Profile of the integration of earthquake precursor animal knowledge in animal ecology course

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Abstract. Earthquake experts have stated that the western coastal region of Sumatra Island is one of the most earthquake-prone areas in Indonesia. In response to this fact, disaster mitigation education programs must involve preparedness and preparedness before an earthquake occurs. This preliminary study aims to describe the profile of integration of biological studies, especially earthquake precursors in animal ecology lectures at the Biology Department of the Faculty of Natural Sciences (FMIPA) Padang State University (UNP). Data collection is done through analysis of lecture documents, surveys and interviews, and data analysis is done descriptively by referring to Hsieh and Shannon (2015) in Malekipour et al., (2017). The instruments used were a checklist of lecture content, semi-structured questionnaires, and interview guidelines. The results of the study show that the lectures on animal ecology in the Department of Biology FMIPA UNP have included the application of basic ecological concepts in everyday life. However, the area of application of these competencies is limited to conservation goals and how to treat animals in the student environment. The study of animal behaviour as a marker of earthquakes has never been integrated and applied in lectures on theory and practicum. Students' knowledge of animal behaviour in an earthquake event is mostly obtained independently from books and articles. From the results of the study, it can be concluded that the lecture on animal ecology is a potential lecture to examine the relationship between animal behaviour and earthquake disasters. Furthermore, it can be recommended integration of the behaviour of earthquake-related animals in animal ecology lectures for prospective biology teacher students, especially in practical learning. It aims to improve the ability and contribution of prospective teacher students involved in anticipating the impact of the earthquake on students living in disaster-prone areas, especially on the west coast of Sumatra.

1. Introduction
Disaster-prone status at Sumatera Island is generally driven by the tectonic plate movement and presence of a series of volcanoes lined the Ring of Fire line of the world. Subduction zones formed in this region cause Sumatra to become center of active seismic. Communities that are at increased risk of the harmful effects are called disaster-prone societies and influenced by constellation of various [1]. The UNESCO study show that the level of risk is higher because most people in disaster-prone areas have low knowledge, which is associated with low disaster preparedness [2,3] and negatively
It is necessary to face multi damage impacts of disasters using the disaster preparedness measures to develop capability required to face and overcome such disasters as disaster management literacy [4].

Disaster literacy is the capacity of individuals to read, understand, and use the information to make decisions and follow decisions in the context of mitigation, preparedness, response and recovery from disasters [1] which consist of knowledge, attitude and skill which applied to make decision in order to face and minimize disaster risks. Disaster education is one way to improve community disaster literacy and mitigation, include development of preparedness curriculum [5] in schools and colleges. Universitas Negeri Padang has capacity to develop earthquake disaster education in relevant field of study to prepare multidiscipline approach, include the science of Biology.

Basically, disasters are a result of widespread ecological damage in the relationship between humans and their environment, that biology contributes to prepare scientific explanation about the role of living things to disaster, for example the relationship animal behaviour before disaster. Previously, numerous studies have been conducted in the relevant field, such as unusual behaviour before earthquake in Tohoku, Peruvian Andes and Wenchuan, China[6]. However, none curriculum discussed these phenomena. Regarding to this fact, the authors were interested to examine how animal ecology course represents earthquake precursor relate to unusual animal behaviour.

2. Methods
This study applies a descriptive method consisting of steps to analyze the syllabus content of lectures, the acquisition of lecturers and students' responses through interviews, and the acquisition of responses to student experience through surveys. To analyze syllabus content, researchers assumed the summative qualitative content analysis approach method. A study using a summative content analysis approach commonly begins with an identification and quantification of certain words or content in the text or literature [7]. In this term, summative qualitative content analysis approach utilizes the counting of words or manifest content and latent meanings and themes to explore the usage of themes in the text.

The instrument employed was a checklist, consist of construct lists and related content lists. Firstly, we identify construct in each syllabus topic, then examine whether animal behaviour-related content is existed, marked as 0 for unrelated content and 1 for any related content. Additional, for each judged construct, we examine the targeted content (an earthquake precursor animal) using a similar scoring system. Finally, it is counted in percentage. To explore the latent meaning and implementation in each construct, we hold an interview toward the lecturer and students. In order to gain any confirmative information and experience during this lesson, we applied the method toward students using a semi-structured questioner.

3. Results and Discussion
Ecology are living systems containing a diversity of factors that interact with each other organically. Animal ecology is a branch of ecological discipline that studies the role and behaviour of animals in the environment. The results of a systematic review positioned behavioural studies as part of a single study domain, in addition to the 4 ecological research domains; are Species Interactions, Community, Ecosystem and other domains (scale, statistics), during these 3 decades [8].

