Doctoral Dissertation

Analyses of Grazing Land Dominating Cattle Feed Plants

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Abstract

The supply of forage depends on availability of plant species. To determine abundance and productivity of plant species could calculate using frequency each plant species in grazing area. Frequency is the number of times a plant species is present in a given number of quadrate of a particular size or at a given number of sample points. Frequency usually expressed as a percentage the concept of frequency refers to the uniformity of a species in its distribution over an area. Some of the important properties of plant species to evaluate the quality of grazing areas are the properties of plant species include the number of co-occurring species richness, specific abundance patterns and compositional (e.g., community types), functional, structural characteristics, and dominance of plant species. The supply of forage for cattle feed depends on pastures and it produces a wide variety of plant species which are superior in quantity and quality. To determining ideal cattle grazing area is difficult to predict, especially among within heterogeneous environments. Importance of conservation to increase management productivity and availability plant species related structure of this thesis divided 5 Chapters which consist of: Chapter 1 showed the general introduction; Chapter 2 is concerned on observation of abundant plant species; Chapter 3 is the main chapter, which focuses on determination frequency of plant species; Chapter 4 focuses on management of dominance plant species to increase productivity of grassland area; and Chapter 5 is general discussion.

The first section of chapter 2 is observation of abundant plant species. Data was collected using Braun-Blanquet method to analyze plant species in grazing areas, Hiroshima, Japan. Phytosociology of plant species were studied by using a line transect of 0-100 m at every 10 m interval. Specimens of each plant species were recorded in each plot of 1 m × 1 m quadrate (n = 11). One-meter square makes 16 parts of 0.25 m × 0.25 m sub-quadrate, the number of plant species was 32 in spring and 21 in summer.

The second section of the chapter 2 discusses about plant height. The statistically analyze showed significant difference ($p < 0.01$) between spring (16.64 cm) and summer (21.55 cm). The plant height in spring is lower than summer. In summer plant height increased because of lack of competition among plant species. Lack of competition occurred due to extreme temperature, where some plant species died.

The third section of chapter 2 investigated vegetation cover rate between spring and summer season. Vegetation cover rate is an important part of an ecosystem, and it has been estimated to monitor vegetation growth. The vegetation cover rate of plant species in spring was 77.18% and summer 81.36%. Vegetation cover rate of could give contribution and estimate productivity of plant species during spring and summer season in the supply needed cattle feed.

The fourth section of chapter 2 determined chlorophyll contents using SPAD (Soil Plant Analysis Development) 502. It has been found chlorophyll content showed statistically significant difference ($p < 0.01$) in spring 41.74 mg/g Fw and summer 36.28 mg/g Fw. In the spring season young leaf start growing which attributes high chlorophyll content and in summer reduces because leaf become old and fiber production increases automatically chlorophyll content decrease.

The fifth section of chapter 2 determined number of plant species diversity. The observation number plant species diversity of this study in spring 33 and summer 21. Number of plant species in spring high because many plant species phase growth and could adapt, whereas in summer decrease because some plant species could not adapt to extreme temperature.

The sixth section of chapter 2 determined productivity of plant species in spring and summer. Generally in this chapter, an productivity of plant species in spring and summer consists of plant height, vegetation cover rate, chlorophylls content, and species number. To determine influence abundance of plant species between spring and summer season show in chapter 2.

The first section of chapter 3 focused on plant species diversity between spring and summer season. In this chapter the properties of plant species assemblages include the number of species richness, interspecific of abundance patterns, compositional community types, functional and characteristics. Here, species richness of plant species is simply predicted present-absence, also to identification of each plant species. Diversity of plant species performs a variety of ecological productivity of food and feed, including recycling of nutrient. There is growing evidence that the level of internal regulation of functions in agro ecosystems largely depends on the level of plant species and animal present. Thus, biodiversity of plant species in grazing area is important not only as a tool to protect plant as cattle feed but also in sustaining their agriculture productivity.

The second sections of chapter 3 were determination frequency of plant species. The frequency of plant species between spring and summer season consist of: feed plant clover (spring = 17.45% and summer = 16.76%), feed plant grass (spring = 27.49% and summer = 61.90%), grassland plant native (spring = 9.40% and summer = 6.92%), other plant native (spring = 6.13% and summer = 9.73%), alien plant (spring = 39.53% and summer = 4.69%). Abundance of plant species diversity (functional group) consists of: feed plant clover (spring = 245 and summer = 143), feed plant grass (spring = 386 and summer = 528), grassland plant native (spring = 132 and summer = 59), other plant native (spring = 86 and summer = 83), alien plant (spring = 555 and summer = 40). Therefore, it is ideal to determine the productivity of functional group. So, I can compare each season based on plant species abundance. This research can measure suitable and abundance of plant species between spring and summer. In case of both season clover and grass are more effective than weeds. Weeds can grow in spring and decrease in summer because some weed cannot survive to extreme temperature. The appearances weed species in spring obstructing appearance of clover and grass species. Thus is not good for productivity of plant species in grazing area.

The first section of chapter 4 is vegetation analysis of dominance plant species between spring and summer season. Dominance of plant species refers to the number of plant species and their relative abundance. Diversity measurements incorporate species richness and species evenness which appear in grazing area. Measurement of dominance of plant species could be used for management rehabilitation of plant species for develop and conservation. Among spring and summer season plant species which are resistant and could adapt in spring consist of: *Trifolium repens* (clover) = 73.86%; *Paspalum dilatatum* (grass) = 69.32%; and *Paspalum notatum* (grass) = 47.73%, whereas in summer *Trifolium repens* (clover) = 81.25%; *Paspalum dilatatum* (grass) = 78.98%; and *Paspalum notatum* (grass) = 98.30%. Mixture frequency dominance of plant species could increase productivity, and quality as cattle feed in grazing area.

The second section chapter 4 determined midpoints cover range of plant species (%). Midpoints cover range of plant species observed are more than 70%, where in spring 75.57% and summer 86.17%. To identify potential and productive plant species as cattle feed floristic-sociological approach is important. Plant community types are units recognized by the total floristic composition of plant community.

The third section chapter 4 determined diversity index, evenness index, and species number. Species number in spring 33 and summer 21. In summer, species number decreased because some plant species could not adapt due to extreme temperature and also influenced the quality of plant species. These indices all combine data on richness and dominance (evenness) using Shannon and Weaver (1963) diversity index to express diversity in the ecological community of plant species. Diversity index, evenness index, and species number are high in spring compared in summer because in spring the plant species still grow up and many plant species could adapt to the cool weather.

The fourth section chapter 4 discussed about the influence of temperature spring and summer to the plant species diversity. In the spring season average temperature was 13.4 °C (minimum 8.9 °C, and maximum 18.2 °C) which increased to average 26.9 °C in summer (minimum 23.6 °C, and maximum 30.9 °C). A similar response has been found in annual specialty plant species in which temperature. The major environmental factor affecting productions with specific stress, such as periods of extreme temperature, overall growth and adapt to plant species depend on season climate, minimum and maximum daily temperatures, and timing of stress in relationship to developmental stages.

The fifth section chapter 4 discussed about management frequency of dominance plant species. Generally frequency of dominance plant species could adapt and resistant in spring consist of: *Trifolium repens* (73.86%), *Paspalum dilatatum* (69.32%), and *Paspalum notatum* (47.73%), whereas in summer *Trifolium repens* (81.25%), *Paspalum dilatatum* (78.98%), and *Paspalum notatum* (98.30%). Sustainability of dominance plant species can use as a management potential solution to the conservation of grazing areas and increase the supply cattle feed because about 70% of cattle feed depend on grass.

Chapter 5 is general discussion. The study was conducted in Setouchi Field Science Center, Hiroshima, Japan. This study focuses on management grazing to select dominance of plant species to increase productivity and conservation grazing area. The important to validate observation number of plant species series a straight line on a plot of abundance plant species between spring and summer. The dominance of plant species in this study consist of *Trifolium repens, Paspalum dilatatum*, and *Paspalum notatum* can use for conservation and management to increase productivity as cattle feed in grazing area for future.

Chapter 1

General Introduction

1.1 Background

The plant species diversity performs a variety of ecological production of foods and feeds, including of nutrients, regulation of microclimate, local hydrological process, suppression of undesirable organisms, and detoxification of noxious chemicals (Altieri, 1994). The supply of plant species as cattle feed depends on grazing area, and it produces a wide of grass species which are superior of quantity, and as also quality. Plant species diversity, animals, micro-organisms existing and interacting within an ecosystem (Vandermeer and Perfecto, 1995). Plant species diversity has provided the foundation for all agricultural plants and animals.

The entire range of the domestic crops used in the world agriculture is derived from wild plant species have been modified through domestication selective breeding and hybridization. The most remaining of diversity contain population of variable and adaptable landraces as well as relatives of crops, which provide valuable genetic resources for crop improvement (Harlan, 1975). The management of grassland areas has profound impacts on the nature conservation and landscape integrity in Japan. These consequent losses because reduced plant species in grazing areas. Therefore, countermeasures to improve the biodiversity and conservation of plant species need to be critically addressed. Over one hundred year ago, agriculture land use posed a scenic coexistence with an estimated grasslands area covering 11% of the total land area in Japan. According to the survey of the Environment Agency (1997), this figure dramatically decrease since the 1960 (Figure 1-1).

The growing evidence of international regulation function in agroecosystems is mostly depending on level of plant species and animal. Thus, plant species diversity in grazing area is important not only as a tool protects plant and animal, but also in sustaining their productivity of agriculture purpose. In general, extensive grazing areas are less productive and give crop energy content compared to those managed intensively. In consequence, the overly-intensive use of grazing in the main reason for the disappearance of many plant species (Bohner, 2007). Diversity simplification for agriculture purposes is an artificial ecosystem that requires intervention, whereas in natural ecosystems the global ecosystems function is a product of plant species diversity through flows of energy and nutrients. This form control is progressively lost under agricultural intensification (Swift and Anderson, 1993). Increasing productivity results in decline in some plant species in grazing areas. Sustainable farming systems such as extensive or organic farming with the use of farm cattle grazing area potential solution to solve biodiversity loss.

Agricultural systems become productive but only by being highly dependent on external inputs. A growing number of scientists, farmers and the general public of long-term sustainability make many contributions for internal input and ecologically simplified productivity of plant species as cattle feed systems in grazing area. To develop of agro ecological technologies and systems which emphasize to conservation-regeneration of biodiversity, soil, water and other resources are urgently needed to meet the growing array of environmental challenges. Enhancing functional plant species diversity in agro ecosystems is a key ecological strategy to bring sustainability for development and conservation.

1.1.1 Importance of plant species diversity in grazing area

Settled grazing areas developed an extended period, in which the vegetation was either modified by livestock or survived as remnants, were marginal or inaccessible. In medium intensity farming areas, the productivity of grazing areas requires for biodiversity in line with agricultural production and other ecosystem function. As already mentioned, cattle eats various plant species. Cattle differ in their preference for taking various plants species, in the order of selection of plant species considered and height of the cut made (Abaye *et al.,* 1994; Bailey, 1999).

Due to the diverse feeding behavior and feed preference, give impact on the area grazed differs between plant species. For example (Bartoszuk *et al.,* 2001) pointed out that cattle prefer taller grasses and other plant species, whereas horse selects the shorter sward. To compare cows, horses are more inclined to take fibrous grasses. Furthermore, they can bite closer to the ground because of their teeth structure (Dumont *et al.,* 2007). Cattle often utilize grassland selectively by grazing some areas more intensively than the other, resulting in local overgrazing (Coughenour, 1991). Production of plant species in grazing area also depends number of plant species present (Vitousek and Hooper, 1993; Tilman and Downing 1994; Tilman, 1996). Their functional diversity or composition of plant species (Hooper and Vitousek, 1997; Tilman *et al.,* 1997) or the identity of individual of plant species (Hector *et al.,* 1999). The specific models are required for effective prediction of the production in response to factors such as climate change, but the effect of species composition and sward structure, which may change as a result of grazing (Milchunas and Lauenroth, 1993). Grazing area received little improvements and grazing management for several decades and was dominated by white clover, kentucky bluegrass, and dandelion (Tracy and Sanderson, 2000b). Annual and perennial forbs also dominated the seed banks of these pastures, and it was concluded that a manager, seeking to establish a diverse, mixed-species pasture consisting of productive grasses and legumes, must reseed the desired species (Tracy and Sanderson, 2000a).

Within communities of the plant species, selection occurs primarily at the patch scale (Hodgson *et al.,* 1994). Cattle show the preference for patches with a high abundance of leaves before stems, leaves before components legumes and grasses dead, avoid patches with toxic plants, mature seed heads, and plant materials with high structural strength (Hodgson *et al.,* 1994). In total, this simple model illustrates a potentially important to determine dominance of plant species and effect diversity of plant species in grazing area as cattle feed. All else being equal, greater diversity increases the chance that species that have a given impact on a community or ecosystem process, if interspecific interactions such plant species to become dominance, then on average or intensity of this community or ecosystem process will depend on diversity.

1.1.2 Management of grassland conservation

Figure 1-2 demonstrated why it is important to seriously address management of grassland conservation. Extinction of plant species or other species through human action is an irreversible phenomenon (Houston, 1994). Once gone, an exterminated plant species represents a lost resource of unknown value. Plant species diversity together with other biological species, are not contributed uniformly over the surface but form spatial patterns of various sorts due to historic, casual and functional reasons.

The management of grassland areas has profound impacts on the conservation and landscape integrity in Japan. These consequent losses because of reduced plant species between spring and summer in grazing areas. Therefore, countermeasures to improve the biodiversity and conservation of plant species need to be critically addressed. The observation of plant species on a plot area can detect and calculate dominance and abundance of plant species, it is not often found in nature. Continuously stocked pastures had a complex structure of species-rich and species-poor patches with secondary patches occurring within primary patches (Barker e*t al.,* 2002). How landscape position and grazing management affected overall species diversity and functional composition of these pastures were not determined. This information is important to improving productivity of pastures for cattle grazing in spatially heterogeneous environments.

The important to validate observation or refute a certain number of plant species a straight line on a plot of abundance plant species. The plant species described by it are very uneven, with dominance of the plant species. Qualitative and structural plant species, such as nutrient contents, digestibility and plant morphology interacting with the choice of the animals (Gordon, 1997; Rook, 2002) and their behavior (Meisser, 2014) are discussed. Important spatial levels as cattle feed, and selective grazing that are influenced by preferred plant species and nutritive values (Dumont, 2000) are considered. Their complexity plant-animal on various process occurred at different spatial and temporal scale in the chosen feed in grazing area are considered (Astigarraga *et al.,* 2002). In the medium intensity farming areas, the productivity of grazing areas requires for biodiversity as same as agricultural production and other ecosystem function.

Functional types of grasses provide most of the biomass (Harmoney *et al.,* 2001) and competitively displace legumes (Guretzky *et al.,* 2004) in the pasture. Legumes have high forage quality (Van Soest, 1982), fix atmospheric N_2 through a relationship with *Rhizobium* bacteria (Heichel *et al.,* 1985), and usually could improve the productivity of pasture mixtures (Sleugh *et al.,* 2000). Weed species give contribute to biomass, but their quality is less than that of grasses and legumes, especially as they mature (Marten and Andersen, 1975; Marten *et al.,* 1987). Grazing area has been shown to affect feed plant clover and abundance plant species as cattle feed. Clover species were greater on backslope positions than on summit or to slope positions, and pastures managed with continuous and rotational stocking produced greater clover biomass than non grazed pastures area (Harmoney *et al.,* 2001). Spatial patterns of species richness also existed and varied by grazing treatment (Barker e*t al.,* 2002).

This model also demonstrates effects of diversity are unavoidably the effects of species differences and that it is possible to distinguish between the impacts on the number of plant species versus their identity. The plant species combinations explain of the observed variance in ecosystem diversity, reinforcing the importance of species composition for ecosystem functioning to determine dominance of plant species and increase management productivity with conservation in grazing area.

1.2 Research Objectives

The main objective of this study was to identify and determine the dominance of plant species that can adapt in spring and summer season. Development of a strategy to protect and improve the richness and plant species diversity was expected can support the sustainability of grazing areas for farmers. Observation and identification plant species in integrated grazing are the first part of this study. It is focused on recognizing the abundance of plant species, determine dominance, productivity of plant species as cattle feed. Therefore, the information of dominance of plant species in this study was hoped can use for development and conservation grazing area in order to increase productivity plant-animal in Japan.

To achieve the above goal, several important works have been conducted. Each chapter investigates a particular issue and tries to solve its specific objectives. Therefore, if the main objective of this study divided into several specific purposes, the list of all objectives in this study can be formulated as follow:

1. To identify and observe abundance of plant species as cattle feed in Setouchi Field Science Center, Hiroshima, Japan.
2. To determine productivity of plant species including plant height, species number, percentage of cover range, diversity index and evenness index.
3. To determine dominance of plant species that can adapt between spring and summer season.
4. To evaluate grassland plants for conservation in the pasture.

1.3 Research Scopes and Limitations of Study Grassland Ecology

The scopes of this study focus on the abundance of plant species in grazing area to increase management productivity as cattle feed. In addition, this study also covers the abundance of plant species as cattle feed in grazing area. It is very important to mention the limitation of this study. This study mainly focuses on management of grazing environment to increase productivity of plant species as cattle feed. Therefore, observation and identification only based on availability abundance of plant species in grazing area.

Quantitative and qualitative study design data were interpreted through inductive and intuitive processes. There are many limitations especially plant species in grassland. Dynamics of grassland ecology, there are several limitations mostly surrounded with the methodology used for the study. The most notable limitations categories include sampling plots (shape and size), taxonomic limitations, data interpretation and processing time (Grime, 1979; Crawley, 1997). The limitation on taxonomical aspect is due to insufficient knowledge of taxonomical hierarchy and specific identification of plant species (Leksono, 2005). Limitation on plant physiognomy is owed to climate and disturbance and other disasters is more or less important aspect. Periodic of dataset provide information but when this is due to unbearable circumstances such as weather pattern of environmental management grazing, resources availability on ecology and conservation.

1.4 Research Framework

As indicated in the previous section, this study is begun with the observed abundance of plant species. The next part is focusing on: 1) determination of frequency plant species; 2) determination of dominance of plant species could adapt in spring and summer; and 3) Increasing productivity of plant species as cattle feed. The whole framework of the study is being described as that shown in Figure 1-3.

1.5 Dissertation Backbone

A doctoral dissertation is a long piece of writing about scientific work. All sentence in a dissertation has to be written with full of consideration and responsibility. Ideally, each sentence in a dissertation has to be assessed and reviewed by experts in the field. The only way that all sentence in a scientific work being reviewed is by submitting the work to the journal, so that it can be assessed and criticized by experts in the international society.

It is an important to state here that all part of this dissertation is based on the published paper, implying that experts in the field have scientifically reviewed any written sentence in this dissertation. These papers become the backbone of this dissertation; hence any quotation taken from this dissertation should be referred to its corresponding paper.

