



Behaviour and Bioacoustic Characteristic of Male Dolphins Bottle Nose (*Tursiops Aduncus*) in Captive, Indonesia

Muhammad Zainuddin Lubis*

Department of informatics engineering, Indonesia

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***Corresponding author:** Muhammad Zainuddin Lubis, Department of informatics engineering, Geomatics engineering, Batam Polytechnic Jalan Ahmad Yani, Batam Centre, Batam 29461, Indonesia Email: zainuddinlubis@polibatam.ac.id; lubiszainuddin@gmail.com

Abstract

Bioacoustic is knowledge that combines biology and acoustic which usually refer to research on the production of sound, dispersion through an elastic medium, and acceptance in animals, including humans. This research using passive acoustic method and behavior observing of male dolphins by doing approach science of the passive acoustic (bioacoustics) is see the difference patterns and a characteristic sound of the porpoise. Dolphins male (*Tursiops aduncus*) preserved in park of safari indonesia cisarua bogor, having value intensity lowest of 28.03dB and the highest is of 32,01dB. With an average parameter measurable namely salinity up to 30% and temperature 23°C with the depth of the pool 4,5meters. Range the frequency of sounds click with the highest intensity of 32,01dB with a clicking sound after food in first day to 2 which is found in range frequency namely 14.000-16.000Hz. Range the frequency of sounds click dolphins male (*tursiop aduncus*) in park of safari with frequency of 14.221-15.100Hz. There is a difference intensity voting against treatment before and after eating by using the pool the same study. Value intensity highest obtained at the sound of after food in second day with the intensity 32, 01dB and value of the lowest intensity of are in before a meal is first day. Dolphins tends to be basic a pool of sea water in as before eating and dolphins always was sitting on the surface of the pond at the time after eating.

Keywords: Bioacoustic; Male dolphins bottle nose (*Tursiops aduncus*); Frequency; Intensity

Introduction

In the world fisheries own with the methods acoustic passive applied to monitor marine mammals, and biota other on the sea [1]. Signals obtained from recording sound marine mammals very weak that calls for amplification and difficult to determine of which the direction that suarara. Passive is sound derived from animals target [2]. The concept of acoustic passive conducted in marine mammals is to detect a sound when mammals it is in the area measurements in environment scope of the tape recorder. The measurement of is done with use software and also with listen. A method of acoustic passive also used odibidang military service in the development of security system of attackers under water in the estuari by doing recording sound which is raised from diving [3].

Marine mammals hearing in is measured in the subject living with use audiometer behavior or technique elektrofisiologi [4]. For species does not learn from vivo audiometer. With some characteristic of hearing can be is predicted based on the

frequency of the results of the production of sound done on the observation the characteristic sounds good is do or not have response behavior in trained animals [5]; or morphological hearing, including the trait of biomechanics from the basilar and characteristic of other sounds [6]. A little bit too known the sound has type yelping (burst), characteristic of spectral, temporal, and amplitude a shrill sound pulse of type the sound of a click very few explored. As for early description in literature that most of it that is worth qualitative, that reflects interpretation hearing subjective and classification hearing in humans [7-10].

The sound of a click generally used for the purpose of echolocation, while the sound of a whistle ledakan-berdenyut and played a major role in internal communication and across group [11]. A whistle that continues indefinitely, giving signals frequency [12], with various wide emissions of 800Hz and 28.5KHz [13] often there are components harmonic [12]. A dolphin start interaction with the provision of signals, with

information, in tape a given frequency. The signal source then relies on a source of to hear and react to the sound. In hearing to dolphins ranged from about 50 Hz-150KHz, with the variation of additional among [12].

For every years, researchers have demonstrated the advantages of hydrophones Single Mode Fiber (SMF) as a potential alternative to the voice navigation and the beginning of the technology/sound navigation and ranging (SONAR). Bioacoustic not be separated from the use of hydrophones as lat voice recorder where the acoustic pressure is recorded on hydrophone is a source of pressure disturbance at sea (ΔP) relative to the pressure of the ocean in the background on the recording medium depth sea water. Excess sound pressure at sea are usually worth a small ($\sim 10^{-2}$ Pa), and it has become the standard in the sea in the literature to show the acoustic sound pressure in the list of the decibel scale (dB) relative to the reference pressure (P_0) of $1\mu\text{Pa}$ [13]. In addition, the convention to use 1m as a reference distance (r_0), namely when calculating the acoustic pressure from the source of the sound.

