INTACT FORESTS, SAFE COMMUNITIES: Additional works consulted

Citation	Link	Notes/ excerpts regarding climate risk and forest management
Abatzoglou, J.T., & Williams, A.P. (2016). Impact of anthropogenic climate change on wildfire across western US forests. *Proceedings of the National Academy of Sciences*, 113(42), 11770-11775.	https://doi.org/10.1073/pnas.1607171113	The authors of this study estimated that climate change contributed to an additional 4.2 million hectares of forest being burned between 1984 and 2015. This nearly doubles the cumulative area in the western United States that would have otherwise burned due to natural climate forcing alone. They also demonstrate that human-caused climate change has lengthened the annual fire season (i.e., the window of time each year with weather that is conducive to forest fires).
Abbott, George and Chapman, Maureen (2018). Addressing the New Normal: 21st Century Disaster Management in British Columbia. Report and findings of the BC Flood and Wildfire Review: and independent review examining the 2017 flood and wildfire seasons.	https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/emergency-management-bc/reports	An independent review of the record 2017 flood and wildfire seasons in B.C. Stakeholders cited overlogging as a concern for both of these risks, and called for a review of logging practices.
Alila, Y., & Green, K.C. (2014). Reply to comment by Bathurst on "A paradigm shift in understanding and quantifying the effects of forest harvesting on floods in snow environments". *Water Resources Research*, 50(3), 2759-2764.	https://agupubs.onlinelibrary.wiley.com/doi/pdfdirect/10.1002/2013WR014334	The authors defend/ provide explanation as to why they believe frequency pairing is better than chronological pairing when studying the impact of logging on floods.
Alila, Y., et al. (2009). Forests and floods: A new paradigm sheds light on age old controversies. *Water Resources Research*, 45(8).	https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2008WR007207	The authors argue that the use of ANCOVA and ANOVA, two statistical tests used to detect changes in a mean, to determine the impact of logging on floods is incorrect since they do not account for changes in flood frequency. They show how a new method that pairs floods by similar frequency is better for determining the effects of forest harvesting on the magnitude and frequency of floods.
Anderegg, W.R., et al. (2020). Climate-driven risks to the climate mitigation potential of forests. *Science*, 368(6497).	https://science.sciencemag.org/content/368/6497/eaaz7005.full?ijkey=ulZK2F6fcwQiM&keytype=ref&siteid=sci	This study reviews "the growing evidence that forests' climate mitigation potential is increasingly at risk from a range of adversities that limit forest growth and health". These including drought, fire and insects.
Anderson, H.W., Hoover, M.D., & Reinhart, K.G. (1976). *Forests and water: effects of forest management on floods, sedimentation, and water supply* (PSW-018). Berkeley, CA: United States Department of Agriculture.	https://www.fs.fed.us/psw/publications/documents/psw_gtr018/psw_gtr018.pdf	The authors "summarize what is known about the forest's influence on the water resource, particularly the effects of current forestry practices". The paper also includes a discussion on "how water supply, floods, erosion, and water quality are affected by timber harvesting, regeneration, tree planting, type conversion, fire, grazing, and the application of fertilizers and pesticides".
Auditor General of British Columbia. (2019). *The protection of drinking water: An Independent Audit.* Victoria, BC: Office of the Auditor General of British Columbia.	https://www.bcauditor.com/sites/default/files/publications/reports/OAGBC_Protection-of-Drinking-Water_RPT.pdf	This is an independent audit report conducted by the Auditor General of British Columbia on the protection of drinking water in the province. Key findings include that the Ministry of Health does not have a strategy to provide clear direction for the protection of drinking water and that there is no drinking water advisory committee to provide advice and recommendations to the minister.
Balcerzak, N. (2020). *How the Williams Lake flood in B.C. is linked to wildfire and deforestation*. Retrieved from https://thenarwhal.ca/how-the-williams-lake-flood-is-linked-to-wildfire-and-deforestation/.	https://thenarwhal.ca/how-the-williams-lake-flood-is-linked-to-wildfire-and-deforestation/	This article describes how the Williams Lake flood in B.C. is linked to wildfire and deforestation. Wildfires, forestry, and urbanization can increase the flood risk.
Barik, M.G., et al. (2017). Improved landslide susceptibility prediction for sustainable forest management in an altered climate. *Engineering geology*, 230, 104-117.	https://www.sciencedirect.com/science/article/pii/S0013795216307682?casa_token=_ndfV15B5ukAAAAA:aGJXWWPpBOs47ve2TMe1JN33zLqsaayEFHuzmVAVTmoAkJ2oxm6BQcxXBj6SoYupipC0mooBV_g8	Two factors that are known to reduce soil strength and increase landslide susceptibility are clear cutting (due to reduced root contributions to soil strength) and degree of soil saturation. Therefore, as projected climate change is expected to result in storms with higher intensity precipitation in many mountainous regions, these areas are likely to become more susceptible to landslide activity resulting in potentially severe consequences to aquatic habitat due to increased sediment loads. Results indicate that more lands need to be preserved from timber harvesting as new areas become susceptible to landslides due to projected climatic changes.
BC Centre for Disease Control. *Wildfire smoke and your health*. Vancouver, BC: Provincial Health Services Authority.	http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/BCCDC_WildFire_FactSheet_HealthEffects.pdf	This 2 page article by BC's CDC outlines the health impacts of wildfire smoke which include coughing, headaches, chest pain, and heart palpitations. The article also outlines who is most at risk and how to reduce exposure.
B.C. Forest Practices Board (2019). Fire Hazard Abatement and the Shovel Lake Wildfire (Complaint Investigation #18061).	https://www.bcfpb.ca/wp-content/uploads/2019/04/IRC221-Shovel-Lake.pdf	In 2018 the B.C. Wildfire Service filed a complaint with the Forest Practices Board, following the Shovel Nose fire. Despite finding that the debris-covered cutblocks presented a serious fire risk, the Board had to conclude that all licensees were actually in compliance with regulations.
Bergeron, Y., et al. (2017). Projections of future forest age class structure under the influence of fire and harvesting: implications for forest management in the boreal forest of eastern Canada. *Forestry: An International Journal of Forest Research*, 90(4), 485-495.	https://link.springer.com/chapter/10.5822/978-1-61091-891-6_8#CR5	Logging is a type of disturbance that targets mature and older forests. It has an additive effect on top of the fires that prevail in much of the boreal region. In other words, harvesting combined with fires has resulted in disturbance rates far above what occurs in natural ecosystems which will lead to a reduction in old growth forests below what occurs naturally. Worsening fires due to climate change will make the situation worse. Proper forest management can help protect the decrease in old forests if implemented.
Bessie, W.C., & Johnson, E.A. (1995). The relative importance of fuels and weather on fire behavior in subalpine forests. *Ecology*, 76(3), 747-762.	https://www.jstor.org/stable/1939341?seq=1	Under extreme weather conditions, the amount of fuel becomes less important since all stands reach the threshold required to allow crown fire development.
Bierbaum, R., et al. (2014). Chapter 28: Adaptation. In: Melillo, J.M., Richmond, T.T., & Yohe, G. (Eds) *Climate Change Impacts in the United States: The Third National Climate Assessment* (pp. 670-706). Washington, DC: U.S. Global Change Research Program.	https://nca2014.globalchange.gov/downloads	The US Global Change Research Program, a working group of 13 US federal agencies, releases National Climate Assessments. Chapter 28 discusses adaption to climate change in the US and includes definitions, what is being done, what could be done, barriers to change and case studies.

Boundary Forest Watershed Stewardship Society. (2019). Submission regarding FRPA Phase II Changes. Retrieved from https://engage.gov.bc.ca/app/uploads/sites/487/2019/09/Boundary-Frst-Watershed-Stewardship-Soc-FRPA-Sub.pdf	https://engage.gov.bc.ca/app/uploads/sites/487/2019/09/Boundary-Frst-Watershed-Stewardship-Soc-FRPA-Sub.pdf	"We know that when left intact our older-aged forests manage our water and help protect us from climate extremes especially because of their carbon storage capacity. Clear-cutting and associated logging practices destroy the composition, structure, and natural function of forests including managing water and climate".
Bradley, C.M., Hanson, C.T., & DellaSala D.A. (2016). Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western United States?. *Ecosphere,* 7(10).	https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.1492	This study looked at the relationship between forest protection status and fire severity for 1500 fires affecting 9.5 million hectares of forest between 1984 and 2014 in pine and mixed conifer forests of western United States. They found that forests with higher levels of protection had lower severity values even though they are generally identified as having the highest overall levels of biomass and fuel loading.
Broadland, D. (2020). The forest-industrial complex's Molotov clearcuts. Focus on Victoria. Accessed at: https://www.focusonvictoria.ca/focus-magazine-march-april-2020/the-forest-industrial-complexs-molotov-clearcuts-r15/	https://www.focusonvictoria.ca/focus-magazine-march-april-2020/the-forest-industrial-complexs-molotov-clearcuts-r15/	Article describing the relationship between clearcut forestry and incidence/intensity of forest fires.
