FREE EDITION · NOTES + 3 SAMPLE MCQS

CUET · BIOLOGY · CLASS XII · CODE 304

# Organisms and Populations

CUET unit: Ecology and Environment → Organisms and Populations

By **UniDrill** · NCERT-grounded study material

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# 📌 Snapshot

- Defines ecology as the study of interactions among organisms and between organisms and their abiotic environment, structured at four levels: organisms, populations, communities, biomes.
- Introduces population attributes that individuals lack — birth/death rates (per capita), sex ratio, age distribution and age pyramids (expanding, stable, declining).
- Establishes population density (N) and its measurement options — total count, per cent cover, biomass, and indirect indices (pug marks, faecal pellets).
- Derives the two growth models that CUET repeatedly tests — exponential (dN/dt = rN; J-shaped) and Verhulst-Pearl logistic (dN/dt = rN[(K-N)/K]; sigmoid), anchored by the intrinsic rate of natural increase (r) and carrying capacity (K).
- Classifies interspecific interactions (mutualism, competition, predation, parasitism, commensalism, amensalism) using +/-/0 notation, with named NCERT examples (Pisaster, Balanus-Chathamalus, koel-crow brood parasitism, fig-wasp, sea anemone-clownfish).

# 📖 Detailed Notes

## 2.1 Core concepts

- **Ecology defined.** Ecology studies the interactions among organisms and between an organism and its physical (abiotic) environment. It is basically concerned with **four levels of biological organisation** — organisms, populations, communities and biomes — and this chapter explores ecology at the population level (NCERT §11 intro, p. 191).
- **Population defined.** In nature individuals rarely live alone; majority of them live in groups in a **well-defined geographical area, share or compete for similar resources, potentially interbreed**, and constitute a population. Even groups arising via asexual reproduction are treated as populations for ecological purposes. Cormorants in a wetland, rats in an abandoned dwelling, teakwood trees in a forest tract, bacteria in a culture plate and lotus plants in a pond are all examples. Selection operates at the population level, so population ecology links ecology to population genetics and evolution (NCERT §11.1.1, p. 191).

- **Population attributes.** An individual has births and deaths; a population has **birth rates and death rates** that are **per capita** — change in numbers with respect to members of the population. Example: 20 lotus plants gave 8 new plants this year, so the per-capita birth rate = 8/20 = **0.4 offspring per lotus per year**. In a lab population of 40 fruitflies, 4 died in a week → per-capita death rate = 4/40 = **0.1 per fruitfly per week**. Other population attributes: **sex ratio** (e.g. 60% females, 40% males) and **age distribution** (NCERT §11.1.1, p. 191).
- **Age pyramids.** When the per-cent of individuals of a given age/age group is plotted, the resulting structure is called an **age pyramid**. For human populations age pyramids show age distribution of males and females in a diagram. The shape indicates growth status — **(a) expanding (broad base), (b) stable (more rectangular), (c) declining (narrow base)** (NCERT §11.1.1, Fig. 11.1, p. 192).
- **Population density (N).** Population size (technically called **population density**, designated **N**) need not be measured in numbers only. It can be as low as **<10 Siberian cranes** at Bharatpur wetlands in any year or run into millions (Chlamydomonas in a pond). Total number is generally the most appropriate measure but can be meaningless or impossible — e.g. **200** Parthenium hysterophorus plants vs a single huge **banyan** tree where stating banyan density as 1 underestimates its role; here **per cent cover or biomass** is more meaningful. **Relative densities** (fish caught per trap) serve some purposes. Some populations must be estimated **indirectly** — the **tiger census** in national parks/tiger reserves is often based on **pug marks and faecal pellets** (NCERT §11.1.1, p. 192).
- **Four basic processes affecting density.** Density at time t+1 follows **N(t+1) = N(t) + [(B + I) − (D + E)]** where **natality (B)** = births, **immigration (I)** = individuals entering, **mortality (D)** = deaths, **emigration (E)** = individuals leaving. Under normal conditions **B and D dominate**, but in a newly-colonised habitat **immigration** may contribute more than birth rate (NCERT §11.1.2, p. 193, Fig. 11.2).
- **Exponential growth.** When resources (food and space) are unlimited, each species realises its innate potential to grow — Darwin's natural-selection observation. **dN/dt = (b − d) × N = rN**, where **r** = **intrinsic rate of natural increase**, a very important parameter for assessing impacts of any biotic or abiotic factor on population growth. The integral form is **N(t) = N(0) e^(rt)** producing a **J-shaped curve** (NCERT §11.1.2, p. 194, Fig. 11.3).
- **Sample r values. Norway rat r = 0.015**, **flour beetle r = 0.12**, **human population in India 1981, r = 0.0205** — NCERT explicitly asks students to find the current value using current birth and death rates (NCERT §11.1.2, p. 194).
- **Darwinian J-curve illustration.** NCERT narrates the chess-grain anecdote where wheat doubles on each square; by half-way the entire kingdom's wheat is inadequate — used to dramatize how fast even slow-growing organisms (elephant, Paramecium doubling daily) build up under unlimited resources (NCERT §11.1.2, p. 195).
- **Logistic (Verhulst-Pearl) growth.** No real population has unlimited resources; competition occurs and only the **'fittest' individual** survives and reproduces. A

