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ENVIRONMENTAL SYSTEMS AND SOCIETIES
STANDARD LEVEL
PAPER 2

Wednesday 14 November 2012 (morning)

2 hours

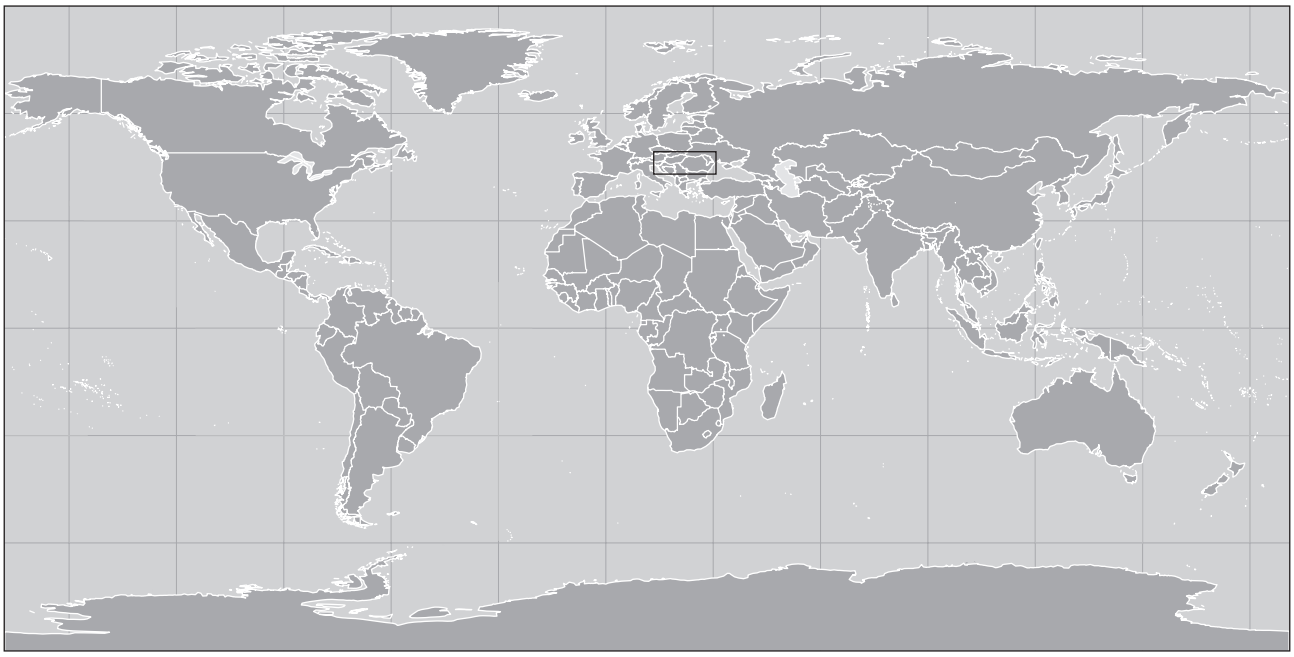
RESOURCE BOOKLET

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 Maps showing the area covered by this case study

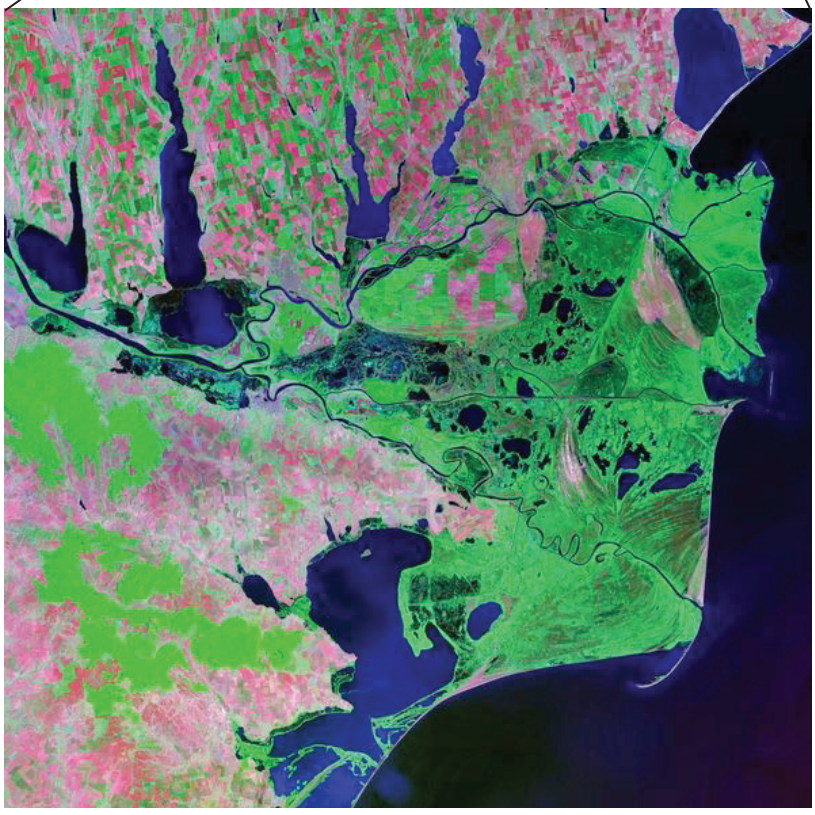
(a) World map showing the location of the Danube River delta



