

Chapter 9. Riparian Zones: Managing Early-Successional Habitats Near the Water's Edge

Thomas P. Hodgman

Bird Group, Maine Department of Inland Fisheries and Wildlife,
650 State Street, Bangor, ME 04401

Tom.Hodgman@state.me.us

As a landowner, you may at some time during your tenure decide to manage the habitat on your property. It may be for economic gain, such as a timber harvest, or converting an old field back into hay production, or pasture, or maybe for simply enhancing wildlife habitat. In any case, the choices that you make should be influenced by how surrounding lands are managed and by the effects that your management will have on adjacent natural communities, whether you own them or your neighbor does. This relationship is never more critical than when considering the effects of upland management on adjacent streams, lakes, and wetlands. Most landowners interested in managing for wildlife habitat on their property are also concerned with protecting or enhancing water quality, protecting aquatic habitat for fish and other aquatic species, and for providing habitat for species that use the margins of wetlands and other aquatic communities. In this chapter, I hope to expand your view of the interface between uplands and wetlands, demonstrate how wildlife is influenced by this transition zone, explain how actions on surrounding lands can affect aquatic communities, and review what steps can be taken to minimize negative effects.

Defining the issue

The riparian zone is the area where terrestrial and aquatic ecosystems converge. It has been defined as the area between the stream channel or near shore portion of a lake or pond and the furthest upland extent of the aquatic system's influence. A riparian zone occupies space above ground, but extends below ground too, where biological processes take place that help protect adjacent aquatic systems. Many riparian zones lack discrete boundaries. Instead, they gradually transition from plants (and soil conditions) tolerant to periodic inundation to those that are less tolerant.

Structurally, riparian habitat is often similar to, and for many wildlife species may be considered, early-successional habitat. Periodic flooding and ice scouring can easily set back succession along larger streams especially in the northern portion of our region. Examples of easily recognized riparian zones include floodplain forests along rivers and streams, the shrubby fringes of lakes, ponds, and streams, sedge- and grass-dominated meadows, as well as damp, braided channels of headwater streams.



Figure 1. Slow moving rivers are often flanked by extensive hardwood floodplain forest. Photos by Tom Hodgman.



Figure 2. Headwater streams are the roots of aquatic systems, yet are vulnerable to disturbance because of their small size and often intermittent flow.



Figure 3. Most lakes, ponds, and rivers are flanked by riparian zones with well-defined shrub communities where woody plants dominate the transition from aquatic to upland habitat.

Photo by Merry Gallagher.

Riparian zones are among the most structurally diverse and naturally dynamic ecosystems in the Northeast. Part upland, part wetland, they frequently hold the greatest diversity of species of any habitat in our region and are considered by some scientists to be more sensitive to environmental change than any other ecosystem. The benefits of riparian zones to wildlife are far reaching. For example, riparian zones serve as travel corridors, help protect and enhance aquatic habitat, and provide structurally complex habitats themselves. A recent report indicated that 90% of wildlife species in the Northeast use riparian habitats. Benefits extend beyond wildlife as well. Riparian zones slow floodwaters and help to protect water quality by reducing erosion and modifying runoff before it enters streams, ponds, and wetlands.

Value as wildlife habitat

When considering land management to benefit a selected group of species, you will find that some species have dual needs. That is, a species may use one habitat type for one aspect of its life cycle and a different habitat type for another. This raises some obvious limitations for small landowners. Just as someone with a ten-acre parcel has less control over wildlife with large spatial needs, owners of small parcels may have less influence on species with complex habitat needs. Some obvious examples of these crossover species include American bitterns, beavers, and wood turtles. All three species are wetland obligates. However, bitterns will forage and sometimes nest in wet meadows and hayfields especially if they are close to marshes. Beavers require woody vegetation for both food and building materials. Young and regenerating aspen stands near a wetland can be the center of beaver activity for years as they construct a dam, lodge, and winter food cache. Wood turtles are aquatic, but lay their eggs in soils adjacent to rivers and streams where adequate sunlight is a prerequisite for a timely hatch. During summer, they venture throughout the riparian zone and into surrounding uplands to forage on such things as wild strawberries, mushrooms, and earthworms. Numerous other species share a desire for upland and wetland habitat. White-tailed deer, moose, some amphibians, and many invertebrates such as dragonflies, and of course, many songbirds fit this description.

Figure 4. Beavers are the ultimate riparian species relying on (and modifying) resources found in both the aquatic and terrestrial ecosystems.
Photo by Tom Hodgman.