Bioacoustic is the knowledge that combines biological and acoustics which usually refer to research on the production of sound, dispersion through an elastic medium, and acceptance in animals, including humans. This involves neurophysiology and anatomy for the production and detection sound, as well as the relations of acoustic signals with medium dispersinya. Findings in this area give evidence for us of the evolution of acoustic mechanism, and from there, evolution animals who use them [14,15]. But because the science of acoustics grown very much to dolphins, researchers formerly had been exercising records and analysis vocalization [16]. Bioacoustic research is needed to know language communication (acoustic communication) in mammals. Bioacoustic be separated from the use of hydrophone as lat voice recorder where pressures acoustics recorded on hidrofon is the source of the disorder pressure on the (ΔP) relatively on the background the recording in the medium sea water. This study aims to analyse and distinguishing characteristics the sound of a click dolphins male bottle nose (*Tursiops aduncus*) in quarantine pool, by using the method bioacoustic and see behavior male dolphins bottle nose (*Tursiops aduncus*).

Materials and Methods

Research activities implemented in March to September 2015. The data activities implemented in safari park Cisarua Bogor, Indonesian. Processing data implemented in laboratory of marine acoustic instrumentation (MAI) in the department of marine science and technology, located in water tank, Bogor Agricultural University.

Tools and Materials

Tools and material used in the methodology this is hidrofon SQ3, a hg thermometer to measure the temperature of sea water; refractometer for measuring salinity sea water is in

swimming; Dolphins EAR 100 hydrophones a serial number DE989505 that is sensors sound underwater camera gopro hero 3 + serves to record the movement of to dolphins visually. Software MATLAB and WAVELAB that is used to cultivate the data collected. Material used by 2 the tail of a dolphins male bottle nose. The data collected from observation dolphins in the pool research is quarantine pool and do the processing of with using software is WAVELAB and data that had been deposited with WAVELAB software will be conducted filters with cutting the data important that is sound actually the porpoise. After was finished will be conducted data analysis the frequency with a method of bioacoustics by producing fast fourier transform instead (FFT) and extracted with the data .txt and see links with behavior the movement and position of the porpoise is. Analysis next executed is analysis power spectral density (MATLAB). So that characteristic of behavior bottle nose male dolphins can be completed.

Hydrophone

Hydrophone is an instrument that serves to listen to underwater sound. This tool converts noise coming from inside the sea water into electrical signals, and can then be ampification, analyzed, or played in the air [17]. Hydrophone is usually in the form of a piezo-electric ceramic slab [14]. Standardization of Hydrophone for purposes of biocoustic issued by Bioacoustic Inc. Dolphin ear hydrophones able to detect the frequency of sounds in 1-2Hz. The threshold lowest hearing of men have earned is only able to obey the voice of to the frequency of 20Hz. Voices outside the threshold normal hearing man can be heard use dolphin ear hydrophones equipped with WAVELAB software. The form of a device dolphin ear hydrophones can be seen in Figure 1. Specification of dolphin ear hydrophones [18] is range of frequencies: 7-22.0000Hz. Type of tranducer Hydrophone: MPC (Piezo). The form of configuration : Omni Directional. Packed of hydrophone: Rugged epoxy case.

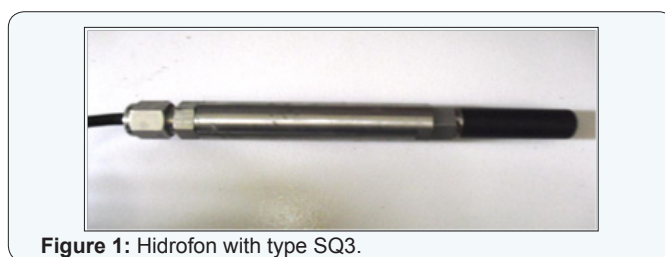


Figure 1: Hidrofon with type SQ3.

