

Brunei human-rainforest interaction

The ecology and ethnobiology of human-rainforest interaction in Brunei (a Dusun case study): ESRC Grant No.R000 23 3088

Background

The project was originally designed to link up with the 1989-92 Brunei Rainforest Research Project (BRP), sponsored by the Royal Geographical Society (RGS) and the Universiti Brunei Darussalam (UBD). This was a major programme of work based in the Batu Apoi reserve of Temburong district, involving a large international group of scientists (mainly biologists and some geographers). In the initial proposals social science inputs were noticeably absent. The application for the award which was subsequently funded was in part an attempt to plug this gap, and a response to a practical opportunity for interdisciplinary cooperation and access to existing research and administrative infrastructures. The application was also made in the context of known ESRC policy with respect to integrating natural and social scientific research on Global Environmental Change. Work in Brunei was considered of particular anthropological significance given the extent to which rainforest had been conserved, but the rapid rate at which most forest-dwellers were being absorbed into a high wage non-subsistence based lifestyle.

Ellen visited Brunei in September 1991 to make preliminary arrangements for the project. By this time, however, it had become clear that the Brunei authorities would not permit research in the Batu Apoi area. As a wildlife reserve, the government did not officially allow human settlement and subsistence extraction, although it was known to occur. As a result, the project moved to Sukang in the Belait district, and our official sponsor and institutional collaborator became the Brunei Museum rather than UBD. Bernstein arrived in the field in April 1992 and made three short preliminary trips to Sukang, where he encountered delays and logistical problems, and for which he was eventually unable to obtain official residence permission. The field site, therefore, moved yet again, this time to Tasek Merimbun (Rambai Sub-district) in the Tutong district, a location which Ellen had visited in 1991 and ear-marked as a possibility.

Moving the field site twice led to inevitable delays, a missed optimal season for collecting ethnobotanical specimens, and to the effective detachment of the ESRC project from the biological work being done in Temburong. However, Tasek Merimbun has otherwise proved to be a most satisfactory field site, with excellent access. The award of a three month extension by the ESRC has compensated for most of the lost time.

Objectives

The original objectives of the project were as follows:

1. To document the significance of rainforest resources and the ecological parameters and opportunities presented by rainforest in the social lives of a people of Brunei (the Dusun), and by extension further our understanding of other comparable parts of southeast Asia.
2. To analyse patterns of human-rainforest interaction, in particular the construction and management of environmental knowledge in changing circumstances.

3. To contribute towards current debates concerning human dependency on rainforest (indigenous and commercial), and the realistic valuation of rainforest as an economic resource.
4. To gain experience from working closely with natural scientists on environmental issues with a view to constructive collaboration in the future.
5. To contribute towards the ultimate aim of the BRP, namely the setting-up of a permanent field centre for research training and to establish UBD as a centre of excellence in rainforest studies.

The main data were therefore to be (a) detailed documentation of all natural species known to and utilised by the sample population, (b) general statements and case material relating to land and resource tenure, (c) measurements of patterns of extraction (seasonally, spatially and by social group), (d) evidence of human modification of forest ecology, and (e) information relating to indigenous forest management, including scheduling strategies.

Objectives 1-3 have been met fully, and are addressed and reported on in detail below. The only change, as a result of moving to Tasek Merimbun, is in the ethnic composition of the settlements studied (Dusun rather than a mixture of Dusun, Iban and others) and in the ecological composition of the forest itself. In retrospect, we consider the homogeneous ethnic composition of the settlements studied to have been an advantage given the short field inputs available; the change in ecological composition of the forest has only been a disappointment to the botanists, who reasonably expected a higher proportion of scientifically unknown endemics in both Batu Apoi and Sukang.

Changing the location of the field site has also meant that we have been unable to make a direct contribution to the establishment of the Kuala Belalong Field Centre (objective 5), though we plan to make our results available to UBD so that they can be used by others working on rainforest in the biology and geography departments. We have retained good working relations with UBD biologists and the BRP organisation, including the Earl of Cranbrook for the Royal Geographical Society. This, together with our work with the Brunei Forestry Centre (Department of Forestry), the Natural History Section of the Brunei Museum and Kew, has contributed to the fulfilment of objective 4.

