MARINE SCIENCE

Paper 9693/01
AS Structured Questions

General comments

It is pleasing to be able to report the slight improvement in the overall performance of candidates in this component of the examination.

Candidates in general performed slightly better on those questions requiring interpretation and application and in types of questions requiring suggestions to interpret information given than factual knowledge.

The lack of knowledge of some basic aspects of the syllabus such as ocean layer formation and carbon dating is of some concern.

Comments on specific questions

Question 1

(a) (i) While most candidates appreciated that the original source of the energy was sunlight a not insignificant number gave phytoplankton as a response.

(ii) Most candidates were able to name the process that captures the energy as photosynthesis. However, for some candidates this was often the only mark gained.

More able candidates gave a clear and precise description of photosynthesis. This included reference to carbon dioxide and water as the raw materials and glucose and oxygen as the end products.

A further mark was available for those candidates who appreciated that light energy is captured by chlorophyll although general references to chloroplasts were not sufficient for credit.

The most common type of error seen in candidate's scripts came from those who misinterpreted the question and gave detailed descriptions of the transfer of energy through the food web detailing the energy loss at each stage.

(b) (i) This part of the question was very well answered and most candidates were able to select a food chain with five organisms.

(ii) This section of the question was also well answered.

(c) This part of the question elicited a wide variety of response and answers varied from the clear and precise to the very muddled and inaccurate.

Many candidates realised that the layer of ice would restrict the amount of light reaching the phytoplankton and thus reduce their population. These candidates also appreciated the consequent reduction in the krill population would lead to a lack of food for the fin whales leading to a decrease in their population.

Some candidates were clearly aware of the effects of the lack of light but failed to give any detail in their responses and answers along the lines of 'there will be less light and this will make the food web less productive' were not uncommon but not worthy of credit.

(d) This part of the question mainly generated answers of two types. Those which w concise and referred to bacteria as decomposers which act on dead organisms or orga and release nutrients which are used by the phytoplankton. Other types of answer usually one of three types;

1. describing the role of the bacteria as food for the phytoplankton;
2. describing bacteria as having a symbiotic relationship with some of the organisms;
3. describing the bacteria as pathogens and their effect on the organisms in the food web.

Question 2

(a) While many candidates were able to describe an ocean current as a movement of sea water, fewer referred to the directional or continuous aspect which should have been included in their explanation.

(b) Most candidates were aware that wind is the primary factor in the formation of surface ocean currents. There were few references to gravity as a factor. There were, however, numerous references to factors influencing the direction of currents rather than their formation.

(c) This part of the question was not answered well and many responses were effectively extended rewordings of the question.

While references to salinity and temperature were common, attempts to link these to the formation of deep ocean layers were generally poor.

Credit was given for a correct reference to the positions of temperature or salinity layers within the ocean but few candidates gained a mark for explaining how these layers were formed.

A considerable number of candidates were under the impression that salinity decreases with depth.

Occasionally, references to changes in density were seen but these were uncommon.

(d) This part of the question generated better responses than the previous part and many candidates had a good appreciation of the concept of *upwellings*.

Good explanations included references to upward movement of cold water bringing nutrients to the surface layers. Few answers referred to the role of wind in upwelling.

Question 3

(a) This part of the question was quite well answered and most candidates were able to give a good explanation of shoaling.

(b) This part was also quite well answered and most candidates gained at least three of the five marks available.

Most often, the marks were gained for valid references to protection from predation and further detail of how shoaling was of value in this respect.

References to the reproductive value of shoaling were much less common among candidates' answers.

Question 4

(a) The action of waves or strong current or storms were the most frequently quoted examples for a factor contributing to erosion of coral. There were a number of rather imprecise answers such as 'tourism' and 'fishing' and without further explanation these were not deemed worthy of credit.

