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Ecological Keystones & Resource Management in the Highland of Palawan: A Case Study in the Singnapan Valley

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ABSTRACT

This article examines different types of ecological keystones according to their systemic function, a case study in the upland part of south western Palawan. For this purpose, a basic ethnographical introduction of the different economical activities of a case study is provided. Then, the seasonal resource availability of the most important plant species is analyzed in order to compare it with cultural preferences, daily economic behaviour, and consumption. The result shows the essential and complex role of the different plants as keystone metaphors in a social ecological system. Further, the study can reveal some conclusions to the question whether the evolution of keystones is given by environmental conditions or cultural values.

Keywords: Keystone concepts, resource management, human ecology, habitat use, ethnobotany, Palawan.

INTRODUCTION

More than 45 percent of Palawan consists of mountains with slopes more than 30 percent especially in southern part of the island (Davis *et al.* 1995). Many of these mountainous areas are inhabited by isolated Palawan settlements who are still practicing swidden agriculture with multicropping system and hunting and gathering. Although Palawan is well-known for its high biodiversity, and diverse vegetation types which include beach forest, tropical lowland evergreen dipterocarp rain forest, lowland semi-deciduous forest, montane forest, and ultramafic and limestone forest, wild food resources which can supply a greater extend of human groups in the upland area are always scarce and their availability is highly dependent on different seasonality. The hypothesis, which states that protein deficiency in a tropical rain forest makes it difficult to live for forest dwellers or even impossible for hunter and gatherer groups living independently of agriculture, has been an anthropological point of heated debate for decades (Bailey *at al* 1989,

Endicott & Bellwood 1991, Headland & Bailey 1991). But how do horticultural groups like the upland people of South Palawan can arrange and cover up their nutritional needs in a biologically diverse but quantitatively poor environment and on what should be their economic activities to cope up with the situation are oftentimes a question. To answer this question, a brief and basic ethnographic introduction on the economy of the people of Singnapan is provided. The monthly availability of the most important agricultural and wild food resources based on the data which were gathered during a one year fieldwork to unveil certain times of abundance and scarcity of different food resources is also presented. Combined with quantitative data the results of the time analysis reveals significant differences of preferred non-redundant resources and non-preferred but abundant resources of food which can be classified in certain levels of keystones as essential parts of the cultural ecological system.

Keystone concepts

Highly demanded resources like rice or supplementary agricultural food supply need strategic planning and proper scheduling. The availability of certain harvest and wild food resources can determine the daily action of the dwellers as well as their decision making in selecting activities and investing in a certain work to achieve or heighten their goals. In the observed region some nonseasonal wild forest products, like bamboo shoots are abundant and available at any time but their presence can be ignored if there are other more preferred sources. The question is, are abundant and long storable plant species compulsory representing the cultural preferred main food of a society?

In this article, the ecological concept of keystones to designate and classify the different types of resources according to their availability, management and consumption is used. The concept of keystone species in a culture has a long history in ecological analysis, although its validity is controversial (Paine 1969, Menge *et al.* 1994). A specific ecological keystone according to its systemic function, as having essential role in maintaining certain levels of complexity within a social ecological system is defined. While in many other studies keystones are centred upon a single biological species (Nabhan & Carr 1994, Platten 2007), the keystone concept is more of a metaphorical complex incorporating several material (food resources) and nonmaterial system elements (worldview, daily activity) of a culture rather than a single species itself (Platten 2005; Henfrey & Platten 2006). Moreover, modern concepts of ecosystem structure and dynamics suggest that a single concept of a keystone cannot be appropriated to describe multiple trophic relations in a culture. Holling (1992) gives the clearest statement in extending the keystone hypothesis such as "All ecosystems are controlled and organised by a small number of key plant, animal, and abiotic processes that structure the landscape at different scales." Furthermore, the key organisational roles cannot be reduced to functional non-redundancy (Schulze & Mooney 1994; Grimm 1995), nor ecological dominance (Power *et al.* 1996; Terborgh 1986). Depending on the

complexity of a cultural system one society can have different types of ecological keystones (Tanner & Hughes 1994). Some ethnobotanical species which play a key role for the social identity can be used concomitantly with "organisms that by virtue of their usefulness may become ecologically crucial to the maintenance of entire anthropogenic environments, subsistence systems and ways of life" (Ellen 2006).