Methods

1. Field research was conducted by Bernstein in and around Merimbun, a dispersed settlement of some 33 dwellings and 332 residents between August and December 1992, and between June and September 1993. He also made brief visits during April 1993 and April 1994. Some research was additionally conducted in surrounding settlements, such as Long Mayan and Bang Ligi. Ellen was in Brunei during September 1991 (reconnaissance), April 1993 and April 1994.
2. The principal unit of study was the individual ethnobotanical voucher: a preferably fertile plant specimen collected in-habitat with the aid of an informant together with full identification, habitat details, classificatory, utilitarian and other cultural data. The specimens were tagged and preserved according to usual botanical standards and deposited in the Brunei Forestry Centre at Sungei Liang. Here they were sorted, dried and

(where possible) provisional determinations were provided. One set of specimens was retained by the Forestry Centre and the remainder packed and dispatched to the University of Kent at Canterbury (UKC) Ethnobiology Laboratory. At UKC the specimens were examined for damage, and sorted into two sets. The better and more complete set was sent to Kew for final determinations by a team led by J. Dransfield working on the Kew Brunei Checklist Project. UKC received updated lists of determinations periodically, as these became available. The third set was retained at UKC, for in-house reference and analysis, and in case it became necessary to send material to other herbaria.

3. Most ethnobotanical vouchers were obtained on daily hikes to different forested areas, accompanied by an informant. Informants were observed in the course of plant collection, and all their spontaneous comments about biota and landscape noted. Occasionally, specimens were shown to other informants. All voucher data were recorded using direct-entry computer techniques on a database designed by Bernstein. Trips to forest locations to locate specimens also provided a general opportunity to acquire data on knowledge of all aspects of the local environment and on activities such as hunting.
4. The collection of ethnobotanical vouchers was backed-up by detailed interviews in the settlements where data could be checked and supplemented. Such interviews were also a means of obtaining data on ethnobotanical and ethnoecological knowledge and resource use which did not directly supplement that obtained during the assemblage of vouchers. Villagers were asked about plants collected. Household heads were surveyed concerning forest use in their households.
5. As forest knowledge is fast disappearing, well-informed subjects were rare. We relied on seven main informants, all men above 50 and with no formal education. Of these, one male was particularly crucial. Informants were trained by Bernstein in simple ethnobotanical collection methods, and were central to the production of voucher specimens. As the project developed, they were also asked to classify voucher plants into more inclusive categories. Our main informant was also taken to the Forestry Centre Herbarium and the Brunei Museum where he was asked to discuss insect specimens in relation to plant hosts and as pathogens. Their knowledge was subsequently compared with that of other residents. Towards the end of the fieldwork phase informants were presented with file cards with the names of 150 forest plants, from which they were asked to eliminate names of which they had not heard, and group those of which they were knowledgeable, explaining their reasons for so doing.
6. Work was conducted mainly in Malay, in which Bernstein is fully competent. Dusun was increasingly used, especially for ethnobotanical discourse, as knowledge was systematically augmented. Much of the work was conducted in collaboration with Bantong Antaran who is a native Dusun speaker.
7. Photography was an integral tool in the project. We have 423 colour transparencies and prints taken in the field and 265 colour prints of plant specimens produced at UKC. Photography was used, for example, as a rapid means of documenting variation in forest composition and structure, and as stimulus material in interviews.
8. The methodologically most innovative research strategy employed was the use of plot surveys. These have a long history in ecology, and have been used in rainforest research since the sixties. In ethnobotany they are relatively novel. Indeed, during the planning stage of our own work there was no published evidence for them being used at all. We

were drawn towards them as a means of measuring the extent of knowledge of individual informants, the relative knowledge of different kinds of forest, and as a means of placing values on specific known areas of rainforest, as the conventions of current environmental economics demand. Two different sites were selected: early regrowth after cultivation, and regrowth after 25 years. The details of this methodology are discussed in Bernstein and Ellen (a), and we discuss below to what extent we think we have contributed to the valuation debate. However, our principal discovery was the utility of plot surveys in general ethnobotanical work, when working closely with indigenous informants.

