

# The importance of frogs to the livelihood of the Bakossi people around Mount Manengouba, Cameroon, with special consideration of the Hairy Frog, *Trichobatrachus robustus*

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**Abstract.** Amphibians are harvested for various purposes around Mount Manengouba including food, international pet trade and cultural reasons. At least seven frog species are regularly collected and consumed: *Conraua crassipes*, *C. goliath*, *C. robusta*, *Trichobatrachus robustus*, *Astylosternus* spp., *Xenopus amieti*, *Kassina decorata*. Over-exploitation of *C. robusta* for food and *T. robustus* for the international pet trade, in addition to the harvest of tadpoles for human consumption, is currently increasing and expected to have negative effects on wild populations. The males of the Hairy Frog, *T. robustus*, locally known as “Ebod” are viewed upon by locals as being mystical. It is believed that these frogs fall from the sky, and that childless human couples can turn fertile after having eaten this frog. All interviewed locals declared to have once eaten a frog, while only 70% of them knew about the cultural significance of the Hairy Frog. Collection of any frog species is undertaken all year round but peaks in the dry seasons (both for food and pet trade). Prices for two large or three medium-sized individuals of *C. robusta* are US\$ 2 at the local food markets, while pairs of the Hairy Frogs are sold for US\$ 8 to the international pet trade. We discuss the need to set up plans for the sustainable harvest to maintain viable populations of these species in the region.

**Key words.** Amphibia, Anura, ethno-zoology, food, harvesting, medicine, mountain streams.

## Introduction

Considerable efforts have been made in surveying the amphibian fauna of western Central Africa and clarifying their distribution and taxonomic status (e.g. SCHIÖTZ 1999, PERRET 1966, AMIET 1975 and many other papers, LAWSON 1993, LEBRETON 1999, RÖDEL et al. 2004). In contrast, little effort has been undertaken to investigate the economic and cultural importance of frogs in this region, although several species are known to be culturally and economically important (e.g. PAUWELS et al. 2003).

Amphibians are abundant in many ecosystems and serve as important links in ecological food chains, being both predators and prey (DUELLMAN 1990). As adults, they are primary and secondary consumers of small animals, i.e. mainly arthropods at various stages, many of which are well known

as pests to crops and disease vectors to humans (BEHANGANA & ARUSI 2004). The suspension feeding larvae may play an important role in the balance of aquatic systems by regulating algal growth (e.g. DICKMAN 1968, SEALE 1980, WASSERSUG 1984, OSBORNE & MCLACHLAN 1985, WHILES et al. 2006) and by being important prey sources to aquatic invertebrate and vertebrate predators (HEYER et al. 1975, GASCON 1989, RÖDEL 1999). Often adults are food for other vertebrates such as fishes, snakes, birds and mammals including humans (reviewed by TOLEDO et al. 2007). Amphibians and reptiles have long been used by humans as food (e.g. WALKER 1966, GIBBONS 2000) and medicine (e.g. KLEMENS & THORBJARNARSON 1995, VAN DIJK et al. 2000). Nowadays, some species are seen as attractive characters in commercial advertising and others are collected or bred for the international pet trade.

Numerous cultures worldwide believe that amphibians have mystical powers and are hence used in various rituals (HOFRICHTER 1998). Ancient cultures in Egypt, Greece, Turkey and Italy used frog amulets for good luck or to protect from evil and such practices continue to the present day (K. ADLER 2007: Amphibians and humans. – <http://www.answer.com/topic/amphibians-and-humans> [last inquiry: 1 March 2007]). Other beliefs focus on the connections of amphibians to water, rainfall and earth. Besides their ecological and cultural values, sometimes frogs constitute one of the main sources of proteins regularly eaten by many indigenous peoples, especially in impoverished societies. Particular species are collected in large numbers and over-collecting may lead to local extinctions or severe population declines. This is especially important if frogs are collected for non-autochthonous use. For example, during 1998–2002, the United States imported 14.7 million wild-caught whole amphibians (SCHLAEPFER et al. 2005). TRUONG (2000) reported that 11 Vietnamese amphibian species of economic value have become rare, some being even in danger of extinction, due to over-exploitation. As many amphibian species predictably aggregate for reproduction or hibernation, this makes them particularly vulnerable to intensive collecting efforts. Recent studies have indicated that commercial or subsistence harvesting has contributed to a decline in many reptile species (e.g. KLEMENS & THORBJARNARSON 1995, VAN DIJK et al. 2000, WEBB et al. 2002). Comparative figures for amphibians seem to be rare or lacking. Inappropriate exploitation of amphibians may increase the already desperate situation of many amphibian populations, already in decline because of habitat destruction and degradation, global warming, and disease (STUART et al. 2004, LIPS et al. 2005, POUNDS et al. 2006). The extent of exploitation of amphibians depends upon their distribution and the demands both of local people and of the international market.

In the Manengouba region of South-

west Cameroon, some amphibians are economically important, others are traditionally pleasing (e.g. *Trichobatrachus robustus* BOULENGER, 1900, *Conraua robusta* NIEDEN, 1908) to the Bakossi people and as such represent a significant entity to the livelihood of the local human population. The Hairy Frog, *Trichobatrachus robustus*, is native to this area, used for various purposes and hence of cultural and economic significance to the Bakossi people. It is collected by young Bakossi for commercial and domestic purposes alike. The unregulated harvesting of these frogs is likely to have a negative impact on the natural populations.

This work was motivated in part by emerging evidence that over-collecting of some frog species may result in the decline or extinction of particular amphibian species and hence as well in the loss of the cultural beliefs for which these species play an important role in the region. Thus, the data presented herein aim to provide a first contribution to the knowledge of the economic and cultural value of the amphibian in a Cameroonian mountainous region.

### Materials and methods

This study was carried out around Mount Manengouba in western Cameroon (N 05°02', E 09°50'). The Kupe-Manengouba and Bakossi mountains comprise some of the wettest forests in Africa. Mount Manengouba has a well developed tropical mountain cloud forest environment that extends to the Eboga caldera at 1,800 m a.s.l. The peak of Mount Manengouba is at 2,411 m a.s.l. The caldera possesses two volcanic lakes (1,950 m a.s.l.) in the middle, with the bigger being 600 m across. There is some forest on the edge of the two lakes but mainly on the south-eastern rim of the craters. Fulani herdsmen inhabit the crater (Fig. 1). They use the area as a winter grazing ground for cattle, sheep, goats, and horses. During the late dry season burning of the grassland is practised. Primary for-

est extends down the slopes on the southern flank to an altitude of 1,500 m above the village of Nsong. The mid-altitude forest in the south-east of the mountain is drier than the forest higher up. The forest on the slopes is intact except near the village of Nsong and the eastern slope to Nkongsamba where agricultural encroachment has extended locally to the altitude of 1,700 m a.s.l. (N 04°59', E 09°52'). The southern slopes of the mountain are still well forested down to around 1,200 m a.s.l. at Manengouba village. Amphibians primarily inhabit the numerous mountain streams of various sizes. The rainy season in the area extends from March to October.

Between August 2005 and December 2006, we gathered data on the economic and cultural importance of amphibians. This survey was mainly conducted on the western and southern flanks of the mountain with six villages visited: Belo, Ebonemin, Manengouba, Moeba, Mouandong and Nsong. Visits to these villages were undertaken during ecological surveys in the region. During these surveys the company of local guides from every village made possible discussions on the importance and cultural significance of amphibian species to villagers. This information was the basis for further questions. Data were collected by means of informal interviews and discussions including the topics: use, knowledge and significance of particular amphibian species to the local people. This also included the preservation and transmission of the cultural information about these animals to the young generation. Interviews were usually conducted in pidgin English and generally in the presence of the respective village guide, as interviewees were more confident to talk openly in the presence of someone they know. Participants were randomly chosen on the basis of the order in which they were met as we walked through the village visiting compounds. Only one person per family was interviewed and only those people who were willing to participate were included in the survey. Interviews were conducted with 33 people, including eight



Fig. 1. The Eboga caldera on Mount Manengouba, Cameroon. Fulani herdsman campsites (in the upper left half of the caldera) and swampy areas at 1,800 m a.s.l. These areas are the main habitats of *Xenopus amieti* and *Kassina decorata*.

people from Ebonemin and five people each in the remaining five villages. The interviewees' age ranged from 18 years (youth) to 66 years (elders of the village) and included 12 women and 21 men.

Firstly, the aim of the survey was briefly explained to the potential interviewee. If they wished to participate in the interview we proceeded with the questioning. During the discussions respondents were asked a series of questions, including:

1. Do you know frogs and which are the ones you eat?
2. Have any of these frogs got significance to you/your tribe?
3. For what other reason do you collect frogs?
4. For whom do you collect and how often do you collect during the year?
5. What difficulties do you encounter while performing this activity?

Identification of species eaten or collected for the trade were clarified with the aid of specimens previously collected during our ecological survey and shown to interviewees. Alternatively we checked and determined the specimens collected by the villagers. Questions were asked in a non-leading way, but yes/no type answers were discouraged. Responses were recorded during or immedi-

ately after the discussion. Interviews took place generally between 5 p.m. and late in the night, after the villagers had come back from their daily occupations.

## Results

### General results

Local people around Mount Manengouba proved to have a detailed knowledge of the seasonality, ecological relationships, cultural attributes and uses of various frog species found in this region. At least seven species of frogs are regularly collected and consumed including *Conraua crassipes* (BUCHHOLZ & PETERS, 1875), *C. goliath* (BOULENGER, 1906), *C. robusta*, *Trichobatrachus robustus*, *Astylosternus* spp., *Xenopus amieti* KOBEL, DU PASQUIER, FISCHBERG & GLOOR, 1980, and *Kassina decorata* (ANGEL, 1940). These species inhabit quite different habitat types ranging from primary forest along fast moving large streams (*C. goliath*, *C. robusta*, *T. robustus*) to stagnant waters in montane grassland (*X. amieti*, *K. decorata*). The former three species are called “Essalle” in the local language with no linguistic distinction of species (for exception see below). People from each of the villages collect these species for food or other purposes (Table 1). The frogs were consumed at various stages ranging from tadpoles to adults (Figs. 2, 3). All interviewees confirmed to have eaten frogs at least once. Collection of tadpoles for consumption was random and may include individuals of other species reproducing in fast moving streams (allocable to the genera *Cardioglossa*, *Phrynobatrachus*, *Leptodactylodon*), as well as tree frogs.

Of all the species consumed in the region, the Hairy Frog, *T. robustus*, whose males are of particular interest as they have a cultural significance to the people and are locally known as “Ebod” (Fig. 4). This species also serves as an income-generating species to the youth of the area (< 30 years), who often collect it for the international pet trade (Table 1). Seventy percent of all interviewees (64% men

and 36% women), knew or have heard of the cultural significance of the Hairy Frog. Men generally were more likely to have this traditional knowledge than women. We recorded also some differences between villages, e.g. whereas all interviewees from Moeba knew about the Hairy Frog’s traditional use, only 40% of the Manengouba people could positively answer this question (Table 2).

### Collection for food

The collection of frogs for local consumption takes place all year round but generally, harvest peaks in the dry season when the levels of the streams and ponds are low and collection is easy. Frogs are continuously collected by the villagers randomly during various daily activities. More organized collection techniques include night search for large frogs in streams. This harvest technique is undertaken by individuals or groups (generally four young men) along streams with flash lights to locate the animals. Machetes, spears, hooks, and nets are used to catch and kill the frogs. This method was practiced in all the villages visited. Collectors slowly move upstream while observing rocks and logs in the water. All frogs found are cut or speared. *Conraua* species are located at waterfalls and rapids and are easily harvested by using nets. Nets are generally set up across the whole width of a stream, normally at sites where abundant frog populations are known to occur. The net is held in position by wooden floats and anchored into the ground using wooden sticks or stones. During the hunt two people are positioned close to the net, carefully observing it, while two others move upstream, using long wooden sticks and spears to explore holes within rocks in the streams and the river banks. These activities chase frogs downstream where they are intercepted by the net and subsequently killed. According to the local hunters this is the most rewarding method for frog hunting as up to 70 individuals can be collected during one night.

Tab. 1. Number of interviewed people according to age class, gender (men/women) and village and reason of collecting frogs. F = Food, LT = Local Trade, IT = International Trade, CV = Cultural Value.

Village / age	total	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69
Belo	4 / 1	1 / 0	2 / 0	0 / 0	0 / 1	1 / 0	0 / 0
Ebonemin	4 / 4	0 / 0	0 / 0	2 / 2	1 / 0	0 / 1	1 / 1
Manengoubaaa	3 / 2	0 / 0	3 / 0	0 / 2	0 / 0	0 / 0	0 / 0
Moeba	2 / 3	0 / 0	1 / 0	0 / 1	1 / 2	0 / 0	0 / 0
Mouandong	5 / 0	1 / 0	1 / 0	2 / 0	0 / 0	1 / 0	0 / 0
Nsong	3 / 2	0 / 0	1 / 0	0 / 0	0 / 0	1 / 2	1 / 0
total (N= 33)	21 / 12	2 / 0	8 / 0	4 / 5	2 / 3	3 / 3	2 / 1
Collection purpose		F, LT, IT	F, LT, IT	F, LT, CV	F, LT, CV	F, LT, CV	F, LT, CV

Hunting without nets by directly killing frogs with machetes and spears are less labor intensive but also less rewarding as hunters often miss frogs that immediately jump into the stream and swim away at the first glance of flashlights.

The largest species in the area is *C. goliath*, which seems to be rare in the Manengouba area. The most abundant species is *C. robusta*. Two hours of spotlight night walk along a stream near the village of Manengouba II permitted us to locate 16 individuals of this species. This species is very much appreciated by many indigenous people as it is hunted and immediately sold fresh in the local markets (Fig. 5). However, the demand has always been greater than the supply in recent years. Large quantities of *C. robusta* are harvested and sold on the local markets of Mouandong and Belo, which are held weekly. *Conraua robusta* meat is highly prized with three medium sized or two large individuals being worth 1,000 CFA (about US\$ 2), respectively. For special ceremonies such as traditional weddings, Christmas, or New Year celebrations, these frogs are demanded by villagers, and young people go hunting them. Since these animals are of high value to people in the region, frog hunting is generally forbidden to non-natives. Every hunter collects only in his village. Regulation of access to streams for hunting is granted by the elders of the villages. These elders can also give permission exceptionally to visitors to

harvest for their immediate needs after reaching an agreement.

Another form of diurnal frog collection is generally practiced by women. This especially concerns the collection of tadpoles, early in the dry seasons when the levels of the streams and ponds are low. This form of hunting is practiced on fast moving streams by using basket traps made from rattan palm. These basket traps are conical with a roundish base. The trap is anchored to the stream bottom and held by one foot in such way that water flows through the trap. The women try to turn over all rocks and logs in the stream by hand (Fig. 6). The tadpoles then usually swim downstream and get intercepted in the traps. The traps are periodically removed from the stream and all tadpoles and freshwater crabs are then transferred into another

Tab. 2. Knowledge of the traditional use of the Hairy Frog, according to village and gender (M = men, W = women) of the interviewees (compare Tab. 1).

Village	yes		no		Yes (%)	No (%)
	M	W	M	W		
Belo	3	1	1	0	80	20
Ebonemin	4	3	0	1	88	12
Manengouba	2	0	1	2	40	60
Moeba	2	3	0	0	100	0
Mouandong	3	0	2	0	60	40
Nsong	2	0	1	2	40	60



Fig. 2. Villager with frogs collected for food. He has a *Conraua goliath* in his right and several *C. robusta* in his left hand (*C. robusta* also on the leaf on the bottom).

basket (Fig. 7). This is continuously repeated while moving upstream until sufficient tadpoles have been collected. During this process, all adult frogs of the consumed species are killed and collected as well.

Adults and tadpoles are also collected in large numbers by women when they block one side of a diverging stream. This dries up one part of the stream. There all stones are subsequently turned over in search for hidden frogs and tadpoles. Women also collect tadpoles and adults of *X. amieti* and *K. decorata* in stagnant water bodies around the caldera twin lakes. In the caldera lakes and in larger streams flowing close to the villages, clawed frogs are netted in huge numbers as seasonal supplements to human diets. Hunting there also generally takes place during the early dry season (November, December) when the water level is low and the tadpoles are concentrated in small remaining water bodies.

#### Preparation

The preparation of “Essalle” varies but individuals are usually eviscerated and then



Fig. 3. *Kassina decorata* tadpoles, collected for consumption.



Fig. 4. Adult male of the Hairy Frog, *Trichobatrachus robustus*.

smoked. For smoking, frogs are placed on a grille above the fire or hung above the fire after spearing them onto a rattan stick. The most famous and appreciated meal prepared with smoked frogs is called “Mpup”. This is a pudding, made from dried and crushed plantains (bananas used for cooking) mixed with slices of smoked “Essalle”. The “Mpup” is eaten with crushed cocoyams (“Essobah”) and a famous black soup made from crushed leaves of another cocoyam variety (“Quanqualang”). “Mpup” is often served during traditional wedding ceremonies (i.e. to in-laws) and during other feasts.



Fig. 5. *Conraua robusta* collected and sold for local consumption.



Fig. 7. Tadpoles (predominantly *Astylosternus* and *Conraua*) and freshwater crabs harvest for food (see Fig. 6).



Fig. 6. Women collecting tadpoles for consumption in mountain streams (see Fig. 7).



Fig. 8. Life *Trichobatrachus robustus* collected for the international pet trade.

### International trade

In the Bakossiland the collection of frogs for the international trade started less than 10 years ago and is on the increase. It is an activity exclusively conducted by youths of less than 30 years old (Table 1). The most commonly collected frog for sale is *T. robustus* (Fig. 8). These frogs are usually delivered to the dealers alive and in pairs. Orders vary from 10 to 15 pairs and dealers generally refuse to take old females as these no longer reproduce. Individuals are sold for US\$ 4 each: Half of the price is paid in advance (before collecting the frogs). According to locals, orders for frogs are commonly received in the dry

season when frogs are also easier to collect (see above). During the dry season orders are normally filled within 10 to 24 days, during the rainy season this takes longer.

Hairy frogs are collected during the day by turning over large rocks and logs. Nets placed downstream are used to intercept the frogs. Blocking water at diverging points is also practiced while collecting *T. robustus*. Collected animals are stored in large drums and buckets with some water until the arrival of the dealers. Collectors check animals every

day and those that die are removed and eaten. On 20 November 2006, we observed 20 individuals of *T. robustus* (10 males and 10 females), collected by a young man at Belo village. Our interview revealed that he had received an order from a dealer from Douala. Demands generally originate from Limbe, a town on the Cameroonian coast, or Douala.

#### Cultural use and value

In addition to the usage of Hairy Frogs as a protein source and the collection for the international pet trade, traditional people have a strong relationship to the male *T. robustus*. They believe that the frogs fall from the sky during heavy rains. Fallen frogs are thought to be found along footpaths in the forest, on plantation roads or in torrent water. The species is believed to have mystical powers, and serves as an indicator of good luck. The most significant attribute of the mystical power of this frog is its ability to turn sterile couples fertile. If a childless couple happens to collect this frog during the heavy rains and subsequently consume it, the wife will certainly conceive if sex is practiced during the day of collection. The frog must be consumed only by this couple. It is also indispensable that the frog has been found by one of the partners and not by a third person. However, for any person collecting the frog during the rains or incidentally on the plantations while clearing or other collective farming activities, then for her or him this is a definite positive sign for life. The meaning may range from “your wife becoming pregnant” to “having the best harvests of coffee, cocoyam, plantains etc. in this season.”

#### Discussion

To our knowledge here we report for the first time the traditional medical use of an African frog, namely *T. robustus* as a cure for sterility. Additionally, this species is commonly

used as a local food source and collected for the international pet trade. Other frogs like various *Conraua* species and their tadpoles are collected as well, but exclusively for local consumption. While *T. robustus* still seems to be abundant in the region, the world’s largest frog, *C. goliath*, seems to be rare. We do not know if this species has been always rare around Mount Manengouba or if the present populations are already reduced due to over-exploitation. WILD et al. (2004) reported that *C. goliath* is present up to 700 m a.s.l. in the eastern tributaries of Kupe and Manengouba which drain into the Dibombe River in the Littoral Province. Our sites were above 1000 m a.s.l. This and the fact that our study region is the western distribution limit of the species, likely are further reasons for the rarity of *C. goliath*.

Frog and tadpole hunting by local people was common around the study site and as far as tadpoles are concerned was not species-specific. Recent studies on the herpetofauna of the Korup National Park (LAWSON 1993) and Mount Nlonako (HERRMANN et al. 2005), both located in Cameroon, also revealed that *C. robusta* and *T. robustus* were frequently consumed. The hunting pressure around the villages surveyed by us was very intense and women often undertook special trips to distant, heretofore unhunted streams to collect the frogs. This is a sign that the current collection is over-exploiting the natural populations as nearby streams no longer offer a sufficient harvest. This is also supported by hunters who indicated that collection is more successful in streams that are distant from the villages. In the Nigerian Oban plateau, where tribes related to the Bakossi people live, the same hunting techniques are used to collect frogs. There women frequently have to walk long distances to collect tadpoles and adult frogs (A. ONADEKO & M.-O. RÖDEL unpubl. data). The low densities of *C. robustus* and *T. robustus* around the villages likely is the result of the simultaneous collection of both adults and tadpoles. A severe impact on tadpoles may ultimately result in

even more critical changes in the population structure than collecting adults only (HEYER 1973, WILBUR 1980). However, collecting effects may be especially dramatic when breeding aggregations form predictably at the same sites. In some amphibian species it is known that aggregations move from year to year (MARSH et al. 1999). As in our region whole streams were regularly checked and harvested for frogs, it is likely that all focus species are equally affected.

We do not know to what extent, or if at all, the mentioned frog populations are already over-exploited and what natural population sizes would be. However, on Mount Manengouba amphibians are not only prone to collection but in addition face various adverse environmental impacts (logging, agricultural encroachment, overgrazing, water pollution by use of pesticides, etc.). Thus, further negative impacts on the growth of tadpoles and adult survival are likely. The cumulative effects of commercial exploitation and habitat loss on reptiles have been discussed by GONWOUO et al. (in press). It is known that the decline of amphibian populations may have severe effects on Neotropical stream systems (WHILES et al. 2006), but comparable data are so far lacking for Africa. The extent to which amphibians could be harvested without overexploiting them depends upon such variables as their reproductive potential, their specific life histories, their distribution and accessibility. Unfortunately, most of these data are still lacking even for the few most commonly harvested frog species. However, based on reports by local people on the difficulties to find the animals, frogs seem to be rarer now than in the recent past.

More sustainable hunting of frogs in the future should not only take into consideration population dynamics, but would best also alter some of the techniques used. These techniques are often harmful to the animals as well as the environment. These include hooked sticks, often used to pull frogs from water and their hiding places under rocks. Many animals are injured but not collected

as a result of such practices and they eventually likely die, thus increasing the death toll. Canalization of mountain streams and turning over all rocks within these streambeds greatly modify the environment more frequently and during other periods (dry instead of core rainy season) than natural, not only for frogs and tadpoles but also for other aquatic organisms.

The collection of amphibians in the region is further enhanced by the international pet trade, at least as it concerns *T. robustus*. It is known with regard to reptiles that removing even a small fraction of adults can bring a population to decline (e.g. KLEMENS & THORBARNARSON 1995). Collecting frogs for the pet trade at Mount Manengouba is a tradition of less than 10 years but is likely to expand in the years to come. Locals have previously been collecting chameleons in the area for the pet trade and recent investigations revealed the population of one of the highly desired species (*Chamaeleo pfefferi*) has dropped drastically (GONWOUO et al. in press). This could be one of the reasons why local collectors are switching to frogs, which seemingly generate the same income, but are less time intensive to collect. As with the chameleons, the populations of *T. robustus* now seem to be reduced as collectors have to move further and further to encounter them. Collection is usually done for everybody who passes by and is willing to pay, and is generally done without export permits. None of the persons interviewed had ever knowingly collected for dealers with an export permit.

*Trichobatrachus robustus* is a species that people of the Manengouba area value more than other members of the local fauna. This relationship is based on inherited beliefs. The origin of their belief that frogs of this species fall from the sky is not yet understood, but may be linked to the migration behavior of this frog, being terrestrial during non-reproductive periods and aquatic during reproduction (e.g. LAWSON 1993). Insofar as the frogs really help curing a childless couple is unknown. However, this belief seems to be

long-standing.

The ongoing social and economic changes in the Manengouba region, including habitat destruction and the collection of *T. robustus* for the international pet trade, may finally result in the local extinction of this species and hence in the extinction of a local tradition. The Mount Manengouba area has recently been recommended to the Ministry of Forestry and Wildlife and the Ministry of Culture as a World Heritage Site on the basis of the cultural values of numerous traditional societies (WILD et al. 2003). Developing sound conservation management programs for frogs and other components of the utilised biological diversity, while integrating the needs of the local populations, should help to save these cultural practices.

### Conclusions

Although the trade of amphibians provides a valuable source of revenue to locals, its practice is uncontrolled and likely to have an important and negative impact on the natural populations of particular frog species. As long as the demand is high and buyers are willing to purchase a wild-caught amphibian, the trade will surely continue. Educating the public on laws and ecology may reduce some of this demand. It is essential to control the level of exploitation to allow sustainable long-term benefits to the local population, e.g. by collecting only for dealers with valid export permits. Respective activities may contribute to protect amphibian populations around Mount Manengouba against the danger of a rapid decline. At the same time, these are also a basis for the sustainable maintenance of the cultural value of some species, i.e. *T. robustus*. Traditional owners stressed the importance of maintaining the cultural values within their clan groups and within the broader Bakossi society. Knowledge of the usage of frogs and other cultural attributes are currently widely held by people in the Bakossi region and this information is passed on to younger ge-

nerations. Nevertheless, elders of the region are already aware that social changes in the region over the last two decades, and particularly more recently, impact the extent to which cultural knowledge and practices are passed on. These changes include the practicing of more sedentary lifestyles resulting from increasing formal education opportunities, access to modern medicine and to various media such as radio, television, and internet. However, some of these changes may also contribute positively to the maintenance of cultural values, through cultural lessons at school, if incorporated into the history of the region.

Improved education of custom inspectors and more frequent inspections may aid in limiting the illegal pet trade. There are also opportunities for the Bakossi people to contribute positively to the maintenance of their cultural values. This includes the regulation of commercial collection of species by young people. This issue can be addressed by village elders in collaboration with traditional chiefs and appropriate organizations, through the development of strategies and actions to minimize and monitor the impact of the activity on wild populations. A detailed study of the natural history of *T. robustus* could certainly contribute to the development of sustainable harvesting plans. These strategies and actions could form part of the proposed Cultural Heritage Management Plan already initiated by the CRES-WWF projects.

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