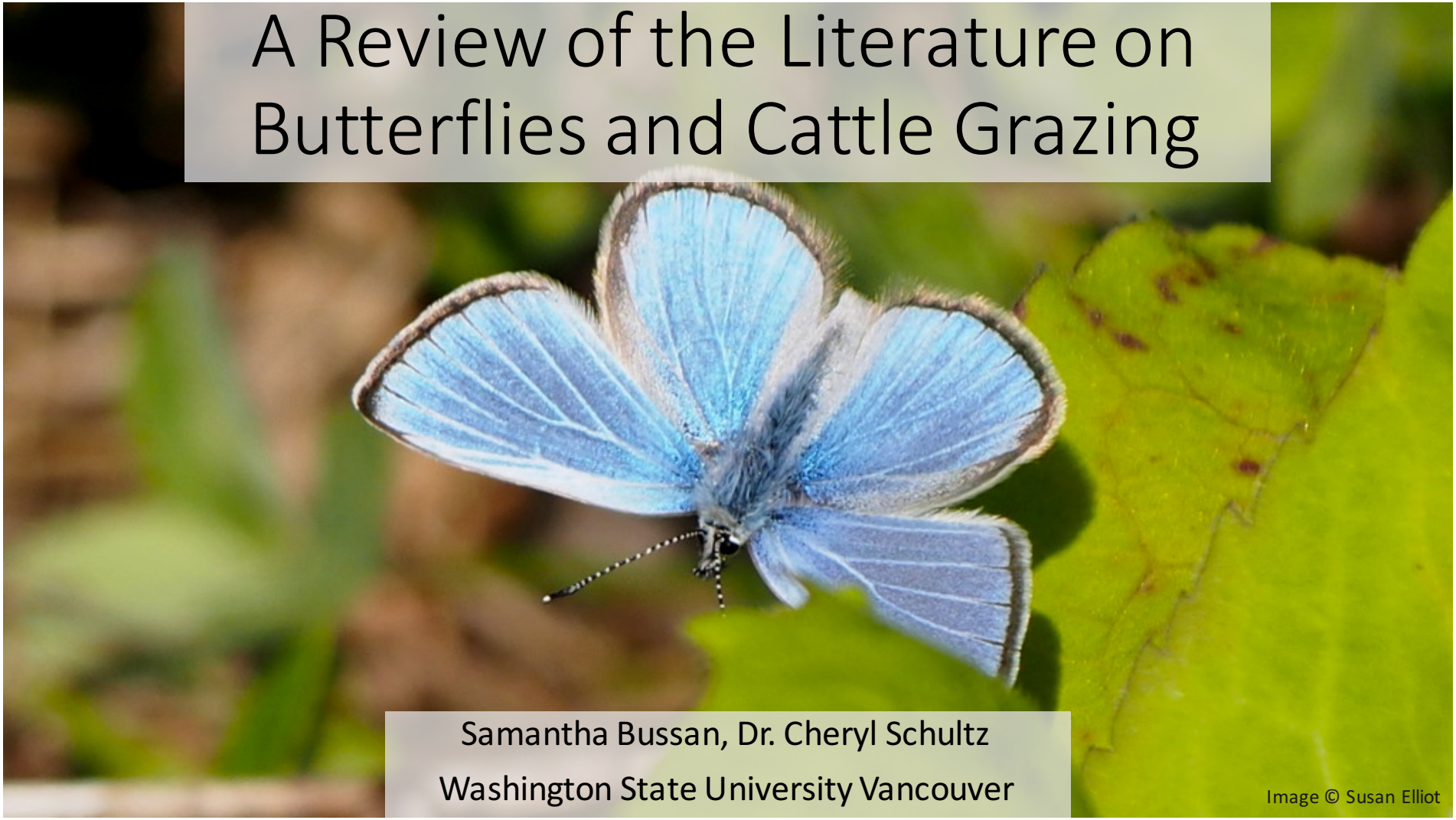
A Review of the Literature on Butterflies and Cattle Grazing



