The Evergreen State College

Land Conversion in Orting

The Effects of Human Development

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Environmental Health

Executive Summary

The population in Orting is growing as people are attracted by the small town feel and beautiful scenery of the valley. Housing developments are being built to accommodate the increase in people, and the impervious surfaces that accompany them, combined with tree loss that destabilizes the hillside soil, are increasing the sediment and chemical runoff into the rivers. The increased levels of pollution harm the salmon populations. As the area that humans inhabit grows, forests are cut down and habitat is lost, pushing elk onto agricultural lands, and drawing cougars with them.

Introduction

Nestled in the foothills of Mt. Rainier, Orting has a cozy, small town feel, but as the town's popularity has grown and families have flocked to the area, some surprising consequences have occurred, and there are others that are likely to follow. Forests are falling and fields are paved to accommodate the sprawling housing developments that families who want to raise their kids in this idyllic landscape are demanding. The loss of tree roots has made the hillsides more vulnerable to erosion and landslides, as well as creating more runoff, which combined with the explosion of new impervious surfaces, has resulted in increased pollution in the river that runs through the valley. People may be gathering here in order to enjoy the beautiful views and small town feel, but if regulations are not established and enforced the market pressures that have developed have the potential to reinvent not only the town, but the entire landscape.

Hillside Erosion

The clearing of trees from hillsides makes hills more vulnerable to erosion, which contributes to runoff. Tree roots, especially evergreen tree roots, grow deep in the soil and act as structure that holds the soil in place, a role that is especially important during rain storms, when spontaneously formed streams carry soil downhill.

Sprawling across the top of a foothill, The Buttes is a hilltop community in Orting that overlooks the valley, and is close to a newly built salmon hatchery. As is common practice when building a housing development, all of the trees that had grown on the building site were chopped down to make way for the new network of houses and roads. Although baby trees have been planted, it will take years for their roots to grow sufficiently to hold soil in place. Eventually these trees will help to hold soil and filter water, as “results show that urban tree canopies reduce runoff ” (Sanders, 1983). However, since the trees that were planted are mostly deciduous, the slopes will not be as stable as they were when covered with evergreens, as deciduous trees roots form balls close to the surface, as opposed to evergreens which have a major tap root that reaches as far underground as the top of the tree does in the sky.

The land use changes that are occurring in Orting are not isolated to this area, as “steep slopes are now routinely being converted from forests” (Pimentel, 1995). This trend is not merely a result of increased housing demand, but is also a result of logging for profit. The Forest industry builds roads in order to access backcountry timber, however these roads have traditionally been built with little or no consideration of topography or water flow. Ron Gold, a long time forestry adviser to Simpson Timber Company and the United States Forest Service, has found in his work that “it often costs more to remove these roads than it did to put them in” (2016). It might seem like a logical solution to leave the roads in place if it is so costly to remove them, however the poor placement of the roads failed to consider hydrology, which makes them vulnerable to landslides. Culverts present another issue, as they were frequently placed in places where water did not naturally drain, and then the creeks that had drained water were filled with sediment in order to re-direct the water through the culvert that ran under the road, however the culverts commonly became plugged by sediment when a branch became caught, and the buildup of water resulted in huge washouts that took enormous pieces of the hillside downhill. In addition to the timber industry, a common strategy of land purchasers is to buy a large parcel of forested land, and then log and sell the timber to finance the building of a house. While this may be a wise business venture on a flat landscape, in the steep hills surrounding the Orting valley it is inviting catastrophe in the form of runoff and landslides. A key step in protecting the foothills of Mt. Rainier from erosion and landslides is to leave the trees in place.

Deforestation of hillsides increases the chance of landslides. Baum *et al.* comments that while there are regulations concerning development within Washington State, landslide “losses continue to mount because economic growth continues to exert pressure to develop in or near landslide prone areas” (2005). For Orting officials the immediate urge to gain more money from taxes is stronger than the non-immediate warning that environmental degradation is occurring.

Building codes are slowly increasing in strength in Washington, but more must be done. The Department of Ecology has stated that "each permittee shall implement and enforce a program to reduce pollutants in storm water runoff" (2012), but the wording is vague enough to allow for many loopholes, such as G3 on page 58, which states that if contamination of a publicly owned water way occurs, the permittee must "Take appropriate action to correct or minimize the threat to human health, welfare and/or the environment". However, there are no requirements for what appropriate action must entail. The permit guidelines are further lenient in the statement that deliberate action to bypass stormwater treatment is permissible, if "severe property damage" (p.58) would otherwise occur. The guidelines do not specify what is to be classified as severe property damage, leaving the permittee to interpret the guidelines in whatever way is most advantageous to them.

