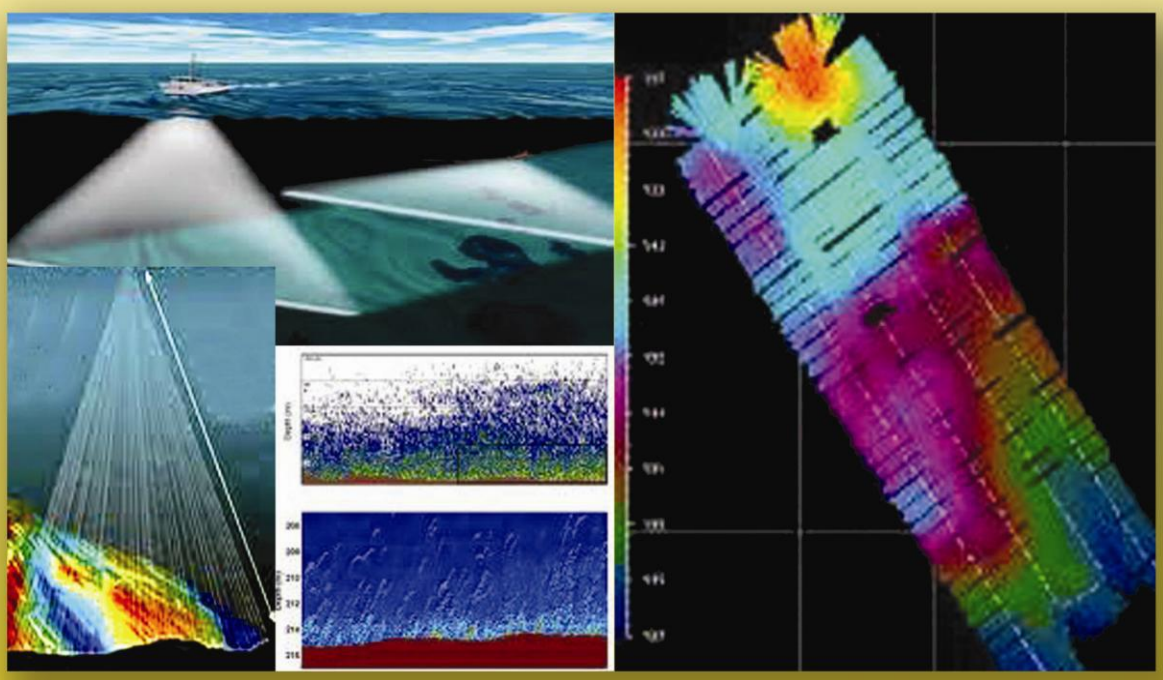
AFAS 2010

THE INTERNATIONAL CONFERENCE ON UNDERWATER ACOUSTICS FOR SUSTAINABLE FISHERIES IN ASIA

" INNOVATION IN ACOUSTICS SCIENCE TECHNOLOGY FOR FOOD SECURITY"

14 - 16 DECEMBER 2010
EASTIN HOTEL, PENANG, MALAYSIA



Organized by
ASIAN FISHERIES ACOUSTICS SOCIETY (AFAS) &
MARINE FISHERY RESOURCES DEVELOPMENT AND MANAGEMENT DEPARTMENT(MFRDMD)
DEPARTMENT OF FISHERIES MALAYSIA

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MESSAGE FROM DIRECTOR - GENERAL OF FISHERIES

Honourable Dato' Ahamad Sabki Mahmood
P.J.K., P.S.K., D.I.M.P.
Director - General of Fisheries
Department of Fisheries Malaysia

On behalf of the Government of Malaysia, I would like to extend our appreciation to the Chairman of AFAS, Professor Dr Kohji Iida for choosing Malaysia as the fourth venue for the annual Acoustic Conference in collaboration with the Department of Fisheries Malaysia.

Echo – sounder was first introduced in Malaysia in the middle of 1960's but it was only in the last decade that Malaysian fishermen in Pulau Pangkor, Pulau Ketam, Perlis , Pulau Langkawi and Mersing started using echo-sounder in fishing operations. Most trawlers and purse-seiners used echo-sounders.

Underwater acoustics device such as echo sounders are widely used our local fishermen, as the technology was used daily and becoming a compulsory item for fishing.

Nowadays, acoustic devices were used not only to record water depth of ponds, lakes, rivers and others water bodies but also used to study migration pattern of marine faunas and most importantly to estimate on fish stocks.

Special thanks also to Prof Dr Iida, organizing and technical committee members who have spent relentless effort in organizing this year AFAS conference. Many thanks also to all sponsors and exhibitors and those involved in making the conference a success.

I wish to all participants' fruitful, information sharing conference, a memorable and an enjoyable stay in Penang. Do enjoy our warm Malaysian hospitality.

Thank you.

MESSAGE FROM DIRECTOR OF RESEARCH

Mr. Raja Mohammad Noordin Raja Omar
Director of Research
Fisheries Research Institute, Batu Maung,
Pulau Pinang, Malaysia

Since acoustic technology is quite new to Malaysia, this event could provide a platform for discussion and exchange of ideas among researchers, academia, engineers, scientist, professionals, manufacturers and also students. We hope that everybody here could share and pick-up some important idea and technology delivered during keynote speeches, technical paper presentations as well as the poster exhibition that have been planned during the conference.

AFAS 2010 International Conference marks a significant gateway for a comprehensive research in acoustic science and technology particularly related to fish stock and identification. We believe it would benefit the world in the long run in order to sustain for food security. We also hope that more solutions and breakthrough will be highlighted during this conference.

Lastly, I would like to take this opportunity to express my sincere thanks and gratitude to our Honorable Dato' Ahamad Sabki Mahmood for his guidance in organizing this conference.

To all participants, welcome to AFAS 2010 Malaysia. It is our hope that the conference will establish a strong network and research collaboration among us. We wish you a memorable and an enjoyable stay in Penang and a fruitful conference.

Thank you.

MESSAGE FROM CHAIRMAN OF AFAS

Professor Kohji Iida
Chairman of AFAS
Hokkaido University, Japan

Dear honourable Dato' Ahamad Sabki Mahmood, distinguished Guests, Ladies and Gentlemen!

On behalf of the Asian Fisheries Acoustics Society, I would like to give a brief address. Our society has just been established 2007 in Dalian, China, and I am very pleased to have the fourth annual meeting AFAS 2010 in here Penang, Malaysia.

Although AFAS is only four years old, we have already experienced five international symposia on Fisheries Acoustics in Asia. Fortunately the number of researchers in Asia has been increased year by year, and the technologies on underwater acoustics have been developed.

The purpose of the establishment of AFAS is to promote further progress of science and technologies on Fisheries Acoustics in Asia by cooperation across borders of countries. Since there are many particular subjects in Asian fisheries such like small quantities with many species, benthic animals, freshwater fishery, and aquaculture, the AFAS aims to challenge to solve these problems using acoustical technologies.

It is a great pleasure for us to have so many people from foreign countries coming together here today. Especially to our delight, we have welcome many friends from Malaysia, Indonesia, Japan, Korea, China, Taiwan, Norway, and from Australia, for this meeting. I believe the network on Fisheries Acoustics in Asia is now spreading more and more. I hope that all participants will feel free to discuss and to exchange opinions, so as to make this meeting success.

Finally I would like to express my sincere gratitude to Dato' Ahamad Sabki Mahmood, Director General of Fisheries, Department of Fisheries Malaysia for hosting this conference and Mr. Raja Mohammad Noordin Raja Omar, Director of Research, Fisheries Research Institute of Malaysia, and Mr. Raja Bidin Raja Hassan, Secretary General of AFAS 2010 and all staffs of the Local Organizing Committee for preparing this conference.

Thank you.