given habitat has enough resources to support a maximum population beyond which no further growth is possible — this limit is the **carrying capacity (K)**. A population growing under limited resources shows a **lag phase** → **acceleration** → **deceleration** → **asymptote** at K, producing a **sigmoid curve** described by **$dN/dt = rN[(K - N)/K]$** — the **Verhulst-Pearl Logistic Growth**. Since resources for growth for most animal populations are finite and become limiting sooner or later, the logistic model is considered the **more realistic** one (NCERT §11.1.2, pp. 195–196, Fig. 11.3).

- **Life-history variation.** Populations evolve to maximise reproductive fitness (**Darwinian fitness — high r**) in the habitat in which they live. Under particular selection pressures, organisms evolve the most efficient reproductive strategy: **breed only once in a lifetime — Pacific salmon fish, bamboo**; or **many times — most birds and mammals**; **many small offspring — Oysters, pelagic fishes**; or **few large offspring — birds, mammals**. Life-history traits evolve in relation to constraints imposed by abiotic and biotic components of the habitat (NCERT §11.1.3, p. 196).
- **Population interactions exist always.** No natural habitat is inhabited by a single species; the minimal requirement is one more species on which it can feed; even plants need soil microbes and pollinators. Hence many interactive linkages exist even in minimal communities (NCERT §11.1.4 intro, p. 196).
- **Sign convention (Table 11.1, p. 197).** Interspecific interactions of two species use '+' (beneficial), '–' (detrimental), '0' (neutral). **Mutualism (+/+), Competition (−/−), Predation (+/−), Parasitism (+/−), Commensalism (+/0), Amensalism (−/0)**. Predation, parasitism and commensalism share a common characteristic — the interacting species live closely together.
- **Predation — roles.** Predators are nature's way of transferring to higher trophic levels the energy fixed by plants; herbivores (sparrow eating seeds, deer eating grass) are also predators in a broad ecological sense. Predators (i) act as conduits for energy transfer across trophic levels, (ii) keep prey populations under control, (iii) help maintain species diversity. **Invasive species** spread fast in the absence of their natural predators — **prickly pear cactus introduced into Australia in the early 1920s** caused havoc on millions of hectares of rangeland; it was brought under control only after a **cactus-feeding moth predator** was introduced. **Biological control** in agricultural pest management is based on this ability (NCERT §11.1.4(i), p. 197).
- **Pisaster experiment.** In rocky intertidal communities of the American Pacific Coast, the starfish Pisaster is an important predator. When all starfish were experimentally removed from an enclosed intertidal area, **more than 10 species of invertebrates became extinct within a year because of inter-specific competition** — showing predators reduce intensity of competition among competing prey species and thereby maintain diversity (NCERT §11.1.4(i), pp. 197–198).

