Vegetated Stream Riparian Zones: Their Effects on Stream Nutrients, Sediments, and Toxic Substances

An Annotated and Indexed Bibliography of the world literature,

including buffer strips and interactions with hyporheic zones and floodplains

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Introduction

The goal of this document is to comprehensively cite and subject index the World literature on vegetated stream riparian zone water quality effects. The scope of the bibliography has been expanded to include literature on hyporheic zone and floodplain/stream channel interactions. Buffer strip research is also included, since these studies seem easily transferable. Unless denoted by an asterisk, each citation has been obtained, studied for content, and cross-indexed for other relevant citations. Only publications which were readily obtained through a research library system were included. Publications on tidaly-influenced wetlands and exclusively lake riparian zones were excluded.

In order to make this goal tenable I have established somewhat arbitrary, but fairly rigid boundaries for relevant subject matter. Studies of all types of vegetation were included; forest, grass, herbaceous. Relevant studies include influences on water quality of inputs of surface and groundwater from the uplands and interactive effects among the water in the channel, the hyporheic zone, and the floodplain. Water quality includes concentrations of nutrients, suspended sediments, dissolved and particulate organic matter, pH, metals, and pesticides of all types. Studies of large woody debris are specifically excluded. Also excluded are studies of the application of municipal sewage and industrial/mining effluent to riparian zones. However, studies were included of effects on agricultural wastewater and a limited number of studies on urban or suburban drainage waters. I have excluded riparian vegetation habitat effects, both terrestrial and aquatic, and in-stream processes such as productivity, nutrient cycling/spiraling, water temperature, and channel morphology.

All citations except for those of student theses have brief annotations to help identify the aspects of these studies, which are particularly relevant. They are also coded for subject matter as listed below.

- **Document Type**
  - D = Contains New Research Data
  - M = Management Oriented
  - R = Review of Relevant Publications
- **Vegetation Type in Riparian Zone**
  - F = Forest
  - G = Grass
  - H = Herbaceous
- **Stream Order, e.g. 1st order, 2nd order**
- **Hydrologic Parameters**
  - GW = Groundwater
  - HZ = Hyporheic Zone Interactions
  - OF = Overland Storm Flows
  - TS = Hydrologic Tracers Utilized
- **Geology of Study Site**
  - CP = Coastal Plain Province
  - PT = Piedmont Province
  - MT = Mountain Provinces
- **Water Quality Parameters**
  - Al = Aluminum
  - Ca = Calcium
  - DAM = Dissolved Ammonium
  - DOM = Dissolved Organic Matter
  - DPP = Dissolved Phosphate Phosphorus
  - DTKN = Dissolved Total Kjeldahl Nitrogen
  - DTP = Dissolved Total Phosphorus
  - Fe = Iron
  - HERB = Herbicides
  - INS = Insecticides
  - K = Potassium
  - Mg = Magnesium
  - Mn = Manganese
  - Na = Sodium
  - NIT = Nitrate & Nitrite
  - PAM = Particulate Ammonium
  - pH = pH
  - POM = Particulate Organic Matter
  - PPP = Particulate Phosphate Phosphorus
  - PTN = Particulate Total Nitrogen
  - PTP = Particulate Total Phosphorus
  - PTKN = Particulate Total Kjeldahl Nitrogen

- TN = Total Nitrogen
- TP = Total Phosphorus
- TrM = Trace Metals
- TSS = Total Suspended Sediments

- **Riparian Processes**
  - BioStor = Storage in Biomass of Riparian Zone
  - Denit-F = Denitrification Measurements in the Field
  - Denit-L = Denitrification or Denitrification Potential Measurements in the Laboratory
  - Nitrif = Nitrification Measurements
  - ET = Evapotranspiration in Riparian Zone
  - Flux = Flux Rates Measured Through Riparian Zone
  - Infil = Infiltration in Riparian Zone
  - MBal = Mass Balance of Movement Through Riparian Zone
  - NutCyc = Special Effects of Nutrient Cycling Within Riparian Zone
  - SedTrap = Sediment Trapping Rates Within Riparian Zone

While these subject codes are not comprehensive, they cover many of the topics relevant to this bibliography. The materials in this bibliography will be maintained in an MS Word computer file, which can be searched for individual or combinations of factors for special interests of users. Obviously, it can also be updated periodically. I hope it will be a useful research and management tool for everyone interested in this topic. You should feel free to download this complete file onto your PC and proceed to conduct your own subject searches. If you are aware of relevant literature not included in this edition, please send a copy to me or E-mail the citation (dcorrell@tampabay.rr.com).

References

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L; G

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of soils throughout a riparian buffer. **D; GW**

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68. **Bormann, F.H., G.E. Likens and J.S. Eaton (1969)** Biotic regulation of particulate and solution losses from a forest ecosystem. Bioscience 19:600-610. Forested Watershed Completely Clear Cut and Herbicide Used to Prevent Regrowth. Most complete report on losses of cations, nutrients, sediments, aluminum, dissolved and particulate organic matter, silicate. **D; F; 1st order; MT; GW; TSS; POM; NIT**

69. **Bormann, F.H., G.E. Likens, D.W. Fisher and R.S. Pierce (1968)** Nutrient loss accelerated by clear-cutting of a forest ecosystem. Science 159:882-884. Forested Watershed was Completely Clear Cut and Herbicide was used to Prevent Regrowth. **D; F; 1st order; MT; GW; NIT; Nitrif; MBAL**

70. **Bott, T.L., J.T. Brock, C.S. Dunn, R.J. Naiman, R.W. Ovink and R.C. Petersen (1985)** Benthic community metabolism in four temperate stream systems: An inter-biome comparison and evaluation of the river continuum concept. Hydrobiol. 123:3-45. Compared net primary production and respiration of a series of 16 streams in four different geographic regions of the US. **D; HZ**

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73. **Boulton, A.J. (1993)** Stream ecology and surface-hyporheic hydrologic exchange:implications, techniques and limitations. Aust. J. Mar. Freshwater Res. 44:553-564. A detailed review of the literature on stream channel water - hyporheic zone exchange. **R; HZ**

74. **Boulton, J.A., S. Findlay, P. Marmonier, E.H. Stanley and H.M. Valett (1998)** The functional

significance of the hyporheic zone in streams and rivers. Annu. Rev. Ecol. Syst. 29: 59-81. A broad review. **R; HZ**

75. **Bourg, A.C.M., D. Darmendrail and J. Ricour (1989)** Geochemical filtration of riverbank and migration of heavy metals between the Deule River and the Ansereuilles Alluvion--chalk aquifer (Nord, France). Geoderma 44:229-244. Measured Changes in Concentration of Dissolved Constituents as Water Passed from the River Channel Through the Bank to Pumping Stations. **D; GW; TrM; Mn; Fe**

76. **Bourg, A.C.M. and C. Bertin (1993)** Biogeochemical processes during the infiltration of river water into an alluvial aquifer. Environ. Sci. Technol. 27:661-666. Measured changes in composition of river water as it infiltrated the bank and floodplain of the Lot River, a tributary of the Garrone in France. Used natural differences in chloride as a tracer. **D, GW, DOM, K, Na, TS, NIT, Mn, Ca, Mg, TrM,**

77. **Bowden, W.B. (1987)** The biogeochemistry of nitrogen in freshwater wetlands. Biogeochemistry 4 (3):313-348. A General Review of all Types of Freshwater Wetlands. **R; NutCyc**

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79. **Brandes, J.A., M.E. McClain and T.P. Pimentel (1996)** 15N evidence for the origin and cycling of inorganic nitrogen in a small Amazonian catchment. Biogeochemistry 34(1):45-56. Measured patterns of N-15 content in stream channel water, riparian zone groundwater, and upland groundwater of a small forest watershed in Amazonas, Brazil. Also measured N-15 content of leaf nitrogen on watershed uplands and riparian zone. **D; F; GW; DON; NIT; DAM**

80. **Braskerud, B.C. (2002)** Factors affecting phosphorus retention in small constructed wetlands treating agricultural non-point source pollution. Ecol. Engin. 19:41-61. Studied sediment and phosphorus retention in four constructed wetlands on first order streams in Norway for a number of years. **D, H, 1st order, PTP, TSS, Mbal, Sed Trap**

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83. **Bren, L.J. (1995)** Aspects of the geometry of riparian buffers strips and its significance to forestry

operations. Forest Ecol. Manage. 75(1-3):1-10. GIS and fractal analyses of a basin in SE Victoria, Australia. Examined effects of protecting forest buffers of various widths along the stream network. **D; F; 4th order; MT**

