hrs on Denman)- 622 observations (5-10% duplication?)
Washington	Fort Lewis	1	Artillery Impact Area: Range 74/76	3 mi to #2	0	Site located on east end of expansive prairie that also contains #2	40-60	prairie	2004	Entire occupied area not accessible. Peak adult counts, transects w/ multiple observers 2004-2007: 68 (estimate 100s present) 1246, 1327, and 637.
		2	Artillery Impact Area: Range 51	3 mi to #1	0	Site located on mid-south portion of expansive prairie that also contains #1	5-10	prairie	1999	Peak adult counts transects w/ multiple observers 2000-2007: 4, 4, 19, 32, 1, 0, 1, 2
	Bald Hills	3	Bald Hill NAP: North Balds	¼ mi to #4; 1 mi to #6,7; 2 mi to #5,17	3	Large bald with oaks and interconnected habitat patches	10-20	bald	1996	Peak adult counts 2002-04, estimate 30-40 each year. Peak adult counts, transect surveys 2005-2007: 11, 3, 0. Extensive effort '07 (10 visits) .
		4	Bald Hill NAP: South Balds	¼ mi to #3; 1 mi to #6,7; 2 mi to #5,17	3	Site consists of 8 small balds: adults have been found in 5	4	bald	1999	Peak adult counts, transect surveys 2002-2007: 7, 4, 123, 40, 4, 0. Extensive effort '07 (14 visits).
		5	Bald Hill End	1 mi to #6,7,17; 2 mi to #3,4	3	Site consisits of 4 balds: adults have been found in 2	5-10	bald	2002	Searched 2002-2007: 2 adults '02, 1 adult '05.
		17	Bald Hill: 1176 NE Spur	1/2 mi to #6, 7; 1 mi to #5; 2 mi to #3,4	3	Small, single bald, 2 smaller degraded balds are adjacent	2	bald	2004	Single visit count 2004: 2 adults. Peak adult counts 2005-2007: 18, 0, 2. Extensive effort '07 (12 visits).
		6	Bald Hill Lower: 1164 Rd	¼ mi to #7; 1/2 mi to #17; 1mi to #3,4,5	5	Site consists of 1 large and 2 small balds	5-8	bald	2002	Single visit count 2003: 15 adults. Peak adult counts, transect surveys 2004-2007: 65, 57, 1, 0. Extensive effort '07 (11 visits).
		7	Bald Hill Upper: 1176 Rd	¼ mi to #6; 1/2 mi to #17; 1mi to #3,4,5	5	Site consists of several small balds: adults have been found in 2.	1	bald	2002	Peak adult counts, transect surveys 2003-2007: 30, 15, 28, 8, 0. Extensive effort '07 (12 visits).
	Clallam County	8	Dungeness Mouth	4 mi to #18	0	Open grassy habitat at river's edge	1	estuarine	1993	Searched 2003-2007: 2 adults '03 only. Post-diapause larvae found '04.
		18	Grays Marsh	4 mi to #8	0	Linear habitat patch between back beach and agricultural fields and wetlands	3-5	estuarine	2006	Peak adult counts, transects w/ multiple observers: 2006 (163), 2007 (135).
		9	Striped Peak	4 mi to #10	0		2	bald	1985	Searched 2003-2007: 5 adults found '03, 1 in '05.
		10	Eden Valley	1 mi to #11, 12	2		10-15	bald	2003	Peak adult counts, transects w/ multiple observers 2003-2007: 47, 92, 127, 68, 47
		11	Indian Valley	1 mi to #10, 12	2		5-8	bald	2003	Entire occupied area not accessible. 2003 est #s in the tens. Increasingly >effort to access habitat 2004-2007, peak adult counts: 19, 10, 29, 46
		12	Highway 112	1 mi to # 10, 11	2		1-2	bald	2003	Searched w/ 1 or 2 visits 2003-2007: 2 adults '03, 1 in '05, 3 in '06.