- **Prey defences.** Predators are 'prudent' because over-exploitation drives the prey extinct. Prey have evolved defences: **cryptic colouration (camouflage)** in some insects and frogs; **chemical defence** — the **Monarch butterfly** is highly distasteful to predator birds because of a special chemical, **acquired during its caterpillar stage by feeding on a poisonous weed**. For plants, herbivores are the predators; **~25 per cent** of all insects are **phytophagous**. Plants evolved **thorns (**Acacia, Cactus) as morphological defence; chemical defences include the highly poisonous cardiac glycosides of Calotropis (no cattle/goats browse it), and the commercial plant chemicals **nicotine, caffeine, quinine, strychnine, opium** — all evolved as anti-herbivore defences (NCERT §11.1.4(i), p. 198).
- **Competition.** Darwin saw interspecific competition as a potent force in organic evolution. Competition is NOT restricted to closely-related species and need NOT require limiting resources — totally unrelated **flamingoes vs resident fishes** compete for **zooplankton in some South American lakes**; in **interference competition** the feeding efficiency of one species is reduced by the inhibitory presence of another even when food/space are abundant. Best definition: **a process in which the fitness (r) of one species is significantly lower in the presence of another species** (NCERT §11.1.4(ii), pp. 198–199).
- **Evidence for competition.** Lab evidence (Gause and others) is clear — competitively superior species eliminates the inferior; field evidence is "not always conclusive". Strong circumstantial cases: (a) **Abingdon tortoise (Galapagos) became extinct within a decade after goats were introduced**, apparently due to the greater browsing efficiency of goats; (b) **competitive release** — a species restricted to a small range expands its distribution dramatically when the competing superior species is experimentally removed; (c) **Connell's elegant field experiments** on rocky sea coasts of Scotland showed the **larger and competitively superior barnacle** Balanus dominates the intertidal area and excludes the smaller barnacle Chathamalus from that zone. **Herbivores and plants appear more adversely affected by competition than carnivores** (NCERT §11.1.4(ii), p. 199).
- **Competitive Exclusion Principle. Gause's principle** states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior will be eliminated eventually — true if resources are limiting. Recent studies suggest **co-existence rather than exclusion** is also possible via **resource partitioning** — **MacArthur** showed **five closely related warbler species** living on the same tree avoided competition by behavioural differences in foraging activities (timing/pattern) (NCERT §11.1.4(ii), p. 199).
- **Parasitism — evolution and adaptations.** Parasitism offers free lodging and meals, hence has evolved in many taxa from plants to higher vertebrates. Many parasites are **host-specific** — host and parasite tend to **co-evolve** (host evolves resistance, parasite counteracts). Adaptations include: **loss of unnecessary sense organs, presence of adhesive organs or suckers, loss of digestive system, high reproductive capacity**. Life cycles are complex with **intermediate hosts /**

**vectors** — the **human liver fluke** (a trematode) needs two intermediate hosts (a **snail and a fish**); the **malarial parasite** needs a **vector — mosquito** (NCERT §11.1.4(iii), pp. 199–200).

