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A-592 Hiroshi SHIMADA

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Long-term fluctuation of red tide and shellfish toxin along the coast of Hokkaido (Review)

The occurrence of red tides in Hokkaido and long-term changes in shellfish toxin has been reviewed over the past 40 years. The red tides have occurred without damaging the fisheries until recent years. However, in 2014, harmful warm-water species were detected. In 2015, harmful red tides caused by the dinoflagellate *Karenia mikimotoi* occurred in Hakodate Bay. Regarding the changes of shellfish toxin, both paralytic and diarrhetic shellfish toxicity increased in the cold regime in the 1980s, and tended to subside after the transition to the warm regime in the 1990s. On the Tohoku coast, the occurrence of red tides and the change in shellfish poisoning tend to be similar to those in Hokkaido. To reveal the northward expansion of warm-water harmful/ toxic species, it is necessary to start monitoring harmful organisms using morphological observations as well as molecular identification.

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A-593 Ryo INAGAWA and Osamu SHIDA

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Distribution of Pacific saury *Cololabis saira* in the pre-fishing season in the Northwestern Pacific off Hokkaido, Japan

The results of pre-fishery surveys for Pacific saury *Cololabis saira* fisheries conducted in the Northwestern Pacific off Hokkaido, Japan from 1986 to 2015 are reviewed in this paper. Immature age 1 (1 year old) fish and age 0 (0 year old) fish were distributed in the northeastern and southwestern parts of the survey area, respectively, and mature age 1 fish were found in the southwestern area. There was no correlation between the mean survey CPUEs, neither biomass, total catches, nor fishery CPUEs of stick-held dip net fisheries. However, a significant positive correlation was found between the mean condition factors of age 1 fish collected in the surveys and commercial fishery indices (total catches and fishery CPUEs of stick-held dip net fisheries). Furthermore, there was a significant positive correlation between the proportion of

age 1 fish caught by the surveys and stick-held dip net fisheries. In this paper, we discuss the relationship between the indices of the surveys and commercial fisheries, and the origin of mature age 1 fish found in the surveys.

A-594 Kodai MORITA

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#### Evaluation of migration level of Pacific saury in Hokkaido by standardized CPUE

I standardized catch per unit effort (CPUE) of stick-held dip net fishery for Pacific saury landing in Hokkaido from 1998 to 2019 with a generalized linear model for assessing the quantity of Pacific saury to migrate to fishing grounds. The estimates of annual changes in standardized CPUE were higher than the nominal CPUE from 2005 to 2009 and lower than that after 2010. The CPUE changes in August and fishing effort by fishing vessel size class were considered as factors causing the differences between these CPUEs. It is suggested that the nominal CPUE included these factors, and the standardized CPUE removed them reflecting the condition that Pacific saury migrated to fishing grounds. In conclusion, the standardized CPUE calculated in this study will be useful as an index for assessing the quantity of Pacific saury to migrate to fishing grounds.

A-595 Tomonori KANETA

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#### The effect of pelvic fin removal on the swimming of fox jacopever *Sebastes vulpes* fry

In artificial seedling release of the fishes, removal of the pelvic fin is widely used because it is a low-cost method that can be implemented in the juvenile stage. However, the effect of pelvic fin removal on swimming ability has not yet been investigated. In this study, we evaluated the effects of pelvic fin removal on the swimming performance of the fox jacopever *Sebastes vulpes* fry. Swimming time was measured at various flow velocities with total lengths of 40, 50, and 60 mm fry, after removing one of two pelvic fins (experiment) or untreated (control). Analysis of swimming time measurements showed that the critical swimming

speed ( $C_{ss}$ ) increased with growth. There were no significant differences between experiment and control groups for the swimming curves and the  $C_{ss}$ . Furthermore, the swimming ability indices (SAI) were almost the same. Therefore, we believe that pelvic fin removal does not influence linear swimming.

A-596 Mitsuru TORAO, Mahito MIYAMOTO and Miki KOBAYASHI

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Effects of diet supplemented with fish oil on the swimming ability development and predation avoidance for chum salmon fry

We examined the effect of fish oil supplementation on the development of swimming speed in chum salmon fry. The effect of fish oil supplementation on the repression of salmon fry predation was also verified. The cruising speed measured by video analysis of escape behavior was significantly increased in the fish oil supplemented group 26 d after emergence when the average fork length was 4.3 cm. The results of the predation test showed that 1) if there was no difference in body size and swimming speed, there was no difference in predation rate; 2) the predation rate was higher when the body size was relatively smaller, and the swimming speed was lower due to fasting; 3) diet supplemented with fish oil reduced the decrease in swimming speed during fasting, and the predation rate was also lower. These results indicate that the feeding of fish oil supplemented diets may repress the decrease in swimming ability and predation of salmon fry when their nutritional status declines after release.

A-597 Masafumi NATSUIKE, Makoto KANAMORI, Chitose YAMAZAKI, Yoshinori NISHIDA and Kazuhiko HONKE

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A case study of behavioral observation of interim cultured scallops using a low-priced time-lapse camera (Technical report)

A-598 Noboru HOSHINO, Takayuki HONMA and Tadashi MISAKA

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Growth and maturity of walleye pollock in the Sea of Japan off Hokkaido in the lower level period of stock size (Note)

A-599 Noboru HOSHINO and Takashi FUJIOKA

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Characteristics of yellowtail catch in Hokkaido, Japan in the 2010s  
(Note)