

Multi-surveyor detection-mark-redetection as a powerful tool for butterfly population monitoring in the pre-imaginal stage

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Abstract

1. For many elusive insect species, which are difficult to cover by standard monitoring schemes, innovative monitoring methods are needed to gain robust data on population trends. We suggest a monitoring of overwintering larvae for the endangered nymphalid butterfly *Limenitis reducta*. 2. We tested one removal and three detection-mark-redetection (DMR) approaches in a field study in the “Alb-Donau” region, Germany. We replaced movement of the study organisms by random movement of multiple different surveyors, and we examined the model assumption of equal detectability using simulations. 3. Our results indicate that multi-surveyor removal/DMR techniques are suitable for estimating abundance of overwintering *L. reducta* larvae. Detection probabilities varied with surveyor experience and the uncertainty of population estimates increased with a decrease in personnel expenditure. Estimated larval densities on a spruce clear-cut ranged between one and three individuals per 100 m². 4. We suggest a detection-mark-redetection (DMR) approach with three trained surveyors for the monitoring of *L. reducta* populations in the pre-imaginal stage. Besides *L. reducta*, the proposed method is likely to be suitable for other insect taxa with specific immobile life-stages and some sessile organisms, e.g. corals, elusive plants, or fungi.

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