

Taylor's Checkerspot Butterfly Working Group
Annual Meeting | Nisqually Wildlife Refuge | Nov. 6th & 7th, 2013

Executive Summary

The annual Taylor's checkerspot butterfly (TCB) working group meeting includes updates to research, monitoring, and conservation actions as well as a needs discussion and update to the Action Plan that lists and prioritizes next best actions for Taylor's that can be accomplished in the next 3-5 years. One major update from the 2013 meeting was the federal listing of the Taylor's checkerspot butterfly as endangered under the ESA. In addition to this major change in the regulatory landscape, many partners have continued to make progress in land protection and restoration, monitoring, and reintroduction efforts, with much of the work being done collaboratively among multiple partners. This year's meeting also had multiple presentations of preliminary research results, which allowed for interesting discussion about how to translate knowledge learned through lab and field research to on-the-ground management changes and decisions.

Day 1 of the meeting included specific project/initiative updates. Ted Thomas (USFWS) provided an overview of impacts and opportunities resulting from the recent ESA listing of the Taylor's checkerspot butterfly as endangered, including critical habitat designation. Following this, two researchers presented data about habitat quality, host plants, and the role this information can play in recovery efforts. Elizabeth Crone (Tufts) presented her research on identifying if 'bad' habitat can be beneficial – finding it can play a positive role - and the different ways in which butterflies use suitable and less-suitable habitat. Nate Haan (UW) presented preliminary results from his research on the history of the relationship between golden paintbrush and TCB, host-plant fidelity, and how this research can improve our reintroduction efforts. Focusing more on restoration actions, Cheryl Schultz (WSU) presented her research on the effects of grass-specific herbicides on checkerspot survivorship, finding that there are lethal and sub-lethal effects, but that practitioners need to balance the positive outcomes against negative effects when restoration planning. Lisa Randolph (WDFW) presented a Rapid Vegetation Assessment, meant to increase the scientific basis of habitat enhancement planning and to provide a determination of site readiness for reintroduction, which will help identify and prioritize sites for reintroduction.

Day 1 of the meeting also included updates regarding monitoring, captive breeding and reintroduction efforts, and habitat restoration. TCB populations were reported to be steady in some areas and declining in others, while reintroduction efforts are being initiated in British Columbia and managers are seeing successes in South Sound. Restoration of occupied and unoccupied habitat continues at a steady pace in the South Sound, with some additional sites being prepared for possible reintroductions in 2014. The day finished up with a brief needs assessment discussion.

Day 2 continued the needs assessment discussion, with an effort to identify the constraints practitioners are facing in their conservation efforts. Staff with expertise was prominent constraint, as well as need for data analysis and processing support. A brief report out was given on the results of the Clallam County Genetic Study Review as well.

The majority of Day 2 was spent reviewing the action plan, including updates and revisions, as well as a reprioritization of actions. The meeting agenda, minutes, and action plan are included.

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Agenda

Wednesday, 6 November 2013

- 9:30 Welcome, Purpose, Introductions
- 9:45 ESA Listing (30 min) Ted Thomas, FWS
- Proposed to final rule
 - Critical habitat designations and exemptions
 - Consultation and permitting process
 - Recovery Planning
- 10:45 *Taylor's Checkerspot Genetics Research Overview – moved to Day 2 due to illness, schedule moved up throughout the day.*
- 10:55 Native and Non-Native Hosts used by Taylor's Surrogates (25 min) Elizabeth Crone, Tufts
- 11:20 Effects of Grass-Specific Herbicides (15 min) Cheryl Schultz, WSU
- 11:35 Taylor's Checkerspot and *Castilleja levisecta* (15 min) Peter Dunwiddie, CNLM/UW
- 11:50 LUNCH (45 min)
- 12:35 Occupied Site Updates
- Denman Island (15 min) Jenny Heron, BC Min. of Env.
 - Olympia National Forest (Clallam Co.) (15 min) Karen Holtrop, USFS,
 - State and Private Lands (Clallam Co.) (15 min) Ann Potter, Dave Hays, WDFW
 - Benton County (15 min) Ben Axt, IAE
- 1:35 South Puget Sound Mary Linders, WDFW
- Range 76 Source Site (10 min)
 - Habitat Assessments (10 min)
 - Habitat Enhancements (10 min)
- 2:05 BREAK (10 min)
- 2:05 South Puget Sound Reintroduction Mary Linders, WDFW
- Captive Rearing Programs (10 min)
 - Reintroduction Sites - Scatter Creek, Glacial, R50, Pacemaker (10 min)
- 2:25 Reintroduction Efforts in BC (15 min) Jenny Heron, BC Min. of Env.
- 2:40 Needs Assessment Discussion Group
- What limitations does your site/region face?
 - What is limiting conservation progress?
- 3:30 ADJOURN

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Tuesday, 7 November 2013

- 9:30 Welcome to Day 2
- 9:45 Taylor's Checkerspot Genetics Research Overview (15 min) Derek Stinson, Ann Potter
- 10:00 Revisit Recovery Planning
- Scope and make-up
 - Draft Population goals
- 10:15 What is an action plan? What isn't it?
- Short term (5yr horizon)
 - Define next best thing to accomplish
 - Prioritized Actions
- 10:30 Review and discuss 2012 Action Plan
- Plan organization
 - By priority
- 12:00 LUNCH (45min)
- 12:45 Revise Plan for 2013-14
- Identify new actions not represented
 - Discuss implementation of actions
 - Reprioritize all actions
- 3:30 ADJOURN

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Day 1 (Nov. 6th, 2013)