(b) (i) The relatively simple mathematical calculation required in this part of the question seemed to be beyond the ability of many candidates with more than half the candidates failing to give the correct answer of 25%. An answer of 3%, (arrived at by deducting 9 from 12) was the most common incorrect response.

(ii) This part of the question was well answered by many candidates but there were number of incorrect responses.

Candidates were expected to deduce that Reef A was experiencing the greatest rate of e and to explain this in terms of the rate of increase in bare rock, rubble or sand or the rat decrease of soft corals, massive corals on that reef. Creditworthy responses also included correc reference to the actual figures in the table used to substantiate the candidate's answer.

Poor answers often simply referred to changes in the materials without an attempt to draw comparisons between the two reefs.

Answers such as 'soft coral goes down on reef A' without comparison to reef B failed to answer the question and did not gain any credit.

(c) This part of the question was very poorly answered and there were very few candidates who gained one or two of the five available marks.

These marks were usually credited for a correct reference to a radioactive isotope of carbon and its half-life.

Other points from the mark scheme were rarely seen.

Question 5

(a) This part of the question was well answered and most candidates were able to observe three differences between normal and El Niño conditions as shown in the diagram.

There were, however, references to differences that could not be seen in the diagram. Of these 'warmer seas during El Niño' was the most common.

(b) Most candidates appreciated that the upwelling of nutrients would be reduced and that the population of fish would fall. Much fewer candidates realised the effect of the lack of nutrients of the population of phytoplankton.

(c) This part of the question was quite well answered. Valid points concerning the effect of high temperature on the zooanthallae and the subsequent death of the coral appeared frequently in the candidate's answers.

Question 6

(a) Most candidates were able to give an adequate description of a tsunami, usually as a very large wave. Few candidates referred to the speed aspect of the wave.

(b) Few candidates did not gain the mark in this part of the question**.**

Underwater earthquakes was the most frequent response but movement of tectonic plates and seismic activity was also seen frequently and were credited as acceptable answers.

(c) (i) On the whole, the standard of graph plotting was not of the quality that had been anticipated and there were a considerable number of poor attempts at drawing a graph of the data given.

The most common errors were:
failure to label the axes or to include the units in the labels;
transposing the axes;
use of incorrect scales such as 0 10 25 50 75 etc.;
poorly plotted points where it was difficult to discern the centre of the plot;
obviously freehand attempts to draw the line of best fit.

(ii) Most candidates were able to read the appropriate figure from their graph although it was difficult to credit those candidates who had used an inaccurate scale.

(iii) This was well answered.

(iv) This part of the question was also well answered although quite a few candidates wh wave height would decrease.

(d) Most candidates were able to provide two valid effects of a tsunami.

Of the many possible and acceptable answers the following were the most common; flooding, death, damage to buildings, damage to infrastructure or a named example, erosion, damage to habitats.

Question 7

(a) Most candidates were able to give at least two features of a tropical cyclone and these were usually strong winds, heavy rain or low pressure.

(b) In this part of the question some candidates confused the features of cyclones with the conditions needed for their formation.

Many candidates were aware that warm water is an essential condition as is low pressure.

(c) (i) Most candidates correctly totalled the number of category 4 and 5 hurricanes.

(ii) Almost all candidates gained one of the two marks for describing the change from 1970 to 1994 as an increase. A majority of the candidates went on to describe the change numerically i.e. from 40 to 96 and gained the second mark.

MARINE SCIENCE

Paper 9693/02

AS Data-Handling and Free Response

General comments

This Paper tests a wide range of skills in ***Section A***, and knowledge and understanding in ***Section B***. There were very many candidates who were unable to demonstrate either good skills or specific knowledge, resulting in many very low scores overall. These weak performances were often compounded by very weak examination technique, in which answers did not relate precisely to the question, or used inappropriate colloquial language that did not convey ideas clearly. On the other hand, there were some excellent answers to all parts of the Paper by some candidates.

