
Looking for population bottlenecks in regulated rivers: Can mayfly eggs survive dewatering?

Emmanuel Jaulin^{*1}, Abdelkader Azougui¹, Antoine Callu¹, Hervé Capra¹, Maxime Logez¹, Hervé Pella¹, and Maria Alp¹

¹RiverLy - Fonctionnement des hydrosystèmes – Institut National de Recherche pour l’Agriculture, l’Alimentation et l’Environnement – France

Résumé

The hydrological regime of many rivers is strongly modified by numerous human activities contributing to drastic freshwater biodiversity loss. Hydroelectricity production, for instance, affects river hydrology and hydraulic properties of riverine habitats. Driven by electricity demand, hydropower plants may induce (sub)-daily variations in discharge, water level and flow velocity downstream of the plant, the so-called hydropeaking. The ecological impacts of hydropeaking have been mainly evaluated for fish and to a lesser extent for invertebrates and riverine plants. Regarding stream insects, a key indicator of ecological stream conditions, drifting and stranding of larvae as well as change in community composition have been recorded as hydropeaking effects. Other life stages of stream insects such as terrestrial imagines or eggs remain understudied and rarely considered in the context of regulated rivers. These life stages are crucial for population dynamics, with the hatching of eggs laid by imagines forming the recruits of the local population. In regulated rivers, the artificial variation of water level can dewater oviposition habitats, leading to egg mortality. The potential recruitment failure can act as a bottleneck on population size. Studying these sensitive life stages is crucial to assess the ecological effect of hydropeaking on stream insect population structure and dynamics. Few studies have evaluated the response of stream insect eggs to dewatering induced by artificial water level variations. This study aims to determine the dewatering duration threshold starting from which the hatching of stream insect eggs is impaired. Mayfly egg masses from a French hydropeaked river were exposed to dewatering events of different duration (0-18 hours) in the laboratory conditions. The egg viability, determined by image analysis, decreased dramatically after six hours of dewatering and became null after nine hours of dewatering. These results raise the question of the extent to which dewatering inducing egg mortality in regulated rivers can act as a bottleneck on population size. Stream insect egg mortality could be proposed as a functional indicator to assess the ecological impact of hydropeaking and to predict the effect of operational mitigation measures.

Mots-Clés: Hydropeaking, Aquatic insects, Life cycle bottleneck, Egg viability

^{*}Intervenant