Campbell, E.M., et al. (2009). Ecological resilience and complexity: a theoretical framework for understanding and managing British Columbia's forest ecosystems in a changing climate. Technical Report 055. British Columbia Ministry of Forest and Range, Science Program, Victoria, British Columbia, Canada.	Link	This document summarizes the theoretical literature on ecological resilience and complexity, and describes how this evolving body of science can begin to guide the management of forest ecosystems in a changing climate.
Canadian Council of Forest Ministers. (2013). *Adapting sustainable forest management to climate change: an analysis of Canadian case studies* (Fo79-10/2013E). Ottawa, ON: Canadian Forest Service.	https://www.ccfm.org/pdf/ENG_CaseStudy_prf10.pdf	10 vulnerability assessment projects are used to develop examples of good practices and describe lessons learned for adapating forest management to climate change.
Canadian Council of Forest Ministers. (2015). *Climate Change and Sustainable Forest Management in Canada: A Guidebook for Assessing Vulnerability and Mainstreaming Adaptation into Decision Making* (Fo79-15/2015E). Ottawa, ON: Canadian Forest Service.	https://www.ccfm.org/pdf/Vulnerability%20Guidebook_June2_EN.pdf	Climate considerations and adaptation should be mainstreamed into forest management. Assessing forest vulnerability to climate change, what adaptation options exist, and mainstreaming adaption are key chapters in this report. It also contains worksheets and resources to consider how climate influences current forest management practices and plans.
CBC. (2018). 'It blows my mind': How B.C. destroys a key natural wildfire defence every year. Retrieved from https://www.cbc.ca/news/canada/british-columbia/it-blows-my-mind-how-b-c-destroys-a-key-natural-wildfire-defence-every-year-1.4907358	https://www.cbc.ca/news/canada/british-columbia/it-blows-my-mind-how-b-c-destroys-a-key-natural-wildfire-defence-every-year-1.4907358	In 2017, 12,812 hectares of B.C. broadleaf forest, which are much more resistent to wildfire, were sprayed with glyphosate to make way for more valuable conifer species. Boradleaf species like aspen are more resistent because they contain more water and don't have the volitile compounds found in pine trees. A group of aspen can even turn a crown fire back into a ground fire. However, a regrowing stand following logging or fire cannot have more than 5% or 2 hectares of broadleaf trees, whichever is lower.
Cheng, J.D. (1989). Streamflow changes after clear cut logging of a pine beetle infested watershed in southern British Columbia, Canada. *Water Resources Research*, 25(3), 449-456.	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/WR025i003p00449?casa_token=2x9dHOFyi9EAAAAA:omLwOAXOj36L4R_Xaf80I3K_-bFd0FrsiFSD9yGudfATghrc4TTm43hxOJDP5QSfkPp1leAXxqMXrgux	This study investigated what impact clearcutting 30% of the watershed of Camp Creek in BC had on streamflow. They found that after logging there was increases in the monthly and annual water yields. The annual peak flows also increased and occured earlier in the year. The results are similar to what has been found in similar studies.
Christianson, A. (2015). Social science research on Indigenous wildfire management in the 21st century and future research needs. *International Journal of Wildland Fire,* 24(2), 190-200.	https://www.publish.csiro.au/wf/wf13048	This study "reviews social science research on Indigenous wildfire management in Australia, Canada and the United States after the year 2000 and explores future research needs in the field". "Approximately 80% of the Aboriginal communities in Canada are located in forests prone to wildfire. Despite the potential risk, social science research on wildland fire management in Aboriginal communities has been scarce".
Cornwall, W. (2014). *As Scientists Examine Landslide, Questions About Logging's Potential Role.* Retrieved from https://www.nationalgeographic.com/news/2014/4/140401-hazel-landslide-mudslide-oso-washington-stillaguamish/	https://www.nationalgeographic.com/news/2014/4/140401-hazel-landslide-mudslide-oso-washington-stillaguamish/	This National Geographic article looks into the role of logging on landslides. While there is no "smoking gun", clear-cutting and river erosion emerge as possible contributors.
Cox, S. (2019). *B.C. failing to protect drinking water: auditor general*. Retrieved from https://thenarwhal.ca/b-c-failing-to-protect-drinking-water-auditor-general/.	https://thenarwhal.ca/b-c-failing-to-protect-drinking-water-auditor-general/	This article in The Narwhal discusses the auditor generals report on drinking water. The key topics discussed are how the risk of contamination increases in small water systems, how no drinking water protection plans developed in last 16 years, and how climate change affects water quality and quantity.
Cumming, S.G. (2001). Forest type and wildfire in the Alberta boreal mixedwood: what do fires burn?. *Ecological applications*, 11(1), 97-110.	Link	This study looked at the burn rate of fires by forest type and found that differing types of forests burned at different rates. Deciduous stands burned at the lowest rate and black spruce stands burned at the highest rate. Different burn rates may be caused by differences in the vertical canopy structure and foliage characteristics.
Daniels, L.D., & Gray, R.W. (2006). Disturbance regimes in coastal British Columbia. *Journal of Ecosystems and Management*, 7(2): 44-56.	https://jem-online.org/index.php/jem/article/view/542	This study found that in wet coastal temperate rain forests in BC, canopy gap processes and not fire are the most important for shaping forest structure. This is in part because stand replacing fires are very rare. This is important to know for sustainable forest management and biodiversity conservation.
De Frenne, P., et al. (2019). Global buffering of temperatures under forest canopies. *Nature Ecology & Evolution*, 3(5), 744-749.	https://www.nature.com/articles/s41559-019-0842-1	The study "found that tree canopies buffer forest floors against both high and low macroclimatic temperatures". Forest are "effectively serving as a thermal insulator compared with open areas; such a buffering effect has the potential to reduce the severity of climate change impacts on forest ecosystems".
Dhakal, A. S., & Sidle, R. C. (2003). Long term modelling of landslides for different forest management practices. Earth Surface Processes and Landforms: The Journal of the British Geomorphological Research Group, 28(8), 853-868.	Link	Partial cutting produced fewer landslides and reduced landslide volume by 1·4- to 1·6-fold compared to clearcutting. Approximately the same total landslide volume was produced when 100 per cent of the site was initially clearcut compared to harvesting 20 per cent of the area in successive 10 year intervals; a similar finding was obtained for partial cutting. Vegetation leave areas were effective in reducing landsliding by 2- to 3-fold. Retaining vigorous understorey vegetation also reduced landslide volume by 3·8- to 4·8-fold. The combined management strategies of partial cutting, increasing rotation length, provision of leave areas, and retention of viable understorey vegetation offer the best alternative for minimizing landslide occurrence in managed forests.
Dovers, S.R., & Hezri, A.A. (2010). Institutions and policy processes: the means to the ends of adaptation. *Wiley Interdisciplinary Reviews: Climate Change*, 1(2), 212-231.	https://onlinelibrary.wiley.com/doi/abs/10.1002/wcc.29	This literature review of past adaptation studies highlights key issues in the literature. They point out that adaptation research focuses predominantly on what ought to happen rather than how that might be achieved. Options to mainstream climate adaptation considerations into policy and decision making are discussed.
Farooqi, T.J.A., Abbas, H., & Hussain, S. (2020). The hydrological influence of forest harvesting intensity on streams: a global synthesis with implications for policy. *Applied Ecology and Environmental Research*, 18(4), 4987-5009.	Link	This study analyzed catchment data from 21 other publications to evaluate the influence of deforestation on streamflow. They found that after the harvesting of broadleaf trees water yield increases 8-23% and increases 9-28% for conifers.

Farooqi, T.J.A., Abbas, H., & Hussain, S. (2020). The hydrological influence of forest harvesting intensity on streams: a global synthesis with implications for policy. *Applied Ecology and Environmental Research*, 18(4), 4987-5009.	Link	The study evaluates the influence of 25, 50, 75, and 100% deforestation on streamflow. Results showed that after the harvesting of broadleaf trees water yield increases up to 8-23% and 9-28% for the harvest of conifers.
Forest Paractices Board. (2019). Resolution of Complaint 17053 – Yates Creek Flooding. Retrieved from https://www.bcfpb.ca/wp-content/uploads/2019/10/IRC226-Yates-Creek-Flooding-Closing-Letter.pdf	https://www.bcfpb.ca/wp-content/uploads/2019/10/IRC226-Yates-Creek-Flooding-Closing-Letter.pdf	In 2018, the Forest Practices Board received a complaint from a property owner in the Yates Creek Watershed that recent harvesting in the watershed had increased peakflows, which, combined with inadequate road maintenance by Interfor and the Ministry of Transportation and Infrastructure, caused damage his private property. However, there is no legal requirement for licensees to consider downstream private property or road infrastructure in a domestic watershed.