Candidates should recognise that this is a Science paper, and that good use and understanding of correct technical terms is expected. It is also expected that examples given, such as in **Question 3**, should be from marine ecosystems, not terrestrial ones such as rainforests.

Comments on specific questions

Section A

Question 1

This was frequently the highest-scoring question overall.

(a) Candidates who looked carefully at the statement about the investigation in lines 1 and 2 – that it was carried out to determine the effect of increased dissolved carbon dioxide on the distribution and abundance of marine organisms – generally obtained two marks here. However, many did not relate their answer to this. Many simply repeated the sentence in (a), stating that the vents contained hydrogen sulfide. Some said that the gases would not affect the atmosphere, which is not relevant.

(b) (i) This was generally well answered. Most candidates correctly stated that the vents reduced the pH of the sea water, or that they made it more acidic. Many also correctly read values from the graph, such as the lowest pH value produced by the vents, or the maximum distance at which the vents had an effect on the pH. However, numerous candidates did not read the graph scale accurately, and gave a value of 75m for the distance at which the pH was at its minimum, or 150m for the distance at which the pH of the sea water is unaffected. Some read the numbers correctly, but gave a wrong unit, usually feet. A few went on to write about the effects on the organisms, which was irrelevant to this question.

(ii) Most candidates scored at least one mark here, and many gave very good answers. Some, however, did not appreciate that the question asked for an 'explanation', and simply gave a description.

(iii) There were many good answers here, in which candidates correctly referred to the drop in sea urchin density at distances far from the vent in regions where the pH was not changing. However, some attempted to suggest other factors that might affect the distribution of the sea urchins, with no reference to Fig. 1.1.

(c) (i) Many candidates demonstrated a good understanding of how to plan an experiment, and these easily gained all five marks. The best answers often achieved this in less than half the space allocated. In contrast, there were many very weak answers. Numerous candidates failed to notice that the experiment was to be done in a laboratory, despite this being printed in bold type. Their experiments generally consisted of a rerun of the investigation already described, in which the

coverage of algae was measured at different sites around the vents, rather than a p experiment. Some did not describe an experiment at all, simply referring instead to the in Fig. 1.2. The collection of quantitative results was often ignored, with no mention of wh be measured, or when.

Candidates also need to take care that they do not assume that a single set of results can 'prove' that a hypothesis is correct. While it is possible to disprove a hypothesis in this way, the results of an experiment like this could only be said to 'support' it. (See syllabus statements 1(c) and 1(f).)

(ii) Many answers simply reiterated or reworded the hypothesis already given, relating the growth of *Posidona* to the coverage of algae, and these scored no marks. Credit was given for the idea that a low or neutral pH would increase the growth of the grass, or that the high levels of CO_2 close to the vents would increase the rate of photosynthesis.

Question 2

(a) Although the majority of answers correctly stated that there are four trophic levels in the web, many said that there were three or six.

(b) Numerous candidates left this entirely blank. Many attempted to calculate 10% of 90, but quite a few of these were unable to do this successfully, arriving at answers such as 81 or 0.9. Of those who did obtain a correct value of 9, relatively few realised that this had to be split between the zooplankton and the bottom-feeding herbivores.

(c) Some candidates answered in terms of energy losses, and others of carbon losses, and either approach was acceptable.

A very large number of candidates gave answers along the lines of 'The 10 percent rule says that only 10 percent of the energy from one trophic level passes to the next.' This gained no marks, as it makes no attempt to suggest *why* this is so. Many answers did no more than list ways in which energy might be lost, without relating their suggestions to this specific situation. It was important that the losses related to those occurring *before* the energy or carbon entered the body of the herbivore. Thus respiration (in the phytoplankton) was credited, but not respiration in the herbivore. Excretion (from the herbivore) was not. If no organism was specified, the process was assumed to relate to the phytoplankton. If faeces were mentioned, it needed to be clear that this referred to the loss of undigested phytoplankton from the herbivore. Thus, 'respiration and faeces' could only be given one mark, because if it was assumed that the respiration was in the phytoplankton, then it could not also be assumed that the loss of faeces was from the herbivore. In general, candidates need to ensure that they relate answers to this type of question to the particular context given, and do not just assume that a generalised answer will suffice.

