NITROGEN AND ECOSYSTEM RESTORATION

Stephen Thomforde
Stantec
Senior Restoration Ecologist
2024

BIBLIOGRAPHY

Allen, C. R., Burr, M. D., Camper, A. K., Moss, J. J., & Stein, O. R. (2023). Seasonality, C: N ratio and plant species influence on denitrification and plant nitrogen uptake in treatment wetlands. Ecological Engineering, 191, 106946. TDN uptake, sewage treatment. Short term

Anderson, R.H., Fuhlendorf, S.D., and D.M. Engle. 2000. Soil nitrogen availability in tallgrass prairie under the fire-grazing interaction. Rangeland Ecology & Management, Vol. 59, No. 6.

Ashton, I. W., Hyatt, L. A., Howe, K. M., Gurevitch, J., & Lerdau, M. T. (2005). Invasive species accelerate decomposition and litter nitrogen loss in a mixed deciduous forest. Ecological Applications, 15(4), 1263-1272.

Bansal, S., Lishawa, S. C., Newman, S., Tangen, B. A., Wilcox, D., Albert, D., ... & Windham-Myers, L. (2019). Typha (cattail) invasion in North American wetlands: biology, regional problems, impacts, ecosystem services, and management. Wetlands, 39, 645-684.

Beachley, G. M., Fenn, M. E., Du, E., de Vries, W., Bauters, M., Bell, M. D., ... & Walker, J. T. (2024). Monitoring nitrogen deposition in global forests. Atmospheric Nitrogen Deposition to Global Forests, 17-38.

Beisner, B. E., Haydon, D. T., & Cuddington, K. (2003). Alternative stable states in ecology. Frontiers in Ecology and the Environment, 1(7), 376-382.

Berry, P., Yassin, F., Grosshans, R., & Lindenschmidt, K. E. (2017). Surface water retention systems for cattail production as a biofuel. Journal of environmental management, 203, 500-509.

Bethke, P. G., & Midgley, M. G. (2020). Amynthas spp. impacts on seedlings and forest soils are tree species-dependent. *Biological Invasions*, *22*(10), 3145-3162. Jumping worms increase soil N

Bobbink, R., Hicks, K., Galloway, J., Spranger, T., Alk 2010. Global assessment of nitrogen deposition effects on terrestrial plant diversity: a synthesis. Ecological applications, 20(1), 30-59.

Bobbink, R., Hornung, M., & Roelofs, J. G. (1998). The effects of air-borne nitrogen pollutants on species diversity in natural and semi-natural European vegetation. Journal of ecology, 86(5), 717-

Briske, D., Washington-Allen, R., Johnson, C., T., & Shugart, H. (2010). Catastrophic thresholds: a synthesis of concepts, perspectives, and applications. Ecology and Society, 15(3).

Buriánek, V., Novotný, R. (2013). Ground vegetation important to biodiversity of forest ecosystems and its evaluation in regard to nitrogen deposition. Journal of Forest Science, 59(6), 238-252.

Burnham, M. B., Christ, M. J., Adams, M. B., W. T. (2021). Assessing the linkages between tree species composition and stream water nitrate in a reference watershed in Appalachia. Forests

Carpenter, S.R., Caraco, N.F., Correl, D.L., Howarth, R.W., Sharpley, A.N., and V.H. Smith. 1998. Nonpoint pollution of surface water with phosphorus and nitrogen. Ecological Applications, Vol. 8,

Ceska, A., & Scagel, A. M. (2011). Indicator plants of coastal British Columbia. UBC Press.

Chudomelová, M., Hédl, R., Zouhar, V., & Szabó, P. (2017). Open oakwoods facing modern threats: Will they survive the next fifty years?. Biological Conservation, 210, 163-173.

Clark, C. M., & Tilman, D. (2008). Loss of plant species after chronic low-level nitrogen deposition to prairie grasslands. Nature, 451(7179), 712. < plant diversity with > N

Clark, C. M., Bell, M. D., Boyd, J. W., Compton. (2017). Nitrogen-induced terrestrial eutrophication: cascading effects and impacts on ecosystem services. Ecosphere, 8(7), e01877.

Clark, C. M., Simkin, S. M., Allen, & Waller, D. M. (2019). Vulnerability of 348 herbaceous species to atmospheric deposition of nitrogen in the United States. Nature Plants, 5(7), 697-705.

Cleland, E. E., & Harpole, W. S. (2010). Nitrogen enrichment and plant communities. Annals of the New York Academy of Sciences, 1195(1), 46-61.

Collins, S. L., Knapp, A. K., Briggs, J. M., Blair, J. M., & Steinauer, E. M. (1998). Modulation of diversity by grazing and mowing in native tallgrass prairie. Science, 280(5364), 745-747.

Cottingham, K. L., Ewing, H. A., Greer, M. L., Carey, C. C., & Weathers, K. C. (2015). Cyanobacteria as biological drivers of lake nitrogen and phosphorus cycling. Ecosphere, 6(1), 1-19.

