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Terras (*Eusideroxylon zwageri* Teijsm. & Binn.), a Cultural Keystone Species of the Berawan People of Sarawak, Malaysia

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ABSTRACT

This article showcases the unique position accorded to the *terras* tree (*Eusideroxylon zwageri* Teijsm. & Binn. Lauraceae) in the Berawan culture. We collaborated with the Berawan people of the Loagan Bunut region of Sarawak, to uncover the most important tree in their culture. In a group interview, the participants ranked the *terras* as the most important tree. The Identified Cultural Influence of Cultural Keystone Species (ICI) and the Use Value Index (UV) was found to be extraordinarily high at 35 and 6.05 respectively. The multidimensional use value of the tree, stemming from its hardy timber, could be the reason behind its cultural importance. We conclude that the *terras* tree should be protected even outside the national parks for its ecological and cultural value.

Keywords: Traditional knowledge, culture, native, vulnerable species, community, belian, biocultural diversity, ecological restoration

INTRODUCTION

Cultural Keystone Species (CKS) are species that enjoy a unique position in the culture of a community (Cristancho & Vining, 2004; Garibaldi & Turner, 2004). Keystone species plays a pivotal role in the natural ecosystem, while cultural keystone species play an important role in maintaining the culture of a community (Paine, 1969). Just as the removal of the former might result in irreparable loss to the ecosystem, the loss of the latter might lead to loss of a culture or its components. This understanding is one of the reasons for the emerging of the field of Biocultural Diversity that explores the links between linguistic, cultural, and biological diversity (Loh & Harmon, 2005; Maffi, 2005). New studies agree that culture and ecology are inseparable entities and

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culturally important species also happen to be ecologically significant ones (Close *et al*., 2002; Maldonado *et al*., 2013). Though critics of CKS argue that the term 'cultural keystone species' misuses the metaphor 'keystone species' (Davic, 2004), studies from different regions of the world have proven its credibility (Brosi *et al*., 2007; Garibaldi, 2009; Butler *et al.*, 2012; Upreti *et al*., 2013). The dual risk of loss of biodiversity and culture threatens the very existence of indigenous communities all over the world (UNESCO & UNEP, 2003); there is an urgent need for studies that could facilitate the conservation of both biodiversity and culture without negating opportunities for upward economic mobility (Gupta *et al.*, 2003).In this scenario, our study aims to uncover the most important tree in the culture of the Berawan people of Loagan Bunut and to promote an understanding of the traditional knowledge and cultural importance accorded to it.

The Berawan People

The Berawan people of Sarawak, who speak the Berawan language,are a native community traditionally involved in fishing. They are the only community accorded with native fishing rights in the natural lake of the Loagan Bunut National Park (LBNP). There are four main Berawan settlements viz., Long Teru in the lower Tinjar, Long Jegan in middle Tinjar, Batu Belah and Long Terawan in the lower Tutoh and middle Tutoh (Metcalf, 1976). Linguistically, the Berawan in Long Teru and Batu Belah share closer ties compared to the communities in Long Jegan and Long Terawan (Metcalf, 1976). Hudson (1978) placed the Berawan language under the Rejang-Baram group while Blust (1972) placed it among the lower Baram languages.

Loagan Bunut- A Unique Ecosystem

The Loagan Bunut ecosystem is a unique one with a freshwater lake spanning around 650 ha playing a decisive role in the ecology of the protected forest. The lake is full most of the year, but can dry out occasionally when the water level in the Sungai Teru that feeds the lake goes down (Hon *et al*., 2007; Sayok *et al*., 2008). The plants and animals in the Loagan Bunut have co-evolved with this unique 'vanishing lake' and so has the Berawan culture. Their unique *selembau* system of fishing, where a scoop net on a floating platform is used to trap fishes (Jensen & Das, 2006), affirms the Berawan traditional knowledge and skills. This study is rooted in the idea that Berawan traditional knowledge and culture recognise the trees in their ecosystem with varying degrees of importance.

