

88076303

**ECOSYSTEMS AND SOCIETIES
STANDARD LEVEL
PAPER 2**

Monday 5 November 2007 (morning)

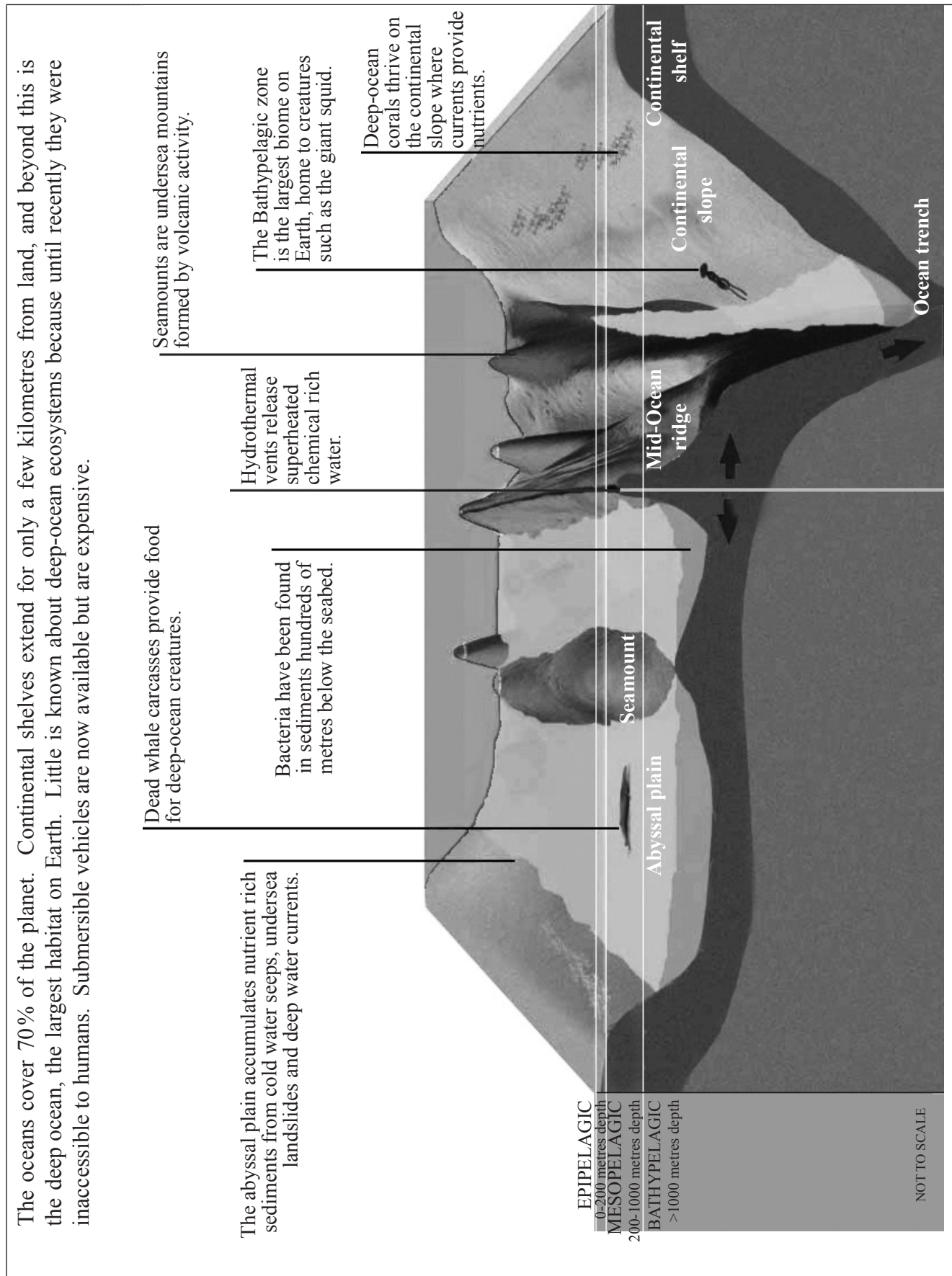
2 hours

RESOURCE BOOKLET

INSTRUCTIONS TO CANDIDATES

- Do not open this booklet until instructed to do so.
- This booklet contains **all** of the resources required to answer question 1.