9. General ethnographic data were obtained in two ways. Firstly, we were able to make use of existing publications and the knowledge of Bantong Antaran, our principal contact at the Brunei Museum, and his colleague Pudarno Binchin. Secondly, Bernstein was able to supplement this opportunistically through ancillary enquiries and by being in Dusun settlements most days throughout the fieldwork phases. By living in the village Bernstein was able to observe such practices as tool making, plant collection, fishing, and the marketing of forest products, and obtain information on patterns of tenure and the social relations of resource use.

Results

• *General*

The Brunei Dusun are one of a number of ethnic groups so-labelled on the island of Borneo, which are, confusingly, ethnically and linguistically unrelated. What they have in common is their historic functional relationship with Malay centres of power and trade, such as Brunei and Banjarmasin. The word 'dusun' in Malay means 'orchard' or 'distant village' and it is our contention that a particular pattern of tree management and agroforestry made them distinctive in the minds of outsiders. Thus, ethnobotanical knowledge and forest ecology become central to definitions of Dusun ethnicity. During the modern period Brunei Dusun were engaged in tributary relations with the Sultan of Brunei and grew rubber for export. Their subsistence economy prior to the rise of oil wealth focused on swidden cultivation, home gardens and forest extraction, both plant gathering and hunting. Freshwater fishing, especially at Tasek Merimbun, was also important.

Dusun have always been politically uncentralised and unstratified. Settlement was, and remains, dispersed, minimising distances between dwelling and resources. In this respect, they differ from the more nucleated settlements of both Malays and many Iban. Although there have been some recent significant studies of Dusun language and culture, very little has been written about them hitherto. The villages which Bantong has concentrated on have relied little on forest extraction. Consequently, quite apart from anything else, we consider our work to represent an important contribution to the general ethnographic knowledge of Dusun culture and social organisation.

The field site at Merimbun was of special interest as the only natural freshwater lake in Brunei, with an ecology unique in Borneo. In 1984 it was declared an ASEAN National Heritage Site, but which, as Brunei Museum scientists have recognised, it requires urgent regional conservation and management action in order to maintain ecological processes, life support systems, genetic diversity and sustainable utilisation. Like other similar sites in southeast Asia, it is currently

under threat. In 1989 a report was commissioned to develop Tasek Merimbun as Brunei's first National Park, but this did not consider the environmental impact.

- *Forest ecology and ethnoecology around Tasek Merimbun*

The forest in the Merimbun area is diverse (see figure 1). Our analysis focused on the forest environment as a domain of knowledge within Dusun culture, practical aspects of human-rainforest interaction and the changes that are taking place. We have basic data on agriculture, and our aggregated ethnobiological inventories take into account cultivated and non-cultivated plants. Indeed, one feature of our data which we hold to be significant is the proportion of plants which occur both in cultivated and uncultivated contexts, including domesticates growing in forest. This is partly explained by the common practice of planting trees in swiddens after the first year, the gradual reabsorption of settlement areas into forest over the longer term, deliberate planting and protection of useful species within the forest and inadvertent distribution by humans and other animals of seed and other propagative plasm. The consequence is a blurring of cultivation and non-cultivation, domesticated and non-domesticated, which makes terms such as 'forest management' unusually appropriate. Moreover, given our introductory remarks on Malay definitions of Dusun identity, it suggests that extraction of products from useful trees, whether strictly cultivated in obvious 'orchards' or from anthropogenic forest, is contributory to their perceived economic role in a regional division of labour.

There is no overall Dusun term for uncultivated land, the word *entalun* referring only to land never known to have been cultivated in living memory. *Gapu* refers both to abandoned fields and secondary forest. Land types are classified as hilly (*bukid*), swampy (*payo*) and alluvial (*gana*). Ground types are classified into either compressed (*pidot*) or uncompressed (*padang*), the latter being sparsely distributed with small plants. Finally, there is *emparan*: grassy swamp land in secondary forest. More than 100 forest toponyms were collected, referring to features such as hills, rivers, houses, ditches and confluences, and confirming the now accepted view that for such peoples forest is perceived as a richly-patterned mosaic rather than as a void.