METHOD

The study was carried out in March 2013 in collaboration with the Berawan people of Loagan Bunut. We met the headmen of the two longhouses in the vicinity of Loagan Bunut national park viz. Rumah Kajan Sigeh and Rumah Meran Surang and obtained the mandatory Prior Informed Consent to proceed with the study. Open-ended questionnaires were used to elicit information on culturally important trees

from the participating volunteers. Interviews were a combination of focus group and individual focussed ones. At first, we invited knowledgeable volunteers to join us for a focus group interview to which around 16 people from Rumah Kajan Sigeh responded. We requested them to list the most important tree species in the Berawan culture. Following this, individual interviews were carried out with 20 volunteers (12 males and eight females) to assess the Identified Cultural Influence of cultural keystone species (ICI) for the top-ranking species of the list, as per the framework provided by Garibaldi and Turner (2004). Individual PICs were also obtained prior to these interviews. Volunteers were also requested to list down the uses of the tree in order to calculate the use value index as:

> Use value, $UV = \Sigma Ui/n$,
> where, 'Ui' is the number of uses mentioned by each informant for a given species and 'n' is the total number of informants (Rossato *et al*., 1999).

The entire study conforms to the ISE code of ethics (International Society of Ethnobiology, 2006). It was also approved by the Human Research Ethics Committee of Curtin University, Sarawak**.**

Significance of ICI and Use Value Indices

Landscape changes are often accompanied by loss of species at least at the local level. While there are various ecological techniques to quantify the magnitude of loss, very few methods have been formulated to gauge its impact on human culture. The CKS concept aims to fill the gap by demonstrating parallels between ecologically important species and culturally important species. Cristancho and Vining first proposed the concept of cultural keystone species; they used the term 'Culturally-defined Keystone Species' to designate "those plant and animal species whose existence and symbolic value are essential to the stability of a culture over time" (Cristancho & Vining, 2004); Garibaldi and Turner (2004) later introduced the framework for determining cultural keystone species. Since culture is a complex and dynamic entity, no single parameter can be used to assess the role of biological elements in it. ICI seeks to address this issue by considering multiple criteria such as the usage of the species, its position in the respective language, ceremonial roles, traditional knowledge, uniqueness and economy. The researchers elicited information on the above factors by asking a series of questions and then assigning scores in the range of 0-5 for each factor, with 5 indicating a high level of cultural significance for that criterion. Thus, the highest possible score for a species is 35 (5 x 7).The CKS model goes beyond understanding the importance of a species in the culture. Garibaldi (2009) has successfully used this model to select seven CKS of the Dene, Cree and Métis people of Fort McKay in Alberta, Canada, to reclaim a large scale bitumen extraction area. Recently, Upreti *et al*. (2013) has also applied the ICI framework to understand the cultural importance of white pine (*Pinus strobus* L.) for the Kitcisakik Algonquin

community of western Quebec, Canada. Recognising the importance of CKS in ecological restoration processes, Eitzel *et al.* (2012) picked up the article by Garibaldi and Turner (2004) as one among the 10 most important articles on ecological restoration. Unlike most ecological indices, ICI depends on the ability of the researcher to assign the appropriate ratings to each parameter. Though this might appear as a limitation, trained ethnobiologists or anthropologists who have gained an insider's perspective of the particular culture are less likely to make judgemental errors. Moreover, the usage of an additional index such as the use value index will facilitate the juxtaposition of results against each other so as to get a clearer picture.

Use value index is classified as a Relative Cultural Index (RCI) that measures the importance of taxa to a particular community (Hoffman & Gallaher, 2007). Prance *et al*. in 1987 calculated the use values of trees to four indigenous people of the Amazonian region. They assigned a value of 1.0 to 'major' uses and 0.5 to 'minor' uses. The familial use value was then calculated by summing the use values of individual species in a family and then dividing it by the number of all species in that family, occurring in the study plot. Later,Phillips and Gentry (1993a; 1993b) calculated the use value of a species for an informant by adding the total number of uses cited for the species and dividing it by the number of 'events'. The use value for one species was then calculated as the sum of the informant use values for that species divided by the total number of informants. This was later adapted by Rossato *et al*. (1999) as the sum of the use categories divided by the number of informants (also see Albuquerque *et al*., 2006). Unlike the ICI, the use value index is based on "informant consensus" and hence is more objective (Tardio & Pardo-de-Santayana, 2008). However, the use value index does not distinguish between active and passive uses unless the researcher specifically distinguishes these two forms of knowledge during the interviewing process.

