WEIGHT CONVERSION OF THE INES MOVIES ACOUSTIC DENSITIES AND THE THRESHOLD EFFECT ON BIOMASS EVALUATION

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ABSTRACT

The detection and the reverberation measurement of the fish by Acoustics allow to analyze their behaviour, distribution and structures. All these investigations are mainly based on a relative evaluation of densities. The method of echo-integration also allows to quantify abundance. It then necessitates to know accurately the acoustic performances of the apparatus and the definition of a weight conversion coefficient to apply on the relative data.

The Ines-Movies system, used during the acoustic surveys of the PELFISH Project, consists of a calculation procedure with conversion coefficient. After determination of the *Decapterus russelli* reverberation index (or TS), in cage this coefficient has been calculated. The accuracy of evaluations resulting from such an index depends particularly on the TS one. But another parameter has to be taken into account; this is the adjustment of threshold during the prospecting. Even with a controlled adjustment of this latter, the conversion of relative integrated values of the Java Sea shows that the evaluations obtained in that way do not correspond to the richness of the area, according to fishing techniques, the level of commercial captures, and the results of experimental fishing as well. The playback of the rough data, available in the Ines-Movies system, allows to better adjust the threshold for evaluation of the targets, taking into account the reverberating surrounding conditions.

KEYWORDS : acoustics, pelagic fish, Java Sea, weight conversion, biomass.

ABSTRAK

Deteksi dan pengukuran pantulan gema ikan secara akustik memungkinkan untuk menganalisis tingkah laku, penyebaran dan struktur ikan. Semua penelitian tersebut di atas terutama didasari oleh evaluasi kepadatan relatif. Metode integrasi gema juga memungkinkan untuk membantu penghitungan kelimpahan. Karenanya perlu untuk diketahui secara akurat kinerja peralatan akustik dan definisi koefisien konversi berat bagi data relatif.

Sistem Ines-Movies yang digunakan proyek PELFISH selama penelitian akustik, terdiri dari prosedur penghitungan dengan perubahan koefisien. Setelah penentuan indeks gema Decapterus russeli (TS), di dalam kurung koefisien ini telah diketahui. Ketilitian dari evaluasi sangat tergantung dari nilai TS. Tetapi, ada parameter lain yang harus diperhitungkan, yaitu penyesuaian ambang selama pencarian. Bahkan dengan pengawasan yang sesuai terhadap hal yang disebut terakhir ini, perubahan konversi nilai kesatuan relatif di daerah Laut Jawa menunjukkan bahwa evaluasi yang dijalankan dengan cara ini tidak berhubungan dengan kekayaan daerah sekitar, dengan teknik-teknik perikanan dan tingkat penangkapan ikan secara komersial, sama halnya dengan hasil-hasil perikanan eksperimental. Dengan sistem Ines-Movies, penayangan ulang data-data kasar memungkinkan pengaturan yang lebih baik terhadap ambang dalam mengevaluasi target, dengan memperhitungkan pemantulan gema pada lingkungan sekitarnya.

KATA KUNCI : akustik, perikanan pelagis, Laut Jawa, konversi berat, biomas.

The acoustic detection is extensively utilized for the study of pelagic populations. The tool, in itself, allows accurate and non disturbing observations, even if the ship can generate some behavioural reactions of the fish in its close surroundings. The method is thus utilized to delimit the zones of fish abundance, their distribution and their changes at various levels of time and space. The tool can also be employed to observe their behaviour.

Using the same instrumental adjustments and the same operating methods, the investigator is capable to easily obtain indexes of relative abundance and to measure accurately their variations. The conversion from relative measure to weight quantification is much more proved to be perilous. It requests an accurate calibration of the utilized equipment and the definition of a weight standard appropriate to the study. It also requires a critical appreciation of the obtained evaluations, taking into account the operating method adopted, the type of distribution and the encountered behavioural situations. At this phase, all available information, especially those provided by the experimental samplings and the rates of commercial catch, will be useful. In the recent years, improvement on the classification of targets according to their energy, as well as the possibility to analyze the data with different criteria of classification, has brought precious contribution.

During the PELFISH Project, several echo-integration surveys have been carried out, allowing to obtain not only estimations of « acoustic » density of fish populations in the Java Sea, but also information concerning the fish behaviour, and a qualitative aspect of the targets (index of reverberation, composition). The used tool is a dual beam echo-sounder (frequency 120 kHz, 3°5 of beam's half angle for echo-integration). The first analyses of data (Petit *et al.,* 1995) have allowed to propose a model of distribution and to give a level of accuracy in the relative evaluations. The adopted procedures for the conversion of those relative measures in weight and the resulting conclusions are presented here.

