Crown of the Continent Ecosystem (CCE)

State of Research: 2000-2015

V. J. Cox, G. R. Fox, A. B. Jacobsen, R. J. Kelly, A. E. Liboiron, J. R. Henderson, and D.P. Hill

Department of Biology, Mount Royal University
Calgary, AB Canada

Table of Contents:

Executive Summary:

The Crown of the Continent Ecosystem (CCE) is recognized for its biological diversity. It encompasses 72 000 km^2 (28 000 mi^2) of the Rocky Mountains from southern Alberta and British Columbia to northern Montana (Crown Managers Partnership Strategic Conservation Framework 2016-2020). To put the biodiversity of the Crown of the Continent into context, the recently protected Castle Wilderness Area in Alberta's portion of the CCE has approximately four times as many provincially rare plants as Banff National Park in an area 1/9th the size (CPAWS, 2009). Spanning international and jurisdictional borders, the CCE faces numerous hurdles to conservation such as scale and fragmentation in policy and practice. Cooperation in the CCE is integral to sustainably managing shared wildlife populations.

The Crown Managers Partnership (CMP) is a partnership amongst the multiple jurisdictions within the CCE and includes federal, state, provincial, First Nation and tribal government agencies and managers. It seeks to enhance policy cohesion with the intended goal of maintaining the integrity of the ecosystem across the entire landscape through collaborative initiatives such as the Crown Aquatic Invasive Species Protocol and the Transboundary Conservation Initiative (Crown Managers Partnership Strategic Conservation Framework 2016-2020).

As identified at the 6th Annual Roundtable on the Crown of the Continent, focusing future research priorities to fill knowledge gaps is challenging because of the numerous and disparate studies being conducted by multiple stakeholders within the CCE. To assist the CMP in identifying research gaps, we compiled and annotated over 200 ecological studies conducted within the CCE between the years 2000 and 2015. These studies were identified using the databases of the Mount Royal University library and Parks Canada, as well as non-digitized reports from Waterton Lakes National Park library. We then classified the research by location, research type, and focal species to identify research gaps and trends in the region.

The goal of this project is to identify the gaps and trends in research being conducted in the Crown of the Continent in order to help direct monitoring and management resources towards those species and areas that are underrepresented. We recognize that this compilation of studies is a sample, rather than a complete list, of the research being conducted. Nonetheless, we believe the sample is representative of the ecological research that was conducted from 2000-2015 and will also serve as an annotated bibliography of the research conducted in the CCE since the year 2000.

Location Analysis:

Each source was analyzed for its location of study. Keyword analysis was conducted to determine where research is being focused geographically within the Crown of the Continent. Location names were assigned based upon the study location stated in the reviewed literature. Large regional locations such as "British Columbia" or "Crown of the Continent" were assigned to sources based upon their general study location when no specific sub-region was given.

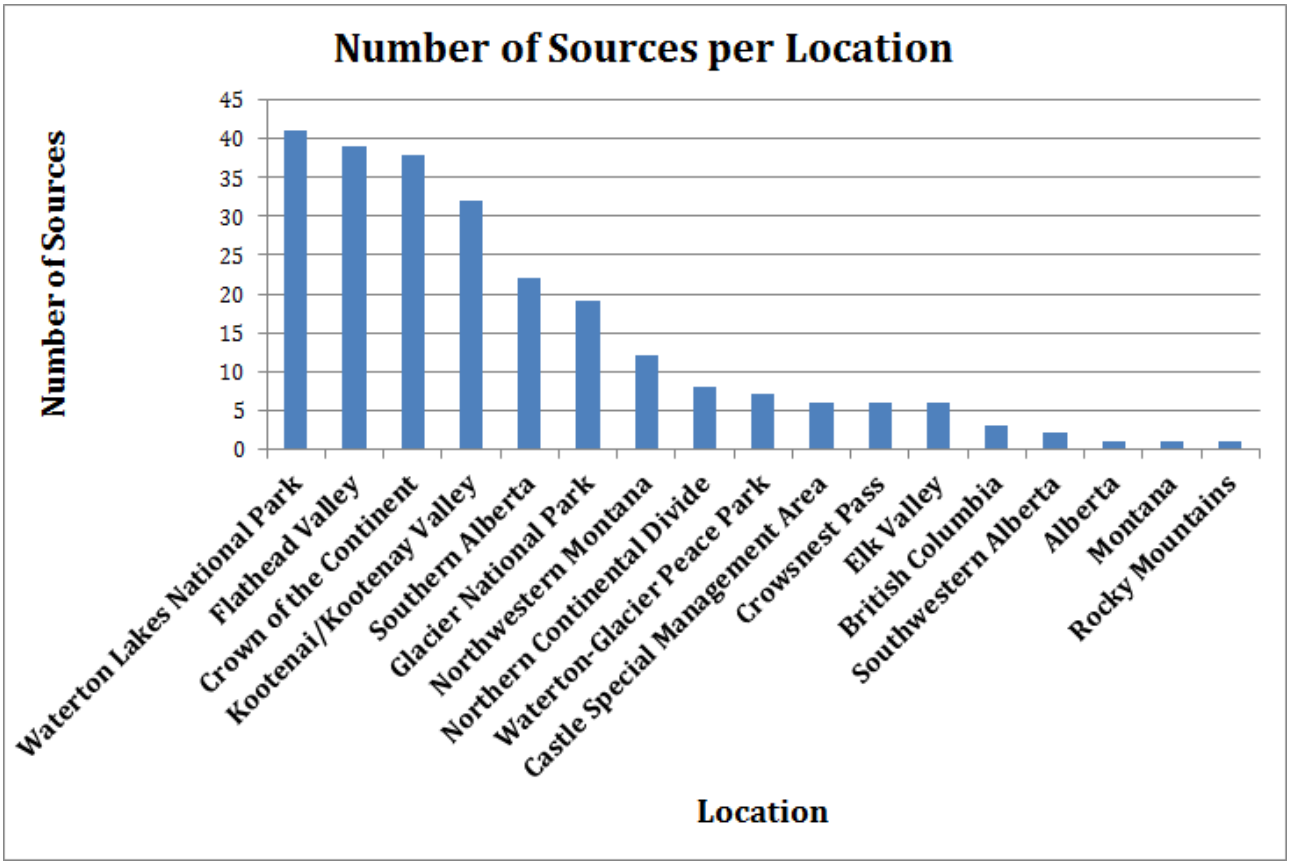

Figure 1: The location associated with the largest number of collected sources was Waterton Lakes National Park (41 sources). The Flathead Valley (Montana portion) was a close second at 39 sources. Glacier National Park was represented by approximately half the number of Waterton at 19 sources. The transboundary Waterton-Glacier International Peace Park was studied as a whole by only 7 sources.

- Location analysis indicated a paucity of studies from the British Columbia portion of the CCE, particularly from areas currently undergoing resource development (Figure 1). Reports and studies sourced from the Elk Valley focused on resource development almost exclusively. The Crowsnest portion of Alberta was similarly represented largely by plans for resource extraction.

- Although numerous sources were compiled from the transboundary Kootenay and Flathead regions of the Crown of the Continent, the majority of research in these areas was conducted south of the Canadian Border.

- Both the Bob Marshall Wilderness and the Yahk/Yaak Valley are completely unrepresented despite their important contributions to biodiversity within the Crown of the Continent (Figure 1).

- It should be recognized that our sample has bias towards the Waterton Lakes National Park location as many sources were collected from the Waterton Lakes Parks Canada Library.

Research Type:

The sources were categorized by research type: monitoring, management, private sector project (e.g. environmental impact assessments for commercial development), and meta-analyses and models (Figure 2).

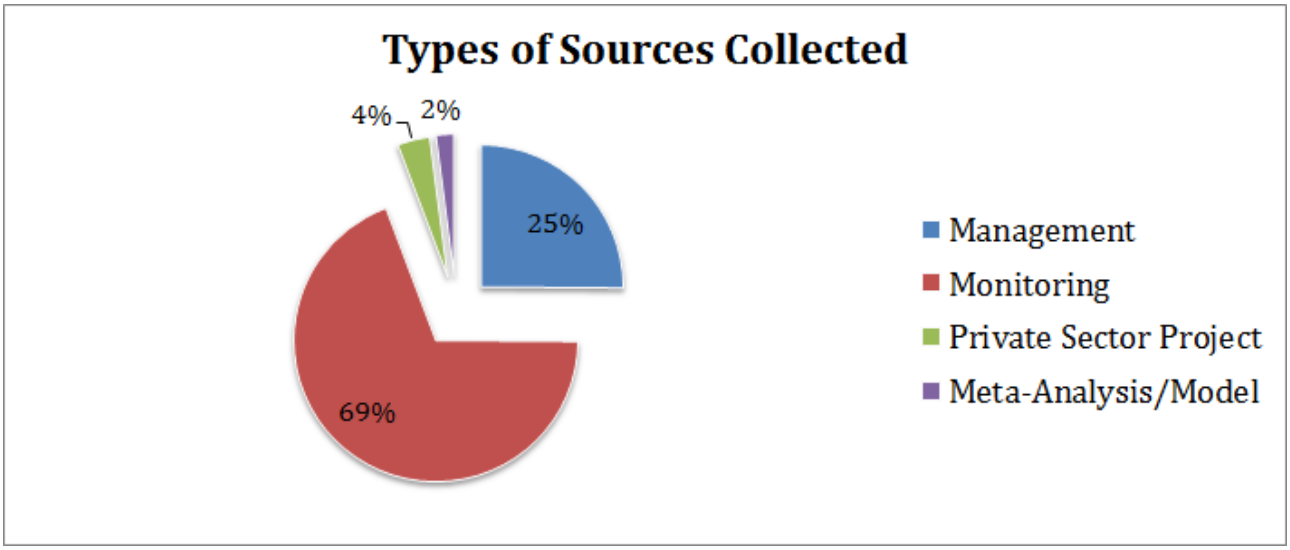

Figure 2.0: The majority (69%) of sources collected in our survey were monitoring studies, while a smaller proportion (25%) of the sources dealt with the management of elements of the CCE. 6% of the collected sources were devoted to private sector projects (impact assessments and project proposals) and the final 2% was comprised of modelling and meta-analysis scholarly articles.

- Many species were only monitored over a short time which reduces the value of this information. To assess cumulative effects, long-term systematic monitoring of indicator species using standardized methods across the CCE is required.

- The management studies tended to focus on future planning as opposed to assessment of current management practices.

- Direct connections between monitoring and management were not always apparent.

Focal Species:

The sources were categorized according to the species studied (Figure 3). Composite categories were used for studies that examined groups of species such as spiders, waterfowl, vascular plants, (mammalian) carnivores, microfauna, and gastropods. “Carnivores” refers to papers that studied multiple carnivore species. “Microfauna”,”Gastropods”, and “Vascular Plants” were grouped into a larger category in order to capture a diversity of species with a minimal number of sources for each.

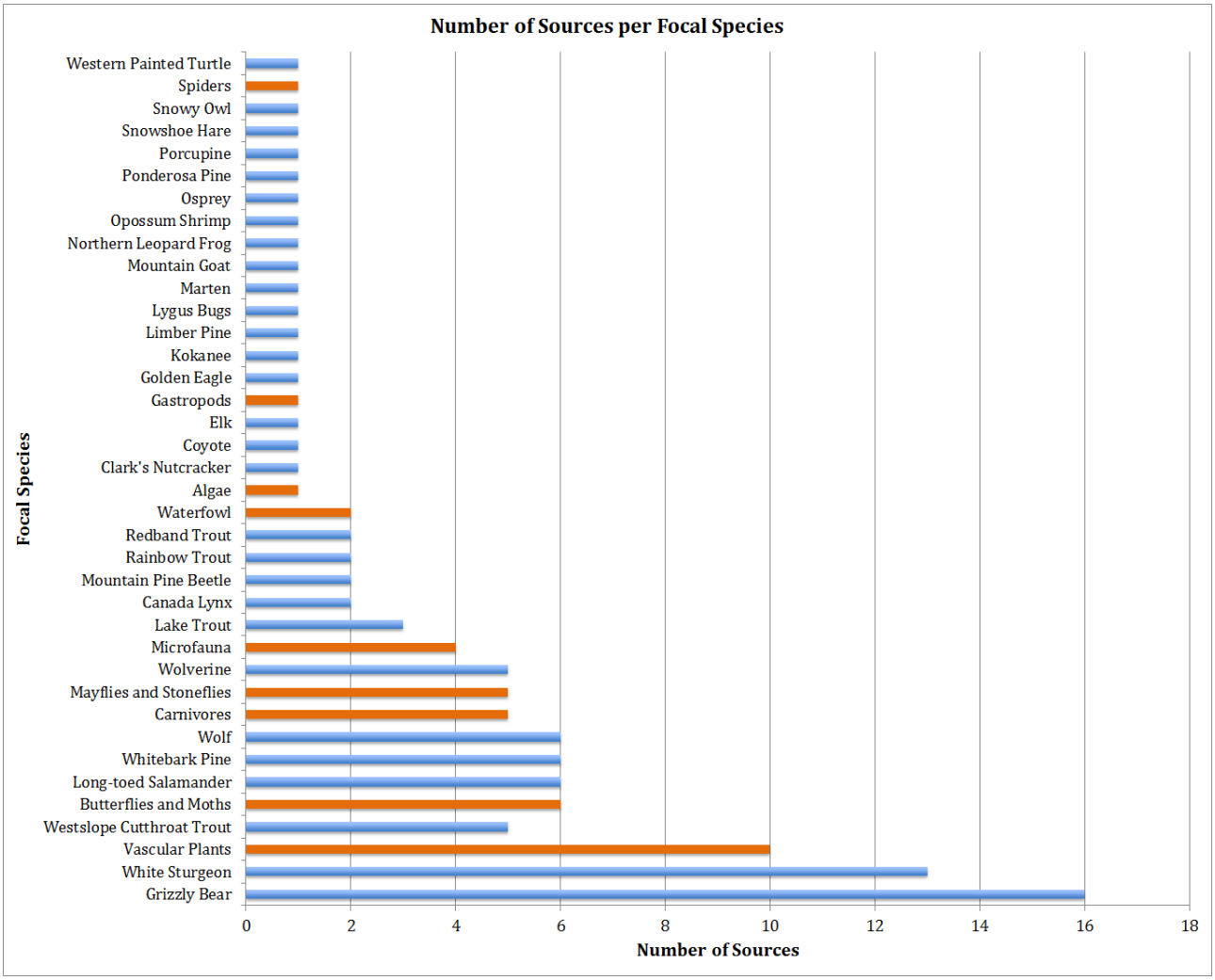

Figure 3: Focal species of reviewed sources and the overall number of sources that involved those species. Grizzly bear was the most frequently studied species (16 sources) followed by white sturgeon

(13 sources). Many of the less charismatic or unlisted species such as the Clark's nutcracker and marten were the subject of only one source each. Note that groups containing more than one species are shown in orange.

- The vast majority of studies in our survey focused on vertebrate animals, especially game fish, grizzly bears, and vertebrate species at risk. In comparison, invertebrate animals were underrepresented. While some of the charismatic megafauna, such as grizzlies, may serve as flagship species or umbrella species for the ecosystem, this cannot explain the bias towards other vertebrate animals. Further, with the exception of the studies on how vertebrate animals are impacted by fragmentation and connectivity, many other studies did not seem widely applicable to developing management policies.

- Terrestrial species were better represented than aquatic species. A large portion of the aquatic studies were on fish, including several studies on Westslope Cutthroat Trout hybridization rates in specific portions of the Crown. Compilation of this hybridization information into range maps using GIS applications will be of more value to managers by providing an overview of the variation in hybridization rates across the landscape and highlighting priority areas for conservation. Given the threat of aquatic invasive species to the CCE, more research needs to be conducted on aquatic invertebrates.

- Plants were underrepresented in the studies, regardless of their conservation status. This is somewhat surprising given that the CCE is known for its diversity of rare plants. Whitebark pine is one of the few plant species studied in any detail.

Conclusion:

Our survey of more than 200 studies conducted in the CCE from 2000-2015 revealed several areas that are data deficient. Based on these data gaps, priority locations and directions for future research and policy should include:

- Bob Marshall Wilderness, Montana
- Yaak/Yahk Valley, Montana and British Columbia
- The British Columbian portion of the CCE
- Aquatic ecosystems including the invertebrate community and non-trout aquatic invasive species
- Plant diversity including non-vascular plants and rare vascular plants
- Assessment of the effectiveness of current management practices
- Compilation of monitoring data into landscape range maps using GIS applications
- Creation and implementation of new management plans based on current monitoring data

- Implementation of systematic, long-term indicator species monitoring programs to assess cumulative management effects across the CCE

Our survey and analysis of ecological studies is a sample of the research that was conducted in the CCE over a 15-year period. This document may be used, in part, as a reference to inform future conservation directives and observe the progression of research within the Crown of the Continent ecosystem.

Acknowledgements:

The authors would like to thank Dr. Dorothy Hill for her unlimited patience and extensive assistance in supervising this project, as well as Dr. Kathy Rettie for her support and guidance. We also thank Parks Canada - Waterton Lakes National Park for allowing us to access their library resources. Special thanks to Dennis Madsen, Jon Stuart-Smith, and Edwin Knox (Parks Canada - Waterton Lakes National Park) for facilitating our access to the Waterton library. Dr. Len Broberg (Crown Managers Partnership) and Dr. Michael Quinn (Mount Royal University) facilitated our participation at the 6th Annual Roundtable on the Crown of the Continent which lead to this project.

Executive Summary References:

Crown Managers Partnership Strategic Conservation Framework 2016-2020. Retrieved from www.http://crownmanagers.org/strategic-plan/

CPAWS (2009). *Castle special place conceptual proposal for legislated protected areas.* Retrieved from http://cpaws-southernalberta.org/upload/castle_special_place_conceptual_proposal.pdf

Reference & Keyword List:

A.

Achuff, P., McNeil, R. L., Coleman, M. L., Wallis, C., & Wershler, C. (2002). *Ecological land classification of Waterton Lakes National Park, Alberta. Vol I: Integrated resource description.* Waterton Park, AB: Parks Canada.

Keywords: Waterton, Management

Alberta Government. (October, 2013). *Draft south Saskatchewan regional plan 2014-2024.* (Regional Plan). Alberta Government.

Keywords: South Saskatchewan Watershed, Alberta, Management

Alberta Wilderness Association, CPAWS, Sierra Club of Canada, & Yellowstone to Yukon. (2011). *Moratorium on motorized access necessary for grizzly survival.* Unpublished manuscript.

Keywords: Castle Wilderness, Grizzly Bear, Management

Al-Chokhachy, R., Muhlfeld, C. C., Boyer, M. C., Jones, L. A., Steed, A., & Kershner, J. L. (2014). *Quantifying the effectiveness of conservation measures to control the spread of anthropogenic hybridization in stream salmonids: A climate adaptation case study* doi:10.1080/02755947.2014.901259

Keywords: Climate Change, Westslope Cutthroat Trout, Rainbow Trout, Hybridization

Apps, C. D. (2007). *Ecology and Conservation of Canada Lynx in the Southern Canadian Rocky Mountains* (Dissertation, University of Calgary, Calgary, Alberta, Canada).

Keywords: British Columbia, Alberta, Canada Lynx, Monitoring

Apps, C. D., Weaver, J. L., Paquet, P. C., Bateman, B., & McLellan, B. N. (2007). *Carnivores in the Southern Canadian Rockies: Core Areas and Connectivity across the Crowsnest Highway.* (Conservation Report No. 3). Toronto, Ontario, Canada: Wildlife Conservation Society Canada.

Keywords: Crowsnest, Carnivore, Connectivity

Arjo, W. M., Pletscher, D. H., & Ream, R. R. (2002). Dietary overlap between wolves and coyotes in northwestern Montana. Journal of Mammalogy, 83(3), 754-766. doi:10.1644/1545-1542(2002)083<0754:DOBWAC>2.0.CO;2

Keywords: Flathead Valley, Wolves, Coyotes, Monitoring

Ausband, D. E., Bassing, S. B., & Mitchell, M. (2014). *Progress Report for Testing Monitoring Techniques for Wolves in Southwest Alberta.* (Progress Report). Missoula, MT, USA: Montana Cooperative Wildlife Research Unit, University Of Montana.

Keywords: Southern Alberta, Wolves, Monitoring

B.

Barclay, R. M. R., Baerwald, E. F., Gruver, J. C. (2007). Variation in bat and bird mortalities at wind energy facilities: Assessing the effects of rotor size and tower height. *Canadian Journal of Zoology, 85*, 381-387. doi:10.1139/Z07-011

Keywords: Southern Alberta, Waterfowl, Bats, Monitoring

Bean, J. R., Woessner, W. W., Muhlfeld, C. C., & Wilcox, A. C. (2015). Multiscale hydrogeomorphic influences on bull trout (*Salvelinus confluentus*) spawning habitat. Canadian Journal of Fisheries and Aquatic Sciences, 72(4), 514-526. doi:10.1139/cjfas-2013-0534

Keywords: Flathead, Montana, Bull Trout, Monitoring

Belt, J. J., & Krausman, P. R. (2012). Evaluating population estimates of mountain goats based on citizen science. *Wildlife Society Bulletin, 36*(2), 264-276. doi:10.1002/wsb.139

Keywords: Glacier National Park, Mountain Goat, Monitoring

Benjankar, R., Jorde, K., Yager, E. M., Egger, G., Goodwin, P., & Glenn, N. F. (2012). The impact of river modification and dam operation on floodplain vegetation succession trends in the Kootenai River, USA. *Ecological Engineering, 46*, 88. doi:10.1016/j.ecoleng.2012.05.002

Keywords: Resource Extraction, Connectivity, Kootenai, Monitoring

Bingay main coal project. (2012). (Project Proposal). British Columbia: Centermount Coal Ltd.

Keywords: Elk Valley

Bixler, R. P. (2014). *Is there an heir apparent to the crown? A more informed understanding of connectivity and networked environmental governance in the Crown of the Continent* (Doctor of Philosophy).

Keywords: Management

Blouin, F. (2006). *The southern headwaters at risk project: A multi-species conservation strategy for the headwaters of the Oldman River vol 5: Landscape pressures on wide-ranging species.* (Alberta Species at Risk Report No. 107). Edmonton, AB: Alberta Sustainable Resource Development, Fish and Wildlife Division.

Keywords: Resource Extraction, Elk Valley, Management

Bosak, K., Boley, B., & Kyla, Z. (2010). Deconstructing the 'Crown of the Continent': Power, politics, and the process of creating National Geographic's geotourism mapguides. *Tourism Geographies, 12*(3), 460-480. doi:10.1080/14616688.2010.494686

Keywords: Connectivity, Crown of the Continent, Management

Boulanger, J., & Stenhouse, G. B. (2014). The impact of roads on the demography of grizzly bears in Alberta: E115535. *PLoS One, 9*(12)doi:10.1371/journal.pone.0115535

Keywords: Connectivity, Endangered Species, Southern Alberta, Grizzly Bear, Management

Boyer, M. C., Muhlfeld, C. C., & Allendorf, F. W. (2008). Rainbow trout (*Oncorhynchus mykiss*) invasion and the spread of hybridization with native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*). Canadian Journal of Fisheries and Aquatic Sciences, 65(4), 658-658. doi:10.1139/f08-001

Keywords: Hybridization, Invasive Species, Southern Alberta, Bull Trout, Monitoring

British Columbia Southern Interior Invertebrates Recovery Team British Columbia. (2011). *Recovery Strategy for Half-moon Hairstreak (Satyrium semiluna) in British Columbia and Alberta.* (Recovery Strategy). Victoria, British Columbia, Canada: British Columbia Ministry of Environment.

Keywords: Species at risk, British Columbia, Half-moon Hairstreak, Management

Burke, S. (2012). *Restoring high elevation whitebark pine systems in the Crown of the Continent: A resilience approach.* (Unpublished)

Keywords: Restoration, Species at risk, Crown of the Continent, Whitebark Pine, Management

Burles, K., & Boon, S. (2011). Snowmelt energy balance in a burned forest plot, Crowsnest Pass, Alberta, Canada. *Hydrological Processes, 25*(19), 3012-3029. doi:10.1002/hyp.8067

Keywords: Climate Change, Crowsnest Pass, Management

Burton, D. P. (2003). *Reintroduction of Plains Bison to Waterton Lakes National Park: Considerations for a Feasibility Analysis.* (Feasibility Analysis). Waterton Lakes National Park, Alberta, Canada: Waterton Lakes National Park.

Keywords: Reintroduction, Waterton, Bison, Management

C.

Canadian Environmental Assessment Agency. (2013). *Environmental impact statement guidelines - Bingay main coal mine project.* Canadian Environmental Assessment Agency.

Keywords: Resource extraction, Flathead, Management

Carroll, C., Noss, R. F., & Paquet, P. C. (2002). *Rocky Mountain Carnivore Project Final Report.* (Final Report). World Wildlife Fund.

Keywords: Connectivity, Rocky Mountains, Carnivores, Management

Castle Mountain Resort Board of Directors. (2003). *Castle mountain resort area structure plan.* (Structure Plan). Castle Mountain Resort, Alberta, Canada.

Keywords: Development, Castle, Private Sector Project

Castle rare and invasive plant survey. (2005). (Survey). Alberta Wilderness Association.

Keywords: Invasive Species, Endangered Species, Castle, Whitebark Pine, Downy Brome, Monitoring

Cegelski, C. C., Waits, L. P., & Anderson, N. J. (2003). Assessing population structure and gene flow in Montana wolverines (*Gulo gulo*) using assignment-based approaches. *Molecular Ecology*, 12(11), 2907-2918. doi:10.1046/j.1365-294X.2003.01969.x

Keywords: Species at Risk, Northwestern Montana, Monitoring

Cerney, D., Butler, D., & Eyton, J. (2008). Assessing landscape change in Waterton Lakes National Park, Canada, using multitemporal composites constructed from terrestrial repeat photographs. *Geocarto International*, 23(5), 347-371. doi:10.1080/10106040801966654

Keywords: Interspecial Interaction, Waterton, Vascular Plants, Monitoring

Clark, A. M., Harper, J. T., & Fagre, D. B. (2015). Glacier-derived August runoff in northwest Montana. *Arctic, Antarctic, and Alpine Research, 47*(1), 1-15. doi:10.1657/AAAR0014-033

Keywords: Climate Change, Glacier, Meta-Analysis/Model

Clark, J. (2002). *Southern Bighorn Sheep Survey 2002 (WMUs 306, 308, 400, 402).* (Wildlife Survey). Blairmore, Alberta, Canada: Sustainable Resource Development, Fish and Wildlife.

Keywords: Crowsnest Pass, Bighorn Sheep, Monitoring

Clevenger, A., Apps, C., Lee, T., Quinn, M., Paton, D., Poulton, D., & Ament, R. (2010). *Highway 3: Transportation mitigation for wildlife and connectivity.* (Final Report). Bozeman, Montana.

Keywords: Connectivity, Crown of the Continent, Monitoring, Management

Clevenger, A. P., Fisher, J., & Schwartz, M. (2014). *Identifying conservation corridors and linkages in the southern Canadian Rocky Mountains.* (Wolverine Hair Snare Survey). Alberta, Canada.

Keywords: Connectivity, Species at Risk, Crown of the Continent, Wolverine, Monitoring

Clevenger, A. P., Mowat, G., & Fisher, J. (2015). *Mapping the wolverine way: Identifying conservation corridors and transboundary linkages in the Canadian Crown of the Continent.* (Summary Report). Alberta-British Columbia Survey.

Keywords: Connectivity, Northern Continental Divide, Meta-Analysis/Model

Coal mountain phase 2. (2014). (Project Proposal). British Columbia: Teck Coal Limited.

Keywords: Resource Extraction, Elk Valley, Private Sector Project

Conrad, J. M., Gomes, C. P., van Hoeve, W., Sabharwal, A., & Suter, J. F. (2012). Wildlife corridors as a connected subgraph problem. *Journal of Environmental Economics and Management*, 63(1), 1-18. doi:10.1016/j.jeem.2011.08.001

Keywords: Connectivity, Northern Continental Divide, Meta-Analysis/Model

Copeland, J. P., & Yates, R. E. (2008). *Wolverine population assessment in Glacier National Parks.* (Comprehensive Summary). Missoula, Montana, USA: USDA Forest Service.

Keywords: Species at risk, Glacier, Wolverine, Monitoring

Craft, J. A., Stanford, J. A., & Pusch, M. (2002). Microbial respiration within a floodplain aquifer of a large gravel-bed river. Freshwater Biology, 47(2), 251-261. doi:10.1046/j.1365-2427.2002.00803.x

Keywords: Interspecial interaction, Flathead, Microfauna, Monitoring

Crown mountain coking coal project. (2014). (Project Proposal). British Columbia: NWP Coal Canada Ltd.

Keywords: Resource Extraction, Elk Valley, Private Sector Project

D.

De la Giroday, H. C., Carroll, A. L., & Aukema, B. H. (2012). Breach of the northern Rocky Mountain geoclimatic barrier: Initiation of range expansion by the mountain pine beetle. Journal of Biogeography, 39(6), 1112-1123. doi:10.1111/j.1365-2699.2011.02673.x

Keywords: Invasive Species, Northern Continental Divide, Mountain Pine Beetle, Jack Pine, Monitoring

Dingwall, P. R., & Canadian Public Policy eBooks. (2009). *Waterton-Glacier International Peace Park (Canada and USA): Report of the reactive monitoring mission, 20 to 27 September 2009 [IUCN/WCPA & UNESCO]* Yellowstone to Yukon Conservation Initiative.

Keywords: Restoration, Peace Park, Monitoring

Doubt, J. C. (2001). *Distribution patterns of moss conservation value with implications for conservation management: A case study of Waterton Lakes National Park* (M.Sc.). Available from ProQuest Dissertations & Theses Global. (304739069). Retrieved from http://library.mtroyal.ca:2092/docview/304739069?accountid=1343

Keywords: Waterton, Management

Duke, S., Anders, P., Ennis, G., Hallock, R., Hammond, J., Ireland, S., … Westerhof, R. (1999). Recovery plan for Kootenai River white sturgeon (*Acipenser transmontanus*). *Journal of Applied Ichthyology, 15*(4-5), 157-163. doi:10.1111/j.1439-0426.1999.tb00226.x

Keywords: Endangered Species, Kootenay, White Sturgeon, Management

Duke, S. D., & Hallock, R. (2001). Recovery progress report for the endangered Kootenai River white sturgeon, *Acipenser transmontanus*. *Endangered Species Update, 18*(3), 75.

Keywords: Endangered Species, Kootenay, White Sturgeon, Management

Duke, D., Quinn, M., Butts, B., Lee-Ndugga, T., & Wilkie, K. (September, 2003). *Spatial analysis of rural residential expansion in southwestern Alberta.* Calgary, AB: Miistakis Institute for the Rockies.

Keywords: Development, Southern Alberta, Management

Dykstra, P. R., & Braumandl, T. F. (2006). *Historic Influence of Mountain Pine Beetle in Stand Dynamics in Canada's Rocky Mountain Parks.* (Mountain Pine Beetle Initiative Working Paper 2006-2015). Victoria, British Columbia, Canada: Natural Resources Canada, Canadian Forest Service.

Keywords: Interspecial Interaction, Invasive Species, Waterton, Mountain Pine Beetle, Monitoring

E.

Egger, G., Politti, E., Lautsch, E., Benjankar, R., Gill, K., & Rood, S. (2015). Floodplain forest succession reveals fluvial processes: A hydrogeomorphic model for temperate riparian woodlands. *Journal of Environmental Management*, 161, 72-82. doi:10.1016/j.jenvman.2015.06.018

Keywords: Crown of the Continent, Meta-Analysis/Model

Eisenberg, C. (2012). *Complexity of food web interactions in a large mammal system* (Doctor of Philosophy in Forest Resources).

Keywords: Interspecial Interaction, Crown of the Continent, Wolf, Elk, Monitoring

Eisenberg, C., Hibbs, D. E., & Ripple, W. J. (2015). Effects of predation risk on elk (*Cervus elaphus*) landscape use in a wolf (*Canis lupus*) dominated system. *Canadian Journal of Zoology, 93*, 99-111. doi:dx.doi.org/10.1139/cjz-2014-0138

Keywords: Interspecial Interaction, Crown of the Continent, Wolf, Elk, Monitoring

Elliott, J. (2002). *Wolverine Conservation in Waterton Lakes National Park, Alberta.* (Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada.

Keywords: Species at risk, Waterton, Wolverine, Monitoring

Ellis, B. K., Stanford, J. A., Goodman, D., Stafford, C. P., Gustafson, D.L., Beauchamp, D. A., … Carpenter, S. R. (2011). Long-term effects of a trophic cascade in a large lake ecosystem. Proceedings of the National Academy of Sciences of the United States of America, 108(3), 107-1075. doi:10.1073/pnas.1013006108

Keywords: Invasive Species, Kootenay, Opossum Shrimp, Monitoring

F.

Flood, J. P., & McAvoy, L. H. (2007). Use of national forests by Salish-Kootenai tribal members: Traditional recreation and a legacy of cultural values. *Leisure/loisir, 31*(1), 191-216. doi:10.1080/14927713.2007.9651378

Keywords: Citizen Science, Kootenay, Monitoring

Fockler, M. N. (2014). *The national forest imperative: A historical geography of national forest landscapes, northern Rockies, Montana* (Ph.D.). Available from ProQuest Dissertations & Theses Global. (1564037247).