Coughlin, J. G., Clark, C. M., Pardo, L. H., Sabo, R. D.(2023). Sensitive tree species remain at risk despite improved air quality benefits to US forests. Nature Sustainability, 1-13. Nitrogen Sulfer

Coughlin, Justin (2023). All Species N Critical Loads. figshare. Dataset. https://doi.org/10.6084/m9.figshare.22692964.v1

Craine, J. M., Tilman, D., Wedin, D., Reich, P., Tjoelker, M., & Knops, J. (2002). Functional traits, productivity and effects on nitrogen cycling of 33 grassland species. Functional Ecology

Cope, W. G., Bringolf, R. B., Buchwalter, D. B. (2008). Differential exposure, duration, sensitivity bivalve life stages to environmental contaminants. North American Benthological Society, 27(2).

Curtis, J.T. 1959 *The Vegetation of Wisconsin An Ordination of Plant Communities* (2nd Ed.). The University of Wisconsin Press. (Nitrophytes and Nitrophiles)

Dahlströma, A., Iuga, A., Lennartsson, T. 2013. Managing biodiversity rich hay meadows Swedish and Romanian grasslands. Environmental Conservation, Vol. 40, Issue 2. Biomass Harvest

D'Imperio, E. A. (2005). Nitrogen dynamics of Centaurea maculosa and native species (Doctoral dissertation, Montana State University-Bozeman, College of Agriculture).

De Schrijver, A., De Frenne, P., Ampoorter, E., Van Nevel, L., Demey, A., Wuyts, K., & Verheyen, K. (2011). Cumulative nitrogen input drives species loss in terrestrial ecosystems. Global Ecology.

de Vries, W., Erisman, J. W., Spranger, T., Stevens, C. J., & van den Berg, L. (2011). Nitrogen as a threat to European terrestrial biodiversity. *The European nitrogen assessment: sources, effects*

Draaijers, G. P. J., Van Ek, R., & Meijers, R. (1992). Research on the impact of forest stand structure on atmospheric deposition. Environmental Pollution, 75(2), 243-249. Nitrogen trees oaks sl

Elgersma, K. J., Martina, J. P., Goldberg, D. E., & Currie, W. S. (2017). Effectiveness of cattail (Typha spp.) management techniques depends on exogenous nitrogen inputs. Elem Sci Anth, 5, 19.

Falkengren-Grerup, U., & Schöttelndreier, M. (2004). Vascular plants as indicators of nitrogen enrichment in soils. Plant Ecology, 172, 51-62.

Folke, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson, and C. S. Holling. 2004. Regime shifts, resilience, and biodiversity in ecosystem management. Annual Review of Eco

Frank, D. A., & Evans, R. D. (1997). Effects of native grazers on grassland N cycling in Yellowstone National Park. Ecology, 78(7), 2238-2248. < Nitrogen Grazers

Galloway, J. N., Schlesinger, W. H., Levy, H., Michaels, A., & Schnoor, J. L. (1995). Nitrogen fixation: Anthropogenic enhancement-environmental response. Global biogeochemical cycles, 9(2), 2

Galloway, J.N., Howarth, R.W., Michaels, A.F., Nixon, S.W., Prospero, J.M., and F.J. Dentener. 1996. Nitrogen and phosphorous budgets of the North Atlantic Ocean and its watershed. Biogeo

Galloway, J. N., & Cowling, E. B. (2002). Reactive nitrogen and the world: 200 years of change. AMBIO: A Journal of the Human Environment, 31(2), 64-71.

Galloway, J. N., Aber, J. D., Erisman, J. W., Seitzinger, S. P., Howarth, R. W., Cowling, E. B., & Cosby, B. J. (2003). The nitrogen cascade. Bioscience, 53(4), 341-356.

Galloway, J.N., Dentener, F.J., Capone, D.G., Boyer, J.H., Townsend, A.R., and C.J. Vöosmarty. 2003. Nitrogen Cycles: Past, Present, and Future. Biogeochemistry, Vol. 70, No.2.

Galloway, J. N., Dentener, F. J., Capone, D. G., Boyer, E. W., Howarth, R. W., Seitzinger, S. P., ... & Karl, D. M. (2004). Nitrogen cycles: past, present, and future. Biogeochemistry, 70(2), 153-226.

Galloway, J. N., Leach, A. M., Bleeker, A., & Erisman, J. W. (2013). A chronology of human understanding of the nitrogen cycle. Philosophical Transactions of the Royal Society B: Biological

Geiser, L. H., Jovan, S. E., Glavich, D. A., & Porter, M. K. (2010). Lichen-based critical loads for atmospheric nitrogen deposition in Western Oregon and Washington Forests, USA. Environmental

Gordon, C. H., Decker, A. M., & Wiseman, H. G. (1962). Some Effects of Nitrogen Fertilizer, Maturity, and Light on the Composition of Orchard grass 1. Agronomy Journal, 54(5), 376-378.

Gobler, C. J., Burkholder, J. M., Davis, Johengen, Van de Waal, D. B. (2016). The dual role of nitrogen supply in controlling the growth and toxicity of cyanobacterial blooms. Harmful algae, 54, 87-

Gosz, J. R. (1981). Nitrogen cycling in coniferous ecosystems. Ecological Bulletins, 405-426.