84**. Bren, L.J. (1998)** The geometry of a constant buffer-loading design method for humid watersheds. For. Ecol. Manage. 110(1-3):113-125. Used topography of a watershed to define variable buffer widths based upon equal loading (equal contibuting watershed area per buffer area). **D; F; MT**

85. **Bretschko, G. and H. Moser (1993)** Transport and retention of matter in riparian ecotones. Hydrobiologia 251:95-101. Measured vertical and lateral inputs to the channel from vegetation and overland flows in shaded and open reaches of a stream in the Alps. **D; 2nd order; TP; TN; POM**

86. **Bridgham, S.D., C.A. Johnston, J.P. Schubauer-Berigan and P. Weishampel (2001)** Phosphorus sorption dynamics in soils and coupling with surface and pore water in riverine wetlands. Soil Sci. Soc. Am. J. 65:577-588. Analyzed 12 soil samples from MN and WI for phosphorus sorption isotherms and correlations between phosphorus concentrations and other soil composition factors. **D, H, Al, DPP, Fe, pH**

87. **Briggs, S.V. and M.T. Maher (1983)** Litter fall and leaf decomposition in a river red gum (Eucalyptus camaidulensis) swamp. Aust. J. Bot. 33:307-316. Directly Measured Vertical Litter Inputs to a Eucalyptus Swamp Forest. Also Measured Composition of the Litter. **D; F; POM; Ca; PTKN; PPP; Mg; K**

88. **Brinson, M.M. (1993)** Changes in the functioning of wetlands along environmental gradients. Wetlands 13(2):65-74. A Broad Review Comparing the Functions of Various Types of Wetlands. **R**

89. **Brinson, M.M., H.D. Bradshaw and R.N. Holmes (1983)** Significance of floodplain sediments in nutrient exchange between a stream and its floodplain. Pp. 223-245, In: Dynamics of Lotic Ecosystems, T.D. Fontaine and S.M. Bartell (Eds.). Ann Arbor, MI: Ann Arbor Science. Monitored Dissolved Nitrogen and Phosphorus in River Channel, Floodwaters over Floodplain, and in Floodplain Soil Pore Waters. Also Conducted Experimental Nutrient Enrichments of Floodwaters with Dissolved Inorganic Nitrogen and Phosphorus and Used N-15 and P-32 Isotopic Tracers. Inferred Nutrient Fluxes and Cycling. **D; F; CP; NIT; DAM; DPP; NutCyc**

90. **Brinson, M.M., H.D. Bradshaw and E.S. Kane (1984)** Nutrient assimilative capacity of an alluvial floodplain swamp. J. Appl. Ecol. 21(3):1041-1057. Experimental Field Nitrogen and Phosphorus Enrichment. Overall Nutrient Dynamics Measured. **D; F; CP; DAM; NIT; DPP; BioStor; NutCyc**

91. **Brown, G.W., A.R. Gahler and R.B. Marston (1973)** Nutrient losses after clearcut logging and slash burning in the Oregon Coast Range. Water Resources Res. 9:1450-1453. Measured Nutrients and Sediments Released From 3 Forested Watersheds for 2 Years Prior and 2 Years After Clear Cutting One, Partially Cutting One, and Leaving One as a Control. **D; F; MT; NIT; TSS; K; DTP**

92. **Brueske, C.C. and G.W. Barrett (1994)** Effects of vegetation and hydrologic load on sedimentation patterns in experimental wetland ecosystems. Ecol. Eng. 3:429-447. Used sediment traps to measure gross sedimentation rates in artificial riparian wetlands with high and low hydraulic loading rates. **D; H; OF; TSS; TS; SedTrap**

93. **Brugger, A., B. Wett, I. Kolar, B. Reitner and G.J. Herndl (2001)** Immobilization and bacterial utilization of dissolved organic carbon entering the riparian zone of the alpine Enns River, Austria. Aquatic Microbial Ecol. 24:129-142. Sampled DOC, bacterial populations and growth rates in bank sediments for a one year period at four sites. **D, HZ, MT, DOM, POM**

94. **Brunet, R.C. and F. Gazelle (1995)** Alternance des phenomenes d'erosion et de retention de la matiere dans la zone inondable de l'Adour au cours d'une saison hydrologique. Acta Ecologica 16 (3):331-349. A one-year study of a 25 km reach of the Adour River in southern France. **D; F; TSS; SedTrap**

95. **Brunet, R.C., G. Pinay, F. Gazelle and L. Roques (1994)** Role of the floodplain and riparian zone in suspended matter and nitrogen retention in the Adour River, south-west France. Regulated Rivers; Research & Management. 9:55-63. Studied Changes in Particulate Concentrations as Floodwaters Moved into Floodplain. Also Used Sediment Traps. **D; F; 7th order; TSS; PTN; NIT; DAM; Flux**

96. **Brunke, M. and T. Gonser (1997)** The ecological significance of exchange processes between rivers and groundwater. Freshwater Biol. 37:1-33. A wide-ranging review. **R; HZ, GW**

97. **Brusch, W. and B. Nilsson (1993)** Nitrate transformation and water movement in a wetland area. Hydrobiologia 251:103-111. Measured mass balances of water, nitrate, phosphate, and iron along a transect through an herbaceous riparian zone for two years in Denmark. **D; OF; GW; NIT; DPP; Fe; H; MBal; ET; TS; Denit-L**

98. **Buchanan, D.B. (1982)** Transport and Deposition of Sediment in Old Woman Creek, Erie County, Ohio. M.Sc. Thesis. Comumbus, OH: Ohio State Univ., pp. 198 pp.

99. **Budd, W.W., P.L. Cohen, P.R. Saunders and F.R. Steiner (1987)** Stream corrider management in the Pacific Northwest: I. Determination of stream-corridor widths. Environ. Manage. 11(5):587-597. A very general review of the environmental benefits of riparian corridors along streams and a case study of the determination of desired riparian buffer widths in the Bear-Evans Creek watershed. **R; F**

100. **Buffington, D.E. (1994)** Nitrous Oxide Dynamics and Denitrification in Four North Carolina Riparian Systems. M.S. Thesis. Raleigh, NC: North Carolina State University. Denit **D; G; F; GW; NIT; -L**

101. **Bunn, S.E. (1986)** Origin and fate of organic matter in Australian upland streams. Pp. 277-291, In:

Limnology of Australia, P. Dedekker and W.D. Williams (Eds.). A Review of Sources, Processing, and Fates of Organic Matter in Streams, Especially Australian Streams. **R**

102. **Burke, M.K., G. Lockaby and W.H. Conner (1999)** Aboveground production and nutrient circulation along a flooding gradient in a South Carolina Coastal Plain forest. Can. J. For. Res. 29 (9):1402-1418. Studied effects of flood frequency on soil nutrient dynamics and forest productivity on the Chehaw River. **D, F, GW, CP, PAM, NIT, Ca, Mg, PPP, POM, K, Mn, pH, BioStor**

103. **Burns, D.A. and M.L. Nguyen (2002) *** Nitrate movement and removal along a shallow groundwater flow path in a riparian wetland within a sheep-grazed pastoral catchment: results of a tracer study. N.Z.J. Mar. Freshwater Res. 36:371-385. **D, GW, TS, NIT**

104. **Burt, T.P. (1997)** The hydrological role of floodplains within the drainage basin system. Pp. 21-32, In: Buffer Zones: Their Processes and Potential in Water Protection, N. Haycock, T. Burt, K. Goulding and G. Pinay (Eds.). Harpenden, U.K.: Quest Environmental. A broad review of the hydrological interactions among the stream channel, flood plain, riparian zone, and adjacent uplands. **R; GW; OF**

105. **Burt, T.P. (2002)** Hydrological processes in riparian buffer zones. Pp. 1-11 **In:** R. Hatano, U. Mander, Y. Hayakawa, V. Kuusemets, Y. Watanabe and K. Kanazawa (eds.), Efficiency of Purification Processes in Riparian Buffer Zones, Their Design and Planning in Agricultural Watersheds, Natl. Agric. Res. Center Hokkaido Region, Kushiro, Japan. A broad review with examples from field studies in Europe. **R**