A further essential characterization of an ecological keystone emphasized in this assessment, is on how to combine cultural or traditional ecological knowledge, biological species and technical practice. Thus, keystones according to their structural roles, within social systems to satisfy elementary needs in a society have been defined. Moreover, keystones as system elements in maintaining any particular level of structural complexity of a culture are described. Decoding elemental keystone in a society needs a comprehensive ethnographical analysis of all sociological and economical variables in a cultural system as well as their mutual relationship to their environment. The classification of several resources as keystones in this article is the implied result of a basic comparison between expressed preferred resources of a group and their resource management. The following sections elaborate these definitions with reference to ethnographic data taken from the very own research of the author on subsistence practices of the upland people in southern Palawan.

Study area

The upland people of the Singnapan Valley are situated along the western slope of Mount Mantalingahan, the highest mountain in the island of c. 2,086 m above sea level located in the southern section of Palawan which belongs to the Municipality of Rizal (Fig. 1). The bowl-shaped valley of Singnapan has a crater-like land formation and encompasses an area of about 856 ha with a general elevation of 240-500 m along the rim and 155 m along the lower part where the Singnapan river dividing the valley with several tributaries in different steeply slopes. The dominant topographic feature of the area is characterized by a deep limestone canyon with numerous sinkholes and caves. With the exception of the agricultural fields, thick tropical primary forest and patches of second growth forest generally cover the area which is characterized by an extremely high degree of biodiversity. The primary forest in the Singnapan valley, like all forest periphery around the Mount Mantalingahan Range, is nowadays threatened by massive encroaching settlements from the lowland despite the fact that the whole range has been declared as a natural protected conservation area by the Philippine Government on June 23, 2009.

METHODOLOGY

In 2010, household and community surveys were done in the whole valley to capture the variation of each settlement size and land uses. Each household was observed with complete information about family composition, different economic activities and agricultural cycle. Location of each household and the agricultural fields were recorded using a Global Positioning System device. These data together with the data aggregated from the household survey, allowed the construction of contextual variables about the different household levels. Household interviews were conducted with male and female household heads as respondents in order to study the local perception of natural environment, and particularly the management and use of planted and wild gathered food resources in general. Names, origin and main characteristics of the crops and forest products utilized by the people were collected on fields under the guidance of local people. Interviews with members of the domestic unit enabled more detailed research on subjects such as networks for trading and sharing of food varieties, farm cycles, selection criteria, decision making, and other subjects related to agriculture, hunting and fishing activities. Qualitative data presented were the results from the analysis of peoples' statements, in an attempt to observe how biodiversity is perceived, named and managed. On the other hand, quantitative data were subjected to basic statistical analysis. Tables were presented to compare the diversity of different food varieties with its different seasonal allocation.

RESULTS AND DISCUSSION

Local settlements

The people of Singnapan are Palawan (Pala'wan, Palawanän) speaking group distributed in 7 local settlements (*rurungan*) with a total number of 54 permanent residential households. There are also a lot of non-permanent residents in the valley who are frequently moving between Singnapan and the adjacent regions like Ugis, Kandawaga, Maktanur, etc. Many of them are maintaining other agricultural fields or have kinships in these areas. Local settlement size ranged from 1 to 8 households and are mainly located in the north and south sides of the Singnapan river. Each local settlement is a simple aggregate of households consisting of a basic uxori-local structure with the father-in-law as the leader. These local communities (*pinemikitan*) organize the spatial arrangement of families and can be viewed as the locus of social interaction. Moreover, their marriage system is polygamous, that is, a male may have two or three wives. Because of the *pinemikitan* regulation most of the males should produce children to each wife to avoid problems with different fathers-in-law (Macdonald 1972, 1977).

