Recent results of the micronekton sampling inter-calibration experiment

by Orio Yamamura

Micronekton (osteichthyes, cephalopods and crustaceans) are ubiquitous in oceanic and neritic areas and are an important component of marine ecosystems. In terms of body size and swimming ability, they are intermediate between mesozooplankton and nekton, so they have an important role in transporting organic materials from the productive euphotic zones to the less productive mesopelagic layers through diurnal vertical migration. Furthermore, in subarctic ecosystems micronekton have indispensable roles in smoothing the seasonal variation of prey availability during the less productive autumn and winter seasons.

MIE-1 cruise

The PICES Working Group (WG 14) on *Effective sampling of micronekton* was established in 1997, under the direction of the Biological Oceanography Committee, to tabulate information on micronekton in the North Pacific, including taxonomic composition, biomass, sampling methods and trophic relationships. At the recommendations of WG 14, PICES formed an Advisory Panel on *Micronekton sampling inter-calibration experiment* (MIE-AP) in 2002, to conduct a field study to compare micronekton sampling gears and other quantifying technologies such as acoustics and visual sampling methods. The initial field survey, MIE-1, was carried out aboard the NOAA R/V *Oscar Elton Sette* in October 2004, off Oahu, Hawaii. Three sampling gears were compared: a 140-m pelagic Cobb trawl, a 4-m Hokkaido University Rectangular Frame Trawl (HUFT), and a 1.8-m Isaacs-Kidd Mid-water Trawl (IKMT). For detailed description and results of that survey, please refer to Brodeur *et al*. in PICES Press Vol. 13(1), pp. 7–11.

MIE-2 cruise

In September–October 2005, AP-MIE conducted its second cruise aboard the R/V *Hokko-maru* (902 t) of the Hokkaido National Fisheries Research Institute (HNFRI), Japan. *Hokko-maru*, launched in 2004, is a state-of-the-art 65-m stern trawler with a MOCNESS-10 and has capabilities to deploy other mid-water sampling gears, including stern trawls equipped with a MULTI-SAMPLER (an opening-closing multiple cod-end system, Simrad Inc.). Other gears compared during the cruise were the Matsuda–Oozeki–Hu Trawl (MOHT; Oozeki *et al*., 2004) and HUFT (**Fig. 1**). The former gear is a 5-m^2 rectangular mid-water trawl with a newly developed depressor, which enables the net to be towed at a desired depth at higher speed (5 knots) with a near perpendicular and stable angle of 8°. For the latter gear, two nets with different mesh sizes (3 mm and 9 mm) were used separately. In addition to the sampling gears, backscattering from the scattering layers was recorded using a Simrad EK-60 echosounder with 38, 70, 120 and 200 kHz transducers. The scientists onboard were: Orio Yamamura (HNFRI), Hiroya Sugisaki (Tohoku NFRI), Kazuhiro Sadayasu, Shinsuke Abe and Ryuichi Matsukura (all Hokkaido University). Since the cruise overlapped the dates of PICES XIV in Vladivostok, Russia, members of AP-MIE from countries other than Japan were not able to participate in the cruise.

Basically, every fishing gear was towed at 4 stations which were all located at the outer shelf of the Doto area, off southeastern Hokkaido Island (bottom depth 380–480 m), during the daytime and nighttime, with an exception of MT (rope trawl with multi-sampler), which was towed at

Fig. 1 Comparison of sampling gears during the MIE-2 cruise: MOHT (left top), MOCNESS-10 (right top), rope trawl with multi-sampler (left bottom), and HUFT (right bottom).

2 stations only during the daytime. Every gear sampled the 0–300 m layer. In total, the myctophid *Diaphus theta* was dominant in both numbers (>80%) and weight (>70%). A brief comparison of catch efficiency of different gears for *D. theta* revealed that MOHT was evidently the most effective gear for the sampling of micronekton (**Fig. 2**).