One intentional deviation in the application of use value index in this research is that the number of uses cited for the tree are individual uses and not use categories. For instance, usability in making of cross and mirror frames are considered as two separate uses. This is in contrast to the opinion of Hoffman and Gallaher (2007) that the consideration of individual uses might lead to an exaggerated score. Our rationale is that each use has a cultural value behind it and no two uses have the same extent of cultural value to be counted as one use category. For instance, though the cross and mirror frames are both wooden structures, the cross has a higher cultural value to a Christian community. Likewise, an ornate mirror frame is not in the same league as the staircase as it has higher cultural significance.

RESULTS

Our study shows that the *terras* tree (*Eusideroxylon zwageri* Teijsm. & Binn. Lauraceae) is the most important tree in the culture of the Berawan of Loagan Bunut. It

is native to Malesia and popularly known as *belian* in Bahasa Melayu and as Bornean Ironwood in English; *terras* is the Berawan name given to the tree. The ratings received by *terras* for each criterion of ICI are provided in Table 1.

Our interviews show that despite its increasing rarity, the *terras* tree is still used routinely for multiple purposes including cultural artefacts. The Berawan of Loagan Bunut are nostalgic about the past when there used to be an abundance of *terras* trees in their neighbourhood, and they strongly believe that the tree cannot be replaced by any other species. The high timber value of the tree still gets them enough revenue through trade, though not at the same magnitude as before. The use value index for *terras* from our interviews with 20 volunteers was found to be 6.05.

$$\text{Use value, UV} = (6+4+4+7+6+3+3+6+9+12+3+10+7+7+4+4+8+7+6+5)/20 = 6.05$$

From the individual interviews carried out to elicit the use value, we understood that the *terras* tree is a multipurpose tree with a diverse range of uses, mostly attributed to its hardwood properties. Due to its all-weather usability, the *terras* tree is used to make wooden structures that risk exposure to sun, rain, wear and tear. The wood is used to make coffins, crosses, wooden sculptures, pillars for longhouses, gates, outdoor staircases, ornate frames for mirrors, pestles, handles for implements and wooden floorings. *Terras* stalks can be used as supports for black pepper and also

TABLE 1
Identified Cultural Influence of *terras* (after Garibaldi & Turner, 2004)

Elements that indicate a cultural keystone	Ratings
Intensity, type and multiplicity of use Is this species used intensively (routinely and in large quantities?) Does this species have multiple uses?	5 5
Naming and terminology in language, including uses as seasonal or phenological indicators, names of months or seasons, place names -Does the language incorporate names and specialised vocabulary relating to the species	5
Role in narratives, ceremonies or symbolism -Is it prominently featured in narratives and or ceremonies, dances, songs or as a major crest, totem or symbol?	5
Persistence and memory of use in relation to cultural change -Is the species ubiquitous in the collective cultural consciousness and frequently discussed?	5
Level of unique position in culture -Is it difficult to replace with other available native species?	5
Extent to which it provides opportunities for resource acquisition from beyond the territory -Is it used as a trade item for other groups?	5
Total	35

Responses to questions were rated in the scale of 5-0 as: 5 (yes, very high), 4 (yes, high), 3 (yes, moderate), 2 (yes, low) 1 (yes, though very low or infrequent), 0 (no, not used).

to pierce holes in the ground for the planting of paddy. It can also be used to make spoons and *keeshang*, a manual paddy dehusker.

During secondary burials accorded to members of elite clans of the Berawan in ancient days, the remains of the deceased would be left on a platform on the top of two poles called *lejeng* (Fig.1), which are essentially two *terras* tree trunks. These trunks are known for their elaborate carvings;two may still be seen in the Loagan Bunut National Park. It is taboo to touch or disturb these poles even if they happen to fall on their own. Violators will either have to offer a pig as sacrifice or provide material donations to the family of the deceased as compensation.

Terras is too heavy to float on water, making it difficult to transport in a swampy ecosystem such as the Loagan Bunut; the Berawan people used to tie them to buoyant trees and then float them downstream. However, the same heavy tree after drying and thinning can be used to make bilges of boats. Boats have a unique place in Berawan culture as they were the sole mode of transportation in the swampy Loagan Bunut terrain until the advent of logging roads and 4-wheel drive vehicles. They are still used for fishing and collection of wild produce.