106. **Burt, T.P., L.S. Matchett, K.W. Goulding, C.P. Webster and N.E. Haycock (1999)** Denitrification in riparian buffer zones: the role of floodplain hydrology. Hydrol. Proc. 13:1451-1463. Studied the concentration of nitrate in groundwater as it moved from uplands across a floodplain to a river channel in England. Studied the flow paths of the groundwater. **D, G, GW, NIT, Denit-L**

107. **Butturini, A. and F. Sabater (1999) *** Importance of tranient storage zones for ammonium and phosphate retention in a sandy-bottom Mediterranean stream. Freshwater Biol. 41:593-603. **D, HZ, DAM, DPP**

108. **Cambell, I.C. and T.J. Doeg (1989)** Impact of timber harvesting and production on streams: a review. Australian J. Mar. Freshwater Res. 40:519-539. A review of the effects of forest harvesting on stream water quality. Not specific for riparian forest harvesting. **R; F**

109. **Cambell, I.C. and L. Fuchshuber (1994)** Amount, composition and seasonality of terrestrial litter accession to an Australian cool temperate rainforest stream. Arch. Hydrobiol. 130(4):499-512. Directly Measured Vertical Litter Inputs to a Stream Channel from a Forested Watershed. **D; F; POM; 2nd Order**

110**. Cambell, I.C., K.R. James, B.T. Hart and A. Devereaux (1992)** Allochthonous coarse particulate organic material in forest and pasture reaches of two south-eastern Australian streams. I. Litter accession. Freshwater Biology 27:341-352. Measured Vertical and Lateral Litter Inputs to Stream Channels. **D; F; G; POM; 3rd Order; 4th Order**

111. **Carbiener, R. and M. Tremolieres (1990)** The Rhine rift valley groundwater-river interactions: Evolution of their susceptibility to pollution. Regulated Rivers: Research & Management. 5:375-389. A Review of 20 Years of Research on Interactions Between the Rhine River Channel and its FloodPlain and Shallow Groundwaters. Includes Data on Nutrients, Toxic Metals, and Chlorinated Hydrocarbons. **R; TrM; INS**

112. **Carignan, R. and J.J. Neiff (1992)** Nutrient dynamics in the floodplain ponds of the Parana River (Argentina) dominated by the water hyacinth Eichhornia crassipes. Biogeochem. 17:85-121. Measured DIN and SRP dynamics and nitrogen fixation on floodplain. **D; DAM; NIT; DPP; BioStor; NutCyc**

113. **Carlyle, G.C. and A.R. Hill (2001)** Groundwater phosphate dynamics in a river riparian zone: effects of hydrologic flowpaths, lithology and redox chemistry. J. Hydrol. 247:151-168. Measured concentrations of dissolved phosphate, iron, and oxygen in groundwaters traversing a floodplain to a river in Ontario. Found phosphate concentrations were negatively correlated with DO and positively with Fe. **D, F, GW, DPP, Fe**

114. **Casey, R.E. and S.J. Klaine (2001)** Nutrient attenuation by a riparian wetland during natural and artificial runoff events. J. Environ. Qual. 30:1720-1731. Studied storm and simulated storm discharges from a golf course in South Carolina through a forested sandy wetland. Measured fluxes into and out of the wetland, also groundwater chemistry along a transect through the wetland. All storm waters became groundwater within the wetland. **D, F, GW, TS, CP, NIT, DPP, Flux**

115. **Casey, R.E., M.D. Taylor and S.J. Klaine (2001)** Mechanisms of nutrient attenuation in a subsurface flow riparian wetland. J. Environ. Qual. 30:1732-1737. Measured denitrification potentials and phosphate binding isotherms in a wetland that received storm discharges from a golf course in South Carolina. **D, F, GW, CP, DPP, NIT, Denit-L**

116. **Castelle, A.J., A.W. Johnson and C. Conolly (1994)** Wetland and stream buffer size requirements - A review. J. Environ. Qual. 23:878-882. A General Review of the width of Buffer Required for Various Functions. **R**

117. **Castro, N.M. and G.M. Hornberger (1991)** Surface-subsurface water interactions in an alluviated mountain stream channel. Water Resourc. Res. 27(7):1613-1621. A hydrological study of the interactions between the channel water and hyporheic waters. **D; HZ; MT; TS**

118. **Cey, E.E., D.L. Rudolph, R. Aravena and G. Parkin (1999)** Role of the riparian zone in controlling the distribution and fate of agricultural nitrogen near a small stream in southern Ontario. J. Contam. Hydrol. 37:45-67. Measured composition of groundwater as it moved from a cropland through

a grassed riparian zone to a stream. Used N-15 and O-18 measurements of nitrate to infer denitrification and changes in chloride to measure dilution of shallow groundwater with deeper groundwater within the riparian zone. **D, G, GW, TS, NIT**

119. **Chafiq, M., J. Gibert and C. Claret (1999)** Interactions among sediments, organic matter, and microbial activity in the hyporheic zone of an intermittent spring-fed stream on the floodplain of the Garrone River in France. Can. J. Fish. Aquat. Sci. 56:487-495. Examined bottom sediment composition and microbial activity in an intermittent, first-order stream at five points along the stream. **D, F, HZ, DOM, POM**

120. **Chapra, S.C. and R.L. Runkel (1999)** Modeling impact of storage zones on stream dissolved oxygen. J. Environ. Engin. (May), 415-419. Modified an existing model to account for hyporheic zone interactions. **D, HZ**

121. **Chaubey, I., D.R. Edwards, T.C. Daniel, P.A. Moore Jr. and D.J. Nichols (1994)** Effectiveness of vegetative filter strips in retaining surface-applied swine manure constituents. Trans. Am. Soc. Agric. Engin. 37:845-850. Used a rainfall simulator to study transport of nutrients and fecal coliforms through filter strips of various widths. **D; G; OF; DAM; PAM; DPP; POM; PTKN; TP; TN; TSS; SedTrap**

122. **Chaubey, I, D.R. Edwards, T.C. Daniel, P.A. Moore Jr. and D.J. Nichols (1995)** Effectiveness of vegetative filter strips in controlling losses of surface-applied poultry litter constituents. Trans. Am. Soc. Agric. Engin. 38(6):1687-1692. Used a rainfall simulator to study effectiveness of various widths of grass filter strips. **D; HZ; G; OF; TSS; NIT; POM; DOM; TKN; TP; DPP; DAM**

123. **Chauvet, E. and H. Decamps (1989)** Lateral interactions in a fluvial landscape: the river Garonne, France. J. N. Am. Benthol. Soc. 8(1):9-17. Review of the Geomorphology of the Garrone River in France and the Role of the Riparian Forests in Buffering Nitrate in Groundwater and Providing Particulate Organic Matter to the River. **R; F; POM; NIT**

124. **Chauvet, E. and A.M. Jean-Louis (1988)** Production de litiere de la ripisylve de la Garonne et apport au fleuve. Acta Oecologia, Oecologia Generalis 9:265-279. Specifically Measured Timing and Flux of Leaf Litter Inputs From Riparian Forests into Stream Channel. **D; F; POM; Flux**

125. **Chescheir, G.M., J.W. Gilliam, R.W. Skaggs and R.G. Broadhead (1991)** Nutrient and sediment removal in forested wetlands receiving pumped agricultural drainage water. Wetlands 11:87-103. Study of Natural Forested Buffers Receiving Agricultural Wastewater. **D; F; CP; TSS; TN; TP; NIT**

126. **Chescheir, G.M., J.W. Gilliam, R.W. Skaggs, R.G. Broadhead and R. Lea (1987)** The Hydrology and Pollution Removal Effectiveness of Wetland Buffer Areas Receiving Pumped Agricultural Drainage Water. Water Resources Res. Inst. Report Num. 231. Raleigh, NC: Univ. North Carolina, 170 pp. Measured and Modeled Effectiveness of Riparian Forests for Removal of Suspended

Sediments and Nutrients from Pumped Agricultural Drainage Waters. **D; F; CP; OF; TN; TP; TSS; MBal**

127. **Chescheir, G.M., R.W. Skaggs, J.W. Gilliam and R.G. Broadhead (1988)** Hydrology of wetland buffer areas for pumped agricultural drainage water. Pp. 260-274, In: The Ecology and Management of Wetlands, D.D. Hook (Ed.), Portland, OR: Timber Press. Field Data and Hydrologic Model Development for Pumped Agricultural Drainage Flow Through a Forested Riparian Zone. **D; F; CP; OF; GW; Tr**