Figure 5. Wood turtles are closely associated with riparian habitats and often venture into neighboring uplands. Photo by Maine Dept. of Inland Fisheries and Wildlife.

Riparian zones may serve as travel corridors, funneling wildlife as they move from place to place in search of food or shelter. White-tailed deer and predators, such as foxes and coyotes are good examples. Otters and mink are two species that are closely tied to aquatic habitats, but spend much of their time in the riparian zone. Both, however, occasionally make brief forays into surrounding uplands. Species such as water shrews and meadow jumping mice have spatial requirements that are small enough to occupy riparian zones for their entire life cycle. Riparian zones that are especially wide can offer sufficient habitat for some songbirds like Louisiana waterthrush, common yellowthroats, prothonotary, and yellow warblers.

Be aware, however, that as habitat conditions in the uplands adjacent to riparian zones are altered, the habitat conditions in the riparian zone also may be altered. This may enhance riparian habitat for some species, yet reduce its suitability for others. Consider too that the habitat needs of some species are not well known and that many species will not be detected or easily identified without careful, trained observation. To ensure that no species of conservation concern will be detrimentally affected, an inventory of wildlife on the property should be conducted. Results of such an inventory will allow you to make more informed decisions and actually may change your opinion as to how you should proceed with management.

Enhancing aquatic ecosystems

It is widely understood that water temperature affects which species live in a particular waterway. This is especially true with fish, but also has been demonstrated for other aquatic life. Streams may no longer support trout populations, for example, if temperatures exceed certain thresholds. Land management activities adjacent to streams, such as logging, can have an important influence on water temperature. In an extreme case, harvesting all trees along a small stream would greatly increase its maximum summer temperature. Following removal of streamside vegetation, it may take from several years (in the case of shrubs) to decades (in the case of a tree canopy) before vegetation develops enough to once again have a shading and thus cooling effect. Removing streamside cover in a small area, especially in the headwaters, can affect much larger portions of the watershed as warm water is transported downstream. In contrast, cool, spring-fed streams, can help to mitigate effects of lost streamside shading further downstream.

Figure 6. Brook trout, a popular sportfish, can benefit when riparian zones are carefully managed.





Figure 7. Extensive timber harvest along headwater streams can have negative effects on aquatic organisms far downstream. Photo by Maine Dept. of Inland Fisheries and Wildlife.

Some ecologists have suggested that slight warming of cold spring-fed streams by removal of some shading vegetation may increase their suitability to aquatic organisms, thus increasing their productivity. Technically, this may be true. However, there is a fine balance between providing enough warmth to enhance productivity and possibly providing too much heat resulting in mortality of valued aquatic organisms. Most states have restrictions on the volume of timber that can be removed adjacent to streams and what sort of activities can be undertaken adjacent to water bodies. Check with your state's forestry and wetland conservation departments regarding such restrictions. Consultation with biologists from your state's fish and wildlife agency is also a must if considering such a management strategy to ensure more good than harm will result from your project. The effects of stream shading are important and alterations, even if allowed by law, can be far-reaching. Care must be taken to strike the right balance.

Surrounding vegetation has other physical influences on aquatic habitat. Direct inputs of leaves and small twigs from surrounding vegetation serve as an important food source for many species of aquatic insects. Input of organic matter in this form is widely considered a critical component of aquatic food webs. Structural inputs too, are important. Large branches and even whole trees falling into streams redirect currents, slow moving water, and create structurally diverse microhabitats in the form of small pools and riffles as water flows over and around such large woody debris. Trees, whether leaning over and shading the surface or partially submerged along lake and pond shores, create important habitat for many fish. Any angler knows that a few casts around a partially submerged log often will result in a strike. Such structural complexity probably provides security from avian predators for large fish, escape cover for small fish, as well as habitat for aquatic insects.

Protecting water quality

Turbidity

Some degree of topsoil erosion is inevitable with many land management activities. As a result, fine sediments are the most widely occurring pollutant in streams. How far that sediment is transported and where it is deposited can be a problem for some species. When water contains a large amount of fine sediments in suspension it becomes more opaque, a condition known as turbidity.

Results of turbid runoff entering streams and rivers can be significant. Aquatic organisms, mayflies for example, have different tolerances for turbidity just as they do for other environmental conditions. Streams that become too turbid often have lower species abundance and diversity. Highly turbid water also blocks sunlight penetration, which in turn limits the depth to which photosynthesis can take place. Bottom dwelling plants as well as phytoplankton can be negatively affected.