- *Systematic ethnobotanical inventory*

The most obvious and easily-predictable outcome of the project has been to provide a major addition to our understanding of the rainforest plant knowledge of a Borneo people. Existing studies, such as those emanating from the Man in the Biosphere programme in East Kalimantan, have added to our knowledge of how indigenous knowledge is employed in the management of resources, and what the consequences of deforestation and new patterns of extraction might be, but they have not been designed to extract systematic knowledge.

We have established a computerised database (cross-referenced to the Kew Brunei Checklist Project database) of Dusun ethnobotanical and related data. This focuses largely on ± 1470 specimens, representing 535 individually numbered vouchers. There are an estimated 436 locally recognised kinds, and at present 417 determinations to family level, 323 to genus level and 172 to species level. The specimens so far identified fall into 95 families, among the most common being *Rubiaceae* (37), *Palmae* (22), *Euphorbiaceae* (21), *Leguminosae* (20), *Zingiberaceae* (14), *Moraceae* (14), *Annonaceae* (11). To this we can add 132 terms for plants (including some domesticates) recorded but not backed up with voucher specimens, identifiable using non-herbarium techniques. Identification is an ongoing process, and we will continue to receive

updates from Kew long after the ESRC phase of the work has terminated, especially where specimens are of rare or previously unknown species.

- *Utilisation of plant resources*

Up until 20 years ago forest extraction was integral to the Dusun way of life. However, rapid social change has led to a dramatic decrease in the use of plants and in the number of people who are knowledgeable about forest resources. Hunting and collecting of wild fruits and vegetables remains culturally and economically important (more so in some areas than in others), but as Dusun become more involved in a wage economy that takes them out of the rural areas such pursuits become less subsistence than recreational.

Some indication of the qualitative character and rapidity of change is the decline in firewood extraction and the use of bark in traditional houses. In the pre-hydrocarbon economy both of these represented among the most important ecological transfers, involving expenditure of considerable time and effort, and relying on a detailed knowledge of the qualities of different species of tree. It has been suggested (Ellen, b) that one significant factor explaining the discrepancy between the numbers of terms consistently reported for agriculturalists and the smaller number of terms recorded for hunter-gatherers is the fact that the latter do not need to discriminate between trees in terms of their structural qualities in house building.

Forty-seven trees were indicated as providing wood for construction. Trees were graded by hardness as **kodo** (hard), **sodong kodo** (medium hard), and **iami** (soft). Both hard and soft woods are useful; medium hard woods the least useful. Another characteristic used in evaluating wood is **liot** (flexibility). Many uses of woods were described, many of them highly specific, such as the use of xx? *Brackenridgea*, for axe handles, or xx? *Cyrtostachys renda* for flooring. Some 67 plants were recorded as having some manufacturing use.

Another major use of trees is to obtain food (mainly edible fruit), stimulants, and flavouring (105 cases). Fruit trees may not be cut down for timber or for other purposes. Some 66 other plants provided edible leaves, roots, stems and shoots. Most fruits are not collected in sufficient quantity to be marketed, but some forest products (food, and even decorative plants) are sold at weekly markets in various parts of Brunei or at roadside stalls. The most common are palm and bamboo shoots, *Gnetum* leaves, various mushrooms and rattan used in the manufacture of carrying baskets and fish traps. **Garu** (*Aquilaria*), and **akau daiang** (*Piperaceae*) are sold to Chinese. This has included some hitherto poorly-reported species, such as the swamp palm **benjiru** (*Licuala spinosa*).

We have to date documented 62 medicinal plants used for treating ailments ranging from ringworm to leprosy, high blood pressure to poison antidotes (e.g. **kapanas** (*Goniothalamus velutinus*)). We have detailed notes on the conditions for which they are used and on mode of preparation. Some of the medicinal plants are hitherto unknown to science, such as **garoncong** (JHB, xx). This aspect of our work has linked in well with earlier work by Bernstein on Taman ethnomedicine.

In addition, we recorded 8 plants used in ritual (e.g. **jimpalang**, *Vitex vestita*, planted in fields to increase the rice crop), 6 poisons (e.g. **binakalud**, *Brucea sumatrana*), 7 plants used for pest

control, 2 for fire-making, 4 with decorative uses, 3 for seed, 16 for firewood, 3 for dyes, 3 for fish bait, and one for curing tobacco.

