

## Five Causal Factors: A General Framework for Wetland Science and Restoration

*abstract of talk presented by Dr. Paul Keddy to open the annual meeting of the Society of Wetland Scientists in Denver, Colorado, 30 May 2018. The theme of the meeting was “Wetland Science: Integrating Research, Practice and Policy - An Exchange of Expertise.”*

*Note: this talk was video-recorded and will be posted online soon.*

In the last century, lack of information limited our understanding of wetlands, and made restoration difficult. We are now drowning in information. Wetland ecology urgently needs some general rules to guide research, protection and restoration.

Consider that physicists can predict future states of the universe using only four forces! What would wetland ecology look of we took this approach?

We cannot hope for general rules based upon species, for example, because there are too many of them (ca. 125,000 species in wetlands). Nor are ecological regions suitable (ca. 867 ecoregions). What is to be done?

I will suggest that our general rules, like the forces in physics, arise out of recurring causal factors. These causal factors determine the biological properties of each wetland (e.g, species composition, rates of decomposition, primary productivity). Three causal factors may be quite sufficient for many purposes. (1) Hydrology is (of course!) the first factor, with particular emphasis upon duration of flood pulses. (2) Nutrients, particularly N and P, then modify the patterns set by flooding, and can cause significant shifts in species composition and rates of decomposition. (3) Natural disturbances such as fire and herbivory then modify the patterns further. These three forces occur in all wetlands, be they peat bogs, mangrove swamps or freshwater marshes.

Every wetland also has local causal factors. Near the coast, salinity is important. Near cities, road networks are important. But these local factors are usually superimposed upon the patterns determined by the preceding general factors.

I will briefly introduce each factor, and share examples that illustrate how these can unify our science and guide our management. Human populations are now changing all three of these forces simultaneously in specific directions, so we may also use them to forecast certain expected changes in the world's wetlands and floodplains in the coming century.