

The Spawners' Shadow price: Joint Production of Recruitment and Growth in Age-structured Fish Populations

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Abstract

Fishery scientists distinguish between recruitment overfishing (i.e. suboptimally low reproduction because the spawning stock is fished down) and growth overfishing (i.e. catching fish at an inefficiently young age). We use an age-structured bio-economic model to study how important the (endogenous) recruitment is compared to the growth of individual fish under optimal management of the fishery, and how severe the problem of recruitment overfishing is at different stock sizes. We answer both questions by quantifying the spawners' shadow price, i.e. the shadow price of the spawning stock under optimal management. We find that the spawner's shadow price may even be negative in optimal steady state. This surprising result arises because recruitment and growth are joint products in age-structured fish populations. Our quantitative analysis for the Eastern Baltic cod fishery shows, however, that the problem of recruitment overfishing does cause large economic costs, as the shadow price of the spawning stock biomass has reached levels between one and two Euros per kilogram in the 1990s and early 2000s, which is a large figure, compared to average landing prices for Eastern Baltic cod of about two Euros per kilogram.