

Populations

AP Environmental Science ■ Unit 3

AP Environmental Science



Populations

What we will cover

- 1 Generalists and specialists
- 2 r - and K -selection
- 3 Survivorship curves
- 4 Carrying capacity
- 5 Age structure
- 6 Fertility and the transition



1 Strategies

Populations

Strategies

Generalists, specialists, r and K



r -selected: many young, fast recovery



K -selected: few young, slow recovery

r fills disturbed places; K stays near capacity.

2 Survivorship

Populations

Survivorship

Survivorship curves

A **survivorship curve** 存活曲线 shows the fraction alive at each age:

- **Type I:** die old (humans)
- **Type II:** steady rate (birds)
- **Type III:** die young (oysters)

Type III goes with r -selection; Type I with K -selection.



Human pop density

3 Carrying capacity

Populations
└ Carrying capacity

Carrying capacity

Carrying capacity 环境容纳量 K is the most an environment can support. Populations overshoot then die-off; limiting factors set K .

J-curve → S-curve; K itself shifts with the weather.



Carrying capacity limits wildlife populations

4 Age structure

Populations
└ Age structure

Age structure diagrams

The shape of an **age structure diagram** 年龄结构图 predicts the future:



Growing
wide base



Stable
straight sides



Declining
narrow base

A big **pre-reproductive** 繁殖前期 group guarantees growth even if births fall today (population momentum).

5 Fertility

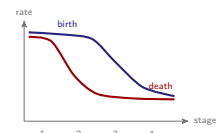
Populations
└ Fertility

Fertility and the demographic transition

Total fertility rate 总和生育率 (TFR) is children per woman.

- **replacement** 更替水平生育率 ≈ 2.1
- **doubling time** (rule of 70): $t = \frac{70}{r}$

As a country industrializes, deaths fall first, then births – the **demographic transition** 人口转变.



6 Recap

Populations
└ Recap

Worked example – the rule of 70

A country's population grows at 2% per year. Find its doubling time, and the growth rate that would halve it.

- Rule of 70: doubling time

$$= \frac{70}{\% \text{ growth rate}}$$
- $= \frac{70}{2} = 35 \text{ years}$
- To halve the doubling time to 17.5 years you would need $70/17.5 = 4\%$.
- Growth is exponential: a small rate change moves the doubling time a long way.

Doubling time $= 70/r$ works for *anything* growing exponentially – population, GDP, energy use. Put r in as a percent, not a decimal.

Populations
└ Recap

Unit 3 – key takeaways

1 Strategies

generalist vs specialist; r (many young) vs K (few)

2 Survivorship

Type I late death, II steady, III early death

3 Capacity

K ; overshoot then die-off; J-curve to S-curve

4 Human pop.

age structure shape; TFR ≈ 2.1 ; the transition

Populations
└ Recap

Check yourself

- 1 Is a panda a generalist or a specialist?
- 2 Which survivorship type fits an oyster?
- 3 What TFR keeps a population steady?
- 4 At $r = 2\%$, what is the doubling time?



Answers 1. specialist 2. Type III 3. about 2.1 4. $70/2 = 35$ years