In Attendance

Jenny Heron, BC Ministry of the Environment; Hannah Anderson, Peter Dunwiddie, Sarah Hamman, Elspeth Hilton Kim, Bill Kronland, Center for Natural Lands Management (CNLM); Ben Axt, Institute for Applied Ecology (IAE); Dennis Aubrey, Dave Clouse, Warren Devine, Valerie Elliott, Jeff Foster, Rod Gilbert, Evan Hayduk, Hal Nelson, Todd Zuchowski, Joint Base Lewis-McChord (JBLM); Liz and Maryann, Mission Creek; Marty Chaney, Natural Resources Conservation Service (NRCS); Karen Lewis, Julie Lowe, Kim McEwan, David Shephardson, Oregon Zoo; Lindsay Hamilton, Sustainability in Prisons Project (SPP); Elizabeth Crone, Tufts University; Judy Lantor, Rich Szlemp, Ted Thomas, US Fish and Wildlife Service (USFWS); Nate Haan, University of Washington; Shelly Ament, Regina Johnson, Mary Linders, Anita McMillan, Gail Olson, Ann Potter, Lisa Randolph, Derek Stinson, Washington Department of Fish and Wildlife (WDFW); Brian Turner, Dave Wilderman, Washington Department of Natural Resources (WDNR); AJ Kroll, Weyerhaeuser.

Ted Thomas, FWS – ESA Listing

Summary

The Taylor's checkerspot butterfly was designated as endangered in October 2013 and nearly 2,000 acres in Oregon and Washington were designated as Critical Habitat for TCB. No special rules for TCB were included in the listing, and recovery planning will begin shortly.

Listing Details

Federal Status: Taylor's checkerspot butterfly (TCB) was designated endangered under the Endangered Species Act (ESA). This can be found in the [Federal Register Volume 78, Number 192](#) and the effective date of the rule is Nov 4, 2013.

Critical Habitat: 1,941 acres were designated as Critical Habitat (CH) for TCB. This was a reduction from the originally proposed acreage, for the following reasons: Unoccupied habitat that was considered 'non-essential' to TCB in was removed; CH that was 'covered' by a management plan WDNR, WDFW, Benton Co. was removed under 4(b)(2) of the Act; and DoD lands covered by an Integrated Natural Resources Management Plan (INRMP) and associated Endangered Species Management Plan (ESMP) were exempted under 4(a)(3)(B)(i) of the Act. All private landowners were given the opportunity to provide us with a management plan for our review so that critical habitat would be excluded from their property under section 4(a)(3)(B)(i) of the ESA. We received several management plans from private landowners and excluded these properties from the final designation of critical habitat. However, not all companies, or organizations submitted a plan and therefore those properties were included in the final designation of critical habitat for Taylor's checkerspot. Public land that had an existing management plan was excluded.

Effect of Listing

Key impacts: Prohibition against take (Section 9); fed agency consultation (Section 7); coordination with the states (Section 6); recovery planning and implementation (Section 4); permits for non-federal actions, scientific research and recovery actions (Section 10).

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Critical Habitat: There are three units of Critical Habitat, Unit 1: South Puget Sound, Unit 2: Straights of San Juan, and Unit 4: Willamette Valley. Note that there is no Unit 3 for TCB CH because units are shared with the streaked horned lark, and Unit 3 does not have TCB, just larks. Consultation is required for actions with a federal nexus that may affect designated CH. Under designated CH, there is no 'take' prohibition. The PCE's (Primary Constituent Elements) for designated CH provide the physical and biological features that are essential to the conservation of the subspecies.

Recovery Planning: The goal of recovery planning is to reverse the decline of the species. Part of the process will be a compilation of the current state of knowledge to provide a tool to guide efforts and funding. Recovery planning is an opportunity to establish partnerships to improve the status of a species, and the recovery plan is a non-regulatory document. FWS needs to have a recovery plan outline 90 days after the listing goes into effect and the final plan will be published in December 2015. The recovery group can be appointed by regional lead or a technical team can be formed.

Research Results and Discussion

Elizabeth Crone, Tufts – Native and Non-Native Hosts used by Taylor's Surrogates

Elizabeth presented her research regarding the Baltimore checkerspot butterfly, which is found in the Eastern range, especially in New England. Her work focused on looking at if bad habitat can be beneficial, and compared habitat use by Baltimore checkerspots on two different host plants – a native plant (turtlehead) and a non-native plant (plantain). Her preliminary results suggest that less-ideal habitat may still be beneficial, and that habitat use does not indicate habitat quality. Her preliminary recommendations are that both host plant species be used together as the non-native plant establishes quickly and can provide a host plant until the preferred native host is present. Elizabeth suggests that this information can be used to develop models for TCB as well as Baltimore checkerspot because both butterflies have similar diffusion rates.

A more detailed description of this research can be found in Appendix A.

*Nate Haan, University of Washington – Taylor's checkerspot and *Castilleja levisecta* (CALE)*

Nate Haan's research asked the broad question "what role could golden paintbrush (CALE) play in Taylor's checkerspot recovery?" with the more specific research question "is golden paintbrush an acceptable host plant for post-diapause larvae?" The project released larvae onto 4 types of release sites: burned and unburned plots within areas with either golden paintbrush (CALE) or lanceleaf plantain (*Plantago lanceolata*) (PLLA) and measured if they remained on the plant in which they were placed, and if they could be relocated. They were able to relocate 32% of the larvae, and larvae were found in similar numbers on both PLLA and CALE. Midway through the study, larvae disappeared from the burned PLLA plot, most likely due to predation by robins. Larvae released on CALE appeared to have higher fidelity to the individual plant to which they were released, while larvae released on PLLA were more likely to migrate to other plants nearby. The most important conclusion of the study was that post-diapause larvae can feed on golden paintbrush and reach adulthood. Further study using a block design rather than extant

plants (as in this pilot study) would help differentiate the effects of host plant identity and other site factors like soil type.

This pilot project also measured iridoid glycosides in CALE, which had not previously been investigated. CALE appears to contain the same iridoids as PLLA, and in similar concentrations. Iridoid glycoside concentrations were low for CALE in plots that had been burned compared to those that had not. More research is needed to confirm the results of this preliminary effort.

A more detailed description of this research can be found in Appendix B and the powerpoint presentation presented by Nate Haan can be found [here](#) (opens CPOP website).