Kohji Iida
Chairman of AFAS

THE INTERNATIONAL CONFERENCE ON UNDER WATER ACOUSTICS FOR SUSTAINABLE FISHERIES IN ASIA, 2010

CONFERENCE SCHEDULE
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SUMMARY OF AFAS 2009

The 3rd Annual Meeting of the Asian Fisheries Acoustics Society, AFAS 2009 entitled "The International Conference on Fisheries Acoustics and Contribution for Sustainable Fisheries in Asia - Innovation in Fisheries Acoustic Technologies for Asian Sustainable Bio-resources Development -" was held at the Civil Service Development Institute in Taipei, Taiwan from the 9th -10th of November 2009, hosted by National Taiwan Ocean University and was organized by Prof. Ming-An Lee. More than eighty participants from eight countries including Taiwan, Japan, Korea, China, USA, Australia, Norway, and Malaysia attended the meeting. All events including the opening and closing ceremonies, five technical sessions, board meeting, general meeting, and welcome/farewell parties were conducted during the session as follows.

1. Board meeting (Pre-conference)

On the day before the conference, the AFAS Board meeting was held at Howard International House. The AFAS Board of Directors present during the meeting were K. Iida, Y. Nishimori, K. Miyashita, Y. Miyamoto, M. Furusawa, K. Abe, Raja Bidin R.H. Ming-An Lee and D.J. Hwang. (1) The accession of new directors, H.J. Lu, K. Sawada and A. Hamano, and dismissal of two directors were approved. (2) The business year in the AFAS statutes was changed in accordance with the calendar year. (3) The fourth Annual AFAS meeting was proposed to be held in Penang, Malaysia in December 2010, organized by Mr. Raja Bidin R.H.

2. Opening ceremony (Conference Day 1)

K.T. Lee, President of NTOU, W.C. Su, Director of Fisheries Research Institute Taiwan, M.A. Lee, Dean of NTOU, and K. Iida, Chairman of AFAS addressed for the AFAS2010 as opening remarks. President Lee sent all sponsors certificate of gratitude respectively. Then all participants had undergone a photography session.

3. General meeting (Conference Day 1)

The 4th general meeting of AFAS was held at the conference room chaired by Prof. A. Hamano, the technical advisor of AFAS. (1) Accession of new directors, (2) Revision of AFAS statutes, and (3) Candidate of AFAS2010 were approved based on the proposal by the board.

4. Technical Session (Conference Day 1 and Day 2)

Four keynote lectures were delivered by D. Chu, K. Iida, D.B. Reeder, and M. Furusawa and 32 papers were presented and reviewed by WG chairs. In the general discussion, the necessities to study sardines and species identification techniques were emphasized.

ABSTRACTS
FOR
ORAL
PRESENTATIONS

I – 1:

Acoustic Surveys for Fish-Abundance Estimation: From Principle to Analysis

K. Sawada

National Research Institute of Fisheries Engineering , Fisheries Research Agency, Hasaki 7620-7, Kamisu, Ibaraki, 314-0408,Japan.

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Quantitative echo sounders have been widely used for fish-abundance estimations in the world. The basic concept of the acoustic survey using the quantitative echo sounder is that the density of fish school is proportional to the volume- or area- backscattering divided by the average target strength (TS) of fish in that school. As we can measure the values of the volume-backscattering and area-backscattering using a quantitative echosounder, if we know the average target strength of the fish school, we will be able to estimate the fish density. The target strength of fish has been measured *in situ* or *ex situ* and also estimated by theoretical models based on the fish morphology and physical parameters such as density of fish and sound speed inside the fish body. Once we can get the regression equation between the fish length and the average TS, we can estimate the average TS by putting length distribution, which is obtained by net samples, into the equation. In this presentation, past acoustic surveys for walleye pollock in the Bering Sea are taken up for explanation of the principle of the acoustic method.

Keywords: quantitative echo sounder, volume-backscattering, target strength

I – 2:

Application of Acoustic Science and Technology

Raja Bidin Raja Hassan, Mohd Tamimi Ali Ahmad, Abdul Razak Latun, Mazalina Ali, Nadzri Seman and Rosdi Mohd Nor

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I – 3:

Application of Underwater Sound for Fisheries

Toyoki SASAKURA

FUSION INC.,JAPAN

The application of underwater sound for fisheries is categorized in three classifications. Category 1 is active transmission equipment such as echo sounder and sonar, category 2 is one way transmission equipment such as pinger and category 3 is two way transmission equipment such as transponder. The application of category 1 is most advanced region of instrumentation and utilize. Principle of echo sounder had been developed 60 years ago. Echo sounder is installed on almost of fishery boat and fisher man cannot do fishing without echo sounder. Purse seiner ship has many types of echo sounders and fishery sonar. Research vessel has quantitative echo sounder and recent developed quantitative sonar. The application of category 2 is limited use of biotelemetry researcher. Fish migration and biology can be solved by pinger fitted fish. These research work aids to commercial fisheries advancement. The application of category 3 is almost not used only research work but also commercial fishing. The transponder is used oceanographic research and marine civil application such as ROV. The principle of these categories equipment and its application are introduced. The concrete plan of the application is also introduced.

Keywords:

I – 4:

Listening to Fish: Application of Passive Acoustics for Determination of Underwater Fish Habitat in Kuala Terengganu Coastal Waters, Malaysia

Khalid Samo[2], Aziani Ahmad[1], Suzuri Hitam [3] and Sulaiman Oladukun[2]

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Fish habitat and behavior studies require documenting and tracking the fishes and this can be accomplished by using acoustics tags. Since, over 700 species of fish are known to produce low frequency sound, by listening to the natural fish vocalization sound, one can determine their presence and hopefully the habitats. While marine biologists are more familiar in this area, fishery scientists have not taken advantage of this technique. This study attempts to characterize, determine and differentiate the different fish habitats at different locations by using passive acoustics recording system based on fish vocalisation sound recorded in the coastal waters of Kuala Terengganu during day and night. The recording system consisted of a hydrophone, amplifier, a notebook computer, power supply and processing software. Results of analysis show that underwater sound recorded at near shore in coral reef sites differ with that recorded at offshore. Moreover, fish activity was observed to be active at night compared to day time based on the noise spectrogram. This paper presents the different characteristics of underwater sound which can be used to determine the preferable habitats of certain marine life. The effect of anthropogenic noise and the problems in differentiating the fish communities and behaviour at their habitat will be discussed.

Keywords: passive acoustic, underwater habitat, coral reefs, FADs, day and night.

II – 1:

The Multi-Dimensional Analysis of Various Artificial Reef Data Sets

Myounghee Kang[1], Takeshi Nakamura[2] and Akira Hamano[2]

[1]Myriax Software Pty Ltd, 110 Murray Street, Hobart, Tasmania 7000, Australia
[2]Department of Fishery Science and Technology, National Fisheries University, Shimonoseki, Yamaguchi 759-6595, Japan

This study is about a three dimensional analysis of multivariate data sets for artificial reefs off the coast of Shimonoseki, Yamaguchi prefecture, Japan. Visualization and quantitative analysis in the Eonfusion application integrates data sets such as: fish school data from an echosounder; environmental data from CTD; artificial reef information; sediment data; bathymetry and coastal line data. The relationships between the quantitative environmental factors and their effect on the characteristics of fish schools around the reef are clearly shown. This multi-dimensional analysis method demonstrates a better way to understand the space and time characteristics of fish schools around artificial reefs.

Keywords: multi-dimensional analysis, artificial reef, acoustic data, environmental data.

