Instructions for Predator-Prey Population Dynamics Code

Population of prey in generation $t: N(t) \rightarrow N(t+1) = N(t)^{1+B*(100-N(t))} - K^* N(t)^* P(t)$

 N_{max} =100 can be sustained by environment with limited resources, kill rate= K

Population of predator in generation $t: P(t) \rightarrow P(t+1) = Q^*N(t)^*P(t), Q = efficiency of prey use$

Populations in relative units.

Suggestions to explore dynamics with different parameters and initial conditions:

a) N(0)= 60, 70

b) P(0)= 0.25, 0.3

c) B=0.0055, 0.0006, 0.00065

d) K= 0.25, 0.3, 0.19, 0.18

Which parameters may be changed slightly while maintaining a stable state of P & N? Which parameters lead to population extinction or explosion?

| B2 | | - ± 2 | X 🗸 | fx N(t+ | +1)=(1.0+B* | (100-N(t)) | *N(t)-K*N(t | :)*P(t) | | |
|----|--------|------------|------------|---------------|-------------|-------------------------------------------------|--------------|---------|--|--|
| | А | В | С | D | E | F | G | Н | | |
| 1 | Prey a | nd Pred | lator | | | This is | used as 2 c | omment | | |
| 2 | | N(t+1)=(1. | 0+B*(100-№ | N(t)))*N(t)-K | (*N(t)*P(t) | This is used as 2 comment lines defining the | | | | |
| 3 | | P(t+1)=Q* | N(t)*P(t) | | | | ons to code | - | | |
| 4 | | | | | | equati | | • | | |
| 5 | | #Prey t=0 | #Predators | Birth rate | Kill rate | Efficiency | in use of pr | ey | | |
| 6 | | N0 | PO | В | К | Q | | | | |
| 7 | | 50 | 0.2 | 0.005 | 0.5 | 0.0205 | | | | |
| 8 | | | | | | | | | | |

| B 3 | | • ± > | < 🗸 | <i>f</i> _x P(t+ | 1)=Q*N(t)* | P(t) | | | |
|------------|---------------------|------------|------------|----------------------------|------------|------------|--------------|----|--|
| | А | В | С | D | E | F | G | | |
| 1 | 1 Prey and Predator | | | | | | | | |
| 2 | - | N(t+1)=(1. | 0+5*(100-N | This is used as 2 comment | | | | | |
| 3 | | P(t+1)=Q* | N(t)*P(t) | | | | | | |
| 4 | | | | | | equatio | ns to code | | |
| 5 | | #Prey t=0 | #Predators | Birth rate | Kill rate | Efficiency | in use of pr | ey | |
| 6 | | | DO | D | к | Q | | | |
| 0 | | NO | PO | В | N | ų | | | |

