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**Performance of alternative assessment methods for Pacific Cod (*Gadus macrocephalus*) in British Columbia: a difficult-to-age species with highly uncertain productivity**

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**Abstract:**

International best practice for ecosystem-based fishery management recommends using a tiered approach to determine the most appropriate assessment method and harvest control rule for a species, based on whether it is data-rich, data-moderate or data-poor. As Canada seeks to implement a tiered approach for providing catch advice for Pacific groundfishes, a major question is how to assess stocks without reliable age-composition data. Age-composition data inform estimates of important parameters defining growth, productivity and selectivity, and therefore influence estimates of fishery reference points as well as stock status. Delay-difference models represent an alternative to explicit age-structured models, subject to certain assumptions about growth, mortality and selectivity. Violation of these assumptions can lead to biased assessment results that impact achievement of fishery objectives. We use closed-loop simulation to test the performance of the delay-difference model, compared with an explicitly age-structured model, for a volatile, difficult-to-age species, Pacific Cod (*Gadus macrocephalus*), in northern British Columbia. We test performance of six alternative harvest control rules against a set of fishery objectives, under alternative configurations of natural mortality (constant or density-dependent) and selectivity (knife-edged or logistic). We explore mechanisms for differences in performance, particularly the propagation of assessment errors and the contribution of age-composition data. We show that even when assessment results are biased, some harvest control rules can still produce desirable management outcomes. The magnitude of trade-offs between conservation and economic objectives was, however, large in some cases, underlining the importance of measuring performance in terms of management outcomes rather than uncertainty *per se*.

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