- **Effects on host & types.** Majority of parasites harm the host — reduce survival, growth, reproduction, density and make the host vulnerable to predation. **Ectoparasites** feed on the external surface — **lice on humans, ticks on dogs, marine copepods on fish,** Cuscuta (a parasitic plant on hedge plants that has **lost chlorophyll and leaves**). **Female mosquito** is not considered a parasite although it needs blood for reproduction. **Endoparasites** live inside the host (liver, kidney, lungs, RBCs); life cycles are more complex due to extreme specialisation; morphological/anatomical features are simplified while reproductive potential is emphasised (NCERT §11.1.4(iii), p. 200).
- **Brood parasitism.** A fascinating example in birds — the parasitic bird lays its eggs in the nest of its host and lets the host incubate them. Eggs of the parasitic bird have **co-evolved to resemble the host's eggs in size and colour** to reduce detection — observe the cuckoo (**koel**) and the **crow** during breeding season (spring–summer) (NCERT §11.1.4(iii), pp. 200–201).
- **Commensalism examples.** One benefits, the other neither harmed nor benefited: **(i) orchid as epiphyte on mango branch**; **(ii) barnacles growing on the back of a whale**; **(iii) cattle egret and grazing cattle** — the egret forages close to cattle because the cattle stir up insects that would otherwise be hard to catch; **(iv) sea anemone (with stinging tentacles) and clownfish** — the fish gets protection from predators, the anemone gets no apparent benefit (NCERT §11.1.4(iv), p. 201).
- **Mutualism examples.** Both species benefit. **Lichens** = intimate mutualism between a **fungus and photosynthesising algae or cyanobacteria**. **Mycorrhizae** = association between **fungi and the roots of higher plants** — fungi help nutrient absorption from soil; plant provides energy-yielding carbohydrates. Plant–animal relationships are spectacular — pollination and seed dispersal; plants offer **pollen and nectar** for pollinators and **juicy nutritious fruits** for seed dispersers; the system is safeguarded against 'cheaters'. Hence many plant–animal interactions involve **co-evolution** (NCERT §11.1.4(v), pp. 201–202).
- **Fig–wasp mutualism.** In many fig species there is a **tight one-to-one relationship** with the pollinator wasp species. The female wasp uses the fruit as an **oviposition site** and uses the developing seeds within the fruit for nourishing its larvae. The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites; in return for pollination, the fig offers some of its developing seeds as food for the developing wasp larvae (NCERT §11.1.4(v), p. 202, Fig. 11.4).
- Ophrys **— sexual deceit.** Not all orchids offer rewards. The Mediterranean orchid Ophrys employs **'sexual deceit' — one petal of its flower bears an uncanny resemblance to the female of a bee species in size, colour and markings**. The **male bee is attracted, 'pseudocopulates' with the flower** and is dusted with pollen; on pseudocopulating with another flower, it transfers the pollen and

pollinates. If the female bee's colour pattern changes during evolution, the orchid co-evolves to maintain the resemblance (NCERT §11.1.4(v), p. 202, Fig. 11.5).

## 2.2 Definitions to memorise

| Term | Definition | Page |
|---|---|---|
| Ecology | Study of interactions among organisms and between organism and physical (abiotic) environment | 191 |
| Population | Group of individuals of a species in a well-defined geographical area, sharing/competing for resources and potentially interbreeding | 191 |
| Birth rate (per capita) | Number of births per individual per unit time | 191 |
| Death rate (per capita) | Number of deaths per individual per unit time | 191 |
| Sex ratio | Per cent of males vs females in a population | 191 |
| Age distribution / age pyramid | Plot of percent individuals of given age groups; shape reveals growth status | 191–192 |
| Population density (N) | Population size in a habitat, expressed as numbers, per cent cover, biomass, relative or indirect indices | 192 |
| Natality (B) | Number of births in a given period added to initial density | 193 |
| Mortality (D) | Number of deaths in the period | 193 |
| Immigration (I) | Same-species individuals entering the habitat in the period | 193 |
| Emigration (E) | Individuals leaving the habitat in the period | 193 |
| Intrinsic rate of natural increase (r) | (b – d); per-capita growth potential of a population | 194 |
| Carrying capacity (K) | Maximum population size a habitat can support | 195 |
| Exponential growth | $dN/dt = rN$; J-shaped curve when resources are unlimited | 194 |
| Logistic (Verhulst-Pearl) growth | $dN/dt = rN[(K - N)/K]$; sigmoid curve when resources are limiting | 195 |
| Darwinian fitness | Reproductive fitness (high r) in the habitat in which species lives | 196 |
| Mutualism | Both species benefit (+/+) | 197 |
| Competition | Both species harmed (–/–); r of one significantly lower in presence of the other | 197, 199 |
| Predation | Predator benefits, prey harmed (+/–) | 197 |
| Parasitism | Parasite benefits, host harmed (+/–); intimate, host-specific, co-evolved | 197, 199 |
| Commensalism | One benefits, other neither benefits nor is harmed (+/0) | 197 |
| Amensalism | One harmed, other unaffected (–/0) | 197 |

