Optimal harvesting strategies for hairtail, *Trichiurus Lepturus* in Korea sea using discrete time age structured model based on nonlinear density-dependence with environmental factor

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ABSTRACT

Hairtail, *Trichiurus Lepturus* is a warm water fish species and is widely distributed in Yellow Sea. This is the second major fishery resource in Korea and so has been occupying a large portion of the catch in Korea for a long time. However, since the 1980s, catches have fallen sharply and the minimum catch was recorded in 2012. From the past, overfishing of immature hairtails has decreased the resources of hairtails, which resulted in the reduction for catches. So, in order to produce maximum sustainable yield, we need the management of hairtail in Korea sea. Thus, in this study, to obtain the optimal harvesting strategies while simultaneously preserving the immature hairtails, we establish the discrete time age-structured model for hairtails. For the survival of immature hairtails, we consider the Beverton-Holt function. Biologically, they eat zooplankton mainly, so that their survival follows density-dependence due to the limited resources of zooplankton. Specifically, hairtail is the representative fish with characteristics of cannibalism. Moreover, female hairtails are known to spawn at a moderate sea surface temperature. Thus, we consider Ricker recruitment function with sea surface temperature in the model. The discrete-time optimal control problem is conducted as Pontryagin's Maximum Principle. By using numerical simulations, we obtain that in the comprehensive sense, it is not the best strategy to strongly limit fishing of hairtails and so the optimal harvesting strategy should be addressed.

REFERENCES
