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MIGRATED AMMENSALISM WITH MORTALITY FOR BOTH THE SPECIES -A CASE STUDY

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ABSTRACT

The paper detects the characteristic nature of Migrated Ammensalism with mortality of both the species. The study is carried out with the help of Phase plane analysis. This model is framed by a couple of first order non linear differential equations. The specific nature of this model is established for identifying the stability in some cases with the aid of null clines, trajectories and solution curves.

Keywords: *Ammensalism, Stability and threshold diagrams.*

I. INTRODUCTION

Mathematical modeling in the life sciences is an effective tool to identify the nature of any model with less expensive and almost all gaining feasible solutions. One of the important roles of mathematicians is to investigate the proper results in various cases of life, medical and social sciences. New mathematical techniques are to be found for dealing the complex situations. Kapur [14] concentrated many diverse topics on mathematical modeling in biological and medical sciences. The computational techniques and required literature are available in the Research work of Meyer [16], Gause [12], Paul Colinvaux [17], Haberman [13], , Thompson [119], Freedman [11] etc. The Basic concepts were constructively introduced by a Volterra [20]. Acharyulu K.V.L.N. [1-10] et.al determined considerable fruitful results in many ecological models.

II. NOTATIONS ADOPTED

N_1 (t) : The population rate of the species S_1 at time t

N_2 (t) :The population rate of the species S_2 at time t

a_i : The natural growth rate of S_i, i = 1, 2.

h_i : The rate of harvest of S_i, i = 1, 2.

a_{11} :The rate of decrease of Ammensal Species due to it's own insufficient resources..

a_{12} :The inhibition coefficient of S_1 due to S_2 i.e The Ammensal coefficient.

The state variables N_1 and N_2 as well as the model parameters a_1, a_2, a_{11}, a_{12} , h_i ,are assumed to be non-negative constants.

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III. BASIC EQUATIONS: The basic equations are given as

$$\frac{dN_1}{dt} = -a_1 N_1 - a_{11} N_1^2 - a_{12} N_1 N_2 + h_1 \quad (1)$$

$$\frac{dN_2}{dt} = -a_2 N_2 + h_2 \quad \text{with initial conditions } N_1(0)=\mathbf{c}_1 \text{ and } N_2(0)=c_2 \quad (2)$$

Case(i): When $\mathbf{a_1=0.856}$, a_{11}=0.578, a_{12}=0.454, h_1=0.645 and a_2=0.679, h_2=0.632.

The Null clines, Solution Curves and Trajectories are drawn in the Fig.1(A), Fig.1(B), & Fig.1(C) respectively.

In this case, The Eigen values are 0.098718 and -0.678 with the eigen vectors (1,0) & (0,1). The Jacobean matrix is $\begin{pmatrix} 0.098718 & 2.9663 \\ 0 & -0.678 \end{pmatrix}$.

Saddle point exists at (-6.5337, 0.93215) and One of the eigen value is non-negative.

Hence, it is unstable.