THE INES-MOVIES ECHO-INTEGRATION SYSTEM

The method of echo-integration is based on the proportionality existing between reverberated energy by a quantity of fishes and its density. That measure of density can be computerized per unit of surface or volume. Recently conceived by IFREMER (Diner *et al.,* 1989; Diner, 1991), the Ines-Movies system has been built around an interface, Ines, and a software, Movies, which can be translated as : « acoustic interface for digitalization and visualization, echo-integration and storage module ». The first systems of echo-integration are analogous and integrate the echoes according to time or number of sounder pulses. That new system allows the integration of energy of the echoes after digitized at a sampling frequency of 7.5 kHz, that is to say, a measure of the signal amplitude every 10 cm. The tool necessitates the use of an echo-sounder giving an analogous signal and a PC computer. It is moreover connected to a log and a GPS (Global Positioning System) which provide it with the speed of the ship and its geographical position. According to the type of employed echo-sounder, the signal input can be adjusted (attenuation). It is then processed, as illustrated in the schematic Figure 1, before integration. A threshold allows to avoid the integration of undesirable signals (such as background noises).

A programmed procedure enables the automatic follow-up of the bottom. Connected to the log, the tool will integrate the echoes on an exact distance, taking into account in the integration the instantaneous speed of the ship and the interval between the pulses. Ten consecutive layers of programmable thickness, referred to the surface, four others referred to the bottom, permit to localize the echoes.

By this way, the system will provide listing or stored files, in real time, with 4 sets of information : a coloured echogram, a file of digitized echoes (that will allow the playback), a file describing the route and the registered events, and at last, a file of echo-integration per distance unit. This latter recapitulates the time, the position and the depth, the integration per distance and per volume, the number of analyzed samplings and those containing a value higher than the threshold, and at last, the number of pulses concerned.

