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Distribution, Altitudinal Range and Abundance of the Fish Species in the Lower Order Streams of the Sepik-Ramu Catchment

A report prepared for project PNG/85/001
Sepik River Fish Sock Enhancement Project

by

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CONTENTS

1. INTRODUCTION

This report provides a summary of data on distribution, altitudinal ranges and abundance of the fish species found in the lower order streams (hillstreams and mountainous streams) of the Sepik-Ramu catchment. Information on fish species of the floodplain, the main channels of the Sepik and the Ramu with their lakes, scrolls and backswamps and the main large tributaries in the intermontane trough can be found in Allen and Coates (1990), Coates (1984, 1987, 1988, 1989a, 1989b, 1990, in prep), Coates and Van Zwieten (in prep.), Ulaiwi (1990) on Cyprinus carpio and the report on Oreochromis mossambicus of Redding (1989).

The data presented here are obtained during the collections made in the period February 1988 to September 1989, village surveys conducted by Mys, and relevant literature. Descriptions of the collecting stations and methods of collection are supplied by Van Zwieten (1989). This report can be seen as supplementary to Van Zwieten (1990) in which basic patterns of species and biomass distributions in the area are discussed.

In the following per species descriptions the altitude range is derived from my own collections; figures in brackets are altitudinal ranges derived from village surveys (*), the works of Coates, Allen and Allen and Coates(**) and other relevant literature (***). The data entries '%total weight in catch' and '%total number in catch' are derived from the complete biomass samples i.e. those samples in which a complete fish kill was obtained in the sampled section of the river and of which I could reasonably assume to have collected all the fish present. These entries show the minimum, maximum and average percentages of the total biomass and density in a sample whenever a species showed up in the catch. Table 1, on the other hand, presents the average biomass and density of each species over all the samples combined.

The entry 'Distribution' is mainly derived from my own collections with occasional additional information from the literature and the village surveys. No attempt has been made to be complete: the distribution outside the Sepik-Ramu catchments is not taken into consideration until Chapter 4, where endemism in the Sepik-Ramu river system is discussed. There are no data on the distribution of fish species in the Finisterre range. The rivers in this mountain range are characterized by steep gradiënts: I do not expect the fish fauna to be different from the other mountain areas in the Ramu catchment; probably the fauna is extremely poor as a result of these steep gradiënts, in comparison ed with mountain areas where less steep gradiënts occur (i.e. Torricelli and Adelbert ranges).

The habitat notes refer to Allen and Coates (1989) in most instances, unless my data and observations differ considerably from the habitat notes contained herein. In the following Allen and Coates (1989) is abbreviated to A & C.

Each habitat note mentions the type(s) of river in which the species under consideration is found. These generalized types are:

1. Marginal floodplain rivers (40 - 120 m.a.s.l.)
2. Lower foothill rivers (80 - 200 m.a.s.l.)
3. Foothills (200 - 400 m.a.s.l.)
4. Lower mountains (600 - 1600 m.a.s.l.)

A description of the general characteristics of this typification can be found in Van Zwieten (1989).

2. DISTRIBUTION, ALTITUDINAL RANGE AND ABUNDANCE

2.1 General comments

Allen and Coates (1990) record 58 species in the Sepik river catchment. In the Ramu catchment are three endemic rainbowfish (Melanotaeniidae), which brings the total number of species in the whole area under consideration to 61. 33 species are found in the regions covered by this study. About twelve of these are confined to below the first 200 m, 21 below 400 m. Only twelve species are found above 400 m altitude, and of these in this study only the two eels Anguilla bicolor and Anguilla marmorata are found at altitudes higher than 800 m (Fig. 3). All of the species found are found at low altitudes (below 100 m).

With a few exceptions the species other than Anguilla sp. found between 400 - 800 m are generally small: three Melanotaeniids (max. 120 mm total length), two Glossogobius species (max. 70 mm TL) and three small Eleotrids (resp max. 70 mm, 100 mm and 100 mm TL). Only one species (with two subspecies) I collected at these altitudes reach larger individual lengths: Neosilurus gjellerupi coatesi and N. gjellerupi gjellerupi (up to 250 mm TL). Arius velutinus is also reported to go up to 800 m in larger rivers, but I have never collected any specimens at these altitudes. This species grows up to a maximum total length of about 350 mm Both these catfishes do not seem to reach their maximum lengths at higher altitudes.

All species found at altitudes above 400 m, except the eleotrid Oxyeleotris fimbriata, can be found in rivers and streams that have gradiënts steeper than or equalling 0.1 m/m up to 0.27 m/m (Fig. 4). Only the three species of rainbowfish, two small eleotrids and one goby can be found in rivers with gradiënts higher than 0.2 m/m.

Except for the three species of rainbowfish, which are relatively fast swimmers, all other species in this

altitudinal region bottom dwelling fish, living in between pebbles and rocks (all the gobies) or in pools, crevices, underneath submerged logs and tree debris.

The remaining 22 species are confined to rivers and streams with generally slower current speeds caused by a relatively low gradiënt. High gradiënts and consequently fast current speeds may be one of the major constraints for species invading higher altitudes.

Closer examination of the biomasses and densities of the individual species (Table 1.) reveal that averaged over all the samples about 75% of the total average biomass is formed by 6 species, and 81% of the total average density are 5 species. A considerable part of these percentages is formed by the three rainbowfishes Melanotaenia affinis, Chilatherina crassispinosa and Chilatherina fasciata (resp. 31.7% of total average biomass and 58.5% of total average density). All three species do not attain individual weights of more than 30 - 40 gram. Glossamia gjellerupi - 22.5% of the total average biomass - only rarely realizes a weight of more than 50 - 60 gram. The two other species that are included in the first 75 % total average biomass are the only fish that attain reasonably high individual weights: Anguilla bicolor and Oreochromis mossambicus. Both these species are found only in very low densities (resp. 0.3 % for the eel and 2.7 % for the tilapia). The latter grows up to 300 gr at lower altitudes, but is stunted at altitudes higher than 100 m, where it does not attain weights of more than 20 - 30 gr.

Figures 2 and 3 explain the biomass and density distribution of all the species over the complete altitudinal range investigated in more detail. The general trend outlined in the last paragraph is seen over the whole altitudinal range: the largest portion of the biomass is formed by Melanotaenia affinis, Chilatherina crassispinosa and C. fasciata and, at altitudes lower than 400 m, Anguilla spp., Oreochromis mossambicus and Glossamia gjellerupi. At altitudes lower than 100 m only Ophieleotris aporos joins these species as it has both a reasonably high average biomass and density. It is also the only species with such a relatively high density that grows up to a fairly large size (300 mm TL). Both biomasses and densities of all other larger species (Plotosidae, Arius velutinus and Oxyeleotris heterodon) are extremely low.

Van Zwieten (1990a) demonstrates that total fish biomass and species number decrease exponentially with altitude. A similar decrease in biomass cannot be shown for each individual species, although the more abundant species of rainbowfish show a slight tendency towards such a

decrease. It seems that with increasing altitude total biomass decreases together with the number of species inhabiting the streams.

2.2 Distribution, altitudinal range and abundance per species

2.2.1 Melanotaeniidae

Melanotaenia affinis (fig.5)

Altitude	:	20 - 800 (1200 **)
%total weight in catch	:	0.03 - 99.9 (average 17.3)
%total number in catch	:	0.14 - 99.8 (average 26.1)
Distribution	:	Torricelli, Highlands, Adelbert, Ramu marginal floodplain, Bayer river

Habitat : see A & C. Also found in slow flowing (marginal) floodplain forest streams, but rarely encountered on the open floodplain. Mainly occurs in smaller tributary streams. Common in rainforest creeks which are relatively well shaded, but also found in some ponds, lakes and reservoirs; usually clear water. River types 1 to 4.

Chilatherina crassispinosa (Fig.6)

Altitude	:	40 - 760
%total weight in catch	:	0.02 - 85.4 (26.5)
%total number in catch	:	0.04 - 94.3 (35.9)
Distribution	:	Torricelli, Highlands, Adelbert, Ramu marginal floodplain

Habitat : this species is distributed over a wider range of habitats than is suggested by A & C : moderate to fast flowing streams and generally not in quiet pools although it is also found in the slow flowing marginal floodplain forest streams of the Ramu. Both in open sections of rainforest exposed to sunlight and in completely shaded rivers. Temperature range down to 20°C. I have the impression that *C. crassispinosa* has the widest habitat range of all the rainbowfishes in this study. River types 1 - 4.

Chilatherina fasciata (Fig.7)

Altitude	:	20 - 320 (500 **)
%total weight in catch	:	0.4 - 71.0 (15.9)
%total number in catch	:	4.8 - 85.2 (25.1)
Distribution	:	Torricelli foothills, Adelbert, Ramu marginal floodplain

Habitat : see A & C. Usually encountered in clear rainforest creeks with slow to moderate flow. This species is found most frequently in rivers with sandy and silty substrates

(marginal floodplain and floodplain forest streams and lower foothills). River types 1 - 3.

Chilatherina campsi (Fig.8)

Altitude	:	80 - 800 ($\pm$ 1000 **)
%total weight in catch	:	0.2 - 46.4 (6.6)
%total number in catch	:	0.2 - 46.8 (8.6)
Distribution	:	Ramu marginal floodplain, Jimi river catchment

Habitat : found both in relatively slow- flowing tributary streams in hilly or mountainous terrains and heavily shaded floodplain forest creeks. River types 1 - 4.

Chilatherina bulolo (Fig.9)

Altitude	:	120 - 200
%total weight in catch	:	0.2 - 14.8 (4.2)
%total number in catch	:	0.8 - 83.3 (24.3)
Distribution	:	Middle Ramu marginal floodplain

Habitat : found in slow flowing, completely shaded floodplain forest streams, with silt and mud substrates, ranging up to creeks with moderate flow and substrates of pebbles covered with diatoms and silt. River types 1 and 2.

Glossolepis maculosis (Fig. 10)

Altitude	:	80 - 120
%total weight in catch	:	0.1 - 2.0 (0.85)
%total number in catch	:	0.2 - 11.4 (4.44)
Distribution	:	Ramu floodplain

Habitat : heavily shaded floodplain forest streams and pools with slow currents, and silty/muddy substrates. River types 1 and 2.

Glossolepis ramuensis (Fig. 11)

Altitude	:	80
%total weight in catch	:	4.0
%total number in catch	:	16.4
Distribution	:	Guam river system (Adelbert range; lower Ramu)

Habitat : the only locality this species was found was a river with moderate flow, heavily shaded by secondary rainforest. The substrate in the riffles consisted of small pebbles overgrown with "Aufwuchs" and pools with a sand and silt substrate. River type 2.

2.2.2 Eleotridae

Mogurnda bloodi (Fig. 13)

Altitude	:	40 - 720 (1500 **)
%total weight in catch	:	>0.0 - 20.1 (5.9)
%total number in catch	:	>0.0 - 97.9 (14.4)

Distribution : Torricelli, Sepik and Ramu marginal floodplain, Eastern highlands, Bayer river)

Habitat : inhabits deeper pools in relatively shallow fast flowing creeks but is also a regular inhabitant of swamps. River types 1 to 4.

Mogurnda nesolepis (Fig.14)

Altitude : 80 - 800
%total weight in catch : >0.0 - 27.7 (3.0)
%total number in catch : >0.0 - 54.0 (13.3)
Distribution : Torricelli, Sepik and Ramu marginal floodplain, Jimi valley, not in Eastern highlands
Habitat : Slow flowing tributaries on the edge of the floodplain, in marginal floodplain forest and in faster flowing rainforest creeks in hilly and mountainous terrain up to 800 m. River types 1 to 4.

Bunaka gyrinoides (Fig. 16)

Altitude : 40 - 200
%total weight in catch : 0.1 - 65.2 (16.3)
%total number in catch : >0.0 - 0.9 (0.25)
Distribution : marginal floodplain and lower foothills of the lower Sepik, Ramu marginal floodplain

Habitat : this species is rare, at least in the areas investigated up till now: only 5 specimens were found during the present collection period. Of these, three were found in floodplain forest and marginal floodplain creeks. Two large specimens were collected in an eastern Torricelli foothill stream in a deep pool with a substrate of bedrock and silt and boulders overgrown with diatoms. The species is supposedly more common in the brackish water areas around the Sepik and Ramu river mouths. River types 1 and 3.

Ophieleotris aporos (Fig.17)

Altitude : 20 - 200
%total weight in catch : 0.2 - 36.1 (11.9)
%total number in catch : 0.2 - 19.1 (4.9)
Distribution : Sepik and Ramu marginal floodplain

Habitat : see A & C. Occurs in a variety of habitats including the main river, swamps, lakes, and turbid or clear tributary streams. It is perhaps the most widely distributed of all fishes in the Sepik system and is particularly common throughout the floodplain and marginal floodplain areas of the lower and middle parts of the river system. River types 1 and 2.

Oxyeleotris fimbriata (Fig. 18)

Altitude	:	40 - 600
%total weight in catch	:	>0.0 - 14.1 (1.80)
%total number in catch	:	0.1 - 10.5 (2.10
Distribution	:	Torricelli, Sepik marginal floodplain, Adelbert

Habitat : see A & C, most common in deeper pools and under logs, snags and driftwood of creeks situated in hilly terrain. River types 1 - 4.

Oxyeleotris heterodon (Fig.19)

Altitude	:	40 - 120
%total weight in catch	:	1.1 - 16 5 (7.9)
%total number in catch	:	0.3 - 2.1 (1.0)
Distribution	:	Sepik and Ramu marginal floodplain

Habitat : see A & C. This species is most common in floodplain areas throughout the lower and middle Sepik. In this study all specimens were found in floodplain forest creeks. River type 1.

2.2.3 Plotosidae

Neosilurus gjellerupi coatesi (= Tandanus coatesi) (Fig. 20)

Altitude	:	80 - 450
%total weight in catch	:	0.9 - 65.9 (16.9)
%total number in catch	:	0.5 - 31.4 (5.3)
Distribution	:	Torricelli/Bewani range

Habitat : It is the most common of all the plotosids found in this study. Like all plotosids it is a bottom dwelling species often found hiding at least during the day under rocks and logs. The subspecies is usually found in moderate to swift flowing rainforest streams, with bottoms consisting of gravel and cobbles. Generally found in pools and quieter parts of such streams. Active during the night. River types 2 - 4.

Neosilurus gjellerupi gjellerupi (= T. gjellerupi)(Fig.21)

Altitude	:	80 - 760 (1600 **)
%total weight in catch	:	>0.0 - 3.8 (1.2)
%total number in catch	:	>0.0 - 0.3 (0.2)
Distribution	:	highlands of the Ramu catchment, Bayer river, Eastern highlands on the border with Irian Jaya

Habitat : clear, rapid flowing tributary streams in mountainous terrain, substrates usually consisting of gravel and pebbles. The subspecies hides under rocks during the day. River types 2 - 4.

Neosilurus idenburgi (= Tandanus idenburgi) (Fig. 22)

Altitude	:	80 - 160 (200 - 500 **)
%total weight in catch	:	>0.0 - 3.8 (1.2)
%total number in catch	:	>0.0 - 0.3 (0.2)
Distribution	:	lower foothills of the Ramu area and Torricelli range

Habitat : generally clear, moderate to rapid flowing rivers in hilly terrain. The bottom consists of gravel and pebbles, but the species is usually found in pools and other quieter areas in a river, preferably in or near decaying leafpacks and tree debris. River types 2 and 3.

Neosilurus niger (= Tandanus novaeguinea) (Fig. 23)

Altitude	:	20 - 240
%total weight in catch	:	>0.0 - 4.3 (1.5)
%total number in catch	:	>0.0 - 3.4 (0.7)
Distribution	:	Sepik and Ramu marginal floodplain, Adelbert range, Western lower Torricelli range.

Habitat : marginal floodplain and floodplain forest creeks with slow to moderate current speeds, but also in pools of lower foothill streams with silty substrates and are littered with decaying debris and logs. See A & C, the species also occurs in the main river and lakes of the floodplain. River types 1 and 2.

2.2.4 Gobiidae

Comment: the taxonomic status of the three small gobies Glossogobius bulmeri, G. sp.17 and G. sp.18 is still under discussion; they are presently identified mainly through the different patterns of black spots on the body. These patterns are not always clear enough, especially with smaller specimens, to make an unequivocal decision on the name of a particular specimen.

Glossogobius bulmeri (Fig. 24)

Altitude	:	120 - 200 (± 1000**)
%total weight in catch	:	>0.0 - 3.8 (1.4)
%total number in catch	:	0.1 - 25.0 (6.5)
Distribution	:	Sepik and Ramu lower foothill streams

Habitat : the species can be found in the raceways and riffles of rivers with moderate current speeds. Substrates consist of cobbles and pebbles under which the fish hides. It is the species with probably the lowest altitudinal range of all the Glossogobius species examined as far as our collecting goes (and with the delimitation of the bad definition of the several species mentioned above). (But see A & C: the holotype and up till then only known specimen was collected from a flowing stream (sic!) between 914 - 1070 m

elevation in mountainous terrain. On the other hand, this might not be G. bulmeri at all, while their Glossogobius sp. 1 is (D. Hoese, pers. comm.)). River types 1 - 3.

Glossogobius sp. 17 (Fig. 25)

Altitude	:	80 - 800
%total weight in catch	:	0.3 - 18.1 (3.3)
%total number in catch	:	0.3 - 59.0 (16.3)
Distribution	:	Western Torricelli (foothills), Jimi valley, Ramu marginal floodplain streams

Habitat : A&C call this species Glossogobius sp.2 (D. Hoese pers. comm.). Most of the specimens were collected in lower foothill streams, with moderate flow in riffle areas and with small cobbles overgrown with diatoms. Some specimens were collected in floodplain forest streams and in mid-altitude mountain streams with small waterfalls and plunge pools. River types 1 - 4.

Glossogobius sp. 18 (Fig. 26)

Altitude	:	80 - 760
%total weight in catch	:	0.3 - 18.1 (3.3)
%total number in catch	:	0.3 - 59.0 (16.3)
Distribution	:	(Eastern?) Torricelli, Bewani, Adelbert?, Eastern Highlands

Habitat : A&C call this species Glossogobius sp. 3 (D. Hoese pers. comm.). Riffles in moderate to fast flowing tributaries in hilly or mountainous forested terrain. River types 2 - 4.

Glossogobius koragensis (Fig. 27)

Altitude	:	120
%total weight in catch	:	0.2
%total number in catch	:	0.7
Distribution	:	Ramu floodplain

Habitat : see A & C: mainly found in lakes and roundwaters of the lowland plain, but also occasionally encountered in main river channels. In this survey only one specimen was found in a floodplain forest creek in the Ramu valley. The species is rare. River type 1.

Stenogobius laterisquamatus (Fig. 28)

Altitude	:	40 - 80
%total weight in catch	:	0.3 - 0.8 (0.5)
%total number in catch	:	0.2 - 0.4 (0.3)
Distribution	:	Sepik floodplain and lower foothills

Habitat : see A & C, main river channels, tributaries, lakes, and roundwaters of the lowland floodplains with mud bottoms. Three specimens were collected during this survey,

all in deep pools of slow flowing rivers, partially filled with logs and tree debris. River types 1 - 2.

2.2.5 Apogonidae

Glossamia gjellerupi (Fig. 29)

Altitude	:	20 - 320
%total weight in catch	:	>0.0 - 73.8 (24.6)
%total number in catch	:	>0.0 - 63.3 (12.3)
Distribution	:	Sepik and Ramu marginal floodplain, Torricelli and highlands lower foothills

Habitat : see A & C, occupies a wide variety of river habitats, including large rivers and small tributary creeks in rainforest, but in rivers with a moderate to swift current only found in pools and stagnant areas. Rather slow fish, preferring quiet waters, large specimens are sometimes found in the Sepik mainstream close to the shore amongst vegetation or log snags. River types 1 - 3.

2.2.6 Teraponidae

Hephaestus transmontanus (Fig. 30)

Altitude	:	40 - 400 (1600 (?)***, 800*)
%total weight in catch	:	0.04 - 41.6 (11.9)
%total number in catch	:	0.04 - 62.1 (9.9)
Distribution	:	Sepik and Ramu marginal floodplain (rare), lower Torricelli, Adelbert, Jimi river (1360 m), Aiome (1600 m?), Amanab (1525 m?)

Habitat : see A & C. Rainforest creeks with a moderately fast current. The bottom usually consists of gravel and cobbles. Particularly common in pools around large rocks or submerged logs. A few specimens were found in floodplain forest area but this does not seem to be a common habitat. I never found this species at altitudes higher than 400 m, but the species was reported to occur at much higher altitudes by villagers (up to 800m). River types 1 - 3.