Cheryl Schultz, Washington State University – Effects of Grass-Specific Herbicides

In response to herbicides being used as a tool to control invasive plants in habitats for at least 17 rare butterflies in the US, and with lab studies showing that herbicides reduce survivorship by up to 30%, Cheryl Schultz researched the effects of grass-specific herbicides on butterfly survivorship of three checkerspot species. Butterflies were reared on native and non-native host plants: *Castilleja* for Edith's and *Chelone* for Baltimore against the non-native plantago.

The treatments were fusilade with nufilm and a water control. All larvae were reared to second instar. The response variables were survivorship to diapause, initial mass versus mass and diapause, and behavior. Negative effects on native host plants were observed. Conclusions to date are that herbicides likely have some lethal and sub-lethal effects; that herbicide effects differ between butterfly species but are similar for native versus non-native host plants; and that there is a need to understand the balance of positive and negative effects for restoration planning, noting that demography is a standard tool for integrating these effects.

Discussion and questions raised by the group in response to Cheryl's presentation of her research focused around how our community, as practitioners, utilize this information to make management decisions. Seeing that this research shows herbicide use doesn't decimate the population, how do we weigh benefits against impacts? Cheryl notes that a long-term small-scale study of annual treatment impacts will be informative.

A more detailed description of this research can be found in Appendix C.

Population Updates

Jenny Heron, BC Ministry of the Environment – British Columbia

Monitoring indicates a decline in the population at the occupied site (Denman Island). TCB population monitoring at Denman Island found 622 in 2007, 1089 in 2008, 9 in 2011, 20 in 2012 and < 20 larvae and < 50 adults in 2013. Population was thought to crash in 2009 or 2010, though not as much as surveying suggests – weather was bad that year, which made it tough for getting out there to survey, leading to lower count than suspected reality.

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Background info: Denman Island was clearcut, after which checkerspots moved in. Since then, a few problems have arisen – first, though the land was slow to regenerate for a few years, Douglas-fir trees and scotch broom really took off in 2013. More importantly, due to landowner carbon crediting, there is a requirement to grow tress on the site, which is not compatible with TCB, though there is a 10 acre TCB reserve incorporated into a proposal and a potential for other non-forested pockets that could support them.

In the last two years, two different sub groups have been created to get people interested in checkerspots. There is a Science and Technical Subgroup and a Stewardship Subgroup, both made up from folks from community. More about their work can be found in the ‘Captive Rearing and Reintroductions’ section below.

Ann Potter, WDFW – Clallam County

Four populations have been identified on Forest Service land – Gray Wolf, Bear Mountain, Three O’Clock Ridge, and Upper Dungeness. Habitat is a combination of natural balds, cliff faces, road sides and clear cuts. A big monitoring effort is underway, and has found consistent results over the last three years. Daily high counts in 2013 were 39 for Bear Mountain, 158 for Three O’Clock Ridge, 265 for Upper Dungeness, and 42 for Gray Wolf. The searches enable a study of the effectiveness of treatment on the sites.

There are three other Clallam County sites: Sequim, which high but variable counts from 2009-2013, ranging from 206 to 599. The site has stabilized dune habitat, and a rare plant has been identified at the site – *Sanicula arctopoides* - which the checkerspots seem to love; Dan Kelly ridge (with a low daily high count <15); and Eden Valley (daily high count 156). Surveys are underway to seek new populations in Clallam County, and surveys for oviposition sites to look at the effectiveness of restoration and for ESA compliance will also be conducted. Clallam County monitoring challenges include weather, staffing and data analysis.

Ben Axt, Institute for Applied Ecology – Benton County

The Fitton Green population is not doing well, and is down 25% this year. There is scotch broom and conifer encroachment, and IAE is making effort to reduce encroachment by removing encroaching conifers from the prime habitat. Some landowners and BPA are interested in supporting restoration work and a meeting is planned. The Beazell population is holding steady after a crash in 2010. Concerns looking forward are: funding (this is the biggest limit), relationships with private landowners, and a genetic bottleneck.

Captive Rearing and Reintroduction Updates

Mary Linders, WDFW – Captive Rearing Programs

There captive rearing program has seen greatly successful survival rates at both facilities (Oregon Zoo and Mission Creek). The biggest variability observed is during the 1st and 2nd instar, which is consistent with wild populations.

At the Oregon Zoo portion of the program, there was an unexplained illness in 2013, with a big die off noticed this year. 15% of the population died as pre-diapause larvae, and some animals

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skipped diapause and went straight to the pupation stage. Some animals were observed throwing up and having diarrhea. If any animals died, the other animals that were in the same containers were culled as to not spread illness. The program is still unsure what the illness was, but it seems to be contained and was not seen at Mission Creek.

Mary Linders, WDFW – Reintroduction in South Puget Sound

The goal of South Puget Sound reintroduction efforts is to establish at least three new populations at three Puget lowland sites in the next decade. For this goal, the project group has defined an established population as: a minimum of 250 adult butterflies, widely distributed across a monitoring area, more than 50 acres in size, where the butterflies occupy the site solely through natural reproduction each year for five consecutive years.

Joint Base Lewis-McChord's (JBLM) Range 76 is the source site for the project, and reintroductions are underway at JBLM sites Range 50 and Pacemaker, Glacial, and Scatter Creek South. Current release strategy in use is to release more than 1,500 post-diapause larvae annually per site for 5 consecutive years. However, if in the first 5 years, more than 500 adults are estimated and they are widely distributed, the project will stop release and only resume if the adult population drops below 250 individuals. To date only Range 50 has met this target.

Lisa Randolph, WDFW – Rapid Vegetation Assessment of Taylor's Habitat

The goal is to quantify known habitat characteristics to increase the scientific basis of habitat enhancement planning and provide a determination of site readiness for reintroduction. Objective 1 is to measure pre-determined habitat characteristics, and Objective 2 is to develop spatially explicit management plans.