Figure 1 Diagram of the deep ocean



[Source: adapted from *Mysteries of the deep sea*, www.newscientist.com/channel/earth/deep-sea]

Figure 2 Biotic and abiotic components of the deep-ocean ecosystem

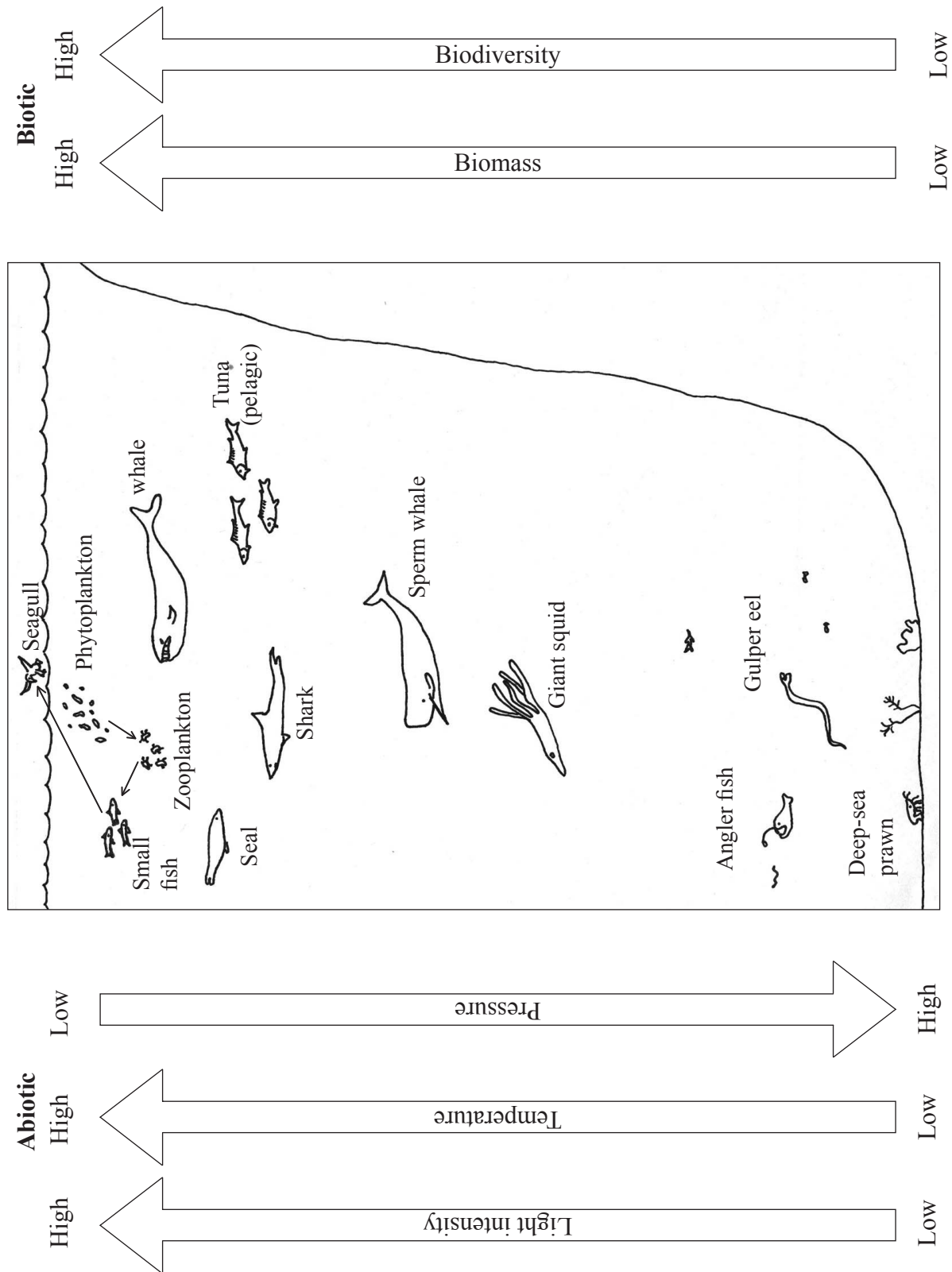
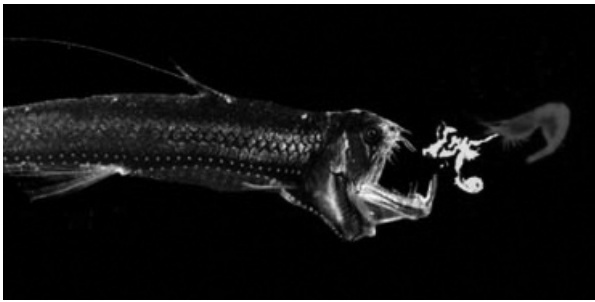