The household (*banua*) is the smallest social and economic nucleus in a local settlement and it represents the basic unit of production, exchange, and consumption. With the exception of sharing regulation among related households, each of them is self sufficient in terms of food procurement and economic maintenance.

While preparation of the agricultural fields is the main activity during the dry season (January to April), the Tau't Batu inhabit certain caves surrounding the valley during the heavy rainy season in the month of July to September. Although many settlements no longer live in the caves, some isolated settlements in the valley still follow the traditional way of living.

Economy

Agricultural Products

The economy of the people of Singnapan is mainly based on swidden agriculture with multicropping system. At the same time, hunting, fishing and gathering are pursued to complement the carbohydrate diet of the people. All households have their own agricultural fields (*uma*) for wild rice cultivation which is characterized by a yearly cycle starting with field preparation during the months of December to March and harvesting around July and August. Depending on the capability of a household, one can manage between one to three fields in a year. The *uma* is also the main production area for cassava, sweet potato and other plants. Moreover, almost all households have a house yard (*legwas*) like a garden which is planted with which serves as a food reserved area.

Rice (*Oryza sativa* Linn.) is the most important crop in terms of time allocation and labour. The complex values and practices that surround this plant, strongly affect subsistence strategies, social organization, seasonal and daily schedules, and perceptions of social identity and well-being. As has been observed in number of households in the Singnapan Valley, many features of the material culture and social life reflect the unique processing demands and culinary properties of wild rice. The constant tasks of field clearing, planting, harvesting and cooking rice are different major determinants of male and female time allocation and provide an important forum for social interaction and transmission of knowledge. It is surprising that people always expressed that rice is their primary, most valuable and most important food which should be stored in granaries owned by the families, in the time of the researcher's first observation during the month of February to March 2007 and later during the first half of 2010, no family had rice for eating except the seeds they normally use for the fields. Upland rice with its different varieties can be harvested only once in a year (around August) and can sustain a household just for a couple of months depending on the amount of production. That means rice, a non-redundant resource connected with non-substitutable values, beliefs and norms

functionally determines the economic behaviour of the cultural system. In case of the people of Singnapan valley, rice is considered as a *cultural keystone*.

In contrast to rice, cassava (*Manihot esculenta*) which is also planted in the same *uma* field, 2 to 4 weeks after planting rice, can be stored in the soil for more or less 2 ½ years and is not susceptible to diseases. Because of its availability during the whole year, the nutritional role of cassava is of central importance to the diet of these people hence, it represents the most dominant food supply. During the observed drought- or precipitation-induced rice shortages in 2007, 2009 and 2010, the people of Singnapan were subsisting only on cassava, some forest products and on hunting and fishing activities. Whenever people visited households for several purposes it was witnessed that each of them got a small portion of the prepared food which is made up of cassava. It is obvious that cassava plays an important role in food transfer among households, hence vital in their social relationships. The communal sharing system of cassava in a local level is quite free and has no restrictions compared to the sharing regulation of rice which is very scarce and therefore valuable. Despite of its abundance, cassava is not culturally preferred like rice. As previously discussed, keystones are defined in relation to the structure and dynamics of social-ecological systems, but in the case of cassava it is restricted to a single level of system organization. Cassava plays a key role as a dominant basis of food supply and is ecologically non-substitutable hence, we can designate it as a *nutritional keystone*.

A lot of different tuber varieties, vegetables and fruits, which can be classified as supplementary food resources, were planted in the same *uma*-fields as well. But their cultivation takes only a small section in field compared to rice and cassava. Table 1 presents the seasonality of the different plants in a year. The sequence of the food listed in the table is based on a free list interviewing method. To emphasize that rice and cassava are the most important crops their beams have different colours to the rest of the crops. The asterisks (*) on the vernacular names of the resources means that the plants are nonseasonal. That means that the plants are accessible at any time of the year. The yellow columns represents the rainy season.