| Term | Definition | Page |
|---|---|---|
| Brood parasitism | Parasitic bird lays eggs in host's nest; host incubates them (e.g. koel–crow) | 200–201 |
| Ectoparasite | Parasite on external surface of host (lice, ticks, Cuscuta) | 200 |
| Endoparasite | Parasite living inside host body (liver flukes etc.) | 200 |
| Competitive Exclusion Principle | Gause — two closely related species competing for the same limiting resource cannot coexist indefinitely | 199 |
| Resource partitioning | Co-existence mechanism via differing feeding times/ patterns (MacArthur's warblers) | 199 |
| Camouflage | Cryptic colouration by prey to avoid detection | 198 |
| Co-evolution | Tightly linked evolution of two interacting species (fig-wasp, Ophrys-bee) | 202 |

## 2.3 Diagrams / processes to remember

- **Figure 11.1, p. 192 — Age pyramids for human population.** Three pyramids labelled left-to-right: **Expanding** (broad base, narrow top), **Stable** (more rectangular columns), **Declining** (narrow base, wide top). Three horizontal age strata stacked: **Pre-reproductive** (bottom), **Reproductive** (middle), **Post-reproductive** (top). Each pyramid splits males and females.
- **Figure 11.2, p. 193 — Population density flow.** Central oval **Population Density (N)** with arrows: Natality (B) and Immigration (I) flow in (+); Mortality (D) and Emigration (E) flow out (–). Embodies **$N(t+1) = N(t) + [(B + I) - (D + E)]$**.
- **Figure 11.3, p. 194 — Growth curves.** Same axes (population density N vs time t). **Curve (a)** — exponential, **$dN/dt = rN$**, J-shaped, unrestricted. **Curve (b)** — logistic, **$dN/dt = rN[(K - N)/K]$**, sigmoid with lag → acceleration → deceleration → asymptote at horizontal dashed line K (carrying capacity).
- **Table 11.1, p. 197 — Six interspecific interactions.** Species A/B sign columns: Mutualism +/+; Competition –/–; Predation +/–; Parasitism +/–; Commensalism +/0; Amensalism –/0.
- **Figure 11.4, p. 201 — Fig–wasp mutualism.** Two panels: (a) Fig flower pollinated by wasp; (b) Wasp laying eggs in a fig fruit (oviposition). Reinforces one-to-one mutualism.
- **Figure 11.5, p. 202 —** Ophrys **+ bee.** Single photograph of bee acting as a pollinator on an orchid flower; petal mimics female bee shape/colour → pseudocopulation → pollen transfer.

## 2.4 Common confusions / NTA trap points

- **Predation vs parasitism** share the (+/–) sign in Table 11.1; distinguish by **closeness/duration of association** — parasites live in/on the host; predators do not.
- **dN/dt = rN does NOT contain K.** Only the logistic equation **dN/dt = rN[(K − N)/K]** does. NTA frequently swaps these.
- **"Intrinsic rate of natural increase" is r = b − d** (per-capita birth minus per-capita death), NOT total births minus total deaths.
- **Commensalism (+/0) vs Amensalism (−/0)** — easy to mix up; the sign on the affected partner flips.
- **Koel–crow** is **brood parasitism** (a form of parasitism), NOT commensalism or mutualism — a recurring distractor.
- In Connell's experiment, Balanus is the dominant (larger, superior) species; Chathamalus is excluded — students sometimes reverse the two.
- The **fig–wasp** system is mutualism even though wasp larvae eat some developing seeds — both partners benefit overall; do not call it parasitism.
- **Female mosquito is NOT a parasite** despite needing blood for reproduction — explicit NCERT statement.
- Cuscuta has **lost chlorophyll and leaves** during evolution — it is an ectoparasitic plant; the **whole plant** is parasitic, not the seeds.
- **K vs r confusion** — K is the **upper limit** (carrying capacity) of population size; r is the **per-capita growth rate**.
- **Logistic curve phases** — lag, acceleration, deceleration, asymptote (4 phases) — NCERT does not call it "log phase, stationary phase" (avoid microbial culture terminology).
- **Monarch butterfly's poison** is acquired during the **caterpillar stage by feeding on a poisonous weed**, not synthesised by the butterfly.