Forest Practices Board. (2012). *Conserving Old Growth Forest in BC* (FPB/SIR/36). Victoria, BC: Forest Practices Board.	https://www.bcfpb.ca/wp-content/uploads/2016/05/SIR36-OGMAs.pdf	This investigation examines how government has implemented old-growth retention as directed in land use plans and how forest licensees are implementing the requirements set by government. The investigation does not examine whether: OGMAs effectively capture representative old growth attributes; the amount of old-growth to be retained is appropriate; or, if one approach to old-growth retention is more effective than the other (i.e., spatial vs. non-spatial).
Forest Practices Board. (2014). *Community Watersheds: From Objectives to Results on the Ground* (FPB/SIR/40). Victoria, BC: Forest Practices Board	Link	This report looks at drinking water protection and the impacts of logging on drinking water in BC. Between 2006 and 2014, logging occurred in 131 of 466 community watersheds in BC. One key finding is "that the designation of community watershed is inappropriate in some watersheds, and where it is warranted, the protection provided is inadequate". The report also found major problems with forest stewardship plans required for logging.
Frey, S.J., et al. (2016). Spatial models reveal the microclimatic buffering capacity of old-growth forests. *Science advances*, 2(4).	https://advances.sciencemag.org/content/2/4/e1501392.short	"Maximum spring monthly temperatures decreased by 2.5°C across the observed gradient in old-growth structure. These cooling effects across a gradient in forest structure are of similar magnitude to 50-year forecasts of the Intergovernmental Panel on Climate Change and therefore have the potential to mitigate climate warming at local scales. Management strategies to conserve old-growth characteristics and to curb current rates of primary forest loss could maintain microrefugia, enhancing biodiversity persistence in mountainous systems under climate warming".
Funk, J.M. (2019). Securing the climate benefits of stable forests. *Climate Policy*, 19(7), 845-860.	https://www.tandfonline.com/doi/full/10.1080/14693062.2019.1598838	Forest that have not yet been impacted by human activity play an important role for carbon storage but do not receive as much attention as deforestation and forest degradation. This study looks at the policy gaps that help prevent more action to address the climate related benefits derived from these forests. There are several barriers to action including the uncertainty around the level of climate services that these forests provide and difficulties describing the real level of threat posed.
Future Forest Ecosystems Scientific Council of British Columbia. (2012). *Climate Change Vulnerability of Old-Growth Forests in BC's Inland Temperate Rainforest*. Prince George, BC: University of Northern British Columbia	https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nrs-climate-change/applied-science/coxsonfinalreportwebversion.pdf	The study found that the impacts of climate change may be particularly severe in inland temperate rainforests. These forests can store 450 Mg C per hectatre in non-soil stocks. Clear cutting removes most of this stored carbon and can also reduce half of the forest-floor carbon. Partial-cut harvesting resulted in retention of nearly 80% of stored carbon. The province needs to halt old growth logging immediately for productivity class / BEC variant combinations that are already known to be critically endangered.
Gauthier, S. et al (2014). Climate change vulnerability and adaptation in the managed Canadian boreal forest. Environmental Reviews, 22(3), 256-285.	https://cdnsciencepub.com/doi/pdf/10.1139/er-2013-0064	Efficient adaptation of the forest management system will revolve around the inclusion of risk management in planning processes, the selection of robust, diversified, and no-regret adaptation actions, andthe adoption of an adaptive management framework.
Gedalof, Z. (2020). *Fire and Biodiversity in BC*. Retrieved from https://ibis.geog.ubc.ca/biodiversity/FireandBiodiversityinBritishColumbia.html	https://ibis.geog.ubc.ca/biodiversity/FireandBiodiversityinBritishColumbia.html	Fire in BC impacts biodiversity in two key ways. Firstly, the presence of fire impacts what species are able to survive on the landscape. The variability of fire on the landscape also gives rise to different species compositions. Fire suppression in the past has had a big impact on ecosystems and proper fire management in the future will be important to maintain biodiversity in the face of climate change.
Giles-Hansen, K., Li, Q., & Wei, X. (2019). The Cumulative Effects of Forest Disturbance and Climate Variability on Streamflow in the Deadman River Watershed. *Forests*, 10(2).	https://www.mdpi.com/1999-4907/10/2/196	Over the study period of 1962 to 2012, the cumulative effects of forest disturbance significantly affected the annual mean streamflow. The effects became statistically significant in 1989 at the cumulative forest disturbance level of 12.4% of the watershed area.
Girard, F., Payette, S., & Gagnon, R. (2008). Rapid expansion of lichen woodlands within the closed crown boreal forest zone over the last 50 years caused by stand disturbances in eastern Canada. *Journal of Biogeography*, 35(3), 529-537.	https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2699.2007.01816.x	In Canada over the last 50 years, the area occupied by closed-crown boreal forests has decreased dramatically. It is being replaced by lichen woodlands since the ecological conditions that allow closed-crown forests to establish and develop are less common. Fire is by far the main disturbance, reducing the ability of natural closed-crown forests to self-regenerate. Given the current biogeographical shift from dense to open forests, the northern part of the closed-crown forest zone is in a process of dramatic change towards the dominance of lichen woodlands.
Glick, P., et al. (2020). *The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction*. Washington, DC: National Wildlife Federation.	https://www.researchgate.net/publication/341941988_The_Protective_Value_of_Nature_A_Review_of_the_Effectiveness_of_Natural_Infrastructure_for_Hazard_Risk_Reduction	"*The Protective Value of Nature* summarizes the latest science on the effectiveness of natural infrastructure in lowering the risks to communities from weather and climate related hazards". These benefits are often referred to as 'natural defences'. The main sections are: inland flooding, coastal hazards, extreme heat and drought, wildfires, and recommendations to advance natural infrastructure solutions. "Certain forest and other wildland management practices may also reduce risks to nearby communities from flooding and debris flows following high-severity wildfires, which can burn away much of the vegetation that holds soil in place and slows runoff (Garfin et al. 2016)"
Goeking, S.A., & Tarboton, D.G. (2020). Forests and water yield: A synthesis of disturbance effects on streamflow and snowpack in western coniferous forests. *Journal of Forestry,* 118(2), 172-192.	https://academic.oup.com/jof/article/118/2/172/5734757?login=true	This paper looked at 78 studies to determine if water yield or snowpack increases after forest disturbances like wildfires, droughts, insects or logging. They found that streamflow and snowback can increase, decrease or remain the same showing that other factors like vegetation structure, climate, and topography influence postdisturbance hydrologic response.
Green, K.C., & Alila, Y. (2012). A paradigm shift in understanding and quantifying the effects of forest harvesting on floods in snow environments. *Water Resources Research*, 48(10).	https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2012WR012449	This study looking at four catchment areas shows that harvesting increased both the magnitude and frequency of floods in the catchment areas.
Guthrie, R. H. (2002). The effects of logging on frequency and distribution of landslides in three watersheds on Vancouver Island, British Columbia. Geomorphology, 43(3-4), 273-292.	https://www.sciencedirect.com/science/article/abs/pii/S0169555X01001386?casa_token=DXDC9d0hkL8AAAAA:YlYgMGsbwP3CMor_bUD-uFXdajEqJz4_d_on_LQ_FoaxdlLFyT9P45v5K7Buwcn25qnCW3w7KhVO#BIB31	The contribution of logging to landslides is well understood from a mechanical perspective. Roads overload and undercut slopes and intercept surface and subsurface drainage. Harvesting may result in changes in the hydrology of slopes and in reducing shallow slope strength by the eventual loss of anchoring root systems through rot. Despite the variation (between 3x to 16x as many landslides after logging), logging substantially increases landslide frequencies.
Halofsky, J.E., & Peterson, D.L. (2016). Climate change vulnerabilities and adaptation options for forest vegetation management in the northwestern USA. *Atmosphere,* 7(3), 46.	https://www.mdpi.com/2073-4433/7/3/46/htm	Due to climate change "dry forests are projected to have significant changes in distribution and abundance of species, partially in response to higher temperature and lower soil moisture, but mostly in response to projected increases in extreme events and disturbances—drought, wildfire, and insect outbreaks. Wildfire and mountain pine beetles have caused extensive mortality across millions of hectares in this region during the past decade, and wildfire area burned is projected to increase 200%–300% by mid-21st century. Science–management partnerships associated with recent assessments have identified an extensive list of adaptation options, including both strategies (general planning) and tactics (on-the-ground projects). Most of the options focus on increasing resilience to disturbances and on reducing current stressors to resource conditions".

Halofsky, J.E., Peterson, D.L., & Harvey, B.J. (2020). Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. *Fire Ecology*, 16(4).	https://doi.org/10.1186/s42408-019-0062-8	This study found that it is difficult to affect the total area burned by fire, since it is driven mainly by climate. However, fuel treatments can help to decrease fire intensity and severity and improve forest resilience to fire, insects, and drought. Planting different genetic stock than has been used in the past may increase seedling survival.