The diameter of 60mm and thick 8mm. Cable type: High Quality, Small noise, with Neoprene/PVC. Size of standart cable: 12Meter. Preamplifier: One packed with line /Earphone output. Power: $\pm 7\text{mA}$ to 9 Volt. Limits a range of frequencies provided was the frequency of sounds that can be heard normally by using earphones and used WAVELAB software for recording sound directly from dolphin ear, so a lower limit frequency can be detected will be more low as reach several hz, and the upper limit of a frequency that can be detected can reach more than 22KHz [19-21]. Hydrophones figure can be seen in Figure 1.

Fourier transform

The basis of characteristic frequency on a signal is transformation fourier [22]. Fast fourier transform instead (FFT) is a algorithm to count discrete fourier transform instead (DFT). Functions general of transformation fourier is find components frequency signal that is hidden by a signal the domain time of with noise [23] is :

$$S = \text{fft}(y) \dots\dots\dots(1)$$

$$S = \text{fft}(y,n) \dots\dots\dots(2)$$

The form of the orders (1) and (2) almost the same, that is counting dft of vector x, only on the order of (2) throne with the use of parameter long FFT (n).

Power Spectral Density

Power spectral density (PSD) definition as the magnitude of the power per intervals frequency , in the form of mathematics [22]:

$$PSD = \frac{|X_n|^2}{f} \dots\dots\dots \frac{((\text{Amplitudo}))^2}{\text{Hz}} \dots\dots\dots (3)$$

Calculation psd in MATLAB uses the method welch [23], namely looking for DFT (Based on accounts with algorithms FFT), then squaring the value of the magnitude.

Parameter environment

Parameter environment measured is temperature and salinity the result of these two physical parameters this is a has the most influence on the level of stress dolphins. Stress experienced therefore, the dolphins can to cause deviations behavior to dolphins. The measurement of temperature sea water in aquariums done by entering a hg thermometer into aquarium. A hg thermometer will be flicts before put into sea water to get any effect muainya and restore the starting point a hg thermometer before measuring started. This sea water temperature obtained by reading on the scale of shown in a hg thermometer.

Processing and analysis data of dolphin sound

Data processing acoustic using software .The sound produced dolphins bottle nose and yielding fast fourier transform instead (FFT). FFT is algorithm to count transformation fourier discrete (FFT) and its reverse. A transformation fourier change time (or room with the frequency and otherwise. As a result, transformation fourier fast much used for many application in engineering, science, and mathematics [24]. To see to scatter per unit time so with WAVELAB software, and data fft deposited in the form of *.txt. After the process so the data mixed with using software microsoft excel and mixed with using software MATLAB for produce figure. Data recording dolphins sound with interpretation into graphical form the frequency and echo level. A graph produced then analyzed and compared with the visual observation. The resulting then analyzed and compared with the visual observation. The visual observation can be done

by see mannerisms of dolphins observed by using the method home video recording a underwater camera when recording of sound dolphins. It is meant to see reaction to dolphins objects or instrument is around by observing mannerisms the porpoises and can see the health of from dolphins during the research/ process of voting. But sketches research male dolphins bottle nose (*Tursiops aduncus*) in captivity / quarantine pool is presented in Figure 2.

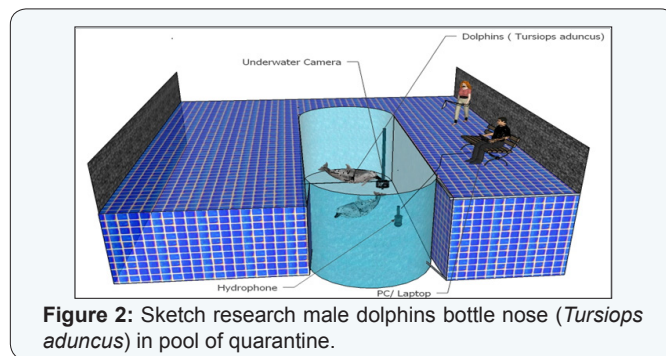


Figure 2: Sketch research male dolphins bottle nose (*Tursiops aduncus*) in pool of quarantine.