265 acres of Taylor's habitat was surveyed for many habitat variables such as TCB resources, structural characteristics, and invasive exotics. Some were recorded as presence/absence, some were counts or percentage. This process is helping identify and prioritize sites for reintroduction.

Jenny Heron, BC Min. of Env. – Reintroduction in BC

A new captive rearing program has created the opportunity for a reintroduction project to be carried out at one of four possible areas on Denman and Hornby Island. The captive rearing program is the result of a champion, Peter Carsten, reaching out and taking the lead on creating and leading a rearing facility at his home. A former zoo keeper, Peter received help from the Oregon Zoo who visited BC to help set up the facility. Eggs were collected and 18 larvae hatched. Peter will be in touch with members of the TCB working group for more information. Peter and his team of volunteers are full of excitement and determination, and are making good progress.

The four possible sites for reintroduction are:

Site 1: Helliwell Park – the site is a maritime meadow that was occupied until 1998. The public is very interested and protective of the site, making it less likely to be a successful project.

Site 2: Tribune Bay Provincial Park – the site is a former farm with lots of high grasses but also a lot of plantain. There is some conifer encroachment, but less than other sites. The public is not interested in this site, which allows for more flexibility for restoration actions.

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Site 3: Denman Island Provincial Park – the site is mostly roads and landings, but broom has taken off in last few years. This site has a lot of potential.

Site 4: No information provided.

Habitat Restoration Updates

Rod Gilbert, JBLM (full presentation available [here](#))

Habitat restoration occurred on six sites (occupied and unoccupied) with a suite of actions including prescribed burns, spot and boom spraying and seeding/plugging. A review of the actions at each site is described below.

Occupied Sites: Range 50 has very limited access and restoration occurs during surveys only – spot sprayed velvet grass and sweet vernal grass, no noxious weed or broom issues. Site burned in July 2013; Range 76 has limited access during the growing season – spot sprayed tall oat grass and noxious weeds. Site burned in July 2013; TA 14 Pacemaker (possibly occupied) had no prescribed burn in 2013 within occupied area, though the adjacent area to the west was burned for lark habitat restoration. No other restoration was conducted in occupied area due to the few numbers of individuals observed during the flight season.

Unoccupied: TA 7S (possible release site in 2014) has burned in 2012, Glyphosate boom spray in Jan 2013, follow-up Reward boom spray in April 2013. No spring Fusilade spray due to lush vegetation response to burn, spot spray only, cut flowering heads. No burn in 2013 because it was still green when Aug rains arrived, then greened up more. Spot sprayed oxeye daisy, hairy cat's ear in Fall 2013; TA 15 was burned in 2013 south of South Creek, post-burn boom spray with Garlon 3A, planted plugs, seeded with drill seeder; TA 22 Johnson Prairie was burned in some northern units, spot sprayed and boom sprayed tall oat grass, spot sprayed sulphur cinquefoil.

Dave Wilderman, WDNR – Bald Hill, unoccupied

Restoration at Bald Hill is underway - invasives and encroaching shrubs are being controlled, and the site is being augmented with native plants. To reduce conifer encroachment, 330 Douglas-fir trees were removed by helicopter from near South Bald 1 and 2, and around North Bald. Following tree removal, habitat enhancements, as previously mentioned, are underway.

Group Needs Assessment Discussion (from Day 1 & 2)

To frame the upcoming Action Plan Discussion, each organization present was asked to identify their primary needs, and identifying factors that are constraining conservation action. While a lack of funding is a frequently mentioned constraint, the most prominent factor mentioned by multiple partners was a lack of qualified personnel. Additional needs included a need for general labor and/or capacity, applied research, and outreach.

Needs for increased qualified personnel include:

- Surveying and monitoring, especially during peak season.

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- Clallam County population (WDFW)
- South Puget Sound areas adjacent to occupied sites (WDFW)
- Once protocol is established, range wide need
- Database management/data processing
 - Database analysis and update to husbandry manual (Oregon Zoo)
 - Data processing of all data collected on habitat, presence, and use
 - Analysis of existing range wide surveying data
 - Distance data analysis of Clallam County population (WDFW)

Additional identified needs:

- Pre-treatment survey protocol to prepare for baseline reporting for recovery planning
- Increased public outreach to private landowners, especially near occupied sites in Clallam County (WDFW, WDNR)
- Committee to create standardized survey and monitoring protocols to allow for the establishment of population estimates, trends, and occupancy as well as cross-site comparison throughout the range for all of these metrics
- Institutional and regulatory consistency, especially in regards to prescribed fire.
- Noting the similar ages of many key players, there is a need for younger practitioners to become experts to continue the legacy of current work.
- Research
 - Basic biological research re: checkerspots and their interactions
 - Larval host plants
 - Parasitoids
 - Identification of reasons for extirpation at extirpated sites range wide
- Continuity by way of an endowment to support monitoring, data analysis, protocol creation, etc. as needed.

Suggested solutions (only a few, as not the focus of the discussion):

- Ted Thomas (FWS) suggested a Taylor's surveying and monitoring training for the conservation community would be beneficial and could potentially be funded through Section 6.
- Mary Linders (WDFW) suggested increased utilization of programs such as the Sustainability in Prison Project (SPP) since they have proven cost effective and productive.

The full notes for this discussion can be found in Appendix D.

Day 2 (Nov 7, 2013)

In Attendance

Jenny Heron, BC Ministry of the Environment; Hannah Anderson, Peter Dunwiddie, Elspeth Hilton Kim, Bill Kronland, CNLM; Ben Axt, Institute for Applied Ecology; Dave Clouse, Warren Devine, Valerie Elliott, Rod Gilbert, Todd Zuchowski, JBLM; Judy Lantor, Rich Szlemp, Ted Thomas, USFWS; Nate Hahn, University of Washington; Mary Linders, Ann Potter, Derek Stinson, WDFW; Brian Turner, Dave Wilderman, WDNR; AJ Kroll, Weyerhaeuser.