Keywords: Northwestern Montana

Fondell, T. F., & Ball, I. J. (2004). Density and success of bird nests relative to grazing on western Montana grasslands. Biological Conservation, 117(2), 203-213. doi:10.1016/S0006-3207(03)00293-3

Keywords: Northwestern Montana, Monitoring

Foottit, R. G. (2001). *Research summary: Collections in Waterton Lakes, Banff and Jasper National Parks under permit # 2001-35: 1) lygus bugs; 2) aphids.* (Summary Report).

Keywords: Invasive Species, Waterton, Lygus bugs, Monitoring

Forde, T., Kutz, S., De Buck, J., Warren, A., Ruckstuhl, K., Pybus, M., & Orsel, K. (2012). Occurrence, diagnosis, and strain typing of *Mycobacterium avium* subspecies *paratuberculosis* infection in Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) in southwestern Alberta. *Journal of Wildlife Diseases, 48*(1), 1-11.

Keywords: Invasive Species, Southwestern Alberta, Bighorn Sheep, Microfauna, Monitoring

G.

Gailus, J. (2010). *A grizzly challenge, ensuring a future for Alberta's threatened grizzlies.* (Report).Canadian Parks and Wilderness Society.

Keywords: Species at Risk, Southwestern Alberta, Grizzly Bears, Monitoring

Gailus, J. (2014). *Failing B.C.'s grizzlies: Report card and recommendations for ensuring a future for British Columbia's grizzly bears.* Vancouver, BC, CAN: David Suzuki Foundation.

Keywords: Species at Risk, British Columbia, Grizzly Bear, Monitoring

Going-to-the-Sun Road rehabilitation plan/ final environmental impact statement. (April 2003). (Impact Statement). Glacier National Park: US Department of the Interior National Park Service.

Keywords: Development, Waterton, Management

Graham, A. L. (2003). Effects of snail size and age on the prevalence and intensity of avian schistosome infection: Relating laboratory to field studies. Journal of Parasitology, 89(3), 458-463. doi:10.1645/0022-3395(2003)089[0458:EOSSAA]2.0.CO;2

Keywords: Flathead, Snails, Monitoring

Grant, J. A. (2005). *Driving forces and barriers to transboundary wildlife management: The Crown of the Continent Ecosystem experience* (M.Sc.). Available from ProQuest Dissertations & Theses Global. (305028830).

Keywords: Connectivity, Crown of the Continent, Monitoring

Grant, J. A., & Quinn, M. S. (2007). Factors influencing transboundary wildlife management in the North American 'Crown of the Continent'. *Journal of Environmental Planning and Management, 50*(6), 765-782. doi:http://library.mtroyal.ca:2063/loi/cjep20

Keywords: Connectivity, Crown of the Continent, Monitoring

Grassy mountain coal project. (2015). (Project Proposal). Alberta: Riverside Resources.

Keywords: Resource Extraction, Crowsnest Pass, Private Sector Project

Grassy mountain coal project: Terms of reference for environmental impact assessment report. (2015). (Environment Impact Assessment). Alberta: Benga Mining Limited.

Keywords: Resource Extraction, Crowsnest Pass, Private Sector Project

Graves, T. A. (2012). *Spatial ecology of grizzly bears in northwestern Montana and estimating resistance to gene flow* (Doctor of Philosophy in Forest Science).

Keywords: Northwestern Montana, Grizzly Bear, Monitoring

Gray, Q. Z., Fraser, D. J., & Grant, J. W. (2014). Extirpation for conservation: Applying predictors of extinction risk to eradicate introduced trout populations for lake restoration. Ecological Restoration, 32(1), 59-67.

Keywords: Invasive Species, Waterton, Management

Guidelines for the preparation of an environmental impact statement: Coal mountain phase 2 project. (2012). Teck Coal Limited.

Keywords: Resource Extraction, Elk Valley, Private Sector Project

Guidelines for the preparation of an environmental impact statement: Grassy mountain coal project. (2012). Benga Mining Limited, Riversdale Resources Limited.

Keywords: Resource Extraction, Crowsnest Pass, Private Sector Project

H.

Hall, M. H. P., & Fagre, D. B. (2003). Modeled climate-induced glacier change in Glacier National Park, 1850-2100. *Bioscience, 53*(2), 131-140.

Keywords: Climate Change, Glacier National Park, Monitoring

Hall, W. L., Zuuring, H. R., Hardy, C. C., & Wakimoto, R. H. (2003). Applying logistic regression to determine regeneration risk to stand replacement fire on the Kootenai National Forest, Montana. *Western Journal of Applied Forestry, 18*(3), 155.

Keywords: Kootenay, Management

Hancock, J. (2002). *Arachnological survey of Waterton Lakes National Park, Alberta, Canada, 2002.* (Arachnid Survey). Pincher Creek, Alberta, Canada.

Keywords: Waterton, Spiders, Monitoring

Hardy, R., & Paragamian, V. (2013). A synthesis of Kootenai River burbot stock history and future management goals. *Transactions of the American Fisheries Society, 142*(6), 1662-1670. doi:10.1080/00028487.2013.790845

Keywords: Kootenay, Burbot, Management

Hardy, R. S., Stephenson, S. M., Neufeld, M. D., & Young, S. P. (2015). Adaptation of lake-origin burbot stocked into a large river environment. *Hydrobiologia, 757*(1), 35-47. doi:10.1007/s10750-015-2226-0

Keywords: Kootenay, Burbot, Management

Hauer, F. R., Stanford, J. A., & Lorang, M. S. (2007). Pattern and process in northern Rocky Mountain headwaters: Ecological linkages in the headwaters of the Crown of the Continent. *Journal of the American Water Resources Association, 43*(1), 104-117. doi:10.1111/j.1752-1688.2007.00009.x

Keywords: Resource Extraction, Connectivity, Crown of the Continent, Monitoring

Haufler, J. B., & Carolyn, A. M. (May, 2002). *Development of the trans-boundary ecoregions for the Yellowstone to Yukon planning area.* Seeley Lake, MT: Ecosystem Management Research Institute.

Keywords: Connectivity, Crown of the Continent, Management

Hernandez, S. (2008). Mountaintop removal at the Crown of the Continent: International law and energy development in the transboundary Flathead River basin. *Vermont Law Review, 32*(3), 547-581.

Keywords: Development, Resource Extraction, Crown of the Continent, Monitoring

Hinck, J. E., Schmitt, C. J., Blazer, V. S., Denslow, N. D., Bartish, T. M., Anderson, P. J., … Tillitt, D.E. (2006). Environmental contaminants and biomarker responses in fish from the Columbia River and its tributaries: Spatial and temporal trends. Science of the Total Environment, 366(2), 549-578. doi:10.1016/j.scitotenv.2005.11.008

Keywords: Crown of the Continent, Monitoring

Hitt, N.P., Frissell, C.A., Muhlfeld, C.C., & Allendorf, F.W. (2003). Spread of hybridization between native westslope cutthroat trout, *Oncorhynchus clarkii lewisi*, and non-native rainbow trout, *Oncorhynchus mykiss*. Canadian Journal of Fisheries and Aquatic Sciences, 60(12), 1440-1440. doi:10.1139/f03-125

Keywords: Hybridization, Flathead, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Hohenlohe, P. A., Day, M. D., Amish, S. J., Miller, M. R., Kamps-Hughes, N., Boyer, M. C., … Luikart, G. (2013). Genomic patterns of introgression in rainbow and westslope cutthroat trout illuminated by overlapping paired-end RAD sequencing. Molecular Ecology, 22(11), 3002-3013. doi:10.1111/mec.12239

Keywords: Hybridization, Flathead, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Holt, D. W., & Zetterberg, S. A. (2008). The 2005 to 2006 snowy owl irruption migration to western Montana. Northwestern Naturalist, 89(3), 145-151. doi:10.1898/NWN07-19.1

Keywords: Flathead, Snowy Owl, Monitoring

Hutto, R., Flesch, A., & Fylling, M. (2014). A bird's-eye view of forest restoration: Do changes reflect success? Forest Ecology and Management, 327, 1-9. doi:10.1016/j.foreco.2014.04.034

Keywords: Restoration, Flathead, Vascular Plants, Monitoring

I.

Ipsos Reid. (2007). *Social science research report for Waterton Lakes National Park.* (Social Science Research Report). Vancouver, BC: Parks Canada.

Keywords: Waterton, Management

J.

Jackson, B. E. (2003). *Long-term osprey (Pandion haliaetus) population dynamics in relation to food web change at Flathead Lake, MT.* (Master of Science). University of Montana, Missoula, Montana.

Keywords: Invasive Species, Interspecial Interaction, Flathead, Osprey, Monitoring

Jalkotzy, M. (2005). *Selected ecological resources of Alberta's Castle Carbondale: A synopsis of current knowledge*. Calgary, AB: Arc Wildlife Services Ltd.

Keywords: Species at Risk, Castle, Monitoring

Janowicz, M. E., Strobeck, C., & Harris, H. (2004). Hybridization between native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) and introduced rainbow trout (*O. mykiss*) in the eastern slopes of the Rocky Mountains in Alberta.

Keywords: Hybridization, Southern Alberta, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Jedd, T. (2015). Accountability and legitimacy in transboundary networked forest governance: A case study of the roundtable on the Crown of the Continent (Ph.D. in Political Sciences).

Keywords: Crown of the Continent, Management

Jedd, T. & Bixler, R. P. (2015). Accountability in networked governance: Learning from a case of landscape-scale forest conservation. *Environmental Policy & Governance, 25*(3), 172-187. doi:10.1002/eet.1670

Keywords: Crown of the Continent, Management

Johnson, B. B. (December 2011). *Assessing social-ecological resilience and adaptive capacity in the face of climate change: An examination of three communities in the Crown of the Continent Ecosystem.* (Unpublished Doctor of Philosophy in Natural Resources and Environmental Studies). University of New Hampshire, Durham.

Keywords: Climate Change, Crown of the Continent, Monitoring

Johnson, J. (2005). *Waterton-Glacier International Peace Park: The economic implications of expanding Waterton park into the Flathead region of British Columbia.* (Economic Report).CPAWS BC Chapter.

Keywords: Development, Crown of the Continent, Management

Johnson, S. (2008). *Sustaining and enhancing the geographical character of place: Indicators for assessing geotourism in the Crown of the Continent* (M.E.Des.). Available from ProQuest Dissertations & Theses Global. (304694783).

Keywords: Tourism, Crown of the Continent, Management

Jokinen, M. E., Jones, P. F., & Dorge, D. (2008). *Evaluating survival and demography of a bighorn sheep (Ovis canadensis) population.* (Population Study). Alberta Conservation Association. Alberta, Canada.

Keywords: Castle, Bighorn Sheep, Monitoring

Jones, L. A., Muhlfeld, C. C., Marshall, L. A., McGlynn, B. L., & Kershner, J. L. (2014). Estimating thermal regimes of bull trout and assessing the potential effects of climate warming on critical habitats. River Research and Applications, 30(2), 204-216. doi:10.1002/rra.2638

Keywords: Climate Change, Species at Risk, Flathead, Bull Trout, Monitoring

Judd, G.J.R., & Gardiner, M.G.T. (2006). Temperature, irradiation and delivery as factors affecting spring-time flight activity and recapture of mass-reared male codling moths released by the Okanagan-Kootenay sterile insect programme. *Journal of the Entomological Society of British Columbia, 103*, 19.

Keywords: Kootenay, Codling Moth, Monitoring

K.

Kanda, N., & Allendorf, F. W. (2001). Genetic population structure of bull trout from the Flathead River basin as shown by microsatellites and mitochondrial DNA markers. Transactions of the American Fisheries Society, 130(1), 92-106. doi:10.1577/1548-8659(2001)130<0092:GPSOBT>2.0.CO;2

Keywords: Species at Risk, Flathead, Bull Trout, Monitoring

Kellerlynn, K. (October, 2002). *Geoindicators scoping report for Waterton-Glacier International Peace Park.* (Strategic Planning Goal Ib4). West Glacier, Montana, USA.

Keywords: Peace Park, Monitoring

Kendall, K. C., Stetz, J. B., Boulanger, J., Macleod, A. C., Paetkau, D., & White, G. C. (2009). Demography and genetic structure of a recovering grizzly bear population. Journal of Wildlife Management, 73(1), 3-17. doi:10.2193/2008-330

Keywords: Species at Risk, Northern Continental Divide, Grizzly Bear, Monitoring

Kendall, K. C., Stetz, J. B., Roon, D. A., Waits, L. P., Boulanger, J. B., & Paetkau, D. (2008). Grizzly bear density in Glacier National Park, Montana. Journal of Wildlife Management, 72(8), 1693-1705. doi:10.2193/2008-007

Keywords: Species at Risk, Glacier National Park, Grizzly Bear, Monitoring

Kirillin, G., Lorang, M., Lippmann, T., Gotschalk, C., & Schimmelpfennig, S. (2015). Surface seiches in Flathead Lake. Hydrology and Earth System Sciences, 19(6), 2605-2615. doi:10.5194/hess-19-2605-2015

Keywords: Flathead, Monitoring

Knudsen, K. L., Muhlfeld, C. C., Sage, G. K., & Leary, R. F. (2002). Genetic structure of Columbia River redband trout populations in the Kootenai River drainage, Montana, revealed by microsatellite and allozyme loci. *Transactions of the American Fisheries Society, 131*(6), 1093-1105. doi:10.1577/1548-8659(2002)131<1093:GSOCRR>2.0.CO;2

Keywords: Kootenay, River Redband Trout, Monitoring

Kondla, N. G. (2004). *Conservation Overview of Butterflies in the Southern Headwaters at Risk Project (SHARP) Area.* (Alberta Species at Risk Report No. 80). Edmonton, Alberta, Canada: Alberta Sustainable Resource Development, Fish and Wildlife.

Keywords: Southern Alberta, Butterflies, Management

Kondla, N. G. (2009). *Waterton Lakes National Park - 2009 Half-moon Hairstreak Project Report.* (Project Report). Waterton Lakes National Park: Parks Canada.

Keywords: Endangered Species, Waterton, Half-moon Hairstreak, Monitoring

Kunkel, K. E., Atwood, T. C., Ruth, T. K., Pletscher, D. H., Hornocker, M. G., Gompper, M., & Vanak, A. (2013). Assessing wolves and cougars as conservation surrogates. Animal Conservation, 16(1), 32-40. doi:10.1111/j.1469-1795.2012.00568.x

Keywords: Interspecial Interaction, Flathead, Wolves, Cougars, Monitoring

Kunkel, K., & Pletscher, D. H. (2001). Winter hunting patterns of wolves in and near Glacier National Park, Montana. *The Journal of Wildlife Management, 65*(3), 520-530.

Keywords: Interspecial Interaction, Glacier National Park, Wolves, Monitoring

Kunkel, K. E., Pletscher, D. H., Boyd, D. K., Ream, R. R., & Fairchild, M. W. (2004). Factors correlated with foraging behavior of wolves in and near Glacier Park, Montana. *Journal of Wildlife Management, 68*(1), 167-178. doi:10.2193/0022-541X(2004)068[0167:FCWFBO]2.0.CO;2

Keywords: Interspecial Interaction, Glacier National Park, Wolves, Monitoring

Kynard, B., Parker, E., & Kynard, B. (2010). Ontogenetic behavior of Kootenai River white sturgeon, *Acipenser transmontanus*, with a note on body color: A laboratory study. *Environmental Biology of Fishes, 88*(1), 65-77. doi:10.1007/s10641-010-9618-9

Keywords: Endangered Species, Kootenay, White Sturgeon, Monitoring

L.

LaMontagne, J. (2000). *Use of migratory stopover areas by trumpeter swans in southern Alberta.* (Unpublished Masters of Science in Biological Sciences). University of Calgary, Calgary, Alberta, Canada.

Keywords: Species at Risk, Southern Alberta, Trumpeter Swan, Monitoring

Langemann, G. E. (2011). *Waterton Lakes National Park archaeological resource management programme, 2010 – 2011.* (Final Report No. 2010-5494). Calgary, AB: Parks Canada.

Keywords: Waterton, Management

Larson, A. J., Belote, R. T., Cansler, C. A., Parks, S. A., & Dietz, M. S. (2013). Latent resilience in ponderosa pine forest: Effects of resumed frequent fire. *Ecological Applications, 23*(6), 1243-1249. doi:10.1890/13-0066.1

Keywords: Montana, Ponderosa Pine, Vascular Plants, Management

Lee, T. (2007). *Crown of the Continent - A backgrounder on connectivity and ecological health.* (2007). Y2Y Crown of the Continent Report). Calgary, AB: Miistakis Institute.

Keywords: Connectivity, Crown of the Continent, Monitoring

Lee, T. & Good, K. (2013). *Scan of Ecosystem Services Programming in the Crown of the Continent.* (Survey Report). Calgary, AB: Miistakis Institute.

Keywords: Crown of the Continent, Monitoring

Lee, P., & Hanneman, M. (2011). *Castle area forest land use zone: Linear disturbances, access densities, and grizzly bear habitat security areas.* (1st Publication for International Year of Forests). Edmonton, Alberta: Global Forest Watch Canada.

Keywords: Connectivity, Castle, Management

Lemay, M. A., & Russello, M. A. (2012). Neutral loci reveal population structure by geography, not ecotype, in Kootenay Lake Kokanee. *North American Journal of Fisheries Management, 32*(2), 282. doi:10.1080/02755947.2012.676383

Keywords: Kootenay, Kokanee, Monitoring

Letts, M. G., Nakonechny, K. N., Van Gaalen, K. E., & Smith, C. M. (2009). Physiological acclimation of *Pinus flexilis* to drought stress on contrasting slope aspects in Waterton Lakes National Park, Alberta, Canada. *Canadian Journal of Forest Research*, 39(3),629-629. doi:10.1139/X08-206

Keywords: Climate Change, Waterton, Limber Pine, Monitoring

Levesque, L. (2005). *Investigating landscape change and ecological restoration: An integrated approach using historical ecology and GIS in Waterton Lakes National Park, Alberta* (Master of Science).

Keywords: Climate Change, Waterton, Vascular Plants, Monitoring

Little, E. E., Calfee, R. D., & Linder, G. (2012). Toxicity of copper to early-life stage Kootenai River white sturgeon, Columbia River white sturgeon, and rainbow trout. *Archives of Environmental Contamination and Toxicology, 63*(3), 400-408. doi:10.1007/s00244-012-9782-3

Keywords: Endangered Species, Kootenay, White Sturgeon, Rainbow Trout, Monitoring

Lonergan, E. R., Cripps, C. L., & Smith, C. M. (2014). Influence of site conditions, shelter objects, and ectomycorrhizal inoculation on the early survival of whitebark pine seedlings planted in Waterton Lakes National Park. Forest Science, 60(3), 603-612.

Keywords: Endangered Species, Waterton, Whitebark Pine, Monitoring

Long, B. (2002). *Crown of the Continent: Profile of a treasured landscape.* Kalispell, MT: Crown of the Continent Ecosystem Education Consortium.

Keywords: Crown of the Continent, Management

Lowell, J. L., Gordon, N., Engstrom, D., Stanford, J. A., Holben, W. E., & Gannon, J. E. (2009).Habitat heterogeneity and associated microbial community structure in a small-scale floodplain hyporheic flow path. Microbial Ecology, 58(3), 611-620. doi:10.1007/s00248-009-9525-9

Keywords: Flathead, Microfauna, Monitoring

Lyons, E. P. (2005). "Give me a home where the buffalo roam": The case in favor of the management-function transfer of the National Bison Range to the confederated Salish and Kootenai tribes of the Flathead Nation. *Journal of Gender, Race and Justice, 8*(3), 711.

Keywords: Northwestern Montana, Bison, Management

M.

MacDonald, M. D. (2001). *An ecosystem approach to integrate sustainability into ecotourism experiences* (M.E.Des.). Available from ProQuest Dissertations & Theses Global. (304683768). Retrieved from http://library.mtroyal.ca:2092/docview/304683768?accountid=1343

Keywords: Tourism, Crown of the Continent, Management

Mace, R. D. (2004). Integrating science and road access management: Lessons from the Northern Continental Divide Ecosystem. Ursus, 15(1),6176(2004) 015<0129:ISARAM>2.0.CO;2

Keywords: Development, Northern Continental Divide, Management

Mace, R. D., Carney, D. W., Chilton-Radandt, T. … Wenum, E. (2012). Grizzly bear population vital rates and trend in the northern continental divide ecosystem, Montana. *The Journal of Wildlife Management, 76*(1), 119-128. doi:10.1002/jwmg.250

Keywords: Northern Continental Divide, Grizzly Bear, Monitoring

MacHutchon, A. G. (2009). *Assessment of Bear-Human Interaction Risk Along the Wishbone Trail, Waterton Lakes National Park.* Nelson, BC, Canada: Parks Canada.

Keywords: Citizen Science, Waterton, Grizzly Bear, Monitoring

Macmynowski, D. P. (2007). Across space and time: Social responses to large-scale biophysical systems. *Environmental Management, 39*(6), 831-42. doi:http://library.mtroyal.ca:2098/10.1007/s00267-006-0082-4

Keywords: Crown of the Continent, Management

MacPherson, L., & Coombs, M. (2013). *A generic rule set for applying the Alberta fish sustainability index second edition.* (Executive Summary).

Keywords: Southern Alberta, Management

Malanson, G. P., Bengtson, L. E., & Fagre, D. B. (2012). Geomorphic determinants of species composition of alpine tundra, Glacier National Park, U.S.A. *Arctic, Antarctic, and Alpine Research, 44*(2), 197-209. doi:http://library.mtroyal.ca:2087/10.1657/1938-4246-44.2.197

Keywords: Climate Change, Glacier National Park, Monitoring

Mally, K. A. (2008). *Hierarchical summer habitat selection by the North American porcupine in western Montana.* (Unpublished Masters of Science in Wildlife Biology). University of Montana, Missoula, Montana, USA.

Keywords: Northwestern Montana, Porcupine, Monitoring

Managh, S.(2006). *Anthropogenic change in the northern Crown of the Continent.* (Status Update). Calgary, AB: Miistakis Institute.

Keywords: Crown of the Continent, Management

Managh, S. (2009). *Anthropogenic change in the northern Crown of the Continent.* (Status update). Waterton Lakes National Park, AB: Parks Canada.

Keywords: Crown of the Continent, Management

Mast, M. A., & Clow, D. W. (2008). Effects of 2003 wildfires on stream chemistry in Glacier National Park, Montana. *Hydrological Processes, 22*(26), 5013-5023. doi:10.1002/hyp.7121

Keywords: Glacier National Park, Monitoring

McCaffery, M., Switalski, T. A., & Eby, L. (2007). Effects of road decommissioning on stream habitat characteristics in the South Fork Flathead River, Montana. Transactions of the American Fisheries Society, 136(3), 553-561. doi:10.1577/T06-134.1

Keywords: Restoration, Development, Flathead, Management

McCuaig, J. M., & Quinn, M. S. (2011). Place based environmental governance in the Waterton Biosphere Reserve, Canada: The role of a large private land trust project. *The George Wright Forum, 28*(1), 95-110.

Keywords: Waterton, Monitoring

McLellan, B. N. (2011). Implications of a high-energy and low-protein diet on the body composition, fitness, and competitive abilities of black (*Ursus americanus*) and grizzly (*Ursus arctos*) bears. Canadian Journal of Zoology, 89(6), 546. doi:10.1139/Z11-026

Keywords: Flathead, Black Bear, Grizzly Bear, Monitoring

McNeil, C. (May, 2005). *Parks Canada review of oversnow vehicle use in National Parks*. Parks Canada.

Keywords: Southern Alberta, Management

McTaggart, P. (2006). *Does elevation have an influencing factor on blister rust (Cronartium ribicola) outbreaks amongst whitebark pine (Pinus albicaulis) communities within the Castle Wilderness Area, southwest Alberta.*

Keywords: Endangered Species, Castle, Whitebark Pine, Monitoring

Michel Creek coking coal project: Loop ridge mine. (2015). (Project Description). British Columbia: CanAus Coal Limited.

Keywords: Resource Extraction, Elk Valley, Private Sector Project

Michel, H., & Gayton, D. (. (2001). Linking indigenous peoples knowledge and western science in natural resource management. *Southern Interior Forest Extension and Research Partnership,* Quaaout Lodge, Chase, B.C.

Keywords: British Columbia, Management

Minshall, G. W., Shafii, B., Price, W. J., Holderman, C., Anders, P. J., Lester, G., & Barrett, P. (2014). Effects of nutrient replacement on benthic macroinvertebrates in an ultraoligotrophic reach of the Kootenai River, 2003–2010. *Freshwater Science, 33*(4), 1009-1023. doi:10.1086/677900

Keywords: Kootenay, Microfauna, Monitoring

Mogen, J. T., & Kaeding, L. R. (2001). *Population biology of bull trout (Salvelinus confluentus) in the Saint Mary River drainage.* (Progress Report). Bozeman, Montana: US Fish and Wildlife Service, Branch of Native Fisheries Management.

Keywords: Species at Risk, Northwestern Montana, Bull Trout, Monitoring

Muhlfeld, C. C., Bennett, D. H., & Marotz, B. (2001). Summer habitat use by Columbia River redband trout in the Kootenai River drainage, Montana. *North American Journal of Fisheries Management, 21*(1), 223-235. doi:10.1577/1548-8675(2001)021<0223:SHUBCR>2.0.CO;2

Keywords: Kootenay, Redband Trout, Monitoring

Muhlfeld, C. C., Bennett, D. H., Steinhorst, R. K., Marotz, B., & Boyer, M. (2008). Using bioenergetics modeling to estimate consumption of native juvenile salmonids by non-native northern pike in the Upper Flathead River system, Montana. North American Journal of Fisheries Management, 28(3), 636-648. doi:10.1577/M07-004.1

Keywords: Species at Risk, Flathead, Bull Trout, Westslope Cutthroat Trout, Monitoring

Muhlfeld, C. C., Giersch, J. J., & Marotz, B. (2012). Seasonal movements of non-native lake trout in a connected lake and river system. Fisheries Management and Ecology, 19(3), 224-232. doi:10.1111/j.1365-2400.2011.00821.x

Keywords: Flathead, Lake Trout, Monitoring

Muhlfeld, C. C., Giersch, J. J., Hauer, F. R., Pederson, G. T., Luikart, G., Peterson, D. P., ... Fagre, D. B. (2011). Climate change links fate of glaciers and an endemic alpine invertebrate. *Climatic Change, 106*(2), 337-345. doi:http://library.mtroyal.ca:2098/10.1007/s10584-011-0057-1

Keywords: Climate Change, Glacier National Park, Insect, Monitoring

Muhlfeld, C. C., Glutting, S., Hunt, R., Daniels, D., & Marotz, B. (2003). Winter diel habitat use and movement by sub-adult bull trout in the upper Flathead River, Montana. North American Journal of Fisheries Management, 23(1), 163-171. doi:10.1577/1548-8675(2003)023<0163:WDHUAM>2.0.CO;2

Keywords: Species at Risk, Flathead, Bull Trout, Monitoring

Muhlfeld, C. C., Jones, L., Kotter, D., Miller, W. J., Geise, D., Tohtz, J., & Marotz, B. (2012). Assessing the impacts of river regulation on native bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) habitats in the upper Flathead River, Montana, USA. River Research and Applications, 28(7), 940-959. doi:10.1002/rra.1494

Keywords: Species at Risk, Flathead, Bull Trout, Westslope Cutthroat Trout, Monitoring

Muhlfeld, C., Kovach, R., Jones, L., Al-Chokhachy, R., Boyer, M., Leary, R., . . . Allendorf, F. (2014). Invasive hybridization in a threatened species is accelerated by climate change. Nature Climate Change, 4(7), 620-624. doi:10.1038/NCLIMATE2252

Keywords: Hybridization, Species at Risk, Flathead, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Muhlfeld, C. C., & Marotz, B. (2005). Seasonal movement and habitat use by sub-adult bull trout in the upper Flathead River system, Montana. North American Journal of Fisheries Management, 25(3), 797-810 doi:10.1577/M04-045.1

Keywords: Species at Risk, Flathead, Bull Trout, Monitoring

Muhlfeld, C. C., Marotz, B., Thorrold, S. R., & FitzGerald, J. L. (2005). Geochemical signatures in scales record stream of origin in westslope cutthroat trout. Transactions of the American Fisheries Society, 134(4), 945-959. doi:10.1577/T04-029.1

Keywords: Flathead, Westslope Cutthroat Trout, Monitoring

Muhlfeld, C. C., McMahon, T. E., Boyer, M. C., & Gresswell, R. E. (2009). Local habitat, watershed, and biotic factors influencing the spread of hybridization between native westslope cutthroat trout and introduced rainbow trout. Transactions of the American Fisheries Society, 138(5), 1036-1051. doi:10.1577/T08-235.1

Keywords: Hybridization, Species at Risk, Flathead, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Muhlfeld, C. C., McMahon, T. E., Kershner, J. L., & Belcer, D. (2009). Spatial and temporal spawning dynamics of native westslope cutthroat trout, *Oncorhynchus clarkii lewisi*, introduced rainbow trout, *Oncorhynchus mykiss*, and their hybrids. Canadian Journal of Fisheries and Aquatic Sciences, 66(7), 1153-1168. doi:10.1139/F09-073

Keywords: Hybridization, Species at Risk, Flathead, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Muhlfeld, C. C., Thorrold, S. R., McMahon, T. E., & Marotz, B. (2012). Estimating westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) movements in a river network using strontium isoscapes. Canadian Journal of Fisheries and Aquatic Sciences, 69(5), 906-915. doi:10.1139/f2012-033

Keywords: Species at Risk, Flathead, Westslope Cutthroat Trout, Monitoring

Musto, D. (2012). *Non-native plants and gardening in the town of Waterton Park: Community-based social marketing analysis and recommendations.* Waterton Lakes National Park: *Parks Canada whitebark and limber pine workshop.* (2003). Calgary, AB: Parks Canada.

Keywords: Invasive Species, Waterton, Vascular Plants, Management

N.

National Parks Conservation Association. (2003). *State of the Parks Waterton – Glacier International Peace Park.* (Natural Resource Assessment).

Keywords: Peace Park, Management

National Park Service. (2008). *Avalanche hazard reduction by Burlington Northern Santa Fe Railway in Glacier National Park and Flathead National Forest, Montana.* (Environmental Impact Statement). Flathead and Glacier Counties, MT: U.S. Department of the Interior.

Keywords: Glacier National Park, Management

Neufeld, M. D., Davis, C. A., Cain, K. D., Jensen, N. R., Ireland, S. C., & Lewandowski, C. (2011). Evaluation of methods for the collection and fertilization of burbot eggs from a wild stock for conservation aquaculture operations. *Journal of Applied Ichthyology, 27*, 9-15. doi:10.1111/j.1439-0426.2011.01837.x

Keywords: Kootenay, Burbot, Monitoring

Neufeld, M. D., & Rust, P. J. (2009). Using passive sonic telemetry methods to evaluate dispersal and subsequent movements of hatchery-reared white sturgeon in the Kootenay River. *Journal of Applied Ichthyology, 25*(2), 27-33. doi:10.1111/j.1439-0426.2009.01336.x

Keywords: Endangered Species, Kootenay, White Sturgeon, Monitoring

Newell, R. L., & Anderson, M. L. (2009). Note on the occurrence of *Siphlonurus autumnalis* (*Ephemeroptera*: *Siphlonuridae*) in a Montana spring brook. Western North American Naturalist, 69(4), 551-555. doi:10.3398/064.069.0415

Keywords: Flathead, Arthropods, Monitoring

Newell, R. L., & Baumann, R. W. (2013). Studies on distribution and diversity of nearshore *Ephemeroptera* and *Plecoptera* in selected lakes of Glacier National Park, Montana. Western North American Naturalist, 73(2), 230-236.

Keywords: Glacier National Park, Arthropods, Monitoring

Newell, R. L., & Hossack, B. R. (2009). Large, wetland-associated mayflies (*Ephemeroptera*) of Glacier National Park, Montana. Western North American Naturalist, 69(3), 335-342. doi:10.3398/064.069.0307

Keywords: Glacier National Park, Arthropods, Monitoring

O.

Ott, S. J., Dobbin, H. S., Keating, K. A., & Weiser, G. C. (2009). Distribution of *Pasteurella trehalosi* genotypes isolated from Bighorn Sheep in Waterton-Glacier International Peace Park. Journal of the Idaho Academy of Science, 45(2), 11.

Keywords: Interspecial Interaction, Peace Park, Microfauna, Bighorn Sheep, Monitoring

P.

Pagnucco, K. S., Paszkowski, C. A., & Scrimgeour, G. J. (2011). Wolf in sheep's clothing: Effects of predation by small-bodied fish on survival and behaviour of salamander larvae. Ecoscience, 18(1), 70-78. doi:10.2980/18-1-3395

Keywords: Interspecial Interaction, Waterton, Long-toed Salamander, Monitoring

Pagnucco, K. S., Paszkowski, C. A., & Scrimgeour, G. J. (2012). Characterizing movement patterns and spatiotemporal use of under-road tunnels by long-toed salamanders in Waterton Lakes National Park, Canada. Copeia, 2012(2), 331-340. doi:10.1643/CE-10-128

Keywords: Connectivity, Waterton, Long-toed Salamander, Management

Pansing, E. R. (2014). *The influence of cache site and rodent pilferage on whitebark pine seed germination in the northern and central Rocky Mountains* (Master of Science, Biology).

