```
Clear["Global`*"];
```

```
Quit[]
```

```
LaunchKernels[]
```

Figures Bistab rm / sig

```
params[ss_, mm_] = {c → 0.05, mu → 1, β0 → 10, k → 0.01, sig → ss, eps → 1, rm → mm};
```

```
β[a_] = β0 a / (1 + a);(* parasite trade-off*)
```

```
rS[ga_] = rm / (1 + c ga) ;(* susceptible hosts trade-off*)
```

```
rI[ga_] = eps rS[ga];(*infected hosts trade-off*)
```

```
getres[aa_, gg_] =
 Solve[{0 == (rS[gg] x + rI[gg] y) (1 - k (x + y)) - (mu + (β[aa] y)) x + gg y,
     0 == β[aa] x y - (mu + aa + gg) y}, {x, y}][[4]] // Simplify;
(*solve epidemiological system*)
```

```
para[a_, ga_] = Block[{}, res = getres[a, ga];
  Seq = x /. res;
  Ieq = y /. res;
  β'[a] - β[a] / (mu + a + ga + sig β[a] Ieq)];
(* parasite selection gradient*)
```

```
hote[a_, ga_] = Block[{}, res = getres[a, ga];
   Seq = x /. res;
   Ieq = y /. res;
   rS'[ga] (1 - k (Seq + Ieq)) + (rI'[ga] (1 - k (Seq + Ieq)) β[a] Ieq) / (mu + a + ga) +
    (rS[ga] (1 - k (Seq + Ieq)) - mu) / (mu + a + ga)] // Simplify;
(*host selection gradient*)
```

```
getcoess[sig_, rm_] := Solve[
  {0 == para[a, ga], 0 == hote[a, ga]} /. params[sig, rm], {a, ga}](*find coess*)
```

```
list =
  Table[{sig, rm, getcoess[sig, rm]}, {sig, 0.0, 1.0, 0.01}, {rm, 0.1, 3.5, 0.05}];
```

```
Export["listbrutrm.csv", list, "CSV"];
```

```
dataAll = {};
dataAll2 = {};
For[i = 1, i ≤ Dimensions[list][[2]], i++,
 For[j = 1, j ≤ Dimensions[list][[1]], j++,
  mysol = Select[{a, ga} /. list[[j, i, 3]], Element[#[[1]], Reals] &&
      #[[1]] > 0 && Element[#[[2]], Reals] && #[[2]] > 0 &];
  AppendTo[dataAll, {list[[j, i, 2]], list[[j, i, 1]], Length[mysol]}];
  AppendTo[dataAll2, {list[[j, i, 2]], list[[j, i, 1]], mysol}];
  Export["datarmsigma.csv", dataAll, "CSV"];
  Export["datarmsigmadat.csv", dataAll2, "CSV"];
 ]
]
```

```
list =
  Table[{sig, rm , getcoess[sig, rm]}, {sig, 0.0, 1.0, 0.1}, {rm, 0.1, 3.5, 0.1}];
```

```
Export["datarmsigmaEqI2.csv", dataEqIrm, "CSV"];
```

```
dataEqIhi = {}; dataEqShi = {}; dataEqIlow = {}; dataEqSlow = {};
For[i = 1, i ≤ Dimensions[list][[2]], i++,
 For[j = 1, j ≤ Dimensions[list][[1]], j++,
  mysol = Select[{a, ga} /. list[[j, i, 3]], Element[#[[1]], Reals] &&
      #[[1]] > 0 && Element[#[[2]], Reals] && #[[2]] > 0 &];

  For[l = 1, l ≤ Length[mysol], l++,
   findEqI = Ieq /. res /. params[list[[j, i, 1]], list[[j, i, 2]]] /.
      a → mysol[[l, 1]] /. ga → mysol[[l, 2]];
   findEqS = Seq /. res /. params[list[[j, i, 1]], list[[j, i, 2]]] /.
      a → mysol[[l, 1]] /. ga → mysol[[l, 2]];
   If[findEqI > 0 && findEqI < 0.53, AppendTo[dataEqIlow,
     {list[[j, i, 2]], list[[j, i, 1]], findEqI}]];
   If[findEqI > 0 && findEqI > 0.53, AppendTo[dataEqIhi,
     {list[[j, i, 2]], list[[j, i, 1]], findEqI}]];
   If[findEqS < 100 && findEqS < 0.72, AppendTo[dataEqSlow,
     {list[[j, i, 2]], list[[j, i, 1]], findEqS}]];
   If[findEqS < 100 && findEqS > 0.72, AppendTo[dataEqShi,
     {list[[j, i, 2]], list[[j, i, 1]], findEqS}]];
  ];
 ]
]

Export["datarmsigmaEqSlow.csv", dataEqSlow, "CSV"];
Export["datarmsigmaEqShi.csv", dataEqShi, "CSV"];
(*Export["datarmsigmaEqIlow.csv",dataEqIlow,"CSV"];
Export["datarmsigmaEqIhi.csv",dataEqIhi,"CSV"];*)
```

```
Part::partd : Part specification a⟦1⟧ is longer than depth of object. ≫

Part::partd : Part specification a⟦1⟧ is longer than depth of object. ≫

Part::partd : Part specification a⟦2⟧ is longer than depth of object. ≫

General::stop : Further output of Part::partd will be suppressed during this calculation. ≫
```

```
findEqS
```

```
0.619807
```

```
dataAllEqS // MatrixForm
```

```
dataEqIhi // MatrixForm
```

```
dataAllEqI // MatrixForm
```