Hanlon, V.C., Otto, S.P., & Aitken, S.N. (2019). Somatic mutations substantially increase the per generation mutation rate in the conifer Picea sitchensis. *Evolution letters*, 3(4), 348-358.	https://www.sciencedaily.com/releases/2019/07/190708172409.htm	Scientists found the first evidence of the tremendous genetic variation that can accumulate in some of our tallest trees. They found that an old-growth Sitka spruce could have up to 100,000 genetic differences in DNA sequence between the base of the tree and the tip of the crown. High mutation in old growth can allow for greater adaptation to changes in environmental conditions.
Harrison, D., & Johnson, J. (2004). *Revitalizing British Columbia's Coastal Economy: A New Economic Vision For The North And Central Coast And Haida Gwaii*. Victoria, BC: Pacific Analytics Inc.	https://www.for.gov.bc.ca/hfd/library/Documents/bib93615.pdf	This paper contains an analysis of the economy of coast British Columbia including the Great Bear Rainforest. It looks at timber, mining, tourism, and a sustainability scenario. The sustainability scenario is a "viable long-term solution to improve the economic and social conditions of coastal First Nations and communities while maintaining the ecological integrity of the Central Coast, North Coast and Haida Gwaii".
Haughian, S.R., et al. (2012). Expected effects of climate change on forest disturbance regimes in British Columbia. *Journal of Ecosystems and Management*, 13(1).	https://jem-online.org/forrex/index.php/jem/article/view/152	"Forest fires are expected to be more frequent and more intense in the southern half of the province and in the Taiga Plains, but less important in other portions of the province. Forest insects and fungal pathogens are expected to more fully occupy the current range of their host tree species and expand ranges northward and to higher elevations along with their hosts. More frequent and detrimental pest outbreaks are expected in some regions when several years of favourable weather align. Wind damage, floods, and landslides can be expected to increase on terrain where they are already a risk factor".
Hayes, Kelly (2019). Okanagan watershed forum held near lake above Peachland. Global News, March 22. Accessed at: https://globalnews.ca/news/5087358/okanagan-watershed-forum-held-near-lake-above-peachland/	https://globalnews.ca/news/5087358/okanagan-watershed-forum-held-near-lake-above-peachland/	Global news story on water quality in Peachland BC. Some residents believe logging is to blame for water turbidity. In an effort to get the turbidity under control, Peachland had to build a $22 million water treatment facility.
Hessburg, P.F., et al. (2019). Climate, environment, and disturbance history govern resilience of western North American forests. *Frontiers in Ecology and Evolution*, 7(239).	https://www.frontiersin.org/articles/10.3389/fevo.2019.00239/full	This paper reviews what forest properties contribute to resilience and resistance. It also contains a detailed look at how to manage for resilience in different regions of North America.
Hoffman, K.M., et al. (2016). 13,000 years of fire history derived from soil charcoal in a British Columbia coastal temperate rain forest. *Ecosphere*, 7(7).	https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.1415	Low forest fire activity in BC's coastal temperate rainforests is due to the high amounts of precipitation and low frequency of lightning in these settings.
Hornbeck, J.W., et al. (1993). Long-term impacts of forest treatments on water yield: a summary for northeastern USA. *Journal of Hydrology*, 150(2-4), 323-344.	https://www.sciencedirect.com/science/article/abs/pii/002216949390115P	Sites investigated in northeastern US had large increases in stream water yield following logging. Water yield increased by up to 350 mm per year in the first year when regrowth was controlled with herbicides. Clearcutting with natural regrowth showed increases in water yield of 1100-250 mm per year. Controlling regrowth also had a big impact on how long yield was increased. When regrowth was not controlled with herbicides, yield increases declined quickly after cutting, usually lasting less than 10 years compared to 20 years or more when regrowth was controlled.
Imaizumi, F., Sidle, R.C., & Kamei, R. (2008). Effects of forest harvesting on the occurrence of landslides and debris flows in steep terrain of central Japan. *Earth Surface Processes and Landforms*, 33(6), 827-840.	Link	Clearcutting can increase the chance of a landslides or debris flows because of changes in slope stability due to root strength decay. The direct impact of clearcutting on landslide occurrence was greatest in forest stands that were clearcut 1 to 10 years earlier with progressively lesser impacts continuing up to 25 years after harvesting.
Jakob, M. (2000). The impacts of logging on landslide activity at Clayoquot Sound, British Columbia. *Catena*, 38(4), 279-300.	https://www.sciencedirect.com/science/article/pii/S0341816299000788?casa_token=D6VUQBLasT8AAAAA:FS09QmKNMje3mHXhsJwxGsoYSFXaghM1jfBxQGkAwCpq5ynLEKialEoPU4pmRmgxgc1glYvljwAh	The frequency of landslides in logged terrain was found to be nine times higher than in undisturbed forest. Debris slides and debris flows are the most frequently occurring mass movements, initiating mostly from road fill failures and from within cutblocks.
Jones, G.M., et al. (2016). Megafires: an emerging threat to old forest species. *Frontiers in Ecology and the Environment*, 14(6), 300-306.	https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/fee.1298	Megafires, made worse by climate change and fire supression, pose a threat to old growth forest species. The authors conclude that restoring historical fire regimes could benefit both old growth species and the dry forest ecosystems they inhabit. At severely burned sites of a 2014 California fire, the probability of owl extirpation was seven times higher after the fire (0.88) than before the fire (0.12). The severity of the fire also rendered large areas of forest unsuitable for owl foraging one year post fire.
Kamloops This Week. (2017). Logging takes our breath away. Retrieved from https://www.kamloopsthisweek.com/logging-takes-our-breath-away-1.23233282	https://www.kamloopsthisweek.com/logging-takes-our-breath-away-1.23233282	Logging can increase the frequency and severity of forest fires. This is in part because logging opens up the canopy which helps to dry out the understory and ground.
Keeton W.S., et al. (2018) Silviculture for Eastern Old Growth in the Context of Global Change. In: Barton A.M., & Keeton W.S. (Eds) *Ecology and Recovery of Eastern Old-Growth Forests* (pp. 237-265). Washington, DC: Island Press.	https://link.springer.com/content/pdf/10.5822%2F978-1-61091-891-6_13.pdf	"Old-growth silviculture increasingly has a place ... filling the niche of enhancing the representation of late successional forests on landscapes where they are now vastly underrepresented. The working hypothesis is that this type of management will contribute to sustainable forest practices focused on providing a broad array of ecosystem goods and services." This chapter includes sections on: lessons from old growth, principles of old growth silvicultute, whether it's possible to restore elements of old-growth structure and function, and adaptive old growth silviculture.
Keleher, K.R. (2019). Ecological drivers of riparian microclimate on the Olympic Peninsula of Washington State (Unpublished master's thesis). The Evergren State College. Retrieved from http://archives.evergreen.edu/masterstheses/Accession86-10MES/Thesis_MES_2019_KeleherK.pdf	http://archives.evergreen.edu/masterstheses/Accession86-10MES/Thesis_MES_2019_KeleherK.pdf	This study looked at how microclimates are impacted by logging near ripparian zones in the Olympic Experimental State Forest in Washington. It was found that the height of logging above the stream was a better predictor for microclimate than distance from the stream.
Klamerus-Iwan, A., et al. (2020). Storage and Routing of Precipitation Through Canopies. In: Van Stan II, J.T., et al. (Eds) *Precipitation Partitioning by Vegetation* (pp. 17-34). Location: Cham, CH: Springer.	https://link.springer.com/chapter/10.1007/978-3-030-29702-2_2#citeas	This chapter of the book highlights the role of forest canopies, vegetation and litter in retaining precipitation.
Kneeshaw D., et al. (2018) Is Management or Conservation of Old Growth Possible in North American Boreal Forests?. In: Barton A.M., & Keeton W.S. (Eds) *Ecology and Recovery of Eastern Old-Growth Forests (pp. 139-157)*. Washington, DC: Island Press.	https://books-scholarsportal-info.proxy.lib.uwaterloo.ca/en/read?id=/ebooks/ebooks4/springer4/2019-06-28/1/9781610918916#page=2	"In this chapter, we first describe the extent of old growth in different regions of the North American boreal forest as it relates to species longevity and prevailing natural disturbance regimes. We also briefly describe how forest management has affected different types of old growth in the recent past. We then present different approaches to maintain this forest type and discuss how conservation, forest management, and forest restoration can be intermixed in order to sustain the multiple old-growth phases found in boreal forests across North America". *
Kneeshaw, D., et al. (2018). Is Management or Conservation of Old Growth Possible in North American Boreal Forests?. In: Barton A.M., Keeton W.S. (Eds) *Ecology and Recovery of Eastern Old-Growth Forests* (pp. 139-157). Washington, DC: Island Press.	https://link.springer.com/chapter/10.5822/978-1-61091-891-6_8	Old growth plays a key role in the maintenance of biodiversity in the boreal forest. In the boreal region the cold climate and frequent disturbance limit the amount of old growth. Forestry increases the amount of disturbance. Forestry can increase the risk of forest fires, largely because logging slash increases the abundance of fine fuels on the ground and the incidence of human-started fires. In addition, forestry can increase the risk of regeneration failure in burned areas where juvenile stands initiated by timber harvesting are lost to wildfire before attaining sexual maturity and producing seeds.
