

Structure and dynamics of soil macrofauna in tropical forest systems converted to pastures or agrosystems.

This study is part of the project "Changements dans les chaînes de décomposeurs de la matière organique dus à la mise en valeur de sols forestiers en Amazonie centrale. Relations avec les transformations de la matière organique et la structure des sols".

This report gives the result of macrofauna densities and biomasses, for the dry and rainy seasons, in 5 systems :

- primary forest
- long-term pasture (15 years) (called Old pasture)
- long-term (11 years) abandoned (in 1992) pasture (called Pasture degr)
- short-term (5 years) abandoned (in 1987) pasture (called Pasture aband). It is now a secondary forest (capoeira)
- short-term (5 years) pasture turned to capoeira (in 1987) and then to agrosylvicultural systems in 1991 (called agrosylv)

The three last systems are found in EMBRAPA field station (km 54). The two last systems are part of the project with NCSU (Block II).

1. Sampling method

The sampling method is that proposed by TSBF Programme with few modifications :

In each plot 10 soil monoliths (25x25x25 cm) placed on a transect are collected. The distance between two monoliths is 5 meters.

Each monolith is separated into four layers : litter, 0-5 cm, 5-10 cm and 10-25 cm which are separately analysed.

From each layer and each monolith macrofauna are hand-sorted and fixed in formalin 5%. They are then determined, counted and weighed.

In each plot, macrofauna were studied during the dry season (November 1993) and the rainy season (March 1994). The third system (Pasture degr) was only analysed in dry season. It will be analysed during the rainy season 1995.

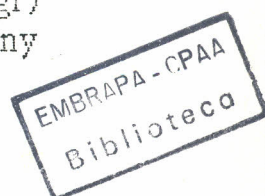
2. Preliminary results

a) Dry season

Macrofauna biomasses and densities showed high differences between plots.

* Biomasses

Biomasses ranged from 1.38 g/m² in the agrosylvicultural system to 21.69 g/m² in the 2 years-abandoned, degraded pasture (Figure 1A). Forest presents a low biomass (2.09 g/m²). In anthropic systems, biomass is



dominated by earthworms (91% in degraded pasture, 76% in agrosilvicultural system, 73% in old pasture and 61% in abandoned pasture) (Figure 2A and 3A). Earthworms give a low proportion of forest biomass (30%). In this natural system, millipedes are dominant (32%).

* Densities

Densities ranged from 46 ind/m² in the agrosilvicultural system to 425 ind/m² in the 2 years-abandoned, degraded pasture (Figure 1B). In forest and in agrosilvicultural system, density is dominated by ants (59% and 47% respectively). Termites are dominant in old pasture (56%), earthworms in degraded pasture (48%) and isopodes in abandoned pasture (55%). Except in degraded pasture, earthworms represent a low proportion of total density (Figure 2B).

Ants are more abundant in forest (169 ind/m², Figure 4A), termites in old pasture (144 ind/m², Figure 4B), Isopoda in abandoned pasture (93 ind/m², Figure 5A) and millipedes in abandoned pasture (41 ind/m², Figure 5B).

b) Rainy season

The degraded pasture was not sampled at this date.

* Biomasses

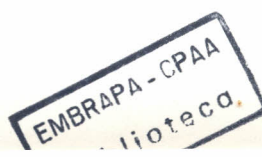
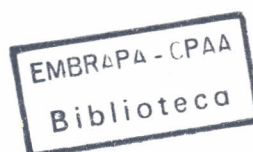
Biomasses ranged from 80 g/m² in the forest to 27 g/m² in abandoned pasture and in agrosilvicultural system (Figure 1A). Earthworms are dominant in all systems (more than 80% except in the abandoned pasture), even in the forest, due to the presence of a few very large earthworms at this site (Figure 2A and 3A). Preliminary data from the rainy season in the degraded pasture, in 1995, indicate value of more than 90 g/m² (mainly due to earthworms).

* Densities

Densities ranged from 3219 ind/m² in the abandoned pasture to 813 ind/m² in the agrosilvicultural system (Figure 1B). Ants are dominant both in forest (78%) and in agrosilvicultural system (60%). Termites are dominant in the old pasture (43%) and in the abandoned pasture (78%). The most important proportion of earthworms is observed in the old pasture (27% of total density, i.e., 602 ind/m²) (Figure 2B and 3B). Isopoda are abundant in the old pasture (342 ind/m²) and in the abandoned pasture (214 ind/m²) (Figure 5A). Millipedes are abundant in the abandoned pasture (168 ind/m²) (Figure 5B).