Genetic Study Review

Paul Severns (Oregon State University), Andrew Bower (USDA Forest Service), and Ann Potter (WDFW) undertook a genetic study review. Paul Severns planned to present but was unable to attend the meeting at the last minute. The report is still in draft form and is not yet available for distribution. Below is the summary from the report, as well as some additional comments from Ann Potter. USFWS was the principle funder for this work, with help from ACUB, Olympic National Forest and WDFW.

*Summary from "Genetic assessment of Olympia National Forest populations of Taylor's checkerspot, *Euphydryas editha taylori* Macy (Lepidoptera: Nymphalidae)," not yet published.*

- We used DNA markers to assess patterns of genetic diversity between 9 populations of *Euphydryas editha taylori* (Taylor's checkerspot) and 2 populations of the closely related *Euphydryas editha colonia* (Hurricane Ridge, Olympic National Park, WA and Fairview Peak, Lane Co. OR).
- There was strong DNA marker evidence for 5 genetically distinct Taylor's checkerspot populations: 1) Olympic National Forest sites, 2) Dan Kelly and Eden Valley, 3) Sequim, 4) Range 76, and 5) Cardwell Hills. Both populations of *Euphydryas editha colonia* were genetically distinct from one another and levels of genetic differentiation between some populations of Taylor's checkerspot were as great as the differences between *E. e. colonia* and Taylor's checkerspot.
- Estimates of within population allelic diversity suggest some inbreeding but we refrain from formally estimating the within population fixation values because missing data and null alleles render this estimate biologically inaccurate with the current data.
- Genetic groupings could be used as management units but the occupied ecological niches, habitat association and patterns of host plant use should also be considered within each management unit.
- DNA markers suggest the potential for more than one taxon to exist within the populations currently considered *E. e. taylori* and *E. e. colonia*.

Additional comments from Ann Potter

Ann added thanks to the many folks that supporting the project with funding, scoping and creating questions. The project group was disappointed with the lack of definitive results, which

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they attribute to the low number of amplified markers as well as a lot of missing values, minimizing the ability of the project to look at diversity. The upside was that they did have good sample sizes (30 or more samples at all but one site in the Olympic National Forest) and there is also a sample from BC, which is great. The group is hoping to get more funding and access to a lab where they can have more control and more confidence in order to try this study again for better results.

Additional discussion from the group

Jenny Heron noted that the populations in the northern part of BC are very different than the ones from southern BC, and Mary Linders added that, in her opinion, any future genetic work should focus on inbreeding more than anything else because the reality of maintaining five small and separate subspecies that are inbred is unrealistic.

Action Planning

Updates

The group went through the action plan line by line and updated it based on completed items, items that are no longer relevant, improving language and adding new items.

Updates to the action plan included updates to language that reflected the growth from starting to expanding and improving captive rearing and reintroduction efforts; an increased focus on monitoring and recovery planning, partly in response to the new federal status of TCB; elevated focus on protecting occupied sites, and a reduction in the emphasis on reducing direct impacts to occupied sites, reflecting progress in that area. The group also increased language in management plans regarding fire as a management tool, as a response to the land management delays and issues caused by a burn ban in 2013.

Ranking

Following the updates to the action plan, the group went through the ranked priorities line by line and noted if the priority has increased, remained the same, or decreased. The group also identified action items that were new or not previously ranked that should be ranked. A discussion then followed to determine the new rank order. Although different rankings were done for each region, there was consensus across the regions on the top three priorities, and those are as follows:

1. Annually monitor all known populations.
2. Assess and control/remove invasive species and structural modifiers, and assess and enhance larval food and nectar plants as appropriate.
3. Develop management/restoration plans including fire at occupied and unoccupied sites. Sites include JBLM, DNR lands in Clallam County, ONF, and all BC sites. **This is a lower priority in Oregon, which ranked "Pursue conservation easements, acquisition, and management agreements, with an emphasis on working with BPA to develop and implement management agreements at Fitton Green" as its #3.*

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2013 Taylor's Checkerspot Butterfly Action Plan								
Strategic Action	Ref. #	Task	All	OR	SS	CC	BC	Status and Implementing Party (Options: Ongoing, Proposed, In Progress, Planned, or No Action Yet)
1. Protect Occupied and Other Key Sites	1.1	1. Pursue conservation easements, acquisitions, and management agreements.						
	1.1.a	<i>a. Work with BPA to develop and implement management agreements at Fitton Green and Scatter Creek.</i>		3				
	1.1.b	<i>b. Pursue acquisition or conservation easement with willing sellers at Bald Hill, Clallam County Balds, Denman Island Private Land and Fitton Green.</i>		5		4		
	1.1.c	<i>c. Finalize voluntary management plans on private land (Clallam County Balds, Denman Island, Bald Hill) under the guidance of WDFW & DNR Forest Practices Board.</i>						
	1.2	2. Minimize Direct Impacts to Occupied Sites.					6	
	1.2.a	<i>a. Redirect ATV use, especially at Dan Kelly Ridge and Denman Island Provincial Park.</i>						In progress (at Dan Kelly)
	1.2.b	<i>b. Minimize incompatible recreation, especially at Scatter Creek.</i>						In progress (ONF)
	1.2.c	<i>c. Minimize training impacts and manage wildfire (in concert with consultation), especially at R74/76, R51.</i>						
2. Improve/Expand/Enhance Habitat	2.1	1. Assess and control/remove invasive species and structural modifiers, and assess and enhance larval food and nectar plants as appropriate.	2	2	2	2	2	Ongoing
	2.2	2. Develop management/restoration plans including fire at occupied and unoccupied sites. Sites include JBLM, DNR lands in Clallam County, ONF, and all BC sites. Lower priority in OR.	3		3	3	3	In progress (ONF)
	2.3	3. Ensure South Sound and BC release sites are in suitable condition.			8		4	
	2.4	4. Improve connectivity between occupied areas and/or suitable habitat.				9		
	2.5	5. Improve larval and nectar plant materials production throughout the range.						
	2.6	6. Link restoration efforts to other species at risk that results in larger distribution of healthy functioning ecosystem (e.g. through funding, communications, messaging, political/public support).						In Progress (ONF)
3. Increase Population Sizes and Number of Populations	3.1	1. Continue to implement captive rearing and reintroduction programs (including monitoring source and release sites) in South Sound.			4			
	3.2	2. Identify and prioritize potential future release sites in coordination with recovery planning efforts and entities.		4				
	3.3	3. Assess the need and potential for reintroduction in areas outside South Puget Sound, particularly in North Sound.						
	3.4	4. Develop new or additional facilities for captive rearing in Benton County and Denman Island.						
	3.5	5. Assess the need and potential to augment existing populations in coordination with recovery planning efforts and entities.						
4. Survey/Monitor	4.1	1. Annually monitor all known populations.	1	1	1	1	1	Ongoing (ONF)
	4.2	2. Develop a standardized survey and monitoring protocol to determine occupancy, trends, distribution, and abundance.		8	1		7	
	4.3	3. Develop a methodology for calculating an estimate of population size.			9			
	4.4	4. Survey suitable habitat for additional populations and/or expansions. Perhaps prioritize regions/areas?				5		Ongoing (ONF)
5. Research	5.1	1. Define habitat restoration targets through research.						
	5.1.a	<i>a. Evaluate quality of various host species in relation to butterfly performance in all life stages (phenology, chemical content, abundance, etc.).</i>		6	7		5	