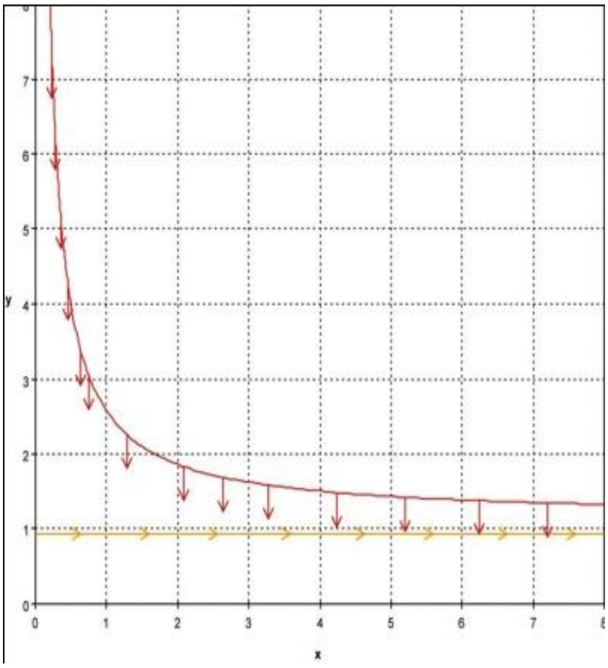

Fig.1(A): Null clines

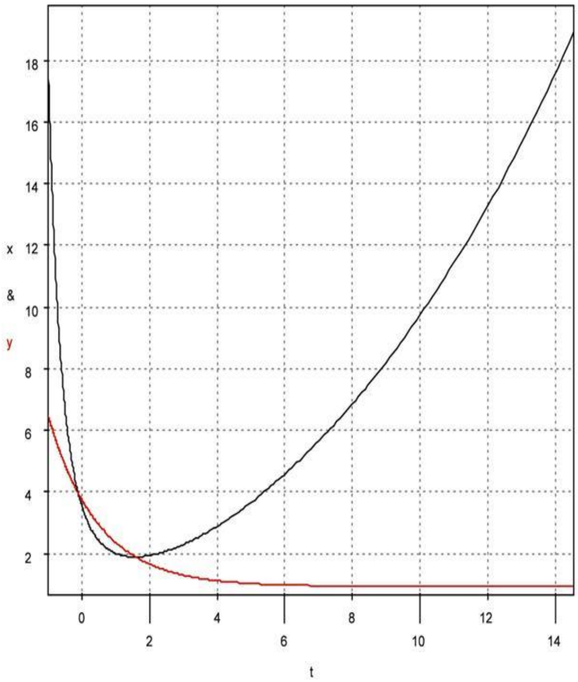

Fig.1(B): Solution Curves

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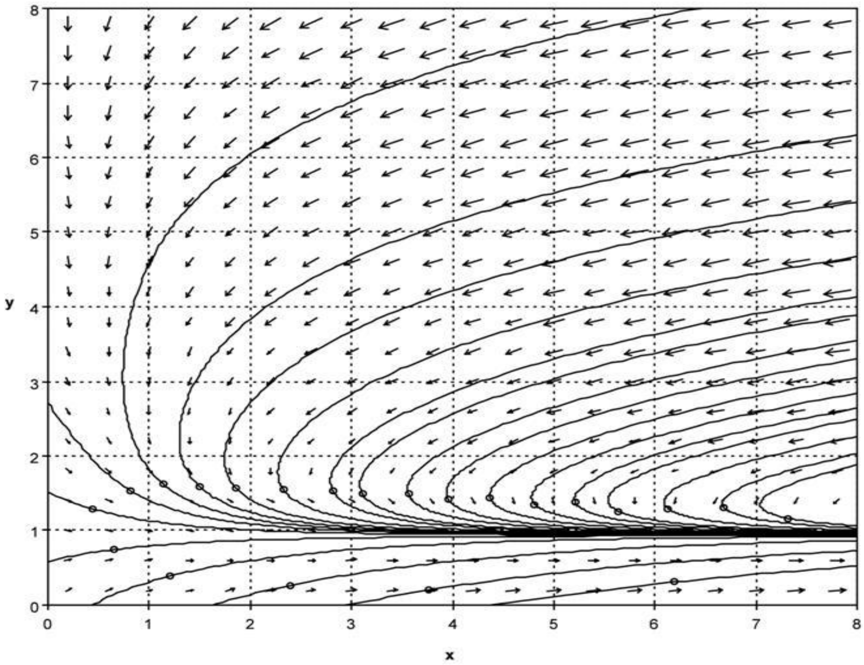


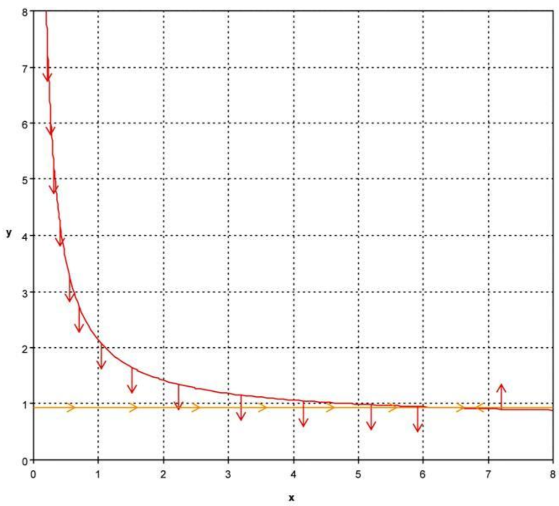
Fig.1(C) : Threshold Diagram

Case(ii): When $\mathbf{a_1=0.656}$, a_{11}=0.578, a_{12}=0.454, h_1=0.645 and a_2=0.679, h_2=0.632. .