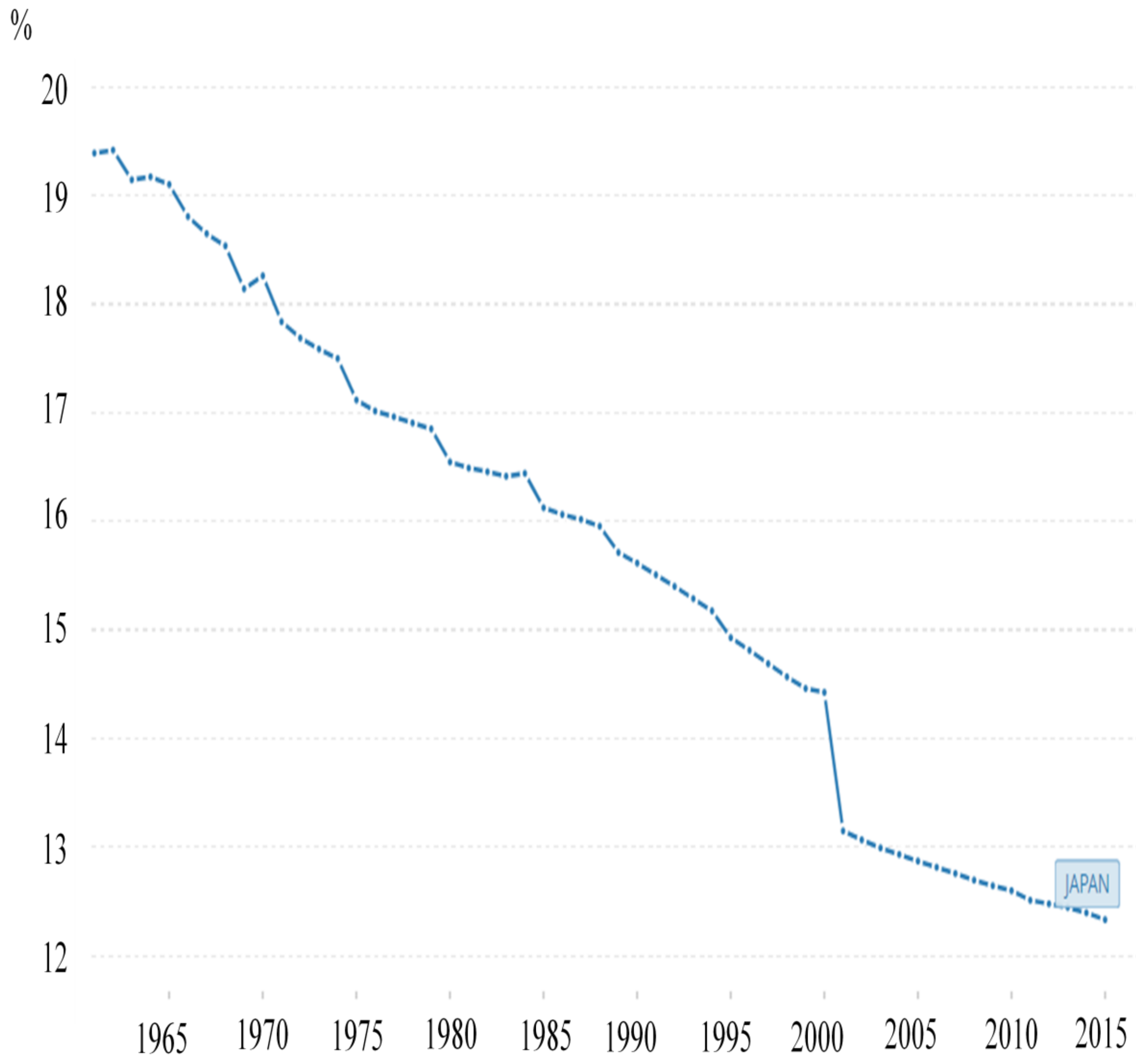


Figure 1-1 Agriculture land (% of land area), Source: World Bank Group, 2016 (http://data.worldbank.org/indicator/AG.LND.AGRI.ZS?end=2013&locations=JP&start=1965)

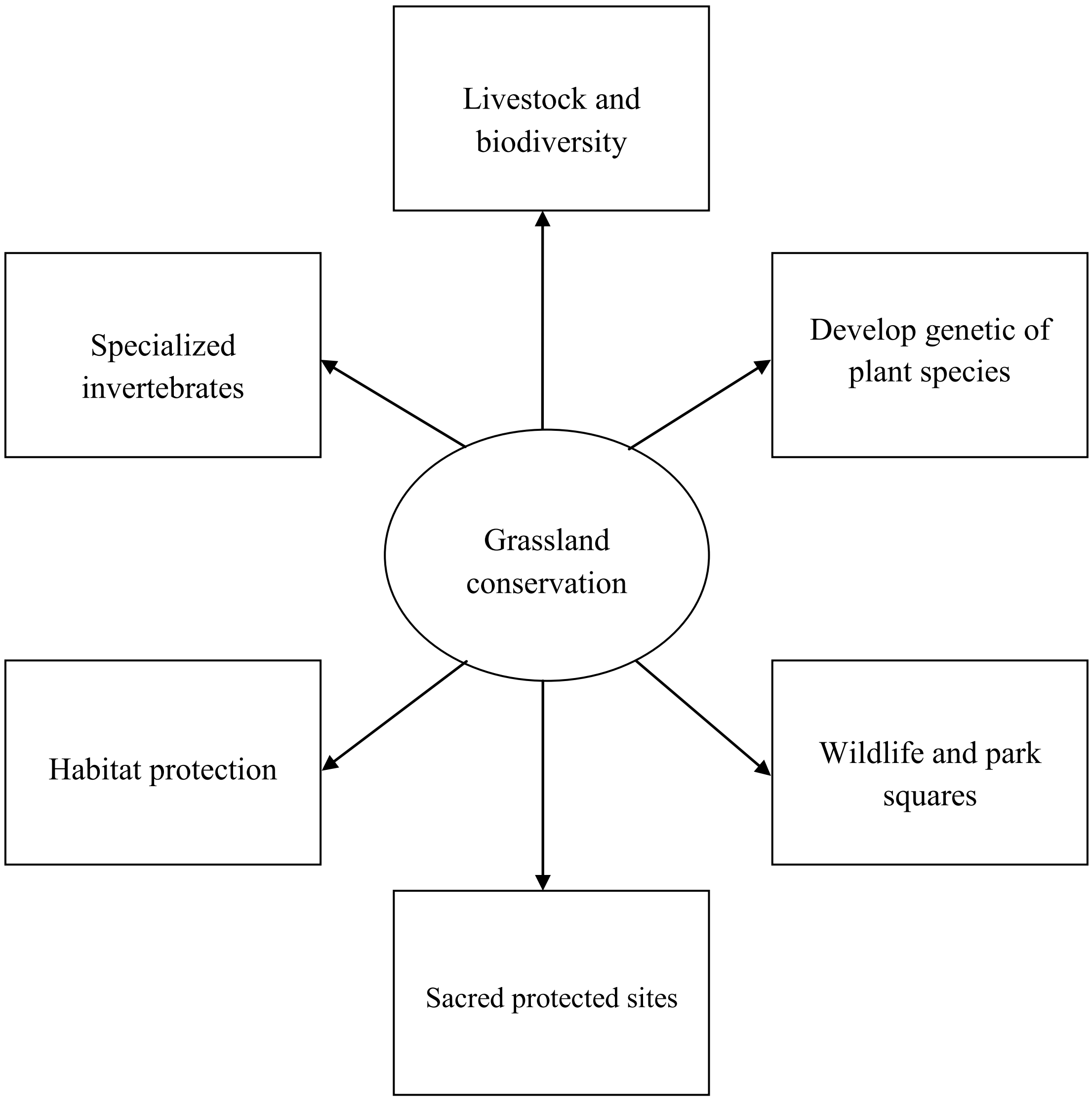


Figure 1-2 Schematic demonstration of why management of grassland conservation are important vegetation types that should be seriously considered for conservation from decline.

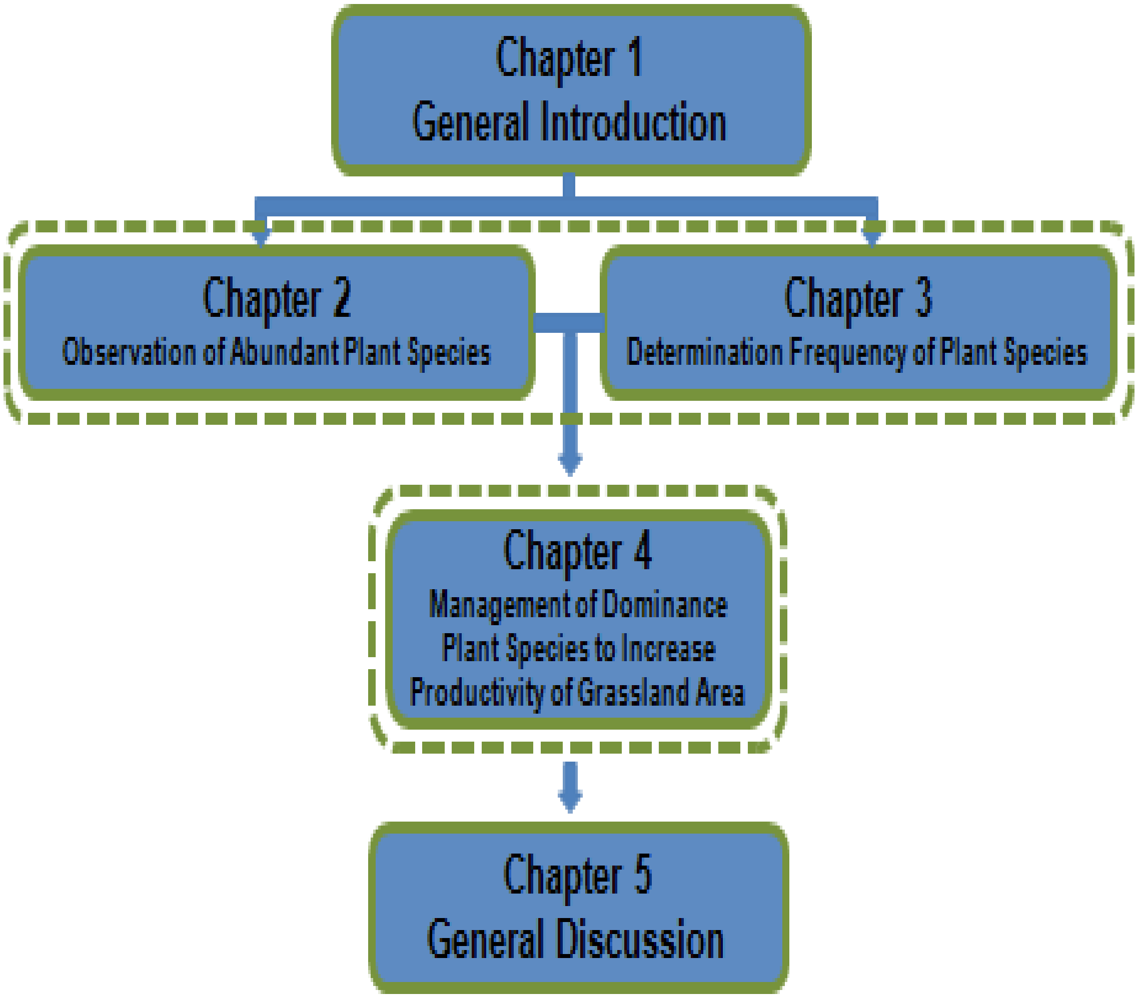


Figure 1-3 Structure of the thesis

Chapter 2

Observation of Abundant Plant Species

2.1 Introduction

The observation biodiversity of plants species performs a variety of ecological beyond the production of foods and feeds, including the recycling of nutrients, regulation of microclimate, local hydrological process, suppression of undesirable organisms, and detoxification of noxious chemicals (Altieri, 1994). Within different pastures, the use of forage resource by herbivores does not necessarily coincide with either vegetation or phytosociological units of plant species as cattle feed. Intercropping, agroecosystem, shifting cultivation and other traditional farming methods mimic natural ecological processes, and their sustainability lies in the ecological models they follow. This use of natural analogies suggests principles for the design of agricultural systems that make effective use of sunlight, soil nutrients, rainfall, and biological resources. Many scientists have now recognized how traditional farming systems can be models of efficiency as these systems incorporate careful management of soil, water, nutrients, and biological resources like dung can used for soil and fertilizer for plant species in grazing area.

The study of these systems is now offering important guidelines for water-use efficiency, pest control, soil conservation, and fertility management of the kind that subsistence farmers can afford (Gliessman, 1995). Due to their complexity, the plant-animal interactions considered on various processes occurring at different spatial and temporal scales (Astigarraga *et al.,* 2002). Although analysis of the natural abundance of plant species provides a potentially powerful tool for physiological research, physiological ecologists with plant species-animals have not adopted it because most of this review is introduce the use of natural variations abundance of plant species in the grazing area.

Abundance of plant species which uses cattle grazing, can be a tool maintain or restore landscape, and also has a beneficial effect on adjacent wild ecosystems (Bartoszuk *et al.,* 2001; Van Braeckel and Bokdam, 2002; Dumont *et al.,* 2007; Isselstein *et al.,* 2007; Janskowska-Huflejt, 2007; Wallis de Vries *et al.,* 2007). Conversion of intensively managed farms to organic methods of management is also beneficial to nature conservation (Haggar and Padel, 1996). A mix farming system with a high proportion of grassland habitats is likely to maintain some plant species is important in farmland. The importance extensive grassland use of plant species diversity conservation is the main reason for the substantial support of the practices to increase production of agriculture. The related to the abundance of plant species, a recent review by (Barlow *et al.,* 2015) on the effect of temperature extremes, frost, and heat, in wheat revealed that frost sterility and abortion of formed grains while excessive heat caused a number of plant species. Analysis by (Meehl *et al.,* 2007) revealed that daily minimum temperatures would increase more rapidly than daily maximum temperatures leading to the increase in the daily mean temperatures and a higher likelihood of extreme events and these changes could have detrimental effects on plant species. Consequently, a remarkable decrease in the range and abundance of many plant species associated with farmland. Sustainable farming systems such as extensive or organic farming, with the use of farm cattle grazing, are seen as a potential solution to continue biodiversity plant species loss. It has been shown that organic and low-input production system support to an abundance of plant species of agriculture ecosystem (Duelli, 1997; Bartoszuk *et al.,* 2001; Hansen *et al.,* 2001; Bohner, 2007). In regions with rich soils, the number of plant species on organic fields has been found to be up to 10 times higher compared to conventional fields (Hieneken, 1990).

The main role of cattle on threatened grassland area is control of plant species richness. This is the critical issue in the conservation and management of grassland. To achieve the expected results, the plant species of cattle grazing and methods of pasture management must be chosen carefully while taking into account the local natural conditions and the conservation goals of the particular area. The abundance of plant species is crucial importance for grassland biodiversity across in Japan. Unfortunately, biodiversity of plant species such biocenosis is currently threatened either by intensive use or by abandonment (Bartoszuk *et al.,* 2001; Dolek and Geyer, 2002; Poschlod and Wallis de Vries, 2002). In large areas in Europe, low grazing pressure leads to a creation of the unexploited area that is progressively covered with shrubs (Bailey *et al.,* 1998). Conversion of intensively managed grazing area to organic methods of management is also beneficial to nature conservation (Haggar and Padel, 1996). A mixed farming system with a high proportion of grassland habitats is likely to maintain some plant species in many countries (Sanderson *et al.,* 2009). The importance of extensive grassland use for biodiversity and landscape conservation is the main reason for the substantial support practices to increase productivity in grazing area.

2.1.1 Definition and concepts abundance of plant species

The dictionary of bioscience defines abundance of plant species in grazing area have related to the biological diversity or it's short form biodiversity as the range of living organisms (such as plant species and animal) in an environment during a specific time period. The term of plant species is thought to be rather new, and the origins of the concept go far back in time. The all of its manifestations, is an essential component of the human existence summarized.

To understanding the natural dynamics of biodiversity at all levels from genes to evolutionary processes and communities to ecosystems is essential for evaluating the impact of humans on natural diversity (Begon *et al.,* 1996). The processes and mechanism that governs the generation, maintenance and loss of diversity (UNEP, 1995). This conservation view on diversity is further expressed to encompass all levels of natural variation from the human intervention and landscape levels (Houston, 1994). Besides, there also very strong perspectives on anthropogenic factor which affect and shape the ecosystems in which biological species live and interact. The extinctions of plant species resulting from human activities throughout the world have caused great concern in the scientific community and among conservation activists (Houston, 1979).

2.1.2 Grassland ecology

The studies in grassland ecology are quite Miocene (Miocene is one of expanding open vegetation systems such as deserts, tundra, and grasslands) at the expense of diminishing closed vegetation. There are however, many publications and many empirical work and management, land use, species and plant communities of pasture and meadows (Numata, 1979). Recently, most of the studies become focused on targets and objectives. This has resulted in study specialty, although in ecology of grassland dynamics, some studies become more specialized on modeling (Ikeda, 2003) species composition and species diversity (Kitazawa and Ohzawa, 2002), species richness (Moore and Keddy, 1989) and conservation (Bayliss *et al.,* 2003).

Ecology can be defined as the study of relationships between organisms and the environment (Molles, 1999). The survival has depended upon how well we could observe variation of plant species and changes in the environment and predicts the responses of cattle to choose variation of plant species. The relationships ecology is rapidly changing and human impacts on natural environment have great impact on plant species diversity, and need to understand the consequences on these changes. Such negative changes threaten the diversity of plant species and may trigger endanger with mass extinction of natural species if management and conservation of plant species are not addressed.

Cattle and larger grazing are the common ecological characteristics in grasslands. Almost one-fourth of earth surface area is covered by grassland. In Japan case, few years ago grassland area stood at 11%, but now only 4% of the total vegetation is distributed with grassland (Ministry of Environment, 1997). The plant species diversity in grassland contains a wide variety especially herbaceous plant sometimes there are more than 30 plant species in a square meter. Beside plant species, there are enormous numbers of animal and insect some of which have specialized niche environments in grassland.

2.2 Materials and Methods

2.2.1 Study site

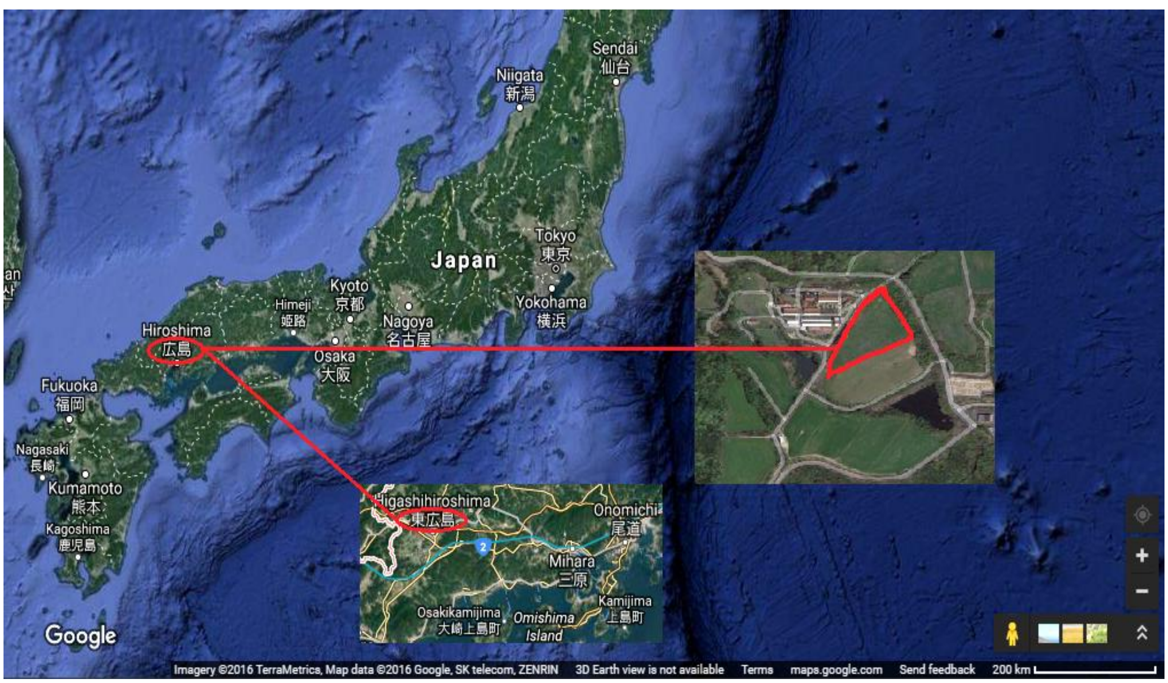


Figure 2-1. Study site at Setouchi Field Science Center. (Source:https://www.google.co.jp/maps/place//@34.3995242,132.7281071,16z/data=!3m1!1e3).