Sedimentation

Another primary concern is sedimentation, which typically refers to deposition of fine materials in streams. This results from the slowing of water by small restrictions in flow, causing sediments to settle out. Sedimentation can have negative effects on aquatic life as well. Fish that spawn on a sand or gravel bottom can lose spawning habitat if fine sediment blankets spawning areas. Habitat for aquatic insects that live on submerged rocks and logs can be smothered by sediment as well. In extreme cases, availability of different microhabitats within a stream can be reduced as pools are gradually filled in with sediment. Sedimentation in headwater streams is especially serious, as these waterways have limited flushing capacity. Careless management that puts even small amounts of sediment in headwater streams is likely to have a long-lasting effect.

Streams with high turbidity often occur in agricultural landscapes where riparian zones have been removed or significantly reduced in extent. Intact riparian zones slow runoff from fields, allowing sediment to fall out before entering waterways. Maintaining riparian zones is an excellent step toward minimizing the negative effects of runoff from adjacent uplands. A number of federal programs exist that provide technical and financial assistance to landowners to restore and maintain riparian buffers. Refer to the Conservation Reserve Enhancement Program (CREP) case study in chapter 11 for more information.

Fortunately, soils in the Northeast, especially forest soils, tend to be coarse-textured and well drained, often with a thick organic layer (leaves and debris) at the surface and are not as easily put into suspension. Consequently, extreme storm events and snowmelt during spring are the times of highest concern. However, consulting with a conservationist from the USDA Natural Resources Conservation Service is recommended as a way to learn more about the soils on your property and their capabilities and limitations.

Eutrophication

Eutrophication is a condition in lakes or ponds (sometimes in moving waters as well) indicating a relatively high level of productivity. A pond with a diverse and robust plant community, abundant planktonic organisms as well as other larger invertebrates, and a healthy and diverse fish population would be considered more eutrophic than a high mountain pond with few plants, few insects, and few or no fish. Generally speaking, streams in forested landscapes tend to be less eutrophic than streams flowing through agricultural areas. With increasing eutrophication, aquatic species composition may change. With changes in abundance and diversity of aquatic insects, fish populations also may change.

Hypereutrophication is a condition where certain nutrients are in great abundance and can lead to some damaging ecological consequences. Typically, nitrogen and phosphorus are the culprits. The sources of these nutrients are often man-made, resulting from chemical fertilizers, sewage, and other untreated wastewater. However, livestock waste also can be a contributing factor. This is especially problematic when livestock are allowed to graze within the riparian zone or allowed access to a stream or pond for water.

Figure 8. Livestock should not be allowed extensive access to streams where they increase nutrient inputs, consume riparian vegetation, and destabilize stream banks. Photo by Tom Hodgman.



During the heat of summer, cattle and other livestock may spend a disproportionate amount of time in the riparian portion of the pasture and consequently consume or trample vegetation there while depositing much manure in or near the water. Over time, especially in adjacent or downstream ponds, nutrients in the water become so high that algae become superabundant. Algae may cover the surface of the water, such that in extreme cases, it strips the water of available nutrients, starves aquatic plants of needed sunlight, and may ultimately affect the amount and distribution of dissolved oxygen available for fish and aquatic insects. Large “sheets” of green slime washing up on the shore or suspended on the surface, often visible as a floating bubbly mat, is an indication that a site has become hypereutrophic. Once conditions have reached this extreme, it can be difficult to reverse. A better strategy may be to do nothing in the upland that would pose an undue threat to neighboring aquatic systems or at least take steps in the riparian zone that will ensure maintenance of high water quality.