Keywords: Endangered Species, Glacier National Park, Whitebark Pine, Monitoring

Paragamian, V. L., & Beamesderfer, R. C. P. (2003). Growth estimates from tagged white sturgeon suggest that ages from fin rays underestimate true age in the Kootenai River, USA and Canada. *Transactions of the American Fisheries Society, 132*(5), 895-903. doi:10.1577/T02-120

Keywords: Endangered Species, Kootenay, White Sturgeon, Monitoring

Paragamian, V. L., Beamesderfer, R. C. P., & Ireland, S. C. (2005). Status, population dynamics, and future prospects of the endangered Kootenai River white sturgeon population with and without hatchery intervention. *Transactions of the American Fisheries Society, 134*(2), 518-532. doi:10.1577/T03-011.1

Keywords: Connectivity, Endangered Species, Kootenay, White Sturgeon, Monitoring

Paragamian, V. L., & Hansen, M. J. (2011). Stocking for rehabilitation of burbot in the Kootenai River, Idaho, USA and British Columbia, Canada. *Journal of Applied Ichthyology, 27*(1), 22-26. doi:10.1111/j.1439-0426.2011.01839.x

Keywords: Connectivity, Kootenay, Burbot, Monitoring

Paragamian, V. L., Hardy, R., & Gunderman, B. (2005). Effects of regulated discharge on burbot migration. *Journal of Fish Biology, 66*(5), 1199-1213. doi:10.1111/j.0022-1112.2005.00670.x

Keywords: Connectivity, Kootenay, Burbot, Monitoring

Paragamian, V. L., & Kruse, G. (2001). Kootenai River white sturgeon spawning migration behavior and a predictive model. *North American Journal of Fisheries Management, 21*(1), 10-21. doi:10.1577/1548-8675(2001)021<0010:KRWSSM>2.0.CO;2

Keywords: Endangered Species, Kootenay, White Sturgeon, Monitoring

Paragamian, V. L., McCormick, J., & Laude, C. (2008). Changes in population indices of a diminishing burbot population in the Kootenai River, Idaho, USA and British Columbia, Canada. *Journal of Freshwater Ecology, 23*(4), 553-563. doi:10.1080/02705060.2008.9664243

Keywords: Connectivity, Kootenay, Burbot, Monitoring

Paragamian, V. L., McDonald, R., Nelson, G. J., & Barton, G. (2009). Kootenai River velocities, depth, and white sturgeon spawning site selection - A mystery unraveled? *Journal of Applied Ichthyology, 25*(6), 640-646. doi:10.1111/j.1439-0426.2009.01364.x

Keywords: Connectivity, Endangered Species, Kootenay, White Sturgeon, Monitoring

Paragamian, V. L., & Wakkinen, V. D. (2002). Temporal distribution of Kootenai River white sturgeon spawning events and the effect of flow and temperature. *Journal of Applied Ichthyology, 18*(4-6), 542-549. doi:10.1046/j.1439-0426.2002.00391.x

Keywords: Endangered Species, Kootenay, White Sturgeon, Monitoring

Paragamian, V. L., & Wakkinen, V. D. (2011). White sturgeon spawning and discharge augmentation. *Fisheries Management and Ecology, 18*(4), 314-321. doi:10.1111/j.1365-2400.2011.00785.x

Keywords: Endangered Species, Kootenay, White Sturgeon, Monitoring

Paragamian, V. L., & Walters, J. P. (2011). Bull trout (*Salvelinus confluentus*) movement in a transboundary river. *Journal of Freshwater Ecology, 26*(1), 65-76. doi:10.1080/02705060.2011.553854

Keywords: Species at Risk, Kootenay, Bull Trout, Monitoring

Parks Canada. (2003). *Whitebark pine and limber pine workshop.* (Workshop Proceedings). Calgary, Alberta: Parks Canada.

Keywords: Endangered Species, Waterton, Whitebark Pine, Limber Pine, Monitoring

Parks Canada. (2008). *Waterton Lakes National Park State of the Park Report* (Status Report). Waterton, Alberta, Canada.

Keywords: Waterton, Management

Paveglio, T. B., Prato, T., & Hardy, M. (2013). Simulating effects of land use policies on extent of the wildland urban interface and wildfire risk in Flathead County, Montana. Journal of Environmental Management, 130, 20-31. doi:10.1016/j.jenvman.2013.08.036

Keywords: Flathead, Monitoring

Pearson, K. J. (2002). *Linnet lake long-toed salamander (Ambystoma macrodactylum) road kill prevention and population and population estimation project summary report.* (Unpublished Technical Report). Waterton Lakes National Park: Canada Parks Agency.

Keywords: Connectivity, Waterton, Long-toed Salamander, Monitoring

Pearson, K. J. (2003-2004). *Southern headwaters at risk project (SHARP) amphibian and western painted turtle (Chrysemys picta) surveys, 2003-2004.* (Alberta Species at Risk Report No. 97). Edmonton: Alberta Sustainable Resource Development, Fish and Wildlife Division.

Keywords: Species at Risk, Southern Alberta, Western Painted Turtle, Northern Leopard Frog, Monitoring

Pearson, K. J. (2004). *The effects of introduced fish on the long-toed salamander (Ambystoma macrodactylum)* (Master of Science - Dept. of Biology).

Keywords: Interspecial Interaction, Southern Alberta, Long-toed Salamander, Monitoring

Pearson, K. J., & Goater, C. P. (2008). Distribution of long-toed salamanders and introduced trout in high- and low-elevation wetlands in southwestern Alberta, Canada. Ecoscience, 15(4), 453-459. doi:10.2980/15-4-3127

Keywords: Southern Alberta, Long-toed Salamander, Monitoring

Pedynowski, D. (2003). Toward a more "reflexive environmentalism": Ecological knowledge and advocacy in the Crown of the Continent Ecosystem. *Society & Natural Resources, 16*, 807-825. doi:http://library.mtroyal.ca:2087/10.1080/08941920309168

Keywords: Crown of the Continent, Management

Pedynowski, D. (2003). Prospects for ecosystem management in the Crown of the Continent Ecosystem, Canada-United States: Survey and recommendations. *Conservation Biology, 17*(5), 1261-1269.

Keywords: Crown of the Continent, Management

Pohl, G. R., Anweiler, G. G., Schmidt, B. C., & Kondla, N. G. (2010). An annotated list of the Lepidoptera of Alberta, Canada. *Zookeys, 38*, 1-549. doi:10.3897/zookeys.38.383

Keywords: Southern Alberta, Arthropods, Monitoring

Potvin, C., Landry, C., Pacas, C., & Bernatchez, L. (2003). *Genetic population structure of cutthroat (Oncorhynchus clarkii) and rainbow (Oncorhynchus mykiss) trout in Banff and Waterton Lakes National Parks, Alberta.* (Final Report). Quebec: Universite Laval.

Keywords: Species at Risk, Waterton, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Prairie Conservation Forum. (2011). *Alberta prairie conservation forum 2010.* (Annual Report). Lethbridge, AB, Canada.

Keywords: Southern Alberta, Management

Prato, T. (2009). Evaluating trade-offs between economic value and wildlife habitat suitability in buffer zones for protected areas in the northern Rocky Mountains, USA. Mountain Research and Development, 29(1), 46-58. doi:10.1659/mrd.992

Keywords: Resource Extraction, Flathead, Meta-Analysis/Model

Prato, T. (2012; 2011). Potential trade-offs between future economic growth and open land conservation adjacent to public protected areas: A case study in northwest Montana. Society & Natural Resources, 25(2), 113-126. doi:10.1080/08941920.2010.550084

Keywords: Development, Flathead, Meta-Analysis/Model

Prato, T., & Fagre, D. B. (2010). Sustainable management of the Crown of the Continent Ecosystem. *The George Wright Forum, 27*(1), 77-93.

Keywords: Crown of the Continent, Management

Q.

Qiu, Z., & Prato, T. (2012; 2011). Economic feasibility of adapting crop enterprises to future climate change: A case study of flexible scheduling and irrigation for representative farms in Flathead Valley, Montana, USA. Mitigation and Adaptation Strategies for Global Change, 17(3), 223-242. doi:10.1007/s11027-011-9322-x

Keywords: Climate Change, Flathead, Monitoring

R.

Rangeland Management Branch, Rangeland Resource Management Program. (2004). Methodology for calculating carrying and grazing capacity on public rangelands. (No. I/197). Alberta Sustainable Resource Development.

Keywords: Southern Alberta, Vascular Plants, Management

Range vegetation and carrying capacity assessment in Waterton Lakes National Park. (2003). Waterton Lakes National Park: High Range Ecological Consultants.

Keywords: Invasive Species, Waterton, Bison, Vascular Plants, Monitoring

Reeves, B. O. K. (2003). *Miistakis: The archeology of Waterton-Glacier International Peace Park archeological inventory and assessment program 1993-1996 vol I.* (Technical Report No. Contract No. 290847). Denver, CO: National Park Service.

Keywords: Peace Park, Monitoring

Rettie, K., & Rogala, K. (December, 2011). *Trail data summary report prepared for S. Boyle and the EI monitoring staff in mountain parks.* (Trail Report).

Keywords: Tourism, Southern Alberta, Monitoring

Rodriguez, J. T. (2005). *Patch characteristics of post fire landscapes in the Crown of the Continent Ecosystem, Montana, USA* (M.S.). Available from ProQuest Dissertations & Theses Global. (1472725052).

Keywords: Crown of the Continent, Monitoring

Rood, S. B., Goater, L. A., Mahoney, J. M., Pearce, C. M., & Smith, D. G. (2007). Floods, fire, and ice: Disturbance ecology of riparian cottonwoods. The review is one of a selection of papers published in the special issue on poplar research in Canada. *Canadian Journal of Botany, 85*(11), 1019-1032. doi:10.1139/B07-073

Keywords: Crown of the Continent, Monitoring

Rood, B. S., Samuelson, G. M., Weber, J. K., & Wywrot, K. A. (2005). Twentieth century decline in stream flows from the hydrographic apex of North America. *Journal of Hydrology, 306*, 215-233.

Keywords: Crown of the Continent, Monitoring

Roon, D. A. B. (2004). Non-invasive genetic sampling as a population assessment tool for brown and black bears within the Greater Glacier Ecosystem (Doctor of Philosophy, Forestry, Wildlife and Range Sciences).

Keywords: Species at Risk, Glacier National Park, Grizzly Bear, Black Bear, Monitoring

Rubidge, E. M., & Taylor, E. B. (2005). An analysis of spatial and environmental factors influencing hybridization between native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) and introduced rainbow trout (*O. mykiss*) in the upper Kootenay River drainage, British Columbia. *Conservation Genetics, 6*(3), 369-384. doi:10.1007/s10592-005-4972-4

Keywords: Species at Risk, Interspecial Interaction, Kootenay, Westslope Cutthroat Trout, Rainbow Trout, Monitoring

Rust, P. J. (2011). Translocation of pre-spawn adult Kootenai River white sturgeon. *Journal of Applied Ichthyology, 27*(2), 450-453. doi:10.1111/j.1439-0426.2010.01488.x

Keywords: Species at Risk, Kootenay, White Sturgeon, Management

Rutherford, A., Ellis, C., McGowen, P., McClure, M., Ament, R., & Grebenc, J. (2014). *Highway mitigation for wildlife in northwest Montana: Estimating the impacts of exurban growth and traffic demand on grizzly bears and other key wildlife species.* Bozeman, MT: Sonoran Institute, Northern Rockies Office.

Keywords: Connectivity, Northwestern Montana, Grizzly Bear, Management

S.

Saint Mary Recovery Unit. (2015). *Draft Saint Mary recovery unit implementation plan for bull trout recovery plan.* (Recovery Implementation Plan). Kallispell, Montana: US Fish and Wildlife Service.

Keywords: Species at Risk, Glacier National Park, Bull Trout, Management

Schwanke, R. (February 2001). *Fire management plan for Waterton Lakes National Park of Canada.* (Fire Management Plan). Waterton Lakes National Park: Alberta, Canada.

Keywords: Waterton, Management

Scott, D., Jones, B., & Konopek, J. (2007). Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park. *Tourism Management, 28*(2), 570-579. doi:10.1016/j.tourman.2006.04.020

Keywords: Tourism, Climate Change, Waterton, Monitoring

Scott, J. D. (2013). *Clark's nutcracker occurrence, whitebark pine stand health, and cone production in the Waterton-Glacier International Peace Park* (M.S.). Available from ProQuest Dissertations & Theses Global. (1436267579).

Keywords: Interspecial Interaction, Endangered Species, Peace Park, Clark's Nutcracker, Whitebark Pine, Monitoring

Selkowitz, D. J., Fagre, D. B., & Reardon, B. A. (2002). Interannual variations in snowpack in the Crown of the Continent Ecosystem. *Hydrological Processes, 16*(18), 3651-3665. doi:10.1002/hyp.1234

Keywords: Climate Change, Crown of the Continent, Monitoring

Sexton, E. K. (2002). *Land-use in the Crown of the Continent Ecosystem: The potential disturbance resulting from coalbed methane production in the east Kootenay coalfields of southeast British Columbia* (M.S.). Available from ProQuest Dissertations & Theses Global. (1124402852).

Keywords: Resource Extraction, Kootenay, Monitoring

Shafer, C. L. (2015). Land use planning: A potential force for retaining habitat connectivity in the greater Yellowstone ecosystem and beyond. Global Ecology and Conservation, 3, 256-278. doi:10.1016/j.gecco.2014.12.003

Keywords: Connectivity, Northern Continental Divide, Monitoring

Shaw, A. (2001). *Conservation and ecological restoration of Rocky Mountain subalpine meadows: Understanding vegetation responses to tree encroachment.*(Unpublished Master of Science in Environmental Studies). Simon Fraser University

Keywords: Interspecial Interaction, Crown of the Continent, Vascular Plants, Monitoring

Shepard, B.B. (2003). *Status of westslope cutthroat trout (Oncorhynchus clarkii lewisi) in the United States: 2002.* (Status Report). Westslope cutthroat interagency conservation team.

Keywords: Species at Risk, Crown of the Continent, Westslope Cutthroat Trout, Monitoring

Smith, C. M. (2008). *Wishbone MAPS Station Summary report 2002-2008.* (Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada, Waterton Lakes National Park.

Keywords: Citizen Science, Waterton, Monitoring

Smith, C. M. (2009). *Wishbone MAPS Station Summary Report 2002-2009.* (Unpublished Technical Report). Waterton Lakes National Park, Alberta, Canada: Parks Canada, Waterton Lakes National Park.

Keywords: Citizen Science, Waterton, Monitoring

Smith, C. M., Domenech, R., & Watt, R. A. (2013, Spring). Wing-tagged golden eagle observed at Waterton Lakes National Park. *Nature Alberta, 43*, 31-33.

Keywords: Waterton, Golden Eagle, Monitoring

Smith, C. M., Kaschube, D. R., Shepherd, B., & Woods, J. (2008). *Monitoring Avian Productivity and Survivorship (MAPS) in Mount Revelstoke, Banff, Waterton Lakes and Jasper National Parks (1993-2006).*(Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada, Waterton Lakes National Park.

Keywords: Citizen Science, Waterton, Monitoring

Spencer, C. N., Gabel, K. O., & Hauer, F. R. (2003). Wildfire effects on stream food webs and nutrient dynamics in Glacier National Park, USA. Forest Ecology and Management, 178(1), 141-153. doi:10.1016/S0378-1127(03)00058-6

Keywords: Glacier National Park, Management

Stafford, C. P., Hansen, B., & Stanford, J. A. (2004). Mercury in fishes and their diet items from Flathead Lake, Montana. Transactions of the American Fisheries Society, 133(2), 349-357. doi:10.1577/02-156

Keywords: Flathead, Monitoring

Stafford, C., McPhee, M., Eby, L., & Allendorf, F. (2014; 2013). Introduced lake trout exhibit life history and morphological divergence with depth. Canadian Journal of Fisheries and Aquatic Sciences, 71(1), 10-20. doi:10.1139/cjfas-2013-0115

Keywords: Interspecial Interaction, Flathead, Lake Trout, Monitoring

Stafford, C. P., Stanford, J. A., Hauer, F. R., & Brothers, E. B. (2002). Changes in lake trout growth associated with *Mysis relicta* establishment: A retrospective analysis using otoliths. Transactions of the American Fisheries Society, 131(5), 994-1003. doi:10.1577/1548-8659(2002)131<0994:CILTGA>2.0.CO;2

Keywords: Flathead, Lake Trout, Monitoring

Stephenson, S., Neufeld, M., Ireland, S., Young, S., Hardy, R., & Rust, P. (2013). Survival and dispersal of sonic-tagged, hatchery-reared burbot released into the Kootenay River. *Transactions of the American Fisheries Society, 142*(6), 1671-1679. doi:10.1080/00028487.2013.774293

Keywords: Reintroduction, Kootenay, Burbot, Management

Stetz, J. B., Kendall, K. C., & Macleod, A. C. (2014). Black bear density in Glacier National Park, Montana. Wildlife Society Bulletin, 38(1), 60-70. doi:10.1002/wsb.356

Keywords: Glacier National Park, Black Bear, Monitoring

Stetz, J. B., Kendall, K. C., & Servheen, C. (2010). Evaluation of bear rub surveys to monitor grizzly bear population trends. Journal of Wildlife Management, 74(4), 860-870. doi:10.2193/2008-435

Keywords: Northwestern Montana, Grizzly Bear, Monitoring

T.

Tannas, C., Tannas, K., Tannas, K., & Tannas, S. (2006). *Range vegetation survey of grazed and ungrazed enclosures on five selected sites.* Waterton Lakes National Park: Eastern Slopes Rangeland Seeds Ltd.

Keywords: Interspecial Interaction, Waterton, Vascular Plants, Monitoring

Tannas, S., Hewins, D., & Bork, E. (2015). Isolating the role of soil resources, defoliation, and interspecific competition on early establishment of the late successional bunchgrass *Festuca campestris*. *Restoration Ecology, 23*(4), 366. doi:10.111/rec.12207

Keywords: Southern Alberta, Vascular Plants, Monitoring

Taylor, M., & Smith, C. M. (2003). *Northern Leopard Frog and Western Toad Inventory in Waterton Lakes National Park, Alberta in 2003.* (Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada.

Keywords: Species at Risk, Waterton, Northern Leopard Frog, Western Toad, Monitoring

The Crown Manager's Partnership. (May, 2013). *Landscape patterns environmental quality analysis*.

Keywords: Southern Alberta, Monitoring

Thompson, M. D. (2003). *Phylogeography of the long-toed salamander, Ambystoma macrodactylum* (Master of Science - thesis).

Keywords: Waterton, Long-toed Salamander, Monitoring

Tilson, D., & McDougall, K. (2003). *Operational Guidelines for the Management of Carnivore/Human Conflicts, Waterton Lakes National Park.* (Operational Guidelines). Waterton Lakes National Park, Alberta, Canada: Parks Canada.

Keywords: Interspecial Interaction, Waterton, Carnivores, Management

Treanor, H. B., Giersch, J. J., Kappenman, K. M., Muhlfeld, C. C., & M. A. H. Webb. (2013). Thermal tolerance of meltwater stonefly *Lednia tumana* nymphs from an alpine stream in Waterton–Glacier International Peace Park, Montana, USA. Freshwater Science, 32(2), 597-605. doi:10.1899/12-100.1

Keywords: Climate Change, Peace Park, Arthropods, Monitoring

Tremblett, K. S. D. (October, 2004). *Evaluation of the biosphere reserve model as a mechanism to implement ecosystem-based management: Using the Waterton Biosphere Reserve as a case study* (Master of Environmental Design - Environmental Science).

Keywords: Waterton, Management

V.

Varney, T. L., Katzenberg, M. A., & Kooyman, B. (2001). *Where do the bison roam? A stable isotopic study of bison grazing behaviour in Waterton Lakes and Banff National Park.* Calgary, Alberta, Canada: University of Calgary.

Keywords: Reintroduction, Waterton, Bison, Management

Vollertsen, J. A. (2005). *Using multiple regression analysis to associate education levels and financial compensation with livestock producers' tolerance for grizzly bears in the northern continental divide ecosystem* (Doctorate of Education, in Education).

Keywords: Interspecial Interaction, Northern Continental Divide, Grizzly Bear, Monitoring

W.

Waller, J. S. (2005). *Movements and habitat-use of grizzly bears along U.S. Highway 2 in northwestern Montana, 1998-2001* (Doctor of Philosophy).

Keywords: Connectivity, Northwestern Montana, Grizzly Bear, Monitoring

Waller, J. S., Servheen, C. (2005). Effects of transportation infrastructure on grizzly bears in northwestern Montana. Journal of Wildlife Management, 69(3), 985-1000. doi:10.2193/0022-541X(2005)069[0985:EOTIOG]2.0.CO;2

Keywords: Development, Northwestern Montana, Grizzly Bear, Monitoring

Wallis, C., Wershler, C., & Riddell, R. (2002). *Ecological land classification of Waterton Lakes National Park, Alberta vol II: Wildlife resources*. Waterton Park, Alberta: Parks Canada.

Keywords: Waterton, Monitoring

Walsh, S. J., Weiss, D. J., Butler, D. R., & Malanson, G. P. (2004). An assessment of snow avalanche paths and forest dynamics using Ikonos satellite data. Geocarto International, 19(2), 85-93. doi:10.1080/10106040408542308

Keywords: Glacier National Park, Monitoring

Wasserman, T. N., Cushman, S. A., Littell, J. S., Shirk, A. J., & Landguth, E. L. (2013; 2012). Population connectivity and genetic diversity of American marten (*Martes americana*) in the United States northern Rocky Mountains in a climate change context. Conservation Genetics, 14(2), 529-541. doi:10.1007/s10592-012-0336-z

Keywords: Connectivity, Northern Continental Divide, Marten, Monitoring

Weaver, J. L. (2001). *The transboundary Flathead, A critical landscape for carnivores in the Rocky Mountains.* (Working Paper No. 18). Bronx, New York, USA: Wildlife Conservation Society.

Keywords: Flathead, Carnivore, Monitoring

Weaver, J. L. (2007). *A Conservation Network for Carnivores in the Southern Canadian Rockies.* Toronto, Ontario, Canada: Wildlife Conservation Society Canada.

Keywords: Connectivity, Southern Alberta, Carnivores, Monitoring

Weaver, J. L. (2013). *Safe havens, safe passages for vulnerable fish and wildlife: Critical landscapes in the southern Canadian Rockies, British Columbia and Montana.* (No. 6). Toronto, ON: Wildlife Conservation Society Canada.

Keywords: Connectivity, Climate Change, Crown of the Continent, Monitoring

Weaver, J. L. (2013). *Protecting and connecting headwater havens: Vital landscapes for vulnerable fish and wildlife southern Canadian Rockies of Alberta.* (WCS Canada Conservation Report No. 7). Toronto, ON: Wildlife Conservation Society Canada.

Keywords: Connectivity, Southern Alberta, Monitoring

Weaver, J. L. (April, 2011). *Conservation value of roadless areas for vulnerable fish and wildlife species in the Crown of the Continent ecosystem, Montana.*(Working Paper No. 40). Bozeman, MT: Wildlife Conservation Society.

Keywords: Connectivity, Flathead, Monitoring

Welch, D. (2002). *Atmospheric science and air issues in Canada's national parks, 2001.* (Ecosystem Monitoring and Data Report No. 7). Gatineau, QC: The National Parks and National Historic Sites of Canada.

Keywords: Climate Change, Waterton, Monitoring

Whited, D. C., Lorang, M. S., Harner, M. J., Hauer, F. R., Kimball, J. S., & Stanford, J. A. (2007). Climate, hydrologic disturbance, and succession: Drivers of floodplain pattern. Ecology, 88(4), 940-953. doi:10.1890/05-1149

Keywords: Climate Change, Flathead, Monitoring

Willoughby, M., Alexander, M., & Adams, B. (2005). *Range plant community types and carrying capacity for the montane sub-region of Alberta 6th edition.* Edmonton, Alberta.

Keywords: Southern Alberta, Vascular Plants, Monitoring

Wyatt, K. H., Hauer, F. R., & Pessoney, G. F. (2008). Benthic algal response to hyporheic-surface water exchange in an alluvial river. Hydrobiologia, 607(1),151-161. doi:10.1007/s10750-008-9385-1

Keywords: Flathead, Algae, Monitoring

Y.

Young, W. T., & Scarnecchia, D. L. (2005). Habitat use of juvenile white sturgeon in the Kootenai River, Idaho and British Columbia. *Hydrobiologia, 537*(1), 265-271. doi:10.1007/s10750-004-1639-y

Keywords: Endangered Species, Kootenay, White Sturgeon, Monitoring

Yung, L., Freimund, W. A., & Belsky, J. M. (2003). The politics of place: Understanding meaning, common ground, and political difference on the Rocky Mountain Front. *Forest Science, 49*(6),855-866. Retrieved from http://library.mtroyal.ca:2092/docview/197724362?accountid=1343

Keywords: Northwestern Montana, Management

Annotated Bibliography:

A.

Achuff, P., McNeil, R. L., Coleman, M. L., Wallis, C., & Wershler, C. (2002). ***Ecological land classification of Waterton Lakes National Park, Alberta. vol I: Integrated resource description.*** **Waterton Park, AB: Parks Canada.**

The "Ecological land classification of Waterton Lakes National Park" is a document that contains all of the information for resource use, landforms, soils, and vegetation within the park. The land is split into three levels: ecoregions, ecosystems, and ecosites. The ecoregions are divided into 25 ecosystems which describe the genetic material, drainage, and soil of the regions. The ecosystems are then split into 83 ecosites which examine landforms, soil composition, and vegetation differences. There are currently 971 species of vascular plants, 6 species of amphibians, 4 species of reptiles, and 256 species of avifauna in the park. The guide also looks at the abundance of wildlife in the areas and the habitats that are necessary for the wildlife based on their abundance in certain areas.

Alberta Government. (October, 2013). ***Draft south Saskatchewan regional plan 2014-2024.*** **(Regional Plan). Alberta Government.**

The Alberta Land-Use Framework supported by the Alberta Land Stewardship Act establishes seven land use regions to integrate all provincial policies under one umbrella and to set ecological, social, and economic outcomes for each region. Regional Planning as supported by the Alberta Government's Integrated Resource Management System (IRMS) is a flexible and dynamic strategy to set objectives for and take measurements of the effectiveness of regional land planning. These outcomes are meant to be collaborative between stakeholders, land managers, and partners. This draft was formed by the South Saskatchewan Regional Advisory Council as well as aboriginal partners and the aforementioned stakeholders. Long term planning establishes a ten year strategic vision for each region. However, private lands are not subject to these planning mandates. Highlights of the 2014 draft include watershed management, attraction of a skilled labor force, holistic infrastructure development, as well as establishment of new conservation areas in the Castle region and Pekisko rangeland area. Zoning in these areas is also experiencing revision, especially with respect to Off Highway Vehicle designations.

Al-Chokhachy, R., Muhlfeld, C. C., Boyer, M. C., Jones, L. A., Steed, A., & Kershner, J. L. (2014). ***Quantifying the effectiveness of conservation measures to control the spread of anthropogenic hybridization in stream salmonids: A climate adaptation case study*** **doi:10.1080/02755947.2014.901259**

Climate conditions have influenced the rate of rainbow trout and westslope cutthroat trout hybridization. Data was acquired from the population genetic data bank from the years of 1984-2011. It was found that temperature of the water was greatly positively correlated with the amount of hybridization within populations and that the stream flow was negatively correlated with the amount of hybridization. The rainbow trout seem to be favoured in the changing temperatures as they have a greater range of tolerated temperatures which results in

the greater survival of their offspring. Therefore, they are outcompeting cutthroat trout. It was also found that the climate and streamflow changes are causing windows for the rainbow trout to expand in the system. It was recommended that conservation efforts should be put into place to slow or stop the hybridization of the native and the non-native trout.

Apps, C. D. (2007). ***Ecology and Conservation of Canada Lynx in the Southern Canadian Rocky Mountains*** **(Dissertation, University of Calgary, Calgary, Alberta, Canada).**

There is a strong difference in the ecology of the Canada lynx between the northern boreal regions and the southwestern extent of their range. The differences in these populations have been hypothesized to have been caused by the decline in the snowshoe hare, which is the primary prey of the Canada lynx. Also, human interactions and activities provide limitations to the lynx's natural range. This study explores these causes as well as other causes related to the conservation of this species through the study of their spatial, habitat, population, and nutritional ecology. The study was conducted in areas of the southern Canadian Rocky Mountains in British Columbia as well as Alberta. They hypothesized that the lynx ecology in these southern areas will resemble that of the boreal populations during the low phase 10-year cycle of the snowshoe hare populations. Throughout the area of southern British Columbia, lynx distribution was found to be greatly uneven due to changes in temperature, terrain, precipitation, and increased forest disturbance. These factors are thought to directly correlate to the mediation of the lynx's energy requirements, interspecific competition, and prey density and distribution. The author further explores the results as well as results of other studies discuss the potential influences of resource management policies and lynx conservation initiatives at the individual, population, and metapopulation levels.

Apps, C. D., Weaver, J. L., Paquet, P. C., Bateman, B., & McLellan, B. N. (2007). ***Carnivores in the Southern Canadian Rockies: Core Areas and Connectivity Across the Crowsnest Highway.*** **(Conservation Report No. 3). Toronto, Ontario, Canada: Wildlife Conservation Society Canada.**

The southern Canadian Rocky Mountains are home to a vast variety of carnivores that are unique to North America and help to support its diversity. The southern Canadian Rockies also represents one of the most important ecosystems that are used in the maintaining of broad ecological connectivity. However, the natural connectivity of the region is highly vulnerable to fracture due to the Crowsnest Highway (Hwy 3) and expanding human developments and activities throughout this region. To address this growing problem of habitat and population fragmentation, the Wildlife Conservancy of Canada conducted modelling and field research during a period of 2001-2004 in order to provide crucial information about the connectivity, viability, and connectivity of carnivore populations that call these southern Rockies home. In the first stage of the study the selected six carnivore species (grizzly, lynx, badger, bobcat, wolf and wolverine) from the area (from a broad range of ecological conditions) and then applied regional models of distribution and vulnerability across the extent of the southern Rockies. In the second stage, researchers used the hair of grizzly bear and lynx and conducted a DNA analysis in order to sample the actual distribution of the two species (general movements relative to Hwy 3) within the zone that was adjacent to the Crowsnest Pass highway. The researcher's modelling suggested that the six varieties of carnivores are most vulnerable where their suitable habitats occurred adjacent to settlements and highways. Two principles in conservation science are known to be fundamental to a successful conservation strategy for these carnivores in the southern Canadian Rockies. These include: (1) guard against an

increase in the excessive mortality rate by a network of core areas that include appropriate security and regulations, and (2) maintain connectivity across the region by opening up linkages in the landscape to connect core areas.

Arjo, W. M., Pletscher, D. H., & Ream, R. R. (2002). Dietary overlap between wolves and coyotes in northwestern Montana. Journal of Mammalogy, 83(3), 754-766. doi:10.1644/1545-1542(2002)083<0754:DOBWAC>2.0.CO;2

Researchers studied a population of wolves currently recolonizing the Flathead Valley of Montana. The study aimed to determine the effect recolonization was having on the local coyote population's diet. Wolves have been absent from the Flathead Valley for approximately 50 years which relieved the coyote population of dietary competition. The study found that the incidents of prey occurrence differed in the two carnivore species. Coyotes consumed more rodent species, whereas wolves targeted ungulate species. This resource partitioning found by researchers leads them to believe coexistence is possible and already occurring.

Ausband, D. E., Bassing, S. B., & Mitchell, M. (2014). *Progress Report for Testing Monitoring Techniques for Wolves in Southwest Alberta.* (Progress Report). Missoula, MT, USA: Montana Cooperative Wildlife Research Unit, University Of Montana.

Grey wolf (*Canis lupus)* populations are very difficult to monitor: they can be elusive and are found in relatively low densities. This study developed a monitoring system in the United States that uses the data collected by hunter surveys and a field-based site survey in order to estimate the abundance and distribution of wolf packs across large areas. The testing took place in southwest Alberta in 2012. The study area extended from the U.S. border north to Alberta Highway 1 and was bordered to the east by Alberta Highway 22. The Porcupine Hills area was also included in this study. Hunter surveys were expanded in 2012 to include the area located north of Highway 1, along Highway 22 up to the Brazeau River, and to the eastern borders of Banff and Jasper National Parks. Big game hunters were asked to report wolf sightings in the western corner of Alberta in the 2012 and 2013 hunting seasons. Additional field surveys were conducted at predicted sites in 2012 and 2013. They combined wolf detection data from all survey methods into a patch occupancy model to estimate grey wolf pack abundance and distribution across the area of study. They did not obtain enough public sightings of wolves or reports of wolf activity from trappers in order to carry out the patch occupancy model. Surveys will be conducted again in summer 2014 for the predicted sites of wolf activity. A full study report is planned for 2015 that will suggest a wolf monitoring framework for use by Alberta Environment and Sustainable Resource Development (AESRD).

B.

