MARINE SCIENCE

Paper 9693/01
AS Structured Questions

Key Messages

Candidates should be guided by the amount of space available for the answer and the number of marks allocated for each question. Questions requiring fairly simple and straightforward answers were answered well. Answers to more demanding questions needed to contain more detailed explanation and application of knowledge. Some questions required careful observation of illustrations to produce an answer describing what is actually visible.

General Comments

Candidates scored more highly on factually based questions than on questions requiring interpretation and analysis. Food webs and energy flow were well understood, as were food webs and trophic levels and the various relationships between organisms with many candidates giving excellent answers. Candidates could improve on understanding the relationship between photosynthesis and the factors which affect it, such as light, temperature and nutrient availability. Candidates also need practise drawing conclusions from evidence

Comments on Specific Questions

Question 1

(a) (i) Many candidates clearly understood plate tectonics. Careful observation was needed of Diagram B in **Fig 1.1** to appreciate that the plates were moving apart.

(ii) Some excellent descriptions were given and many candidates scored well. The most frequent incorrect response described transforming boundaries.

(b) A logical sequence of the events which characterise hydrothermal vent formation is needed in order to be credit worthy. Candidates needed to emphasise the importance of pressure in forcing heated water back into the ocean and to explain the role of magma in this process. Subsequent water cooling and the precipitation of minerals to form the vent were also needed.

Question 2

(a) (i) The brief description of photosynthesis given by some candidates was not sufficient to be credit worthy. Candidates needed to emphasise that at this time of year it was the increasing factor levels that were affecting productivity.

(ii) Most candidates scored well. The terms uptake or absorption should be used rather than consumption.

(iii) Most candidates understood that the zooplankton line rises and falls with the phytoplankton but the lines drawn often needed to be clearer and more precise. Some candidates incorrectly drew the zooplankton line above the phytoplankton line, often without a relative time lag.

(b) (i) Most candidates answered this correctly.

(ii) Many candidates worked out the answer correctly using the figures given in **Fig. 2.2**. The most common error was basing the answer on 10% of 92 000.

(iii) An error carried forward from 2**(b)(ii)** was credited if the answer was about 10% of the figure given in 2**(b)(ii)**.

(iv) Most candidates answered correctly although a significant number of candidates did not understand the concept of energy.

(c) Several characteristics from each process which showed similarities or differences needed to be compared in order to gain credit, for example chemosynthesis uses chemical energy whereas photosynthesis uses light energy. Many candidates discussed their location in the ocean rather than the details of the processes.

Question 3

(a) (i) Many candidates correctly identified the producer organisms.

(ii) Most candidates were familiar with the dynamics of a food web. Some candidates used abbreviations when only the full name was accepted, e.g. COT for Crown of Thorns Starfish.

(iii) There were many excellent and well-reasoned answers which explained that the Box Jellyfish numbers would fall, leading to less food available for the turtles and a consequent decline in their population. Candidates who focused incorrectly on the extinction of the turtles needed to consider the other food source in the web.

(iv) Many answers only described sharks as a top predator when they should have explained the detail of what sharks feed on, the idea of moving between habitats and the wide range of conditions they could tolerate.

(b) Most candidates scored highly. Clear explanations of why light penetration and temperature could affect coral zooxanthellae photosynthesis at these depths were given. Some referred correctly to the symbiotic relationship between coral and zooxanthellae.

Question 4

(a) The biological use of calcium in fish was well known. A few candidates correctly described corallite production. Some candidates referred incorrectly to bone formation in coral.

(b) (i) Most candidates were able to name at least two of the processes. A few incorrectly described primary and secondary consumers as a process.

(ii) Many candidates understood and could describe runoff. The more complete answers described the idea of calcium dissolving into the water from the rocks. A few candidates correctly made reference to leaching.

(iii) Most candidates were able to describe decomposition after the death of an organism, but very few mentioned the role of bacteria in this process.

Question 5

(a) Many candidates knew some of the causes of erosion. To achieve full credit here, completely different causes needed to be described, for example storms and hurricanes are the same cause. Incorrect causes of erosion in this context were tides, global warming, coral bleaching and temperature. Few candidates mentioned that abrasion by sediments or sand could cause erosion.