Samantha Bussan, Dr. Cheryl Schultz

Washington State University Vancouver

Image © Susan Elliot

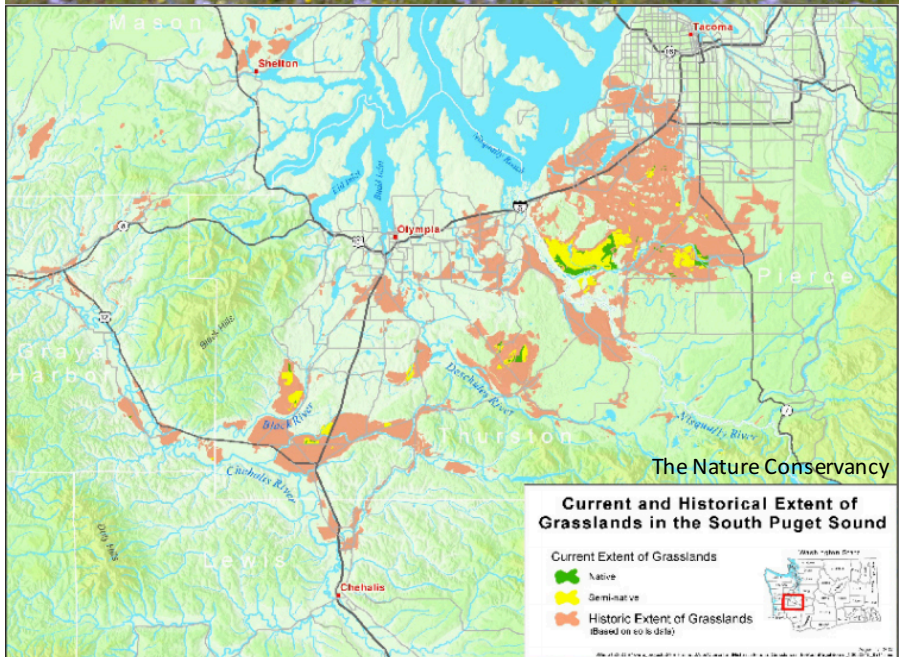
Temperate Grasslands

- One of most endangered ecosystems in the world
  - South Puget Sound: Less than 3% of original extent remaining
    - The Nature Conservancy, 2018

- How do we conserve native flora and fauna in a human-dominated agroecosystem?



Glacial Heritage Preserve, WA



The Nature Conservancy

Grazing Background-Ecosystem Influence



Baraboocandy.com


Rapid City Journal

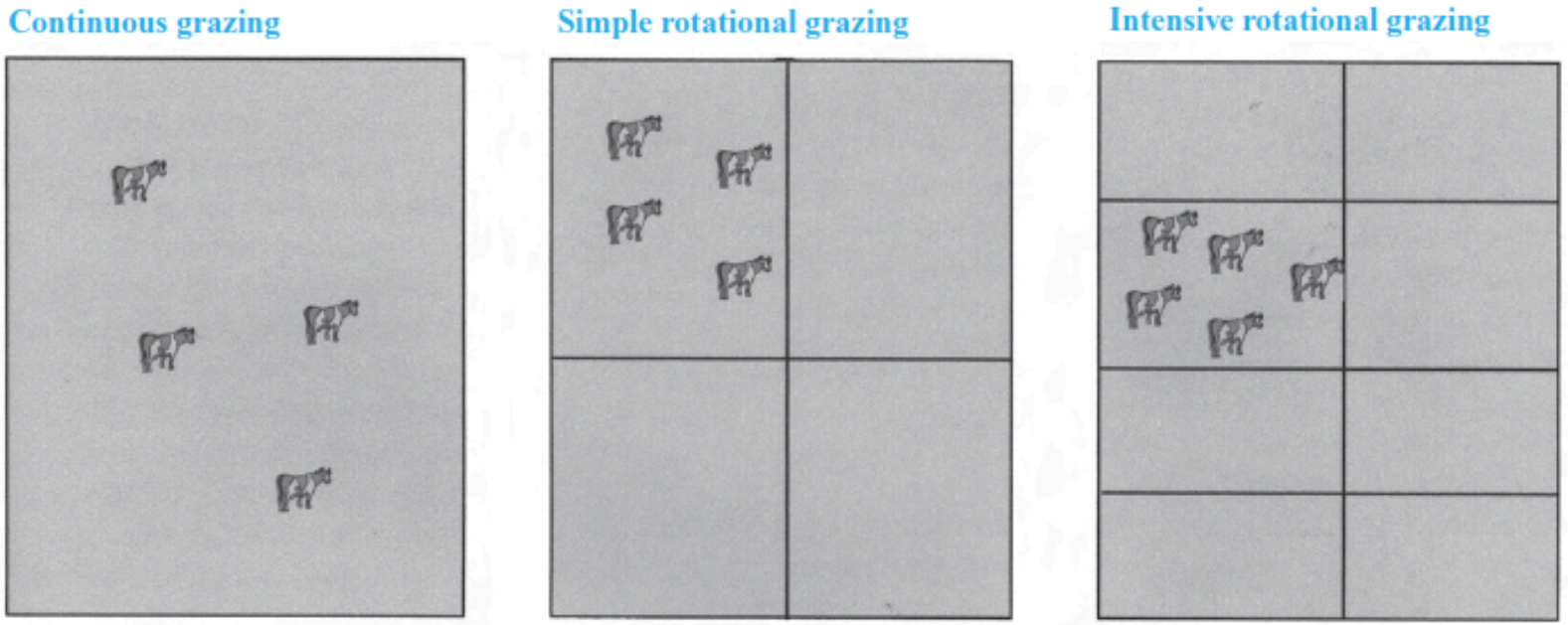
Grazing Background-Positives

- Food production/Profit
- Restoration/conservation
- Exotic grass control
- Reduce competition for forbs
- Increase diversity of plant community
- Fuels reduction