128. **Chescheir, G.M., R.W. Skaggs, J.W. Gilliam and R.G. Broadhead (1991)** Hydrology of two forested wetlands that receive pumped agricultural drainage water in eastern North Carolina. Wetlands 11(1):29-53. An Engineering and Hydrologic Study of Two Forested Buffers Receiving High Volumes of Pumped Agricultural Drainage Waters. The Same Sites Were Also the Focus of Nutrient and Sediment Dynamic Studies. **D; F; TSS**

129. **Chestnut, T.J. and W.D. McDowell (2000)** C and N dynamics in the riparian and hyporheic zones of a tropical stream, Luquillo Mountains, Puerto Rico. J. N. Am. Benthol. Soc. 19:199-214. Measured mass balances by bromide dilution for dissolved fractions of nitrogen and organic carbon in a 100 m reach of a small stream on a forested watershed. Used shallow wells to examine concentrations in riparian and hyporheic zones. **D, F, GW, HZ, TS, MT, DAM, DOM, NIT, MBal**

130. **Cirmo, C.P. and J.J. McDonnell (1997)** Linking the hydrologic and biogeochemical controls of nitrogen transport in near-stream zones of temperate-forested catchments: a review. J. Hydrol. 199:88-120. A broad review of nitrogen dynamics in the near-stream saturated zone. **R; F; HZ; GW**

131. **Clairain Jr., F.J. and B.A. Kleiss (1989)** Functions and values of bottomland hardwood forests along the Cache River, Arkansas: Implications for management. Pp. 27-33, In: Forested Wetlands of the Southern United States, D. Hook and R. Lea (Eds.). Orlando, FL: USDA Forest Service, SE Exp. Sta. Outline of Plans for Input/Output Study of a River Segment with Extensive Floodplain Forest. **D; F; TSS**

132. **Claret, C. and D. Fontvieille (1997)** Characteristics of biofilm assemblages in two contrasted hydrodynamic and trophic contexts. Microb. Ecol. 34:49-57. Studied biofilms on the bottom of the channel and in interstitial water of gravel bars at two locations on the Rhone River. Measured biomass and activity, protein content of biofilms. **D; HZ; DOM; POM; TSS; NIT**

133**. Claret, C., P. Marmonier, J.-M. Boissier, D. Fontvieille and P. Blanc (1997)** Nutrient transfer between parafluvial interstitial water and river water:influence of gravel bar heterogeneity. Freshwater Biol. 37:657-670. Studied emerging interstitial waters at downstream ends of two gravel bars in the Rhone River. **D; HZ; NIT; DOM**

134. **Claret, C., P. Marmonier and J.-P. Bravard (1998)** Seasonal dynamics of nutrient and biofilm in

interstitial habitats of two contrasting riffles in a regulated large river. Aquat. Sci. 60:33-55. Studied intersititial water as it moved through gravel bars in the Rhone River. Related dissolved oxygen changes to water quality changes. **D; 7th order; HZ; DOM; NIT; Nitrif; Denit-F**

135. **Clary, W.P. (1995)** Vegetation and soil responses to grazing simulation on riparian meadows. J. Range Manage. 48:18-25. Measured effects on species composition and primary production of various intensities of seasonal grazing. **D, H**

136. **Clausen, J.C., K. Guillard, C.M. Sigmund and K. Martin Dors (2000)** Water quality changes from riparian buffer restoration in Connecticut. J. Environ. Qual. 29:1751-1761. Compared two adjacent fields before and after a grassed riparian buffer was established on the lower area of one field. Used piezometers to estimate groundwater flows and sample nitrogen and phosphorus concentrations. Also sampled overland storm flows and measured potential denitrification in soil samples. Measured plant uptake. **D, G, 1st order, GW, OF, DAM, DTKN, DTP, NIT, TSS, TKN, TP, TS, Denit-L, SedTrap, MBal**

137. **Clausen, J.C., K.G. Wayland, K.A. Saldi and K. Guillard (1993)** Movement of nitrogen through an agricultural riparian zone: 1. Field studieds. Water Sci. Tech. 28(3-5):605-612. Studied a riparian site in NE Connecticut that is currently double cropped in corn and winter rye in preparation for a comparison study when part of the site is reforested for 35 m from the stream channel. Sampled overland flows, groundwater along two transects in each of two fields, soil water, precipitation chem. and stream flow and chemistry. Analyzed for hydrol. cond. of soils, dissolved nitrogen species, and chloride. **D; G; GW; OF; DAM; DTKN; NIT; MBal**

138. **Clawson, R.G., B.G. Lockaby and B. Rummer (2001)** Changes in production and nutrient cycling across a wetness gradient within a floodplain forest. Ecosystems 4:126-138. Compared three communities in GA which differed in frequency of innundation. **D, F, OF, POM, PTN, PPP, K, Mg, Ca, BioStor, NutCyc**

139**. Clinnick, P.F. (1985)** Buffer strip management in forest operations: a review. Australian Forestry 48:34-45. A Review of the Use of Riparian Buffers to Control Suspended Sediments. **R**

140. **Clinton, S.M. and R.T. Edwards (2000)** Hyporheic flows in a riparian terrace of a coastal temperate rainforest river. Pp. 173-178 in: Riparian Ecology and Management in Multi-Land Use Watersheds. P.J. Wigington Jr. and R.L. Beschta (Eds.), Amer. Water Resourc. Assoc., Middleburg, VA. Studied flowpaths in hyporheic zone of the Queets River in the Olympic rainforest. **D, F, HZ, MT**

141. **Clinton, S.M., R.T. Edwards and R.J. Naiman (2002)** Forest-river interactions: Influence on hyporheic dissolved organic carbon concentrations in a floodplain terrace. J. Amer. Water Resources Assoc. 38:619-631. Measured patterns of dissolved organic carbon concentration, hydrologic flow paths at low and high flow for a river in Washington. **D, F, GW, HZ, DOM**

142. **Congdon, R.A. (1979)** Litter fall of the paperbark tree (Melaleuca cuticularis) in the marshes of the Blackwood River Estuary, Western Australia. Aust. J. Ecol. 4:411-417. Directly Measured Vertical Litter Inputs and Analyzed Litter for Total N and P. **D; F; POM; PTKN; PTP**

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Moving From Agricultural Fields to Stream along a Transect. Measured Nitrate Concentrations, Eh, and Inferred Denitrification. **D; CP; GW; NIT; DOM; DAM**

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Goulding and G. Pinay (Eds.). Harpenden, UK: Quest Environmental. A review and discussion of various modeling approaches to hydrology and nutrient dynamics of riparian zones. **R; GW; NIT**

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denitrification during infiltration of river water into a sand and gravel aquifer in Saxony, Germany. Water Res. 32:450-460. Studied changes in nitrate concentration and N-15 abundance as Elbe River water infiltrated into the flood plain. Also used a laboratory microcosm system to simulate the effects of the flood plain. **D, GW, NIT, Denit-F, Denit-L, Infil**

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313. **Groffman, P.M., N.J. Boulware, W.C. Zipperer, R.V. Pouyat, L. E. Band and M. F. Colosimo (2002)** Soil nitrogen cycle processes in urban riparian zones. Environ. Sci. Technol. 36:4547-4552. Studied four forested riparian zones in the Baltimore, MD region, one of which was not urbanized and served as a control. Focused on urban caused stream channel incision and its effects on nitrification and denitrification. **D, F, 1st Order, 2nd Order, PT, NIT, Denit-L, Nitrif, NutCyc**

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acetylene block denitrification tests with and without added glucose. Looked for correlations with microbial biomass, root biomass, soil carbon and nitrogen. **NIT; D; F; GW; POM; PTN; BioStor; Denit-L; Nitrif; TS**

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Not Receiving High Nitrate Groundwater Fluxes from Suburban Housing Developments. **D; F; GW; Denit-L; NIT**

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337. **Hayakawa, Y., K. Kanazawa and M. Hojito (2002)** Nutrient retention in grassland buffer strip. Pp. 67-76, In: R. Hatano, U. Mander, Y. Hayakawa, V. Kuusemets, Y. Watanabe and K. Kanazawa (eds.), Efficiency of Purification Processes in Riparian Buffer Zones, Their Design and Planning in Agricultural Watersheds, Natl. Agric. Res. Center Hokkaido Region, Kushiro, Japan. Two fields of cropland were treated with normal and double fertilizer levels. Downslope were areas of grassland and of bare soil. A confining layer was found at a depth of 2 M. Groundwater table and nitrate concentrations were measured monthly for two years. **D, G, GW, NIT**