- *Ethnobotanical classification*

A decision was made early in the project to focus on plant (rather than animal) collection because the basic data generated in this way was essential to any study of specific knowledge and use of forests. This strategy has not only enabled us to form a picture of Dusun empirical knowledge of their plant world but to contribute to ongoing debates on the character of ethnobiological classification in traditional societies, especially in relation to the concept of life-form, the role of utilitarian features, the recognition of covert categories and the social distribution of knowledge. The project incorporates the first full-length study of the ethnobotany of a Borneo people which addresses central issues in the debate on ethnobiological classification.

Our provisional analysis suggests that there are four unambiguous life-forms in the sense employed by Brent Berlin (1992) in his *Ethnobiological Classification* : **kayu** (wood, 210+ vs)¹, **akau** (vine, 71+ vs), **uwai** (rattan, 16+ vs) and **kulat** (fungus, 14+ vs). However, other categories cannot be unambiguously sorted according to Berlin's scheme: for example **bulu'** (bamboos), and various groupings of palm. There are many covert immediate groups: bananas, grasses, ferns, ginger and *Licuala* palms. Some inclusive categories, such as **usak** (flower) and **sakot** (undifferentiated detritus) are used in ways which suggest they are integral to Dusun classification of their plant world, but are non-taxonomic; other terms such as **sancam** (vegetable) and **raun** (leaf) are special-purpose and utilitarian. Herbaceous plants do not form a distinct category, and grasses (18+ vs) aggregated into the categories **kumpau**, **rumput**, and **telincim**. In terms of nomenclature, we discovered that the more salient a category (the more life-form-like it became) the less necessary to encode a superordinate category in the name of a particular plant. This underlines the observation that it is the boundaries of categories which need to be reinforced when diagnostic characteristics are more marginal. We conclude, overall, that there is a gradient or 'degree of inclusivity', rather than a clear system of ranks, with a degree of optionality and overlapping which fits the Berlin scheme only awkwardly.

From plot survey inventories we discovered that about 12 per cent of plants occurring in uncultivated areas are identified by informants to below the basic naming level (what Berlin has designated sub-generic rank, that is, folk specific or folk varietal). At this level, binomials identify habitat (e.g. swamp, hill, water, forest), colour (of leaf or bark), or other qualities such as scent, names of animals, other plants and spirits. Diagnostic characteristics used widely in identifying trees are thickness and colour of bark, size and colour of leaf, degree of hardness, smell, and the appearance of latex. The same criteria are used for vines, with the addition of the contrast set creeping:climbing. Many plants are regarded as having male and female types, for the most part reflecting accurately their status as monoecious or dioecious. The ordinary, unmarked or 'true' type is said to be female, male plants have small leaves, and produce flowers but no fruit. The colour of the bark may also be a sign of the sex of the plant. They may be associated with different habitats, mainly male on the hills and female in rivers and swamps. Some plants are known to be only male or female. Informants disagreed over whether certain plants (e.g. ferns and mushrooms) were sexed.

- *Composition of forest plots*

Knowledgeable informants could provide names (other than life-forms or the most general basic and intermediate categories) for between 86 and 97 per cent of species growing in marked plots. Of those plants named, one informant provided 158 names in two plots of secondary dipterocarp forest totalling 1152 square meters. We discovered that the rank order of numbers of identifiable plants per species varied depending on whether all plants, or only those of sufficient size to be useful were counted. We have also found that in each of the plots examined the five most common plants account for about a third of all enumerated plants, and the 10 most commonly occurring plants account for nearly half of enumerated plants; plants occurring only once or twice in a plot accounting for about half of all named plants.

The plot surveys permitted us to get a much better idea of the uneven character of indigenous knowledge and how this relates to the intrinsic patchiness of species distribution and the relative utility of plants. These data, however, do not readily translate into values commensurable with those sought by environmental economists, and (together with other information gathered) suggest that current techniques for placing values on tropical rainforest to reflect indigenous uses and knowledge will require some revision.

