Presentation Type:
Platform Preferred

Track:
Special Symposium

Session:
Ecological models for assessing the risks of chemicals and other stressors

Abstract Title:
Quantifying the Effects of Pesticide Exposure on Annual Reproductive Success of Birds

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Abstract: The Markov chain nest productivity model (MCnest) was developed for quantifying the effects of specific pesticide-use scenarios on the annual reproductive success of simulated populations of birds. Each nesting attempt is divided into a series of discrete phases (e.g., egg laying, incubation, nestling rearing), and results from avian toxicity tests are used to represent the types of effects possible in the field during each breeding phase. The expected exposure dose each day throughout the breeding season can be compared to the toxicity thresholds assigned to each breeding phase to determine whether the nest attempt is at risk. The primary output of the model is an estimate of the number of successful nest attempts per female per year, which is multiplied by the number of fledglings per successful nest to estimate the number of fledglings per female per breeding season (i.e., annual reproductive success). We present a series of MCnest simulations to demonstrate the extent to which the magnitude of change in annual reproductive success can be affected by considering life history attributes and the timing of pesticide applications relative to a species' typical breeding phenology. For a given pesticide-use scenario, MCnest can identify which species are at greatest risk. By allowing multiple species to be run under a single scenario, it can also help to identify the life-history traits that contribute to a species' vulnerability to a given pesticide-use scenario. It also can determine which application dates have the greatest impact and demonstrate the extent to which pesticide characteristics (e.g., residue half-life, mode of action) affect productivity. MCnest goes beyond the current qualitative screening-level assessments of risks to avian reproduction to provide an approach for quantifying the reduction in annual reproductive success by integrating species life history and timing of pesticide exposures, despite limitations in existing information on species life history and toxicity responses from existing laboratory tests.