2.2.7 Ariidae

Arius velutinus (Fig. 31)

Altitude	:	80 - 160 (400**, 800*)
%total weight in catch	:	>0.0 - 66.6 (23.1)
%total number in catch	:	>0.0 - 32.2 (9.2)
Distribution	:	larger river lower Torricelli and highlands, Sepik and Ramu marginal floodplain

Habitat : see A & C, in the main channel and floodplain system the species is strictly confined to turbid river

channels. It is the only Ariid species that ascends rivers up to fairly high elevations. In mountainous areas the species is only found in the larger rivers (> 10 m width, >0.20 m average depth) with relatively low gradiënts, where it inhabits deeper pools. At lower altitudes it occurs there together with Parambassis confinis. Villagers claimed to catch the fish in larger rivers with relatively low gradiënts at altitudes up to 800m. River types 1 - 2.

2.2.8 Ambassidae

Parambassis confinis (Fig. 32)

Altitude	:	40 - 320
%total weight in catch	:	0.1 - 30.6 (6.2)
%total number in catch	:	0.2 - 60.0 (8.6)
Distribution	:	Sepik and Ramu marginal floodplain, larger rivers lower foothills Torricelli and highlands

Habitat : see A & C. As Arius velutinus the species only appears in pools in larger, at times turbid rivers, but it does not seem to ascend the rivers up to altitudes as high as the catfish. River types 1 - 3.

2.2.9 Hemirhamphidae

Zenarchopterus kampeni (Fig. 33)

Altitude	:	80 - 120 (300 *)
%total weight in catch	:	0.1 - 14.8 (5.2)
%total number in catch	:	0.1 - 17.4 (4.1)
Distribution	:	Sepik and Ramu marginal floodplain and lower foothills of the Adelbert , Torricelli and Bewani ranges and highlands

Habitat : occurs mainly in higher order rivers, floodplain lakes and marginal areas of the floodplain. In the lower foothills the species has a preference for large quiet pools. See A & C. River types 1 and 2.

2.2.10 Anguillidae

Anguilla bicolor pacifica (Fig. 34)

Altitude	:	40 - 120 (1000 **)
%total weight in catch	:	>0.0 - 94.0 (22.3)
%total number in catch	:	>0.0 - 8.3 (1.3)
Distribution	:	Sepik and Ramu floodplain and mountains

Habitat : see A & C. In this survey the species usually was found in rivers and creeks with muddy and silty substrates, although its range extends up to high elevations, where it

occurs in clear fast flowing streams. In the highlands an extensive trap fishery on both eels, the only occurring fish species, exists. River types 1 - 4.

Anguilla marmorata (Fig. 35)

Altitude	:	400 - 960
%total weight in catch	:	90.3 - 100
%total number in catch	:	2.1 - 100
Distribution	:	Sepik and Ramu floodplain?, all the mountain ranges

Habitat : the two specimens found in this study were both collected from small (< 2m width) first order creeks with clear water and a substrate of bedrock and sand. At high altitudes it is fished upon with specialized eel traps. A & C comment that it is relatively common in small rocky streams flowing from the North Coast of New Guinea. It seems to prefer these habitats.

2.2.11 Cichlidae (introduced)

Oreochromis mossambicus (Fig. 37)

Altitude	:	20 - 320 (1500**, 2160 *)
%total weight in catch	:	0.2 - 97.0 (24.8)
%total number in catch	:	0.1 - 75.0 (10.9)
Distribution	:	Torricelli, Sepik and Ramu marginal floodplain, Upper Ramu valley

Habitat : see A & C. The species attains a for the Sepik situation normal length in larger rivers (>15 m width) with moderate flow and large pools up to an altitude of 80 - 100 m. At higher elevations, smaller and faster flowing rivers, O. mossambicus usually does not attain sizes larger than 100 mm, and is most probably stunted. It apparently breeds in these rivers although it is not known what habitats are used for nesting sites. River types 1 - 3.

2.2.12 Cyprinidae (introduced)

Cyprinus carpio (Fig. 37)

Altitude	:	80 - 120
%total weight in catch	:	>0.0 - 24.8 (11.4)
%total number in catch	:	>0.0 - 2.0 (0.7)
Distribution	:	Ramu marginal floodplain, Bewani range at lower altitudes (not in Torricelli foothills)

Habitat : specimens were caught in floodplain forest streams in the Ramu valley and a lower foothill stream in the Adelbert range. See A & C and Ulaiwi (1990). River types 1 and 2.

2.2.13 Poeciliidae (introduced)

Gambusia affinis (Fig. 38)

Altitude	:	40 - 240
%total weight in catch	:	0.04
%total number in catch	:	1.4
Distribution	:	Ramu marginal floodplain, middle Ramu tributaries, Sepik floodplain and lakes,

Habitat : specimens were found at three distinct habitats: the blackwaters around Chambri lakes in shallow water near and in between reeds, the Ramu marginal floodplain in shallow pools and in a tributary of the middle Ramu descending from the Finisterre with a substrate of rocks and sand.

* village surveys Benoît Mys

** Allen and Coates (1989), Allen (1987), Allen and Cross (1982)

*** Mees and Kailola (1977)

4. DISCUSSION AND CONCLUSIONS RELATING TO STOCKING

1. Of the 32 species mentioned in the text 27 can be found all over the study area in the lower order streams within their altitudinal range. Three species of rainbowfish, Glossolepis maculosis, G. ramuensis and Chilatherina bulolo, are only found in the marginal floodplain area of the Ramu catchment. The distribution of Neosilurus gjellerupi coatesi is confined to the Torricelli range, N. gjellerupi gjellerupi is found only in the central dividing range (highlands) at altitudes from 40 m up to 750 m (there are reports of this (sub)species ascending to 1500 m). Three species are rare, both in the floodplain area and in the area covered by this study: Stenogobius laterisquamatus, Glossogobius koragensis and Bunaka gyrinoides. These are probably only found at lower altitudes, in the marginal floodplain area and the slow flowing rivers of the grasslands and floodplain forests. According to Munro (1967) Bunaka gyrinoides is also a brackish water species.
At altitudes above 800 m generally no fish are found except the two Anguilla spp..

2. Out of the 32 species found in the study area, 5, possibly 6, are endemic to the Sepik-Ramu system. These are Hephaestus transmontanus, Glossogobius bulmeri, G. sp.17, G. sp.18 and G. koragensis. Chilatherina campsi is at the moment recorded on both sides of the central dividing range, but doubt exists whether these recordings involve the same species. Three rainbowfish species have an unknown distribution, but probably only one of these is endemic to the Sepik-Ramu system: Glossolepis ramuensis. Chilatherina bulolo is found in the middle Ramu and the Markham system and Glossolepis maculosis is found in the Ramu and the Gogol system (Parenti and Allen).

16-18 (including the two rainbowfish) species are endemic to Northern New Guinea, but are found in other river systems like the Mamberano, the Neumayer, the Gogol, the Markham and smaller rivers along the coast of New Guinea. Only four native species have a distribution outside Northern New Guinea: Oxyeleotris aporos, Oxyeleotris fimbriata, Anguilla bicolor and Anguilla marmorata. Oxyeleotris fimbriata, found in Papua New Guinea and Cape York, is presently considered a complex of species. The various populations in northern and southern New Guinea and in Australia most likely represent several distinct taxa (personal communication G. Allen and D. Hoese).

3. The altitudinal distribution of all the species is from low altitudes (40 m in the present survey) upwards.

There are no species confined only to higher altitudes. Furthermore, there are no typical patterns of density and biomass distribution that suggest that certain species are only abundant within a limited area of their altitudinal range, although some further analysis on this point has to be done yet. None of the species, except Anguilla spp. and possibly Arius velutinus, migrate within the basin from lower altitudes to higher altitudes and vice versa or from and to the floodplain region. Little is known about the migration patterns of A. velutinus: the species appears always in samples at lower altitudes throughout the year, but according to villagers at higher altitudes it appears only during specific periods in their rivers. Anguilla bicolor seems to migrate upstream in the main Sepik channel between January and March. No data on the migration of A. marmorata are available.
The fish fauna at mid and higher altitudinal ranges is extremely poor (van Zwieten 1990a). The data suggest a simple decrease of species numbers with altitude. A substitution of species that have similar lifestyles at increasing altitude, as is found in other areas (e.g. Roberts 1978, Haines 1983, Balon and Stewart 1983), does not appear to occur.

4. Not only is the fish fauna of the Sepik-Ramu area extremely poor, the fauna is also dominated by only a few species: 50 - 75 % of the biomass at all altitudes is formed by about four to seven species: at higher altitudes these are Melanotaenia affinis, Chilatherina crassispinosa and Chilatherina fasciata, all rainbowfish, and Anguilla spp. At lower altitudes Glossamia gjellerupi, Ophieleotris aporos, and Oreochromis mossambicus are added to this list. In terms of densities the situation is even more extreme: 80 - 90 % of the number of individuals per hectare are four to six species: at higher altitudes these are the three already mentioned rainbowfish, and the small eleotrid Mogurnda nesolepis. At lower altitudes Glossamia gjellerupi and Ophieleotris aporos form a significant part of the fish density as well. It is typical of the situation in the lower order streams that a considerable part of the total biomass in a sample can be made up by only a few specimens of Oreochromis mossambicus and Anguilla spp. as they are often the only relatively large species found.

5. Except for the rainbowfish, Hephaestus transmontanus, Glossamia gjellerupi and Zenarchopterus kampeni, all the other species are bottom dwelling fish confined to certain habitats like pools, riffles etc. The rainbowfish live in relatively large schools in midwater feeding primarily on insects from the surface of the water, Z. kampeni lives in pools feeding from the surface. H.

transmontanus and G. gjellerupi live in midwater in pools under logs etc., mainly feeding from the bottom.

It is clear from these remarks that any introduction of a species at altitudes above 800-1000 m can only have a possible effect on the eel populations migrating to those altitudes. All the other species are found below this range: introductions to mid- and high altitudes will have effects on the native species only if the introduced species descends to lower altitudes. This possible effect must be the major consideration for any introduction at higher altitudes. All the species found at higher altitudes are found at lower altitudes as well, which means that possible detrimental effects of an introduction on native species will be confined to the altitudes to which the introduced species will descend below 800 m.

The foothills and lower mountains, from 80 m to 800 m, are the main areas where introductions could have severe detrimental effects on exiting fish stocks. Habitats are almost entirely rhithronic rivers bordered by well developed forest. Introductions to rivers in such regions should concentrate on species with very well defined and specialised habits. In terms of trophic niches species feeding on (i) aufwuchs and algae; (ii) detritus; and, (iii) allochtonous material like fruits, seeds, berries, nuts and leaves raining onto the waters from the forest are suggested as likely candidates (Van Zwieten 1990b).

The present distribution and biomass of the fish species in the Sepik-Ramu basin has a most significant implication for subsistence fisheries. In the fishing-survey done by Mys (Mys and Van Zwieten 1990) it appeared that the following fish species were caught most often in the following order: Melanotaeniidae (unspecified), Neosilurus spp, Oreochromis mossambicus, Hephaestus transmontanus, Arius velutinus, Glossamia gjellerupi, Anguilla spp.. 10 other species were regularly fished upon, including gobies and small eleotrids like Mogurnda nesolepis. Only 7 of the species reported here were not mentioned by the villagers in the interviews. It is significant that four of the most important species(groups) in subsistence fisheries - Neosilurus spp, Arius velutinus, Oreochromis mossambicus and Anguilla spp. - have very low densities, and, in the case of Neosilurus spp., a very low biomass as well. It is suspected that in some areas with high population densities, some of these species, specifically Neosilurus spp., are overfished (Mys and Van Zwieten 1990).

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6. TABLE AND FIGURES

Table 1 : Total weight and total number per species as percentages of the total added weight and total number of fish collected in the complete biomass samples during the period January 1988 - September 1989.

Fig.1 : Average biomass per species (kg/ha) over altitude (meter above see level) in steps of 100 m altitudinal ranges. Averages of individual species are calculated over all the samples collected within a given altitudinal range. The total average biomass in a range is presented with its standard error. The curve presents the regression line of the average biomass of the samples in a given altitudinal range ($y = e^{(10.973 - 0.0024x)}$, $r^2 = 21.9$, $p < 0.001$)

Fig.2 : Average density per species (no/ha) over altitude (m.a.s.l.) in steps of 100 m altitudinal ranges. Averages of individual species are calculated over all the samples collected within a given altitudinal range. The total average density in a range is presented with its standard error. The curve presents the regression line of the average density of the samples in a given altitudinal range ($y = e^{(9.524 - 0.0032x)}$, $r^2 = 20.0$, $p < 0.001$)

Fig.3 : Species distribution versus altitude in the lower order streams of the Sepik and Ramu catchment. The datapoints represent the different altitudes at which a species was collected. An.bi.= Anguilla bicolor, An.ma.= A. marmorata, Ar.ve.= Arius velutinus, Bu.gy.= Bunaka gyrinoides, Ch.bu.= Chilatherina bulolo, Ch.ca.= C.campsi, Ch.cr.= C. crassispinosa, Ch.fa.= C. fasciata, Cy.ca.= Cyprinus carpio, Ga.af.= GAmbusia affinis, Gg.ko.= Glossogobius koragensis, Gg.bu.= G. bulmeri, Gg.17.= G. species 17, Gg.18.= G. species 18, Gl.gj.= Glossamia gjellerupi, Gp.ma.= Glossolepis maculosis, Gp.ra.= G. ramuensis, He.tr.= Hephaestus transmontanus, Me.af.= Melanotaenia affinis, Mo.bl.= Mogurnda bloodi, Mo.ne.= M. nesolepis, Mo.sp.= M. new species, Ne.ni.= Neosilurus niger, Op.ap.= Ophieleotris aporos, Or.mo.= Oreochromis mossambicus, Ox.fi.= Oxyeleotris fimbriata, Ox.he.= Oxyeleotris heterodon, Pa.co.= Parambassis confinis, St.la.=

Stenogobius laterisquamatus, Ta.co.= Neosilurus gjellerupi coatesi, Ta.gj.= N. gjellerupi gjellerupi, Ta.id.= N. idenburgi, Ze.ka.= Zenarchopterus kampeni.

Fig.4 : Species distribution versus gradiënt in the lower order streams of the Sepik and Ramu catchment. The datapoints represent the different gradiënts of the rivers in which the species was collected. Gradiënts were calculated from 1 : 100.000 maps with 40 m contour lines. Legends see Fig.3.

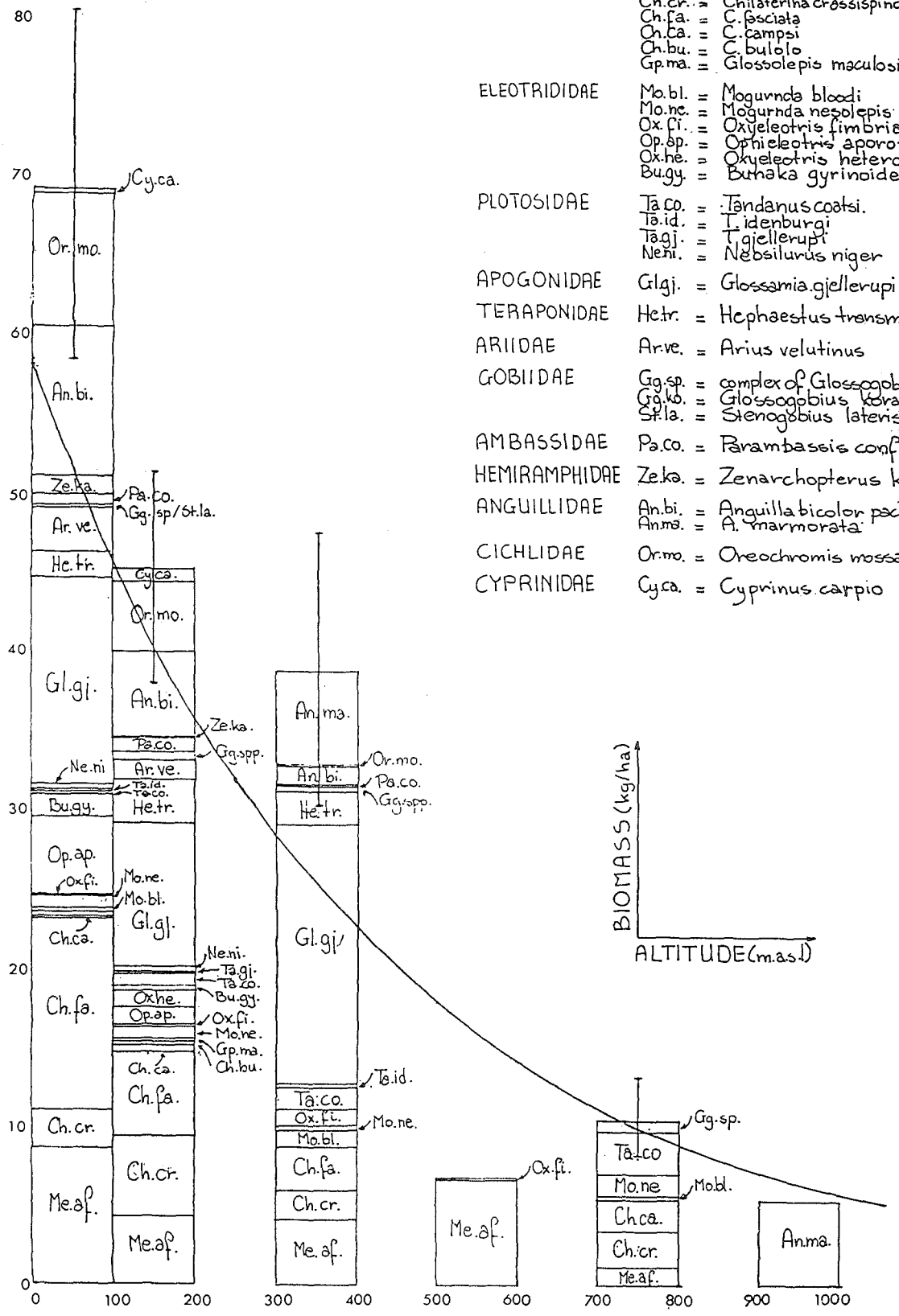
Fig.5 - 38: Distribution patterns over the Sepik and Ramu catchment areas of the species found in the marginal floodplain, foothill and mountain streams of the Finisterre, Adelbert, Torricelli, Bewani and Central Highland mountain ranges. The points in the maps represent the collection sites of this survey and the surveys of Allen, Coates and Parenti in the Ramu area in 1987

5. Melanotaenia affinis
6. Chilatherina crassispinosa
7. Chilatherina fasciata
8. Chilatherina campsi
9. Chilatherina bulolo
10. Glossolepis maculosis
11. Glossolepis ramuensis
12. Glossolepis multisquamatus
13. Mogurnda bloodi
14. Mogurnda nesolepis
15. Mogurnda new species
16. Bunaka gyrinoides
17. Ophieleotris aporos
18. Oxyeleotris fimbriata
19. Oxyeleotris heterodon
20. Neosilurus gjellerupi coatesi
21. Neosilurus gjellerupi gjellerupi
22. Neosilurus idenburgi
23. Neosilurus niger
24. Glossogobius bulmeri
25. Glossogobius sp.17
26. Glossogobius sp.18
27. Glossogobius koragensis
28. Stenogobius laterisquamatus
29. Glossamia gjellerupi
30. Hephaestus transmontanus
31. Arius velutinus
32. Parambassis confinis
33. Zenarchopterus kampeni
34. Anguilla bicolor

35.Anguilla marmorata
36.Oreochromis mossambicus
37.Cyprinus carpio
38.Gambusia affinis

TABLE 1

SPECIES	% Total Weight	% Total Number
Anguilla bicolor	10.8	0.3
A. marmorata	2.2	>0.0
Melanotaenia affinis	10.9	26.4
Chilatherina fasciata	13.0	20.1
C. crassispinosa	7.8	12.0
C. campsi	0.7	3.4
C. bulolo	0.4	1.8
Glossolepis maculosis	0.2	0.9
Glossamia gjellerupi	22.5	8.7
Ophieleotris aporos	4.1	1.8
Oxyeleotris heterodon	0.5	0.1
O. fimbriata	0.5	0.6
Bunaka gyrinoides	0.8	>0.0
Mogurnda bloodi	0.5	0.5
M. nesolepis	1.6	13.9
Neosilurus gjellerupi coatesi	2.4	0.6
N. gjellerupi gjellerupi	0.1	0.1
N. idenburgi	0.1	>0.0
N. novaeguinea	0.5	0.2
Arius velutinus	3.1	0.3
Parambassis confinis	1.2	0.5
Hephaestus transmontanus	4.5	2.3
Glossogobius spp.	0.6	2.9
G. koragensis	>0.0	>0.0
Stenogobius laterisquamatus	>0.0	>0.0
Zenarchopterus kampeni	0.7	0.2
Oreochromis mossambicus	9.3	2.1
Cyprinus carpio	1.0	0.1
Gambusia affinis	>0.0	>0.0



MELANOTAENIIDAE
- Me.af. = Melanotaenia affinis
- Ch.cr. = Chilaterina crossispinosa
- Ch.fa. = C. fasciata
- Ch.ca. = C. campsi
- Ch.bu. = C. bulolo
- Gp.ma. = Glossolepis maculosis