Result and Discussion

Sound mammal (dolphins) to in this research is the noise that derived from dolphins out of the skull dolphins. According to [25], sound is a very important thing to behavior while communicating to several kinds of dolphins and according to [26,27] mammals can issue various amplitude votes for communicating in exchange information. Information brought from signals sound describing on the state of the danger that threatens, the state of aggressively to scare off our enemies, or call peminangan. A voice too resulting from the impact of behavior such as at eating, move, escape the enemy, and reproduction (sexuality and phase enlargement) [16]. From the data recording sound, dolphins bottle nose (*Tursiops truncatus*) having three type a different voice.

Third type these sounds can be distinguished only by using normal hearing. Third type the sound was a click, whistle and burst. In the data of sound dolphins done on the and sunday different. The process of recording dolphins sound done three times recording. This research absent from the parameter measurable namely measuring parameter temperature and salinity which is with the pool research that is quarantine pool. Salinity and temperature before and after in the pool quarantine dolphins male to the measurement of parameter are on the day to 1, 2 and 3 in the pool quarantine, and time the that is, before and after dolphins eat. The process recording sound of dolphins done in 3 times the parameters of data with a date and sunday different. Researched process will be covered by the parameters of the parameters of measurable is measure of the parameters of temperature and salinity that were on the pool research namely quarantine pool.

Salinity and temperature before and after quarantine pool male dolphins with the measurement of the parameters are in the day to 1, 2 and 3 on the pool quarantine , and time adoption

of which is before and after eating dolphins with the results of salinity and temperature before eating the magnitude of salinity, which is 30‰, while the withdrawal of the data after eating salinity fell to 29‰ this has led to salinity which is found in quarantine pool already injection with the factors that is somewhere so and the day of second with salinity of 28‰ on as before eating and 27‰ after eating with the temperature before eating 23°C and after eating is as much as 22°C .

Characteristic of Dolphins Sound

Sound is a very important thing to behavior while communicating to several kinds of fish and according to [28] fish can issue various amplitude votes for communicating in exchange information .Information brought from signals sound describing on the state of the danger that threatens, the state of aggressively to scare off our enemies, or call peminangan. A voice too resulting from the impact of behavior such as at eating, move, escape the enemy, and reproduction (Sexuality and phase enlargement) [16,27]. Result of this research in the form of the sound derived from software WAVELAB was conducted anti logs and mixed with using software MATLAB so as to produce a chart of the sound intensity against frequency. The frequency of a recorded namely 5.200-22.000Hz. The data shows on a chart namely ping 62 to ping 195. Spectrum of sound click can be seen in Figure 3, and charts relations frequency to intensity before a meal day to, 1, 2, 3 and after eating day to 2, 3 it can be seen in Figure 4.

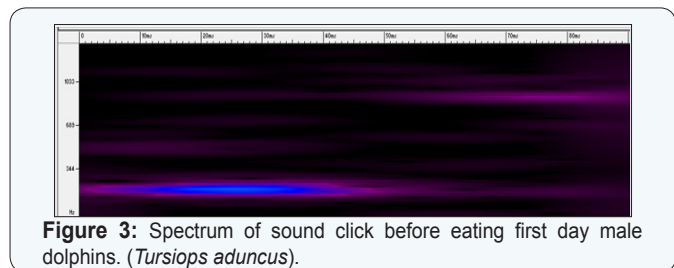


Figure 3: Spectrum of sound click before eating first day male dolphins (*Tursiops aduncus*).

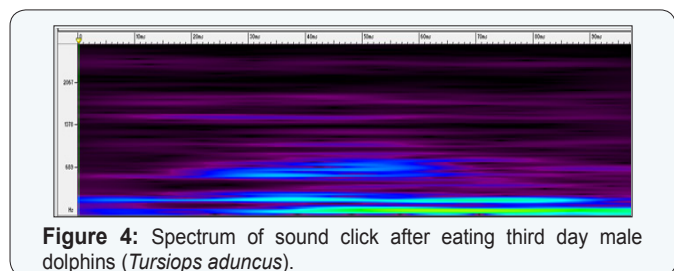


Figure 4: Spectrum of sound click after eating third day male dolphins (*Tursiops aduncus*).