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(hyporheic zone) beneath a sandy-bed, third-order stream in northern Michigan. Pp. 27-35, In: J.A. Stanford and J.J. Simons (Eds.), Proc. First International Conf. Ground Water Ecology, Amer. Water Resources Assoc., Bethesda, MD. Measured sediment bacterial populations, respiration, and carbon turnover rates in a riffle/pool sequence. **D, HZ, DOM**

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353. **Hendricks, S.P. (1996)** Bacterial biomass, activity, and production within the hyporheic zone of a north-temperate stream. Arch. Hydrobiol. 136(4):467-487. Studied microbial communities at depths of 10 and 50 cm, tested response to added DOC. **D; HZ; 3rd order; DOM**

354. **Hendricks, S.P. and D.S. White (1991)** Physicochemical patterns within a hyporheic zone of a northern Michigan river, with comments on surface water patterns. Can. J. Fish. Aquatic Sci. 48:1645-1654. Mapped interstitial water temperature and composition with depth along a 10 km reach. **D; HZ; F; DOM; DPP; NIT; 3rd order**

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360. **Hickin, E.J. (1984)** Vegetation and river channel dynamics. Canadian Geographer 28(2):111-126. A general review of the effects of riparian vegetation on stream channel morphology and dynamics. **R**

361. **Hill, A.R. (1990)** Ground water flow paths in relation to nitrogen chemistry in the near-stream zone. Hydrobiologia 206(1):39-52. Followed Pathways of Groundwater Through Stream Riparian Zone with Tracers, Sampling Along Transects of Nested Piezometers and Ground Water Wells. **D; F; 2nd order; NIT; DAM; TS; GW**

362. **Hill, A.R. (1990)** Groundwater cation concentrations in the riparian zone of a forested headwater stream. Hydrol. Proc. 4:121-130. Used Tracers to Follow Pathways and Chemistry of Groundwater Through a Stream Riparian Zone. **D; F; GW; 2nd order; TS; Ca; Mg; K**

363. **Hill, A.R. (1991)** A ground water nitrogen budget for a headwater swamp in an area of permanent ground water discharge. Biogeochemistry 14:209-224. Compared Local and Regional Ground Water Inputs and Their N- Content. Also Discharges From the Swamp. Used a Chloride Balance. **D; F; 2nd order; GW; TN; DAM; NIT; DTKN**

364. **Hill, A.R. (1993)** Nitrogen dynamics of storm runoff in the riparian zone of a forested watershed. Biogeochemistry. 20:19-44. Estimated Overland Flow With O-18 as a Tracer and Measured Ammonium and Nitrate in Rain, Throughfall, and Stream. **D; F; OF; 2nd order; DAM; NIT**

365. **Hill, A.R. (1993)** Base Cation Chemistry of Storm Runoff in a Forested Headwater Wetland. Water Resources Res. 29(8):2663-2673. Followed Fluxes of Major Cations Through a Forested Riparian Swamp During Storm Events. **D; F; 2nd order; OF; Ca; Mg; K; Na**

366. **Hill, A.R. (1996)** Nitrate removal in stream riparian zones. J. Environ. Qual. 25:743-755. A very comprehensive review of the fate of nitrate in groundwater entering riparian zones. **R; F; G; GW; NIT**

367. **Hill, A.R. (1997)** The potential role of in-stream and hyporheic environments as buffer zones. Pp. 115-127, In: Buffer Zones: Their Processes and Potential in Water Protection, N. Haycock, T. Burt, KGoulding and G. Pinay (Eds.). Harpenden, UK: Quest Environmental. A review of nutrient processing in stream channels and hyporheic zones. **R; HZ; NIT; DPP**

368. **Hill, A.R. and K.J. Devito (1997)** Hydrologic-chemical interactions in headwater forest wetlands. Pp. 213-230, In: Northern Forested Wetlands: Ecology and Management, C.C. Trettin, M.F. Jurgensen, D.F. Grigal, M.R. Gale and J.K. Jeglum (Eds.). Boca Raton, FL: CRC/Lewis Publ. A review synthesizing a series of previous papers on three forested swamps in Ontario**. R; F; DAM; NIT; DTKN; TN; TP; DPP**

369. **Hill, A.R., K.J. Devito, S. Campagnolo and K. Sanmugadas (2000)** Subsurface denitrification in a forest riparian zone: Interactions between hydrology and supplies of nitrate and organic carbon. Biogeochemistry 51:193-223. Measured concentrations of nitrate and DOC along a plume of nitrate and

manipulated conditions in piezometers by injecting acetylene, glucose and or nitrate. **D, F, GW, DOM, NIT, TS, Denit-F**

370. **Hill, A.R., C.F. Labadia and K. Sanmugadas (1998)** Hyporheic zone hydrology and nitrogen dynamics in relation to the streambed topography of a N-rich stream. Biogeochemstry 42:285-310. Studied a 3rd order stream in Ontario and measured exchanges of water and nutrients between the channel and the sediments. **D, F, 3rd order, HZ, TS, DAM, NIT**

371. **Hill, A.R. and D.J. Lymburner (1998)** Hyporheic zone chemistry and stream-subsurface exchange in two groundwater-fed streams. Can. J. Fish. Aquatic Sci. 55(2):495-506. Measured exchange rates and depths between channel waters and interstitial waters. Used chloride tracer and examined nitrate/ammonium retention with and without added nutrient. **D; F; 2nd order; 3rd order; HZ; DAM; NIT; TS; Denit-F**

372. **Hill, A.R. and M. Shackleton (1989)** Soil N mineralization and nitrification in relation to nitrogen solution chemistry in a small forested watershed. Biogeochemistry 8(2):167-184. On a Completely Forested Watershed, Compared Soil Nitrification Rates, Groundwater Nitrate Concentrations for Upland and Riparian Forest Communities. **D; F; GW; 2nd order; NIT; Nitrif; DAM; BioStor**

373. **Hill, A.R. and J.M. Waddington (1993)** Analysis of storm run-off sources using oxygen-18 in a headwater swamp. Hydrol. Processes 7:305-316. Used a Tracer to Determine Source of Overland Storm Flows in a Forested Swamp. **D; F; 2nd order; OF; TS**

374. **Hill, A.R. and J. Warwick (1987)** Ammonium transformations in springwater within the riparian zone of a small woodland stream. Can. J. Fish. Aquat. Sci. 44(11):1948-1956. Spring water was Experimentaly Enriched with Dissolved Ammonium, Then Allowed to Flow Through a Stream Riparian Forest into the Channel. Rates of Ammonification and Nitrification were Measured. **D; F; 2nd order; NIT; DAM; Nitrif**

375. **Hillbricht-Ilkowska, A. (1993)** Temperate freshwater ecotones: Problem with seasonal instability. Pp. 17-34, In: Wetlands and Ecotones, B. Gopal, A. Hillbricht-Ilkowska and R.G. Wetzel (Eds.). New Delhi: National Institute of Ecology. A review containing some conceptualizations of riparian zones. **R**

376. **Hillbricht-Ilkowska, A. (1995)** Managing ecotones for nutrients and water. Ecology International 22:73-93. A general review of ecotones including riparian ecotones. **R**

377. **Hinkle, S.R., J.H. Duff, F.J. Triska, A. Laenen, E.B. Gates, K.E. Bencala, D.A. Wentz and S. R. Silva (2001)** Linking hyporheic flow and nitrogen cycling near the Willamette River ï¿½ a large river in Oregon, USA. J. Hydrol. 244:157-180. Used isotopic tracers and chloride and nitrate concentrations along with discharges and pressure gradients to determine volumes and directions of exchange between the channel and hyporheic zone. Also measured potential denitrification. **D, F, GW, HZ, TS, 9th Order, NIT, Denit-L, Flux, MBal**

378. **Hoffmann, C.C., M. Mbai, G. Blicher-Mathiesen and C. Paludan** (In Press) Studies of hydrological and biogeochemical processes in a freshwater wetland, 19 pp. All forms of dissolved nitrogen were followed in shallow groundwater as it moved accross a fen and into a stream channel. Mass balances were calculated. **D; GW; H; NIT; DAM; DTKN; DPP; MBal; Fe; pH**