II – 2:

Feature Extraction for Discrimination between Jack Mackerel and Chub Mackerel by Using the Split-Beam System

Ikuo Matsuo[1], Masanori Ito[1], Tomihito Imaizumi[2], Tomonari Akamatsu[2], Yong Wang[3] and Yasushi Nishimori[3]

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Identification and classification of fish species are essential for acoustic surveys of fisheries. The target strength (TS) and temporal structures were important features for discrimination of fish species and the estimation of fish abundance. It has been shown that these characteristics were changed dependent on both fish species and incident angle to fish body in the case that echoes were measured from the anaesthetized fishes (jack mackerel and chub mackerel) in the tank. In this study, the echoes were measured from the live fish in the sea. The temporal structures and TS were calculated by using the cross-correlation function and Fourier transform. The position of fish in 3D space was computed by using the split-beam. Both fish movement and the angle of incident to fish body were by tracking process. Fish discrimination was done by judging similarity to the advance calculated templates of each species. It was examined that fish species could be classified by using these characteristics and incident angle. [Supported by the Research and Development Program for New Bio-industry Initiatives]

Keywords: broadband signal, split-beam echo-sounder, species discrimination

II – 3:

Developments of a New Broadband Split-Beam Echo Sounder with Variable Beam-Width

Yong Wang[1], Shinji Ogawa[1], Yasushi Nishimori[1], Masahiko Furusawa[2], Masanori Ito[3], Ikuo Matsuo[3], Tomohito Imaizumi[4] and Tomonari Aakamatsu[4]

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Recently, fishermen wish to know fish size and fish species within a fish school before catching it. Monitoring fish body size, school size and fish swimming speed within the school using a fisheries echo sounder will be useful for the improvement of sustainable fisheries. For this purpose, a new broadband split-beam echo sounder has been developed as reported in the previous AFAS meeting. In order to get higher order information such as behavior, echo trace tracking is necessary. However, in shallow waters or experimental tanks, it is difficult to track the individual fish, because the transducer's beam-width is very narrow, <10 degrees @-3dB at 100 kHz. We have developed a new transmission system to adjust the transducer's beam-width at 8 degrees, 12 degrees, and 27 degrees, respectively. In this paper, we show echograms recorded by the new broadband split-beam echo sounder with variable beam-width. This method will be useful to monitor and count the fish not only in shallow water but also the monitoring in an enclosure for the aquaculture. [Supported by the Research and Development Program for New Bio-industry Initiatives]

Keywords: broadband, split-beam, echo sounder, beam-width, individual fish

II – 4:

Observation of Sandeel Using a Combination of Scientific Multibeam Echo Sounder, Omni Directional Sonars, and Multi Frequency Split Beam Echo Sounders

Egil Ona[1] and Lars Nonboe Andersen[2]

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The lesser sandeel *Ammodytes marinus* is a critically important mid-trophic species in the North Sea ecosystem. It is also a major target for industrial fishing for animal feed and fertilizer. However, it is a difficult species to assess using standard acoustic methods as it is mainly found in relatively shallow water, burrows in the sand during night, forms smaller dense sparse complex schools sparsely distributed during day, and has a relatively weak back-scattering strength. In this work multiple acoustic tools including a scientific multibeam echo sounder (Simrad ME70), omni directional sonars (Simrad SX90 and Simrad SH90), and multi frequency split-beam echo sounders (Simrad EK60) are used to provide more information about the sandeel.

Keywords: sandeel, scientific multibeam echo sounder, omni directional sonars, multi frequency, split-beam echo sounder

II – 5:

Discrimination of Three Tuna Species Using the Broadband Split-Beam System by Masanori Ito Discrimination of Three Tuna Species Using the Broadband Split-Beam System

Masanori Ito[1], Ikuo Matsuo[1], Tomihito Imaizumi[2], Tomonari Akamatsu[2], Yong Wang[3] and Yasushi Nishimori[3]

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For sustainable fisheries, selective catch of species has been anticipated world widely. By-catch of multiple species of tuna has especially gained a lot of attention because of the strong demand of Japanese market. In order to avoid catching unintended fish, remote discrimination of tuna species is requested before purse seine operation. In this study, broadband split-beam was applied to discriminate three species of tuna: bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*) and skipjack tuna (*Katsuwonus pelamis*). Three tuna species were captured in the wild and temporarily held in three enclosures species by species for the experiment. Ultrasonic broadband sound was projected nearly horizontally to the enclosure and echoes from tuna were measured. Each fish was tracked to measure the swimming direction because echo characteristics depended on the angle of incident beam to fish body. Difference of location of a fish between pings could be measured precisely because the range resolution of broadband signal was so high that it was possible to measure individual echoes separately. Two types of discrimination method were validated. First method used ratio of multiple peaks' intensities to discriminate bigeye tuna out of others. Bigeye tuna had swimbladder but the other tuna species has no or very small ones. This suggests dominant echo level of a bigeye tuna should be larger comparing with other species. As a result detecting rate of bigeye tuna was 45 %, which was 13 % higher than the identification of others. Second method employed temporal envelope pattern of echoes. At first averaged patterns of the envelopes of each species (a template) was calculated. Test data of each species was matched with the templates and calculated the Euclid distance. The closest template was judged to be the identified species. This method could discriminate yellowfin tuna and skipjack tuna with more than 50 % accuracy. [Supported by the Research and Development Program for New Bio-industry Initiatives]

Keywords: broadband signal, split-beam echo-sounder, species discrimination

III – 1:

Characteristics of Three-dimensional Target Strength of Fish for Horizontal Sonar

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We discuss the acoustic characteristics of three-dimensional target strength (3DTS) of fish for horizontal sonar. Experiments were conducted in a water tank using a defrosted Japanese mackerel. Measurements were made by changing the horizontal incident angle of acoustic beam of 50 kHz and the pitch angle of tethered fish. Following the experiment, morphological characteristics including the swimbladder size and shape were measured using soft X-ray microscopy and digitized. The theoretical 3DTS was estimated using the prolate spheroid model and compared with the measured 3DTS. Results showed that the TS strongly depended on the fish orientation. The maximum and minimum TS were recorded at the broadside and the head/tail aspect of the fish, respectively. The horizontally averaged TS gradually increased as the pitch angle increased, showing the minimum at 0° pitch angle and maximum at 90°. The measured horizontally averaged TS values were 3 to 5 dB lower than estimated theoretically. Possible reasons from the theoretical, biological, and the technical viewpoints were discussed.

Keywords: 3DTS, horizontal sonar, prolate spheroid model

III-2:

On the Sound Production Mechanisms and Acoustic Characteristics of the Sea Catfish *Hexanematichthys sagor* (Hamilton, 1822)

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The sea catfish, *Hexanematichthys sagor*, found abundantly along the coastal waters of Peninsular Malaysia, has long been known to produce sounds especially among the local fishermen. Records in literature on this subject however, are scarce to be found. Hence, the purpose of this study is to identify and to describe the sound-producing mechanisms of the *H. sagor*, and also to characterise its sound signals. Fish samples were collected from the estuaries of Matang Mangrove Reserve in Perak, Malaysia. Anatomical studies have shown that the *H. sagor* possesses two types of sound-producing mechanisms as is typical within the members of the Ariidae family, i.e. (i) drumming of swimbladder extrinsic sonic muscles and (ii) pectoral fin spine stridulation. The elastic spring apparatus, *Springfederapparat*, formed by the modified, flexible transverse process of the fourth vertebra i.e. Müllerian ramus, to which the anterior surface of the swimbladder is attached to, is an essential component in the swimbladder drumming mechanism. The associated protractor muscles originate from the occipital region of the neurocranium and insert themselves onto the anterior surfaces of the enlarged ramus. Incidentally, contractions of the adductor profundus and superficial adductor muscles allows adduction and abduction movements of the pectoral spine respectively; simultaneously, contraction of the arrector ventralis of the pectoral spine allows the pulling and pressing of the microscopic bony ridges located on the distal end of pectoral fin spine against the rough lateral face of the spinal fossa wall, ensuing in the stridulatory mechanism. Passive acoustic surveys were conducted both in the field and at the hatchery under controlled conditions and sound samples were collected using a single hydrophone (HPA1, Burns Electronic Hydrophone System) connected to a digital recorder (Edirol R1, Roland). Subsequent sound analysis was done using the acoustical analysis software SoundRuler ver. 0.9.6.0 written by Marcos Gridi Papp. Based on the results acquired from the sound signal processing and spectrograms, the frequency range of the *H. sagor* lies within 190 to 1077 Hz. The mean sound duration for drumming sounds is 31.8 ± 20.18 ms with a dominant frequency of 658 ± 86 Hz. On the other hand, stridulation sounds have a mean sound duration of 75.2 ± 17.43 ms and a dominant frequency of 1012 ± 65 Hz, much exceeding those of drumming sounds. Drumming sounds can also be easily distinguished from stridulation sounds in terms of waveforms pattern, whereby individual pulses of drumming sounds showed distinct double peaks accompanied by a reduction in amplitude over time; this double pulse characteristics is found to be lacking in the latter where instead, it is comprised of a series of sharply increasing broadband pulses, with rather maintained sound amplitude throughout the duration of the call.