- *Plant knowledge and social change*

The main sociological outcome of the research has been to demonstrate how ethnobotanical and ethnoecological knowledge alters as a result of rapid socio-cultural change, especially in situations where forest and existing biodiversity have been maintained. Although we would expect knowledge of the forest environment to have been always asymmetrically distributed within a population, the disjunction at the present time between what is known by a few older men and the mass of younger people is sharply accentuated. This is linked to a general reduction in the use of the Dusun language (and its replacement by Brunei Malay) and of traditional ritual practices, to such an extent that combined with exogenous market and political forces, including dependence on a public sector economy, influence of the national ideology of Melayu Islam Beraja (Malay Islamic Monarchy) and general absorption into Malay culture, the future existence of a clearly demarcated Dusun identity is in doubt. Moreover, it is evident that the symbolic and general cultural associations of the forest are changing amongst both Dusun and Brunei Malay as the forest declines in economic importance and all Bruneians are absorbed into a peri-urban way of life (Ellen and Bernstein, a).

Activities

We have presented papers at the British Association (1993), the Brunei Museum (1991, 1992), the International RGS-UBD conference on Tropical Rainforest Research (1993, two papers), the annual meeting of the Association of Southeast Asianists in the UK (1994), American Anthropological Association meeting (1992, 1993), Durrell Institute of Conservation and Ecology (1992), British Medical Anthropology Society (1993), Pithecanthropus Centennial (1993), Forest Ecology Institute, University of Vienna (1994), European Association of Social Anthropologists, Oslo (1994), and an EC funded conference on 'Indigenous people of the tropical forest', Brussels (1993). Two of the papers delivered are already in press (Bernstein e, Ellen a), and there are plans to publish two others (Ellen, b and c).

Outputs

1. The Dusun ethnobotanical database will be available for on line consultation at UKC and through the CSAC Ethnographics Gallery, on WorldWideWeb, at document location <http://lucy.ukc.ac.uk/brunei/html>. The database design which Bernstein developed for the project will be available to other researchers.
2. A modified version of the ESRC report will be sent to the Brunei Research Council, and we intend to distribute hard copies of the same to other potentially interested parties in Brunei and elsewhere. Recipients will include Kew, the Royal Geographical Society, the Royal Society South-East Asian Rainforest Research Programme, NRI Chatham and the Overseas Development Institute Social Forestry Network. An electronic version will be published on the Internet.

Paper published output

J.H. Bernstein

- a) 1993 Poisons and antidotes among the Taman of West Kalimantan, Indonesia. *Bijdr. tot de Taal-, Land en Volkenk* . 149, 3-21.
- b) 1993 The shaman's destiny: symptoms, afflictions, and reinterpretation of illness among the Taman. In *The seen and the unseen: shamanism, mediumship and possession in Borneo* , Robert L. Winzeler (ed.) Borneo Research Council Monograph Series, vol.2, pp.171-206.
- c) Research note: the ecology and ethnobiology of human-rainforest interaction in Brunei. *ASEASUK News* (n.s.) 14, 24-25.
- d) 1993 Review of 'The folk biology of the Tobelo people: a study in folk classification', by P.M. Taylor. *Anthropological Forum* 6, 644-6.
- e) In press, Higher-order categories of Brunei Dusun ethnobotany: the folk classification of rainforest plants. In *Tropical rainforest research: current issues* , Webber E. Booth (ed.) Universiti Brunei Darussalam.
- f) In press, Stones in Taman culture. In *The realm of the sacred in Southeast Asia* , Robert R. Reed and Eric Crystal (eds.) Berkeley: Center for Southeast Asian Studies.
- g) In press, Review of 'The peoples of Borneo' by V.T. King, *Bulletin of the School of Oriental and African Studies* .
- h) *Piper methysticum* : from myths to postage stamps (book review). *Journal of Biogeography* .
- i) In press, The deculturation of the Brunei Dusun. In *Politics, land and ethnicity in the Malay peninsula and Borneo: Non-Malay indigenous groups and the state* , Robert L. Winzeler (ed.).
- j) In prep., Spirit attack and soul capture: the explanation and treatment of serious illness among the Taman.
- k) In prep., *Shamans and magical healers in Borneo: a study of Taman ethnomedicine* (full length monograph).
- l) In prep., Malay medicine in the upper Kapuas.

Bernstein and Ellen

- a) *Licuala* palms in Brunei Dusun ethnobotany.

Bernstein, Ellen and Bantong

- a) In prep., The use of plot surveys in the study of ethnobotanical knowledge: a Brunei Dusun example.

The Brunei Museum has agreed that a major technical report on the work should appear in the Brunei Museum Journal Monograph Series under the title *The ethnobotanical knowledge of the Brunei Dusun*, to be jointly authored by Bernstein, Ellen and Bantong.

Ellen

- a) In press, Putting plants in their place: anthropological approaches to understanding the ethnobotanical knowledge of rainforest populations. In *Tropical forest research: current issues*, Webber E. Booth (ed.) Universiti Brunei Darussalam.
- b) In press, Modes of subsistence and ethnobiological knowledge: between extraction and cultivation. In *Pithecanthropus Centennial*, vol.2, Michael Warren and L. van Slikkerveer (eds.) Leiden: Pithecanthropus Centennial Foundation.
- c) In prep., The cognitive geometry of nature: a contextual approach. In *The cultural construction of nature*, P. Descola and G. Palsson (eds.).

Ellen and Bernstein

- a) 1994 Urbs in rure: cultural transformations of the rainforest in modern Brunei, *Anthropology Today* 10(4), 16-19.

Bernstein a, b, d, f, g, h, j, k and l either arise from his Taman work or indirectly from the Brunei fieldwork. However, all were either written or revised while he was a full-time ESRC research officer at UKC, and in some cases have a direct connection with the Brunei project. Some are cited in the Results section. Ellen a-c do not arise directly from the project, but were produced collaterally and raise issues of theory which we have explored in the context of the project.

Impacts

- The Dusun ethnobotanical database and herbarium collection are lodged at the UKC Ethnobiology Laboratory, where they are available for teaching indigenous knowledge and environmental anthropology to both DICE and Social Science students.
- One set of voucher specimens has been deposited at Kew and the full ethnobotanical data accompanying these are available as part of the Kew Brunei Checklist Project database. The data will be available to users, including commercial users, of the Index Kewensia. A second set of vouchers and labels is deposited at the Brunei Forestry Centre herbarium, where it represents the most detailed ethnobotanically annotated collection there. Apart from general reference purposes, the collection provides the first authoritative list of Dusun vernacular names and an update to the original Ashton list.
- Our work has contributed to the basic descriptive taxonomy, ecology, ethnobiology and ethnography of the Brunei Museum survey of the Tasek Merimbun area. This survey is linked to plans to develop Merimbun as a recreational centre and to protect the lake and its environs. Our work is written into the proposal prepared by the Brunei Museum for a research facility at Tasek Merimbun (Marina Wong, 1993 Br.Mus.Ref. 3/JMB/490/76/2).

Future Research Priorities

- Systematic ethnobiological research characteristically requires long-term commitments during both the fieldwork and post-fieldwork phases. In order for documentation of a particular domain of indigenous biological knowledge to be comprehensive, repeated inputs are necessary: to check existing data, to take the opportunity of varying field conditions (such as seasonality and annual variations in availability of biota), localities and populations. In the post-field phase obtaining determinations from institutions with competent specialists is often painfully slow, especially when the material is rare or new to science. We anticipate at least a five year period before we have all determinations for our herbarium specimens. Although Bernstein and Ellen have no immediate plans for further research in Brunei, we hope that the Tasek Merimbun work has established a research model and precedent which will encourage more research by Brunei Museum staff on other Brunei groups.
 - Our work has highlighted the urgency of documenting ethnobotanical knowledge loss in an area of rapid socio-cultural change, and it is clear to us that it is important to undertake research in other areas of both rapid ecological and socio-cultural change before important indigenous knowledge disappears altogether. It has also indicated how little we know about the effects of changes of this kind on classificatory and substantive knowledge, and its distribution within a population. Our use of plot surveys has encouraged us to investigate further how these might be used even more productively in the study of the content and distribution of ethnobotanical knowledge. Ellen has plans to develop the use of plot surveys for the study of Nuaulu ethnobotanical knowledge (Maluku, Indonesia).
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