Barclay, R. M. R., Baerwald, E. F., Gruver, J. C. (2007). Variation in bat and bird mortalities at wind energy facilities: Assessing the effects of rotor size and tower height. *Canadian Journal of Zoology, 85*, 381-387. doi:10.1139/Z07-011

Wind power is an excellent source of renewable energy and is a growing industry all over North America. There are many concerns about how wind turbines are affecting local and migrating

bird and bat populations all over the continent. This study assesses the influence that turbine size has on bird and bat fatalities by analyzing various data supplied by North American wind energy facilities. The results showed that tower height ultimately did not have an effect on bird populations but it did affect bat populations. Mitigation strategies are put forth by the authors such as minimizing tower height which may decrease the amount of bat fatalities.

Bean, J. R., Woessner, W. W., Muhlfeld, C. C., & Wilcox, A. C. (2015). Multiscale hydrogeomorphic influences on bull trout (*Salvelinus confluentus*) spawning habitat. Canadian Journal of Fisheries and Aquatic Sciences, 72(4), 514-526. doi:10.1139/cjfas-2013-0534

The study examined the effects of the landscape and water systems on the spawning of bull trout. It was found that bull trout preferred to spawn in the finest grained gravel substrates that are available in their habitat. It was found that the spawning beds would become mobilized in moderate to high streamflow. This mobilization can help prevent redd scour in current seasonal streamflow patterns. Bull trout redds were mostly found in unconfined alluvial valleys. It appears that multiple geomorphic, thermal, and hydrological factors influence bull trout reproductive success.

Belt, J. J., & Krausman, P. R. (2012). Evaluating population estimates of mountain goats based on citizen science. *Wildlife Society Bulletin, 36*(2), 264-276. doi:10.1002/wsb.139

This study examines the effectiveness of citizen science data in monitoring mountain goat populations in Glacier National Park, Montana. Data from both volunteers and biologists was compared in order to determine the accuracy of the estimates for mountain goat abundance. The study found that volunteer abundance estimates were affected by a lower mean detection probability but this effect was minimized from a higher frequency of visits. The abundance estimates from biologist data were significantly more variable than the estimates taken from volunteer data. The large scale of Glacier National Park creates unique challenges for monitoring wide ranging mountain goat populations and citizen science data can help monitor these populations. Citizen science data, in this context, was found to be statistically comparable to biologist data.

Benjankar, R., Jorde, K., Yager, E. M., Egger, G., Goodwin, P., & Glenn, N. F. (2012). The impact of river modification and dam operation on floodplain vegetation succession trends in the Kootenai River, USA. *Ecological Engineering, 46*, 88. doi:10.1016/j.ecoleng.2012.05.002

Many factors and areas are affected by dam construction. For plants, there is a sudden change in the hydrological factors. This not only involves a sudden lack of water, but also it often includes modification of the river in order to accommodate the construction of the dam. The effect on the riparian vegetation is studied in this paper. The researchers used a dynamic vegetation model and examined historic, pre-dam, and post-dam plant data and hydrological conditions. It was found that the locations that had colonization and cottonwood young transition vegetation were very similar to the historic conditions, but they declined in the post-dam environment. The reed and grassland vegetation, however, increased in post-dam environments compared to historical data. The results showed the effects of altered hydrological processes on riparian ecosystems.

Bingay main coal project. **(2012). (Project Proposal). British Columbia: Centermount Coal Ltd.**

The proposed coal coking project by Centermount Coal Ltd. would be placed in the Elk River Valley in southeast British Columbia within the "enhanced resource development zone". The proposed components of the project include an open pit and underground mine, permanent and temporary rock waste dumps, a rail line and load out, and processing factories. The coal plant would be 21 km north of Elkford and would produce two megatons per year of high quality metallurgical coal. The Rocky Mountain coalfields currently support five other large coal mines.

Bixler, R. P. (2014). ***Is there an heir apparent to the crown? A more informed understanding of connectivity and networked environmental governance in the Crown of the Continent*** **(Doctor of Philosophy).**

When dealing with environmental governance, people need to be aware that there is no point at which the governance can stop. The county lines are not indicators that the environmental work is done. In order to get correct governance for the ecosystems, many levels need to be assessed. The interactions between these levels are complex and interdependent. Unfortunately, so are the intergovernmental and stakeholder relationships that are necessary to govern the ecosystems. This need to consult all of the levels has greatly challenged the management of the ecosystems as a whole. It takes effort from all parties involved to face and conquer these challenges.

Blouin, F. (2006). ***The southern headwaters at risk project: A multi-species conservation strategy for the headwaters of the Oldman River vol 5: Landscape pressures on wide-ranging species.*** **(Alberta Species at Risk Report No. 107). Edmonton, AB: Alberta Sustainable Resource Development, Fish and Wildlife Division.**

The Southern Headwaters at Risk Project (SHARP) is an approach to species management that attempts to conserve species at risk of decline in the Oldman River basin. This particular volume of SHARP focuses on wide-ranging species such as mountain lion, lynx, marten, fisher, black bear, grizzly bear, grey wolf, golden eagle, elk, and other ungulates. For each species in southwestern Alberta, specific landscape pressures are identified resulting in a multi-species approach to conservation in the Oldman watershed. Identified threats to survival include habitat alteration, degradation, and loss through infrastructure development, resource extraction, and agriculture. Current landowner and management initiatives meant to reduce the impact of these human mediated activities are also discussed.

Bosak, K., Boley, B., & Kyla, Z. (2010). Deconstructing the 'Crown of the Continent': Power, politics, and the process of creating National Geographic's geotourism mapguides. ***Tourism Geographies, 12*****(3), 460-480. doi:10.1080/14616688.2010.494686**

This is an in depth study of the creation of National Geographic's geotourism mapguides with the criticism that no map or spatial representation of an area is ever objective. Every representation of physical location is laden with political, social, and cultural biases that result in two dimensional representations of places and spaces. Bosak, Boley, and Kyla contend that

maps are thus "power tools" used to construct preferred images of social and cultural boundaries and locations that often do not reflect local values or opinions. This interpretation of the mapguides created for tourists in the Crown of the Continent reveals why maps are abstract, social constructions that confer power differentials and economic value, and reveal the underlying politics of the information presented in the National Geographic map guides. It is suggested that tourism in the Crown of the Continent is being reshaped by documents such as these by fulfilling the creator's own interests as well as those of state and regional tourism operators.

Boulanger, J., & Stenhouse, G. B. (2014). The impact of roads on the demography of grizzly bears in Alberta: E115535. *PLoS One, 9*(12)doi:10.1371/journal.pone.0115535

Road networks, specifically roads built to for resource extraction, have fragmented grizzly bear habitat and put populations at risk. This study examines the effect road networks are having on grizzly bear mortality and reproductive success in Alberta. Researchers found that vulnerability to road mortality is age dependant, with juveniles and sub-adult bears being more vulnerable. Females with younger cubs had a higher vulnerability to road based mortality than females without cubs or mature cubs. A second objective of the study was to provide estimates of road density thresholds in order to minimize conflict and promote recovery. Females with young cubs, an essential demographic to population recovery, require thresholds much lower than mature and unattached grizzlies.

Boyer, M. C., Muhlfeld, C. C., & Allendorf, F. W. (2008). Rainbow trout (*Oncorhynchus mykiss*) invasion and the spread of hybridization with native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*). Canadian Journal of Fisheries and Aquatic Sciences, 65(4), 658-658. doi:10.1139/f08-001

Gene flow of the westslope cutthroat trout populations is a topic of great concern. The populations are continually being hybridized with other types of trout. The study took thirteen microsatellite loci in order to estimate the gene flow and the invasion of the hybrids in the Flathead River system. It was found that 14 of 31 sites had no introgression of the hybrids. However, the cutthroat trout are in great danger of becoming extinct by hybridization. Eradicating sources for the hybrids was the recommendation for conservation efforts for the trout.

British Columbia Southern Interior Invertebrates Recovery Team. (2011). *Recovery Strategy for Half-moon Hairstreak (Satyrium semiluna) in British Columbia and Alberta.* (Recovery Strategy). Victoria, British Columbia, Canada: British Columbia Ministry of Environment.

The half-moon hairstreak, *Satyrium semiluna*, is listed on the species at risk act as an endangered species in Canada. It was assessed by COSEWIC because of its small range which is widely restricted, and population decline has occurred as a result of habitat loss. The recovery of the half-moon hairstreak is biologically and technically achievable. The half-moon hairstreak is a small butterfly that has a brownish-black colouration (almost soot like). Their flight period is from May to June in British Columbia and from late June to July in Alberta. This is thought to be correlated with the flowering periods of the plants that provide nectar to the butterflies. The threats to the half-moon hairstreak are occurring from increased agricultural land use and development, as the butterflies' native habitat consists of dry arid grasslands found in both B.C

and Alberta. Additional threats, although they need to be studied and clarified further, include the increased competition from introduced animal and plant species that have resulted in habitat changes. Also, the butterflies have been impacted by domestic livestock overgrazing their habitat. The goal put forth by The Ministry Environment of British Columbia is to ensure the persistence of the population and distribution of the half-moon hairstreak in its specific range in Canada. The recovery objectives listed in this document include: (1) "To establish habitat protection for the eight known extant Half-moon Hairstreak locations", (2) "To assess and mitigate the extent of known and potential threats at each Half-moon Hairstreak location", (3) "To confirm the distribution of all populations (existing and new locations) of Half-moon Hairstreak in British Columbia and Alberta", and finally (4) "To address knowledge gaps such as life history, dispersal and population information, and habitat requirements."

British Columbia Southern Interior Invertebrates Recovery Team. (2011). ***Recovery Strategy for Half-moon Hairstreak (Satyrium semiluna) in British Columbia and Alberta.*** **(Recovery Strategy). Victoria, British Columbia, Canada: British Columbia Ministry of Environment.**

The whitebark pine is considered not only a foundation species, but also a keystone species within the Crown of the Continent and in the high elevation forest systems in Western North America. It is mainly anthropogenic and natural disturbances that are the main cause for the tree's rapid decline in numbers. The thesis looks at methods for long term restoration of the species and management of the whitebark pine ecosystems in the crown of the continent area. The purpose of the research is to shift the approach from a single species approach to management to a species in context approach. It was found that there are many different types of management being used for the whitebark pine within the different sub regions of the Crown of the Continent, and this is most likely due to the differences in the governments of those areas. Cooperation in the management of the species is largely driven by the legislative or mandated programs for the whitebark pine trees.

Burles, K., & Boon, S. (2011). Snowmelt energy balance in a burned forest plot, Crowsnest Pass, Alberta, Canada. ***Hydrological Processes, 25*****(19), 3012-3029. doi:10.1002/hyp.8067**

This study conducted in the Crowsnest Pass quantifies natural disturbance on forests in headwater basins. Due to changing climatic conditions such as enduring drought and increased air temperatures, potential for natural disturbances like wildfire and mountain pine beetle has increased. These highly susceptible forests also tend to be within snow-melt dominant hydrologic systems. Sub-canopy snow melt processes are highly affected by these disturbances, resulting in cumulative effects within the downstream watershed. Differences in energy balance were quantified between a representative plot of severe burning and a control plot on the edge of the boundary of the 2003 Lost Creek wildfire. Results indicated rapid snow melt and complete snowpack removal earlier in the burned plot than in the control plot. The author notes that these effects are comparable to those seen in cleared stands, but standing dead trees reduce the incoming effects of short wave radiation, wind speed, and temperature and also reduce snow accumulation. This implies that the impacts observed on snowpack melt have the potential to be more pronounced in cleared stands.

Burton, D. P. (2003). ***Reintroduction of Plains Bison to Waterton Lakes National Park: Considerations for a Feasibility Analysis.*** **(Feasibility Analysis). Waterton Lakes National Park, Alberta, Canada: Waterton Lakes National Park.**

The dominant herbivore that ruled the North American plains until political, environmental, and economic factors drove them extinct was the plains bison, *Bison bison bison*. During the 20th century recovery efforts were taken to try and recover the species but agriculture, natural resource extraction, urban development, and ranching but they were ineffective. Bison populations have ultimately been isolated due to these causes. The purpose of this particular report is combine all information that will help to assist park managers in assessing how feasible it is to reintroduce this species to Waterton Lakes National Park and to potentially develop a plan. Ecological, archaeological, historical, and visitor risk considerations were taken into account. The report also actively outlines possible reintroduction scenarios and operations considerations for the reintroduction of bison to Alberta.

C.

Canadian Environmental Assessment Agency. (2013). ***Environmental impact statement guidelines - Bingay main coal mine project.*** **Canadian Environmental Assessment Agency.**

This document identifies the information requirements of the Environmental Impact Statement. It specifies the nature, scope, and extent of the information available. The goal is to find the potential changes in the environment and give thorough evaluations of the effects on the environment that will occur from the project.

Carroll, C., Noss, R. F., & Paquet, P. C. (2002). ***Rocky Mountain Carnivore Project Final Report.*** **(Final Report). World Wildlife Fund.**

The goal of this report is to develop biological information that is necessary in order to conserve various carnivore species in the Rocky Mountains. They synthesized data and available knowledge into predictive models for carnivore habitat and population which will allow them to identify the areas that are most suitable for carnivore species across the landscape. From this information they can also forecast how populations react to alternative scenarios that may be present in the future. This will ultimately be used to make recommendations for future management and protection plans in an effort to conserve the large variety of carnivore species that call this region home.

Castle Mountain Resort Board of Directors. (2003). ***Castle mountain resort area structure plan.*** **(Structure Plan). Castle Mountain Resort, Alberta, Canada.**

This document identifies the information requirements of the Environmental Impact Statement. It specifies the nature, scope, and extent of the information available. The goal is to find the potential changes in the environment and give thorough evaluations of the effects on the environment that will occur from the project. The Castle Mountain Resort has been a ski facility since 1966 in southwestern Alberta. The structure plan focuses on the need to balance the difficulty of the hills to meet the needs of the skiers and it also looks at the infrastructure that will balance the skier visits so they are not all occurring on the weekends. The purpose of the plan is to help with the management of the land use in the area.

Castle rare and invasive plant survey. **(2005). (Survey). Alberta Wilderness Association.**

The management of natural resources may be greatly helped by the knowledge of the rare plants in an area. Rare plants are highly susceptible to any changes within the environment, and thus may be very useful for management. A survey of rare plants that occurred over three years was started in the Castle region. 43 species were surveyed over the three year period. 17 rare plants were found in the first year, 32 in the second, and only 12 in the third. They surveyed the weeds that were present in the area. The study discussed the results of the rare plant and weed surveys. They also discussed the disturbance factors present in the study area and their effects on the rare plant species.

Cegelski, C. C., Waits, L. P., & Anderson, N. J. (2003). Assessing population structure and gene flow in Montana wolverines (*Gulo gulo*) using assignment-based approaches. *Molecular Ecology*, 12(11), 2907-2918. doi:10.1046/j.1365-294X.2003.01969.x

The wolverine population in northwestern Montana is the best candidate for long term survival and recovery. Recruitment from the Canadian populations to the north is essential to the recovery process. Researchers aimed to track the gene flow and genetic structure of the Montana wolverine population using 10 polymorphic microsatellite loci. There is evidence to support male biased dispersal and a population substructure capable of supporting three subpopulations. However, there is evidence to support the claim that the fragmented Montana population has lower levels of gene flow than larger populations to the north.

Cerney, D., Butler, D., & Eyton, J. (2008). Assessing landscape change in Waterton Lakes National Park, Canada, using multitemporal composites constructed from terrestrial repeat photographs. *Geocarto International*, 23(5), 347-371. doi:10.1080/10106040801966654

A 90 year image analysis conducted in Water Lakes National Park (WLNP) used satellite image analysis to process georegistered images of the montane valley bottom eco-regions. By producing multi-temporal plant classification analyses from images of Bellevue Hill, Horseshoe Basin, and Lakeview Ridge from photographs taken between 1914 and 2005 it was possible to observe changes in spatial cover conditions. Vertical spread of forest cover was indicated along the higher elevations of Lakeview Ridge and on the hills behind Horseshoe Basin. Proliferation of conifer and aspen species on the eastern slopes of Bellevue Hill was also observed. Meadow composition along Lakeview Ridge appears to have changed over the 90 years survey period.

Clark, A. M., Harper, J. T., & Fagre, D. B. (2015). Glacier-derived August runoff in northwest Montana. *Arctic, Antarctic, and Alpine Research, 47*(1), 1-15. doi:10.1657/AAAR0014-033

Researchers studied glacially derived runoff in Glacier National Park, Montana. The rapid disappearance of glaciers is a cause for concern and this study was conducted to help determine how changing runoff levels impact water scarcity. Measurements were taken from five remote glaciers in order to create a model examining local glacial melt. Researchers found that the glaciers produced more meltwater than expected during the month of August, and over time this loss could lead to a decrease in discharge in local rivers and streams.

Clark, J. (2002). ***Southern Bighorn Sheep Survey 2002 (WMUs 306, 308, 400, 402).*** **(Wildlife Survey). Blairmore, Alberta, Canada: Sustainable Resource Development, Fish and Wildlife.**

From February 25th to March 21st 2002 an aerial census of bighorn sheep populations was conducted in eight different wintering areas. The survey that took place on February 25th followed a large snowfall and then was deferred following a chinook. It resumed on March 25th following another snowfall that lead to high quality conditions. Approximately 628 bighorn sheep were surveyed during this time period.

Clevenger, A. P., Fisher, J., & Schwartz, M. (2014). ***Identifying conservation corridors and linkages in the southern Canadian Rocky Mountains.*** **(Wolverine Hair Snare Survey). Alberta, Canada.**

Shared wildlife populations are an integral part of the greater Crown of the Continent Ecosystem (CCE). The Canadian population of wolverine is essential to the recovery of the northern U.S. population. The CCE is currently being fragmented by industrial development, road networks, and motorized recreational vehicles. This study examined wolverine populations in Canadian protected areas within the Crown of the Continent as well as Glacier National Park by gathering genetic and occupancy data through hair snares. This report details the results from three years of initial research as part of a greater long term landscape level study of the wolverine in the CCE. Twenty hair traps were set up, six were located in Waterton Lakes National Park and the rest were located in the greater Crowsnest area of Alberta. The study found that naive occupancy rate for the Waterton-Crowsnest area was 8.33%, this preliminary occupancy rate from the first three years of research is much lower than other Canadian regions.

Clevenger, A. P., Mowat, G., & Fisher, J. (2015). ***Mapping the wolverine way: Identifying conservation corridors and transboundary linkages in the Canadian Crown of the Continent.*** **(Summary Report).Alberta-British Columbia Survey.**

The Canadian side of the Crown of the Continent has proven to be a crucial habitat for the wolverine. This habitat supplies individuals and genes from the Canadian population to the highly fragmented population situated in the northern United States Rocky Mountains. The Crowsnest Highway is known to fragment this crucial landscape. The goal of this project/survey is to obtain spatial information regarding the wolverine population, habitat, and connectivity in the Crown of the Continent transboundary region. This particular study was conducted in the Canadian portion of the Crown of the Continent ecosystem between British Columbia and Alberta. Data was collect from January 2015 to April 2015 using hair and camera sampling. The estimated occupancy of wolverines in the B.C. and Alberta region was 25% and the estimates were found to decrease from north to south with no differences in wolverine occupancy from east to west. The study has planned to further its data collection in 2016 in order to complete a range of samples through the Rocky Mountains. The results from the planned collective 6-year research study will be used in decision making regarding land use management, wolverine harvesting at the federal, provincial, and state levels, and transboundary conservation work in the Crown of the Continent.

Clevenger, A., Apps, C., Lee, T., Quinn, M., Paton, D., Poulton, D., & Ament, R. (2010). ***Highway 3: Transportation mitigation for wildlife and connectivity.*** **(Final Report). Bozeman, Montana.**

Highway 3, as well as differing land use and development around the highway, has greatly affected the connectivity of the wildlife in the area. This disruption of habitat connectivity has created a major problem for the conservation efforts and management of the wildlife in the area. The report is meant to reflect the best available understanding of wildlife management options for the highway and adjacent land to improve habitat connectivity for wildlife.

Coal mountain phase 2. **(2014). (Project Proposal). British Columbia: Teck Coal Limited.**

This project proposes to create an extension of an existing operation. The project area will be 20 km northwest of an existing operation on the Marten and Wheeler Ridges in southeast British Columbia. The proposal would allow for the creation of an open pit mine, roads, coal stockpile, pits, waste spoils, site-specific maintenance, and office facilities. Teck is currently producing 6 megatonnes of metallurgical coal per year. The expansion would increase the production by 3.5 megatonnes per year.

Conrad, J. M., Gomes, C. P., van Hoeve, W., Sabharwal, A., & Suter, J. F. (2012). Wildlife corridors as a connected subgraph problem. ***Journal of Environmental Economics and Management*****, 63(1), 1-18. doi:10.1016/j.jeem.2011.08.001**

In order to connect wildlife that have been separated by roads, many wildlife corridors are created to help with the connectivity of species in areas of biological significance. The goal of the corridors is to mitigate ecological habitat fragmentation. This paper tries to find the optimal corridor design that links suitable ecosystems and balances the funds that are available. A hybrid format was suggested to create an optimal structure in order to solve the some of the connectivity problems the researchers faced. The approach is fairly general and can be applied to help multiple species with similar problems.

Copeland, J. P., & Yates, R. E. (2008). ***Wolverine population assessment in Glacier National Parks.*** **(Comprehensive Summary). Missoula, Montana, USA: USDA Forest Service.**

The Glacier National Park Wolverine Research Project conducted a study that included live trapping and monitoring wolverines using radio instruments. This was done to study their reproductive status, distributions, and rendezvous sites. Female wolverine dens were also located. A total of 28 wolverines were captured. 23 reproduction sites for six of the recorded females were documented. Approximately seven kits were captured and instruments were placed at their den sites. The kits were monitored during their first summer with their mothers. It was observed that kit survival was fairly low. Causes of death were found to be predation, falling from cliffs, and hunting. Data showed that wolverine home ranges were approximately 521 square kilometers for males and approximately 139 square kilometers for females. The project also used DNA profiling which ultimately indicated that there is a limited population structure and only a small number of males contribute to the genetic variation of the species.

Craft, J. A., Stanford, J. A., & Pusch, M. (2002). Microbial respiration within a floodplain aquifer of a large gravel-bed river. Freshwater Biology, 47(2), 251-261. doi:10.1046/j.1365-2427.2002.00803.x

The microbial oxygen production in the Flathead River is a great contributor to the ecosystems present there. The study examines the aerobic respiration and the carbon turnover rate from the microbial biofilms present in the Flathead River. Samples were taken from both hyporheic and phreatic sites to a laboratory where the researchers increased the organic carbon present in the water and then tested the respiration rates. It was found that there was a change from 0.01 to 0.33 mg of O_2 across the sites. The productivity of the microbes was much greater than the benthic productivity. The conclusion was that these microbes are essential to the ecosystem of the Flathead River. The studies did show the main production of the microbial was in the floodplain, and not in the river itself.

Crown mountain coking coal project. **(2014). (Project Proposal). British Columbia: NWP Coal Canada Ltd.**

The Crown Mountain Coal Project proposes the creation of an open pit mine, rock waste dumps, processing and support facilities, roads, a rail line, and load out facilities in the Elk Valley. The mine would produce 3.7 megatonnes of coal per year.

D.

De la Giroday, H. C., Carroll, A. L., & Aukema, B. H. (2012). Breach of the northern Rocky Mountain geoclimatic barrier: Initiation of range expansion by the mountain pine beetle. Journal of Biogeography, 39(6), 1112-1123. doi:10.1111/j.1365-2699.2011.02673.x

The study examines the relatively recent range expansion of the mountain pine beetle into the seldom occupied Rocky Mountain climatic zone. Mountain pine beetle populations are now threatening eastern pine forests after migrating west through the northern continental divide ecosystem. The researchers studied the possible mechanisms of this range expansion from the beetle's native southwestern British Colombia: transport of infected plant material by humans, corridor migration, and changing atmospheric conditions.

Dingwall, P. R., & Canadian Public Policy eBooks. (2009). ***Waterton-Glacier International Peace Park (Canada and USA): Report of the reactive monitoring mission, 20 to 27 September 2009 [IUCN/WCPA & UNESCO]*** **Yellowstone to Yukon Conservation Initiative.**

This report summarizes a seven day mission undertaken by UNESCO and IUCN to assess the Waterton International Peace Park and surrounding area. Locations in Montana, British Columbia, and Alberta were visited, and particular attention was placed on the transboundary flathead basin. Discussions and presentations took place with state, federal, provincial, local, and NGO representatives. The purpose of this mission was to monitor conservation in the International Peace Park while accessing the Outstanding Universal Value of the area.

Doubt, J. C. (2001). ***Distribution patterns of moss conservation value with implications for conservation management: A case study of Waterton Lakes National Park*** **(M.Sc.). Available from ProQuest Dissertations & Theses Global. (304739069). Retrieved from http://library.mtroyal.ca:2092/docview/304739069?accountid=1343**

The management of the floristic resources in Waterton Lakes National Parks depends on the establishment of a flora conservation necessity-based management plan. In the study, mosses are categorized and their conservation priorities are assessed. The spatial and environmental cues and the value of the distribution of the mosses are considered for conservation purposes. The results of the study give conservation a good base for future management decisions.

Duke, S., Anders, P., Ennis, G., Hallock, R., Hammond, J., Ireland, S., . . . Westerhof, R. (1999). Recovery plan for Kootenai River white sturgeon (*Acipenser transmontanus*). *Journal of Applied Ichthyology, 15*(4-5), 157-163. doi:10.1111/j.1439-0426.1999.tb00226.x

The white sturgeon (*Acipenser transmontanus*) is an endangered species that lives in the Kootenai River, and has been in decline since the mid 1960's. This population was isolated from other sturgeon about 10,000 years ago in the last ice age. The decline in this population has been caused by human intervention. Industrial developments, floodplain diking, and the building of dams has caused alteration in the sturgeon's spawning, incubation, and rearing success. It has also reduced the biological productivity of the fish. A draft recovery plan was set into motion in order to save this species. In this plan, the short-term goals are to stop extinction and to re-establish successful natural recruitment. The long term goals are to re-establish the population, protect the current habitat, and to restore the habitat that has been lost. It was recommended that there be monitoring and research conducted in the future to ensure the survival of this species.

Duke, S. D., & Hallock, R. (2001). Recovery progress report for the endangered Kootenai River white sturgeon, *Acipenser transmontanus*. *Endangered Species Update, 18*(3), 75.

The white sturgeon, *Acipenser transmontanus,* was listed as endangered in 1994 mostly due to the human activities affecting their reproductive patterns. There was a recovery plan set into action. It may take years to know if the recovery plan has worked, but so far there has been completion of or partial completion of all but four of the originally proposed tasks. The future looks good for the sturgeon in the area, as long as the recovery plan is continued.

Duke, D., Quinn, M., Butts, B., Lee-Ndugga, T., & Wilkie, K. (September, 2003). ***Spatial analysis of rural residential expansion in southwestern Alberta.*** **Calgary, AB: Miistakis Institute for the Rockies.**

The human population and footprint within the Crown of the Continent area has greatly increased. The Crown of the Continent Ecosystem (CCE) has been under great pressure from the continual increase in the human presence and the demand of resources that goes along with it. The most notable effect of human population has been habitat fragmentation. In order to protect the environment, and keep up with the expansion of the rural community, there needs to be greater management of the type and location of new business and residential developments within the Crown of the Continent Ecosystem.

Dykstra, P. R., & Braumandl, T. F. (2006). ***Historic Influence of Mountain Pine Beetle in Stand Dynamics in Canada's Rocky Mountain Parks.*** **(Mountain Pine Beetle Initiative Working Paper 2006-2015). Victoria, British Columbia, Canada: Natural Resources Canada, Canadian Forest Service.**

The mountain pine beetle (*Dendroctonus ponderosae*) is a major forest disturbance that is also known to contribute to ecosystem recovery as well as to help maintain biological processes. This paper discusses the historic unmanaged forests of two particular ecosystems in Rocky Mountain national parks: one in Kootenay, Banff, and Yoho National Parks, and the other in Waterton Lakes National Park. They measured the structural attributes of the mountain pine beetle as well as the species composition and found that the mountain pine beetle greatly influenced the structure and composition of the two ecosystems that were studied.

E.

Egger, G., Politti, E., Lautsch, E., Benjankar, R., Gill, K., & Rood, S. (2015). Floodplain forest succession reveals fluvial processes: A hydrogeomorphic model for temperate riparian woodlands. ***Journal of Environmental Management*****, 161, 72-82. doi:10.1016/j.jenvman.2015.06.018**

A hydrogeomorphic model was developed as part of this study to help better understand riparian habitat and successional patterns. Researchers examined naturally flowing and dammed reaches of the Flathead and Kootenai Rivers of Idaho, Montana, and British Columbia. A strong relationship was found between fluvial vegetation measurements and erosion. Local successional patterns were dependant on hydraulic processes in that area. Spatial patterns in vegetation differed strongly from naturally flowing areas to dammed sections.

Eisenberg, C. (2012). ***Complexity of food web interactions in a large mammal system*** **(Doctor of Philosophy in Forest Resources).**

Food webs are a complex combination of predator and resource driven effects. This dissertation looks at food web relationships between the predation of elk (*Cervus elaphus)* by the wolf (*Canis lupus)*, elk herbivory of aspen (*Populus tremuloides),* and the effects of fire. The study took place in the heart of the Crown of the Continent Ecosystem where observation locations included the North Fork Valley in the western portion of Glacier National Park, the Waterton Valley in the eastern part of Waterton Lakes National Park, and finally, the Saint Mary Valley in the eastern part of Glacier National Park. The objective of this dissertation was to investigate bottom-up (fire) and top-down (predation risk) factors and context dependence of these various relationships with data collection occurring over a period of three years. Overall it was found that wolf predation alone did not drive the food web interactions that were being specifically studied. Ultimately, bottom-up and top-down forces were found to work cohesively in the valleys that contained well established wolf population**s.**

Eisenberg, C., Hibbs, D. E., & Ripple, W. J. (2015). Effects of predation risk on elk (*Cervus elaphus*) landscape use in a wolf (*Canis lupus*) dominated system. *Canadian Journal of Zoology, 93*, 99-111. doi:dx.doi.org/10.1139/cjz-2014-0138

Some key drivers of herbivore behaviour is acquiring food as well as avoiding predators. The purpose of this paper is to investigate the interactions between bottom-up (food, fire, and thermal) and top-down (predation) effects on elk (*Cervus elaphus*) population by wolves (*Canis lupus*). Wolf scat and fecal pellet sample surveys were conducted at three wolf population levels in three specific valley areas: Saint Mary (low population levels), Waterton (moderate population levels), and North Fork (high population levels). All three valleys were found to have high elk pellet density, and wolf scat density was found to be similar where there was no fire, but was higher than elk pellet density in burned areas. Predation was higher in the North Fork Valley, and therefore showed lower elk pellet density. Overall the methods that were best at predicting elk density in a particular region resulted in both top-down and bottom-up effects. It was found that predation risk influenced elk occurrence negatively which promoted the idea that even minimal amounts of wolf exposure caused elk to avoid these sites.

Elliott, J. (2002). *Wolverine Conservation in Waterton Lakes National Park, Alberta.* (Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada.

Gulo gulo luscus, the wolverine, is a carnivore found in the mountainous regions of Waterton Lakes National Park. There have been no intensive studies done on this species. The purpose of this report is to compile all wolverine data, known sightings, and tracks that will allow further research and identify monitoring requirements for park managers. This report also lists what is considered high quality wolverine habitat in Waterton Lakes National Park, and provides recommendations and survey methodologies that could be used in the future.

Ellis, B. K., Stanford, J. A., Goodman, D., Stafford, C. P., Gustafson, D.L., Beauchamp, D. A., . . . Carpenter, S. R. (2011). Long-term effects of a trophic cascade in a large lake ecosystem. Proceedings of the National Academy of Sciences of the United States of America, 108(3), 107-1075. doi:10.1073/pnas.1013006108

The expansion of *Mysis diluviana*, the opossum shrimp, caused far reaching impacts on the trophic cascade of Flathead Lake. The disturbance caused by the introduction of the crustacean reverberated throughout the ecological community over a 120 year record collected at Flathead Lake Biological Station. Temporal data from biophysical measurement in primary side channels and aerosol deposition signalled an opossum shrimp population explosion in Flathead Lake between 1958 and 1988 which peaked and crashed at less than half of the peak population density. This crash quickly contributed to a rapid decline of kokanee populations. This has resulted in the present day non-native community composition which is dominated by opossum shrimp and a robust population of lake trout. The shrimp provide the trout with a deep water food source. This turnover of species has resulted in extirpation of kokanee and imperilment of native cutthroat and bull trout. These compositional changes result in high trophic impacts redirecting energy flow in a manner that is felt even by large apex predators such as bald eagles. Predictions of Cascading Trophic Interactions (CTI) include that introduction of piscivores, such as bald eagles, will reduce the population density of

planktivores like lake trout. The CTI also predicts that the interactors which induce the most population-level instability will induce permanent change in the food web.

F.

