Characterization of Sound Spectrum based on Natural Animals as an Alternative Source of Harmonic System Audio Bio Stimulators for Increasing Productivity of Food Plants

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Abstract. Natural Animal Sound Spectrum Characterization based on Fourier analysis is a fundamental scientific study of the spectrum of natural animal sounds that can be used as a stimulator of growth and productivity in food intensification. The results of characterization are very useful for adding scientific treasures in the field of biophysics, especially to support the use of natural animal sounds as stimulators of growth and productivity of food crops through spectrum analysis based on Fourier analysis so that it has a strong theoretical basis to be developed into an applied industry in the field of food intensification. Natural animal sound spectrum is obtained by recording animal sounds naturally in nature by using a voice recorder. Furthermore, the sound of these natural animals analyzed their spectrum characteristics using Adobe Audition to determine the peak frequency produced. Sound spectrum characterization which has peak frequency sonic bloom between 3000Hz - 5000 Hz is made as an audio stimulator for growth and productivity of food crops. From various 27 sources of animal sounds recorded and analyzed, there are 17 types of animals that have frequency peaks in range sonic blooms (3000-5000 Hz) and can be produced into stimulators and 1 combined stimulator. While the results of the sound timbre analysis of each animal has a frequency range including: 1-1000 Hz a number of 6 animals, 1000-2000 Hz of 8 animals, 2000-3000 Hz a number of 14 animals, 3000-4000 Hz a number of 12 animals, 4000-5000 Hz is 2 animals, and 5000-6000 Hz is 4 animals.

1. Introduction
The increasing extinction of natural animals in agricultural areas which are very necessary for plant growth has a negative impact on the environment and guaranteed availability in the future, because basically the sound is very useful for fertilizing leaves (foliar) with the fertilizer solution which functions to open leaf stomata. Therefore, one excellent research that is consistently developed through research activities at the signal group Acoustic Physics Laboratory, FMIPA UNY is about utilizing the Audio Organic Growth System or Audio Bio harmonic system (ABHS) based on the frequency of local natural animals to increase crop productivity. To make the results of the study have a broad meaning and as a theoretical foundation for applied research, it is necessary to develop characterizations of the spectrum of other natural animal sounds such as birds and insects and theoretical recommendations to determine specific frequencies that can be used as stimulators of food. The result of the characterization of the Natural Beast Spectrum based on Fourier analysis is a basic scientific study of the natural spectrum of sound that can be used to stimulate growth in food intensification[1].

The resulting spectrum character is very useful to add to the scientific repertoire in the field of Biophysics, especially to support the use of modified animal sounds through spectrum analysis based on Fourier analysis so that it has a strong theoretical foundation to be developed into applied industries in the field of food intensification. In order to be used optimally, and equipped with audio to stimulate the opening of leaf stomata,
the types of animals that have the character as stimulators can be known. It is very important to know that the sound coming out of natural animals can be utilized by surrounding plants as a stimulator of growth and productivity of food crops [2]. Making stimulators from natural animal sounds that have peak frequencies between 3000 Hz-5000 Hz is very important because it can be used as an alternative stimulator for food crops. Characterization of the sound spectrum of natural animals is chosen to document the results of studies and analyzes so that they have scientific benefits as a basis for leads to application in food intensification crops growth and productivity[3].

2. Method
The object of this research is the sound of animals, especially birds and insects [4]. The total number of animals recorded was 27 animals.