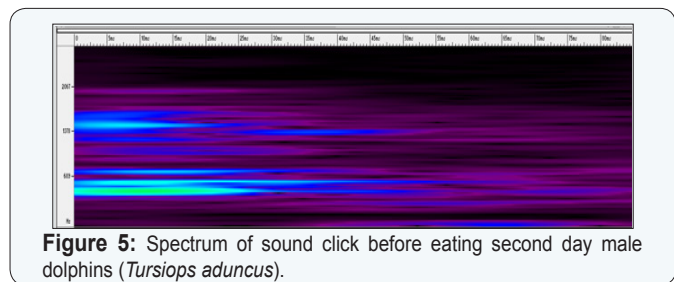


Figure 5: Spectrum of sound click before eating second day male dolphins (*Tursiops aduncus*).

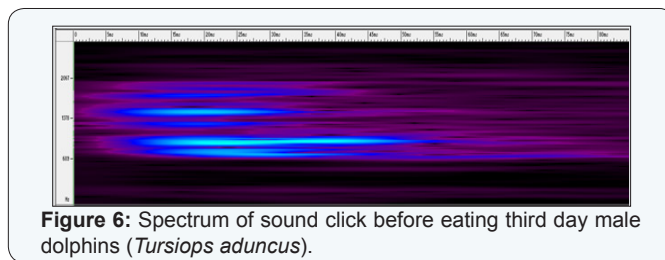


Figure 6: Spectrum of sound click before eating third day male dolphins (*Tursiops aduncus*).

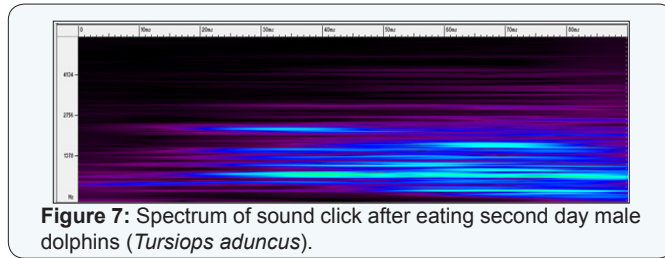


Figure 7: Spectrum of sound click after eating second day male dolphins (*Tursiops aduncus*).

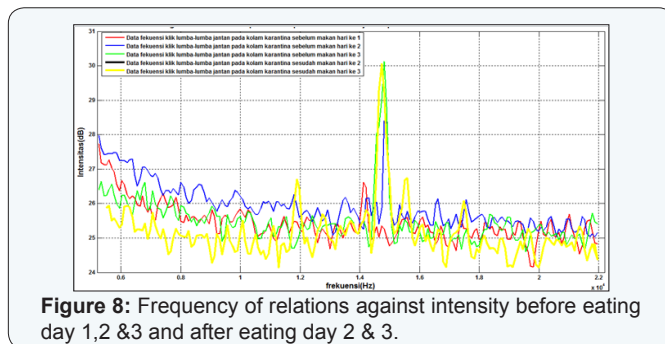


Figure 8: Frequency of relations against intensity before eating day 1, 2, 3 and after eating day 2 & 3.

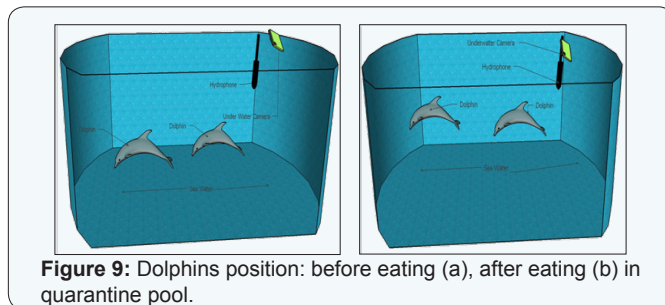


Figure 9: Dolphins position: before eating (a), after eating (b) in quarantine pool.