Section A

It is important that candidates answer these questions in ***sections (a)***, ***(b)*** and so on. Some candidates simply wrote one continuous paragraph for each question, and some even wrote one continuous paragraph that contained answers to both **questions 3** and **4**.

Question 3

(a) This question tested syllabus statement 2(h). Candidates who knew the examples in the syllabus – coral-eating butterfly fish and tuna – generally gained at least three marks, and often all five. However, many appeared to be unfamiliar with the terms 'specialised niche' and 'generalised niche' and made incorrect guesses at their meaning. A surprising number gave examples from non-marine ecosystems, such as pandas and rabbits. These were not credited as named examples, but otherwise all marks were available for such answers, if they correctly explained the meanings of the terms.

Various definitions of the term 'niche' were accepted. The most frequently being, 'the role of an organism in an ecosystem', or 'the range of environmental space occupied by a species'. Some candidates used the terms 'job', 'duty' or 'task', and these were not credited. These candidates usually went on to describe the niche of an organism as what it did *for* the ecosystem, with no mention of its own requirements, and it was rare to give more than one or two marks for such answers.

(b) Good answers frequently began with an explanation of the meaning of the term 'high b and these candidates often set their answer in the context of a coral reef, immediately ga marks. Care was needed with terminology here. Credit was given for saying that high biodi means that many different *species* are present, but not many different *organisms.*

Candidates who mentioned competition usually went on to correctly explain how narrow niches reduce interspecific competition. Some described the principle of competitive exclusion, and gave specific examples. However, those who thought of a niche as the 'duty' of an organism often gave erroneous explanations here, along the lines of the presence of many different organisms meaning that each one of them did not have as many 'duties' to do. A typical statement might be 'In habitats with high biodiversity, the organisms have less of a job to fulfil because there are more organisms to help out and get the job done'. No credit was given for this type of statement.

(c) This question tested syllabus statement 2(g). The example of an unstable ecosystem given in the syllabus is sand on a reef slope, and once again candidates who knew this example generally went on to give good answers. However, many either did not know an example, or did not understand the meaning of the term 'unstable'. Their answers tended to relate to *extreme* ecosystems rather than *unstable* ones. These were often hydrothermal vents. Others chose to write about sandy or rocky shores, which again are not examples of unstable systems; although environmental factors do change in these ecosystems, the changes are regular and predictable.

Where inappropriate examples were given, candidates could still gain some marks if they gave good explanations of why it was difficult for many species to survive in such conditions, and that few species possessed suitable adaptations.

As the question used the term 'Discuss', marks were also available for giving the opposite point of view, but this was done by only a few candidates.

Question 4

(a) This was usually well answered, and many candidates easily picked up all three marks.

(b) This question tested syllabus statement 6(f), and it was not well answered. Very few candidates had any specific knowledge of sandy shore communities, or the environmental factors that influence their development. Answers were frequently entirely general, describing factors common to any littoral environment; such answers could gain a few marks if well done, but this was rarely the case. Factors were often simply listed, rather than described as required by the question. It was rare for any particular organisms that might be part of a sandy shore community to be mentioned, and even when candidates did attempt to do this their examples – for example 'crabs' – were too general to be credited.

(c) Some candidates demonstrated excellent knowledge of erosion and sedimentation, and how they can give rise to rocky and muddy shores. However, many apparently had absolutely no knowledge relating to this topic. Confusion of erosion (the removal of rock waste, for example by water) and weathering (the break-down of rocks) was very common. Good answers generally contained reference to strong wave action creating rocky shores. There was some confusion between waves and tides.