Content analysis toward constructs outlined in Table 1 reveals 57.1% of the distribution of topics within the scope of basic ecology courses. The constructed structure arranged in each topic is still dominant in conceptual ideas (i.e. topics 1, 3, 4, 5, 7, 8, 13, 14). It turns out that this is induced by the limitations on the formulation of the objectives of the lecture, include: (1) understanding the concept of ecosystems, the law of tolerance and limiting factors for animals, (2) able to think and associate basic ecological concepts in life, and (3) able to use basic ecological methods learned. The three objectives are not specified in the principles of animal ecology learning. It could be the reason why topics and constructs developed seemed not specific to animal ecology.
The construct composition that places animal content as the main discussion only reaches 42.9%. Further identification of the practicum syllabus exposes almost similar results, where merely 28.6% of the topics which involve animals as objects of discussion. From a number of specific animal constructs in the lecture syllabus of theory and practicum, there were no constructs that communicated specific behaviour found, whereas behavioural studies included basic studies in a single domain of study [9]. To confirm this conjecture, the authors conducted interviews with lecturers who had experienced teaching animal ecology for 30 years. The results of interviews indicate that the behaviour of animals has been included in animal ecology courses, only incidental or based on cases that are trendy at certain times.

Regarding the distribution of the lecture material, students expressed the benefits obtained. Applicative benefits that have been felt in general by students are to add insight into animals, increase sensitivity to the environment and improve laboratory practicum skills. The specific benefits felt by students are recognizing various kinds of dangerous animals, conducting water quality tests, supporting environmental stability and gaining knowledge about ways to treat certain animals.

Based on the student's report, animal ecology lesson has provided benefits in increasing knowledge about animal content in normal situations. But it has not provided benefits in a context that challenges students to use knowledge of animal ecology in solving problems. The main target of animal ecology courses is an understanding of the basic aspects that underlie the performance of animals as individuals, populations, communities, and ecosystems they occupy, including the introduction of patterns of interaction processes and important factors that lead to the success or failure of organisms and ecosystems. These various factors and processes are noticed that can be used as the basis for compiling modelling, forecasting and its application to human interests, such as; habitat, distribution, and abundance, food, behaviour, and others.

Animal conservation is seen as the main objective of animal ecology lectures, according to the teacher's answer "to increase students' knowledge so that they are able to respond to the scarcity and extinction of animal species in Indonesia". In principle, the purpose of conservation is true as one of the essences of ecological lectures. However, living systems and technology are increasingly complex, requiring studies of animal ecology to also develop from conservation goals to objectives that involve solving contextual problems. For example, for the purpose of description of behaviour and ecology of animals can be facilitated with GPS technology. The conceptual shift from viewing nature as a balanced concept to constantly changing, unpredictable, complex ecosystems in the last 3 decades further strengthens the need for expansion of the area of behavioural studies and animal ecology, towards problem-based studies solving. One way is to redesign animal ecology lectures by increasing research activities.

So far, many studies on ecology and behaviour have been carried out including the development of the fields of cognition, evolution, and biomedicine. Recently, Berger-tal et al., suggested the need for translation of behavioural theory to be more applicable and to act as a proven predictor, but in order to improve the management and conservation of wild animal life [10]. Berger-tail’s suggestion about the translation of animal behaviour to function as a predictor can be adapted to adjust the need for increased earthquake literacy in the context of disaster mitigation in Padang City as one of the disaster-prone areas in Indonesia. Several studies have shown that animal changes have the ability to respond to certain phenomena before an earthquake, such as showing a reaction to the rejection of stimuli originating from the geophysical process in the earthquake zone.

An earthquake is a natural event that causes massive disruptive effects on the lives of humans, animals, and plants. Serious disruption, sudden attack on the community, and requiring extraordinary action to deal with it is called disaster. In fact, earthquakes are disasters that cause damage to reciprocal relationships between humans and other biotic and abiotic environments, or simply disasters are ecological damage. Earthquake made great damage to fragile ecological environment and it may seriously damage the basis of ecosystem in affected areas [11]. The affected areas in Wenchuan Earthquake lie in critical areas for biodiversity conservation in Min Mountain-Hengduan Mountain where the ecological environment is sensitive and rich in biodiversity.
Disaster management that considers ecological damage should be developed based on ecological concepts and principles. In this case, the study of animal behaviour is in the midst of gene and environmental interactions and acts as a mediator between the animal's fitness and anthropogenic disturbances. Investigations of animal ecology related to earthquakes have been widely studied by researchers. Majority of the research suggests the impact of earthquakes on certain animal populations, such as Panda, Fish [12] such Ayu Fish population (Plecoglossuss alveisalveis) [13], and Fucacinae family [14]. Rodil, Jaramillo, Acuña, Manzano, and Velasquez reported that the field carried out promptly after major disturbances, and the monitoring of the affected sites is after a disturbance is a large-scale natural phenomenon and artificial defences on beach ecology [15]. However, an earthquake is proven can increase fauna diversity through the mechanism of modulation of specific species processes and the interaction of species with other species caused by tectonic deformation [16].