3. Discussion and conclusion.

A few macrofauna groups are dominant in these systems. Other groups less abundant were also present : Diptera larvae, Coleoptera adults and larvae,



Arachnida, Mollusca, Hemiptera, Homoptera larvae, Planipenne larvae, Lepidoptera larvae, cockroaches, Orthoptera larvae.

Macrofauna densities and biomasses are very different between the rainy season and the dry season and between the five plots.

During the dry season, densities and biomasses are low as compared with the rainy season. Thus biological activities are much more important during the wet season. Actually the forest shows the most important differences between the dry season and the rainy season (on a weight basis).

Earthworms generally dominate in biomass, except in forest during the dry season. They seem to dominate in density in the 2 years abandoned, degraded pasture.

Ants dominate in forest and in the agrosylvicultural system while isopoda, termites and millipedes are more abundant in the old pasture and in the abandoned pasture. Moreover the ratio termites/earthworms is very high in the abandoned pasture while the ratio ants/earthworms is high in the forest and in the agrosylvicultural system (Figure 6A and 6B).

The forest is mainly represented by ants, and large endo-epigeic earthworms. The agrosylvicultural system is characterised by ants as well.

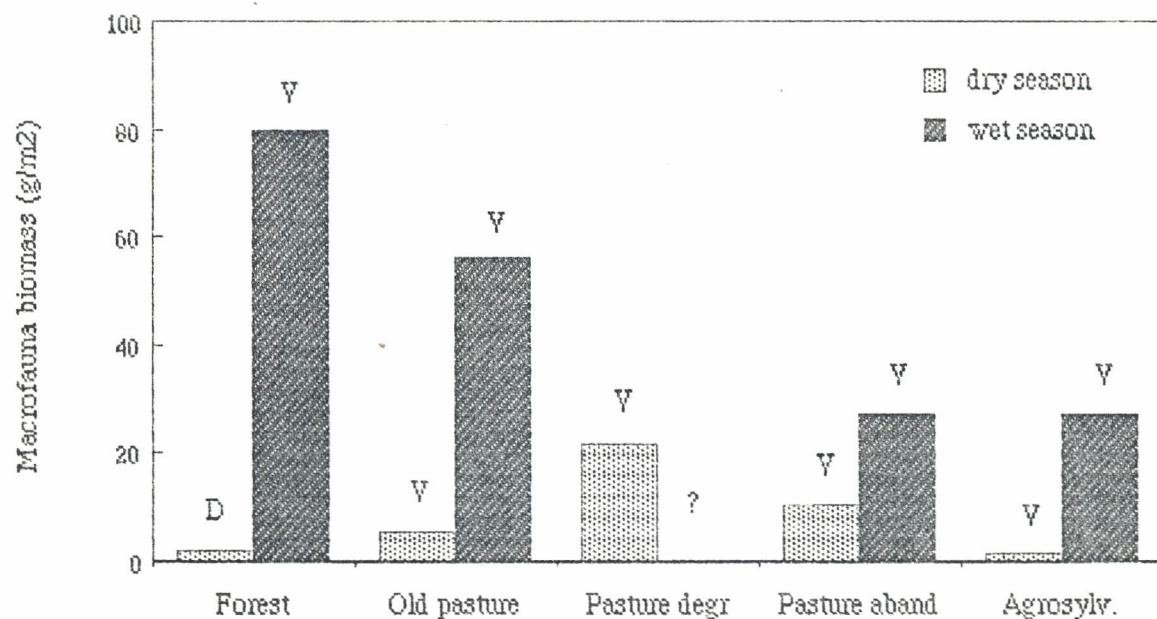
This two tree-component systems are both characterised by a high ants/earthworms ratio.

On the opposite the different pastures are characterised by termites (on a number basis) and earthworms (on a weight basis). In the two pastures (old pasture and degraded pasture) we particularly found high earthworms densities. Actually the grass-component system are characterised by high earthworm densities. In the old pasture Isopoda are abundant as well while they are rare in the degraded pasture (preliminary observations from 1995). The abandoned pasture (capoeira) is characterised by high termite and millipede densities and very high termite/earthworm ratio.