Keywords: fish anatomy, sound producing mechanism, sonic muscle

III-3:

Characteristics of Mean Volume Backscattering Strength for Multiple Frequencies of Phytoplankton (*Cochlodinium polykrikoides*): Focus on the 3.5, 5.0 and 7.5 MHz

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The goal of this study is to understand the characteristics of mean volume backscattering strength of harmful algal blooms (*Cochlodinium polykrikoides*, called red-tide) with multiple ultrasonic frequencies. The red-tide is a directly cause serious damages to marine ecology, fisheries, and related industry in the coastal water of Korea and South-East Asia region. As an essential parameter for bioacoustic studies, the measurements of mean volume backscattering strength for the red-tide species were performed for multiple ultrasonic frequencies (3.5, 5.0 and 7.5 MHz). In order to know variation of mean volume backscattering strength with numbers, the number of cells was changed from 0 to 1500 cell/ml. For the correct measurements of the volume backscattering strength, the TVR and RVS of three ultrasonic transducers were measured and calibrated. The measured volume scattering strength data in laboratory were compared with those of theoretical model, based on the spherical and cylindrical fluid scatterers. As preliminary results, the measured volume backscattering strengths are increased with the number of cells and frequency and have some difference between frequency and cell numbers. In the future, these features will be used to the real-time detection and the classification of the red-tide species in the coastal ocean.

Keywords: harmful algal blooms, ultrasonic multiple transducers, mean volume backscattering

III-4:

Simple and Yet Precise Fisheries Acoustic System and Survey

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Acoustic fisheries surveys using a quantitative sounder have become a routine work, but they are not necessary popular in Asian countries. The important reasons are: acoustic instruments are rather complicated and expensive, survey ships as the platform and their operation system are sometimes not sufficient, and some acoustic knowledge is necessary for conducting surveys. Considering such situation, in order to spread acoustic surveys in Asia, it is necessary to establish a rather simple, user friendly and yet precise sounder system (simple and precise system) and survey methods. Since the quantitative sounder, personal computer, and processing software have highly advanced compared with the past, complicated manual processing has become unnecessary. Therefore, to develop such a simple and precise system and to make possible to conduct rather simple surveys are not so difficult. This paper discusses systems and survey methods for such purpose. To make the system simple, we use only one or two frequencies. The main frequency is 38 kHz which has suitable features such as to realize high signal-to-noise ratio (SNR) and has been used as the standard frequency. If possible, we adopt another frequency of 120 kHz as the sub frequency to make possible species identification using the frequency characteristics of scattering. The 38 kHz system is designed to achieve the principle of the highest SNR to tolerate moderate noise. We adopt two estimation methods: the echo integration method and the split-beam target strength (TS) measurement method. The species composition is ordinary complicated in Asian waters and the specie identification is important. The reason why we adopt the rather complicated split-beam method is that the TS, size, and behavior information is inevitable for species identification. The system is made as automatic as possible and the raw amplitude data and split-beam phase-difference data are stored on a large memory for further processing using elaborated commercial software. Also in operation, we adopt methods which make the survey easy and simple without lowering the precision. Assuming a vessel is not ideal, the noise level is displayed to suggest a suitable vessel speed or allowable sea condition. Of course the calibration is made by applying the ordinary calibration process using a calibration sphere, but we introduce a alternative checking method using echoes from a homogeneous sea bottom. Above mentioned instruments and operation will be realized by available instruments and software with small modification without developing a special system. The most important point is that with a rather simple system we can conduct a robust and yet precise surveys by careful construction of the system and introduction of some devices.

Keywords: acoustic survey, fisheries resources, quantitative echo sounder, robust and precise

III-5:

Dorsal Target Strength Observation of Free Swim Juvenile Yellowfin Tunas (*Thunnus albacore*)

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In order to recognize echo features of yellowfin tuna (*Thunnus albacore*; YFT) aggregated by Fishing Aggregation Device (FAD), we measured dorsal target strength (TS) of free swim fish. There were about 50 live YFT with approximate fork length (FL) from 25 to 80 placed in the tank in diameter 12 meters and 3.8 meters depth, and measurements were made by a 200 kHz EY60 split-beam echosounder. Paired vertical and horizontal cameras synchronized with VGA recorder system were used to pick up image of the YFT entering target zone (depth = 2.6 ~ 3.4 m) of acoustic beam, with which body length and tilt angle of the YFT were obtained to match echoes. Paired photo images and associated acoustic echoes of 185 single targets with tilt angles range from -25.6° to 25° were segregated and analyzed. According to the 185 set of samples, the dorsal TS of juvenile YFT were altered by vertical title angle while conducting vertical movement. The maximum values of TS were observed during YFT heading down at -0.7° ~ -18.4°. Such differences in TS were proven to be caused by the angle between swim bladder and vertebrate of YFT according to the anatomic and X-ray pictures. In this study we also measured swim bladder volume of 33 YFT collected from the same FAD with body length of 34.1 ~ 72 cm. We found that the development of swim bladder volume in early stage of juvenile YFT (< 62 cm) were quite rapid ($V_{SB} = 5*10^{-6}$ FL $^{3.9298}$,$r^2 = 0.7861$, $p < 0.01$). The dorsal TS variation in relation to swim bladder and vertical movement of YFT will be important features for echo trace recognition and quantitative assessment of YFT abundance aggregated by FAD.

Keywords: target strength, yellowfin tuna, FAD, tilt angle, swim bladder

III-6:

Laboratory Measurement of Target Strength Using Quantified Fish Finder

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We developed the algorithm for detection and quantification of several fish using Quantified Fish Finder. Acquisition of acoustic data was conducted in the water tank, then data processing and analysis using Matlab software. Hydroacoustic data consisted of voltage amplitude and echo level of fish such as golden fish (*Cyprinus Carpio*), catfish (*Clarias* sp.) and black tilapia (*Oreochromis niloticus*). The results show the amplitude values of Golden fishes is 25-32 volts, echo levell from -21 dB to-14 dB, catfish have a range of 27-32.5 volt, echo level -19.5 dB to-17.8 dB and black tilapia is 23-28.5 volt with echo level -19.75 dB to-18 dB. We examine the relation between fork length and target strength of Black Tilapia (*Oreochromis niloticus)* by $< TS >= 20 \log FL - 70.06$. We analyze the echo signal using Continuous Wavelet Transform (CWT) to identify fish target.

Keywords:

IV-1:

Environmental Factors Influencing the Vertical Distribution of Walleye Pollock Juveniles in Funka Bay, Japan Before and After the Transition Period of Food Organisms

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Funka Bay in northern Japan is an important nursery ground for walleye pollock (*Theragra chalcogramma*). Juveniles in the bay go through the transition period of food organisms (TL of juvenile = 30mm), during which their diet shifts to larger prey. This study examined the vertical distribution of juveniles during and after this period to better understand how their distribution is affected by physical and biological (prey organisms) factors in the bay. Net sampling and acoustic surveys were conducted in 2006 and 2007 aboard the R/V Kinsei-maru in May of with a framed mid-water trawl net and in June with a mid-water trawl net. The net samplings were conducted to fish schools observed using an on-board quantitative echosounder. In the present study, the correlation between juvenile size and distributed depth of juvenile in May was analyzed using the sample data, and sizes (<30mm and >30mm) were separated using depth. Acoustic data at 38kHz frequency were collected in the daytime by on-board quantitative echosounder EK60 (Simrad). We examined vertical distribution and biomass of pollock juveniles in Funka Bay using the data. CTD measurements were conducted in the area covering the acoustic transect lines. The body widths of prey organisms in juveniles collected in each tow were measured, and the relationship between juvenile pollock size and prey size was analyzed. Juveniles increased in size with depth in May during the transition period of food organisms and descended in June after this period. In May, juveniles smaller than 30 mm occurred mainly in the warm and low-salinity water, and juveniles larger than 30 mm occurred mainly in the deeper cold and low-salinity water. Juveniles in the deeper water mass fed on larger prey.