Flood, J. P., & McAvoy, L. H. (2007). Use of national forests by Salish-Kootenai tribal members: Traditional recreation and a legacy of cultural values. *Leisure/loisir, 31*(1), 191-216. doi:10.1080/14927713.2007.9651378

The purpose of this study was to examine how the Salish- Kootenai tribe of Montana uses and values National Forests in both historical and contemporary contexts. Researchers aim to provide National Forest managers with information on how changes in these areas impact the Salish-Kootenai tribe members. Information was gathered by interviewing 60 members on the Salish-Kootenai tribe. The study found that the tribe uses surrounding National Forests for a diverse set of outdoor activities. The tribe members expressed barriers to land use such as management policies and racism or a lack of understanding from non-native populations.

Fockler, M. N. (2014). *The national forest imperative: A historical geography of national forest landscapes, northern Rockies, Montana* (Ph.D.). Available from ProQuest Dissertations & Theses Global. (1564037247).

This dissertation focuses on the complex historical, social and landscape relationships associated with changing management and use of National Forests in the Crown of the Continent. A case study of the Rocky Mountain Division of the Lewis and Clark National Forest is used to examine landscape change, management and policy. Cultural, political, and social attitudes towards nature and land use are discussed.

Fondell, T. F., & Ball, I. J. (2004). Density and success of bird nests relative to grazing on western Montana grasslands. Biological Conservation, 117(2), 203-213. doi:10.1016/S0006-3207(03)00293-3

Common bird species of the western Montana grasslands are facing decline. The researchers examined nest density in both ungrazed and grazed areas. The study found that nest density correlated strongly to the visual obstruction of vegetative cover. Birds selected nesting sites based on the evenness of vegetative cover across the plot area. Grazing affected nest density by altering the number of suitable nesting sites. In two of the ten species studied nest success was lower in grazed plots than in ungrazed plots, although this was not found to be a contributing factor to nest success in the other species.

Foottit, R. G. (2001). *Research summary: Collections in Waterton Lakes, Banff and Jasper National Parks under permit # 2001-35: 1) lygus bugs; 2) aphids.* (Summary Report).

Lygus bugs cause significant damage to agricultural crops. The article summarized the systematic research conducted on a lygus bug population in both Waterton Lakes National Park and Banff National Park. There was initial representation from four lygus bug species found in the collection sites.

Forde, T., Kutz, S., De Buck, J., Warren, A., Ruckstuhl, K., Pybus, M., & Orsel, K. (2012). Occurrence, diagnosis, and strain typing of *Mycobacterium avium* subspecies *paratuberculosis* infection in Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) in southwestern Alberta. *Journal of Wildlife Diseases, 48*(1), 1-11.

Many wildlife species, including the Rocky Mountain bighorn sheep, *Ovis canadensis canadensis*, play a key role in the transmission of *Mycobacterium avium* subspecies *paratuberculosis* which is known to cause Johne's disease. A young male Rocky Mountain bighorn sheep was found in 2009 to be infected with the disease. It was found through bacterial isolation in a bighorn sheep fecal culture and three out of forty four fecal samples tested positive for this strain of bacteria and fecal samples taken from distant bighorn sheep populations all tested negative for the bacteria strain. These detailed molecular analyses taken in southwestern Alberta are crucial to understand how these diseases can be transmitted to other wildlife as well as livestock.

G.

Gailus, J. (2010). *A grizzly challenge, ensuring a future for Alberta's threatened grizzlies.* (Report).Canadian Parks and Wilderness Society.

This report draws attention to Alberta's vulnerable grizzly bear population following the research done in the "2010 Status of the Grizzly Bear Report in Alberta" conducted by the Government of Alberta. Grizzly bear populations are being impacted by industrial activities, road networks, and proximity to human activity. According to this report Alberta's grizzly bear population is going to decline by 30% in the coming 36 years under the current conditions. The importance of minimizing conflict between humans and grizzlies is essential to the future survival and recovery of the species. Concern is raised over the reduction in the area allotted for grizzly bear habitat and recovery by the Alberta government recovery plan. Many of the grizzly's habitat requirements are not being met under current policies, putting the threatened population at greater risk of decline.

Gailus, J. (2014). *Failing B.C.'s grizzlies: Report card and recommendations for ensuring a future for British Columbia's grizzly bears.* Vancouver, BC, CAN: David Suzuki Foundation.

This study aimed to assign a grade to the current grizzly bear management measures being implemented. According to this report card B.C's grizzly bear management should be assigned a failing grade. The government has not honored their commitment to protect and minimize the threats to this species. Some progress has been made in the scientific monitoring and public awareness of the grizzly population, however, the government is failing to have a meaningful impact in the field. The B.C. government has found that habitat exists and can support a healthy grizzly bear population, but measures have not been taken to designate and set aside management areas for this species.

***Going-to-the-Sun Road rehabilitation plan/ final environmental impact statement.* (April 2003). (Impact Statement). Glacier National Park: US Department of the Interior National Park Service.**

The structural integrity of the Going-to-the-Sun Road has been greatly impacted in recent years, and Glacier National Park is looking to rehabilitate the road and correct the structural problems. The rehabilitation of the road would improve safety, preserve the cultural value and the historical value of the road, as well as improve the visitor rates to the area. The most effective method would balance the conservation efforts, historical and scenic value, and visitor needs.

Graham, A. L. (2003). Effects of snail size and age on the prevalence and intensity of avian schistosome infection: Relating laboratory to field studies. Journal of Parasitology, 89(3), 458-463. doi:10.1645/0022-3395(2003)089[0458:EOSSAA]2.0.CO;2

The avian schistosome *Trichobilharzia ocellata* is a waterborne parasitic infection that requires both an avian and snail host to complete a lifecycle. A population of snails, *Stagnicola elrodi*, in the Flathead Lake of Montana was studied to determine if snail size was correlated to the extent of parasitic infection. In the lab there was a positive correlation between snail size and parasitic intensity. However, in the field it is more likely that size is primarily correlated to age and not parasitic intensity inducing gigantism.

Grant, J. A. (2005). *Driving forces and barriers to transboundary wildlife management: The Crown of the Continent Ecosystem experience* (M.Sc.). Available from ProQuest Dissertations & Theses Global. (305028830).

This dissertation examines the barriers to conservation efforts in the Crown of the Continent Ecosystem. The jurisdictional borders often create barriers to the borderless ecosystem and transient wildlife populations. This study acknowledges the need for more collaborative efforts that cross borders. The dissertation compares multinational European management approaches to that of the Crown Managers Partnership. Interviews with stakeholders, managers, and biologists were conducted in order to determine the barriers to cooperative management.

Grant, J. A., & Quinn, M. S. (2007). Factors influencing transboundary wildlife management in the North American 'Crown of the Continent'. *Journal of Environmental Planning and Management, 50*(6), 765-782. doi:http://library.mtroyal.ca:2063/loi/cjep20

Migratory wildlife and ecoregions are particularly vulnerable when managed over multiple jurisdictions. In the interest of conserving and preserving current wildlife populations, the researchers argue that transboundary management approaches must be adopted. The barriers discussed are financial, administrative, and institutional. Researchers interpret interviews with managers, biologists, and stakeholders in order to better understand these barriers to transboundary conservation and offer broadly applicable recommendations.

***Grassy mountain coal project.* (2015). (Project Proposal). Alberta: Riverside Resources.**

Located seven kilometers north of Blairmore in the Crowsnest pass of Alberta, a proposed open pit mine is slated to produce 3000 tonnes of metallurgical coal per day. Riversdale Resources Limited has held the lease for the Grassy Mountain property since 2013. Exploration is currently underway to determine coal quantity and quality. The 2800 ha surface mine development would require additional structures to be built in order to support operations.

Grassy mountain coal project: Terms of reference for environmental impact assessment report. **(2015). (Environment Impact Assessment). Alberta: Benga Mining Limited.**

The Grassy Mountain Coal Project Environmental Impact Assessment (EIA) deals with the environmental concerns of the public, discusses them, as well as explores possible ways that these concerns can be met. They also look at the concerns of the aboriginals in the area. The EIA considers the impacts on the environment as well as the socioeconomic effects of the entire project. It also examines appropriate areas for the project to be constructed in and the overall effects of the project in this area of study.

Graves, T. A. (2012). ***Spatial ecology of grizzly bears in northwestern Montana and estimating resistance to gene flow*** **(Doctor of Philosophy in Forest Science).**

The effect of habitat characteristics on grizzly bear populations was examined. Vegetative and habitat characteristics affected grizzly populations, as well as mortality risks. The study found that current population distribution followed the pattern seen in the past. Simulations and models were used to determine the effect of landscape characteristics on population gene flow, isolation, and composition.

Gray, Q. Z., Fraser, D. J., & Grant, J. W. (2014). Extirpation for conservation: Applying predictors of extinction risk to eradicate introduced trout populations for lake restoration. Ecological Restoration, 32(1), 59-67.

Non-native trout species must be eradicated in order to restore the lakes of Waterton Lakes National Park. However, the self-sustaining fish populations existing in these lakes must be studied further. This study developed linear models based on proportion of females and mature individuals within the population, catch per unit effort, and mature trout length. Abundance and length differed significantly between mountain lake populations but not the proportion of mature individuals or females. These measures were then used to determine each population's vulnerability to extinction. The study found that two populations in the Lineham basin were most vulnerable to eradication due to low population densities and are, therefore, prime candidates for management.

Guidelines for the preparation of an environmental impact statement: Coal mountain phase 2 project. (2012). Teck Coal Limited.

This document is used to supply the required information that is needed to create an environmental impact assessment for Coal Mountain phase 2 in southeast British Columbia.

Guidelines for the preparation of an environmental impact statement: Grassy mountain coal project. **(2012). Benga Mining Limited, Riversdale Resources Limited.**

This document is used to outline the required information that is needed to create an environmental impact statement for the Grassy Mountain Coal Project in the Crowsnest Pass region.

Hall, M. H. P., & Fagre, D. B. (2003). Modeled climate-induced glacier change in Glacier National Park, 1850-2100. *Bioscience, 53*(2), 131-140.

In 1850 the Blackfoot-Jackson glacier basin had glaciers that encompassed 21.6 square kilometers, and they receded to only 7.4 square kilometer by the year 1979. The climatic changes and their effects on the ecosystem were analyzed, and from this data two models were created. The models were developed to predict the effects of future impacts and the size of the glaciers. The first model simulated the effects of climate change caused by excess carbon in the atmosphere, and the second model simulated the effects of climate change under normal atmospheric conditions. It was found that all of the glaciers would be gone by the year 2030 under the first model, and under the second model, the melting would be greatly slowed.

H.

Hall, W. L., Zuuring, H. R., Hardy, C. C., & Wakimoto, R. H. (2003). Applying logistic regression to determine regeneration risk to stand replacement fire on the Kootenai National Forest, Montana. *Western Journal of Applied Forestry, 18*(3), 155.

In 1994, fire managers in Kootenai National Forest observed that there was a difference in the amount of regeneration that occurred, or if it occurred at all, with wildfire running through the areas. They set out to create triage for the areas and to prioritize management. A logistic regression model was applied to the data from a set of region stands. From this model odds ratios were established and used to identify the regeneration stands or areas that were most at risk.

Hancock, J. (2002). *Arachnological survey of Waterton Lakes National Park, Alberta, Canada, 2002.* (Arachnid Survey). Pincher Creek, Alberta, Canada.

This survey strives to develop an inventory of all species of Arachnida (spiders) that are present in Waterton Lakes National Park. This will ultimately contribute to potential biodiversity indicator taxa by developing a database of all species present.

Hardy, R., & Paragamian, V. (2013). A synthesis of Kootenai River burbot stock history and future management goals. *Transactions of the American Fisheries Society, 142*(6), 1662-1670. doi:10.1080/00028487.2013.790845

The burbot fish, *Lota lota*, is an endemic species in the Kootenai River. The burbot fishery in this area was once a major contributor to the economy of Idaho. This fishery was shut down in 1992 due to the damage that the construction of a dam caused to the burbot population. Construction started on the dam in 1972 and since then the fishery greatly declined. The construction of the dam caused the river's nutrient concentration, temperature, and seasonal discharge to change. The effect of this change was the most apparent in the winter when the burbot fish spawn and migrate. It is essential that the operational discharge of the dam be changed in the winter to maintain the temperature and flow rate necessary for this species to spawn and migrate effectively.

Hardy, R. S., Stephenson, S. M., Neufeld, M. D., & Young, S. P. (2015). Adaptation of lake-origin burbot stocked into a large river environment. *Hydrobiologia, 757*(1), 35-47. doi:10.1007/s10750-015-2226-0

The burbot, *Lota lota maculosa*, river population has rapidly declined due to the habitat changes that have occurred since the construction of the Libby Dam. There has been a conservation strategy utilized to help save this species. The river is currently being stocked using fish from a self-sustainable lake population. It has been found that the introduced fish are adapting, dispersing, and there are good survival rates of the stocked population. It appears that these stocked fish are going back to the historical use of the habitat and are occupying historical locations. It has been shown that this species can successfully survive, grow, disperse, and spawn in a river ecosystem.

Hauer, F. R., Stanford, J. A., & Lorang, M. S. (2007). Pattern and process in northern Rocky Mountain headwaters: Ecological linkages in the headwaters of the Crown of the Continent. *Journal of the American Water Resources Association, 43*(1), 104-117. doi:10.1111/j.1752-1688.2007.00009.x

The Crown of the Continent Ecosystem is full of many different species and habitats. With this area holding the headwaters for most of the continent's rivers it is of great concern that the headwaters are being affected by human activity. The alluvial floodplains are known for their high species diversity. However, the nutrients in the system are low. One of the ways that these nutrients are restored in the water system is through fire, which can supply nutrients for as many as five years. The natural fire patterns in the CCE are being disrupted. Sediment transport from the logging in the area, as well as the roads that are continually being placed is also a concern. The biggest contributors to sediment transport are the coal and gas fields present in the northern part of the ecosystem. The transport of the sediments is directly affecting the spawning of the native trout. If something doesn't change, then the ecosystem and everything in it will be greatly affected for the worse.

Haufler, J. B., & Carolyn, A. M. (May, 2002). *Development of the trans-boundary ecoregions for the Yellowstone to Yukon planning area.* Seeley Lake, MT: Ecosystem Management Research Institute.

An ecoregion is a region that reoccurs predictably throughout a local ecosystem. This project aimed to publish a map of classified ecoregions spanning the Y2Y corridor. Inherent to this process was that development an organizational system to describe and delineate spatial boundaries of historic and persisting ecosystems. This also consolidated the Bailey (1995) systems of classification, British Columbia's Ecoregional Classification (www.env.gov.bc.ca), and Canada's National Ecological Framework systems of classification, all of which have previously been used for mapping in this area.

Hernandez, S. (2008). Mountaintop removal at the Crown of the Continent: International law and energy development in the transboundary Flathead River basin. *Vermont Law Review, 32*(3), 547-581.

Transboundary water resources and their management have far reaching implications for numerous jurisdictions. The Flathead River travels through both Canada and the United States and mining and resource extraction in British Columbia is currently putting these waters at risk. The recent proposal put forward by Cline Mining Company for an open pit coal mine in Foisey Creek could negatively impact the waterways in that area and downstream. This mine development is particularly concerning for the Flathead River.

Hinck, J. E., Schmitt, C. J., Blazer, V. S., Denslow, N. D., Bartish, T. M., Anderson, P. J., . . . Tillitt, D.E. (2006). Environmental contaminants and biomarker responses in fish from the Columbia River and its tributaries: Spatial and temporal trends. Science of the Total Environment, 366(2), 549-578. doi:10.1016/j.scitotenv.2005.11.008

In this study, fish were collected from 16 sites within the Columbia River basin between September 1997 and April 1998. They documented the temporal and spatial trends of the fish. The environmental contamination of the fish was also recorded. Each species was examined for contaminants. The toxins that were found over the toxic level were lead, selenium, and mercury. Organochlorine pesticides were not found to be in toxic levels. It was recommended that the levels of toxins within the fish should be continually be monitored to help to determine the emerging problems and to isolate sites where the problems are occurring.

Hitt, N.P., Frissell, C.A., Muhlfeld, C.C., & Allendorf, F.W. (2003). Spread of hybridization between native westslope cutthroat trout, *Oncorhynchus clarkii lewisi*, and non-native rainbow trout, *Oncorhynchus mykiss*. Canadian Journal of Fisheries and Aquatic Sciences, 60(12), 1440-1440. doi:10.1139/f03-125

The westslope cutthroat trout is a greatly endangered species. It is continually being outcompeted for resources by the non-native rainbow trout and hybridization between the two species is high. This paper looks at the spatial and temporal features of the hybridization of these two fish species. The researchers analyzed 42 different sites and found that 24 of them have hybridized fish present. In 2001, it was observed that another 7 sites had been hybridized since the original testing in 1998. It appears that the hybridization of these trout is moving in an upstream manner. The hybridization levels appeared to be more associated with neighbouring fish than with geographical barriers.

Hohenlohe, P. A., Day, M. D., Amish, S. J., Miller, M. R., Kamps-Hughes, N., Boyer, M. C., . . . Luikart, G. (2013). Genomic patterns of introgression in rainbow and westslope cutthroat trout illuminated by overlapping paired-end RAD sequencing. Molecular Ecology, 22(11), 3002-3013. doi:10.1111/mec.12239

Conservation efforts need a rapid and inexpensive way to determine genome-wide single nucleotide polymorphism and genotyping. This would allow for precise and accurate estimates of the population and the alleles present in the each population. This would be a very useful tool when dealing with super invasive alleles from the rainbow trout to the westslope cutthroat trout. The genotyping that used in the study showed that there are elevated levels of invasive alleles in the westslope cutthroat trout. The invasive alleles from the rainbow trout were found to be excessively high in the trout populations. There were some alleles which were expected

to be much more predominant in the genome wide study and the researchers think that the lack of these alleles is due to natural selection.

Holt, D. W., & Zetterberg, S. A. (2008). The 2005 to 2006 snowy owl irruption migration to western Montana. Northwestern Naturalist, 89(3), 145-151. doi:10.1898/NWN07-19.1

Over one winter season in 2005-2006 the Flathead and Mission Valley of Montana received an influx of migratory snowy owls. 42 owls were recorded in northwestern Montana. In a relatively small field, 500 m^2, 32 individuals were seen roosting. This study examined age, sex, and prevalence of this newly established healthy owl population.

Hutto, R., Flesch, A., & Fylling, M. (2014). A bird's-eye view of forest restoration: Do changes reflect success? Forest Ecology and Management, 327, 1-9. doi:10.1016/j.foreco.2014.04.034

This study looked into the implications of restoration on bird species in an effort to determine whether or not restoration is beneficial to the birds. The treatments took place in the Flathead National Forest in Montana. Birds were surveyed at 72 points in treated and untreated stands, three years before and then two years after the treatment. It was found that there was a similarity in the bird communities that were present. There were a few bird species that were found to change significantly after the treatment, but they were still similar to the species that were present without the restoration taking place. The results show that old-growth forests are essential to many species of birds, and restoration will not be enough to maintain the bird species. Longer and larger studies are needed in this field.

I.

Ipsos Reid. (2007). *Social science research report for Waterton Lakes National Park.* (Social Science Research Report). Vancouver, BC: Parks Canada.

This report was produced to support the social component of the upcoming State of the Park report for Waterton Lakes National Park. This report provides information on public use, visitor experience and visitor demographics in the park. Most of the information compiled to complete this report is from the 2005 Patterns of Visitor Use Survey.

J.

Jackson, B. E. (2003). *Long-term osprey (Pandion haliaetus) population dynamics in relation to food web change at Flathead Lake, MT.* (Master of Science). University of Montana, Missoula, Montana.

Following the introduction of the opossum shrimp, *Mysis relicta*, fish populations in Flathead Lake, Montana have shifted from surface feeders to deep water fishes. The effect of this shift on osprey populations was the focus of this dissertation. Nests, fledglings, and prey remains were observed over a one year period to determine osprey success and diet. By comparing data to earlier studies conducted in the 1970's (pre-shrimp introduction) it was found that osprey in 2001 were more productive and their diet consisted of lake trout and northern pikeminnow,

but no cutthroat trout. Pre-introduction of opossum shrimp, ospreys consumed cutthroat trout, which comprised 9 percent of their diet, as well as a greater number of large scale suckers when compared to the post-introduction population.

Jalkotzy, M. (2005). ***Selected ecological resources of Alberta's Castle Carbondale: A synopsis of current knowledge*****. Calgary, AB: Arc Wildlife Services Ltd.**

The Castle region is rich in biodiversity and natural resources, but has had a tumultuous relationship with government and management. This area is of particular interest because it hosts a vast amount of botanical diversity. The Castle area also includes areas that represent various ecotones and includes many species at risk.

Janowicz, M. E., Strobeck, C., & Harris, H. (2004). Hybridization between native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) and introduced rainbow trout (*O. mykiss*) in the eastern slopes of the Rocky Mountains in Alberta.

The native westslope cutthroat trout populations have greatly declined throughout their range. The populations that are remaining are small and often isolated. The study compares the habitat and genetic composition of 61 populations of the westslope cutthroat trout. The native trout are being outcompeted by other salmonids that have been introduced. The decline is also due to predation, over exploitations of the fishing industry, and hybridization between the subspecies. Of the 61 populations only 26 were found to be pure westslope cutthroat trout, whereas 35 were found to be hybridized. There were 12 pure rainbow trout populations reported. The study showed the genetic status of the pure westslope cutthroat trout. It was recommended that further genetic studies be conducted in order to further our understanding of the remaining populations.

Jedd, T. (2015). Accountability and legitimacy in transboundary networked forest governance: A case study of the roundtable on the Crown of the Continent (Ph.D. in Political Sciences).

This dissertation examines transboundary governance, specifically the Roundtable on the Crown of the Continent. The research examines networked governance's path to legitimacy and their ability to hold parties accountable. The current and future role of government between the countless stakeholders in forestry management is discussed.

Jedd, T. & Bixler, R. P. (2015). Accountability in networked governance: Learning from a case of landscape-scale forest conservation. ***Environmental Policy & Governance, 25*****(3), 172-187. doi:10.1002/eet.1670**

There are many challenges that are still present in transboundary conservation, even though many of these challenges have been successfully overcome. The authors explored the social relationships which are present in the conservation network between Canada and the United States.

Johnson, B. B. (December 2011). ***Assessing social-ecological resilience and adaptive capacity in the face of climate change: An examination of three communities in the Crown of the***

Continent Ecosystem. **(Unpublished Doctor of Philosophy in Natural Resources and Environmental Studies). University of New Hampshire, Durham.**

This dissertation uses three case study locations to illustrate the greater Crown of the Continent Ecosystem's ability to adapt to change. Both social and ecological resilience is examined in Fernie, British Columbia and Choteau and Kalispell, Montana. Interviews and surveys were used to gather data from public and private stakeholders in natural resource industries. Researchers were able to create identifiers of climate change observed or perceived by participants. Researchers are optimistic that stakeholders will be able to address and protect ecological integrity for the future.

Johnson, J. (2005). ***Waterton-Glacier International Peace Park: The economic implications of expanding Waterton park into the Flathead region of British Columbia.*** **(Economic Report). CPAWS BC Chapter.**

The report examines the economic implications, benefits and drawbacks of expanding the Waterton and Glacier National Parks to include the Flathead Valley region of British Columbia. Researchers discuss loss of logging, oil and gas revenue and exploration as well as guided hunting activity. Only logging and guided hunting provide significant economic impacts through job and revenue loss. The park expansion provides significant economic benefits to the Elk Valley of British Columbia by supporting more human activities while still protecting wildlife.

Johnson, S. (2008). ***Sustaining and enhancing the geographical character of place: Indicators for assessing geotourism in the Crown of the Continent*** **(M.E.Des.). Available from ProQuest Dissertations & Theses Global. (304694783).**

The Crown of the Continent Ecosystem is currently undergoing a change of what drives the local economy. It used to be based upon resource use and consumptions, and is now supported by the recreation and tourism in the area. This development that is occurring to support the rise in tourism and recreation is altering the environment and could be destroying it. In order to deal with this stakeholders in the Crown of the Continent region created a Geotourism MapGuide. It is used to find unique natural, historical, and cultural places in the area. The purpose of this article is to evaluate the Geotourism MapGuide project.

Jokinen, M. E., Jones, P. F., & Dorge, D. (2008). ***Evaluating survival and demography of a bighorn sheep (Ovis canadensis) population.*** **(Population Study). Alberta Conservation Association. Alberta, Canada.**

The Yarrow-Castle population of bighorn sheep has experienced massive die-offs from pneumonia infections. Researchers assessed the Yarrow-Castle population's survival rates in both ewes and lambs, along with demography to estimate reproduction, growth rates, and recruitment.

Jones, L. A., Muhlfeld, C. C., Marshall, L. A., McGlynn, B. L., & Kershner, J. L. (2014). Estimating thermal regimes of bull trout and assessing the potential effects of climate warming on critical habitats. River Research and Applications, 30(2), 204-216. doi:10.1002/rra.2638

Climate change is greatly affecting the vulnerability of aquatic species and habitats all around the world. The increase in temperature may cause serious implications for species and landforms in the area. There are no spatial models currently that would show the impacts of this change in the climate. This study decided to construct a spatial flow-routed model, a spatial hierarchical model, as well as a non-spatial model. It was found that using the spatial models was better than the non-spatial models. The most concerning species at risk is the already threatened bull trout due to extreme sensitivity to water temperature. It was also found that with the climate changing at the current rate the headwaters will be isolated from the rest of the river in the summer and the lower portions of the river will be too warm for the bull trout to survive in. These models are recommended to be used to help with conservation efforts, and to help create management strategies for the future of this ecosystem.

Judd, G.J.R., & Gardiner, M.G.T. (2006). Temperature, irradiation and delivery as factors affecting spring-time flight activity and recapture of mass-reared male codling moths released by the Okanagan-Kootenay sterile insect programme. *Journal of the Entomological Society of British Columbia, 103*, 19.

The wild codling moth, *Cydia pomonella*, was studied in both the field and lab in this study. The wild population was captured and released in the Kootenay-Okanagan region. The study aimed to determine if temperature and radiation could account for sterile spring moth's poor pheromone trap catches in both captive and wild populations.

K.

Kanda, N., & Allendorf, F. W. (2001). Genetic population structure of bull trout from the Flathead River basin as shown by microsatellites and mitochondrial DNA markers. Transactions of the American Fisheries Society, 130(1), 92-106. doi:10.1577/1548-8659(2001)130<0092:GPSOBT>2.0.CO;2

The changing demographics of the land are a serious threat to bull trout populations. The genetic structure of 14 populations of bull trout from the upper Flathead River were tested and it was found, based on the mitochondrial DNA, that there are two separate lineages that formed after the last glaciation. There was little variation, but there were definitely differences between them. The populations that were found in the drainages had greater differentiation present. It was thought that this was due to genetic drift caused by isolation. It was also found that there has been no recolonization of this species if a population becomes extirpated. They recommended that all of the local populations should be protected as the species would be unable to recover if further extirpation occurs.

Kellerlynn, K. (October, 2002). ***Geoindicators scoping report for Waterton-Glacier International Peace Park.*** **(Strategic Planning Goal Ib4). West Glacier, Montana, USA.**

The purpose of this report was to identify geoindicators by addressing three main goals: (1) identify geologic processes and features, (2) evaluate human impacts, and (3) provide recommendations based on data gaps.

Kendall, K. C., Stetz, J. B., Boulanger, J., Macleod, A. C., Paetkau, D., & White, G. C. (2009). Demography and genetic structure of a recovering grizzly bear population. Journal of Wildlife Management, 73(1), 3-17. doi:10.2193/2008-330

The southern grizzly bear populations are at risk of decline, and this has been known for decades. Researchers took genetic data from hair snares and rubbing sites along with historical capture data to estimate population abundance. The study found that human caused mortality in 2004 was around 4.6%. This mortality rate is 0.06% over the sustainable mortality rate of 4%. Grizzlies within the Northern Continental Divide Ecosystem were found existing over 10000 km^2 outside of the designated management area. Potential barriers to gene flow are also discussed.

Kendall, K. C., Stetz, J. B., Roon, D. A., Waits, L. P., Boulanger, J. B., & Paetkau, D. (2008). Grizzly bear density in Glacier National Park, Montana. Journal of Wildlife Management, 72(8), 1693-1705. doi:10.2193/2008-007

This paper is a comprehensive grizzly bear density study conducted in Glacier National Park. Genetic data was collected from both baited hair traps and unbaited hair rub tree sites. A model was developed to account for unequal access to sampling sites for the greater population estimates. The study area found 240.7 grizzlies in the given area. The bear density within Glacier National Park was found to be 2.4 times that of the populations outside of the park, where the average grizzly density was 30 bears/1000 km^2.

Kirillin, G., Lorang, M., Lippmann, T., Gotschalk, C., & Schimmelpfennig, S. (2015). Surface seiches in Flathead Lake. Hydrology and Earth System Sciences, 19(6), 2605-2615. doi:10.5194/hess-19-2605-2015

Surface seiches are standing waves within enclosed bodies of water that contribute the estimation of flood risk, coastal erosion, and lake bottom sediment transport. More generally, theses dynamic hydrological features of lakes contribute to our understanding of shoreline habitat and lake ecology. Flathead Lake in Montana experiences high seiche amplitude. To determine characteristics of seiche modality, seiche frequencies were calculated to inform of oscillation features affecting lake wide circulation, and was more specifically investigated around small islands and in proximity to river inflow. Lake management is affected by the distribution of surface standing waves as it is related to shoreline erosion, flood mitigation, and invasive species introduction.

Knudsen, K. L., Muhlfeld, C. C., Sage, G. K., & Leary, R. F. (2002). Genetic structure of Columbia River redband trout populations in the Kootenai River drainage, Montana, revealed by

microsatellite and allozyme loci. ***Transactions of the American Fisheries Society, 131*****(6), 1093-1105. doi:10.1577/1548-8659(2002)131<1093:GSOCRR>2.0.CO;2**

The redband trout is a fish that is found in the Kootenai River, Kootenay Lake, and Columbia River. The study looked at the genetic divergence between the populations in these three areas. The allele frequency data was collected by microsatellite and allozyme loci. It was found that between all the populations, there was only a diversity of about 3.5 percent. There was a 40.7 percent diversity between the Kootenay Lake and Kootenai River populations. It was recommended that managers of fisheries restock the populations of redband trout with watershed-specific fish to maintain the genetic diversity between the populations.

Kondla, N. G. (2004). ***Conservation Overview of Butterflies in the Southern Headwaters at Risk Project (SHARP) Area.*** **(Alberta Species at Risk Report No. 80). Edmonton, Alberta, Canada: Alberta Sustainable Resource Development, Fish and Wildlife.**

In the Southern Headwaters at Risk Project (SHARP) area, a study was conducted that looked at the butterflies in the area. It included an overview of the butterflies that were present in the area, as well as the distribution, general habitat for each species present, and peak flight periods for each species in order to aid further research. The butterflies were assessed for their current endangered status and placed into groups based on this status. It was found that 9 species are unique to this area and 31 species are at risk in the area, with 78 percent of all known Alberta species being present. Recommendations for future conservation efforts were made based on the data collected. Key variables for the butterfly habitat were discussed, as well as a brief conservation strategy that could be put to use later.

Kondla, N. G. (2009). ***Waterton Lakes National Park - 2009 Half-moon Hairstreak Project Report.*** **(Project Report). Waterton Lakes National Park: Parks Canada.**

Waterton Lakes National Park hired Kondia to build on past research that has been done on the endangered half-moon hairstreak butterfly in the past. This study looked at the populations and presence of the butterfly within the Waterton region to determine future habitats and sustainable areas for the butterfly. An index was made of the population size in the area and surveys were conducted to determine the presence of the butterfly in given areas. There was found to be a viable population on the Blakiston Creek Fan. This population would need to be monitored in the future and it was recommended that the surveying would be done for at least two days per year. The Blakiston Fan is the only known area in Alberta to have these butterflies, and this population is the only known population existing within a park. The butterflies were found using a straight line transect and spotted while the experimenter walked at a leisurely pace. The data collected shows that there are many places the butterflies could survive, but they are not present there.

Kunkel, K. E., Atwood, T. C., Ruth, T. K., Pletscher, D. H., Hornocker, M. G., Gompper, M., & Vanak, A. (2013). Assessing wolves and cougars as conservation surrogates. Animal Conservation, 16(1), 32-40. doi:10.1111/j.1469-1795.2012.00568.x

The potential of using wolves and cougars as key species in creating future conservation planning to preserve landscape heterogeneity is great. The study was conducted on populations of wolves and cougars in the Flathead and North Fork River basins of Montana. Spatial models were created using kill site distribution. These templates found that wolf kill sites were spatially in higher quality habitat than cougar sites. Cougar sites fell 40% outside the spatial wolf template and were significantly more rugged than the wolf template. The ability of both wolf and cougar templates to capture more rugged terrain and use a greater heterogeneity of habitat makes them important surrogate species for conservation and habitat management.

Kunkel, K., & Pletscher, D. H. (2001). Winter hunting patterns of wolves in and near Glacier National Park, Montana. *The Journal of Wildlife Management, 65*(3), 520-530.

Wolves are currently recolonizing northwestern Montana. Researchers studied search distance to kill in recolonizing wolves in Montana and Canada to determine the effects on ungulate and other prey populations. Results indicated that elk, moose, and deer all appeared to be similarly vulnerable to wolf predation. Snow depth greatly affected the number of deer predated. Researchers found that wolves, in general, selected the most abundant and accessible prey species.

