One patch, with and without effect of microbes on pollinators

This creates phase plane and time series plots for one-plant model with and without feedbacks between microbes and pollinators, and with low and high yeast dispersal rates (keeping bacterial dispersal rates constant).

Load package and set working directory:

In[ ]:=
```
Needs["EcoEvo`"];
SetDirectory[NotebookDirectory[]];
SetDirectory[ParentDirectory[] <> "/_figures/_raw-nb"];
```

Define model in EcoEvo:

In[ ]:=
```
SetModel[{Pop[Y] → {Equation :→ dy disp[B, h, S0, L0] Y (1 - Y - B) - m Y,
      Range :→ Interval[{0, 1}], Color → RGBColor["#FFCC33"]},
    Pop[B] → {Equation :→ (db0 + db disp[B, h, S0, L0]) B (1 - Y - B) - m B,
      Range :→ Interval[{0, 1}], Color → RGBColor["#333399"]},
    Parameters :→ {dy ≥ 0, db0 ≥ 0, db ≥ 0, h ≥ 0, L0 ≥ 0, m ≥ 0, S0 ≥ 0}}];
disp[B_, h_, S0_, L0_] := Module[{P},
    P = S0^h / (S0^h + B^h);
    P / (L0 + P)
  ];
```

Create functions used throughout and define unchanging parameter values:

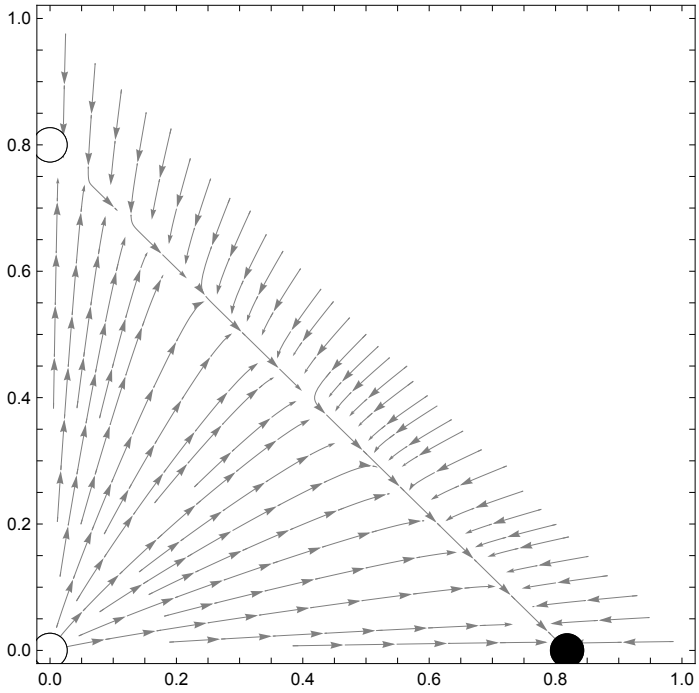
In[•]:=
```
Pvec[S0_, h_, L0_, t_, simBFun_] = disp[simBFun[t], h, S0, L0];
timeseriesPlot[maxt_?NumericQ, hiStart_?NumericQ, loStart_?NumericQ] :=
  Module[{sim1, sim2, simp1, simp2, p1, p2, pp1, pp2},
   sim1 = EcoSim[{Y → hiStart, B → loStart}, maxt];
   sim2 = EcoSim[{Y → loStart, B → hiStart}, maxt];
   simp1 = PlotDynamics[sim1, AxesLabel → None];
   simp2 = PlotDynamics[sim2, AxesLabel → None];
   p1 = Plot[Pvec[S0, h, L0, t, sim1[[2]][[2]]],
     {t, 0, maxt}, PlotStyle → Directive[Thick, Gray, Dashed],
     AspectRatio → 0.85, PlotRange → {Automatic, {0, 1}}];
   p2 = Plot[Pvec[S0, h, L0, t, sim2[[2]][[2]]],
     {t, 0, maxt}, PlotStyle → Directive[Thick, Gray, Dashed],
     AspectRatio → 0.85, PlotRange → {Automatic, {0, 1}}];
   pp1 = Show[p1, simp1, PlotRange → {Automatic, {0, 1}}, AxesOrigin → {0, 0}];
   pp2 = Show[p2, simp2, PlotRange → {Automatic, {0, 1}}, AxesOrigin → {0, 0}];
   GraphicsRow[{pp1, pp2}, ImageSize → Medium]
  ];
db = 0.4;
db0 = 0.3;
m = 0.1;
S0 = 0.4;
```