ELEOTRIDIDAE
- Mo.bl. = Mogurnda bloodi
- Mo.ne. = Mogurnda nesolepis
- Ox.fi. = Oxyeleotris fimbriata
- Op.ap. = Ophieleotris aporos
- Ox.he. = Oxyeleotris heterodon
- Bu.gy. = Butaka gyrinoides

PLOTOSIDAE
- Ta.co. = Tandanus coatsi.
- Ta.id. = T. idenburgi
- Ta.gj. = T. gjellerupi
- Ne.ni. = Neosilurus niger

APOGONIDAE
- Gl.gj. = Glossamia gjellerupi

TERAPONIDAE
- He.tr. = Hephaestus transmontanus

ARIIDAE
- Ar.ve. = Arius velutinus

GOBIIDAE
- Gg.sp. = complex of Glossogobius bulmeri
- Gg.ko. = Glossogobius koragensis l.
- St.la. = Stenogobius laterisquamatus

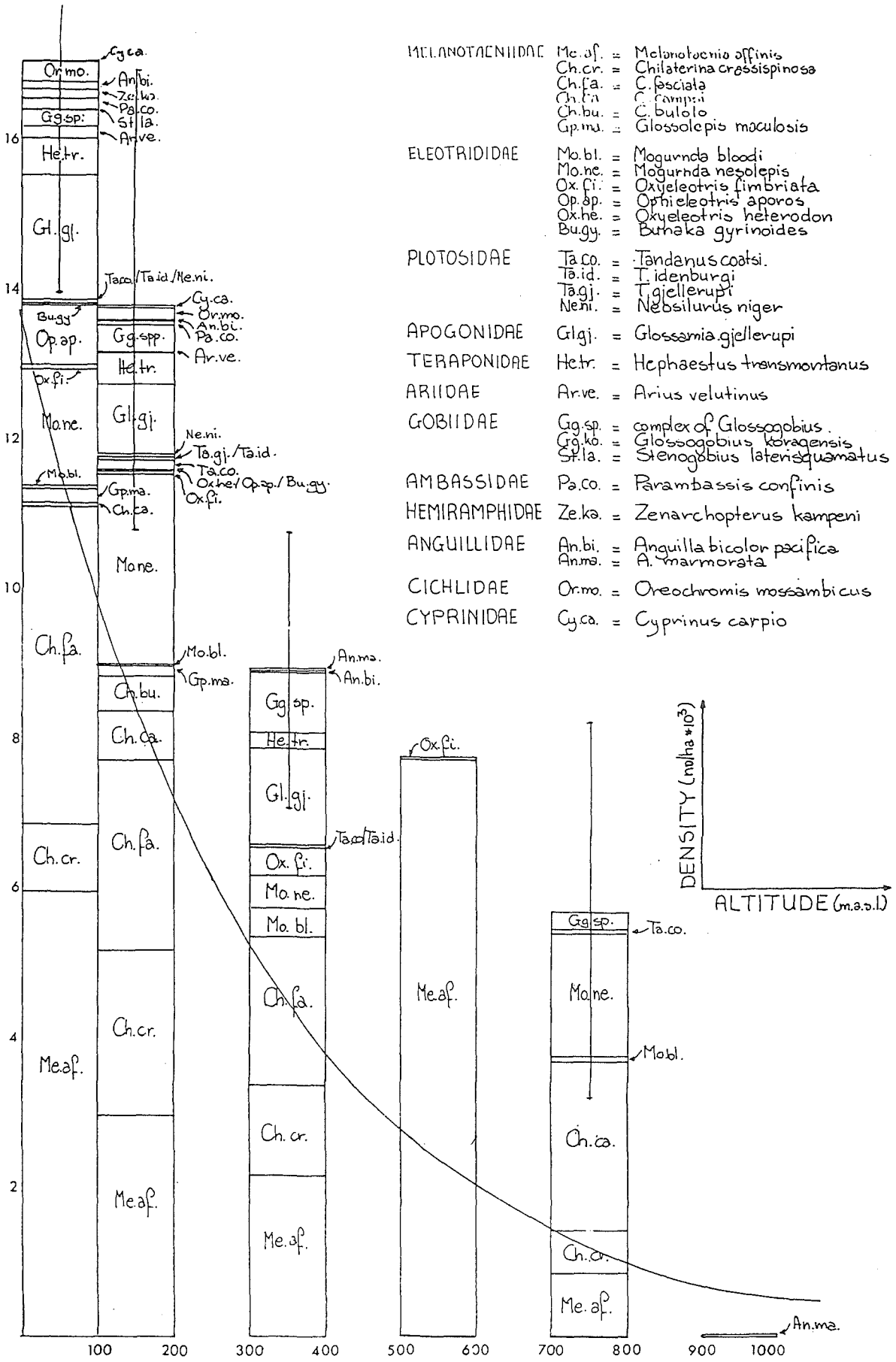
AMBASSIDAE
- Pa.co. = Parambassis confinis

HEMIRAMPHIDAE
- Ze.ka. = Zenarchopterus kampeni

ANGUILLIDAE
- An.bi. = Anguilla bicolor pacifica
- An.ma. = A. marmorata

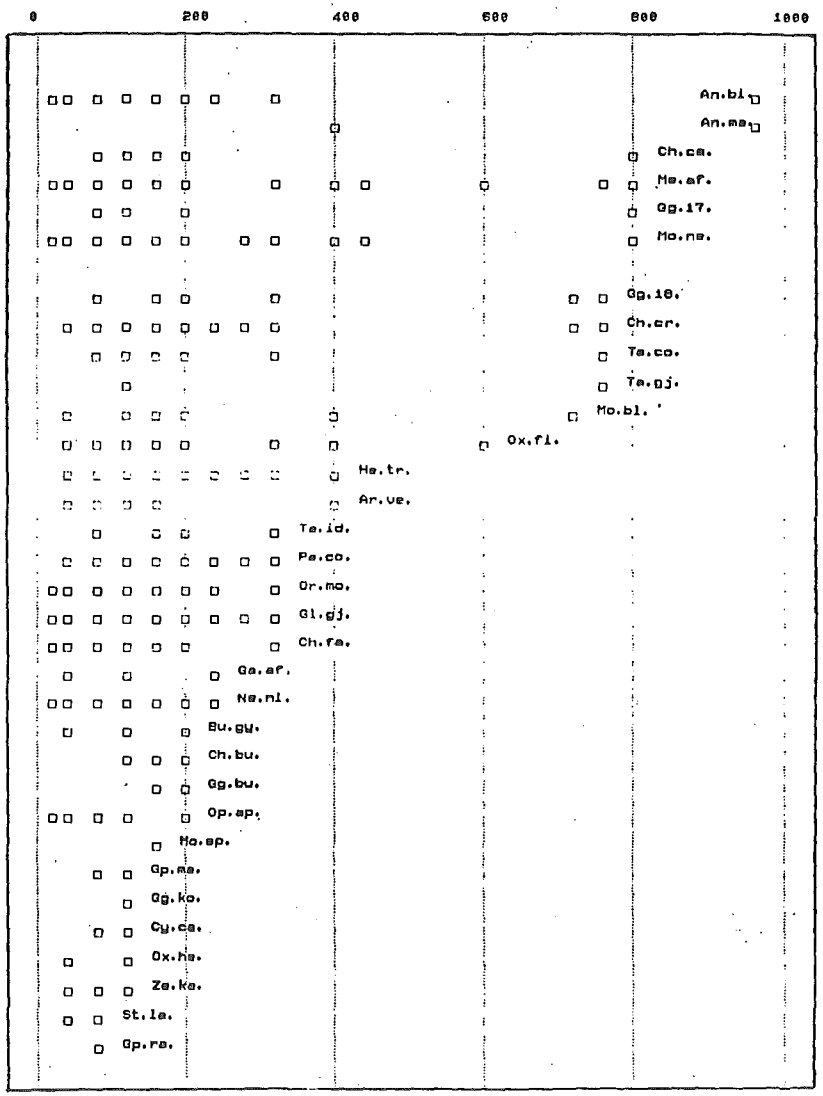
CICHLIDAE
- Or.mo. = Oreochromis mossambicus

CYPRINIDAE
- Cy.ca. = Cyprinus carpio



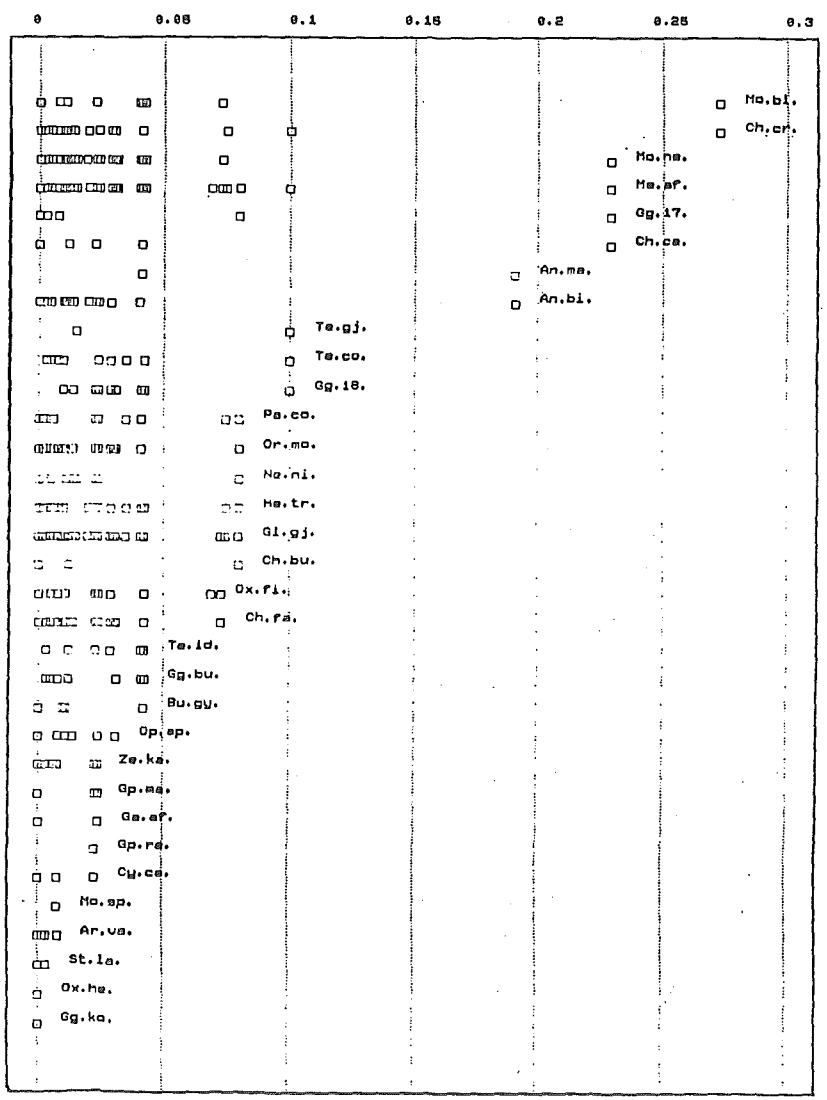
MELANOTAENIIDAE	Me.af.	= Melanotaenia affinis
	Ch.cr.	= Chilaterina crassispinosa
	Ch.fa.	= C. fasciata
	Ch.ca.	= C. campsi
	Ch.bu.	= C. bulolo
	Gp.ma.	= Glossolepis maculosis
ELEOTRIDIDAE	Mo.bl.	= Mogurnda bloodi
	Mo.ne.	= Mogurnda nesolepis
	Ox.fi.	= Oxyeleotris fimbriata
	Op.ap.	= Ophieleotris aporos
	Ox.he.	= Oxyeleotris heterodon
	Bu.gy.	= Bunaka gyrinoides
PLOTOSIDAE	Ta.co.	= Tandanus coatsi.
	Ta.id.	= T. idenburgi
	Ta.gj.	= T. gjellerupi
	Ne.ni.	= Nebsilurus niger
APOGONIDAE	Gl.gj.	= Glossamia gjellerupi
TERAPONIDAE	He.tr.	= Hephaestus transmontanus
ARIIDAE	Ar.ve.	= Arius velutinus
GOBIIDAE	Gg.sp.	= complex of Glossogobius.
	Gg.ko.	= Glossogobius koragensis
	St.la.	= Stenogobius laterisquamatus
AMBASSIDAE	Pa.co.	= Parambassis confinis
HEMIRAMPHIDAE	Ze.ka.	= Zenarchopterus kampeni
ANGUILLIDAE	An.bi.	= Anguilla bicolor pacifica
	An.ma.	= A. marmorata
CICHLIDAE	Or.mo.	= Oreochromis mossambicus
CYPRINIDAE	Cy.ca.	= Cyprinus carpio

Altitude (m)

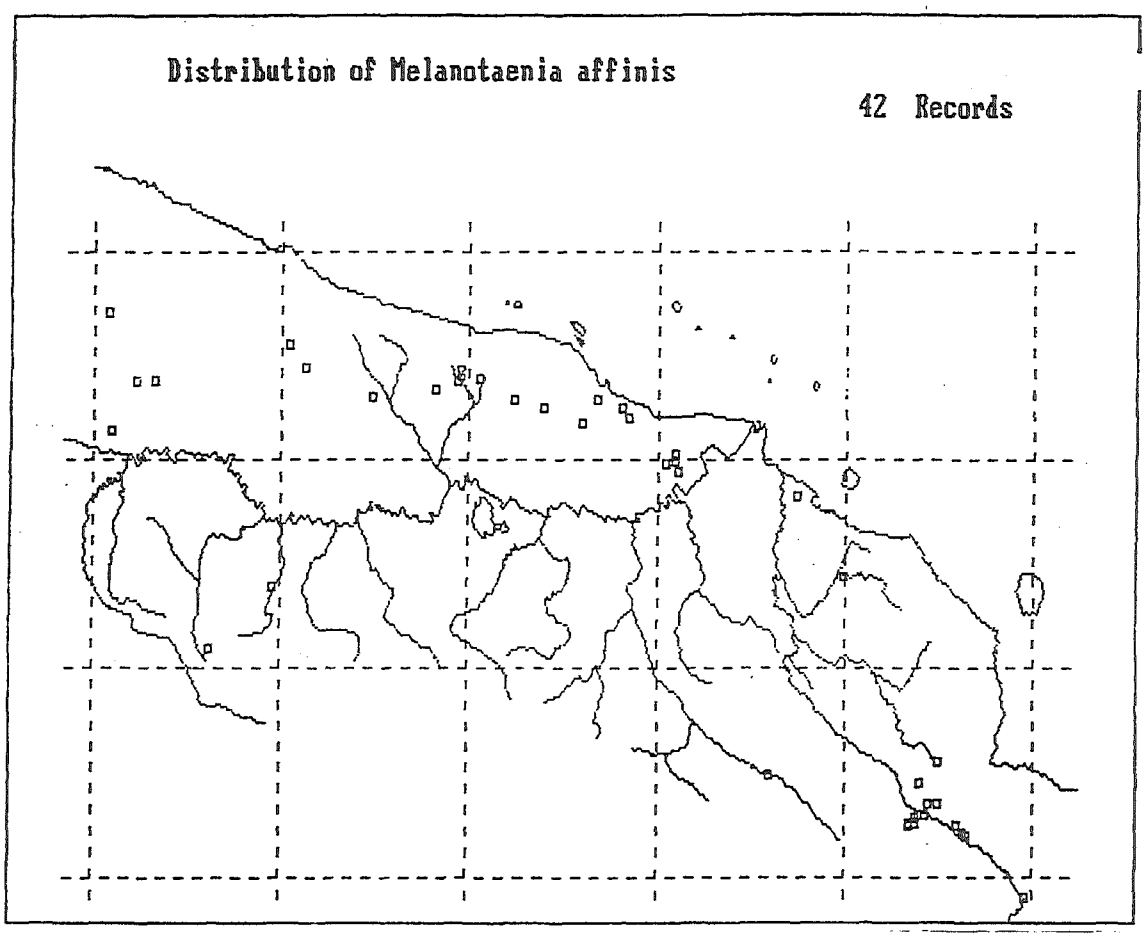


SPECIES DISTRIBUTION - ALTITUDE
LOWER ORDER STREAMS SEPIK-RAMU CATCHMENT

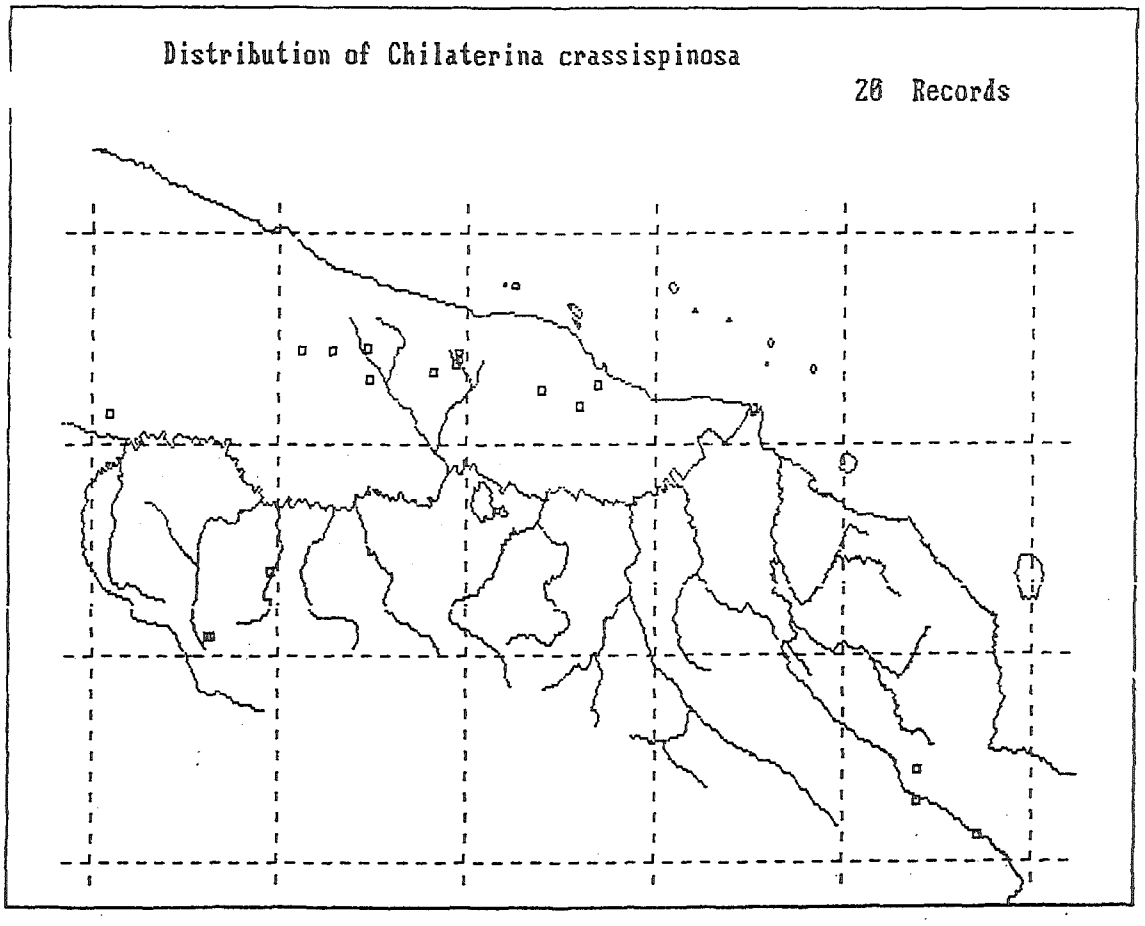
Gradient (m/m)



