



ANSWER BOOK

Managing ecosystems sustainably

Ecology, populations and environmental change · Unit B20

OCR A 6.3.2 · Edexcel A 5.22 · Edexcel B 10.4 i, 10.4 iii

14 questions · 49 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

- A1** **B1** a sustainable yield is the amount that can be harvested from a population [2]
MES-Q15 in a given period without reducing the size of that population, so the same harvest can be taken again. **B1** the maximum sustainable yield is the largest such harvest available from the population, which in the simple logistic model occurs at about half the carrying capacity.
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SECTION B · Standard, 3 to 5 marks

- B1** **B1** for: a very large population is far from extinction, and taking very little from it [5]
MES-Q9 clearly avoids the collapse that a much smaller population close to zero would risk. **B1** for: the half-capacity maximum is a model's figure, and the carrying capacity is estimated rather than measured and varies from year to year, so a stock kept large and fished lightly is protected against an overestimate or a poor breeding year, which is why managers set limits below the modelled maximum. **B1** against: in the simple logistic model, net population growth, and so the largest catch that can be taken and replaced, is greatest at about half the carrying capacity rather than at the carrying capacity itself. **B1** against: at the carrying capacity itself, births and deaths are equal and net growth is zero, so a population left at its largest possible size actually produces no surplus at all to harvest sustainably. **B1** judgement: the claim confuses population size with sustainable yield; the largest repeatable catch comes from holding the stock at about half its carrying capacity, not from leaving it as large as possible, though the stock must still be kept well clear of the very low levels where recruitment collapses.
- B2** **B1** the trees are cut down to a stump close to the ground, called a stool, and [4]
MES-Q1 many new shoots grow from it, supplied by the established root system. **B1** the wood is divided into compartments and one compartment is cut each year, on a rotation of roughly seven to twenty years. **B1** after a full rotation the first compartment has regrown and is cut again, so the yield and the standing crop of the wood stay the same year after year. **B1** at any moment the wood contains compartments at every stage of regrowth, from open sunlit ground to shaded older growth, so habitat diversity and species diversity are both higher than in an unmanaged or clear-felled wood.
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- B3** **B1** in support: farmed fish are enclosed, so nothing is taken from the wild stock to supply them to consumers, no unwanted species are caught by accident and the sea bed is not damaged as it is by trawling. **B1** against: carnivorous farmed species such as salmon are fed on fishmeal made from wild-caught fish, so the pressure on wild stocks is moved rather than removed. **B1** against: dense stocking spreads parasites such as sea lice and diseases to wild fish passing the cages, uneaten food and faeces enrich the water beneath them, and escaped farmed fish interbreed with wild ones and dilute their local adaptations. **B1** a judgement: aquaculture reduces pressure on the stocks used directly for food, but it is only a net gain where the species farmed is not fed on wild fish and where waste, disease and escapes are controlled. [4]
MES-Q2
- B4** **B1** for: the stock is declining, so the present catch is above the sustainable yield, and every year that continues the population falls further and the same quota takes a larger share of it. **B1** for: allowing the biomass to climb back towards half the carrying capacity raises the sustainable yield itself, so the long-term catch is larger than it would otherwise be. **B1** against: the loss of income and of jobs falls on the fishing communities immediately, while the benefit arrives years later and may be taken by somebody else, and stock estimates carry real uncertainty. **B1** a judgement: the cut is justified because a collapse costs every job permanently, as at the Grand Banks, but it should come with support during the recovery and with the fleet involved in setting and policing the rules, or it will not hold. [4]
MES-Q3
- B5** **B1** selective felling identifies individual mature trees and removes them, leaving the canopy and the structure of the forest around them standing, whereas clear felling takes every tree in an area at one time. **B1** under selective felling the soil stays covered and held by the roots of the trees left behind, so it is not eroded or leached, whereas a clear-felled area is left bare and loses soil and mineral ions. **B1** the forest goes on fixing carbon and remains a habitat under selective felling, and the gaps are filled by seed from the trees around them, whereas clear felling removes the habitat and the carbon fixation together and the area has to be replanted. **B1** clear felling yields far more timber per hectare per visit and costs less per tree extracted, whereas selective felling yields less and costs more, which is why it is not used everywhere. [4]
MES-Q7
- B6** **B1** nothing is removed inside the zone, so individuals survive to spawn more than once and the biomass inside climbs back towards the carrying capacity. **B1** a large old female produces far more eggs than a small one, so a recovered stock releases eggs and larvae out of all proportion to the area of the zone, and those larvae drift out into the water that is fished. **B1** as the density inside rises, adults and juveniles move out across the boundary, so the fished stock outside is supplied from inside and catches near the boundary rise. **B1** it may fail if the zone is smaller than the area a fish moves over, if it is not policed, or if the same fleet simply fishes the water that is left open, so the same total is taken from a smaller area. [4]
MES-Q8