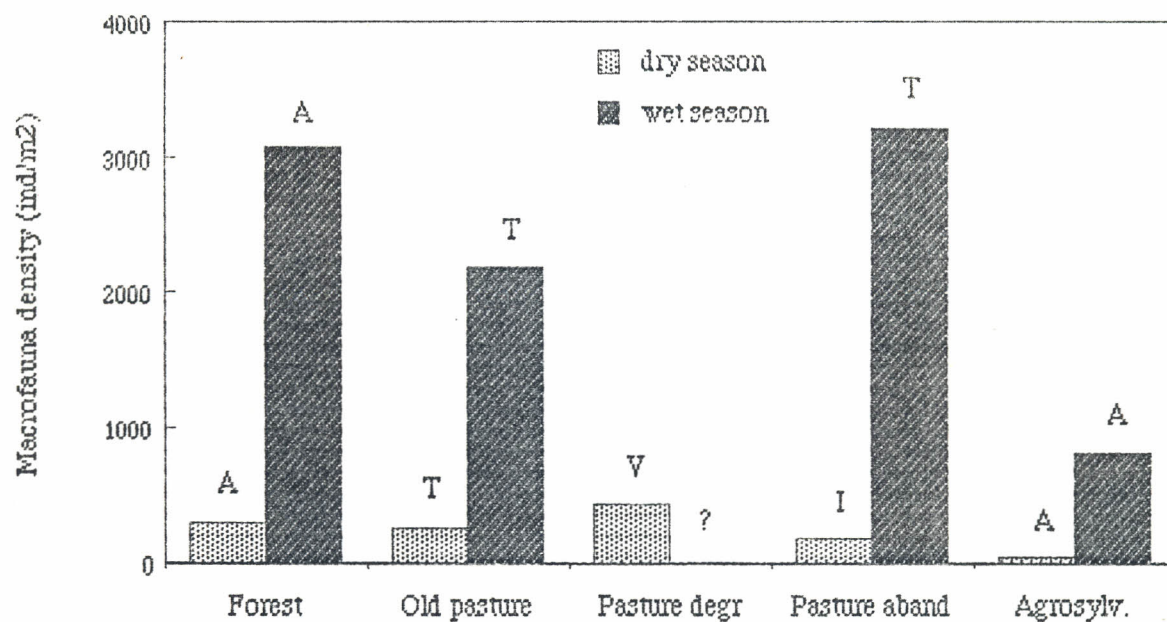
When forest is turned to pasture, the macrofauna communities strongly evolved (Figure 7). Ants community decreased and termites, Isopoda and earthworms strongly increased. In some extreme cases, the presence of *Brachiaria* results in a strong dominance of earthworms (one species) leading to an important soil degradation (compaction which impedes water movements). When these pastures are turned to a secondary forest, earthworms are replaced by termites, millipedes and Isopoda. When pastures are turned to capoeira and then to cultivated systems (agrosylvicultural systems) with a tree component, ants become dominant.

Thus earthworms are linked to pastures (degraded systems) while ants are mainly characteristic of tree-component systems.

Figure 1 : Total macrofauna densities and biomasses and dominant groups (A=Ants, D=Millipedes, I=Isopoda, T=Termites, V=Earthworms)