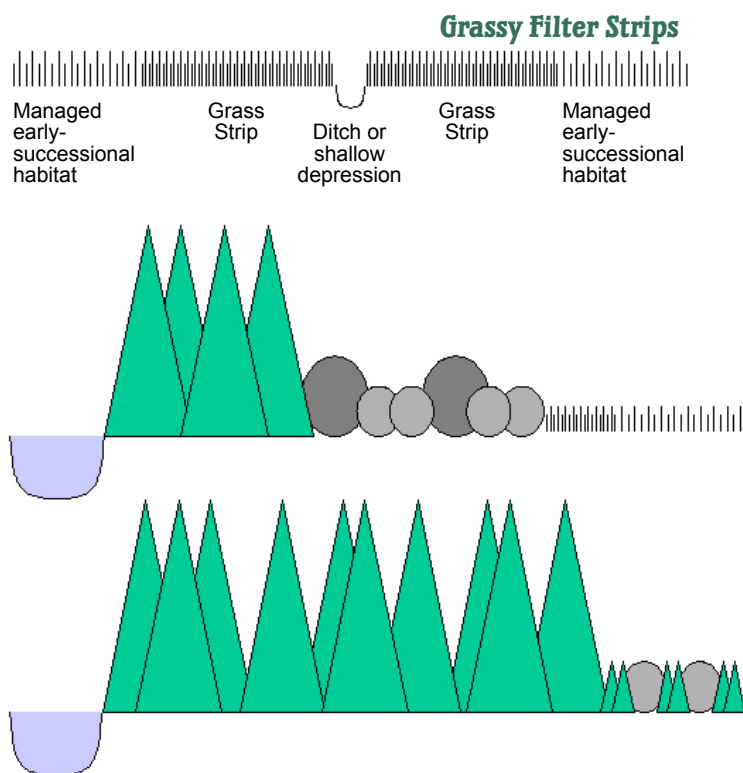
Riparian buffer strips

If you could meet multiple objectives with one management technique, would you try it? If that same technique allowed for flexibility in landowner objectives, desired habitat conditions, and overall appearance, would you be interested? If this idea sounds interesting, then perhaps riparian buffer strips are something you should consider.

Setbacks from shorelines that are intended to protect lakes, ponds, streams, and rivers from activities in adjacent uplands are often referred to as riparian buffer strips. Buffer strips will help remove sediment from overland flow, lock up nutrients and pollutants from runoff, improve habitat value for aquatic organisms by shading surface waters and adding coarse and fine organic matter (twigs and leaves), and provide travel corridors and habitat for wildlife.

Riparian buffers, whether managed or unmanaged, provide a multitude of benefits. Long narrow strips of forest along waterways, however, provide little more than a beauty strip. Such narrow strips may be vulnerable to windthrow, thus jeopardizing stream bank stability, serve as ecological traps where nesting birds suffer high rates of nest loss to predators, and generally are an inadequate means to protect aquatic systems. Buffer design and use have become quite complex, but generally fit two categories: grassy filter strips and multi-layered designs.

Figure 9. Three examples of riparian buffers compatible with early-successional habitat management in both agricultural and forested settings.



Grassy filter strips

Grassy filter strips are used in agricultural settings, often along drainage ditches and between tilled fields, to limit the transport of sediment to nearby streams or other water bodies. Management that entails plowing, disking, or tilling should always assume some loss of topsoil and owners should take precautions to guard against negative effects of sedimentation downslope. Buffers along drainage ditches and along the edges of waterways also may reduce movement of agricultural chemicals, chiefly pesticides and fertilizers.



Figure 10. In a shallow depression between two fields, a grassy filter strip and narrow shrub zone buffer downstream areas from runoff from this hayfield. Photo by Tom Hodgman.

Grassy strip buffers should be considered an absolute minimum for protecting water quality, but should not be used to replace an established natural shrub or forested buffer. Grassy strips obviously should not be grazed or they will likely lose much of their value for slowing overland flow of water and ultimately removing contaminants. Strips as narrow as 20 feet have been used, but are not as effective as wider ones. Wide grassy strips actually may provide habitat for some species, and strips as wide as 150 feet should be considered when increasing wildlife habitat is an important landowner objective.

Multi-layered buffer strips

Multi-layered buffer strips employ a series of vegetation of different heights (i.e., layers) that provide a more natural transition from managed upland to an aquatic system and may be applied in both agricultural and forested settings. If wide enough, multiple layers of vegetation are often desirable to many bird species, therefore, this technique provides not only buffering of aquatic ecosystems, but wildlife habitat as well.

A typical design when buffering upland activities that involve significant soil disturbance, such as disking, could include a strip of herbaceous vegetation (i.e., grassy strip) next to a strip of shrubs, and finally a forested strip along the shoreline or stream bank. The herbaceous strips would function similar to the method described above, while the shrub strip would slow waters during flooding and generally add structural and therefore habitat diversity to the buffer. The forested portion would stabilize banks of streams and shores of lakes and ponds and contribute to removal of nutrients from ground water.

Figure 11. Around this marsh, a mix of grass and shrubs have been allowed to develop buffering this wetland from activities in the neighboring upland. If left undisturbed, shrubs will likely increase in this riparian buffer over time. Photo by Tom Hodgman.