- B7** MES-Q10 **B1** for a strict ban: the forest is protected in full only if no logging happens at all, since any legal cutting sets a precedent that is hard to police or to limit once it is allowed. **B1** against a strict ban with no alternative: rules that remove a community's only cash income without support are poorly complied with, since the people enforcing the ban do not depend on the resource while the people who do have every reason to keep logging. **B1** an alternative: successful schemes usually involve local people in setting the rules, give them a share of the benefit, for example from licensed harvesting, tourism or payment for managing the land, and keep the rules simple enough to be checked. **B1** judgement: a ban imposed without local involvement or an alternative income is likely to be broken or resented, so a managed, locally-involved scheme is more likely to protect the reserve in the long run than an unsupported ban, even though it permits some harvesting. [4]
- B8** MES-Q4 **B1** at the carrying capacity births and deaths are equal, so the population adds nothing each year and there is no surplus to harvest. **B1** at a very low population size there are too few individuals reproducing, so the number added each year is also small. **B1** at about half the carrying capacity the population is on the steepest part of the sigmoid curve, with many reproducing individuals and resources not yet limiting, so it adds the greatest number each year and that surplus is the largest catch that can be replaced. [3]
- B9** MES-Q5 **B1** a larger mesh allows smaller, immature fish to escape from the net. **B1** those fish survive to reach reproductive age and breed at least once before they can be caught, so recruitment to the stock continues. **B1** a closed season prevents adults from being taken while they are spawning, so the eggs are laid before any of those fish are removed from the population. [3]
- B10** MES-Q11 **B1** pollarding is the same cutting operation as coppicing, encouraging new shoots to grow from the cut, but carried out about two metres above ground rather than at ground level. **B1** the new shoots then grow out at that height, above the reach of grazing animals such as deer, cattle or sheep. **B1** a stool cut near the ground would have its new shoots eaten as they grew, so pollarding is used instead wherever the wood cannot be fenced against grazing. [3]
- B11** MES-Q12 **B1** the total allowable catch is set from a survey estimate of the stock, and if that estimate is wrong the quota set from it may be higher than the stock can actually sustain. **B1** fish caught in excess of a boat's quota are often thrown back dead rather than landed, unless a landing obligation applies, so fish are still removed from the stock without being limited by the quota. **B1** a quota limits the total mass taken but does nothing about which fish are taken, so young, immature fish can still be caught and removed before they have had a chance to breed even once. [3]

B12 **B1** capping days at sea, engine power or the number of licensed boats is [3]
MES-Q13 intended to limit how much fishing pressure is applied to the stock, on the assumption that less time or fewer boats fishing means a smaller catch. **B1** boats become more efficient over time, for example through better sonar or larger nets, so the same nominal effort, the same number of days or boats, is able to catch more fish than before. **B1** if efficiency rises fast enough, a capped effort can still take a catch above the sustainable yield, so limiting effort alone does not guarantee the limit on catch that was intended.

B13 **B1** at high density each tree competes intensely with its close neighbours for [3]
MES-Q14 light, water and nutrients, so individual trees grow more slowly and the plantation produces many thin poles rather than fewer thick trunks. **B1** timber production usually requires fewer, thicker trunks rather than many thin poles, so an unthinned plantation yields a lower-value crop even though the total number of trees standing is high. **B1** thinning removes some trees, usually the smaller or poorer ones, reducing competition and letting the remaining trees grow larger and thicker, giving a more valuable crop by the time of felling.

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