379. **Holland, M.M., D.F. Whigham and B. Gopal (1990)** The characteristics of wetland ecotones. Pp. 171-198, In: The Ecology and Management of Aquatic-Terrestrial Ecotones, R.J. Naiman and H. DeCamps (Eds.). Paris: UNESCO. A General Review of the Ecology of Upland/Wetland Riparian Zones. **R**

380. **Holmes, R.M., S.G. Fisher and N.B. Grimm (1994)** Parafluvial nitrogen dynamics in a desert stream ecosystem. J. N. Am. Benthol. Soc. 13(4):468-478. Measured changes in dissolved inorganic nitrogen as stream waters and shallow groundwaters interacted along the bank of a desert stream**. D; GW; HZ; TS; NIT; DAM; Nitrif**

381. **Holmes, R.M., S.G. Fisher and N.B. Grimm (1994)** Nitrogen dynamics along prafluvial flowpaths: importance to the stream ecosystem. Pp. 47-56, In: Proc. Second Internatl. Conf. Groundwater Ecology, J.A. Stanford and H.M. Valett (Eds.). Bethesda, MD: Amer. Water Resources Assoc. Measured nitrate concentrations in inflowing and outflowing waters of gravel bars in Sycamore Creek, Arizona. **D; NIT; Nitrif**

382. **Hopmans, P., D.W. Flinn and P.W. Farrell (1987)** Nutrient dynamics of forested catchments in southeastern Australia and changes in water quality and nutrient exports following clearing. Forest Ecol. Manage. 20:209-231. Three forested watersheds in Australia were studied for six years. Inputs of wet deposition and outputs at V-notch weirs (weekly samples) were measured for four years, then one watershed was cleared and burned except for a 30 meter buffer zone. All three watersheds were in native Eucalypt forest, but the cleared one was replanted in Pinus radiata. **D; F; TSS; pH; Na; K; Ca; Mg; MBal**

383. **Howard-Williams, C. (1991)** Dynamic processes in New Zealand land-water ecotones. New Zealand J. Ecol. 15:87-98. A General Review of New Zealand Studies of Stream Riparian Ecotones Including Nutrient and Sediment Interactions. **R**

384. **Howard-Williams, C., J. Davies and S. Pickmere (1982)** The dynamics of growth, the effects of changing area and nitrate uptake by watercress Nasturtium Officinale R. Br. in a New Zealand stream. J. Appl. Ecol. 19:589-601. Detailed Study of Nitrogen Assimilation and Storage by Herbaceous Vegetation on Stream Bank. **D; H; 2nd order; NIT; BioStor**

385. **Howard-Williams, C. and M.T. Downes (1984)** Nutrient removal by streambank vegetation. Pp. 409-422, In: Land Treatment of Wastes. Water & Soil Misc. Publ. 70, R.J. Wilcock (Ed.). Nitrate Removal by Streambank Herbaceous Vegetation. **D; H; 2nd order; NIT; DAM; DTKN**

386. **Howard-Williams, C., S. Pickmere and J. Davies (1986)** Nutrient retention and processing in New Zealand streams: the influence of riparian vegetation. New Zealand Agricultural Science 20:110-115. A general review of the nutrient processing functions of riparian zones. **R; NIT**

387. **Hubbard, R.K. and R.R. Lowrance (1994)** Spatial and temporal patterns of solute transport through a riparian forest. Pp. 403-411, In: Riparian Ecosystems in the Humid U.S., Functions, Values and Management. Wash., D.C.: Natl. Assoc. Conserv. Districts. Followed Movement of Nitrate and Bromide Applied to the Soil Surface Upslope from a Riparian Forest. **D; F; GW; CP; TS; NIT**

388. **Hubbard, R.K. and R.R. Lowrance (1994)** Riparian forest buffer system research at the Coastal Plain experiment station, Tifton, GA. Water Air Soil Pollut. 77:409-432. A review with some current, new data. **R; D; F; GW; OF; NIT; Denit-F**

389. **Hubbard, R.K. and R.R. Lowrance (1996)** Solute transport and filtering through a riparian forest. Trans. Amer. Soc. Agric. Engin. 39(2):477-488. Applied nitrate and bromide tracer to the edge of a riparian forest and tracked movement for several years. **D; F; GW; OF; TS; CP; NIT**

390. **Hubbard, R.K. and R. Lowrance (1997)** Assessment of forest management effects on nitrate removal by riparian buffer systems. Trans. Amer. Soc. Agric. Engin. 40(2):383-391. Studied effects of clear-cutting and selective logging on nutrient functions of a riparian forest in GA. **D; F; 2nd order; GW; CP; NIT; DAM**

391. **Hubbard, R.K., G.L. Newton, J.G. Davis, R. Lowrance, G. Vellidis and C.R. Dove (1998)** Nitrogen assimilation by riparian buffer systems receiving swine lagoon wastewater. Trans. Am. Soc. Agr. Engin. 41:1295-1304. Drainage from an irrigated pasture was tracked through riparian areas of grass and grass plus forest. **D, G, F, CP, GW, OF, NIT, DAM, TKN**

392. **Hubbard, R.K., J.M. Ruter, G.L. Newton and J.G. Davis (1999)** Nutrient uptake and growth response of six wetland/riparian plant species receiving swine lagoon effluent. Trans. Am. Soc. Agr. Engin. 42:1331-1341. Measured the growth and biomass/nutrient content increase of various wetland plants in a riparian zone subjected to high nutrient loading. **D, CP, TKN**

393. **Hubbard, R.K., G. Vellidis, R. Lowrance, J.G. Davis and G.L. Newton (1995)** Using riparian buffers to treat animal waste. Pp. 127-134, In: Animal Waste and the Land Water Interface, K. Steele (Ed.). New York: Lewis. Hardwood Deciduous Forest was Replanted in a Streamside Riparian Zone. Then animal waste from a sewage lagoon was applied upslope to examine effects of the riparian zone on water quality of both overland flows and shallow groundwater. **D; F; OF; GW; CP; NIT; DAM; TN; DPP; DTP**

394. **Huggenberger, P., E. Hoehn, R. Beschta and W. Woessner (1998)** Abiotic aspects of channels and floodplains in riparian ecology. Freshwater Biol. 40:407-425. A wide-ranging review. **R**

395. **Hupp, C.R. and D.E. Bazemore (1993)** Temporal and spatial patterns of wetland sedimentation, West Tennessee. J. Hydrology 141:179-196. Used Tree Cores and Depth of Burial of Original Tree Roots to Measure Long-Term Sedimentation. Short-Term Sedimentation was Measured Over Clay Pads. **D; F; SedTrap**

396. **Hupp, C.R. and E.E. Morris (1990)** A dendrogeomorphic approach to measurement of sedimentation in a forested wetland, Black Swamp, Arkansas. Wetlands 10:107-124. Measured Sedimentation Rates for a Forested Floodplain. **D; F; CP; TSS; SedTrap**

397. **Hupp, C.R., M.D. Woodside and T.M. Yanosky (1993)** Sediment and trace element trapping in a forested wetland, Chickahominy River, Virginia. Wetlands 13(2):95-104. Measured Sediment Depositon Rates in a Forested Flood Plain and the Trace Element Composition of the Deposited Sediments. **D; F; CP; TrM; TSS; SedTrap; BioStor**

398. **Hussey, M.R., Q.D. Skinner, J.C. Adams and A.J. Harvey (1985)** Denitrification and bacterial numbers in riparian soil of a Wyoming mountain watershed. J. Range Management 38:492-496. Soils at Three Shallow Depths Along Transects from Stream Channel to Uplands were Analyzed for Numbers of Denitrifying Bacteria and Potential Rates of Denitrification. **D; Denit-L**

399. **Inamdar, S.P. (1996)** Investigation of Hydrologic and Sediment Transport Processes on Riparian Hillslopes. Ph. D. Thesis. Blacksburg, VA, Virginia Polytech. Inst. & State U. Developed a physically-based continuous simulation model of hydrology and sediment transport in forested and herbaceous riparian buffers. **D; TSS; OF**

400. **Inamdar, S.P. and T.A. Dillaha (2000)** Relationships between drainage area, slope length, and slope gradient for riparian slopes in Virginia. Trans. Am. Soc. Agr. Eng. 43(4):861-866. Tested methods of estimating overland storm flows and concentrated flows into riparian zones from digital elevation data in the Ridge & Valley area of VA. **D, OF, MT**

401. **Inamdar, S.P., R.R. Lowrance, L.S. Altier, R.G. Williams and R.K. Hubbard (1999)** Riparian ecosystem management model (REMM):II. Testing of the water quality and nutrient cycling component for a Coastal Plain riparian system. Trans. Am. Soc. Agr. Eng. 42:1691-1707.