Kunkel, K. E., Pletscher, D. H., Boyd, D. K., Ream, R. R., & Fairchild, M. W. (2004). Factors correlated with foraging behavior of wolves in and near Glacier National Park, Montana. *Journal of Wildlife Management, 68*(1), 167-178. doi:10.2193/0022-541X(2004)068[0167:FCWFBO]2.0.CO;2

This study examined the relationship between wolf predation and ungulate populations and implications for both ungulate and predator management. Researchers studied a population of ungulates and wolves in northwestern Montana and southeastern British Columbia. Wolves primarily focused their hunting efforts on white-tailed deer during the winter months. Wolves hunted in areas that were both easy to access and suitable deer habitat. Kill sites were often found in areas that supported wolf stalking behaviour such as the bottom of ravines and valleys.

Kynard, B., Parker, E., & Kynard, B. (2010). Ontogenetic behavior of Kootenai River white sturgeon, *Acipenser transmontanus*, with a note on body color: A laboratory study. *Environmental Biology of Fishes, 88*(1), 65-77. doi:10.1007/s10641-010-9618-9

This paper studies the ontogenetic behaviour and color of wild white sturgeon (*Acipenser transmontanus)* found in the Kootenai River. The researchers found that the embryos (hatchling free) of the white sturgeon population are photonegative, meaning they avoid sunlight and hide after hatching, and are grey in colour. The late-embryos were found to be the opposite: they were photopositive, use cover less, and prefer a white substrate. They are also known to develop a black tail. The common body and tail color found in the Kootenai, Columbia, and Sacramento Rivers indicated that there must be a common adaptation between the populations. This adaptation is presumed to be for various signalling purposes or to avoid predators. Geographic behaviour studies must be conducted to aid future restoration programs.

L.

LaMontagne, J. (2000). ***Use of migratory stopover areas by trumpeter swans in southern Alberta.*** **(Unpublished Masters of Science in Biological Sciences). University of Calgary, Calgary, Alberta, Canada.**

Stopover areas used by migratory birds, including waterfowl, provide a valuable energy resource in order to breed and reproduce successfully. Trumpeter swans (*Cygnus buccinator)* are considered an at risk species and this thesis examines what is considered prime migratory spring stopover habitat in the Calgary and Cardston-Mountain View areas of Alberta. Focal animal techniques were used to measure trumpeter swan time budgets. The biotic and abiotic properties of the ponds that trumpeter swans utilized in the spring months were assessed to determine the appeal of these stopover locations to this waterfowl species.

Langemann, G. E. (2011). ***Waterton Lakes National Park archaeological resource management programme, 2010 – 2011.*** **(Final Report No. 2010-5494). Calgary, AB: Parks Canada.**

This report actively describes the archaeological work that has been done recently in Waterton Lakes National Park (2010). This report describes two main projects which include monitoring the initial construction of the Kootenai Brown Trail and the construction of the Red Rock Canyon day use area within the park. These projects have been built upon known archaeological sites. No significant archaeological concerns have been raised regarding the Kootenai Brown Trail, and no artefacts or features were found at the Red Rock Canyon.

Larson, A. J., Belote, R. T., Cansler, C. A., Parks, S. A., & Dietz, M. S. (2013). Latent resilience in ponderosa pine forest: Effects of resumed frequent fire. ***Ecological Applications, 23*****(6), 1243-1249. doi:10.1890/13-0066.1**

Ponderosa pine forests need wildfire in order to keep their ecosystem resilient. When fire is removed for some time, the ecosystem loses its resilience and allows for a transition to a different ecosystem when fire is reintroduced. Unlogged forests that haven't experienced fire in years were evaluated in Montana. When the fire was reintroduced in 2003, it reduced the tree density and allowed for an invasion of lodgepole pines. Once frequent fire was re-established in 2011, the tree density dropped again and many of the lodgepole pines were unable to survive. It is recommended that fire started by lightning be allowed to burn in the ponderosa forests, as they show resilience to this natural process that other trees do not.

Lee, T. (2007). ***Crown of the Continent - A backgrounder on connectivity and ecological health.*** **(2007). Y2Y Crown of the Continent Report). Calgary, AB: Miistakis Institute.**

Y2Y is a conservation initiative that works in the Crown of the Continent Ecosystem (CCE). The CCE is an ecological hot spot, and one of the most significant places for this initiative. The purpose of the document is to give background information on Y2Y, and other organizations that work with them, to help save the CCE and develop strategies that can be used to aid the conservation efforts. In order to assess this, key ecological targets were chosen and tested for connectivity in the areas, as well as the health of the ecosystems overall.

Lee, T. & Good, K. (2013). ***Scan of Ecosystem Services Programming in the Crown of the Continent.*** **(Survey Report). Calgary, AB: Miistakis Institute.**

This document is a report detailing the ecosystem services that the Crown of the Continents provides to the public. This report expresses the difficulty of assigning value to ecosystem services and their importance to conservation in the Crown.

Lee, P., & Hanneman, M. (2011). ***Castle area forest land use zone: Linear disturbances, access densities, and grizzly bear habitat security areas.*** **(1st Publication for International Year of Forests). Edmonton, Alberta: Global Forest Watch Canada.**

The purpose of this study was to find and analyze the disturbances that are occurring within the Castle Area Forest Land Use Zone. They examined the motorized use management policies and regulations of the Alberta Government and compared that to what motorists are actually doing on the land. The potential impact on the grizzly bears in the area if there were to be open route densities was also studied.

Lemay, M. A., & Russello, M. A. (2012). Neutral loci reveal population structure by geography, not ecotype, in Kootenay Lake Kokanee. ***North American Journal of Fisheries Management, 32*****(2), 282. doi:10.1080/02755947.2012.676383**

The use of genetic tools is used to define stocks for the management of fisheries. Traditional approaches, such as neutral markers, may in fact be inadequate at sensing fine scale structures in populations that have recently diverged. A freshwater form of sockeye salmon, *Kokanee oncorhynchus,* has been known to display divergent reproductive ecotypes. This study used the expressed sequence tag and both linked and non-linked microsatellites to investigate the species stock structure in Kootenay Lake, British Columbia. Conflicting evidence was found for differences between the ecotypes and the geographical structure of the populations within the lake. The researchers state that additional studies are needed in this area.

Letts, M. G., Nakonechny, K. N., Van Gaalen, K. E., & Smith, C. M. (2009). Physiological acclimation of ***Pinus flexilis*** **to drought stress on contrasting slope aspects in Waterton Lakes National Park, Alberta, Canada.** ***Canadian Journal of Forest Research*****, 39(3), 629-629. doi:10.1139/X08-206**

There has been a great increase in the number and severity of droughts in Canada due to climate change. This study explores the effects of drought on limber pine. Gas-exchange rates and characteristics were studied over a two year severe drought period. It was determined that the trees could restrict their water usage. The needles lasted longer, there was greater water consumption efficiency, and there was stable carbon isotope consumption. In general, photosynthesis declined and there was lower stomatal conductance. It was suggested that shoulder-season photosynthesis may become more and more necessary for plants to use if drought due to climate change continues.

Levesque, L. (2005). ***Investigating landscape change and ecological restoration: An integrated approach using historical ecology and GIS in Waterton Lakes National Park, Alberta*** **(Master of Science).**

The paper focuses on the landscape in Waterton Lakes National Park and how it has changed since 1889. It has been found that there has been a consistent increase in the arboraceous vegetation in the area which has caused a great decline of the grasslands in the park. It is mainly the change in climate, grazing patterns, fire regulation, and change from the First Nation's management that allowed this vegetative change to occur. This paper emphasizes the need for management of the area to be from multiple sources.

Little, E. E., Calfee, R. D., & Linder, G. (2012). Toxicity of copper to early-life stage Kootenai River white sturgeon, Columbia River white sturgeon, and rainbow trout. ***Archives of Environmental Contamination and Toxicology, 63*****(3), 400-408. doi:10.1007/s00244-012-9782-3**

The white sturgeon populations in North America are currently in decline. This may be the result of overharvesting, the use of dams, and increased agriculture and mineral extraction. The extraction of the minerals is causing a large amount of metals in the water at spawning sites. A test was done to see the effects of the copper that is present in the water on white sturgeon populations. The sturgeon were exposed to copper in a 96 hour flow-through 30 days after hatching. It was found that the 30 day old sturgeon were extremely sensitive to the copper. However, older sturgeons were less sensitive than the rainbow trout in the experiment. These results show that copper contamination could be killing the freshly hatched sturgeon and, therefore, contributing to the decline of white sturgeon populations.

Lonergan, E. R., Cripps, C. L., & Smith, C. M. (2014). Influence of site conditions, shelter objects, and ectomycorrhizal inoculation on the early survival of whitebark pine seedlings planted in Waterton Lakes National Park. Forest Science, 60(3), 603-612.

The whitebark pine is an endangered tree that lives in the high elevations of the Rocky Mountains. They are currently under serious threat of going extinct due to blister rust, mountain pine beetles, and fire suppression in the areas they occupy. In order to help this species survive, 200,000 rust resistant seedlings were planted. However, the survival rates were very low. This paper studies the places and conditions that would help to increase the survival rate of these seedlings. The researchers planted seedlings in 21 plots that were distributed between burned and unburned areas and areas with and without bear grass. The highest survival rate was 82 percent, in areas that had no bear grass and were burned. It was also determined that if there was shelter present for the seedlings then the survival rate increased by 10-12.5 percent in the favourable areas. Shelter increased the survival rate more in areas that were initially not as successful. This study found that this restoration process has been more successful than any other restoration attempt for the whitebark pine.

Long, B. (2002). ***Crown of the Continent: Profile of a treasured landscape.*** **Kalispell, MT: Crown of the Continent Ecosystem Education Consortium.**

In 1995, the Crown of the Continent Ecosystem Education Consortium (COCEEC) opened. The main goal was to bring a "bioregional focus to the education" in the area. As the education programs were being set up, federal land management went from only looking at small areas to encompassing entire ecosystems. This was an eye-opener for the COCEEC, and they found that it was time they started to gear the education in that direction as well. Since the start of COCEEC they have continually supported ecosystem based schooling. They created a document called "The Crown of the Continent Ecosystem Profile" with the purpose of being a science based document of the natural science, history, and culture of the Crown of the Continent to be used by schools in the future.

Lowell, J. L., Gordon, N., Engstrom, D., Stanford, J. A., Holben, W. E., & Gannon, J. E. (2009). Habitat heterogeneity and associated microbial community structure in a small-scale floodplain hyporheic flow path. Microbial Ecology, 58(3), 611-620. doi:10.1007/s00248-009-9525-9

This paper studies the diverse microbial organisms that are essential to ecosystem health in the North Fork floodplain of the Flathead River, Montana. Researchers wanted to know whether or not habitat differences influence microbial diversity on the floodplain. The habitat heterogeneity was assessed by measuring trace elements such as phosphorus, nitrogen, dissolved oxygen, carbon, and nitrates.

Lyons, E. P. (2005). "Give me a home where the buffalo roam": The case in favor of the management-function transfer of the National Bison Range to the confederated Salish and Kootenai tribes of the Flathead Nation. ***Journal of Gender, Race and Justice, 8*****(3), 711.**

This article examines the Salish- Kootenai Tribe's effort to play an active management role in the National Bison Reserve and other wildlife areas. It is argued that the tribe should have more involvement in the management of these areas including biologic and fire processes and visitor experience and bison programs. This involvement has been supported by U.S. Fish and Wildlife but not followed through. Researchers believe this reluctance to hand over management responsibilities is due to underlying racism and work by anti-Indian groups.

M.

MacDonald, M. D. (2001). ***An ecosystem approach to integrate sustainability into ecotourism experiences*** **(M.E.Des.). Available from ProQuest Dissertations & Theses Global. (304683768). Retrieved from http://library.mtroyal.ca:2092/docview/304683768?accountid=1343**

This is a Master's Degree thesis that outlines the development of a process that tries to integrate social, economic, and ecological sustainability into ecotourism in the biosphere reserves of the

Crown of the Continent. Indicators and monitoring mechanisms were identified in order to incorporate ecotourism goals into experiences in the Crown of the Continent. The author studies five separate ecotourism experiences. Indicators and monitoring mechanisms were included for all five experiences in order to try and demonstrate how these ecotourism goals are used within the system. Recommendations are also provided in order to try and overcome certain restraints associated with these ecotourism experiences.

Mace, R. D. (2004). Integrating science and road access management: Lessons from the Northern Continental Divide Ecosystem. Ursus, 15(1),6176(2004)015<0129:ISARAM>2.0.CO;2

A committee was created in the Northern Continental Divide Ecosystem with the purpose of developing regulations for road access on public lands. The paper looks at the history of management like this in the area and makes suggestions of ways that it can be improved for the future use of other committees.

Mace, R. D., Carney, D. W., Chilton-Radandt, T. ... Wenum, E. (2012). Grizzly bear population vital rates and trend in the northern continental divide ecosystem, Montana. The Journal of Wildlife Management, 76(1), 119-128. doi:10.1002/jwmg.250

A six year study was conducted from 2004-2009 on grizzly bear populations within the Northern Continental Divide Ecosystem. Populations were assessed by radio collaring females and monitoring their reproductive success. After acknowledging cub mortality, mean litter size was found to be 2.27 cubs per litter. The researchers found that grizzly bear fecundity in the Northern Continental Divide Ecosystem is causing population growth.

MacHutchon, A. G. (2009). *Assessment of Bear-Human Interaction Risk Along the Wishbone Trail, Waterton Lakes National Park.* Nelson, BC, Canada: Parks Canada.

High numbers of bear-human interactions happen each year in Waterton Lakes National Parks. Front country areas show the majority of these interaction events but they are increasingly more common as hikers are using remote areas more often. Hikers meeting bears along the trails does not always result in aggressive encounters, but aggressive encounters have occurred in the past. In order to reduce the chance of these negative encounters between bears and humans, Parks Canada has requested the assessment of bear-human interaction on the Wishbone Trail in Waterton Lakes National Parks.

Macmynowski, D. P. (2007). Across space and time: Social responses to large-scale biophysical systems. *Environmental Management, 39*(6), 831-42. doi:http://library.mtroyal.ca:2098/10.1007/s00267-006-0082-4

This paper outlines the two critical aspects of ecosystem management concepts. The first states that greater attention needs to be paid to policy and practice. The second is a discussion of ecosystem management strategies. This study assesses perspectives and experiences of non-

governmental organizations and governmental managers. Ten key challenges are identified regarding the increase and intensity of transboundary cooperation.

MacPherson, L., & Coombs, M. (2013). ***A generic rule set for applying the Alberta fish sustainability index second edition.*** **(Executive Summary).**

The Fish Sustainability Index (FSI) was created to be used as a tool for biologists when conducting stock assessments of fish across the province and also across species. This is meant to be an operator's manual which grows and changes with new information as well as new demand. They ranked the sustainability of the species with respect to their theoretical populations if there was no human activity in the area. In order to construct a complete model, a current assessment of the population is required. It is recommended that the assessments of each species should be conducted regularly. The FSI defines how sustainable the populations are and determines the theoretical value of the populations if there was minimal human activity in the area.

Malanson, G. P., Bengtson, L. E., & Fagre, D. B. (2012). Geomorphic determinants of species composition of alpine tundra, Glacier National Park, U.S.A. ***Arctic, Antarctic, and Alpine Research, 44*****(2), 197-209. doi:http://library.mtroyal.ca:2087/10.1657/1938-4246-44.2.197**

The alpine tundra seems to be threatened by current climate change. This may be untrue, however, as there is a diversity of alpine tundra based on topographic variation. The features of the geomorphology may be the factors that keep this terrain alive. The local moisture differences such as snow beds may be very important to this terrain. Changes in the precipitation may be just as important changes in temperature for the future of this ecosystem.

Mally, K. A. (2008). ***Hierarchical summer habitat selection by the North American porcupine in western Montana.*** **(Unpublished Masters of Science in Wildlife Biology). University of Montana, Missoula, Montana, USA.**

The porcupine is the second largest rodent in North America and is found throughout our forests. There has been little to no research done on the North American porcupine (*Erethizan dorsatum)* in western Montana. Recently populations have seen a decline in areas where sightings were once common. This study was conducted in order to quantify the home ranges of the porcupines, as well as quantifying hierarchical habitat selection in the second, third, and fourth order. This study also took into consideration porcupine mortality and their reproductive rates.

Managh, S. (2006). ***Anthropogenic change in the northern Crown of the Continent.*** **(Status Update). Calgary, AB: Miistakis Institute.**

The objective of this project is to observe the various changes happening in the northern portion of the Crown of the Continent Ecosystem by studying increases in levels of human activity. This is a very important issue as not monitoring human activity ultimately contributes to issues related to land management, development, habitat suitability, and resource extraction. In order to

document the changes in human activity within this portion of the Crown of the Continent two projects were proposed: (1) to create a broad scale, multitemporal image to try and document large changes with the landscape, and (2) to record a series of anthropogenic metrics on the amount of traffic and road density to see the changes by humans happening within this ecosystem. It was found that increased road density, increased traffic volumes, and resource extraction may ultimately lead to increased habitat fragmentation. This will stop the movement of large carnivores and would, therefore, decrease their amount of secure habitat.

Managh, S. (2009). ***Anthropogenic change in the northern Crown of the Continent.*** **(Status update). Waterton Lakes National Park, AB: Miistakis Institute.**

In 1993 the Natural Resources Conservation Board stated that if an expansion of a four-season ski resort located in the West Castle area were to occur it could only do so if the surrounding public lands were secured through the designation of the Waterton-Castle Wildland Area. This caused the changes in development as well as the changes in human use of the area to be monitored so that the area could be assessed for potential wildlife and ecosystem destruction. In order to document the changes in human activity within this portion of the Crown of the Continent, two projects were proposed: (1) a broad scale, multitemporal image classification was attempted in order to try and document large changes with the landscape, and (2) a series of anthropogenic metrics, where the amount of traffic and road density were used in order to see the changes by humans happening within this ecosystem.

Mast, M. A., & Clow, D. W. (2008). Effects of 2003 wildfires on stream chemistry in Glacier National Park, Montana. ***Hydrological Processes, 22*****(26), 5013-5023. doi:10.1002/hyp.7121**

The streamflow in Glacier National Park was monitored between 2003 and 2007 for chemical differences that were related to the fire that occurred in 2003. The streamflow, constituents, nutrients, and sediments in the water were assessed in burned and unburned watersheds. The fire appeared to have minimal effects on nutrients; except for a chloride and sulfate. Other effects from the fire were minimal.

McCaffery, M., Switalski, T. A., & Eby, L. (2007). Effects of road decommissioning on stream habitat characteristics in the South Fork Flathead River, Montana. Transactions of the American Fisheries Society, 136(3), 553-561. doi:10.1577/T06-134.1

There are lots of studies done on the effects of roads in streambeds, but no studies have been done on whether or not the effects are reversible if the roads are decommissioned. It was found that the roads caused a significant increase in fine sediment which has greatly impacted the survival rate of the aquatic animals present in the streams. In the study twelve streams were examined with three different watershed treatment types: the first was roadless, the second was with road use, and the third was with decommissioned roads. The streams that had high levels of road usage had higher levels of fine sediment than streams that had no roads or decommissioned roads. Places that had a lot of vegetative regrowth were found to have less fine sediment in the streams. It was recommended that more studies should be done to fully determine the effects of the roads on the streams and the effectiveness of decommissioning roads.

McCuaig, J. M., & Quinn, M. S. (2011). Place based environmental governance in the Waterton Biosphere Reserve, Canada: The role of a large private land trust project. *The George Wright Forum, 28*(1), 95-110.

In order for long-term environmental projects to work, there needs to be management strategies that go past borders, and look at conservation as a whole. In order to help with this cause, Conservation easements and full ownership of land have been put into place to help get conservation to be a priority on private land. Other conservation techniques outside of state-managed techniques may be the next step in environmental governance.

McLellan, B. N. (2011). Implications of a high-energy and low-protein diet on the body composition, fitness, and competitive abilities of black (*Ursus americanus*) and grizzly (*Ursus arctos*) bears. Canadian Journal of Zoology, 89(6), 546. doi:10.1139/Z11-026

Grizzly bear and black bear populations in the Flathead Valley of British Columbia were studied in order to determine the impacts of a primarily vegetarian diet on body condition and fitness. Bear condition was determined by analyzing scat samples. It was found that their diet was predominantly made up of low protein fruit in summer and during this time bears put on fat but lost mean muscle mass. The researchers believed this loss in lean muscle supplemented the protein that was lacking in the fruit based diet.

McNeil, C. (May, 2005). *Parks Canada review of oversnow vehicle use in National Parks*. Parks Canada.

Over the course of the year there are many different types of motorized vehicles that are used in National Parks. This includes in the water, on the land, and in the air. The purpose of the paper is to review the current legislation of the access of motorized vehicles that travel over snow. It also attempts to determine the current use of these vehicles in the area and clear up the issues that are currently circling the topic. This will allow for future debate on the issue and help with the making of management strategies in the future.

McTaggart, P. (2006). *Does elevation have an influencing factor on blister rust (Cronartium ribicola) outbreaks amongst whitebark pine (Pinus albicaulis) communities within the Castle Wilderness Area, southwest Alberta.*

The whitebark pine is considered a keystone species. It is found in subalpine forests in North America. The whitebark pine regulates the snow melt, stabilizes the slope, and is a common food source for many species. The blister rust infection is currently spreading through the populations of whitebark pine trees. It is a serious disease which leads to lack of cone production and death of the tree. The paper looks at whether the blister rust incidences decrease as the elevation rises within the Castle region. It was found that the elevation does not lower the cases of blister rust, and neither do any of the physical properties that were examined. There is a great decline in whitebark pine throughout the area, not only due to the blister rust, but also due to being outcompeted by spruce and fir trees.

***Michel Creek coking coal project: Loop ridge mine.* (2015). (Project Description). British Columbia: CanAus Coal Limited.**

The Michel Creek Coking Coal Project is considering producing the Loop Ridge deposit. The company is planning to mitigate any detrimental environmental effects that may occur by building an environmentally conscious mine. The engineering plan was brought together by environmental science as well as First Nations. The environmental challenges that were identified are analyzed and discussed in the document.

Michel, H., & Gayton, D. (2001). Linking indigenous peoples knowledge and western science in natural resource management. ***Southern Interior Forest Extension and Research Partnership,*** **Quaaout Lodge, Chase, B.C.**

110 people got together in 2001 in order to discuss the practical and theoretical aspects of linking western science and indigenous peoples' knowledge in the sector of natural resource management. There were representatives from both native and non-native communities, as well as indigenous knowledge keepers, resource managers, academics, scientists, and elders. Cultural protocol, workshops, discussions, and presentations took place at this conference

Minshall, G. W., Shafii, B., Price, W. J., Holderman, C., Anders, P. J., Lester, G., & Barrett, P. (2014). Effects of nutrient replacement on benthic macroinvertebrates in an ultraoligotrophic reach of the Kootenai River, 2003–2010.*Freshwater Science, 33*(4), 1009-1023. doi:10.1086/677900

Impounds remove the sediment and nutrients from the rivers. After the Libby Dam was built, the nutrient, macroinvertebrate, and fish levels have declined in the Kootenai River. In order to help with this, a nutrient-addition program was proposed. A before-and-after study was conducted, and in 2003 they began monitoring responses of the benthic macroinvertebrates from the added nutrients. In 2010 they reassessed the area and found that there was no major alteration in the macroinvertebrate community, but everything else in the water had increased. This increase includes the filter feeders and food resources for native fish. Biomass had increased by 48 percent, and the mean total abundance of the macroinvertebrates increased by 69 percent. This was a greatly successful study.

Mogen, J. T., & Kaeding, L. R. (2001). ***Population biology of bull trout (Salvelinus confluentus) in the Saint Mary River drainage.*** **(Progress Report). Bozeman, Montana: US Fish and Wildlife Service, Branch of Native Fisheries Management.**

The St. Mary River is one of only five distinct population segments of bull trout left in the United States. The bull trout has been extirpated from many areas such as California. The study was conducted when the trout was considered endangered. This study examined the locations of spawning areas and factors that are limiting population and made recommendations to reduce these factors. The study used multiple methods including radio telemetry, fishery surveys, sampling in the canal, electrofishing, and trapping. It was found that the spawning was occurring in the Boulder and Kennedy Creeks, and that bull trout were found in all of the principal tributaries that were surveyed. It was recommended that further research be done using radio telemetry, as it was found to give especially useful results.

Muhlfeld, C. C., Bennett, D. H., & Marotz, B. (2001). Summer habitat use by Columbia River redband trout in the Kootenai River drainage, Montana. ***North American Journal of***

Fisheries Management, 21(1), 223-235. doi:10.1577/1548-8675(2001)021<0223:SHUBCR>2.0.CO;2

In the Columbia River there has been a great decline in the number, distribution, and genetic diversity of the redband trout. Using snorkel surveys in the summers of 1997 and 1998, the microhabitat, mesohabitat, and macrohabitat were examined. The distribution of the fish was studied as well. The young and mature fish preferred the deep microhabitats, whereas the very young fish preferred shallow, slow moving water. The results demonstrated that medium-elevation reaches with lots of pools are critical habitat for redband trout populations. This data should be very useful in determining the impacts of land usage on the remaining populations and in helping to develop recovery and management strategies for the species.

Muhlfeld, C. C., Bennett, D. H., Steinhorst, R. K., Marotz, B., & Boyer, M. (2008). Using bioenergetics modeling to estimate consumption of native juvenile salmonids by non-native northern pike in the Upper Flathead River system, Montana. North American Journal of Fisheries Management, 28(3), 636-648. doi:10.1577/M07-004.1

The predation of native fishes, such as bull and westslope cutthroat trout, by pike species introduced to recreational fisheries in the upper Flathead River was examined. Adult non-native pike consumed westslope cutthroats in the summer whereas bull trout were consumed by both young and old pike in every season. Of the various fish species consumed by the pike, bull trout and westslope cutthroat trout comprised 5% of their total diet.

Muhlfeld, C. C., Giersch, J. J., & Marotz, B. (2012). Seasonal movements of non-native lake trout in a connected lake and river system. Fisheries Management and Ecology, 19(3), 224-232. doi:10.1111/j.1365-2400.2011.00821.x

The Flathead River and Lake system's native fish population is at risk due to the presence of non-native lake trout. This study was undertaken in order to track the movement of the sub-adult non-native lake trout through the Flathead River and Lake. Using radio telemetry it was determined that the distribution of lake trout was dependant on temperature and season. Migration in the Flathead River and Lake system also correlated with prey migration.

Muhlfeld, C. C., Giersch, J. J., Hauer, F. R., Pederson, G. T., Luikart, G., Peterson, D. P., . . . Fagre, D. B. (2011). Climate change links fate of glaciers and an endemic alpine invertebrate. *Climatic Change, 106*(2), 337-345. doi:http://library.mtroyal.ca:2098/10.1007/s10584-011-0057-1

Climate warming is happening faster in the high-elevation mountainous regions than anywhere else in the world. This has led to the loss of glaciers and snowpack, but the effects of this change on alpine streams invertebrates are unknown. The meltwater stone fly *(Lednia tumana)* has a fundamental niche, and is in great danger if the glaciers disappear. The reason that this species is so at risk is that it lives in the streams under the glaciers which may disappear. This stonefly has no other habitat. The climate change that is occurring is a serious threat to the future distribution and persistence of this species. Research on this stone fly is greatly needed to prevent the extinction of many other species that are dependent on the fly, and to help understand how climate change is affecting their ecosystem.

Muhlfeld, C. C., Glutting, S., Hunt, R., Daniels, D., & Marotz, B. (2003). Winter diel habitat use and movement by sub-adult bull trout in the upper Flathead River, Montana. North American Journal of Fisheries Management, 23(1), 163-171. doi:10.1577/1548-8675(2003)023<0163:WDHUAM>2.0.CO;2

Thirteen sub-adult bull trout were monitored using radio telemetry in the Flathead River, Montana. Diel movement and habitat were recorded. Nine of the thirteen tagged fish had movement attributed to light intensity. Researchers found that sub-adults moved from deep channels in the day to shallow, slow flow, unsheltered areas at night.

Muhlfeld, C. C., Jones, L., Kotter, D., Miller, W. J., Geise, D., Tohtz, J., & Marotz, B. (2012). Assessing the impacts of river regulation on native bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) habitats in the upper Flathead River, Montana, USA. River Research and Applications, 28(7), 940-959. doi:10.1002/rra.1494

This paper assessed the impacts of flow regulation on the South Fork of the Flathead River, Montana, on threatened native fish populations. The South Fork of the Flathead River's flow has been altered for power generation, flood mitigation, and fish recovery in the Columbia River basin. The impacts of flow alteration and alternative flow management on native bull trout and westslope cutthroat trout were studied. The researchers monitored the effect changes in discharge would have on critical fish habitats.

Muhlfeld, C., Kovach, R., Jones, L., Al-Chokhachy, R., Boyer, M., Leary, R., . . . Allendorf, F. (2014). Invasive hybridization in a threatened species is accelerated by climate change. Nature Climate Change, 4(7), 620-624. doi:10.1038/NCLIMATE2252

The impact of climate change on invasive species hybridization in the threatened westslope cutthroat trout and non-native rainbow trout is discussed. Researchers employ a long-term genetic study to monitor the hybridization in the two fish species. The Flathead watershed remains relatively pristine, making it the ideal study location for tracking the spatial and temporal spread of rainbow trout and westslope cutthroat trout hybridizations accelerated by climate change.

Muhlfeld, C. C., & Marotz, B. (2005). Seasonal movement and habitat use by sub-adult bull trout in the upper Flathead River system, Montana. North American Journal of Fisheries Management, 25(3), 797-810 doi:10.1577/M04-045.1

Muhlfeld and Marotz conducted a study using radio telemetry to track sub-adult bull trout movement, migration, and dispersal in the upper Flathead River system, Montana. Researchers wanted to learn more about how the bull trout uses and moves throughout its habitat, as connectivity is considered a significant barrier to this threatened species. Sub-adults were frequently observed moving downstream towards the Flathead Lake and lower reach of the Flathead River.

Muhlfeld, C. C., Marotz, B., Thorrold, S. R., & FitzGerald, J. L. (2005). Geochemical signatures in scales record stream of origin in westslope cutthroat trout. Transactions of the American Fisheries Society, 134(4), 945-959. doi:10.1577/T04-029.1

The elemental composition and ratio of westslope cutthroat trout scales were analyzed. Specimens were collected from the North, South and Middle Fork of the Flathead River, Montana. There was a strong correlation between the elemental composition of the water and those found in the westslope cutthroat scales. Researchers discovered that scale elemental ratios could identify natal stream origin in individual fish.

Muhlfeld, C. C., McMahon, T. E., Boyer, M. C., & Gresswell, R. E. (2009). Local habitat, watershed, and biotic factors influencing the spread of hybridization between native westslope cutthroat trout and introduced rainbow trout. Transactions of the American Fisheries Society, 138(5), 1036-1051. doi:10.1577/T08-235.1

This study examines the various biotic, watershed, and habitat characteristics that are influencing the spread of hybridization between non-native and native fishes that is occurring in the Flathead River system of Montana and British Columbia. Diagnostic microsatellite loci were used to determine the level of hybridization between rainbow trout and westslope cutthroat trout populations. Connectivity, disturbance, and water temperature levels were significant indicators of hybridization.

Muhlfeld, C. C., McMahon, T. E., Kershner, J. L., & Belcer, D. (2009). Spatial and temporal spawning dynamics of native westslope cutthroat trout, *Oncorhynchus clarkii lewisi*, introduced rainbow trout, *Oncorhynchus mykiss*, and their hybrids. Canadian Journal of Fisheries and Aquatic Sciences, 66(7), 1153-1168. doi:10.1139/F09-073

Radio telemetry was used to assess the spatial and temporal distributions of the westslope cutthroat trout and various non-native fish species in the Flathead River system of British Columbia and Canada. The distances traveled by westslope cutthroat trout to the spawning headwaters was greatest, with the hybridized species traveling less extensively. Researchers found that the time of spawning was altered by the species and level of hybridisation.

Muhlfeld, C. C., Thorrold, S. R., McMahon, T. E., & Marotz, B. (2012). Estimating westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) movements in a river network using strontium isoscapes. Canadian Journal of Fisheries and Aquatic Sciences, 69(5), 906-915. doi:10.1139/f2012-033

Researchers examined the life history of westslope cutthroat trout using strontium variations found in fish otoliths. These naturally varied strontium isotope concentrations can be compared to the levels found in rivers and streams to track fish origin and movement throughout a lifetime. Otoliths collected had highly correlated strontium isotope levels to their natal streams.

Musto, D. (2012). ***Non-native plants and gardening in the town of Waterton Park: Community-based social marketing analysis and recommendations.*** **Waterton Lakes National Park: Parks Canada whitebark and limber pine workshop. (2003). Calgary: Parks Canada.**

The study looked at the application of community-based social marketing in regards to non-native plant management within the town of Waterton. Social marketing was ultimately not recommended, as it is impractical. It was recommended instead that the rest of the money for this project go towards responding to a large infestation of non-native plants that was discovered in 2011. The paper also included determining the non-native plant problem, selecting an audience which would deal with the non-native problem, and assessment of the application of this program. It was determined that this program would not work, and it was suggested that funds should be spent elsewhere to reduce the non-native plant population in Waterton Lakes National Park.

