

FISH FAUNA OF SAYAP-KINABALU PARK, SABAH

Lee Nyanti (Oceanic Science Department, Universiti Kebangsaan Malaysia, Sabah Campus, Malaysia)

Fish collections were made using electrofishing device from four rivers in the Sayap area of Mount Kinabalu. All rivers are generally shallow, fast flowing, of rocky substrate and mostly shaded by forest canopy. A total of 10 species from the family Gastromyzontidae and 2 species from Cyprinidae were collected. Ninety nine percent of the total number of individuals caught is from the family Gastromyzontidae.

INTRODUCTION

In Borneo, knowledge of freshwater fishes begins with the classical works of Bleeker during the period 1851-60. However all of his fishes came from Kalimantan, Indonesia then known as Dutch Borneo. With the exception of Gunther's (1874) description of *Gastromyzon borneensis*, Vaillant (1893) was the first to report on the freshwater fishes of Sabah (then known as North Borneo) which include fish fauna from Mount Kinabalu. Weber and de Beaufort's (1913; 1916; 1922) works on the Indo-Australian fishes included intensive collections and discussion on most of the species found in Sabah. However, the work of Inger & Chin (1990) remains as the most comprehensive record of the fish fauna of Sabah. Recent studies carried out in Borneo included those of Roberts (1982), Watson & Balon (1984), Lelek (1987), Chin & Inger (1989) and Roberts (1989).

Sabah comprises about one-tenth of Borneo's total land area but has more than one third of the freshwater fishes known from Borneo. This fauna is dominated by the ostariophysii (cyprinids and siluroids) and their relatives (Inger & Chin, 1990). The diversity of fresh and brackish water fish species in Sabah rivers is uniformly distributed except in the eastern and southwestern portion of the state. The naturally highly acidic waters and the influence of recent volcanic activities on rivers in Maliau Basin and around Tawau respectively, reduced the diversity by at least fifty percent (Kirk, 1968; Nyanti et al., in press).

Many of the important rivers in Sabah have their origins from Mount Kinabalu. Liwagu River flows eastwards from the southern slope of the mountain and join Labuk River which drains into Labuk Bay. Three rivers, namely the Mamut River, Lohan River and Langanan River flow from the eastern side into the Sugut River before finally draining into the Sulu Sea. Kindingan River and Kinaran River flow from the northern side of the mountain and join Bongon River before draining into the Marudu Bay. The Pegalan River flows southward from the south of Liwagu River to join the Padas River before draining into Brunei Bay. The Kemantis River, Lumutuk River and Minodtuhan River flow from the north-western slope to join Wariu River that merge with the Kadamaian River before draining into the South China Sea.

The most recent study on fish fauna of Mount Kinabalu Park and the nearby area was carried out by Abdullah (1990). However, his work was only confined to the rivers on the southern and eastern part of the mountain. This report, a result of the surveys carried out in June 1992 during the Sayap-Kinabalu Scientific Expedition, records for the first time the fish fauna from four rivers that have their origins from the north-western part of Mount Kinabalu Park.

MATERIALS AND METHODS

The collection of fishes at Sayap area were made at seven selected stations within the Kinabalu Park area and three stations outside the park. Two stations were selected from Kemantis River (KM1 & KM2), one from Lumutuk Besar River (LB 1), one from Minodtuhan River (MTI) and six from Wariu River (WA1, WA2, WA3, WA4, WA5 and WA6) (Figures I a & I b). Stations WA4, WA5 and WA6 were situated outside the park area and relatively at a lower altitude (Table 1). Stations were chosen based on the altitude and accessibility since the overall habitat conditions were generally similar. The general features of the rivers consist of shallow ripples and pool areas and at each station both of these habitats were sampled.

At each station, fish were collected using electrofishing device consisting of two copper electrodes on wooden handles and powered by a 500 watt portable AC generator. Fishes were collected using dip nets. Seine net with small mesh size (3mm) was placed across the river at the lower end of the station before electroshocking starts in order to prevent any fish from drifting downstream. This device was the most suitable since all the stations were shallow, narrow and rocky (Table 1). The width of the river, range of depths, current speeds at one third and two third of water depth, altitude, general water condition, distance covered during electroshocking and the general characteristics of the habitat chosen were also recorded.