A formal design known as the multi-species riparian buffer system uses plantings to create the buffer. In this system, the minimum widths are 20 to 24 feet for warm-season grasses, followed by a 12-foot strip of shrubs, and finally a 30-foot wide strip of trees closest to the water. This system was designed in the Midwest where riparian zones have been heavily degraded. However, there is little reason not to employ a similar system in the Northeast, though plantings may not be necessary unless a riparian zone needs to be restored.

Selective removal of some large shrubs and trees over time would extend the effective life of this design. A three-layer design would seem to fit well adjacent to pasture, hayland, or old fields, especially if the managed area already is ringed with shrubs and other early-successional vegetation. This system could be easily modified to include just shrub and tree strips when landowner objectives are focused on maintaining a high proportion of shrub cover in the upland. Or, if abundant shrub cover already exists at the water's edge, then perhaps there would be no need (opportunity) for a forested strip.

Another design, more applicable in forested settings, where early-successional forest is the target, involves forest strips of varying widths and timber harvest intensity. The first strip, located at the water's edge is permanent forest cover and should remain undisturbed (i.e., no harvest). The second strip is the managed forest zone and allows for periodic selective harvesting. Single tree removal or removal of small groups of trees (e.g., group selection) would be acceptable in this zone. Widths of these strips vary, but in general, should be 100 to 150 feet wide.

One ecologically based approach to define buffer width in this setting compares the similarity of the vegetation within the riparian buffer to that of the abutting managed area. When the riparian buffer and managed area are quite dissimilar (e.g., forested riparian zone adjacent to large clearcut) consider retaining a no-cut and/or limited-cut buffer totaling several hundred feet. In contrast, if the riparian zone and adjacent managed site are similar (e.g., forested riparian zone adjacent to forest cover with only single tree or large group selection harvests) then a riparian buffer equal in width to one or two tree heights may be adequate.

An even more prescriptive approach to buffering aquatic systems from timber harvest is used in the northern part of our region. This approach includes varying buffer widths and harvest intensities within buffers depending on size of water body or stream order (i.e., a classification system for moving waters where first order streams are unbranched headwater streams, second order streams are formed by the confluence of two first order streams, and third order streams are formed by the confluence of two second order streams, etc.). This approach allows the harvest of 30% or less of the stand volume of trees six inches or less in diameter over a ten year period within the riparian buffer. Residual basal area per acre following harvest must not be less than 100 square feet for softwood stands, 80 square feet for mixed stands, and 60 square feet in hardwood stands. These criteria are applied to a buffer width (on each side of a stream) of 660 feet for fourth order streams and larger, 330 feet for third order streams, 250 feet for nonforested wetlands and ponds less than ten acres, 100 feet for vernal pools, nonforested wetlands less than ten acres, and first and second order streams, and 75 feet for unmapped, intermittent streams. In addition, no-harvest zones of 25 feet are included within the widths described above for third and fourth order streams, nonforested wetlands less than ten acres, lakes, and large ponds (greater than ten acres).

Additional considerations

Using riparian zones as buffers seems to be a relatively simple strategy for protecting aquatic environments. Buffers may take many shapes, but what is suitable for owners of agricultural lands may not be directly applicable to forest landowners. Some degree of creativity and flexibility on a site-by-site basis often will be necessary as long as integrity of the aquatic ecosystem is maintained. There may be cases where the presence of, or potential for, high priority species of conservation concern, such as woodcock or golden-winged warbler, justify management activities in the riparian zone. For example, if carefully planned to minimize soil disturbance, a small timber harvest in an aspen-dominated stand adjacent to a stream could result in a long-term food resource for beaver. The young, regenerating forest also could provide habitat for grouse and woodcock. Furthermore, regenerating (or reclaiming) a stand of alders within the riparian zone

that is being overtopped by trees would provide foraging habitat for woodcock and other shrub-nesting birds. Additionally, research has demonstrated that berry-producing shrubs in riparian corridors are important for fall migrating birds. The amount of fruit such shrubs produce can be enhanced by removing overtopping vegetation. As each situation is unique, your state wildlife agency would be a good place to seek advice on how to approach individual situations.