## 2.5 Key processes / classifications

| # | Item | NCERT example | Category / Mechanism | Page |
|---|---|---|---|---|
| 1 | Population (vertebrate) | Cormorants in a wetland | Group of conspecifics sharing area | 191 |
| 2 | Population (mammal) | Rats in an abandoned dwelling | Group of conspecifics | 191 |
| 3 | Population (plant) | Teakwood trees in a forest tract | Group of conspecifics | 191 |
| 4 | Population (microbe) | Bacteria on a culture plate | Asexual but treated as population | 191 |

| # | Item | NCERT example | Category / Mechanism | Page |
|---|---|---|---|---|
| 5 | Per-capita birth rate | 8 lotus added to 20 = 0.4/lotus/year | Birth rate calculation | 191 |
| 6 | Per-capita death rate | 4 of 40 fruitflies = 0.1/fruitfly/week | Death rate calculation | 191 |
| 7 | Sparse population | <10 Siberian cranes at Bharatpur | Low density example | 192 |
| 8 | Dense population | Chlamydomonas in millions in a pond | High density example | 192 |
| 9 | Indirect census | Tigers via pug marks & faecal pellets | Indirect density measurement | 192 |
| 10 | Per-cent cover/biomass | 200 Parthenium vs 1 banyan | Density by cover | 192 |
| 11 | Sample r value | Norway rat r = 0.015 | Slow intrinsic increase | 194 |
| 12 | Sample r value | Flour beetle r = 0.12 | Fast intrinsic increase | 194 |
| 13 | Sample r value | India human population 1981, r = 0.0205 | Demographic r | 194 |
| 14 | Single-time breeders | Pacific salmon, bamboo | Life-history strategy | 196 |
| 15 | Repeat breeders | Most birds and mammals | Life-history strategy | 196 |
| 16 | Many small offspring | Oysters, pelagic fishes | r-style strategy | 196 |
| 17 | Few large offspring | Birds, mammals | K-style strategy | 196 |
| 18 | Mutualism — lichen | Fungus + alga/cyanobacterium | +/+ | 201 |
| 19 | Mutualism — mycorrhizae | Fungus + plant roots | +/+ | 201 |
| 20 | Mutualism — fig–wasp | One-to-one species | Co-evolution | 202 |
| 21 | Mutualism — Ophrys | Orchid–bee sexual deceit | Pseudocopulation, co-evolution | 202 |
| 22 | Predation | Pisaster on intertidal invertebrates | Maintains diversity | 197 |
| 23 | Predation — invasive control | Cactus-feeding moth on prickly pear in Australia | Biological control | 197 |
| 24 | Plant defence — morphological | Thorns of Acacia, Cactus | Anti-herbivore | 198 |
| 25 | Plant defence — chemical | | Anti-herbivore | 198 |