Extant Taylor's Checkerspot Sites: Status Updated December 2007

State / Province	Site Group	ID#	Site Name	Distance/ nearest neighbors	# of sites w/in ~1mi	Site comment	Acres habitat	Habitat type	Year found	Survey history
Oregon	Fitton Green	13	Fitton 1 (Cardwell Hill Meadow)	150m to #14	1	Managed by county park Modified pollard	5	bald	1999	Combined Fitton 1 and 2 2003-07 estimate ~ 750, 1104,1221, 300, 650
		14	Fitton 2 (Power Line)	150m to #13	1	Managed by county park Modified pollard	2.5	bald	1999	
		20	Fitton 3 (Cardwell West)	1 mile #13	1	small site now privately owned	2	bald	2004	6 individuals found in 2004, 7 individuals found in 2005, 0 in 2006, no survey 2007
		21	Fitton 4 (morton)	2 mile #13	0	Owned by Frank Morton	2	bald	2004	3 found in 2004, not found in 2005 or 2006
		22	Fitton 5	2 miles from #13	0	under power line. Owned by US Bank	2	bald	2004	2 found in 2004, not found in 2005
		23	Fitton 6	2 miles from #13	0	adjacent to powerline Owned by US Bank	2	bald	2004	1 found in 2004, not found in 2005
		24	Fitton 7 (south FG)	2 miles from #13	0	In fitton green natural area, might be good for introduction	2	bald	2004	1 found in 2004, 2 in 2005, 0 in 2006, 1 in 2007
		25	Fitton 8	2 miles from #13	0	Not found in habitat found in riparian vegitation	2		2004	1 found in 2004, not found in 2005
		26	Fitton 9	150 m to #13	1	small meadow	1	bald	2006	8 counted in 2006 and 12 counted in 2007 (one day counts)
	Beazell County Park	27	Beazell 1							Combined Beazell 1-5 2004=500; 2005=484; 2006=150; 2007=422
		15	Beazell 2 (formerly labeled Beazell 1)	100m to #16	1	County park, modified pollard	20	bald	2004	
		16	Beazell 3 (formerly labeled Beazell 2)	100m to #15	1	County park, modified pollard	15	bald	2004	
		28	Beazell 4							
		29	Beazell 5 (fornerly Beazell south)							Note: 364 counted at this site in 2007
	Fort Hoskins	30	Fort Hoskins 1		0	County park		Bald	2005	One found in 2005, none found in 2006 or 2007

HABITAT REQUIREMENTS

Habitat conditions suitable for supporting Taylor's checkerspot butterfly (*Euphydryas editha taylori*) are defined by climate and vegetation. Balds, prairies, and coastal meadows can have appropriate conditions for sustaining suitable habitat through time. Taylor's checkerspot requires grassland dominated by fescue or other short-stature grass species, with a diversity and abundance of larval host plants and spring nectar sources. Larvae (caterpillars) also need sufficient warmth to digest and grow as well as safe sites in which to diapause for a 7-month stretch that spans summer, fall and winter. Adults also need sufficient warmth to fly and protection from high winds.

Within native grassland habitat, microclimate may strongly affect the distribution of important plants and consequently the distribution of larval and adult butterflies. Food plant diversity and variation in phenology are important to checkerspot survival and occur in response to microclimatic conditions created by differing soils, slopes, aspects, forest edge, and other factors. For example, trees such as Garry oak in or adjacent to a site, can create shady patches that extend the growing or flowering seasons of host and nectar plants, and can be key to survival during drought years. Ideally, these conditions allow for the availability of vigorous, green vegetation throughout the larval growth period and abundant nectar through the adult flight stage, in spite of annual variation in temperature and moisture.

Habitat quality is also determined by the availability of food resources. Singer et al. (1988) found that oviposition preference in *E. editha* populations is inherited, and larvae exhibit higher rates of survival and growth on their primary host plant, apparently due to differences in digestive physiology (Rausher 1982, Singer et al. 1988). Larval food plants include members of the figwort family (Scrophulariaceae), as well as members of the closely related Plantain family (Plantaginaceae), which contain iridoid glycosides (Wahlberg et al. 2004). Larvae feed on a wider range of host plants than females choose for oviposition (Kuussaari et al. 2004), and use and availability of host plants varies between sites (see Host Plant table). These bitter-tasting chemicals have been found to stimulate oviposition in *E. chalcedona* and larval feeding in some *Euphydryas* species (Ehrlich and Murphy 1987, Kuusaari et al. 2004). Individual plants vary in the amount of iridoids and other compounds, and females select an oviposition plant based on chemical composition, not just on species identification (Wahlberg et al. 2004). Iridoid glycosides are sequestered in the larvae and make the adults distasteful, if not emetic, to birds and other predators.