Table 1: Seasonality of planted crops, vegetables and fruits

Vernacular Name (Scientific Name)	Terrestrial Activities Agriculture, Hunting, Fishing, Gathering (AHFG)											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1. Paray <i>Oryza sativa</i> Linn.												
2. Kumbahang* <i>Manihot esculenta</i> Crantz												
3. Talos* <i>Colocasia esculenta</i> L. Schott												
4. Bankuka* Family Araceae												
5. Ube <i>Dioscorea alata</i> Linn.												
6. Punti* <i>Musa sp.</i>												
7. Mais <i>Zea mays</i> Linn.												
8. Sanglay* <i>Ipomoea batatas</i> (Linn.) Lam												
9. Aturay <i>Setaria italica</i> (L.) Beauv.												
10. Batad <i>Sorghum bicolor</i> (L.) Moench												
11. Lasgoy Family Gramminae												
12. Pakpak Family Bombacaceae												
13. Niyog <i>Cocos nucifera</i> Linn.												
14. Manti <i>Nephelium lappaceum</i>												
15. Ampayas* <i>Carica papaya</i> Linn.												
16. Antak* <i>Phaseolus vulgaris</i> Linn.												
17. Parangi <i>Ananas comosus</i> (L.)												
18. Tabu <i>Elaeagnus philippinensis</i>												
19. Biga-bajang* Family Araceae												
20. Imlung <i>Cucumis sativus</i> L.												

The table shows the diversity of food resources of the Tao't Batu people. The plant bulks listed revealed the dispersion of available food resources during the whole year. In a second inspection, one can recognize the existence of two diet periods in which food is generally very scarce: the months of November to December and February to April. After the month of heaviest precipitation (August and September) local groups usually started to clear the fields. Cutting trees and clearing the soil is a hard work in which people need a high amount of carbohydrates. While cassava is available at any time, the harvest arrangement for the time of *Tälos* (taro species), the third most preferred nonseasonal vegetable is intentionally planted after the rainy season. Few other crops like *Tabu* are available in the same time but for a much lesser extent. The period of February to April is also characterized by low alternative source of crops with exceptions of *Ube* (tuber variety) and *Manti* (rambutan). This period is generally marked by field activities like choosing, clearing, preparing, cultivating and seeding.

It is evident that the availability of the most important crops like *Päray*, *Bänkuka*, *Punti*, *Mais*, *Batad*, and *Lasgoy* are significantly concentrated during the months of August and September when heavy rain is coming and, partially, people start to move into the caves. Although hunting and collecting are also practiced during this time, the stored crops in the plots represent the most important and dominant food source for the survival of the group. Especially the highly preferred rice has been eaten in this time, one or two times a day, it is supplemented with gathered products like snails, mushrooms or certain edible vines.

Wild nonseasonal and seasonal vegetables of fruits

An ample diversity of wild fruits and vegetables exist in surrounding forests of the Singnapan-valley. Although some species are abundant and nutritional important, the accessibility of the species is highly depending on a different seasonality for example *Sampatukar* (wild pineapple with red husk), *Ampayas*, *Pahu* and *Bungton* (Table 2). Other nonseasonal wild forests are continuously bearing fruits or have edible roots or stalks like *Batbat*, *Busnig*, *Lagwas* and *Pakis*. But there are significant differences in the available yields and, with few exceptions, almost all of these species are not storable because of the humid tropical conditions:

Table 2. Nonseasonal wild crops/fruits

Vernacular Name (Scientific Name)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Batbat <i>Arenga undulati</i>												
Badak <i>Artocarpus champeden</i> (Lour.) Sprengel												
Palaw <i>Landolphia sp.</i>												
Pakis <i>Acrostichum aureum</i> Linne												
Pahu Family <i>Anacardiaceae</i>												
Lakwas <i>Hedychium coronarium</i> Koenig												
Sampatukar Family <i>Bromiliaceae</i>												
Busnig <i>Arenga brevipes</i> Becc.												
Bungton <i>Garcinia mangostana</i> Linne												
Paratungon <i>Elaeis quineensis</i> Jacq.												