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	5.1.b	<i>b. Research and develop best management practices for using fire in relation to butterfly recovery.</i>			6	7		
	5.1.c	<i>c. Improve our understanding of the influence of weather and climate on population dynamics and reintroductions.</i>						
	5.1.d	<i>d. Assess the need and potential for wet prairie and deep soil sites to contribute to recovery.</i>					Proposed (ACUB)	
	5.1.e	<i>e. Define butterfly habitat selection through research, i.e. oviposition & adult habitat, nectar and larval food plant density, phenology, soil type/structure, and spatial arrangement.</i>					In progress (WDFW). Ovipos. Complete in Clallam Co., AIA, OR.	
	5.1.f	<i>f. Determine the characteristics of occupied habitat, with respect to nectar plants, host plants, and vegetation structure.</i>					In Progress (WDFW)	
	5.1.g	<i>g. Identify pre and post diapause food plants, particularly in the Olympia Peninsula.</i>					Ongoing (ONF)	
	5.2	2. Conduct genetic and meta-population studies to determine population isolation/diversity.		7		6	In Progress (ONF)	
	5.2.a	<i>a. Determine the appropriate taxonomy for populations identified as E. e. taylori using genetic analyses.</i>						
	5.2.b	<i>b. Determine the degree of genetic structuring within and between populations of E. e. taylori</i>						
	5.3	3. Evaluate effects of habitat management on Eet populations.		9			8 Ongoing (ONF)	
	5.4	4. Collect information on plantago pathogen in order to identify and calculate the level of risk to Eet.						
	6. Policy and Outreach	6.1	1. Develop Recovery Plan.			5	8	Completed in B.C.
		6.2	2. Inform and discuss effects of ESA status and cooperatively develop solutions (e.g. monitoring & project survey requirements, recovery planning, and conservation measures).					
		6.3	3. Share information between entities, establish partnerships, and maintain a working group.					
6.4		4. Share information about listing and conservation to landowners that do or may have occupied or suitable habitat.						

APPENDIX A

Elizabeth Crone, Tufts – Native and Non-Native Hosts used by Taylor's Surrogates

Summary (provided in minutes)

Elizabeth presented her research regarding the Baltimore checkerspot butterfly, which is found in the Eastern range, especially in New England. Her work focused on looking at if bad habitat can be beneficial, and compared habitat use by Baltimore checkerspots on two different host plants – a native plant (turtlehead) and a non-native plant (plantain). Her preliminary results suggest that less-ideal habitat may still be beneficial, and that habitat use does not indicate habitat quality. Her preliminary recommendations are that both host plant species be used together as the non-native plant establishes quickly and can provide a host plant until the preferred native host is present. Elizabeth suggests that this information can be used to develop models for TCB as well as Baltimore checkerspot because both butterflies have similar diffusion rates.

Background Information

The Baltimore checkerspot butterfly occurs on the Eastern coast and is especially present in New England. The population is increasing in Massachusetts but dwindling in Maryland. There are two host plants that the butterfly uses, the native turtlehead (*Chelone glabra*) and plantain (*Plantago lanceolata*) introduced from Europe. Research has shown that plantain is a lower quality host, as less biomass is gained from a plantago diet, and a separate research study showed that blue jays ate caterpillars that had eaten plantain but spit out caterpillars that had eaten turtlehead.

Research Question

Is bad habitat good? As long as the bad habitat is not a sink, it can elevate total numbers of animals on landscape. If we assume that plantago is low quality habitat, there is a need to quantify how it is used by checkerspot. The work includes determining effect of the different host plants to viability attributes in the different life stages.

Methods

Field studies of source-sink dynamics conducted in Harvard, Massachusetts: Measured survival of post-diapause larvae on individual plants contained in bug dorms on the site. In 2012, larvae were only observed on turtlehead, so the researchers put larvae in bug dorms with either plantago or turtlehead. They found caterpillars on both plants. The second year findings show that a delay of fall mowing, which allows the presence of plantago to continue later in the season, resulted in a lot of caterpillars being found on plantago. In both years, there was higher survival for post-diapausal larvae found on turtlehead than plantago.

In order to quantify adult survival as a function of what plant they were reared on as post-diapausal larvae, mark re-sight studies were conducted. Researchers captured 107 in 2012 and 280 in 2013. Found no significant effects of larval host on adult survival. Results also found that for adult fecundity, there was no effect of post-diapause host. Pooled all butterflies together and did mark-resight study of larval nests. Found 70 nests and 140 females. An upcoming study will look at pre-diapause and overwinter survival. Results from this will enable the group to have data on the full cycle in a year or so.