MARINE SCIENCE

Paper 9693/03
A2 Structured Questions

General comments

There were relatively few candidates for this paper. Their performance showed a good spread of achievement showing some good knowledge and understanding of marine science.

Comments on specific questions

Question 1

This question was fairly well answered.

(a) (i) The majority of candidates gained at least 2 marks for this section. Candidates were usually able to identify two nutrients, but often were not able to explain their function clearly. The most common correct answers were nitrates and magnesium. Some candidates misinterpreted the question and gave the inorganic materials necessary for photosynthesis.

(ii) There were some good answers to this question. Candidates showed good knowledge of the causes and effects of El Nino, often giving answers that exceeded the expectation of the mark scheme.

(b) Almost all candidates gave a correct answer to this question, most commonly related to primary production and the idea of a habitat.

Question 2

This question was not well answered. Candidates showed little understanding of the concept of surface area: volume ratio. Consequently, many were not able to explain adaptations to optimise for gas exchange or to explain why multicellular organisms need these adaptations.

(a) Most candidates gave a correct definition. Candidates who answered in terms of particles, implying a solid, rather than a liquid or a gas were given credit. However candidates should be encouraged to think of diffusion in terms of molecules.

(b) (i) Candidates appeared to find it difficult to express their answers clearly. The majority were expressed in terms of a linear relationship; relatively few candidates explained the proportional relationship.

(ii) Most candidates approached this question from the idea that a larger size would mean a greater surface area without relating this to the even greater increase in volume. Most answers referred to greater oxygen uptake through the increased surface area, but not the consequent effect of a greater volume on the distribution of oxygen.

(c) (i) The relatively limited understanding of the surface area to volume relationship meant that most candidates did not expand their answer further than a coral polyp having tentacles to increase surface area. Very few candidates appreciated that the water filled central cavity gave access to both sides of the body cell layers.

(ii) Most candidates recognised that fish have many more cells than a coral polyp and greater metabolic activity. However very few could relate this to the long diffusion distances from the surface and the impermeable nature of most of the outer surface of a fish.

(d) The descriptions of the water pumping mechanism of a grouper were very basic and showed confusion with that of a tuna. Few candidates gained more than one mark, understanding that there is a buccal pumping mechanism. The descriptions lacked scientific terminology, for example the operculum was commonly referred to a gill cover candidates did not distinguish between the mouth, buccal cavity and opercular cavity. Referen to the pressure changes that occur as result of the pumping mechanism were very rare.

Question 3

This question was fairly well answered, although in part **(c)** candidates answered more in relation to the aquaculture system rather than the environment.

(a) (i) Most candidates gained at least one mark, usually in relation to the eggs.

(ii) Almost all candidates gained this mark. The most common answer was related to the sessile nature of oysters and the free swimming shrimp.

(b) The majority of candidates gained one mark for describing the filter feeding of these two organisms. However few candidates were unable to relate this to the tidal nature of the habitats. Answers often stated that these habitats were rich in nutrients, but not why. In describing feeding of animal species, candidates should be encouraged to refer to food, rather than nutrient. Nutrient is more commonly used to describe the different types of macromolecule, vitamins or mineral salt content.

(c) (i) Most candidates gained two marks. The most common answers were related to temperature and food supply.

(ii) Very few candidates related their answer to the environment. The only common correct answer was often a reverse argument about the use of chemicals in intensive systems and the potential damage to the environment. Candidates should be encouraged to answer using positive statements rather than using reverse arguments, which in some cases may not be a valid answer.

Question 4

Candidates found difficulty in this question, as in the previous question to relate their answer to environmental protection. Many answers were in terms of fisheries protection.

(a) (i) Most candidates were aware of the damage to the seabed caused by bottom trawlers. The rest of the answers, however, were mostly about conserving the target fish species. Very few candidates mentioned the benthic habitat or community.

