



N C S R News

Volume 3, Issue 1

Polar Ice – Polar Bears by Lester W. Reed, Jr. PhD

Although the causes may be debated, the reality of global warming is a scientific fact. Much has been written about the potential consequences of this warming trend but one that holds particular interest for environmental scientists and wildlife experts is the impact on the polar bear and their dependency on the Arctic's polar ice shelf. According to the International Arctic Climate Impact Assessment, data gathered over the past decades show that sea ice has lost thickness, melted faster in spring and re-formed later in fall. Vast stretches near Alaska have become ice-free during the last three summers, setting a record in 2003 and a near-record in 2004 for least coverage ever measured. The thick multi-year ice essential to polar bears has been shrinking by 8 to 10 percent per decade.

As the pack ice that is the bedrock of polar bears' existence melts the bears are facing unprecedented environmental stress that will cause their numbers to plummet. Polar bear experts say the loss of ice will devastate the seal-loving carnivores, thought to number up to 25,000 in 19 separate populations. Believed to have evolved at least 250,000 years ago from brown bears, polar bears spend their lives stalking seals and an occasional beluga whale or walrus in a frozen wilderness of grinding floes. They are curious and relentless hunters, with sharp teeth and short claws totally adapted to marine life. In fact, polar bears are considered marine mammals because they spend most of the year - and much of their lives - on the frozen seas of the Arctic. As the southern edge of the Arctic ice cap melts in summer, the bears follow the retreating sea ice and spend their summers fasting on land, living off body fat stored from hunting in the spring and winter. As specialists closely tied to a frozen environment, polar bear populations decline as the habitat is altered.

In addition to polar bear decline, the disappearance of sea ice will likely impact a closely related species – the Arctic fox. In the pack ice, the Arctic fox follows the polar bear in the same way that jackals follow lions and other carnivores in the tropics to feed on the leftovers from their kills. During the arctic winter polar bears are often followed by two or

three foxes, patiently waiting for the bear to find and kill a seal. In the spring the polar bears' seal hunting is thought essential to the survival of the foxes as there is no other food for them. If they can find a bear to follow, the foxes are assured of a reasonable supply of food. If the bear population declines so will the number of Arctic fox.

The impact of the shrinking icepack and its impact on the polar bear provide faculty an entry point into discussions and exploration of global warming and its causes and potential impact on the environment. For more information on this topic visit www.worldwildlife.org/polarbears, www.adn.com/front/story/6678177p-6564950c.html, www.bearbiology.com, or search on polar ice-polar bears.

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This project was supported, in part, by the **National Science Foundation**. Opinions expressed are those of the authors and not necessarily those of the Foundation.



Creating Longevity for Community Based Education by Jon Yoder, MTA

Over the last 12 years as the Secondary Education Coordinator for NCSR I have worked with many teachers and exemplary programs. Unfortunately, I have seen almost all of them disappear when the instructor, who is the energy and passion behind it all, retires or leaves the school. To me this loss was not only a disappointment and clearly a waste of effort but, most importantly, it deprived students of proven effective and meaningful teaching and learning. As I reflected on the issue I became aware that my situation was not much different. There was no anchor for my program, called the Natural Resources Academy, which would ensure it would not just drift away if I was not involved. How could I ensure that the community-based program I started and nurtured would continue post Jon Yoder? My solution was to imbed the program with multiple supporting constituents who would have a stake in keeping the effort going.

Forming a coalition of partners we used instituted a "Community Applications" approach that operates on the NCSR model of teaching science by doing science. The approach tied students' to efforts important to community stakeholders. Example projects are a native versus nonnative crayfish study for the Oregon Department of Fish and Wildlife, stream monitoring for the City of Salem, stream channel profiling for the watershed council, and educational projects for Willamette Mission State Park. We also established a state-of-the-art stream gaging project in partnership with Oregon Department of Water Resources that has a real time satellite feed of stream data to our school web site. Obviously each institution and location would have its own projects base on community needs and resources; however, the model insures sustainability by creating joint ownership of the educational effort with others with a vested interest in maintaining the activities or developing new projects.