The Null clines, Solution Curves and Trajectories are drawn in the Fig.2(A), Fig.2(B), & Fig.2(C) respectively. In this case, The Eigen values are -0.10128 and -0.678 with the eigen vectors (1, -4.79994E-18) & (0,1).The Jacobean matrix is $\begin{pmatrix} -0.10128 & -2.8912 \\ 0 & -0.678 \end{pmatrix}$

The equilibrium point occurs at (6.3684, 0.93215)

Both eigen values are negative. Hence, it is Stable



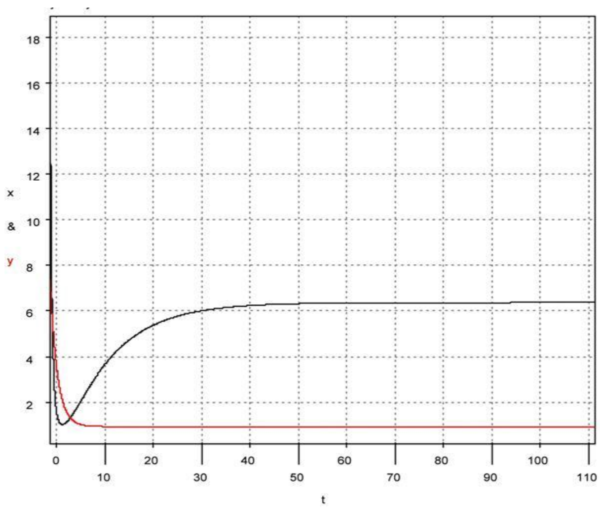


Fig.2(A): Null clines **Fig.2(B): Solution Curves**

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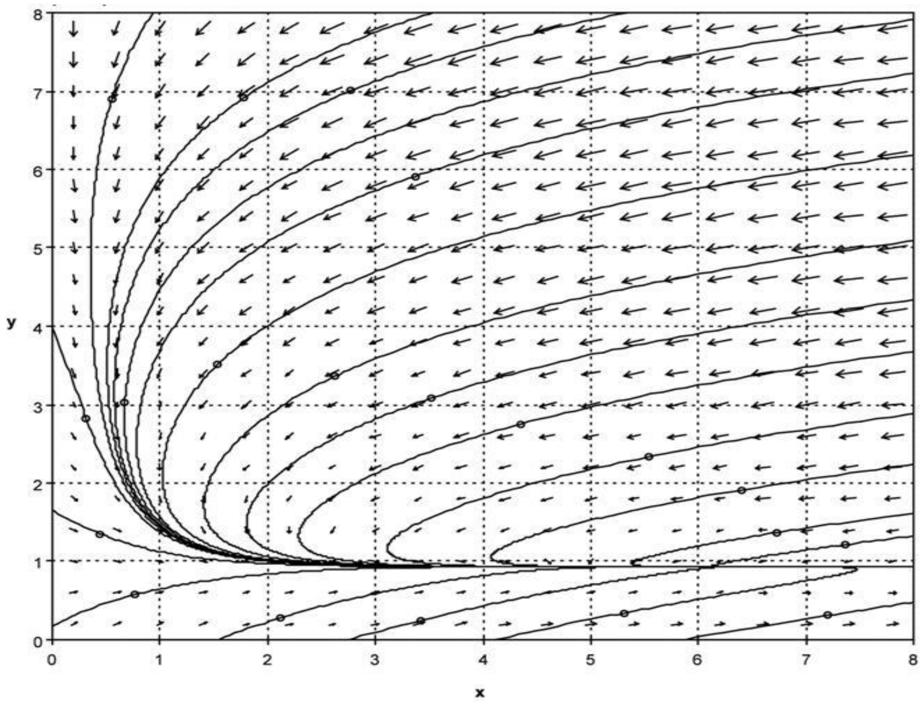


Fig.2(C) : Threshold Diagram

Case(iii): When $\mathbf{a_1=0.456}$, $a_{11}=0.578$, $a_{12}=0.454$, , $h_1=0.645$ and $a_2=0.679$, $h_2=0.632$. . The Null clines, Solution Curves and Trajectories are drawn in the Fig.3(A), Fig.3(B), & Fig.3(C) respectively.