(b) (i) Candidates needed to study the photographs before developing their response as generalised comments such as ‘for settling’ or ‘providing a home’ were not precise enough to be credit worthy. Many candidates named a valid property of the reef balls without giving reasons for its suitability

(ii) Many candidates gave excellent answers explaining the effect of the reef in reducing wave action which then helped to prevent erosion of the sea shore.

(iii) Few candidates knew any of the disadvantages of artificial reefs. Many candidates described the pollution concerns in artificial reefs and some candidates incorrectly described how reef organisms would not settle on such a reef.

(c) (i) The majority of candidates used the graph correctly although some who gave the correct figure omitted the units.

(ii) The effect of reef balls was not well understood by candidates and this hindered the interpretation of the beach and sea bed profile changes. Some candidates correctly used comparative figures but then didn't explain how the reef balls would alter the profile. The most common error was describing changes in the mean sea level, which stayed constant at zero

Question 6

(a) Overall, most candidates had some knowledge of this topic but answers would have been improved by the process being described in a complete and logical sequence. Many candidates focused on the pressure situation and how this develops rather than describing the transformation of a storm into a cyclone. Some candidates correctly described evaporation and condensation without mentioning energy release. Many candidates appreciated a critical temperature of the sea is required for cyclone formation. Where the Coriolis effect was described this needed to be in the context of spiralling or rotating winds and clouds. Some candidates realised that it is the warm moist air rising that is important but some thought incorrectly that the water was rising.

(b) Many candidates cited incorrectly that wind was a feature which was visible in **Fig 6.1** rather than describing the spiral or circular pattern of clouds. The eye or eye wall needed to be named, rather than described, to gain credit.

(c) (i) Most candidates correctly worked out the relationship shown in **Fig. 6.2** but some omitted air or wind from their description.

(ii) Most candidates were able to count the cyclones accurately from **Fig. 6.2**. The most common error was to include the two systems whose wind speeds were less than 118 km per hour.

(d) Many candidates correctly described the idea of bringing water and nutrients to drought stricken areas but fewer included benefits to agriculture and crop production. Descriptions of rebuilding, renewal of infrastructure and employment did not gain credit.

MARINE SCIENCE

Paper 9693/02

AS Data-Handling and Free Response

Key Messages

Candidates should:

- read the questions carefully, noting the 'command words' used and the mark allocation for each part
- distinguish carefully between 'describe' and 'explain'
- select appropriate information to answer the questions and try to avoid including irrelevant details
- manipulate data presented in tables, rather than quoting figures directly, when describing results
- try to write free response answers in a logical, coherent sequence
- use scientific terms and vocabulary
- include appropriate units with numerical answers.

General Comments

This paper includes questions requiring both data handling and answers written in continuous prose. The questions are intended to test candidates' knowledge and understanding of the syllabus content, and their ability to apply their knowledge in new and possibly unfamiliar contexts. In **Section A**, questions may relate to Scientific Method (Syllabus Section 1) and will expect candidates to be able to understand the relationship between hypothesis, experiment and theory in science and also to recognise uncertainty in experimental results. Questions may also relate to practical activities, including the design of an investigation to test a hypothesis, with references to the control of variables and collection of quantitative data.

A very wide range of responses was seen. Some candidates did not attempt any of the questions, whereas some candidates gained nearly full credit. **Questions 1** and **2**, in particular, required candidates to read the questions carefully and to apply the information provided. A number of responses to **Question 1(a)**, for example, made no reference to dog whelks, but described the term niche in general terms.

In **Section B**, the first part of **Question 4** was generally answered well and the marks for this question were usually similar to those for **Question 3**. Overall, candidates tended to score better in **Section B** than in **Section A**, indicating that many were able to recall factual content of the syllabus more successfully than they were able to apply their knowledge of principles and concepts in a logical and deductive manner.

Comments on Specific Questions

Section A

Question 1

(a) The majority of candidates gained partial credit for stating that the term niche refers to the role of an organism in its environment. The word 'role' was expected here, or another precise definition of the term niche. Inaccurate words such as 'job', 'task, or 'purpose' were not given credit. Some candidates did not refer to the role of dog whelks and so could not gain full credit.