All individuals caught were fixed in 10% formalin and later preserved in 70% ethanol. They were identified, measured, weighed and preserved at the Museum of Ichthyology at the Marine Science Department of the Universiti Kebangsaan Malaysia, Sabah Campus.

RESULTS AND DISCUSSION

River characteristics

The characteristics of each station surveyed from the four rivers are shown in Table 1. The water quality of these rivers within the Kinabalu Park area falls under the Class I category and is more than 84% saturated with dissolved oxygen (Lee *et al.*, 1994). Inger and Chin (1990) found the water temperature of most shaded forest streams to be between 25-27 °C. In this survey, the water temperature ranged from 18-19 °C for all stations located within the park. This is due to the locations of the stations at a relatively higher altitude and completely enclosed by forest canopy in most part.

Table 1
The characteristics of each station surveyed at four rivers on the North-eastern side of Mount Kinabalu. Distance means the length of river sampled.

Station	Altitude (m)	Depth (m)	Wide (m)	Distance (m)	Current Speed (m/s)	Description of habitat
WA 1	1050	0.3-1.2	0.3-2	15	2/3 D: 0.27 1/3 D: 0.48	Clear water, rocky bottom, river enclosed by forest canopy.
MT 1	1010	0.2-0.6	0.3-1.5	15	2/3 D: NA 1/3 D: 0.24	Clear water, rocky bottom, isolated pools existed along the stream that is almost completely enclosed by forest canopy.
LB 1	920	0.1-0.3	1-2	15	1/3 D: NA 1/3 D: 0.38	Clear water, rocky bottom covered by algae, river enclosed by forest canopy.
WA 2	900	0.4-0.6	2-5	15	2/3 D: NA 1/3 D: 0.55	Clear water, rocky bottom, 3/4 of stream enclosed by forest canopy, Sloping gently.
WA 3	850	0.2-0.4	3-5	15	2/3 D: 0.61 1/3 D: 0.67	Clear water, rocky bottom covered by algae. Partially enclosed by forest canopy. Sloping gently,
KM 1	850	0.2-0.3	3-5	15	2/3 D: 0.05 1/3 D: 0.18	Clear water, rocky bottom covered by algae, river completely enclosed by forest canopy. Station right below water fall.
KM 2	800	0.1-0.8	1-3.5	15	2/3 D: NA 1/3 D: 0.31	Clear water, rocky bottom covered by algae. River has steep gradient and enclosed by forest canopy.
WA 4	600	0.2-1	5-8	15	2/3 D: NA 1/3 D: 0.93	Clear water, rocky bottom and river has steep gradient not enclosed by forest canopy.
WA 5	540	0.3-0.3	1-1.5	10	Almost stagnant	Isolated pool with clear stagnant water. Bottom is rocky. Located right below the dam. River not enclosed by forest canopy.
WA 6	170	0.3-1	5-8	10	2/3 D: NA 1/3 D: 0.46	Clear water, rocky bottom and not enclosed by forest canopy.