In this case, The Eigen values are -0.30128 and -0.678 with the eigen vectors (1,0) & (0,1) and the Jacobean matrix is $\begin{pmatrix} -0.30128 & -0.97195 \\ 0 & -0.678 \end{pmatrix}$

The equilibrium point of this system exists at (6.3684, 0.93215)

Both eigen values are negative. Hence, it is Stable

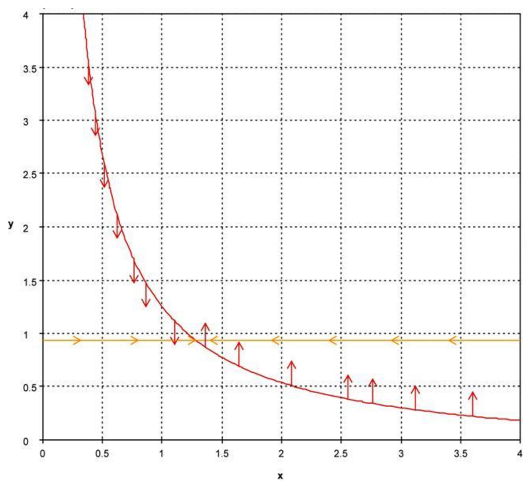


Fig.3(A): Null clines

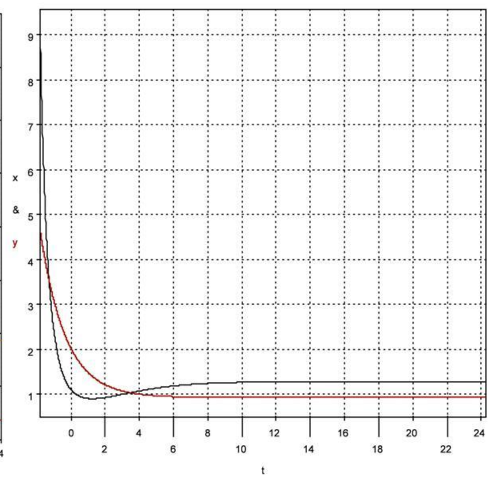


Fig.3(B): Solution Curves

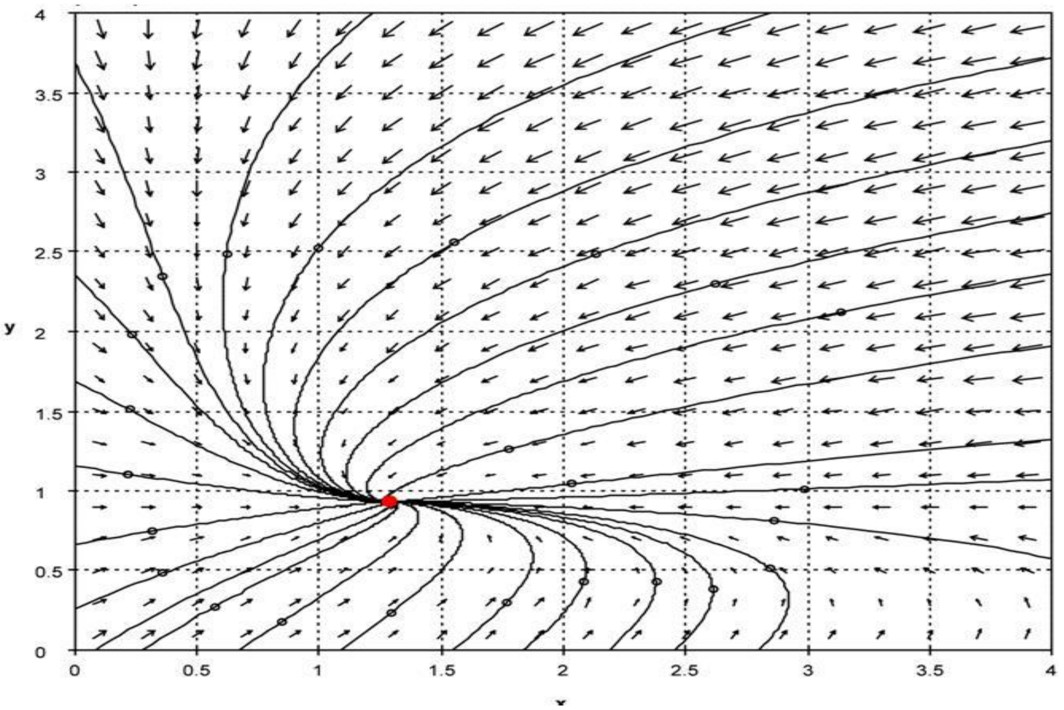


Fig.3(C) : Threshold Diagram

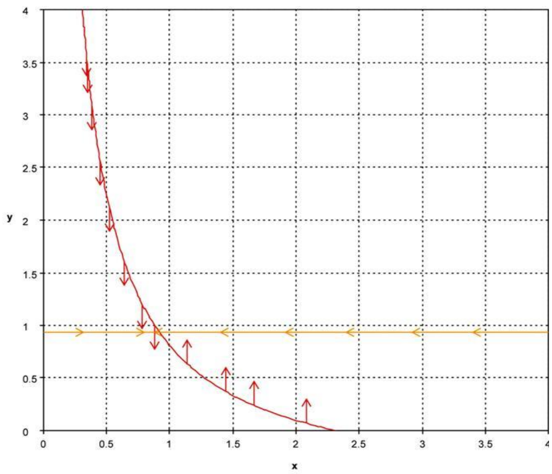
Case(iv): When $\mathbf{a_1=0.256}$, a_{11}=0.578, a_{12}=0.454, , h_1=0.645 and a_2=0.679, h_2=0.632.