402. **Inamdar, S.P., M.J. Michell and J.J. McDonnell (2000)** Topographic and riparian controls on hydrologic and biogeochemical response of forested catchments. Pp. 137-142, in: Riparian Ecology and Management in Multi-Land Use Watersheds. P.J. Wigington Jr. and R.L. Beschta (Eds.), Amer. Water Resourc. Assoc., Middleburg, VA. Modeled hydrology and nitrogen discharges from Archer Creek using variable source areas. **D, F, MT, DTKN, NIT**

403. **Inamdar, S.P., S. Mostaghimi, P.W. McClellan and K. M. Brannan (2001)** BMP impacts on sediment and nutrient yields from an agricultural watershed in the Coastal Plain region. Trans. Amer. Soc. Agr. Engin. 44:1191-1200. Examined data from a long-term study of a 1463 ha watershed in

Virginia prior to and after implementation of in-field BMPs and installation of filter strips. **D, M, G, 3rd order, CP, DAM, TSS, NIT, DKN, TKN, DPP, DTP, PPP, TP**

404. **Inamdar, S.P., J.M. Sheridan, R.G. Williams, D.D. Bosch, R.R. Lowrance, L.S. Altier and D. L. Thomas (1999)** Riparian ecosystem management model (REMM): I. Testing of the hydrologic component for a Coastal Plain riparian system. Trans. Am. Soc. Agr. Eng. 42:1679-1689.

405. **Ingendahl, D., E. Ter Haseborg, M. Meier, O. van der Most, H. Steele and D. Werner (2002)** Linking hyporheic community respiration and inorganic nitrogen transformations in the river Lahn (Germany). Arch Hydrobiol. 155 (1):99-120. Studied respiration and nitrification in bottom sediments. Carried out nitrate and ammonium enrichment experiments. **D, DAM, HZ, NIT, POM, Nitrif**

406. **Ishida, T. and K. Nakamura (2002)** Runoff on grassland slopes with riparian forest in a volcanic ash-covered area of Eastern Hokkaido. Pp. 298-303, In: R. Hatano, U. Mander, Y. Hayakawa, V. Kuusemets, Y. Watanabe and K. Kanazawa (eds.), Efficiency of Purification Processes in Riparian Buffer Zones, Their Design and Planning in Agricultural Watersheds, Natl. Agric. Res. Center Hokkaido Region, Kushiro, Japan. Studied the hydrology of an area with upland grass pastures and lowland riparian forests with high infiltration rates. **D, F, OF, GW**

407. **Iversen, T.M., J. Thorup and J. Skriver (1982)** Inputs and transformation of allochthonous particulate organic matter in a headwater stream. Holarct. Ecol. 5:10-19. Estimated Inputs of Forest Litter to Stream on a Completely Forested Watershed in Denmark. Does Not Describe How Inputs were Measured. **D; F; 1st order; POM**

408. **Jacinthe, P.A., P.M. Groffman, A.J. Gold and A. Mosier (1998)** Patchiness in microbial nitrogen transformations in groundwater in a riparian forest. J. Environ. Qual. 27:156-164. Used large soil cores to conduct laboratory studies of nitrogen cycling and flux under various experimental conditions**. D; F; GW; NIT; DAM; DOM; POM; Denit-L; Nitrif**

409. **Jacks, G., A. Joelsson and S. Fleischer (1994)** Nitrogen retention in forest wetlands. Ambio 23 (6):358-362. A two and a half year study of six forested watersheds in Sweden which drained into forested bog riparian wetlands. Inputs to the bogs from the atmosphere and the uplantds were measured along with outputs from the bogs. **D; F; NIT; TN; MBal**

410. **Jacobs, T.C. and J.W. Gilliam (1983)** Nitrate Loss From Agricultural Drainage Waters: Implications for Nonpoint Source Control. Raleigh, NC: Univ. North Carolina, 208 pp. Study of Two Coastal Plain Agricultural Watersheds. Followed Groundwater Nitrogen Through Riparian Forests. Measured Eh and Riparian Plant Biomass and Nutrient Reservoirs. **D; F; CP; GW; NIT; DAM; Flux; BioStor**

411. **Jacobs, T.C. and J.W. Gilliam (1985)** Riparian losses of nitrate from agricultural drainage waters. J. Environ. Qual. 14:472-478. Used Data From Groundwater Well Transects and Eh Probes with a

Hydrological Model to Estimate Nitrate Mass Balances for Groundwater Moving from Croplands to Stream Channels Through Riparian Forests. **D; F; CP; GW; NIT; MBal**

412. **James, B.R., B.B. Bagley and P.H. Gallagher (1990**) Riparian zone vegetation effects on nitrate concentrations in shallow groundwater. Pp. 605-611, In: New Perspectives in the Chesapeake System: A Research and Management Partnership. Ches. Res. Consort. Publ. No. 137, J.H. Mihursky and A. Chaney (Eds.). Solomons, MD: Ches. Res. Consort. Measured Nitrate Concentrations in Groundwater Under Leguminous, and Nonleguminous Forested Riparian Zones, also Under Forests Experimentally Clear Cut. **D; F; G; GW; NIT**

413. **Jansson, M., R. Andersson, H. Berggren and L. Leonardson (1994)** Wetlands and lakes as nitrogen traps. Ambio 23:320-325. A general review of the functioning of wetlands as nitrogen traps. **R; TN; NIT**

414. **Johnson, S.L. and A.P. Covich (1997)** Scales of observation of riparian forests and distributions of suspended detritus in a prairie river. Freshwater Biol. 37:163-176.

415. **Johnston, C.A. (1991)** Sediment and nutrient retention by freshwater wetlands: Effects on surface water quality. Crit. Rev. Environ. Control 21(5-6):491-565. An Overall Review of the Water Quality Modifying Functions of Freshwater Wetlands. **R**

416. **Johnston, C.A. (1993)** Material fluxes across wetland ecotones in northern landscapes. Ecol. Appl. 3(3):424-440. Spatial Distribution and Accumulation Rates of Nutrients Within a Forested Wetland Along the Course of a Stream. **D; F; 2nd order; TN; TP; TSS; NIT; Flux**

417. **Johnston, C.A., G.D. Beubenzer, G.B. Lee, F.W. Madison and J.R. McHenry (1984)** Nutrient trapping by sediment deposition in a seasonally flooded lakeside wetland. J. Environ. Qual. 13:283-290. Study of History and Rate of Sediment Trapping by a Small Streamside Forested Wetland. Cs 137, nitrogen and phosphorus content of soils measured. **D; F; 2nd order; SedTrap; TP; TN**

418. **Johnston, C.A., S.D. Bridgham and J.P. Schubauer-Berigan (2001)** Nutrient dynamics in relation to geomorphology of riverine wetlands. Soil Sci. Soc. Am. J. 65(2):557-577. A comparative studly among several sites. **D, H, DAM, NIT, pH, DPP, TSS, TN, TP, SedTrap**

419. **Johnston, C.A., N.E. Detenbeck and G.J. Niemi (1990)** The cumulative effect of wetlands on stream water quality and quantity. A landscape approach. Biogeochemistry 10:105-141. Principal Components Analysis of Nutrient Discharges from 33 Watersheds was Used to Correlate Wetlands with Various Nutrient Parameters. **D; TSS; NIT; DAM; TP; DTP; DTKN; DPP**

420. **Johnston, C.A., G.B. Lee and F.W. Madison (1984)** The stratigraphy and composition of a lakeside wetland. Soil Sci. Soc. Am. J. 48:347-354. Soil History of a Forested Wetland Along a Small Stream with an Agricultural Watershed. **D; F; 2nd order; SedTrap; TP; TN**

421. **Johnston, C.A., J.P. Schubauer-Berigan and S.D. Bridgham (1997)** The potential role of riverine wetlands as buffer zones. Pp. 155-170, In: Buffer Zones: Their Processes and Potential in Water Protection, N. Haycock, T. Burt, K. Goulding and G. Pinay (Eds.). Harpenden, UK: Quest Environmental. A very broad review of freshwater riverine wetlands and their role in nutrient trapping and cycling. **R; SedTrap; TP; TN**