Kolden, C.A., et al. (2017). Fire effects on historical wildfire refugia in contemporary wildfires. *Forests*, 8(10).	https://www.mdpi.com/1999-4907/8/10/400/htm	This paper is all about refugia vs non refusia, their importance and influence on forest fires. They looked at refusia and non refusia forests following fires in 2012. Variation in forest fires across a landscape leads to heterogeneity in forest structure and composition which supports biodiversity, ecosystem services, and resilience.

Langhammer, J., Su, Y., & Bernsteinová, J. (2015). Runoff response to climate warming and forest disturbance in a mid-mountain basin. *Water*, 7(7), 3320-3342.	https://www.mdpi.com/2073-4441/7/7/3320/htm	This study looking at the impact of forest disturbance on hydrology. "Significant changes were detected in the share of direct runoff and baseflow, intra-annual variability of the runoff regime, seasonal runoff patterns, and the distribution of peak and low flow events. The seasonal runoff substantially shifted from summers (decreased from 40% to 28%) to springs (increased by 10%). The occurrence of peak flow events has doubled since the 1980s".
Law, B.E., et al. (2018). Land use strategies to mitigate climate change in carbon dense temperate forests. *Proceedings of the National Academy of Sciences*, 115(14), 3663-3668.	https://www.pnas.org/content/115/14/3663.short	The study looked at mitigating the emissions of the forestry industry. Lengthened harvest cycles on private lands, and restricting harvest on public lands increase the net ecosystem carbon balance more than reforestation and afforestation in Oregon. Also, increasing forest carbon on public lands reduced emissions compared with storage in wood products due to the longer residence times.
Leggett, J.A. (2015). *Climate Change Adaptation by Federal Agencies: An Analysis of Plans and Issues for Congress* (R43915). Washington, DC: Congressional Research Service.	https://fas.org/sgp/crs/misc/R43915.pdf	"Forest ecosystems have inherent characteristics that enhance their capacity to survive disturbance events (resistance) or facilitate recovery after disturbance (resilience). Despite this inherent capacity, current thinking suggests that the rapid pace and magnitude of climate change may exceed the resistance and resilience capacity of many forests". The US Forest Service "is establishing a restoration and resilience policy to provide a foundational policy for sustainable management of the national forests. As part of the policy, the agency is focusing on restoration strategies aimed to improve the capacity of the ecosystem to withstand stressors and return to specified desired conditions post-disturbance".
Lertzman, K., et al. (2002). Long-term fire regime estimated from soil charcoal in coastal temperate rainforests. *Conservation Ecology*, 6(2).	https://www.jstor.org/stable/26271885?seq=1#metadata_info_tab_contents	Multiaged stand structures, dominance of late-successional, fire-sensitive species, and evidence from paleological charcoal studies indicate that stand-replacing fires have been extremely rare in temperate rainforests over the past several thousand years. This rarity of fire has supported the development of ecosystems characterized by very large, old trees and the ubiquity of late-seral species and structures at stand and landscape scales.
Lesmeister, D.B., et al. (2019). Mixed severity wildfire and habitat of an old forest obligate. *Ecosphere*, 10(4).	https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.2696	This study looked at spotted owl habitat in Oregon before and after wildfires. They found that the old growth forests the owls prefer for nesting was less likely to burn than other forest types. Preserving old growth forests has biodiversity and fire management benefits.
Lin, Y., & Wei, X. (2008). The impact of large-scale forest harvesting on hydrology in the Willow watershed of Central British Columbia. *Journal of Hydrology*, 359(1-2), 141-149.	https://www.sciencedirect.com/science/article/pii/S0022169408003120?casa_token=0XWUy7feNiMAAAAA:2mqaDcNt5xQf_yUVo0fyrZdhc4b5pTE5qPXq-jlFpRAXjmt9ZsEJ2wdZqG6ALJ1vMrGwEedpMWJz	This study looked at the impact of logging on the hydrology of the Willow watershead in central BC. Logging significantly increased mean and peak flows during the spring and year as a whole but decreased in the summer and winter. Results for low flow were inconclusive.
Lutz, J.A., et al. (2018). Global importance of large diameter trees. *Global Ecology and Biogeography*, 27(7), 849-864.	https://onlinelibrary.wiley.com/doi/epdf/10.1111/geb.12747	This study looked at the contribution of large trees to forest density, richness and biomass in 48 forest plots. The key takeway they found is that the largest 1% of trees make up around 50% of the aboveground live biomass in a forest. The authors "recommend managing forests for conservation of existing large-diameter trees or those that can soon reach large diameters as a simple way to conserve and potentially enhance ecosystem services".
Lyons-Tinsley, C., & Peterson, D.L. (2012). Surface fuel treatments in young, regenerating stands affect wildfire severity in a mixed conifer forest, eastside Cascade Range, Washington, USA. *Forest Ecology and Management*, 270, 117-125.	https://www.sciencedirect.com/science/article/abs/pii/S0378112711002313?via%3Dihub	This study looked at a 70,925 hectare fire in Washington that burned through all the plantations in the area and the surrounding lodgepole pine forest. The authors compared fire severity in plantations with and without fuel treatments using three metrics to quantify severity: mortality (%), exposed mineral soil (%), and char height (m). Sites without fuel treatments had more severe fires: 77% tree mortality in untreated sites compared to 37% in treated sites.
Mason, G. (2020). On the issue of climate change, we are choking. Retrieved from https://www.theglobeandmail.com/opinion/article-on-the-issue-of-climate-change-we-are-choking/	https://www.theglobeandmail.com/opinion/article-on-the-issue-of-climate-change-we-are-choking/	According to the Canadian Disaster Database, the number of wildfire disasters in the country, primarily in the West, has been growing in recent decades, from less than 10 in the 1980s to more than 50 between 2011 and 2017.
Meddens, A.J., et al. (2018). Fire refugia: what are they, and why do they matter for global change?. *BioScience*, 68(12), 944-954.	https://academic.oup.com/bioscience/article/68/12/944/50989288	"Fire refugia are landscape elements that remain unburned or minimally affected by fire, thereby supporting postfire ecosystem function, biodiversity, and resilience to disturbances". The authors of this paper "outline the principal concepts underlying the ecological function of fire refugia and describe both the role of fire refugia and uncertainties regarding their persistence under global change. An improved understanding of fire refugia is crucial to conservation given the role that humans play in shaping disturbance regimes across landscapes".
Meidinger, D., & Pojar, J. (1991). Special Report Series 6: Ecosystems of British Columbia (0843-6452). Victoria, BC: BC Ministry of Forests.	https://www.for.gov.bc.ca/hfd/pubs/Docs/Srs/Srs06.pdf	This report contains detailed descriptions of the Biogeoclimatic Ecosystem Classification (BEC) types found in BC. BEC is a system used to classify ecosystems. BEC's disscussed in this paper include sub-boreal pine, bunchgrass, and montane spruce.
Meigs, G.W., et al. (2020). Influence of topography and fuels on fire refugia probability under varying fire weather conditions in forests of the Pacific Northwest, USA. *Canadian Journal of Forest Research*, (50)7, 636-647.	https://www.nrcresearchpress.com/doi/10.1139/cjfr-2019-0406#.XxSUk_ITGb8	This study tried to determine where fire refugia (areas that burn less frequently and severely) are most likely to occur. This type of information can be used for to prioritize the conservation of late-succession forests that are most likely to survive forest fires.
Menning, K.M., & Stephens, S.L. (2007). Fire Climbing in the Forest: A Semiqualitative, Semiquantitative Approach to Assessing Ladder Fuel Hazards. *Western Journal of Applied Forestry*, 22(2), 88-93.	https://academic.oup.com/wjaf/article/22/2/88/4718038	Ladder fuels help fire on the forest floor reach the canopy which can turn low intensity fires into severe canopy fires. This study in northern California found that over 25% of sites are at high risk and around 40% are moderate risk of this occuring from ladder fuel.
Messier, C. et al. (2019). The functional complex network approach to foster forest resilience to global changes. Forest Ecosystems, 6(1), 21.	https://link.springer.com/article/10.1186/s40663-019-0166-2	"Here, we briefly review the focus and limitations of past and current forest management and silvicultural practices mainly as developed in Europe and North America. We then discuss some recent promising concepts, such as managing forests as complex adaptive systems, and approaches based on resilience, functional diversity, assisted migration and multi-species plantations, to propose a novel approach to integrate the functionality of species-traits into a functional complex network approach as a flexible and multi-scale way to manage forests for the Anthropocene"
Miller, D.J., & Sias, J. (1997). *Environmental Factors Affecting the Hazel Landslide.* Hazel, WA: M2 Environmental Services.	http://www.netmaptools.org/Pages/Hazel/Hazel.pdf	The study used models to look at the environmental factors impacting the Hazel landslide. They found that clearcutting "could result in as much as a 51 percent increase in the amount of water seeping into the ground" and that clearcutting all the forest in an area "where rain is absorbed and funneled onto the hillside would increase the risk of a slide by up to 30 percent".