The Nature Conservancy

Grazing Management

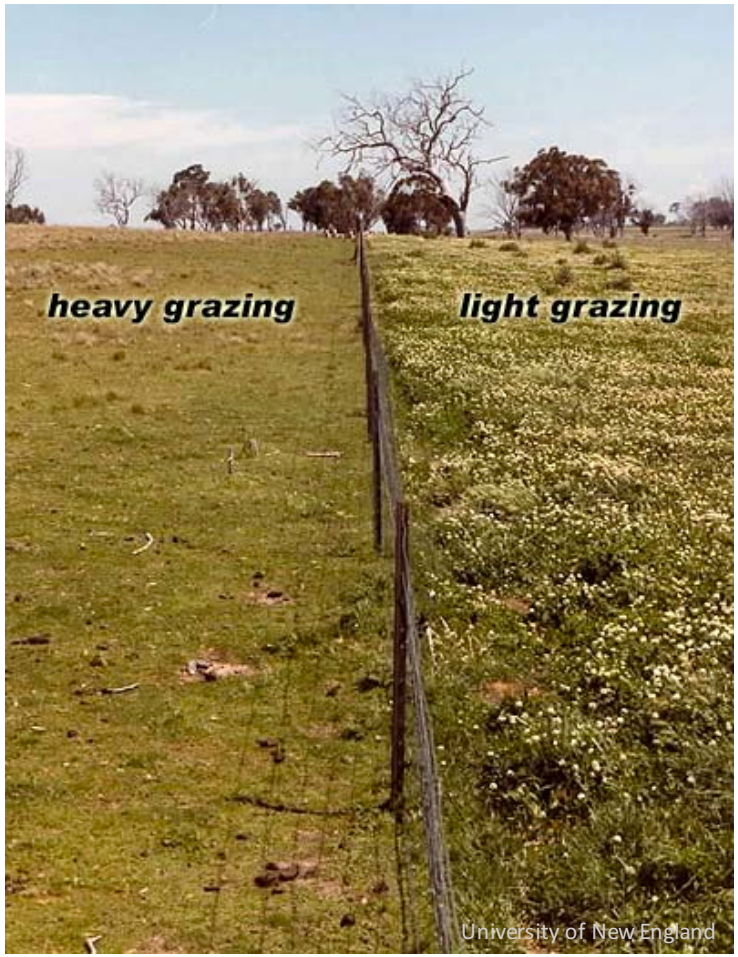


University of Minnesota Extension—Grazing Management Handbook

Grazing Intensity

- Livestock units/hectare
- Intensity levels vary by ecosystem & ecosystem productivity

- Economic perspective:
  - Intermediate intensity=just right?
  - Manley et al., 1997



Indicator Species

- Tendency to only study plants
- Why study butterflies?
  - Unique habitat needs


European Environment Agency


LaCrosse Tribune

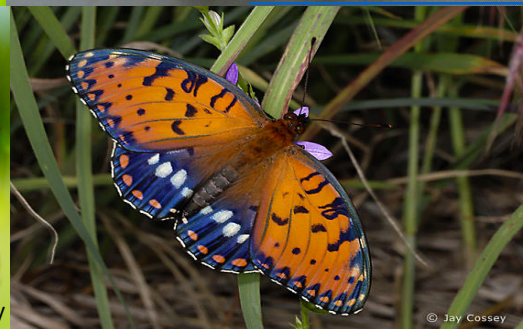

European Environment Agency


Dumi / Wikipedia Commons


Laughing Frog Photography


Arboreal Boids, Flickr


European Environment Agency


© Jay Cossey

Methods

- Searches in Web of Science for how cattle grazing affects butterflies
- “butterfl*,” “lepidopter*,” “insect*,” “arthropod*,” or “invertebrate*”
- “graz*,” “cattle,” “cow*,” “livestock”



WEB OF SCIENCE

Results

- 90 relevant papers
  - Random subset of 50
- Conducted in 18 different countries
- Average of four years
- 16 covered one year
- Swengel & Swengel, 2001*b;* Jerrentrup et al., 2014
  - 10 years
- Johannsen et al., 2017
  - 31 years