Grime, J. P., & Pierce, S. (2012). The evolutionary strategies that shape ecosystems. John Wiley & Sons.

Grosshans, R. E., Venema, H. D., Cicek, N., & Goldsborough, G. (2011). Cattail farming for water quality: Harvesting cattails for nutrient removal and phosphorous recovery

Gruber, N., & Galloway, J. N. (2008). An Earth-system perspective of the global nitrogen cycle. Nature, 451(7176), 293-296. Nitrogen

Guretzky, J. A., Dunn, C. D., & Bishop, A. (2018). Plant Community Structure and Forage Nutritive Value of Reed Canarygrass-Invaded Wetlands. Agronomy Journal, 110(1), 200-209.

Fujita, Y., & Uesaka, K. (2022). Nitrogen fixation in cyanobacteria. *Cyanobacterial Physiology*, 29-45. Oxygen Paradox

Haddad, N. M., Haarstad, J., & Tilman, D. (2000). The effects of long-term nitrogen loading on grassland insect communities. Oecologia, 124(1), 73-84. >N equals < insect diversity Cedar Creek

Henskens, F. L. F. (1993). The carbon and nitrogen physiology of Achillea millefolium L.(yarrow) (Doctoral dissertation, Lincoln University). Nitrogen and Yarrow

Hiltbrunner, E., Aerts, R., Bühlmann, T., Huss-Danell, K., Magnusson, B., Myrold, D. D., ... & Körner, C. (2014). Ecological consequences of the expansion of N 2-fixing plants in cold biomes.

Hobbs, N. T., Schimel, D.S., Owensby, C. E., and D.S. Ojima. 1991. Fire and grazing in the tallgrass prairie: contingent effects on nitrogen budgets. Ecology, Vol. 72, No. 4.

Hofmeister, J., Mihaljevič, M., Hošek, J., & Sádlo, J. (2002). **Eutrophication of deciduous forests** in the Bohemian Karst (Czech Republic): the role of nitrogen and phosphorus. Forest Ecology

Hofmeister, J., Mihaljevič, M., & Hošek, J. (2004). The spread of ash (Fraxinus excelsior) in some European oak forests: an effect of nitrogen deposition or successional change?. Forest Ecology

Hofmeister, J., Hošek, J., Modrý, M. (2009). The influence of light and nutrient availability on herb layer species richness in oak-dominated forests in central Bohemia. Plant Ecology, 205, 57-75.

Horn, K. J., Thomas, R. Q., Clark, C. M., Pardo, (2018). Growth survival relationships of 71 tree species with nitrogen and sulfur deposition across the conterminous US. PloS one, 13(10)

Hutchinson, G. E., & Wollack, A. (1940). Chemical analyses of a core from Lindley Pond, North Branford, Part 2 of Studies on Connecticut lake sediments. American Journal of Science, 238(7),

Isbell, F., Reich, P. B., Tilman, D., Hobbie, S. E., Polasky, S., & Binder, S. (2013). Nutrient enrichment, biodiversity loss, and consequent declines in ecosystem productivity. Proceedings of the Na

Isbell, F., Tilman, D., Polasky, S., Binder, S., & Hawthorne, P. (2013). Low biodiversity state persists two decades after cessation of nutrient enrichment. Ecology letters, 16(4), 454-460.

James, C., Fisher, J., Russell, V., Collings, S., & Moss, B. (2005). Nitrate availability and hydrophyte species richness in shallow lakes. Freshwater biology, 50(6), 1049-1063.

Jefferies, R.L., and J.L. Maron. 1997. The Embarrassment of riches: atmospheric deposition of nitrogen and community and ecosystem processes. Tree, Vol. 12, No. 2.

Jokerud, M. (2013). Impact of Nitrogen Deposition on Species Richness and Species Composition of Ombrotrophic Mires in Western Norway (Master's thesis, The University of Bergen).

Jones, M. D., Phillips, L. A., Treu, R., Ward, V., & Berch, S. M. (2012). Functional responses of ectomycorrhizal fungal communities to long-term fertilization of lodgepole pine (Pinus contorta Dougl. ex Loud. var. latifolia Engelm.) stands in central British Columbia. Applied Soil Ecology, 60, 29-40.

Karst, T.L., Smol, J.P. 2000. Paleolimnological evidence of limnetic nutrient concentration equilibrium in a shallow macrophyte-dominated lake. Aquatic Science, Vol 62, No. 1. (Cool paper how

Kearney M, Simpson SJ, Raubenheimer D, Helmuth B. Modelling the ecological niche from functional traits. Philos Trans R Soc Lond B Biol Sci. 2010 Nov 12;365(1557):3469-83. doi:

Kitchell, J.F., Schindler, D.E., Herwig, B.R., Post, D.M., Olson, M.H. 1999. Nutrient cycling at the landscape scale: The role of diel foraging migration by geese at the Bosque del Apache National

Kleidon, A. (2010). Life, hierarchy, and the thermodynamic machinery of planet Earth. Physics of life reviews, 7(4), 424-460.

Knops, J. M., Ritchie, M. E., & Tilman, D. (2000). Selective herbivory on a nitrogen fixing legume (Lathyrus venosus) influences productivity and ecosystem nitrogen pools in an oak savanna.