Food and nectar plants also provide key nutrients. Larvae are the main feeding and growth stage of butterflies. The plants eaten by larvae must contain sufficient carbohydrates and the amino acids required for growth, and much of the needed resources for producing eggs (Boggs and Nieminen 2004). Adult butterflies do not grow, but nectar is required to maintain activity and develop eggs or sperm. Eggs laid in the first few days are produced from larval-derived nutrients. The availability of nectar is known to affect egg production in Edith's checkerspots, and high egg production may help offset the high mortality of early instars. *E. e. bayensis* reared in a lab and fed nectar produced

nearly double the number of eggs and lived longer than those not fed (Murphy 1981), though the increase was primarily in late-season egg clusters (Hellmann et al. 2004).

Adult checkerspots seem to prefer certain nectar plants, but will use a variety of available sources (see Nectar Plant table). Available nectar sources may differ between years due to relative changes in the phenology of checkerspot flight periods and the flowering of potential nectar plant species. Shepard (2000) indicates that *E. e. taylori* in British Columbia nectared almost exclusively on spring gold (*Lomatium utricularium*) and the elimination of this species by weedy exotic vegetation may have contributed to some *E. e. taylori* extinctions there.

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Potential and known nectar plants by site for Taylor's checkerspot (Euphydryas editha taylori)

Site Name	Amelanchier alnifolia	Armeria maritima	Balsamorhiza deltoidea	Bellis perennis	Berberis spp.	Brassica campestris	Calochortus tolmei	Camassia quamash	Cerastium arvense	Crataegus monogyna	Cytisus scoparius	Eriophyllum lanatum	Fragaria virginiana	Hypochaeris radicata	Lepidium campestre	Linanthus bicolor	Lomatium triternatum	Lomatium utriculatum	Malus sp.	Marah oreganus	Mimulus spp	Plagiobothrys figuratus	Plagiobothrys scouleri	Plectritis congesta	Potentilla anserina	Ranunculus occidentalis	Ranunculus spp.	Rubus ursinus	Saxifraga integrifolia	Sedum spp.	Taraxacum officinale	Teesdalia nudicaulis	Trifolium repens	Zygadenus venenosus
Annual/Perennial	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A	A	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	A	P	P
Oregon																																		
Fitton Green	N						N						N			N		N	N					N										
Beazell							N						N													N					N			
Washington																																		
1164 Bald			N					N																N										
1176 Bald			N																		N			N										
1176 NE Spur																																		
Bald Hill End																								N										
Bald #1-S NAP																																		
Bald #3-s NAP																																		
Bald #6-s NAP S.																																		
Bald #7-s NAP S.																				N				N										
Bald #8-s NAP S.																					N			N					N					N
Bald Hills NAP N.			N					N																N										
Glacial Heritage																																		
Mima Mounds NAP																																		
Scatter Creek N.								N																										
Scatter Creek S.			N					N									N																	
Rock Prairie																																		
Range 51 - AIA			N																										N					
Range 74/76 - AIA		N	N					N					N		N		N	N								N			N			N		N
Pacemaker																													?					
South Creek								N	N	N	N						N		N							N								
The Triangle																													?					
Training Area 7S																																		
Johnson Prairie																																		
Boistfort Prairie																																		
Long Island																																		

N = documented nectar source

Shading = occurs on site; horizontal stripes = augmentation of naturally occuring plant; vertical stripes = only propagated plants occur.

Potential and known nectar plants by site for Taylor's checkerspot (Euphydryas editha taylori)

Site Name	Amelanchier alnifolia	Armeria maritima	Balsamorhiza deltoidea	Bellis perennis	Berberis spp.	Brassica campestris	Calochortus tolmei	Camassia quamash	Cerastium arvense	Crataegus monogyna	Cytisus scoparius	Eriophyllum lanatum	Fragaria virginiana	Hypochaeris radicata	Lepidium campestre	Linanthus bicolor	Lomatium triternatum	Lomatium utriculatum	Malus sp.	Marah oreganus	Mimulus spp	Plagiobothrys figuratus	Plagiobothrys scouleri	Plectritis congesta	Potentilla anserina	Ranunculus occidentalis	Ranunculus spp.	Rubus ursinus	Saxifraga integrifolia	Sedum spp.	Taraxacum officinale	Teesdalia nudicaulis	Trifolium repens	Zygadenus venenosus
Annual/Perennial	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A	A	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	A	P	P
Washington																																		
Dan Kelly Ridge					N								N															N			N			
Eden Valley					N				N			N		N				N			N			N						N			
Striped Peak													N																					
Highway 112																																		
Dungeness Mouth																									N									
Graysmarsh				N		N																			N						N			
British Columbia																																		
Denman Island													N	N									N				N	N					N	
Beacon Hill Park																																		
Helliwell Park																		N																
Shawnigan Lake/ Mill Bay													N																					