Miller, D.J., & Sias, J. (1998). Deciphering large landslides: linking hydrological, groundwater and slope stability models through GIS. *Hydrological Processes*, 12(6), 923-941.	https://onlinelibrary.wiley.com/doi/abs/10.1002/%28SICI%291099-1085%28199805%2912%3A6%3C923%3A%3AAID-HYP663%3E3.0.CO%3B2-3	This study investigated what impacts logging had on the Hazel landslide. Even a small reduction in the stability of marginally stable slopes can increase the amount of time they are susceptible to failure. It is the peer reviewed version of the above paper.
Moomaw, W.R., Masino, S.A., & Faison, E.K. (2019). Intact forests in the United States: Proforestation mitigates climate change and serves the greatest good. *Frontiers in Forests and Global Change*, 2(27).	https://www.frontiersin.org/articles/10.3389/ffgc.2019.00027/full#h10	Reforestation and afforestation are considered important climate change mitigation strategies. However, growing existing forests intact to their ecological potential, termed proforestation, is a more effective, immediate, and low-cost approach, that could be mobilized across suitable forests of all types. Proforestation also has co-benefits like ecosystem services such as biodiversity enhancement, water and air quality, flood and erosion control, and public health benefits.

Moos, C., et al. (2018). Ecosystem-based disaster risk reduction in mountains. *Earth-science reviews*, 177, 497-513.	https://www.sciencedirect.com/science/article/pii/S0012825217303446?casa_token=cN8OPPpO0sQAAAAA:lwce2_EoHkQCOBWHQtbFlj5Y8S6zL8RO5PlO2OBaPPUXHcWUwWRDnQjEisf6OXysE2oUWHclGQ1A	This paper looks at how forests influence the risk associated with natural disasters like avalanches and landslides.
Nolan, R.H., et al. (2018). Safeguarding reforestation efforts against changes in climate and disturbance regimes. *Forest Ecology and Management*, 424, 458-467.	https://www.sciencedirect.com/science/article/abs/pii/S0378112718304146	This study reviews the risks climate change possses to reforested areas and the management actions and policies that can be deployed to reduce the risk. This includes planting design and species selection.
North, M.P., et al. (2019). Tamm Review: Reforestation for resilience in dry western US forests. *Forest Ecology and Management*, 432, 209-224.	https://www.sciencedirect.com/science/article/abs/pii/S0378112718313161?via%3Dihub#!	This paper looks at the problems and challenges of current reforestation practices in the US and makes suggestions as to how they can be improved given the increasing frequency and severity of wildfire and drought. There is an emphasis on building resilience to have more successful reforestation.
O'Gorman, P.A., & Schneider, T. (2009). Scaling of precipitation extremes over a wide range of climates simulated with an idealized GCM. *Journal of Climate*, 22(21), 5676-5685.	Link	Extreme precipitation events will become more common with a warming climate and will increase at a similar or greater rate than mean pricipation.
Odion, D.C., et al. (2004). Patterns of fire severity and forest conditions in the western Klamath Mountains, California. *Conservation Biology*, 18(4), 927-936.	https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/j.1523-1739.2004.00493.x?casa_token=UZfUKRJ0ah8AAAAA%3AhJVIMAzibSDTrlfj0EApfC9W_htqctvCSA_2NN5fVIgoN7fBY4pTNu5pYFywaZPBlrT4NPnhMaTQoRds	Tree plantations in the study area had twice as much severe fire than natural multi-aged forests. Patchy landscape patterns and variable age class distributions are important to maintain biodiversity.
Parfitt, B. (2019). *Muddied waters: how clearcut logging is driving a water crisis in B.C.'s interior*. Retrieved from https://thenarwhal.ca/muddied-waters-how-clearcut-logging-is-driving-a-water-crisis-in-b-c-s-interior/.	https://thenarwhal.ca/muddied-waters-how-clearcut-logging-is-driving-a-water-crisis-in-b-c-s-interior/	Clearcutting in watersheds is negatively impacting the water quality of communities in central BC' interior including Peachland. This article goes into detail about the history of logging in watersheds, protecting watersheds and the impacts of logging.
Parisien, M., & Moritz, M.A. (2009). Environmental controls on the distribution of wildfire at multiple spatial scales. *Ecological Monographs,* 79(1), 127-154.	https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/07-1289.1	This study used models to predict wildfire suitability and found that temperate rainforests only rarely experience fire-conducive conditions.
Pearson, A. F. (2010). Natural and logging disturbances in the temperate rain forests of the Central Coast, British Columbia. *Canadian Journal of Forest Research*, 40(10), 1970-1984.	https://www.researchgate.net/publication/237151629_Natural_and_logging_disturbances_in_the_temperate_rain_forests_of_the_Central_Coast_British_Columbia	Disturbance is an important process in ecosystems. This study looked at the area affected by natural disturbance vs logging in coastal BC. They found logging disturbance is more common than natural disturbance. Valley bottoms showed the largest difference with 10x more disturbance from logging than natural disturbances.
Perry, G., Lundquist, J., & Moore, R. D. (2016). *Review of the potential effects of forest practices on stream flow in the Chehalis River basin*. Seattle, WA: University of Washington.	http://depts.washington.edu/mtnhydr/people/Perry_Chehalis_forest_streamflow.pdf	"There is further agreement in the literature that in small drainages, low flows increase in magnitude following harvest. Low flows often revert to pre-harvest levels within 5-10 years post-harvest and may even shift to deficits as vegetation regrows. Decreased forest cover leads to decreased evapotranspiration, resulting in increased soil moisture and subsequently, increased low flows".
Peterson, D.L., et al. (2009). *Effects of timber harvest following wildfire in western North America* (PNW-GTR-776). Portland, OR: U.S. Department of Agriculture.	https://www.fs.usda.gov/treesearch/pubs/32036	By reducing evapotranspiration, disturbing the soil organic horizon, and creating hydrophobic soils in some cases, fire can cause large increases in surface-water runoff, streamflow, and erosion. Through soil disturbance, especially the construction of roads, logging with ground-based equipment and cable yarding can exacerbate this effect, increasing erosion and altering hydrological function at the local scale. Effects on aquatic systems of removing trees are mostly negative, and logging and transportation systems that disturb the soil surface or accelerate road-related erosion can be particularly harmful unless disturbances are mitigated.
Prevedello, J.A., et al. (2019). Impacts of forestation and deforestation on local temperature across the globe. *PLoS ONE,* 14(3).	https://doi.org/10.1371/journal.pone.0213368	Changing the forest cover of an area can impact the microclimate since trees affect both albedo and evapotranspiration. Deforestation causes local warming while forestation causes local cooling. This study looked at the impact of forest cover change around the world between 2000 and 2010 and found that deforestation caused warming of 0.38 and 0.16 °C in tropical and temperate regions respectively. Forestation caused cooling in those regions of -0.18 ± and -0.19 °C. This shows that forestation has the potential to reverse deforestation impacts on local climate.
Prichard, S.J., & Kennedy, M.C. (2014). Fuel treatments and land- form modify landscape patterns of burn severity in an extreme fire event. *Ecological Applications*, 24(3), 571-590.	https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/13-0343.1	This study looked at the same 2006 fire in Washington as the article by Lyons-Tinsley & Peterson (2012). They found that recent pine beetle attack was associated with higher burn severity. While fuel treatments like prescribed burning are unlikely to substantially reduce the area burned, they were particularly effective at reducing burn severity. Recent literature suggests that fuel treatment can be an effective management strategy for increasing forest landscape resilience to wildfires.
Raffa, K.F., et al. (2008). Cross-scale drivers of natural disturbances prone to anthropogenic amplification: the dynamics of bark beetle eruptions. *Bioscience*, 58(6), 501-517.	https://academic.oup.com/bioscience/article/58/6/501/235938	The authors outline the impacts beetle outbreaks have, the factors that trigger outbreaks, and how human activity like forest management impacts those factors. Thresholds for factors like tree host abundance, beetle density, favorable weather, and escape from natural enemies must be reached for beetles to exert widespread disturbance. Climate change and reduced habitat heterogeneity increase the likelihood that these thresholds will be met thus increasing the chance of an outbreak.