There are numerous variations suggested for buffer designs and widths, and recommendations vary from state to state. As previously indicated, state regulations should be consulted whenever managing lands near waterways. Some interesting modifications to buffer width include varying the width of a buffer depending on the slope of the adjacent managed upland. For example, sites managed for early-successional habitat that occur on steep slopes should consider a wider riparian buffer than sites that rise very little from the riparian zone. So then, is wider always better? The law of diminishing returns certainly applies to the concept of riparian buffers. That is, beyond a certain point there is no additional gain (i.e., protection) afforded to the water body with a wider buffer. One aspect to consider is to imagine where the riparian edge may have been before the area was first disturbed. This may be easy in some areas with much natural vegetation in place, but not so in areas that have been cleared up to the stream bank.

Are buffers and their widths the only concern? No, when streams run at peak flow, often referred to as bank full, they exert great influence on the characteristics of the channel. Over time, stream channels tend to become straighter while increasing in width, but not necessarily depth. In general, both of these conditions result in streams with lower structural diversity and can lead to lower biological diversity as well. Drainage basins that receive much timber harvesting (i.e., 1/2 to 2/3 of basin area converted from mature to young forest) can greatly increase peak flows. In predominantly forested landscapes, keeping young forest and other open areas (early-successional habitats) to less than 2/3 of the area of the drainage basin will help to prolong stream channels in their natural condition. In the end, as long as you are in compliance with state regulations, the decision of how you manage adjacent uplands, how you lay out a buffer, and the intensity with which you manage (e.g., timber harvest) within the riparian zone is yours. Whenever possible, let nature, the experiences of others, and your good judgment guide your decision making.

Riparian zones stand at the transition between terrestrial and aquatic ecosystems. As an area of transition, they are strongly influenced by activities on adjacent lands. Riparian zones host more species of wildlife and more rare plants than nearly any other habitat and are among the most dynamic ecosystems in our region. Despite their resilience, many riparian zones have been degraded either by grazing, overharvesting of timber, or have been converted to other land uses, often agricultural. The use of riparian zones as buffers between management in the uplands and sensitive aquatic systems has been recognized for years. This concept has been put into place along countless miles of stream banks and shorelines through the use of riparian buffer strips. Use of buffer strips can be designed to meet habitat management objectives as well as safeguard aquatic habitat from potentially damaging runoff. Many riparian zones, in effect, may provide early-successional habitat if managed appropriately and if large enough to accommodate the spatial needs of wildlife. It is much easier to protect water quality in small streams than major streams and rivers. Small landowners, therefore, can play an especially important role as seemingly small changes along headwater streams can have far reaching effects downstream. Management of early-successional habitat to benefit wildlife is important as many of these species suffer from an ever-shrinking habitat base and subsequent population declines. However, management for these habitats must be done with consideration for surrounding habitats as well.

Suggested reading

- Allan, J. D. 1995. Stream ecology: structure and function of running waters. Kluwer Academic Publishers, Boston, MA. 488 pp.
- International Paper. 2003. Northeast area, sustainable forestry policy: Maine/New Hampshire area standards for water resource management. 21 pp.
- Mitsch, W. J. and J. G. Gosselink. 1986. Wetlands. Van Nostrand Reinhold Co., Inc. New York, NY. 539 pp.
- Meyer, J. L., L. A. Kaplan, N. Newbold, D. L. Strayer, C. J. Woltemade, J. B. Zedler, R. Beilfuss, Q. Carpenter, R. Semlitsch, M. C. Watzin, and P. H. Zedler. 2003. Where rivers are born: the scientific imperative for defending small streams and wetlands. American Rivers and The Sierra Club. 24pp. www.amrivers.org/doc_repository/WhereRiversAreBorn1.pdf
- Naiman, R. J., H. DeCamps, and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* 3(2):209-212.
- National Research Council. 2002. Riparian areas: functions and strategies for management. National Academy Press, Washington, DC. 428 pp.
- Pelletier, S. K. 1999. Special habitats and ecosystems: riparian and stream ecosystems. Pages 47-55 in C. A. Elliott, ed. Biodiversity in the forests of Maine: guidelines for management. University of Maine Cooperative Extension, Bulletin #7147.
- Verry, E. S., J. W. Hornbeck, and C. A. Dolloff, eds. 2000. Riparian management in forests of the continental eastern United States. Lewis Publishers, Boca Raton, FL. 402 pp.

Biography

Tom Hodgman has 17 years experience as a biologist in northern New England. He earned a B.S. in Environmental Science from Unity College and an M.S. in Forest and Range Management from Washington State University. Tom has both teaching and research experience in the subject of wetlands ecology. He currently serves as a Wildlife Biologist for the Maine Department of Inland Fisheries and Wildlife where he works primarily in the conservation of nongame birds especially those associated with wetland habitats.