SPECIES DISTRIBUTION - GRADIENT
LOWER ORDER STREAMS SEPIK-RAMU CATCHMENT


Distribution of Melanotaenia affinis
42 Records

5


Distribution of Chilaterina crassispinosa
20 Records

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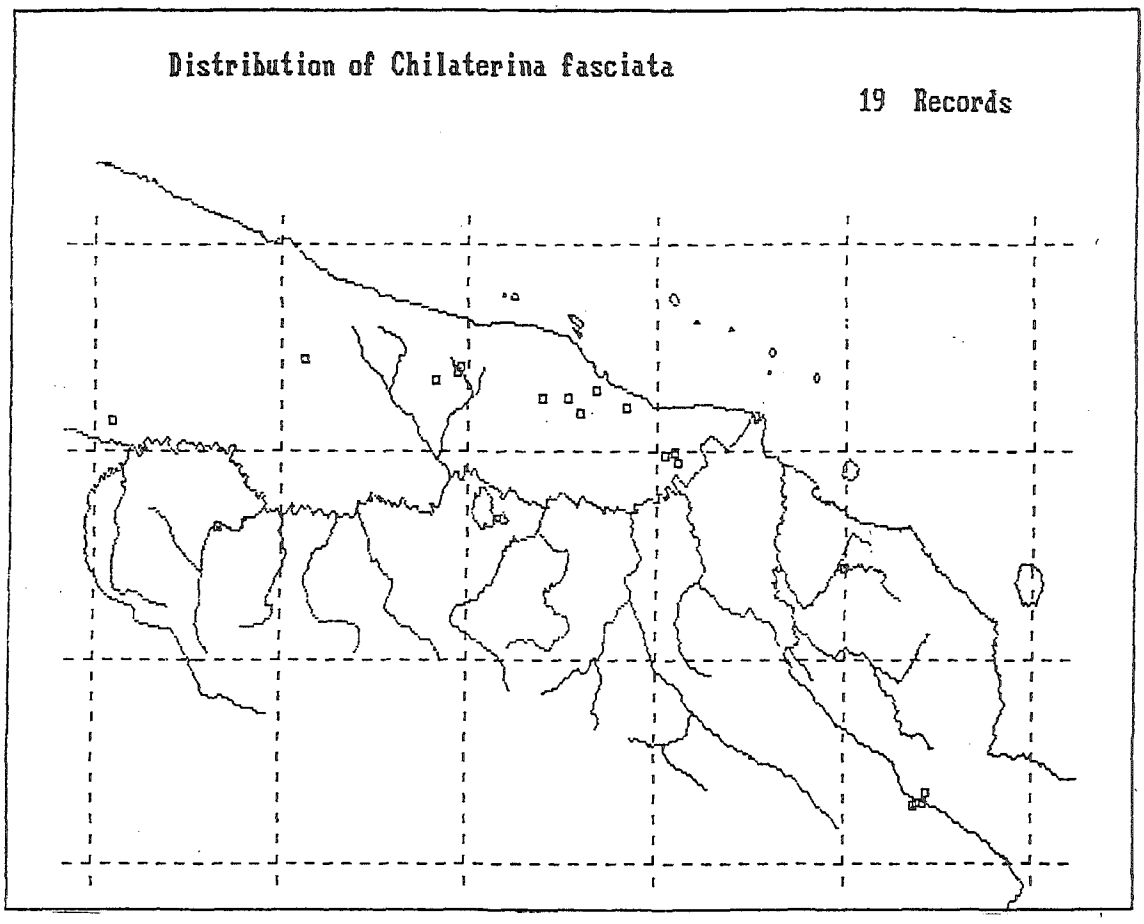
Distribution of Chilaterina fasciata
19 Records

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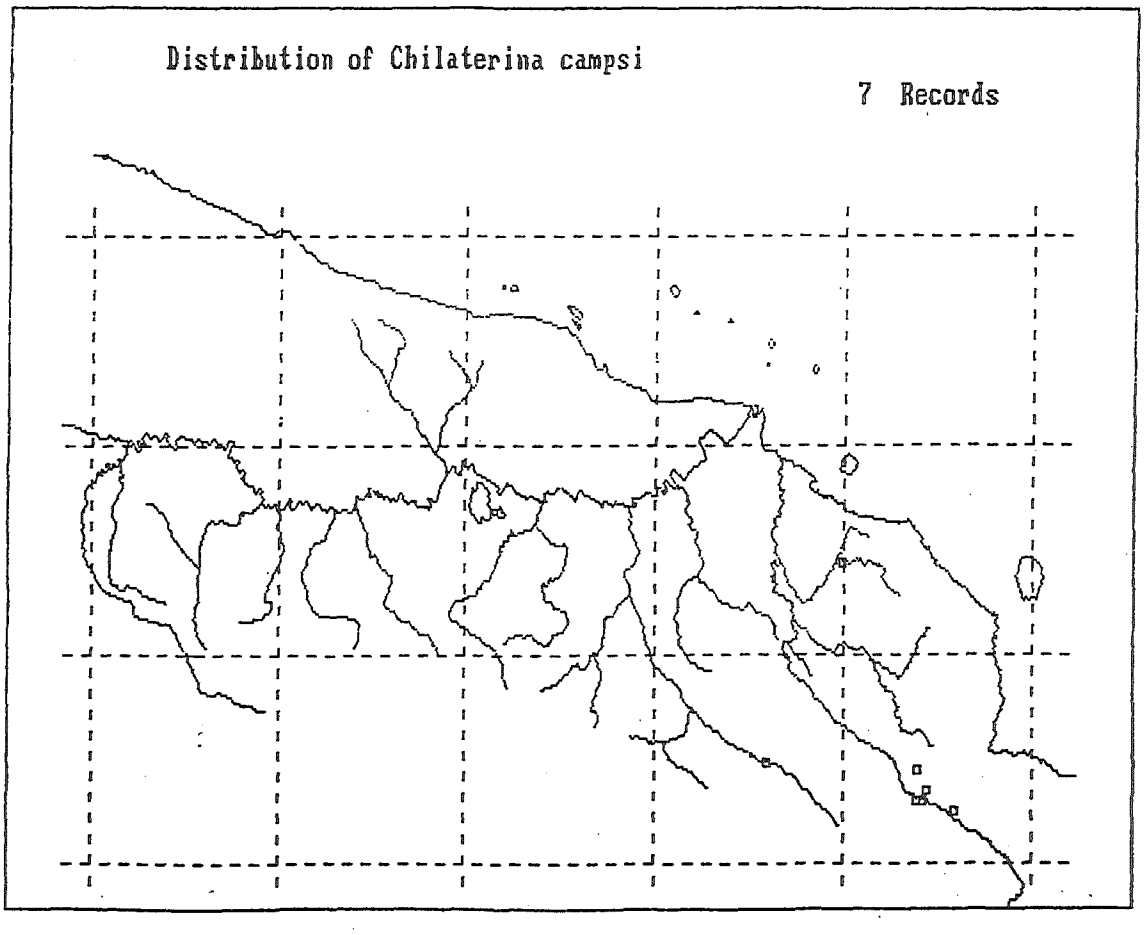
Distribution of Chilaterina campsi
7 Records

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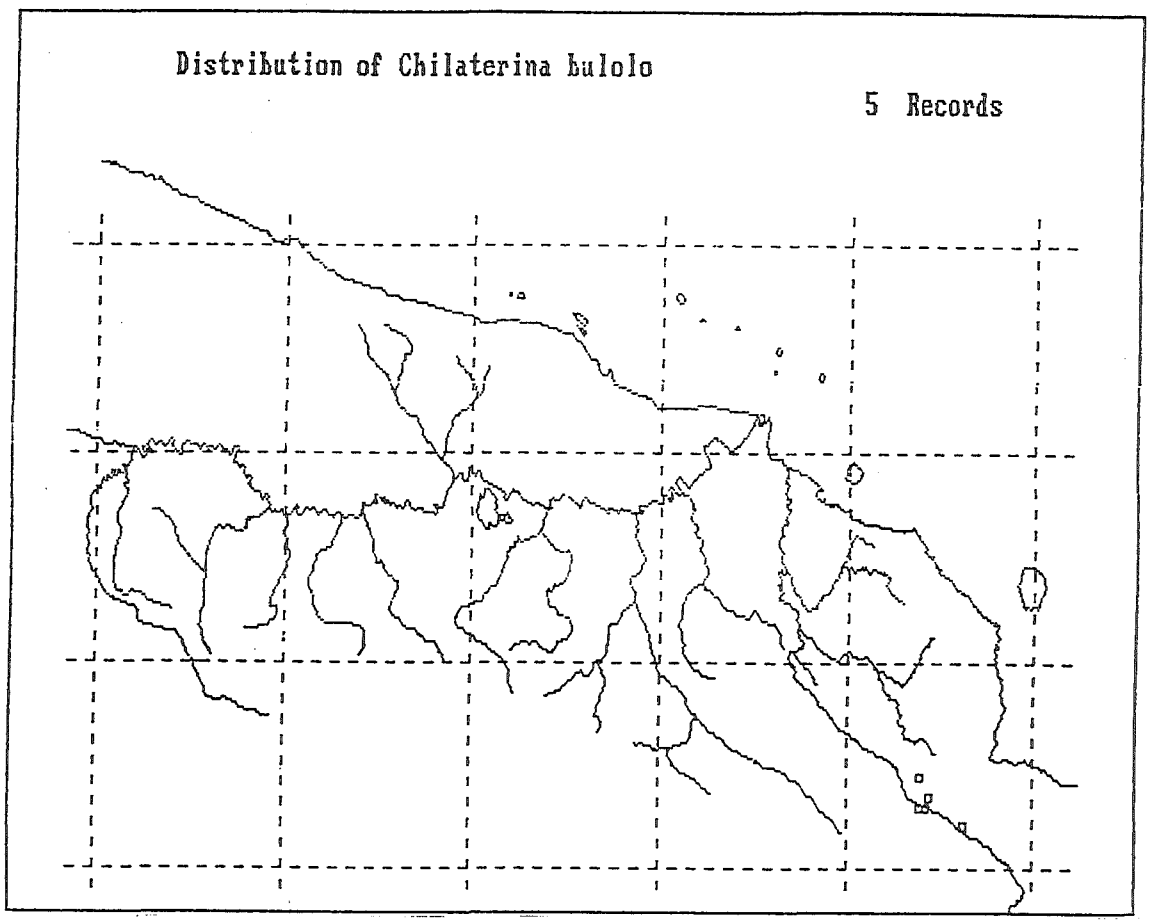
Distribution of Chilaterina bulolo
5 Records

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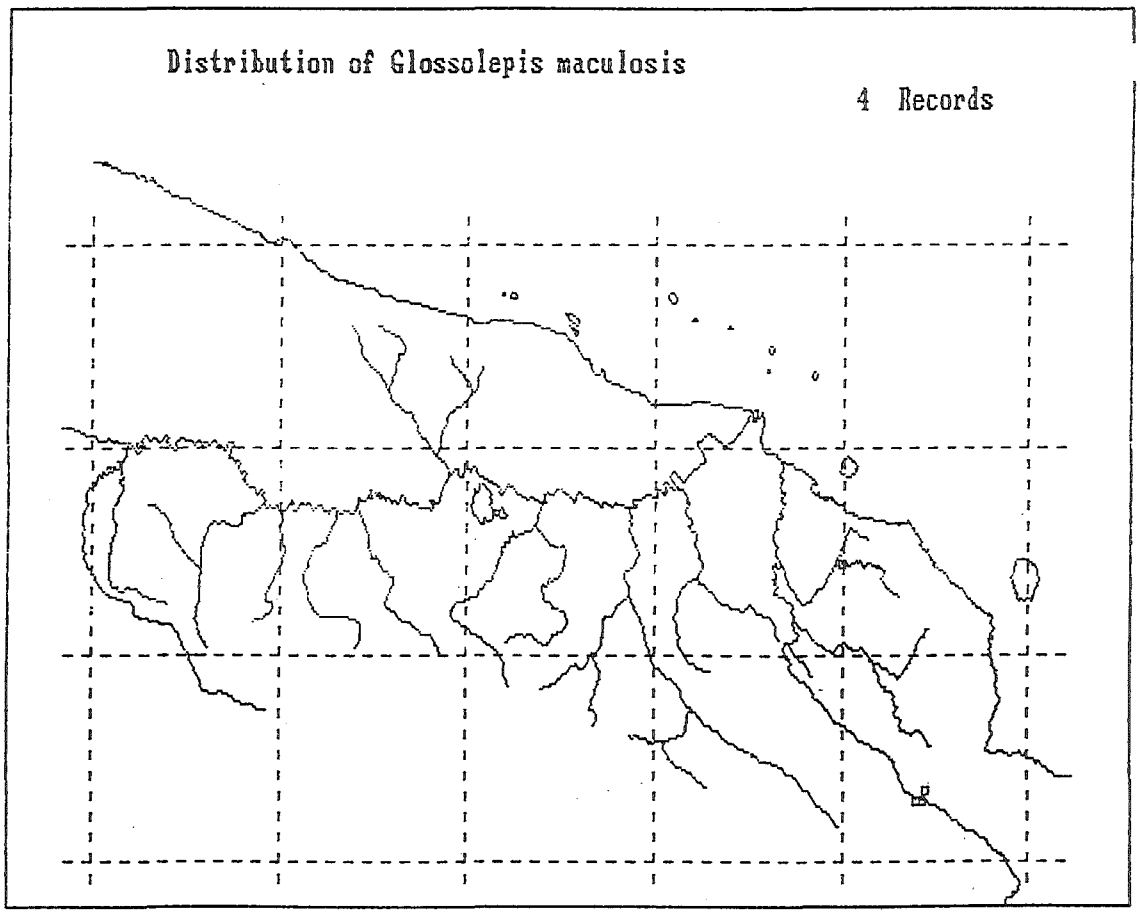
Distribution of Glossolepis maculosis
4 Records

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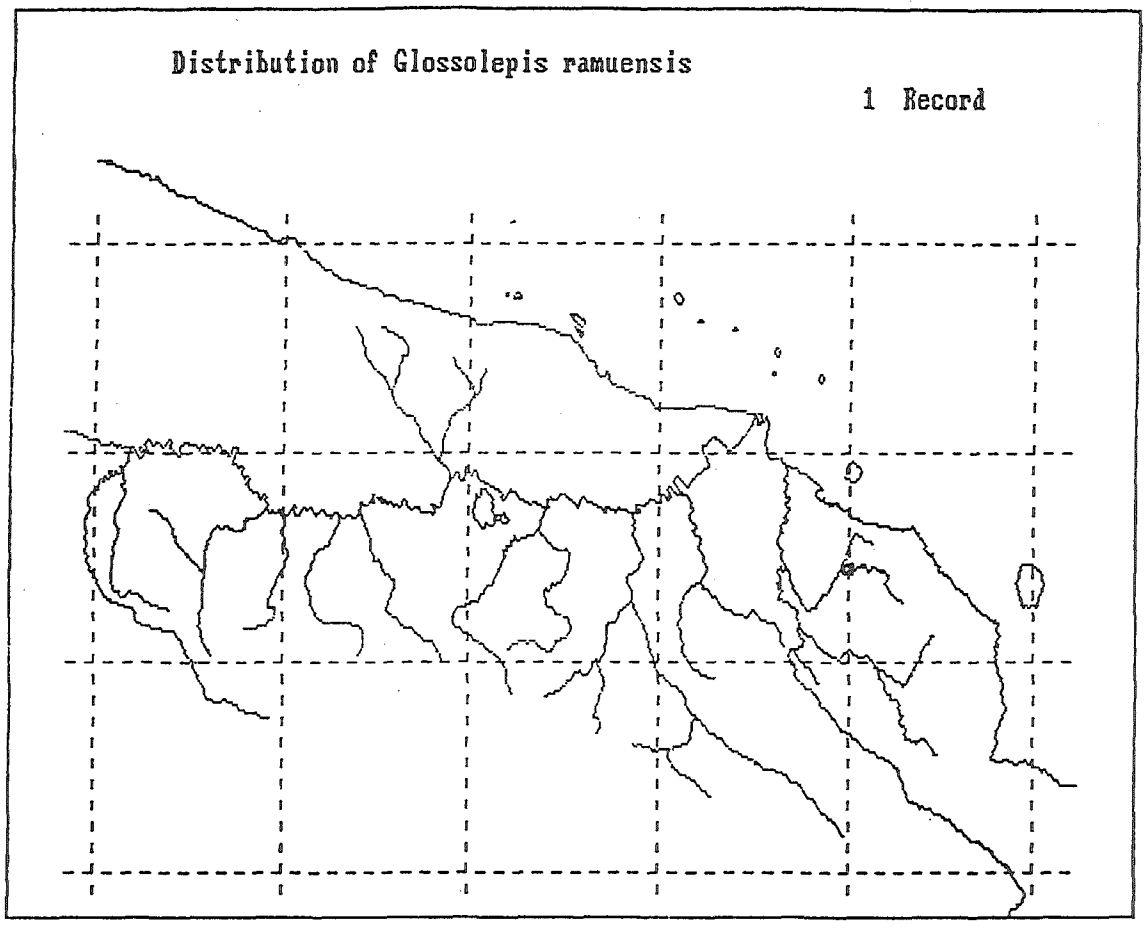
Distribution of Glossolepis ramuensis
1 Record

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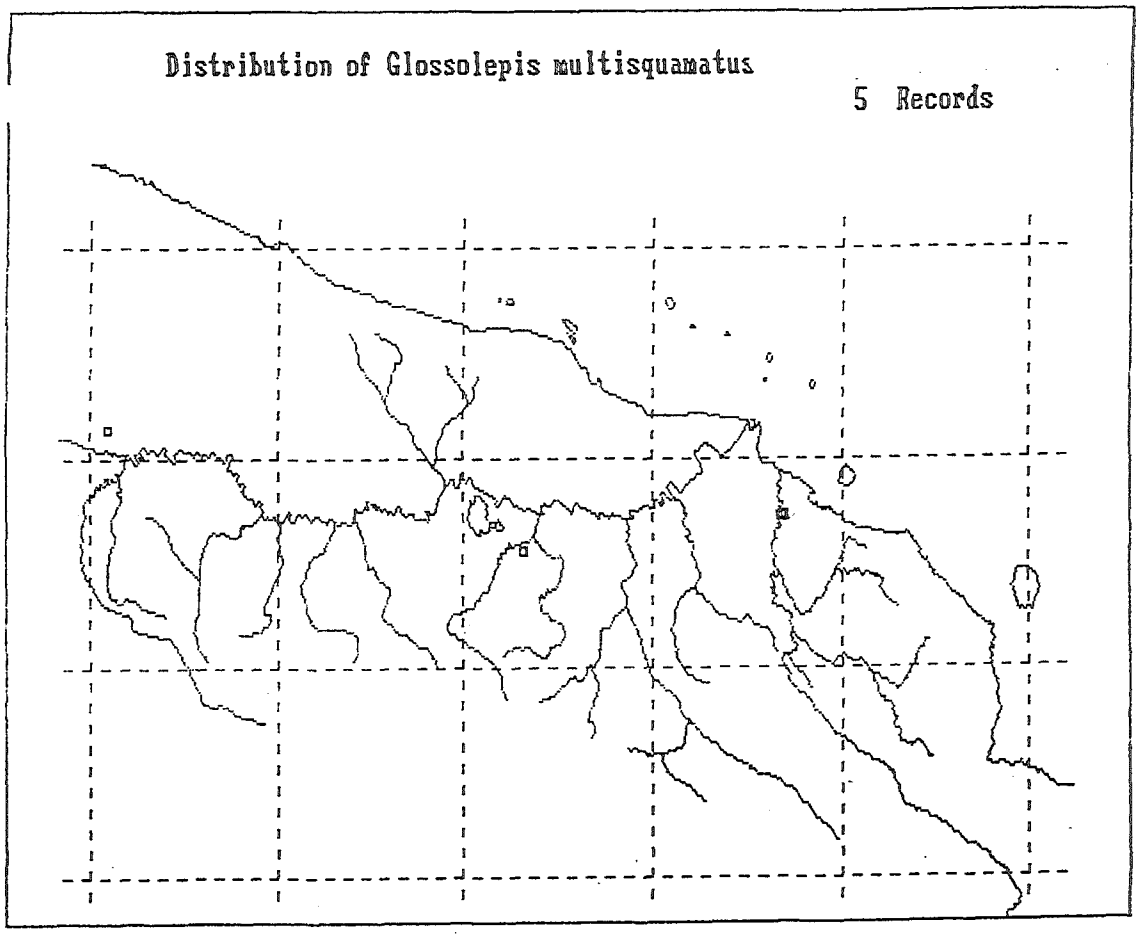
Distribution of Glossolepis multisquamatus
5 Records