Phase planes and time series plots

No feedbacks, high yeast dispersal

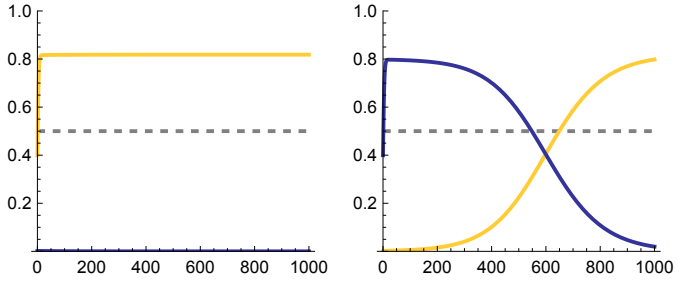
In[ ]:=
```
Clear[h, dy, L0];
h = 0.0; dy = 1.1; L0 = 0.5;
p = PlotEcoPhasePlane[ {Y, 0, 1}, {B, 0, 1},
  IsoclineStyle → {Opacity[0], Opacity[0]},
  RuleListPlotOpts → {StableMarker →
      {Graphics[{Black, Disk[{0, 0}]}, ImageSize → 20, AlignmentPoint → {0, 0}]},
    UnstableMarker → {Graphics[{EdgeForm[{Black}], FaceForm[White], Disk[{0, 0}]},
       ImageSize → 20, AlignmentPoint → {0, 0}]}},
  FrameLabel → None,
  RegionFunction → Function[{Y, B}, 0 ≤ Y + B ≤ 1]]
Export[File["1patch-h0-dy1.1-phase.pdf"], p];
Clear[p];
```

Out[ ]=



In[ ]:=
```
Clear[h, dy, L0];
h = 0.0; dy = 1.1; L0 = 0.5;
combinedPlot = timeseriesPlot[1000, 0.4, 0.001]
Export[File["1patch-h0-dy1.1-timeseries.pdf"], combinedPlot];
Clear[combinedPlot];
```