A) BIOMASS



B) DENSITY

Figure 2 : Earthworms/total macrofauna ratio on weight and number basis

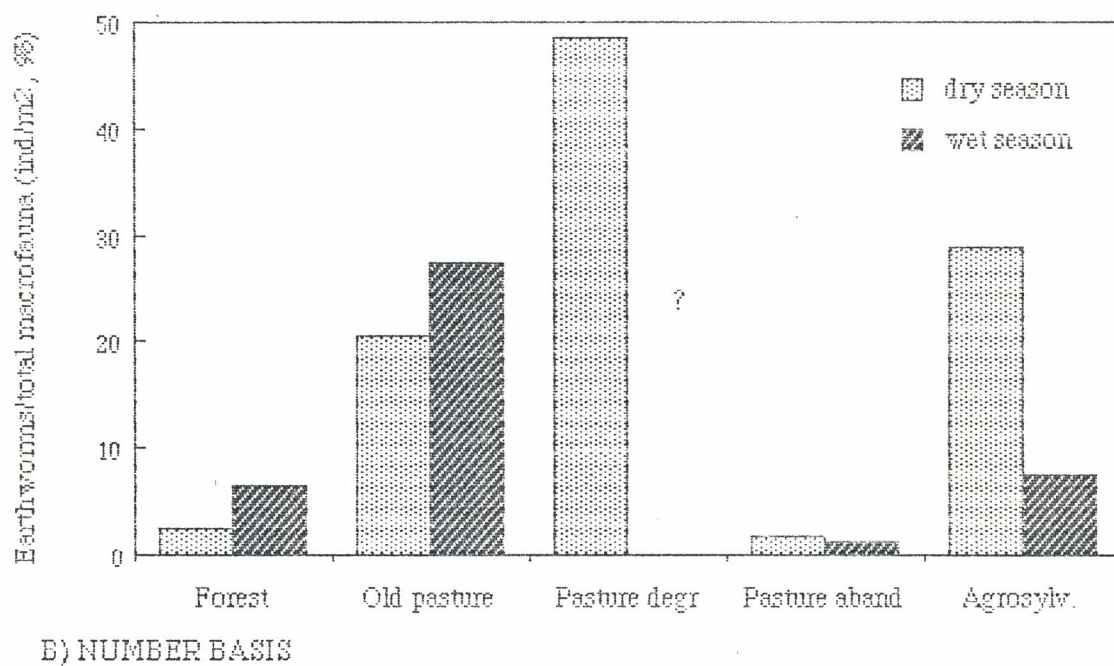