Reid, M.E., et al. (2003). Debris-flow initiation from large, slow-moving landslides. In: Rickenmann, D., & Chen, C.l. (Eds) *Debris-Flow Hazards Mitigation: Mechanics, Prediction, and Assessment* (pp. 155-166). Rotterdam, NL: Millpress	https://pubs.er.usgs.gov/publication/70025354	Debris flows can preferentially start from the margins of larger, deeper, slower-moving landslides in mountainous terrain. At the locations of the study three factors helped to explaint this: steepened ground, elevated poor water pressure, and cracked material.
Reilly, M.J., et al. (2017). Contemporary patterns of fire extent and severity in forests of the Pacific Northwest, USA (1985–2010). *Ecosphere*, 8(3).	https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecs2.1695	The study looked at recent patterns of wildfire in the Pacific Northwest and found that in areas that usually have low and mixed severity fire, high severity fire was much more common than historical patterns. Overall spatial patterns of burn severity are similar to what is expected.

Rogger, M., et al. (2017). Land use change impacts on floods at the catchment scale: Challenges and opportunities for future research. *Water resources research*, 53(7), 5209-5219.	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2017WR020723@10.1002/(ISSN)2333-5084.SCISOC1	Forest cover can lead to lower and more delayed flood peaks compared to cropland and grassland. However, this is often limited to small and moderate size rain storms. Only in some cases can forests reduce flood frequency over the full range of storm sizes. Also, Deforestation can increase soil erosion and the development of gullies which both may enhance floods in steep terrain and increased snow accumulation and hence snowmelt in deforested regions.
Rollerson, T.P., Thomson, B., & Millard, T.H. (1997). Identification of coastal British Columbia terrain susceptible to debris flows. In: Chen, C. (Ed) *Debris-flow Hazards Mitigation; Mechanics, Prediction and Assessment* (pp. 484-495). Reston, Va: American Society of Civil Engineers.	http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.534.717&rep=rep1&type=pdf	The impact of logging on landslides was examined. It was found that the presence of natural landslides shows a positive association with post-logging landslide activity.
Ross, L. (2020). Climate Change and Wildfires: Projecting Future Wildfire Potential. Retrieved from http://427mt.com/2020/08/06/projecting-future-wildfire-potential/	http://427mt.com/2020/08/06/projecting-future-wildfire-potential/	The Moody's affiliate Four Twenty Seven put out a paper in August that said over the next two decades, climate change will increase the frequency of the wildfires we see now, causing unprecedented economic damage. In the U.S., the health-care costs linked to air pollution caused by forest fires are already more than US$100-billion annually, according to the data firm's report. Insurance rates are also going up as a result of the dangers forest fires pose to many communities.
Shanley, C., et al. (2015). Climate change implications in the northern coastal temperate rainforest of North America. *Climatic Change*, 130(2), 155-170.	https://link.springer.com/article/10.1007/s10584-015-1355-9	This paper looks at the anticipated impacts of climate change on coastal temperate forests. They found climate change will impact a wide range of ecosystem-level effects including: increased frequency of flooding and rain-on-snow events; an elevated snowline and reduced snowpack; changes in the timing and magnitude of stream flow; shrinking alpine habitats; altitudinal and latitudinal expansion of lowland and subalpine forest types; shifts in suitable habitat boundaries for vegetation and wildlife communities; and shifts in anadromous salmon distribution and productivity.
Shore, R. (2020). Designing a more resilient forest: Team of scientists take aim at source of BC's catastrophic fires. Retrieved from https://vancouversun.com/news/local-news/designing-a-more-resilient-forest-team-of-scientists-takes-aim-at-source-of-b-c-s-catastrophic-fires	https://vancouversun.com/news/local-news/designing-a-more-resilient-forest-team-of-scientists-takes-aim-at-source-of-b-c-s-catastrophic-fires	Fire suppression has increased fuel loads which leads to more intense fires. There is evidence that thinning increases growth rate and carbon sequestration by reducing competition for resources like water. Broadleaf species are often killed on silviculture plantations to grow desirable trees faster. However, broadleaf species are important since they help with nutrient cycling and protecting conifer seedlings from frost while providing shade. "The average annual direct emissions from wildfires in B.C. during the 1990s was 6 Mt CO2e — that's six million tonnes of greenhouse gases stated as CO2 equivalents. In the 2000s, forest fires released 16 Mt CO2e annually. In each of 2017 and 2018, that figure was closer to 197 Mt CO2e, or 33 times more than the average year in the '90s."
Spellerberg, I. A. N. (1998). Ecological effects of roads and traffic: a literature review. Global Ecology & Biogeography Letters, 7(5), 317-333.	http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.458.3397&rep=rep1&type=pdf	Provides a helpful overview of literature related to impacts of roads during construction, as well as in the short and long term.
Spittlehouse, David, and Stathers, Robert (1990). Seedling Microclimate. BC Ministry of Forests.	https://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Lmr/Lmr65.pdf	Removing vegetation canopies increases the wind speed near the ground (p.8)
Stednick, J.D. (1996). Monitoring the effects of timber water yield harvest on annual. *Journal of Hydrology*, 176, 79-95.	https://www-sciencedirect-com.proxy.lib.uwaterloo.ca/science/article/pii/0022169495027807?via%3Dihub	This literature review found that as little as 15% of the catchment area needs to be harvested to cause a measurable increase in annual water yield in the Rocky Mountain region compared with 50% in the Central Plains.
Stephens, S.L., et al. (2014). Temperate and boreal forest mega fires: characteristics and challenges. *Frontiers in Ecology and the Environment*, 12(2), 115-122.	https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/120332	"Three factors – climate change, fire exclusion, and prior disturbance, collectively referred to as the "mega-fire triangle" – likely contribute to today's mega-fires. Some characteristics of mega-fires may emulate historical fire regimes and can therefore sustain healthy fire-prone ecosystems, but other attributes decrease ecosystem resiliency". A good example of a program that seeks to mitigate mega-fires is located in Western Australia, where prescribed burning reduces wildfire intensity while conserving ecosystems.
Stephens, S.L., et al. (2020). Fire and climate change: conserving seasonally dry forests is still possible. *Frontiers in Ecology and the Environment*, 18(6), 354-360.	https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/fee.2218?casa_token=br7AbGoRjHIAAAAA%3AyNDEQAgTN6FghlyTD-dr1SeDRoAPJ_v9sGkbc9JG64DG1mBk2XE1w4Yn3KmbO10LZ6VfiLgX9d59jT1	The area burned by severe wildfire in seasonally dry forests is expected to increase as a result of climate change. Forest management can help to improve forest resilience. The authors argue that fire use treatments like including prescribed fires and managed wildfires as well as thinning will provide many co benefits, including enhanced biodiversity, increased water availability, greater carbon storage, improved forest resilience, and reduced air pollution.
Stephenson, N.L., et al. (2014). Rate of tree carbon accumulation increases continuously with tree size. *Nature*, 507(7490), 90-93.	https://www.nature.com/articles/nature12914	The study conducted an analysis of 403 tropical and temperate tree species and found that for most species mass growth rate continues to increase with increasing tree size. Large old trees continue to fix large amounts of carbon and in some cases can add a simlar amount of carbon to the forest than what's found in an entire medium sized tree.
Syphard, A. D., Radeloff, V. C., Keeley, J. E., Hawbaker, T. J., Clayton, M. K.,Stewart, S. I., et al. (2007). Human influence on California fire regimes. Ecological Applications, 17, 1388e1402.	https://pubag.nal.usda.gov/download/7756/PDF	Describes patterns of ignition at the wildland-urban interface in California.
Tebaldi, C., et al. (2006). Going to the extremes. *Climatic Change*, 79(3-4), 185-211.	Link	The study analyzes historical and future simulations of ten extreme temperature and precipitation indicators from an ensemble of 9 Global Circulation Models contributing to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. The models clearly show greater temperature extremes consistent with a warmer climate. The models also show more precipiation and greater precipitation intensity for most of the precipitation indices.
The Environmental Law Center Society. (2013). *An old growth protection act for British Columbia*. Victoria, BC: University of Victoria.	http://www.elc.uvic.ca/wordpress/wp-content/uploads/2015/01/An-Old-Growth-Protection-Act-for-BC_2013Apr.pdf	This paper talks about the current system for protecting old growth forests and the problems with the Old Growth Management Areas (OGMAs) used today. Key elements that should be included in new legislation to protect old growth forests are then discussed.
Thompson, J.R., Spies, T.A., & Ganio, L.M. (2007). Reburn severity in managed and unmanaged vegetation in a large wildfire. *Proceedings of the National Academy of Sciences*, 104(25), 10743-10748.	https://www.pnas.org/content/104/25/10743.short	This study looked at an area in Oregon that was burned by fire in 1987 and 2002. Areas that were salvage-logged and planted after the initial fire burned more severely than comparable unmanaged areas, suggesting that fuel conditions in conifer plantations can increase fire severity despite removal of large woody fuels.
Tremblay, Y., et al. (2009). Changes in stream water quality due to logging of the boreal forest in the Montmorency Forest, Quebec. *Hydrological Processes: An International Journal*, 23(5), 764-776.	Link	Following clearcutting, concentrations of NO3, K+, total Fe, specific conductance, and Mg2C in streams increased by up to 6000%, 300%, 71%, 26%, and 19% respectively during the second summer after logging.