[Source: www.un.org/depts/cartographic/english/htmain.htm]

(b) Map of the Danube (showing countries that it passes through and the delta). The Iron Gates represents the location of two hydroelectric dams.

(c) Map of the Danube River delta and the Kiliya, Sulina and St George channels

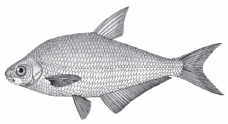


[Source: http://en.wikipedia.org/wiki/File:Danubemap.jpg
http://en.wikipedia.org/wiki/File:Danube_delta_Landsat_2000.jpeg]

Figure 2 Background Information to the Danube River delta

- The Danube is the longest river in the European Union. It flows through or forms the borders of ten countries.
- The Danube River delta marks the point where the Danube River flows into the Black Sea.
- The Danube River delta includes UNESCO Biosphere Reserves and a World Natural Heritage site.
- A delta is a fan-shaped landform that is created at the mouth of a river where the river flows into an ocean, sea or lake.
- A delta is formed by the continuous deposition (dropping) of sediment that has been carried by the river. Sediment adds height to the delta and helps it extend out into the sea.
- A river can divide into separate channels as it goes across its delta.
- The Danube River delta is a wetland ecosystem rich in plants (over 1000 species), birds (300 species, including the largest pelican colony in Europe) and fish (including several endangered species of sturgeon).
- Moldova is a country which takes nearly 20 % of its water supply requirements from a branch of the Danube.

Rainbow Trout
(Oncorhynchus mykiss)



White-eye Bream
(Abramis sapa)

Barbel
(Barbus petenyi)

Russian Sturgeon
(Acipenser gueldenstaedtii)

Dalmatian Pelican
(Pelecanus crispus)

