OPTIMAL RELEASE SITE, SEASON AND SIZE OF SPOTTED HALIBUT DETERMINED BY CAGE EXPERIMENTS AND LANDINGS

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Spotted halibut *Verasper variegatus* is one of the commercially important flatfishes in Japan, and reaches approximately 60 cm total length [TL]. Recently, this flatfish has attracted attention as a new species for marine stock enhancement because of its high growth rate, high market price (about $25-100/kg), and depleted population size. Eight prefectures are trying to replenish the stocks by mass release of juveniles, but the release strategy of this species has not yet been established. We conducted experimental releases in net cages, samplings of potential predators, predation experiments, and market surveys of released fish to determine an optimal release site, season, and size of spotted halibut in Miyako Bay, northeastern Japan.

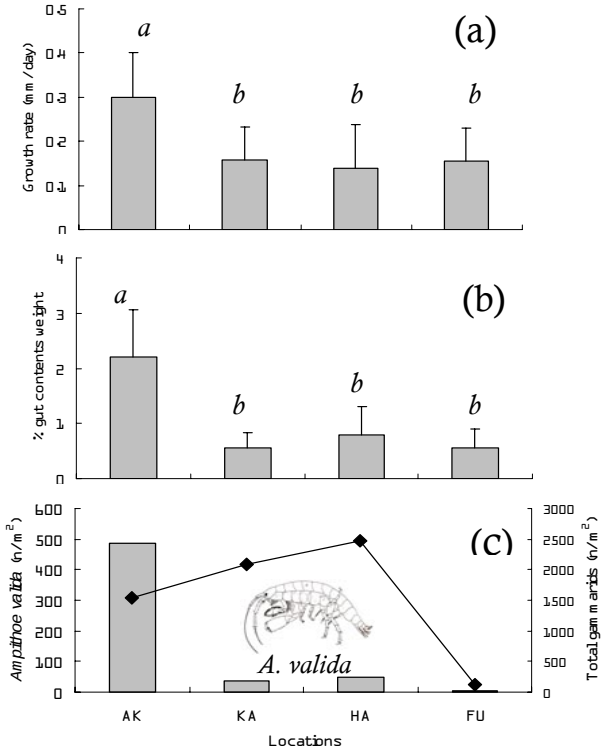

Figure 1: (a) Growth rate (b) % gut contents weight of juveniles in cages and (c) density of gammarids (*A. valida* and all species) at four release locations.

In 2004, four release sites (Akamae (AK), Kanehama (KA), Hanoki (HA) and Fujinokawa (FU)) in Miyako Bay were evaluated by using instantaneous growth rates and gut content analyses of juveniles released in cages in relation to water temperature, salinity, sediment composition, and prey availability. Cultured halibut (80±2 mm TL, n=6) were released in three cages at each site and a 13-day experiment was conducted beginning on 29 June 2004. Fish showed higher growth rate and gut fullness in AK (Figure 1a, b). Major prey items in all the locations were gammaridean amphipods, and only fish in AK ate the large species of amphipods, *Ampithoe valida,* in saturation; the density of this gammarid species was markedly high in AK (Figure

1c), an area characterized by lower salinity and muddy sand with low sea grass densities.

In 2005, five potential release periods were evaluated in AK using similar procedures as in the previous experiment. Spotted halibut juveniles (mean 54.7-90.4 mm TL, n=8-2/cage) were released into six cages for 10-day trials from May to August. Fish grew significantly faster in the 3rd and 4th periods (Figure 2). Fish released in the 3rd period had the highest gut fullness.

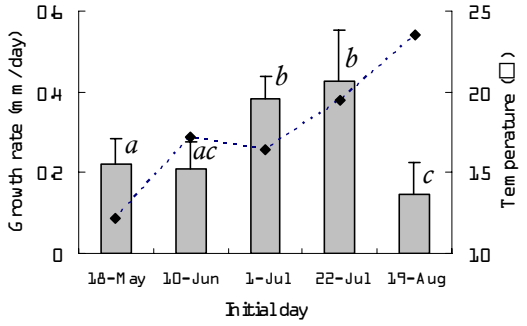

Figure 2: Growth rate of juveniles in cages and mean water temperature.

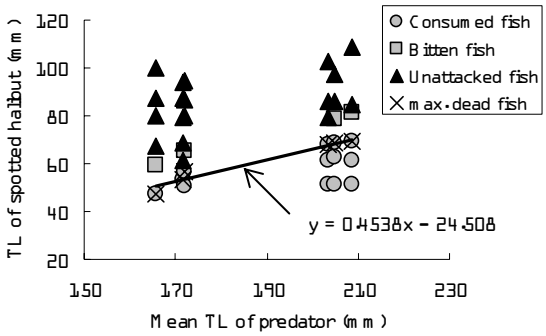

Figure 3: Length of spotted halibut consumed, bitten or unattacked by Japanese flounder.

Potential predators were screened by set-net samplings from 18 June - 30 August 2005 in AK. Over 3000 individuals of 35 species were collected. The piscivorous Japanese flounder at 1 year of age (mainly 160-200 mm TL) seemed to be the strongest potential predator. Laboratory experiments estimated that the size-refuge of spotted halibut from these predators was >80 mm TL (Figure 3).

Finally, market surveys of landed fish released in AK at early July 2004 (mean 81.7 mm TL, n=19000) was conducted in the Miyako Fish Market. From February to October 2005, 47 fish were landed, with some individuals over 300 mm TL. One fish collected in July was 446 mm TL and weighed 1.3 kg (Figure 4).

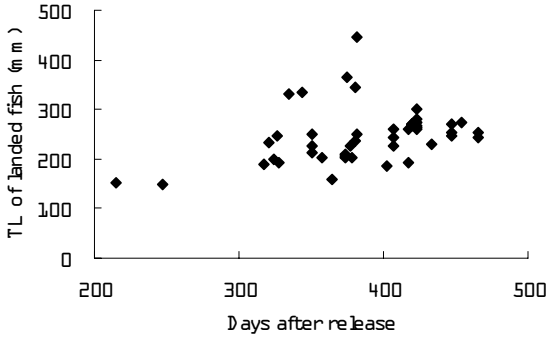

Figure 4: Total length of recaptured spotted halibut.

We propose that the release of juveniles over 80 mm TL at a site with ample large amphipods in early July is the best release strategy for spotted halibut stock enhancement.