Keywords: walleye pollock, acoustic survey, the transition period of food organisms

IV-2:

Spatial and Temporal Distribution of Oncaeide in Chabahar Bay

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Zooplankton organisms as community are important grazers in the pelagic zone consuming a wide range of food particles that vary in size and type. The zooplankton also aids in the vertical export of carbon out of the mixed layer as particulate, skeletal, and fecal material. Further, Chabahar bay is an important port in Gulf of Oman and is a suitable fish site. This bay is important geographically and economically, but very little published information is available on the Bay. Oncaeidae samples conducted from Zooplankton sampling during four oceanography cruises August 2007 (SW-monsoon), November 2007 (post-monsoon), February 2008 (NE-monsoon), and May 2008 (pre-monsoon). Five stations were investigated throughout the Chahbahar Bay. Two stations (St 1 and 2) were located far from shore waters with 22 m depth, another two stations were the near shore with 6m depth (St. 3 and 5) and the final station (St. 4) was located in the middle of the Bay with 12m depth. Zooplankton was collected by using of 100-µm mesh nets equipped with. Investigations into the spatial and temporal distribution of Oncaeidae were studied in Chahbahar Bay (Gulf of Oman). Zooplankton were identified 4 species of Oncaeidae(*Oncaea media, Oncaea minuta, Oncaea venusta and Oncaea clevei*. The abundance of *Oncaea media* was maximum in the post-monsoon (>700 ind. m^{-3}) and disappeared in pre-monsoon while *Oncaea minuta* was maximum in post-monsoon (>130 ind. m^{-3}) and disappeared in NE-monsoon (Table1). *Oncaea venusta* showed highest abundance in post-monsoon (>350 ind. m^{-3}) and lowest in pre-monsoon (<60 ind. m^{-3}). The highest densities of *Oncaea clevei* was in post-monsoon (>200 ind. m^{-3}) and disappeared in pre-monsoon.

Keywords:

IV-3:

Comparison of Acoustic Zooplankton Biomass Related to Different Mesh Size in the Waters off Northern Taiwan

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Acoustical and biological sampling of zooplankton in the waters off northern Taiwan has been carried out for 9 courses by ocean research vessel Ocean Researcher II during 2007 to 2009. The volume backscattering strength (Sv) was measured at 38 kHz; in the meanwhile a joined Bongo net and an ORI net were used to collect the biological organisms. The joined Bongo net is composed by four single net with identical diameter in mouth of 60 cm, but different mesh size of 200 μm、330 μm、500 μm and 1000 μm respectively. For the ORI net, diameter of mouth is 160 cm with each mesh size of 330 μm. While sampling, both sets of net were dragging vertically in the study area across the continental region to shelf brake waters. The estimated densities of zooplankton at different mesh size of Bongo nets were compared using Friedman chi-square test and Dunn test. Our results showed that biomass of zooplankton were differently at each mesh size of Bongo nets. Overall, the biomass sampled by the Bongo net was the highest at mesh size of 200 μm, but the lowest at mesh size of 1000 μm. In addition, there were no significant differences in biomass between the mesh size of 330 μm and 500 μm (Dun test, $p<0.05$). The regression analysis showed a linear relationship between the log of zooplankton density ρ(mg/m^3) and the acoustic Sv (dB), with correlation coefficients greater than 0.52 for all nets. Comparing the slopes and intercepts of the five equations, there were significant differences between the intercepts, but not for slope. The highest intercept was found in the Bongo net of 200 μm mesh size, but the lowest intercept was in the mesh size of 1000 μm. It suggested that the evaluation of net sampling efficiency need to consider the factor of the mesh size.

Keywords: acoustic survey, zooplankton biomass, mesh size, northern taiwan waters

IV-4:

Acoustic Scattering Measurements of Zooplankton in the East China Sea in Early Summer 2010

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The East China Sea is an important area for the productivity of aquatic organisms because it is at the mercy of the marine environment of various water masses such as China's coastal water and the Tsushima current, formed from a branch from the Kuroshio Current. As an aquatic food organism, zooplankton plays an important role in the estimation of fisheries' resources and the understanding of marine ecosystems. In addition, most zooplankton forms in the Sound Scattering Layer (SSL) by diurnal vertical migration, such as in the ascent toward the surface layer at night time and descent toward the sea bottom during the day. However, so far, study of SSL in the waters of Korea has left much to be desired. Accordingly, this study assessed the depth and location of the SSL using acoustics, and looked at zooplankton of the target layer using sampling gear. A field survey was carried out on June 26, 2010 in the East China Sea using "DONGBAEK" which belongs to Chonnam National University. Acoustic observation used a quantitative echosounder of 38 kHz and 120 kHz (split beam) installed at the bottom of a ship. Zooplankton was horizontally towed for about 10 minutes at a speed of two to three knots using Frame Midwater Trawl (FMT, 2m*2m). Also, at the FMT entrance attached to a flow meter, catch monitoring system to tow at an accurate depth, and a Temperature and Depth Recorder (TDR) to know changes in depth. The results showed that there were eight taxa of zooplankton in the SSL: Hydroida, Thaliacea, Copepods, Amphipods, Chaetognatha, Decapod larvae, *Euphausiid pacifica* and Fish larvae.

Keywords: East China Sea, Sound Scattering Layer, zooplankton

IV-5:

Acoustic Characteristics of *Sergia lucens* Resources in Waters off Southwest Part of Taiwan

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Sergia lucens is one of the important commercial shrimp in southwest part off Taiwan. In recent decade, the utilization of this shrimp had increased about 2.8 times from 1999(14,139mt) to 2008(39,974mt). Assessment of standing stock is the key point for the evaluation of *Sergia lucens* of all harvest impacts and for fishery regulation. According to catch from bottom-trawl fishing boat, the species of the greatest commercial interest, *Sergia lucens*, is always combined with several species. Though it is impossible to segregate the echo of *Sergia lucens* from other species, catch rate can be used as a variable to estimate the total weight of *Sergia lucens* from each catch. In order to estimate the standing stock of *Sergia lucens*, a discriminating function was established in this study by using factors of fishing conditions, including time of sunrise(X1) and fishing operation(X2) and mean volume for backscattering strength (X3=MVBS). 17 test-fishing of trawls of 4 cruises were carried out with a Simrad EY500 scientific echo sounder onboard to collect acoustic data of *Sergia lucens* in southwestern coast off Taiwan, from Feb. 11th to 12th and from 20th to 21st, 2010. Three types of catch rate (between 72% and 59% as high-density type, between 58% and 29% as middle-density type, and below 28% as low-density type) were defined according to actual catch rates of *Sergia lucens* among 17 test fishing. As results shown, the first discriminating function (D1=-0.555X1-0.355X2+1.175X3) can predict the catch rate of *Sergia lucens* very effectively and up to 100% accuracy. Mean predicted catch rate were estimated step by step by comparing actual mean catch rate and increasing/decreasing 1% predicted catch rate. Finally, mean predicted catch rate of three types were estimated as 66.5%, 46.5% and 3%, respectively. This can be used to convert the actual weight of catch, and resulted in the standing stock of *Sergia lucens* will be the accumulated weight of predicted catch.

Keywords: *Sergia lucens*, mean volume backscattering strength, standing stock

IV-6:

The Development of Fish Forecasting System Using Sea Surface Temperature and Chlorophyll Satellite Images

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In this paper, we propose a new statistical modeling approach to develop a Fish Forecasting System (FFS) using Sea Surface Temperature (SST) and Chlorophyll satellite images. The model uses SST, Chlorophyll and fish catch data to develop the FFS model particularly to detect pelagic fishes in South China Sea. The system also incorporates an Intelligent Feedback System (IFS) to improve the model over time. The input for IFS comes from fishermen as a feedback data. The approach is general and could be used with other remote sensing data sets or data assimilation products.