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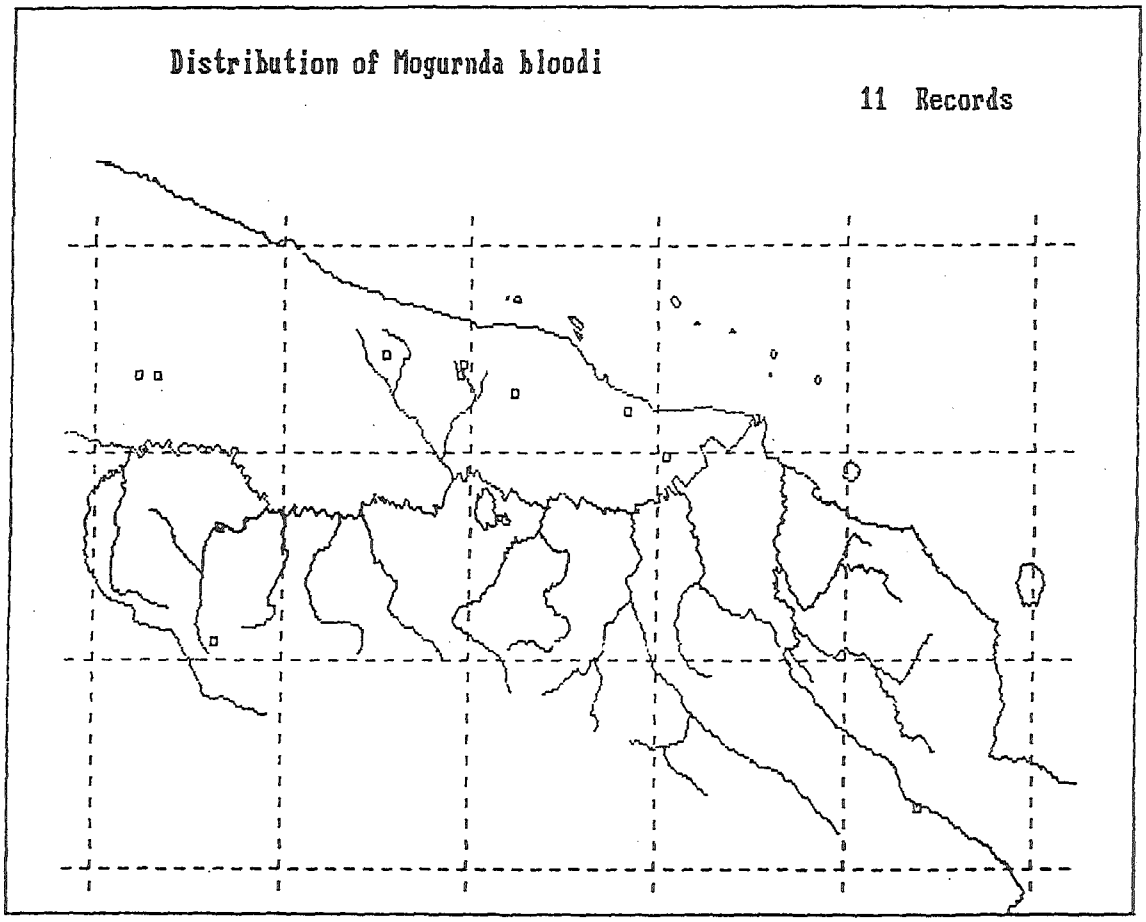
Distribution of Mogurnda bloodi
11 Records

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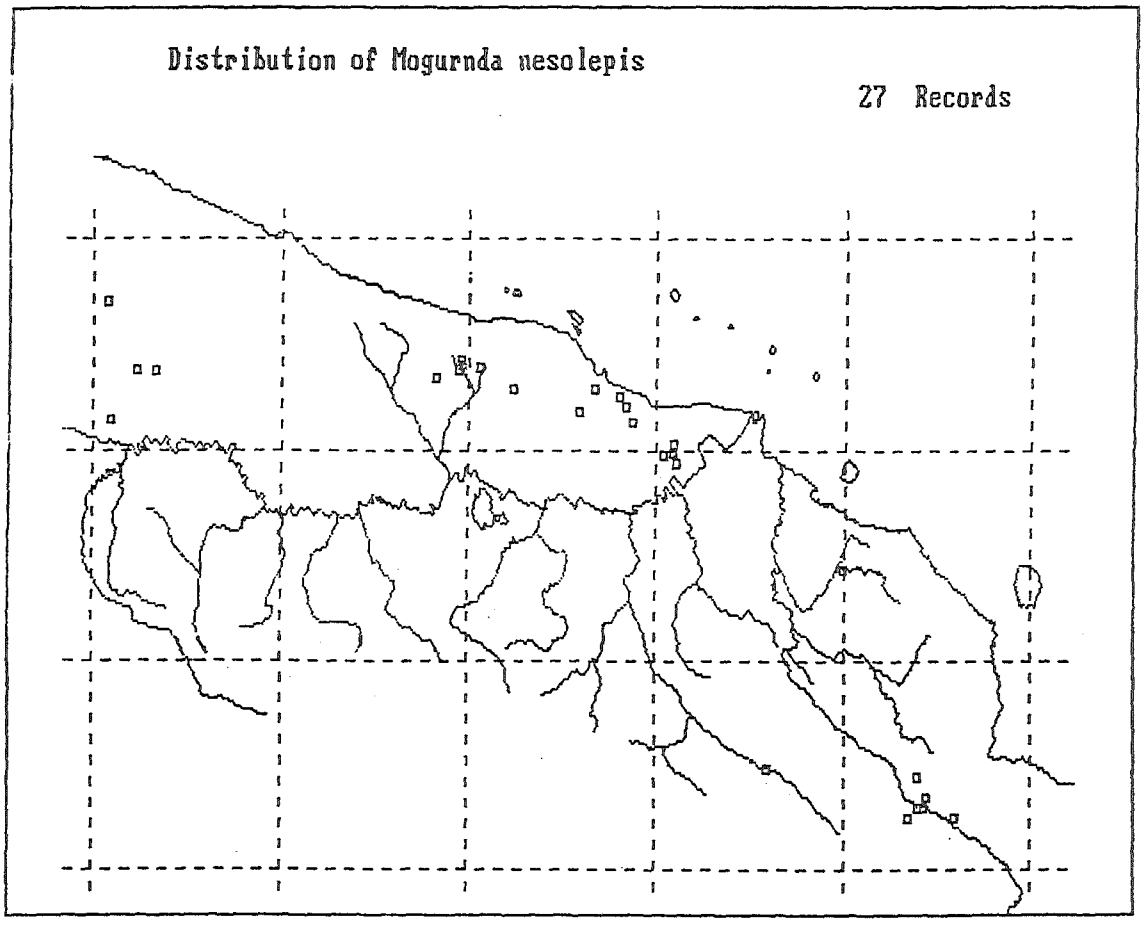
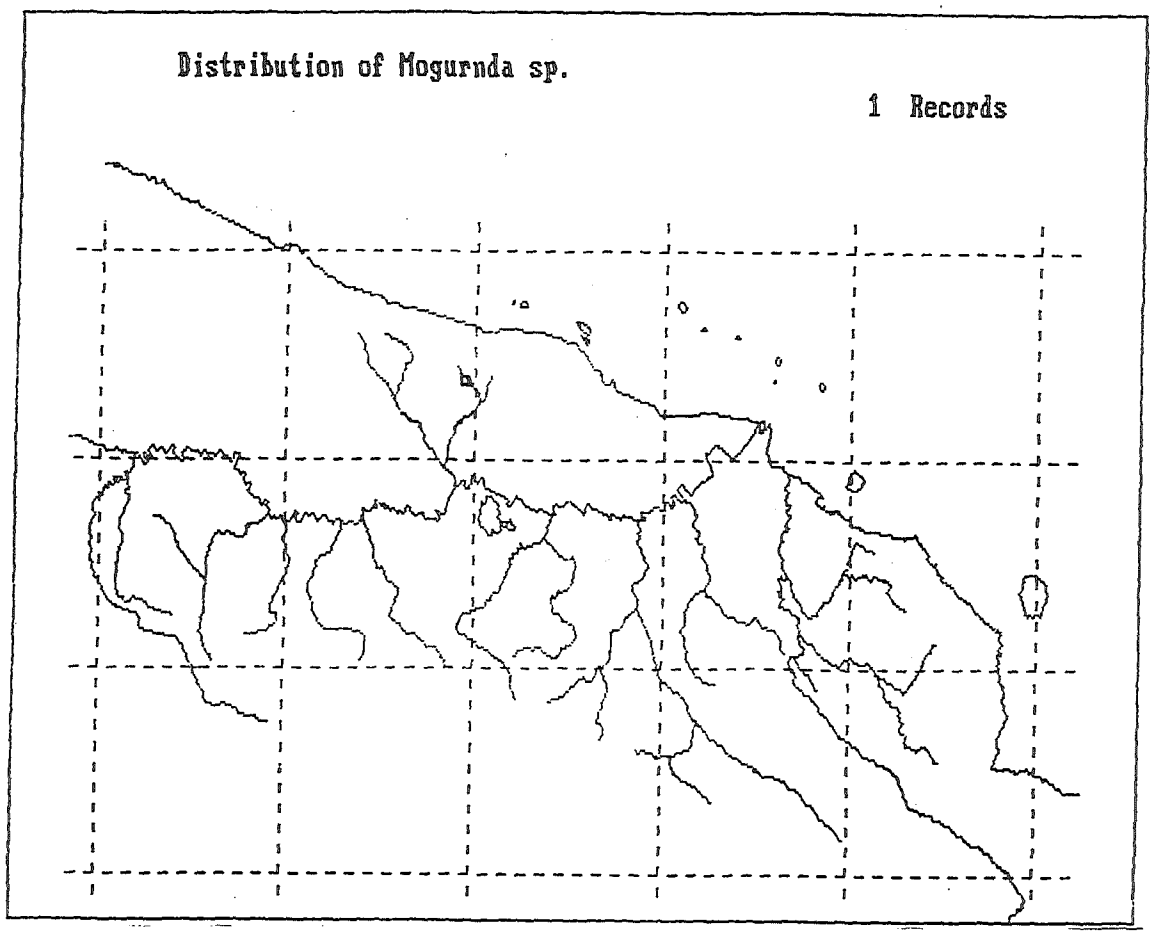
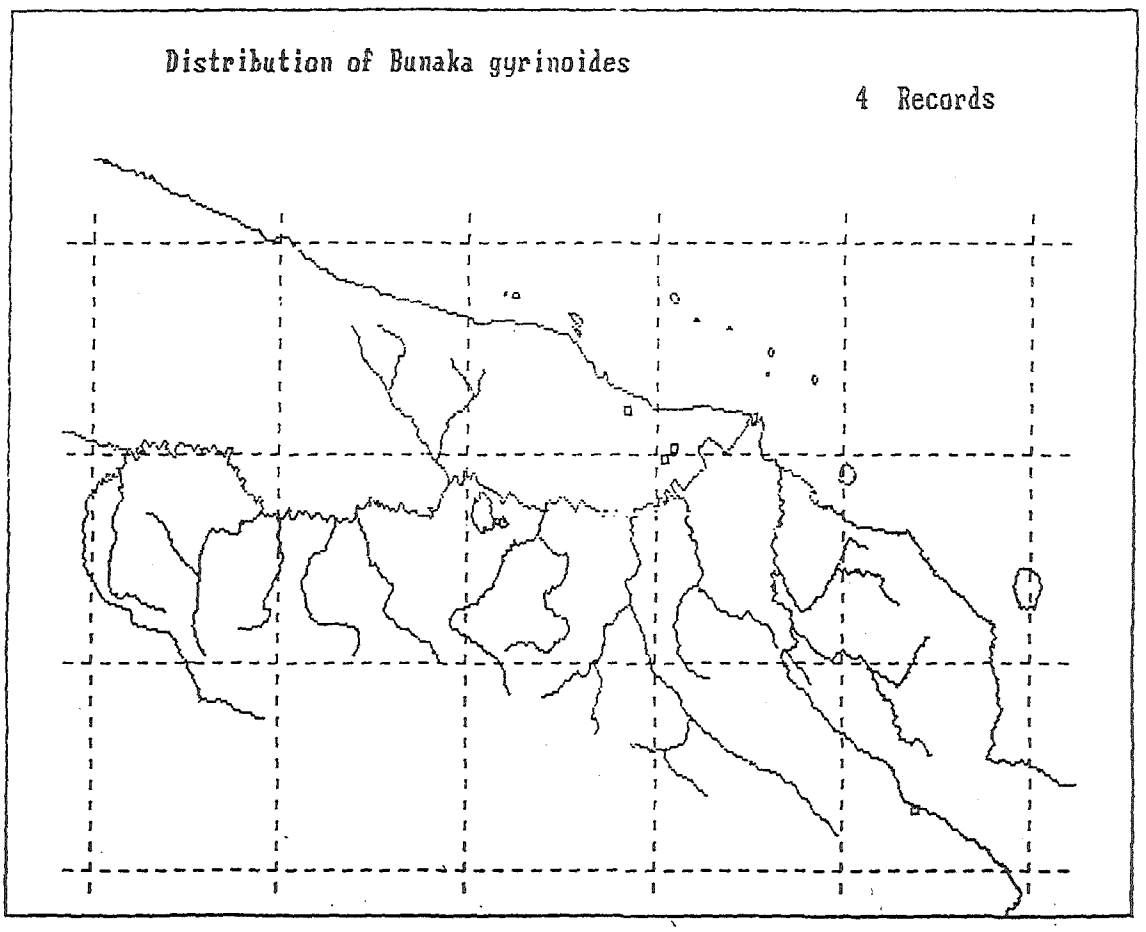

