TRADITIONAL KNOWLEDGE OF *DYPSIS FIBROSA* (ARECACEAE) IN EASTERN MADAGASCAR[1]

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Byg, Anja and Henrik Balslev *(Department of Systematic Botany, Institute of Biology, University of Aarhus, Nordlandsvej 68, DK-8240 Risskov, Denmark).* TRADITIONAL KNOWLEDGE OF *DYPSIS FIBROSA* (ARECACEAE) IN EASTERN MADAGASCAR. *Economic Botany 55(2):263–275, 2001.* Dypsis fibrosa *is widespread in eastern Madagascar and local people regard it as one of the most important palms due to its use as thatch. In an interview survey 12 different uses of this palm were reported. Most informants knew only one or two uses, but variance was large. How many uses people know and what they use different palm parts for is correlated to socioeconomic factors such as personal wealth and home village. Comparison of data obtained from interviews and observations showed that there is not always a strict correlation between ethnobotanical data elicited in surveys, actual extent of use, and importance accorded to different plant resources. Informants were generally aware of an human-caused decline in* D. fibrosa *abundance, but viewed it as inevitable and suggested to replace* D. fibrosa *products by other materials. Although local people view* D. fibrosa *as very important, motivation for its conservation and sustainable use seems to be low.*

Key Words: *Dypsis fibrosa*; informants' knowledge and actions; knowledge patterns; environmental awareness; Betsimisaraka; eastern Madagascar.

The endemic palm *Dypsis fibrosa* (Wright) Beentje and Dransfield is widespread in low- and mid-altitude rainforests of northwestern and eastern Madagascar. It belongs to the Vonitra group of palms, characterized by their leaf sheaths, which disintegrate into piassava fibers, and by their habit of branching dichotomously above or below ground (Dransfield and Beentje 1995) (Fig. 1D). Vonitra palms were an important source of cash income for rural Malagasy in the first half of this century when piassava fibers were exported to Europe and used for production of brushes. *Dypsis fibrosa* was at that time the main source of piassava in Madagascar (Dransfield and Beentje 1995). Today other materials have replaced piassava fibers in industrial brush production and export of *D. fibrosa* fibers has declined to insignificant amounts, but people of the eastern forests still use *D. fibrosa* in the construction of their homes and for many other purposes.

The ethnic group of the Betsimisaraka inhabits a large part of Madagascar's eastern escarpments, where *Dypsis fibrosa* has its main distribution. In these mountains most people are subsistence farmers and they usually supplement farm yields by gathering forest products. Rapid growth of the human population and decline of primary forests is nowadays threatening the continued contribution of forest products to people's livelihoods. Every year, farmers clear 1000–1500 km^2 of primary forest to provide new arable land for traditional swidden agriculture (Parsler 1997). At the same time the growing population's demand for forest products places an increasing pressure on remaining forest tracts (DuPuy et al. 1992).

The aim of this study was fourfold. Firstly, it was to document historical and present day uses of *D. fibrosa* and to quantify the importance of different uses of this palm in three Betsimisaraka communities. Quantification of plant knowledge and use can provide valuable information concerning causes of plant importance. Quantitative information can indicate whether importance of a plant is due to one specific use or whether it is due to a multitude of different applications.

The second aim of the study was to investigate whether personal socioeconomic factors such as gender, age, and income influence local people's knowledge of the uses of *Dypsis fibro-*

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Fig. 1. *Dypsis fibrosa.* A. Construction of a roof with *D. fibrosa* leaves. B. Completed house. C. Preparation of thatching panels from leaves. D. Habit (All photos by J. Dransfield, 1986).

sa. Especially in situations where environmental and cultural changes lead to changes in values and practices, distribution of knowledge and use can be expected to be heterogeneous and to have important implications for future resource use within the community. Personal factors influence the way people react to ongoing changes and how these changes affect their lives. Thus, patterns of knowledge can indicate ongoing changes and help predicting what impact changes will have on the knowledge pool of a community and on certain groups in a society.

The third aim of the study was to clarify whether knowledge of uses, as elicited in questionnaires, and the observed extent of utilization are representative of each other.

Most ethnobotanical studies assume implicitly that informants' answers are representative of present-day usage of plant products. Only very few studies distinguish between actual use and knowledge of uses, either by posing questions which explicitly distinguish between knowledge and use (see, e.g., Joyal 1996) or by measuring the quantities harvested or consumed (e.g., Houghton and Mendelsohn 1996). Results obtained by these methods have however rarely been compared and analyzed with respect to differences between what informants say and what they do. The validity of the assumed direct relationship between informants' responses and actions has therefore not been confirmed empirically (Phillips 1996). In this study interview

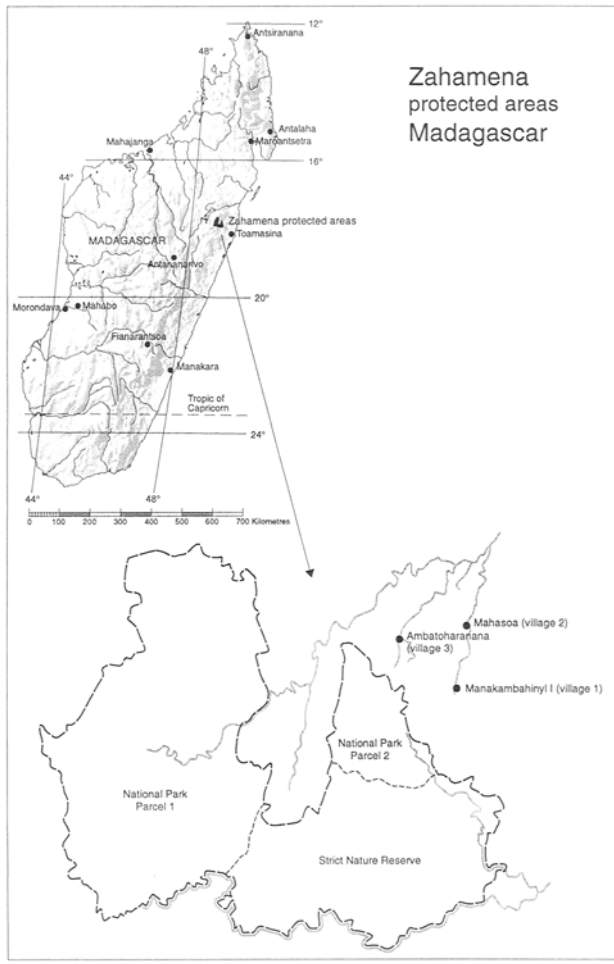

Fig. 2. Map showing location of the Zahamena Protected Areas in eastern Madagascar and of the three villages where interviews were conducted.

data were supplemented by and compared with systematic observations of which kind of roof materials informants had used in the construction of their houses, nonsystematic observations of other uses, and informal talks with local people and park rangers.

The fourth aim was to use the case of *Dypsis fibrosa* to investigate to what degree local residents were aware of the ongoing decline of one of the natural resources in their area and of its underlying causes.

Study Area

Fieldwork was done near the Zahamena Protected Areas in the eastern escarpments of Madagascar (Fig. 2), located approximately 50 km inland from the east coast (17°30′–17°43′ S, 48°41′–49°03′ E) and covering about 640 km^2. Altitude ranges from 200–1500 m above sea level. Precipitation is high throughout the year (1500–2000 mm annually), though lessening to the west and temperatures are moderate (monthly mean temperatures: 15–24°C). The vegetation consists of rainforest in the east, through humid forest to semihumid forest in the western parts of the protected areas. The protected areas include two national park lots with limited public access, reserved for purposes such as recreation and education, and one part designated as strict nature reserve excluding all activities apart from approved scientific research. The core protected areas are surrounded by buffer zones where con-

TABLE 1. THREE VILLAGES IN THE ZAHAMENA AREA IN EAST MADAGASCAR WHERE A SURVEY ABOUT THE USES OF *D. FIBROSA* WAS CARRIED OUT. VILLAGES DIFFERED IN SIZE, PROXIMITY TO THE PROTECTED AREAS AND SOCIAL HETEROGENEITY. POPULATION SIZES ARE ESTIMATES FOR 1997 BASED ON A POPULATION COUNT IN 1994 WITH AN ASSUMED GROWTH RATE OF 1.7%.

Village no. 1 (Manakambahiny 1)	Village no. 2 (Mahasoa)	Village no. 3 (Ambatoharanana 3)
2100 inhabitants	40 inhabitants	460 inhabitants
2–3 hours walking distance from forest	3–4 hours walking distance from forest	½–1 hour walking distance from forest
social and commercial center of eastern vicinity of the Zahamena protected areas with numerous small shops, weekly markets, churches, large public school and other social institutions	few small shops, church, public school and health center; inhabitants rely on nearby village no. 1 for further schooling and trade	very few social and economic institutions: small private school, one small shop, church
considerable social stratification within village: large well-built houses with tin roof as well as small derelict huts consisting of local materials	houses vary in the materials employed	houses all of similar size, small, but well-kept and exclusively consisting of local materials
	situated on main track connecting village no. 1 and the administrative center of the area; exposed location at hillside, has repeatedly been hit by cyclones	recent settlement (1940s), illegal status until revision of park boundaries in 1995, repeated eviction and resettlement events

trolled extraction of some forest products takes place. Outside the protected areas and buffer zones primary forest is virtually nonexistent.

This study took place on the moister east side of the Zahamena Protected Areas in the province Toamasina, prefecture Fenoarivo Atsinanana, subprefecture Vavatenina. The three villages encompassed in the study are located at 500–700 m altitude above sea level, one to two days walking distance from the nearest road. Villages were chosen so as to differ with regard to size, proximity to the protected areas, and age (Table 1).

METHODS

The study is based on 54 interviews with local residents. The number of times different answers were obtained in the survey were counted and analyzed statistically to determine whether there were patterns in informants' knowledge and whether these could be related to socioeconomic variables. All interviews were done in Malagasy with park rangers acting as interpreters. Personal information used in analyses are listed in Table 2. Questions about *D. fibrosa* concerned its different uses and abundance. In addition, informants were asked which palm species they thought were most important. As informants frequently responded to the posed questions with multiple answers the total number of answers was often larger than the total number of informants.

Numbers of *D. fibrosa* uses known by informants were analyzed by means of mixed linear regression, whereas all other analyses consisted of logistic regression. For the linear regression variables were partly transformed to achieve values of skewness and kurtosis ≤ 1. This makes it possible to obtain reliable linear regression results in cases where data are not normally distributed. Variables used in linear regression analysis were: square root (number of uses of *D. fibrosa* known), village, gender, age, ln wealth, square root (education + 3), family size, roof index, irrigation, log (rice), log (p.c. rice), crops, and log (animals + 0.2).

As logistic regression procedures do not assume that data are normally distributed, untransformed variables were used in these analyses. Logistic regression was in all cases carried out in a forward stepwise variable selection procedure. Binary dependent variables were generally

TABLE 2. DESCRIPTION AND CODING OF SOCIOECONOMIC VARIABLES USED IN THE ANALYSIS OF RELATIONSHIPS BETWEEN KNOWLEDGE OF *DYPSIS FIBROSA* AND PERSONAL FACTORS IN THE LIVES OF INFORMANTS.

Variable name	Description and coding
Village	1 = Manakambahiny 1; 2 = Mahasoa; 3 = Ambatoharanana 3
Sex of informant	0 = female; 1 = male
Age of informant	Years
Education	No. of years that the informant has attended formal schooling
Family size	No. of people in household incl. informant
Roof index	Rated index of roof materials of informants' houses as an indication of relative wealth and social position; the rating was based on informants' comments on which roof materials were the longest lasting and the most popular, but are eventually a reflection of the subjective perception by the researcher; 0.33 = bamboo or *Ravenala madagascariensis*; 0.67 = *D. fibrosa*; I = corrugated tin
Irrigation	Employment of irrigation systems for growing paddy rice, 0 = no; 1 = yes
Rice	Mean annual harvest in kg
p.c. Rice	Mean annual per capita harvest, i.e., kg of rice per person in household
Crops	No. of different crops/agricultural methods employed
Animals	No. of domestic animals expressed in converted animal units where Zebu cows serve as reference animals, i.e., 1 Zebu = 1 unit (conversion factors were calculated on the basis of approximate in-village prizes of the different kinds of domestic animals)
Wealth	Summary variable consisting of the variables Roof index, p.c. Rice, Crops, and Animals, as well as information on additional income sources (1 = additional income sources; 0 = no such income sources available); values of each contributing variable were standardized with regard to the highest score attained within that particular variable and were subsequently summed and divided by the number of contributing variables, so as to give a wealth rank with highest possible score 1 and a minimum value of 0

coded as 0 = negative answer, and 1 = positive answer within a certain category. Dependent variables analyzed are listed in Tables 4–6.

In the logistic regression analysis of informants' evaluation of *D. fibrosa*'s importance answers implying that *D. fibrosa* was regarded as an important species were coded as 1 while other answers were coded as 0.

Knowledge about abundance was modeled as a number of nominal variables with several response levels. These variables were: 1. abundance (common, rare, no knowledge), 2. observed changes in distribution (no change, decline in abundance, juvenescence, decline and juvenescence, no knowledge), 3. anticipated causes (population increase, overexploitation, collecting method, swidden agriculture, and "other"), and 4. proposed amelioration measurements (cultivation, replacement of the used *D. fibrosa* products by other materials, preservation of remaining populations, "other," and no proposition). Apart from the same socioeconomic explanatory variables as in the other cases of logistic regression analysis (Table 2) the number of uses of *D. fibrosa* known to informants was included as an explanatory variable in the analysis of informants knowledge and opinion concerning the abundance of *D. fibrosa*. In addition direct observations were made of the actual use of different products of *D. fibrosa*.

RESULTS AND DISCUSSION

HISTORICAL AND PRESENT DAY USE OF *DYPSIS FIBROSA*

Fifty-two out of 54 informants knew *D. fibrosa* and 31 stated that it was one of the most important palm species. Often importance of certain palm species has been ascribed to the many different uses that one species can have (Balick 1984). Indeed, in the case of *D. fibrosa* 12 different uses were observed in the course of the survey (Table 3). The derived palm products are based on different above ground parts of the palm and serve a wide range of purposes from medicine and food to decoration and construction. Three of the 12 uses have been reported previously in the literature: use of leaf sheath

TABLE 3. UTILIZATIONS OF *D. FIBROSA* REPORTED IN A SURVEY ENCOMPASSING 54 INFORMANTS LIVING IN THREE DIFFERENT VILLAGES IN EASTERN MADAGASCAR. NUMBERS IN PARENTHESES GIVE THE NUMBER OF INFORMANTS MENTIONING A CERTAIN USE.

Palm part	Uses
Leaf blades	*Thatch* (52) *Decoration:* whole leaves to decorate houses, e.g., at clerical festivities (1)
Leaf sheath fibers	*Commerce:* fibers used to be harvested as a source of cash income and were sold to the furniture industry (for use as upholstery) by middlemen, though many informants were unaware of this (9) *Rope* (7) *Cleaning* of household gear, i.e., as pot scourer (3) *Upholstery* of mattresses (2) Use not specified (2)
Trunk	*Salt* (extracted through boiling): used as *medicine,* mainly against chronic cough in children (12); formerly also used as *seasoning* (14) Use of salt not specified (5) Collection of *edible grubs* (boiled or fried) from cut stems which have been left rotting for 2–3 months (usually in connection with leaf harvest) (1)
Heart	*Medicine* (boiled and eaten): mainly used against chronic cough in children (3) *Food* (2)
Inflorescence	*Broom* (10)

fibers (piassava) for rope making (DuPuy et al. 1992) and export (Dransfield and Beentje 1995), use of inflorescences as brooms (Dransfield and Beentje 1995), and use of leaves as thatching material (Dransfield and Beentje 1995; DuPuy et al. 1992). In addition, DuPuy et al. (1992) reported that piassava fibers are used to make shoulder pads for porters to rest their carrying poles on. Apart from these incidental reports of *D. fibrosa* uses no systematic surveys have previously been conducted on the subject. Table 3 summarizes the different uses elicited in this survey and the number of times each use was mentioned.

The most frequently mentioned use of *D. fibrosa* was the use of leaves for thatch. All informants who knew *D. fibrosa* also knew of this use (Table 3). Leaves of any age can be used for thatching as long as the pinnae are intact. In forests where leaves are harvested it is common to see individuals of *D. fibrosa* that have been completely stripped of their leaves, apart from one or two emerging ones. This constant pruning activity can prevent palms from growing and keep them in a quasi-juvenile state (Dransfield and Beentje 1995). An even more destructive way of harvesting is to cut down the whole tree to obtain the leaves, a practice, which is also frequently encountered. For the roof of an average sized hut (ca. 3 × 4 m ground area) 500 panels of leaves are needed (Fig. 1A, B). One panel consists of five half leaves, i.e., leaves where the pinnae have been removed on one side and which have been tied together (Fig. 1C). As for other work in the forest, it is men who carry out the harvest of *D. fibrosa* leaves. Contrary to most other uses of this species, which are of a more opportunistic nature, men go to the forest specifically to harvest the leaves. Palm thatch is also one of the few palm products that is subject to a considerable commercial trade in the villages. One panel of *D. fibrosa* leaves costs U.S. $0.05 (U.S. $1 = 5037 FMG, Nov. 1998). Trade also encompasses leaves of other palm species used for thatch, which cost double the price of *D. fibrosa* leaves due to their greater length. Most informants stated that D. *fibrosa* leaves were the superior thatch material. Depending on the quality of leaves and skill of the constructor a roof can last about five years in a hut without a fireplace. Where a fireplace is present a roof can last 10–20 years, due to the insect deterring effect of the smoke and soot settling on the inside of the roof which acts like a preservative.

One person stated that the leaves also were used for decorative purposes, e.g., at clerical festivals (Table 3).

Sixteen informants reported use of *D. fibrosa* piassava fibers. Harvest of piassava fibers is potentially a nondestructive activity, as the fibers are remainders of old leaf sheaths and can be cut off the stem without damaging it. Main application of fibers was fabrication of rope (seven of 23 answers). Use of fibers as a pot scourer for cleaning household gear and as stuffing of mattresses seem to constitute marginal uses. Nine informants recalled collection of fibers as a source of cash income (Table 3), though nowadays trade in fibers does not seem to be taking place any more.

Of 54 informants 26 knew of the extraction of salt from the trunk pith of *D. fibrosa* through boiling. About the same number of persons recalled use of this homemade salt for seasoning and for medicinal purposes (Table 3). The main medicinal application of *D. fibrosa* salt was as a curative against chronic cough, especially in children, while one informant reported that the salt could be used to treat a pancreatic disorder associated with malaria and another reported that it could be used to cure infections with intestinal worms. In all cases the medicinal use consisted in oral intake of the salt. In addition to salt extracted from *D. fibrosa,* some informants also used heart of palm as cough medicine (see below).

Heart of palm is generally a popular food, boiled and eaten together with rice or sometimes mixed with other vegetables. Extraction of palm hearts is done by cutting down palm trunks. It is thus a practice that is lethal for single-stemmed palms. Local people consume hearts of many different species of palms, but *D. fibrosa* does not seem to represent an important food source and it is less affected by the destructive harvesting methods than many other palms due to its branching habit. Only two informants mentioned dietary consumption of *D. fibrosa* hearts (Table 3). Three informants mentioned using *D. fibrosa* hearts for medicinal purposes, as curative against cough (Table 3). Hearts used for medicinal purposes are prepared in the same way as for dietary consumption. Taken together with the information concerning the use of *D. fibrosa* salt, this means that altogether 13 informants used *D. fibrosa* products for medicinal purposes.

Many informants had brooms of dried *D. fibrosa* inflorescences in their homes, but only 10 informants mentioned these brooms when questioned about uses of *D. fibrosa* (Table 3). The entire inflorescence is used and the peduncle, which can achieve a length of 1 m, serves as shaft. The rachillae, which are 15–50 cm long and 1–2 mm in diameter (Dransfield and Beentje 1995), constitute the brushes.

Although *D. fibrosa* is used for many purposes, the majority of informants could recall only one or two uses. Average number of uses reported by informants was 2.28, but variation between individuals was large (s = 1.56). In contrast to the generally large disparities in informants' knowledge there was a large degree of consistency concerning use of the leaves as thatch. Taken together with the small number of uses that informants knew on average this indicates that the main reason for the importance accorded to *D. fibrosa* were not the many different uses of this palm, but rather only one specific use.

Socioeconomic Factors and Knowledge Distribution

Stepwise linear regression revealed that the squared number of uses informants knew was significantly related to their gender ($P < 0.05$) in such a way that men knew of more uses. The same analysis showed that the squared number of uses known was also related positively to people's wealth ($P < 0.01$). Logistic regression analysis revealed that the estimation of the importance of palm species was related to the village where they live ($P < 0.01$) and to the size of their rice harvest ($P \ll 0.05$). Other results of logistic regression are shown in Tables 4–6. In most cases different aspects of people's knowledge were related to their wealth and to the village where they live.

In general, wealthier people knew most. In as far as responses indicate actual use of products it could have been expected that less wealthy people would know more about palm products, assuming that they depend more on "wild products" than more wealthy people. There can be different explanations why this was not the case. Firstly, obtained answers may not have been proportional to actual use of products. Indeed, considering that most of the observed *D. fibrosa* populations were found within the protected areas and buffer zones the collection of many products possibly infringe park laws. As a result it seems likely that people, who use *D. fibrosa* the most, may be least willing to say so. Another explanation could be that poorer people perhaps

TABLE 4. RESULTS OF LOGISTIC REGRESSION OF KNOWLEDGE ABOUT USE OF DIFFERENT PARTS OF *D. FIBROSA* ONTO SOCIOECONOMIC VARIABLES. LOGISTIC REGRESSION WAS CARRIED OUT TO DETECT RELATIONSHIPS BETWEEN PERSONAL FACTORS IN THE LIVES OF INFORMANTS AND THEIR KNOWLEDGE OF NATURAL RESOURCES (TABLES 4–6). PERSONAL FACTORS LISTED IN THE TABLES ARE ONLY THOSE WHICH SHOWED RELATIONSHIP WITH UTILIZATIONS. FOR A FULL LIST OF ALL THE PARAMETERS INCLUDED IN THE LOGISTIC REGRESSION SEE TABLE 2. THE DIRECTION OF THE RELATIONSHIP IN THE CASE OF BINARY DEPENDENT VARIABLES IS INDICATED BY + AND −, REFERRING TO POSITIVE AND NEGATIVE LOGISTIC REGRESSION PARAMETERS, RESPECTIVELY. SIGNIFICANCE LEVELS ARE INDICATED BY ASTERISKS (*: $0.01 < P \leq 0.05$; **: $0.001 < P \leq 0.01$; ***: $0.0001 < P \leq 0.001$; (*): $0.05 < P \leq 0.07$; NS: NOT SIGNIFICANT).

	Roof index	Crops	Animals	Wealth	*P*	U
Leaf blades					NS	
Leaf sheath fibers		−**	−***		<0.0001	0.32
Heart					NS	
Inflorescence	(*)				0.053	0.11
Stem pith				−**	0.0013	0.13

had abandoned the traditional way of life in their struggle for existence or did not have the necessary resources to engage in anything but most basic agricultural activities. However, considering the scarcity of alternative agricultural methods and income sources in the area, and the opportunistic nature of the collection of most products, this explanation does not seem plausible. A more likely explanation is perhaps that knowledge of forest resources such as *D. fibrosa* potentially can make a significant contribution to rural household economies, if it is fully taken advantage of. Thus, more knowledgeable informants might have become wealthier by means of a larger participation in the knowledge pool in the first place.

Economic consequences of the decline in availability of *D. fibrosa* for the more wealthy people, who seem to be the main user group, will probably be limited even where exploitation of forest resources has contributed to creating their wealth. These people are nowadays in a good position to find and afford alternative materials and products. A tendency towards replacement of traditional products is already becoming manifest. Many people have for example replaced palm thatch with corrugated tin. However, even though poorer families seemingly do not use as many natural products as wealthier residents, declining availability of natural resources may put additional economic pressure on these families. The products which they do use, such as thatch, may be basic and costly to replace. In addition, the opportunity to advance economically by means of entrepreneurial exploitation of local knowledge disappears.

While informants' knowledge of *D. fibrosa* uses in many cases was significantly related to their home village, there was no clear tendency in this relationship. There were certain core uses, such as thatch and salt, which were known by a large number of informants and these were equally often mentioned in all villages, whereas

TABLE 5. RESULTS OF LOGISTIC REGRESSION OF KNOWLEDGE ABOUT USE OF *D. FIBROSA* FOR DIFFERENT PURPOSES ONTO SOCIOECONOMIC VARIABLES. SEE TABLES 2 AND 4 FOR FURTHER DETAILS.

	Village	Sex	Education	Crops	Wealth	Interactions	*P*	U
Artisanry			−**				0.005	0.34
Commerce				−**			0.0027	0.19
Construction							NS	
Food	*	+*			−**	−* (Sex*Wealth)	0.0003	0.35
Medicine				−*			0.027	0.088
Tools	*			−*		* (Vill.*Crops)	0.0088	0.23
Other uses					−*		0.015	0.14

TABLE 6. RESULTS OF LOGISTIC REGRESSION OF KNOWLEDGE ABOUT ABUNDANCE OF *D. FIBROSA* ONTO SOCIOECONOMIC VARIABLES. SEE TABLES 2 AND 4 FOR FURTHER DETAILS.

	Village	Age	Education	Animals	Wealth	Use number	Interactions	*P*	U
Abundance	*				(*)	*	** (Vill.*Wealth)	<0.0001	0.41
Changes		*		*				0.0064	0.25
Causes				(*)				0.053	0.097
Propositions		NS	*					0.061	0.14

some of the less often cited uses were mentioned at different frequencies in different villages. There were also differences between villages concerning which palms people regarded as most important and how aware they were of ongoing environmental changes (Table 6). As the three villages differ not only in their proximity to the park, but also in size, history, and availability of social institutions and externally produced goods, there is no obvious explanation for these patterns. Nevertheless, while some major applications are "universal," others can vary substantially within a small geographical area, attesting to the necessity to refrain from making sweeping generalizations both in scientific and applied contexts.

Despite clear-cut gender roles in the implementation of collection of forest products, which is a typical male activity, gender did not seem to have a great impact on the knowledge level of the individual. The involvement of women in processing and manufacturing many products may explain this lack of association.

Only in the case of changes in abundance could a relationship between knowledge and age be detected (Table 6). As changes take place over time and become manifested in the mind of individuals through comparing past and present experiences, it seems logical that age should have an effect on the individual's experience and evaluation of change. The nonexistent relationship between age and knowledge of palm products shows that knowledge of uses is acquired early in life and is not experiential in the sense of a gradual increase in knowledge throughout life based on the individual's increasing experience or training. An even distribution of knowledge among age classes reduces the risk of knowledge being rapidly lost due to natural and socioeconomic changes (Phillips and Gentry 1993). Nevertheless, some older informants complained that children nowadays were ignorant about plants and that the younger generation only knew of some uses by hearsay, but did not know how to manufacture those products themselves. Such comments indicate that a certain knowledge erosion is taking place in the study communities and that especially knowledge of rarer uses is in danger of being lost.

The analysis of the significance of socioeconomic variables consisted in most cases of logistic regression, because that does not require normally distributed data and can be used with nominal dependent variables. Although analysis showed that aspects of palm knowledge could be regressed onto personal variables, this in itself does not prove causality of these personal factors. Neither does failure of regression analysis in proving relationships between personal factors and knowledge guarantee that there is no connection. Parameter estimates and explanatory value of a variable partly depend on other variables contained in the model. When results are interpreted in a cautious way, as indicating trends rather than representing absolute causative correlations, the methods employed in this study can provide a useful framework with regard to understanding processes and mechanisms influencing interactions of plants and people.

KNOWLEDGE VERSUS ACTUAL USE

Although all informants who knew *D. fibrosa* (52 persons) also mentioned its use as thatching material only 25 informants actually had roofs that consisted of *D. fibrosa* thatch. The remaining informants used mainly corrugated tin or leaves of the traveler's palm *Ravenala madagascariensis* Adans. (Strelitziaceae). Although there was a significant difference between villages with regard to the frequency of employment of *D. fibrosa* leaves as thatch (χ^2-test, $P = 0.0012$) there was no such difference with regard to the frequency with which use of *D. fibrosa*

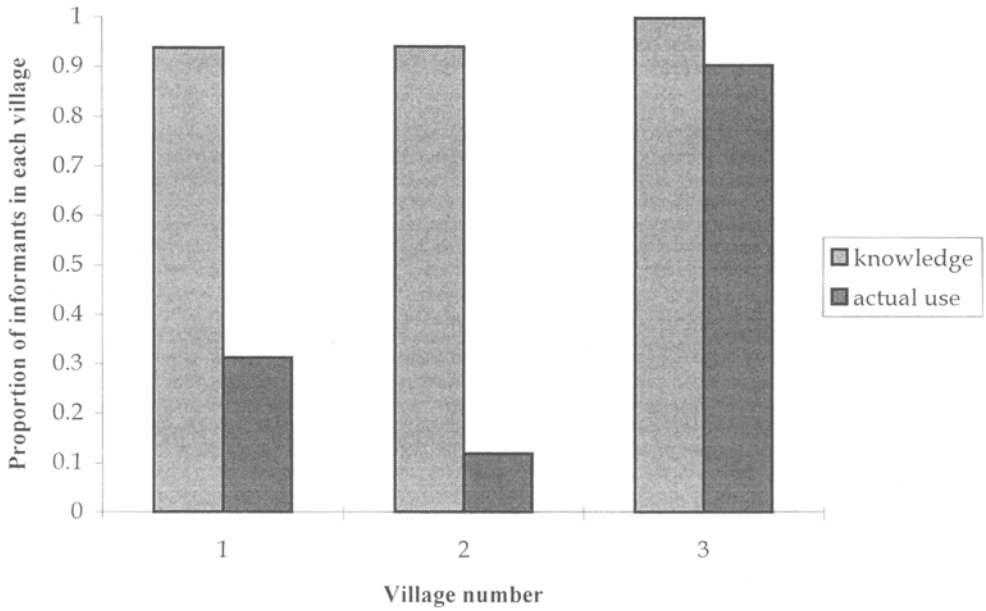

Fig. 3. Difference between proportion of informants reporting use of *Dypsis fibrosa* thatch and proportion of informants actual using it in three villages in East Madagascar. The frequency of actual use of *D. fibrosa* thatch differed significantly between the three villages ($P = 0.0012$), while there was no between village difference with regard to the frequency with which use of *D. fibrosa* leaves was mentioned in the interviews.

leaves was mentioned in interviews (Fig. 3). There was thus no relationship between informants' reports of the use of *D. fibrosa* leaves as thatch material and the roofing material of their houses (Tables 4, 5). Other examples of discrepancies between use and responses are the reports of historical applications, which are no longer in use, such as seasoning use of *D. fibrosa* salt and trade with piassava fibers. Another example is the use of dried *D. fibrosa* inflorescences as brooms. Although these brooms were a ubiquitous household tool, they were rarely mentioned in interviews. These discrepancies indicate that other values such as historical and cultural attributes were influential in determining informants' responses and notions of importance of plants and products. Thus, the position a product takes in the mind of people is not always dependent on purely materialistic usefulness or frequency of actual use. Some products, such as the brooms were widely used, but apparently regarded as trivial and did not contribute much to the notion of palm importance. On the other hand, some historical uses, such as salt and fibers, were still mentioned probably due to their great practical significance in former times. Palm salt was formerly important due to the unavailability of alternative seasoning and medicinal agents while fibers constituted an important source of monetary income. On European markets one kilo of piassava earned 30–50 French Franc in the 1950s (Dransfield and Beentje 1995) and even though the Malagasy collector probably received only a small fraction of this amount it may have helped rural families substantially in making a living.

The frequent reports of use of thatch leaves indicates that it was this use, which was largely responsible for securing *D. fibrosa* a pre-eminent position in the minds of people as being an important plant despite the declining practical importance of palm thatch. As with the historical uses, the importance still accorded to the leaves can partly be explained by their former practical significance (although there always have been other natural thatch materials available). In addition, *D. fibrosa* thatch still constitutes a visible element in village life as the leaves are still collected and traded in the villages, though not used by all people. Discrepancies between answers and actual use may thus indicate ongoing change of use patterns where some people are still using certain products whereas others have already replaced them by alternative products. Another

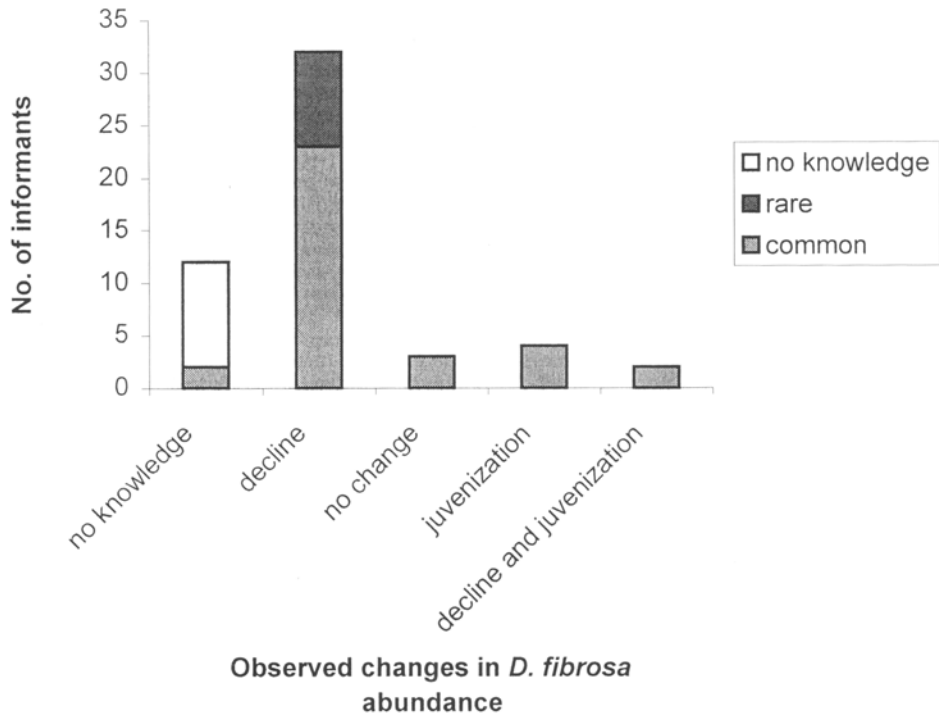

Fig. 4. Changes in the abundance of *D. fibrosa* according to informants. Column patterns indicate informants evaluation of how common a palm *D. fibrosa* is.

reason for the strong position of palm thatch in the minds of local people can be the strong symbolic significance which building a house has in many sedentary communities. In some Malagasy ethnic groups position and size of the house is indicative of a person's family relations and social identity and therefore a natural focal point in village life (Huntington 1988).

Changes in Abundance of *Dypsis fibrosa*

Forty-three informants commented on the abundance of *D. fibrosa.* Thirty-four of these characterized *D. fibrosa* as a common species whereas nine thought that it was rare (Fig. 4). Concerning changes in abundance of *D. fibrosa* the majority of informants thought that there had been a change taking place. All informants described the change as consisting of some kind of deterioration, mostly in the form of a decline in abundance, but some informants also said that the population structure of *D. fibrosa* had changed so that only young individuals remained nowadays (Fig. 4). These reports of demographic changes in *D. fibrosa* populations accord well with similar reports in literature of exploitation consequences. Dransfield and Beentje (1995) described how harvest of leaves of another endemic Malagasy palm, *Ravenea lakatra,* used for weaving keep most individuals in a juvenile-like rosette state.

Nearly all informants evaluated observed changes as negative and thought that it would have a significant impact on their lives. When asked what they thought was causing these changes, most informants mentioned general causes such as the traditional practice of swidden agriculture, increase of the human population or a combination of the two. Some people, however, specifically associated the observed change with over-exploitation of *D. fibrosa* or with destructive collecting methods such as cutting down whole plants instead of just harvesting mature leaves.

Concerning amelioration of anticipated negative effects of the decline of *D. fibrosa* the most common suggestion was to replace *D. fibrosa* thatch with other materials, either other plant materials or corrugated tin. Other suggested solutions included reforestation and preservation of remaining forest tracts as countermeasures

against the decline of *D. fibrosa.* Some informants also suggested cultivation of *D. fibrosa.* While cultivation of *D. fibrosa* is taking place in botanical and private gardens around the world (Dransfield and Beentje 1995), this is not the case in rural Madagascar and informants were generally unaware of the fact that cultivation already had been successfully implemented in other countries.

These results show that local people were well aware of human-induced changes taking place in their environment and were also concerned about potential consequences of such changes. Not only were people aware of large-scale changes such as a general decline in forest cover, but nearly one quarter (six) of those informants, who had observed changes, had also noticed a change in population structure of *D. fibrosa.* While some informants were concerned about disappearance of knowledge and traditions due to the decline of useful species such as *D. fibrosa,* most people were primarily concerned with anticipated practical and economic effects. They were worried that the decline in *D. fibrosa* abundance would make it more difficult and expensive to obtain roofing material for their houses. That consequences for house construction was the main concern confirms the impression that it is the use of leaves as thatch that is the main cause for the importance accorded to *D. fibrosa* by informants.

Despite fearing negative impacts and being aware of the human causes of changes most informants thought that the decline was inevitable, as "clearing of the forest means food on our table" as stated by one informant. Such statements attest to the pragmatic and utilitarian attitude of local people towards their natural surroundings. This attitude results in decisions that concern the environment, first and foremost being made on the basis of cost-benefit considerations. The value of conservation schemes to local people thus becomes a question of how well they can contribute to securing access to important resources. In addition, costs arising from conservation schemes are by local people set against costs of exploiting and subsequently replacing resources by alternative products. In the case of *D. fibrosa* the majority of informants suggested replacement of palm products rather than development of sustainable ways of exploitation as a solution of how to cope with the decline in palm abundance. This attitude is due to the availability of alternative products, though these are of inferior quality or more expensive, whereas sustainable exploitation methods are thought to require strict regulations and have not yet been encountered. Accordingly, motivation among local people for sustainable exploitation of *D. fibrosa* is low. Cost-benefit considerations are decisive for the attitude of local people towards conservation plans and for the success of projects aiming to implement those plans.

Summary and Conclusion

This study shows that knowledge of local people can indicate ongoing changes. Local people are well aware of changes in their environment and of human causes of these changes. In addition, there are large variations in the knowledge of informants concerning use of *D. fibrosa.* Personal factors in the lives of informants often influence both their knowledge and use of products. In this study the most decisive factors for people's answers were indicators of their wealth and their home village. Although the reasons for these patterns are not entirely clear, they are indicative of heterogeneities within communities and possibly also of changes, where different people adapt to new situations in different ways and at different speed and knowledge transfer may have been disrupted. Knowledge of use patterns may help predicting how changes will affect different groups in society and the community's knowledge pool.

A comparison of actual utilization and frequency of responses indicated that use of some *D. fibrosa* products had been undergoing changes in the recent past. Thus, use of *D. fibrosa* leaves as thatching material was mentioned by all who knew the plant, but was actually employed by less than half of all informants. This change in utilization patterns probably had different external and internal reasons such as declining populations of *D. fibrosa* and greater availability of lasting alternative materials such as corrugated tin. Despite the diminishing actual use, it was the use as thatching material to which *D. fibrosa* owed its pre-eminent position as most important palm in the studied communities. Such discrepancies attest to the fact that it is neither always the number of uses which makes a plant important in the eyes of local people nor necessarily the actual degree of use. It is therefore of great importance to distinguish between actual uses and knowledge of uses, including

historical ones. Attributes and products which contribute to the importance of a certain plant in the eyes of local people are not necessarily dependent on present frequency of use as was seen in the case of *D. fibrosa* thatching. Therefore, choice of methods must match the aim of a study. Otherwise researchers may draw misleading conclusions due to a mismatch of aims and methods and due to confusion of knowledge and actual use of plant products. If a researcher for example wishes to investigate what effect exploitation of natural resources has on plant populations it would be advisable explicitly to ask for the actual employment or to measure the quantities harvested or consumed. The usually employed method of obtaining oral information on plant use from one or several informants without distinguishing between use and knowledge would in this case at best lead to unreliable data and could at worst lead to decidedly false conclusion as to the effect of plant use. When the aim of a study on the other hand is to investigate a community's needs and to investigate the potential for conservation initiatives, local knowledge and cultural attributes of a plant or product might be as decisive as the actual extent of use and should therefore be included in the investigation.

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