| | | - | \times | ~ | <i>fx</i> =(1- | ·B*(B10-100 | 0))*B10-K* | B10*C10 |) | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------|-------------|-----------|---------------|------------|-------------------------------------------------------------------------|
| | А | В | | С | | E | F | G | Н | | |
| 1 | Prey | and P | redat | or | | | | | | | |
| 2 | | | | | N(†))*N(t)-K | (*N(t)*P(t) | | | | | |
| 3 | | |)=Q*N(t | | | | | Г | | | |
| _ | | 1 (011) | | , , , , | | | | | Storage cel | lls for na | ming |
| 4 | | | | | | | | | and definir | | - |
| 5 | | #Prey | t=0 #P | redator | Birth rate | Kill rate | Efficiency | ir use o | parameter | - | |
| 6 | | NO | PO | | В | К | Q | | | | |
| 7 | | | 50 | 0.2 | 0.005 | 0.5 | 0.0205 | J | program, c | | |
| 3 | | | | / | | | | | explore dif | ferent | |
| 9 | | | | | | | | | conditions | | |
| _ | | • | 50 | | | | | | | | |
| 0 | | 0 | 50 | 0.2 | | | • • • | | | | |
| 1 | | 1 | 57.5 | 0.205 | | Initial popu | lations, va | ary to se | e correlatior | ns! | |
| | | | 2 | . I | | | | | | | |
| C11 | | | | | Q*B10*C10 | | | | | | |
| 4 | A | В | 136 | | umn B hav | e | G I | 4 | 1 1 | K | L |
| P | Prev a | nd Pred | at the | formul | a for the | | | | | | |
| | | N(t+1)=(1. | 10100 | ative p | ey populat | tion | | | | | |
| 3 | | P(t+1)=Q* | | | | | | | | | |
| 1 | | r((+1)-0() | (c) + (c) | | | | | | | | |
| 5 | | #Prev t=0 | #Predato | r: Birth at | e Kill rate | Efficiency in u | se of prev | | | | |
| 5 | | NO | PO | в | | column C | | | | | |
| 7 | | 50 | 0. | 2 0.0 | 36 | | | | | | |
| В | | | | | | for the ite | | | | | |
| 9 | | | | | predato | or nonulatio | | | | | |
| | | | | | | n populatio | n | | | | |
| 0 | 0 | 50 | 0. | 2 | L . | | | vr-Prov F | volution | | |
| and a second | 0 | 50 57.5 | | | | | | or-Prey E | volution | | |
| 1 2 | 1.7 | 57.5 | 0.20 0.24164 | 4 | 80 | , populati | | or-Prey E | volution | | 1 |
| 1 2 3 | 1 | 57.5 63.825 67.65789 | 0.20 0.24164 0.3161 | 5 4 7 | | | | or-Prey E | volution | | 1 |
| 1 2 3 4 | 1 | 57.5 63.825 67.65789 67.9032 | 0.20 0.24164 0.3161 0.43852 | 5 4 7 3 | 80 | | | or-Prey E | volution | | 0.9 |
| 1 2 3 4 5 | 1 2 3 4 5 | 57.5 63.825 67.65789 67.9032 63.91201 | 0.20 0.24164 0.3161 0.43852 0.61043 | 5 4 7 3 1 | | \bigwedge | | or-Prey E | | | |
| 1 2 3 4 5 6 | 1 2 3 4 5 6 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 | 5 4 7 3 1 5 | 70 | | | or-Prey E | | | 0.9 |
| 1 2 3 4 5 6 7 | 1 2 3 4 5 6 7 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 | 5 4 7 3 1 5 5 | 70 60 | \bigwedge | | or-Prey E | | | 0.9 |
| 1 2 3 4 5 6 7 8 | 1 2 3 4 5 6 7 8 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 | 5 4 7 3 1 5 5 5 2 | 70 60 | \bigwedge | | or-Prey E | | | 0.9 |
| 1 2 3 4 5 6 7 8 9 | 1 2 3 4 5 6 7 8 9 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 | 5 4 7 3 1 5 5 5 2 9 | 70 60 | \bigwedge | | or-Prey E | | | 0.9 |
| 11 12 13 14 15 16 17 18 19 20 | 1 2 3 4 5 6 7 8 9 9 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 33.07577 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 0.44421 | 5 4 7 3 1 5 5 5 2 9 7 | 70 60 | \bigwedge | | or-Prey E | volution | | 0.9 |
| 1 2 3 4 5 6 7 8 9 0 1 | 1 2 3 4 5 6 7 8 9 10 11 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 33.07577 36.7972 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 0.44421 0.30120 | 5 4 7 3 1 5 5 5 2 9 7 3 | 70 60 Asso | \bigwedge | | or-Prey E | | | 0.9 0.8 0.7 0.6 0.5 0.4 |
| 1 2 3 4 5 6 7 8 9 9 0 0 1 1 2 | 1 2 3 4 5 6 7 8 9 10 11 12 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 33.07577 36.7972 42.88392 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 0.44421 0.30120 0.2272 | 5 4 7 3 1 5 5 5 2 9 7 3 1 | 70 60 Aaud uotteindo 30 | \bigwedge | | or-Prey E | volution | | 0.9 0.8 0.7 0.6 0.5 |
| 1 2 3 4 5 6 7 8 9 9 00 11 2 3 | 1 2 3 4 5 6 7 8 9 10 11 11 12 13 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 33.07577 36.7972 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 0.44421 0.30120 0.2272 0.19974 | 5 4 7 3 1 5 5 5 2 9 9 7 3 1 5 | 70 60 | \bigwedge | | or-Prey E | volution | | 0.9 0.8 0.7 0.6 0.5 0.4 |
| 1 2 3 4 5 6 7 8 9 9 20 11 22 3 3 4 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 33.07577 36.7972 42.88392 50.25889 57.73907 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 0.44421 0.30120 0.2272 0.19974 0.20579 | 5 4 7 3 1 5 5 2 9 9 7 3 1 5 9 | 70 60 Aaud uotteindo 30 | \bigwedge | | or-Prey E | volution | | 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 |
| 11 22 33 44 45 56 67 78 89 99 200 21 22 23 24 25 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 33.07577 36.7972 42.88392 50.25889 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 0.44421 0.30120 0.2272 0.19974 0.20579 0.24359 | 5 4 7 3 1 5 5 2 9 9 7 3 1 5 9 9 4 | 70 60 As 50 40 40 a) 40 30 20 | \bigwedge | | or-Prey E | volution | | 0.9 0.8 0.7 0.6 0.5 0.4 0.3 |
| 11 22 33 44 55 66 77 88 99 90 20 21 22 23 24 25 26 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 | 57.5 63.825 67.65789 67.9032 63.91201 55.93735 45.89218 37.26336 32.87643 33.07577 36.7972 42.88392 50.25889 57.73907 63.99828 | 0.20 0.24164 0.3161 0.43852 0.61043 0.79978 0.91712 0.86282 0.65910 0.44421 0.30120 0.2272 0.19974 0.20579 0.24359 0.31958 | 5 4 7 3 1 5 5 2 9 7 3 1 5 9 9 4 7 | 70 60 AaJ 40 40 40 30 20 10 | | Predato | | | | 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.1 0 |
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