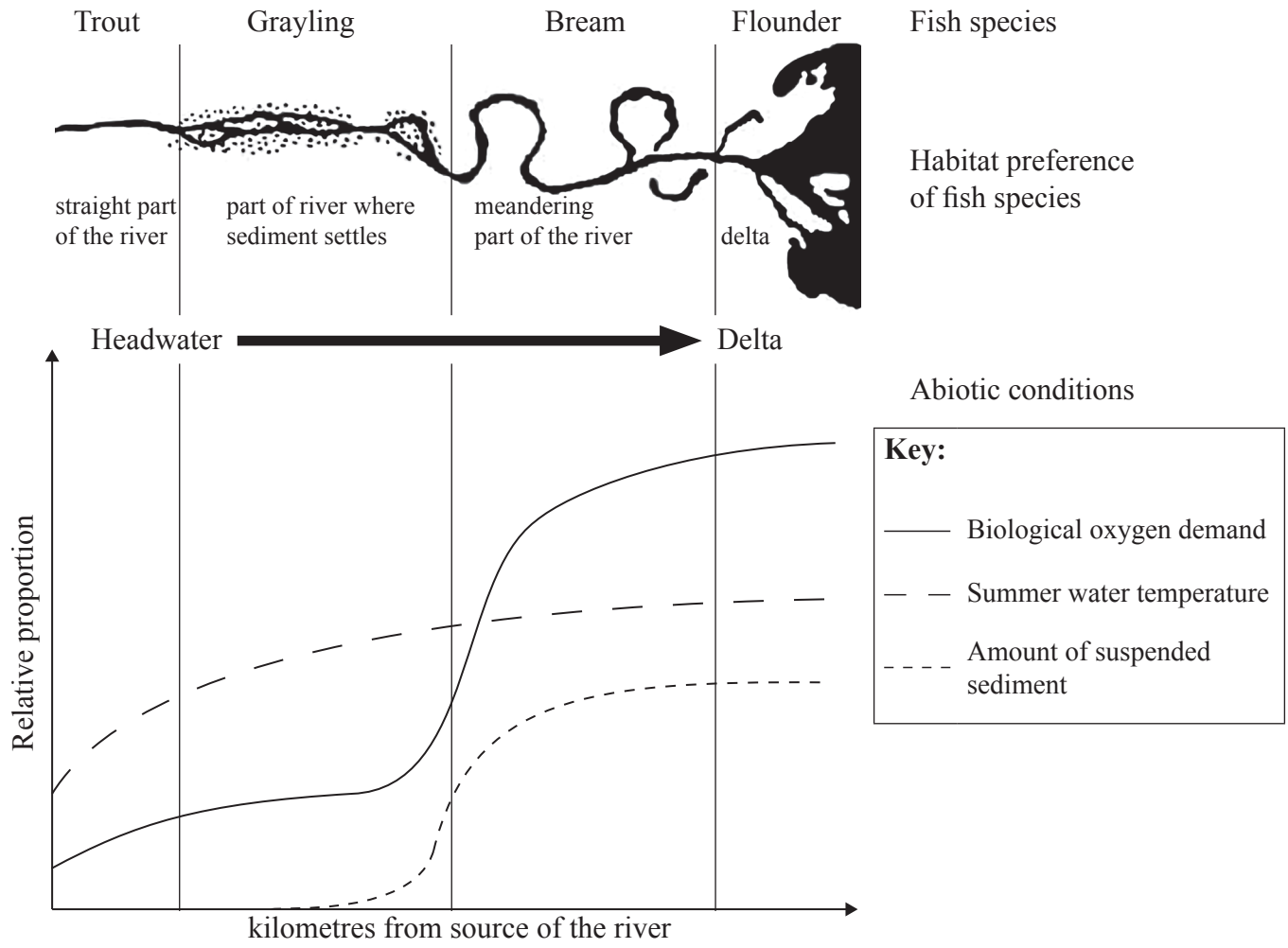
Eurasian Spoonbill
(Platalea leucorodia)

Lesser Bulrush
(Typha angustifolia)

Common Reed
(Phragmites australis)

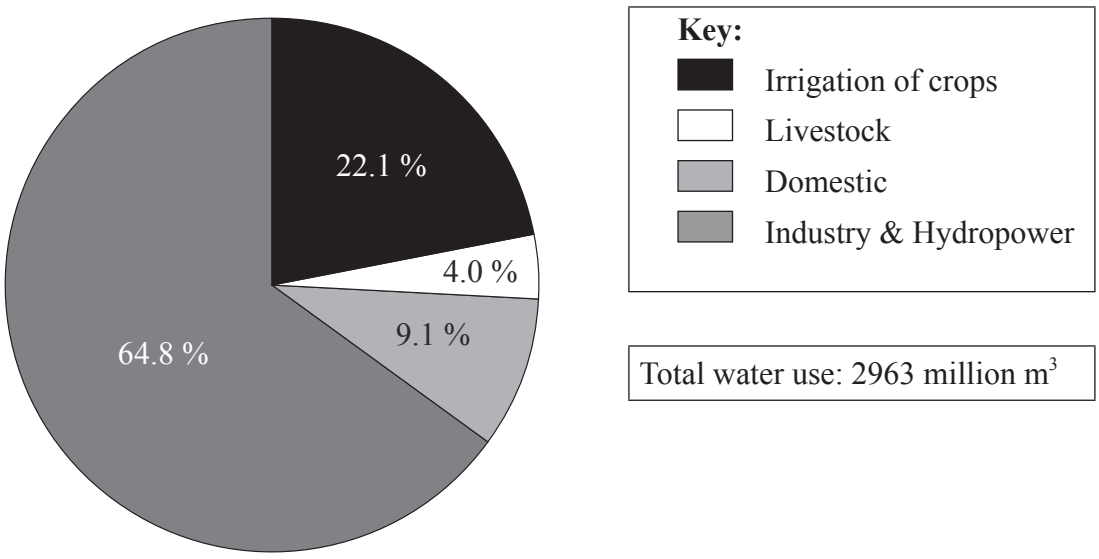
[Source:
Rainbow Trout: http://en.wikipedia.org/wiki/File:Rainbow_trout_FWS_1.jpg, author: Timothy Knepp, US Fish and Wildlife Service
White-eye Bream: http://commons.wikimedia.org/wiki/File:Abramis_sapa.png.
Barbel: http://en.wikipedia.org/wiki/File:Barbel.jpg, created by Neil Phllips.
Russian Sturgeon: http://en.wikipedia.org/wiki/File:Waxdick_(Acipenser_gueldenstaedtii_)_-_crop.jpg, created by Daniel Dohne.
Dalmatian Pelican: http://en.wikipedia.org/wiki/File:Pelecanus_crispus-20030720.jpg, created by Doug Janson.
Eurasian Spoonbill: http://en.wikipedia.org/wiki/File:Loeffler.jpg, created by Creandro.
Lesser Bulrush: http://en.wikipedia.org/wiki/File:Typha_angustifolia_(habitus)_1.jpg, created by Le.Loup.Gris.
Common Reed: http://en.wikipedia.org/wiki/File:Phragmites_australis_Schilfrohr.jpg, created by Darkone.]