Figure 3 Adaptations to the deep-ocean environment

Examples of adaptations of deep-ocean species:

- long arms and ability to be able to sift through mud and detritus for food
- bioluminescence (the ability to produce light) – used to attract mates, to obtain food, for camouflage or to confuse predators
- nets of tentacles to trap falling detritus for food
- angler fish use light-producing bacteria that live on a special fishing rod-like fin that hangs over the angler's head and wiggles in the water to attract prey
- red or purple colouration (in normal light) *e.g.* deep-ocean prawn – because of the absence of red light at depth these animals are invisible
- bodies that are completely filled with water so that an increase in pressure has little effect. For this reason jellyfish, squid *etc.* have no difficulty when moving through the water column.

[Source: adapted from www.mesa.edu.au/seachange/97/deepsea.htm]



Deep-ocean prawn ejecting bioluminescence

[Source: adapted from <http://people.cornellcollege.edu/a-carlson/geo105/whatisbiolum.htm>]



Deep-ocean prawn

[Source: www.oceans.gov.au/norfanz/new2creatures.htm]



Angler fish

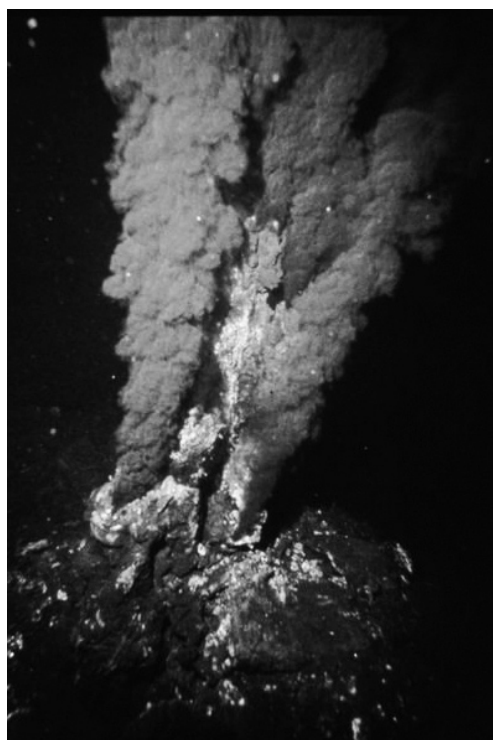
[Source: www.oceanexplorer.noaa.gov]

Figure 4 Diversity hot spots – deep-ocean vents

Of great interest to marine scientists was the discovery of communities of animals living around deep vents on the ocean floor. From these vents pour large quantities of heated seawater which contain high quantities of hydrogen sulfides and dissolved minerals. These vents occur where tectonic plates are slowly moving apart. Clouds of bacteria are found around these vents. The bacteria draw their energy not from the sun as plants do but from the hydrogen sulfides discharged from the vents. The bacteria in turn provide food for a range of other animals including shrimp, crabs and worms, which in turn support species of fish.

Metre-long tube worms in the vents have developed an unusual relationship with the bacteria around the vents. The tube worms have no mouth and no digestive tract. Instead, they have bacteria living inside an interior sac. The red hemoglobin in the tube worms' feathery gills can bind to the hydrogen sulfide in the hot vent water and carry it to the bacteria. The bacteria are able to oxidize the hydrogen sulfide and in doing so, convert large amounts of carbon dioxide from seawater into organic carbon, which is then absorbed by the tube worms.