Besides recalling the uses of the tree, the volunteers also shared information on the ecological importance of the *terras*. Owing to its tall nature, hornbills and eagles nest in the canopy of the tree. Giant squirrels, known as *kerawak* in Berawan (*Ratufa affinis* Raffles, 1821) can be seen aplenty at the base of the tree. The flower buds are relished by the *nyikek* (Muller's Bornean Gibbon, *Hylobates muelleri* Martin 1841). Two species of porcupine (identity unconfirmed) also feed on the fruit of the *terras*. Both of these porcupine species were once hunted by the people.

Fig.1: The *lejeng* poles of Loagan Bunut National Park

In general, the participants were of the view that the rarity of the species caused by logging and expansion of palm oil plantations outside the National Park territory has had an impact on its usability as well as on the skills and traditional knowledge of the people related to the tree. The consensus among the participants on the result of the above phenomenon is that the younger generation has lost most of the traditional knowledge of *terras*, though they consider this species as an 'important and irreplaceable ' one.

DISCUSSION AND CONCLUSION

The *terras* tree ranks high (35/35) in terms of ICI, indicating the high importance accorded to it in the Berawan culture. It excels in all the six criteria required for a species to be considered as a cultural keystone species. The high use value of six is an indication that on average, people know at least six uses of the plant. However, it should be borne in mind that this study considers independent uses and not use categories. The Berawan language recognises this tree by the name *terras*, which is unrelated to the Bahasa Melayu name, *belian*. It is an essential feature of indigenous languages to recognise important elements in an ecosystem by indigenous names (Johannes, 1993; Franco & Narasimhan, 2009; Si, 2013). Artefacts made of *terras* too find a prominent place in the Berawan culture. The top ranking accorded to *terras* is justified as the ICI and use value clearly agree with the consensus that emerged in the group interview that the *terras* is the most important tree in Berawan culture. The fact that Berawan use *terras* as *lejeng* poles to honour the deceased souls and the taboos and the sanctity associated with the structure further corroborate this consensus. There is considerable amount of debate on the right to secondary burials with some authors of the view that secondary burials were the privilege of an elite class while some others argue that it was just a matter of economic capability (Metcalf, 1981). However, our informants agreed with the former. A deceased soul is elevated to the role of 'ancestor' and venerated by the native community, which is the general practice the world over; it is only natural that a tree associated with such beliefs immediately gains prominence in the culture (Fortes, 1965; Soles, 2001). For the Berawan of Loagan Bunut who adopted Christianity, the wooden cross is the most important cultural symbol. Being the most preferred tree for making the cross also imparts an aura of regality to the tree. From the uses and the results of the indices, we understand that the multidimensional properties of the tree, stemming from its hardy timber, is the chief reason behind the top rank accorded to it. It should be noted here that of all the timber species in Sarawak, *terras* offers the highest degree of resistance to marine borers (Choon & Cookson,1996). Plants and animals can be used to convey a message of political power and status; it can be argued that the *terras* is equated with aristocracy just as the lion is equated with power and strength all over the world.

The tree, besides ranking high in the ICI, is also unique and irreplaceable for

the community. Studies from other parts of Borneo show that *E. zwageri* enjoys a similar position in other native cultures too. For instance, the Dayak Benuaq Ohookng people of East Kalimantan use the tree to conjure spirits as it incorporates mystic power (Zahorka, 2007); the tree is also used for medicinal purposes in Kalimantan (Wahyuni, 2011). Research done in Malinau, Indonesia also show that *E. zwageri* is the most preferred tree in the local culture for construction purposes (Sheil *et al*., 2007; Moeliono *et al*., 2009). Owing to its importance in native cultures, communities have devised various traditional management systems to manage the population of *terras*, and Peluso (1992) argues that the traditional management regimes of the native communities can foster better conservation of *E. zwageri*. There is also enough evidence to show that *E. zwageri* has to be conserved for its ecological importance (Eltz *et al*., 2003; Sheil & van Heist, 2000; Whitmore, 1984).

The Berawan people's claim that commercial logging and plantations have contributed to the rarity of the *terras* tree outside the national park is supported by researchers who have studied the change in land use of Loagan Bunut (Sayok *et al*., 2009). The example of low visibility of hornbills in Borneo and elsewhere caution that cultural importance given to a species can also lead to a decline in its population (Bennett *et al*., 1997; Choudhury, 2009). However, in the case of *terras*, decline in population is mainly attributed to the commercial or illegal logging and not its cultural use (Bullinger, 2006; Peluso, 1992).

