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CH4 emissions from two floodplain fens of differing nutrient status

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Floodplain fens emit large amounts of CH4 in comparison with ombrotrophic bogs. Little is known about the effect of fluvial nitrogen (N) and phosphorus (P) on CH4 dynamics in fens, although N and P affect carbon (C) dynamics indirectly in other environments by controlling plant growth and root exudate release, as well as by altering microbial biomass and decomposition rates. This study aimed to compare CH4 emissions from two floodplain fen sites which differ in nutrient status, Sutton Fen (52°45'N 001°30'E) and Strumpshaw Fen (52°36'N 001°27'E), in the Norfolk Broadland of England.

Sutton and Strumpshaw Fen are under conservation management and both sites have water levels that vary within a few decimetres above and below the surface. The sites are dominated by reed (Phragmites australis). Areas within the fens where the reed was cut in 2009 were chosen for this study. Average plant height and mean aboveground biomass were significantly greater at Strumpshaw (107.2 $\pm$ 7.8 cm and 1578 $\pm$ 169 g m-2, respectively) than Sutton (56.5 $\pm$ 5.1 cm and 435 $\pm$ 42 g m-2) as were mean foliar N and P contents (21.8 $\pm$ 1.5 g kg-1 and 2.0 $\pm$ 0.2 g kg-1 at Strumpshaw, versus 16.3 $\pm$ 1.5 g kg-1 and 1.1 $\pm$ 0.1 g kg-1 at Sutton). Foliar NPK ratios showed Strumpshaw to be N limited, whereas Sutton was both N and P limited, depending on microsite. Surface peat N and P contents were also greater at Strumpshaw (28.3 $\pm$ 0.35 g kg-1 and 0.78 $\pm$ 0.02 g kg-1, respectively) than Sutton (18.32 $\pm$ 0.87 g kg-1 and 0.43 $\pm$ 0.1 g kg-1). These results indicate clear differences in nutrient status between the two sites despite their geographical proximity and other similarities.

CH4 emissions were monitored monthly between 19th June 2012 and 2nd September 2013 using tall static chambers and glass funnel-traps, the latter for ebullition. Steady fluxes did not follow a clear seasonal pattern; however, emission was greatest in the summer months. Strumpshaw had a greater range in efflux (0.25 to 134.2 mg CH4 m-2 h-1) than Sutton (0.17 to 29.82 mg CH4 m-2 h-1). Ebullition was generally greater at Sutton throughout the study period, with rates ranging from 0 to 62.09 mg CH4 m-2 h-1 and 0 to 19.30 mg CH4 m-2 h-1 for Sutton and Strumpshaw, respectively. Fluxes were generally within the range of values reported in the literature for ebullition (0 to 466 mg CH4 m-2 h-1) and steady fluxes (0 to 76.83 mg CH4 m-2 h-1). Results show the importance of floodplain fens for CH4 emission, and more research needs to be undertaken to fully understand the factors controlling CH4 fluxes from these systems.