The second approach was to create a permanent home for the Natural Resources Academy. But how? The school district could not fully fund a facility for the program regardless of how attractive or successful it might be. The answer was connecting the community to the effort. This approach focused on a need for a place where students and community can more easily interface. Such a facility would serve community needs as well as address sustainability of the Academy program. The effort required patience and

perseverance on the part of many dedicated individuals and organizations. But finally the Straub Environmental Learning Center came to fruition. The facility is a partnership between the school district, the City of Salem and private donors. The center has a state of the art science classroom, a community room, office space and restrooms that support a variety of activities including Academy classes. To strengthen the community use of the Center a nonprofit organization was created that conducts a variety of programming. This organization facilitates intergenerational programs for the entire community such as an environmental lecture series, household ecology workshops, and a youth environmental conference (exhibits and presentations of community-based projects by area schools). The Center's community programs are planned and coordinated by a board of community members (including representatives of natural resource agencies) which also has the support of a senior level advisory committee. So the idea of having community-based programming for our students and adults has become a reality. And, more importantly it will survive.

I am aware that the approach we have used may not be practical for everyone. However, the principles of tying instruction to community needs and enlisting a wide base of stakeholders are the keys to ensuring your exemplary programs do not fade away.



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Riparian Forest Design and Management in Agricultural Settings by Art McKee, PhD, Et. al.

Introduction

Streamside, or riparian, forests play many critical roles: controlling the movement of sediments and nutrients into streams, reducing erosion along streambanks, slowing the overbank flow during floods and trapping sediments, shading the stream to reduce temperatures and providing both terrestrial and aquatic habitat. These roles are quite obvious as you walk along a stream tumbling down a densely forested slope of the Cascades. They are tougher to see, however, as you walk along a stream in much of our landscape that has been converted to agriculture. To maximize the productivity of crops, we've plowed close to the stream's edge and cut down the tall trees to reduce the shade on the crops. The frequent result is a minimal strip of low vegetation for a buffer alongside channelized, diked and riprapped streams. As a consequence, the aquatic habitats are simplified, stream temperatures are higher, and there is little chance for sediment coming off the fields to be trapped in the narrow buffer strips, or nutrients moving through the ground water to be captured by the roots of the scant vegetation left along the stream. Terrestrial habitat is pretty minimal as is the aquatic.

In some parts of our agricultural landscape the reduction in riparian functions is extreme and the aquatic habitat so degraded that few aquatic species can live there. These reaches of stream create serious barriers to movement of fish up- and downstream. The need to restore the riparian forest and all the functions it provides for aquatic habitat and water quality is compelling.

Fortunately, these losses are reversible, and while riparian forest buffers do not grow up overnight the restoration can be much faster by employing active management guided by stand development models. Active management, a term for carefully planned silviculture, can produce large trees faster than by simply letting natural successional processes do the thinning.

Goal: Produce Large Trees.

Producing large trees is an increasingly common riparian management goal. Large trees provide more shade and a more diverse terrestrial habitat by virtue of their stature and more complex canopies. Large trees that fall into

stream are more stable, especially with the root systems still attached, and are extremely important components of aquatic systems as their size provides a wider variety of functions and habitats. Whole trees and large logs directly affect stream hydraulics creating pools and riffles. They slow the current allowing sediments to settle out, and sort gravels by directing the current into many different velocities. They also function as in-stream cover for fish and provide a substrate for algal growth.

It is clear that any additions of large wood to these streams will be beneficial and move the system closer to natural conditions. The riparian forest buffer does not need to be especially wide to function as a source of large wood as well as provide shade. Trees can be intentionally cut to fall into the stream to provide the large wood needed.

Thinning Effects and Design of Riparian Systems

Competition among plants is relatively well understood and thinning has been a widely used silvicultural practice for centuries. As forest stands mature, there is increasing competition for limited light and nutrients. The crowding that occurs in un-thinned stands leads to competition-induced mortality in predictable ways. Thinning forests stands improves the quality of the residual stand and promotes vigorous stands with improved growth potential by concentrating growth on fewer stems. Done properly, thinning controls stand density and maintains accelerated tree growth (e.g., increasing size, volume, and canopy depth) for decades. Overly dense, un-thinned stands run the risk of stagnation, where tree growth is retarded and desired tree size is delayed.

For riparian buffer management, the normal commercial objective of silviculture – production of optimum numbers of large, straight tree stems for market – could be reoriented to produce large trees for aquatic and riparian habitat functions in as short a time as possible. It is entirely possible that the thinning schedule to achieve riparian stand goals may allow for commercial thinning that would provide financial incentives for streamside landowners to manage buffer areas.



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Role of Stand Growth Models in Active Management

Stand growth models provide a very useful tool to evaluate alternative silvicultural systems for a given site and provide insight into the probable length of time necessary to reach desired riparian forest conditions. An example from a series of model runs using a forest vegetation simulator, FVS for a riparian stand in Skagit County, Washington is shown below (Figure 1). In this example, the modeled stands were composed of Douglas-fir, western red cedar, red alder, and black cottonwood.

