CASE STUDY

NATIONAL PARK PLITVIČKA JEZERA

TUTOR INSTRUCTIONS

BY TOXLEARN4EU
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Case study
problem-based learning

Plitvička jezera case
by IMROH (HR)

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1. Introduction

Plitvička jezera is the oldest Croatian National Park (NP) and Europe's oldest UNESCO World Natural Heritage Site. It fulfils UNESCO's criteria: (1) *to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*, (2) *to be outstanding examples representing major stages of earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features*; (3) *to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals*.
The park is settled in a karst region with specific geological properties (porous rock). Karst is a type of landscape where the dissolving of the bedrock has created sinkholes, sinking streams, caves, springs, and other characteristic features. It is typically made of limestone - calcium carbonate (calcite) or the double carbonate of calcium and magnesium (dolomite) however, at the park, the microenvironment enables the formation of tufa. Tufa is a hollow, porous rock created from the deposition of dissolved calcium carbonate in the water by plants, algae and mosses. At the park, tufa is responsible for forming 16 cascading lakes that are extremely beautiful, however, the processes of tufa formation and degradation are extremely reliable on water quality such as pH, saturation with minerals, etc.

Since the national park is a highly touristic place (particularly in summer), the whole surrounding area has increased anthropogenic activities. More tourists lead to higher traffic, urbanization of the surrounding area, and an increase in agriculture. These human activities impact the environment which is quite sensitive to changes. UNESCO has recently stressed several concerns – the direct impact of tourists, the impact of the construction of new accommodation spaces and inadequate infrastructure, air pollution, and water contamination.

2. Plan of conducting the case study

Step 1. Design of the case
Split your students into 3 groups (3 – 6 students per group): Research institute; Government; and UNESCO

Step 2. Group's goals
a) The research institute group has the goal to develop **a report** – describing the current situation at the NP
b) The government group has the goal to develop **a rulebook** – stating which improvements need to be implemented in order to preserve NP's UNESCO status
c) The UNESCO group has the goal to develop **a checklist of criteria** – how they will evaluate whether the first two groups have done their job correctly

It is the task of the first two groups to convince the UNESCO group to keep the park on the list of World Natural Heritage Sites.

Step 3. Reaching the goals
To achieve their goals, each group will have a budget of **1.000 TOXcash** (fictional currency) and they will be presented with a set of analyses (each per different price) they can choose to complete their assignments.

They have analysis groups: radionuclides, persistent organic pollutants (POPs), air pollution, metals, microbiology and water quality, and genotoxicity for 3 sampling sites and two seasons. Since there are different matrixes which analyses are made from, they can also choose between two species of fish and moss.

The pricelist for each dataset

Pricelist	method	medium	per site/2 seasons (TOXcash)
Radionuclides	gamma activity	sediment and water	**35**
	gamma activity	moss and fish	**40**
Genotoxicity	comet assay 2D cells	water	**20**
	comet assay 3D cells	water	**30**
	comet assay 2D cells	sediment	**20**
	comet assay 3D cells	sediment	**30**
	comet assay *in vivo*	fish	**30**
POPs	OCP, GC	sediment	**30**
	PCB, GC	sediment	**30**
	OCP, GC	moss	**50**
	PCB, GC	moss	**50**
Air pollution	PM, gravimetry	air	**85**
	PM, sensors	air	**25**
	PAH, HPLC	air	**100**
Metals	ICP-MS	water	**100**
	ICP-MS	fish	**125**
Water quality	microbiology, CFU	water	**30**
	chemistry, GC-MS	water	**30**

*POPs – persistent organic pollutants, OCP – organochlorine pesticides, GC – gas chromatography, PCB – polychlorinated biphenyls, PM – particulate matter, PAH – polycyclic aromatic hydrocarbons, HPLC – high performance liquid chromatography, ICP-MS - Inductively coupled plasma mass spectrometry, CFU – colony forming units, GC-MS – gas chromatography mass spectrometry

Step 4. Students' work

Give your students enough time to plan how to approach the problem, which analyses to choose, time for their interpretation, and the preparation of final reports [at least 18 hours in total].

Students can pick the data they need and do not have to pick all the data simultaneously. They can use literature, the Internet, and reliable sources to check the context of their data, compare results, etc. However, since the data are fictional, they will not find an explanation for these specific tasks in the available literature.

You can give periodical subtasks to the groups (e.g.):

BRAINSTORM - Develop a plan - what your group needs to do and how to get a result

USE DATA, start analysing it and find literature

START PREPARING your presentation. You should have picked all the data you need

THINK OF FUTURE ACTIONS you might include in your presentation

PRACTICE your presentation

Students can also ask for help from tutors/mentors, however, it is not advisable to give them answers but to guide them toward the solution. E.g. by asking them more questions.

Step 5. Presentation of students' work

Each group will have 15 min to present their work, which will be followed by 5 – 10 min for discussion. They can use different approaches to increase the effectiveness of their presentation (short videos they did, dramatic play, staging an environmental protest riot, etc.)

At the end, organize a vote to select a winning group.

3. Related documents

- Case study PowerPoint presentation for lecturers
- Case study Database
- Case study Form
- Toxlearn4EU Summer School Zagreb selected lectures (link)

- Note that the whole case is fictional and serves learning purposes –

4. Remarks for the lecturers

When selecting among organisms, note that:
- *Leuciscus cephalus* is a common fish, while *Chondrostoma phoxinus* is critically endangered
- *Polytrichum vulgare* is a common moss, while *Palustriella commutate* is a tufa-forming moss

This info should be considered when presenting and discussing.

Database tricks
Radioecology:
Beryllium is formed by sunlight and is detectable after rain. The half-life is 53 days.
If students found this information – you can give them an explanation that the analysis was done 7 days after the rain, while there was no rain at the reference site.
Potassium is a naturally occurring nuclide and is typical for specific rocks (half-life 109 years), so it is typical for certain terrains.
Caesium 137 has a half-life of 30 years, and it's detectible from the Chornobyl disaster
Caesium 134 has a half-life of 2 years, and it's detectible from the Fukushima disaster
Strontium 90 has a half-life of 29 years, and it's detectible from the Chornobyl disaster
Iodine 131 is man-made, has a half-life of 8 days, and implies spillage. It is used for medical treatment.
If students found this information – you can give them an explanation that 5 days ago there was an accident where a van crashed and there was a spillage of I-131. Please notice that the road is quite near the lakes at sampling site S2.

Genotoxicity:
There are no tricks there, but the choice of fish

POPs:
The same here, but the choice of moss

Air pollution:
Sensor-based analyses are cheaper but not reliable, therefore in the summer period they cannot be sure for air pollution analyses.

Metals:

There are no tricks there, but the choice of fish

Microbiology:
In the summer season site S2 is indicating sewage wastewater pollution.
It is not a common discharge, because the pollution cannot be traced S1 -> S2 -> S3, but since the karst is very porous, some water discharged found its way to the lakes from surrounding inadequate sewage systems.

5. Learning outcomes

After completing the case study, students will be able to:

- work in groups, with attention to task and time management
- manage budget related to a specific activity
- critically assess data from laboratory work
- search for the data using reliable sources
- present results
- respond to queries related to their task

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