Social Interactions of Pigmented and Albino Catfish

(experimental background and data description)

NMST551 – Statistický projektový seminář | Winter term 2025/2026

Introduction/Motivation

A simulated experiment was conducted at the Czech University of Life Sciences in 2016 – 2017. The main idea of the experiment was to compare and analyze social/aggressive interactions of two groups of catfish (*Silurus glanis*, Linnaeus 1758) individuals while competing among each other for limited supply of food and hideout sources.

A group of regular pigmented catfish (four pieces) or a group of albino catfish (again four pieces) was placed into an artificial indoor aquarium with a hideout being placed roughly in the middle. The movements and mutual interactions between the four individuals in the aquarium were (partially) recorded with a high-resolution camera for the follow-up period of 24 hours. After the experiment, the recording was viewed by experts while focusing on specific interaction types. In particular, the occurrence of the following events was taken into account:

- a change of an individual in the hideout (denoted as `zdroj W_L`);
- an unsuccessful try to take over someones place in the hideout (`Q_L_pokus`);
- aggressive interactions (biting `A_biting`, chasing `A_chasing`, lateral display `A_latdispl`, and frontal display `A_frontdispl`);
- total movement activity (`total`);

Any occurrences of such activities were recorded into the underlying data together with the corresponding time, the type of the group of catfish being present in the aquarium (regular pigmented vs. albino), and some additional group specific characteristics: average weight of the group (`W_prumer`), maximum weight (`W_max`), minimum weight (`W_min`), average length (`delk_pr`), maximum length (`delk_max`), minimum length (`delk_min`).

All together, there were 28 analogous experiments conducted (analogous in a sense, that the conditions of the indoor aquarium were kept the same—at least as much as possible: temperature, visibility, artificial light to mimic day/night conditions, other chemical/physical parameters, or the time of food suply) while in 14 experimens there were regular pigmented individuals placed into the aquarium and in 14 experiments albino individuals were used instead.

The mutual interactions occurring between the individuals when competing for the limited hideout sources are not about to be explained only with respect to the group type (regular pigmented group vs. albino group) but also with respect to various "subject specific" physiological characteristics (such as stress enzyme levels or blood analysis). For this purpose, analogical experiments (however, without camera recordings) took place aside in order to assess these characteristics (taken always post mortem). Four individuals (regular pigmented or albino ones) were again placed into an identical indoor aquarium assuring the same conditions as in the first aquarium but, after some specific time they were all taken out to take brain, gill, and liver samples together with blood tests. Another four individuals of the same type were placed into the aquarium instead until they were taken out again in order to take another set of the "subject-specific" and time-specific physiological characteristics.

Given some previous research in this area (see, for instance, Slavik et al., 2015), the whole 24 hour follow-up period can be effectively split into 4 disjoint fragments of a day (0:00 – 6:00, 6:00 – 12:00, 12:00 – 18:00, and, finally, 18:00 – 24:00). In this respect, the specific times for physiological samples were defined in a way that two samples are always taken within each fragment of a day (thus, 4 individuals and 2 sampling opportunities are given within each fragment for every group – regular

pigmented or algino invididuals). Various parameters are assessed from the blood tests (such as the cortisol level, lactate, glucose, albumin, etc.) and the concentration of different enzymes is also measured for the brain, gill, and liver samples (for instance, SOD, CAT, or TBARS).

Scientific Hypothesis
The main idea is to focus on differences between aggressive interactions occuring among regular pigmented catfish and within a group of albino individuals. For instance, if there is a difference in cortisol or glucose, then it could be interpreted in terms of a higher level of stress. Or, alternatively, if there is a difference in lactose then it should be explained by in terms of giving more effort into various encounters.

To be explicit, the following scientific hypothesis are formulated:

1. The social interactions between individuals of the same type (regular pigmented or albino individuals) when competing for the limited hideout sources are generally different (albino individuals are expected to be less active in the given environment);
2. Aggressive interactions and their occurrences depend on a 24 hour daily cycle (in general, it is assumed that the catfish individuals are more active during a day).;
3. The difference between the social interactions of regular pigmented catfish and albino catfish can be linked to different stress levels (in general, albino individuals are considered to be more stressed as they are assumed to be more threatened than regular pigmented individuals);
4. The difference between the social interactions of regular pigmented catfish and albino catfish can be explained by differences in the concentration of various chemicals in the blood.

Technical limitations of the experiment
An obvious difficulty of this experiment lies in the fact that the "subject-specific" physiological characteristics (blood tests and gill, liver, and brain samples taken always post-mortem) can not be directly linked to specific individuals and their social/aggressive interactions. Other technical limitations of the whole experiment made it impossible to collect more precise data. For instance, for the first experiment with the albino individuals, the camera device was not set properly and the obtained recordings could not be used to assess the interactions of the group. Moreover, the same four individuals were used for some experiments and there are only 11 experiments with unique groups of four albino individuals while there were 14 experiments with unique groups of 4 regular pigmented individuals (variable `č.vzorku` in the main data file).

Data files
All together, there are three (`xlsx`) data files available separately for the social interaction and the occurrence of aggressive behavior, blood test results, and the stress enzyme samples. The files can be downloaded from the official course website in SIS (student's login required) together a detailed description of the whole experiment (in Czech).

- Data file from the analysis of the video records: `social_interactions.xlsx`
- Blood test results: `blood_results.xlsx`
- Stress enzymes samples: `stress_enzymes.xlsx`

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