Kourtev, P. S., Huang, W. Z., & Ehrenfeld, J. G. (1999). Differences in earthworm densities and nitrogen dynamics in soils under exotic and native plant species. Biological Invasions, 1(2-3), 237-

Kuglerová, L., García, L., Pardo, I., Mottiar, Y., & Richardson, J. S. (2017). Does leaf litter from invasive plants contribute the same support of a stream ecosystem function as native vegetation?.

Larkin, D. J., Freyman, M. J., Lishawa, S. C., Geddes, P., & Tuchman, N. C. (2012). Mechanisms of dominance by the invasive hybrid cattail Typha× glauca. Biological Invasions, 14, 65-77.

Lavergne, S., & Molofsky, J. (2004). Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical reviews in plant sciences, 23(5), 415-429.

Levy, P., van Dijk, N., Gray, A., Sutton, M., Jones, M., Leeson, S., ... & Sheppard, L. (2019). Response of a peat bog vegetation community to long-term experimental addition of nitrogen. Journal of

Li, D., Zhang, S., Adyel, T. M., Liu, K., & Gong, L. (2020). Negative effects on the leaves of submerged macrophyte and associated biofilms growth at high nitrate induced-stress. Aquatic

Likens, G. E., Bormann, F. H., Johnson, N. M., Fisher, D. W., & Pierce, R. S. (1970). Effects of forest cutting and herbicide treatment on nutrient budgets in the Hubbard Brook

Liu, Y. Y., Sun, Y., Müller-Schärer, H., Yan, R., Zhou, Z. X., Wang, Y. J., & Yu, F. H. (2019). Do invasive alien plants differ from non-invasives in dominance and nitrogen uptake in response to

Levy, P., van Dijk, N., Gray, A., Sutton, M., Jones, M., Leeson, S., ... & Sheppard, L. (2019). Response of a peat bog vegetation community to long-term experimental addition of nitrogen. *Journal of*

May, R. M. (1977). Thresholds and breakpoints in ecosystems with a multiplicity of stable states. Nature, 269(5628), 471-477.

Mathewson, D. D., Hocking, M. D., & Reimchen, T. E. (2003). Nitrogen uptake in riparian plant communities across a sharp ecological boundary of salmon density. BMC ecology, 3, 1-11.

Mountford, J. O., Lakhani, K. H., & Kirkham, F. W. (1993). Experimental assessment of the effects of nitrogen addition under hay-cutting and aftermath grazing on the vegetation of meadows on a

Namuhan, Wang, J., Yang, G., Song, Y., Yu, Y., Wang, J., ... & Zhang, H. (2024). Mechanisms of biodiversity loss under nitrogen enrichment: Unveiling a shift from light competition to cation

Nixon, S.W. 1995. Eutrophication: A definition, social causes, and future concerns. Ophelia 41: 199-219.

Nordin, A., Strengbom, J., Witzell, J., Näsholm, T., & Ericson, L. (2005). Nitrogen deposition and the biodiversity of boreal forests: implications for the nitrogen critical load. *AMBIO: A Journal of the*

Odum, H.T., R.C. Pinkerton. 1955. Times speed regulator: The optimum efficiency for maximum power output in physical and biological systems. (Ecosystem Function and Integrity)

Odum E.P. (1962). Relationships between structure and function in the ecosystem. Japanese Journal of Ecology, 12(3), 108-118. (Ecosystem Function and Integrity)

Odum, E. P. (1968). Energy flow in ecosystems: a historical review. American Zoologist, 8(1), 11-18. (Ecosystem Function and Integrity)

Odum, E. P. (1975). Diversity as a function of energy flow. In Unifying concepts in ecology (pp. 11-14). Springer, Dordrecht. (Ecosystem Function and Integrity)

Odum, E.P. 1969. The strategy of ecosystem development. Science 164:262-270. (Foundational Paper. Nutrient regulation in ecosystems, see table 1)

Odum, E. P. (1985). Trends expected in stressed ecosystems. Bioscience, 35(7), 419-422. (Nutrient deregulation in stressed ecosystems, Table 1)

Odum, H.T. 1988. Self organization, Transformity, and Information. Science 242. (How and why ecosystems evolve to regulate nitrogen)

Odum H.T. 2007. Environment, Power, and Society for the Twenty First Century. 2nd addition, the original being published in 1971 Columbia University Press. (Quantifiable metrics for "Quality" and

Olsen, S., Chan, F., Li, W., Zhao, S., Søndergaard, M., & Jeppesen, E. (2015). Strong impact of nitrogen loading on submerged macrophytes and algae: a long-term mesocosm experiment in a

Pardo, L. H., Fenn, M. E., Goodale, C. L., Geiser, L. H., Driscoll, C. T., Allen, E. B., ... & Dennis, R. L. (2011). Effects of nitrogen deposition and empirical nitrogen critical loads for ecoregions of the

Pavlovic, N. R., Chang, S. Y., Huang, J., Craig, K., Clark, C., Horn, K., & Driscoll, C. T. (2023). Empirical nitrogen and sulfur critical loads of US tree species and their uncertainties with machine

Payne, R. J., Dise, N. B., Field, C. D., Dore, A. J., Caporn, S. J., & Stevens, C. J. (2017). Nitrogen deposition and plant biodiversity: past, present, and future. Frontiers in Ecology and the

Perry, L. G., Blumenthal, D. M., Monaco, T. A., Paschke, M. W., & Redente, E. F. (2010). Immobilizing nitrogen to control plant invasion. O*ecologia*, *163*(1), 13-24.