(b) (i) The standard of graph plotting was variable and relatively few candidates gained full credit. Common errors included non-linear scales, scales which were difficult to use, not labelling the axes appropriately and reversing the axes. Relatively few candidates drew an acceptable line of best fit, many joined successive points, often with free-hand lines, or extrapolated the line to zero.

(ii) Candidates found this very difficult. Some candidates thought that a shore with an exposure of 8 was the most exposed or referred to exposure of the molluscs rather than exposure of the shores. Many candidates discussed the relationship between exposure of the shore and the length of the shells, rather than the relationship between exposure of the shore and the length: aperture ratio.
In questions of this type, where interpretation and description of data is required, it is important for candidates to support their answer with appropriate references to the data, such as giving the overall difference in the ratio as the exposure changed from 1 to 8.

(iii) Candidates found this very difficult and many did not synthesise information given in the question to provide an appropriate explanation for the relationship. Some candidates referred correctly to the ability of the molluscs to adhere to rock surfaces, but this was often not related to the relative size of the foot in relation to the degree of exposure of the shore. Many candidates did not interpret correctly the ratios in terms of the relationship between the size of the aperture and the overall length of the shell. Incorrect responses included erosion of the shells, predation, or the avoidance of drying.

(c) There were a wide range of responses. Some candidates gave good experimental details including references to the control of variables and collection of quantitative results. These answers often included suggested numbers of dog whelks and barnacles, an appropriate temperature range and a duration for the experiment. Some candidates described a field-based investigation rather than a laboratory one but some of these gained partial credit for suitable experimental details. Weaker candidates often included vague references to the amount of barnacles rather than number or mass and references to noting or recording results which were also not creditworthy. The more precise ideas of counting the number of barnacles eaten (in a given time) or measuring the barnacles remaining were required. Some candidates suggested unsuitable temperatures, such as 80 °C, rather than an appropriate range of environmental temperatures.

Question 2

(a) The majority of candidates answered correctly, giving a mean value of 20.94. An answer to two decimal places was expected, in order to be consistent with the other mean values quoted in the table.

(b) (i) Most candidates gained credit for a description of the relationship between depth and salinity, but this was less often supported with an appropriate quantitative reference such as giving the overall increase in salinity. Some candidates quoted figures directly from the table without manipulating them, which did not gain credit. Some candidates gave explanations of the changes in salinity, these were not relevant to the question and so did not gain credit.

(ii) Candidates found it difficult to express their ideas accurately. Some candidates gave descriptions in terms such as ‘salt is heavier than water therefore the salt sinks’ rather than water with a higher salinity has a higher density and therefore tends to sink below water of a lower salinity. Some candidates gave explanations in the context of an ocean rather than in an estuary which contains water of different salinities. Incorrect responses included explanations of the relationship in terms of temperature gradients or the availability of oxygen and nutrients.

Section B

Question 3

(a) Approximately half of the candidates gained credit for giving a correct biological use of nitrogen and of magnesium in marine ecosystems; slightly more gave an acceptable use of phosphorus which often included references to DNA or bone.. A number of candidates either gave answers which were not specific enough to gain credit such as ‘used in the nitrogen cycle’ or ‘used for growth’ or omitted this part.

(b) Some good answers in which candidates organised their explanations in a logical sequence, beginning with an increase in the dissolution of atmospheric carbon dioxide followed by the consequent effect of this on the productivity of primary producers in a marine ecosystem. These candidates also recognised that an increase in photosynthesis of the primary producers makes more food available to consumers which, in turn, increases the productivity of consumers. Weaker candidates confused oxygen and carbon dioxide, or suggested that the increase in productivity was due to an increase in the availability of oxygen. T

(c) Relatively few candidates clearly and accurately linked the factor with its effect on the concentration of dissolved oxygen, such as a reference to photosynthesis producing oxygen and therefore increasing its concentration. Many candidates gave vague statements such as 'organisms use oxygen' or 'oxygen varies with depth' without further discussion. Some of the weaker candidates gained credit for citing temperature and depth as factors. Others included respiration and photosynthesis although the effect of these on the concentration of dissolved oxygen was frequently inaccurate. Inappropriate references to upwelling, run-off, pollution and eutrophication did not gain credit unless they were adequately explained. This question relates to learning outcome **(d)** of Section 7 of the syllabus and candidates were expected to discuss both the physical and the biological reasons for the variability of dissolved oxygen in sea water.