Metrics

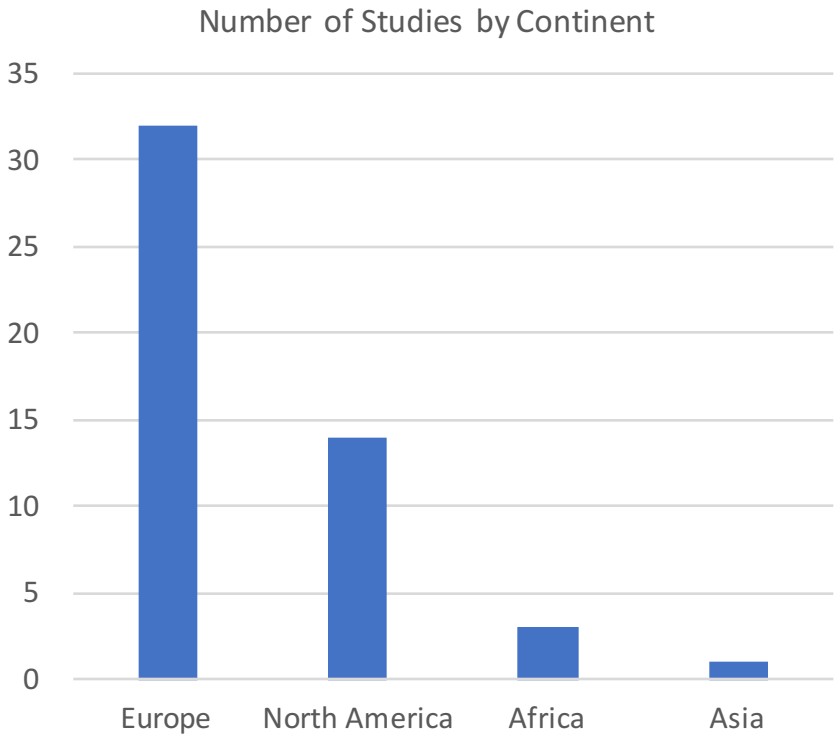
Butterflies

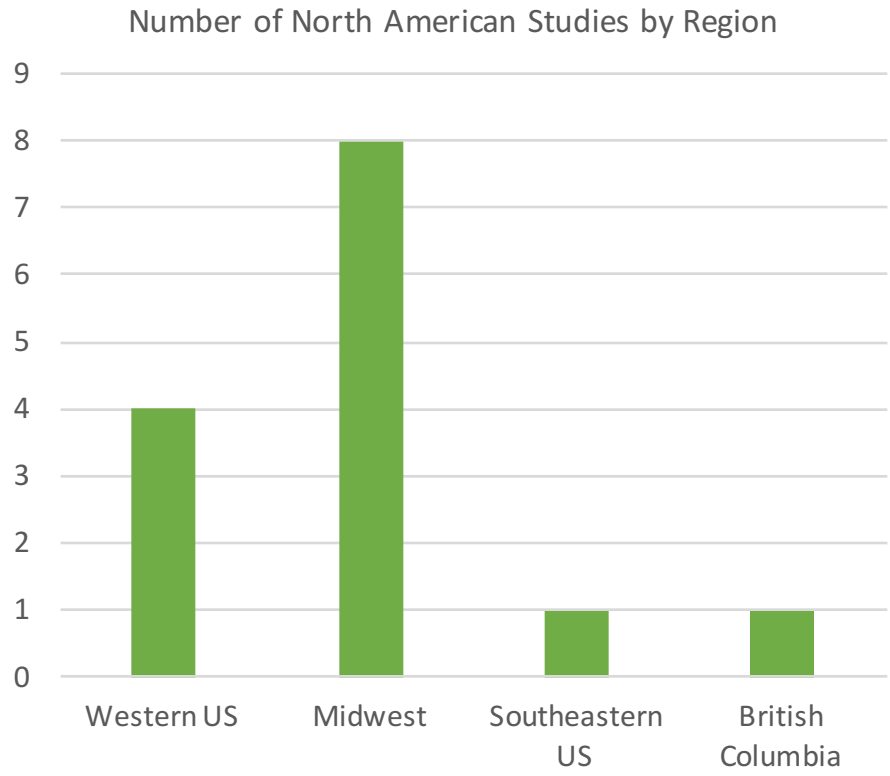
- Majority adult count data
- 6 Included larval/egg counts
- Species richness, diversity of butterfly communities (n=34)
- Specific species (n=26)
- Ouin et al., 2004—Behavior data
- Weiss, 1999, Schtickzelle et al., 2007—Demographic data

Grazing

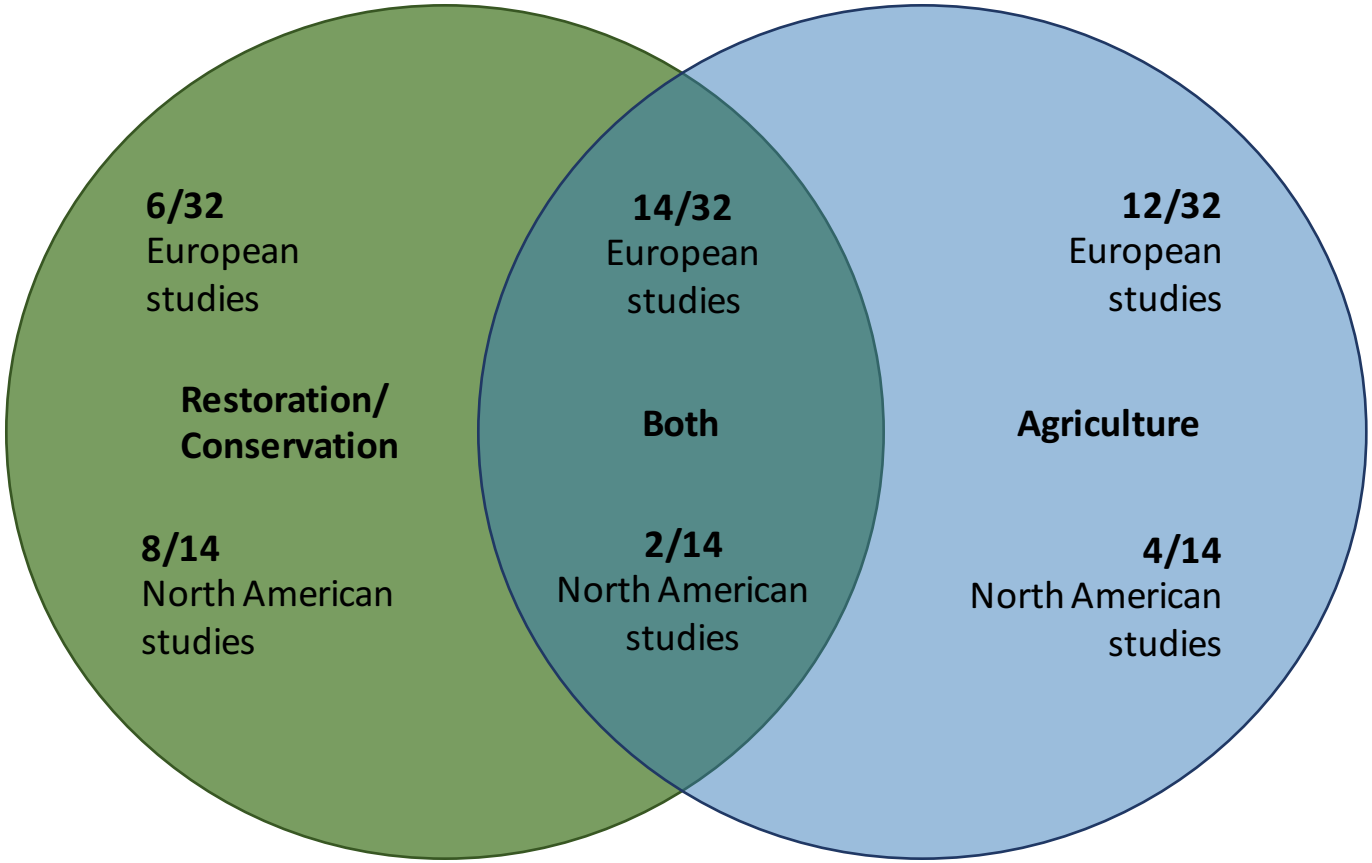
- Intensity and/or vegetation height
- Grazing management system
- Grazing vs other disturbance
- Only two included indirect economic analyses
- Other factors