Post, D.M., Taylor, J.P., Kitchell, J.F., Olson, M.H., Schindler, D.E., Herwig, B.R. 1998. The role of migratory waterfowl as nutrient vectors in a managed landscape. Conservation Biology, Vol. 12,

Ratajczak, Z., Nippert, J. B., & Ocheltree, T. W. (2014). Abrupt transition of mesic grassland to shrubland: evidence for thresholds, alternative attractors, and regime shifts. Ecology, 95(9), 2633-

Reich, P.B., Peterson, D.W., Wedin, D.A., and K. Wrage. 2001. Fire and vegetation effects on productivity and nitrogen cycling across a forest grassland continuum. Ecology, Vol. 8, No. 6. Nitrogen

Richards, B. N. (1962). Increased supply of soil nitrogen brought about by Pinus. Ecology, 43(3), 538-541. Nitrogen tree spp.

Rimer, R. L., & Evans, R. D. (2006). Invasion of downy brome (Bromus tectorum L.) causes rapid changes in the nitrogen cycle. The American midland naturalist, 156(2), 252-258.

Ritchie, M. E., Tilman, D., & Knops, J. M. (1998). Herbivore effects on plant and nitrogen dynamics in oak savanna. Ecology, 79(1), 165-177. Nitrogen.

Ritchie, M. E., Tilman, D., & Knops, J. M. (1998). Herbivore effects on plant and nitrogen dynamics in oak savanna. Ecology, 79(1), 165-177. Herbivores Nitrogen

Rosenzweig, M.L. 1969. Paradox of Enrichment: Destabilization of Exploitation Ecosystems in Ecological Time. Science, Vol. 171, No. 3969. Nitrogen.

Rothstein, D. E., Zak, D. R., & Pregitzer, K. S. (1996). Nitrate deposition in northern hardwood forests and the nitrogen metabolism of Acer saccharum marsh. Oecologia, 108, 338-344.

Russell, K. M., Galloway, J. N., Macko, S. A., Moody, J. L., & Scudlark, J. R. (1998). Sources of nitrogen in wet deposition to the Chesapeake Bay region. Atmospheric Environment, 32(14-15),

Sabo, A. E., Forrester, J. A., Kruger, E. L., & Mladenoff, D. J. (2023). Herbaceous plant height is an early indicator of groundlayer response to an experimental manipulation of forest structure and

Saklaurs, M., Dubra, S., & Liepa, L. (2021). CASE STUDY OF RIPARIAN VEGETATION AFFECTING WATER QUALITY OF SMALL STREAMS IN LATVIA. International Multidisciplinary Scientific

Salemaa, M., Kieloaho, A. J., Lindroos, A. J., Merilä, P., Poikolainen, J., & Manninen, S. (2020). Forest mosses sensitively indicate nitrogen deposition in boreal background areas. Environmental

Scanga, S. E., & Leopold, D. J. (2012). Managing wetland plant populations: Lessons learned in Europe may apply to North American fens. Biological conservation, 148(1), 69-78. Biomass harvest

Scheffer, M. 1998. Ecology of Shallow Lakes. Kluwer Academic Publishers. (Role of nutrients in ecosystem regime shifts)

Scheffer, M., Carpenter, S., Foley, J. A., Folke, C., & Walker, B. (2001). Catastrophic shifts in ecosystems. Nature, 413(6856), 591. (Role of nutrients in ecosystem regime shifts)

Scheffer, M., & Carpenter, S. R. (2003). Catastrophic regime shifts in ecosystems: linking theory to observation. *Trends in Ecology & Evolution*, *18*(12), 648-656. (Role of nutrients in ecosystem

Schere-Lorenzen, M., Eland, A., Nollert, S., and E. Schulze. 2000. Plant Invasions in Germany: General Aspect and Impact of Nitrogen Deposition. In Invasive species in a changing world. Editors,

Simkin, S. M., Allen, E. B., Bowman, W. D., Clark, C. M., Belnap, J., Brooks, M. L., ... & Waller, D. M. (2016). Conditional vulnerability of plant diversity to atmospheric nitrogen deposition across the

Smith, V.H., Tillman, D. G, and J.C. Nekola. 1999. Eutrophication: Impacts of excess nutrient inputs on freshwater, marine, and terrestrial ecosystems. Environmental Pollution, Vol. 100, Issue 1-3.

Smith, V.H. 2003. Eutrophication of freshwater and coastal marine ecosystems a global problem. Environmental Science and Pollution Research, Vol. 10, No. 2.

Smith, V. H., Joye, S. B., & Howarth, R. W. (2006). Eutrophication of freshwater and marine ecosystems. Limnology and oceanography, 51(1part2), 351-355.