The study was conducted in Setouchi Field Science Center, which has an area of 1.6 ha (consist of six Wagyu cattle or *Bos Taurus*) in Hiroshima, Japan (34° 23´ N, 132° 43´ E). The elevation ranged from 230 to 240 m above sea level. In grazing area, seeding and fertilizer were conducted in autumn (October). Harvest and additional fertilizer were conducted in spring (after collect data), at the time growth plant in summer conducted to collect data and identify plant species and also determine dominant plant species which is *Trifolium repens, Paspalum dilatatum*, and *Paspalum notatum*.

2.2.2 Plant species diversity

Observation of plant species diversity conducted by method where floristic sociological approach plant species of community types are conceived as units recognized plant species by their total floristic composition. All formal vegetation descriptions in the Braun-Blanquet method require table observation of plant species in the field providing the complete species information for the vegetation communities. Among the species building up the floristic composition of a community, some plant species are better indicators than the others. The approach seeks to use species whose ecological relationships make them most efficient indicators. Diagnostic species include characteristics, differential species, and constant companions.

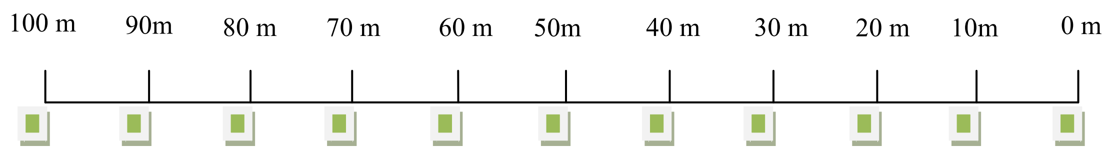
Plant species diversity in grassland ecology research reported benefits of plant contradict with the high productivity obtained from relatively of plant species, and from an increasingly narrow genetic diversity seen in current agriculture. Some result of research indicate that increased frequency of plant species diversity increases primary production in grasslands and benefits other ecosystem functions such as availability as cattle feed. The results and concepts have spilled over into other areas (Brummer, 1998) such as forage and grazing land research, and are beginning to influence management recommendations. For example (Tilman, and Downing, 1994) suggested exploring the concept of high diversity grazing lands for livestock production.

Diagnostic plant species diversity used organize communities into a hierarchical classification of which the association in the basic unit. The frequency of the various actually to determines how many species present and productivity of plant species in a paddock. The productivity and species richness were determined by abundance quality of frequency of various plant species. The plant species calculation in the paddock was defined by a square meter, where species were identified in each plot based on name and data record of plant species presence (presence = 1 and absent = 0). To determine frequency of plant species diversity data in each plot area, the following observation model was used (Braun-Blanquet, 1964). Grazing mix forage in the fact, determines how many species were present in diversity vegetative structure which can determine productivity and quality.

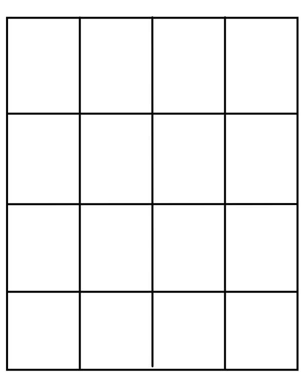
Much of the early applied research on complex species plant mixtures was done in clipping studies to screen various combinations of plant species. For example, early research in Connecticut compared 50 different single and multiple plant species combinations of grass and clover (1,2,3, or 7 species) for yield under clipping (Brown and Munsell, 1936). The range frequency of plant species in grazing area was large for the single and two species plots, but dominance frequency of plant species could increase productivity and availability plant species in grazing area. The yields of the complex mixtures were mid range of the some species plant mixtures (2-4) become highest, which is more adapted between spring and summer season.

2.2.3 Vegetation analysis

To study the plant species diversity, field observation was conducted during two seasons, spring (April-May) and summer season (August-September) 2015. Observation in the paddock was done by using the line transect 0−100 m point every 10 m interval (Figure 2-2). The distance between each treatment used 1 m × 1 m quadrate (n = 11). One meter square makes 16 parts 0.25 m × 0.25 m sub-quadrate (Braun-Blanquet, 1964).



1m x1m quadrate (n=11)
Incl. 0.25m x 0.25m sub-quadrate



L quadrate (1m x1m)

S quadrate (0.25m x 0.25m)

- Species Compositions

Figure 2-2. Scheme of the observation vegetation area

2.2.4 Data analyzed

Data was analyzed to determine plant species diversity, plant height, vegetation cover rate, and species number using methodology by (Braun-Blanquet, 1964). All trials were conducted in thrice, using ANOVA (Analysis of Variance) with P values are determined at 0.01 and 0.05.

2.3 Results and Discussion

2.3.1 Frequency of plant species diversity in spring and summer

The frequency of plant species diversity is one characteristic of community in grazing area, it is mechanism generating stability and protect availability of plant species. The nature of plant community at a place is determined by species to grow and develop in such environment (Bliss, 1962). Plant species diversity in agriculture will differ across agro ecosystems with different structure, and management. In fact, there is great variability in basic ecological patterns among the various dominance agro ecosystems. To investigate the effects of plant species diversity and environmental conditions, a two-source mixing model (Phillips and Gregg, 2001) was applied, and thus it was possible to determine kinds of plant species in spring and summer season.

In the vegetation density, soil surface cover, and soil texture can determine the amount of water and nutrients available to plants (Rosenthal *et al.,* 2005). Strong seasonality conditions, such as those observed in grazing area between spring and summer season often raise the question of how distinct are plant species responses to the productivity and frequency of each plant species. The main objective of this work is thus to compare the responses of co-occurring species possessing different functional traits, to changes in the frequency of plant species in spring and summer in grazing area. To achieve this, species-specific responses to the combined seasonal frequency of plant species in spring and summer were evaluated. For that, each frequency of plant species diversity was compared and showed (Figures 2-3 and 2-4).

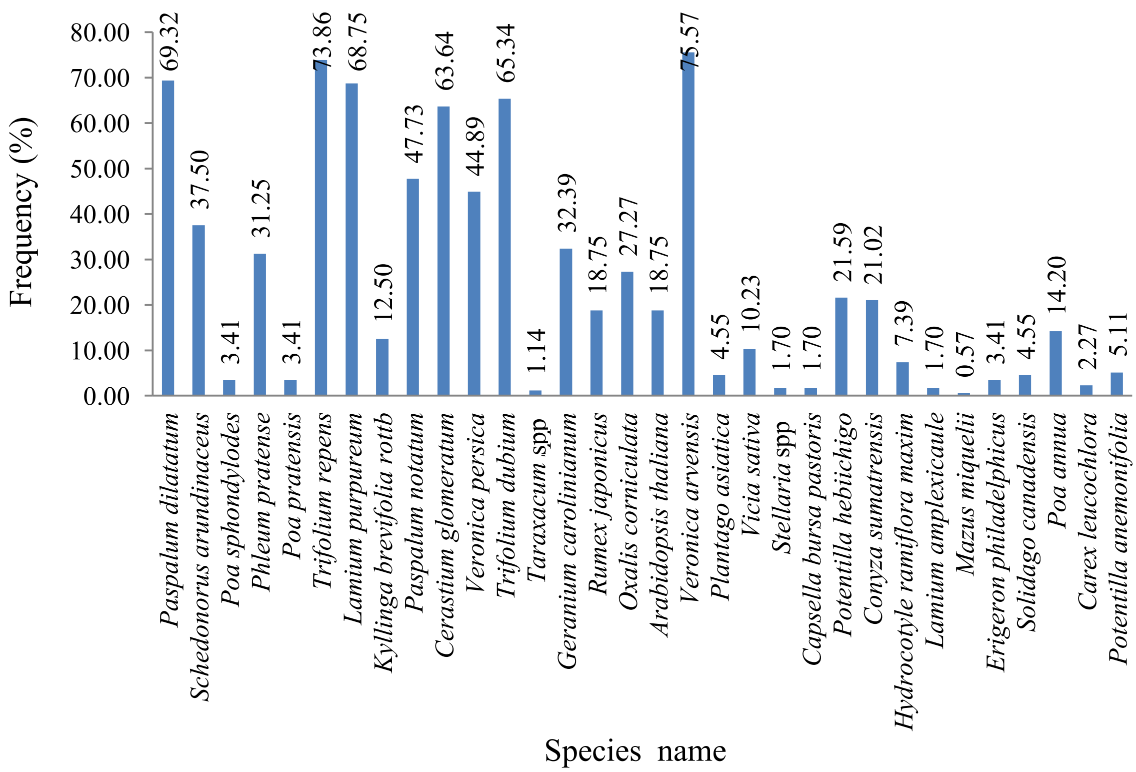


Figure 2-3. Frequency of plant species in spring

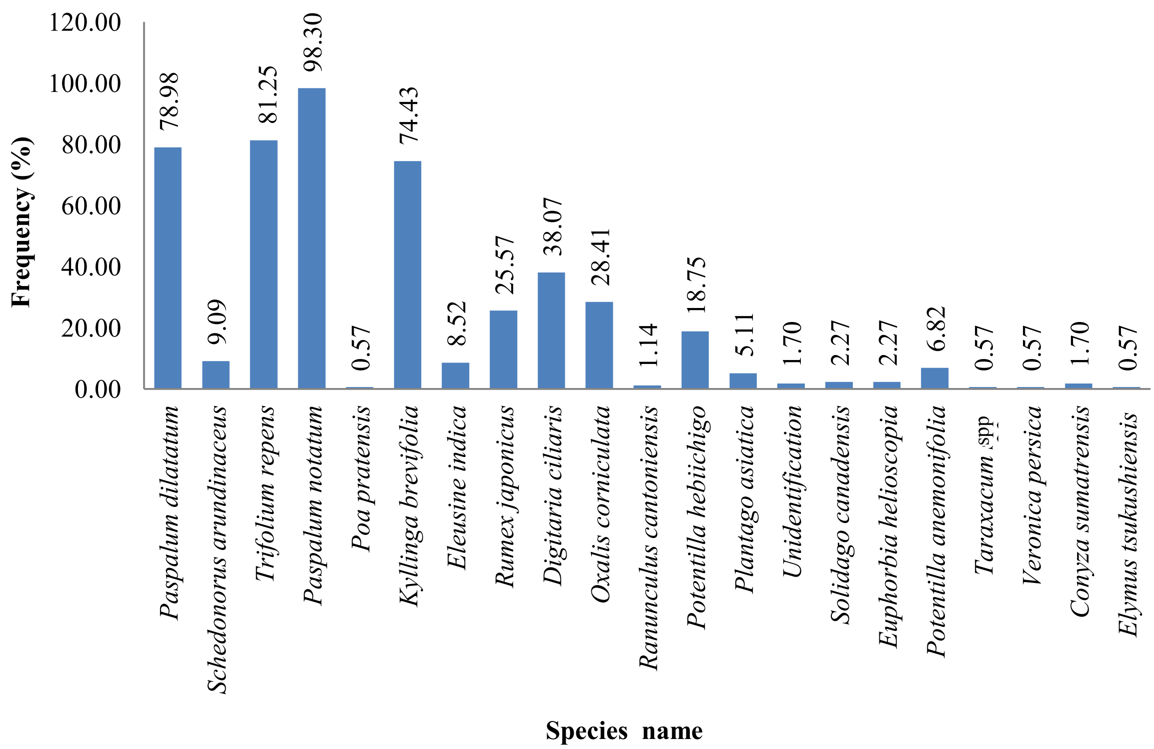


Figure 2-4. Frequency of plant species in summer

An interesting observation was that the differences for plant responses between sites were more apparent in spring than summer, reflecting the overall water stress during a summer drought, which led to a limited metabolic activity of some plant species. Generally, diversity of plant species in spring season high than summer because plant species phase growth and could adapt in spring, whereas in summer decreased because some factor of plant species could not adapt to extreme temperature, on the other hand the plants growth declined due to lack of soil water content and nutrient quality.

According to Vandermeer and Perfecto (1995), two distinct components of plant species diversity can be recognized in agro ecosystems. The first component, planned diversity associated with the crops and livestock purposely included in the agro ecosystem by the farmer, and which will vary depending on the management inputs and crop spatial/temporal arrangements. The second component, associated biodiversity, includes all soil flora and fauna, herbivores, carnivores, decomposers, and etc. That colonize the agro ecosystem from surrounding environments and that will thrive in the agro ecosystem depending on its management and structure of plant species.

The plant species diversity are needed ascertain the effects on per head and per hectare production along with effects on the composition as cattle feed products (Carpino *et al.,* 2003). Such studies must be long term to consider whether the effect of frequency of plant species diversity on the seasonal supply of herbage (Daly *et al.,* 1996) contribute to improve animal performance. They must be long term to consider the dynamic interaction between grazing and plant species diversity (Provenza *et al.,* 2003), in particular how changes in dominance frequency of plant species diversity under grazing could increase productivity, and availability of plant species as cattle feed.

2.3.2 Plant height between spring and summer season

In general, plant height between spring and summer is higher than standard of cattle feed in the grazing area. Observation of plant height conducted in different survey plots from 0-100 m, at 10 m intervals between spring and summer. In this study plant height in the spring minimum 9.31 cm, and maximum 19.88 cm, whereas in summer minimum 14.25 cm and maximum 32.69 cm. Plant height was lower in spring compared to summer, because plant species started growing and competition by using soil nutrients. It is found that commonly plant height in both of seasons depends on the structure of plant species, and the stronger photosynthesis on the summer which may positively increase the growth of plants species (Figure 2-5).

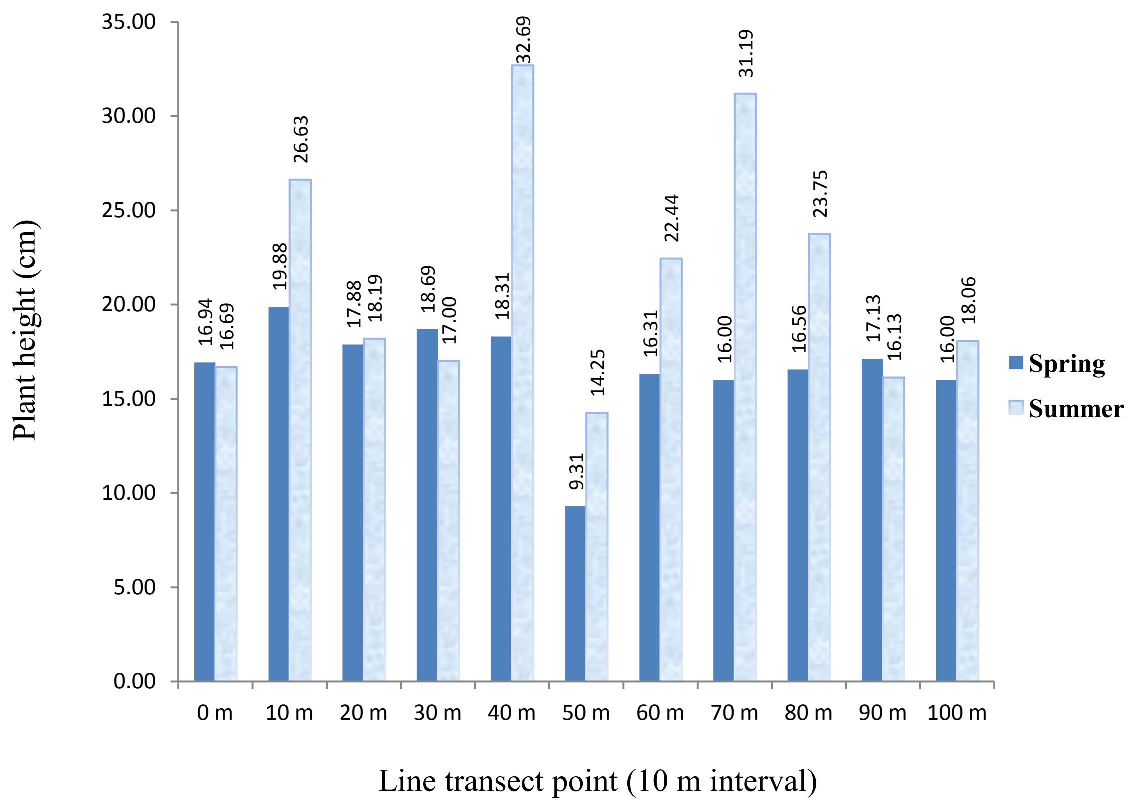


Figure 2-5. Plant height of plant species diversity in spring and summer

Plant height depends on different kind of plant species presenting in grazing area. Thus the management and production of plant height are important to increase abundance of plant species as cattle feed. The frequency distribution of density, cover, the biomass of plants as well as plant height is used as indicators for biological abundance and dominance of vegetation to describe species composition and spatial patterns of vegetation in different plant communities (Chen *et al.,* 2008). Species that are either tolerated or adapted to grazing (e.g., low palatability, adapted growth form) can react with compensatory growth, or even increasing productivity (McNaughton, 1983), and they are thus favored (Grime, 2001). In summer plant height is increased, because numbers of plant species present fewer, so the ability of plant species diversity grows faster.

Plant height is a crucial component of an ecological strategy, as it is a major determinant of a plant species ability to compete for light, and because of correlations between plant height and traits such as leaf mass fraction, leaf area ratio, leaf nitrogen per area, leaf mass per area and canopy area (Falster and Westoby, 2003). Plant height also an important part for life-history traits including seed mass, production time, longevity and the number of seeds a plant can produce per year (Moles and Leishman, 2008). These traits are central in determining how a species lives, grows and reproduces. Size of plant species is also correlated with metabolic rate and with maximum population density (Enquist *et at.,* 1998). In addition to having a central role in plant ecological strategy, plant height affects important ecosystem variables such as capacity (through its relationship with plant biomass) and animal.

To have a central role in plant ecological strategy, plant height affects important ecosystem variables such as carbon sequestration capacity (through its relationship with plant biomass) and animal diversity (for example, bird and mammal species diversity are tightly correlated with foliage height diversity (MacArthur, and MacArthur 1961; MacArthur, 1964; Recher, 1969; August, 1983). Given the obvious importance of plant height and the fact that it is a relatively easily measured plant trait, one might expect global patterns in height to be well known. In this study, quantification global patterns plant height and the first large-scale, cross-species investigation of relationships between plant height and environmental conditions.

To address of differing degrees of trait overlap response and effects between spring and summer, we must analyze the specific functions for the traits involved plant species in grazing area. Analyses are presented in the following section, first for the relationship between resource gradients and productivity, then for the apparently tenuous relationship between tolerances and adapt of plant species in spring and summer. The expanded investigation of the plant species independence between the responses of ecosystem affects, and finally discuss overlaps between response and function can be inferred related because plant height in grazing area can determine an increase or decrease the productivity of the supply cattle feed.

In the seasonal grazing regimes plant height between spring and summer was dictated by plant biomass availability and amount on grazing pressure. Finally, the timing of the peak plant height was in the summer season, because in summer allot number of plant species decrease, so in this case reduce competition of plant species to used nutrient of soil to grow in grazing area. Adaptation of plant species is related to alternative sets of traits that allow plants to appear during spring and summer season or to tolerate regrowing vigorously (thick bark, ability resulting from investment in underground reserves) or regenerating from the canopy or soil seed banks, fast growth rate, and rapid maturation. The relative importance of tolerance mechanisms, seeding or sprouting, has been related frequency and intensity plant species (Oechel and Strain, 1985).