Silvicultural prescriptions can be used in the model that permit a high degree of stand manipulation, in contrast to allowing natural successional processes. In the example below (Fig. 1.), the silviculture systems evaluated using FVS include: 1) letting the initial plantation grow with no management; 2) a single thinning at 25 years; and 3) thinnings at 20 and 40 years. The model thins stands from below with the goal of leaving 50% of the initial stocking and the largest trees standing at any point in time.

Discussion

Thinning produces more trees that meet the large-size criterion. Thinning concentrates the growth on fewer individuals so the effect is a greater number of individuals that are at the “target diameter”. This equates to a higher “value” from either a financial or ecological standpoint.

All of the silvicultural systems modeled provide some large trees for in-stream subsidy. Growth models can estimate the time when a particular silviculture system produces the target size for placement into the stream.

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Figure 1 summarizes the model runs for the example stands at 100 years. The model indicates that the largest diameters would be produced by a single thinning entry at 25 years, and the tallest trees produced by thinnings at 20 and 40 years. Unthinned stands would have smaller diameters and heights.

Growth models can provide much more information than is presented in this note about diameters, heights and densities at multiple points in time under different silvicultural treatments. It is easy to envision how a landowner could use information from such models to decide what silvicultural system to use, when to log, and what to expect for merchantable volume as well as what would be available to fall into the stream. Active management of the riparian forests can be much better informed by use of such models and there would be much less uncertainty for the landowner.

Growth models would be especially useful in agricultural settings where landowners are not used to thinking about growing plants over long time periods. Uncertainties about what to expect would be minimized and confidence increased in designing a silvicultural system to restore riparian forests in ways that meet the owner’s goals.

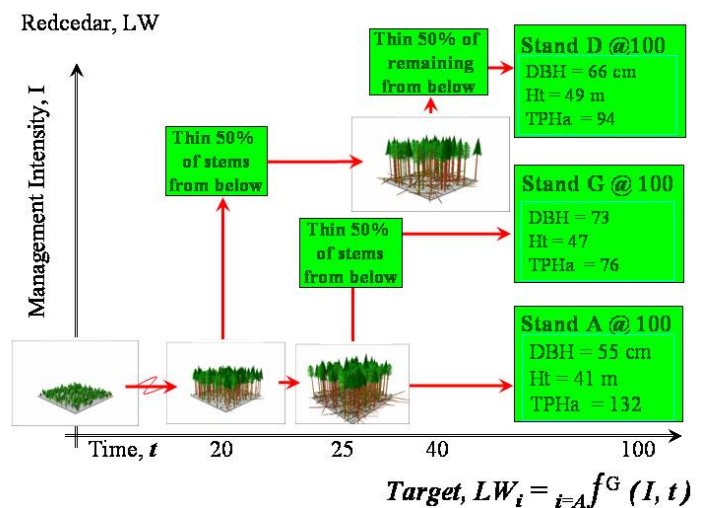


Figure 1. Model output at 100 years for three silvicultural systems: unthinned (Stand A), a single thinning at 25 years (Stand G), and thinning entries at 20 and 40 years (Stand D). DBH = mean diameter at breast height in cm; Ht = mean height in m; TPHa = trees per hectare.



Conveying the Concept of Systems in Ecosystems by Ara Andrea, PhD

As responsible natural resources instructors, we continually immerse ourselves in the latest research, return seasonally to the field with our colleagues, and meet often with natural resource managers to keep current and active in our respective fields. While doing this, we become accustomed to seeing and hearing certain ideas and concepts over and over again. While we may personally be acquainted with the history and linkages that have led to a “hot” current topic or event, we need to be careful to concentrate on thoroughly detailing these specifics for our students, even though the linkages may seem obvious to us.

For example, a common often-heard phrase in professional forestry, in the western US, is: “Years of effective fire suppression have led to declined forest conditions, leaving forests at a high risk of catastrophic wildfire.” Although this may “click” with forest managers and academicians who have been living and working in these western woods for many years, it is, in fact, an oversimplified statement that hides many layers of probable contributing events. To fully educate students on the multiple layers of natural systems that exist within our conifer-dominated forests, educators must convey the complexity and delicateness of the linkages—linkages that we often understand incompletely. Research offers many insights into the myriad associations between abiotic and biotic elements of a forested ecosystem. These data produced by research must be offered to students in a meaningful way.

