Supplementary Materials

Fig. S1

Tables S1-3

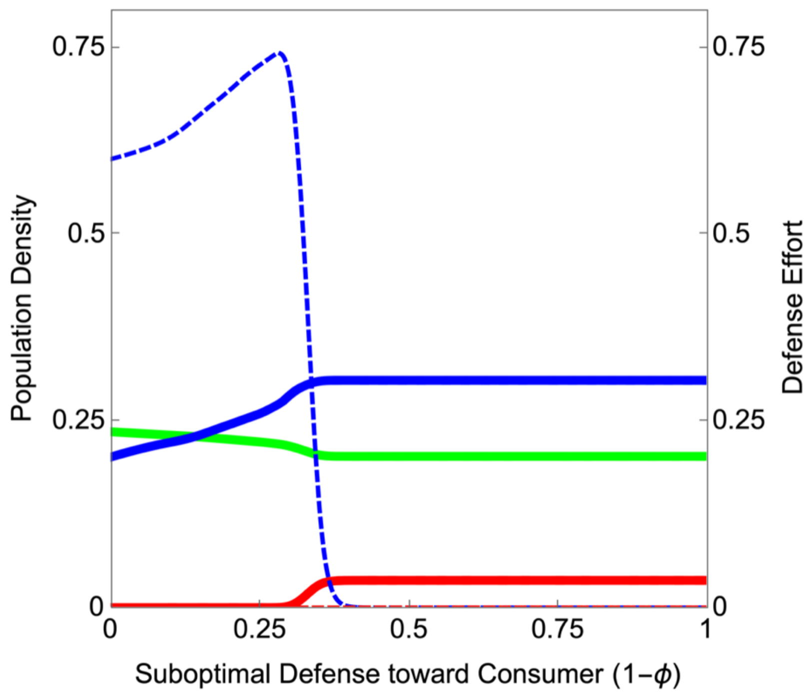

Fig. S1 Consumer novelty can promote native omnivore coexistence. Equilibrium densities and defense effort levels across a restricted range of suboptimal defense toward an introduced consumer. Solid green, blue and red lines indicate equilibrium densities of the resource, consumer, and omnivore, respectively. Dashed lines indicate levels of defense effort directed toward each predator species (colors match predator identity). Parameter values were chosen such that increasing consumer novelty permits the coexistence of an otherwise excluded omnivore. At perfect defense efficiency toward the consumer (far left) effective defense results in exclusion of the omnivore. Decreasing defense effectiveness allows the consumer to increase density providing and increased energy source for the omnivore, which can then persist (albeit at low density) despite reduced resource abundance. Note: this phenomenon only occurs under restricted parameter values (e.g., low resource productivity).

Invasion scenario	Predator	Defense Effort	Coexistence criteria (focal predator can persist when expression is > 0)
	Omnivore	0	$\frac{aPN\ bPN\ (aNR\ bNR\ k\ r - mN) + aNR\ aPR\ bPR\ k\ mN}{aNR^2\ bNR\ k} - mP$
		int.	$\frac{r(aPN\ bPN\ c0 + aNR\ aPR\ bPR\ k\ (fN - c0))}{aNR\ fN} - mP$
		1	$\frac{aNR\ aPN\ bNR\ bPN\ (c0 - 1)\ (fN - 1)\ k\ r - mN\ (aPN\ bPN + aNR\ aPR\ bPR\ (fN - 1)\ k)}{aNR^2\ bNR\ (fN - 1)^2\ k} - mP$
Suboptimal Defense	**Consumer**	0	$\frac{aPR\ k\ (aNR\ bNR\ mP - aPR\ bPR\ mN) + aPN\ (mP - aPR\ bPR\ kr)}{aPR^2\ bPR\ k}$
		int.	$aNR\ bNR\ k\ r - \frac{c0\ r\ (aPN + aNR\ aPR\ bNR\ k)}{aPR\ fN\ \boldsymbol{\phi}} - mN$
		1	$\frac{aNR\ aPR\ bNR\ k\ mP\ (1 - fN\phi) + aPN\ (mP - aPR\ bPR\ (c0 - 1)\ k\ r\ (fN\ \boldsymbol{\phi} - 1))}{aPR^2\ bPR\ k\ (fN\ \boldsymbol{\phi} - 1)^2} - mN$