Distribution of Mogurnda nesolepis
27 Records

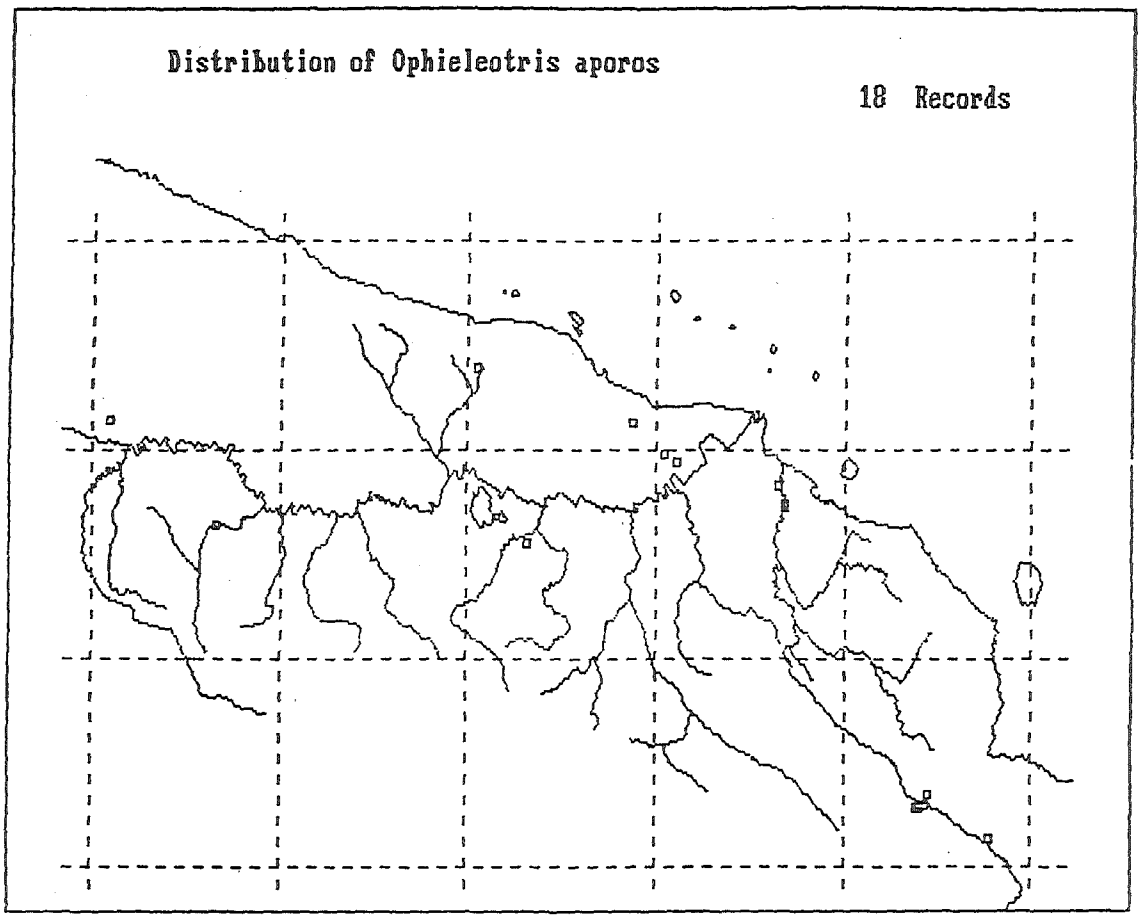
14


Distribution of Mogurnda sp.
1 Records

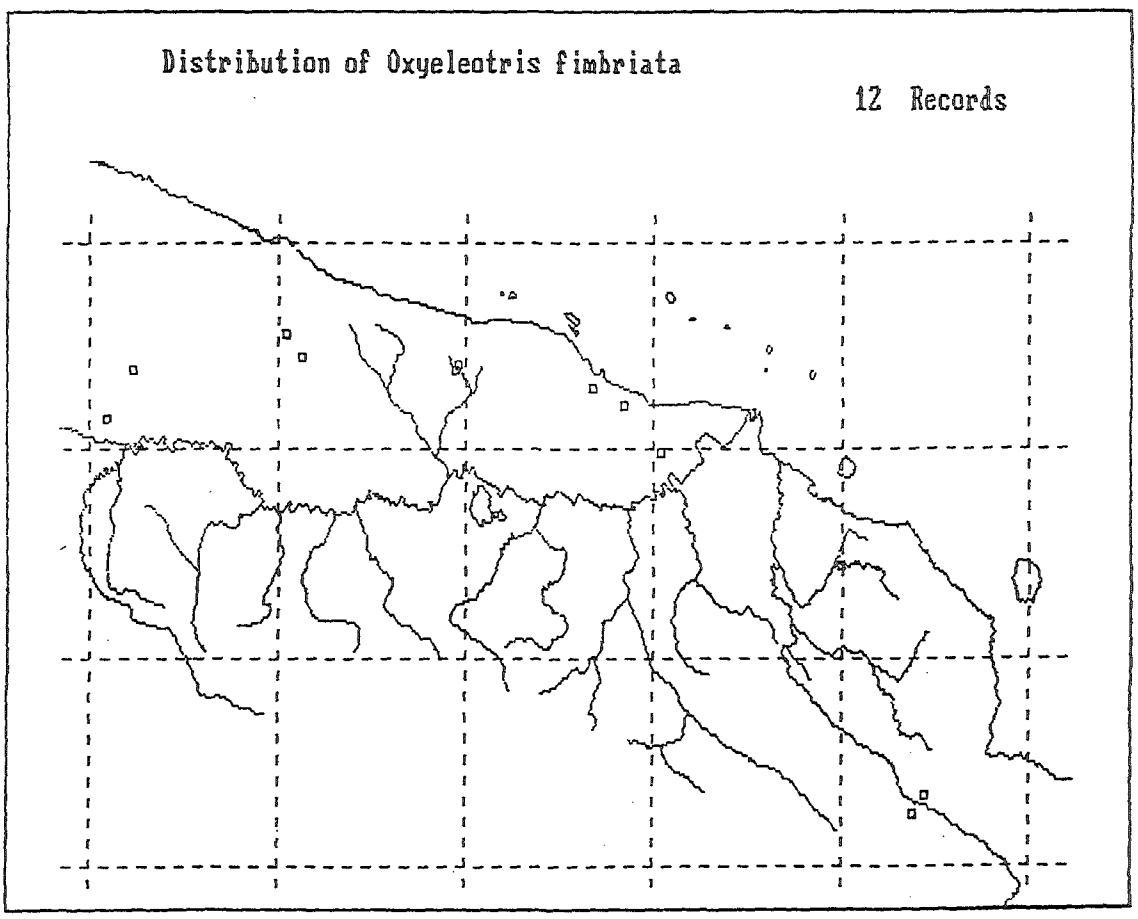
15


Distribution of Bunaka gyrinoides
4 Records

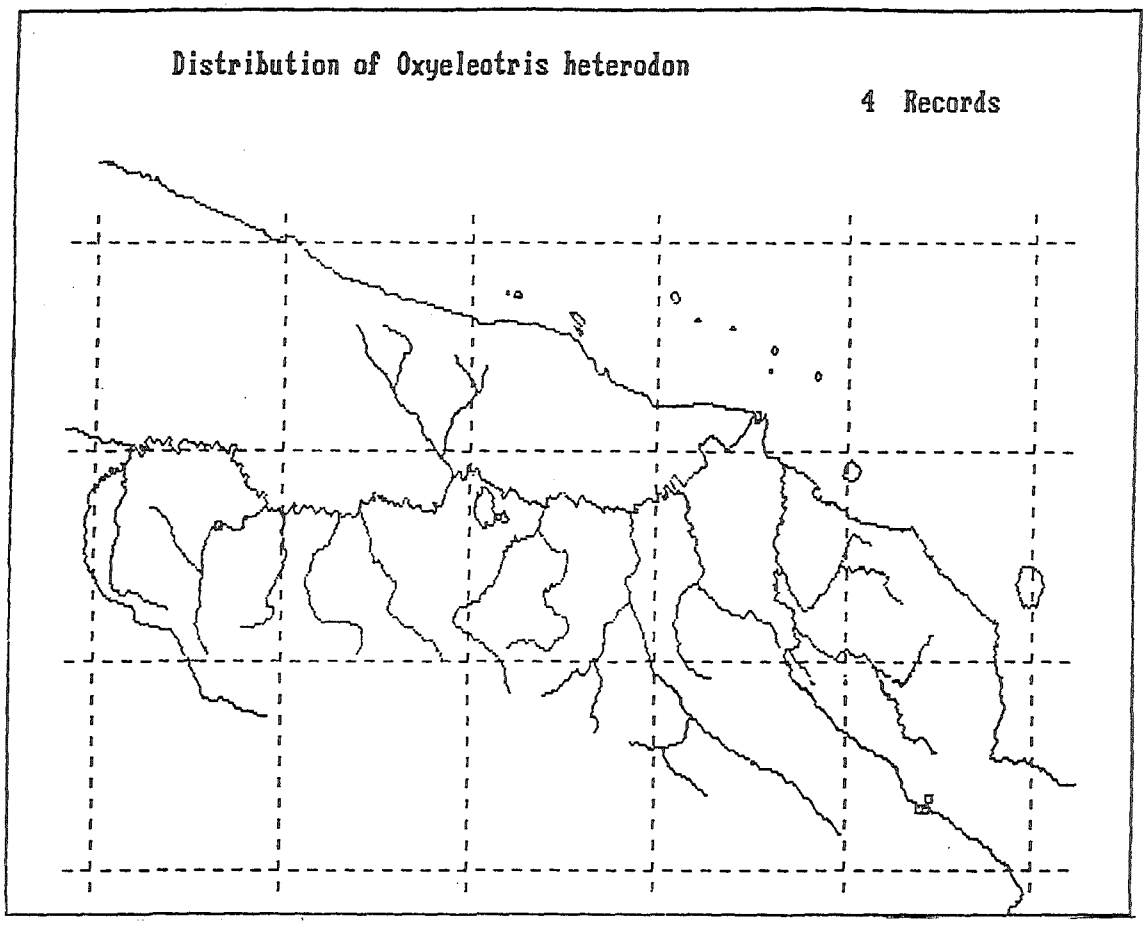
16


Distribution of Ophieleotris aporos
18 Records

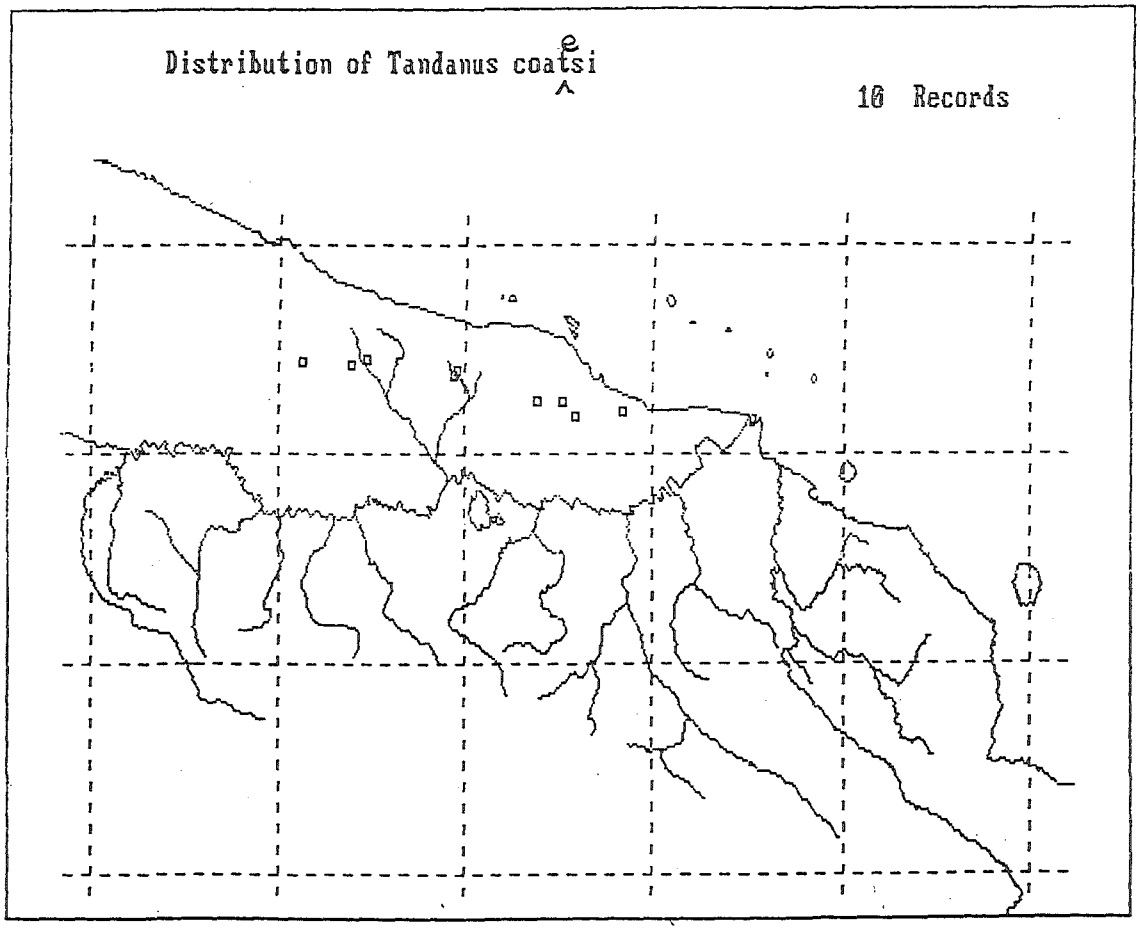
17


Distribution of Oxyeleotris fimbriata
12 Records

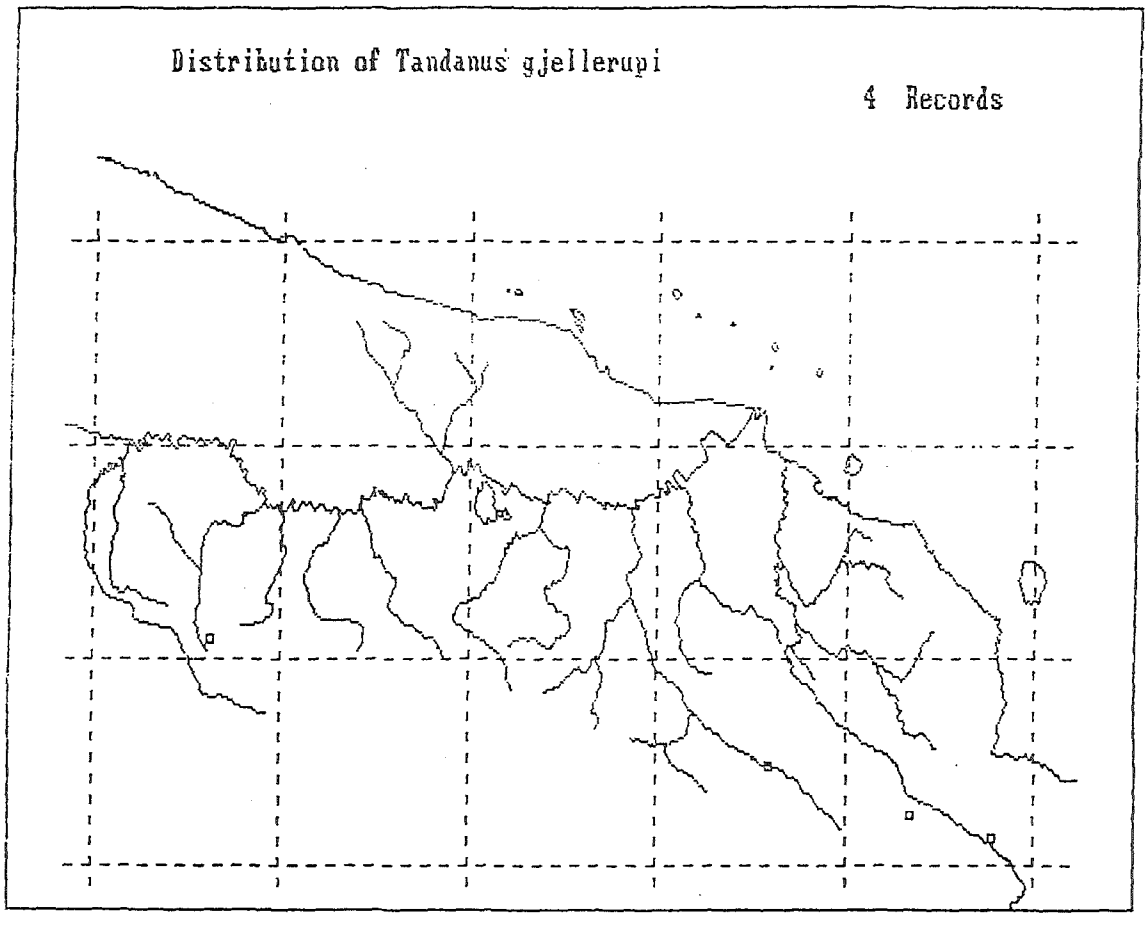
18


Distribution of Oxyeleotris heterodon
4 Records

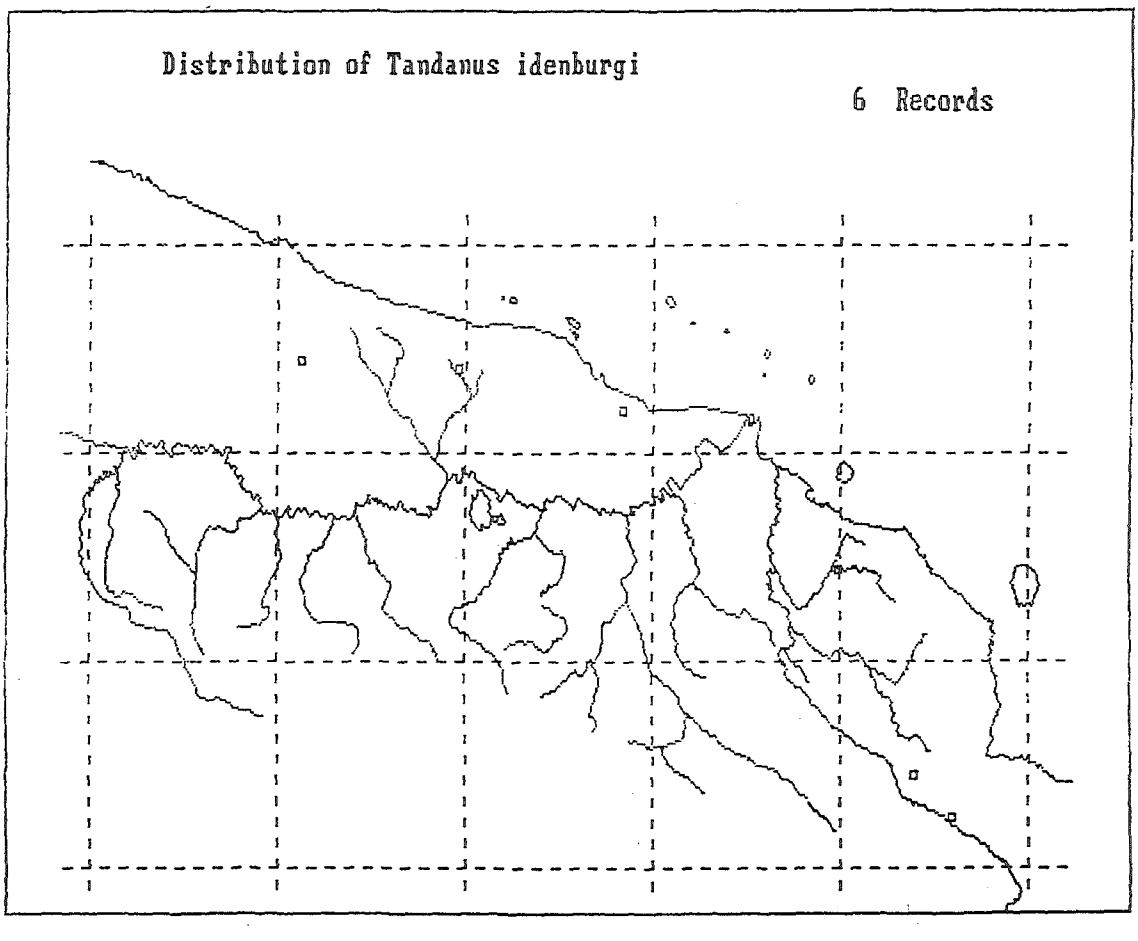
19


Distribution of Tandanus coatsi
10 Records

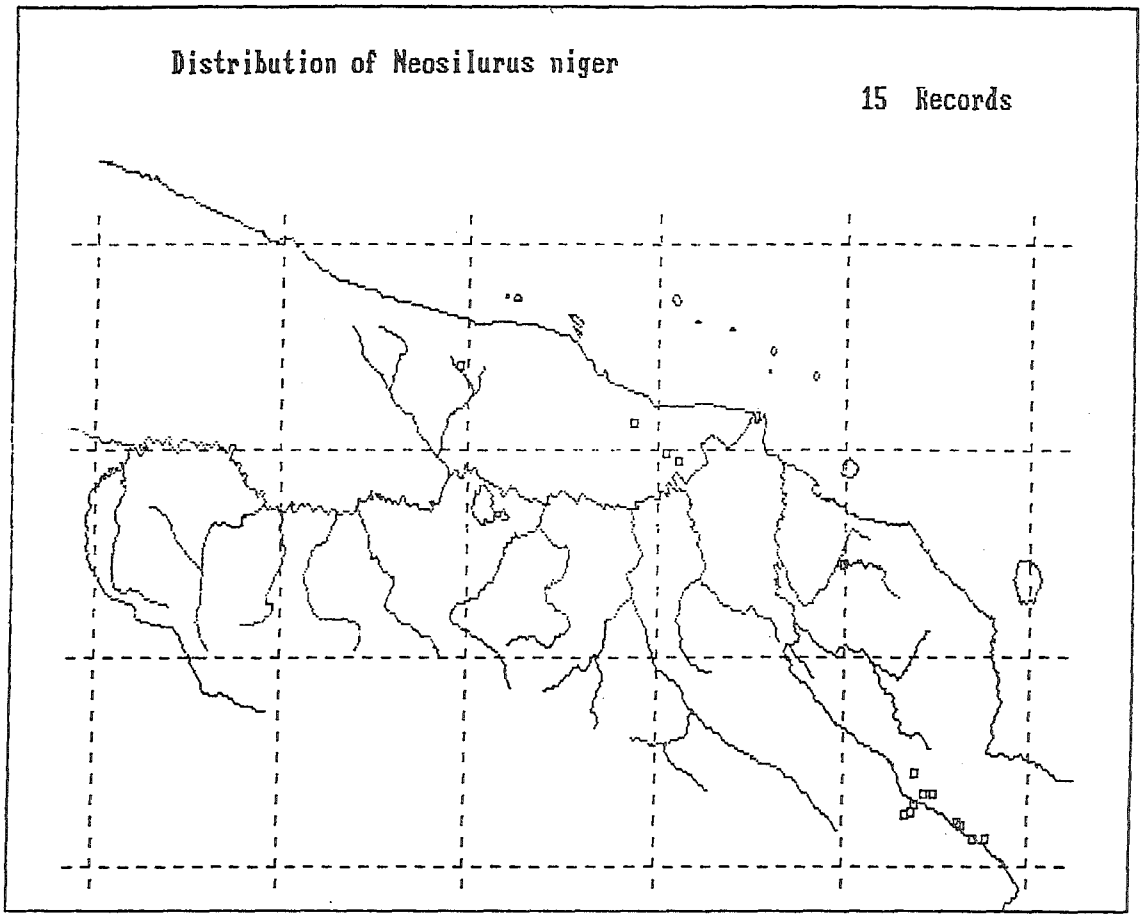
20


Distribution of Tandanus gjellerupi
4 Records