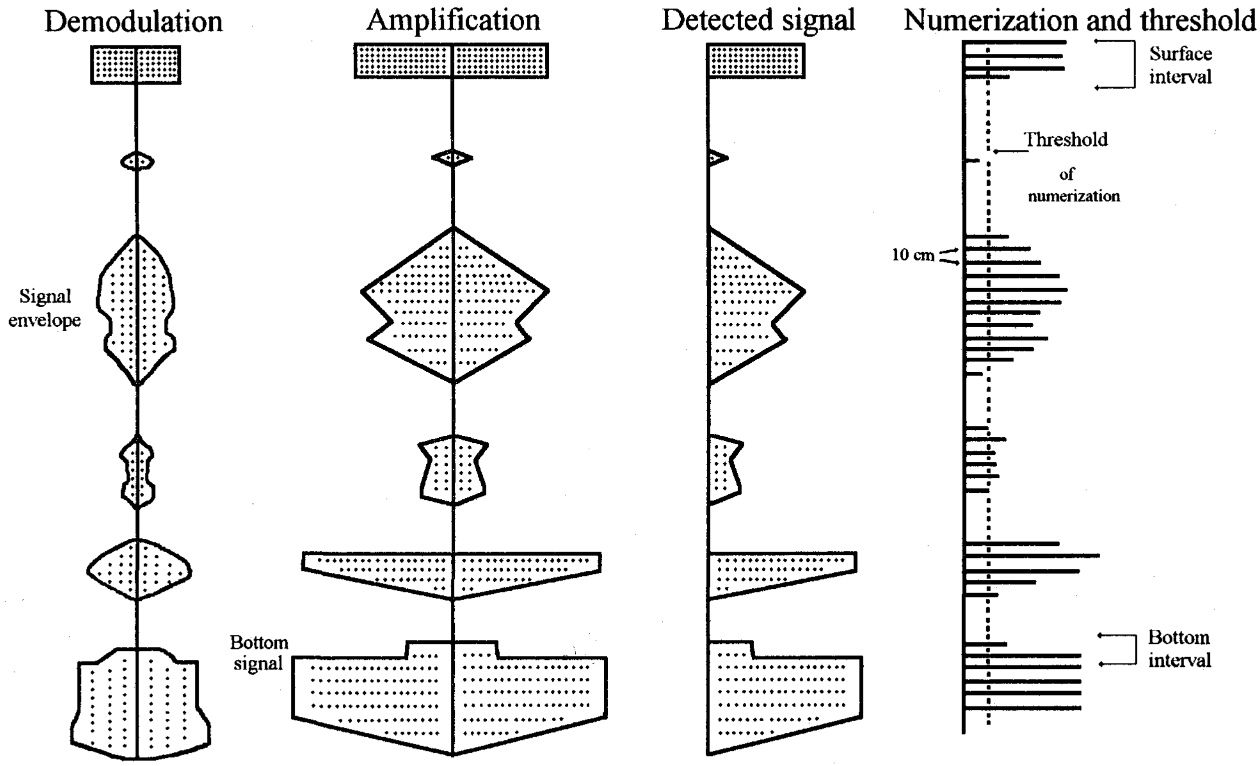

Figure 1 **Schematics of the signal processed by Ines-Movies before squaring and integration.**

Gambar 1 **Skema proses sinyal oleh Ines-Movies sebelum pengkwadratan dan integrasi.**

INTEGRATION OF ECHOES. FORMULATION

The integration takes place during a programmed distance (1/10 mile minimum) and the result is given per distance and per volume. During the PELFISH surveys, the measures of density per distance were used. For one layer, the echo-integration is calculated according to the relation below :

$$Qd = \frac{FK}{G^2} \sum_{j=1}^{n} d_j \sum_{i=1}^{m} U_{ij}^2$$

Qd = mean integration for echoes higher than the threshold, along 1 nautical mile

F = setting factor to process Qd values without decimal

K = equivalent to a hard gain

d_j = distance between the ping j and j+1, in meter

n = number of pings during 1 mile

m = number of i elementary samples during the j ping

U_{ij} = echo voltage (>threshold) for the j pulse and the i elementary sample, multiplied by the soft gain G

The gain G is introduced to amplify the received signal and allows by this way the good functioning of the automatic bottom detection.

Weill *et al.*, (1993) brought a supplementary accuracy on the coefficient K and d_j :

$$K = \frac{\text{hard gain}^1}{1852\eta}$$

where η is the number of elementary samples by meter, so $\eta = 10$.

And, for d_j :

$$d_j = S_j T_j$$

where :

S_j = speed of the ship in meter per second between two transmissions

T_j = period of transmission in second.

The coefficient d_j is introduced to take into account the variations of speed during the prospecting. In fact, a same voltage U_{ij}, obtained at low or high speed, does not represent the same quantity of energy by unit of distance. This coefficient allows then an adjustment of the voltage according to the actual covered distance.

Finally, the value Qd is a relative measurement of the abundance, proportional to the sum of voltage squared during a distance, within the thickness of the integrated water column.

CONVERSION IN WEIGHT

Principle

The obtained integration values can be directly used as an index of abundance and allow the spatial analysis of the distributions as well as the one of seasonal variations. These values remain comparable ones to the others, while they have been obtained using the same adjustments. It is not anymore the case if the acoustic characteristics of the whole sounder-transducer system change, all the more so if the settings (gains, threshold) of measurements are modified. It is the reason why people try as much as possible to use the same adjustments during consecutive surveys.

The conversion in weight of those values supposes to pass from relative to absolute references, to be free from particular conditions of measurement. Two stages are necessary for that; the first one requires to take into consideration the acoustic characteristics of the echo-sounder/integrator system in the way to convert the data in decibels[2]. The second consists to convert those last data in weight, recognizing the acoustic response chosen as "weight standard of measures".

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[1]This hard gain is usually 1,000 , or 30 dB; however, its value can be modified to adjust the amlitude signal output of the sounder with the input level of interface. Then, it has to be controlled by user.

[2]Pratically, the technique consists of deducting the instrumental constant from the data :

$$\text{CI (in dB)} = -(SL+VR) + 20\,\text{Log}R + 2\alpha R - 10\,\text{Log}\frac{c\tau}{2} - 10\,\text{Log}\Psi - \text{Gains}$$

with SL = Source level; VR = Reception sensitivity; R = Maximal range of TVG; α = Absorption coefficient; c = Speed of the sound; τ = Pulse duration; Ψ = Equivalent beam angle; Gains = Gain of sounder and integrator

To define the acoustic characteristics of an echo-sounder, the biologists have developed a procedure of performance control feasible in the field. It requests the use of a standard sphere. The acoustic response of this latter has been previously measured in laboratory and the measure of its reverberated signal amplitude allows to quantify the performances of the tool.