Majority of Literature from Europe



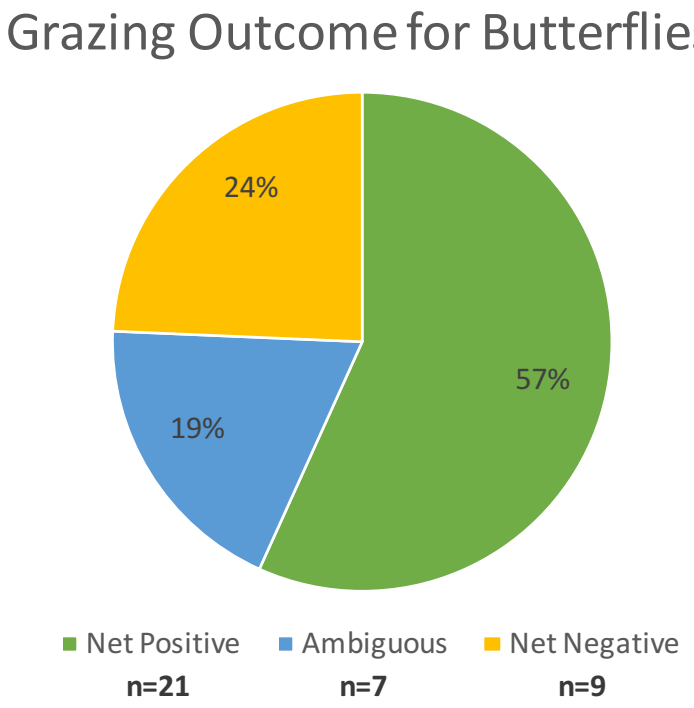


Purpose of grazing: Intersection in Europe



Major conclusions

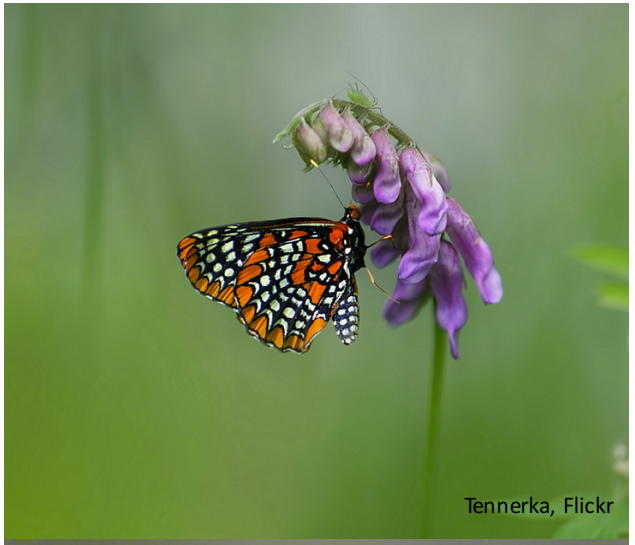
- Cattle grazing a net positive for butterflies in over half of studies
  - Based on results and discussion
  - Butterfly communities: caveats for individual species and biology
- Grazing intensity important
  - n=16
  - Low to intermediate intensity gradient