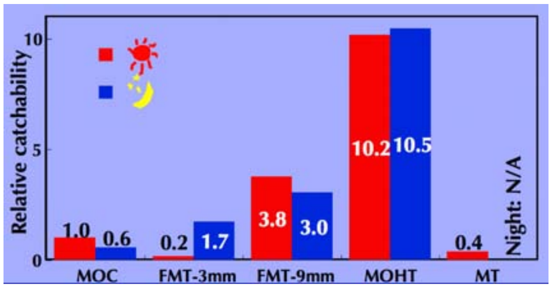

Fig. 2 Comparison of catchability (number of Diaphus theta *(in >40 mm SL) per volume of seawater filtered) for different sampling gears during MIE-2: MOCNESS-10 (MOC), Hokkaido University Frame Trawl (FMT), Matsuda–Oozeki–Hu Trawl (MOHT), and rope trawl with multi-sampler (MT). Numbers are standardized so that MOCNESS-10 during daytime = 1.0.*

MIE-3 cruise

After the MIE-2 cruise, AP members were keen to find ship time for some unfinished business. A direct comparison between IKMT and MOHT was essential because there are so much historical data collected with an IKMT. After two years, the third experiment was carried out onboard the R/V *Oscar Dyson* in the eastern Bering Sea, from September 18–27, 2007. Despite the vessel being engaged in an NPAFC/BASIS salmon survey, Dr. Jim Murphy of the Auke Bay Laboratory (NOAA/NMFS) kindly donated ship time for our experiment. The scientists participating in the experiment were: Orio Yamamura (HNFRI), Hiroki Yasuma (HU) and Andrey Suntsov (NWFSC, NOAA). Although 48–72 hours of ship time were expected for the experiment, the actual duration was only 24 hours due to the extraordinarily rough weather in the Bering Sea during autumn. The gears compared during this cruise were a 1.8-m IKMT and a MOHT. A Cantrawl 300/262 rope trawl was also included in the arsenal, but the limited time window excluded this gear from the comparison. To reduce the time required for each deployment, a site adjacent to St. Paul Island, with a bottom depth of *ca*. 60 m, was chosen for the experiment where age-0 walleye pollock were densely distributed. The sampling was in a day/night sequential design, in which different gears were towed sequentially at each location, with triplicate samples collected during daylight and night at the same ship speed (3 knots). Aside from the sampling gears, backscattering from the scattering layer was recorded using a Simrad EK-60 echosounder with 15, 38, 70, 120 and 200 kHz transducers. The catch was dominated by age-0 walleye pollock (>99%), offering a good opportunity for gear comparison (**Fig. 3**). The catchabilities of the nets were compared by relative number of pollock per volume of seawater filtered by the nets. The nets showed similar catchability during the daytime (1.1 times larger for MOHT in density estimate), but MOHT showed significantly higher catchability in night sampling (2.8 times higher). The fact that the catch efficiencies during the daytime were similar for both gears indicates that visual avoidance by age-0 pollock was virtually identical between these gears. The 2.8 times difference for nighttime tows may represent the difference in the stability of net angle and net mouth opening during hauls.

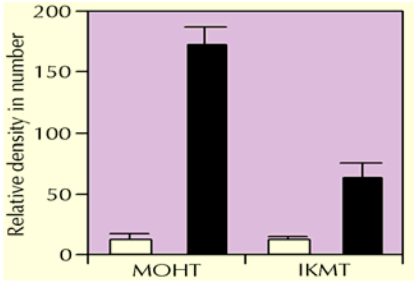

Fig. 3 Comparison of catchability (number of walleye pollock per volume of seawater filtered) between MOHT and IKMT during MIE-3; open bars: daytime, solid bars: nighttime.

How do we proceed?

We have undertaken 3 inter-calibration experiments, providing data for direct and indirect comparison of 8 different micronekton sampling gears. The results suggest that MOHT is the most reliable sampling gear for micronekton. Nevertheless, a brief comparison between acoustic and net sampling suggests that MOHT still underestimates the standing stock by >50%. Fortunately, some data sets are available for direct comparison between results of acoustic and net sampling. We are planning to include a comparison in the final AP-MIE report to be submitted to BIO next fall at PICES XVII in Dalian, China.

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