Table 2
List of fishes caught in the Sawap area of Kinabalu Park

Species		Station									
		WA 1	MT 1	LB 1	WA 2	WA 3	KM 1	KM 2	WA 4	WA 5	WA 6
Protomyzon aphelocheilus	N	1	-	3	5	8	6	4	21	42	71
	SL	54	-	26.3±3.3	43.4±2.9	55.4±4.4	36.8±7.5	40.0±1.4	41.5±9.2	32.2±8.5	37.8±6.7
	TL	67	-	34.0±3.6	54.8±3.7	68.9±5.2	46.2±8.9	49.8±1.8	51.0±11.2	42.8±10.5	46.9±2.8
	WT	2.50	-	0.3±0.1	1.4±0.2	1.7±0.4	0.9±0.6	0.8±0.1	1.2±0.8	0.5±0.4	0.9±0.5
Protomyzon borneensis	N	-	-	1	3	7	6	12	32	15	-
	SL	-	-	30	42.3±2.6	54.0±7.5	38.7±8.4	42.5±6.1	42.9±8.7	32.6±7.0	-
	TL	-	-	39	53.0±2.8	67.7±8.8	48.7±10.7	53.0±7.4	54.6±10.9	41.6±8.7	-
	WT	-	-	0.50	1.2±0.2	1.8±0.9	0.9±0.4	1.1±0.5	1.4±0.9	0.6±0.3	-
Protomyzon griswoldi	N	-	-	-	1	-	-	-	-	-	4
	SL	-	-	-	31	-	-	-	-	-	35.5±4.0
	TL	-	-	-	40	-	-	-	-	-	42.3±4.6
	WT	-	-	-	0.50	-	-	-	-	-	0.6±0.2
Protomyzon whiteheadi	N	-	-	3	7	2	4	6	28	11	10
	SL	-	-	30.3±3.3	41.4±5.5	51.5±6.5	44.3±7.4	36.3±5.9	36.2±5.9	37.3±7.9	38.2±2.5
	TL	-	-	37.7±4.9	51.6±6.2	65.5±8.5	55.8±9.9	54.5±8.7	54.5±8.7	48.0±9.7	47.7±2.8
	WT	-	-	0.4±0.2	1.3±0.4	1.7±0.6	1.5±0.7	1.3±0.6	1.3±0.6	0.8±0.4	0.9±0.2
Glaniopsis hanitschi	N	22	22	19	15	12	27	8	16	-	-
	SL	48.9±9.6	51.3±10.9	44.0±10.6	57.9±11.3	58.1±10.6	47.1±8.8	51.3±6.4	64.8±10.1	-	-
	TL	58.7±10.9	60.5±12.9	52.7±12.5	69.5±13.6	68.8±11.9	56.9±10.6	61.3±7.5	77.9±11.9	-	-
	WT	1.9±0.9	2.2±1.4	1.3±1.0	3.2±1.8	1.7±11.9	1.8±0.9	2.1±0.8	4.3±1.8	-	-
Glaniopsis gossei	N	1	-	-	-	-	-	-	-	-	-
	SL	28	-	-	-	-	-	-	-	-	-
	TL	32	-	-	-	-	-	-	-	-	-
	WT	0.20	-	-	-	-	-	-	-	-	-

Table 2 (Continued)

Species		Station									
		WAI	MTI	LBI	WA2	WA3	KMI	KM2	WA4	WA5	WA6
Parhomaloptera microstoma	N	102	40	11	88	128	25	17	1	-	-
	SL	36.1±4.5	34.1±8.4	38.6±3.3	36.8±3.4	37.1±3.9	35.7±4.9	35.9±1.8	30	-	-
	TL	43.0±5.1	41.9±7.8	46.4±3.3	44.3±3.8	43.6±4.6	42.6±5.6	42.8±2.7	38	-	-
	WT	0.5±0.2	0.6±0.5	0.5±0.1	0.5±0.1	0.4±0.2	0.5±0.2	0.4±0.1	0.3	-	-
Neohomaloptera johorensis	N	-	-	-	-	-	-	8	-	-	-
	SL	-	-	-	-	-	-	12.3±2.1	-	-	-
	TL	-	-	-	-	-	-	15.6±2.3	-	-	-
	WT	-	-	-	-	-	-	0.03±0.01	-	-	-
Gastromyzon microstoma	N	-	-	-	-	-	-	-	2	-	-
	SL	-	-	-	-	-	-	-	1.9±0.1	-	-
	TL	-	-	-	-	-	-	-	2.6±0.2	-	-
	WT	-	-	-	-	-	-	-	0.2±0.1	-	-
Gastromyzon monticola	N	-	-	-	-	-	-	20	10	16	
	SL	-	-	-	-	-	-	57.1±10.3	42.2±7.8	49.3±11.8	
	TL	-	-	-	-	-	-	71.7±12.8	52.9±9.7	61.9±14.9	
	WT	-	-	-	-	-	-	5.1±3.5	1.7±1.1	3.5±3.1	
Tor duorensis	N	-	-	-	-	-	-	-	3	3	
	SL	-	-	-	-	-	-	-	42.3±17.5	64.7±11.1	
	TL	-	-	-	-	-	-	-	57.0±23.4	86.3±13.5	
	WT	-	-	-	-	-	-	-	2.3±2.7	5.2±2.3	
Paracrossochilus acerus	N	-	-	-	-	-	-	-	-	1	
	SL	-	-	-	-	-	-	-	-	40	
	TL	-	-	-	-	-	-	-	-	51	
	WT	-	-	-	-	-	-	-	-	0.9	

N is the total number of individuals. TL and SL are total length and standard length respectively in centimeters - standard deviation, and WT is weight in grams.

