In winter, the bluefin swam within the surface mixed layer at shallower depths less than 10 m the night than during the day; swimming depth had a diel rhythm. While in the summer, as the thermocline developed, the bluefin made frequent dives through the thermocline for short periods (~640 s) perhaps for feeding, although the bluefin spent most of their time at the surface. It is suggested that bluefin avoid rapid temperature change at the thermocline using behavioral thermoregulation. In addition, it was also revealed that vertical movement activity could be related to light intensity. The bluefin made few vertical movements on days when solar radiation was comparatively low, implying that low visibility may prevent the movements to depths below the thermocline.
There were also observed changes in the average nighttime depth distributions of the fish in relation to moon phase. Furthermore, the frequency of feeding events was low at that time. Therefore, this phenomenon could be used to hide or escape large predators such as sharks.The frequency of feeding events was low even though all the monitored fish dove every dawn and dusk, irrespective of the seasons or location. It is often theorized that a delay in the mechanical adaptation of the retina of the bluefin to the change in the ambient light intensify might cause visual disorientation. Judging from these facts, it is, possible that these twice-daily vertical movement patterns occurred in response to avoid the ambient light change at sunrise and sunset. In conclusion, the bluefin tuna could both forage as a predator and avoid predators by making use of ambient light intensity change temporally and/or spatially.

Why Fishes Migrate: Behavioral Drive and Evolutional Process

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In order to know the cause why fishes migrate, the initial drive of migratory behavior and evolutional process of migration were discussed. Fish migration is typically defined as a regular habitat transition between the spawning area and growth habitat of a species. It is important for a better understanding of fish migration and life history of migratory fishes to know the evolutionary processes and speciation mechanisms in fishes, but very little has been learned about this aspect of fish migration
Anguillid eels are thought to be derived from a marine ancestor in tropical waters that completed their migration within the ocean, and expand their migration loop into freshwater habitat for growth. In contrast, salmon would originate as freshwater fishes in temperate or higher latitude regions with a potadromous migration only within freshwater habitat, and enter the marine habitat for growth. Comparing to growth habitat, the spawning habitat is more conservative for a species and not easy to be changed. Occurrence of river residents or land-locked population in freshwater habitat in salmon suggests an importance of spawning area in freshwater as the place of origin for the species. In contrast, recent otolith microchemistry has revealed the presence of “sea eels” or marine residents that spend all their life in marine habitat and never migrate into freshwater, suggesting the sea-origin of freshwater eels. Recent discovery of spawning areas of tropical anguillid eels, *Anguilla borneensis* and *A. celebesensis*, in tropical coastal waters gave a direct evidence for small-scale migration of several tens or hundreds kilometers in tropical eels. Thus, Anguillid eels in temperate regions appeared to establish their large-scale migration of thousands kilometers by shifting their growth habitat to higher latitudes, but keeping their spawning areas in tropical waters.
Behavioral experiment on the upstream migration of the ayu, *Plecoglossus altivelis,* showed that behavioral drive should be located as an intermediate between the stimuli (environmental factor) and response (activity or behavior), *e.g.* between the water stream and swimming upstream or the waterfall and jumping behavior, respectively, since the response varied greatly even at the constant stimulus level. In the ayu, the drive was hypothesized to be a repulsion that occurred between the individuals when they come too close each other inside an optimum distance to the nearest neighbor (ODNN) in school. The fish group with larger ODNN tended to jump more actively towards waterfall and swim upstream more vigorously. Effect of various environmental and physiological conditions, such as temperature, light, fish density, hunger, circadian rhythm *etc.*, on upstream migration of the ayu could be well explained by this repulsion-drive model. For example, an increase in water temperature would expand ODNN value and cause a rise in repulsion (drive level) or lowering a threshold level for sensitivity to a stimulus, and thus, induce an increase in behavioral response, presenting more active jumping behavior or upstream migration even at the same stimulus level. It is noteworthy that random jumping behavior was observed without any stimuli for upstream migration when the drive level was raised by an increase in water temperature. This is so-called “vacuum activity” that occurs without any stimuli, and this random jumping behavior without orientation might be the first step for migration of the ayu. Therefore, we speculate that “an escapement from unfavorable environment” might be an initial behavior of primitive migration of fishes.