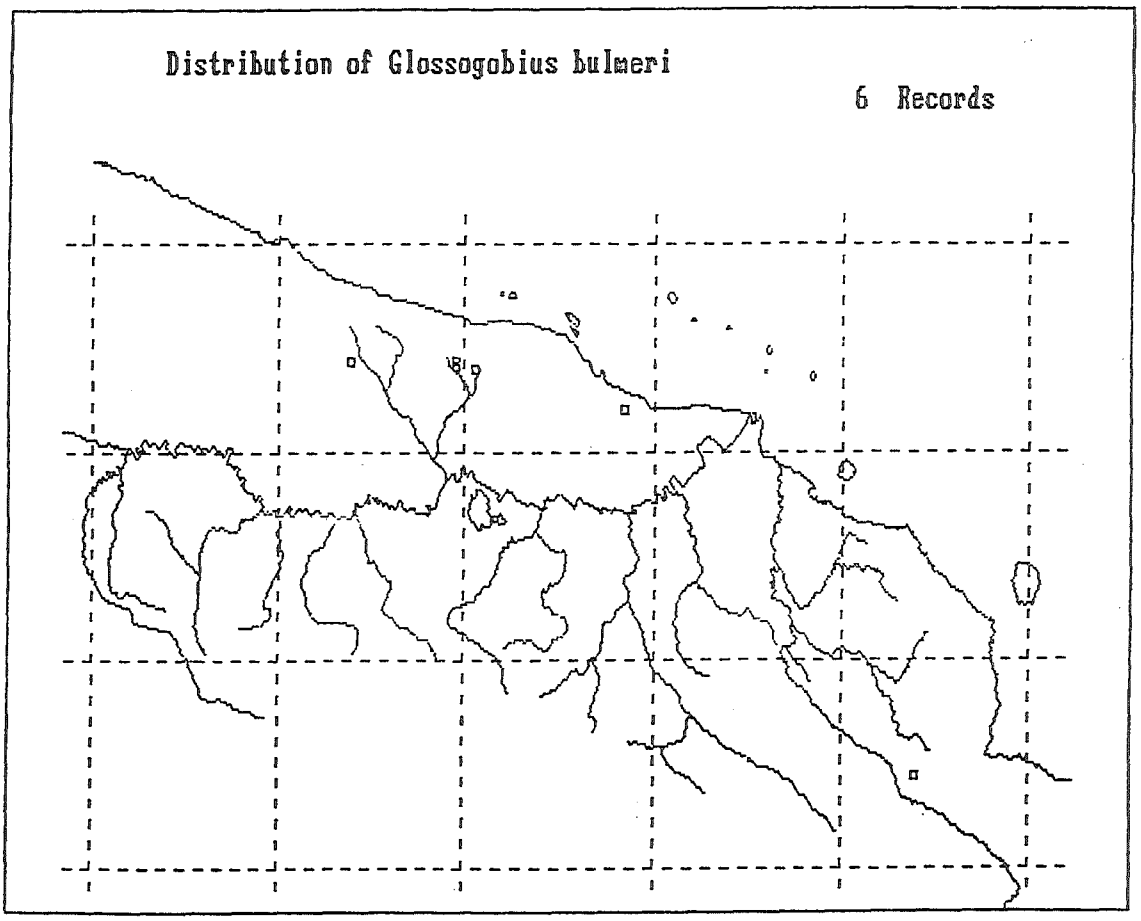
21


Distribution of Tandanus idenburgi
6 Records

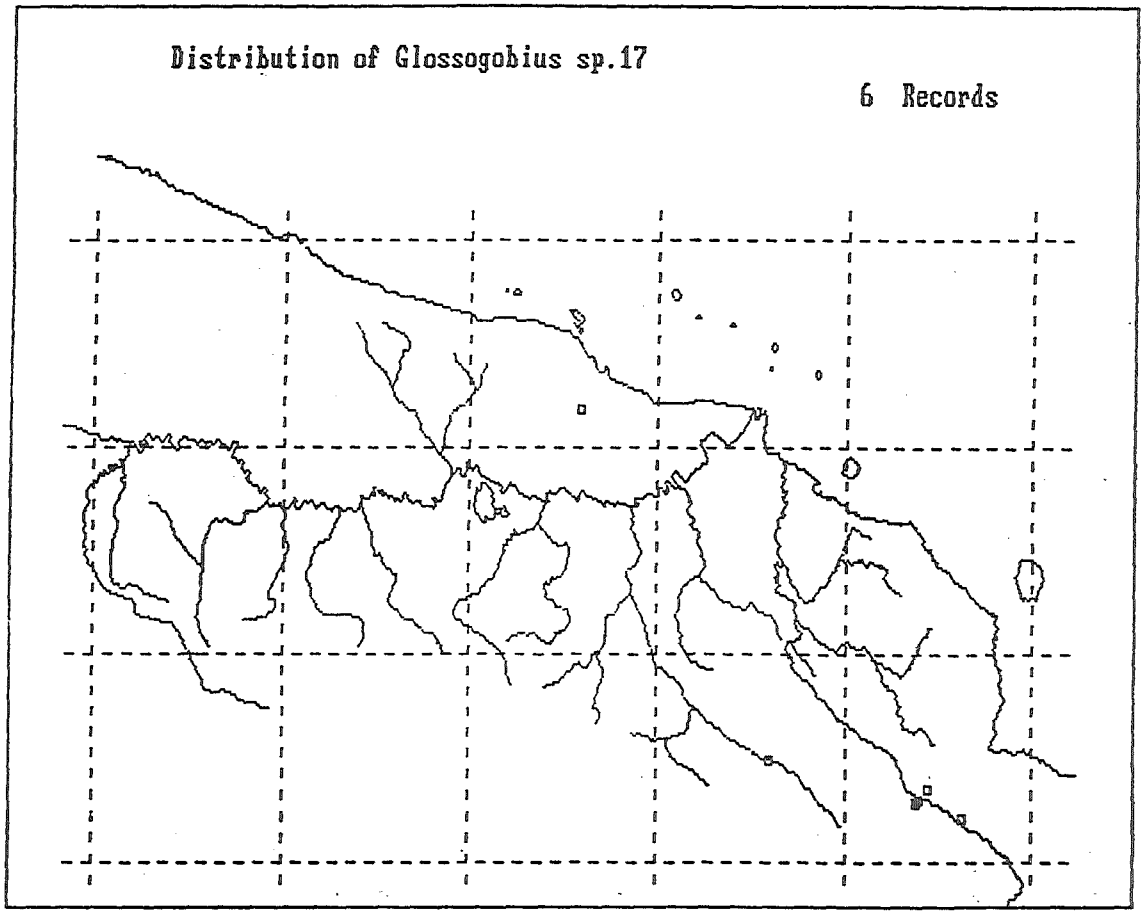
22


Distribution of Neosilurus niger
15 Records

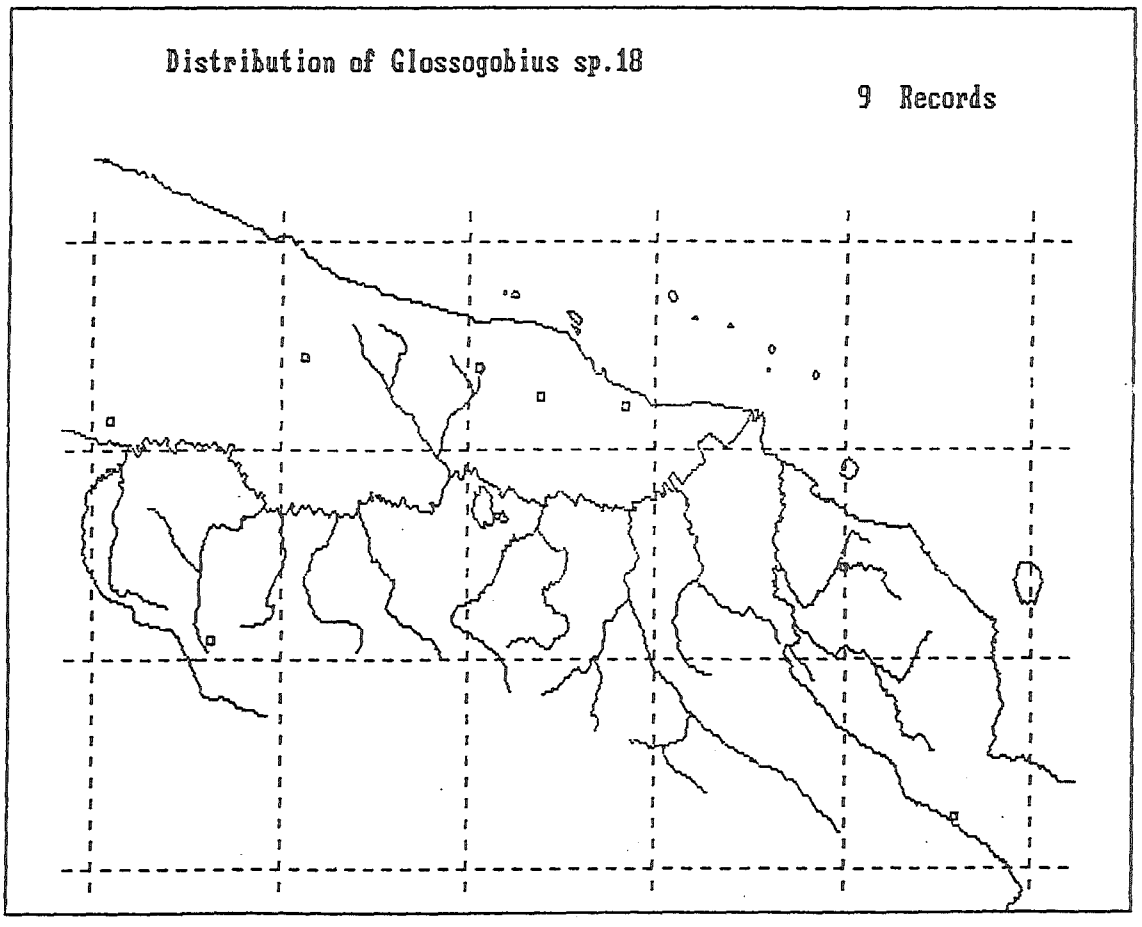
23


Distribution of Glossogobius bulmeri
6 Records

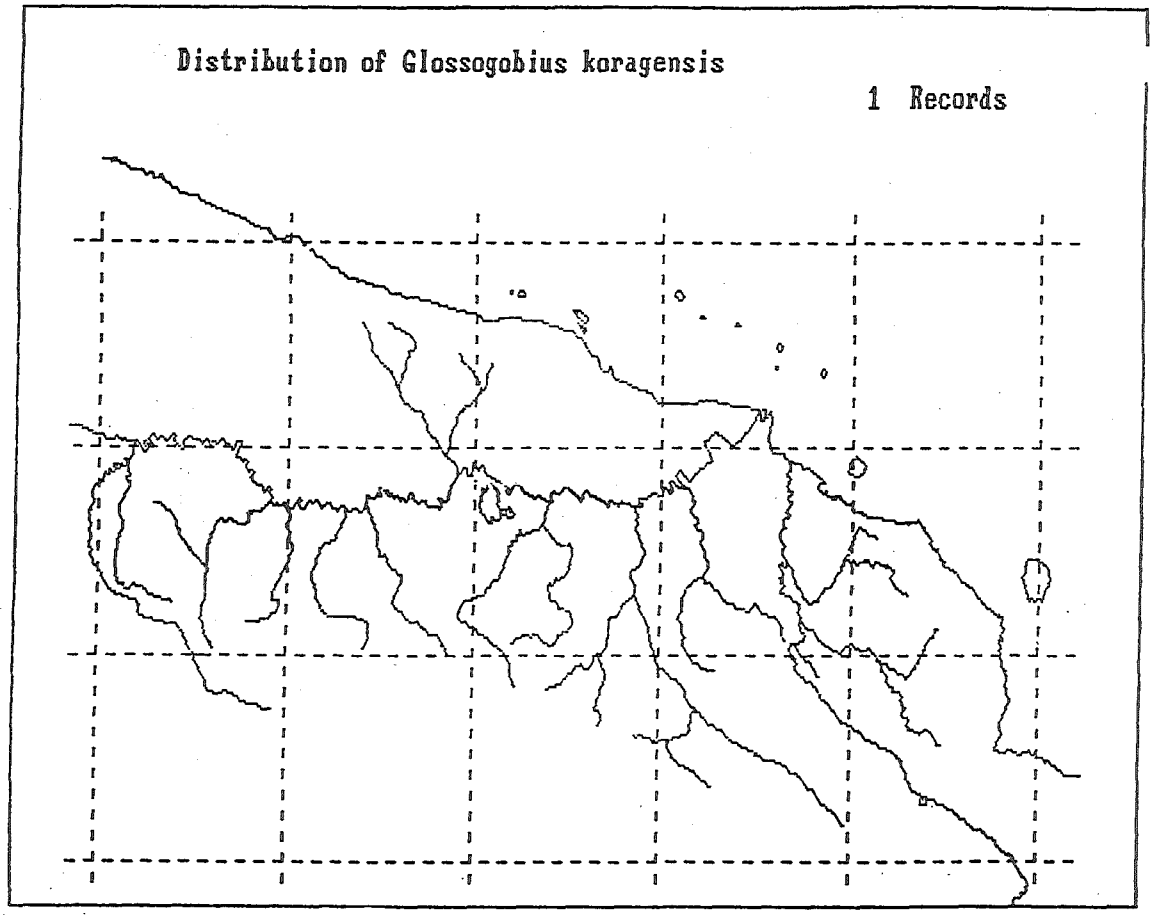
24


Distribution of Glossogobius sp.17
6 Records

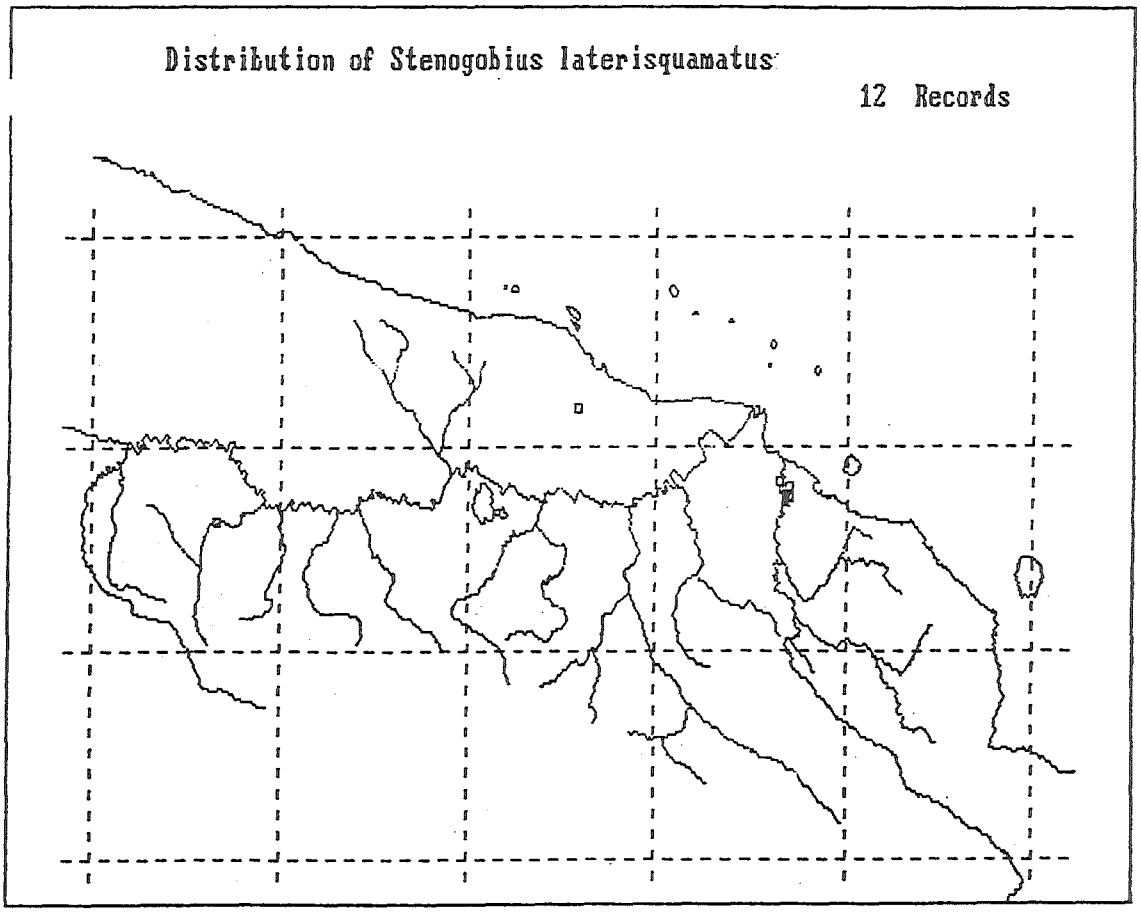
25


Distribution of Glossogobius sp.18
9 Records

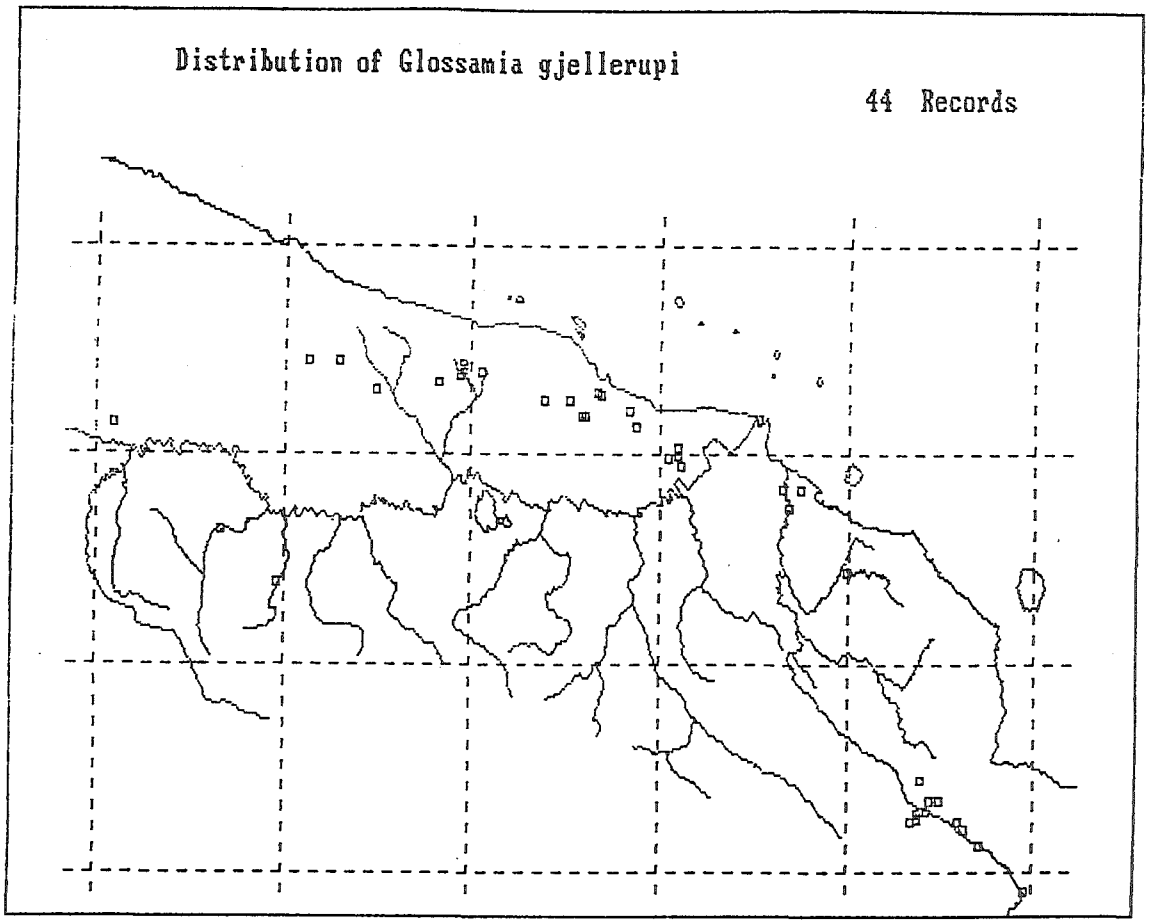
26


Distribution of Glossogobius koragensis
1 Records

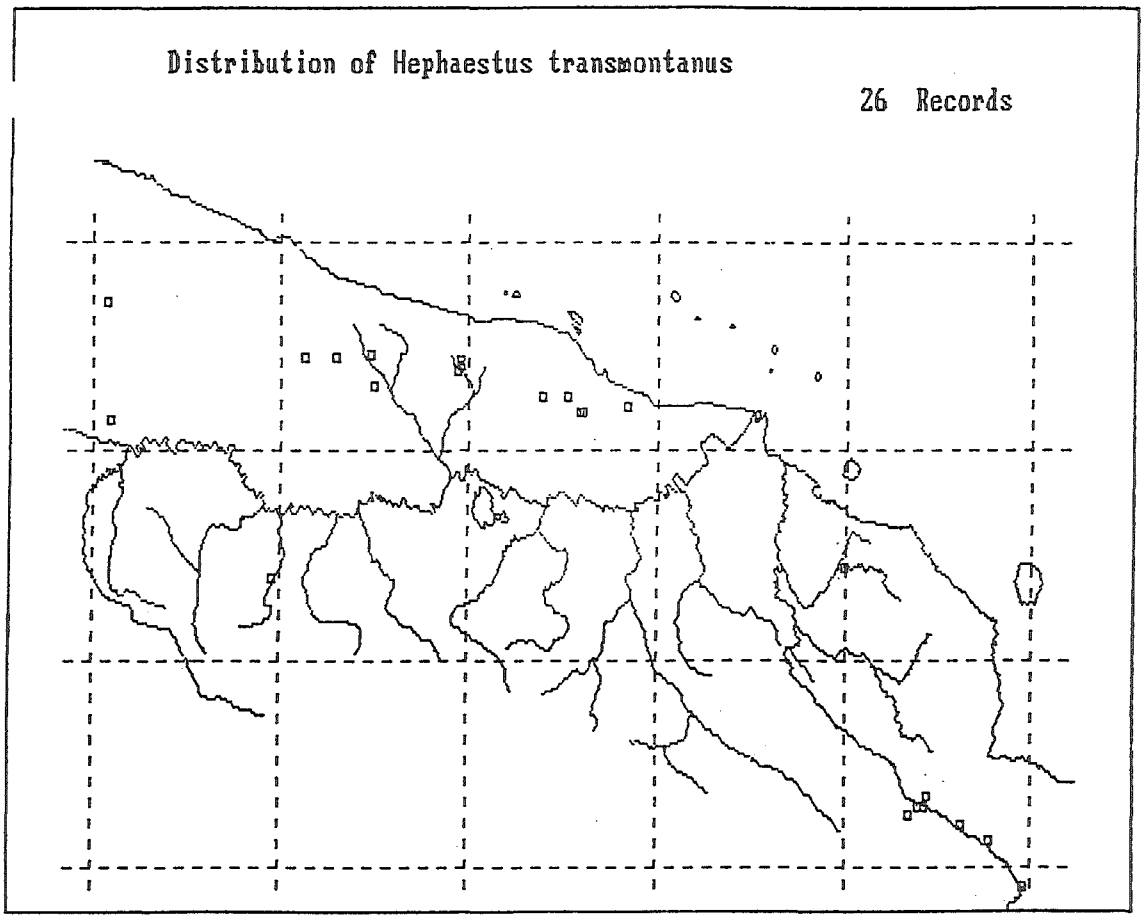
27


Distribution of Stenogobius laterisquamatus
12 Records

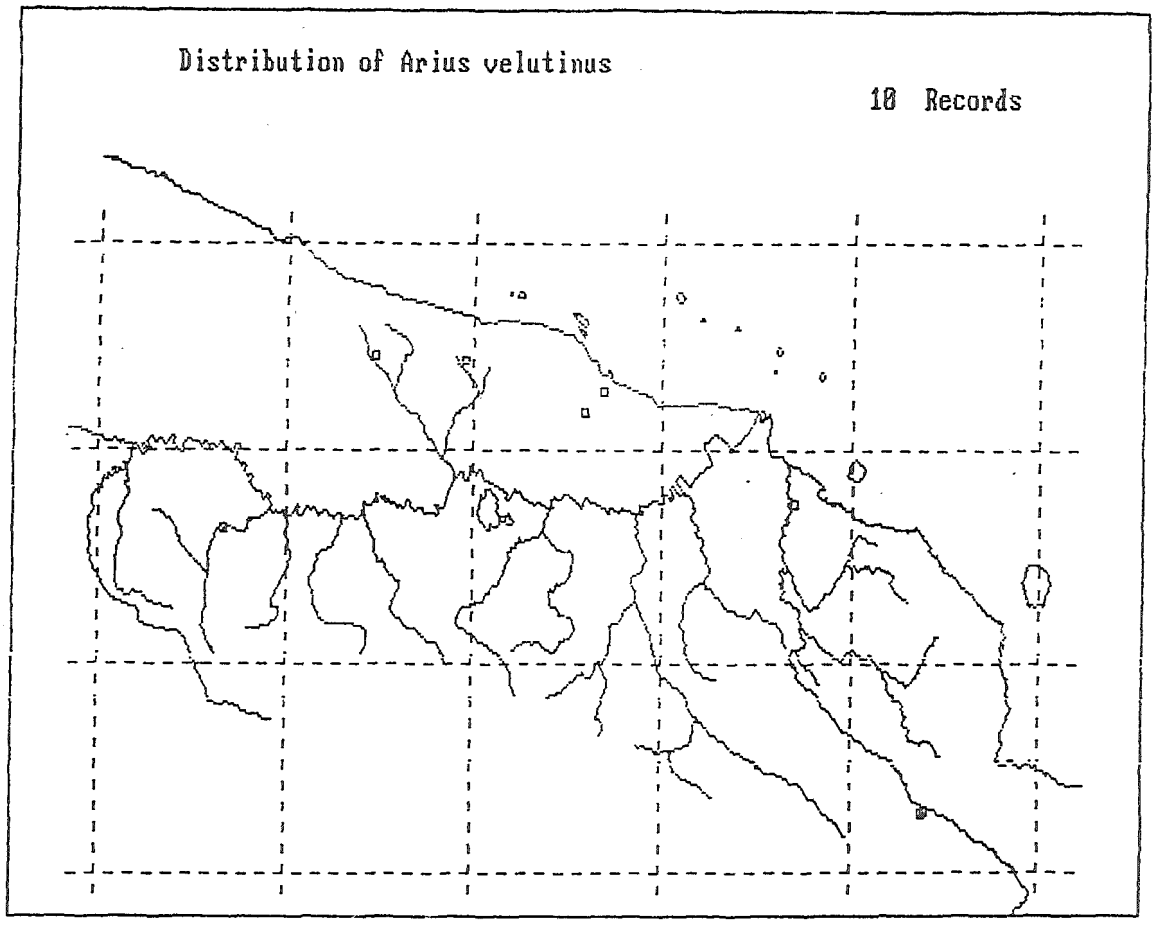
28