All rivers are generally shallow, ranging from 0.5m at the long stretches of ripples area to about 1.2m at the pool (Table 1). During the survey period, the widths of the river ranged from 0.3m-8m. It is postulated that due to the variation in the flow regimes caused by the wet and dry seasons, the widths and depths of the river could fluctuate further. The river bottom is usually covered by a thin layer of algae and the banks are lined by boulders and rocks. The current velocity is high at the shallow ripples area ranging from 0.05-0.61 ms^{-1} at 2/3 depth and 0.18-0.93 ms^{-1} at 1/3 depth. This high velocity is due to the steepness of the river gradient. The water flow at the pool area ranged from 0.04-0.16 ms^{-1} . All these features are typical of the undisturbed first order stream at high altitudes. These type of rivers are strongly influenced by the riparian vegetation which generally reduces autotrophic production by the shading and contributes large amount of allochthonous detritus (Vannote *et al.*, 1980).

Fish Fauna

A total of 900 individuals representing 2 families namely, Gastromyzontidae and Cyprinidae were caught from Sayap area between altitude 170m to 1050m above sea level. Gastromyzontidae was represented by 10 species from 5 genera and cyprinidae by 2 species from 2 genera (Table2). Abdullah (1990) recorded a total of 22 species from 5 families whereas Chin (1978) reported a total of 32 species from the southern and eastern part of Kinabalu Park and the surrounding areas. The larger number of species reported by both researchers was due to most of their sampling stations located at an altitude below 600m. Bain *et al.* (1988) reported that high variables and unpredictable flow regimes appeared to be a highly frequent disturbance that affects fish and acts to reduce community complexity. Therefore, areas of lower elevation generally has a relatively higher number of species but the population size of each species may not be large. Analyses based on the number of individuals in each family showed that 99.2% are represented by gastromyzontidae whereas only 0.8% are represented by cyprinidae. Gastromyzontidae is the only family recorded from all the stations within the Kinabalu Park area and from one station (WA4) outside the park. All these stations are at an altitude of 600m and above. Altitude, hence the physical habitat characteristics (water depth, current velocity, substrate) are important factors influencing fish community composition. Changes in river flow will modify physical habitat, and these rivers with such highly variable flow will provide highly unstable aquatic habitats. The species from the family gastromyzontidae, being aerodynamically shaped are adapted to living on the rocky bottom of the swift flowing mountain rivers or in ripples of lowland streams and are the most highly specialized of cyprinoids. They are characterized by more or less enlarged and horizontally flattened paired fins and in the case of *Gastromyzon*, the greatly enlarged pelvic fins are united to each other posteriorly (Roberts, 1989). Commins *et al.* (1973) showed the importance of terrestrial debris, especially leaves, as a food web base for stream invertebrates and subsequently fish. The largest organic accumulations occur in streams with the most pool area for settling and these streams tend to be at lower elevation where topography is less rugged. As elevation and gradient increase, pool area decreases and most allochthonous material is carried through the system before it can be consumed directly by fishes or converted into food by other organisms. Therefore, fishes in fast