[Source: adapted from www.mbl.edu/email/images/nur04506_sm.jpg]



Deep-ocean vent



Tube worms

[Source: www.mesa.edu.au/seachange/97/deepsea.htm]

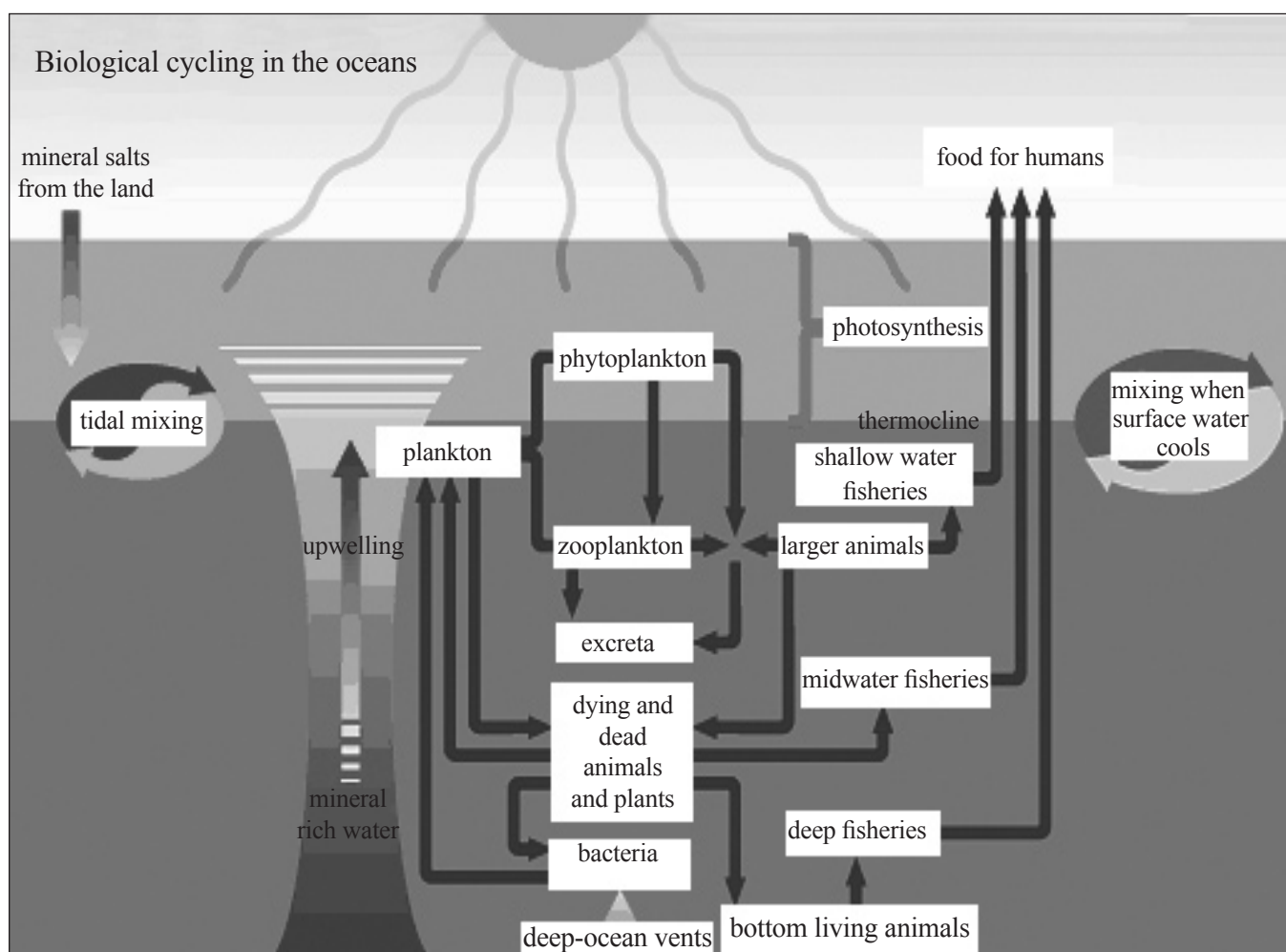
Figure 5 Nutrient cycling in the deep ocean

The habitat is a predominately dark and cold environment with much lower productivity than shallower waters. No light penetrates beyond 1000 m and even at depths of 150 m light levels are reduced to 1 % of those at the surface and are insufficient to support photosynthesis.