Question 4

(a) (i) The majority of candidates gave answers that gained at least partial credit usually for references to the number of individuals of one species within a given area or habitat. The examples given were not always qualified with reference to the habitat, a named species on its own was not creditworthy. The majority of examples given were from a marine environment, although several gave terrestrial examples. Answers such as 'a population is the number of species in a habitat' is ambiguous as it could refer to the number of a species or to the number of different species in a habitat, thus confusing population with community.

(ii) The majority of candidates gained at least partial credit. There were frequent references to photosynthesis or chemosynthesis and to a suitable named example such as phytoplankton, sea grass or algae. Many candidates recognised correctly that producers make energy available to higher trophic levels, or that they produce organic substances. Weaker candidates thought that producers create energy. This is a popular misconception and would be more accurately expressed as 'producers trap light energy and convert it to chemical energy.

(b) Many candidates found this difficult and, although they sometimes included general features of a sandy shore, these features were less often associated with the reasons why sandy shores usually support a low biodiversity. There were a number of acceptable references to sandy shores as an unstable habitat which is subject to erosion, but many of the answers included no further details. Some of the features quoted related to all types of shore such as periodic immersion by sea water and temperature fluctuations, rather than to the specific features of sandy shores. Credit was usually gained for references to the unstable substrate and to erosion. Stronger candidates also included references to the porosity of sand and the lack of a suitable substrate for attachment of organisms. A number of candidates gained credit for references to burrowing organisms or for naming a specific example such as ghost crabs.

(c) The majority of candidates found this very challenging and many answers included few or no relevant details. There was a tendency to describe the conditions required for the growth of corals, their role in ecosystems, or how coral reefs provide protection for coastal habitats. Few candidates explained adequately why coral reefs contain narrow ecological niches, although there were some references to competition as a result of coral reefs having a high biodiversity. The most common creditworthy response was for a reference to zooxanthellae, or to species of fish associated with a coral reef, including parrotfish and butterflyfish. Stronger candidates described correctly the consequences of overlapping niches in terms of competition and niche specialisation, which were expected for full credit.

MARINE SCIENCE

Paper 9693/03
A2 Structured Questions

Key Messages

- Read questions carefully and answer only what is being asked.
- Use correct terms and specific knowledge to qualify statements such as 'affects the coral reef' or 'causes problems to the marine organisms'.
- Use data provided in questions to support answers.

General Comments

There were some clear, well-written answers showing a good knowledge of the syllabus content and the ability to use knowledge to interpret information given in questions. There was no evidence of lack of time as the majority of candidates attempted all the sections of all questions. To access high marks it is essential that candidates avoid vague or generalised answers that do not address the question. For example in question **1(a)** candidates were asked to describe and explain the graphs in **Fig. 1.1**. Most candidates could not explain the graphs and often did not describe the actual graph in the question. In questions **6(c)** and **7(a)**, candidates' answers were often limited to vague statements, such as in **6(c)**: 'sea-level rising will have a negative effect on the coast' or the glaciers retreating affects marine life, and in **7(a)**: 'pollution causes harm to the reef'. These sorts of answers do not gain credit.

Comments on Specific Questions

Question 1

This question was about environmental factors affecting the rate of photosynthesis and how these factors affect the depth at which phytoplankton are found.

(a) Very few candidates gained more than half of the available marks. Good answers gave a description that related to the graphs in **Fig. 1.1** and some explanation about their shape in relation to limiting factors. The explanation for the effect of temperature was better known than those for either light or carbon dioxide.

Better explanations for the effect of temperature referred to enzymes and their denaturation at high temperature. Very few candidates knew why photosynthesis increases with temperature until the optimum is reached. Weaker candidates confused optimum and maximum rates of photosynthesis and often failed to describe the graph. A common answer, which did not gain credit, was 'above and below a certain temperature photosynthesis decreases'.