The cultural importance accorded to any species depends on its usability and availability to the community. In other words, it is essential that the species be present both in the physical and collective memory domains (Nabhan, 2000). For instance, a study by Ramstad *et al*. (2007) shows that the survival of Maori traditional knowledge on *tuatara* (*Sphenodon* spp.) and the latter's position in Maori culture is intrinsically linked to the availability of *tuatara*. Another study by Mathew *et al*. (2006) on *Artocarpus hirsutus* Lam., an endemic tree from the Western Ghats of India, shows that changing cultural preferences related to a species may lead to a decline in the availability of that species.

Recognising its rapidly declining population, IUCN has classified *E. zwageri* as a 'vulnerable species' as per the criteria A1cd+2cd (IUCN 2012). Clearly, over exploitation, shifting agriculture, timber export, coupled with the slow radial growth rate of 0·058 cm y^{-1} (Kurokawa *et al.*, 2003), appears to have contributed to its vulnerable status. As indicated by Garibaldi and Turner (2004), the ecological status of a CKS can limit its availability for cultural purposes. We feel that if a situation arises in future where there are no *terras* available to the Berawan and other interacting cultures, there is a risk of the tree's losing its cultural importance, leading to both loss of species as well as erosion of culture at the local level. At present, it is encouraging to see the contemporary Berawan culture recognising the importance of the species.

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REFERENCES

Albuquerque, U. P., Lucena, R. F. P., Monteiro, J. M., Florentino, A. T. N., & Almeida, C. (2006). Evaluating two quantitative ethnobotanical techniques. *Ethnobotany Research and Applications*, 4, 51–60.

Bennett, E. L., Nyaoi, A. J., & Sompud, J. (1997). Hornbills *Buceros* spp. and culture in northern Borneo: Can they continue to coexist? *Biological Conservation*, *82*, 41-46.

Blust, R. A. (1972). Report of linguistic field work undertaken in Sarawak. *Borneo Research Bulletin, 4*, 12-13.

Brosi, B.J., Balick, M.J., Wolkow, R., Lee, R., Kostka, M., *et al*. (2007). Cultural erosion and biodiversity: Canoe-making knowledge in Pohnpei, Micronesia. *Conservation Biology, 21,* 875–879.

Bullinger, C. (2006). *Comparison of local government's policies on Kutai and Dayak Benuaq villages in Kutai Barat, Indonesia: Factors influencing village life and household well-being since decentralization*. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Butler, J. R. A., Tawake, L., Tawake, A., Skewes, T. & McGrath, V. (2012). Integration of traditional ecological knowledge and fisheries management in the Torres Strait, Australia: The catalytic role of turtles and dugong as cultural keystone species. *Ecology and Society, 17*(4), 34.

Cristancho, S., & Vining, J.(2004). Culturally defined keystone species. *Human Ecology Review*, *11*(2), 153-164.

Choon, L. W.,& Cookson, L. J. (1996). *Laboratory study on the natural durability of Sarawak timbers against marine borers*. Kuching: Timber Research and Technical Training Centre, Forest Department.

Choudhury, A. (2009). Significant recent ornithological records from Manipur, North-east India, with an annotated checklist. *Forktail, 25*, 71–89.

Close D. A., Fitzpatrick, M. S., & Li, H. W. (2002). The ecological and cultural importance of a species at risk of extinction, Pacific lamprey. *Fisheries*, *27*, 19–25.

Davic, R. D. (2004). Epistemology, culture and keystone species. *Ecology and Society, 9*(3).

Eitzel, M. V., Diver, S., Sardiñas, H., Hallett, L.M., Olson, J. J., *et al*. (2012). Insights from a cross-disciplinary seminar:10 Pivotal Papers for Ecological Restoration. *Restoration Ecology, 20*(2), 147–152.

Eltz, T., Bruhl, C. A., Imiyabir, Z., & Linsenmair, K. E. (2003). Nesting and nest trees of stingless bees (Apidae: Meliponini) in lowland dipterocarp

forests of Sabah, Malaysia, with implications for forest management. *Forest Ecology and Management, 172*, 301–313.

Franco, F. M., & Narasimhan, D. (2009). Plant names and uses as indicators of knowledge patterns. *Indian Journal of Traditional Knowledge, 8*(4), 645-648.