Different methods have been described to convert the relative measures of integration in weight (Burczynski, 1982; Johannesson and Mitson, 1983). It is some questions of establishing a proportion between a number or a quantity of fish (species or a mixing of species) and its acoustic response (Midttun and Nakken, 1971). The relation can be set up directly, for example during a trawling, but the technique does not presume the possibility for the preys to avoid or escape the net. Other authors have proceeded directly the integration on precise quantities of fish in cage (the « FAO calibration method », Johannesson and Mitson, 1983); but is the behaviour of the fish confined in a cage, still normal ? Is its acoustic response not modified ? Others, at last, have obtained good results by integration and echo-counting (Marchal, 1982), but the operation supposes that the fish is well scattered, the species and its size determinated otherwise. No method seems ideal and one has to be satisfied with rare opportunities allowed by the equipment or advantageous exceptional environmental conditions. A simple method consists to use a known index of reverberation, but experiments realized on tropical species are still very few. Having a dual beam echo-sounder, 120 kHz at our disposal, we have carried out measurements of reverberation index on fish in cage (Cotel and Petit, 1996). To determine the constant of weight conversion, the average TS (Target Strength) of *D. russelli* (16 cm of fork length, about 59.6 grams of fresh weight), one of the most abundant species in the Java Sea, has been chosen : -35.45 dB/kg.

Procedure of Ines-Movies conversion

The system Ines-Movies ensures the integration of echoes by measuring the signal energy at a sampling frequency of 7.5 kHz; to take into account the performances of the tool. It was then reasonable to measure the reverberated energy, and not only the amplitude of the signal anymore, for the conversion of data. A procedure, in the menu of Movies, allows to measure automatically the energy reverberated by a sphere of reference (a tungsten ball of well-known reverberation index, here, TS = -41 dB) placed at a certain distance in the acoustic beam. That measure, which takes place according to the same procedure of a normal integration, has certainly to be realized with the same sounder adjustments as used during the prospecting. The system provides with the energy received per meter and calculates the performances of the sounder, in the field, for the distance of the target. This last value allows to verify that the given energy measurement on the sphere suits well with the echo-sounder performances which have been otherwise measured[3].

The instrumental constant, called C, including the hard gain of the integrator is given by :

$$C = \frac{1}{IE}\left[10^{\left(\frac{TSb - 20 Log b - 10 Log \Psi}{10}\right)}\right]$$

where :

I = Hard gain of the Ines interface

E = Energy by meter of the reference sphere, in squared volts

Tsb = Target strength of the standard sphere, in dB

b = Distance of the sphere, in meter

ψ = Equivalent beam angle, in dB

[3] Those performances take into account the gain of the sounder, as during the echo-integration.

Introducing the TS factor, TSf in dB/kg, the weight conversion coefficient, called Cw, for the selected target is :

$$Cw = \frac{1}{IE}\left[10^{\left(\frac{TSb - 20 Log b - 10 Log \Psi - TSf + 35.35}{10}\right)}\right]$$

The coefficient 35.35 $\left(\text{or } \frac{10 Log(1852)^2}{1000}\right)$ allows to express Cw in tons by squared mile.

During the experiment, the sphere of tungsten, situated at 7.5 m from the transducer, has given an energy of 351948 E-07 V^2/m, so the conversion factor is :

Cw = 57 tons/nautical mile^2

However, during the surveys, the value of the F factor (equation 1) was 1000. So, the weight conversion factor must be divided by 1000 and becomes :

Cw = 0.057 ton/nautical mile^2

CONCLUSION

Thanks to the rigorous control of the apparatus and to the experiments in cage, it is possible to define a coefficient of weight conversion for our density measurements. It still remains to analyze the confidence to bring to its use and the consequences which result in its application to the relative measures of density realized in the Java Sea.

The definition of the weight conversion factor depends on the accurate knowledge of the standard target reverberation index. In fact, the control of acoustic equipment such as the echo-integrator, according to the experiment, are operations relatively easy, at least in laboratory. The accurate determination of the reverberation index of a given species is much more difficult. For the calculation, an index of average reverberation has been selected, the measures of density by echo-integration being also of average. It is true that during the experiments, the dispersion of values was relatively high. Johannesson (1984), by experimenting on close species[4] evaluated the acoustic response at -45 dB for a length of 13.6 cm, thus a value clearly higher than ours. Other experiments, associating the measure of TS and integration, which were not feasible with our equipment, could allow to sweep out the uncertainty.