The description of the effect of light was often correct, but explanations were then given in terms of light 'giving energy' to the reaction, rather than the role of chlorophyll in trapping light energy. Very few candidates showed an understanding that chlorophyll becomes saturated at high light intensity but thought that the plant could not use the light. Weaker candidates often did not use the graph as they stated that as light increased so did photosynthesis.

The description of the effect of carbon dioxide concentration was also usually correct. Stronger candidates were able to explain that carbon dioxide is a substrate for photosynthesis; weaker candidates stated that it is needed but did not say why. Very few candidates were able to explain why the graph plateaued with weaker candidates thinking that this is the maximum rate of photosynthesis.

Most candidates seemed to be unaware of the role of limiting factors. Only stronger candidates showed an understanding that the rate of photosynthesis is governed by the external factor in least supply and gave this as the reason why both light intensity and carbon dioxide concentration graphs plateau.

(b) Most candidates knew that phytoplankton are found in the surface layers of the ocean. Stronger candidates referred to the (eu)photic zone or specified the depth of water. Weaker candidates stated that the phytoplankton are on or at the surface of the ocean. Candidates were expected to use their knowledge of light penetration, thermoclines and carbon dioxide availability to explain why phytoplankton are found in this region. Stronger candidates showed this understanding for light and temperature, but rarely for carbon dioxide. Many answers were too generalised for credit, for example 'The light, temperature and carbon dioxide is suitable for phytoplankton'.

Question 2

This question was testing the understanding of osmoregulation by tuna and salmon in sea water and the ability of salmon to osmoregulate in both sea water and fresh water.

This question proved challenging for almost all candidates. Few candidates showed understanding of the principles of osmoregulation in marine fish. There was considerable confusion between osmoregulators and osmoconformers: commonly one of the fish was described as an osmogegulator and the other as an osmoconformer.

(a) (i) Candidates needed to use the data provided in **Table 2.1** about osmotic concentration in order to answer the question. Stronger candidates knew that water would be lost from the fish by osmosis, made correct comparisons between sea water and blood plasma, and referred to the data. Weaker candidates referred to sodium or ion concentration and commonly stated that ions moved by osmosis. Few candidates realised that the reason for swallowing sea water is to replace the water lost by osmosis, the majority thought it was to replace ions lost. Data used from tables sometimes didn't include the units.

(ii) The majority of candidates referred to either sodium or to ions rather than to the chloride ions specified in the question. Stronger candidates were able to use **Table 2.1** to compare chloride concentration in sea water with the chloride concentration of fish blood, although units were often omitted. Few candidates understood that drinking sea water results in excess chloride concentration of the blood, which in turn would increase water loss from tissues. Many candidates stated that chloride ions would be excreted, but did not make the connection to the excess chloride originating from the sea water swallowed. A common misconception was that the chloride ions were needed to balance the sodium ions.

(b) Candidates were expected to relate their answers to the problems encountered by fish in fresh water and the mechanisms of salmon that allow them to survive in this environment. Very few candidates stated more than that salmon are euryhaline and in some cases that they spend part of their life cycle in fresh water. Confusion between osmoregulators and osmoconformers was particularly common. Many candidates didn't understand that osmoregulators maintain the osmotic concentration of their blood by maintaining the balance of water and ions in the blood. Stronger candidates showed some understanding that in fresh water salmon need to produce large volumes of dilute urine to remove excess water and to take up chloride ions through the gills. Few of these candidates understood that these processes occur because water passes into the fish by osmosis and chloride ions are lost as a result of the differences in osmotic concentration between fresh water and the blood of the fish. Candidates who did comment on the difference in the osmotic concentration often stated incorrectly that salmon could survive in fresh water because their osmotic concentration was closer to fresh water than tuna.

Question 3

This question was testing understanding of the life cycles of grouper and salmon.

(a) (i) Stronger candidates referred to the poor chances of fertilisation. Weaker candidates referred to survival of the fertilised egg.

(ii) Most candidates identified the use of a nest as an advantage, but tended to link this to the survival of the offspring, rather than to the enclosed space containing the eggs and sperm closer together. Weaker candidates often restated the question.