The vertical defoliation imposed by cattle on tall plants (dominants), associated with the opening of gaps by biomass and conservation altered the competitive interactions enabling the establishment of competitive plant species, with the consequent increase in species richness (Grubb, 1986). Grazing area under continuous grazing was more evenly during the grazing season. Thus, several species were able to germinate and established grazing area. Difference moderate and heavy grazing under the continuous regime is explained by the prevailing role of the regular opening of sites for the establishment in the closed sward, compared with the intensity of grazing that apart from the continuous heavy treatment, possible losses of the plant species. The invasion of grazing could use dominance of plant species to increase productivity as cattle feed in grazing area.

2.3.3 Vegetation cover rate

The terrestrial biosphere affects the atmosphere, land surface, and climate by influencing the energy, moisture, and carbon fluxes at the surface. Turn impact of phenology, distribution, and type of vegetation (Foley *et al.,* 1996; Pielke *et al.,* 1998; Prentice *et al.,* 2000; Denman, 2007). The critical to understand the mechanisms behind the variations plant species to determine and predict not only the ecosystems, and the related carbon cycle but also the mediation of the climate system by feedbacks of the ecosystems. Field-based observational data vegetation provided limited usefulness for the studies and predictions vegetation cover rate of plant species in grazing area. Many authors have suggested that plant dispersal and herbivore may have important impacts on vegetation of cover rate pattern formation in grazing area. Therefore, examine how changes parameter values, as well as changes in other parameters related to a diversity of plant species, chlorophyll content, properties, affect vegetation pattern formation and temperature of environmental.

Vegetation cover rate in the spring minimum was 55.00%, and maximum 95.00%, whereas in summer minimum 60.00%, and maximum 95.00%. Vegetation cover rate of plant species generally in spring and summer is high, because plant species appearance of grass which present in spring and summer could adapt in grazing area more than 77.18% (Figure 2-6).

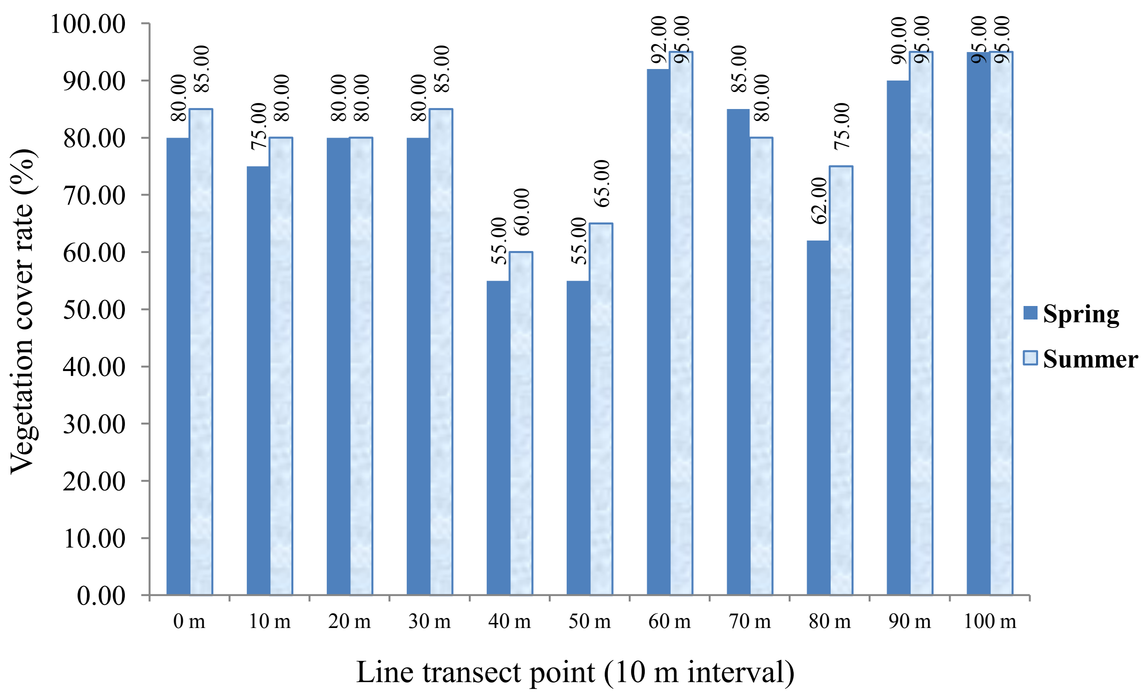


Figure 2-6. Vegetation cover rate of plant species in spring and summer

However, dispersal and productivity increases could utilized of herbivore as feed, the same qualitative behavior is still possible, though less likely. These theoretical results are in line with empirical findings of (Rietkerk *et al.,* 2000). On a gradient of herbivore impact, they found areas with a closed vegetation cover at low herbivore impact, areas of spatial vegetation patterning at levels of intermediate impact, and areas of bare soil at high herbivore impact (Rietkerk *et al.,* 2000) provided evidence for the positive feedback between plant density and water infiltration in areas where vegetated patches alternated with bare soil.

As a most important result, it was concluded that on the observed test sites erosion processes are occurring in patterns of high spatial frequency at far higher percentages of vegetation cover than tends to be assumed by most investigations into land degradation (Marzolff, 1999). Generally, a vegetation cover of 30-40% is taken as a threshold beyond erosion rates reach negligible amounts. In contrast, results of this study showed sheet erosion on fallow land with up to 70% overall vegetation cover rate. Looking at small sized patterns, moderate sheet erosion can even be observed at up to 90% vegetation density, and process dynamics may during several observation periods intensify even with increasing vegetation cover rate.

The plant species are likely to exhibit pattern increase formation if they can improve soil structures are could growing on infiltration capacity, if they can improve soil structures which lead to growing soil infiltration capacity, and if the soil structure comprises, the plant species can adopt in grazing area that is not very drought tolerant. The nature of this positive feedback is that at higher plant species densities in grazing area can use as cattle feed. In addition, the dominant factors of plant species can control diversity of plant species substantially influence to the plants species activities. In this study the variation of the characteristics in plant responses to environmental conditions between spring and summer could be explained by grazing area and vegetation cover rate of plant species can maintenance and increase supply cattle feed.

2.3.4 Chlorophyll content

Chlorophyll content of plants species in natural environments are inescapable subjected to alterations in irradiance and photosynthesis, and such changes can occur over a wide range of temporal and spatial scales (Bjorkman and Ludlow, 1972). Fluctuations in a light which occur over a time scale in spring and summer are accommodated by processes controlling the level energy of the photosynthetic membrane and the activities of enzymes of carbon and inorganic mineral assimilation (Foyer *et al.,* 1990). Additionally, the composition of the photosynthetic apparatus is highly sensitive to long-term changes in both the irradiance and the quality of chlorophyll and adaptation of plant species.

Chlorophyll content of plants signifies its photosynthetic activity as well as the growth and development of biomass. Degradation of photosynthetic pigments has been widely used as an indicator of air pollution (Ninave *et al.,* 2001). In this study chlorophyll content of plant species in spring minimum 38.81 (mg/g Fw), and maximum 45.54 (mg/g Fw), whereas in summer minimum 34.15 (mg/g Fw), and maximum 38.21 (mg/g Fw) shown in Figure 2-7. The chlorophyll content in spring increase, because each young plant species grow fertility in the cold season. The total chlorophyll contents of leaf decreased in summer as compared spring because some factors: 1) In summer chlorophyll decreased because some plant species could not adapt to extreme temperature, so automatically the level of chlorophyll content reduced per unit leaf, and 2) leaf chlorophyll contents decreased because young leaf of plant species in spring become old and contained high fiber in summer.

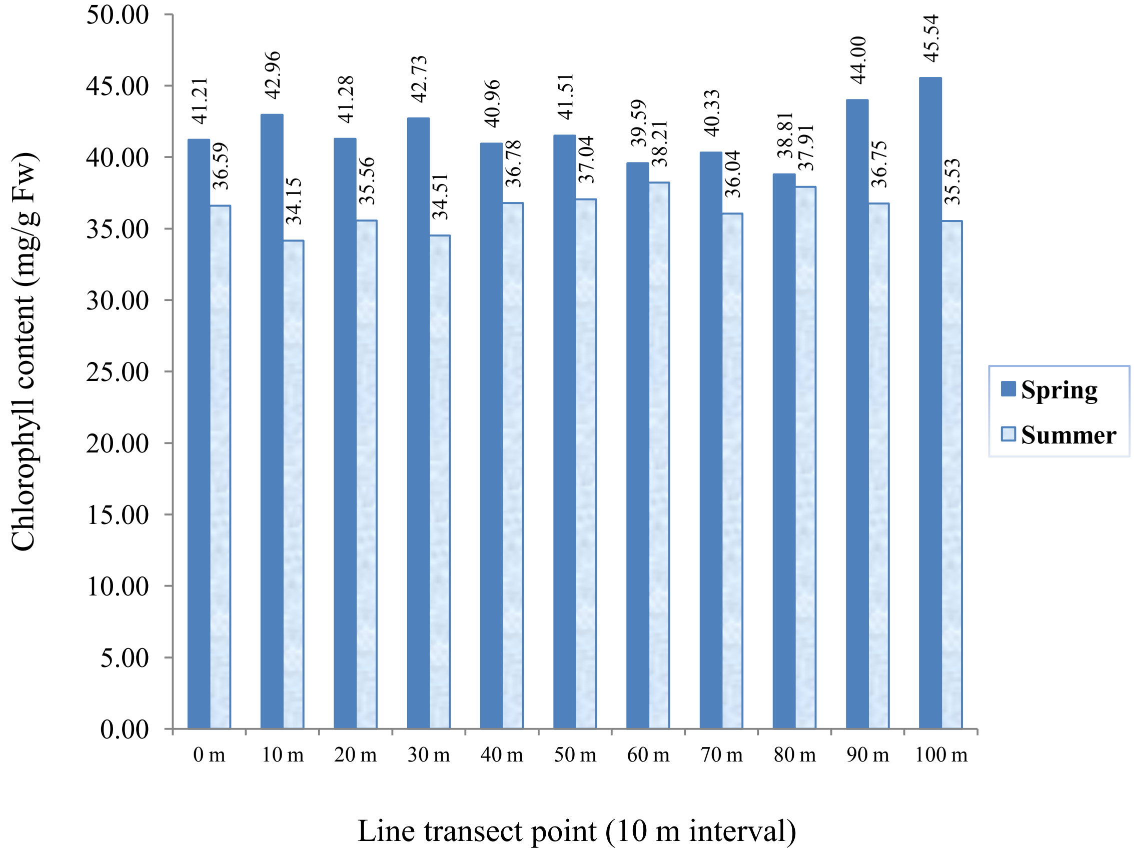


Figure 2-7. Chlorophyll content of plant species in spring and summer

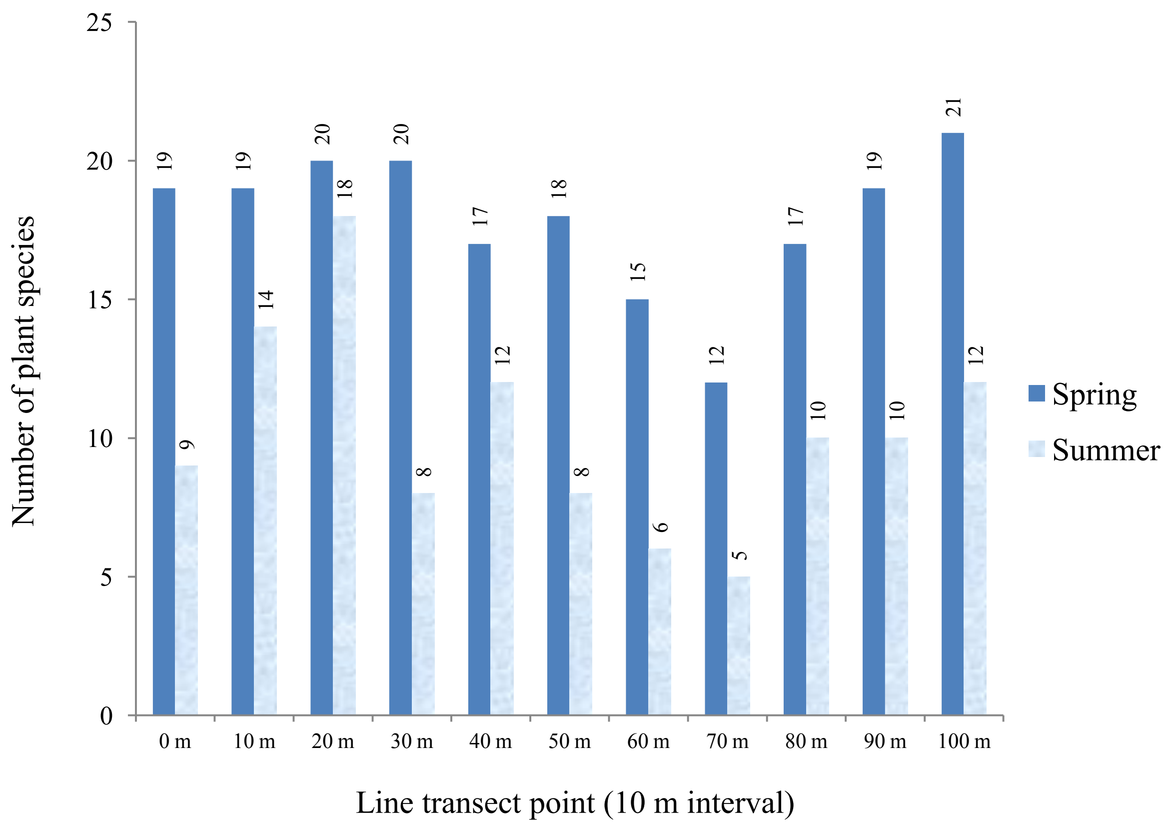
Decreasing chlorophyll content in summer (Scheibling, and Anthony, 2001) related to polycyclic hydrocarbons in cell sap which block the stomata spores for diffusion of air and thus put stress on plant metabolism resulting in chlorophylls degradation. Mandal (2000) depicted that the reduction in the concentration of chlorophyll might have also been caused due to the increased in chlorophyllase enzyme activities which in turn effects the chlorophyll concentration in plants.

There is substantial plant species variation in chlorophyll content for given growth irradiance and in the capacity to alter photosynthetic rates in response to a change in irradiance (Boardman, 1997; Anderson and Osmond, 1987). The diversity of plant species that the tendency to alter amounts of thylakoid membrane components in response to the quantity and quality of light and environmental factor between spring and summer are also could influence the quality of chlorophyll content of plant species. To determine the quality of grazing area, we can detect from chlorophyll content, if the chlorophyll contents was high, then the plant species fertility and productivity will be increased in grazing area.

2.3.5 Number of plant species diversity

Number of plant species diversity has so broad meaning and consists of genetic diversity up to ecosystems. Species plant diversity are known equal to the difference that is limited to diversity in a local or regional surface (Krebs, 1998). The plant species diversity is one of the important specifications of bio-societies that are measured in different ways (Krebs, 1998). The number of plant species in spring minimum 12.00, and maximum 21.00, whereas in summer minimum 5.00, and maximum 18.00. Total number of plant species excluding alien plant in spring minimum 9, and maximum 14, whereas in summer season minimum 4 and maximum 11 (Figure 2-8). Number of plant species in spring was high because many plant species could adapt, but decreased in summer because some plant species could not adapt to extreme temperature.

Species number in turn influences the physical and chemical properties of soil to a great extent. It could improve the soil structure, infiltration rate, and water holding capacity. However, the general vegetation has been dealt with in detail by (Sage *et al.,* 1989). They have recognized some vegetation types based on habitat, form, and density dominance of plant species, though the vegetation patterns are controlled by such factors as habitat, slope, temperature, exposure to sunlight and altitude besides biotic factors. An increasing trend in species diversity was observed from spring and summer which declined with the commencement appearance number of plant species. This characteristic is attributed to the fact that during spring and summer season.



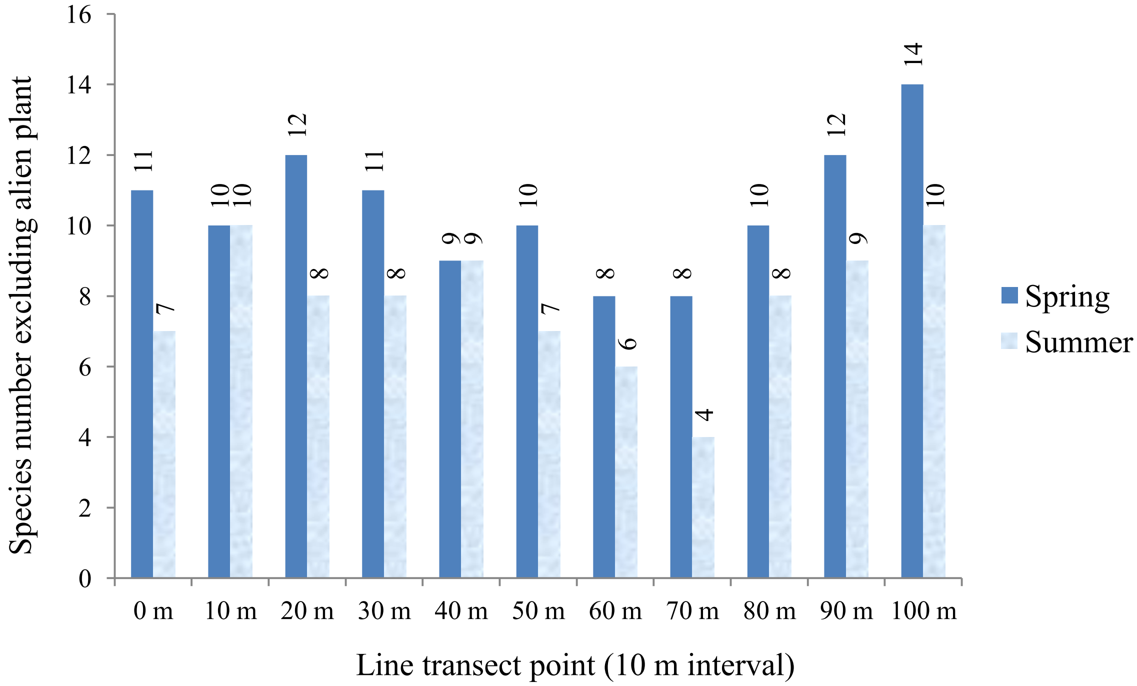


Figure 2-8. Species number of plant diversity in spring and summer

Most of the plant communities consist of several species which compete for light, water, and nutrients. Plant species in the community ranked by their relative success in competition, productivity to the best measure of success or importance in the grazing area. Some of the plant species were decreasing productivity in summer connect the few most important of dominance plant species with a more significant number of species are importance (whose number of plant species primarily determines the community's diversity or richness in species) and a smaller number of rare species. These numbers of plant species are of varied forms and are believed to express different patterns of competition and differentiation of diversity plant species. It is probably true of plants as of animals, that no two species in a stable community occupy the same niche. The development of niche differentiation makes possible the occurrence together of many plant species which are partial, rather than direct, competitors. The number of plant species tends to evolve also toward habitat differentiation between spring and summer season, toward the scattering of their center's maximum population density about environmental gradients, so that few appearance of plant species are competing with one another in their population centers. Evolution of both season and habitat differentiation permits many plant species to exist together in communities, with distributions broadly and continuously forming the landscape's many intergrading populations.

Number of plant species in a particular season is seen due of optimum conditions for their growth. Similar observations in context with the present study were also reported by (Kukshal *et al.,* 2009). Maximum species showed dominance during spring and summer season at both sites; thus it becomes evident that during these periods frequent occurrence of species is mainly due to the presence of suitable temperature, enough moisture and micro-nutrients (Nanette *et al.,* 2007; Zaman, 1997; Skarpe, 1990). The difference in the species composition from site to site is mostly due to microenvironmental changes (Mishra *et al.,* 1997). Some plant species go on sprouting depending upon the root/seed stock in the soil and there adding to number of plant species in total resulted from more diversity.