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Results

Mass of caterpillars at 21 days is higher on turtlehead than if you rear on plantago, and the study looked separately at wet plantago and dry plantago to be thorough. Research found two vital rates potentially affected: post diapause survival, and potentially overwinter survival. Found that relative population growth rate on turtlehead is nearly twice as good as plantago, so although it is unknown if plantago is source or sink, turtlehead is better either way.

Research also looked at habitat use by tracking butterflies in a field and used patterns of flight behavior to calculate habitat specific diffusion rate, which allows you to calculate the proportion of time in a certain habitat type. Research used three step characteristics – distance, time, and direction (turning angle). Found a higher diffusion rate for turtlehead than plantago, so plantago has higher use, relative to availability. Found that habitat use does not equal habitat quality. They prefer to lay eggs on turtlehead (spent only 10% of time on turtlehead, but laid 35% of eggs there). In the lab, found that nearly every time they offered turtlehead, the butterfly would lay eggs.

Conclusions

Plantago is a lower quality host, but the question remains, is it good enough to sustain populations? Not sure yet – probably yes, but unclear as yet. Importantly, habitat use does not equal habitat quality. Preliminary recommendation: use both species together in restoration. Since non-native plantago establishes quickly, it may help establish hosts until a better host is available, in order to keep populations on site. This data can be used to develop models, as TCB has similar diffusion rate as BCB.

APPENDIX B

Nate Haan, University of Washington – Taylor's checkerspot and *Castilleja levisecta*

Summary (provided in minutes)

Nate Haan's research asked the broad question "what role could golden paintbrush (CALE) play in Taylor's checkerspot recovery?" with the more specific research question "is golden paintbrush an acceptable host plant for post-diapause larvae?" The project released larvae onto 4 types of release sites: burned and unburned plots within areas with either golden paintbrush (CALE) or lanceleaf plantain (*Plantago lanceolata*) (PLLA) and measured if they remained on the plant in which they were placed, and if they could be relocated. They were able to relocate 32% of the larvae, and larvae were found in similar numbers on both PLLA and CALE. Midway through the study, larvae disappeared from the burned PLLA plot, most likely due to predation by robins. Larvae released on CALE appeared to have higher fidelity to the individual plant to which they were released, while larvae released on PLLA were more likely to migrate to other plants nearby. The most important conclusion of the study was that post-diapause larvae can feed on golden paintbrush and reach adulthood. Further study using a block design rather than extant plants (as in this pilot study) would help differentiate the effects of host plant identity and other site factors like soil type.

This pilot project also measured iridoid glycosides in CALE, which had not previously been investigated. CALE appears to contain the same iridoids as PLLA, and in similar concentrations. Iridoid glycoside concentrations were low for CALE in plots that had been burned compared to those that had not. More research is needed to confirm the results of this preliminary effort.

Research question

Was golden paintbrush historically a food plant for TCB? If so, it could be an opportunity for synergistic recovery of both species. Broad research question: What role could golden paintbrush play in TCB recovery? And more specifically, is golden paintbrush a suitable and acceptable host plant for post-diapause larvae?

Methods

Larvae were released onto both golden paintbrush and lanceleaf plantain in small numbers at Glacial Heritage Preserve. Measure: do they remain on the plant in which they were placed? Can we re-locate them? There were 420 larvae in all, and 21 plants in each plot, with 4 total plots (5 larvae on each plot). Each plot was revisited 4 times, each time presence/activity were recorded.

A small pilot study was also conducted to look at iridoid glycoside levels between burned and unburned plots on both CALE and PLLA. In unburned plots, plantago and golden paintbrush have similar levels. In burned CALE plots, there are low concentrations of iridoid glycoside. Need to do more research to get better results, and there are plans to do so. Overall iridoid glycoside content is fairly similar between CALE and plantain.

Larval survey results

There was a 32% re-location rate. No difference in abundance was detected between food plant species or burn treatments. Larvae on golden paintbrush had a higher fidelity to original release plant (early results). Site that was burned and had plantain, after 2nd survey, there were no larvae – robins

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had possibly eaten them, which is interesting in context of iridoid glycosides, since they are supposed to make birds throw up, so it is unclear what happened. The unburned plantain plot had the lowest rate of plant fidelity. Overall, there was quite strong fidelity. Also found several adults in paintbrush plots. Reasonable to assume they are adults of the larvae they released.

Conclusion

Post-diapause larvae can feed on golden paintbrush and reach adulthood. Nate would like to expand on the results of this pilot study using several host plant species across multiple soil types.

APPENDIX C

Cheryl Schultz, Washington State University – Effects of Grass-Specific Herbicides

Summary (included in minutes)

In response to herbicides being used as a tool to control invasive plants in habitats for at least 17 rare butterflies in the US, and with lab studies showing that herbicides reduce survivorship by up to 30%, Cheryl Schultz researched the effects of grass-specific herbicides on butterfly survivorship of three checkerspot species. Butterflies were reared on native and non-native host plants: *Castilleja* for Edith's and *Chelone* for Baltimore against the non-native plantago. The treatments were fusilade with nufilm and a water control. All larvae were reared to second instar. The response variables were survivorship to diapause, initial mass versus mass and diapause, and behavior. Negative effects on native host plants were observed. Conclusions to date are that herbicides likely have lethal and sub-lethal effects; that herbicide effects differ between butterfly species but are similar for native versus non-native host plants; and that there is a need to understand the balance of positive in negative effects for restoration planning, noting that demography is a standard tool for integrating these effects.

Discussion and questions raised by the group in response to Cheryl's presentation of her research focused around how our community, as practitioners, utilize this information to make management decisions. Seeing that this research shows herbicide use doesn't destroy the population, how do we weigh benefits against impacts? Cheryl notes that a long-term small-scale study of annual treatment impacts will be informative.