Keywords:

V-1:

The Application of Micro Transponder to the Fish Cage Shape Measurement System

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In aquaculture, it is important to dynamically measure the shape of the fish cage. However, there was an example of estimating the dynamic behavior of the shape until now in simulations, etc.. The example of measuring the movement of the fish cage directly was not reported in most except for the case by the experimental tank. The reason seems to be because there were no effective methods that measure the cage shape. Then, the measurement of the fish cage shape was tried by the development of micro transponder fixed to the cage. We have already developed a pinger (an ultrasonic transmitter) of small long life and long-range achievement. The transponder that on the basis of this, it designed receiving amplifier of small type and low consumption current, and that it put it in the case of the size equal to a pinger was produced experimentally. Geometries including the battery were φ10×40mm on the prototype named “Traponpinger”. The world is being minimum transponder on this. Using two of CR626SW(φ6.8×2.6mm32mAh), the battery life was about a day. Using one of BR-2/3A(φ18×30mm1000mAh) , the battery life was about a month. In the experiment, the shape of fish cage installed in the aquaculture sea area was intermittently measured for 3 days during two weeks. The battery was BR-2/3A in order to measure Therefore; the size of Traponpinger was largest φ20mm×100mm maximum. The measurement of the shape of the yellowtail fish cage (length 10m× width 10m× depth 6m) was done by fixing Traponpinger at 8 places of the cage. The simultaneous measurement was carried out in cycle period 5 second. The receiver was installed at the four corners of the cage, and the M sequence signal of Traponpingers was correlated and was processed real-time, and 8 position measurements were carried out. As the result, it was possible to quantitatively measure the dynamic alteration of the cage, though there was a malfunction by underwater noise.

Keywords: transponder, fish cage, ultrasonic telemetry

V-2:

Underwater Sounds of Biological Origin for Habitat Monitoring in Kuala Terengganu Coastal Waters

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Biological and physical underwater sound recordings in proximity of Fish Aggregating Device (FAD) were conducted in waters of Bidong Island. The water surrounding the island is covered with coral reefs and artisanal fishermen placed FADs to assist in fishing using hand-lines. The recordings were made by using a passive acoustics technique and through listening of ambient and biological sound which were subsequently analyses. Twelve different types of biological calls have been recognized and their unique characteristics are presented and interpreted. Eight different types of calls recorded from coral reefs area consisted of long vocal, croaking, bruping, drumming, whistling like sounds. The other four similar and different calls recorded in the vicinity of FADs were groan, chirp, drumming and rapid clicking sound. The characteristics mainly the frequencies and sound patterns were compared for both sites. From the sound or noise spectrums, the coral reefs area (near shore habitat) is comparatively noisier compared to the surrounding at FAD. These unique sounds are easily identifiable from their spectrum plots and acoustically different at both locations. This study was an early attempt to identify the origin and the characteristics of noises in different habitats in Malaysia. The different types of calls made by different fish and aquatic lives have potential to be developed for fish biodiversity and productivity measurements of a particular ecosystem.

Keywords: underwater sound, coral reefs, FADs, habitat, hydrophone

V-3:

Development and *in situ* Application of Ultrasonic Acoustic System for Real-Time Marine Harmful Algal Bloom's Detection

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The representative harmful algal bloom (HAB, called red-tide) in the coastal waters of Korea is a dinoflagellate (*Cochlodinium polykrikoides*) that caused serious damages to marine ecology, fisheries, and related industry during summer season. In order to mitigate or eliminate the species before making a vast damage, early detection is most important. In general, the detection of the red-tide is counting method from filtered seawater. In spite of the advantages such as quantitative and qualitative analysis, the method is limit to the necessary time and cost. For more quickly detecting the species, new approaches are necessary. Recently hydroacoustic techniques are applied to *in situ* detection of aquatic organisms in seawater or freshwater environment. Based on the acoustic scattering property of the species, we are trying to develop acoustic detection system of harmful algal bloom using ultra-frequency over the 3 years. The prototype system is mainly composed of ultrasonic sensor (3.5 and 5.0 MHz), GPS, power, pulser-receiver, signal processor, network, and land-based control unit. The interactive data and control command transfer between *in situ* the system and land-based center was used CDMA and wire/wireless internet. For making the most of the system's advantage, the system separately consists of two types; ship-board and mooring-type. Based on the laboratory evaluation, we tested and applied many times the system in the several conditions (with red-tide, without red-tide) of the coastal waters. Despite some modification in the near future, the system can be applied to real-time monitor or detect HAB in the coastal water and expanded to another field for detecting aquatic micro-organisms.

Keywords: real-time monitoring, red-tide, ultrasonic acoustic system

V-4:

Development of a New Ultrasonic Biotelemetry System Using the Multilayer Piezoelectric Actuator

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We developed a new ultrasonic biotelemetry system that the transmission distance was achieved over 1,000 meters, the life of the ultrasonic transmitter (the pinger) was realized 240 days battery life when 30 seconds repetition using the small battery SR626SW 32mAh. The pinger size was designed theφ10mm and 40mm long. The pinger's transducer was used the multilayer piezoelectric actuator. The M sequence signal was used the pinger and the correlation processing of receiving system was adopted for the high recognition against the noise and to avoid the collision of the pingers. In these reasons, a highly efficient ultrasonic biotelemetry system would be desired to the ocean having a high underwater ambient noise that is especially from the temperate zone to the tropics. The four parameters are defined as the estimated factors for this system, long distance transmitting, battery life, pinger size and ability of recognition. The four parameters of the pinger are analyzed and investigated to design the optimum ultrasonic biotelemetry system. The first parameter, long distance, must be considered the transmitting frequency. The second, battery life, must be designed the effective transducer and the low power dissipation circuit. The third, smallest pinger size, must be adopted the microelectronics components. The last, high recognition, depend on the signal processing method of the transmitting system under the water. The system consists of the tiny pinger and the high performance receiving equipment including the transducer. The pinger can transmit the IDs and the depth information each repetition interval. The receiver process to correlate the received the M sequence signal from the pinger using the FPGA chip and calculate the direction of the pinger. The row data can be stored to the PC through the data conversion from analog to digital, 16 bits 192 kHz sampling. The actual experimental data will be presented to obtain in the Tokyo Bay using the developed system.

Keywords: ultrasonic biotelemetry, the M sequence, ambient noise

V-5:

Change of the Pinger Source Level Due to Implanted Fish

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Grasp of the marine organism ecology is important in order to carry out resource management and conservation of the aquatic organism. Especially, the ultrasonic biotelemetry has been used as one of the observation techniques for behavior of fish, marine mammals and so on. In this technique, the ultrasonic transmitter (pinger) is implanted in the target fish. After releasing the fish, the fish behavior is estimated by tracking the pinger signal using the ultrasonic receiver. The distance between pinger and receiver (receiving distance) is important in this technique. If the receivers are installed without grasping the receiving distance, the fish behavior will not be estimated accurately and precisely. However, in the research using this technique, there were the dispersion on receiving distance and the measuring method of the distance was not clear. In addition, the cause of the dispersion has not been clear either. Recently, the pinger was implanted surgically into the peritoneal cavity of the fish. In this case, the source level of the pinger is expected to change by fish's internal structure (swim bladder, bone, internal organs, etc). As a result, it is thought that it greatly influences the acoustic pressure received by the receiver. However, there is no previous work that clarifies these. In this study, the acoustic pulse was transmitted from the inside of fish, and the source level was measured around the fish. And, it aimed to clarify the change. Three southern bluefin tuna were used as specimens and the experiment was conducted in a large freshwater tank. The nondirectional transmitter was used instead of the pinger. The frequency was 51, 60, and 78 kHz that were typical frequencies of the ultrasonic biotelemetry system. In our results, the possibility in which the source level changed became clear, when the pinger was inserted in peritoneal cavity of the fish.