Stevens, C. J., Duprè, C., Dorland, E., Gaudnik, C., Gowing, D. J., Bleeker, A., ... & Dise, N. B. (2010). Nitrogen deposition threatens species richness of grasslands across Europe. *Environmental*

Switzer, G. L., Nelson, L. E., & Smith, W. H. (1966). The Characterization of Dry Matter and Nitrogen Accumulation by Loblolly Pine (Pinus taeda L.) 1. Soil Science Society of America Journal,

Tájek, P., Tenčík, A., Konvička, M., & John, V. (2023). Vegetation changes at oligotrophic grasslands managed for a declining butterfly. Nature Conservation, 52, 23-46.

Tilman, D. (1985). The resource-ratio hypothesis of plant succession. The American Naturalist, 125(6), 827-852.

Tilman, D. (1987). Secondary succession and the pattern of plant dominance along experimental nitrogen gradients. Ecological monographs, 57(3), 189-214.

Tilman, D., and D. Wedin. 1991. Plant traits and resource reduction for five grasses growing a nitrogen gradient. Ecology, 72:685-700.

Tilman, D & Wilson, S. D. (1991). Component of plant competition along an experimental gradient of nitrogen availability. Ecology, 72(3), 1050-1065

Tomassen, H. B., Smolders, A. J., Limpens, J., Lamers, L. P., & Roelofs, J. G. (2004). Expansion of invasive species on ombrotrophic bogs: desiccation or high N deposition?. Journal of applied

Vandinther, N., & Aherne, J. (2023). Ecological Risks from Atmospheric Deposition of Nitrogen and Sulphur in Jack Pine forests of Northwestern Canada. Nitrogen, 4(1), 102-124. Reindeer

Vetaas, O. R. (1992). Micro-site effects of trees and shrubs in dry savannas. Journal of vegetation science, 3(3), 337-344. Nitrogen and trees

Vitousek, P.M., and W.A. Reniers. 1975. Ecosystem succession and nutrient retention: a hypothesis. BioScience 25:376:381.

Vitousek, P.M., Mooney, H.A., Lubchenco, J., and J.M Milillo. 1997c. Human domination of earth's ecosystems. Science, Vol. 277, No. 5325. Nitrogen

Vitousek, P.M., Aber, J., Howarth, R.W., Likens, G.E., Matson, P.A., Schindler, D.W., Schlesinger, W.H., and D. Tilman. 1997a. Human Alteration of the Global Nitrogen Cycle. Ecological

Vitousek, P. M., Hättenschwiler, S., Olander, L., & Allison, S. (2002). Nitrogen and nature. AMBIO: A Journal of the Human Environment, 31(2), 97-102.

Vitousek, P. M., Loope, L. L., & Westbrooks, R. (2017). Biological invasions as global environmental change. Nitrogen invasion

Yousaf, A., Khalid, N., Aqeel, M., Noman, A., Naeem, N., Sarfraz, W., ... & Khalid, A. (2021). Nitrogen Dynamics in Wetland Systems and Its Impact on Biodiversity. Nitrogen 2021, 2, 196–217.

de Vries, W., Erisman, , L. (2011). Nitrogen as a threat to European terrestrial biodiversity. The European nitrogen assessment: sources, effects and policy perspectives, 436-494.

de Vries, W., Du, E., & Butterbach-Bahl, K. (2014). Short and long-term impacts of nitrogen deposition on carbon sequestration by forest ecosystems. Current Opinion in Environmental

de Vries, W., & Schulte-Uebbing, L. (2019). Impacts of nitrogen deposition on forest ecosystem services and biodiversity. Atlas of ecosystem services: drivers, risks, and societal responses, 183-

Walter, C. A., Raiff, D. T., Burnham, M. B., Gilliam, F. S., Adams, M. B., & Peterjohn, W. T. (2016). Nitrogen fertilization interacts with light to increase Rubus spp. cover in a temperate forest. *Plant*

Wan, S., Hui, D., and Y. Luo. 2001. Fire effects on nitrogen pools and dynamics in terrestrial ecosystems: A meta-analysis. Ecological Applications, Vol. 11, No. 5.

Wang, X., McConkey, B. G., VandenBygaart, A. J., Fan, J., Iwaasa, A., & Schellenberg, M. (2016). Grazing improves C and N cycling in the Northern Great Plains: a meta-analysis. Scientific

Wasan, J. P. M., Pyle, L. A., & Bennett, J. A. (2023). Disturbance and nutrient availability drive absinthe (Artemisia absinthium) invasion in a native rough fescue grassland. Ecoscience, 1-12.

Wedin, D. A., & Tilman, D. (1990). Species effects on nitrogen cycling: a test with perennial grasses. Oecologia, 84(4), 433-441. Nitrogen

Wedin, D. A., & Tilman, D. (1996). Influence of nitrogen loading and species composition on the carbon balance of grasslands. Science, 274(5293), 1720-1723. Nitrogen

Whittaker, R. H., Likens, G. E., Bormann, F. H., Easton, J. S., & Siccama, T. G. (1979). The Hubbard Brook ecosystem study: forest nutrient cycling and element behavior. Ecology, 60(1), 203-220.