Figure 3 Habitat preference of Danube fish species



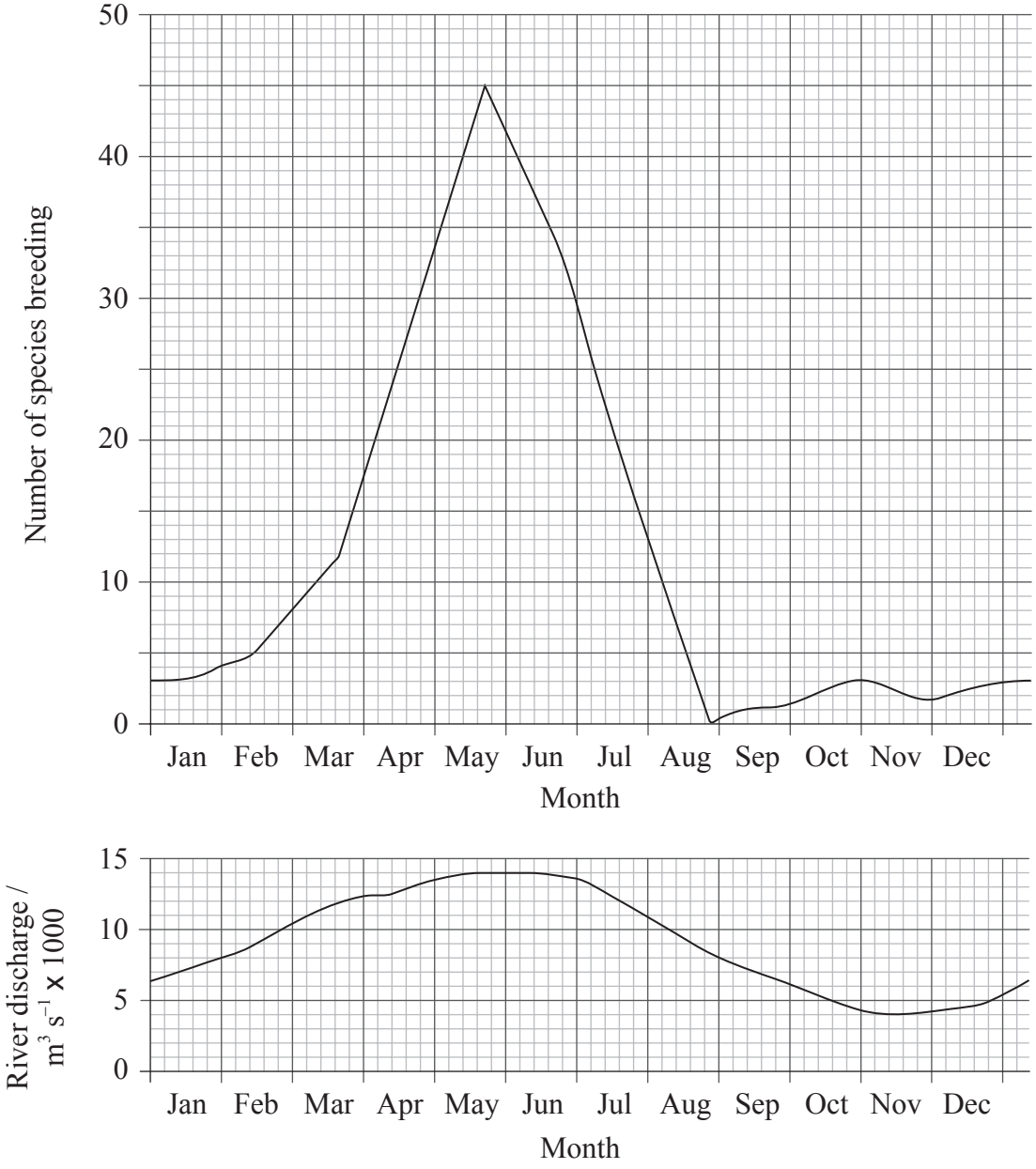
[Source: ICPDR (2009) Ecological prioritization of measures to restore river and habitat continuity in the DRBD. Used with permission.]