Species-specific responses matter

- Weiss, 1999
  - Bay checkerspot (*Euphydryas editha bayensis*)
  - Cattle grazing controlled invasive grasses
  - Bay checkerspots found only in grazed areas

- Schtickzelle, et al 2007
  - Bog fritillary (*Proclossiana eunomia*)
  - Cattle grazing restoration destroyed habitat features
  - Recruitment rate and butterfly use decreased by 2/3


Tennerka, Flickr

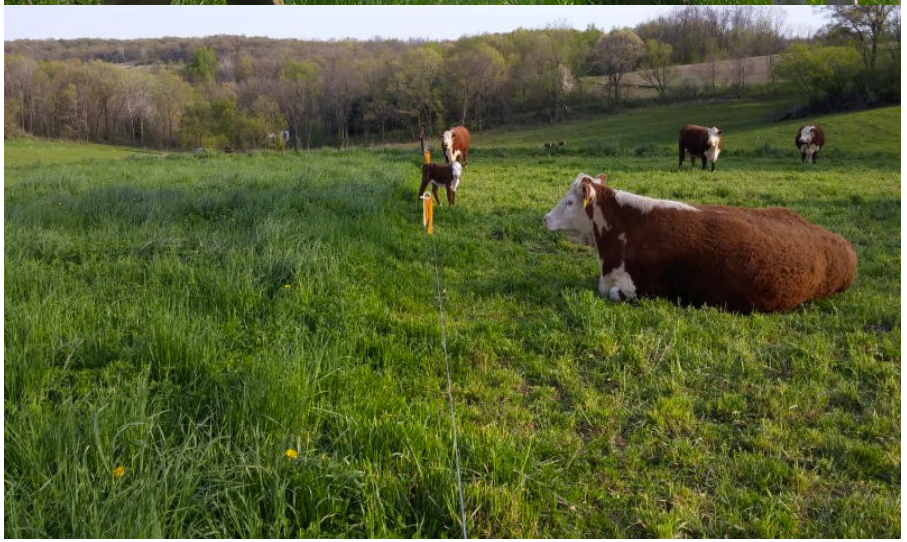

Lepidoptera.se

Key findings

- Vogel et al, 2007
  - Interaction between fire and grazing on butterfly communities
  - Abundance highest in grazed and burned sites

- Enri et al, 2017
  - Grazing management system
  - Conservation grazing: rest period
  - Diversity and abundance increased in rested paddock
  - Cattle weight comparable between systems





Conclusion

- European bias to literature
- Intersection of grazing purposes in Europe
- Over half of studies found net positives for butterflies
- Low or intermediate grazing intensity best

- Research gaps:
  - North American/Cascadia butterflies
  - Rotational grazing with rest period
  - Economic costs/benefits
  - Heterogeneity at landscape scale



Future Work

- Conserving native butterflies in an agroecosystem
  - CNLM
  - Thurston County WSU Extension
  - NRCS
- Butterfly behavior and movement studies
  - Prairies
  - Business-as-usual pastures
  - Conservation grazing pastures
- Landowner survey



Thank you

samantha.bussan@wsu.edu



Citations

Aniello B.D., Stanislao I., Bonelli S., Balletto E. 2011. Haying and grazing effects on the butterfly communities of two Mediterranean-area grasslands. Biodiversity Conservation **20**:1731–1744.

Artoňová A, Kolář V, Marešová J, Šašić M, Šlancarová J, Sucháček P, Konvička M. 2017. Isolated Asian steppe element in the Balkans : habitats of Proterebia afra (Lepidoptera : Nymphalidae : Satyrinae) and associated butterfly communities. Journal of Insect Conservation 21:559–571. Springer International Publishing.

Beck J.J., Hernadez D.L., Pasari J.R., Zavaleta E.S. 2015. Grazing maintains native plant diversity and promotes community stability in an annual grassland. Ecological Applications **25:**1259–1270.

Bock C.E., Bailowitz R.A., Danforth D.W., Jones Z.F., Bock J.H. 2007. Butterflies and exurban development in southeastern Arizona. Landscape and Urban Planning 80:34–44.

Bonari G, Fajmon K, Malenovský I, Zelený D, Holu J, Jongepierová I, Ko P, Jan U, Chytrý M. 2017. Agriculture , Ecosystems and Environment Management of semi-natural grasslands benefiting both plant and insect diversity : The importance of heterogeneity and tradition. Agriculture, Ecosystems and Environment 246:243–252.

Börschig C., Klein A.M., von Wehrden H., Krauss J. 2013. Traits of butterfly communities change from specialist to generalist characteristics with increasing land-use intensity. Basic and Applied Ecology **14:**547–554.

Debinski D.M. et al. 2011. A cross-taxonomic comparison of insect responses to grassland management and land-use legacies. Ecosphere **2:**1–16.

Delaney J.T., Moranz R.A., Debinski D.M., Engle D.M., Miller J.R. 2016. Exotic-Dominated Grasslands Show Signs of Recovery with Cattle Grazing and Fire. PLOS ONE:1–15.

Dumont B., Farruggia A., Garel J.P., Bachelard P., Boitier E., Frain M. 2009. How does grazing intensity influence the diversity of plants and insects in a species-rich upland grassland on basalt soils? Grass and Forage Science **64:**92–105.