As previously indicated, all the acoustical energy returning to the transducer does not represent the one which is reverberated only by targeted species. A part of it is produced by particles, plankton, larvae... Another fraction of that "background noise" can be generated by the electronic apparatus itself and the surrounding noises. It is the reason why the received signal has to be filtered using a threshold, under which signals are not taken into account. Its level is adjusted by observation of the signal on oscilloscope. There, the emergence of individual target signals appears clearly enough from the background noise. During the surveys, the threshold has been adjusted to 42, then 33 mV_{RMS} since December 1992; it has been measured in diurnal phase. Those thresholds can appear relatively low, but the recent implementations in electronics have certainly improved the quality of the reception. At 30 metres depth, where, in average, begins the maximum of detection, the adopted thresholds allow the detection of individual targets of -57 to -60 dB. By supposing a proportionality between the fish length and its reverberation index, those values would correspond to fishes of 4 to 10 cm length. The diurnal

[4]Johannesson cites *Decapterus* but does not specify the species; the experiment took place in Pulau Sanger, in the north-east of Sulawesi. The value, at 120 kHz, is calculated by echo-integration on fish in cage.

adjustment of a low threshold, which can be justified by the scattering of the targets and the ambient poorness can become a relative handicap by night if the global reverberating level of the ambient changes by the rising of a fauna, better detected. The insonified volume increasing with the depth, the targets, even low reverberating, are not anymore individual, decreasing particularly the selective effect of threshold. It seems that in the Java Sea, at least in some season, the effect is particularly more remarkable when nurseries are met, forming considerable aggregations. They have been encountered in the western and in the eastern part of the Java Sea and an observation with an underwater camera during light attraction has revealed the abundance of juveniles.

Using the weight conversion factor calculated, the evaluations of detected density during the surveys of October 1993 and February 1994 cannot be compared with the potentialities of the environment, the fishing techniques used and the rates of catch. The experimental fishing operations, even supposing avoidance, also do not confirm that overabundance. In the same sense, the TS measurements, during the different surveys show well an important proportion of targets clearly less reverberating than the average value used in the conversion factor. If then, the density measurements obtained, which represent a « biomass » measurements, are in discrepancy with those which could have been expected from the target species only. The reason is that the analysis criterion of collected information has to be adapted to the particular environmental conditions.

The system Ines-Movies that has been chosen to realize the echo-integration consists of procedures, in this case very precious, which can allow to playback the rough data. Different thresholds have been tested and finally, according to the spectrum of the echo amplitudes and the sensibility of available adjustment, the choice of the latter is very limited[5]. For the data collection, thresholds of 33 or 42 mV have been chosen. A threshold of 46 mV does not modify much the values but a threshold of 78 mV tends to eliminate severely the individual echoes, the aggregations only remain.

Finally a threshold of 62 mV_{RMS} was adopted, which, taking into account the value of the TS target (-47.7 dB), corresponds approximately to the echo of an individual fish at 20 metres depth. The surveys of October 1993 and February 1994 have been played back in laboratory with that new threshold. The synthetic result is presented in Table 1, in regard to the values measured previously with the prospecting threshold (33 mV). For that, the Java Sea is divided into three strata, using the model of stratification elaborated during the Workshop Akustikan I (Petit *et al.,* 1995), but by modifying slightly the geographical limit of the strata :

- the C zone, in the East of Longitude 113° E; its limitation in the East 114° E seems restrictive, regarding the extent of the area the most visited by big seiners, and the penetration of oceanic water in dry season.
- the B zone, in the West of 113° E.
- the A zone, in the South of Latitude 6° S. Originally, the northern limit of the zone was badly defined, due to the lack of data. This adopted limit is not ideal, because it includes, within the A zone, towards the East great depths while it seems that the bathymetry has some influence on the abundance, at least in wet season. But the zone thus defined corresponds enough to the range of about 30 miles where operate small and medium seiners.