| # | Item | NCERT example | Category / Mechanism | Page |
|---|---|---|---|---|
| | | Cardiac glycosides of Calotropis; nicotine, caffeine, quinine, strychnine, opium | | |
| 26 | Competition — invasive vs native | Galapagos goats vs Abingdon tortoise | Extinction of native | 199 |
| 27 | Competition — Connell | Balanus excludes Chathamalus | Intertidal exclusion | 199 |
| 28 | Resource partitioning | MacArthur's 5 warbler species on same tree | Co-existence | 199 |
| 29 | Parasitism — endoparasite | Human liver fluke (snail + fish hosts) | Complex life cycle | 200 |
| 30 | Parasitism — vector | Malarial parasite via mosquito | Vector-borne | 200 |
| 31 | Ectoparasite | Lice (humans), ticks (dogs), copepods (marine fish), Cuscuta | External | 200 |
| 32 | Brood parasitism | Koel laying eggs in crow's nest | Co-evolved egg mimicry | 200–201 |
| 33 | Commensalism | Orchid epiphyte on mango branch | +/0 | 201 |
| 34 | Commensalism | Barnacles on whale | +/0 | 201 |
| 35 | Commensalism | Cattle egret + grazing cattle | +/0 | 201 |
| 36 | Commensalism | Clownfish + sea anemone | +/0 | 201 |

## 🎯 Practice MCQs

**Q1. Which of the following is an attribute of a population but NOT of an individual organism?**

**A.** Birth and death

**B.** Sex

**C.** Age

**D.** Sex ratio

**Q2.** A population of 40 fruitflies kept in the laboratory loses 4 individuals in one week. The death rate per fruitfly per week is

**A.** 0.04

**B.** 0.10

**C.** 0.40

**D.** 4.00

**Q3.** In the rocky intertidal communities of the American Pacific Coast, removal of the starfish *Pisaster* led to

**A.** Extinction of more than 10 invertebrate species within a year due to interspecific competition

**B.** Population explosion of *Pisaster*'s prey followed by ecosystem recovery

**C.** Replacement of *Pisaster* by another predator within a year

**D.** An increase in species diversity due to release from predation



## 📊 PYQ Alignment

Organisms and Populations is one of the highest-yield chapters in CUET Biology — historically contributing 8–12 MCQs per year across CUET 2023–25, with strong emphasis on (i) numerical questions on exponential and logistic growth (dN/dt = rN and the Verhulst-Pearl equation), (ii) sign-convention matching for the six interspecific interactions, (iii) named NCERT examples (Pisaster, Balanus-Chathamalus, koel-crow, Ophrys, fig-wasp, lichens, mycorrhizae) and (iv) assertion-reason items on carrying capacity, intrinsic rate of natural increase, and age pyramid shapes.

### CUET 2025 — Actual PYQs from this chapter

**Q.24 (CUET 2025)** If individuals in reproductive age group exceed pre-reproductive group, population growth is:

- A) Expanding
- B) Stable
- C) Declining

- D) [option not extracted — see source]

Tests: aligns with §2 (organisms & populations) Answer: Not in extracted key — verify against official NTA key

## CUET 2024 — Actual PYQs from this chapter

**Q.34 (CUET 2024)** Match interspecies relationships with features. Commensalism, Mutualism, Amensalism, Parasitism.

- A) [option not extracted — see source]
- B) [option not extracted — see source]
- C) [option not extracted — see source]
- D) [option not extracted — see source]

Tests: aligns with §2 (organisms & populations) Answer: Not in extracted key — verify against official NTA key

**Q.36 (CUET 2024)** Two species coexist by violating competitive exclusion principle through:

- A) Eliminating inferior species
- B) Resource partitioning
- C) Symbiosis
- D) Changing grazing area

Tests: aligns with §2 (organisms & populations) Answer: Not in extracted key — verify against official NTA key

## CUET 2023 — Actual PYQs from this chapter

**Q.33 (CUET 2023)** Out of the following plants, which is not browsed by cattle?

- A) Wheat
- B) Cowpea
- C) Sugarcane
- D) Calotropis

Tests: aligns with §2 (organisms & populations) Answer: Not in extracted key — verify against official NTA key

**Q.34 (CUET 2023)** Fresh water animals cannot live long in sea water because of:

- A) Temperature variations
- B) Tidal waves
- C) Predators
- D) Osmotic problems

Tests: aligns with §2 (organisms & populations) Answer: Not in extracted key — verify against official NTA key