Nonseasonal wild products with continuously edible portion are widespread and are constantly used by the Tao't Batu people. Especially *Batbat* is highly abundant, very popular as an additional side dish, closely dispersed in the adjacent forest and is also used as a food reserve in times of emergency. Other nonseasonal wild products like *Pakis* or *Busnig* are more rarely located and their available amount is very scanty and not enough for supplying a greater number of individuals. On the other side the availability of seasonal products like *Badak*, *Pahu*, *Sampatukar* and *Bungton* and many other fruits are concentrated during the months of May to June which represents mostly the time in which people are waiting for their almost harvestable rice crops.

Hunting and Fishing

Although highland people are highly engaged in managing and sustaining their fields for agricultural products almost all observed households are very active in hunting, fishing and gathering too. Classifying small-scale populations in different evolutionary-tined categories like "horticulturalist" or "hunter-gatherers" is very common in the anthropological literature and has significantly been contributing for deep social related analyses. Many horticulturalist groups like some upland Naga-groups in West-Flores in Indonesia or the Yanomami in South America (Lizot 1977) subsist to a greater extend on seasonal swidden agriculture but their food supply depend on hunting and gathering in the same time. In our case it would be a quite unbalanced definition of the economical system of highland

Palawan people classifying them sorely as horticulturalists because their main protein source income usually relying on hunting and fishing activities, although nowadays to a less extend than before.

Especially hunting for wild boar and other games like monkey, bear cat, and fox is an extraordinary important supply of protein and takes a special role in the regulation of sharing in a community. Unfortunately through the introduction of airguns in the beginning of 1990ies, which has almost replaced the blowgun in the observed area, these animals are very rare and seldom to encounter. That's why many hunters are more engaged today in tracing squirrels, turtles and birds which are getting slowly extinct in the whole valley as well. Fishing in the Singnapan river is frequently practised by almost all households during the dry season in January to April. Similar to hunting, they have different methods like stunning or building traps made by forest products.

In the rainy season the game targets of hunting and gathering are oriented to the caves. Related household groups, who residing in the caves during this time, are catching bats through swatting down with a net-like woven palm. Fishing with bamboo made traps (*asag*) is partly possible only on shallow parts of the river close to the caves. But all of these hunted and fished preys are contributing only a small part for the daily food procurement because it takes a lot of time, work, and their availability is limited.

Summarizing the recent hunting situation in the Singnapan-valley, we can state that

- a.) there are still existing some local groups who are more *investing* time in hunting and gathering activities (small communities, more highland, more isolated) on the one side and
- b.) there are many groups who are mostly *spending* their time for heightening their agricultural products for trading and selling purposes on the other side (bigger communities, buffer-zone and highland, frequently contacts with lowlanders and hence less isolated).

We can find both cases in the Singnapan-valley. The local settlements which are located near to the rim of Kandawaga can be classified with the category a.) while the settlements in the western part belong to the category b.).

SUMMARY

We can summarize that the defined ecological keystones in the case study are complexes of values (rice) *and* practice (cassava) with different elementary functions to social reproduction and consumption. The ecological keystones are in no case directly equivalent to a single biological species. More important, there are different keystones whose contribution to the cultural and ecological system is of

significant importance. While the decoded cultural keystone is a non-redundant plant species connected with a range of purely subjective factors like beliefs, ideas, norms and values concerning social identity, the nutrimental keystone itself is ecologically crucial and irreplaceable for the maintenance of entire trophic environments and subsistence systems. The analysis suggests that, in a theoretical point of view, societies can potentially choosing their cultural keystone independently to environmental limitations and this shape the way in which particular economically important species are used. However, for a more deeper mutual understanding a more thorough investigation of the keystones in the upland Palawan culture is needed to provide more elaborate work including a more detail analysis in meaning, significance, potential and limitations of the different species as well as time allocation and economic behaviour.