Elmer A., Lane J., Summerville K., Lown L. 2012. Does Low-Density Grazing Affect Butterfly (Lepidoptera) Colonization of a Previously Flooded Tallgrass Prairie Reconstruction? The Great Lakes Entomologist **45**:69–78.

Elwell SL, Griswold T, Elle E, Elle E. 2016. Habitat type plays a greater role than livestock grazing in structuring shrubsteppe plant – pollinator communities. Journal of Insect Conservation 20:515–525. Springer International Publishing.

Enri SR, Probo M, Farruggia A, Lanore L, Blanchetete A, Dumont B. 2017. Agriculture , Ecosystems and Environment A biodiversity-friendly rotational grazing system enhancing fl ower-visiting insect assemblages while maintaining animal and grassland productivity. "Agriculture, Ecosystems and Environment" 241:1–10. Elsevier B.V.

Farruggia A., Dumont B., Scohier A., Leroy T., Pradel P., Garel J. 2011. Grass and Forage Science An alternative rotational stocking management designed to favour butterflies in permanent grasslands. Grass and Forage Science 67:136–149.

Fiedler K, Wrbka T, Dullinger S. 2017. Pluralism in grassland management promotes butterfly diversity in a large Central European conservation area. Journal of Insect Conservation 21:277–285. Springer International Publishing.

Fraser M.D., Moorby J.M., Vale J.E., Evans D.M. 2014. Mixed Grazing Systems Benefit both Upland Biodiversity and Livestock Production. PLOS ONE 9.

Gardiner A.J., Reid R.S., Kiema S. 2005. Impact of land-use on butterflies in southwestern Burkina Faso. African Entomology **13**:201–212.

Goodenough A.E., Sharp M.H. 2016. Managing calcareous grassland for the declining Duke of Burgundy Hamearis lucina butterly: efects of grazing management on Primula host plants. Journal of Insect Conservation **20**:1087–1098.

Jerrentrup J.S., Klimek S., Marchiori E., Bittante G., Ramanzin M., Sturaro E., Marini L. 2016. Impact of dairy farming on butterfly diversity in Alpine summer pastures. Agriculture, Ecosystems & Environment **232**:38–45.

Jerrentrup J.S., Wrage-Monnig N., Rover K.U., Isselstein J. 2014. Grazing intensity affects insect diversity via sward structure and heterogeneity in a long-term experiment. Journal of Applied Ecology **51**:968–977.

Johansson V, Knape J, Franzén M. 2017. Population dynamics and future persistence of the clouded Apollo butter fl y in southern Scandinavia : The importance of low intensity grazing and creation of habitat patches. Biological Conservation 206:120–131. Elsevier Ltd.

Kerr J.T., Sugar A., Packer L. 2000. Indicator Taxa, Rapid Biodiversity Assessment, and Nestedness in an Endangered Ecosystem. Conservation Biology **14**:1726–1734.

Konvicka M., Benes J., Cizek O., Kopecek F., Konvicka O., Vitaz L. 2008. How too much care kills species: Grassland reserves, agri-environmental schemes and extinction of Colias myrmidone (Lepidoptera: Pieridae) from its former stronghold. Journal of Insect Conservation **12**:519–525.

Kormann UG. 2014. Scale-dependent management of biodiversity and ecosystem processes in fragmented landscapes. Georg-August-University.

Kruess A., Tscharntke T. 2002. Grazing intensity and the diversity of grasshoppers, butterflies, and trap-nesting bees and wasps. Conservation Biology **16**:1570–1580.

Kruse M, Stein-Bachinger K, Gottwald F, Schmidt E, Heinken T. 2016. Influence of grassland management on the biodiversity of plants and butterflies on organic suckler cow farms. Tuexania **36**:97–119.

Manley W.A., Hart R.H., Samuel M.J., Smith M.A., Waggoner J.W., Manley J.T. 1997. Vegetation, Cattle, and Economic Responses to Grazing Strategies and Pressures. Journal of Range Management **50**:638.

Marschalek DA, Faulkner DK, Deutschman DH. 2017. Population Ecology Livestock Grazing Shapes the Vegetation Structure and Subsequent Habitat Use by the Endangered Skipper Pyrgus ruralis lagunae (Lepidoptera : Hesperiidae). Environmental Entomology 46:3,445–453.

Milberg P, Bergman K, Cronvall E, Eriksson ÅI, Glimskär A, Islamovic A, Jonason D, Löfqvist Z, Westerberg L. 2016. Agriculture , Ecosystems and Environment Flower abundance and vegetation height as predictors for nectar-feeding insect occurrence in Swedish semi-natural grasslands. "Agriculture, Ecosystems and Environment" 230:47–54. Elsevier B.V.

Moranz R.A., Debinski D.M., McGranahan D.A., Engle D.M., Miller J.R. 2012. Untangling the effects of fire, grazing, and land-use legacies on grassland butterfly communities. Biodiversity and Conservation **21**:2719–2746.

Moranz R.A., Fuhlendorf S.D., Engle D.M. 2014. Making sense of a prairie butterfly paradox: The effects of grazing, time since fire, and sampling period on regal fritillary abundance. Biological Conservation **173**:32–41.