(ii) (iii) These two sections were marked together as the distinction between gill nets and other types of drift net were not known by most candidates and there is some overlap in their disadvantages. Most candidates knew that drift nets trap very large numbers of fish, but very few explained why a gill net makes it almost impossible for fish to escape. The danger posed by these nets to marine mammals and birds was well known, but again candidates did not explain why these animals were killed by nets. The ecological consequences of the use of these nets was rarely mentioned, although some candidates gained a mark if they mentioned by-catch or throw-back survival rates.

(b) There were some well reasoned answers to this question. Almost all candidates were aware of the difficulty in patrolling large areas of sea and the differences between countries in the attitudes to fisheries protection. The other common theme in answers was the economic consequences of fishing restrictions.

Question 5

Overall this question was poorly answered, in particular part **(a)**.

(a) (i) Most candidates were able to make one correct suggestion. The most common being increased tourism. A common incorrect answer was an increase in domestic rubbish, often the result of too much packaging.

(ii) Many candidates left this question blank. Other answers were too vague for credit, i … it is poisonous' and 'it clogs up the sea'. Candidates should be aware of the main com… domestic sewage, the chemical or physical effects of these components on the marine env… and the potential effects on the living organisms.

(b) A high proportion of the candidates were aware that filter feeders use sewage as a source of food, but often the answers were too imprecise to gain credit. For example 'people eat them full of sewage' and 'we will be eating our own wastes'. Examiners were looking for the understanding that pathogens and toxic chemicals can accumulate in the shrimps so that if the shrimps are eaten there is a risk of infection or toxic chemicals accumulating in the human body.

(c) Most candidates gained at least two marks for showing an understanding of biomagnification or bioaccumulation and the toxic content of antifouling paints. There were also some good explanations of the effects of TBT on marine molluscs.

Question 6

This question was well answered by the majority of candidates.

(a) (i) Most candidates gave at least two correct suggestions. The most common were employment, better standard of living and foreign investment in the country.

(**ii)** Most candidates also gave at least two correct suggestions. The most common were related to disturbing turtles, tourist disruption of traditional values or life style and increased pollution from litter. Some answers were too vague for credit, for example 'noise 'and 'pollution' without any further qualification.

(b) Almost all candidates gave a correct answer. Reference to limited water was the most frequent choice. A common incorrect suggestion was 'lack of deep water'.

Question 7

Answers to this question were varied. Some candidates were familiar with the use of microorganisms for clearing oil spillages, others seemed to be guessing.

(a) Most definitions did not match that given in the syllabus. Candidates tended to answer in terms of changing a process within an organism to improve the organism and thus benefit humans.

(b) (i) Most candidates gave a correct answer. The answer 'evaporation from tankers' was not allowed as this is more likely to affect the atmosphere and not the sea.

(ii) Most candidates were aware that microorganisms digest oil, but very few then expanded their answer to explain that the products of this digestion were harmless.

(iii) Very few candidates could make a correct suggestion. The most common correct answer was related to keeping the microorganisms on the shore. A few candidates recognised that the surface area would be increased.

(iv) Many candidates left this blank. Common unsuitable suggestions were 'It is too expensive' and 'it would pollute the beach'.

MARINE SCIENCE

Paper 9693/04

A2 Data Handling and Free Response

General comments

The number of entries for this paper was relatively low but even so a good range of marks was seen, although there was some polarisation between two extremes. Stronger, self motivated candidates often have acquired a level of knowledge and understanding that is beyond what is required whilst weaker candidates with less ability to learn independently from a range of resources were unable to identify the required level of detail. There was good evidence of excellent detailed knowledge from several candidates. Weaker candidates tended to have some knowledge of the topic areas covered but this was often far too superficial.

Comments on specific questions

Section A

Question 1

(a) (i) Most candidates were able to identify from the absorption spectrum graph that that chlorophyll *a* has two peaks and the majority correctly quoted these as being at approximately 440nm and 650nm.