Therefore, organic material must be transferred into the deep waters, which occurs in various ways. Dead phytoplankton sink, and though much is consumed as it settles, sufficient amounts enter the deep water to sustain much of the biomass there. The constant rain of organic detritus (remains of organisms from above) can be so thick it is called “marine snow”. Many species migrate, feeding in the surface waters and moving down during the day, avoiding predators. In this way, surface production is cascaded through to deeper layers.

Of relatively minor productive importance is organic material from large carcasses (e.g. dead whales) sinking to the ocean floor and sulfur-based organic production associated with deep-ocean vents. The concentration of organic material decreases exponentially with depth.

[Source: adapted from www.oceansatlas.org]



[Source: adapted from www.oceansatlas.com/world_fisheries_and_aquaculture/html/ecosys/coastmarine/typesofeco/img/121.biocycle.gif]

Figure 6 Fishing in the deep ocean

Until recently, the great depth of the oceans has made them difficult to exploit as the existence of more abundant resources in shallower waters have meant that little incentive existed to fish in the deep oceans.

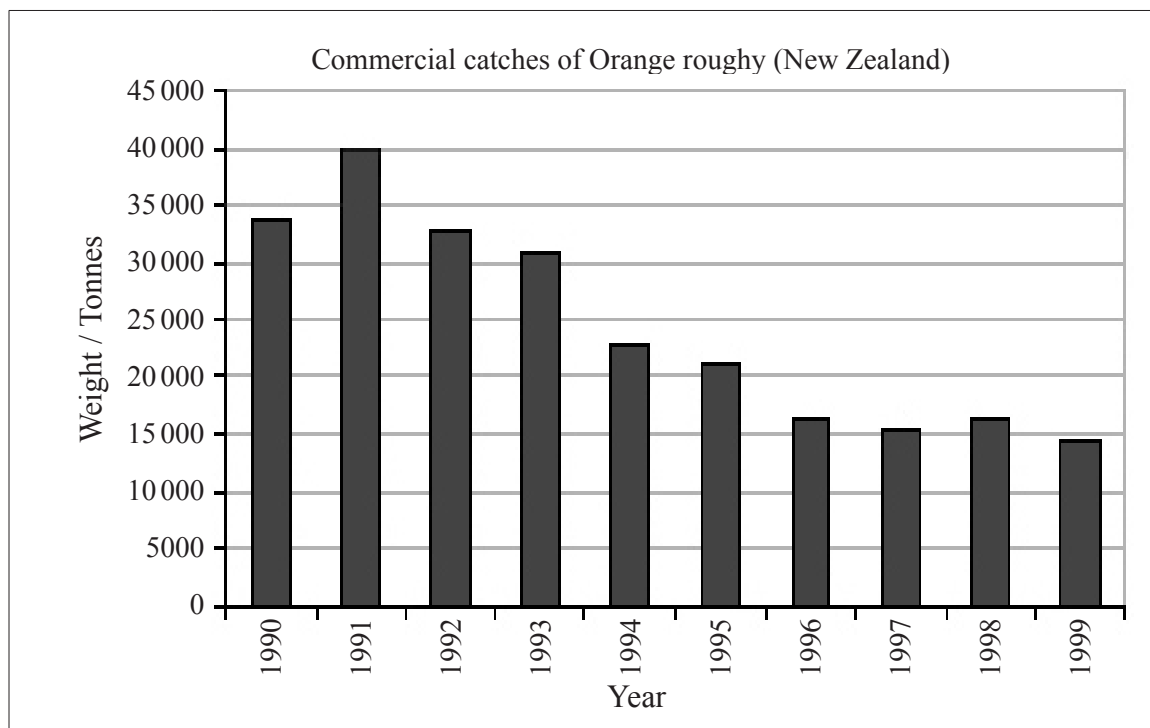
With the reduction of opportunities for development of inshore fisheries and the improvement of fishing technology and navigation instruments, deep-ocean fishing expanded in the 1990s. A well-known example is that of the Orange roughy, a deep-ocean species found around New Zealand. Specially aimed trawling techniques have been developed. Maximum sustainable levels of exploitation of Orange roughy may be as low as 5-10% of un-fished biomass. Accumulating evidence about stock declines indicates that Orange roughy are being exploited unsustainably and ongoing yields are likely to be around 5% of those initially obtained.

