

Markscheme

November 2019

Environmental systems and societies

Standard level

Paper 1

8 pages

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Subject details: Environmental systems and societies SLP1 markscheme**Mark allocation**

Candidates are required to answer **ALL** questions. Total = **[35]**.

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

1. (a) estuary/tropical rainforest; [1]
- (b) depth of water / shallow water is warmer / shallow water is easier to warm up / deep water is cooler;
 position in relation to land / distance from land;
 latitude / distance from equator / northern areas are cooler / southern areas are warmer;
 cold ocean currents (Labrador) coming down from the north and warm ocean currents (Gulf Stream) coming up from the south; [1 max]

Do not accept 'climate change / global warming / variation in climate / salinity / temperature'.

- (c) there are few major estuaries in the world;
 they do not cover much of the Earth's surface;
 estuaries have quite a small surface area;
 they represent a small proportion of the world's ecosystems; [1 max]
- (d) mix of saline and fresh water so different habitats, therefore more biodiversity, (therefore more productivity);
 zonation/range of temperature/salinity results in greater habitat diversity (therefore higher productivity);
 shallow water, so warmer and receive more light and therefore more productive (primary productivity);
 tides/river systems/upwellings bring in nutrients that give rise to phytoplankton blooms/primary productivity;
 mineral/nutrient run-off from surrounding agricultural land / nutrient run-off from surrounding watershed into the estuary;
 water levels rise and fall, exposing mud flats, which are a food source for shore birds (secondary productivity);
 migratory birds and whales stop here to feed, temporarily raising the secondary productivity; [3 max]

*Do not accept only 'high biodiversity'.
 Do not accept only 'large/complex food webs'.*

2. (a) phytoplankton → zooplankton → crabs → halibut → beluga whale;
 phytoplankton → zooplankton → shrimp → cod → beluga whale;
 phytoplankton → zooplankton → squid → cod → beluga whale; [1 max]

*Response should indicate the flow of energy from phytoplankton to beluga whale (e.g. using arrows in the correct direction or words indicating what is eating what).
 For beluga whale accept either beluga or whale.
 Do not accept a food chain that includes sun/light.*

- (b) 1920: accept 6000–6300;
 1940: 2000; [1 max]

Both responses required for [1].

(c) $\left(\frac{(6000 - 2000)}{6000} \times 100 = \right) 66.7\% / 67\% ;$

$\left(\frac{(6300 - 2000)}{6300} \times 100 = \right) 68.2\% / 68\% ;$

[1 max]

*Accept answers between 66.67% and 68.25%. Also accept 66.6 recurring.
Accept answers between -66.67% and -68.25% (as it is a percentage decrease).
Units are not required.*

Only the final answer is required for [1].

Do not accept 66%/66.6% (incorrect rounding).

- (d) these are persistent toxins that build up in the fatty tissues (and beluga whales have 40–50% body fat);
they are at the top of the food chain (biomagnification along the food chain);
bioaccumulation over a long life span;
increasing concentration of pollutants (bioaccumulation) within the species consumed by the whale;
persistent pollutants accumulate along the food chain due to decrease of biomass and energy;
eat benthic feeders, which assimilate toxins by scavenging corpses of marine organisms;

[3 max]

Do not accept just the terms 'biomagnification/bioaccumulation'.

- (e) isolation is leading to genetic diversity loss and lowered resistance to disease;
small population size may affect reproductive rate / low genetic diversity may affect the reproductive rate;
slow development / late to reach sexual maturity / produce only a low number of offspring;
pollutants bioaccumulating in fatty tissues interfere with successful reproduction;
high levels of pollutants still found in their habitat, impacting their ability to reproduce effectively / industrial effluent discharges may kill/harm whales /
pollutants could adversely affect food supply of the whale;
shipping causes separation of mother from calf (increasing number of calf deaths);
ships/human activities produce noise that interferes with feeding behaviour/reproduction in whales;
water temperatures rising, moving outside tolerance of beluga whale food source, reducing food availability;
invasive species may reduce food available for beluga whale;
despite being protected, may get caught in commercial fishing nets and drown;
may be killed in collisions with boats, as the St Lawrence River is an important shipping route;
commercial fishing removing food source / competition for food with commercial fisheries;
there may be illegal hunting of beluga whales;

[4 max]

Do not accept only 'threat of pollution / hunting / due to sport fishing / K-selected species and therefore slow to recover'.

3. (a) frequent egg laying (3 times per year);
many eggs laid at one time (5000);
young fish grow quickly / early maturity; [1 max]

- (b) *Positive [2 max]:*
provide additional food source for native fish (e.g. yellow perch);
eat other invasive species, such as the zebra mussel;

Negative [2 max]:

increased competition for food, outcompeting native fish;
outcompetes the native mottle sculpin for the best egg-laying sites;
outcompetes native species which may become extinct;
eat other fish eggs, reducing populations/biodiversity;
introduce disease, reducing populations/biodiversity; [3 max]

Accept any other reasonable response.