CONCLUSIONS

The seasonal availability of the resources and the economical management of the observed case study lead us to some tentative theoretical thesis which are of significant importance for a deeper grasp of the mutual interrelationship between cultural systems and environmental limitations:

1. Rice is the most preferred food type which is highly valuable, very scarce, labour-intensive and susceptible for diseases (most symbolical crop, *cultural keystone*).
2. Cassava is the main major source of carbohydrates which is not culturally preferred like rice, but high labour-intensive, abundant, not susceptible for diseases and storable in the soil for a long time (*nutritional keystone*).
3. Further planted crops like different tuber species, corn and fruits like pineapples are diverse but their availability are seasonally limited and to a much lesser extend in proportion to cassava (additional food supply).
4. Wild collected vegetables and fruits are abundant and diverse too, but their available yields are very poor, species are seasonally limited and they scarcely dispersed (additional food supply).
5. Meat is a very scarce source, but highly preferred. In the case study big game is very rare and hunting activities are more concentrated in small preys and fishing resources (alternative protein source).

These concluded assertions, particularly in Nr. 2, gives the opposition of that what people constantly expressing as their preferred main food source. The fact that the nutrimental keystone covers almost the essential needs of the people reveals a fundamental function of the evolution of keystones in cultural systems itself. The choice of a keystone is not restricted to single species and, moreover, the selection of a cultural keystone depends on social and cultural system progress and can be generated independently of environmental limitations. According to our analysis,

the cultural keystone is non-redundant and their management is intensively connected with social values, knowledge, cultural daily practice and social identity. In opposition to cultural keystone, the nutrimental keystone is of irreplaceable importance for the survival of the group. As a non-substitutable, environmental non-restricted and therefore abundant species, it can potentially determine the daily consumption habits of a society. The following graphic shows the proportional fractions of the food consumption among the Tau't Batu:

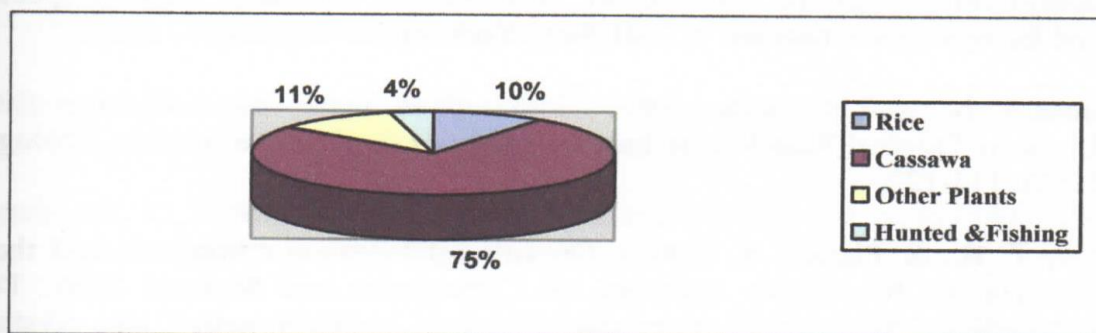


Figure 1 Proportional fractions of food consumption.

The graphic demonstrate the dominant role of cassava consumption. More important, the graphical proportion of rice is almost the same like the item "Other Plants" which is designating different species of tuber, banana, fruits and gathered vegetables. While the availability of tubers and bananas are highly depending on their seasonality and serves sorely a supplementary source, the pointed proportion of "Hunting and Fishing" is problematic. Most of the male members in the different households are spending a lot of hours in a week for hunting birds and squirrels. But these activities are mostly restricted to the dry season and the total game is always small in relation to the invested time. Because of the absence of wild boar in the valley, hunting and fishing has not the same function anymore to serve as protein source like in the past. But it still shapes the daily economic behaviour of the households.

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