Munguira ML, Azcón JMB, Cobo SC, Barros EG. 2017. Ecology and recovery plans for the four Spanish endangered endemic butterfly species. Journal of Insect Conservation 21:423–437. Springer International Publishing.

The Nature Conservancy, 2018

Nilsson S.G., Franzén M., Jönsson E. 2008. Long-term land-use changes and extinction of specialized butterflies. Insect Conservation and Diversity 1:197–207.

Öckinger E., Eriksson A.K., Smith H.G. 2006. Effects of grassland abandonment, restoration and management on butterflies and vascular plants. Biological Conservation 133:291–300.

Ouin A., Aviron S., Dover J., Burel F. 2004. Complementation/supplementation of resources for butterflies in agricultural landscapes. Agriculture, Ecosystems & Environment 103:473–479.

Potts S.G., Woodcock B.A., Roberts S.M., Tscheulin T., Pilgrim E.S., Brown V.K., Tallowin J.R. 2009. Enhancing pollinator biodiversity in intensive grasslands. Journal of Applied Ecology **46**:369–379.

Pöyry J., Lindgren S., Salminen J., Kuussaari M. 2005. Responses of butterfly and moth species to restored cattle grazing in semi-natural grasslands Juha Po. Ecological Applications 122:465–478.

Pöyry J., Luoto M., Paukkunen J., Pykälä J., Raatikainen K., Kuussaari M.. 2006. Different responses of plants and herbivore insects to a gradient of vegetation height: An indicator of the vertebrate grazing intensity and successional age. Oikos 115:401–412.

Pöyry, J., Lindgren, S., Salminen, J., Kuussaari, M. 2004. Restoration of Butterfly and Moth Communities in Semi-Natural Grasslands by Cattle Grazing. Ecological Applications **14**(6):1656–1670

Pryke J.S., Roets F, Samways M.J. 2016. Wild Herbivore Grazing Enhances Insect Diversity over Livestock Grazing in an African Grassland System. PLOS ONE 11:1–15.

Schtickzelle N., Turlure C., Baguette M. 2007. Grazing management impacts on the viability of the threatened bog fritillary butterfly *Proclossiana eunomia*. Biological Conservation 136:651–660.

Sjödin N.E, Bengtsson J, Ekbom B. 2008. The influence of grazing intensity and landscape composition on the diversity and abundance of flower-visiting insects. Journal of Applied Ecology 45:763–772.

Smee M, Smyth W, Tunmore M, French-Constant R, Hodgson D. 2011. Butterflies on the brink: habitat requirements for declining populations of the marsh fritillary (Euphydryas aurinia) in SW England. Journal of Insect Conservation 15:153–163.

Smith L.M, Cherry R. 2014. Effects of Management Techniques on Grassland Butterfly Species Composition and Community Structure. American Midland Naturalist 172:227–235.

Swengel A.B, Swengel S.R. 2001. Effects of prairie and barrens management on butterfly faunal composition. Biodiversity and Conservation 10:1757–1785.

Swengel, A.B., Swengel, S.R. 2001. A Ten-Year Study to Monitor Populations of the Regal Fritillary, *Speyeria idalia* (Lepidoptera: Nymphalidae) in Wisconsin, U.S.A. The Great Lakes Entomologist 34:97–115.

van Klink R, van der Plas F, van Noordwijk CGET, Wallisdevries MF, Olff H. 2015. Effects of large herbivores on grassland arthropod diversity. Biological Reviews **90**:347–366.

Vogel J.A, Debinski D.M, Koford R.R, Miller J.R. 2007. Butterfly responses to prairie restoration through fire and grazing. Biological Conservation 140:78–90.

Wallis De Vries M, Parkinson A, Dulphy J, Sayer M, Diana E. 2007. Effects of livestock breed and grazing intensity on grazing systems: 4. Effects on animal diversity. Grass and Forage Science 62:185–197.

Wallis De Vries M.F, Parkinson A, Dulphy J, Sayer M, Diana E. 2007. Effects of livestock breed and grazing intensity on grazing systems: 4. Effects on animal diversity. Grass and Forage Science 62:185–197. Available from http://www.blackwell-synergy.com/doi/abs/10.1111/j.1365-2494.2007.00579.x.

WallisDeVries, M.F., Noordijk, J., Coliin, E.O., Smit, J.T., Veling, K. 2016. Contrasting responses of insect communities to grazing intensity in lowland heathlands. Agriculture, Ecosystems & Environment 234: 72-80.

Wang Y, Chen J, Liu W, Xu R. 2007. Effect of cultivating croplands and grazing in arid grassland habitats on teh conservation of melitaeine buterflies in a mountainous area in Nrothern China. Science in China Series C: Life Sciences **50**:40–46.

Weiss S.B. 1999. Cars, cows, and checkerspot butterflies: Nitrogen deposition and management of nutrient-poor grasslands for a threatened species. Conservation Biology 13:1476–1486.

Wilkerson M.L, Roche L.M, Young T.P. 2013. Indirect effects of domestic and wild herbivores on butterflies in an African savanna. Ecology and Evolution 3:3672–3682.