[Source: adapted from www.oceansatlas.org]



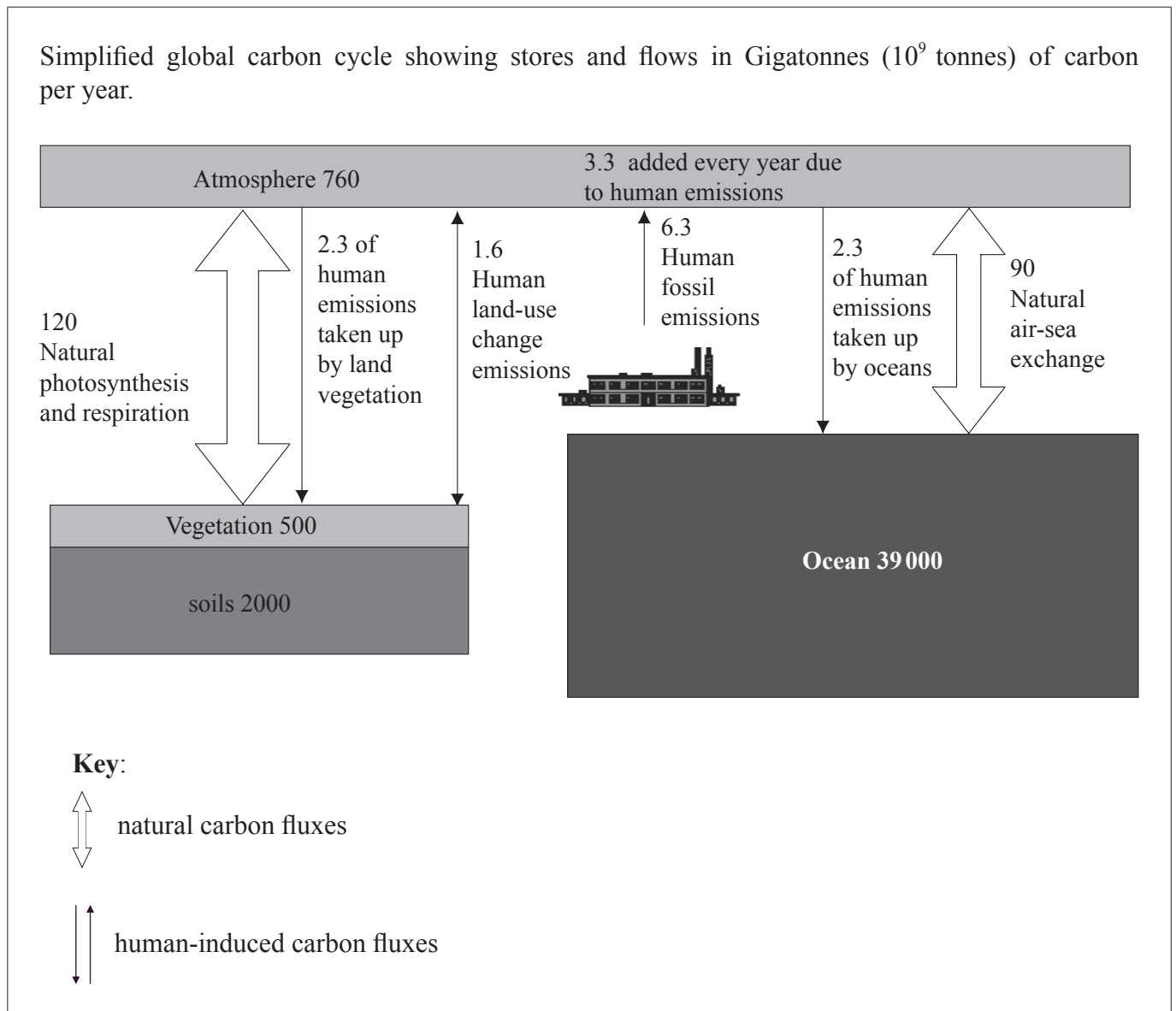
Orange roughy

[Source: www.starfish.govt.nz/science/facts/fact-orange-roughy.htm]



[Source: adapted from www.starfish.govt.nz/shared-graphics-for-download/roughy_chart.gif]

Figure 7 The deep ocean as a carbon sink



[Source: adapted from IPCC SRLULUCF 2000 and IPCC TAR WGI 2001]