2.3.6 Productivity of plant species in spring and summer season

Ecologists have been trying to explain the observed relation between the number of plant species, productivity or availability of plant species diversity in grazing area (Waide *et al.,* 1999; Mittelbach *et al.,* 2001; Currie *et al.,* 2004). Behind the species richness-productivity relationship remain controversial. The continental global to the global scale, a positive relationship prevails (Currie *et al.,* 2004), and most hypotheses focus on explaining why the number of plant species increases with species richness. The explained by competitive exclusion (Grime, 1973; Tilman and Pacala, 1993). According to this explanation, the number of plant species decreases toward low productivity levels due to an increase in environmental stress, tolerant plant species at an advantage. By contrast a decrease in species richness towards high productivity because increasing competition for light, which becomes limiting resource at these levels of productivity in grazing area. Generally, an productivity of plant species in spring and summer consists of plant height, vegetation cover rate, chlorophyll content, and species number. To determine the productivity of plant species between spring and summer season show in (Table 2-1).

The plant height (cm) was significantly difference ($p < 0.01$) between spring (16.64 cm) and summer (21.55 cm). Plant height in the spring is lower than summer because in the spring plant species is growing phase. Whereas in summer plant height was increased, because some species could not adapt to extreme temperature and plant species only a few, so in this case a nutritive value of the soil used for plant species to grow faster. Plant height can determine the fertility of soil, and the abundance and availability of plant species as cattle feed. In general, the observation of plant height between spring and summer is high for standard on the cattle grazing. Figure 2-5 showed the difference of plant height in different surveyed plots of 0-100 m, at 10 m of intervals between spring and summer.

Table 2-1. Statistic analysis of productivity plant species in spring and summer season

Features	Season	Min	Max	Range	SD	(N=11) with mean ± standard error
Plant height (cm)	Spring	9.31	19.88	10.56	2.72	16.64 ± 0.82[b]
	Summer	14.25	32.69	18.44	6.32	21.55 ± 1.91[a]
Vegetation cover rate (%)	Spring	55.00	95.00	40.00	14.16	77.18 ± 4.28[a]
	Summer	60.00	95.00	35.00	11.64	81.36 ± 3.52[a]
Chlorophyll content (mg/g Fw)	Spring	38.81	45.54	6.74	1.96	41.72 ± 0.59[a]
	Summer	34.15	38.21	4.06	1.28	36.28 ± 0.39[b]
Species number excluding alien species	Spring	9.00	14.00	5.00	2.59	10.45 ± 0.63[a]
	Summer	4.00	11.00	7.00	3.71	7.90 ± 1.05[b]

Summary statistics of plant height (cm), vegetation cover rate (%), chlorophyll content (mg/g Fw), species number between spring and summer seasons. Each value of variable with different letter is significantly different ($p < 0.01$) and vegetation cover rate are not significantly different ($p > 0.05$) respectively of seasons.

In general, the plant height in summer is higher than spring, and the highest was recorded at 32.69 cm in summer, whereas the lowest was at 19.88 cm in spring. It is found that commonly plant height between both seasons depends on the structure of plant species to become dominant, and the stronger photosynthesis on the summer may positively increase the growth of plants. Plant height depends on kind of plant species present in grazing area; thus the management and production of plant height are important to increase the abundance of plant species for animal feed. The frequency distribution of density, cover, the biomass of plants as well as plant height is used indicators for biological abundance and dominance of vegetation to describe species composition and spatial patterns of vegetation in different plant communities (Chen *et al.,* 2008). Species that are either tolerant or adapted to grazing (e.g., low palatability, adapted growth form) can react with compensatory growth, or even increasing productivity (McNaughton, 1983), and are thus favored (Grime, 2001).

Vegetation cover rate of plant species between spring and summer was not-significant ($p > 0.05$) between spring (77.18%) and summer (81.36%) because from the productivity of plant species diversity in spring and summer was same in the grazing area. The vegetation cover rate of plant species was high contribution in grazing area because plant species in spring and summer can supply and availability as cattle feed. Although there were more exotic of plant species in grazing area, no causal link can be recognized between the reduction of species richness and ecosystem invisibility (Tilman, 1999; Rosenzweigh, 1995; Tilman, 1997). The alien plant species appearance makes a positive contribution to native species and under the intense grazing pressure (Kukshal *et al.,* 2009).

Most of the plant species showed their dominance during spring and summer. Thus their frequent occurrence is varied among temperature, enough moisture, and micronutrients (Nannete *et al.,* 2007; Zaman, 1997; Skarpe, 1990). Therefore, vegetation cover rate it is important to create a plant species inventory, and in order to determine species composition as provide baseline information about vegetation pattern in this area for future research on changes in biological communities caused by land-use impacts and environmental management in grazing area.

The chlorophyll content was significantly different ($p < 0.01$) between spring (41.72 mg/g Fw), and summer (36.83 mg/g Fw). The result could determine differences in levels of chlorophyll content between spring and summer seasons, as the chlorophyll content can reflect the heritability and growth of plant species in the grazing areas (Richards, 2000). In this study, specific of chlorophyll content between spring and summer season was significantly influenced by temperature. Mainly local climate at each growing location seems to have affected particular leaf area. Chlorophyll content of plants signifies its photosynthetic activity as well as the growth and development of biomass. Photosynthetic pigments has been widely used as an indicator of growth in summer (Ninave *et al.,* 2001).

The study revealed that the total chlorophyll content of leaf significantly decreased in the summer season, because in summer season temperature is extreme and reduce chlorophyll content of the leaf. These characteristics have promoted the development of various approaches, based on model inversion or the use of empirical and semi empirical methods, to estimate the chlorophyll content both at the leaf and canopy scales (Blackburn, 1998b; Datt, 1999; Daughtry *et al.,* 2000; Demarez and Gastellu-Etchegorry, 2000;

Gitelson *et al.*, 1996; Zarco-Tejada *et al.,* 2001). Among these investigations, studies using optical indices for chlorophyll estimation have focused on evaluating fertility and evaluated stress of plant species between spring and summer seasons.

The species number between spring and summer seasons is significantly different ($p < 0.01$) (Table 2-1). In the summer season, species number decreased because some plant species could not adapt to extreme temperature. Plant species diversity affected by some plant species which could not adapt to the summer and also influence the quality of species diversity (Hulbert, 1969). Reduction of species number may be attributed to low nutrient availability and limit CO_2 uptake (Tissue and Oechel, 1987; Fetcher, 1988; Sage *et al.,* 1989). The respiration per unit of dry weight of leaf area can indicate either the increase (Oechel and Strain, 1985) or decrease (Gifford *et al.,* 1985), depending of plant species, because the process of photosynthesis could influence to species number in a grazing area.

2.4 Conclusion

Generally frequency of plant species diversity, species number and chlorophyll contents were very high in spring than summer because some factor: 1) plant species started to grow and more young leaves of plant species could adopt in spring, and 2) fertility of soil and environment have correlation positive to the plant species, whereas in summer plant height has increased than the spring because in summer some plant species could not adapt in extreme temperature.

The vast majority of grasslands have been eliminated or highly modified by a variety of human activities, including conversion to croplands. Sustainable of grazing area is important to develop, especially native plant in grassland because native species easier adapt in grazing area if compared other plant species. In this case, the native plant in grassland could be protected and give contribution as cattle feed in grazing area.

Chapter 3

Determination Frequency of Plant Species

3.1 Introduction

Determining frequency of plant species depend on number of plant species present (Vitousek and Hooper, 1993; Tilman and Downing, 1994; Tilman *et al.,* 1996), their composition of the plant species (Hooper and Vitousek, 1997; Tilman *et al.,* 1997) or to identity of individual species (Hector *et al.,* 1999). Frequency of plant species refers to the number of plant species and their relative abundance in grazing area. Frequency of plant species measurements incorporates to species name, richness and species evenness. Sustained grazing of natural grasslands from long-lived perennials to annuals or short-lived perennials, with a concomitant decrease in production and an increase in its variability over time (Illius and O'Connor, 1999). Severe of grazing area may reduce both aerial and basal cover of grassland, and increase evaporation and runoff a dysfunction landscape, characteristic by water and nutrient loss through a removal of litter and surface soil (Tilman, 1997; Ludwig *et al.,* 1997).

Site specification of therefore required for efficient prediction of productions in response to factors such as climate change, but the effect of species compositions and sward structure, which may change as a result of grazing (Milchunas and Lauenroth, 1993), on temporal trends in productions has not been well investigated. Frequency of plant species was further associated with a particular diversity and abundance of plant species. The amount and variation time of production were measured to evaluate the effects of precipitation, a composition of plant species, basal cover, and production of one year on production of the following year plant species diversity and individual of plant species in grazing area. Because of increasing productivity of plant species in grazing could be to supply cattle feed. The ability of grassland to provide forage as the single most important source of nutrient to support cattle production which depends on both its aboveground net primary productivity (ANPP) and its nutritional value (Snyman, 2002).

Furthermore, a composition of plant species diversity are likely to influence productivity and plant nutrient value in most habitats (Hooper *et al.,* 2005). To determine quality and quantity of plant species available as cattle feed, it is important to evaluate the effect of grazing on cattle performance. Previous observations in grazing area have emphasized the effect of grazing intensity on the effect on animal intake of nutrients on grasslands (McKown *et al.,* 1991; Wang *et al.,* 2009). Despite the however important role in Japan, grazing area as a major feed resource for cattle feed farming relatively little is known about the effects of grazing on plant composition as cattle feed. Furthermore, a composition of plant species and diversity are likely to influence plant production and plant nutrient value (Hooper *et al.,* 2005). The mass ratio suggests that dominance frequency of plant species rather than diversity manipulate ecosystem function and stability (Ren *et al.,* 2012). Each plant species plays a different role in influencing the community of productivity of plant species diversity (Hooper *et al.,* 2005), and it has long been discussed whether the relationship between species diversity and productivity is positive, negative or not-significant (Tilman *et al.,* 2006).

The selection process can occur at the different spatial level that is characterized by plant species own time scale (Fortin *et al.,* 2003). At the smaller spatial levels, selective grazing is influenced by the abundance of plant species and the nutritive value of the plant (Dumont *et al.,* 2000). Qualitative and structural factors, such as nutrient content, digestibility, and morphology of the plant species interact in the choices of the animal (Illius *et al.,* 1992; Person *et al.,* 1994) and their behavior (Stejskalova *et al.,* 2013). Plant-herbivore relations can play a central role in energy and nutrient cycling because the palatability, growth rate, and decomposition rate of plant species are often linked. When palatability is defined based on the degree of which species is consumed relative to its abundance, recent studies have documented a clear, positive correlation between palatability and both plant growth rate (Bryan *et al.,* 1989) and decomposition rate (Grime *et al.,* 1996). However within grassland ecosystems, its remains uncertain whether of diversity plant species has the greatest effect on productivity and forage nutrient use, and on considered as most effective as the indicator to increase productivity plant species as cattle feed. Management to develop dominance frequency of plant species and conservation are objectives on such grazing particularly challenging and needs to be seriously addressed. Intensification on measurement analyzing of plant species could use for conservation grassland area in Japan.

3.2 Materials and Methods

3.2.1 Study site

The study was conducted in Setouchi Field Science Center in Hiroshima, Japan (34° 23′ N, 132° 43′ E), which has an area of 1.6 ha. In grazing area conducted seeding of plant species diversity every year in autumn. To efficiency grazing area, their available six Wagyu cattle or Bos Taurus will be utilized plant species as cattle feed to increase productivity and protect of soil fertility use dung as fertilizer organic (symbiosis-mutualism) of plant-animal. The elevation ranged from 230 to 240 m above sea level, and the mean of slope angle was approximately 5 degree. The climate of the study site was a temperature range with warm, humid summers and cold and dry winters.

3.2.2 Diversity of abundance and frequency of plant species

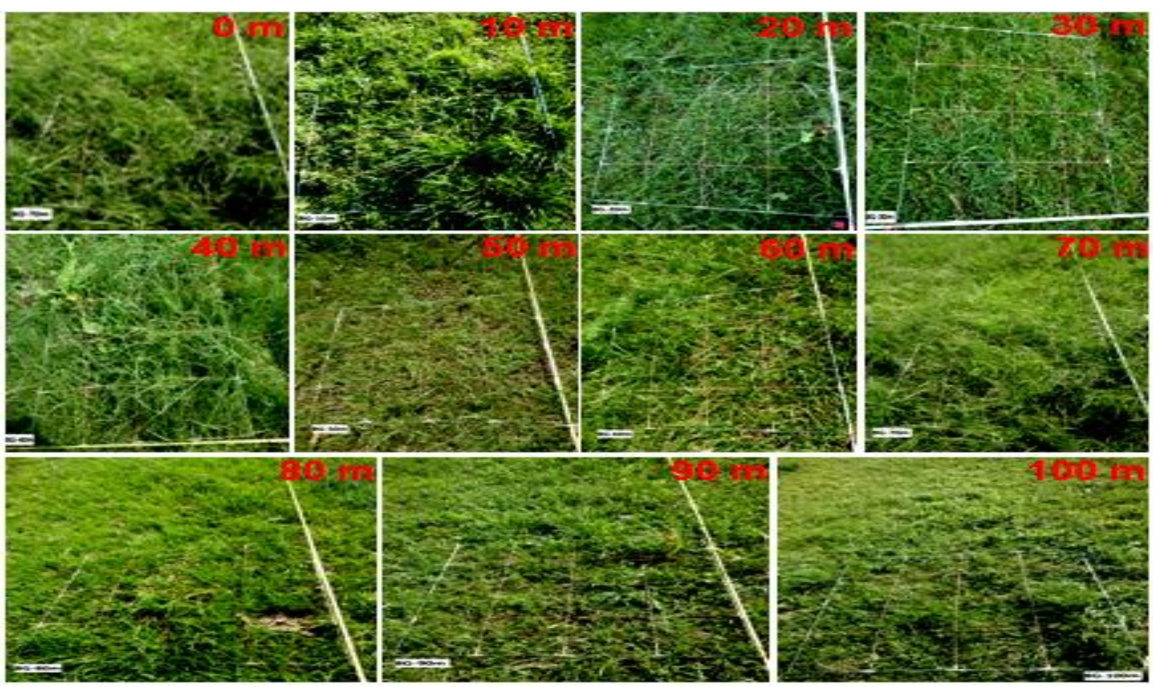
Observation abundance and frequency of plant species conducted by a method (Braun-Blanquet, 1964) where floristic sociological approach plant species of community types are conceived as units recognized species by their total floristic composition. The productivity and stability of plant species in grassland ecosystems depends in part on the functional composition and plant species diversity. Recent experiments showed that species richness on grasslands have greater productivity (Hector *et al.,* 1999; Tilman *et al.,* 2001). All formal descriptions of vegetation in the Braun-Blanquet method require table observation in the field providing the complete plant species information for the vegetation communities. Among the species building up the floristic composition of a community, some plant species are better indicators than the others. The approach seeks to use species whose ecological relationships make them most efficient indicators. Diagnostic species include species characteristics, differential species, and constant companions.

3.2.3 Collected data

Collecting data to identify plant species diversity in grazing area used to organize communities into a hierarchical classification of which the association in the basic unit. The frequency of the various plant species determines how many present and productivity in a paddock. Species diversity calculated in the paddock was defined by a square meter (Figures 3-1), where species were to identified in each plot based on name and data record of species presence (presence = 1 and absent = 0). To determine the frequency of each plant species data in each plot area, the following observation model was used (Braun-Blanquet, 1964). Plant species diversity in fact determines how many species were present in the diversity of structure plant species which can determine productivity and quality each plant species as cattle feed. In this way, more and more threatened vulnerable extinct plant species can be conserved as well as protected to develop and conservation.

a) Grazing area

b) Observation and identification of plant species diversity



Figures 3-1. Observation and identification of plant species diversity

3.2.4 Vegetation analysis of plant species diversity

To study plant species composition was examined through field observation during spring (April-May) and summer season (August-September) 2015. Phytosociological of plant species were investigated by using the line transect 0-100 m point every 10 m interval. Specimens of each plant species were recorded per plot and were recognized the distance between each treatment used 1 m × 1 m quadrate (n = 11). One meter square makes 16 parts 0.25 m × 0.25 m sub-quadrate using a formula by (Braun-Blanquet,1964):

$$\text{Relative frequency (\%)} = \frac{\text{Number of occurrences}}{\text{Number of releves}} \times 100\%$$

The Braun-Blanquet scale is also adaptable to an assessment of exiting on the grazing area. By comparing frequency dominance of plant species value having similar species composition, gross estimates of reduction in plant cover can be made. This method has good potential for estimating dominance plant species, also could for using conservation of plant species in the grazing area. The methods, listed in order of increasing quantification which consist of: 1) tabulation of plant species list, 2) estimation of relative abundance, 3) estimation of foliar coverage, and 4) density measurement (steam counts). Frequency is also used, but usually calculated from abundance, coverage, or density data. Observation conducted in grazing area to development study work under definite cost and time constraints. Consequently the efficient of selection, cost-effective methods that meet objectives is vitally important to development and conservation grazing area to increase productivity and availability as cattle feed.

3.2.5 Classification of functional group

The set of species co-existing in a given community constitute a functional group if they have similar functions of species characteristics. Dependence on ecosystem service is defined by a theoretical framework or by empirical evidence. Functional groups in vegetation science are known as plant functional types. Functional groups may be defined externally using categories for key traits or generated from several traits using cluster techniques. In this chapter show identify functional groups, selecting the appropriate measures to evaluate species similarity based on trait profiles, and choosing linkage algorithms to confirm the functional groups. Changes in the relative abundance of each group in a sample may be used to interpret the relationship of community composition with environmental conditions.

The functional group is a collection of organisms with similar suites of co-occurring functional attributes they have similar responses to external factors or effects on ecosystem processes (Cornelissen *et al.,* 2003). A functional group is often referred as plant functional type in vegetation sciences or as a 'guild' when referring to animals. Ecosystem properties or processes determine the services an ecosystem provides. These properties are associated with functional attributes of individuals or population. Thus, the plant functional type or the guilds are defined based on sets of species traits useful to explain ecosystem properties. Related classification of functional group of plant species divided 5 groups which consist of: 1) feed plant clover, 2) feed plant grass, 3) grass plant native, 4) other plant natives, and 5) alien plant.

3.3 Results and Discussion

3.3.1 Plant species diversity

Plant species diversity is one characteristic of species name in the community. It is mechanism generating stability. The plant community at a place is determined by species to grow and develop in such environment (Bliss, 1962). The most notable categories include sampling plots, taxonomic, physiognomic, investigation of plant species ecology and conservation, data interpretation and processing time (Grime,1979; Crawley, 1997). Regarding sampling, accurate plant species studies are faced with sample-size problem. It has been revealed that large sample quadrates sample more species while relatively small size quadrates have less species (Crawley, 1997). The taxonomical aspect is due to insufficient knowledge on taxonomical hierarchy and specific identification of species (Leksono, 2005). The maximum occurrence of plant species in spring and summer season could increase the productivity of plant species as cattle feed, availability of moisture provided by rains and other environmental factors. A similar of observations mirrored to present study was also mention (Sharma *et al.,* 2012). The observation abundance and frequency plant species diversity between spring and summer season was 32 in spring and 21 in summer (Tables 3-1 and 3-2).

