外部発表業績

Fisheries Schience

Temporal changes in the nutrient status of Matsushima Bay after a wastewater plant was destroyed by a tsnami on 11 March 2021

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We investigated how the nutrient status of Matsushima Bay was affected when a wastewater plant was destroyed by a tsunami in March 2011. The nutrient concentrations in the seawater and the treated water from the wastewater plant increased just after the tsunami, but decreased again to pre-tsunami levels after 2013. The amount of untreated water that passed through the wastewater plant decreased just after the tsunami. It was estimated that approximately 40.7×10^3 m3/day of the treated water from the wastewater plant was discharged to Matsushima Bay; therefore, the quantity of effluent from the wastewater plant was less than one percent of the water inflow from Takagi River and Sendai Bay (which are outside Matsushima Bay) to Matsushima Bay. The nutrient concentrations of seawater in Sendai Bay were lower than those in Matsushima Bay. The results suggest that nutrient concentrations in Matsushima Bay after the tsunami did not increase because any untreated or poorly treated effluent was easily diluted by the river flow and the inflow of seawater. Many people were concerned about eutrophication, therefore, because of the decreased functioning of the wastewater plant in Matsushima Bay. Marked eutrophication in the bay was not observed after August 2011.

Aquacultural engineering

Identification and counting of Pacific oyster Crassostrea gigas larvae by object detection using deep learning

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Natural seedling collection is widely used in the culture of various bivalve species. For successful natural seedling collection, collectors must be installed when larvae appear in the water column at a stage immediately before attachment. Aquaculture farmers generally identify target larvae by morphological features through microscopic examination in a time- and labor-expensive exercise, which also requires a level of expertise to ensure accurate larval identification. We develop a deep-learning-based object-detection technique that ultimately might reduce the time and effort required to accurately identify and count Pacific oyster larvae, render their identification more consistent, and negate the need for expertise. Images of plankton net samples collected in Matsushima and Sendai bays, Japan, were taken using a new photographic device with a CMOS image sensor. Images of oyster larvae identified by an expert were used to create a library of labeled images to train a deep-learning model, which proved to be 82.4% accurate in precision, 90.8% in recall, and 86.4% in F-measure. A further method for estimating larval shell height from the rectangular shape of oyster larval images is also developed. The standardized mean difference in shell height between measurements and estimates is 3.3%. This deep-learning model has the potential to significantly reduce the time and effort required to identify oyster larvae in plankton samples, and thereby costs of this exercise.

Management of Biological Invasions

Success in population control of the invasive largemouth bass *Micropterus salmoides* through removal at spawning sites in a Japanese shallow lake

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The control of invasive species is of major importance for ecological conservation, and there is a need for more effective techniques and approaches to control these species, especially in open habitats. Two types of activities were conducted to control the population of largemouth bass (Micropterus salmoides) in Lake Izunuma-Uchinuma,Japan. The first activity was a lake wide catch using set nets deployed all along the lakeshore beginning in 2001. The second activity, beginning in 2004, focused on catches during the spawning season over spawning sites, distributed along lakeshore segments with sandy substrates. The efforts of both activities were similar (involving about 140 people/year). From 2001 to 2003, the catch per unit of fishing effort (CPUE)of largemouth bass using set nets increased; however, CPUE decreased dramatically after catches at the spawning sites started. The numbers of nests spawned, larvae, and adults of largemouth bass also decreased after the start of spawning site catches. In 2010, the CPUE of other fish species, whose numbers had decreased due to predation by largemouth bass, recovered to the same number as before the expansion of largemouth bass. Capturing largemouth bass at the spawning sites was an effective approach to controlling this species and conserving fish communities in the lake.

Marine Ecology Progress Series

Bottom temperature warming and its impact on demersal fish off the Pacific coast of northeastern Japan

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Global climate change occurs not only at the ocean surface but also at the ocean bottom, which is the main habitat of demersal fish. To clarify the current status of bottom temperature warming off the Pacific coast of northeastern Japan, we examined gridded bottom temperature fields from 2003 to 2019. These fields were created by a newly developed gridding method using flexible Gaussian filter weighting with time, distance, and depth. Spatially averaged bottom temperature had a strong, significant warming trend of 0.083 to 0.115°C yr-1 in depth zones of 150-300 m, indicating bottom temperature warming. Corresponding to the warming, increases in landing amounts were found for warm-water species such as searobin in the middle region of our study area (37°50'-39°N). Seasonal catch amounts suggest that ribbon fish and swimming crab recently began to overwinter and reproduce in the area. The distribution shifts of non-target species in fisheries were also analyzed using bottom otter trawl survey data from the area from 2003 to 2019. Northward distribution shifts and increases in density were observed in blackbelly lantern shark and bighand grenadier, indicating that bottom temperature warming led to habitat expansion. Conversely, darkfin sculpin and jelly eelpout shifted northward with decreasing density, suggesting that bottom temperature warming had a negative effect on them. Deepsea bonefish shifted deeper into colder waters with increasing density and mean body weight. Thus, changes and responses of demersal fish to bottom temperature warming in the area were revealed.