The general tendencies, emerging from the results, lead to interesting findings. In October, which is a rich period, the raise of the threshold does not reduce the relative increase of nocturnal biomasses, even though we estimated that the latter could be principally due to the nocturnal rising of the small size target : the day-night ratios are stronger. There are two possible interpretations : the semipelagic nocturnal fauna filtered by the new threshold represents well the fauna, which is the object of evaluation. It is also possible that the effect of threshold is still insufficient regarding the low scattering of smaller

[5]The precision of adjustment could be sensibly improved by raising the programmed gain at 5 instead of 4 as during the surveys, while using the same threshold. This would allow, at the playback, to enlarge markedly the accuracy of the threshold, providing that it does not lead to saturation on the schools, which is less probable.

targets, and, in this case, the separation between the two bulks of biomass would be almost impossible to discriminate.

Table 1 Relative densities per nautic mile, using 2 different thresholds (33 or 62 mV) and biomass (threshold : 62 mV), for the three zones of the Java Sea : zone A = Lat. 6°S; zone B = Long. 113°E; zone C = Long. 113°E (N/D Ratio : Night/day relative density ratio; 62/33, D. Ratio : Ratio of relative density at 62 and 33 mV threshold; B : biomass, in tons/mile^2 weight conversion coefficient : 0.057 ton/squared mile).

Tabel 1 Kepadatan relatif per mil, menggunakan 2 batas (threshold 33 dan 62 mV) serta biomassa (threshold : 62 mV), pada tiga zona di Laut Jawa : zona A = lintang. 6°S; zona B = bujur 113°E; zone C = bujur 113°E (N/D Ratio = Rasio siang dan malam; 62/33, D. Ratio : ratio kepadatan pada threshold 62 dan 33 mV, B : biomasa, dalam ton/mil^2; koefisien konversi berat = 0.057 ton/nmil^2).

		OCTOBER 1993				FEBRUARY 1994			
		Relative Density/mile		62/33 D.		Relative Density/mile		62/33 D.	
		Thresh. 33mV	Thresh. 62mV	Ratio	B.	Thresh. 33mV	Thresh. 62mV	Ratio	B.
	Day	593	137	23%	8	729	192	26%	11
	Night	1903	571	30%	33	1664	269	16%	15
A	Total	1034	283	27%	16	1156	228	20%	13
	N/D Ratio	3.2	4.1			2.3	1.4		
	Day	909	150	17%	9	359	72	20%	4
	Night	1736	310	18%	18	787	114	14%	6
B	Total	1308	227	17%	13	573	93	16%	5
	N/D Ratio	1.9	2.1			2.2	1.6		
	Day	1385	423	31%	24	318	152	48%	9
	Night	3815	1280	34%	72	793	264	33%	15
C	Total	2682	880	33%	50	561	210	37%	12
	N/D Ratio	2.8	3.0			2.5	1.7		

Regarding to the relative proportion of density remaining after high threshold adjusting, the three zones are well individualized. The stratification originally suggested is found to be confirmed by this new processing. The remaining proportion of density after playback is more important in zone C and A and the zone B is clearly poorer. In relation to October, the results of February are not less interesting. The trends of the nycthemeral ratios between the two evaluations are reversed : in February, the increase of threshold reduces their value, what moreover goes in parallel with the general impoverishment of the environment by disappearance of a great part of semipelagic fauna in the region. The smaller proportion of biomass ratio (62/33) during the night would confirm the phenomenon. At last, the individuality of the three strata, from one season to the other, is well preserved in the proportions of biomass as well as in the level of global richness, with an impoverishment slightly more pronounced for the stratum more oceanic because from those three strata, it is the latter where the environmental conditions have been mostly modified.

The values of biomass estimated with the threshold of 62 mV and the calculated constant do not differentiate the evaluations previously realized in the region (Tab. 2).

Table 2 Some recent biomass evaluations of pelagic fish in South Asia.
Tabel 2 Beberapa perkiraan biomassa ikan pelagis di Asia Selatan.