Background

Herbicides are being used as a tool to control invasive plants in habitats for at least 17 rare butterflies in the US, but lab studies show that herbicides reduce survivorship by 20%-30%. If herbicides are in the mix of restoration plans, what impact are they having? Looked at three checkerspot species: Baltimore and two subspecies of Edith's, to find an answer.

Methods

Butterflies were reared on native and non-native host plants: *Castilleja* for Edith's and *Chelone* for Baltimore, against the non-native plantago. Treatments were fusilade with nufilm and a water control. All larvae were reared to second instar. There were 20 larvae per group, with 5-6 groups of each treatment x host plant combo. The response variables were survivorship to diapause, initial mass versus mass and diapause, and behavior. Saw negative effects on native host plants.

Conclusions to date

Herbicides likely have some lethal and sub-lethal effects; herbicide effects differ between butterfly species, but are similar for native versus non-native host plants; need to understand balance of positive and negative effects for restoration planning; demography is a standard tool for integrating these effects. Next steps are to hopefully get post diapause to adult. Next stage of bigger proposal is to do individual based monitoring.

Discussion

Considering small difference between control and treatment, in terms of effects on an organism, where should we begin to be concerned? None of the data suggest it decimates the population, so how do we mix our tools in a way to augment the population? What is the impact of annual application? Doing long-term small-scale look at annual treatment impacts will be informative.

APPENDIX D - Needs Assessment/Discussion Full Notes

Shelly Ament and Anita McMillan (WDFW): In Clallam County, primary needs are more qualified trained staff time for surveying and monitoring, especially during peak time and with weekend availability. WDFW can provide internal training, which would ideally be geographically focused, since skill sets for each habitat type vary. Ted Thomas (FWS) suggests a Taylor's training for the conservation community would be a great project for Section 6 funding.

Oregon Zoo: At the moment, funding from ACUB is sufficient to support the captive rearing program at its current capacity, though more funding would be necessary to expand reintroductions into Oregon. Mary Linders (WDFW) suggests finding a program such as Sustainability in Prisons to achieve additional capacity since those are more cost effective. The Zoo needs more money and staff in order to update the husbandry manual, which is necessary to support more efficient captive rearing in the region. Karen Lewis (Oregon Zoo) has been developing a database but needs more time and resources to complete.

Lisa Randolph (WDFW): Could use more surveying in land surrounding occupied sites in south Puget Sound.

Sarah Hamman (CNLM): Someone to spend the time to dig through and process all of the data that has been collected on habitat, presence, and use would be really helpful. A post doc or PhD student to do this would be perfect, as this takes money and the right skills.

Shelly Ament (WDFW): Outreach and education to private landowners would be really helpful and is needed, there is especially a need near occupied sites in Clallam County. Need to get them on board with conservation efforts, create information sheets, reduce off-road vehicle use in occupied sites, and more. DNR has been doing a great job, but they need more of it. Also need more gating and other barriers to protect sites. There have been occasions where folks have run into local landowners that have checkerspots on their land and are excited by it - need the resources to capitalize on that excitement so these landowners can be stewards.

Mary Linders (WDFW): There is a need to develop standardized survey and monitoring protocols that allow us to establish population estimates that looks at trends and occupancy. Need to be able to have a broad look to look for new sites as well as routine monitoring for occupied sites. Jenny Heron (BC Ministry of the Env.) added that it's very important for cross-site comparison. An agreement on marking methods would be great. If you are going to do a mark/capture survey, consistent protocol would be good.

Ann Potter (WDFW): There is a need to refine Clallam County monitoring notes – there is also a need for staffing capacity for monitoring, and a need for analysis of existing data that has been collected. Range wide need to do this. In Clallam County, specific need to do distance data analysis.

Ted Thomas (FWS): Staffing capacity needs to be expanded throughout the range. Once a survey/monitoring method is developed, need to get new young folks who can take over and continue this work.

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Ann Potter (WDFW): Didn't begin working with butterflies thinking fire was an important part of restoration but she now sees it is essential. Not being able to burn this year was a massive issue. Need to get administrative ability necessary to make sure that ban doesn't happen again.

Nate Haan (UW): There are gaping holes in knowledge of checkerspots and their interactions with other organisms – we still need basic biological research to be done. On larval side, don't have knowledge of what host plant could be used for larvae. Elizabeth Crone's talk highlighted this issue. Derek Stinson (WDFW) points out that another knowledge gap is parasitoids.

Jenny Heron (BC Ministry of the Env.): Mary Linders (WDFW) talked about the need to have continuity, so consider trying to establish a checkerspot endowment. Although it is a pie-in-the-sky idea, it would be enormously helpful. One of her biggest impediments in her job is not having someone to put together protocols.

Dave Hays (WDFW) notes for informational purposes that with the listing of the species, there is going to be more emphasis on monitoring or compliance, something people often don't account for in their project budgets. Monitoring can be very costly, sometimes 1:1 with restoration costs. Ted Thomas (FWS) noted that for any permitting – section 7 or section 10 – terms and conditions will almost always say 'you need to survey before you begin restoration actions'. Ted Thomas said that a source of funding the group could tap into more is the Section 6 funding. Although it is not a large pot of money it is specifically for work with listed species.

Mary Linders (WDFW): Consider getting a working sub-group to focus specifically on researching a protocol for understanding where larvae go for diapause and where to look for specimens. Dave agrees – if we could work through compliance issues on a population basis, there would be a much lower cost to compliance action. Peter Dunwiddie (CNLM) asked what of this info is really useful, and what of it is just checking a box? If we're spending a lot of time getting negative info that we already expected, and we only have a month or two to do it and not the money to do it, what are you going to do differently to make it more productive and efficient and useful. Rod Gilbert (JBLM) said he would consider leading a meeting to create a plan/protocol for pre-treatment surveys. One of the most pressing needs in the recovery planning is a baseline report on sites, populations, etc.

Jenny Heron asks if there has been a systematic search of historic sites to determine reason for extirpation. This was done in BC. Rich Szlemp (FWS) says that in Oregon there are many sites that could potentially have butterflies on them, but don't.