Pre-earthquake ecological studies have also been carried out. However, it is generally limited to measuring ecosystem components, such as the amount of fauna data in an earthquake-prone location to be compared with post-earthquake data. In practice, the collection of pre-earthquake ecological component data is still a challenge, especially when collecting epifauna samples in coastal areas.

The trend in the study of behavior in earthquake precursors animal-animals that display unusual behavior because they respond to changes in natural phenomena before an earthquake occurs, has long generated. The unusual behavior of animals can be observed by the people so that it is used as a precursor for earthquakes to occur. Several instances of strange animal behavior, also in plants such as pollen, mushroom, and algae, which were observed which could causally support the hypotheses that were induced by the physical presence of gas, electric charges, and electromagnetic waves in the atmosphere [17].

Lecturers and students in animal ecology lectures said that they had known about factual animal phenomena which showed anomalies in behavior in the event of an earthquake, especially volcanic earthquakes. As many as 73.8% of students knew about animal behavior anomalies related to earthquakes. The knowledge that animal behavior anomalies associated with earthquakes were obtained from media in the form of books and articles. Examples of changes in animal behavior that are known to students are migration, unusual flying patterns and birds singing, the anxiety of Cats and Dogs, and mice that hide away before an earthquake. However, students do not have direct personal experience in observing these behavioral changes. Changes in locomotion of mice, unusual behavior of dogs, cats and changes in the amount of cow's milk production have been reported as examples of macroscopic biological anomalies. Information on changes in the behavior of study object animals was also obtained based on retrospective data using questionnaires and correlation analysis between respondents' answers and seismic data.

To determine whether an animal behaviour observed is an earthquake precursor or not, adequate knowledge and skills are required, because not all anomalies that have been observed and reported by certain groups of people can be accepted as bioindicators of earthquakes. Grant et al., managed to refute the perception of the Italians that the sound and migration of large frogs before the L’Aquila earthquake was a marker of a large earthquake. Therefore, strengthening of animals and their behaviour and behavioural observation methods must be the competence of students domiciled in disaster-prone areas, especially earthquakes, and can be integrated into formal learning about disaster mitigation in the form of basic competencies in the earthquake, tsunami, and natural disasters.

Based on respondents' answers, it can be described that the integration of issues or problems that occur in the life of the community has the potential to be realized through laboratory activities. A teacher, which is also a Biology teacher candidate, must be able to complete research in the laboratory and in the field. Accurate and thoughtful observation can be trained through practical activities in the laboratory.

Observation skills are very necessary for the context of animal behaviour phenomena as earthquake precursors, as well as components of scientific work skills as one of the main standards of science teachers [18]. This implies the need for the dissemination of earthquake-related knowledge into a form
of hands-on activity for students [19]. This skill is needed because higher education has a contribution to students because it plays a significant role in the readiness of students in earthquake disasters [24], including tectonic earthquakes. There are several other evidence programs that strengthen insights into tectonic earthquake mitigation that are effective against increasing community earthquake literacy [7,20-24].

4. Conclusion
From the results of the study, it can be concluded that in animal ecology courses at the Biology Department FMIPA UNP contains more fundamental ecological topics than topics related to ecology and animal behaviour. Integration of behavioural studies appears incidentally and has more to do with conservation goals. Based on the findings, the reconstruction of animal ecology courses needs to be considered, at least including the study of animal behaviour. The study of earthquake precursor animals has never been included in the document and discussed in the lecture, but lecturers and students have acknowledged the existence and importance of the study of earthquake animal behaviour to be discussed in a scientific context. This is important so that precursory animal knowledge of earthquakes obtained independently can experience reinforcement in accordance with valid behavioural science expertise.

Furthermore, it can be recommended to integrate the behaviour of earthquake-related animals in animal ecology lectures for prospective biology teacher students. Integration can be done in theory lecture activities, but it is more appropriate in practical learning. Through practice observation skills can improve the ability and contribution of prospective teacher students involved in anticipating the impact of the earthquake on students living in disaster-prone areas, especially on the west coast of Sumatra.

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