Naïveté	**Consumer**	0	$\frac{aPR\ k\ (aNR\ bNR\ mP - aPR\ bPR\ mN) + aPN\ (mP - aPR\ bPR\ k\ r)}{aPR^2\ bPR\ k}$
		int.	$\frac{aNR\ bNR\ (\frac{\sqrt{k}\sqrt{r}\sqrt{\rho(aPR\ bPR\ k\ r(c0 - fP)^2 + 4\ c0\ fP\ mP) - 4\ c0\ fP\ mP}}{\sqrt{aPR}\ \sqrt{bPR}\ \sqrt{\boldsymbol{\rho}}} - c0\ k\ r + fP\ k\ r)}{2\ fP} - \frac{aPN\ c0\ r}{aPR\ fP\ \boldsymbol{\rho}} - mN$
		1	$\frac{aPN\ (aPR\ bPR\ k\ r\ (c0\ (-fP) + c0 + fP - 1) + mP) - aPR(fP - 1)\ k\ (aNR\ bNR\ mP + aPR\ bPR\ (fP - 1)\ mN)}{aPR^2\ bPR\ (fP - 1)^2\ k}$

Table S1 Coexistence criteria for introduced omnivore. *Int.* indicates defense effort that is adaptively allocated between 0 and 1.

Invasion scenario	Predator	Defense Effort	Coexistence criteria (focal predator can persist when expression is > 0)
	Consumer	0	$\frac{aPR\ k\ (aNR\ bNR\ mP - aPR\ bPR\ mN) + aPN\ (mP - aPR\ bPR\ k\ r)}{aPR^2\ bPR\ k}$
		int.	$\frac{r\ (aPN\ c0 + aNR\ aPR\ bNR\ k\ (fP - c0))}{aPR\ fP} + mN$
		1	$\frac{aPN\ (aPR\ bPR\ k\ r\ (c0\ (-fP) + c0 + fP - 1) + mP) - aPR\ (fP - 1)\ k\ (aNR\ bNR\ mP + aPR\ bPR\ (fP - 1)\ mN)}{aPR^2\ bPR\ (fP - 1)^2\ k}$
Suboptimal Defense	**Omnivore**	0	$\frac{aPN\ bPN\ (aNR\ bNR\ k\ r - mN) + aNR\ aPR\ bPR\ k\ mN}{aNR^2\ bNR\ k} - mP$
		int.	$\frac{c0\ r\ (aPN\ bPN - aNR\ aPR\ bPR\ k)}{aNR\ fP\ \boldsymbol{\phi}} + aPR\ bPR\ k\ r - mP$
		1	$\frac{aPN\ bPN\ (aNR\ bNR(c0 - 1)\ k\ r\ (fP\ \boldsymbol{\phi} - 1) - mN) + aNR\ aPR\ bPR\ k\ mN\ (1 - fP\ \boldsymbol{\phi})}{aNR^2\ bNR\ k\ (fP\ \boldsymbol{\phi} - 1)^2} - mP$

Naïveté	**Omnivore**	0	$\frac{aPN\ bPN\ (aNR\ bNR\ k\ r - mN) + aNR\ aPR\ bPR\ k\ mN}{aNR^2\ bNR\ k} - mP$
		int.	$\frac{aPN\ bPN\ c0\ r}{aNR\ fN\ \boldsymbol{\rho}} - \frac{aPRbPR(-\frac{\sqrt{k}\sqrt{r}\sqrt{\boldsymbol{\rho}\ (aNR\ bNR\ k\ r\ (c0 - fN)^2 + 4\ c0\ fN\ mN) - 4\ c0\ fN\ mN}}{\sqrt{aNR}\sqrt{bNR}\sqrt{\boldsymbol{\rho}}} + c0\ k\ r - fN\ k\ r\ )}{2\ fN} - mP$
		1	$\frac{aNR\ aPN\ bNR\ bPN\ (c0 - 1)\ (fN - 1)\ k\ r - mN\ (aPN\ bPN + aNR\ aPR\ bPR\ (fN - 1)\ k)}{aNR^2\ bNR\ (fN - 1)^2\ k} - mP$

Table S2 Coexistence criteria for introduced consumer. *Int.* indicates defense effort that is adaptively allocated between 0 and 1.

Table S3.