N.

National Parks Conservation Association. (2003). ***State of the Parks Waterton - Glacier International Peace Park.*** **(Natural Resource Assessment).**

The State of the Parks Report provides an overview of the many the threats to the long term ecological integrity of the Waterton-Glacier International Peace Park including, but not limited to, multiple outside pressures, climate change, introduced and invasive species, fire suppression, and staffing and funding challenges.

National Park Service. (2008). ***Avalanche hazard reduction by Burlington Northern Santa Fe Railway in Glacier National Park and Flathead National Forest, Montana.*** **(Environmental Impact Statement). Flathead and Glacier Counties, MT: U.S. Department of the Interior.**

Glacier National Park is analyzing a request from the Burlington Northern Santa Fe (BNSF) railway in which they requested that Glacier National Park allow them to use explosives to lessen the avalanche hazards in the area. The document details the analysis and responds to questions that the public rose during the comment period. In the end the BNSF withdrew the request. However, Glacier National Park finished the process as they suspect the BNSF will present a request on the subject in the future.

Neufeld, M. D., Davis, C. A., Cain, K. D., Jensen, N. R., Ireland, S. C., & Lewandowski, C. (2011). Evaluation of methods for the collection and fertilization of burbot eggs from a wild stock for conservation aquaculture operations. ***Journal of Applied Ichthyology, 27*****, 9-15. doi:10.1111/j.1439-0426.2011.01837.x**

The number of burbot fish has declined to the point where they are almost extirpated in the studied area. This probably due to the changes in the habitat and overfishing in the area. The purpose of the paper is to help enable the release of hatchery-raised burbot as a short-term recovery plan for the species. Moyie Lake is currently being used as a brood source. The study examined the success of fertilizing burbot eggs and transporting them to the hatchery. The possibility of collecting eggs for conservation efforts was also explored. The results showed that the eggs were successfully fertilized, but the survival rate was variable. These results indicate that they

can be collected and transported, but some more work needs to be done in order to improve the fertilization methods to raise the survivability of the eggs at the hatchery.

Neufeld, M. D., & Rust, P. J. (2009). Using passive sonic telemetry methods to evaluate dispersal and subsequent movements of hatchery-reared white sturgeon in the Kootenay River. *Journal of Applied Ichthyology, 25*(2), 27-33. doi:10.1111/j.1439-0426.2009.01336.x

Sonic tags were placed on 35 one year old white sturgeon, *Acipenser transmontanus*. These 35 sturgeons were released into five sites in the Kootenay River. It was found that the sturgeon that were placed in the three deep and low-gradient sites showed a very high rate of dispersal, both up and down stream. The fish that were placed in the shallow, high-gradient area all migrated downstream to a lower-gradient area within two months of being released. These results show that the sturgeons prefer the low-gradient areas, and that they are capable of moving great distances to find suitable habitats.

Newell, R. L., & Anderson, M. L. (2009). Note on the occurrence of *Siphlonurus autumnalis* (*Ephemeroptera*: *Siphlonuridae*) in a Montana spring brook. Western North American Naturalist, 69(4), 551-555. doi:10.3398/064.069.0415

The mayfly *Sphlonurus autumnalis McDunnough* is not commonly known, and was found in the floodplains habitat of the Flathead River. The nymphs were cared for and raised, and adults emerged between September and October.

Newell, R. L., & Baumann, R. W. (2013). Studies on distribution and diversity of nearshore *Ephemeroptera* and *Plecoptera* in selected lakes of Glacier National Park, Montana. Western North American Naturalist, 73(2), 230-236.

The diversity of the species *Ephemeroptera* and *Plecoptera* were examined in the lakes in Glacier National Park. The shallow shoreline sites were sampled by disturbing the bottom and collecting and examining the substratum. 29 lakes were examined in total, and only three were found to have no mayflies or stoneflies. In the rest of the lakes, there was high diversity of both species present.

Newell, R. L., & Hossack, B. R. (2009). Large, wetland-associated mayflies (*Ephemeroptera*) of Glacier National Park, Montana. Western North American Naturalist, 69(3), 335-342. doi:10.3398/064.069.0307

A survey of mayflies was collected from 355 water bodies and wetland habitats in Glacier National Park, Montana. Researchers monitored species richness and occurrence. The most abundant and frequently identified species was *Callibaetis ferrugineus hageni*. A total of nine taxa were collected during the survey. The study found that species richness was not as high in the wetland regions as in river and lake habitats. According to the researchers, this was the first extensive invertebrate study in Glacier National Park.

O.

Ott, S. J., Dobbin, H. S., Keating, K. A., & Weiser, G. C. (2009). Distribution of *Pasteurella trehalosi* genotypes isolated from Bighorn Sheep in Waterton-Glacier International Peace Park. Journal of the Idaho Academy of Science, 45(2), 11.

Research was conducted in Waterton Lakes National Park and Glacier National Park on multiple social groups of bighorn sheep to measure the distribution of *Pasteurella trehalosi* genotypes within the populations. Through genetic analysis, the study found that three genotypes were present in the population. Two of the genotypes were present across the study area and one was isolated to Waterton Lakes National Park.

P.

Pagnucco, K. S., Paszkowski, C. A., & Scrimgeour, G. J. (2011). Wolf in sheep's clothing: Effects of predation by small-bodied fish on survival and behaviour of salamander larvae. Ecoscience, 18(1), 70-78. doi:10.2980/18-1-3395

Fish species have a great impact on the larvae of salamanders. They may directly impact them by eating them, or indirectly impact them by eliciting antipredator behaviours. There is normally an allopatric distribution of fish and long-toed salamanders. However, in Linnet Lake in Waterton Lakes National Park, they coexist. There has recently been a 60 percent drop in salamander numbers in the last 14 years. The study was designed to look at the impact of the lake chub, which is the fish that coexists with the salamanders, on the decline in the salamander population. It was found that once the lake chubs reach a certain size they can eat the salamander larvae. The larvae respond by reducing their activity and increasing their refuge use. This is one of the only studies regarding the consumption of amphibian larvae by fish.

Pagnucco, K. S., Paszkowski, C. A., & Scrimgeour, G. J. (2012). Characterizing movement patterns and spatio-temporal use of under-road tunnels by long-toed salamanders in Waterton Lakes National Park, Canada. Copeia, 2012(2), 331-340. doi:10.1643/CE-10-128

Linnet Lake in Waterton Lakes National Park is a breeding ground for long-toed salamanders. There has been a great decrease in the salamander population in the last 15 years. It is believed that this is partly due to road mortality on the road that is adjacent to the breeding ground. There were amphibian tunnels placed under the road in 2008 to help decrease the rate of road mortality in the long-toed salamander. The project has been successful: the mortality rate has decreased from 10 percent to less than 2 percent. The researchers monitored the tunnel use and found that there was no discrimination of the tunnels based on body size, sex, or distance from the tunnel. The salamanders were 20 times more likely to use the tunnels if they were heading into the breeding ground than if they were heading out of the breeding grounds. It was suggested that there be more monitoring done on these tunnels to gain a better understanding of their usage and effectiveness, as well as to see if the use of the tunnels increases over time.

Pansing, E. R. (2014). ***The influence of cache site and rodent pilferage on whitebark pine seed germination in the northern and central Rocky Mountains*** **(Master of Science, Biology).**

Plant regeneration is dependent on six factors: the production of seeds, dispersal of microsite types, persistence, germination, seed survival, and plant establishment. If any of these are interrupted, then there is no regeneration of the trees. In order to determine the regeneration of the whitebark pine germination rates, cache pilferage rates, germination and pilferage rates in differing elevations, and microsite types cache size and relationships between rodent density and pilferage rates were examined in Glacier National Park. In 2012, 735 simulated caches were placed in six locations, each containing one to seven seeds. In 2013, the sites were examined and it was found that higher germination occurs near rocks, and that pilferage is higher within the tree line. Pilferage rates drop when in the subalpine ecosystem. This suggests that the germination and pilferage of the whitebark pine seeds depends greatly on the geographical location.

Paragamian, V. L., & Beamesderfer, R. C. P. (2003). Growth estimates from tagged white sturgeon suggest that ages from fin rays underestimate true age in the Kootenai River, USA and Canada. ***Transactions of the American Fisheries Society, 132*****(5), 895-903. doi:10.1577/T02-120**

The pectoral fins of 760 recaptured white sturgeon, *Acipenser transmontanus,* were examined to determine the effectiveness of age estimations based on the size and length of the fins. It was found that the age estimations from the fins were highly underestimated. The true ages of the fish were 30-60 percent higher than the estimations. The growth of the fins was less than was expected. Results such as these can cause substantial changes in the population parameters which can improve the way that conservation and management of this species is conducted.

Paragamian, V. L., Beamesderfer, R. C. P., & Ireland, S. C. (2005). Status, population dynamics, and future prospects of the endangered Kootenai River white sturgeon population with and without hatchery intervention. ***Transactions of the American Fisheries Society, 134*****(2), 518-532. doi:10.1577/T03-011.1**

The species *Acipenser transmontanus,* or white sturgeon, is currently endangered in the Kootenai River basin. Over 40 years of mark recapture data was used to project the future and current outlook for the species. White sturgeon populations have been severely impacted by dam development in all the river systems they inhabit. The researchers estimate a decline from 7000 individuals in the 1970's, to approximately 760 individuals in the year 2000. White sturgeon is a long lived species that does not reach sexual maturity for several years. The study projects that by 2030 there will be 50 individuals at the current declination rate. Due to white sturgeon's slow maturity, individuals currently introduced into the population from breeding programs will not be able to reproduce in the population until 2020. Hatchery introduction hopes to avoid founder effects and provide genetic diversity to the struggling population.

Paragamian, V. L., & Hansen, M. J. (2011). Stocking for rehabilitation of burbot in the Kootenai River, Idaho, USA and British Columbia, Canada. ***Journal of Applied Ichthyology, 27*****(1), 22-26. doi:10.1111/j.1439-0426.2011.01839.x**

The burbot fish, *Lota lota,* are at a great risk of extirpation in the Kootenai River due to the damage that has been caused by the construction of the Libby Dam upstream of their habitat. This study looks at the number of immature burbot fish that will need to be stocked in the area each year to stabilize the population. In order to estimate the number, the researchers used an age-structured simulation model. It was found that there would need to be between 110000 and 900000 fish stocked annually for the next 25 years. They also suggest rehabilitation goals for the area. Maintaining a population of 17 000 fish aged 4 or older is the ultimate goal. Once this goal is reached, it is recommended that the dam flow rates change just before and during the spawning season to regulate the temperature and flow of the water.

Paragamian, V. L., Hardy, R., & Gunderman, B. (2005). Effects of regulated discharge on burbot migration. *Journal of Fish Biology, 66*(5), 1199-1213. doi:10.1111/j.0022-1112.2005.00670.x

The Libby Dam is greatly affecting the movement of the burbot fish, *Lota lota.* This is due to the low discharge coming downstream from the dam. 24 adult burbot were tracked from 2000-2004. When the fish moved more than or equal to five kilometers in less than or equal to ten days it was considered a stepwise movement. The movement did not change during pre-spawning or spawning seasons. The stepwise movements went up when the discharge from the dam was greater than 300 m^2 per second. The burbot that started stepwise movements at times of low discharge stopped frequently. This research shows that the lack of discharge coming from the dam is greatly affecting the movement capabilities of this species.

Paragamian, V. L., & Kruse, G. (2001). Kootenai River white sturgeon spawning migration behavior and a predictive model. *North American Journal of Fisheries Management, 21*(1), 10-21. doi:10.1577/1548-8675(2001)021<0010:KRWSSM>2.0.CO;2

Using both sonic and radio telemetry 49 mature male white sturgeons' migration behaviour was monitored over seven years. The white sturgeon in this region migrate from Kootenay River and Lake in British Columbia to Idaho to spawn. Males exhibited migration behaviour after temperature and water level rose in the spring. The average amount of time spent in Idaho spawning was 30 days, however, this varied greatly in each individual. Females also migrated, but they left later and stayed for a shorter amount of time. A model was created using various environmental triggers to determine the time individuals would leave to spawn.

Paragamian, V. L., McCormick, J., & Laude, C. (2008). Changes in population indices of a diminishing burbot population in the Kootenai River, Idaho, USA and British Columbia, Canada. *Journal of Freshwater Ecology, 23*(4), 553-563. doi:10.1080/02705060.2008.9664243

A population of burbot, *Lota lota*, in the Kootenai River of Idaho and British Columbia was the focus on this study. Researchers monitored various aspects of the declining population: relative weight, stock density, catch per unit effort, and proportional stock density. Many species of fish, including the burbot, have been impacted by the construction of the Libby Dam in Montana. This study examines the recruitment failures and changes the burbot population is currently facing.

Paragamian, V. L., McDonald, R., Nelson, G. J., & Barton, G. (2009). Kootenai River velocities, depth, and white sturgeon spawning site selection - A mystery unraveled? *Journal of Applied Ichthyology, 25*(6), 640-646. doi:10.1111/j.1439-0426.2009.01364.x

The white sturgeon, *Acipenser transmontanus,* in the Kootenai River became a concern right after the Libby Dam became fully operational. The white sturgeons follow a short two-step migration pattern every fall and spring. The spring mitigation of discharge has allowed an increase of spawning which was thought to help the recovery of the species. Unfortunately, the area in which the spawning is happening is not favourable for incubation or rearing, which leads to an extremely low survival rate for the sturgeon. It was found that the spawning areas did not change based on the velocity of the water, and thus it is assumed that the sturgeon are spawning in the same area as they were before the dam. In order to bring the velocity of the river back to where it needs to be to remove the sediment that is settling there, it would need to be high enough to classify as in the flood stage. It is recommended that management plans include habitat modification instead of dam alteration.

Paragamian, V. L., & Wakkinen, V. D. (2002). Temporal distribution of Kootenai River white sturgeon spawning events and the effect of flow and temperature. *Journal of Applied Ichthyology, 18*(4-6), 542-549. doi:10.1046/j.1439-0426.2002.00391.x

The temporal distribution of the spawning of white sturgeon, *Acipenser transmontanus,* has been disturbed. This paper studies the flow and temperature of the water, as well as natural and man-made variations that have occurred in the Kootenai River. from 1994-2000, eggs were collected using artificial substrate mats and were studied using microscopic examination. It was estimated that there were between 9 and 20 spawning events lasting about 17-31 days. Spawning occurred most commonly in temperatures that were 7.5-14 degrees Celsius. It was found that after the onset of spawning temporal distribution seems to be based on shape of the river, as well as stability and temperature of the flow within the river. It was also found that if there was a water temperature difference of greater than or equal to 0.8 degrees Celsius, It may greatly disrupt the spawning. It was suggested that while fast flow rates are not necessary, there may be a secondary benefit that is unknown at this point.

Paragamian, V. L., & Wakkinen, V. D. (2011). White sturgeon spawning and discharge augmentation. *Fisheries Management and Ecology, 18*(4), 314-321. doi:10.1111/j.1365-2400.2011.00785.x

Spawning events of the white sturgeon, *Acipenser transmontanus,* were examined between the years 1994-2002. This was done to see if the manipulation of the flow from the Libby Dam was causing change in the spawning behaviours of the white sturgeon. Originally the spawning appeared to have nothing to do with the discharge from the dam. However, in four of the eight years the spawning occurred 2-11 days after the highest river discharge from the dam. It was determined that the spawning was positively correlated to the mean daily discharge, but not to the mean temperature of the water. The highest probability of spawning was when the water temperature was between 9.5-9.9 degrees Celsius.

Paragamian, V. L., & Walters, J. P. (2011). Bull trout (*Salvelinus confluentus*) movement in a transboundary river. *Journal of Freshwater Ecology, 26*(1), 65-76. doi:10.1080/02705060.2011.553854

A nine year study conducted from 1998 to 2006 tracked the movements of 19 threatened bull trout from the Kootenai River of Idaho and British Columbia to Kootenai Falls, Montana. Not all of the fish tracked migrated to spawn: half were annual spawners and others only spawned in alternate years. Most of the fish migrated some distance. Nine remained for some time at Kootenai Falls. Two fish did not migrate and stayed in Kootenay Lake.

Parks Canada. (2003). *Whitebark pine and limber pine workshop.* (Workshop Proceedings). Calgary, Alberta: Parks Canada.

The whitebark and limber pine workshop's goal is to help save these two endangered tree species within Canada and the United States. The workshop was held in order to allow researchers to update the audience about their research, identify common research goals and knowledge gaps, and to get a transboundary group working to provide guidance for future research. At the end of the workshop it was proposed that a conservation network be set up that was specific to these trees. This would help to monitor and facilitate research along with other goals. There are more discussions planned to help this project along and to ensure its success.

Parks Canada. (2008). *Waterton Lakes National Park State of the Park Report* (Status Report). Waterton, Alberta, Canada.

The state of the park report provides assessments of multiple elements and indicators of Waterton Lakes National Park's ecological integrity. Other aspects of the park, such as visitation and visitor education, are also discussed.

Paveglio, T. B., Prato, T., & Hardy, M. (2013). Simulating effects of land use policies on extent of the wildland urban interface and wildfire risk in Flathead County, Montana. Journal of Environmental Management, 130, 20-31. doi:10.1016/j.jenvman.2013.08.036

The researchers used a wildfire loss simulation model in to assess the wildfire risk in different areas of Flathead County. It was done to explore the effects of wildfire on different land and vegetation types in areas and to assess how they will react to a wildfire. In Flathead County, the land use policies are extremely restrictive and reduce the amount of and footprint of residential building. It was determined that if the building policies were more moderate the wildfire risk would drop.

Pearson, K. J. (2002). *Linnet Lake long-toed salamander (Ambystoma macrodactylum) road kill prevention and population and population estimation project summary report.* (Unpublished Technical Report). Waterton Lakes National Park: Canada Parks Agency.

In Waterton Lakes National Park there has been a great decline in the population of long-toed salamanders. They believe the greatest cause for this is the vehicular traffic, as there is now a road that crosses the path of migration for the salamanders. They also believe that the decline could be due to predation, as well as competition. The study looks at how to reduce the roadway mortality of the salamanders. It obtained a population estimate for the salamanders

and improved the knowledge of their patterns. They used the mark-recapture technique and caught 57 salamanders and 19 of these salamanders were killed by vehicles. 37 salamanders were recaptured, 2 had been previously marked, giving an estimation of 289 individuals. It was recommended that beneath-road crossing structures be built. Stopping the use of herbicide was also recommended as the salamanders are greatly affected due to the permeability of their skin.

Pearson, K. J. (2003-2004). ***Southern headwaters at risk project (SHARP) amphibian and western painted turtle (Chrysemys picta) surveys, 2003-2004.*** **(Alberta Species at Risk Report No. 97). Edmonton: Alberta Sustainable Resource Development, Fish and Wildlife Division.**

The Southern Headwaters At Risk Project (SHARP) deals with the management and conservation of species at risk in the headwater region of the Oldman River in Alberta. In this study they investigated the distribution of amphibians in the area, the distribution and origin of the western painted turtle, and established land guidelines for future use. They used encounter and call surveys at 121 bodies of water. The places were determined based on a lack of previous data or a need for more data in those locations. It was found that all amphibian species, except for the northern leopard frog, had a greater population size than previously recorded It appears that the turtles were intentionally introduced to the Crowsnest Pass area. However, there is no conclusive evidence. The study suggests that the worst threats to the amphibians in the area are climate change, habitat alteration and fragmentation, pollution in the area, disease, and introduced species. They recommend further survey efforts in areas that have not yet been assessed, and in areas that have shown a possible decline in an amphibian species.

Pearson, K. J. (2004). ***The effects of introduced fish on the long-toed salamander (Ambystoma macrodactylum)*** **(Master of Science - Dept. of Biology).**

Trout and minnows have been introduced to many Albertan ecosystems which are a natural habitat to the long-toed salamander. This thesis studies the effects that these introduced fish have on the survivability of the long-toed salamanders in the area. The study was conducted with field surveys, some laboratory experiments, as well as an outdoor mesocosm experiment. It was determined that there is a great separation between the species. Where minnows and trout are found there are no longer long-toed salamanders in that location. This is due to the incredible decline of salamander survivability in the areas with the introduced fish. The fish are outcompeting the salamanders and eating or injuring the larvae in the area.

Pearson, K. J., & Goater, C. P. (2008). Distribution of long-toed salamanders and introduced trout in high- and low-elevation wetlands in southwestern Alberta, Canada. Ecoscience, 15(4), 453-459. doi:10.2980/15-4-3127

Several trout have been introduced into the wetlands in Waterton Lakes National Park and the adjacent Castle region. This has had a serious impact on the native long-toed salamander populations. This paper compared the distribution of long-toed salamander larvae and trout. There were surveys done in 27 low elevation wetlands and 30 high elevation wetlands. It was found that there were no salamander larvae in the higher elevation wetlands when there were trout present. There were only four places in the lower elevations that showed some

coexistence between the two species; the rest showed similar results to the high elevation surveys. It was suggested that further studies be done in order to fully understand the relationship between these two species.

Pedynowski, D. (2003). Toward a more "reflexive environmentalism": Ecological knowledge and advocacy in the Crown of the Continent Ecosystem. *Society & Natural Resources, 16*, 807-825. doi:http://library.mtroyal.ca:2087/10.1080/08941920309168

This article examines a particular case study that states where the regional environmental movement is changing from what is known as traditional wilderness advocacy to integrated social and ecological needs of the environment. The purposes of this paper are to examine and describe what current environmentalists are using as environmental knowledge, to look at the rationale that is used to cite ecological knowledge claims, and to assess what changes increased social-biophysical knowledge into processes of environmental activism. This paper states that there needs to be an increase in the diversity of knowledge and discourse in order to completely discuss the environmental issues.

Pedynowski, D. (2003). Prospects for ecosystem management in the Crown of the Continent Ecosystem, Canada-United States: Survey and recommendations. *Conservation Biology, 17*(5), 1261-1269.

The purpose of this paper was to find people that can potentially work on international ecosystem management within the Crown of the Continent. 33 interviews were conducted in all fields that are related to the Crown of Continent. From these interviews, 10 challenges were discovered when attempting to better the transboundary efforts. These 10 challenges are described as well as analyzed in the paper. It was also found that co-operation in transboundary issues were less supported across country borders than across provincial or state lines. Recommendations were made to help alleviate this problem.

Pohl, G. R., Anweiler, G. G., Schmidt, B. C., & Kondla, N. G. (2010). An annotated list of the *Lepidoptera* of Alberta, Canada. *Zookeys, 38*, 1-549. doi:10.3897/zookeys.38.383

This is an annotated list of the 2367 *Lepidoptera* species that are known to call Alberta home. Each species includes the scientific name, year of publication of the original description, and the author, distribution, adult phenology, and their occurrence.

Potvin, C., Landry, C., Pacas, C., & Bernatchez, L. (2003). *Genetic population structure of cutthroat (Oncorhynchus clarkii) and rainbow (Oncorhynchus mykiss) trout in Banff and Waterton Lakes National Parks, Alberta.* (Final Report). Quebec: Universite Laval.

The report looked at the genetic structure of populations of cutthroat trout in Banff National Park and Waterton Lakes National Park. It compared the genetic structure between places and native populations, and native populations that were stocked. Fishless areas were assessed before stocking. It was found that the genetic diversity was much lower in Banff National Park than Waterton Lakes. The cutthroat trout had many loci that were monomorphic which is reason for concern. It was recommended that no more stocking should occur to allow the natural populations to regain their diversity.

Prairie Conservation Forum. (2011). ***Alberta prairie conservation forum 2010.*** **(Annual Report). Lethbridge, AB, Canada.**

The Prairie Conservation Forum (PCF) is a stewardship group funded by Environment and Sustainable Resource Development (ESRD) who works closely with the Crown Manager's Partnership. Their vision involves conservation of the biological diversity of native prairie grasslands and parklands for the benefit of future generations. As such, they are focused highly on education and research that helps to expand the knowledge base available on native prairie ecosystems. The PCF education committee plans field trips to engage aboriginal youth in value based mapping projects. Their MUTLISAR project publishes Species-at-Risk conservation plans and detailed conservation habitat strategies for southwestern Alberta, as well as a yearly Grassland Vegetation Inventory that conducts aerial analysis of grassland vegetation. It also provides education for proficient use of these imaging tools. Their Wind Energy Initiative is aiding in the production of guidelines to help mitigate surface disturbance of wind energy farms on native grasslands.

Prato, T. (2009). Evaluating trade-offs between economic value and wildlife habitat suitability in buffer zones for protected areas in the northern Rocky Mountains, USA. Mountain Research and Development, 29(1), 46-58. doi:10.1659/mrd.992

Conflict between natural resource development and environmental protection in the face of population growth in the Rocky Mountain region is increasing. Using an Ecosystem Landscape Modeling System, researchers aimed to quantify the trade-offs being experienced in the Flathead region of Montana. The study aimed to (1) identify the trade-offs occurring between resource development and habitat conservation or disturbance, and (2) to determine if stricter regulation would decrease the impact and amount of trade-offs being made. The researchers found that in the buffer zones for protected areas surrounding the Flathead region strict regulation would have a positive impact on habitat disturbance when facing a future of increasing population and anthropogenic development.

Prato, T. (2012; 2011). Potential trade-offs between future economic growth and open land conservation adjacent to public protected areas: A case study in northwest Montana. Society & Natural Resources, 25(2), 113-126. doi:10.1080/08941920.2010.550084

As there is more pressure to develop lands adjacent to national parks and protected areas, conflicts arise between the economic benefits of developing the land and the conservation benefits of leaving the land undeveloped. Researchers used an Ecosystem Landscape Modeling System to simulate the implications of developing various land parcels in Flathead County, Montana, in nine theoretical futures. Researchers discuss the economic benefits, including job creation, versus large open land conservation benefits. They also explore the possibility of implementing stricter land use policies.

Prato, T., & Fagre, D. B. (2010). Sustainable management of the Crown of the Continent Ecosystem. ***The George Wright Forum, 27*****(1), 77-93.**

This overview of management in the CCE examines adaptive and integrated ecosystem management as it has been applied across the Crown. Sustainable management occurs when historical resource and tourism use are maintained while upholding the intrinsic values of the land itself without impeding its ability to provide ecosystem services. To implement this kind of

management over large landscapes, Prato & Fagre identify four requirements: a commonly held vision, identification of baseline sustainability, selection of best management practices in the light of unsustainability, and consistent monitoring and flexibility within management practices to maintain the desired sustainability of the state of the ecosystem. This flexibility is termed Active Ecosystem Management (AEM), and treats each management action as an experiment to test the response of the ecosystem. Detailed applications of AEM are exemplified in case studies of the Nyack Floodplain of the Flathead River, the Rocky Mountain Front, the Blackfeet Trust, and the Blackfoot Challenge. Feasibility of implementing sustainable management in the CCE is dependent on national park mandates. Institutional frameworks are also discussed.

Q.

Qiu, Z., & Prato, T. (2012; 2011). Economic feasibility of adapting crop enterprises to future climate change: A case study of flexible scheduling and irrigation for representative farms in Flathead Valley, Montana, USA. Mitigation and Adaptation Strategies for Global Change, 17(3),223-242. doi:10.1007/s11027-011-9322-x

Climate change is greatly affecting crop production. The resulting impacts of climate change are evaluated in the study. It was found that if there is no adaptation of crop production methods there will be a 7-48 percent decrease in production in the near future. It was found that neither the flexible scheduling of crop production or changes in the irrigation system would increase the amount of crop produced in the future. It seems that the adverse effects of climate change are permanent.

R.

Rangeland Management Branch, Rangeland Resource Management Program. (2004). Methodology for calculating carrying and grazing capacity on public rangelands. (No. I/197). Alberta Sustainable Resource Development.

The management of rangeland and grazing is a great barrier for conservation work. There are four steps that need to be implemented when managing the grazing of livestock in order to maintain the health of the forage: the first is survey the plants between grazing periods, the second is to avoid early spring foraging, the third is distributing the livestock evenly across the plants, and the fourth is to balance the livestock with the available forage. The grazing areas are assessed by PLFD rangeland agrologists in order to calculate the grazing capacity and carrying capacity for the area. The ecologically sustainable stocking rates are then sent to ranchers to be used as a guide to ensure that there is sustainable grazing is occurring on rangelands across Alberta. This paper describes the methodology of rangeland management.

***Range vegetation and carrying capacity assessment in Waterton Lakes National Park.* (2003). Waterton Lakes National Park: High Range Ecological Consultants.**

Since 1952 there has been a small herd of bison which graze in the bison paddock along the northeast edge of Waterton Lakes National Park. Parks Canada wants to release the bison into a larger

area within Waterton Lakes National Park. First they needed to understand what that would do to the vegetation in the area. In order to do this 20 vegetation transects were placed in the bison paddock, as well as outside of the paddock in order to compare the impact from the bison with the impact from the elk. It was found the bison paddocks had differences in the coverage compared to similar sites outside of the paddock. There was higher coverage of Kentucky bluegrass and lower coverage of some native plants, being the smooth rye and the rough fescue, which is a key species. It was also found that the soil was more disturbed in the paddocks, and there were higher levels of exposed soil due to the change in coverage and the hoof disturbance. There needs to be more research before the bison will be released from their paddocks.

Reeves, B. O. K. (2003). ***Miistakis: The archeology of Waterton-Glacier International Peace Park archeological inventory and assessment program 1993-1996 vol I.*** **(Technical Report No. Contract No. 290847). Denver, CO: National Park Service.**

This is a technical report that actively explains the results that were found from a four year archaeological inventory program that took place in Glacier National Park between 1993 and 1996. The purpose of this study was to pinpoint and determine archeological sites for the National Register of Historic Places. Data from Waterton Lakes National Park was also included.

Rettie, K., & Rogala, K. (December, 2011). ***Trail data summary report prepared for S. Boyle and the EI monitoring staff in mountain parks.*** **(Trail Report).**

The purpose of this report is to present the data that was obtained from information regarding day use trails. The data was then presented in a way that was suitable for use in describing impacts on natural resources in documents like State of the Park Reports. The report provides a summary regarding the average levels of trail use in mountain parks using data collected over multiple years.

Rodriguez, J. T. (2005). ***Patch characteristics of post fire landscapes in the Crown of the Continent Ecosystem, Montana, USA*** **(M.S.). Available from ProQuest Dissertations & Theses Global. (1472725052).**

This dissertation discusses fire regimes, fire severity, and fire behaviour in the CCE. The study is broken into two parts: (1) range of landscape patches post fire and (2) identification of similarities and differences between fires using power law distribution to patch burn severity. The study was conducted on fire burn patches in the Montana portion of the Crown of the Continent Ecosystem in Glacier National Park, and the Great Bear, Bob Marshall, and Scapegoat Wildernesses.

Rood, B.S.., Goater, L. A., Mahoney, J. M., Pearce, C. M., & Smith, D. G. (2007). Floods, fire, and ice: Disturbance ecology of riparian cottonwoods. The review is one of a selection of papers published in the special issue on poplar research in Canada. ***Canadian Journal of Botany, 85*****(11), 1019-1032. doi:10.1139/B07-073**

Cottonwoods are very well adapted to riparian ecosystems. Physical features in the environment were tested to see how the population of cottonwoods reacted to floods, fire, and ice. Major floods were essential for the seedlings as it deposited nutrients and forced deep rooting. Fire allowed for regrowth, and ice was found to cause barren sites which allowed seedlings to colonize the affected area. It is important for this species to be exposed to these natural processes. Flooding cycles need to be reintroduced in the area to maintain cottonwood stand health.

Rood, B. S., Samuelson, G. M., Weber, J. K., & Wywrot, K. A. (2005). Twentieth century decline in stream flows from the hydrographic apex of North America. *Journal of Hydrology, 306*, 215-233.

The Crown of the Continent is an area that has many provincial and national parks located within it. This protection has resulted in minimal impact on the ecosystems from the humans in the area. Research of historic streamflow patterns is possible due to this low impact. This paper analyses 31 river reaches to determine the mean annual discharge from the rivers. The analyses showed that there was a decrease in flow for 21 of the streams, while 10 of them stayed fairly constant from historical times. Alberta rivers that flow to Hudson Bay were the most likely to decrease. It is predicted that there will be continual decrease in the discharge in the future. This decrease in water will affect many aquatic ecosystems and crop production.

Roon, D. A. B. (2004). Non-invasive genetic sampling as a population assessment tool for brown and black bears within the Greater Glacier Ecosystem (Doctor of Philosophy, Forestry, Wildlife and Range Sciences).

Genetic sampling using hair samples in grizzly bear research is relatively new. This dissertation and research was part of the Greater Glacier Bear DNA Project. The research, as part of the project, aimed to create a comprehensive estimate of the grizzly population in the Glacier area as well as examine gene flow and improve methodology. Methods of genetic sample storage are discussed along with female controlled gene flow in the greater Glacier area.