AREA			Time	Tons/n.mile^2
Thailand	(1)	West	July 1980	15
Peninsular		East	June 1980	12
Malaysia	(1)	West	Jun-Jul 1980	19
Sumatra	(1)	North/West	August 1980	15
Sulawesi +			Oct-Dec 1980	15.4
Makassar St.	(2)			
Anambas	(3)		Jun-Jul 1981	5.5
			Nov-Dec 1982	5.4
			Jun-Jul 1983	2.9
			Nov-Dec 1983	48.8
Natuna	(3)		Jun-Jul 1981	10.6
			Nov-Dec 1982	4.4
			Jun-Jul 1983	1.2
			Nov-Dec 1983	59.3
Sangihe	(3)		Apr-May 1982	5.0
			Aug-Sep 1982	57.7
Talaud	(3)		Aug-Sep 1982	41.7
South Irian Jaya	(4)	Bintuni Area	July 1983	11.1
North Irian Jaya	(4)	135°-138° E	August 1983	4.4
East Banda Sea	(5)	128°-134° E	August 1984	5.4
			Feb-Mar 1985	1.4
Java Sea	(6)	Whole	1987	11.3
Java Sea	(7)	109°-111° E	May 1985	28

(1) results cited by Johannesson (1984)
(2) from Amin *et al.*, (1980), cited by Bailey *et al.*, (1987)
3) evaluations made by CIDA/FAO Indonesian Fisheries Development Project (Johannesson, 1984)
(4) Corindon 10, 11 cruises evaluations (Boely *et al.*, 1986)
(5) evaluations made by Amin and Nugroho (1990)
(6) estimation cited by Bailey *et al.*, (1987)
(7) Pechindon cruise evaluation (Boely *et al.*, 1987)

Those values, however, indicate the seasonal richness of the "oceanic" zone of the Java Sea, intensively exploited by the fleet of seiners, and particularly allow to measure the impact of the environmental seasonal variations to the abundance (Potier and Boely, 1990). In that region the annual deviation is of the order from 1 to 10. Those evaluations are sensible to the same bias of every evaluation using the same method. Their accuracy depends, first of all, on the gridding of sampling and from that point of view, the calculations carried out tend to show that in spite of an important spacing of the transects, the evaluations conserve a relative acceptable accuracy, thanks to a distribution rather homogeneous of the fauna (Petit *et al.,* 1995). But a considerable uncertainty still remains, in the level of reliability of adopted constant and in the proportion respectively attributable to each group of species in an environment containing a high pelagic diversity and where fishing gears enough selective (light attraction) are difficult to put to contribution for an evaluation of different specific categories. Interesting investigations would be developed in that domain of sampling, in closer cooperation with the fishing fleet.

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DISCUSSION

(Chairman Dr. MARCHAL)

Mr. MUNANDAR

Q : - How do you adjust the threshold for the surveys ? Would it be better to collect the data without any threshold and then to play back at the laboratory with different settings ?

A : - The amount of data should be so huge that it should require an enormous computer. It justifies the necessity to have a threshold.

Dr. MARCHAL comments : "You always have a threshold; the threshold is defined from the ambient noise that you do not wish to integrate. Therefore, you have to put a certain threshold level to avoid electrical noise or other disturbance."

Dr. MASSE comments : "With the INES MOVIES system, you can use, in real time, a second threshold for detection analysis. If you consider this threshold was too high as you were collecting the rough data, you can play back the data by decreasing the level of this setting for another analysis. In fact, there are 2 thresholds within the system : a low one to store the data and a second one to analyze these data."

Dr. NAINGGOLAN

Q : - Dual-Beam system has a narrow beam and a wide beam. Which beam did you use for echo-integration ?

A : - We used the narrow beam.

Dr. SIREGAR

Q : - How do you adjust the threshold before the surveys ? Must we try different values ?

A : - On survey, the oscilloscope as a part of the control equipment displays continuously the signal precisely. From this display, we can discriminate the signal due to plankton, micro organism and/or noise, from fish which is higher and gives voltage peaks; after evaluation of these undesirable signals, we adjust the threshold correctly regarding to their electrical levels. One problem still remains : if you change the threshold you started with during a survey, it becomes difficult to compare the data before and after this change.

DR. MERTA

Q : - You mentioned that the conversion factor was 0.57 tons per nautical mile, and this, for *Decapterus russelli* of 16 cm length. Since, in the Java Sea, multiple species cohabit, how can you apply this conversion factor to calculate the biomass, although *D. russelli* is one of the dominant species in the catches ?

A : - It is hazardous to apply directly any conversion factor to every density. That is the reason why we prefer using relative density instead of absolute density and its conversion problem.

Dr. MARCHAL comments : "Relative density is acoustic density or reverberation volume. From this value, you can any times change and convert biomass if you have conversion factors. You can improve your evaluation if you have more information about the fish composition and the Target Strength by species. This relative density is the basic data. To conclude, I recommend to calculate this biomass by small area and only if you have an idea about the fish composition; otherwise, it does not mean anything."

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