

Melaleuca quinquenervia encroachment in drained sulfidic backswamps: links to increasing ground water acidity

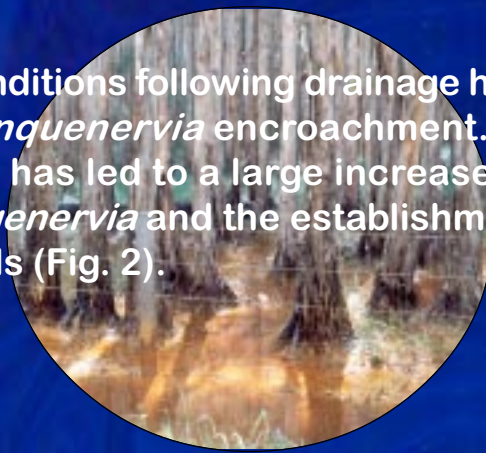
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The issue

Encroachment of *M. quinquenervia* in drained ASS backswamps.

- Drainage induced alteration of the hydrology of coastal ASS backswamps has led to significant changes in wetland vegetation .
- Pre-drainage vegetation in many ASS backswamps was often dominated by reeds and rushes with fringing stands of *M. quinquenervia* and Casuarina on higher margins. Vegetation sequences were related to micro-topography/ hydrology. Available historic data suggests the lowest lying parts of some ASS backswamps was often largely free of *M. quinquenervia* (Fig.1).

- A shift towards drier conditions following drainage has been associated with *M. quinquenervia* encroachment. In some ASS backswamps this has led to a large increase in the aerial extent of *M. quinquenervia* and the establishment of dense, monoculture stands (Fig. 2).



Results

Large increases in titratable acidity and Fe^{2+} beneath encroaching *M. quinquenervia* forests.

- Shallow ground water transects, targeting the sulfuric horizon, perpendicular to stands of encroaching *M. quinquenervia* in several ASS backswamps have shown large increases in titratable acidity (5-10 times), ferrous iron, chloride and aluminium associated with the tree line (Fig. 3).
- A shallow ground water transect bracketing a single, large 80 yo + *M. quinquenervia* in a drained ASS backswamp showed significant increases in titratable acidity, iron immediately adjacent to the tree (Fig. 4 and Fig. 5). This was accompanied by clear changes in pH and Eh, a decrease in the Cl:Fe ratio and increasing sulfate .

Possibilities

Available data suggests a number of possible mechanisms. These may include:

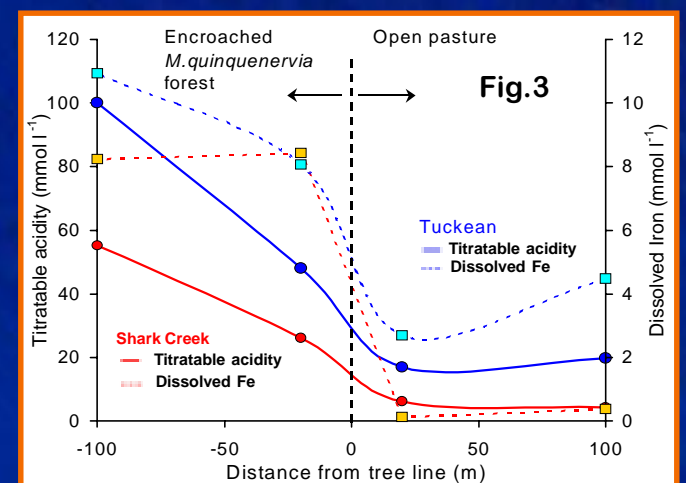
- Enhanced sulfide oxidation due to increased water table draw down or rhizosphere O_2 diffusion.
- Evapo-concentration of acidic ground water solutes due to increased water use combined with selective ion exclusion at the roots.
- Organic acids associated with *M. quinquenervia* leaf litter or root exudates assisting ferric iron mineral dissolution, downward leaching and reduction.