Rubidge, E. M., & Taylor, E. B. (2005). An analysis of spatial and environmental factors influencing hybridization between native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) and introduced rainbow trout (*O. mykiss*) in the upper Kootenay River drainage, British Columbia. *Conservation Genetics, 6*(3), 369-384. doi:10.1007/s10592-005-4972-4

The rainbow trout, *Oncorhynchus mykiss,* which have been introduced to the upper Kootenay River drainage in British Columbia, are readily hybridizing with native westslope cutthroat trout, *Oncorhynchus clarkii lewisi.* In this study the authors assess the geographic distribution and extent of the hybridized cutthroat trout and rainbow trout species by using four diagnostic nuclear loci. They studied and tested 981 fish in 23 sample locations located on the upper Kootenay drainage and found that 14 percent of the fish were hybrids. Management strategies need to be put in place in order to preserve the genetic integrity of the native westslope cutthroat trout species for the future.

Rust, P. J. (2011). Translocation of prespawn adult Kootenai River white sturgeon. *Journal of Applied Ichthyology, 27*(2), 450-453. doi:10.1111/j.1439-0426.2010.01488.x

The legitimacy of translocation as a conservation measure was the focus of this study. Researchers aimed to translocate 29 white sturgeon to a more suitable spawning habitat, as the original spawning site had become too silty. Silt-laden water is an unsuitable environment for eggs. The sturgeons were fitted with both radio and sonic transmitters before being relocated to an ideal spawning habitat. After multiple stages of release during 2003-2004, the researchers determined that males stayed at the translocation site longer than females on average. There was some evidence of reproduction: seven immature eggs were observed on substrate. However, this could not be confirmed as successful spawning.

Rutherford, A., Ellis, C., McGowen, P., McClure, M., Ament, R., & Grebenc, J. (2014). *Highway mitigation for wildlife in northwest Montana: Estimating the impacts of exurban growth and traffic demand on grizzly bears and other key wildlife species.* Bozeman, MT: Sonoran Institute, Northern Rockies Office.

The construction of housing and roads is occurring in both the Flathead area and Lincoln County. With this increase in the number of houses and people there will be an increase in the number of roads and traffic. This paper analyses the impacts of this human connectivity on habitat connectivity for large carnivores. It models possible problems and solutions. The main goal was to keep the habitat continuity in spite of the increase in human motorized traffic in the area. This project is considered unique as it looks to solve the problems that may be faced instead of reacting to them as they occur. Habitat connectivity can be preserved in the area through collective efforts and accurate predictions.

S.

Saint Mary Recovery Unit. (2015). *Draft Saint Mary recovery unit implementation plan for bull trout recovery plan.* (Recovery Implementation Plan). Kallispell, Montana: US Fish and Wildlife Service.

The recovery plan explores threats present to the bull trout as well as management plans that are necessary for the recovery of the species. It estimates the timeline needed for bull trout recovery and the cost of the project. The current status of the bull trout in the St. Mary River is strong. It is currently the design and management of the St. Mary that is the main factor affecting the populations. In order to allow the recovery it was recommended that a screen be constructed to limit entrainment of the trout. A second recommendation was to develop fish passage facilities for upstream migration. The third recommendation was to allow adequate stream flow. It is expected that this plan would take 25 years minimum to be in full effect, and will cost $38 million. The plan also gives a breakdown of how long each part would take, as well as how much each section will cost.

Schwanke, R. (February 2001). *Fire management plan for Waterton Lakes National Park of Canada.* (Fire Management Plan). Waterton Lakes National Park: Alberta, Canada.

The Waterton Lakes National Park fire management plan was created to help the long-term composition of the area and maintain the native vegetation. The main goal is to maintain the role of fire in the area while ensuring the safety of the inhabitants. Assessments were made to determine where prescribed fire would work best. A secondary goal of the plan was to increase the awareness of the benefits of natural processes such as fire in the park.

Scott, D., Jones, B., & Konopek, J. (2007). Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park. ***Tourism Management, 28*****(2), 570-579. doi:10.1016/j.tourman.2006.04.020**

Nature based tourism is a major industry in the Rocky Mountains, and climate change could severely impact this resource. The study examines the direct and indirect implications of climate change on the tourism industry. A model was created and predicted that the visitation in the area would increase between 6 and 10 percent by the 2020's, and by the 2050's there would be an increase between 10 and 36 percent. It was found, however, that in the 2080's there would be less visitation likely due to the large climate amount of climate change occurring by that decade. This was assessed using a survey in the park which asked people if they would visit as much in the climate conditions that are expected in the 2080's. A major finding for this study was that two analyses showed contrasting results. They also discussed what effects climate change will have on management in the future.

Scott, J. D. (2013). ***Clark's nutcracker occurrence, whitebark pine stand health, and cone production in the Waterton-Glacier International Peace Park*** **(M.S.). Available from ProQuest Dissertations & Theses Global. (1436267579).**

Whitebark pine, *Pinus albicaulis,* is dependent on Clark's nutcrackers to disperse its seeds. The nutcrackers are the primary seed dispersers for this species. A management plan is needed to restore the Whitebark population due to a recent absence of seed dispersal. This paper studied the relationship between the nutcrackers and the whitebark pine trees. Five study areas were selected across Waterton Lakes National Park. The health of the trees was assessed and visitation by Clark's nutcrackers was recorded. It was estimated from the results that there were 66.7 cones and only 0.85 nutcrackers for each hectare of land. The results suggest that there is very low visitation from the nutcrackers to the whitebark pine communities in this area.

Selkowitz, D. J., Fagre, D. B., & Reardon, B. A. (2002). Interannual variations in snowpack in the Crown of the Continent Ecosystem. ***Hydrological Processes, 16*****(18), 3651-3665. doi:10.1002/hyp.1234**

Glacier regression has been accounted for in the Rocky Mountains located in northern Montana, southeastern British Columbia, and southwestern Alberta. The variations within the snowpack of this region ultimately control these changes. This paper looks at the variation in long-term snowpack of this region and its associated ecosystem challenges and change.

Sexton, E. K. (2002). ***Land-use in the Crown of the Continent Ecosystem: The potential disturbance resulting from coalbed methane production in the east Kootenay coalfields of southeast British Columbia*** **(M.S.). Available from ProQuest Dissertations & Theses Global. (1124402852).**

There have been great impacts on the environment from the production of coalbed methane. The purpose of this study was to find the total effects of this production. There were three methods used to determine the effects: the first was finding the total disturbance that has occurred which was done by considering the direct and indirect impacts, the second method was examining the potential linear disturbances, and the third was determining the grizzly bear displacement in the area. The effect on river systems where well discharge water is drained was also discussed. It was determined that there would be great displacement of large carnivores in the area.

Shafer, C. L. (2015). Land use planning: A potential force for retaining habitat connectivity in the greater Yellowstone ecosystem and beyond. Global Ecology and Conservation, 3, 256-278. doi:10.1016/j.gecco.2014.12.003

The paper evaluates the connectivity of grizzly bear populations between the Greater Yellowstone Ecosystem and the Northern Continental Divide Ecosystem. Researchers discuss the need to minimize fragmentation within and between these two critical ecosystems. This study reviews management and various tools available to regulators and managers that may help facilitate large animal dispersal and reduce fragmentation.

Shaw, A. (2001). ***Conservation and ecological restoration of Rocky Mountain subalpine meadows: Understanding vegetation responses to tree encroachment.*** **(Unpublished Master of Science in Environmental Studies). Simon Fraser University**

Tree encroachment has been occurring in North America for the last century, but there are minimal studies on how encroachment of the trees is affecting meadow vegetation. In the study, 14 meadow sites were selected. Both wet and dry meadows were studied. Nonmetric multidimensional scaling showed that the species present changed from meadow to forest habitats. This occurred equally in the wet and dry meadows, and showed little difference between the encroachment areas. The results showed that the encroachment of the trees has led to loss, abundance, richness, and diversity of the meadow species. It was found that encroachment had a greater effect in the wet areas, though encroachment in this meadow type did not occur faster than encroachment in the dry meadows. It showed that inhibitory effects on the meadow vegetation were caused by much younger trees in the wet areas than in the dry areas. The paper states that there are areas that need to be restored in future conservation efforts.

Shepard, B., B. (2003). ***Status of westslope cutthroat trout (Oncorhynchus clarkii lewisi) in the United States: 2002.*** **(Status Report). Westslope cutthroat interagency conservation team.**

The assessments show that the westslope cutthroat trout are well distributed through their historical range. It was suggested that two different conservation management strategies be adopted.

One strategy is to isolate the cutthroat trout to stop introgression, disease, and competitive factors. The second focuses on connecting the occupied areas to allow interbreeding between cutthroat trout populations. Their historical range has greatly decreased in recent years. There are 563 separate populations of the westslope cutthroat trout which occupy 24450 miles of habitat. The larger, more interconnected populations are less susceptible to disease and other risk factors

Smith, C. M. (2008). ***Wishbone MAPS Station Summary report 2002-2008.*** **(Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada, Waterton Lakes National Park.**

The goal put forth by the Monitoring Avian Productivity and Survivorship (MAPS) program is to provide democratic data on land bird species for the future. The goal is to help to identify the multitude of factors that are driving population trends in various species of birds that have been previously identified by other monitoring programs across North America such as the North American Breeding Bird Survey and the Christmas Bird Counts. This report outlines the objectives needed in order to produce a cooperative effort among all parties involved in collecting this data from 2002-2008.

Smith, C. M. (2009). ***Wishbone MAPS Station Summary Report 2002-2009.*** **(Unpublished Technical Report). Waterton Lakes National Park, Alberta, Canada: Parks Canada, Waterton Lakes National Park.**

The purpose of the Monitoring Avian Productivity and Survivorship (MAPS) program is to provide democratic long-term data on land bird species. The goal of this study is to identify factors that are driving population trends in various species of birds that have been previously reported by other North American monitoring programs such as the North American Breeding Bird Survey and the Christmas Bird Counts. This report outlines the objectives needed in order to produce a cooperative effort among all parties involved in collecting data from 2002-2009.

Smith, C. M., Domenech, R., & Watt, R. A. (2013, Spring). Wing-tagged golden eagle observed at Waterton Lakes National Park. ***Nature Alberta, 43*****, 31-33.**

The golden eagle (*Aquila chrysaetos)* has been seen migrating to the north in the spring and to the south in the fall along the Rocky Mountains in Alberta in recent years. It has been found that the east slope side of this section of the Rocky Mountains provide thermals that are valuable to this species of bird. The Spring Intercept Feeding program was developed by Alberta Environment and Sustainable Development and used strategically placed carcasses of various animals collected from highway collisions. Golden eagles were observed at these carcasses and data was collected on the number of sightings.

Smith, C. M., Kaschube, D. R., Shepherd, B., & Woods, J. (2008). ***Monitoring Avian Productivity and Survivorship (MAPS) in Mount Revelstoke, Banff, Waterton Lakes and Jasper National Parks (1993-2006).*****(Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada, Waterton Lakes National Park.**

The object of this study is to compare and detect the different trends in populations, productivity, and survival of specific avian species in Waterton Lakes National Park and Canada's other

mountain national parks. Four MAPS stations were in operation from 1993 to 2006. The birds were captured and banded at these locations in order to monitor avian productivity and survivorship. The data was assessed to determine whether there were population increases or decreases in avian populations, and whether or not these changes were driven by productivity in the avian breeding grounds or by adult survivability in the winter nesting grounds and during migration. This data collection ultimately contributes to the assessment of biodiversity in the terrestrial ecosystems of Canadian mountain national parks.

Spencer, C. N., Gabel, K. O., & Hauer, F. R. (2003). Wildfire effects on stream food webs and nutrient dynamics in Glacier National Park, USA. Forest Ecology and Management, 178(1), 141-153. doi:10.1016/S0378-1127(03)00058-6

The effect of wildfires on aquatic ecosystems was the focus of this study. Some of the impacts examined and documented included water chemistry, fish mortality, and aerial debris. By analyzing the levels of certain isotopes found in invertebrates and fish affected by wildfire, researchers found that these organisms were enriched in some isotopes and deficient in others. Fire suppression has been the favored method of wildfire management in the past, but the researchers suggest that fire actually makes nutrients more readily available for uptake in an ecosystem and is a beneficial process.

Stafford, C. P., Hansen, B., & Stanford, J. A. (2004). Mercury in fishes and their diet items from Flathead Lake, Montana. Transactions of the American Fisheries Society, 133(2), 349-357. doi:10.1577/02-156

This paper examined the amount of mercury present in the two fish species *Salvelinus namaycush* and *Coregonus clupeaformis*. It was found that there were higher rates of mercury in larger and older fish. It was also found that there was a positive correlation between the mercury concentration in the fish and the depth that the fish occupied. There was no increase in mercury concentration between the two sexes for either fish species. This paper suggests that there is need to study not only the concentrations, but also the biological attributes of the organisms that are being tested.

Stafford, C., McPhee, M., Eby, L., & Allendorf, F. (2014; 2013). Introduced lake trout exhibit life history and morphological divergence with depth. Canadian Journal of Fisheries and Aquatic Sciences, 71(1), 10-20. doi:10.1139/cjfas-2013-0115

A population of lake trout found in Flathead Lake, Montana was studied. This population appeared to have characteristics that would indicate a divergence from other lake trout. The researchers found evidence to suggest that individuals within the Flathead Lake lake trout population had depth preferences. It is believed that this altered behaviour has arisen following the invasion of another fish species, *Mysis diluviana.* Trout living in a deeper environment had larger eyes, matured both smaller and slower, and had deeper bodies than their shallow living relatives.

Stafford, C. P., Stanford, J. A., Hauer, F. R., & Brothers, E. B. (2002). Changes in lake trout growth associated with *Mysis relicta* establishment: A retrospective analysis using otoliths.

Transactions of the American Fisheries Society, 131(5), 994-1003. doi:10.1577/1548-8659(2002)131<0994:CILTGA>2.0.CO;2

After the establishment of the shrimp *Mysis relicta* there was a great increase in the lake trout, *Salvelinus namaycush,* population in Flathead Lake. The lake trout were tested for growth after the introduction of the shrimp and were mathematically calculated for the growth before the shrimp were established. It was found, however, that there was no correspondence between the establishment of the shrimp and the growth of the trout. There is a need for more research in this field.

Stephenson, S., Neufeld, M., Ireland, S., Young, S., Hardy, R., & Rust, P. (2013). Survival and dispersal of sonic-tagged, hatchery-reared burbot released into the Kootenay River. *Transactions of the American Fisheries Society, 142*(6), 1671-1679. doi:10.1080/00028487.2013.774293

One to three year old hatchery reared burbot dispersal and survival in Kootenay Lake and River was monitored in this study. 109 fish were tagged using radio telemetry. Researchers found that the released burbot had a high survival rate. The burbot were also able to disperse throughout the lake and river system. Released fish were able to successfully spawn. However, the younger fish had greater difficulty migrating. Researchers found that for the burbot, releasing individuals bred in a fishery could be an effective conservation method for this population.

Stetz, J. B., Kendall, K. C., & Macleod, A. C. (2014). Black bear density in Glacier National Park, Montana. Wildlife Society Bulletin, 38(1), 60-70. doi:10.1002/wsb.356

Researchers developed a population density estimate for the black bear population in Montana's Glacier National Park. Genetic sampling was used to determine abundance and individuals visiting at sampling sites. From the data the study model found that the black bear population residing in Glacier National Park was estimated to be 603 individuals. Density estimates for Glacier National Park were also determined.

Stetz, J. B., Kendall, K. C., & Servheen, C. (2010). Evaluation of bear rub surveys to monitor grizzly bear population trends. Journal of Wildlife Management, 74(4), 860-870. doi:10.2193/2008-435

A study was conducted to gather a comprehensive population estimate of the grizzly population residing in northwestern Montana. This research effort was undertaken because little monitoring had occurred after the grizzly bear population was listed in 1975. The genetic data of the 379 bears identified was analyzed to determine sex specific declines in the grizzly population and to assess the precision of growth predictions using tree rub data. The researchers believe that yearly non-invasive genetic studies on the grizzly bear populations can be a suitable alternative for radio collaring.

T.

Tannas, C., Tannas, K., Tannas, K., & Tannas, S. (2006). ***Range vegetation survey of grazed and ungrazed enclosures on five selected sites.*** **Waterton Lakes National Park: Eastern Slopes Rangeland Seeds Ltd.**

Three permanent exclosures were created in elk winter range in 1956. In 1968 two exclosures were created in Bighorn sheep winter range. The study is a re-evaluation of the permanent range exclosures that went up in these five sites to determine how grazing is affecting plant biodiversity in the areas. Quantitative data was collected for both the control and the grazed plots. This was done by gathering clippings of the biomass in each area. It was found that a lack of grazing had very similar effects as severe disturbance on the areas. If there was no grazing, one plant would start to dominate over the others and biodiversity would drop considerably. However, if there is too much grazing, then all of the plants would die. It was shown that there needs to be moderation for grazing: just enough to keep the plant levels down, but not so much as to completely destroy the plants present.

Tannas, S., Hewins, D., & Bork, E. (2015). Isolating the role of soil resources, defoliation, and interspecific competition on early establishment of the late successional bunchgrass Festuca campestris. ***Restoration Ecology, 23*****(4), 366. doi:10.111/rec.12207**

Native grasslands are a great resource for biodiversity while also supporting seasonal grazing for animals. However, the native grasslands of western Canada are in danger of not being able to revegetate themselves with all of the biodiversity and variability that they once had. The invasive grass *Poa pratensis* is stopping the revegetation of native *Festuca campestris* in their grasslands. The study looks at the grasses and how they are competing in the environment. They used two greenhouse studies to determine this: one where both seedlings were of equal age, and one where the native grass was two months older. It was found that the largest factor causing the decrease in the native grass was the invasive grass outcompeting it for resources, and not the composition of the soil or defoliation. It is recommended that when restoring *F. campestris* that the negative impacts of the invasive species be reduced to allow for proper growth of the native grass.

Taylor, M., & Smith, C. M. (2003). ***Northern Leopard Frog and Western Toad Inventory in Waterton Lakes National Park, Alberta in 2003.*** **(Unpublished Technical Report). Waterton Park, Alberta, Canada: Parks Canada.**

Amphibians are severely at risk of decline in Waterton Lakes National Park (WLNP). It has been found that the northern leopard frog (*Rana pipiens)* has been absent in WLNP since 1980, and the western toad (*Bufo boreas*) is also thought to be experiencing population declines. Both of these species are categorized under species of special concern by COSEWIC. An inventory for the northern leopard frog and the western toad was conducted in 2003 in WLNP. Three survey methodologies were used to determine if these species were present in the park as well as where they were distributed. Approximately 120 historical (priority locations) and potential habitats were surveyed. The western toad was found to be in 33% of the survey locations and leopard frogs were not found in any survey location. Further surveys need to be conducted to determine exact populations.

The Crown Manager's Partnership. (2013). ***Landscape patterns environmental quality analysis*****.**
There are many environmental impacts that occur when human activities become involved in the wilderness. This paper is meant to be a guide to better understand the landscape dynamics of the CCE. The goal is to use this knowledge to manage the area effectively. The document is meant to help future managers make informed land management decisions.

Thompson, M. D. (2003). ***Phylogeography of the long-toed salamander, Ambystoma macrodactylum*** **(Master of Science - thesis).**

The phylogeography of the long-toed salamander was investigated. It was found that there are two cohesion species: the coastal clade and the continental clade. The genes of the two populations and the structure of the genes were mapped. They focused on two mitochondrial genes which exhibited the differential evolvability of the long-toed salamander. Results from surveys showed that there were nine distinct populations present in Alberta. A broader study is being conducted to help determine the phylogenealogy of the populations because the current study inaccurate due to these populations interbreeding. It the study' purpose was to find the phylogenetic patterns, determine the effect of glacial retreat on the phylogeneology, and set a base for future work in the area. It was found that glacial retreat has resulted in more habitat for the long-toed salamanders. Another, larger, study is recommended to track the genetics and spread of the long-toed salamander.

Tilson, D., & McDougall, K. (2003). ***Operational Guidelines for the Management of Carnivore/Human Conflicts, Waterton Lakes National Park.*** **(Operational Guidelines). Waterton Lakes National Park, Alberta, Canada: Parks Canada.**

An executive decision was made at the Carnivore Workshop in Banff National Park on the November 8, 2001 to expand guidelines for human/carnivore interactions and conflicts within the park. These carnivores include wolves, cougars, and coyotes. In order to elevate consistent management strategies a response model was adapted from the State of California Department of Fish and Wildlife "Public Safety Wildlife Guidelines". This model actively describes the type of interaction, the type of incidence, the level of response, and the amount of public information required to manage these conflicts.

Treanor, H. B., Giersch, J. J., Kappenman, K. M., Muhlfeld, C. C., & M. A. H. Webb. (2013). Thermal tolerance of meltwater stonefly ***Lednia tumana*** **nymphs from an alpine stream in Waterton–Glacier International Peace Park, Montana, USA. Freshwater Science, 32(2), 597-605. doi:10.1899/12-100.1**

Global climate change is greatly affecting the structure, function, and diversity of aquatic ecosystems, especially those located in alpine regions. The thermal tolerances of the stonefly, *Ledina tumana*, were assessed to help understand the potential effects of warmer water on the species. The critical thermal maximum and the lethal temperature maximum were assessed. Nymphs collected and were tested for thermal tolerance by being placed in a bath where the temperature was slowly and continually increased. It was found that the lethal temperature maximum was 32.3 plus or minus 0.28 degrees Celsius.

Tremblett, K. S. D. (October, 2004). ***Evaluation of the biosphere reserve model as a mechanism to implement ecosystem-based management: Using the Waterton Biosphere Reserve as a case study*** **(Master of Environmental Design - Environmental Science).**

A biosphere reserve protects an area that is a major aspect and influential part of a bioregional landscape. This Master Degree Project assesses the concept of biosphere reserves by using the Waterton Biosphere Reserve as a case study. An analysis was done on the Waterton Biosphere Reserve and data was collected from already published literature. The findings are used to expand the understanding of biosphere reserve models in order to implement them into EBM (ecosystem based management).

V.

Varney, T. L., Katzenberg, M. A., & Kooyman, B. (2001). ***Where do the bison roam? A stable isotopic study of bison grazing behaviour in Waterton Lakes and Banff National Park.*** **Calgary, Alberta, Canada: University of Calgary.**

Bison once dominated our Canadian Plains. They were known to play an important role in the ecology and supported the indigenous peoples of the plains. Bison numbers dramatically decreased and now only a few small herds persist. Park managers on the plains are interested in the diet of the bison and their movements. The research approach this particular report has used is stable isotopic analysis on bison bones that have been found in various archaeological sites. The information taken from this analysis can help to reconstruct the climate, vegetation, and lifeways of past bison herds as well as the people that lived at the same time.

Vollertsen, J. A. (2005). ***Using multiple regression analysis to associate education levels and financial compensation with livestock producers' tolerance for grizzly bears in the northern continental divide ecosystem*** **(Doctorate of Education, in Education).**

This dissertation aimed to determine to what extent education and compensation could impact the human willingness to coexist with grizzly bears in the Northern Continental Divide Ecosystem (NCDE). Data was collected via survey from 700 livestock producers. The study found that financial compensation and education did impact willingness to coexist and tolerance of grizzly activity.

W.

Waller, J. S. (2005). ***Movements and habitat-use of grizzly bears along U.S. Highway 2 in northwestern Montana, 1998--2001*** **(Doctor of Philosophy).**

Animal movement and habitat selection was examined in this dissertation using radio telemetry collaring. Researchers wanted to monitor grizzly bear habitat connectivity along the US Highway 2. The research indicated a negative correlation between traffic volumes and crossing events by grizzlies. Grizzlies were also more likely to cross the highway at night when traffic levels were lower. Telemetry data gathered from this study indicates that the highway may become a significant barrier to grizzly populations over the next 30 years.

Waller, J. S., Servheen, C. (2005). Effects of transportation infrastructure on grizzly bears in northwestern Montana. Journal of Wildlife Management, 69(3), 985-1000. doi:10.2193/0022-541X(2005)069[0985:EOTIOG]2.0.CO;2

Connectivity, habitat fragmentation, and mortality caused by railroad and road networks were the focus of this study. Grizzly bear movements and car and rail traffic was tracked in Montana along the Highway 2 corridor. Bears were seen to cross the highway when the traffic volume was lowest. Vehicle traffic was lowest at night, however rail traffic increased. Researchers determined that the highway is reducing bear movement and may have implications for future bear populations.

Wallis, C., Wershler, C., & Riddell, R. (2002). *Ecological land classification of Waterton Lakes National Park, Alberta vol II: Wildlife resources*. Waterton Park, Alberta: Parks Canada.

The document uses inventories, maps, and GIS to analyse the ecological land classification of Waterton Lakes National Park. Landform, soil, and vegetation surveys are used to evaluate park ecoregions, ecosections, and ecosites. The study recognized four unique ecoregions based on vegetation and species present: montane, parkland, subalpine, and alpine. Important wildlife habitats, extant species, and local biodiversity are discussed.

Walsh, S. J., Weiss, D. J., Butler, D. R., & Malanson, G. P. (2004). An assessment of snow avalanche paths and forest dynamics using Ikonos satellite data. Geocarto International, 19(2), 85-93. doi:10.1080/10106040408542308

Ikonos panchromatic and multispectral satellite data was obtained during a study from 2000-2002 focusing on US Highway 2 on the southern border of Glacier National Park. This study mapped avalanche and vegetation patterns within the region.

Wasserman, T. N., Cushman, S. A., Littell, J. S., Shirk, A. J., & Landguth, E. L. (2013; 2012). Population connectivity and genetic diversity of American marten (*Martes americana*) in the United States northern Rocky Mountains in a climate change context. Conservation Genetics, 14(2), 529-541. doi:10.1007/s10592-012-0336-z

Alpine high elevation habitats and species are vulnerable to the effects of climate change. Researchers looked at connectivity between marten populations in order to identify current and future fragmentation vulnerability in the face of climate change levels expected by 2080.

Weaver, J. L. (2001). *The transboundary Flathead, A critical landscape for carnivores in the Rocky Mountains.* (Working Paper No. 18). Bronx, New York, USA: Wildlife Conservation Society.

Carnivores are primary members of ecosystems. The area of the Rocky Mountains from Yellowstone all the way to the Yukon provides prime conservation habitats for these vital species. This report assesses the importance of the transboundary area known as the Flathead which is a crucial region for carnivore conservation. Available information was compiled regarding ecological resilience, distribution, movements, relative abundance, and key food sources and habitats in regards to five major carnivore species (wolf, lynx, wolverine, marten and grizzly

bear). Three key prey species are also assessed and these include the moose, white-tailed deer, and elk.

Weaver, J. L. (2007). ***A Conservation Network for Carnivores in the Southern Canadian Rockies.*** **Toronto, Ontario, Canada: Wildlife Conservation Society Canada.**

The southern Canadian Rockies house the most diverse and intact system of carnivores in North America (approximately 17 species). The three factors that contribute to this abundance are as follows: (1) there is a broad array of ecological conditions such as climate, vegetation, and elevation, (2) there is a large overlap of geographic range among the many species in this region, and (3) a large portion of the range is remote from development and human activities and is a place of sanctuary for these wide-ranging carnivores. Carnivores serve as a useful focus point for conservation planning. Carnivores are effective in reflecting the lower levels of ecosystems due to their top position on the food chain. Predators actively influence interactions and behaviour of their prey and are therefore are known as a keystone species for their role in the ecosystem. By conserving carnivores, many other animal and plant species may be conserved as well. Many carnivore populations are declining from degradation of habitat, loss of prey, and over killing. Strategies relevant to landscape planning for conservation strategies regarding wide ranging carnivores are: (1) to maintain areas of habitat quality and security that are connected by (2) linkages in the landscape. The challenge is to map main areas and these linkages as one in order to contribute to the viability, security, and connectivity of the large carnivore populations across this area.

Weaver, J. L. (2013). ***Safe havens, safe passages for vulnerable fish and wildlife: Critical landscapes in the southern Canadian Rockies, British Columbia and Montana.*** **(No. 6). Toronto, ON: Wildlife Conservation Society Canada.**

The southern Canadian Rockies were for the most part ignored up until the 1950's. Roads built to access coal and timber began to fragment the habitat following primary industry expansion into the southern Rockies. Now with the melting glaciers and climate change, the animals that used to call this place home are searching for other suitable habitats. However, the native animals are unable to move to new areas because their ranges have been heavily fragmented. The purpose of this paper is to discuss and decide how land and resource management can be used to mitigate this issue.

Weaver, J. L. (2013). ***Protecting and connecting headwater havens: Vital landscapes for vulnerable fish and wildlife southern Canadian Rockies of Alberta.*** **(WCS Canada Conservation Report No. 7). Toronto, ON: Wildlife Conservation Society Canada.**

The purpose of this document is to discuss land and resource management for the proposed Saskatchewan River Land Use Plan. The main focus was to discover the conservation value of the area. In this document conservation lands are recommended, and key features for conservation work in the landscape are found in an effort to assess the connectivity across Highway 3. It is determined that roads are negatively affecting the habitat continuity and are

restricting wildlife movement. A commitment to solving connectivity issues is required to save the vulnerable species in the southern Rockies.

Weaver, J. L. (2011). ***Conservation value of roadless areas for vulnerable fish and wildlife species in the Crown of the Continent ecosystem, Montana.*** **(Working Paper No. 40). Bozeman, MT: Wildlife Conservation Society.**

The effort to preserve the Crown of the Continent Ecosystem and its diverse ecoregions and biodiversity by creating more protected areas is the central focus of this report. The report discusses promoting resiliency in the face of climate change which is the key goal of managers and conservation groups in the area. Managers can help promote resiliency in the Crown of the Continent by increasing connectivity and the number of protected areas in the region in an effort to minimize negative impacts on wildlife.

Welch, D. (2002). ***Atmospheric science and air issues in Canada's national parks, 2001.*** **(Ecosystem Monitoring and Data Report No. 7). Gatineau, QC: The National Parks and National Historic Sites of Canada.**

Information from weather and climate stations in Canadian national parks is used to analyze atmospheric health, climate change, weather, and air quality in the parks. This information was used to identify air issues facing each park. The effects of air pollutants on ecosystems and biota were also examined.

Whited, D. C., Lorang, M. S., Harner, M. J., Hauer, F. R., Kimball, J. S., & Stanford, J. A. (2007). Climate, hydrologic disturbance, and succession: Drivers of floodplain pattern. Ecology, 88(4), 940-953. doi:10.1890/05-1149

This paper describes a long-term study tracking floodplain dynamics in the Nyack floodplain of the Middle Fork in the Flathead River, Montana. Floodplain ecosystem habitat was examined using aerial imagery and satellite data. Changes in habitat, using historical aerial images, were related to seasonal flood magnitudes and the temperature regimes of the Pacific Decadal Oscillation. The researchers found that changes in the PDO affected flood magnitude and frequency.

Willoughby, M., Alexander, M., & Adams, B. (2005). ***Range plant community types and carrying capacity for the montane sub-region of Alberta 6th edition.*** **Edmonton, Alberta.**

The montane sub-region is a greatly diverse area of Alberta. The biodiversity present means that the lands are important for many uses including habitat for many wildlife species, productive watersheds, and wood fibre production, as well as a good summer place for livestock to graze. The study looks at the effects of grazing on the populations that are present in the area in order to get a better understanding of what management options are available. Carrying capacity guides are being developed in the areas to pull the picture together and provide a framework for future use. The guide represents all of the plots that were assessed within the sub-region. The guide separates the plants into different categories and gives specific information about each plant and each category.

Wyatt, K. H., Hauer, F. R., & Pessoney, G. F. (2008). Benthic algal response to hyporheic-surface water exchange in an alluvial river. Hydrobiologia, 607(1), 151-161. doi:10.1007/s10750-008-9385-1

The algal response to hyporheic-surface water exchange was examined in this study. It was found that the algal cell density was higher in places in rivers where hyporheic-surface water exchange occurs. The algal density changed significantly between downwelling and upwelling areas. The results showed that the benthic algal communities change in response to the direction of the hyporheic flux of the river.

Y.

Young, W. T., & Scarnecchia, D. L. (2005). Habitat use of juvenile white sturgeon in the Kootenai River, Idaho and British Columbia. *Hydrobiologia, 537*(1), 265-271. doi:10.1007/s10750-004-1639-y

In this particular study ultrasonic telemetry was used in order to assess habitat features in the Kootenai River in both Idaho and British Columbia that are readily used by endangered juvenile white sturgeon (*Acipenser transmontanus)*. The study took place during the summer and early fall months of 1999 and 2000, and it was found that the juvenile white sturgeon preferred waters with a higher velocity and greater depths within the Kootenai River. There was also found to be little cover within the river itself other than depth and large sand bars. The combination of velocity and depth preferences ultimately supported the hypothesis that the large sand bars are providing refuge for the sturgeon.

Yung, L., Freimund, W. A., & Belsky, J. M. (2003). The politics of place: Understanding meaning, common ground, and political difference on the Rocky Mountain Front. *Forest Science, 49*(6),855-866. Retrieved from http://library.mtroyal.ca:2092/docview/197724362?accountid=1343

Various viewpoints are an important aspect of the management of conservation efforts and natural resources. This study looks at people's values, interests and photos in regard to the Rocky Mountain Front in Montana and critiques a case study that involves discourses about the names of places which provided insight into the political names of places. Place is a major contributing factor to management plans and this article states that a sense of place showcases an integrative approach to understanding the various relationships in different regions. Their results represented the various ways that people's ideas regarding conservation, governance, and property are connected with place meanings. They state that knowledge regarding the politics of place can affect forest management and policy, which will ultimately contribute to the effectiveness of decision making processes.