Table 3-1. Classification of functional group plant species diversity between spring and summer

Species composition	Functional group	Spring season		Summer season	
		Abundance	Frequency (%)	Abundance	Frequency (%)
Trifolium repens	1) Feed plant, clover (main)	130	73.86	143	81.25
Trifolium dubium	Feed plant, clover	115	65.34	0	0
Paspalum dilatatum	2) Feed plant, grass (main)	122	69.32	139	78.98
Paspalum notatum	Feed plant, grass (main)	84	47.73	173	98.30
Schedonorus arundinaceus	Feed plant, grass	66	37.5	16	9.09
Phleum pratense	Feed plant, grass	55	31.25	0	0
Poa annua	Feed plant, grass	25	14.2	0	0
Kyllinga brevifolia	Feed plant, grass	22	12.5	131	74.43
Poa sphondylodes	Feed plant, grass	6	3.41	0	0
Poa pratensis	Feed plant, grass	6	3.41	1	0.57
Digitaria ciliaris	Feed plant, grass	0	0	67	38.07
Elymus tsukushiensis	Feed plant, grass	0	0	1	0.57
Veronica persica	3) Grassland plant, native	79	44.89	1	0.57
Rumex japonicus	Grassland plant, native	33	18.75	45	25.57
Plantago asiatica	Grassland plant, native	8	4.55	9	5.11
Stellaria spp	Grassland plant, native	3	1.7	0	0
Lamium amplexicaule	Grassland plant, native	3	1.7	0	0
Taraxacum spp	Grassland plant, native	2	1.14	1	0.57
Unidentification	Grassland plant, native	0	0	3	1.70

Table 3-1. Classification of functional group plant species diversity between spring and summer (continued)

Carex leucochlora		Grassland plant, native	4	2.27	0	0
Oxalis corniculata	4)	Other plant, native	48	27.27	50	28.41
Potentilla hebiichigo		Other plant, native	38	21.59	33	18.75
Hydrocotyle ramiflora	5)	Alien plant	13	7.39	0	0
Potentilla anemonifolia		Alien plant	9	5.11	12	6.82
Eleusine indica		Alien plant	0	0.00	15	8.52
Veronica arvensis		Alien plant	133	75.57	0	0
Lamium purpureum		Alien plant	121	68.75	0	0
Cerastium glomeratum		Alien plant	112	63.64	0	0
Geranium carolinianum		Alien plant	57	32.39	0	0
Conyza sumatrensis		Alien plant	37	21.02	3	1.70
Arabidopsis thaliana		Alien plant	33	18.75	0	0
Vicia sativa		Alien plant	18	10.23	0	0
Solidago canadensis		Alien plant	8	4.55	4	2.27
Euphorbia helioscopia		Alien plant	4	2.27	4	2.27
Capsella bursa-pastoris		Alien plant	3	1.7	0	0
Mazus miquelii		Alien plant	1	0.57	0	0
Ranunculus cantoniensis		Alien plant	0	0	2	1.14
Erigeron philadelphicus		Alien plant	6	3.41	0	0

Table 3-2. Frequency of plant species between spring and summer (%)

Species name	Spring	Summer
Veronica arvensis	75.57 ± 13.58 a	0.00 ± 0.00 f
Trifolium repens	73.86 ± 42.20 a	81.25 ± 37.60 ab
Paspalum dilatatum	69.32 ± 28.01 ab	78.98 ± 25.35 ab
Lamium purpureum	68.75 ± 19.36 ab	0.00 ± 0.00 f
Trifolium dubium	65.34 ± 43.33 abc	0.00 ± 0.00 f
Cerastium glomeratum	63.64 ± 21.79 abcd	0.00 ± 0.00 f
Paspalum notatum	47.73 ± 24.88 abcde	98.30 ± 5.65 a
Veronica persica	44.89 ± 26.93 abcdef	0.57 ± 1.88 f
Schedonorus arundinaceus	37.50 ± 37.81 bcdefg	9,09 ± 20.42 def
Geranium carolinianum	32.39 ± 25.98 cdefgh	0.00 ± 0.00 f
Phleum pretense	31.25 ± 40.12 defgh	0.00 ± 0.00 f
Oxalis corniculata	27.27 ± 23.76 efgh	28.41 ± 24.74 cd
Potentilla hebiichigo	21.59 ± 36.27 efgh	18.75 ± 37.29 cdef
Conyza sumatrensis	21.02 ± 33.10 efgh	1.70 ± 4.04 f
Rumex japonicas	18.75 ± 17.23 efgh	25.57 ± 15.42 cde
Arabidopsis thaliana	18.75 ± 13.69 efgh	0.00 ± 0.00 f
Poa annua	14.20 ± 16.79 fgh	0.00 ± 0.00 f
Kyllinga brevifolia rottb	12.50 ± 17.23 fgh	74.43 ± 27.87 b
Vicia sativa	10.23 ± 12.58 gh	0.00 ± 0.00 f
Hydrocotyle ramiflora maxim	7.39 ± 10.01 gh	0.00 ± 0.00 f
Potentilla anemonifolia	5.11 ± 16.96 gh	6.82 ± 15.17 def
Plantago asiatica	4.55 ± 6.31 gh	5.11 ± 10.01 ef
Solidago canadensis	4.55 ± 10.11 gh	2.27 ± 7.54 f
Poa sphondylodes	3.41 ± 8.08 h	0.00 ± 0.00 f
Poa pratensis	3.41 ± 11.31 h	0.57 ± 1.88 f
Erigeron philadelphicus	3.41 ± 5.84 h	0.00 ± 0.00 f
Carex leucochlora	2.27 ± 5.78 h	0.00 ± 0.00 f
Lamium amplexicaule	1.70 ± 5.65 h	0.00 ± 0.00 f
Stellaria spp	1.70 ± 5.65 h	0.00 ± 0.00 f

Table 3-2. Frequency of plant species between spring and summer (%) (continued)

Capsella bursa-pastoris	1.70 ± 5.65 h	0.00 ± 0.00 f
Taraxacum spp	1.14 ± 2.53 h	0.57 ± 1.88 f
Mazus miquelii	0.57 ± 1.88 h	0.00 ± 0.00 f
Eleusine indica	0.00 ± 0.00 h	8.52 ± 16.12 def
Digitaria ciliaris	0.00 ± 0.00 h	38.07 ± 30.93 c
Ranunculus cantoniensis	0.00 ± 0.00 h	1.14 ± 2.53 f
Unidentification	0.00 ± 0.00 h	1.70 ± 5.65 f
Euphorbia helioscopia	0.00 ± 0.00 h	2.27 ± 4.21 f
Elymus tsukushiensis	0.00 ± 0.00 h	0.57 ± 1.88 f

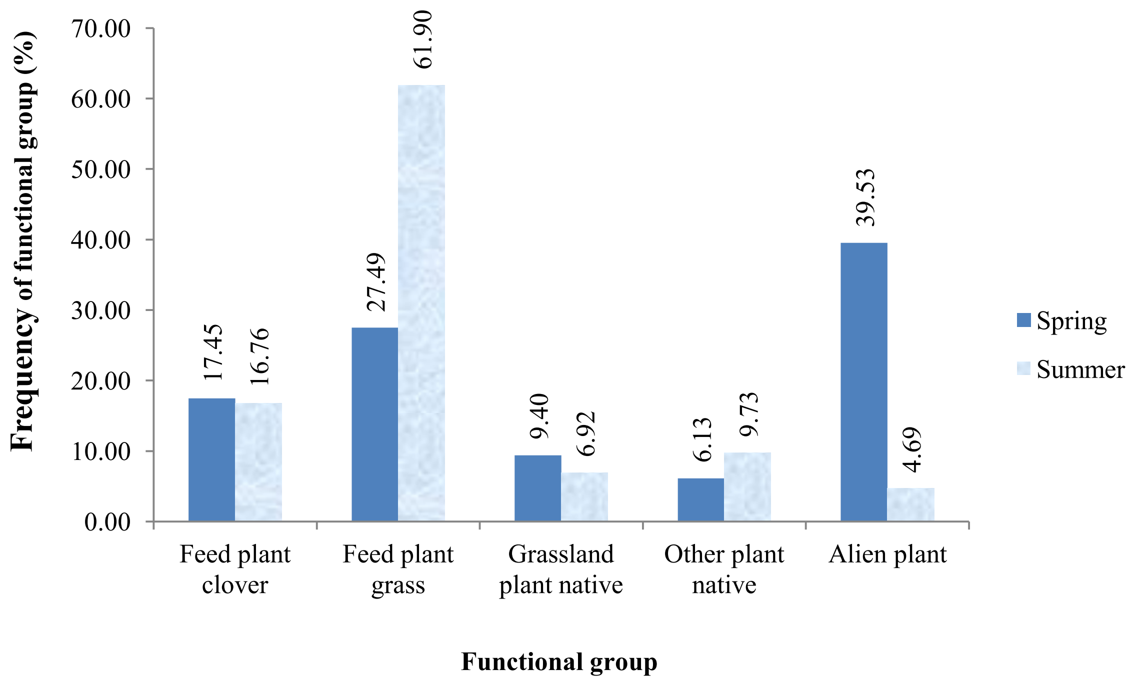
Values of variable with different letter show are significantly different ($p < 0.01$) respectively of seasons.

In the summer, some of plant species were decreased, therefore in this case the absorption and supplementation of nutrients can be increased according to the dominance frequency of plant species that conserve and breed grass in the grazing area. At moderate densities the degree of discrimination among plant species may be slightly reduced, but it was increased in total amounts of tissue removal per plant composition due to selective foraging (Marquis, 1981; Tilghman, 1989; Brown and Stuth, 1993). Alteration of grazing regimes affect to the abundance of plant species (Mulder, 1989; Hester, 2006), but mechanisms of plant species responses to plant morphological and physiological traits are often not explicitly quantified.

In Table 3-2, dominance frequency of plant species consist of *Trifolium repens*, *Paspalum dilatatum*, and *Paspalum notatum* among diversity of plant species (i.e., grazing resistant species) influenced to the productivity of plant species. The dominance frequency of plant species diversity can increase the productivity in grassland. The high-frequency of plant species between spring and summer are important to predict the combination of traits that are typical to short grass increasing in abundance. When the grazing pressure was enhanced, tall grass is decreased, and the tolerance ration can set management to community structure and taxonomy, phylogenetic, and functional across of plant species diversity.

3.3.2 Frequency and functional group of plant species diversity

Literature on the effects of grazing on plant communities and the relationship between grazing and frequency of plant traits is already large and is growing (Diaz *et al.,* 2007). Although there are differences in type and number of plant species diversity, they contain the highest number of herbaceous plant species. Species diversity in grassland traverses back to climate as the main determinant factor for many distinctive plant communities. Plants with positive responses to grazing are frequently found to be short in stature (Diaz *et al.,* 2001; Cingolani *et al.,* 2005; Diaz *et al.,* 2007) i.e., they most probably increase in abundance plant species by avoiding grazing (resistance strategy). The plant species diversity of this study consists of 3 parts: clover, grass, and weed (Figure 3-2). The diversity of plant species in grazing area reported benefits of biodiversity to the high productivity obtained from relatively few species, and from increasingly narrow genetic diversity in agriculture.



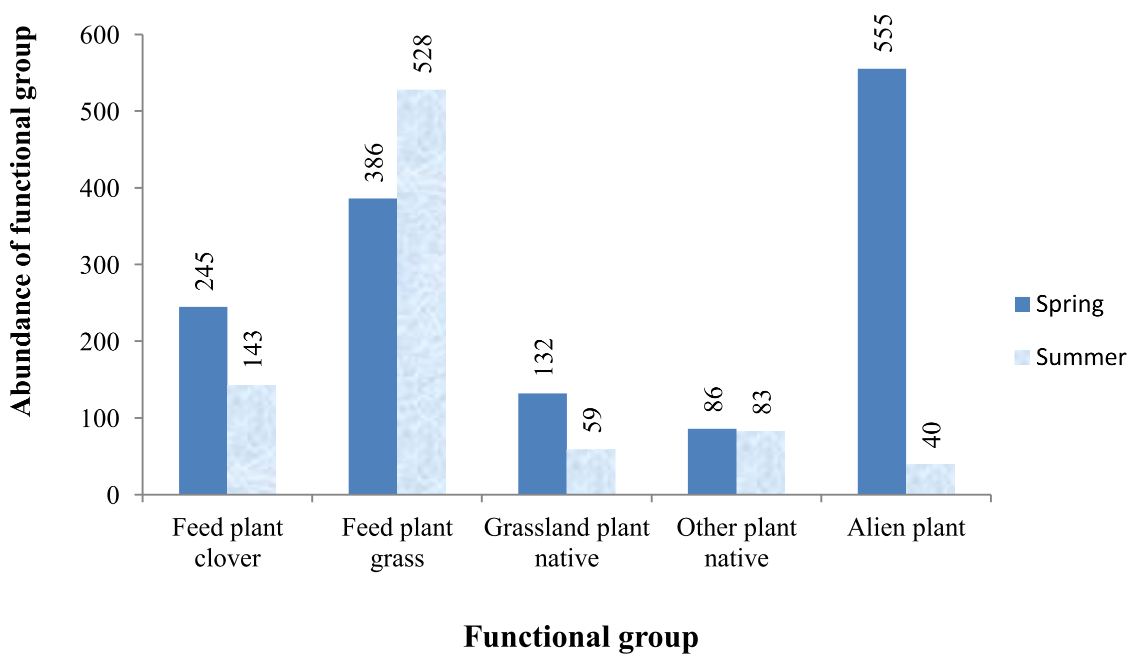


Figure 3-2. Frequency and functional group of plant species between spring and summer season

In this study functional groups of alien plant, feed plant clover, and feed plant grass increase in spring because plant species is phase growth, whereas in summer season alien plant was decreased because some plant species could not adapt to extreme temperature so in this case some plant species could adapt in summer still growing and absorb nutrient of soil and using as growth faster. The functional group of feed plant clover and feed plant grasses increased in summer season because could adapt, and alien plant was decreased in summer automatically feed plant clover and feed plant grass can growth faster and could give the contribution to balance the availability of cattle feed. In grazing area, feed plant clover and feed plant grass should be balanced to supply as cattle feed because feed plant clover and feed plant grass are rich nutrient and could give contribution as cattle feed for production and productivity in grazing area. Herbivore selectivity and response of palatable and unpalatable of plant species to grazing is certainly a complex matter, reported pattern range from decreases in selected of plant species (Anderson and Briske, 1995; Diaz, 2000; Brathen and Oksanen, 2001; Pakeman, 2004), no relationship (Cingolani *et al.,* 2005), to increase abundances of selected plant species (Jonsdottir, 1991; Bullock *et al.,* 2001).

Some results of research indicates that increased plant species diversity could increases primary production in grazing area and benefits to resistant of plant species as cattle feed. The diversity of plant species relative to habitat productivity is evaluating grazing response in general. The grazing has previously been reported to be low to moderate (Holecheck *et al.,* 1999) in the low and high-density treatments, respectively (Evju *et al.,* 2006). Although herb species abundances responded to both enhanced and changes in plant species compositions were only related to grazing treatment (Austrheim *et al.,* 2008).

3.4 Conclusion

Plant species diversity refers to the number of plant species and their relative abundance in grazing area. Diversity measurements incorporate to species richness and species evenness. Identification of plant species between spring and summer season could determine potential and selected kinds of feed plant cloveres and feed plant grasses could adapt in spring and summer. Feed plant grasses increase can suppress alien plant in growing season (summer), and also could give the contribution to increase productivity as cattle feed in grazing area.

Chapter 4

Management of Dominance Plant Species to Increase Productivity of Grassland Area

4.1 Introduction

The management of grassland areas has an important impact on the nature conservation and landscape integrity in Japan. In the other hand the livestock production is depended on management of plant species diversity as feeds in grazing areas. The effects of nutrients and other inputs, such as, application of inorganic fertilizers and the overuse of pesticides, have caused biodiversity loss and environmental pollution on the grazing environment (Soule and Piper, 1992; Haggar and Peel, 1993; Marrs, 1993; Neuberger, 1994). These effects may cause reduction of plant species diversity between spring and summer in grazing areas. Therefore, improvement of plants species diversity and conservation of plant species needs to be critically addressed.

The grazing area site selection should be supported by the availability of feed especially in heterogeneous environment between plant species and cattles. In medium intensity farming areas, the productivity of grazing areas requires a management to control biodiversity of grasses. This management system can be developed to conserve grasses in grazing area. In low-intensity farming areas, natural grazing and semi-natural grazing are highly variable. It covers 15-25% area of the European countryside (EEA, 2004). The settlement of grazing area has developed over an extended period, which the natural vegetation was either modified by livestock or survived as remnants. It was marginal or inaccessible because limited resource actually can do conservation management for increasing potential area. In the intensity of farming area as cattle feed, the productivity of grazing requires a consistent agricultural management for increasing production and other ecosystem function.

Plant species diversity in grazing area can be determined by (i) soil nutrient status, its modification by an addition of fertilizers and organic manures such as dung and urine from grazing animals; and (ii) defoliation other disturbances, primarily through the intensity and frequency of grazing, timing frequency of mowing, natural environmental stresses (flooding, drought, fire, burrowing), and farming activities (Grime, 1997). Dominance of plant species makes assumptions a ranked abundance list or a species distribution is derived. Observation abundance of plant species pattern cannot be used to validate or discards a particular, as has been extensively argued by (Pieloue, 1975, 1981). The important before trying to verify observation number series a straight line on a plot of abundance plant species. The plant species described by it are very uneven, with the high dominant of the most abundant plant species. It is not often found in nature (Whittaker, 1975) found it in plant communities in harsh environments or early succession stage.

The management of dominance plant species in this study can be used for conservation and increasing production as cattle feed in grazing area. Qualitative and structural plant species, such as nutrient contents, digestibility and plant morphology interacting with the choice of the animals (Gordon, 1997; Rook, 2002) and their behavior (Meisser, 2014) are discussed. Important spatial levels (patch and feeding as cattle feed), and selective grazing that is influenced by preferred plant species and nutritive values (Dumont, 2000) are considered. Due to their complexity plant-animal on various process occurred at different spatial and temporal scale in the chosen feed in grazing area (Astigarraga *et al.,* 2002). In the medium intensity farming areas, the productivity of grazing areas requires management for biodiversity consistent with agricultural production and other ecosystem function.

The objectives of this study were 1) to analyze plant species diversity in a grazing ecosystem in Hiroshima, Japan, 2) to provide information for farmers, and 3) to promote conservation grazing area using dominance of plant species. Dominance of plant species and several parameters including plant height (cm), midpoint of cover range (%), diversity index, evenness index, and vegetation cover rate (%) were determined to estimate potential grazing area.

4.1.1 Vegetation analysis dominance of plant species

To select dominance of plant species the phonological factor responses of plant species were developed. Development of plant species will increase because could adapt to the temperature of environmental in spring and summer. Environmental factor and temperature between spring and summer season could select plant species to be annual (nonperennial) crops are given in (Hatfield *et al.,* 2008, 2011) for different plant species. For example, an extreme temperature of environmental factor event for plant species in grazing area will be warmer than for a cool season, where the temperature maximum for growth is 25 °C compared to 38 °C. To understand extreme of environmental temperature events and their impact on plants, we have to consider the plant species temperature response relative to the environmental factor and temperature between spring and summer.

Related spring and summer, livestock production is depending on plant species as feed and availability in grazing areas. Dominance of plant species can increase productivity of grasses as cattle feed. The diversity of plant species in environmental performs a variety of ecological service beyond the production of foods and feeds, including the recycling of nutrients, regulation of microclimate, local hydrological process, suppression of undesirable organisms, and detoxification of chemicals (Altieri, 1994). The frequency of plant species is important as prominent role in the life cycle of plants and animals. The supply dominance of plant species for cattle depends on pastures, and produces a wide variety of grass species which are superior in quantity and quality. The management of grassland areas has profound impacts on the conservation and landscape integrity in Japan. Reducing of plant species between spring and summer in grazing areas needs improvement of biodiversity and conservation of plant species need to be critically addressed.