2.1. Procedure

2.1.1. Observation
Observation is done by choosing animals that have a clear voice and choosing a place to avoid noise that can damage the data. Retrieval of data in the field: Retrieval of data in the field is carried out directly on animal sound sources. Recording is done several times to get good recordings and to minimize the presence of noise. Sound cutting: Voice cutting is done manually using Adobe Audition CS6 by blocking the wave section, cutting sound waves with noise found in the friends and then stored in WAV format. Original Voice Frequency Analysis: Analysis of peak frequency is done using Matlab R2014b. Analysis is done with the FFT program in Matlab. Peak Variety cutting frequency: Cutting the range of frequency peaks is done using Adobe Audition CS6. Cutting is done on the original sound to get a variety of frequency peaks which are then produced into stimulators. Cutting is done by blocking the wave part at each peak that appears on the wave. Analysis of Variable Peak Frequency: The results of the cut off of the various frequency peaks that have been carried out then need to be analyzed to determine the cutoff frequency peak. This analysis is carried out using the FFT program in Matlab. Making Stimulators from each animal: Making stimulators is done using Adobe Audition CS6. Stimulators are produced using a variety of peak frequencies from each animal that have been analyzed and selected peaks included in the sonic bloom. Stimulators are produced in the form of MP3 and WAV with an duration of one hour. Making a Combined Simulator: Making a combined stimulator is done using Adobe Audition CS6. Combined stimulators are produced using a combination of several animal frequency peaks with a frequency range of 3000Hz to 5000Hz. Stimulators are produced in the form of MP3 and WAV with an duration of one hour. Stimulator Validation: The stimulator validation is done using to find out the output results produced by the stimulator. Validation is done using the FFT program in Matlab R2014b. Data, Instruments, and Data Collection Techniques: Research instruments in the form of data collection in the field. Data collection instruments include digital voice recorders used to record animal sounds and laptops that have been installed with Adobe Audition CS6 and Matlab R2014b software. Data analysis technique: Cut the sound recording from the original sound source to get the desired variety of original sounds using the Adobe Audition CS6 software. The sound that is cut is the sound of the part contained in the entire spectrum of sound of natural animals. The sound pieces are then analyzed for the peak frequency of the sound to get the frequency using the Matlab R2014b (32-bit) program.

3. Results and Discussion

3.1. Frequency Analysis Results
Frequency analysis is carried out on all recorded sound sources in order to know the original peak frequency and can find out the types of animals included in the range sonic bloom. There were 27 types of animals that had been analyzed and 17 animals were included in the range sonic bloom. The animals included in the Sonic Bloom include: Anis Merah, Cendet, Ciblek, Ijo Cucak, Pecalang Crow, Jalak Suren, Jangkrkik, Kacer Sumatra, Kenari, Kinjengtangis, Kutilang, Lovebird, Mozambic, Murai Batu, Orong-orong, Pentet, and Pleci.
3.2. Audio Stimulator Production Results

The first stimulator is obtained from various frequency data which is then carried out by the synthesis process to produce stimulators. In each stimulator there are only frequency peaks which are included in the range sonic bloom. Stimulators will be produced in 2 types, the first type is by producing each animal sound source and the second type with produce from several animal sound sources that are included in the sonic bloom frequency range. The following are the results of the audio stimulator obtained from 17 sound sources.

Table 1. Table the results of frequency range of the audio stimulator

| No. | Animal Name   | Frequency Range (Hz) |
|-----|---------------|----------------------|
| 1   | anis merah    | ±3000-3500           |
| 2   | Cendet        | ±3000-4000           |
| 3   | Ciblek        | ±3000-3500           |
| 4   | cucak ijo     | ±3000                |
| 5   | jalak pecalang| ±3000                |
| 6   | jalak suren   | ±3000-5000           |
| 7   | Jangkrik      | ±4500                |
| 8   | kacer sumatra | ±3000-4000           |
| 9   | Kenari        | ±3500-4000           |
| 10  | kinjeng tangis| ±5000                |
| 11  | Kutilang      | ±3000-3500           |
| 12  | love bird     | ±4000-5000           |
| 13  | Mozambic      | ±3000-4000           |
| 14  | murai batu    | ±3000-4000           |
| 15  | orong-orong   | ±3000                |
| 16  | Pentet        | ±3000-4000           |
| 17  | Pleci         | ±3000-4000           |

Validation is needed to find out the output of the stimulator that has been produced. Validation of stimulator output from each animal sound source was carried out using Matlab R2014b by making a wave analysis program listing using the FFT program Matlab R2014b algorithm. Following are the results of stimulator validation:

Figure 1. Stimulator Spectrum Graph of Anis Merah, Cendet and Ciblek

Anis Merah stimulator has a frequency band between 2500Hz to 4000Hz with frequency peak output dominant at 3050Hz and 3537Hz peaks according to the expected Anis Merah frequency peak, which is in the range 3000Hz to 3500Hz. The Cendet Stimulator has a frequency band in the range of 2800Hz to 4000Hz. Cendet stimulators are produced in the frequency range 3000Hz to 4000Hz. The plot of the Sandalwood stimulator analysis chart shows several dominant frequency peaks from
3000Hz to 4000Hz, namely, 3096Hz, 3538Hz, 3602Hz, and 3952Hz. Ciblek Stimulator has a frequency band from 2500Hz to 4000Hz. Ciblek Stimulators are produced in the frequency range 3000Hz to 3500Hz. The Ciblek stimulator analysis plot shows the peak frequency dominant at 2807Hz, 3112Hz, 3473Hz and 3581Hz.

Pecalang Starling Stimulators have a frequency band in the range of 2500Hz to 3500Hz. Pecalang Starling Stimulator is produced in the 3000Hz range. The starling pecalang stimulator chart plot appears the dominant frequency peak at 2848Hz, 2805Hz and 2894Hz. Starlings suren stimulators have frequency bands in the range of 2500Hz to 5500Hz. The starch suren stimulator is produced in the range 3000Hz to 5000Hz. The starling suren stimulator chart plot appears the dominant frequency peak at 3088Hz, 3934Hz, 5075Hz, and 5389Hz. Cricket stimulators are produced in the frequency range of 5000 Hz, the peak frequency stimulator at a peak frequency of 4747Hz.

The Sumatran glass stimulator has a frequency band in the range of 2500Hz to 4000Hz. Sumatran glass stimulators are produced in the range 3000Hz to 4000Hz. The dominant peak frequency that appears in the chart analysis plot is at the numbers 3036Hz, 3408Hz, and 3937Hz. Walnut stimulators have frequency bands in the range of 3000 Hz to 4000 Hz. Walnut graph plot analysis shows the dominant frequency peak at 3598Hz and 3943Hz. The crystalline stimulator is in the frequency range of 5000 Hz. Graph analysis on stimulators will cause the dominant frequency peak to appear at the numbers 5054Hz to 5104Hz. The finite stimulator has a frequency band in the range 2500Hz to 4000Hz. The finches stimulator is produced in the range 3000Hz to 3500Hz. The plot of the stimulator analysis finalized the dominant frequency peak at 2988Hz, 3091Hz, 3425Hz and 3511Hz.
The lovebird stimulator has a frequency band in the range 3000Hz to 5500Hz. The lovebird stimulator is produced in the range 4000Hz to 5000Hz. Stimulator graph analysis lovebird appears dominant frequency peak at 3895Hz, 4086Hz, 4738Hz, and 5056Hz. Mozambic stimulators have frequency bands in the range of 2500Hz to 4000Hz. Mozambic stimulators are produced in the range 3000Hz to 4000Hz. The plot of the results of Mozilla's stimulant analysis shows the dominant frequency peak at 2759Hz, 2995Hz, 3538Hz and 3887Hz. The Murai Batu stimulators have frequency bands in the range 2500 to 4000Hz. Murai Batu stimulator produced in the range 3000Hz to 4000Hz. The dominant peak frequency that appears on the magpie stimulator at 2888Hz, 3120Hz, 3306Hz, 3753Hz, and 3841Hz.

Orong-orong stimulator is produced at a peak frequency of 3000Hz dominant. The chart plot of the analysis shows that the dominant frequency peak is at 2747Hz, 2825Hz, and 2924Hz. The pentet stimulator has a frequency band in the range of 2500Hz to 4000Hz. The Pentet stimulators are produced in the range 3000Hz to 4000Hz, after being analyzed the dominant frequency peak that appears on the Pentet stimulator is at the numbers 3080Hz, 3495Hz, and 3936Hz. The Pleci stimulator has a frequency band in the range 2500 to 4000Hz. Pleci stimulators are produced in the range 3000Hz to 4000Hz. The results of the stimulator analysis appear the dominant frequency peak at the number 2724Hz, 3120Hz, 3483Hz, and 3941Hz.