N = documented nectar source

Shading = occurs on site; horizontal stripes = augmentation of naturally occuring plant; vertical stripes = only propagated plants occur.

Potential and known nectar plants by site for Taylor's checkerspot (Euphydryas editha taylori)

Site Name	Notes / Observer
Annual/Perennial	
Oregon	
Fitton Green	once.
Beazell	N obs: Dana Ross (2006)
Washington	
1164 Bald	N obs includes WDFW group count: 22 April 2004
1176 Bald	Mimulus obs incudes WDFW group count 22 April 2004
1176 NE Spur	Added veg info from Mike Walker 2004
Bald Hill End	Plectritis obs: Kelly McAllister: 1 June 2002; Veg info: Kelly and Mike W
Bald #1-S NAP	
Bald #3-s NAP	
Bald #6-s NAP S.	
Bald #7-s NAP S.	Marah obs: Dan Grosboll 6 May 2003; Ranunculus: Ann Potter
Bald #8-s NAP S.	MISP and ZYVE N obs: Mike Walker 6 May 2005. PLCO N obs: McAllister & Potter 14 May 2002.
Bald Hills NAP N.	PLCO N obs: Gilbert 2000, Grosboll & Potter 2002.
Glacial Heritage	
Mima Mounds NAP	
Scatter Creek N.	CAQU obs: Potter 1997.
Scatter Creek S.	CAQU obs: Jackson 1978; Potter 1997. LOTR, BADE N obs: Potter 1997
Rock Prairie	
Range 51 - AIA	BADE N obs: Potter 2003
Range 74/76 - AIA	N obs: (BADE, SAIN, LOTR, LOUT) includes Potter 29 April 2004
Pacemaker	
South Creek	N obs: Hays et al (2000); Malus, Potter 1997; CRMO LCTA 1997.
The Triangle	
Training Area 7S	
Johnson Prairie	
Boistfort Prairie	Vegetation info: Cathy Maxwell & Ann Potter
Long Island	

N = documented nectar source
Shading = occurs on site; horizontal stripes = augmentation of naturally occuring plant; vertical stripes = only propagated plants occur.

Potential and known nectar plants by site for Taylor's checkerspot (Euphydryas editha taylori)

Site Name	Notes / Observer
Annual/Perennial	
Washington	
Dan Kelly Ridge	N obs Potter 2004-2007, Ament 2007; majority of N obs on FRVI.
Eden Valley	N and veg obs: Potter 2003-2007, most N on ERLA, BESP, SESP, LOUT.
Striped Peak	N and veg obs: Potter 2003, 2004. COPA & PLCO in only a few, very small patches.
Highway 112	
Dungeness Mouth	N obs and veg info: Potter
Graysmarsh	(late).
British Columbia	
Denman Island	All obs. C. Guppy except N on PLSC (C. Guppy & J. Balke); N (HYRA) N. Page May/June 2007
Beacon Hill Park	
Helliwell Park	N obs (Shepard 2000); RAOC (Miskelly 2000)
Shawnigan Lake/ Mill Bay	N obs (Shepard 2000).

N = documented nectar source
Shading = occurs on site; horizontal stripes = augmentation of naturally occuring plant; vertical stripes = only propagated plants occur.