422. **Jones Jr., J.B. (1995)** Factors controlling hyporheic respiration in a desert stream. Freshwater Biol. 34:91-99. Studied respiration of sediments from cores. Related to particle size distribution and DOC. **D; DOM; HZ**

423. **Jones Jr., J.B., S.G. Fisher and N.B. Grimm (1995)** Vertical hydrological exchange and ecosystem metabolism in a Sonoran Desert stream. Ecology 76:942-952. Examined sediment respiration and relation to sources of organic carbon seasonally. **D; HZ; DOM; POM; GW**

424. **Jones Jr., J.B., S.G. Fisher and N.B. Grimm (1995)** Nitrification in the hyporheic zone of a desert stream ecosystem. J. N. Am. Benthol. Soc. 14(2):249-258. Measured respiration and nitrification rates in various hyporheic areas where downwelling or upwelling occur. **D; HZ; NIT; Nitrif; DAM; DOC; POC; DTKN; DPP**

425. **Jones Jr., J.B. and R.M. Holmes (1996)** Surface-subsurface interactions in stream ecosystems. Trends Ecol. Evol. 11:239-242. A short review. **R**

426. **Jones Jr., J.B., R.M. Holmes, S.G. Fisher and N.B. Grimm (1994)** Chemoautotrophic production and respiration in the hyporheic zone of a Sonoran Desert stream. Pp. 329-338, In: Proc. Second Internatl. Conf. Groundwater Ecology, J.A. Stanford and H.M. Valett (Eds.). Bethesda, MD: Amer. Water Resources Assoc. Measured bacterial metabolic rates in riparian soils of various settings at Sycamore Creek, Arizona. Compared areas of flood plain bank with sand/gravel bars. **D; GW; Nitrif; Denit-L; POM; DOM; DAM; Fe; pH**

427. **Jordan, T.E., D.L. Correll, W.T. Peterjohn and D.E. Weller (1986)** Nutrient flux in a landscape: the Rhode River watershed and receiving waters. Pp. 57-76, In: Watershed Research Perspectives, D.L. Correll (Ed.). Washington, D.C.: Smithsonian Press. An Overview and Landscape Level Analysis of Nutrient Flux in a Coastal Plain Watershed Including the Effects of Riparian Forests on Agricultural Drainage. **R; F; NIT; TN; TP; TSS; MBal**

428**. Jordan, T.E., D.L. Correll and D.E. Weller (1993)** Nutrient interception by a riparian forest receiving inputs from adjacent cropland. J. Environ. Qual. 22(3):467-473. Followed Surface and Groundwater Moving From Cropland Through a Floodplain on a 3rd Order Stream. Measured Eh, all forms of Nitrogen, Chloride, and Dissolved Organic Matter. Used Bromide Tracer in Groundwater. **D; F; CP; TS; TSS; NIT; TN; MBal**

429. **Jordan, T.E., D.E. Weller and D.L. Correll (1998)** Denitrification in surface soils of a riparian forest: Effects of water, nitrate and sucrose additions. Soil Biol. Biochem. 30(7):833-843. Riparian soils were manipulated with water, nitrate, and or organic matter. Large flow-through chambers were used to measure N2O flux with and without acetylene. **D; F; 1st order; GW; CP; NIT; DOM; Denit-F**

430. **Kadlec, R.H. and J.A. Kadlec (1978)** Wetlands and water quality. Pp. 436- 456, In: Wetland Functions and Values: The State of Our Understanding, P.E. Greeson, J.R. Clark and J.E. Clark (Eds.). Minneapolis, MN: Amer. Water Resources Assoc. A General Review of How Wetlands Interact with Flooding Waters and Change Their Water Quality. **R**

431. **Kanazawa, K. and Y. Hayakawa (2002)** Denitrification in grassland buffer strip. Pp. 133-139 In: R. Hatano, U. Mander, Y. Hayakawa, V. Kuusemets, Y. Watanabe and K. Kanazawa (eds.), Efficiency of Purification Processes in Riparian Buffer Zones, Their Design and Planning in Agricultural Watersheds, Natl. Agric. Res. Center Hokkaido Region, Kushiro, Japan. Denitrification potential was measured in soil depth profiles, also temperature dependence of denitrification potential. **D, G, GW, NIT, Denit-L**

432. **Kao, D.T.Y. and B.J. Barfield (1978)** Predictions of flow hydraulics of vegetated channels. Trans. Amer. Soc. Agric. Eng. 21(3):489-494. Model of Overland Flow Through Simulated Grass Buffer. **D; G; OF**

433. **Kaplan, L.A. and J.D. Newbold (1993)** Biogeochemistry of dissolved organic carbon entering streams. Pp. 139-166, In: Aquatic Microbiology, An Ecological Approach, T.E. Ford (Ed.). Boston: Blackwell. A broad review of the dynamics of dissolved organic carbon in stream ecosystems. Covers sources and sinks on watershed, in the riparian zone, and hyporheic zone. **R; GW; HZ; DOM**

434. **Karr, J.R. and I.J. Schlosser (1978)** Water Resources and the Land-Water Interface. Science 201:229-234. A Review of the Effects of Forested Stream Riparian Zones on Sediment Transport and Deposition, Nutrient Exchange, and Stream Habitat Factors. **R**

435. **Kauffman, J.B., R.L. Case, D. Lytjen, N. Otting and D.L. Cummings (1995)** Ecological approaches to riparian restoration in northeast Oregon. Restoration & Manage. Notes 13:12-15. A discussion and review of various approaches to riparian restoration in the Pacific northwest. **R, M**

436. **Kauffman, J.B. and W.C. Kreuger (1984)** Livestock impacts on riparian ecosystems and streamside management implications ï¿½ A review. J. Range Manage. 37:430-438. A general review of various impacts of livestock and game animals on riparian zones. **R**

437. **Kaushik, N.K., J.B. Robinson, P. Sain, H.R. Whiteley and W. Stammers (1975)** A quantitative study of nitrogen loss from water of a small spring-fed stream. Pp. 110-117, In: Proc. 10th Canadian Symp. Water Pollution Research in Canada, T.C. Hutchinson (Ed.). Toronto: Univ. Toronto. Small entirely spring fed stream. Measured vertical and lateral leaf litter inputs and flux of dissolved nitrogen

within 3 reaches. Excavated above and below ground plant biomass. **D; F; 1st order; POM; DTKN; NIT; Denit-L; BioStor**

438. **Keim, R.F. and S.H. Schoenholtz (1999)** Functions and effectiveness of silvicultural streamside management zones in loessial bluff forests. Forest Ecol. Manage. 118:197-209. Twelve forested first-order watersheds in MS were subjected to a range harvest from controls to clear cuts and effects on channel morphology and water quality were monitored for three years. **D, F, 1st Order, TSS, pH**

439. **Kemp, G.P., W.H. Conner and J.W. Day Jr. (1985)** Effects of flooding on decompositon and nutrient cycling in a Louisiana swamp forest. Wetlands 5:35-51. Laboratory and Field Mesocosm Experiments on Nutrient Trapping from Floodwaters in a Floodplain Harwood Forest. **D; F; CP; TSS; TP; TN; DPP; PPP**

440. **Kemp, G.P. and J.W. Day Jr. (1984)** Nutrient dynamics in a Louisiana swamp receiving agricultural runoff. Pp. 286-293, In: Cypress Swamps, K.C. Ewel and H.T. Odum (Eds.). Gainsville, FL: University Presses of Florida. Nutrient Dynamics of a Forested Swamp Were Inferred From Water Quality and Hydrologic Data. **D; F; CP; NIT; DAM; DTKN; DPP; ET**

441. **Kemp, M.J. and W.K. Dodds (2001)** Statial and temporal patterns of nitrogen concentrations in pristine and agriculturally-influenced prairie streams. Biogeochem. 53:125-141. Measured channel and groundwater dissolved nitrogen concentrations in several reaches of several streams. Some had riparian forest in the lower reaches and some did not. **D, F, GW, NIT, DAM, DTKN**

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D, F, GW, HZ, TS

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CP; TSS; TrM; TP; TN; Flux

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forest) to a stream. **D, G, F, CP, GW, OF, TAM, TS, TPP, TKN, TP, NIT, Denit-L, Flux, MBal**

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hyporheic zone. **R; GW; HZ**

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Channelization. Inferred Effects Were Caused by Interuption of Channel/Floodplain Forest Interactions. **D; F; TN; TP; NIT; DAM; DPP; DTP**

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