Impervious surfaces

Transforming the natural landscape into neighborhoods creates large areas of impervious surfaces, and brings in more pollution, all of which harms the environment. Impervious surfaces include roads, parking lots and driveways, as well as roofs and compacted soil. Rushton finds that "Impervious surfaces… cause more storm-water runoff and pollutant loads than any other type of land use" In a natural landscape rainwater is absorbed by the soil, slowly percolating through the earth and replenishing groundwater. When impervious surfaces replace natural landscapes, the volume of water runoff increases, as the surfaces act as a barrier that prevents water from being absorbed by the soil. Impervious surfaces present a further issue as the water gains velocity running across the smooth surfaces that it would not accumulate running over the uneven surface of a forest floor or field, and the momentum, when the water reaches the end of the smooth surface, erodes the dirt that it meets.

Roads accumulate harmful chemicals that are washed by rainwater into water sources. These harmful chemicals accumulate as cars leak fluid, and leave tire and exhaust residue, which is washed through a network of ditches by rainwater into the nearby river. In their 2015 study Zorpas *et al*. stated that “heavy metals copper (Cu), lead (Pb), and zinc (Zn) and polycyclic hydrocarbon aromatics (PHAs) are of particular concern in such runoff due to their prevalence, toxicity to aquatic organisms, and persistence in the environment”. The increase in housing also creates greater traffic, which results in more harmful chemicals being deposited on roads.

There are solutions available for combating runoff, and some of these solutions have been implemented in Orting. The downtown park has a flourishing water garden, and one of the housing developments by the river has a more than adequate buffer strip that works to keep storm water runoff from entering the water.

Strips of vegetation covered soil known as buffer strips are commonly used to lessen the impacts of runoff, as the plants help to slow the course of the water, giving it time to soak into the soil, as well as lessening erosion by decreasing the water velocity. Buffer strips are effective at filtering out sediment, with Zeigler *et al*. finding that “ the buffer reduced suspended sediment concentration by 34 to 87%” (2006), however buffer strips are less effective at filtering out toxic chemicals, which are extremely ecologically harmful.

In their paper Dietz and Clausen maintain that “rain gardens have been recommended as the best management practice to treat storm-water runoff” (2005), as they are aesthetically appealing, low maintenance, and extremely effective. Rain gardens can be sized in order to accommodate various amounts of water that will drain from given area, and Diets and Clausen comment that “rain gardens worked well for overall flow retention”. Rain gardens are essentially large holes filled with water tolerant vegetation where ditches and pipes drain storm water. Rain gardens are adventitious in that they help to maintain the natural water cycle, as water passes through the soil into the groundwater, and that they filter the water as it passes through the soil. Although the act of percolating storm water and removing chemicals from the water naturally results in higher concentrations of harmful chemicals in the soil of rain gardens, it is a better solution to runoff than dumping the chemicals in the river, and will suffice until a superior option has been created.

Brattebo and Boothe suggest that “permeable pavements offer one solution to the problem of increased storm water runoff” (2003). Permeable pavements are generally made up of slabs of impermeable pavement, with gaps in between, but can also be made of pavement that is porous enough to allow water to pass through it. In a study of pavement constructed to be porous enough to allow water to pass through, Brattebo and Booth found that “Motor Oil was detected in 89% of samples from the asphalt runoff but not in any water sample infiltrated through the permeable pavement. Neither Lead nor diesel fuel were detected in any sample. Infiltrate Measured 5 Years earlier displayed significantly higher concentrations of zinc and significantly lower concentrations of copper and lead” (2003).

There are ways to lessening environmental harm while still building houses, and in Orting many of these options are being utilized. The harm that is occurring could be significantly lessened if more these alternatives where put into place with greater frequency.

Effects on salmon

Runoff is a threat to salmon, as "the U.S. Commission on Ocean Policy recently highlighted non- point source pollution as one of the most significant emerging threats to aquatic species" (Sandahl, J. et.al. 2007). Runoff effects fish in two main ways. The first is that soil and debris provides nutrients to algae while changing salmon habitat, and the second is that runoff generally contains toxic chemicals.