Coastal Management Matrix

Threats		source	habitat degredation									habitat loss / fragmentation				potentailly incompatible management practices									management / research					exacerbates vulnerability			
		stress	Scotch broom	English hawthorne	Encroachment of native shrubs	Succession to Douglas-fir forest	Tall oatgrass	Non-native perennial grasses	Non-native annual grasses	Non-native perennial forbs	Non-native annual forbs	Development	Isolation of sites	Insufficient nectar	Insufficient larval host plants	Incompatible / lack of habitat management	Off-road driving, horse-back riding, and recreation	Military training activities	Insecticide use (especially Btk and mosquito abatement)	Communications antenna development/maintenance	Timber harvest	Road development/maintenance	Broadcast herbicide application	Grazing	Over-collecting	Field research activities	access issues	Control burns	Fire management or fire in general	Small population size	Parasites / disease	Wildfire	Climate change
On-the-ground management tools	weed control	Mowing																															
		Handpull			X																												
		herbicide																															
		control						X	X																								
		removal																															
	native plants	bot. assessment																															
		augment plants												X	X																			
		limit aug. of plants																															
		plant propagation																															
		supplement diversity																															
	Eet	population search														X														X			
		translocation																															
Coordination / planning / administrative tools	landowner	coordinate Access																															
		limit access																															
		landowner approval														X													X				
		engage landowner																															
	land management	coordinate estuary management														X																	
		develop recommendations																															
		develop strategy																															
		develop management plan																															
	protection	create connections											X																				
		easement / acquisition																															

shaded column indicates identified threat

Bald Management Matrix

Threats		source	habitat degredation									habitat loss / fragmentation				potentaillly incompatible management practices									management / research					exacerbates vulnerability			
		stress	Scotch broom	English hawthorne	Encroachment of native shrubs	Succession to Douglas-fir forest	Tall oatgrass	Non-native perennial grasses	Non-native annual grasses	Non-native perennial forbs	Non-native annual forbs	Development	Isolation of sites	Insufficient nectar	Insufficient larval host plants	Incompatible / lack of habitat management	Off-road driving, horse-back riding, and recreation	Military training activities	Insecticide use (especially Btk and mosquito abatement)	Communications antenna development/maintenance	Timber harvest	Road development/maintenance	Broadcast herbicide application	Grazing	Over-collecting	Field research activities	access issues	Control burns	fire management or fire in general	Small population size	Parasites	Wildfire	climate change
On-the-ground management tools	weed control	Mowing		X	X	X				X																							
		Handpull	X		X	X				X																							
		herbicide	X	X	X	X		X		X																							
		control						X	X																								
		removal																															
	native plants	bot. assessment												X	X																		
		augment plants												X	X																		
		limit aug. of plants													X												X						
		plant propagation																															
		supplement diversity																															
	Eet	population search																															
		translocation																												X			
Coordination / planning / administrative tools	landowner	coordinate Access																															
		limit access															X																
		landowner approval																															
		engage landowner										X				X																	
	land management	coordinate timber management																															
		develop recommendations																															
		develop strategy				X	X	X	X					X	X															X			
		develop management plan														X																	
	protection	create connections										X	X																				
		easement / acquisition										X	X			X																	

Shaded column indicates identified threat

Lowland Prairie Management Matrix

Threats		Source	habitat degredation									habitat loss / fragmentation				potentially incompatible management practices										management / research					exacerbates vulnerability			
		Stress	Scotch broom	English hawthorne	Encroachment of native shrubs	Succession to Douglas-fir forest	Tall oatgrass	Non-native perennial grasses	Non-native annual grasses	Non-native perennial forbs	Non-native annual forbs	Development	Isolation of sites	Insufficient nectar	Insufficient larval host plants	Incompatible habitat management	Off-road driving, horse-back riding, and recreation	Military training activities	Insecticide use (especially Btk and mosquito abatement)	Communications antenna development/maintenance	Timber harvest	Road development/maintenance	Broadcast herbicide application	Grazing	Over-collecting	Field research activities	access issues	Control burns	fire management or fire in general	Small population size	Parasites / disease	Wildfire	Climate Change
On-the-ground management tools	weed control	Mowing																																
		Handpull			X					X																								
		herbicide								X																								
		control			X			X	X																									
		removal				X																												
	native plants	bot. assessment																																
		augment plants												X	X																			
		limit aug. of plants																																
		plant propagation				X								X	X																			
		supplement diversity												X	X																			
	Eet	population search																																
		translocation																																
Coordination / planning / administrative tools	landowner	coordinate access																										X						
		limit access																																
		landowner approval																									X							
		engage landowner																																
	land management	coordinate military training																														X		
		develop recommendations																																
		develop strategy													X													X						
		develop management plans																																
	protection	create connections											X																					
		easement / acquisition																																

Shaded column indicates identified threat