Wilkins, K., Clark, C., & Aherne, J. (2022). Ecological thresholds under atmospheric nitrogen deposition for 1200 herbaceous species and 24 communities across the United States. Global change

Yan, L., Zhang, S., Lin, D., Guo, C., Yan, L., Wang, S., & He, Z. (2018). Nitrogen loading affects microbes, nitrifiers and denitrifiers attached to submerged macrophyte in constructed wetlands.

Kercher, S. M. and Zedler, J. B. 2004. Multiple disturbances accelerate invasion of reed canary grass (Phalaris arundinacea L.) in a mesocosm study. Oecologia 138: 455–464.

Xu, H., Paerl, H. W., Qin, B., Zhu, G., & Gaoa, G. (2010). Nitrogen and phosphorus inputs control phytoplankton growth in eutrophic Lake Taihu, China. Limnology and oceanography, 55(1), 420-

Models

Figure 1a. *Anatomy* of Catastrophic Regime Shift (CRS) / State Transition Model: CRS models provide a powerful tool for identifying drivers of declines in ecosystem integrity and providing insight for restoration of critical processes to achieve high quality, native, functional and self-reinforcing ecosystem that are provisional of ecosystem services. See, (Scheffer 2001, 2003, Carpenter 2006, 2008, 2011, Folke 2004, Biggs 2009, Davis 2010, Archibald 2012, Ratajczak 2014, Conversi, 2015, 2019, Luvuno 2018, Wang 2018).

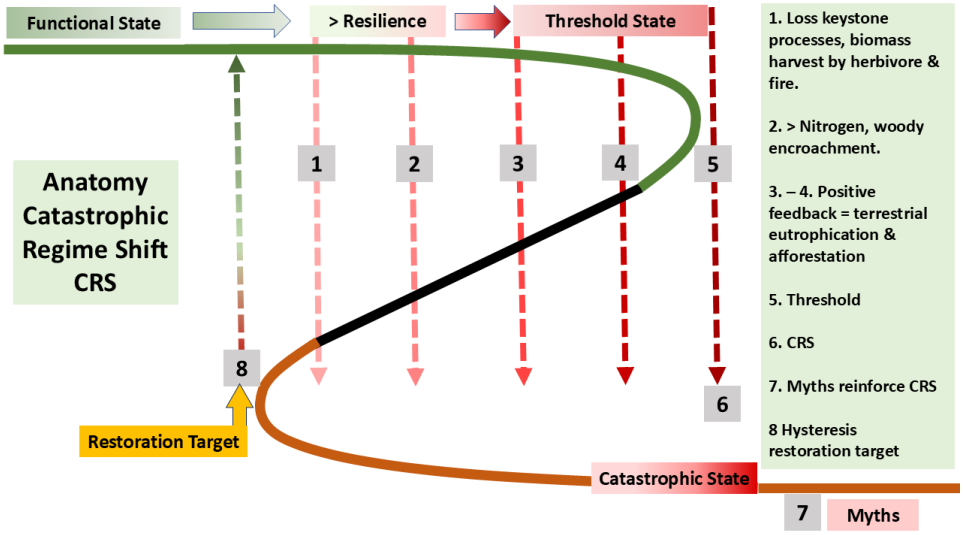

Figure 1b. *Simulation* of Catastrophic Regime Shift (CRS) / State Transition Model:

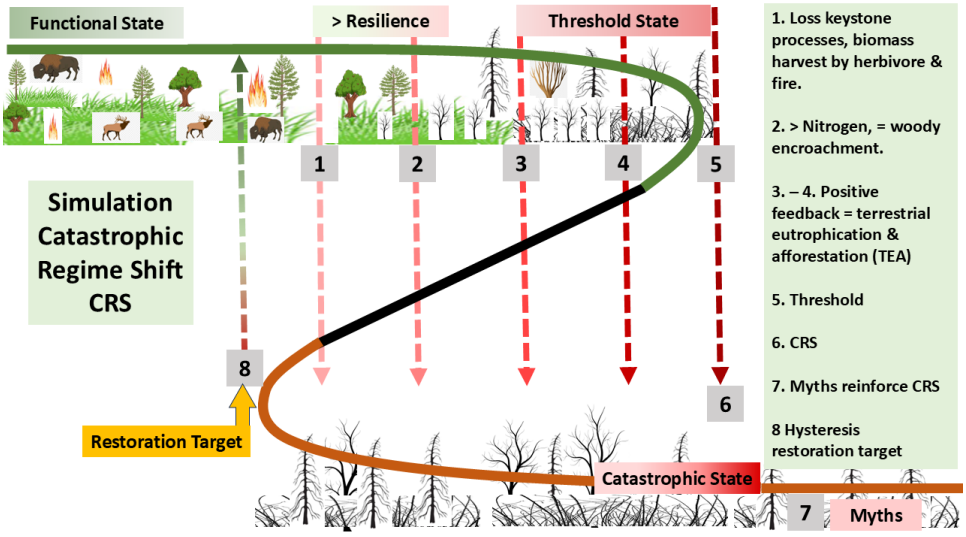

Figure 2a. Terrestrial Eutrophication and Afforestation (TEA) Model for Hardwood Savanna Ecosystems: TEA is a positive feedback loop that emerges once a threshold is exceeded. Positive feedback loops are nonlinear properties that rapidly cascade highly evolved functional ecosystems into catastrophic dysfunctional ecosystems (Figures 1a. – 1c). Loss of keystone processes (LKP) causes the collapse of foodwebs that in turn collapses nutrient cycles. Collapsed nutrient cycles cause soil eutrophication, in particular, by nitrogen. In turn, nitrogen favors faster-taller, weedier plants (nitrophytes / r-strategist). Faster-taller herbaceous plants are soon subsumed by weedy woody species. In turn, weedy woody species store nutrients above ground in non-edible, labile structures that rapidly decompose nutrients to feed nitrophilic propagules. Soon, faster-taller trees and shrubs out-compete K-strategist for sunlight. The dying opens niches spaces and releases nutrients that finalize the nitrophilic take-over. Soon, state dynamics (energy flows and nutrient cycles) are controlled by nitrophiles that reinforce eutrophic, toxic, dysfunctional conditions that erode ecological capital. Soils erode, banks slough, and nutrients spew, all pulled by gravity downward through watersheds and terminally depositing into the aquatic, and the devastation continues. The TEA model is analogous to aquatic eutrophication and represents a classic CRS example. The TEA model is also directly responsible for aquatic eutrophication.

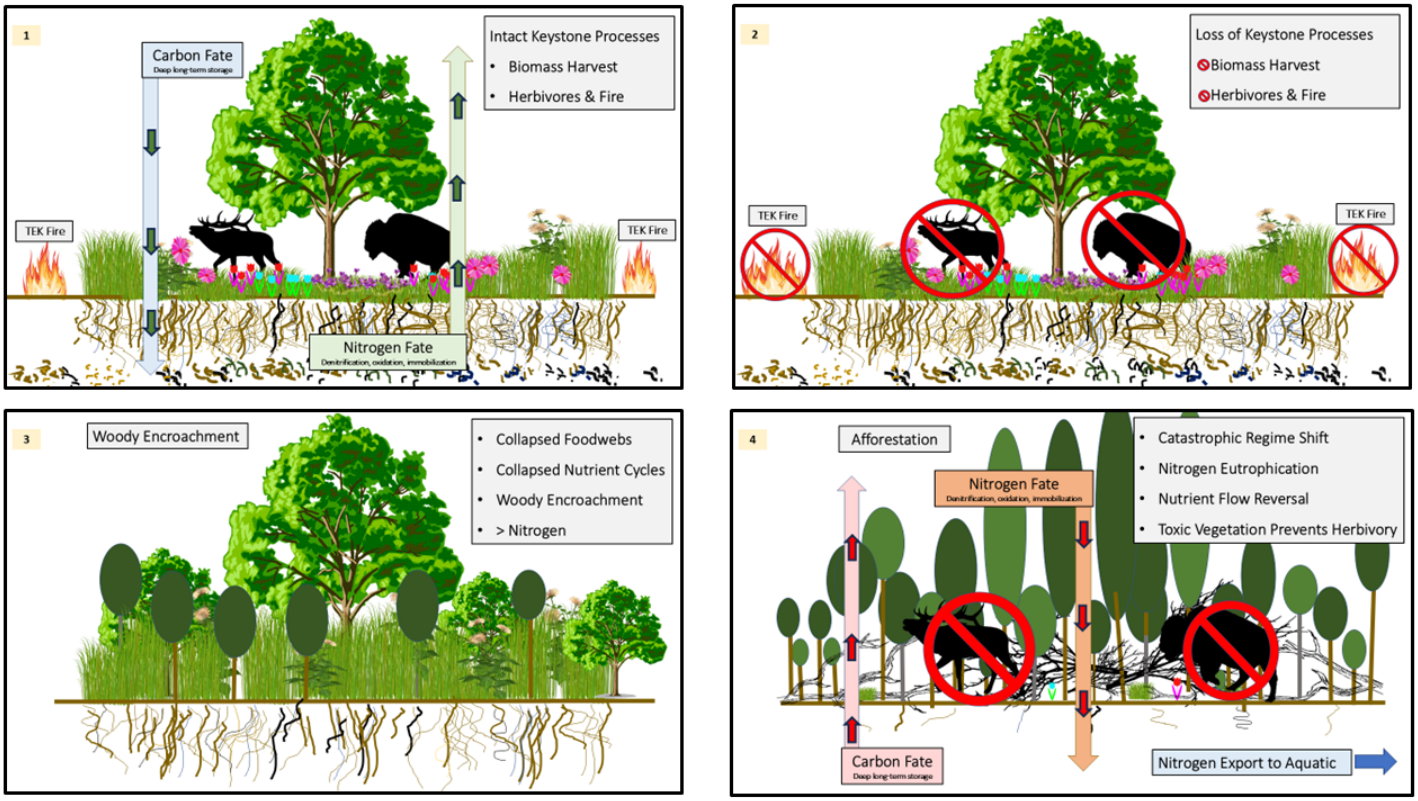

Figure 2b. Terrestrial Eutrophication and Afforestation (TEA) Model for Northern Mixed Coniferous Deciduous Savanna Ecosystems: