Fishing in the Tropical Rain Forest : Utilization of Aquatic Resources among the Semaq Beri Hunter-Gatherers of Peninsular Malaysia

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YUKIO KUCHIKURA
Gifu University

INTRODUCTION

There has recently been much discussion as to whether hunter-gatherers can live independently of agriculture in the tropical rain forest [*e.g.* HEADLAND 1987; BAILEY *et al.* 1989; HEADLAND and BAILEY 1991; KUCHIKURA 1993]. The focal point of the argument is whether naturally occurring food resources are sufficient in quality and quantity in the biome [HUTTERER 1983; RAMBO 1988]. However, most discussions on the food availability and utilization in the tropical rain forest concentrate on terrestrial food resources, such as wild food plants (wild tubers and fruits) and game animals, and overlook of aquatic resources [GRAGSON 1992a].

Although many tropical populations depend on subsistence fishing for their dietary protein, information on resource utilization in the freshwaters of the interior is still very scarce. Numerous ethnographic studies refer to and describe fishing activities in the tropical lowlands, but most are unsystematic and anecdotal [GRAGSON 1992b: 109].

The purpose of this article is to present quantitative data on the fishing activities and utilization of aquatic resources of the Semaq Beri, a hunting and gathering group living in the interior of the Malay Peninsula. In this article, daily fishing activities, efficiency, and catch composition are quantitatively analyzed with special focus on sex and age. The role of fishing in procurement of animal foods is analyzed to understand the overall food-procurement strategy of the study group. Finally, the efficiency of fishing and consumption of aquatic resources of the study group is compared with those of other peoples of the world, especially of the Amazon and New Guinea. The data were obtained through a 12-month field study carried out in 1978–79 and a short visit in 1991.

1. THE RESEARCH AREA

The study community, composed of a maximum 60 persons, belongs ethnically to the Semaq Beri, one of the language groups of Senoi, although some Batek Negritos have joined this community through marriage. Most of the Semaq Beri, 1700 in total, have practiced shifting cultivation and lived in permanent

settlements. A few groups in the most interior part of Pahan have been nomadic until the last decade. The community I studied belongs to the latter type. These people moved to the present village of Kampong Orang Asli in Ulu Trengganu District of Trengganu State in 1977, leaving their homeland at the junction of Pahan, Kelantan and Trengganu State [KUCHIKURA 1987]. This movement took place due to the policy of the Department of Orang Asli Affairs (JOA) of the Malaysian Government, inducing nomadic communities to live in permanent settlements and take up agriculture.

Except during the rainy months of November and December, the villagers seldom stayed in the village, but spent a great deal of time on trips away from the village, including lengthy journeys (called "treks" in this paper) into the interior areas along the Trengganu, Kerbat, and Tereggan Rivers. From August 1978 to July 1979, a total of 21 treks were carried out, and the duration ranged from 2 to 36 days. The main purpose of the treks was to collect rattan (*Calamus* spp.) for sale, and to forage wild foods.

All the foods consumed by the villagers during the study period came from four sources: foods either purchased or obtained from rattan traders as advance payments for rattan (42.7% of the total energy intake), rations supplied by the JOA (24.3%), cultivated foods harvested in their own gardens (21.9%), and wild foods procured by hunting, fishing and gathering (11.3%). It is remarkable that about 70% of the total energy came from exogenous foods. It should be also noted, however, the people still relied on hunting and fishing of wild fauna for 43.3% of protein consumed during the study period. The nutritional status of the people was assessed to be good. They were consuming energy and protein at levels above the standards set by FAO/WHO [KUCHIKURA 1988a].

The Malay Peninsula has a typical equatorial climate characterized by constantly high temperature, high relative humidity, and high annual rainfall. In Trengganu, the peak rainy season is in November, December and January due to the Northeast Monsoon. Flooding starts usually in late November and sometimes continues into January, although the annual variation is great. The climate for several months following the flood season is quite dry and hot. According to meteorological records (1968–1978) of the nearby station in Kuala Brang, the mean annual precipitation reaches nearly 3800 mm, 40% of which is concentrated in two months of November and December.

The western interior of Trengganu State is mountainous. The Semaq Beri activity area was ordinarily confined to the foothills below 600 m in altitude, covered with lowland tropical rain forest. For compiling quantitative data on the villager subsistence, their activity area was divided into two: the "village area" and "camp area" (Figure 1). The former is defined as the area within a five-kilometer radius of the village, where day-trips for various purposes were carried out.

The "camp area" is defined as the parts of the interior where treks to collect rattan were carried out. In fact, the "camp area" extends along the major rivers, such as the Trengganu, Kerbat and Terengan, to the west of the reservation. The

remotest camp site was about 30 km away from the village.

A broad logging road reached up to the border between Trengganu and Kelantan, crossing the Ulu Trengganu area from east to west. The timberyards and the forestry worker living quarters were located at the meeting points of the rivers along the logging road. The Semaq Beri made full use of the logging roads for travel and other activities. The logging activity is one of the most important factors in the Semaq Beri's increasing reliance on selling rattan [KUCHIKURA 1987, 1988a].

The complex network of streams and rivers formed in the activity areas of the Semaq Beri provides a variety of aquatic resources. The Semaq Beri classify the water system on the basis of topography and size: *pahog, lawog, gerade'*, and *palu'*. The *pahog* is a small stream of the uppermost part of a river, less than five meters in width and less than one meter in depth. The *lawog* is an intermediate size of river where several *pahog* streams merge, 10–30 meters wide and less than three meters deep. An assembly of the *lawog* is the *geradu'*, the main rivers, such as the Trengganu, Kerbat, and Terengan. The size of the *geradu'* in the Semaq Beri land is 50–250 meters wide, and the depth may exceed ten meters. The *palu'* is any form of still water of various sizes, from a vast lake to a small pool or dam made when a stream was obstructed by timber road construction or a natural landslide.

The *lawog* were the most important fishing grounds for the Semaq Beri. The percentage of time spent in each body of water to the total fishing time was: *lawog* (69.6%), *pahog* (17.0%), *palu'* (9.2%), and *geradu'* (4.2%). Judging from the preferential use of the *lawog*, it was assumed to be the most appropriate for their

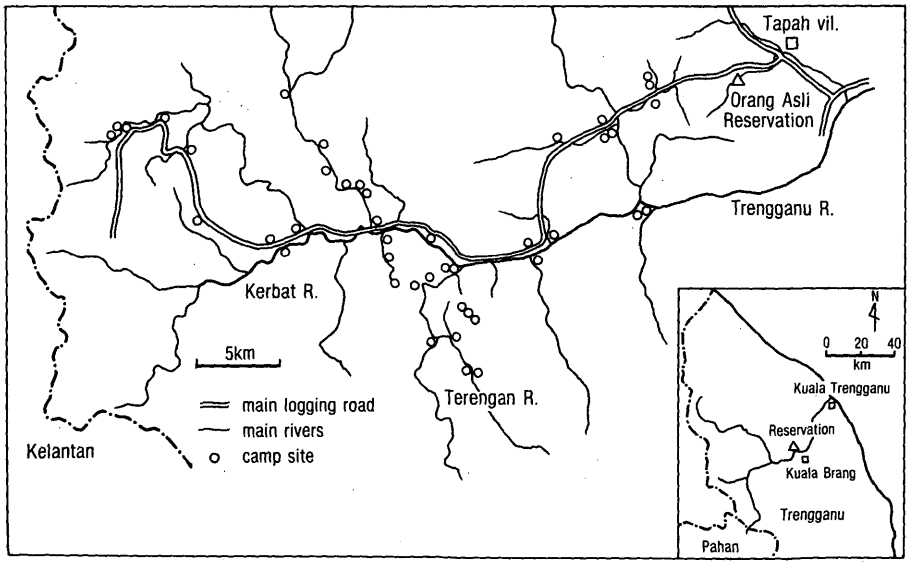

Figure 1. Activity Area and Camp Sites of the Study Group

fishing techniques among the categories of water system.

2. DATA COLLECTION

The data on fishing activities were compiled separately for the "village area" and "camp area." Activities in the village were studied for 140 successive days, from August 1978 to January 1979. In addition, data were also collected for 74 days when I was present on and off at the village from February to June 1979. Activities in the camp area were recorded during a total of 12 separate treks, during 120 days from September 1978 to July 1979. I accompanied many fishing events both in the village area and at the camp area, where I observed the detail of fishing activities. As for the fishing trips I did not accompany, the departure and arrival times of each individual were recorded, and the catches brought back were weighed. On arrival the trekkers were interviewed about the route of the trips and which categories of water system they had fished in.

The sex-age categories were used throughout the present study. The categorization is based on the Semaq Beri age-grade system, in which five stages are arranged for each sex [KUCHIKURA 1987]. Small children under approximately ten years are called *krakon* for both sexes. This age-grade is ignored in the present study, because they rarely engaged in the subsistence activities. The children up to age 15 or so in the next stages, *blujin* for males and *kra'i'e'* for females, begin to participate in various subsistence activities. The boys and girls who reached sexual maturity proceed to the *bujang* and *kra'ya'* stages, respectively, and are expected to seriously engage in economic activities and domestic work. Although a man remains at this stage until the latter half of his twenties regardless of his marital status, a woman is never called *kra'ya'* after marriage. The men and women in the latter half of their twenties enter into the *toha* stage. The older people (approximately over 50 years) may be called *a'* for male and *gaya'* for female.

In the present study, the male *toha* persons were divided into two groups: *toha*-I and *toha*-II. The *toha*-I was composed of the three oldest males, including one person of *a'* stage. The members of *toha*-I had retired from the role of "hunter" in blowpipe hunting. In this type of hunting, a hunting group sometimes consisted of two kind of roles: the "hunter" who chased and shot at game, and the "carrier" who did not use the blowpipe and only carried the game [KUCHIKURA 1988b]. *Toha*-I members participated in blowpipe hunting only as the "carriers." All of the *toha*-II group were the "hunters." All married women were included in the *toha* group despite the fact that two of them were under age 20, because the kinds and contents of work of married women were the same.

3. AQUATIC RESOURCES AND FISHING METHODS

1) Aquatic Resources

The animals utilized as food are classified into three categories on the basis of habitat: tree-dwelling (*ay ha' delong*), ground-dwelling (*ay ha' ate*) and water-dwelling (*ay ha' tom*). The fishing activities are here defined as procurement of the "water-dwelling animals," which include fish species, turtles and water tortoises, frogs, shrimps, crabs, and shellfish (Table 1).

Among about 30 species of fish captured and identified during the study period, the cyprinids were overwhelmingly important, accounting for 84% of the total yield of fish species (Table 2). Of the cyprinids, two species (*Tor tambroides* and *Acrossocheilus* sp.) were large-sized, weighing up to 3.5 kg, with a mean of 400–500 g. Other species of the cyprinids were much smaller, ranging from 10–100 g. The two larger species of the cyprinids amounted to 56% of the total yield of fish. Another important family of fish was the channids, weighing 300–400 g maximum. All fish of this family were captured in the ponds and pools (*palu'*), accounting for 9% of the total yield of fish. Minor families of fish, including the osteoglossids, cobitids, bagrids, pristolepids, and mastacembeloids, together accounted for only 7% of the total yield of fish.

The two species of tortoise and turtle were much more important food sources than fish species, together accounting for nearly 70% of the total yield of aquatic animals in net weight. The water tortoise (*Cyclemis dentata*) is fairly common in all the interior water systems, from the small mountain streams (*pahog*) to the main rivers (*geradu'*). The tortoise grows to over 3 kg, with a mean weight of about 1.7 kg for the samples I weighed. The Malayan mud turtle (*Trionyx cartilagineus*), when fully mature, is the largest among the animals the Semaq Beri ordinarily pursue. The largest individual captured during the study period weighed 26.8 kg, while the mean weight of the turtles was 9.7 kg. Although the turtle is far less common than the water tortoise, much effort was devoted to search and pursuit because of the large quantity of meat it provided.

Another important aquatic animal is the giant frog (*Rana macrodon*), with a mean body weight of 540 g. The frogs, usually found in the shallows of larger rivers (*lawog* and *geradu'*), accounted for 4% of the total amount of aquatic animals procured. Small water creatures, such as shrimps, crabs, and shellfish, were least important in the Semaq Beri's diet, although they are commonly found in their activity areas.

2) Fishing Tools and Methods

A variety of tools and methods were employed to exploit the resources in accordance with the size of the water system (Table 3).

The rod-and-line method was mainly used in the small streams (*pahog* and *lawog*) and ponds (*palu'*) for small-sized fish, including smaller cyprinids such as

Table 1. Composition of Aquatic Resources Captured by Various Fishing Methods

Resources	Rod-and-line fishing (kg)[1]	Poison fishing (kg)	*Lem-lem* fishing (kg)	Dive fishing (kg)	Frog fishing (kg)	Row total (kg)
VILLAGE AREA:						
Fish species	6.3 (1.1)[2]	14.1 (2.3)	—	5.8 (1.0)	—	26.2 (4.4)
Water tortoise (*Cyclemys dentata*)	—	—	57.7 (9.6)	30.6 (5.1)	—	88.3 (14.7)
Malayan mud turtle (*Tryonyx cartilagineus*)	—	—	46.0 (7.7)	82.5 (13.7)	—	128.5 (21.4)
Giant frog (*Rana macrodon*)	—	—	—	—	1.6 (0.3)	1.6 (0.3)
Sub-total	6.3 (1.1)	14.1 (2.3)	103.7 (17.3)	118.9 (19.8)	1.6 (0.3)	244.6 (40.8)
CAMP AREA:						
Fish species	35.4 (5.9)	—	—	107.0 (17.9)	—	142.4 (23.8)
Water tortoise (*Cyclemys dentata*)	—	—	46.3 (7.7)	81.3 (13.6)	—	127.6 (21.3)
Malayan mud turtle (*Tryonyx cartilagineus*)	—	—	28.7 (4.8)	32.0 (5.3)	—	60.7 (10.1)
Giant frog (*Rana macrodon*)	—	—	—	2.7 (0.5)	21.1 (3.5)	23.8 (4.0)
Sub-total	35.4 (5.9)	—	75.0 (12.5)	223.0 (37.3)	21.1 (3.5)	354.5 (59.2)
COMBINED:						
Fish species	41.7 (7.0)	14.1 (2.3)	—	112.8 (18.9)	—	168.6 (28.2)
Water tortoise (*Cyclemys dentata*)	—	—	104.0 (17.3)	111.9 (18.7)	—	215.9 (36.0)
Malayan mud turtle (*Tryonyx cartilagineus*)	—	—	74.7 (12.5)	114.5 (19.0)	—	189.2 (31.5)
Giant frog (*Rana macrodon*)	—	—	—	2.7 (0.5)	22.7 (3.8)	25.5 (4.3)
Column Total	41.7 (7.0)	14.1 (2.3)	178.7 (29.8)	341.9 (57.1)	22.7 (3.8)	599.1 (100.0)

1) Edible weight.
2) Percentage to the total yield.

Puntius spp., *Rasbora* spp., snakeheads of the genus *Channa*, catfish of the genus *Clarias* and *Mystus*, the pristolepids, and so on. Large fallen trees or road construction sometimes obstructed streams and formed small pools which offered good fishing spots. The fishing gear consisted of hook and nylon line bought at the town stores, and a pole of palm rib fashioned on the spot. Earthworms were used for bait. The rod-and-line fishing was done by all age classes of both sexes except toddlers, more frequently by adult women and older girls and less by adult men. Large fishing parties were occasionally formed to make an excursion to

Table 2. Percent Distribution of Fish Species

Scientific Name	Rod-and-line (%)	Poison (%)	Dive (%)	Row Total (%)
Osteoglossidae				
Scleropages formosus	0.2	—	—	0.2
Cyprinidae				
Cycleochelichthys apogon	1.7	0.2	0.2	2.1
Hampala macrolepidota	—	—	0.6	0.6
Mystacoleucus margipatus	0.4	0.1	0.2	0.7
Osteochilus hasseltii	0.9	0.7	0.2	1.8
O. vittatus	0.6	0.3	7.7	8.6
O. spilurus	0.1	0.5	—	0.6
Puntius gonionotus	3.3	3.5	1.3	8.1
P. lateristriga	0.9	0.2	0.1	1.2
P. partipertazona	n	0.1	—	0.1
P. sp.	—	0.1	—	0.1
P. sp.	0.4	0.1	—	0.5
P. sp.	n	0.1	—	0.1
Rasbora elegani	0.6	0.1	0.1	0.8
Tor tambroides	0.2	—	35.3	35.5
Acrossocheilus sp.	—	—	20.2	20.2
Acrossocheilus sp.	1.6	0.6	0.9	3.1
Cobitididae				
Acanthophthalmus kuhilii	—	0.1	—	0.1
Bagridae				
Mystus nemurus	0.8	0.2	—	1.0
Clariidae				
Clarias batrachus	1.1	0.5	—	1.6
C. macrocephalus?	—	0.2	0.2	0.4
Pristolepidae				
Pristolepis fasciatus	1.7	0.3	1.0	3.0
Channidae				
Channa lucius	1.4	—	—	1.4
C. macropeltes	6.4	—	0.1	6.5
C. striatus?	1.1	—	—	1.1
Mastacembeloidae				
Mastacembelus armatus	0.1	0.1	—	0.2
Others	0.4	n	—	0.4
Column Total	23.9	8.0	68.1	100.0

*n: negligible.

unusually good fishing spots far from the camp, including all the adult women and their children of the camp together with one or two adult men.

A long nylon line of 20–30 m with a large baited hook was used in the deep

Table 3. Classification of the Water System and Percent Use of Fishing Grounds[1]

Category of the water	Rod-and-line fishing (%)	Poison fishing (%)	*Lem-lem* fishing (%)	Dive fishing (%)	Frog fishing (%)	Net fishing (%)	Row Total (%)
geradu'	0.6	—	—	3.6	—	n[2]	4.2
lawog	11.8	4.0	22.3	30.2	1.2	0.1	69.6
pahog	5.9	2.7	7.0	1.2	0.2	—	17.0
palu'	9.2	—	—	—	—	—	9.2
Column Total	27.5	6.7	29.3	35.0	1.4	0.1	100.0

1) Percentage of the time spent in each fishing method and in each water-body category to the total fishing time.
2) Negligible.

water of the main rivers, mainly targeting the two large-sized species of cyprinids. The line cast by hand as far as possible from the shore of a river was retrieved using an empty tin as a reel. This fishing method, observed in only two instances during the study period, was done exclusively by men.

Poison fishing was practiced three times during my stay; twice in the streams near the village and once in the mountain stream several kilometers away from the village. The poison used in these instances was obtained from a kind of wild yam (*Dioscorea piscatorum*)[1]. The yam tubers were pounded on a rock and dumped in the stream. After a while, fish began to float on the surface of water. Dams were built of sticks and palm leaves at several points downstream from the place where the poison was thrown in to sweep up and catch fish there. Poison fishing was practiced only during the drier months when the water was low. The preparation and introduction of the poison into the stream were usually the task of adult men, and the fish were collected mainly by women and children. The kinds of fish obtained by this method were almost identical with the rod-and-line method, although the relative proportions were slightly different. According to the Semaq Beri, once the poison was introduced, it might take about three months for fish to return to the stream.

The Semaq Beri had two types of fish trap, both of which were made from rattan. The first type, called *bubu*, had an elongated shape with a funnel-shaped opening of rattan splints at one end and the other end closed by a lid. The trap was placed in the stream with an accompanying weir built of sticks and palm leaves. The weir was the same as the ones used as the dam for fish poisoning. The opening of the trap was set facing downstream so that fish ascending the stream were obstructed by the dam and compelled to enter the trap. The second type, called *tawar,* was cylindrical in the entrance and tapered at the other end in order to entangle the fish advancing into the interior of the trap. Fish-trapping has lost its importance to the Semaq Beri, and the catch by this method was negligible in the fish yield during the study period.

Fish-spearing, using a "spear-gun," has been the most important fishing

method for the study group since the latter half of the 1970's when swimming goggles became popular and available. Swimming and diving, a fisherman shoots at fish hiding under rocks or tree debris with a spear-gun made with a thin iron rod. The spear is discharged by the stretched ribbon of an inner-air tube from the wooden projectile stand. Almost all of the catch of the two large-sized species of cyprinids were obtained by this method. The less common species captured by this method were *Osteochilus vittatus, Puntius gonionotus, Hampala macrolepidota*, a smaller species of *Acossocheilus*, which ranged from 150–300 g in weight. It is remarkable that this fishing method, probably modeled after that of the local Malays, had almost simultaneously been prevailing among the Orang Asli populations [HOWELL 1984; RAMBO 1985].

A set of casting nets, bought at the store and owned by the village headman, was freely borrowed by anyone who wanted to use it. The set of nets was usually used in the shallows of a larger river (*geradu'*). After the net was thrown by a man, he and two or three co-workers dashed toward the net to pin down the fish caught in the mesh. I observed only two occasions when the set of nets was used in such manner. The nets might also be used as a gill net, set parallel to the shore in the deeper water. However, the nets accounted for only a negligible amount of fish during the study period.

Fish-driving, the traditional fishing among the Orang Asli populations [SKEAT and BLAGDEN 1906], was observed on only one occasion. A large *tawar* type trap was placed in the opening of stone piles which were built across a relatively wide and shallow river. Several persons in a row drove fish toward the trap from upstream by slapping the water surface.

A method called *lem-lem* was usually employed for searching for the water tortoise (*Cyclemys dentata*) and the Malayan mud turtle (*Trionyx cartilagineus*) in the small rivers or streams with a depth of less than one meter. A fisherman prodded the underwater holes or under boulders with a stick or machete, or thrust his feet in to the holes. When he felt the tortoise, he caught it by hand. In the deeper water, a fisherman searched for both tortoise and fish simultaneously, while swimming and diving.

There was another searching and catching method for the mature turtle, which is most active in the twilight hours. While walking along the river or stream, a man searched the likely places for the turtles to hide, carefully looking for the turtle's snout. A harpoon (*tikam*) was usually used for catching the mature turtle, too ferocious to catch by hand. The barbed, detachable harpoon head, made from a piece of iron blade and fixed to the end of a wooden shaft about two meters long, was stabbed into the turtle's soft shell. Then, the turtle was pulled up by hauling the rope connected to the harpoon, and was knocked to death with a machete.

On a moonless night, the giant frog (*Rana macrodon*) was caught by using an electric torch. Walking slowly in the shallows, a fisherman threw a beam of light in the direction of the songs of the frogs, and quickly caught the frog, blinded and

immobilized by the light.

4. EFFORT, RETURN, AND EFFICIENCY OF FISHING

1) Time Spent in Fishing and Other Subsistence Activities

The amounts of time (in minutes) spent daily in fishing and on other various subsistence activities are presented according to the sex-age categories (Table 4).

The fishing activities were classified into five categories according to method: rod-and-line, poison, *lem-lem*, dive, and frog fishing. Such fishing activities as drive-fishing and net fishing, which occurred on only one or two occasions, were excluded from the present study.

Among the categories of fishing, the *lem-lem* fishing and dive fishing require definition and explanation. As mentioned above, more than one resource was sometimes pursued in a single activity. While swimming and diving, the men were engaged in spearing fish, simultaneously in searching for water tortoise and mud turtle. So I could not separate the data for spearing from that for pursuit of the tortoise and turtle when analyzing the quantitative variables such as time spent in the activities. The distinction I made between these two categories of fishing is based on the depth of water where fishing is practiced. Fishing for the water tortoise and the mud turtle in the shallower water is here defined as *lem-lem* fishing. It does not include swimming and diving. Fishing with swimming and diving in the deeper water, including spearing and catching turtle and tortoise, is considered dive fishing.

Among the sex-age categories, the *bujang* spent the largest amount of time in fishing, both in the village and camp areas; 66 minutes or 33.3% of the daily total time dedicated to subsistence activities. With advanced age grades, fishing reduced its importance in subsistence activities for men; respectively, the *toha*-I and *toha*-II groups spent 23 min and 38 min daily on fishing, which are equivalent to 11.8% and 18.9% of the total time dedicated to subsistence activities. The boys of the *blujin* stage devoted less time to fishing than the *bujang* group, but the time allocation pattern among the subsistence activites, expressed by the proportion of time spent in each subsistence activity to the total amount of time dedicated to subsistence activities, was similar to that of the *bujang* group. The *blujin* boys actually worked and played together with the *bujang*. It is remarkable that the total amount of time dedicated to subsistence activities was almost identical among the three male age stages over the *bujang* stage, despite the difference in time allocation pattern. This means that a Semaq Beri man, after reaching maturity, works as much as possible despite his age in order to fulfill his obligations imposed in a hunting and gathering society based on thoroughgoing egalitarianism and mutual aid [*e.g.* TANAKA, 1973].

Compared with men, women dedicated much less time to the subsistence activities. The time the *toha* women spent on the overall subsistence activities was

Table 4. Time Spent in Various Fishing Activities and in Other Subsistence Activities[1)]

Sex-Age category	Fishing						Blow-pipe hunting[2)]	Gather-ing[3)]	Agri-culture	Col-lecting[4)]	Total
	Rod-and-line	Poison	*Lem-lem*	Dive	Frog	Sub-total					
(1) VILLAGE											
Male:											
toha-I	—	4	19	—	—	23	(80)	5	63	7	178
toha-II	1	3	21	14	—	39	86	5	34	4	168
bujang	2	2	25	31	1	61	(32)	2	22	8	122
blujin	5	2	6	16	1	30	(11)	1	7	3	52
Female:											
toha	6	2	—	—	—	8	(3)	4	53	—	68
kra'ya'	14	2	—	—	—	16	—	6	28	—	49
kra'i'e'	8	5	—	—	—	13	—	5	24	—	42
(2) TREKS											
Male:											
toha-I	1	—	20	—	—	21	(66)	3	—	160	250
toha-II	5	—	13	18	1	37	65	1	—	160	263
bujang	5	—	16	48	5	74	(49)	1	—	171	295
blujin	8	—	5	30	2	45	(26)	—	—	166	237
Female:											
toha	24	—	—	—	—	24	(2)	20	—	6	52
kra'ya'	23	—	—	—	—	23	—	2	—	4	29
kra'i'e'	15	—	—	—	—	15	—	—	—	—	15

1) Minutes per person per day spent in each activity. The number of persons in each sex-age category: *toha*-I (3); *toha*-II (8); *bujang* (4); *blujin* (4); female *toha* (12); *kra'ya'* (2); *kra'i'e'* (1).
2) The figures in parenthese are the time the "carriers" spent in blowpipe hunting.
3) Gathering of wild plant foods, such as yams and fruits.
4) Collecting of rattan and incense wood (*Aquilaria* spp.).

about one third of the time *toha* men spent over the course of a year. The increasing emphasis of rattan sales for subsistence had freed the women from foraging activities, such as collecting wild yam. Therefore, the reliance on the women's labor for food acquisition was much reduced as compared with the traditional way of life. This trend can be confirmed by the fact that the women of a Batek Negrito community in Kelantan, which depends much more on wild foods than the Semaq Beri, spent 172 min, or 2.7 times more daily than the Semaq Beri women in subsistence activities [ENDICOTT and BELLWOOD, 1991]. The *toha* and *kraya'* women spent 13 min and 19 min daily on fishing, or 20.3% and 41.3% of the total time dedicated to the overall subsistence activities, respectively. The daily average time the women spent fishing was about one third of that of the men.

The proportion of the time spent on each fishing activity varied greatly among the sex-age categories. The *toha*-I men spent 85% of the total fishing time *lem-lem* fishing, and they never engaged in dive fishing or frog fishing. The dive fishing gained its importance in total fishing as the age-grade descended; the *toha*-II group allocated 41% of the total fishing time to dive fishing, although the two oldest men of this category did not participate in dive fishing; dive fishing was the main fishing method for the men of *bujang* and *blujin* categories, who spent nearly 60% of their total fishing time in dive fishing. Compared with *lem-lem* fishing, dive fishing requires more strenuous work, low temperature tolerance, and alert sensory-motor action. The younger men are, in general, superior to the older in these abilities. On the other hand, *lem-lem* fishing requires experience in pinpointing where a tortoise or turtle is likely to hide. On this point, the older men have an advantage over the younger.

The difference in fishing patterns among the male age categories may be analyzed from another perspective: tradition vs. innovation. For the study group, poison and *lem-lem* fishing were traditional fishing methods, in contrast to dive fishing, a newly introduced technique. The younger are more eager to embrace a new technique than the older, who adhere to tradition.

Women engaged in only the rod-and-line and poison fishing, regardless of age. Women's time spent as a whole accounted for 73% of the total villagers' time spent in the rod-and-line fishing.

2) Seasonality in Frequency of Fishing Events

The frequency of fishing events is here represented as the percentage of persons who actually engaged in fishing within the total number of persons present in a given period of study (Table 5). The yearly frequency of fishing events for the males of the four age categories jointly was 8.5% in the village and 30.5% at the camp area. Because of the general abundance of aquatic resources, the males went fishing 3.6 times more frequently in the camp area than in the village area. This tendency was true for women as well; the average frequency for the three age-categories was 5.2-fold higher in the camp area than in the village area. Among all sex-age categories, the *bujang* group showed the highest frequency both in the

Table 5. Frequency of Fishing Events according to Sex-Age Categories

Sex-age category	Village (%)	Camp (%)	Combined (%)
Male:			
toha-I	5.1	9.0	6.0
toha-II	7.9	20.4	11.9
bujang	14.3	51.1	30.1
blujin	7.6	35.5	17.0
Average for the males	8.5	30.5	15.9
Female:			
toha	2.7	16.9	6.7
kra'ya'	5.1	16.6	8.0
kra'i'e'	3.5	11.4	5.6
Average for the females	3.2	16.5	6.2

* Frequency of fishing events is the percentage of the number of persons engaged in fishing to the total number of persons present in a given period.

village and in the camp areas; the next highest group was the *blujin*. The *toha*-I group had the lowest frequency in the camp area. Because they worked equally hard to obtain rattan as the younger groups, it might be physically too strenuous for them to fish.

The frequency of fishing events fluctuated monthly in the village area and varied greatly among the treks (Table 6). The monthly frequency of fishing in the village area negatively correlated with the monthly precipitation, except for May and June. The rising rivers and frequent floods during the rainy months made any type of fishing dangerous and unproductive. At the end of the rainy season, the people resumed fishing, believing that the floods brought more abundant resources. However, the actual situation was contrary to their expectation. The villagers seldom engaged in fishing after May, in response to the decline in the fish return rates in the village area and the end of the mud turtle mating season. The decline in the frequency of fishing in May and June was partly due to the increase in cash income from the rattan trade. The increase in the purchase of tinned fish or raw sea fish in the market decreased the overall procurement of animal food.

Although there was a tendency for the trek fishing frequency to decrease during the rainy months (Trek-7/8 and Trek-12), the large variation among the treks was rather due to the geographical constraints in the locations where the camps were set up. When there was no river near by, such as *lawog* or *geradu'* suitable for *lem-lem* or dive fishing, the adult men over the *bujang* stage rarely engaged in fishing. Instead, women and smaller boys attempted to procure fish by rod-and-line fishing in the small streams or ponds. Conversely, when the camp was set up in the vicinity of the larger river or streams suitable for the *lem-lem* or dive fishing, women rarely went fishing because men brought back sufficient

Table 6. Fluctuation of Frequency in Fishing Events

(A) VILLAGE AREA

Month	Number of days observed	Frequency of fishing events		
		Male[1]	Female[2]	Combined
1978				
Aug.	5	10.7	0.0	5.9
Sep.	30	8.8	2.9	5.9
Oct.	31	1.1	0.6	0.9
Nov.	30	0.6	3.8	2.1
Dec.	31	2.5	3.6	3.1
1979				
Jan.	14	20.9	11.6	16.9
Feb.	12	18.6	5.8	13.1
Mar.	15	25.2	5.6	17.1
Apr.	15	12.1	0.0	6.8
May	14	0.6	0.0	0.3
Jun.	17	0.0	0.0	0.0

(B) TREK (CAMP AREA)

Trek number	Date	Days	Frequency of fishing events		
			Male[1]	Female[2]	Combined
1[3]	Sep. 1– Sep. 5	5	0.0	—	0.0
3	Sep. 14– Sep. 18	5	48.0	60.0	52.5
5[3]	Sep. 26– Sep. 29	4	18.2	—	18.2
7/8	Oct. 17–18/ Oct. 22–24	5	10.0	24.0	16.4
12	Jan. 15– Feb. 8	25	27.1	26.7	26.9
13[3]	Feb. 11– Feb. 18	8	33.6	—	33.6
15	Mar. 6– Mar. 21	16	52.8	4.6	31.6
17	Apr. 7– Apr. 16	10	37.7	1.1	22.7
18-I[4]	Apr. 26– May. 6	11	9.9	12.3	11.0
18-II	May 7– May. 16	10	64.4	14.3	42.5
19	May 31– Jun. 6	7	3.2	61.2	28.6
21	Jun. 24– Jul. 7	14	29.9	3.2	17.9

1) The average for the males over the *blujin* stage.
2) The average for the females over *kra'i'e* stage.
3) The treks were composed of only males over the *blujin* stage.
4) The trek was divided into two parts for the data compilation because the course of trek shifted and half the participating families returned to the village in the second half of the trek.

amounts of fish or tortoise meat. If Trek-5 and Trek-13, in which the members were composed of only adult men and older boys, are excluded from the calculation, there was a significant, although weak, negative correlation, between the combined fishing frequency of adult men over the *bujang* stage and that of the *toha* women ($r=0.421$, $d.f.=6$, $p<0.02$).

Table 7. Return Rates of Fishing

(A) Fishing Method	Per-event return[1]			Hourly return[2]		
	Village	Camp	Combined	Village	Camp	Combined
Rod-and-line fishing	68	130	114	14	60	40
Poison fishing	392	—	392	55	—	55
Lem-lem fishing	997	893	951	128	247	161
Dive fishing	1226	1028	1089	172	351	258
Frog fishing	160	422	378	123	557	446
Average	719	568	621	110	226	158
(2) Sex-Age Category						
Male:						
toha-I	643	742	679	80	188	104
toha-II	1101	914	998	150	306	202
bujang	1217	828	934	173	345	254
blujin	517	505	509	77	231	143
Average for the males	915	786	831	126	288	186
Female:						
toha	112	236	199	22	100	63
kra'ya'	100	125	113	19	45	29
kra'i'e'	129	113	120	22	51	31
Average for the females	111	209	172	22	88	53

1) Edible g/person/event.
2) Edible g/hr.

3) Daily Return and Efficiency

Both the daily and hourly return rates per person varied considerably with the fishing activities, and also showed a great difference between the village and the camp areas (Table 7).

Rod-and-Line Fishing

The streams in the vicinity of the village had been depleted through intensive exploitation by the study group and the Malays. Thirty out of 93 (or 32%) persons who engaged in this type of fishing in the village had no return. The daily return rate was only 68 g/person in edible weight, and one hour's fishing produced 14 g in the village area.

Compared with that of the village area, the success rate (the percentage of the persons who brought back some return to the total persons engaged in fishing) was very high (96%) at the camp area. A person normally obtained 500–800 g of fish in 1–3 hours' fishing at a good fishing spot. One hour of actual fishing averaged 60 g of fish in edible weight, and the net amount of return per event was 130 g/person. These figures showed fishing in the camp area was 2–4.5 times more efficient than that in the village area.

Poison Fishing

Of the three instances of poison fishing during the study period, the first instance took place in an undisturbed stream far from the village (about 5 km away from the village), and the second and third instances in two different streams within the village boundary. Six adult men participated in the first instance, which required 11.6 hrs, including travel time to and from the fishing spot. The total amount of catch, mainly consisting of *Puntius* spp., was 10.5 kg in gross weight, equivalent to 1.23 kg/person and 105 g/hour in edible weight. The second and third instances were much less efficient than the first case, because of the depletion of fish resources in the vicinity of the village. The per-event and hourly return rates was jointly calculated at 224 g/person and 36 g/hour. The average return rates for the three instances were 392 g/person/event and 55 g/hour, which were much higher than those of the rod-and-line fishing.

Lem-Lem Fishing

The per-event return was higher in the village area, but, conversely, the hourly return rate was higher in the camp area. The net per-event per person return rate was 997 g/person in the village area and 893 g/person in the camp area. On the other hand, the hourly return rate was 128 g in the former and 247 g in the latter. This perplexing fact is explained by the difference in fishing time per event between both areas. The average time per event was 7.8 hrs in the village area and 3.6 hrs at the camp area. The difference in fishing time was mainly due to travel time, to and from the fishing spot. This is also true for dive fishing, and discussed in a later section.

The success rate of fishing also varied greatly between the two areas: 51.9% in the village area and 72.7% in the camp area. The higher per-event return despite the lower success rate in the village area may be based on the difference in the composition of catch: the mud turtle comprised about 40% of the total catch in the village area, and about 25% at the camp area. If the people pursue only *C. dentata*, they will constantly get a relatively small quantity of meat (about 1.0 kg/person/event in edible weight). If, on the other hand, one mud turtle is captured, a large quantity of meat is obtained (5.8 kg/person/event in edible weight). Such events, however, occurred only one out of seven or eight fishing events, both in the village and the camp areas.

Dive Fishing

Dive fishing accounted for 48.6% of the fishing yield in the village area and 62.9% in the camp area. The per-event return rate was the highest both in the village area and in the camp area: 1226 g/person and 1028 g/person. The hourly return rate was the highest in the village area (172 g/hr) and the highest next to frog fishing in the camp area (351 g/hr). Considering that frog fishing accounted for only 5.9% of the total yield even in the camp area, dive fishing can be regarded

essentially as the most important and productive fishing activity.

As with *lem-lem* fishing, the composition of catch showed a marked difference between the village and camp areas. In order of the percentage of the total net weight of yield, they were: the mud turtle (70.3%), the water tortoise (26.0%), and fish species (3.7%) in the village area; the water tortoise (41.8%), fish species (41.7%), and the mud turtle (16.5%) in the camp area. There was a tendency for the larger mud turtles to be found more frequently in the village area than at the camp area. This was probably related to the geographical difference between the two areas. The lower reaches of a river may provide a more suitable habitat for the turtles than the upper courses of a river. In the interior areas where the camps for collecting rattan were set up, the relatively undisturbed rivers or streams provided many good fishing spots for the two species of large-sized fish, *Tor tambroides* and *Acrossocheilus* sp., and the water tortoise. The two fish species, which were the main targets of spear fishing at the camp area, were rarely caught in the village area because of the depletion of resources or for geographical reasons.

Frog Fishing

Since frog fishing was practised in the night just around the village or camps, it was usually done for a very short duration. The fishing time ranged from 0.5 to 1.5 hrs. While the amount of catch in a single fishing instance was not large (160 edible g/person in the village area and 422 edible g/person at the camp area), the hourly yield in the camp area was the highest among all the fishing activities (557 edible g/hr).

Difference in Fishing Efficiency by Sex-age Categories

The great variation in return rates among the sex-age categories was based on various factors, such as the fishing techniques or their combination, physical strength, experience and skill (Table 5). The *toha*-II and *bujang* groups had the highest efficiency both in the per-event return and in the hourly return rate. They brought back 800–1200 edible grams of fish and/or turtle meat in a fishing event, which was equivalent to 140–210 g of animal protein. An average family (equivalent to 2.7 adult males, calculated by applying man-value coefficient for food consumption, KUCHIKURA, 1987) consumed 105 g of animal protein per day. In this regard, an adult male could fulfill his family requirement of the day with some surplus.

Women were much less efficient in fishing than men regardless of age, because they generally engaged only in the fishing activities with a lower efficiency. The per-event returns of their fishing could only satisfy their own demand of animal protein of the day.

Gradual Depletion of Aquatic Resources in the Village Area

It was expected that aquatic resources near the village might have been depleted by intensive exploitation in the past, and that, in contrast, the areas far

Table 8. Variation of Return Rate in Accordance with the Distance of Fishing Ground from the Village

Fishing method	Near zone[1]			Intermediate zone[2]			Remote zone[3]		
	Time per event (hr)	Return per event (g)[4]	Hourly return (g)[4]	Time per event (hr)	Return per event (g)	Hourly return (g)	Time per event (hr)	Return per event (g)	Hourly return (g)
Rod-and-line fishing	3.7	40	11	6.6	111	17	—	—	—
Poison fishing	6.2	227	37	11.6	1217	105	—	—	—
Lem-lem fishing	4.9	206	42	7.8	968	121	10.2	2138	209
Dive fishing	2.4	176	73	6.3	752	120	11.5	2365	205
Average	3.9	134	35	7.7	723	98	11.2	2309	206

1) The area within a 2-km radius of the village.
2) The zone between the 2-km and 5-km radii of the village.
3) The area over the 5-km radius of the village.
4) Edible weight.

away from the village were subject to less resource depletion. In order to compare return rates in which resource depletion will be reflected, the activity area around the village was divided into three zones: the near zone within a 2-km radius of the village, the intermediate zone from 2 to 5 km from the village, and the remote zone over 5 km from the village (Table 8). In any fishing method, the per-event return rate increased remarkably with the distance from the village. The hourly return rates also improved as the distance from the village to the fishing spots became longer, although the total time in a fishing event apparently increased because of the longer travel time.

Dive fishing in the village area showed a typical pattern of resource depletion. The expeditionary fishing events, highly focused on the mud turtle, took place several times between February and April, corresponding to the mating season in which the turtles, solitary in other seasons, gathered in specific places found in the remote zone. For example, in the expedition carried out by a group of 12 men on 2 April 1979, five large turtles were captured, weighing 48.6 kg in total. The per-event return for these expeditions amounted to 2.37 edible kg/person with a mean hourly return rate of 205 edible grams.

On the other hand, dive fishing within the near zone had a much lower efficiency. For example, dive fishing performed during the hottest season of February to May produced only 77 edible grams per event with an hourly return rate of 21 edible grams. Dive fishing in the near zone might been seen as "playing in water" to cool off after exposure to the strong sun in the cleared land.

DISCUSSION

1) Role of Fishing in Procurment of Animal Foods

The Semaq Beri obtained animal foods through five means: blowpipe hunting, hunting with hand and no equipment, fishing, purchasing, and rations supplied by the government (JOA).

The proportions in which the food sources contributed to the intake of animal foods greatly varied with the season and procurement location (Table 9). No food source alone supplied a constant and considerable amount of animal food. The people had to adjust their constant nutritional demands to the irregularity and inconsistency of food sources. What foods the people ate and depended upon were mainly determined by the availability and the degree of ease of acquisition, measurable by the return for effort.

The supply of animal food through hunting with hand and no equipment was quite irregular because the hunting was casual, and because of the uneven distribution of the animal species pursued, in particular, the Burmese brown tortoise (*Testudo emys*) which accounted for 71.9% of the total net yield of the hunting. Owing to past human predation, the tortoise was scarce in the vicinity of the village but abundant in the relatively undisturbed interior parts. On several treks, the animals provided 40–50% of the total amount of animal food consumed during the treks.

The availability of purchased foods varied with the amount of money earned through collecting rattan. The people gave priority to staple foods, such as rice and wheat flour, over animal foods, such as tinned and raw fish. They bought animal foods only when there was money left after the purchase of staple foods. After April, when they could afford to buy animal foods because of an increased opportunity in collecting rattan, purchased foods gained in importance, accounting for 30–50% of the animal foods consumed in the village.

The JOA rations, although obtainable with the least effort (practically zero), were less reliable. The animal foods, mainly composed of salted and tinned fish, were not always among the rations and the amount varied. However, even as the ration supply was interrupted by the floods during the rainy months, it contributed 30–70% of the total amount of animal foods consumed in the village during the drier months.

As compared with three other sources, the foods obtained by blowpipe hunting and fishing were more reliable and predictable, together accounting for 73.4% of the total amount of animal foods consumed in the village, and 78.5% on the treks. Of the total amount of animal foods supplied by the two strategies, 91.5% was procured by the adult males of the three age categories over the *bujang* stage. The adult male Semaq Beri allocated their efforts between the two alternatives (blowpipe hunting and fishing)[2] based on two criteria: efficiency (return rate) and catch stability. According to optimal foraging theory [SMITH,

Table 9. Consumption of Animal Food and Relative Contributions by Food Sources

	Per-person per-day intake (g)	Percent contribution of food source				
		Blowpipe hunting	Hunting with hand	Fishing	Purchasing	JOA rations
(A) Village						
1978 Aug.	112	5.3	—	82.7	12.0	—
Sep.	125	54.3	1.8	41.8	2.1	—
Oct.	210	59.3	5.1	2.4	3.4	29.9
Nov.	219	85.0	3.8	0.5	2.7	8.0
Dec.	180	83.5	9.4	6.8	0.3	—
1979 Jan.	209	55.6	12.7	30.3	1.4	—
Feb.	116	—	27.5	53.9	18.6	—
Mar.	184	—	14.3	83.3	2.4	—
Apr.	159	—	1.1	60.7	31.7	6.5
May	94	—	—	—	32.9	67.1
Jun.	127	17.5	—	—	48.8	33.7
Average	167	51.6	6.8	21.7	8.2	11.7
(B) Trek						
Trek number						
1	467	49.8	48.6	—	1.6	—
3	334	7.8	37.5	54.7	—	—
5	220	—	—	100.0	—	—
7/8	481	73.2	20.0	6.8	—	—
12	219	27.4	48.6	24.0	—	—
13	360	—	12.0	88.0	—	—
15	259	7.5	9.0	83.5	—	—
17	197	—	3.6	96.4	—	—
18-I	126	71.4	7.9	20.7	—	—
18-II	245	40.0	4.9	53.5	1.6	—
19	58	25.9	—	74.1	—	—
21	268	24.7	18.5	56.8	—	—
Average	231	26.7	21.7	51.4	0.2	—

1983: 633–634], optimal foragers preferentially allocate foraging time to alternatives with higher return rates, and they respond to shifts in return rates with appropriate shifts in time allocation so as to maximize foraging efficiency. Stability or security in food procurement, on the other hand, is pointed out as being equally or more important in procurement decisions in some situations [JOCHIM 1981: 90]. The stability of catch is here represented in quantitative terms by the success rate defined as the proportion of successful hunts or fishing events to the total number of hunts or fishing events.

In the village, the adult males invested their foraging time equally to blowpipe

Table 10. Time Allocation of Adult Males between Blowpipe Hunting and Fishing, in Relation to Return Rate and Success Rate[1)]

Area/Season	Blowpipe hunting			Fishing		
	Time spent[2)] (min/day)	Success rate[3)] (%)	Return rate (g/hr)[4)]	Time spent (min/day)	Success rate[3)] (%)	Return rate (g/hr)[4)]
Village area:						
Drier months[5)]	44	43.5	225	44	65.8	175
Rainy months[5)]	171	41.7	313	3	0.0	0
Average	74	42.5	267	34	64.5	172
Trek (camp area):						
Drier months/ treks along the larger rivers[6)]	21	39.1	323	62	94.7	420
Rainy months or treks away from the larger rivers[7)]	116	30.4	326	22	61.5	105
Average	60	32.6	324	42	86.2	333

1) The subjects are the adult males over the *bujang* stage, and the fishing treated here includes *lem-lem* fishing and dive fishing (see the note 2).
2) The time spent by the "carriers" is included.
3) The percentage of successful hunts or fishing events to the total number of hunts or fishing events in a given time.
4) Edible grams per hour.
5) The rainy months in the village area were November and December, and the drier months were the remaining ten months.
6) Compared with the village area, the rainy season started about one month earlier and ended one month later in the interior and mountainous part of the Trengganu State where treks were carried out in the study years. This category includes Treks 3, 5, 13, 15, 17, 18-II, and 21.
7) The treks carried out in the rainy season were Treks 7/8, and 12. In Treks 1, 18-I, and 19, their courses were away from the larger rivers (*lawog* and *geradu'*).

hunting and to fishing during the drier months (Table 10). While the average return rate was higher in blowpipe hunting than in fishing in this season, the success rate was conversely higher in fishing than in hunting. The time allocation in the drier months may emphasize the stability of catch, or it can be interpreted as an ecleticism between the two criteria.

However, further explanation is needed for the perplexing time allocation in the hottest months of February to June, which cannot be explained only by these two criteria. In these months, the adult males neglected blowpipe hunting and spent considerable time in fishing in spite of its very low return rate and high catch instability. Such behavior was not due to a decreased return rate, as it was not the case, but, rather, related to the increasing availability of purchased foods in the village. Another likely reason was the strong sunlight during these months. They disliked exposure to strong sunlight because it was believed to cause various diseases. In this season, the hunters were reluctant to go hunting because they had to expose themselves to the sun on the main logging road, the paths in the oil palm plantations, and abandoned foresting roads, which were inescapable in traveling to

hunting grounds.

During the hottest months, the adult males frequently fished while diving in the rivers and streams near the village in order to "cool the bodies" heated by the strong sunlight, despite the depletion of aquatic resources. The catch was of secondary consideration on these fishing occasions, which evidently lowered the average return rate and success rate.

On the other hand, the rising rivers and frequent floods during the rainy months, as mentioned earlier, made fishing impossible or unproductive. Several men actually went fishing (*lem-lem* fishing), but came back in vein. In the rainy months, the adult males, the *toha*-II group ("hunters"), in particular, concentrated their efforts on blowpipe hunting. The return rate was improved in this season, probably because the heavy rain made monkeys and gibbons, the main targets, slow in movement.

On the treks, the adult males allocated the greater part of time available to exploitation of wild animal resources to fishing whenever they found good rivers or streams for fishing in the vicinity of the camp during the drier months (Table 8). In such situations, both the average return rate and the success rate (the stability of catch) were much higher in fishing than in blowpipe hunting.

On the treks in the rainy months (Trek-7/8 and Trek-12) and where the camps were set up far from the rivers suitable for *lem-lem* fishing and dive fishing (Trek-1, the first half of Trek-18, and Trek-12), the fishing return rate and success rate decreased considerably. In these situations, the adult males switched to blowpipe hunting, which turned out to be three times as efficient as fishing. The time allocation was more predictable on the basis of the two criteria during the treks than in the village.

In conclusion, there was a tendency for the Semaq Beri adult males to allocate more time to whichever method, blowpipe hunting or fishing, had the higher return. Emphasis was placed on stability of catch when there was no difference in return rate. The people, however, sometimes behaved contrary to these principles. The decision-making process for food procurement clearly includes factors that are difficult or impossible to assess in quantitative terms [JOHNSON and BEHERENS 1982].

2) Comparisons of Fishing Efficiency and Consumption of Aquatic Resources

The efficiency of fishing and the consumption of aquatic resources of the Semaq Beri are here compared with those of the populations in the interiors of the Amazon and Papua New Guinea, where data on fishing and food consumption have been accumulated (Table 11).

Hames [1989] listed the hourly return rates of adult males for ten populations in the Amazon interior. The average was 400 edible g/hr, ranging from 90 to 1480 g/hr. Excluding one population of the Cocamilla with an extremely high figure, the average was 280 edible g/hr. The fishing efficiency of the Semaq Beri's *bujang* group on the treks, the highest among the Semaq Beri sex-age categories, is

Table 11. Comparison of Fishing Efficiency among the Populations Living in the Interiors of the Tropics

Ethnic group	Region/Nation	Return rate (edible g/hr)[1]	Sex-Age	Source
Cocamilla	Amazon	1484	Adult males	Hames [1989][2]
Ye'kwana	Amazon	280	Adult males	Hames [1989][2]
Shipibo	Amazon	798	Adult males	Hames [1989][2]
Yanomama	Amazon	259	Adult males	Hames [1989][2]
Yanomama	Amazon	126	Adult males	Hames [1989][2]
Yanomamo	Amazon	259	Adult males	Hames [1989][2]
Wayano	Amazon	308	Adult males	Hames [1989][2]
Sanema	Amazon	106	Adult males	Hames [1989][2]
Yanomami	Amazon	92	Adult males	Hames [1989][2]
Xavante	Amazon	280	Adult males	Hames [1989][2]
Bari	Amazon	346	Adult males	Beckerman [1983]
Pume	Amazon	656	Adult males	Gragson [1992]
Machiguenga	Amazon	339	All age-sex	Baksh [1985]
Maku	Amazon	158	All age-sex	Milton [1984]
Samo	PNG[3]	90	Adult males	Kuchikura [1995]
Purari Delta (Ravikoupara Vill.)	PNG	125	Adult males	Haines [1978]
Gadio Enga	PNG	68–190	All age-sex	Dornstreich [1973]
Etolo	PNG	144	All age-sex	Dwyer [1985]
Wopkaimin	PNG	142	Adult males	Hyndman [1987]

1) The data presented in live weight are converted to edible weight with the coefficients used in my study on the Semaq Beri [Kuchikura 1988b].
2) For the original sources cited by Hames [1989], see the article.
3) Papua New Guinea. In Papua New Guinea, cited are only the data on fresh water fishing with the exclusion of those on coastal fishing.

comparable to the average figure for the Amazonian populations. The average of the Semaq Beri adult males over the *bujang* stage on the treks (305 edible g/hr) is only slightly higher than the latter Amazonian average, while the combined efficiency for the village area and the camp area (198 edible g/hr) is much lower.

Semaq Beri fishing on the treks where the aquatic resources were far more abundant in comparison with the village area may be comparable in efficiency with those of the Amazonian. However, it must be noted that the Amazonian fishing focuses only on fish species, and that fish species comprised only 28% of the total yield of fishing for the Semaq Beri. It can be safely said that the interior water systems of the Amazon are far more abundant in fish than those of the Malay Peninsula.

The interior populations of Papua New Guinea have fishing efficiencies of 100–200 edible g/hr. The overall efficiency of the Semaq Beri, including all sex-age categories and both the village and camp areas, fell in the middle point of the range of Papua New Guinea. However, fishing data in quantitative terms are not

Table 12. Comparison of Animal Protein Derived from Aquatic Resources among the Inland Populations in the Tropical Rain Forests

Ethnic group	Region/Nation	Intake of animal foods and its proportions to the total protein and energy intakes				
		A (g)	B (%)	C (g)	D (%)	E (%)
Semaq Beri[1]	Malaysia	9	16	53	54	9
Yupa[2]	Amazon/ Columbia	22	41	38	71	11
Xavante[3]	Amazon/ Brazil	11	29	39	59	14
Machiguenga[4]	Amazon/ Peru	18	46	39	57	9
Maku[5]	Amazon/ Brazil	14	27	51	73	13
Pume[6]	Amazon Venezuela	?	64	?	83	23
Gidra[7] (Rual Vill.)	PNG	6	14	46	45	4
Gidra[7] (Ume Vill.)	PNG	13	22	58	47	6
Begua[8]	PNG	14	32	44	92	11
Sanio-Hiwoe[9]	PNG	3	17	15	69	10
Samo[10]	PNG	4	11	33	43	3
Gadio Enga[11]	PNG	2	6	33	28	7
Wopkaimin[12]	PNG	1	2	47	45	22
Chimbu[13]	PNG	—	—	25	4	1

A: per-person per-day intake of protein derived from aquatic resources in gram.
B: percentage of protein from aquatic resources to the total amount of protein of animal foods.
C: total amount of protein consumed per person per day in gram.
D: percentage of animal protein to the total amount of protein consumed.
E: percentage of energy derived from animal foods to the total amount of energy
1) KUCHIKURA [1988a]; 2) DUFOUR [1983]; 3) FLOWERS [1983]; 4) BAKSH [1984]; 5) MILTON [1984]; 6) GRAGSON [1992b]; 7) OHTSUKA *et al.* [1985]; 8) AKIMICHI [n.d.]; 9) TOWNSEND [1969]; 10) KUCHIKURA [1995]; 11) DORNSTREICH [1973]; 12) HYNDMAN [1986]; 13) BAILEY and WHITEMAN [1963].

available from the populations living along the large rivers, such as the Sepik and the Fly, who are assumed to depend much more on aquatic resources for their diet and to have higher fishing efficiency than the populations listed here.

Compared with the Semaq Beri, the interior populations of the Amazon on which food consumption data are available show the higher contribution of aquatic resources to protein intake (Table 12). Although the percentage of animal protein to the total protein intake is also higher among them than the Semaq Beri, the amount of per-person per-day protein intake is lower than the Semaq Beri because of the low protein content of their staple food (manioc). This fact emphasizes the importance of aquatic resources as a protein source.

The two populations of the Gidra living along the rivers in the lowland of Papua New Guinea have a consumption pattern for aquatic resources similar to

the Semaq Beri: around 10 g of protein intake derived from aquatic resources, 20–25 g of animal protein, and 15–20% of protein from aquatic resources to the total protein intake. The Begua and the Sanio-Hiwoe, both of which inhabit the swamps and depend on sago for more than 85% of food energy, present a sharp contrast in utilization of animal food. The former obtain 15 g of protein per-person per-day from the lake and 20 g from the savanna behind the village. The environment of the Sanio-Hiwoe is neither favorable for fishing, nor for hunting. They get only 3 g and 4 g of protein from the two strategies for procuring animal food, respectively. The populations of foot hills (the Samo and the Gadio-Enga) and of the fringe of highlands (the Wopkaimin) consume 2–4 g of protein derived from aquatic resources. The populations of the central highlands are not practically accessible to aquatic resources.

NOTES

1) Poison is also extracted from tree bark (*Diospyros* spp.) and roots (*Derris* spp.), which were not used during my stay. According to the Semaq Beri, the wild yam was easier to find in the forest than other poison.
2) Among the fishing practiced by adult males, this paper concerns *lem-lem* fishing and dive fishing. Other fishing methods are not considered here, because they are not as important as blowpipe hunting in procuring animal foods. The adult males engaged in rod-and-line fishing and poison fishing only on rare occasions. Frog fishing was done only in the night time when blowpipe hunting was impossible.

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