Figure 4 Water use in Moldova in 1992



[Source: www.fao.org/nr/water/aquastat/countries/moldova_rep/index.stm]

Figure 5 Relationship between the number of fish species breeding and water flow (river discharge) in the Danube River delta.



[Source: adapted from http://www.fao.org/docrep/003/T0537E/T0537E06.htm]

Figure 6 Natural Income sources from the Danube River delta

Cattle

Fishing

Tourism

Shipping

[Source:
Cattle image: http://en.wikipedia.org/wiki/File:IMG_cow.JPG, author Route 11
Fishing image: http://en.wikipedia.org/wiki/File:DanubedeltaSulinaarm2.jpg
Tourism image: http://en.wikipedia.org/wiki/File:Cazaresulinaoras2.jpgNeagra.jpg
Shipping image: http://upload.wikimedia.org/wikipedia/commons/7/7b/Canalul_Dunare_Marea_Neagra.jpg]

Figure 7 Changes to the amount of sediment flow into the delta between 1921 and 1990 due to dam construction and flood control structures.

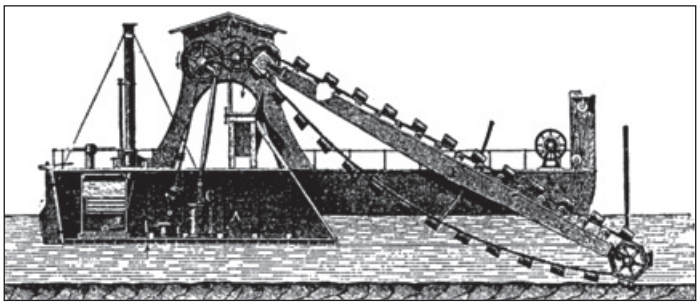
Years	Average sediment flow / tons yr^{-1}
1921–1960	67.5
1971–1980	41.3
1981–1990	29.2

[Source: http://assets.panda.org/downloads/vision_doc_280107_final.pdf]

Figure 8 Dredging techniques

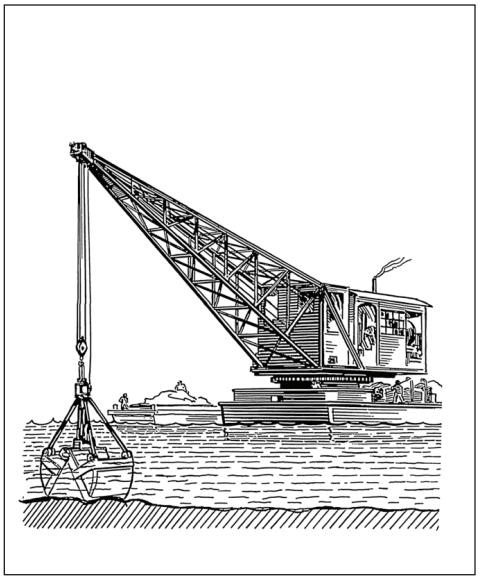
To ensure that the sediment carried by the river does not interfere with navigation, regular dredging of the river must be carried out. This involves scooping out sediment using heavy machinery. Dredging has also been used to straighten channels.

(a) Bucket dredging



[Source: http://en.wikipedia.org/wiki/File:Dredging_technique_schematic.png
Fröléens konversationslexikon vol. II, p. 780-781 (Stockholm 1914).]

(b) Grab dredging



[Source: http://en.wikipedia.org/wiki/File:Dredge_(PSF).png. Created by Pearson Scott Foresman.]