US Forest Service. (2004). *Easy Fire Recovery and Proposed Nonsignificant Forest Plan Amendments* (Volume 2). Washington, DC: United States Department of Agriculture.	https://play.google.com/books/reader?id=nYw2AQAAMAAJ&hl=en&pg=GBS.RA6-PA45	This is the final environmental impact statement for a fire recovery project in the Malheur National Forest. Among other things it has information on how plantation have increased flammability compared to natural forests.
US Forest Service. (2010). *National Road Map for Responding to Climate Change*. Washington, DC: United States Department of Agriculture.	http://www.fs.fed.us/climatechange/pdf/roadmap.pdf	In responding to climate change, the Forest Service will take three types of actions: 1. assessing current risks, vulnerabilities, policies, and gaps in knowledge 2. engaging internal and external partners in seeking solutions and 3. managing for resilience, in ecosystems as well as in human communities, through adaptation, mitigation, and sustainable consumption strategies.
US Forest Service. (2011a). *A Performance Scorecard for Implementing the Forest Service Climate Change Strategy*. Washington, DC: United States Department of Agriculture.	http://www.fs.fed.us/climatechange/pdf/performance_scorecard_final.pdf	This is an outline of what the Climate Change Performance Scorecard will look like. It will be administered annually to each National Forest. The scorecard is a set of ten yes-or-no questions in four areas: organizational capacity, partnerships and conservation education, adaptation, and mitigation. At least seven of the questions, with at least one in each dimension, must be answered yes each year to achieve compliance.
US Forest Service. (2011b). *Northwoods Climate Change Response Framework*. Washington, DC: United States Department of Agriculture.	https://www.nrs.fs.fed.us/partners/ccrf/#:~:text=A%20collaboration%20of%20the%20USDA,%2Dthe%2Dground%20forest%20management.	The Northwoods Climate Change Response Framework (NCCRF) is a collaboration of the USDA Forest Service and many other organizations. It engages forest managers in Minnesota, Wisconsin, and Michigan to integrate climate change into forest management.
US Forest Service. (2012). *Effects of Climate Variability and Change on Forest Ecosystems: a Comprehensive Science Synthesis for the U.S*. (PNW-GTR-870). Portland, OR: United States Department of Agriculture.	http://www.treesearch.fs.fed.us/pubs/42610	This is a very well written report on how climate change affects forest ecosystems. It includes chapters on what the impacts of climate change on forests are, the connection between forests and human communities, and strategies for adaptation and mitigation. Among other things the authors found that "wildfires, insect infestations, pulses of erosion and flooding, and drought-induced tree mortality are all expected to increase during the 21st century. These direct and indirect climate-change effects are likely to cause losses of ecosystem services in some areas. The ability of communities with resource-based economies to adapt to climate change is linked to their direct exposure to these changes, as well as to the social and institutional structures present in each environment".
Vergani, C., et al. (2016). Root reinforcement dynamics in subalpine spruce forests following timber harvest: a case study in Canton Schwyz, Switzerland. *Catena*, 143, 275-288.	Link	The study estimated root reinforcement 5, 10, and 15 years after timber harvest in spruce stands. It was found that 5 years after harvest the root reinforcement is only 40% that of a live forest and there is no reinforcement after 15 years. However, after 15 years natural regeneration could provide around 30% of the root reinforcement of a live forest.
Vore, M.E., et al. (2020). Climatic influences on forest fire and mountain pine beetle outbreaks and resulting runoff effects in large watersheds in British Columbia, Canada. *Hydrological Processes*.	https://onlinelibrary.wiley.com/doi/abs/10.1002/hyp.13908	Bad fire seasons happen when a warm and dry summer is preceded by multiple seasons of cool and wet conditions. Mountain pine beetle outbreaks are connected with low precipitation, warm growing season temperatures, and a lack of extremely cold temperatures during winter.
Wellstead, A., & Stedman, R. (2015). Mainstreaming and beyond: Policy capacity and climate change decision-making. *Michigan Journal of Sustainability*, 3, 47-63.	https://quod.lib.umich.edu/m/mjs/12333712.0003.003?view=text;rgn=main	This article looks into the capacity of institutions and government to mainstream climate change considerations into decision making. The authors looked at past studies to identify the factors that influence government's ability to implement adaption policies and measures.
Williamson, T., et al. (2019). Adapting to climate change in Canadian forest management: Past, present and future. *The Forestry Chronicle,* 95, 76-90.	https://pubs.cif-ifc.org/doi/abs/10.5558/tfc2019-015	Although in its early stages, forest management in Canada has already started to consider climate change. This paper looks into what more can be done to adapt to climate change and manage forests more sustainably. While "Climate change affects forests at multiple scales: tree level, stand level, and landscape level. To address climate change, forest management may need to be modified to consider responses of forest ecosystems at multiple scales including broader landscape scales".
Winkler, R., Spittlehouse, D., & Boon, S. (2017). Streamflow response to clear cut logging on British Columbia's Okanagan Plateau. *Ecohydrology*, 10(2).	https://onlinelibrary.wiley.com/doi/abs/10.1002/eco.1836	This study looked at 2 watersheads in the Okanagan over 28 years. 47% of one watershed was logged while the other had no logging. It was found that logging only increased annual yield by 5% but there was dramatic change in the timing and magnitude of April through June streamflow. In the first 7 years after logging, "average April and May water yield increased by 29% and 19%, respectively, while June and July water yield decreased by 23% and 17%, respectively. These streamflow shifts increase the risk of channel destabilization and damage to aquatic habitat during the snowmelt season, and water shortages in the Okanagan region early in the irrigation season (June through July)".
Winkler, R., Spittlehouse, D., & Boon, S. (2017). Streamflow response to clear cut logging on British Columbia's Okanagan Plateau. *Ecohydrology*, 10(2).	Link	"A paired watershed analysis showed that during the first 7 years post logging, average April and May water yield increased by 29% and 19%, respectively, while June and July water yield decreased by 23% and 17%, respectively. These streamflow shifts increase the risk of channel destabilization and damage to aquatic habitat during the snowmelt season, and water shortages in the Okanagan region early in the irrigation season (June through July)".
Winkler, R.D., Spittlehouse, D.L., & Golding, D.L. (2005). Measured differences in snow accumulation and melt among clearcut, juvenile, and mature forests in southern British Columbia. *Hydrological Processes: An International Journal*, 19(1), 51-62.	https://onlinelibrary.wiley.com/doi/abs/10.1002/hyp.5757	The results of this study "not only show that snow accumulation and melt differ significantly between clearcut, juvenile, and mature stands, but also that snowmelt patterns vary among juvenile stands with distinct structural differences".
Zald, H.S., & Dunn, C.J. (2018). Severe fire weather and intensive forest management increase fire severity in a multi ownership landscape. *Ecological Applications*, 28(4), 1068-1080.	https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.1710?casa_token=z71-vmq88W0AAAAA%3AePbkLRRxLhL2hPGX9e6oZPo0zrfKwfVM2nCl2t9Jn43Eu5qkpUY6yd7BJDr6l73syx6eJEMbZbdMZvi3	A study looking into fire intensity in Oregon and Washington found that mean predicted fire severity was higher on private industrial forests than federally owned forests that have a much greater proportion of older forests. This study found that intensive plantation forestry characterized by young forests and spatially homogenized fuels, rather than pre fire biomass, were significant drivers of wildfire severity.
Zhang, M., & Wei, X. (2012). The effects of cumulative forest disturbance on streamflow in a large watershed in the central interior of British Columbia, Canada. *Hydrology and earth system sciences*, 16(7), 2021-2034.	Link	The severe forest disturbance in the study areas increased annual mean flow by an average of 48.4 mm per year. This was partly offset by an average decrease in annual mean flow of 35.5 mm per year caused by climatic variability.
Zhang, M., et al. (2017). A global review on hydrological responses to forest change across multiple spatial scales: Importance of scale, climate, forest type and hydrological regime. *Journal of Hydrology*, 546, 44-59.	Link	Forest cover loss can increase annual runoff. The sensitivity of annual runoff to forest cover change can increase with elevated dryness in both small and large watersheds. The drier a watershed, the more pronounced is the response intensity of annual runoff to forest cover change.
Zhu, J., et al. (2020). How does root biodegradation after plant felling change root reinforcement to soil?. *Plant and Soil*, 446(1), 211-227.	https://link.springer.com/article/10.1007/s11104-019-04345-x	The root reinforcement provided by trees on a slope decreases after cutting. Both root mechanical and structural traits are impacted by stem cutting. Tensile strength decreased 19.7%, Young's modulus decreased 46.9%, hemicellulose content decreased 45.3%, and shear strength provide by roots decreased 85.9% twelve months after stem cutting.