(iii) Most candidates related their answer to predation, but many candidates referred to fewer predators in fresh water rather than to the higher risk of predation in the ocean.

(b) Most candidates grouped the two types of fish. Stronger candidates linked the mass migration to spawning grounds with fishermen being able to predict where to find large numbers of fish. Weaker candidates tended to give answers which were too vague for credit, such as the fish travel in large numbers but without any reference to spawning grounds.

(c) The most common correct answers were related to a greater food supply.

Question 4

This question was testing knowledge of different methods used in commercial fishing.

(a) (i) Most candidates gained at least one mark for calculating correctly the distance to a shoal of fish. The most common error was not dividing the total distance travelled by the sound by 2. Some candidates did not include the units or used metres / second.

(ii) Most candidates gave a correct answer, commonly the size of a fish shoal. Common responses which did not gain credit included 'amount of fish' and 'length of fish'.

(b) (i) Most answers described damage to coral reef and the trapping of non-target species. Stronger candidates also referred to the loss of benthic habitats and damage to the sea bed caused by the dragging of the trawl along the sea floor. Some candidates were also aware of the indiscriminate nature of the trawl and the formation of sediment. Weaker candidates often gave statements such as 'destroying habitats or destroying the ecosystem'.

(ii) Most candidates were aware that purse seine nets have a lot of by-catch but were not able to explain why. A few stronger candidates linked dolphin feeding on shoals of fish to the presence of these mammals in purse seine nets. Weaker candidates usually gained credit for a named example of by-catch, commonly dolphin or turtle.

(c) Many candidates were not familiar with the role of factory ships as either large vessels that process and store fish on board or, as in some cases, the additional role as support vessels for smaller fishing boats. Stronger candidates understood that these vessels can stay at sea for extended periods of time and process and store large quantities of fish. Weaker candidates discussed catching more fish and making more profit.

Question 5

This question was about fishing of giant clam and the features of an aquaculture project to cultivate giant clams.

(a) (i) For annual catch: stronger candidates appreciated that although there were fluctuations there was an overall decrease in catch, and they were able to quote correct figures from **Fig. 5.1**. Weaker candidates tended to describe all the changes shown by the graph without quoting any figures.
For price: stronger candidates recognised the overall increase in price and also quoted correct figures. The strongest candidates also noticed the spike in price towards the end of the time period.
Many candidates misread the double axis graph and so quoted incorrect figures and often units were omitted. A number of candidates misinterpreted the question and answered by relating the size of the catch to the price.

(ii) Stronger candidates showed a clear understanding of supply and demand. Weaker candidates did not address this concept and answered in terms of 'a large catch means a low price', or more commonly 'a low catch means a high price so the fishermen can make enough money'.

(b) (i) Almost all candidates gave at least one correct answer, commonly 'land based tanks' or 'feeding the larvae with algae'. The most common incorrect response was 'retaining juveniles for breeding stock'.

(ii) Stronger candidates usually gave oxygen supply and the removal of wastes. Some candidates only mentioned oxygen supply. Weaker candidates answered in terms of providing the 'natural conditions' of the clams, controlling salinity, controlling water temperature or providing nutrients.

(iii) Few candidates gave more than one correct answer, the most common being retaining the juveniles as breeding stock. Stronger candidates either linked the retaining of juveniles to there being no further requirement of wild clams as breeding stock or recognised that the wild stock was still likely to be fished, so aquaculture would have a limited impact. Weaker candidates commonly referred to the clams not being released to the wild so that they could not breed with, or pass diseases to, the wild clams. A misconception from some candidates was that giant clams bred by aquaculture are genetically modified.

Question 6

This question tested knowledge and understanding of global warming.

(a) Most candidates gained maximum credit. Weaker candidates often made careless mistakes such as 'less carbon in the air from fossil fuels'. 'Less oxygen in the air' was the most common incorrect response.

(b) There were few high scoring answers as many candidates did not appear to be familiar with the evidence against human causes of global warming. Stronger candidates mainly referred to volcanic action and carbon dioxide release, solar activity and warming of the atmosphere. Candidates often gave responses which were limited by explanations that were not clearly linked to any evidence. Weaker candidates often gave vague comments about global cycles or ice ages with no further comment. Some candidates only copied information from **Fig. 6.1**.

