Evolutionary suicide

New features

- multiple resident attractors due to Allee effect
- attractor inheritance
- evolutionary suicide

Full population dynamics

$$\frac{d}{dt} n_i = n_i \left(\frac{r[x_i] \sum_{j=1}^{k} n_j}{1 + \sum_{j=1}^{k} n_j} - 1 - \sum_{j=1}^{k} a[x_i, x_j] \, n_j \right) \qquad (i = 1, \ldots, k)$$

MONOMORPHIC RESIDENT POPULATION

Monomorphic resident population dynamics:

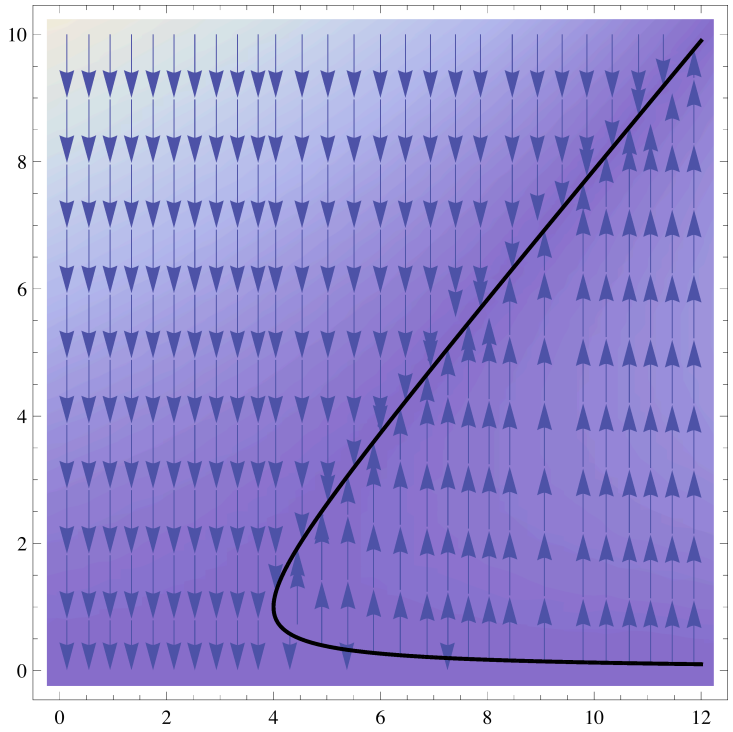
```
dn[n_] = n (r[x] n / (1 + n) - 1 - a[x, x] n);
```

Default parameter values and functions:

```
r[x_] := x;
a[x_, y_] := Exp[x - y];
```

Equilibria and stability:

```
nEquil = ContourPlot[dn[n], {x, 0, 12}, {n, 0, 10}, Contours → {0}, ContourShading → False,
    ContourStyle → {Black, Thick}, PlotPoints → 100];
nStream = StreamDensityPlot[{0, dn[n]}, {x, 0, 12}, {n, 0, 10}, StreamStyle → Arrowheads[0.04]];
Show[nStream, nEquil]
```



Reset:

```
Clear[r, a];
```

Stable resident population equilibrium:

```
Solve[dn[n] == 0, n]
```

$$\left\{\{n \to 0\}, \left\{n \to \frac{-1 - a[x, x] - \sqrt{-4\, a[x, x] + (1 + a[x, x] - r[x])^2} + r[x]}{2\, a[x, x]}\right\}, \left\{n \to \frac{-1 - a[x, x] + \sqrt{-4\, a[x, x] + (1 + a[x, x] - r[x])^2} + r[x]}{2\, a[x, x]}\right\}\right\}$$

```
n[x_] := (-1 - a[x, x] + Sqrt[-4 a[x, x] + (1 + a[x, x] - r[x])^2] + r[x]) / (2 a[x, x]);

discr[x_] := -4 a[x, x] + (1 + a[x, x] - r[x])^2
```

Default parameter values and functions:

```
r[x_] := x;
a[x_, y_] := Exp[x - y];
```

Invasion fitness and selection gradient belonging to the stable resident population equilibrium:

```
s[x_, y_] := r[y] n[x] / (1 + n[x]) - 1 - a[y, x] n[x];
ds[x_] := (∂y s[x, y]) /. {y → x};
```

Pairwise invadability plot (PIP) belonging to the stable resident population equilibrium::

```
PIPbnd = ContourPlot[If[discr[x] > 0, s[x, y]], {x, 0, 12}, {y, 0, 12}, Contours → {0},
    ContourStyle → {Black, Thick}, ContourShading → False, PlotPoints → 100];

PIPint = DensityPlot[If[discr[x] > 0 && s[x, y] > 0, s[x, y]], {x, 0, 12}, {y, 0, 12},
    PlotPoints → 50];

nPos = ContourPlot[discr[x], {x, 0, 12}, {y, 0, 12}, Contours → {0}, ContourStyle → {Black, Thick},
    ContourShading → False, PlotPoints → 10];
```

```
Show[PIPint, PIPbnd, nPos]
```