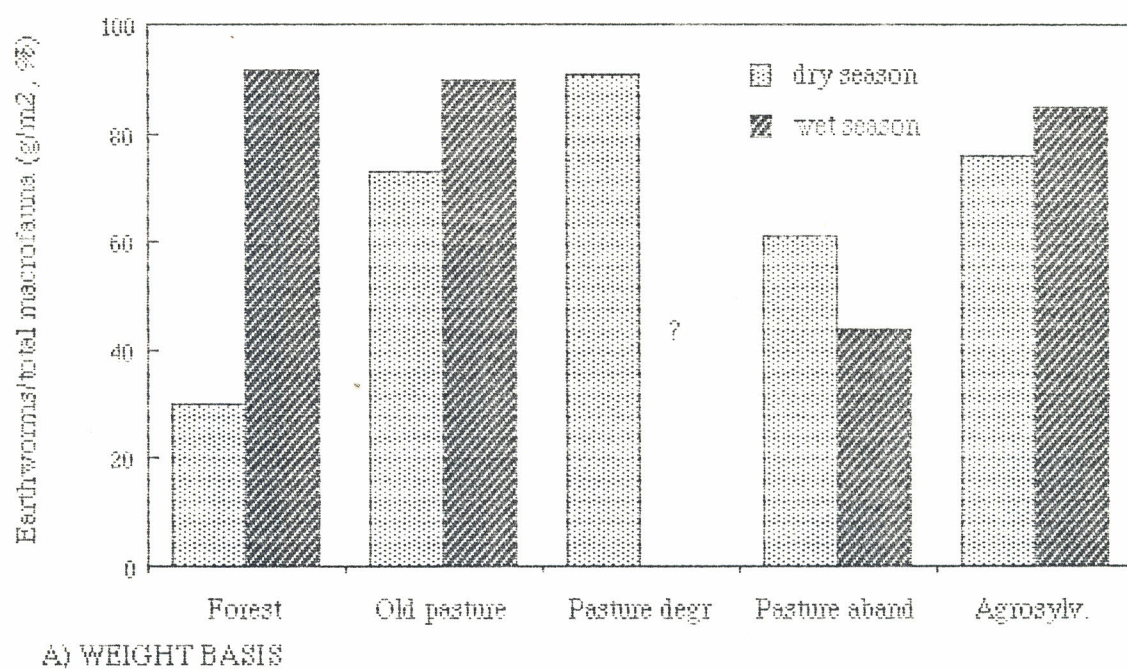
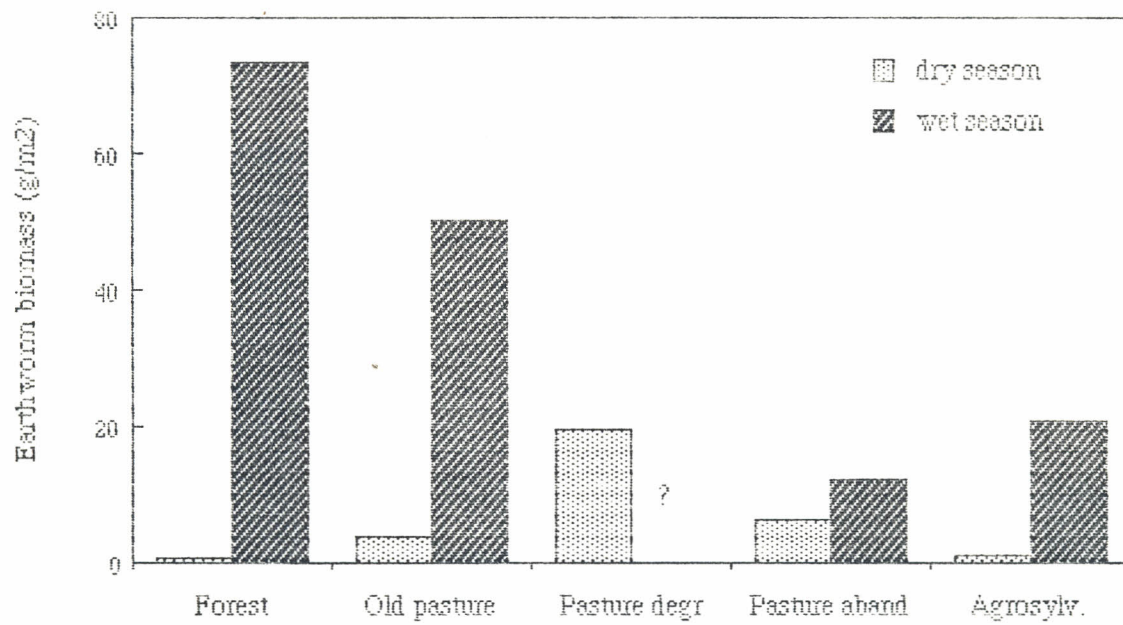
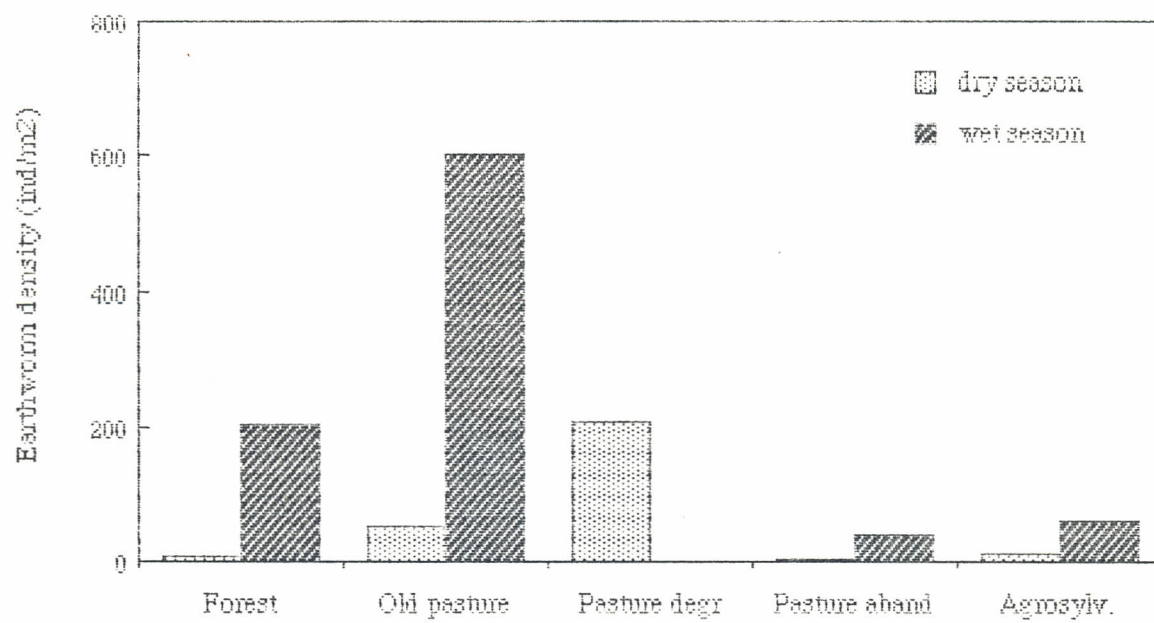