(ii) Most candidates were able to identify at least one difference in the absorption spectra of fucoxanthin and chlorophyll *a*. Most referred to the higher overall absorption of chlorophyll *a* and the idea that chlorophyll *a* has two peaks rather than one. A few weaker candidates misread the wavelengths and some only referred to one difference.

(b) (i) This question discriminated between weaker and stronger candidates. More able candidates recognised that green algae contain chlorophyll and then made the link between the fact that at depth, only the 440nm wavelength light is available as shown by Fig. 1.2. They often went on to state that this means that photosynthesis rate at depth would be low. Weaker candidates often did not realise that the algae contain chlorophyll and were not able to make the link between the different depths of penetration of different wavelengths of light in the water and photosynthesis.

(c) This question was found to be challenging for weaker candidates. More able candidates were able to identify the pattern in pigment distribution with depth. They also went on to make the link between the absorption of light by fucoxanthin and the light quality that is penetrating at depth and how this gives the algae an advantage at depth. Weaker candidates were often able to gain credit for describing the distribution patterns of the algae but failed to expand on this.

Question 2

(a) Most candidates were able to identify that catches are decreasing and that the majority of fish caught are in the 2-5 year age group. Few made any references to numerical data.

(b) Most candidates were able to predict that cod stocks would decrease. Only stronger candidates then went on to describe that this was a consequence of catching younger fish and catching fish that had not reached full reproductive capacity.

(c) Few candidates were able to calculate a percentage decrease. Many simply divided the final population by the starting population. Approximately half were able to calculate the numerical decrease.

(d) Most candidates were able to give at least one consequence with the majority of stronger candidates citing more than 4 potential consequences. Weaker candidates often simply stated "restrictions" without giving any more detail. The most popular consequences given were closed seasons, setting up of refuge zones, reduced mesh sizes and unemployment in the towns.

Section B

Question 3

(a) Strong candidates gave excellent, detailed answers here. Many were able to refer to the correct nomenclature for the salmon stages and link this up to the geographical locations of the salmon and the feeding / breeding behaviours. Weaker candidates failed to give sufficient detail. They often had vague ideas as to the life cycle of salmon and knew that salmon live in both river and sea but failed to give detail / named stages that would be of an A level standard.

(b) Stronger candidates fully appreciated the difference between internal and external fertilisation. Some excellent references to wastage/probability of fertilisation and the needs of sessile organisms were seen. Most of the weaker candidates failed to understand the question and referred to internal vs external development of the offspring.

(c) Some outstanding answers were seen here. Several candidates gave a level of detail that was well beyond that of A level giving a full explanation of r and k selection strategies. Very good references to care of offspring in both whales and tuna were given – many candidates have very detailed knowledge and fully understand the different strategies. Weaker candidates were able to access some marking points – most appreciated that whales employ more parental care and also that tuna do not. Weaker candidates again failed to give detail commensurate with A level rather than GCSE.

Question 4

(a) Some excellent answers were seen here. Many candidates gave good descriptions of both types of aquaculture in terms of tanks vs "natural" methods. Many weaker candidates did not seem to have encountered these terms before.

(b) Many candidates gave excellent, detailed accounts of the aquaculture of shrimp, groupers, salmon and oysters. The majority were able to cite the need for oxygenation, food, cleaning, and disease limitation. Fewer candidates mentioned the economics of the venture. Weaker candidates often appreciated the need for feeding and waste removal but little else. A few gave examples of fish that are not actually farmed.

(c) Stronger candidates generally gave excellent, detailed accounts of aquaculture impacts. Pollution was considered by the majority of candidates but only the stronger candidates explained how it could be reduced. Many candidates understood the dangers that escape has upon local ecosystems but few gave methods to reduce this. Good references were seen to human population effects – both increasing employment opportunities and unemployment were described but again only better candidates were able to give methods for reducing the impact of this.