

## **Reducing risk in an increasingly interdisciplinary world: the role of bycatch, distribution networks, and risky behaviour as regulatory pillars for live bait pathways**

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Management of bait has shifted widely over the past 50 years in response to numerous ecological and economic factors, as demonstrated by regulatory frameworks and outreach to address the human-mediated spread of aquatic species. Major regulatory changes have reduced invasion risk while increasing the sustainability of harvest, but often at the expense of harvest efficiency. To demonstrate the ongoing ecological benefit associated with past and present regulatory change, I provide an overview of the baseline ecological risk associated with baitfish use, with examples from Ontario, Canada and Michigan, USA. Like most risks involving invasive species, those associated with the bait trade are interdisciplinary, requiring approaches for management that simultaneously target ecological factors and human dimensions relevant to invasive species. Three overarching issues exist: 1) mixed stocks leading to bycatch during harvest from the wild; 2) the joint efficiency of distribution networks and mobility of anglers, which facilitate extensive overland movement of fishes; and, 3) risky human behaviour, such as imperfect culling ability and decisions to release left-over fishes to the wild. Although the per-event probability of harvesting or an angler introducing invasive fishes is low, the scale of most pathways result in high probability that invasive fishes are introduced each year. Multiple realistic opportunities for risk management exist, such as retailers as control points, targeting the dichotomy of depreciative vs. vandalistic tendencies during outreach and enforcement, and managing harvest with the same regulatory tools used for other commercial fisheries.