The combined stimulator has a frequency band of 2500Hz to 5500Hz. The graph shows the 9 desired peak frequencies with a value of 2988Hz, 3497Hz, 4084Hz, 4506Hz, and the above graphs are the results of analysis of peak frequencies in the stimulator. It can be seen that there are maximum frequency peak values of each stimulator that appear in the plot of the graph of the output generated from the stimulator. From the making of stimulators, each peak frequency can be summarized, among others: (3.0 \pm 0.2) 10^3 Hz contained in Group A (the red anis stimulator, sandalwood, ciblek, cucak ijo, pecalang starch, starch suren, kacer sumatra, kutilang, mozambic, murai stone, orong-orong, pentet and pleci), (3.5 \pm 0.1) 10^3 Hz found in Group B (red anis stimulants, sandalwood, ciblek, suren starlings, kacer sumatra, walnuts, finches, mozambic, stone magpie, pentet and pleci), (4.0 \pm 0.1) 10^3 Hz found in Group C (sandalwood stimulators, starch suren, kacer sumatra, walnuts, lovebird, mozambic, magai batu, pentet, and pleci), (4.5 \pm 0.2) 10^3 Hz found in Group D (cicada and lovebird stimulators), and (5.0 \pm 0.2 ) 10^3 Hz contained in the stimulator of Group E (starlings suren, kenjeng tangis and lovebird). The graph can be seen in Figure 7. After the synthesis results are obtained, the wave spectrum can be produced as a stimulator with a duration of \pm 1 hour in MP3 and WAV format.
4. Conclusions
Based on the results of the discussion described, it can be concluded that:

- Animal sound sources included in the sonic bloom frequency range are for Anis Merah, Cendet, Ciblek, Green Cucak, Pecalang Starling, Surak Jalak, Kacer Sumatra, Walnuts, Kutilang, Lovebird, Mozambic, Murai Batu, Pentet, Pleci, and for Jangkrik, Kinjengtangis, and Orong-orong insects.

- Stimulator sources have been produced which can be used for the application of sonic bloom technology to increase plant growth and productivity. There are 2 types of stimulators, namely original stimulators from animals with the original frequency range and stimulators with a frequency range of 3000Hz-5000Hz obtained from combining peak frequencies from several sound sources. Of the bird species produced 14 stimulators, namely, for the frequency of 3000Hz on stimulator Cucak ijo and Pecalang Starling, the frequency of 3000-3500Hz on Anis Merah stimulator, Ciblek, Kacer Sumatra, Mozambic, and Kutilang, frequency 3000-4000Hz on Sandalwood, Murai Batu, Pleci, and Pentet stimulators, frequencies from 3500 to 4000Hz on Walnuts stimulators, frequencies from 3000 to 5000 Hz on Starling Suren stimulators, frequency 4000-5000Hz on Lovebird stimulators. For this type of insect, the frequency is 3000Hz on the Orong-orong stimulator, the frequency is 4500Hz on the Cicada stimulator, and the frequency 5000Hz on the cryptic stimulator. Stimulators from a combination of several peak frequencies use frequency peaks in the range 3000-5000Hz which are obtained from frequency peaks of Ciblek, Pentet, Lovebird, and Crickets.

- The source of the stimulator has been validated using Matlab R2014b. The output of the validation peak of the audio stimulator frequency is as desired but there are still other frequency peaks that appear around the dominant frequency peak with uncertainties which are analyzed for each dominant frequency peak that appears as follows: (3.0 ± 0.2) 10^3 Hz in the red anis stimulator, cendet, ciblek, cucak ijo, pecalang starlings, starlings suren, kacer sumatra, finches, mozambic, stone magpie, orong-orong, pentet and pleci, (3.5 ± 0.1) 10^3 Hz found in red anis stimulants, sandalwood, ciblek, starlings suren, kacer sumatra, walnuts, finches, mozambic, magpie stone, pentet and pleci, (4.0 ± 0.1) 10^3 Hz found in sandalwood stimulators, starch suren, kacer sumatra, kenari, lovebird, mozambic, mura batu, pentet, and pleci, (4.5 ± 0.2) 10^3 Hz found in cicada and lovebird stimulators, and (5.0 ± 0.2) 10^3 Hz found in starch suren stimulators, with crystals and lovebird.

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