Plant species are commonly classified into either response or affect plant functional types (Diaz *et al.,* 2002). Response functional types are groups of plant species that respond similarly to the abiotic and biotic environment of plant species diversity in grazing area. Classification of plants as increases, decreases, and invaders in response to grazing (Dyksterhuis, 1949) is an example of grouping plants species by their response to the biotic environment. Plants that show resistance to grazing may be further classified into those that exhibit avoidance (Briske, 1996). The effect of plant functional types are groups that affect to ecosystem processes such as productivity, nutrient, and tropic transfer similarly (Diaz *et al.,* 2002). In experiments examining the effects of diversity on productivity of grasslands, functional types included grasses, clover, legumes, and woody plants (Hooper and Vitousek, 1997; Tilman *et al.,* 1997).

The response and effect of plant species functional group may further be classified by life history (feed plant clover, feed plant grass, grassland plant native, other plant native, and alien plant). Perennial grasses may be bunch or sod-forming (Briske, 1996), and clover may be the clone or crown forming (Beuselinck *et al.,* 1994). Patterns diversity of plant species, and functional composition plant species have been evaluated in the northeastern USA. These pastures received improvements and grazing management for several decades and dominated by white clover, kentucky bluegrass, and dandelion (Tracy and Sanderson, 2000b). Dominated the seed of these pastures, and it was concluded that a manager, seeking to establish of plant species diversity consisting of productive grasses and legumes, must reseed the desired species (Tracy and Sanderson, 2000a).

On low-intensity livestock grazing, natural and semi-natural grazing are highly variable. These areas cover 15-25% area of the in European countries (EEA, 2004). Settled grazing area developed over a long period, in which the natural vegetation was either modified by livestock or survived as remnants, were marginal or inaccessible. In medium intensity farming areas, the productivity of grazing areas requires management for diversity consistent with agricultural production and other ecosystem function. Varied plant species of forage resource by herbivores does not necessarily coincide with either of plant species.

Due to their complexity, the plant-animal interactions considered on various processes occurring at different spatial and temporal scale (Altieri, 1994). Determination influence dominance of plant species to the productivity as cattle feed that gives decision of plant species and how much to eat under conditions controlled. The choice test has frequently used in ecological research (McMahon *et al.,* 2010), but fewer have been used to obtain new insights into the aspect of ruminant nutrients. The properties of plant species assemblages include the number of co-occurring species richness, specific abundance patterns and diversity of compositional (e.g., community types), functional and structural characteristics of plant species in grazing area (Whitaker *et al.,* 2001). Qualitative and structural factors, such as nutrient contents, digestibility and plant morphology interact with the choice of animals (Gunter *et al.,* 2005), and their behavior (Meisser *et al.,* 2011).

4.1.2 Management of grassland conservation to increase productivity

Conservation grassland is synthetic discipline that provides a specific foundation for resource management effort aimed to conserve, restore and sustain the full range of increase productivity plant species in grazing area. Species diversity includes variation and changes among individuals and population, species richness, habitat heterogeneity, and the diversity interactions among plant species and the human communities. Biological conservation is only one of the many possible land uses and like other it depends on good management (Tait *et al.,* 1988). Conservation of plant species has become a continual issue in many countries (UNEP, 1995). However, the importance of conservation has greatly increased impacts from human activities had climbed over the years.

Conservation use of all methods and procedures which are necessary to bring any endangered of plant species or threatened to required habitats through scientific resource management. The conservation grazing area using dominant of plant species could adapt in spring and summer is very important ecological aspect and increase productivity plant species. To increased human influences on the environment and habitat areas of plant species, need to back up with integrated conservation approach. This management and use of resources while simultaneously using land efficiently in order to maintain the natural relationships among plant species. Appearance of plant species positioned by ecological process are supported with habitats and abundance resource but are disturbed only by human activities. The conservation grazing area is very important tool to define these loopholes from disturbance that may threaten plant species, management planning, management regimes and the applications centered with ecological approach.

4.1.3 Importance of management conservation to increase productivity and availability plant species

Grasslands are some of the most plant species rich and high diversity types. Grassland particularly is home to a large number of plant species. In grassland, plant species diversity traverses back to climate as the main determinant for many distinctive plant communities but this has been overridden by intervention and the effect of ungulate animal species. More recently, human activities have dramatically altered these communities for example there has been a dramatic decrease in vegetative distribution of the North America prairie lands, most of which were turned into farms in the early 1900's (www.worldbiomes.com). In Japan, since the 1960's economic growth, there had been decrease in grassland across the country due to abandonment and farmer aging (Naito and Nakagoshi, 1995). Despite distribution of plant species and animal, many natural types of grassland have been converted to secondary elements which triggered endanger and disappearance of native species (UNEP, 1995). Therefore, conservation of grassland through management is a very important process (Houston, 1979).

The main form of management are mostly grazing, trampling, burning, and mowing activities. In savannas, burning and grazing are common management practices while in the temperate grasslands, mowing and grazing are the predominant management regimes (UNEP, 1994). The plant species disappearance, conservation through management activities is an important aspect. Good management planning and approaches are viable ways to fully utilize land resources without having much detrimental impact on the environmental. Although grassland and plant species conservation approaches differ from country to country plant species conservation. In agriculture landscape, cultivation, trampling, mowing, grazing and abandonment are the main disturbance factors which can increase or decrease plant species diversity.

4.1.4 Plant species and conservation grasslands in Japan

Over one hundred year ago, agriculture land use posed a scenic coexistence with estimated grasslands area covering 11% of the total area in Japan. According to the survey of Environment Agency (1997). The 1960 survey records revealed that portion of land used as pastures, fodder production and public grazing areas was 22% of the total arable land. This was largely due to many factors in agriculture policy and purpose of farming to specialized mechanized activities like meat production. However, urbanization spiraled throughout the country, there has been continuous decrease in grasslands. This has triggered the conservation of grasslands to be seriously addressed. It is feared that herbaceous plant species that depend on grassland and type of plant species.

Grazing, mowing, and periodic burning are regarded as traditional management practical in Japan, since they were used from the Edo-era (1603-1867), with abandonment activities included in some grassland studies (Kitazawa and Ohsawa, 2002). Although decrease in area size, grassland in Japan is managed through mowing, periodic burning, grazing and trampling including abandonment activities. Most of the grassland scattered in Japan are regarded as secondary (semi-natural) type mostly *Miscanthus sinensis* type, *Sasa* (dwarf bamboo) type, and *Zoysia japonica* types. To conserve the grasslands and maintain the diversity of grasslands, most of the management activities are carried out in designed parks. Although this has been considered, crop cultivation and agricultural land use changes still remain the treats to grassland conservation to increase productivity and availability as cattle feed.

Conservation of the certain vegetation element such as grassland deals with enormous plant and animals that inhibit the environment. Biological of plant species is very important, especially in grazing area, because many kinds species living there and have symbiosis mutualism. If many important plant species is being exploited to extinct in isolation it is extremely hard to restore this process. Thus, conservation dominance of plant species is an important measurement to balance the resources and to utilize them in a sustainable manner. Without seriously addressing conservation grassland area and awareness issue at all respective levels, it is predicted that more and more plant species diversity will be extinct by 2025.

4.2 Materials and Methods

4.2.1 Study site

The study was conducted in Setouchi Field Science Center, which has an area of 1.6 ha (consist of six Wagyu cattle or *Bos Taurus*) in Hiroshima, Japan. The elevation ranged from 230 to 240 m above sea level, and the mean of slope angle was approximately 5 degrees. The climate of the study site was a temperate zone warm, humid summers and cool, and dry winters. The annual temperature was 14.6° C, and the annual precipitation was 621.9 mm (Kawamura *et al.,* 2011).

4.2.2 Vegetation analysis

To study the species composition, the examination was conducted through a field observation during spring and summer seasons 2015. The Braun-Blanquet scale was used to determine the plant species that can adapt between spring and summer. Assessment of dominance plant species existing in the grazing area was determined by comparing the abundance of plant species, and calculating appearance dominance of plant species. This method is potential to estimating development and conservation dominance of plant species in the grazing area as cattle feed. Phytosociological of plant species was studied by using a line transect of 0-100 m at every 10 m interval. Specimens of each plant species were recorded in each plot of 1 m × 1 m quadrate (n = 11). Of which, one-meter square was made makes 16 parts of 0.25 m × 0.25 m sub-quadrate (Braun-Blanquet, 1964).

4.2.3 Data analysis

There are several indices to calculate plant species diversity. Some calculation and statistical test were done on individual target plant of their growth and reproductive abilities. Other indices were calculated to determine community patterns, species richness and species diversity patterns to statistically interpret and explain the vegetative position and growth phenomena of plant species in grazing area, trampling, and abandonment condition. The vegetation data were quantitatively analyzed for determining density, frequency, and abundance according to the method described by (Braun-Blanquet, 1964) using a formula:

$$\text{Relative frequency (\%)} = \frac{\text{Number of occurrences}}{\text{Number of relevant}} \times 100\%$$

A diversity index measures a community of plants species. Diversity indices provide more information about community composition than simply species richness (i.e., number of biological species in a unit area); they also take the relative abundance of difference species into account. They provide important information about rarity and commonness of plant species in community. Quantifying diversity is an important analytical tool to understand community structure of plant species diversity. Relative frequency of these parameters was calculated following (Philips,1959). Diversity index and evenness index computed according to (Simpson, 1949) using formula:

Diversity index:

$$D = \frac{\Sigma\, n(n-1)}{N(N-1)} \times 100\%$$

Where,

D = Diversity index

n = The total number of plant species of a particular species

N = The total number of plant species of all species

Evenness index:

$$E = D/Dmax$$

Where,

D = Number derived

Dmax = Maximum possible value

In analyzing vegetative data sets, distance methods yield of quantitative parameters. These are also obtained in the quantitative plots methods. Any one of parameters may be interpreted as an important a value (Whittaker,1975). This depends on which of the values, the investigator considers most important for a particular plant species, and group of species community.

4.3 Results and Discussion

4.3.1 Vegetation analysis of dominance plant species (%)

Table 4-1 showed the species number and frequency dominance of plant species in the spring and summer seasons. Sustainability dominance of plant species can be used in grazing area as a potential solution to the biodiversity of plant species, and conservation of grazing areas to increase the supply of animal feed. Because 70% of the nutrition of cattle feeds were used for meat production and growth. It is indicated that there are three dominance plant species found in the grazing area consist of: *Trifolium repens, Paspalum dilatatum* and *Paspalum notatum*. In the spring season, *Trifolium repens* (73.86%) was the most dominance plant species, followed by *Paspalum dilatatum* (69.31 %) and *Paspalum notatum* (47.73%). However, in the summer season, *Paspalum notatum* (98.30%) was the most dominance species, followed by *Trifolium repens* (81.25%) and *Paspalum dilatatum* (78.98%) were the recessive species (Table 4-1). The determination dominance of plant species is important on projection as a percentage of quadrate area (Mueller-Dombois and Ellenberg, 1974).

Table 4-1. Vegetation analysis dominance of plant species

Feed plant name	Spring season		Summer season	
	Number of species	Frequency (%)	Number of species	Frequency (%)
Trifolium repens	130.0	73.86	143.0	81.25
Paspalum dilatatum	122.0	69.32	139.0	78.98
Paspalum notatum	84.0	47.73	173.0	98.3

In this study, the dominance of plant species can contribute to availability cattle feed. As with overall plant species diversity found were the feed plant grass (*Paspalum dilatatum* and *Paspalum notatum)* and feed plant clover (*Trifolium repens)*, species composition and diversity within functional types in this grazing area were strongest on backslope positions. Plant species diversity was correlated positive with the percentage of cover consisting grass and clover. To develop and conserve grazing area seeding a diverse assemblage of clover species improve forage production and quality on backslope and may improve its fertility (Harmoney, 1999; Harmoney *et al.,* 2001).

Extensively managed grassland areas are crucial importance for grassland biodiversity in Japan. Unfortunately, biodiversity of such biocenosis is currently threatened either by intensive use or by abandonment (Bartoszuk *et al.,* 2001; Dolek and Geyer, 2002; Wallis de Vries *et al*., 2007). In large areas in Europe, low grazing pressure leads to the creation of unexploited areas that are progressively covered with shrubs (Bailey *et al.,* 1998). Soussana and Duru, (2007) stated that within 20 years, permanent grassland in Western Europe had declined by 12%. This is particularly the case in areas with unfavorable agriculture conditions. This phenomenon has been observed in Poland, where as a result of decreasing number of cattle and horse, fewer of them are being grazed on grassland (Janskowska-Huflejt, 2007).

The importance of extensive grassland used for biodiversity plant species conservation is the main reason for the substantial support of these practices to increase production agriculture in general in the form subsidy payment and national government legislation (Hole *et al.,* 2005). Although there are differences in type and number of species distributed, they contain the highest number of herbaceous plant. Grasslands are some of the most species richness and high diversity vegetation types. Diversity of plant species in grassland traverses back to climate as the main determinant factor for many distinctive plant communities but this has been overridden by human intervention and the effects of ungulate animal species. Despite the enormous distribution of plant and animal, many natural types of grassland have been converted to secondary elements which triggered endanger and unnoticed disappearance of native species (UNEP*,* 1995).

4.3.2 Midpoint of cover range of plant species diversity (%)

Observation midpoint of a cover range of plant species on environmental impact in grazing area was predicted for land development, as required by the United States government regulatory agencies, vegetation studies are conducted using variety of methods. Density measurement (stem counts) is one method that is frequently used. Density measurement of shrub and herbaceous vegetation is time-consuming and costly.

The Braun-Blanquet cover-abundance scale was used to analyze plant in several ecological studies. Results from one of these studies show that the Braun-Blanquet method requires only one-third to one-fifth the field time required for the density method. Furthermore, cover-abundance ratings are better suited than density values to elucidate species-environment relationships graphically. To extensive surveys, this method provides sufficiently accurate baseline data to allow environmental impact assessment to know productivity of plant species as cattle feed in grazing area.

Percentage of cover range and a midpoint of a cover range of plant species following the Braun-Blanquet scale shown in (Table 4-2). The dominance of plant species is not only depend on density but also from calculating from midpoint coverage (Whittaker *et al.,* 2001). Additional explanatory variable for the percentage of cover range from plant species depends on the spatial scale under consideration. At the global scale or regional scale can improve prediction by temperature or an index of vapor-transpiration (Rosenzweig, 1968; Lieth, 1975; Lauenroth, 1979; Webb *et al.,* 1983) that way more closely reflect water balance, and by consideration of the seasonal distribution of precipitation (Sala *et al.,* 1998). The nature of plant species at a place is to determine by other plant species that grow and develop in such environments (Bringgs and Knapp, 1995).

Table 4-2. Conservation percentage of cover range from plant species diversity (%)

Braun-Blanquet scales	Percentage of cover range (%)	Midpoint of cover range from plant species (%)	
		Spring	Summer
5	75-100	75.6	86.2
4	50-75	68.2	74.4
3	25-50	36.8	30.7
2	5-2	14.4	7.4
1	<5 (numerous individuals)	2.6	1.3
+	<1 (few individuals)	0.57	0.57

Percentage of cover range plant species was influenced by edaphic factors that affect soil water-holding to the capacity and nutrient availability (Dye and Spear, 1982; Paruelo *et al.,* 1999). Seasonal precipitation is better predict percentage of cover range (Huellet and Tomanek, 1969; Siflet and Diez, 1974; Smoliak, 1986), it may carry over effect of production on that of the succeeding year (Hanson *et al.,* 1982) and output may be affected by grazing (Milchunas and Lauenroth, 1993). To determine midpoint cover range of plant species (%) is depend on the number of plant species present (Hooper and Vitousek, 1997; Tilman and Downing, 1994; Tilman *et al.,* 1996), their functional diversity or composition (Hooper and Vitousek, 1997; Tilman *et al.*, 1997) or identity of individual plant species (Hector, 1999).

Midpoints between spring and summer seasons could be occurred due to an availability of moisture provided by rains and through other environmental factors. Similar patterns of observations were also mentioned in (Sharma *et al.,* 2012). In addition, (Alhassan *et al.,* 2006) reported that similar factors were responsible for the variation in species number and diversity. Frequent distribution of plant density, cover, biomass per unit area and height are used as measures to describe species composition and spatial patterns of vegetation (Chen *et al.,* 2008). In general, the midpoint of plant species between spring and summer seasons on plant species diversity is one of the most important characteristics of a community plant species.

4.3.3 Diversity index, evenness index, and species number between spring and summer

Diversity and evenness are not only depend on density, but also fluctuate from the midpoint coverage of plant species in grazing area, could be determined based on the highest number of plant species, diversity index, and evenness index (Whittaker, 1972). (Hill, 1973) showed that the diversity number of different order probe aspect of the community. The number of order only takes into account the most prevalent plant species. At the other plant species is the reciprocal of the proportional abundance of each plant species. The calculation of all plant species are considered as different with relative differences between plant species. In nature, some plant species are much more closely related to some rest of the community abundance of plant species.

According to this finding, species diversity increased under mowing management but dramatically diminished under trampling. Moreover, the total number of different plant species found under abandonment was also low but compared to the trampling, there was slightly increased number of difference species. Furthermore, the differences in species diversity under management practices. In this result diversity index, evenness index, and species number in spring was higher than summer (Table 4-3). The large of diversity index, evenness index, and species number in spring cause richness of the plant species diversity.

Table 4-3 The diversity indexes, evenness index, and species number between spring and summer.

Major community	Spring	Summer
Diversity index	0.70	0.53
Evenness index	0.60	0.65
Species number	19	15

Species richness shows a total number of species in the community, but the actual number of plant species in the plant community is usually immeasurable. The evenness index expresses how evenly the individuals in the community are distributed over the different species. The heterogeneity indices incorporation of both aspects, but (Heip, 1974) suggested that an evenness index should be independent of species richness. Diversity index, evenness index, and species number in spring were increased because many plant species could be adapted with cool weather and grew, however in summer, diversity index, evenness index, and species number were decreased because some plant species could not adapted to extreme temperature, and this case also influenced the quality of species diversity (Hulbert, 1969).

The main descriptors of community structure of plant species richness were found to vary along the gradient of plant species between spring and summer. The increasing of diversity index, evenness index, and species number in the spring season is relative abundance of the most common species. In summer season diversity index, evenness index, and species number reduction total density on the ground grazing area. The dominance of plant species were could appeare in different periods, and this led to an increase productivity of some plant species. In grazing areas with high vegetation cover, dominants benefited from the lower temperatures by lengthening their periods of activity. Seasonal patterns in community structure tracked temperature fluctuations and varied between habitat types.

The diversity of plant species did vary between seasons or habitat types. The relative abundance of dominance groups in the two types of habitats showed a different pattern between seasons. In grasslands, subordinates increased and dominants decreased their relative abundance from spring to summer. The overall conclusion from this study is communities of plant species between spring and summer by temperature variations and adaptation of plant species appearance is different in grazing area. One important finding seen to have contributed to high diversity in grazing area was the number of plant species recorded. These findings indicated that, although may be different in other similar studies.

4.3.4 The influence of temperature spring and summer to the plant species diversity

Responses to temperature in the spring and summer season are important to determine diversity and identify of plant species that could adapt in these seasons. The rate of plant growth and development depends upon the temperature, average wind speed, the sunlight per day factor between spring and summer season range represented by (Figure 4-1).