Figure 3 : Earthworm biomasses and densities

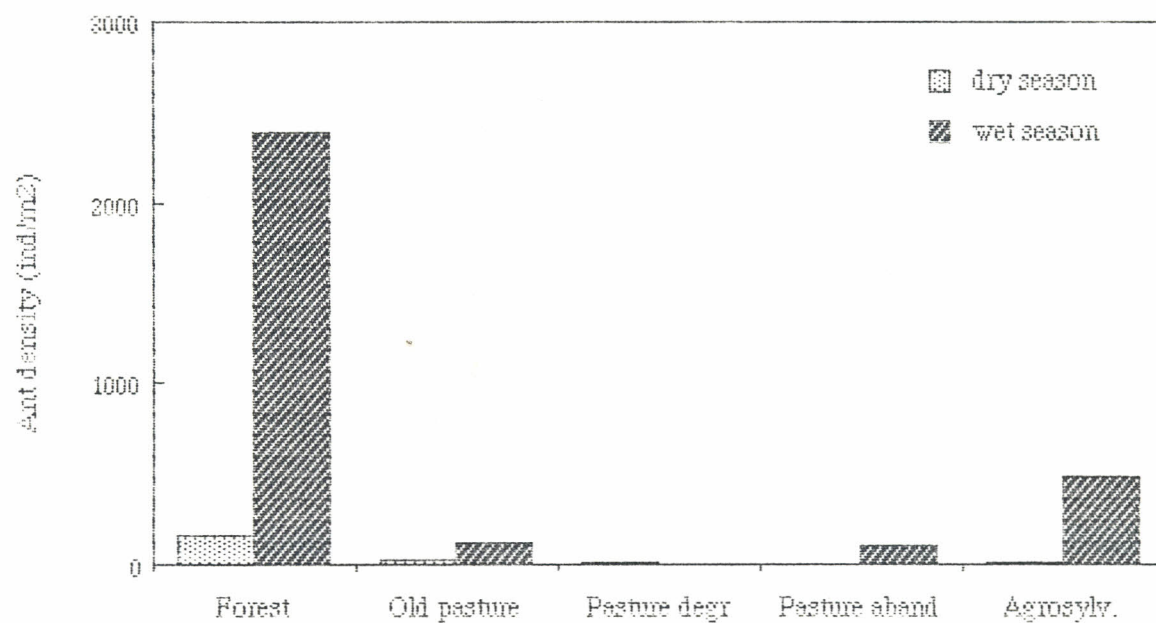


A) BIOMASS

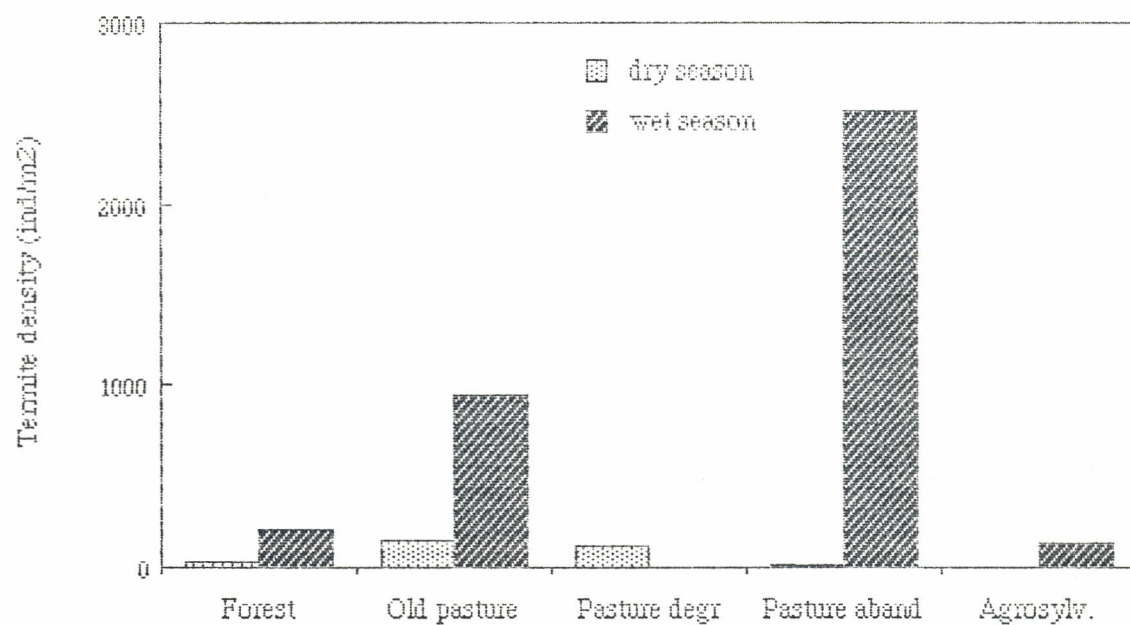


B) DENSITY

Figure 4 : Ants and termites densities

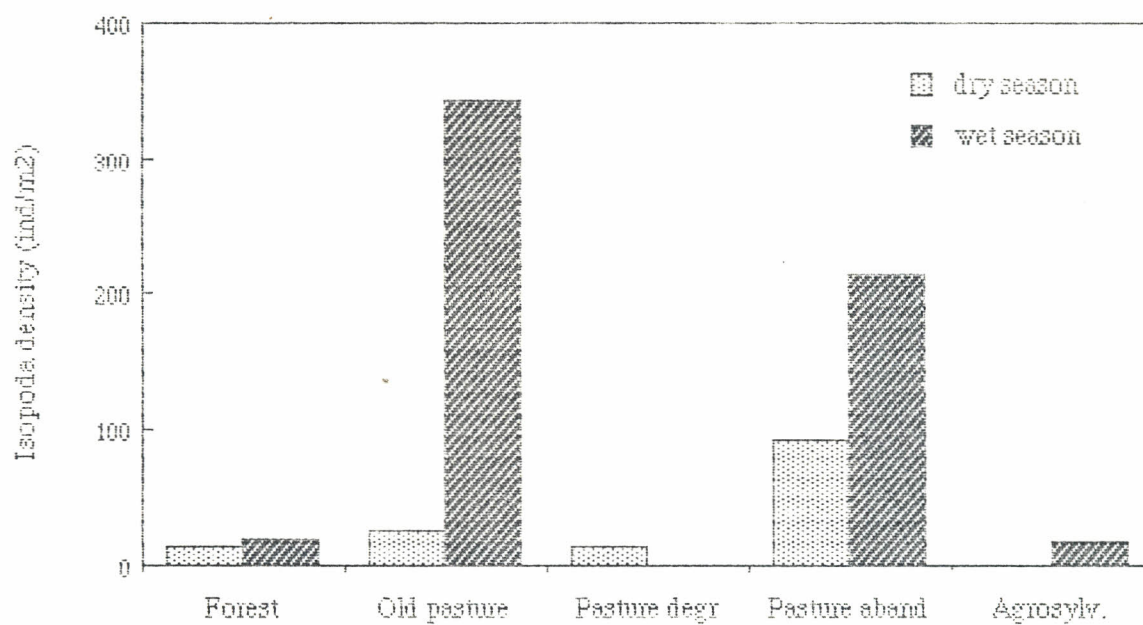