Distribution of Glossamia gjellerupi
44 Records

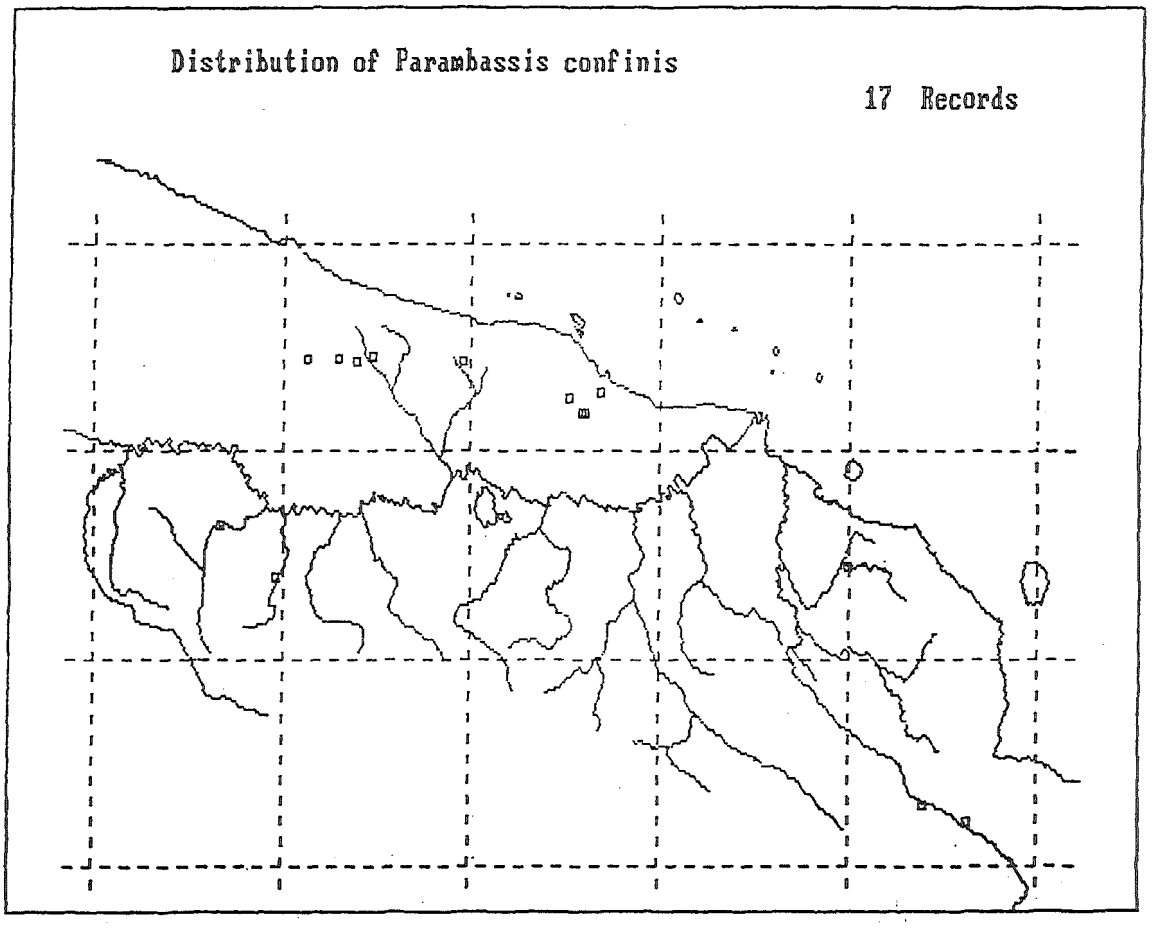
29


Distribution of Hephaestus transmontanus
26 Records

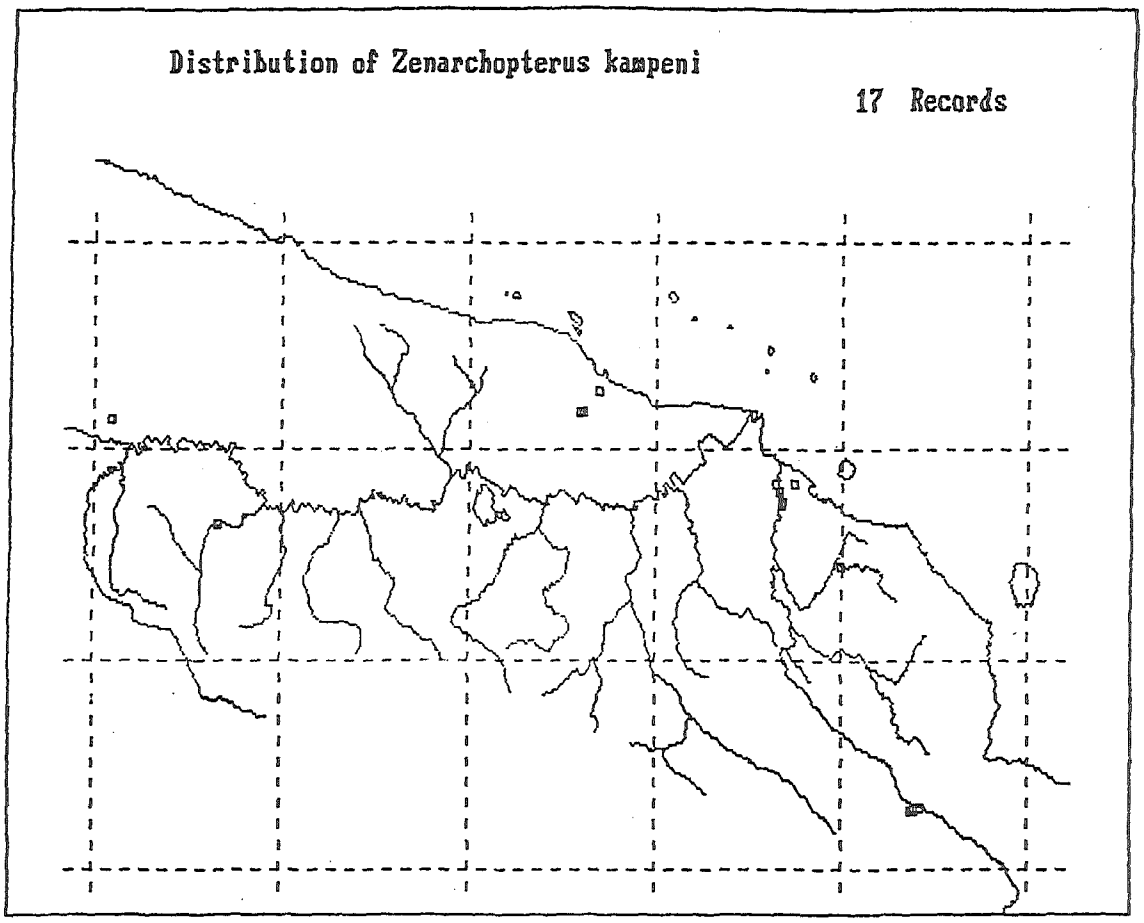
30

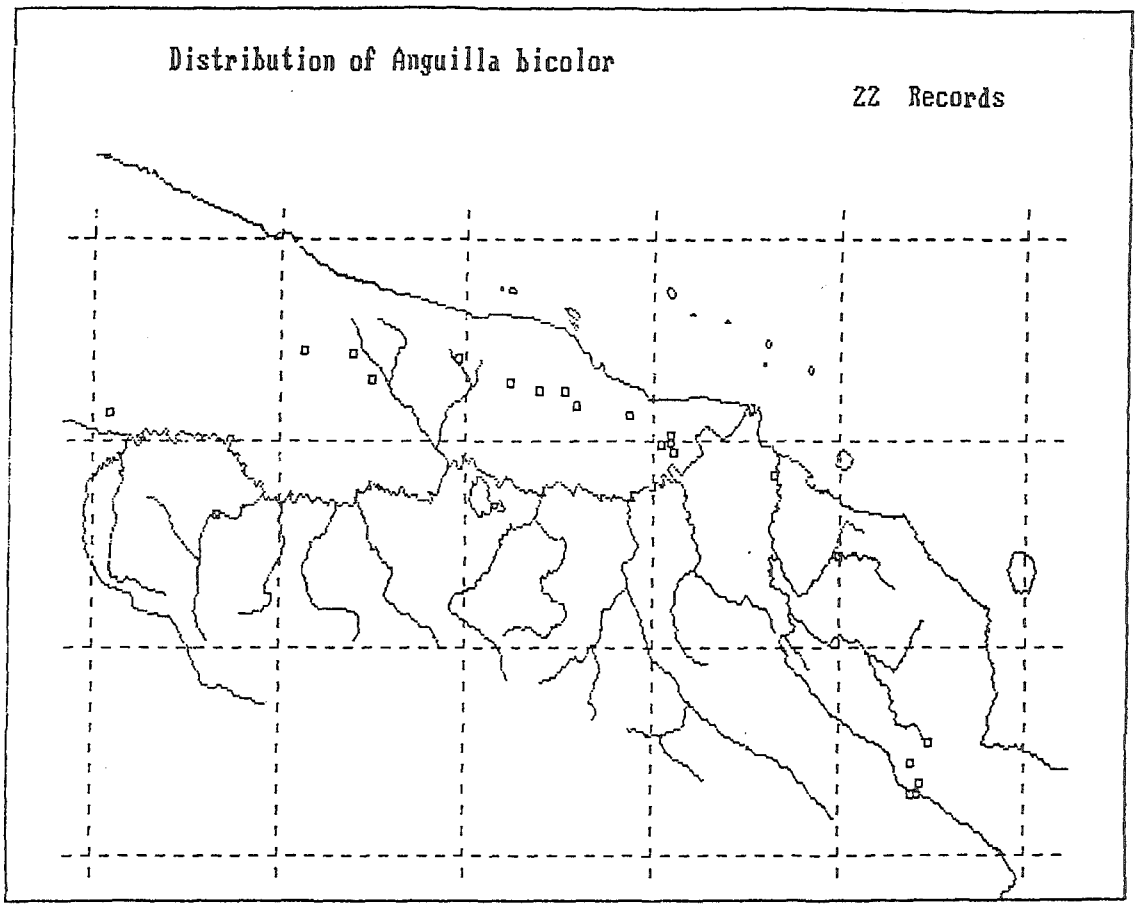

Distribution of Arius velutinus
10 Records

31

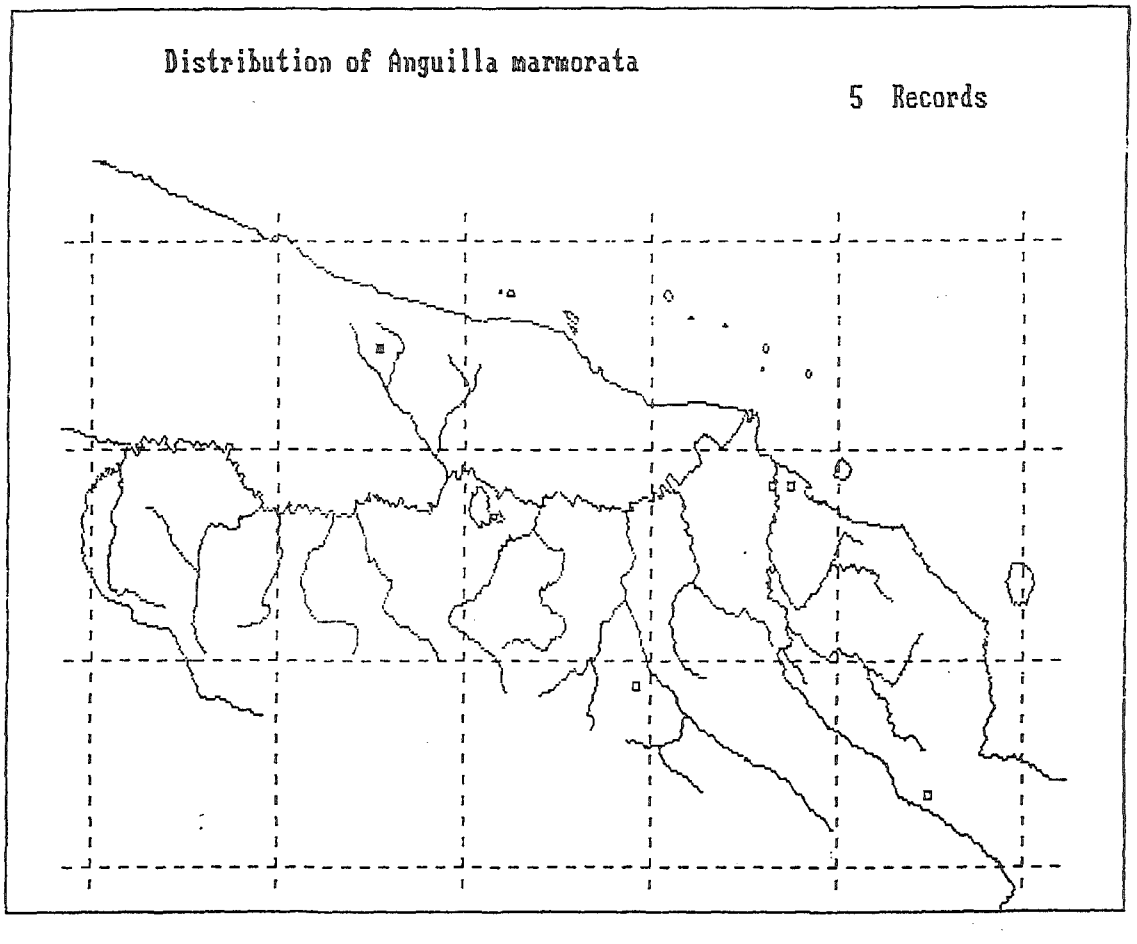

Distribution of Parambassis confinis
17 Records

32

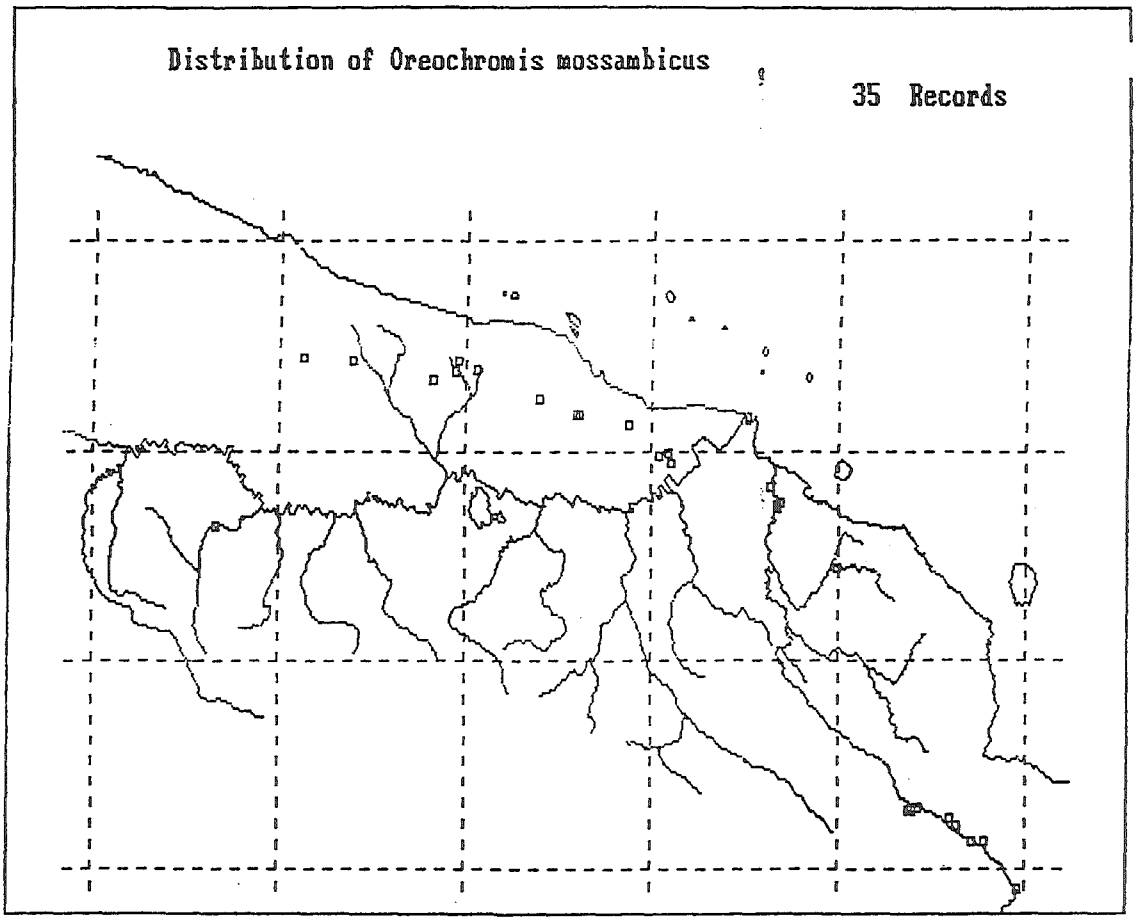

Distribution of Zenarchopterus kampeni
17 Records


Distribution of Anguilla bicolor
22 Records

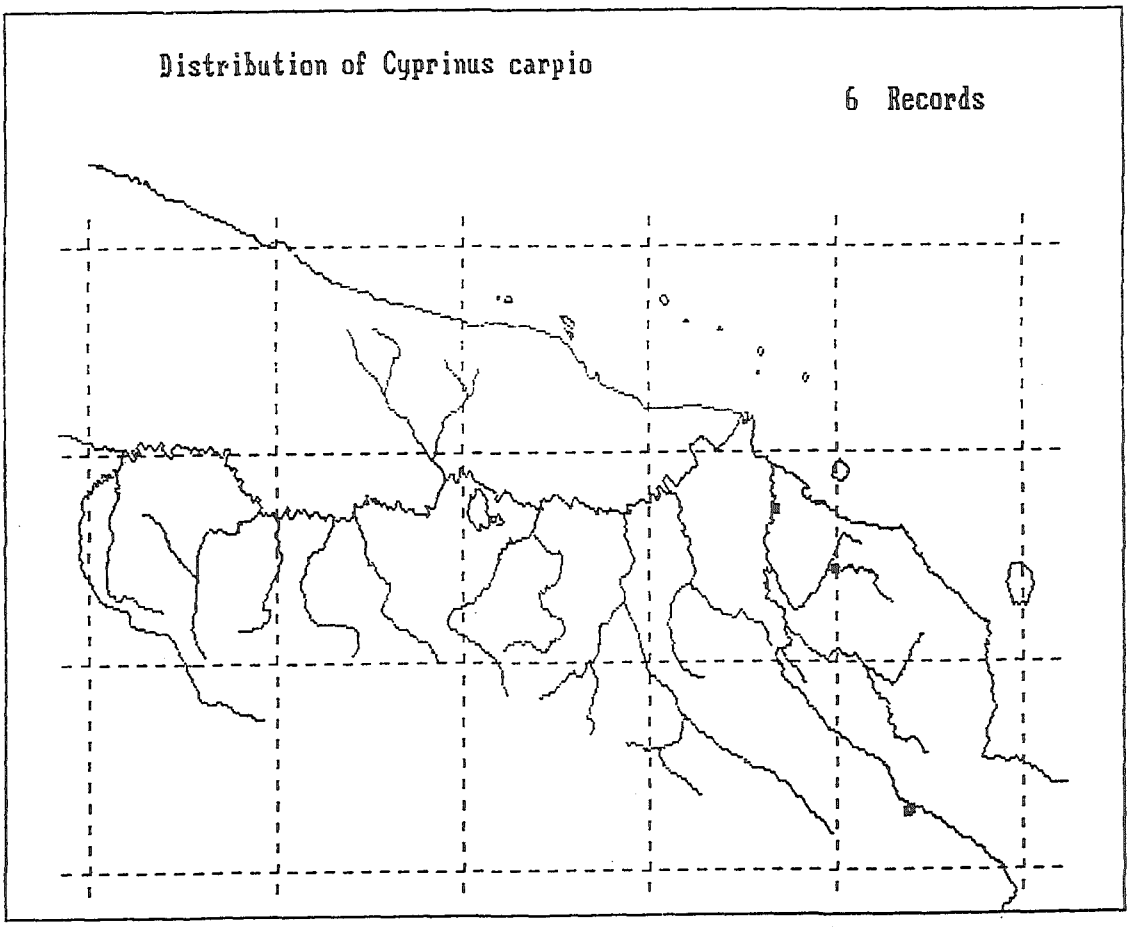
34


Distribution of Anguilla marmorata
5 Records

35


Distribution of Oreochromis mossambicus
35 Records

36


Distribution of Cyprinus carpio
6 Records

37