The Null clines, Trajectories and Solution curves are drawn in the Fig.4(A), Fig.4(B), & Fig.4(C).

In this case, The Eigen values are -0.50128 and -0.678 with the eigen vectors (1, 5.70161E-16) & (0,1).The Jacobean matrix is $\begin{pmatrix} 0.50128 & -0.58416 \\ 0 & -0.678 \end{pmatrix}$

The equilibrium point of this system exists at (6.3684, 0.93215)

Both eigen values are negative. Hence, it is Stable



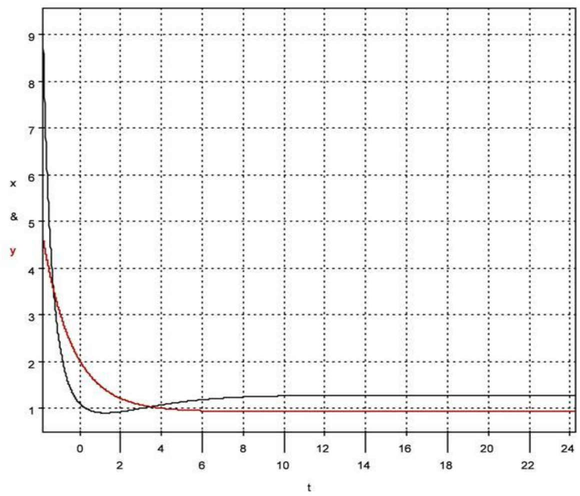


Fig.4(A): Null clines **Fig.4(B): Solution Curves**

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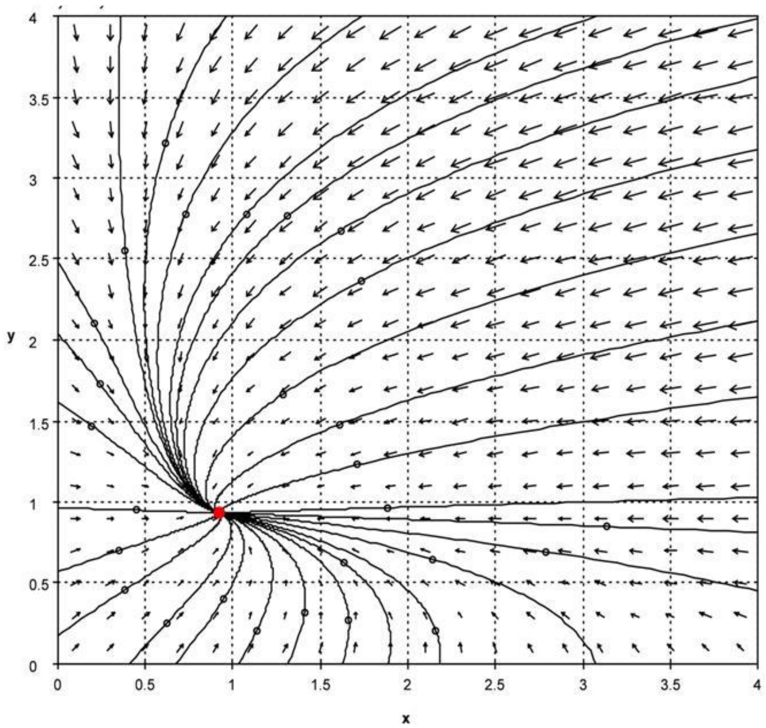

Fig.4(C) : Threshold Diagram

Case(v): When $\mathbf{a_1=0.056}$, a_{11}=0.578, a_{12}=0.454, h_1=0.645 and a_2=0.679, h_2=0.632.

The Null clines, Trajectories and Solution curves are drawn in the Fig.5(A), Fig.5(B), & Fig.5(C).