Storm water runoff contains debris that has high levels of nitrogen, which algae need to have available to them in order to grow. When the runoff water enters the river is causes explosive algae growth. When the algae die, bacteria begin consuming them, using up all of the available oxygen and creating an anoxic environment, in which the lack of oxygen causes fish to die. An excess of sediment can also bury salmon eggs too deeply, so that when the young fish hatch they are unable to reach the water, and die buried in the stream bed. In some cases runoff is so severe that "there's so much gravel that the river goes subterranean" (Gold, 2016). When a river exists entirely underground it is impossible for adult salmon to return and spawn, and an entire population of fish can cease to exist.

Chemicals contained in stormwater can have serious effects on salmon, as Sandahl, J. et.al. found, "copper-containing stormwater runoff from urban landscapes has the potential to cause chemosensory deprivation and increased predation mortality in exposed salmon" (2007). Spending much of their lives in the darkness of ocean waters, salmon are very dependent on their sense of smell to avoid predators. Copper damages the olfactory nerve of fish, resulting in less awareness of their surroundings, and making them more vulnerable to predators.

Salmon rely on their sense of smell to locate the river where they hatched. When spawning season arrives salmon seek out the river where they hatched. It is thought that salmon are able to identify their river of origin by the unique blend of sediments that it disposes in the ocean, explaining why Baldwin et.al. found that the “migratory patterns of adult salmon are disrupted when olfactory function is lost” (2003).

The rivers that run through Orting have not been so filled with sediment that they have gone subterranean. However, the network of roadside ditches deposit the chemical filled roadside runoff into the water. There have not been studies of the rivers that run through the Orting valley, but it can be assumed that the fish in these waters are adversely effected in much the same way as other salmon populations.

It is clearly evident that if salmon are to continue to thrive in Orting’s rivers, that the problem of runoff must be addressed. From logging to housing to using roads, the human habitants of the Orting valley are damaging the ecosystem that is essential for salmon survival. Until solutions are implemented salmon and other aquatic life will continue to suffer the consequences of runoff.

Habitat loss

The forests that cover the foothills around the Orting valley provide habitat for a broad spectrum of animals, ranging from cougars and bears, to elk and deer, to hawks, eagles, insects, amphibians, and more. The river that winds through the valley is a salmon spawning river, as well as home to many other species of fish. While animals like fish and birds act as an attraction that draws people to the valley, bigger animals such as elk and cougars need a larger space to sustain them, and a sense of territory possession that can create conflict between them and the humans who have taken up residence.

It is not uncommon when hiking the trails in the hills around the Orting valley to encounter a herd of elk, or sometimes a lone buck, but their increasing presence on roads presents a hazard to motorists, and farmers do not appreciate the elks' presence in their fields. As the forest habitat that the elk live in becomes sparser, there are fewer plants for them to eat, which creates pressures that push the elk to venture into agricultural fields to find food. Thomas and Henderson note that "human encroachment into elk habitat is increasing at an unprecedented rate" (1998), and the loss of forest habitat for elk is likely to drive them further into urban and farm areas, creating conflicts between humans and elk.

The hills around Orting are home to mountain lions, which prey on the elk and deer, however humans fear and resent their presence, despite the fact that many of the places where humans are venturing to hike and build their homes were cougar territory long before humans began living there. Lambert *et al.* comments that "The increased number of cougar complaints following 1996 does not seem to be due to excessively high densities and growth rates but could be related to… increased human intrusion into cougar habitat" (2006 p.253). The need for food that is driving the elk into areas populated by human is also likely to affect all of the animals that cougars prey on, which will draw the cougars into these areas as well.

Conclusion

As land in the Orting valley is repurposed from forest and farmland to human dwellings in order to accommodate human demands, consequences will occur. The loss of trees makes hillsides more vulnerable to erosion and landslides, which result in environmental degradation and loss of human life and property. The increase of impervious surfaces such as roads, roofs, and parking lots increases the prevalence of runoff, while the influx of cars increases the quantity of toxic chemicals in runoff water. Greater amounts of runoff pollution pose risks to salmon as copper damages their sense of smells and nitrogen promotes algae growth and creates anoxic an environment in the river where young salmon grow and old salmon return to spawn. The loss of habitat pushes large animals into populace areas and results in undesired human contact. The market pressures that are creating these problems are driven by the desire of people to live in an idyllic small town like Orting, but if reasonable limits are not set and enforced, the Orting valley may become considerably less picturesque.

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