Fortes, M. (1965). Some reflections on ancestor worship in Africa. InM. Fortes, & G. Dieterlen (Eds.). *African Systems of Thought* (pp. 122-142). London: Oxford University Press.

Garibaldi, A., & Turner, N. (2004). Cultural keystone species: Implications for ecological conservation and restoration. *Ecology and Society, 9*(3), 1.

Garibaldi, A. (2009). Moving from model to application: Cultural keystone species and reclamation in Fort McKay, Alberta. *Journal of Ethnobiology, 29*(2), 323-338.

Gupta, A. K., Sinha, R., Koradia, D., Patel, R., Parmer, M., *et al.* (2003). Mobilizing grassroots technological innovations and traditional knowledge, values and institutions: Articulating social and ethical capital. *Futures, 35,* 975-987.

Hoffman, B., & Gallaher, T.(2007). Importance indices in ethnobotany. *Ethnobotany Research and Applications, 5*, 201–218.

Hon, J., Sylvia, N. G., Kong, D., & Gumal, M. (2007). Loagan Bunut National Park – A refuge for lowland birds? In *Proceedings of the ninth Hornbill workshop on protected areas and biodiversity conservation* (p. 228-235). Kuching: Sarawak Forestry.

Hudson, A.B. (1978). Linguistic relations among Bornean peoples with special reference to Sarawak: An interim report. *Studies of Third World Societies, 3*, 1-44.

International Society of Ethnobiology (2006). *International Society of Ethnobiology Code of Ethics (with 2008 additions)*. Retrieved April 05, 2013, from http://ethnobiology.net/code-of-ethics/

IUCN (2012). *IUCN red list of threatened species. Version 2012.2*. Retrieved July 16, 2013, from www.iucnredlist.org

Jensen, K., & Das, I.(2006). *Biological observations on the Asian soft-shell turtle in Sarawak, Malaysian Borneo, with notes on the biology and conservation of other non-marine turtles. For the Care and Conservation of Tortoises, Terrapins and Turtles Worldwide*. Retrieved 06 April, 2013, from http://asianturtlenetwork.org/library/reports_papers/papers/Testudo_article_on_Amyda_by_KJensen_2006.pdf

Johannes, R. E. (1993). Integrating traditional ecological knowledge and management with environmental impact assessment. In J. T. Inglis, (Ed.).*Traditional ecological knowledge: Concepts and cases* (pp. 33-40). Ottawa:International Program on Traditional Ecological Knowledge and International Development Research Centre.

Kurokawa, H., Yoshida, T., Nakamura, T., Lai, J., & Nakashizuka, T. (2003). The age of tropical rain-forest canopy species, Borneo ironwood (*Eusideroxylon zwageri*), determined by 14C dating. *Journal of Tropical Ecology*, *19*(01), 1-7.

Loh, J., &Harmon, D. (2005). A global index of biocultural diversity. *Ecological Indicators, 5*, 231–241.

Maffi, L. (2005). Linguistic, cultural, and biological diversity. *The Annual review of Anthropology, 29*, 599–617.

Maldonado, B.,Caballero, J., Delgado-Salinas, A., & Lira, R. (2013). Relationship between use value and ecological importance of floristic resources of seasonally dry tropical forest in the balsas river basin, México. *Economic Botany, 67*, 17-29

Moeliono, M., Wollenberg, E., & Limberg, G.(2009). *The decentralization of forest governance*. London: Earthscan.

Mathew, S. P., Mohandas, A.,Shareef, S. M., & Nair, G. M. (2006). Biocultural diversity of the

endemic 'wild jack tree' on the Malabar coast of South India. *Ethnobotany Research and Applications, 4*, 025-040.

Metcalf, P. (1976). Who are the Berawan? Ethnic classification and distribution of secondary treatment of the dead in central north Borneo. *Oceania, 40*(7), 85-105.

Metcalf, P. (1981). Meaning and materialism: The ritual economy of death. *Man, 16*(4), 563-578.

Nabhan, G. P. (2000). Interspecific relationships affecting endangered species recognized by O'odham and Comc´aac cultures. *Ecological Applications, 10*, 1288–1295.

Paine, R. T. (1969). A note on trophic complexity and community stability. *The American Naturalist, 103*(929), 91-93.

Peluso, N. L. (1992). The ironwood problem: (Mis) Management and development of an extractive rainforest product. *Conservation Biology, 6*(2),210-219.