(c) Answers were often extensive but too generalised to gain credit. Candidates needed to select the changes on land and in the ocean which are relevant to marine organisms and coastal environments but many candidates gave responses about atmospheric changes. Most candidates were familiar with the effect of increased temperature on coral, but only stronger candidates explained why the temperature is rising and the consequential effect on habitats of coral reefs. Weaker candidates often gave vague responses such as 'the coral dies and affects food chains'. Stronger candidates also explained the effect of sea ice retreating on habitats for marine mammals or the effect of loss of coral reefs on coastal protection. Very few candidates gave a clear description of the effect of an increase in sea level. Many candidates did not understand that low lying land is at particular risk and that this land is likely to be lost permanently but tended to answer in terms of the coast being destroyed which would damage the coastal ecosystem and flood everything. Many candidates gave extensive descriptions of changes in salinity due to ice melting and glaciers retreating however these did not gain credit as the ocean has variable salinity and the change in salinity is likely to have greater effects on the circulation of ocean currents.

Question 7

This question was about human impact on the marine environment and sources of conflict between marine protection, marine recreation and local communities.

(a) (i) Most candidates were able to give at least two examples of ways in which humans damage coral reefs. The most common being damage from divers or boat anchors and the illegal collection of coral as souvenirs. Stronger candidates showed an awareness of land based sources of pollution from agriculture or industry and of pollution from boat engine petrol or oil. Weaker candidates referring to pollution often failed to gain credit as the nature of the pollution and it's source were not mentioned.

(ii) Very few candidates were able to make a valid suggestion. Most responses were along the lines of 'taking an active role in maintaining the reef ' or ' monitoring the reef'. A few stronger candidates recognised that monitoring involves checking that rules or guide lines for activities in marine protected zones or reefs are being followed. These candidates often also referred to ways in which these can be monitored.

(b) Candidates were expected to consider the sort of activities that might be popular in a marine protected area, such as diving, fishing or sight-seeing. They were then expected to explain how the management of a reserve might want to restrict numbers and tourism might want to increase numbers. Most candidates gave answers that were too general, and which focused on management of a reserve stopping any access and tourism wanting maximum access. Stronger candidates gave a source of conflict but often gave only one side of the argument or answered in terms of how the money from tourism could be used by the marine reserve. Weaker candidates tended to describe the effect of tourism on marine protected areas.

(c) Many candidates misinterpreted the question and described the effect on the reserve of building hotels on the beach and the disposal of wastes from hotels rather than in terms of the use of the resources of a marine protected area. Other candidates assumed that a marine protection zone automatically meant that tourism would decrease because there would be no access to the protected area. The most common correct responses were related to conflict between fishermen and conservation groups about limitations on fishing, and also about shopkeepers or hotels wanting to increase tourism to boost sales but conservation groups wanting to limit tourist access. Weaker candidates tended to give responses which were too vague for credit such as ‘fishermen want to fish where they want and conservation groups are against this’, or ‘shopkeepers want to sell shells, coral and dried starfish from the reserve’.

MARINE SCIENCE

Paper 9693/04

A2 Data-Handling and Free Response

Key Messages

There were many excellent answers demonstrating that candidates were well prepared, had excellent factual knowledge and could apply their knowledge to unfamiliar situations but the overall standard of responses was mixed.

Candidates need to ensure that they:

- read questions carefully taking into consideration the command words used.
- look at the mark allocations for each question.
- write answers that have the detail and vocabulary required at A level.

General Comments

The standard of responses was variable. There were many excellent answers that showed thorough detail and many candidates are learning to use key vocabulary with confidence. Graph plotting skills were much better than in previous examination series and the majority of candidates could perform the simple calculations correctly. Weaker candidates still have a tendency to write answers lacking detail, avoid key vocabulary and do not take into account the number of marks allocated to a question.

Comments on Specific Questions

Section A

Question 1

(a) The standard of graphs was generally excellent. Over half of the candidates plotted a graph that used linear scales and labelled them accordingly. Many of the candidates correctly used two separate y axes. Plotting was generally far more accurate and most candidates joined the points with straight lines. The majority of candidates who drew two lines usually added a key of some form. Some of the candidates did not appreciate the need for two separate y axes and plotted a scattergram of mangrove area against CPUE. Some candidates needed to take more care with plotting and drawing lines.