A) ANTS

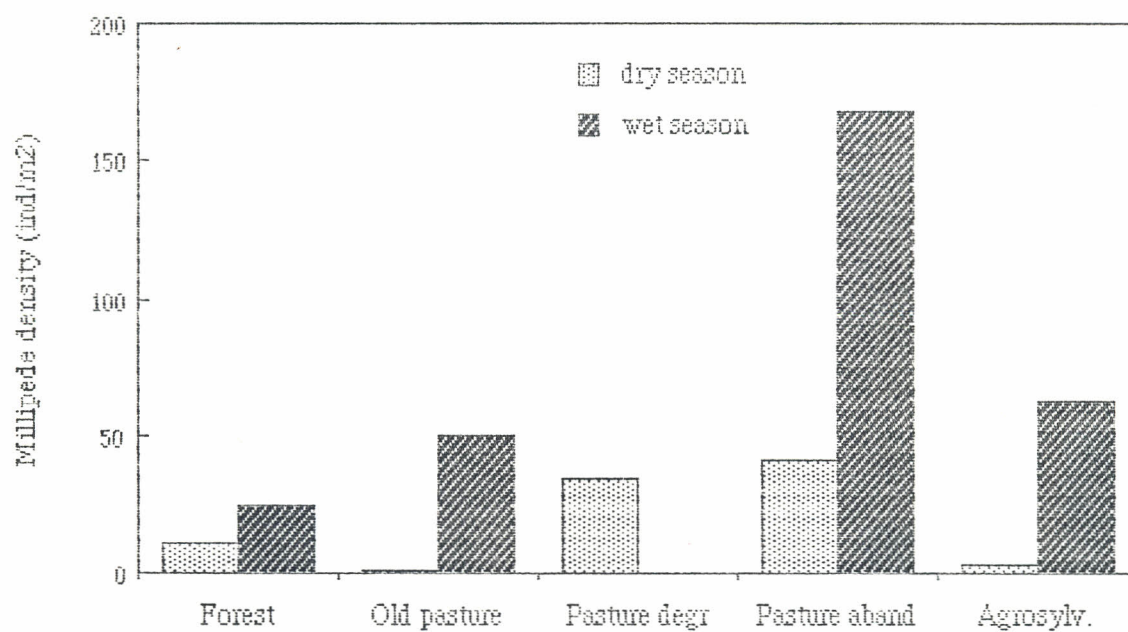


B) TERMITES

Figure 5 : Isopoda and millipedes densities

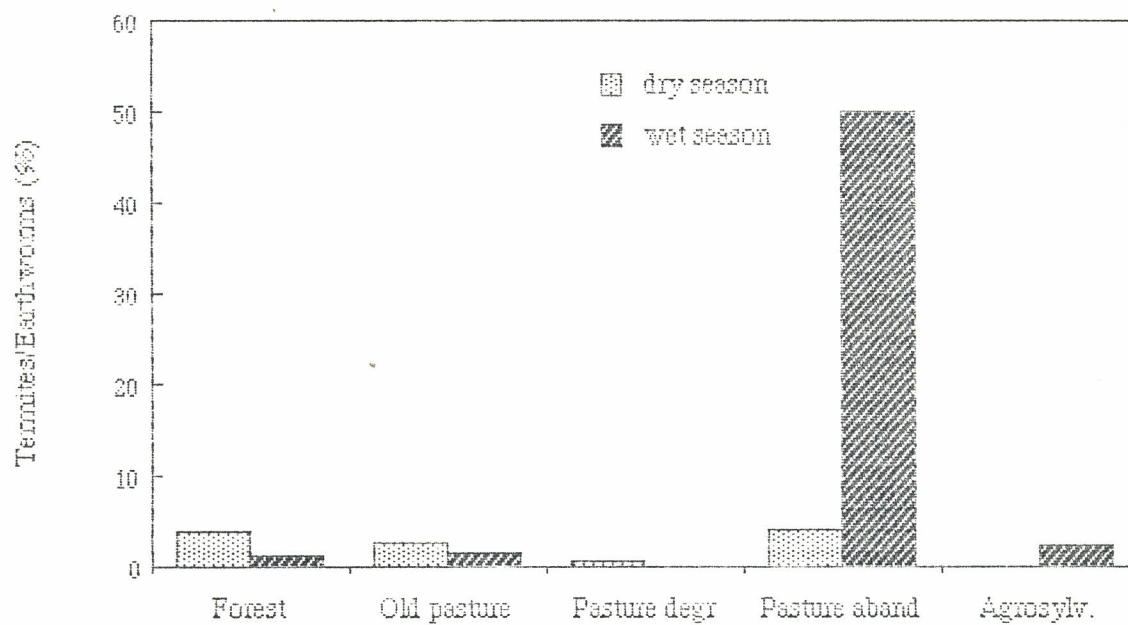


A) ISOPODA

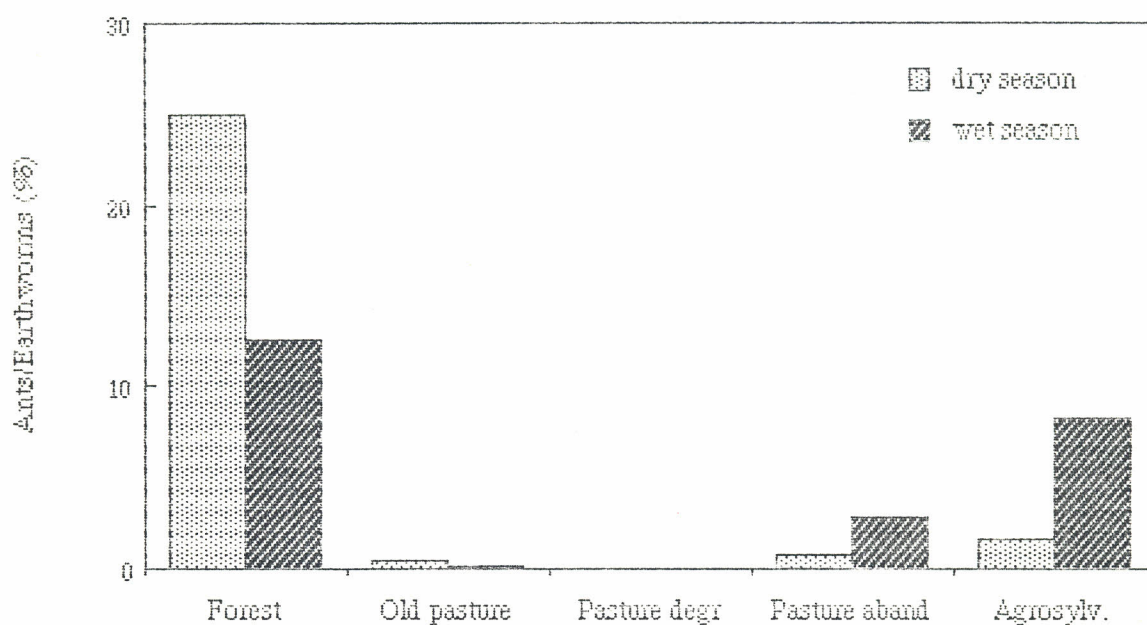


B) MILLIPEDES

Figure 6 : Ratio termites/earthworms and ants/earthworms on a number basis



A) TERMITES/EARTHWORMS



B) ANTS/EARTHWORMS

Figure 7 : Modification of macrofauna dominant groups when a forest is converted to pastures and agrosystems in North Manaus area (Amazonia).

