Educational study of acoustic surveys in coastal shallow area at Southeast Asia

Yoshinori MIYAMOTO[1], Keiichi UCHIDA[1], Yuttana THEPAROONRAT[2], Monton ANONGPONYOSKUN[3]

1 Tokyo University of Marine Science and Technology, Japan
2 Training Department of Southeast Asian Fisheries Development Center (SEAFDEC/TD), Thailand
3 Kasetsart University, Thailand

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In Japan, there is a significant decrease in catches of coastal fisheries in recent years. Fishermen have been pointing out how the fishes are now smaller in size and how the number of yearling fishes has decreased. These phenomena have clearly indicated the decreasing of fish stocks and prompted Japan government to conduct coastal stock assessment surveys to look into the matter. Aside from stock assessment, it is also important to understand current situation of the industry and to evaluate the risk of overfishing and the necessity of resource management.

Fish stock assessment is usually conducted by acoustic surveys or by net samplings using a research vessel and for acoustic surveys, scientific echo sounder are commonly used. Unlike the ordinary fish finders, in addition to the usual functions, these scientific echo sounders can also measure the quantity(the density) of fish by processing the echo reflection(the target strength) from the fish. Despite that these fish finders are extremely efficient for fish stock assessment, there are difficulties in stock assessments due to the expensive cost of fish finders and the lack of specialists or researchers that can analyse the data. And also, in present, only larger vessels can afford to equip scientific echo sounders. This made it more difficult to conduct stock assessments in shallow coastal and bay areas. Despite the need to assess the abundant fisheries resources in these shallow areas, there is almost no stock assessment survey done in these areas.

In Asian countries, coastal fisheries are extremely important in the sense of food security. However, especially in Southeast Asia, there is hardly any stock assessment done on the important commercial species in coastal areas. There are some institutions like SEAFDEC who conduct stock assessment in Southeast Asia coastal water but due to the lack of the number of specialists or researchers that can conduct acoustic survey, it is still impossible to conduct enough surveys to understand the fish stocks in the areas. Most of the fishermen are capable of using a fish finder, but to use fish finder for stock assessment requires special training and knowledge about acoustic survey. In Southeast Asia, such training and education are not offered even in higher education institutions. There are many researchers who received higher education or even PhD regarding underwater acoustic technologies from japan universities, but very few of them continue to specialize in this field after returning to their home countries. Training experts in underwater acoustic consumes a lot of time and effort as it requires a wide range of basic knowledges including physics, electrical and electronics, statistics and biology etc. And when it comes to implementing the actual acoustic surveys, there are also challenges like the difficulties to determine species by echo data, the expensive cost of fish finders, the usage of equipment limited to larger vessels and the time and effort required to analyse extremely abundant data. These challenges are for many countries, but they are much more severe in Southeast Asia due to the education and survey systems in these countries.

Hence, in order to enhance acoustic stock assessment in shallow coastal area of Southeast Asia, we attempt to develop a new acoustic survey system that enables stock assessment by only using the usual commercial fish finders that can easily be found on most of the coastal fishing boats. Without any modification on the fish finder itself, this new survey system implement a newly designed data recording system that records acoustic signals. The newly developed system was tested in-situ.

Most of the existing commercial fish finders process acoustic signals digitally. This is why modifications such as adding a D/A converter are required for signals output. And in most cases, signals processing are done according to each manufacturer of the fish finder. This makes it difficult to determine if the signals are being revised or calibrated. To cope with this matter, we developed a new system with an interface that can extract signals between a commercial fish finder and the transducer. By using this new system, it will be possible to conduct surveys by using the existing fish finder on smaller boats. Surveys will no longer be limited by the size of boats and the type of the fish finders.

In our studies, we used the GP-1670F, a common GPS fish finder by Furuno that is widely used in small fishing and leisure boats. It is equipped with GPS plotter function and transmits two frequencies:50kHz and 200kHz. The oscillator used is 520-5PSD. And by using NMEA0183-RS232C, the boat position and depth information will be transferred to the computer. In the prototype signals acquisition unit, the ultrasonic transmitting signals from the fish finder will work as a trigger and the receiving amplifier will amplify the echo of the reflected waves. The signals are then digitalized by the AD converter and recorded into the computer. However, most of the commercial fish finder is not capable of transmitting only one of the frequencies. This makes it difficult to differentiate the frequencies by the trigger signal. And also, the reflected signals are weak and need to be amplified. Therefore, we designed a receiving amplifier with a band path filter that only amplifies 50kHz signals. It is also capable of two levels of amplifying. The gain at 50kHz is LOW 58.0dB;HIGH 77.7dB and the gain at 200kHz is 6dB. 200kHz signals output via AD converter will be an almost 0V.

The reason of using 50kHz is because it is less influenced by the beam range and the environmental changes underwater. These make 50kHz the appropriate frequencies for easy fish finding. On the other hand, 200kHz has high resolution in distance. It will be much easier to capture the echo from small fishes and by using 200kHz, it is possible to conduct much more detailed observation. However, the experimental sites in our studies is only 20m deep and the normal 200kHz beam range will be too narrow to be used in these shallow sites. Hence, in order to maximize the transmitting area, we chose to use 50kHz.

For AD converter, we used the Pico Scope 4224 by Pico Technology. The sampling rate is max.80Ms/sec., the resolution 12bit and the power is via USB. This Pico Scope is usually used as a digital oscilloscope. Device drivers and control demands etc. are provided by the manufacturer and it is easy to develop software for recording signals into computer. Here, we used the Fish Finder by Fusion Inc. to record CSV files into computer. The sampling frequency is 19.53kHz and sampling number is 800. It is capable to record 1500m/s echo waves from as deep as 30m. As for the fish finder used in this study, the transmission interval and the pulse range are automatically altered according to the depth and this will cause the changes of the trigger intervals and the length of data recording. Therefore, we maintain the setting of the depth to 80m to avoid the changes in the transmitting interval and the pulse range.

For the CSV files, the time is not recorded. And so we used the converter NMEA2000-0183(IF-NMEA2K2) to enable NMEA0183-output of boat positon and depth information. These information are then recorded using Windows-HYPERTRM.EXE and later used to synchronize the time and the acoustic data.

As the final outcome of this study, we expect to complete a manual that can be used as a textbook for acoustic surveys in shallow water. We have completed the development of the system and have held lectures

in Kasetsart University. Along with the actual surveys in-situ, we will complete the manual.

And regarding the newly developed interface, we have received consent from the manufacturer to publish the circuit diagram. This will help us to enhance the usage of the system and the education in Southeast Asia. And with this circuit diagram, we expect to complete a manual that can be used even by beginners. As for the software, due to copyrights, we are planning to develop another software that can be openly used.