Result of the spectrum (Figure 3) showed signal fittest present at the data is 20-40ms , on the outcome of the spectrum (Figure 5) show strongest signal that is at 0-20ms , on the outcome of the spectrum (Figure 6) show strongest signal that is at 10-30ms, on the outcome of the spectrum (Figure 7) show strongest signal that is at 30-90ms, and the outcome of the spectrum (Figure 8) viewed sound or signal shown in the spectrum has been mostly and light in blue very showy that is at sound spectrum after eating day to -2 in seconds to 70 with long sounds namely the 80ms with signal of the spectrum the strongest at 40-90ms. Based with the charts relations frequency to intensity dolphins male at the time before and after eating (Figure 9) with only a maximum frequency 22.000Hz. On the frequency porpoises porpoises male in quarantine pool before a meal day to 1 in show by a graph red. Data frequency click porpoises porpoises male in the quarantine pool before a meal

day to 2 blue. Data frequency click dolphins male in quarantine pool before a meal day to 3 colour-coded green. Data frequency click dolphins male in quarantine pool after eating day to 2 in mark with black . Shows the maximum frequency of 22.000Hz and with the intensity early 28dB and value intensity the end of the 24,82dB.

Intensity dolphins click 1 having intensity early higher 25,73dB and intensity of the low on click 3 namely 24,83dB. While at the sound of porpoises click 2 have intensity early 24,22dB. Intensity the end of 23,57dB, and at the sound of porpoises click 3 having intensity early 23,83 dB while final score namely 24,77 dB. Based on table 8 after eating day to 3 intensity early dolphins sound in click 1 having 23,59dB and intensity of the end of 24,23dB, while in click 2 votes dolphins have intensity early namely 24,73dB and intensity of the end of the 24,78dB. In click 3 intensity early namely 24,60dB and intensity of the end of the 23,77dB. Sound click 4 have intensity early namely is 25,63dB and intensity of the end of the 25,15dB .We can see from intensity dolphins click 4 have intensity early higher 25,63dB and intensity of the low on click 1 namely 23,59dB .Value intensity highest look on a chart above is on a range of frequency 14.221-15.100Hz In 65-70ms. Data of frequency click dolphins in quarantine pool after eating day to 3 in give a yellow color. Value intensity highest obtained by the dark line green and yellow that is, before eat day to 3 and after eating day to 3 value intensity by up to 30dB in range frequency namely 14.221-15.100Hz in range time which is about seconds 65-70.

Value intensity after feeding on click 3 and click 4 having the same value, and this could have been as a received is the same sound that is assuming dolphins sound male same, while compared to a vote before eating. Dolphins preserved in park of safari Indonesia, cisarua bogor the frequency of sounds click with highest intensity of 32,01dB with a clicking sound 3 after food in a day to 2 which is found in range frequency namely 14.000-16.000Hz. The frequency of sounds click dolphins male (*Tursiops aduncus*) in park of safari is that is at the frequency of 14.000-15.000Hz. With the intensity lowest of 28,03dB and the highest is of 32,01dB , and according to [29-31] of acoustic signals that is to dolphins namely by range 20 KHz. Explore for analysis communication signals of ultrasonic at frequency of the origin of recording of sound whistle and they sound were obtained from two factors that is generally studies species of the dolphins and know who dimilki spectrum pattern.

The behaviour of Dolphins in Quarantine Pool

The results of recording behavior dolphins with underwater camera looking dolphins dominant lying around on the surface at the time after eating and before eating are at the base and swimming of column sea water in Figure 9. In Figure 9 can be seen dolphins tend to be above the surface in ponds at the time after being given feed and at the time before the given feed dolphins tend to be column at the base and have sea water

contamination on an outdoor quarantine pool, showed feeding on the dolphins very influential on behaviour and will result in a weak high sound frequency resulting from the dolphins.

Conclusion

Sound intensity treatment before and after eating by using the pool the same study have value of the intensity of highest obtained at sound after eating in the second day with their intensity 32,01 dB and value of the lowest intensity of are on before eating in first day. Dolphins tend to be somewhere didasar a pool of sea water on as before eating and dolphins always was sitting on the surface of the pond at the time after eating. The provision of eating treatment very influential on the perceived value of the frequency and the intensity of resulting from male dolphins.

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