Now, let’s look at that statement about high-risk catastrophic wildfire areas being in areas that have experienced decades of fire suppression. First, it is important that instructors convey to students that a “healthy” forest is a social perception, not necessarily a scientifically defined concept. For example, in areas that are experiencing rapid pine mortality from the mountain pine beetle (bark beetle) in the Northwest, most people would define the contiguous acres of red-crowned pines as “unhealthy” due to an epidemic, or outbreak, of the beetles. In fact, one might just as accurately say that there appears to be an epidemic, or over-population, of *pinus*, and the beetles are just bringing the forest back to a “healthy” state. Bottom line: In most of these instances, tree death is caused by a combination of biotic and abiotic factors; no single agent is responsible, but the consequences to human goals and objectives drive the focus of research

and definitions of “health.” Generally, forest health, or decline, is measured by amount of tree mortality and by physical signs of decreased vigor, such as die-back and leaf chlorosis. In practice, forest health is measured by looking at symptoms that interfere with human needs and wants such as loss of aesthetics, reduced revenue from timber production, or poorer water quality.

When considering the known linkages that may have brought a forest into decline (the trees are dying and exhibiting symptoms of diminished vigor), it is important to look at three layers of factors that have contributed to the widespread damage or decline of trees:

- **Predisposing factors:** long-term factors that alter the tree’s ability to defend against or repair damage from disease, stress or injury. Factors such as age, soil compaction, and air pollution can be predisposing factors.
- **Inciting factors:** short-term stresses or injuries that reduce tree vigor, often resulting in branch die-back. The effects from inciting factors are noticeable, and they are especially damaging to trees that are predisposed. Drought, defoliating insect infestations, frost damage and mechanical injury are examples of possible inciting factors.
- **Contributing factors:** environmental factors, usually in the form of biotic diseases or agents, that lead to tree mortality. Many of these agents opportunistically invade stressed trees that have experienced initial decline from predisposing and inciting factors. Their presence is often an indication of an already weakened tree. Bark beetle infestations, root rots (root-decay fungi), and canker fungi are examples of contributing factors that “attack” a tree, leading to its death.

In high-risk fire areas, it is important to look at the probable layers of events that may have led to many acres of dead and dying trees. First, it is important to look at the history of these pine-dominated ecosystems. Periodic low-intensity fires developed as a critical component of a vigorous, pine-dominated forest. Pines, such as the ponderosa and

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lodgepole, evolved adaptations, such as thick bark, to tolerate, reproduce and thrive in the presence of these fires. Pines also counted on these fires to keep out more competitive, moisture-robbing species and less vigorous pines, maintaining stands with more open stem spacing. Decades of fire suppression have omitted this important element in these systems, leading to over-dense stands of pine, often crowded with invading true fir and Douglas-fir species. Limited soil nutrients and moisture could not support the growing dense stands, and tree vigor declined as the forests grew (predisposing factors). Many areas in the West also were experiencing periods of drought, further aggravating the ability of trees to remain vigorous (inciting factor). Decreased vigor in trees led to a compromised ability to effectively ward off invading pathogens and bark beetles (contributing factors). Western pine beetles, mountain pine beetles and pine engravers had greater success penetrating tree bark to reproduce in the nutrient-rich phloem, since the trees' abilities to chemically or physically repel the beetles (usually by "pitching out" the beetles) were compromised. More successfully invading beetles led to larger, more successful broods and an increase in the number of "healthy" trees were girdled by the cambium-mining beetles.

Contiguous acres of dead and dying tree stems, both standing and downed, created a tinder box of dried-up fuel, just waiting for the next opportunity of fire ignition. While this is a rather linear view of the "pathway" to tree mortality, and

it leaves out other possible peripheral factors such as root-rot fungi and dwarf mistletoe, it helps exemplify to students how complex and delicate these forested ecosystems are, and that there are no simple answers to the problems that plague them.

It has been demonstrated that prudent forest management can lower the risk of unacceptable loss of property and resource assets due to insect infestations through various silvicultural prescriptions. Many of the conditions that favor bark beetle outbreaks are those which are associated with long periods of little or no management of forests. We know that silvicultural actions such as thinning and species manipulation can help control some of these damaging, elevated-population outbreaks of diseases and insect infestations. Thinning can reduce competition for moisture and nutrients and promote better physiological condition of the remaining trees, thus, increasing vigor and creating stronger tree defense systems. Reintroduction of controlled low-intensity ground fires can also help maintain tree vigor by reducing competition from moisture-robbing shrubs and grasses. Tree selection and planting strategies designed to encourage species best adapted to a site can also help reduce the effects of predisposing and inciting factors.

Ara Andrea is a forestry instructor at Chemeketa Community College and a regular contributor to NCSR's curriculum development efforts.