Keywords: ultrasonic biotelemetry, pinger, source level

V-6:

A Review of Passive Acoustic Monitoring Methods for the Detection of Cetaceans in Southeastern Asia Region

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Biodiversity is the key factor for the sustainable echo systems. Especially in southeastern Asia waters, resources of many marine species reduced quickly. Conservation and sustainable management are required, but the monitoring of the echo system is not the easy task. Cetaceans are the top predators in the ocean. They depend on the lower tropic level such as fish, crustacean and shellfish. Reduction or extinction of a local population of a cetacean species indicates the loss of species in the lower tropic level. This means that we can use the cetaceans as the warning index of the sustainability of the local water diversity. Here we review passive acoustic monitoring methods of cetaceans in Asian waters. Recently passive acoustic method is getting popular quickly for the survey of cetaceans. Frequent production of high-frequency bio-sonar signals allows the animal to be detectable using simple underwater recording systems. A stereo acoustic event data-logger (A-tag, Marine Micro Technology, Saitama, Japan) fixed on a buoy or placed on a seabed has been used for the long term observation of movement and density of dolphins and porpoises. The data logger towed from a ship enabled passive acoustic transects to estimate the distribution of odontocetes. The passive acoustic monitoring methods were not only successful in detecting the presence of animals, but also in counting, localizing, and tracking phonating individuals. Three major target species in southeastern Asia region are finless porpoises *Neophocaena phocaenoides*, Indo-Pacific humpback dolphins *Sousa chinensis*, Irrawaddy dolphins *Orcaella brevirostris*, which habituate local waters and sensitive for the diversity of the local echo system.

Keywords: biodiversity, finless porpoise, Indo-Pacific humpback dolphin, Irrawaddy dolphin, passive acoustic method, biosonar

ABSTRACTS
FOR
POSTER
PRESENTATIONS

P-1:

Spatial and temporal variation of Paracalanus in Chahbar Bay-Gulf of Oman

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P-2:

Effect of pH on the Waste Production of Catfish in Running Water System

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The objective of this study was to observe the effect of pH on the waste production of African catfish, *Clarias gariepinus* in a running water system. Nine months old male catfish having average weight of 50.00g were placed in a running water system with a density of 64. Water samples were collected twice daily and analyzed for ammonia nitrogen, phosphate and nitrate contents. The samples were analyzed with HACH spectrophotometers DR2800. Water samples temperature was also recorded for each sampling. Nitrate showed significant difference with higher value (1.16±0.08 mg/L) for pH>7 as compared to pH<7 (0.94±0.06 mg/L). No significant difference was observed for ammonia nitrogen, phosphate and temperature. Positive correlation was also observed between pH and nitrate (r=0.26). This study allows to conclude that pH plays an important role in the production of the waste contents which may have a substantial effect on the survival of the catfish.

Keywords: African catfish, pH, waste production

P-3:

Study on the Jellyfish Acoustic Scattering in Korea Coastal Region: Major Three Species (*A. aurita*, *N. nomurai* and *C. nozakii*)

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A massive jellyfish that appeared in the coastal regions of Korea causes sometimes serious damages to marine ecology, fisheries, and related industry over the last decade. The origin and cause of the massive jellyfish have not yet clearly investigated in the ocean. In order to understand the abundance and distribution of massive jellyfish are needed to know where or when their blooms will happen. Then, the acoustic technique is one of the useful methods to obtain the information if the acoustic characteristics of the targets are known. Major jellyfish species in the coastal water of Korea are known to *A. aurita*, *N. nomurai* and *C. nozakii*. During last 3 years, studies on the characteristics of the acoustic scattering strength, especially target strength (TS), have been intensively conducting for the three jellyfishes. For the measurements, 120, 200 and 420 kHz split-beam transducers were used in the large cage and transducer directions for the experiments were separately down-aspect and side-aspect. The numbers for TS measurement were 39 (diameter 10 - 22 cm in air) for *A. aurita*, 52 (diameter 12 - 79 cm in air) for *N. nomurai*, and 20 (diameter 19 - 46 cm in air) for *C. nozakii*, respectively. Considering symbiotic relationship between jellyfish (*N. nomurai* and *C. nozakii*) and small fish, TS of the symbiotic fish was also measured. Finally, physical properties such as sound speed contrast and density contrast were investigated to apply acoustic scattering model in the near future. The results of the TS studies for three jellyfish species can be used as an essential data for the acoustic detection of jellyfish in open ocean or coastal area.

Keywords: *A. aurita*, *C. nozakii*, jellyfish, *N. nomurai*, target strength

P-4:

Application of Micro Cavitations Bubbles for Mitigation of Harmful Phytoplankton in Seawater

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The representative species cause harmful algal bloom (HAB, called red-tide) in the coastal waters of Korea is a dinoflagellate (*Cochlodinium polykrikoides*) that gives serious damages to marine ecology, fisheries, and related industry during summer season. When the red-tide occurred in the ocean, as a natural absorbent material of red-tide, amount of clay to mitigate red-tide have been sprayed in Korea. The method for red-tide mitigation involves considerable human power and cost and may make a harmful effect on the coastal ecosystem. As a pilot study, we considered physical approach to mitigate or eliminate of the red-tide. In physics, if propeller with a blade rotates in water with very high speed, the propeller makes mass cavitation bubbles around water. When the cavitation bubble returns to liquid condition from vapor, surrounding waters of the bubbles accelerate into the bubble inside, finally the bubbles suddenly collapsed. With the principle, we have a hypothesis that the returning power or speed (>1000 m/s) of the cavitation bubble can break red-tide cell in the water. We, therefore, tried to make micro cavitation bubbles under the various tiny propellers with a high speed motor (3000 rpm) and red-tide species was instantaneously exposed to mass cavitation bubbles. From the measurements, most of cell population was apparently reduced under the laboratory condition. In the field measurement of the red-tide water, cell numbers were compared with before and after of the cavitation bubbles experiment from the cell counting. After cavitation bubbles experiment in the red-tide blooms water, the cells density has a tendency to rapidly decrease and chain of cell was broken. These results suggest that it may be possible to decease of harmful algal blooms from cavitation bubbles.

Keywords: cavitation bubble, cell density, mitigation, red-tide

P-5:

The Characteristics of Biomass Distribution Summarized by Acoustic Surveys Conducted in the Waters Adjacent to the Continental Shelf of Northeast Taiwan

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In this study we used EK500 data collected by the Ocean Researcher II in the northeastern waters of Taiwan during 2006~2008 to build distributional model of total biomass from coastal to continental slope (10~300 m). We calculated the index of sound scattering intensity of each transects among surface, middle, and lower layers, including mean volume backscattering strength (Sv) of 38kHz and 120 kHz. With these Sv value, we used GLM (Generalized Linear Model) to analyze effects of layer, area, and slope on the biomass distribution. The major results of this research are as following:

1. The Sv value of different layers in the 28 transects show that biomass density changed decreasingly by the depth of waters and the distance to coast. The mean decreasing rate for 38 kHz and 120 kHz were -0.58 and -0.34 dB/nm.
2. The decreasing phenomenon of 38 kHz is more significant than those of 120 kHz, which imply that the distribution density of larger organisms decreasing faster than small organisms. Small organisms disperse from coast to offshore in the surface layer and large organisms are more dependent on the seafloor relief.
3. According to all transects of 38 kHz and 120 kHz, we estimated the total biomass distribution density of coastal (depth < 75 m), continent shelves (75 m< depth < 200 m) and slope (depth > 200 m) were 22:9:6 and 17:11:9, respectively.
4. The GLM analysis shows that temporal factors (year, month) and spatial factors (layer, area, and slope) were major factors of biomass variation, which explain 60.8% and 40.05% variation of Sv for 38 kHz and 120 kHz, respectively.

Keywords: volume back scattering strength, EK500, North Eastern Taiwan, biomass

P-6:

Acoustic Quantification of Bottom Backscattering Strength Using Multibeam Echosounder

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We used multibeam echosounder Simrad EM3000 to measure bottom backscattering strength and water depth. The research location is near Northern Sumatra seawaters. The position and water depth of each sounding point are plotted into bathymetric map. The results show bottom backscattering strength for sand is -19. dB, -21.9 for silt, -27.0 for clay bottom.