In this case, The Eigen values -0.678 and -0.70128 with the eigen vectors ((0.99845, -0.055669) & (0,1).The Jacobean matrix is $\begin{pmatrix} 0.70128 & -0.417566 \\ 0 & -0.678 \end{pmatrix}$

The equilibrium point of this system occurs at (6.3684, 0.93215)

Both eigen values are negative. Hence, it is Stable

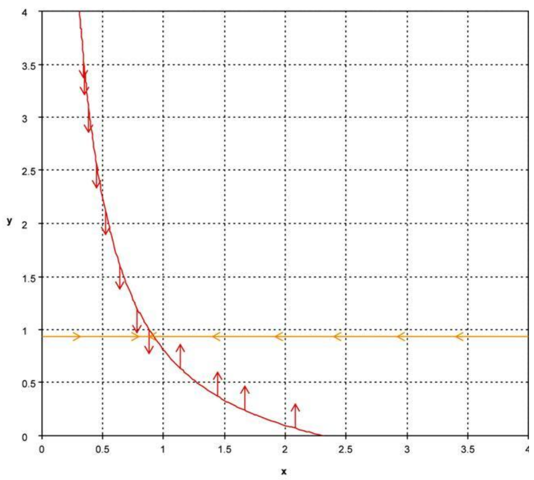

Fig.5(A): Null clines

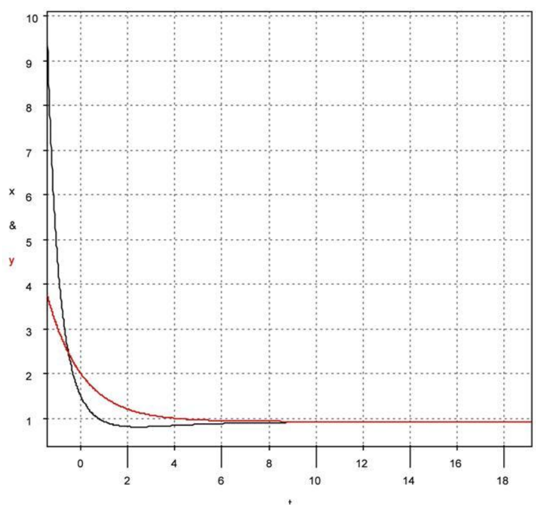

Fig.5(B): Solution Curves

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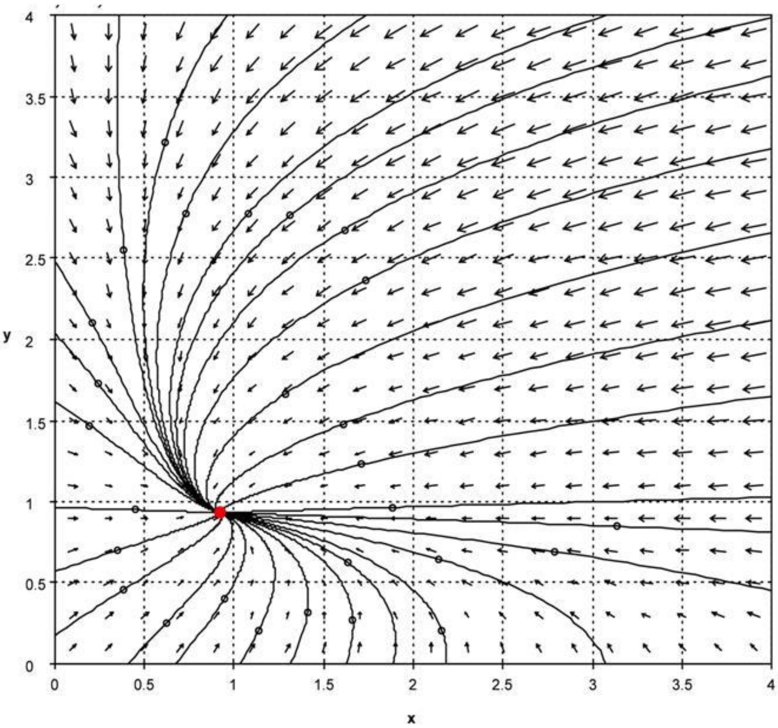

Fig5(C) : Solution Curves

IV. CONCLUSIONS

The nature of Stability in Ecological Ammensalism with mortality of both the species is discussed. The stability of this model can be achieved at the least growth rate of Ammensal Species with the fixed growth rate of Enemy species. In this case, the system will not be altered with the influence of the Ammensal coefficient. The enemy species decreases through out the interval.But Ammnsal Species has no dominant nature initially.After onwards,it overcomes the enemy Species with gradual dominance.

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