<table>
<tr><th></th><th></th><th colspan="8">Parameter value</th></tr>
<tr><th>Parameter</th><th>Interpretation</th><th>Fig. 1</th><th>Fig. 2</th><th>Fig. 3</th><th>Fig. 4</th><th>Fig. 5</th><th>Fig. 6</th><th>Fig. 7</th><th>Fig. S1</th></tr>
<tr><td>r</td><td>Resource intrinsic growth rate</td><td>1</td><td colspan="2">1</td><td>0.9</td><td colspan="2">1</td><td>1</td><td>1</td></tr>
<tr><td>k</td><td>Basal productivity</td><td>1</td><td>grad.</td><td>5</td><td>5</td><td>grad.</td><td>5</td><td>3</td><td>0.7</td></tr>
<tr><td>c_0</td><td>Coefficient of cost of defensive effort</td><td>grad.</td><td>0.25</td><td>grad.</td><td>0.25</td><td>0.25</td><td>grad.</td><td>0.1</td><td>0.1</td></tr>
<tr><td>f_N</td><td>Efficiency of defensive effort toward consumer</td><td>0.8</td><td colspan="2">0.8</td><td>0.7</td><td colspan="2">0.8</td><td>0.6</td><td>0.8</td></tr>
<tr><td>f_P</td><td>Efficiency of defensive effort toward omnivore</td><td>0.8</td><td colspan="2">0.8</td><td>0.7</td><td colspan="2">0.8</td><td>0.6</td><td>0.8</td></tr>
<tr><td>a_{PR}</td><td>Attack rate of omnivore on resource</td><td>0.9</td><td colspan="5">0.9</td><td>1</td><td>0.9</td></tr>
<tr><td>a_{PN}</td><td>Attack rate of omnivore on consumer</td><td>1</td><td colspan="2">grad.</td><td>1.2</td><td colspan="2">grad.</td><td>0.8</td><td>0.9</td></tr>
<tr><td>a_{NR}</td><td>Attack rate of consumer on resource</td><td>1.5</td><td colspan="5">0.8</td><td>0.8</td><td>0.8</td></tr>
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<table>
<tr><th colspan="10">Parameter value</th></tr>
<tr><th>Parameter</th><th>Interpretation</th><th>Fig. 1</th><th>Fig. 2</th><th>Fig. 3</th><th>Fig. 4</th><th>Fig. 5</th><th>Fig. 6</th><th>Fig. 7</th><th>Fig. S1</th></tr>
<tr><td>b_{PR}</td><td>Conversion efficiency of resource to omnivore</td><td>0.5</td><td colspan="5">0.5</td><td>0.4</td><td>0.5</td></tr>
<tr><td>b_{PN}</td><td>Conversion efficiency of consumer to omnivore</td><td>0.5</td><td colspan="5">0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td>b_{NR}</td><td>Conversion efficiency of resource to consumer</td><td>0.8</td><td colspan="5">0.7</td><td>0.9</td><td>0.9</td></tr>
<tr><td>m_P</td><td>Mortality rate of omnivore</td><td>0.5</td><td colspan="5">0.5</td><td>0.55</td><td>0.5</td></tr>
<tr><td>m_N</td><td>Mortality rate of consumer</td><td>0.2</td><td colspan="5">0.2</td><td>0.1</td><td>0.05</td></tr>
<tr><td>v</td><td>Adaptive rate of defensive response</td><td>1.0</td><td colspan="5">1.0</td><td>1.0</td><td>1.0</td></tr>
<tr><td>φ</td><td>Effectiveness of defense toward recognized invader</td><td>NA</td><td colspan="2">1, 0.75, 0.5</td><td>grad.</td><td colspan="2">1, 0.75, 0.5</td><td>grad.</td><td>grad.</td></tr>
<tr><td>ρ</td><td>Naïveté in defense allocation toward unrecognized predator</td><td>NA</td><td colspan="2">1, 0.75, 0.5</td><td>grad.</td><td colspan="2">1, 0.75, 0.5</td><td>grad.</td><td>grad.</td></tr>
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Table S3 Parameter values used to produce figures. *Grad.* refers to a parameter reflecting a gradient control parameter in the figure. *NA* refers to a parameter that is not applicable given the context of the figure. Note: Coexistence condition Figs. 2, 3, 5 and 6 use identical (fixed) parameter values except for those reflecting different invasion scenarios. Parameter values vary across Figs. 1, 4, 7, and S1. Parameter values in Figs 2, 3, 5 and 6 were chosen to maximize the region of three-species coexistence where the most informative dynamics occur. Retaining identical parameter values across all plots results in much of the informative dynamics being compressed into much smaller regions of control parameter space.