Keywords:

APPENDICES

APPENDIX 1

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APPENDIX 2

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Myriax is now widely recognized as the world leader in the development of hydrocoustic visualization and analysis software for the global scientific community. Through Myriax's commitment to supporting each individual user, Echoview is now in use by more than 218 research institutes in over 32 countries around the world, and has become the standard for advanced hydroacoustic research in marine and freshwater environments.

Echoview is an advanced hydroacoustic data-processing application for fisheries scientists and environmental managers who need to monitor and understand aquatic environments. It provides the ability to quickly and easily visualise, process and characterise the data from a wide range of echosounder and sonar systems with an extensive range of user-definable algorithms. Echoview is unsurpassed in its scope, power and flexibility and has been widely adopted as the global industry standard for fisheries acoustics and related studies. Its applications include biomass assessment in marine and lake environments and fish tracking and counting in rivers. A major advantage of Echoview is its ability to handle data from all major echosounder brands and its compatibility with a range of acoustic data formats including Simrad, BioSonics, Kaijo, HTI, HAC and others.

In 2008 Myriax launched its second major software product, Eonfusion. Eonfusion developed from the need to integrate the results of hydroacoustic surveys with information from physical oceanographers, phytoplankton scientists, biological oceanographers, zoologists and a multitude of other disciplines. Up to this point, there was no simple and effective way for this information be integrated and studied over a range of scales in space and time. Eonfusion is now the answer. As Eonfusion expands into the consciousness of scientists around the globe, we are already seeing an overwhelming array of exciting applications for this cutting-edge 4D data-visualization and analysis package. From the marine realm through to sea-level-rise modelling, freshwater ecology, terrestrial animal tracking, training tools for athletes and even the analysis of global markets, we can expect Eonfusion to change the way in which we view, interpret and ultimately understand the world around us.

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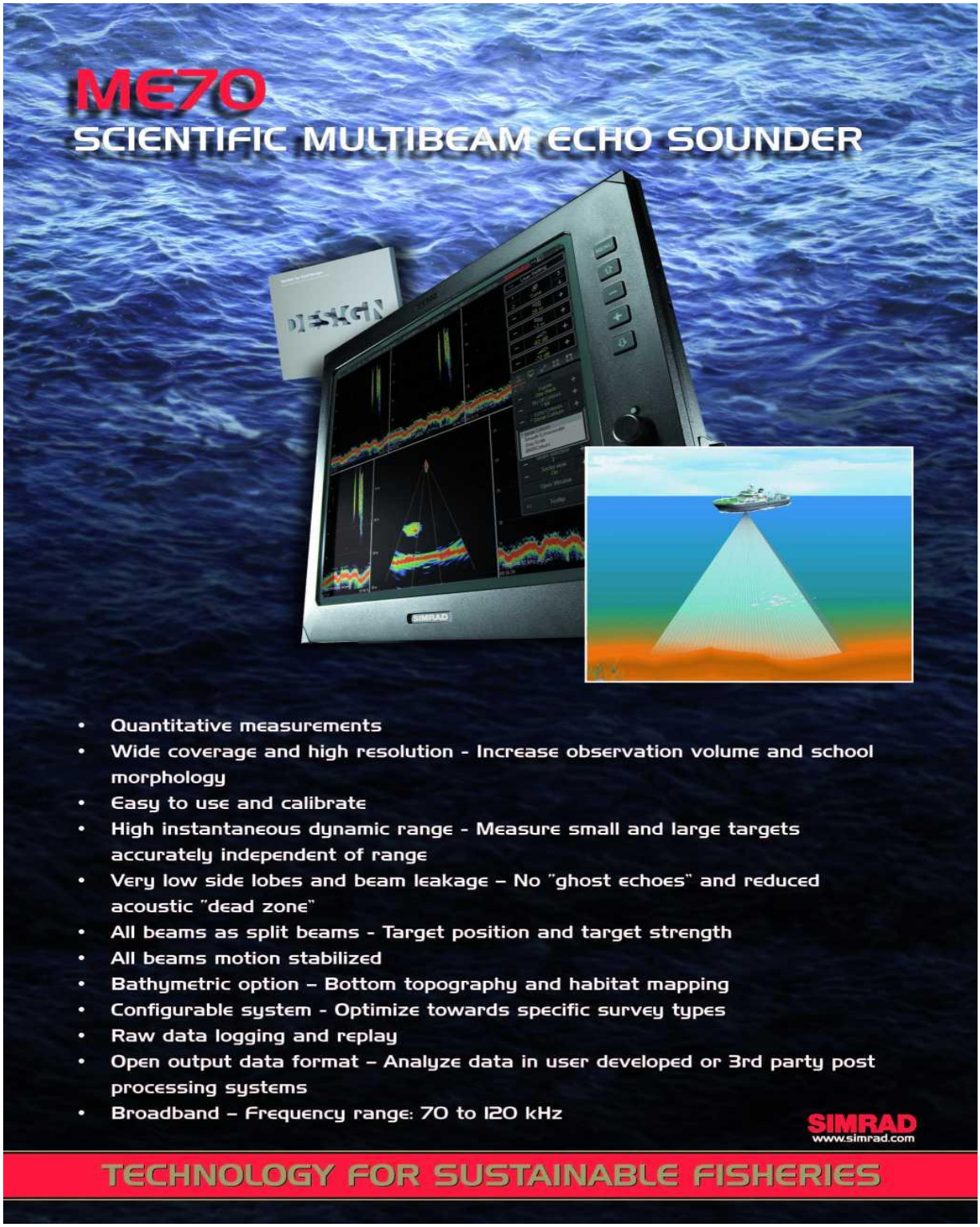

Instruments for Dynamic Oceanography

Sea Bird Electronics

Ohmex

TideM8

TideM8 uses the latest low power processor and flash memory technology to keep track and record water level. The new design offers precise calendar and time keeping functions together with solid state data retention. The TideM8 is designed to interface directly to external displays or computers using serial communications with Bluetooth, the Ohmex Short and Long range radio telemetry modems and a range of dedicated LCDs for simple remote display of numeric data.

SonarMite

SonarMite is the smallest, lightest, truly portable hydrographic echo sounder system available. Using the latest battery technology the device complies fully with modern environmental, safe transit and final disposal requirements. The instrument provides multiple communication interfaces including RS232, Bluetooth and USB. The new custom USB interface cable has been designed for the SonarMite to provide a sealed IP67 connector.

Lindorm

Sedimeter

instrument for monitoring
- Sedimentation
- Siltation
- Erosion
- Scour
- Resuspension
- Near-bed turbidity

Axelsson Sediment Corer

This sediment corer is designed for quantitative analysis of sediment properties using X-rays. It also allows for taking stereo-images of the sediment core. Unlike round corers this equipment gives cores with a constant cross section, which facilitates interpretation and analysis.

Nilsson sampler

Star Oddi

The DST is a miniature underwater data logger available with sensors such as temperature, depth, salinity, tilt, compass and acoustic listening (GPS). The DST data logger stores the measured data in its internal memory. All measured data is stored in the logger's internal memory. When the logger is recovered after the measuring period, recorded data is uploaded in the supporting SeaStar software where it can be viewed and analyzed in graphic and tabular form. The same logger can be reused as long as the battery lasts.

LinkQuest

FlowQuest series of current profilers are ideal for measuring currents and flows in oceans, harbors, lakes and rivers, and for measuring waves in oceans and coastal areas. With its capability for significantly longer range, standard deepwater depth rating and seamless integration with third-party sensors and LinkQuest acoustic modems, the FlowQuest system is not just a current profiler. It also serves as a focal point for your underwater deployment.

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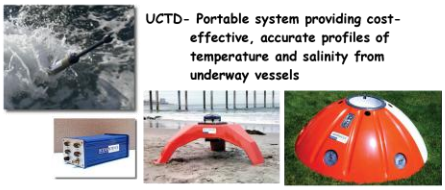

UCTD- Portable system providing cost-effective, accurate profiles of temperature and salinity from underway vessels

SOSI

World's leading manufacturer of oceanographic winches and handheld diver GPS.

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Nutrient Sensors

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