(b) Most candidates found this question very demanding and only a handful scored maximum marks. Many did not appreciate the command word “evaluate” and instead of evaluating the data in the table and their graph, they gave answers about the role of mangroves in increasing biodiversity. Most recognised that the most simple pattern shown was a positive correlation between mangrove area and CPUE but fewer went on to recognise that there was a time lag between the two factors or that some years did not support the overall trend. Few candidates gave a manipulated numerical answer with most simply quoting data points.

(c) Most candidates found this question easily accessible and the majority gave credit worthy responses. Most recognised that the mangroves would provide opportunities for food and the fishing industry although many did not then go on to look at problems. Stronger candidates often wrote extremely well thought through answers discussing the effect of an invasive species on existing food chains and population numbers.

Question 2

(a) About half of the candidates were able to perform the calculation correctly. Many of those who did not achieve the correct final answer were able to determine at least one of either surface area or volume. Candidates are reminded of the need for calculators in the examination.

(b) Most candidates were able to recognise that the surface area : volume ratio decreased as the fish volumes increased. A significant number, however, were unable to recognise the pattern.

(c) Many candidates gave vague responses such as stating that the fish would require more oxygen. Stronger candidates recognised that the surface area : volume ratio was small for these fish and linked this to the diffusion of oxygen. Candidates should try and use terms such as diffusion where appropriate. Many weaker candidates thought that the water flow would allow faster osmosis or more nutrients. Few candidates considered the metabolic rate of the fish.

(d) Candidates needed to look at the different species of fish and recognise that the yolk sacs were in different proportions. Only the strongest candidates gave sensible suggestions that were in agreement with the data. The most common creditworthy responses discussed the developmental rate of the fish and the nutrient levels of the water affecting the female fish producing the eggs and the ability of the fry to feed.

Section B

Question 3

(a) (i) Some candidates gave excellent answers that explained fully the procedures used for generating GM salmon. Many weaker candidates, however, gained very little credit. Common misconceptions included the ideas that GM salmon are injected with hormones or that they are generated through selective breeding. Some candidates were reluctant to use scientific vocabulary often getting no further credit than the idea of adding a growth gene. Many candidates were confused as to the differences between the promoter gene and the growth gene. Many candidates misinterpreted the question and gave answers about the uses of GM salmon.

(ii) Most candidates were able to gain some credit and the majority were able to discuss the benefits and problems associated with GM salmon. Most candidates recognised as an advantage that the fish would reach market size faster and would help make more profit. They also recognised as a disadvantage the escape of the salmon and its subsequent effects on natural ecosystems. A few candidates misinterpreted the question and discussed the benefits and drawbacks of salmon farming in general rather than farming GM salmon.

(b) Most candidates were able to gain some credit but often gave vague answers about pollution without giving much scientific detail. Candidates needed to appreciate that untreated waste could contain a range of substances such as minerals, fertilisers, organic waste and pathogens and then explain the problems caused by them such as such as decay and eutrophication or turbidity reducing light penetration for producers.

Question 4

(a) Candidates found this question demanding but stronger candidates scored full, or almost full, credit. Stronger candidates were able to recognise the ecological need for conservation and the value of species to humans, many also went to explain damaging economic effects and how conservation can be harmful at times to other species. Many candidates only discussed the need for humans to protect the main environment and often gave highly specific examples. A few candidates thought that any species that were not valuable to man or that were potentially harmful to man should not be conserved.

(b) Most candidates have an excellent knowledge and understanding of the methods that are employed to ensure that fish stocks do not drop and many candidates gained full credit or at least three quarters of the credit available. They appreciated that fishing should not harvest more fish than can be reproduced and went on to explain the methods that governments use such as different types of restriction and methods of monitoring and enforcement. Some weaker candidates recognised the need for restrictions but gave no specific examples other than “less

fishing". Other candidates misinterpreted the question and wrote about how the maximum amount of fish could be taken from the sea using large nets and factory ships or about methods of fish farming.