Phillips, O., & Gentry, A. H. (1993a). The useful plants of Tambopata, Peru: I. Statistical hypothesis tests with a new quantitative technique. *Economic Botany, 47*, 15-32.

Phillips, O., & Gentry, A. H. (1993b). The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. *Economic Botany, 47*, 33-43.

Prance, G. T., Balée W. B., Boom, M., & Carneiro, R. L. (1987). Quantitative ethnobotany and the case for conservationin Amazonia. *Conservation Biology, 1,* 296-310

Ramstad, K. M., Nelson, N. J., Paine, G., Beech, D., Paul, A., Paul, P., Allendorf, F. W., & Daugherty, C. H. (2007). Species and cultural conservation in New Zealand: Maori traditional ecological knowledge of tuatara. *Conservation Biology, 21*, 455–464.

Rossato, S. C., Leitão-Filho, H. F., & Begossi, A. (1999). Ethnobotany of Caiçaras of the Atlantic forest coast (Brazil). *Economic Botany*, *53*, 387-395.

Sayok, A. K., Nik, A. R., Melling, L., Samad, R. A., & Efransjah, E. (2008). Some characteristics of peat in Loagan Bunut National Park, Sarawak, Malaysia. InJ. O. Reiley, C. J. Banks, &B. Radjagukguk (Ed.). *Carbon-climate-human interactions on tropical peatland, Yogyakarta, 27-29 August 2007*(pp. 92-100). United EU CARBOPEAT and RASTORPEAT partnership, Gadjah Mada university, Indonesia and University of Leicester, United Kingdon.

Sayok, A. K., Seng, L., & Belanda, R. D. (2009). Impacts of land-use on Bunut Lake, Sarawak, Malaysia. *13th World lakes Conference, Wuhan, China. 1-5 November, 2009*. Retrieved 10 July, 2013, from http://wldb.ilec.or.jp/data/ilec/WLC13_Papers/S15/s15-4.pdf

Sheil, D., Padmanaba, M., van Heist, M., Basuki, I., Liswanti, N., Wan, M., Puri, R.K., Rukmiyati, Rachmatika, I., & Samsoedin, I. (2007). Examining the conservation significance of local peoples' perceptions and uses of different forested landscapes. In P. Gunarso, T. Setyawati, T. Sunderland, & C. Shackleton (Eds.). *Managing forest resources in a decentralized environment: lessons learnt from the Malinau research forest, east Kalimantan Indonesia* (pp. 27-45). Bogor, Indonesia: CIFOR.

Sheil, D., & van Heist, M. (2000). Ecology for tropical forest management. *InternationalForestry Review, 2*, 261-270.

Si, A. (2013). Aspects of honeybee natural history according to the Solega. *Ethnobiology letters* 4, 78-86. Soles, J. S. (2001). Reverence for dead ancestors in prehistoric crete. In R. Laffineur, & R. Hägg (Eds.). *Proceedings of the8th International Aegean Conference/8e Rencontre égéenne internationale. Göteborg, Göteborg University, 12-15 April 2000* (p. 229-236). Liège: Université de Liège.

Tardío, J., & Pardo-de-Santayana, M. (2008). Cultural importance indices: A comparative analysis based on the useful wild plants of southern Cantabria (Northern Spain). *Economic Botany, 62,* 24–39.

UNESCO & UNEP (2003). *Cultural diversity and biodiversity for sustainable development*. Nairobi: UNEP. Retrieved 20 September, 2013, from http://unesdoc.unesco.org/images/0013/001322/132262e.pdf

Upreti, Y., & Asselin, H. (2013). Cultural importance of white pine (Pinus strobus L.) to the KitcisakikAlgonquin community of western Quebec, Canada. *Canadian Journal of Forest Research, 43,* 544–551.

Wahyuni, T. (2011). *Can traditional forest management protect and conserve ironwood ulin stands? An option and approach in East Kalimantan.*(PhD thesis). Leiden: University of Leiden.

Whitmore, T. C. (1984). *Tropical rain forest of the Far East. (2nd ed.)*. Oxford, UK: Clarendon Press.

Zahorka, H. (2007). The Shamanic belian sentiu rituals of the Benuaq Ohookng, with special attention to the ritual use of plants. *Borneo Research Bulletin, 38*, 127-147.