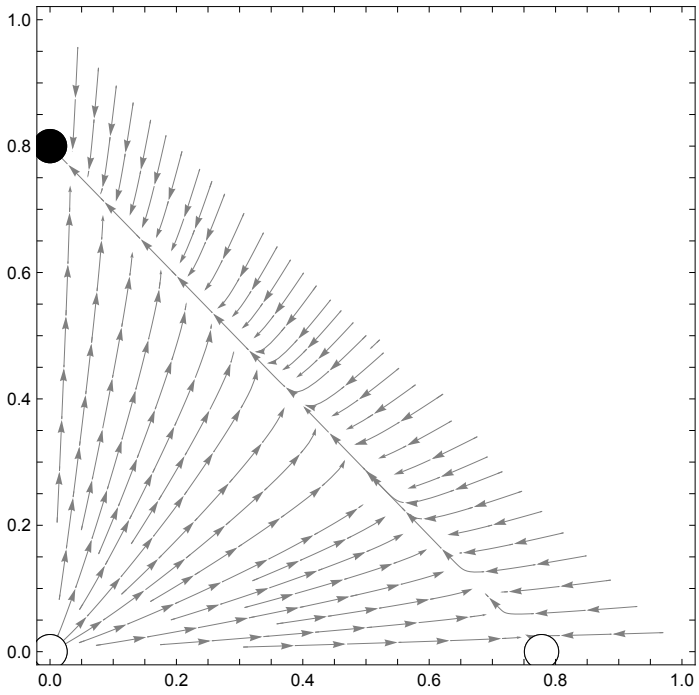
Out[ ]=



No feedbacks, low yeast dispersal

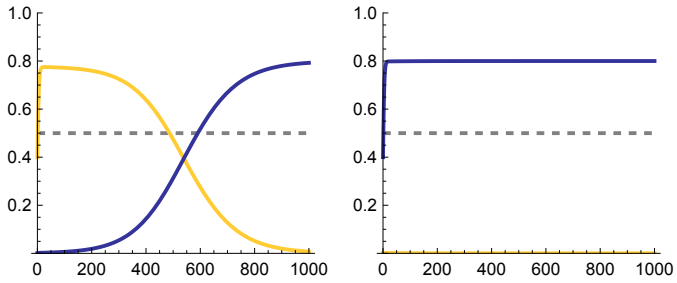
In[ ]:=
```
Clear[h, dy, L0];
h = 0.0; dy = 0.9; L0 = 0.5;
p = PlotEcoPhasePlane[ {Y, 0, 1}, {B, 0, 1},
  IsoclineStyle → {Opacity[0], Opacity[0]},
  RuleListPlotOpts → {StableMarker →
      {Graphics[{Black, Disk[{0, 0}]}, ImageSize → 20, AlignmentPoint → {0, 0}]},
    UnstableMarker → {Graphics[{EdgeForm[{Black}], FaceForm[White], Disk[{0, 0}]},
       ImageSize → 20, AlignmentPoint → {0, 0}]}},
  FrameLabel → None,
  RegionFunction → Function[{Y, B}, 0 ≤ Y + B ≤ 1]]
Export[File["1patch-h0-dy0.9-phase.pdf"], p];
Clear[p];
```

Out[ ]=



In[ ]:=
```
Clear[h, dy, L0];
h = 0.0; dy = 0.9; L0 = 0.5;
combinedPlot = timeseriesPlot[1000, 0.4, 0.001]
Export[File["1patch-h0-dy0.9-timeseries.pdf"], combinedPlot];
Clear[combinedPlot];
```