Do not accept only 'outcompetes native species', for credit must be linked to competition for food, egg laying sites or species extinction.

Do not accept 'aggressively takes the habitat of native species'.

- (c) resources declined due to competition with round goby;
competition for/loss of nesting sites;
loss of food resources due to additional competition;
realized niche has changed because of impacts of climate change affecting temperature; [3]

4. (a) 120 000 (units/100 ml); [1]

Units are not required.

- (b) eutrophication / algal bloom;
... due to high levels of nitrates and phosphates/nutrients;
hypoxic conditions;
... due to high oxygen demand;
rotten egg smell / production of hydrogen sulphide;
... due to anaerobic decomposition;
increase in micro-organisms/pathogens within shellfish;
... due to pathogens being filtered out of the water;
ill health in people / increase in waterborne disease;
...eating shellfish/fish contaminated with pathogens/bacteria (from sewage);
...from swimming in water contaminated with pathogens/bacteria (from sewage);
...drinking water contaminated with pathogens/bacteria;
death/loss of benthic species
... due to particulates blocking feeding/respiratory systems;
decrease in photosynthesis;
... due to increase in turbidity (reducing light penetration); [2 max]

Accept any other reasonable response. Answer must have the named problem and the associated outline for both marks.

Do not accept 'thermal pollution/increase in temperature'.

Do not accept just 'loss of biodiversity / water unsuitable for human use'.

- (c) can use indirect or direct measures of pollution;
direct measurements of dissolved oxygen using a probe / light and dark bottle method to measure BOD / direct counts of coliform units using microscopes / Secchi disc to monitor turbidity / titration to measure changes in nitrates/phosphates;
freshwater invertebrates can be used as indicator species;
compare with historic data / take measurements before the release of the untreated sewage (for 'normal' measurements);
take measurements along the length of the river, from the point source downstream (to determine area impacted);
take measurements over a period of time, to observe changes in water quality; **[3 max]**

5. *pro-sustainable actions [4 max]*

beluga whales have protected status (environmental sustainability) / management has stopped hunting of beluga whales to ensure sustainability in the area;
protected marine areas will ensure nursery areas for continued commercial fishing (environmental/economic sustainability);
protected areas can help to conserve species/biodiversity;
government is working to mitigate damage caused by shipping (reducing ship speed to avoid hitting whales) during migratory season of the right whale (environmental sustainability);
aquaculture development can reduce pressure on wild catch (environmental sustainability);
money/income from oil fields could lead to economic sustainability;
improvements in technology reduces the risk of future spills (environmental sustainability);
whale watching brings in money to local communities (economic sustainability) / activities such as whale watching encourages conservation of species/biodiversity;
commercial fishing can be sustainable with use of quotas/limitations on catch times/ changes to net size to reduce bycatch (environmental sustainability);
sewage treatment from cities is in place, reducing nutrient/organic/pathogen loading in water (environmental sustainability);
government has promised \$197 million into aquatic research which may lead to increased sustainable management/policies;
government has promised to protect 10 % of Canada's coastline from fishing and drilling which could protect critical habitats/species;

non-sustainable actions [4 max]

shipping lanes go through the marine reserve in the St Lawrence River estuary, disturbing beluga/right whales;
shipping brings in invasive species which are changing the ecology of the region;
the protected areas are small and do not correspond with habitat of critically endangered right whales / protected areas do not cover entire range of beluga whales;
beluga numbers have not increased/right whales are being found dead as there is an ongoing problem/management is not effective;
contaminants from aquaculture can cause algal blooms;
species may escape from aquaculture that could adversely affect native species e.g. create competition for resources/reduce genetic diversity/transfer disease to wild populations;
whale watching can interfere/disturb organisms;
release of untreated sewage in the past has adversely affected some species/water uses / there is lack of government management in controlling discharge of untreated sewage / many people do not have access to sewage treatment resulting in the release of untreated wastewater into waterways;

government has proposed sites for oil and gas exploration/drilling which could adversely affect some species/biodiversity;
an oil spill would irreparably harm the organisms within the protected area;
use of non-renewable natural capital/fossil fuels is unsustainable due to their combustion/use resulting in release of carbon dioxide/GHGs/contributing to climate change;
mean temperatures in the Gulf are rising due to global warming;
there is a lack of strategies to deal with the impacts of climate change/global warming on the fishing industry;
no policies in place to manage pollution of POPs/microplastics/heavy metals / release of pollutants such as POPs/heavy metals is harming some species;
rate of commercial fishing which is greater than the growth rate of the fish is not sustainable / depletion of fish stocks by overfishing is not sustainable;
uncontrolled/poorly managed sport fishing could result in the reduction of some species/biodiversity;

Award [5 max] for both sustainable and non-sustainable actions.

Conclusion [1 max]

*A valid conclusion should be credited if it is explicit, balanced (addresses both sides of the argument), supported by evidence and makes a clear value judgement.
Do not credit the conclusion if only one side of the argument has been considered within the overall response*

[6 max].