ABSTRACT: This literature review addresses how wide a streamside forest buffer needs to be to protect water quality, habitat, and biota for small streams (≤100 km$^2$ or ~5th order watershed) with a focus on eight functions: (1) *subsurface nitrate removal* varied inversely with subsurface water flux and for sites with water flux >50 l/m/day (~40% avg base flow to Chesapeake Bay) median removal efficiency was 55% (26-64%) for buffers <40 m wide and 89% (27-99%) for buffers >40 m wide; (2) *sediment trapping* was ~65 and ~85% for a 10- and 30-m buffer, respectively, based on streamside field or experimentally loaded sites; (3) *stream channel width* was significantly wider when bordered by ~25-m buffer (relative to no forest) with no additional widening for buffers ≥25 m; (4) *channel meandering and bank erosion* were lower in forest but more studies are needed to determine the effect of buffer width; (5) *temperature* remained within 2°C of levels in a fully forested watershed with a buffer ≥20 m but full protection against thermal change requires buffers ≥30 m; (6) *large woody debris (LWD)* has been poorly studied but we infer a buffer width equal to the height of mature streamside trees (~30 m) can provide natural input levels; (7, 8) *macroinvertebrate and fish communities*, and their instream habitat, remain near a natural or semi-natural state when buffered by ≥30 m of forest. Overall, buffers ≥30 m wide are needed to protect the physical, chemical, and biological integrity of small streams.

(KEY TERMS: riparian ecology; nonpoint source pollution; temperature; nutrients; best management practices; sediment; rivers/streams; macroinvertebrates; fish; streamside forest buffer; nitrate; streambank stability; woody debris.)


INTRODUCTION

The Environmental Protection Agency (USEPA, 2013) recently reported that 55% of the river and stream length in the United States (U.S.) is in poor condition. Streamside disturbance and poor riparian vegetation cover were the most widespread stressors, reported in 20 and 24%, respectively, of the streams and rivers in the study. Streamside forests have historically formed the natural interface between hillslope and aquatic processes for most watersheds worldwide. This was particularly true in North America, where even streams in grassland prairies were apparently bordered by forest (West and Ruark, 2004). Removal of those natural streamside forests greatly alters the physical, chemical, and biological dynamics of streams, as well as the structure and function of their ecosystems (Hynes, 1975; Gregory et al., 1991; Sweeney, 1993; Naiman and Décamps, 2013).