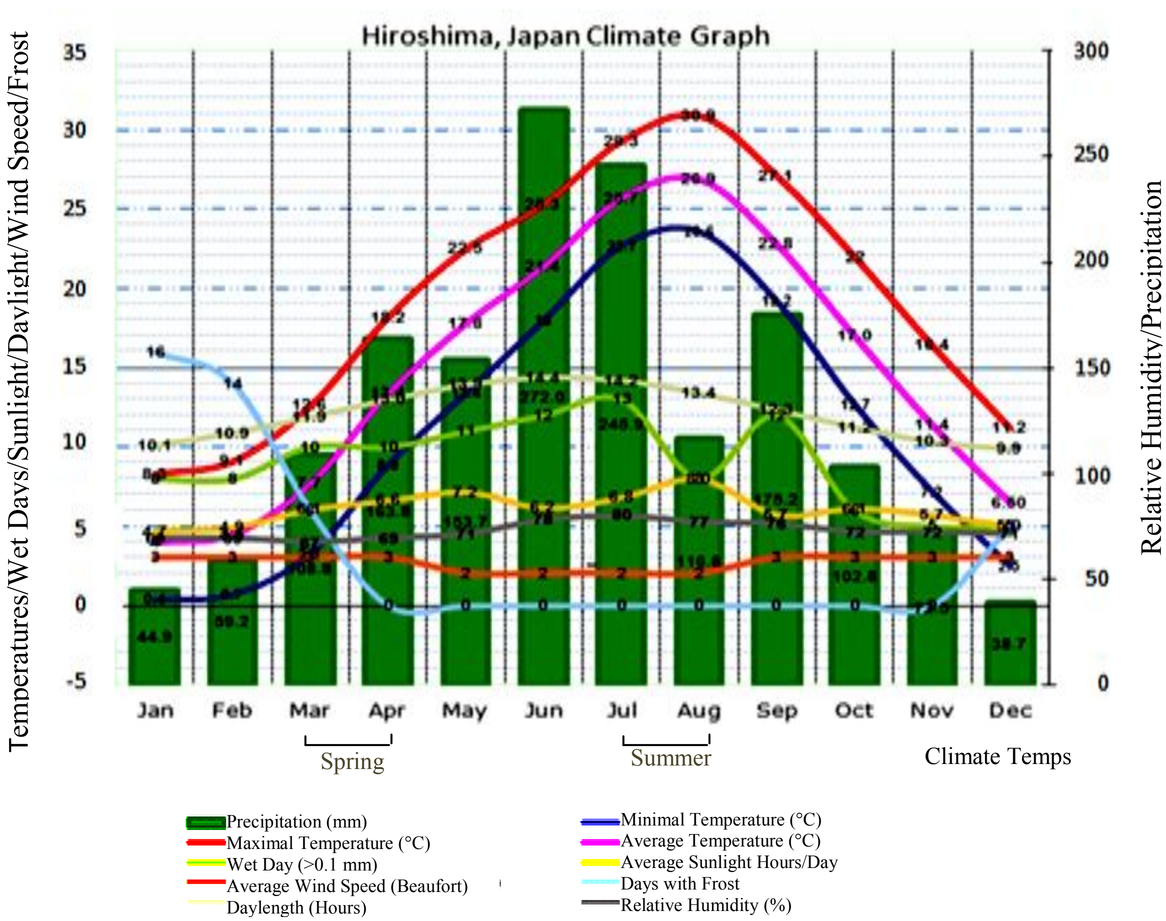


Figure 4-1 Environmental factor and temperature between spring and summer season

The maximum temperature in spring (April to May) was 18.20 °C and in summer (August to September) was 30.9 °C. These temperatures were associated to abundance and frequency of the functional group of plant species between spring and summer (Figure 3-2). An analysis by Meehl *et al.,* (2007) revealed that daily minimum temperature would increase more rapidly than daily maximum temperatures leading to the increase in the daily mean temperatures and the greater likelihood of extreme events and these changes could affect grazing area. If these changes in temperature are expected to occur over then understanding the potential impacts on plant growth, and will help develop adaptation strategies to offset these impacts. To evaluate the effect of the temperature between spring and summer season have influence positive to the species number, diversity index, and evenness index. The first cycle in spring maximum 18.20°C was normal temperature for species number had 33, whereas in summer season maximum 30.90°C was emergency period of some plant species to adapt in environment in case species number had 21. The effect of increase temperature from spring to summer gave negative impact of plant species, however midpoint of cover range and plant height gave positive impact because reduce species number in summer and nutrient of soil will be used of plant and then give impact to growth faster.

The effects of extreme temperature from either acute or chronic exposure can have large impact on plant growth and development. The interactions of the temperature and soil water content need to be understood in order develop effective adaptation practices for agronomic systems in response to climate extremes. Similar responses have been found in specialty crops in which temperature is the major environmental factor affecting production with specific stresses, such as periods of hot days, overall growing seasons climate, minimum and maximum daily temperatures and timing of stress in relationship to developmental stages having the greatest effect (Ghost *et al.,* 2000; Pressman *et al.,* 2002; McKeown *et al.,* 2005; Sonsteby and Heide, 2008; Dufault *et al.,* 2009). When plants are subjected to mild heat stress (1°C to 4°C above optimal growth temperature), there was moderately reduced yield (Sato, 2006; Timlin *et al.,* 2006; Wagstaffe and Battey, 2006; Tesfaendrias *et al.,* 2010). Exposure of plants to extreme temperatures will limit the ability of the plant to productivity due to disruption of the pollination process. The magnitude of this impact varies among species, however there is a consistent negative impact on plants. One aspect of high temperature extremes often overlooked is the effect of extreme event on the atmospheric water vapor demand. Subjecting plants to a more intense heat stress (generally greater than 4°C above optimum resulted in severe yield loss extending to complete crop failure (Ghost *et al.,* 2000; Sato *et al.,* 2000; Kadir *et al.,* 2006; Gote and Padghan, 2009; Tesfaendrias *et al.,* 2010).

An increasing water vapor demand will cause more water to be transpired by the leaf until the water supply becomes limited and the stomata conductance will decrease leading to higher leaf temperatures and a reduction in photosynthesis. If the plant is exposed to extreme temperatures, water stress could occur quickly because the plant lacks sufficient capacity to extract water from the soil profile to meet the increased atmospheric demand. Although the rates of development were faster in the vegetative stage of development the shortening of this period was not detrimental to yield because there was no negative effect of plant species or biomass because the exposure to temperature. This aspect needs to be evaluated to more completely determine the impact of warmer temperatures during the complete live cycle of plants.

Responses to temperature differences among plant species throughout their life cycle and are primarily the phonological responses, i.e., stages of development plant species. For each plant species a defined range minimum, average, and maximum temperature form the boundaries of observable growth. Development of plant species in grazing area increases as temperatures rise to the plant species optimum level. For most plant species, vegetative development usually has a higher optimum temperature than for reproductive development of plant species. Temperature effects on management of grazing environment to increase productivity of cattle feed is dependent upon of plant species. Under an increasing climate change scenario there is a greater likelihood of air temperatures exceeding the optimum to select dominance plant species could adapt in spring and summer season. The dominance plant species could use as management to increase productivity and develop grazing area for availability cattle feed in the future

4.3.5 Management frequency of dominance plant species

Determine the frequency of dominance plant species is one characteristic of grass species community to increase management productivity in grazing area. It is mechanism generating stability of the nature of plant community at a place is determined by species to grow and develop in such environment (Bliss, 1962). The frequency of dominance plant species could adapt and resistant in spring consisted of: *Trifolium repens* (73.86%), *Paspalum dilatatum* (69.32%), and *Paspalum notatum* (47.73%), whereas in summer

Trifolium repens (81.25%), *Paspalum dilatatum* (79.98%), and *Paspalum notatum* (98.30%). It is indicated that there are three dominance of plant species found in the grazing area was *Trifolium repens, Paspalum dilatatum*, and *Paspalum notatum*. Sustainability dominance of plant species can use in grazing area as a potential solution to the biodiversity of plant species and management conservation of grazing areas to increase the supply of cattle feed because 70% of feed nutrition quality of cattle feed used for the production of meat and growth of the cattle.

Determination of dominance plant species is important on projection as a percentage of quadrate area (Mueller-Dombois and Ellenberg, 1974). In this study, the dominance of plant species can contribute to availability, and increasing supply for cattle feed in Japan. Plant species occurring within the pastures were classified into three functional types: forage grasses, forage clover, and weed species. A summary of absolute dominance of plant species (%) in the grazing area is important to do conservation and increasing productivity of plant species as cattle feed (Table 4–4).

Table 4–4. Frequency of dominant feed plants and number of plants species (%)

Feed plant species	Spring season		Summer season	
	Frequency (%)	Number of species	Frequency (%)	Number of species
Trifolium repens	73.86	130	81.25	143
Paspalum dilatatum	69.32	122	78.98	139
Paspalum notatum	47.73	84	98.30	173

Mixture frequency of dominance plant species can increase productivity and nutrient quality as cattle feed in Japan. Hartnett *et al.,* (1996) mentioned that dominance plant species can strongly affect nutrient cycling rate in the pasture. The effects of dominance plant species between clover and grass mixtures to the subsequent increases in soil nitrogen availability because of N fixation. Absolute data, shown as the dominance plant species if compare other plant species based on percentage comparison. These grazing areas generally received little improvements and grazing management for several decades and were dominated by *Trifolium repens, Paspalum dilatatum*, and *Paspalum notatum*. Annual and perennial also dominated the seedbanks of this grazing, and it was concluded that a manager, seeking to establish a diverse, mixed plant species consisting of productive grasses and clover, must reseed the desired species (Tracy and Sanderson, 2000a).

The dominance of plant species, need not be based solely on density (Whittaker *et al.,* 2001). I chose these functional types because the appearance of grasses provide most of the biomass (Harmoney *et al.,* 2001) and competitively displace clover (Guretzky *et al.,* 2004) in these grazing area. Clovers have high forage quality (Van Soest, 1982), fix atmospheric N_2 through a symbiotic relationship with *Rhizobium* bacteria (Heichel *et al.,* 1985). Usually improve the productivity of pasture mixtures (Sleugh *et al.,* 2000). Weed species contribute to biomass, but their forage quality is usually less than that of grasses and clovers, especially as they mature (Marten and Andersen, 1975; Marten *et al.,* 1987).

4.4 Conclusion

In this study, three dominance of plant species consisted of *Trifolium repens*, *Paspalum dilatatum* and *Paspalum notatum*. The increasing frequency dominance of plant species provides a positive impact on the growth of midpoint of the cover range, diversity indexes, evenness indexes, and plant height between spring and summer. Therefore, a management is needed to develop a strategy to protect and improve the richness of plant species that could support sustainability of grazing areas for farmers. This study also provides valuable information for development of grassland in Hiroshima, Japan.

Chapter 5

General Discussion

5.1 Preamble

The study was conducted in Setouchi Field Science Center, Hiroshima, Japan, with an area of 1.6 ha (34° 23´ N, 132° 43´ E). The elevation ranges from 230 to 240 m above sea level, and the mean slope angle was approximately 5 degrees. This study focuses on environmental management grazing to select dominance of plant species to increase the productivity as cattle feed.

This study also examines plant species diversity, productivity and dominance of plant species, and whether it could adapt in spring and summer season in Japan. For determining grazing area, the availability of feed especially within heterogeneous environments between plant species and cattle is important. In medium intensity farming areas, the productivity of grazing areas requires management and conservation of biodiversity, grazing area, and other ecosystem function consistently.

It is important to validate observation or refute a certain number of plant species series a straight line on a plot of abundance plant species between spring and summer in grazing area. The plant species described by it are very uneven, with the high dominance of the most abundant plant species. The dominance of plant species in this study could use for conservation and management to increase production as cattle feed in grazing area.

5.2 Plant Species Diversity as Cattle Feed

Diverse plant species that invades natural areas is important to human road constructions a major environmental factor between spring and summer of plant species in grazing area. Moreover, ongoing environmental changes and increasing prevalent ecosystem composition, plant species function differ from any historical controlling to ecosystem functioning in this potentially succession context, as well about the suitability of widely used treatments for recovery of vegetation in the diversity of plant species as cattle feed in Japan. In the case must be set and recovering ecosystem of plant species.

Therefore, promoting shifts in the community of plant species, to increase production of plant species at short time scales, seems a reasonable strategy to restore the degraded ecosystem and to increase the productivity of plant species as cattle feed. Sustainability of dominant plant species can be used in grazing area as a potential solution for conservation management and thereby increasing the supply of cattle feed. The consensus that diversity is essential for maintaining ecosystem functioning and the stability of ecosystem process under human influence and fast-changing environment.

This study used plant species diversity in grazing area of Hiroshima, Japan to provide valuable information to the farmers, and promotion of grazing area conservation using dominance plant species as cattle feed. The important before trying validating observation or refute a certain number of plant species series a straight line on a plot of abundance plant species. The plant species described by it are very uneven, with high dominant of the most abundance plant species.

The first section of chapter 2, analyzed the observation of plant species. In general, observed number of plant species diversity in spring was 32 and summer 21. Sustainability of dominant plant species is of major importance, because 70% nutrition of cattle feed was used for meat production and growth. The study found that there are three dominant plant species in the grazing area consist of: *Trifolium repens, Paspalum dilatatum* and *Paspalum notatum*. In the spring season, *Trifolium repens* was the most dominant species, followed by *Paspalum dilatatum* and *Paspalum notatum*. In the summer season *Paspalum notatum* was the most dominant species, followed by *Trifolium repens,* and *Paspalum dilatum*.

The relationship between dominant feed plant species influences plant height varied in plant species during spring (16.64 cm) and summer (21.55 cm), suggesting which plant height in the spring was lower than summer. In summer plant height increased, because some plant species could not adapt to extreme temperature, resulting less competition for natural resources between the survived plant species to growth faster. The distribution of plant density, plant cover, biomass per unit area, and plant height, were used to measure biological abundance of vegetation dominance, species composition and spatial patterns of vegetation in different plant communities (Chen *et al.,* 2008).

The diversity of vegetation cover rate (%) in grazing area is an important part of an ecosystem, and it has been used to estimate the monitoring of vegetation growth in a region. The result of this study showed that the vegetation cover rate varied between springs (77.18%) and summer (81.36%). The vegetation cover rate of plant species in the grazing area was high because species appearance of grass in spring and summer can supply feed animal in the grazing area.

This research reported chlorophyll content varied between diverse plant species during spring (41.72) and summer (36.28). Chlorophyll content can reflect the heritability and growth of plant species in the grazing areas, and the result suggested that genotypic differences between the plant species under observation (Richards, 2000).

The diversity of species number in grazing area could influence or control the frequency, duration, and intensity of plant species in the grazing areas. The species number varied between spring (10.45) and summer (7.90). In the summer season, species number decreased because of plant species affected by species which could not adapt to the summer and also influenced the quality of species diversity (Hulbert, 1969). Reduction of species number may be attributed to low nutrient availability and low CO_2 accumulation, thus some plant species could not adapt in the summer season.

The second sections of chapter 4 investigated midpoint cover range of plant species diversity (%) and it varied between spring (75.57%) and summer (86.17%). Additional explanatory variable for the percentage of cover range from plant species depends on the spatial scale under consideration. At the global scale or regional scale, improved prediction has been achieved by including temperature or an index of evapotranspiration of plant species of spring and summer. Midpoints between spring and summer seasons could be occurred due to an availability of moisture provided by rains and through other environmental factors. In addition, Alhassan *et al.,* (2006) reported that similar factors were responsible for the variation in species number and diversity of plant species.

Measuring diversity index varied between spring (0.70) and summer (0.53), whereas evenness index was higher in spring (0.60) than summer (0.65). This result showed availability of plant species could supply cattle feed in grazing area. Species richness shows a total number of species in the community, but the actual number of plant species in the plant community is usually immeasurable. The evenness index expressed how evenly the individuals in the community are distributed over the different species. The heterogeneity indices incorporated of both aspects, but Heip (1974) suggested that an evenness index should be independent of species richness. Diversity index, evenness index, and species number in spring were increased because many plant species could be adapted to cool weather and grow vigorously. This case also influenced diversity index, evenness index, and species number. The indices of diversity plant species and evenness were not only dependent on density, but also fluctuated from the midpoint coverage of plant species in grazing area, could determine based on the highest number of plant species, diversity index, and evenness index (Whittaker, 1972).

The third sections of chapter 4 investigated environmental factor and temperature in the spring and summer season are important to determine diversity and identification of plant species could adapt to spring and summer season. The temperature in spring (April to May) maximum 18.20 °C and in summer (August to September) maximum 30.90 °C have related to abundance and frequency of the functional group of plant species between spring and summer. Response to the temperature difference between spring and summer through their life cycle and are primarily the phonological responses, i.e., stages of plant development. For each plant species a defined range of minimum and maximum temperature form the boundaries of observable growth, for example an extreme event for plant species will be warmer than cool season plant species, where the maximum temperature for growth is 25 °C compared to 38 °C. In understanding extreme events and their impact on plant species as cattle feed, consideration on plant response relative to the environment temperature have to given.

A similar response has been found in annual specialty plant species in which temperature. The major environmental factor affecting production with specific stress, such as periods of extreme temperature, overall growth and adapt to plant species depend on season climate, minimum and maximum daily temperatures, and timing of stress in relationship to developmental stages having the greatest effect (Ghost *et al.,* 2000; Pressman *et al.,* 2002; McKeown *et al.,* 2005; Sonsteby and Heide, 2008; Dufault *et al.,* 2009). When plants are subjected to mild heat stress (1°C to 4°C above optimal growth temperature), there was moderately reduced yield (Sato, 2006; Timlin *et al.,* 2006; Wagstaffe and Battey, 2006; Tesfaendrias *et al.,* 2010).

5.3 Future Perspective of the Research

The productivity and stability of aboveground plant species in grazing area depend in part on the functional composition and diversity of plant species. Recent research finding showed the plant species richness in grazing area has greater influence to increase productivity as cattle feed, and reduced variability of aboveground biomass. These findings have been the case suggesting the importance of plant species diversity especially dominance of plant species. Some scientists have suggested that the productivity and stability of ecosystem do not depend on the number of plant species but rather the presence of key plant species and functional types (Grime, 1997; Huston, 1997).

Plant species-area commonly classified into either response or affect plant functional types could adapt in grazing area and give supply as cattle feed in grazing area. Response plant functional types are a group of plant species diversity that responds similarity to the environment. Classification of plant species as increases, decreases, and invaders in response to grazing area could manage an example of plant species by their response could adapt to the biotic environment.

The resistance dominance of plant species between spring and summer season in grazing may be further classified into those that exhibit avoidance or tolerance mechanism to select plant species as cattle feed. The effect of select plant species could adapt in spring and summer give impact on management to increase productivity and conservation of grazing area.

To improve the efficiency and effectiveness of plant species between spring and summer in this study, the dominance of plant species which consist *Trifolium repens*, *Paspalum dilatatum* and *Paspalum notatum* (Figure 5-1) can be used to increase productivity and conservation of grazing area as supply cattle feed for future.

a) *Trifolium repens*

b) *Paspalum dilatatum*

c) *Paspalum notatum*

Figure 5-1. Dominant feed plant species in spring and summer seasons.

Sustainability dominant feed plant species can be used in grazing area as a potential solution to the management and conservation of grazing areas to increase the supply and availability of cattle feed. Because 70% nutrition of cattle feed was used for meat production and growth. It is indicated that these are three major plant species found in the grazing area, consist of *Trifolium repens*, *Paspalum dilatatum*, and *Paspalum notatum* could be used to increase productivity and conservation grazing area to supply cattle feed for future.

5.4 Scientific Contribution of This Study

This is to mention that this study produced several scientific contributions to basic science. As any doctoral dissertation is expected to find something new in its field, the dominance of plant species consist of *Trifolium repens*, *Paspalum dilatatum*, and *Paspalum notatum* in this study could deliver several interesting finding, from which the author can consider them as novelties.

Findings are relatively new in the field, and some other are kinds of confirmation to the previous scientific publication and reports. If these findings are listed from the most important aspects to the least one, the sequence may be as that listed can be contributed to select plant species especially could be used by the farmer, to increase management productivity, availability of plant species, conservation, and increase the quality of cattle feed particularly in summer season of Japan.

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