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Tracking changes in Isoëtes reproductive ecology responding to changes in lake water temperature and chemistry

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Biological response of aquatic macrophytes to changes in water chemistry and temperature has been studied on a background of the long-term research of Bohemian Forest lakes recovery from acid stress. Isoëtes lacustris and I. echinospora are common aquatic macrophytes adapted for living in soft-water lakes widely distributed in European lake districts; however, in central Europe they are rare glacial relicts. In Černé and Plešné lakes, two populations survived a thirty-year period of severe acidification but failed to reproduce. In our experimental and field studies on Isoëtes reproduction we identified early ontogenetic stages to be most vulnerable to changes in lake water pH, temperature, and aluminium (Al) toxicity .We described specific symptoms on plantlets reflecting various lake water acidity and Al-toxicity and defined critical limits of the stressors for plant survival. Using a mathematical model we also described temperature-related changes in species reproductive phenology and revealed their narrow temperature tolerance. The knowledge of critical environmental factors and their limits for species survival allows us to infer changes in species reproduction in response to both historical and ongoing changes in climate and lake water chemistry. Due to species-specific ecological traits, we can now explain the recent population recovery of I. echinospora contrasting with the poor reproduction of I. lacustris that will be constrained by environmental stressors for at least during the next 20 years.