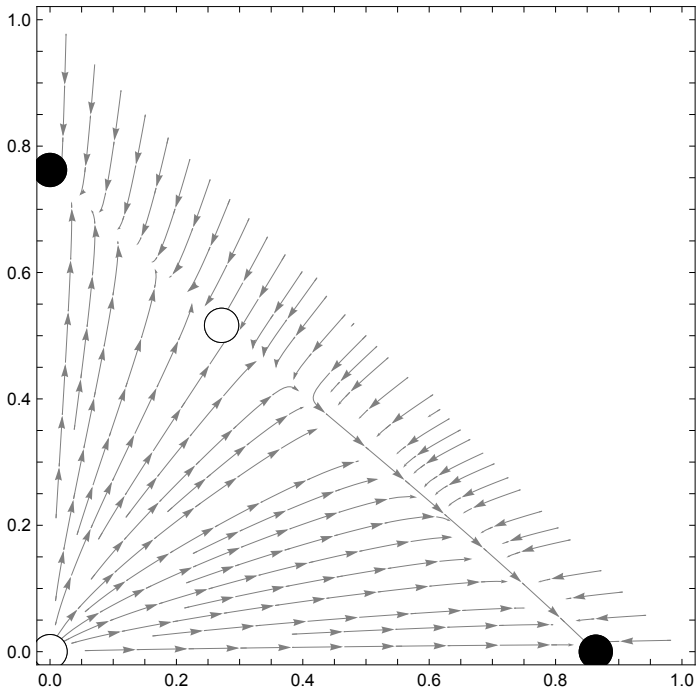
Out[ ]=



With feedbacks, high yeast dispersal

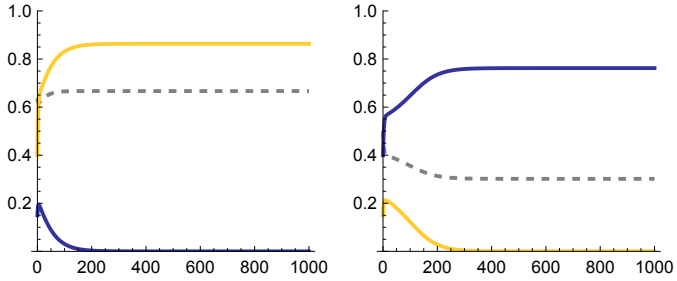
In[ ]:=
```
Clear[h, dy, L0];
h = 2.0; dy = 1.1; L0 = 0.5;
p = PlotEcoPhasePlane[ {Y, 0, 1}, {B, 0, 1},
  IsoclineStyle → {Opacity[0], Opacity[0]},
  RuleListPlotOpts → {StableMarker →
      {Graphics[{Black, Disk[{0, 0}]}, ImageSize → 20, AlignmentPoint → {0, 0}]},
    UnstableMarker → {Graphics[{EdgeForm[{Black}], FaceForm[White], Disk[{0, 0}]},
       ImageSize → 20, AlignmentPoint → {0, 0}]}},
  FrameLabel → None,
  RegionFunction → Function[{Y, B}, 0 ≤ Y + B ≤ 1]]
Export[File["1patch-h2-dy1.1-phase.pdf"], p];
Clear[p];
```

Out[ ]=



In[ ]:=
```
Clear[h, dy, L0];
h = 2.0; dy = 1.1; L0 = 0.5;
combinedPlot = timeseriesPlot[1000, 0.4, 0.15]
Export[File["1patch-h2-dy1.1-timeseries.pdf"], combinedPlot];
Clear[combinedPlot];
```

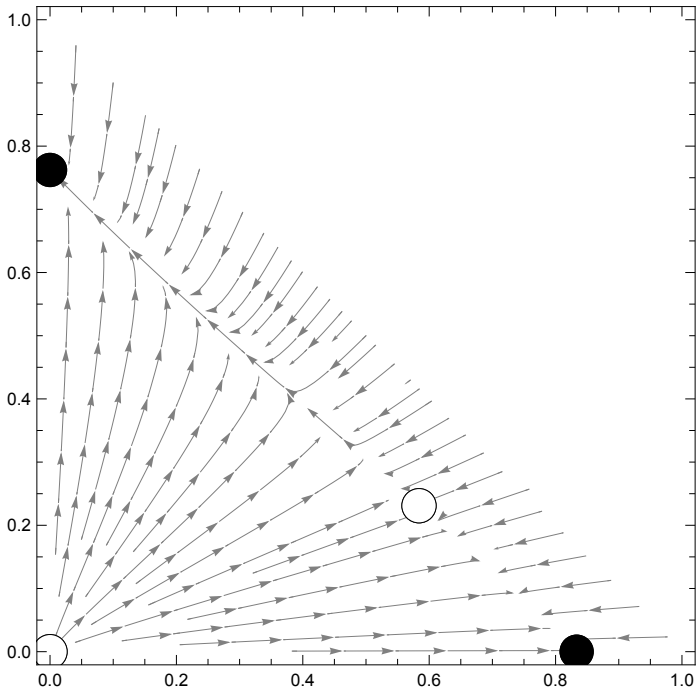
Out[ ]=



With feedbacks, low yeast dispersal

In[ ]:=
```
Clear[h, dy, L0];
h = 2.0; dy = 0.9; L0 = 0.5;
p = PlotEcoPhasePlane[ {Y, 0, 1}, {B, 0, 1},
  IsoclineStyle → {Opacity[0], Opacity[0]},
  RuleListPlotOpts → {StableMarker →
      {Graphics[{Black, Disk[{0, 0}]}, ImageSize → 20, AlignmentPoint → {0, 0}]},
    UnstableMarker → {Graphics[{EdgeForm[{Black}], FaceForm[White], Disk[{0, 0}]},
       ImageSize → 20, AlignmentPoint → {0, 0}]}},
  FrameLabel → None,
  RegionFunction → Function[{Y, B}, 0 ≤ Y + B ≤ 1]]
Export[File["1patch-h2-dy0.9-phase.pdf"], p];
Clear[p];
```

Out[ ]=



In[•]:=
```
Clear[h, dy, L0];
h = 2.0; dy = 0.9; L0 = 0.5;
combinedPlot = timeseriesPlot[1000, 0.4, 0.15]
Export[File["1patch-h2-dy0.9-timeseries.pdf"], combinedPlot];
Clear[combinedPlot];
```

Out[•]=