水産増殖

宮城県沿岸におけるカナガシラの漁獲量の増加と生活史特性

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　Commercial fisheries stocks of the searobin *Lepidotrigla microptera* collected off Miyagi Prefecture by set net and bottom trawl started increasing gradually in 2006, and eventually exceeded 300 tons in both 2016 and 2017. Gompertz growth formulae estimated by the age determination using otoliths showed a significant difference between male and female. The asymptotic total lengths of males and females were 252 mm and 279 mm, respectively , and it was found that females grew larger. The total length and age at maturity were estimated to be 230 mm at 3+ years for males, and 250 mm at 3+ years for females. The gonad weight index peaked in June and decreased rapidly from July to August; this is in accordance with searobin spawning season which occurs in Miyagi Prefecture from June to August. No predominate age group was identified from the age composition, but with individuals aged 4+ years accounting for the majority of examined searobins, it is fathomable that individuals of the 2015 age-class and earlier had already spread out. Taken together, these results suggest that environmental conditions in Miyagi waters have improved over the past decade and, consequently, have possibly attributed to increased recruitment of searobins.

黒潮の資源海洋研究

近年の宮城県における主要な漁獲物組成と海洋環境の変化

岡村悠梨子・増田義男・矢倉浅黄・田邉徹・阿部修久・雁部総明（宮城水技セ）

　近年宮城県では，冷水性魚種の水揚量が減少して，今まで水揚げされてこなかった暖水性魚種が増加しており，海洋環境の変化と合わせて漁獲物組成の変化に関心が高まっている。大型定置網の季節別魚種別水揚量の推移と，定置網以外で近年水揚量が増加している魚種の水揚量の推移を調べた。また水塊分類ソフトにより，本県沖へ接岸する水塊の季節的変動を調べた。定置網における漁獲物組成の季節的な変化は，基本的に資源動向と連動して水揚量を増減させていたが，季節や魚種によっては接岸する水塊の影響を受けている可能性があった。2018年の夏から秋の時期は，黒潮から分離した暖水塊由来と思われる黒潮水の出現率が高かく，近年増加したタチウオなどの暖水性魚種はこの暖水塊とともに来遊したと考えられた。

日本水産学会誌

カキの適正養殖量とブランド化とICT

伊藤博（水産林政部水産業基盤整備課）・奥村裕（水産機構・水技研）・筧茂穂（水産機構・資源研）・上野宗一郎（IDDK）・関内孝行（プロトソリューション）・鈴木宏輔（アンデックス）

　東日本大震災からのカキ養殖復旧の過程で実施したカキの適正養殖量の推定，新たな方法による一粒ガキ生産やブランド化，ICTを導入した種ガキ調査時の漁業関係者への情報提供に関する取り組みについて報告した。

アクアネット

養殖ギンザケの魚病

熊谷　明（宮城水技セ）

　海面のギンザケ養殖ではビブリオ病の発生が最も多く，年により赤血球封入体症候群(EIBS)，BKD，レンサ球菌症，せっそう病が発生している。これらの疾病のうち，海面養殖中に感染するのはビブリオ病のみで，この他の疾病は種苗生産場で感染し，内水面および海面で発病している。各疾病の最近の発生状況と養殖現場で取られている対策，最新の研究事例，課題等について概説した。

東北底魚研究

宮城県沖で底びき網によって混獲されるマサバについて

増田義男・雁部総明・岡村悠梨子（宮城水技セ）

　宮城県の底びき網で混獲されるさば類の漁獲量は増加しつつあり，その動向について研究者や水産業界からの注目度が高まっていることから，なぜ多獲性浮魚類であるマサバが底びき網で混獲され，増えつつあるのかについて，過去の水揚げデータ，市場測定，精密測定，標本船調査や調査船調査等から得られた情報を用いて検討した。近年冬春季は親潮の勢力が弱く，北上暖水が強いため，本県周辺海域は暖水傾向にあり，マサバ未成魚が越冬しやすい環境となっており，成魚の一部も越冬していると考えられた。また，越冬中及び北上回遊中のマサバは，海底で主にツノナシオキアミを捕食しているが，海底は水温が低いために動きが鈍く，４ノット程度の沖底の曳網速度でも混獲されてしまうものと考えられた。

（シンポジウム等）

「ウニ短期蓄養における高タンパク質飼料の有効性」

吾妻行雄（東北大院農），猪股英里（東北大院農），細田俊輔（東北大院農）,前田航平（東北大院農），堀　拓磨（東北大院農）,垂水裕樹（宮城水技セ）,紺野智太（宮城水技セ）

日本水産学会誌（2021）　シンポジウム記録

「宮城県沖合底びき網漁業の実情〜宮城県における深海魚資源の有効利用に関する取組事例〜」
増田　義男（宮城水技セ）
水産学会東北支部会ミニシンポジウム　2021年10月　オンライン開催

「仙台湾におけるタチウオの漁況と生物特性」
増田　義男（宮城水技セ）
令和3年度　中央ブロック資源海洋調査研究会シンポジウム「タチウオの漁業と資源」　2021年10月　オンライン開催

（授業等）

「マボヤ被嚢軟化症の国内侵入と疾病の現状」

熊谷　明（宮城水技セ）

東京大学大学院演習　2021年6月7日（オンライン授業）