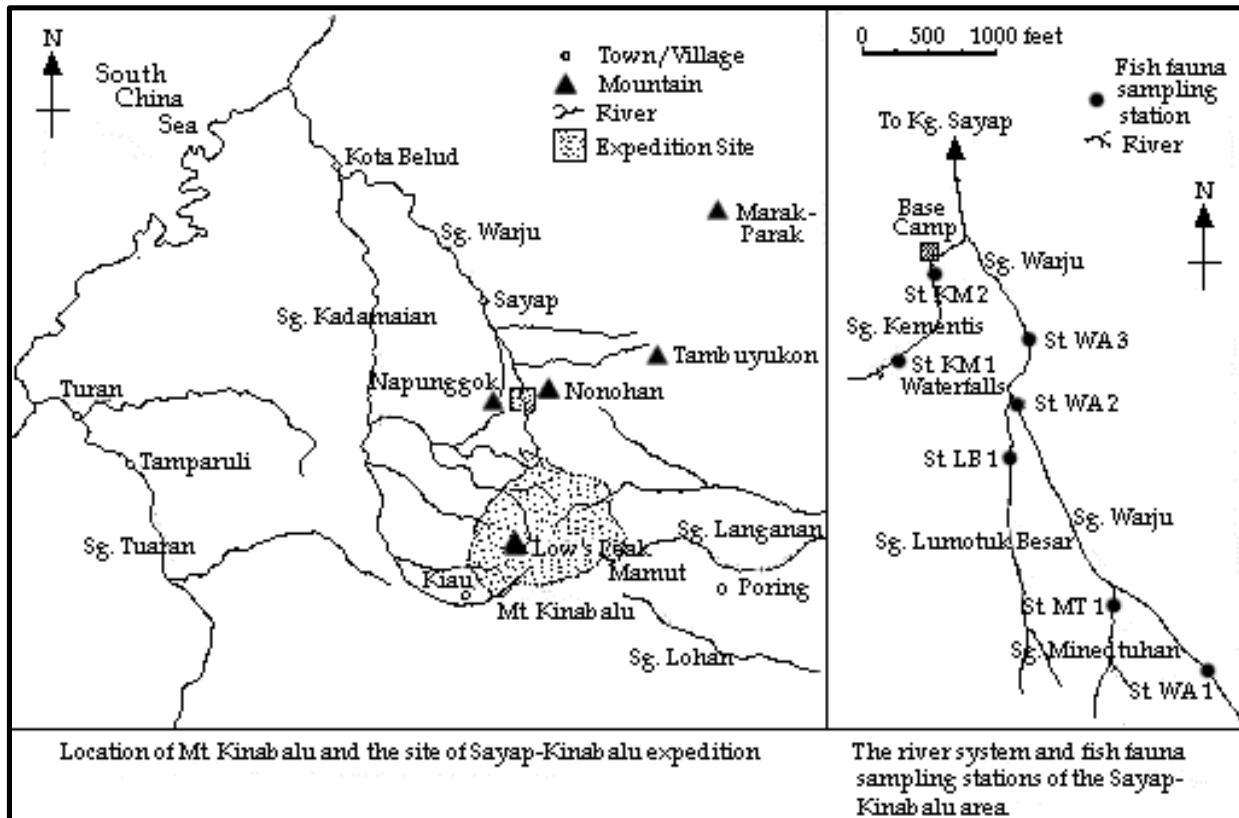


Figure 1a

Figure 1b

flowing streams may encounter less variety in food supplies but increase as the turnover time for terrestrial inputs to the system declines. Constriction of the food web alters the quantity of some foods and eliminates some specialized fishes (Watson & Balon, 1984). Gastromyzontidae, however graze on the algae growing on the rocks (Inger & Chin, 1990) thus does not depend directly on the allochthonous input.

Two species from the family cyprinidae were recorded from the area outside the park at altitudes of 170m and 540m. According to Lowe McConell (1975), cyprinidae commonly dominated the whole of southeast Asia. In western Borneo, about one third of all freshwater fishes belong to this family (Roberts, 1989). This phenomena was also observed for rivers at a lower altitude in Sabah (Inger & Chin, 1990). However at an altitude of more than 600m, gastromyzontidae normally replaces cyprinidae.

In the southern and eastern part of Kinabalu Park and its surrounding area, Abdullah (1990) reported that *Protomyzon whiteheadi* is widely distributed but the population size decreases with decrease in altitude. This survey also found that this species is widely distributed but contrasts to his observation, population size is more or less maintained if not increasing with a decrease in altitude (Table 2).

CONCLUSIONS

The characteristics of the four rivers in the Sayap area of Kinabalu Park is typical of the first order stream at high altitude. The fish fauna is dominated by the species from the family gastromyzontidae. These species are specially adapted to living in swift flowing mountain rivers.

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