Conclusions and Implications

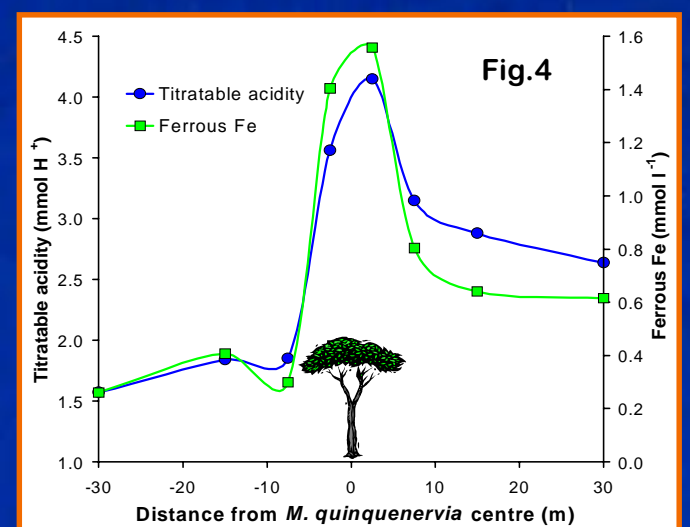
- The encroachment of *M. quinquenervia* in drained ASS backswamps appears to be associated with significant increases in ground water acidity and ground water metal concentrations in sulfuric horizons.
- Increased ground water acidity will enhance acidity concentrations in drains that bisect these areas. At artificially drained sites where the dominant pathway of acid export is shallow groundwater seepage, this process may be contributing to acid and metal export loads.



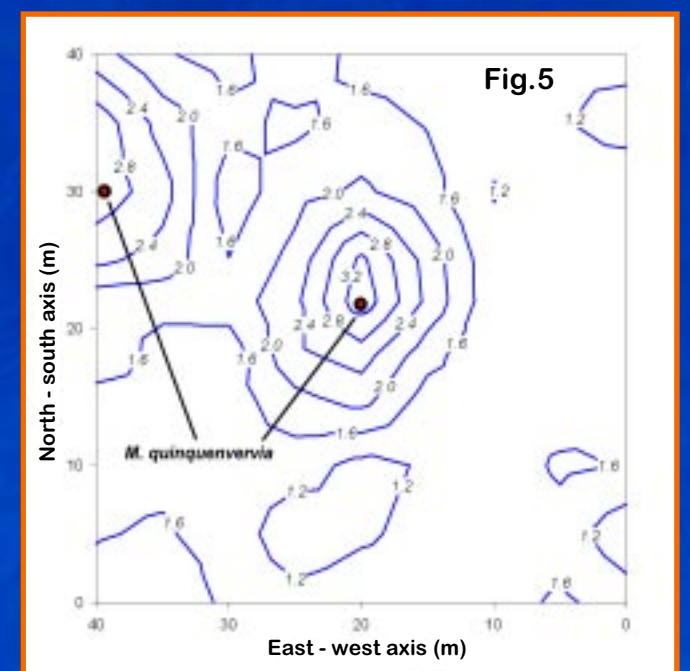
M. quinquenervia forest encroachment in Eastern Shark Ck. ASS backswamp. 1870 vegetation boundary based on Portion map analysis.



Changes in titratable acidity and dissolved Fe concentrations of shallow ground water in two separate ASS backswamps associated with encroaching *M. quinquenervia* tree line.



Changes in titratable acidity and Fe^{2+} concentrations of shallow ground water associated with an individual *M. quinquenervia* in an open pasture ASS backswamp.



Titratable acidity ($mmol\ l^{-1}\ H^+$) in ground water adjacent to two *M. quinquenervia* in an open pasture ASS backswamp, Shark Ck. (EM38 inferred $r^2 = 0.96$, $n=5$).