# “VISIONARIUM”

## SEPTEMDECIM

# XVII

**al Tvärminne Zoological Station.**
**University of Helsinki,**
**September (13)14 - 16, 2018**

Tvärminne Zoological Station 1903

The purpose of the Visionarium meeting is to continue in the spirit of the former "Planeringsgruppen" (Swedish Medical Council 1968-2001) by bringing together scientists in vision research to informal meetings to present on-going and planned research and to discuss and establish future projects. Projects in the planning stage are as welcome as already finished projects. Convener and organizer has since the beginning 2002 been Dr Magnus Lindström (magnus.lindstrom@helsinki.fi).

**About Tvärminne Zoological Station.**

The station was founded as a private research base in 1902 by Professor Johan Axel Palmén, who bequeathed it to the University of Helsinki in 1919. Since then, the Station has gradually evolved into the modern research and education institute of today. A prerequisite for a modem field station is that it attracts high quality research. By this measure, Tvärminne is clearly successful. More than two hundred research scientists (non-graduate and graduate students included) work yearly at the Station. We are indebted to the late Professor Palmén for perhaps our greatest asset. He chose the best imaginable location for his field station, not only for marine studies but for many others. The University of Helsinki built new buildings for the station in 1970 and has kept them in good condition, although a major repair is scheduled to begin 2019. We have managed to keep our instrumentation and field equipment up-to-date. Although priority has been given to marine research in developing our infrastructure, it is by no means the only subject at T.Z.S. We got a hovercraft in 2016, and the new research boat will be delivered end of 2019. For vision scientists there is the Electrophysiological laboratory, old but very flexible.

If you are planning an international field course or seminar, please, don't hesitate to contact the Station for more information. Please, check our home pages at: http://www.helsinki.fi/tvarminne.

A history book covering the Station's first little more than one hundred years has been published in Finnish and Swedish. The book is plentifully illustrated, interesting and even fun. The Swedish version is easier to understand for English speaking readers. Take a look at the book outside the Office, in which it can be bought for a reduced price of only 30 €, A good gift, especially for Swedish or Finnish speaking biologists celebrating their 50-year anniversaries!

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**About Visionarium, and especially Visionarium XVII**

The seventeenth Visionarium has brought 46 scientists to Tvärminne. After this meeting Visionarium has been visited about 694 times by ca. 239 scientists, who have given ~576 presentations. This achievement was something I never could imagined when I back in 2002 invited colleagues, mainly from Helsinki, to take part in an unofficial meeting for vision scientists The meeting was a success, and next year our colleagues from Sweden and Russia joined us. Since that time Visionarium has been international. For arranging this year's meeting I have received a grant from the Otto A. Malm Foundation, for which I express my gratitude. I also thank those who kindly have sent supporting letters along with my application. Thanks are due to the Zoological Station, which kindly has paid for printing of the Abstract Book and for the cultural entertaining by the JAMM Barbershop Quartet. I hope that the Visionarium will have an equally positive effect as the former Planning Group on the flow of ideas, and for creating contacts and collaborations. As important as the lectures is the social part of the program. I feel that however fast the electronic web works, it can never replace personal contacts. You are all very welcome.

Also, let us congratulate Martta Viljanen, who last Friday, Sept. 7th, defended her thesis about Adaptation to Environmental Light Conditions in Mysid Shrimps.

| Visionarium | | Date | Participants | Presentation. |
|---|---|---|---|---|
| I | 2002 | 27-29/9 | 23 | 17 |
| II] | 2003 | 26-28/9 | 27 | 20 |
| III | 2004 | 24-26/9 | 33 | 27 |
| IV | 2005 | 23-25/9 | 37 | 37 |
| V | 2006 | 22-24/9 | 47 | 31 |
| VI | 2007 | 28-30/9 | 44 | 30 |
| VII | 2008 | 17-19/10 | 39 | 34 |
| VIII | 2009 | 25-27/9 | 52 | 39 |
| IX | 2010 | 7-10/10 | 34 | 24 |

| Visionarium | | Date | Participants | Presentations |
|---|---|---|---|---|
| X | 2011 | 23-25/9 | 43 | 37 |
| XI | 2012 | 28/9-30/10 | 37 | 31 |
| XII | 2013 | 4-6/10 | 42 | 35 |
| XIII | 2014 | 9-12/10 | 39 | 35 |
| XIV | 2015 | 24-27/9 | 51 | 41 |
| XV | 2016 | 20-23/10 | 58 | 52 |
| XVI | 2017 | 28/9-1/10 | 59 | 48 |
| XVII | 2018 | 13-16/9 | 46 | 36 |

different possible outcomes, considering color discriminability within the blue range spectrum, in *Rhinella* (Anura: Bufonidae) tadpoles and juveniles.

## MORPHOLOGICAL AND SPECTRAL DIVERSITY IN THE EYES OF DIURNAL FROGS

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Light intensity changes several orders of magnitude throughout the day in terrestrial environments and is the most critical factor in setting the limits to eye performance; furthermore, the spectral composition of light also shifts in that period. There are a number of ways in which the visual system can adjust to light availability in diurnal and nocturnal environments. Among them, the proportions of photoreceptor types, their morphology and spectral sensitivity have been shown to match the daily activity patterns in several vertebrate groups. Among amphibians, the diurnal strawberry poison frog has been shown to lack the blue-sensitive rods typically present in frogs and salamanders, and the spectral sensitivities of the other photoreceptors are considerably shifted compared to the data from nocturnal species. However, it is not known whether these peculiarities are restricted to this species or are visual system adaptations shared with other diurnal amphibians. We are currently working to elucidate the extent to which the eyes of frogs have adapted to diurnal and nocturnal lifestyles during the multiple independent diel pattern transitions throughout their evolutionary history. For this, we are studying their photoreceptor spectral sensitivities with microspectrophotometry and their morphologies with histology and transmission electron microscopy. We have targeted species from different phylogenetic lineages, including diurnal clades that evolved from nocturnal ancestors and nocturnal clades that evolved from diurnal ancestors. Our results so far show considerable variation between diurnal and nocturnal species and also among diurnal species. We will discuss the evolutionary plasticity of the different traits and how features in the visual environment other than light intensity might be involved in shaping anuran visual systems.

## GANGLION CELLS - LOCAL EDGE DETECTORS (SPOT DETECTORS) IN RABBIT, FISH AND FROG RETINAS.

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The description of the external world in different animals, regardless of their systematic position (fish, frog, rabbit), occurs in the retina with the help of the same operators (detectors: spot, direction of movement, oriented lines). Vision plays an important role in the behavior of most animals, including fish. We can say that in fish vision determines behavior. In frogs and fish, most of the axonal terminals of the output neurons of the retina - ganglion cells (GCs) - come into the tectum opticum (TO). Tectum has a layered structure: axonal terminals of different types of GCs enter at different levels. In addition, the fish TO is "anatomically" easily accessible. That is why fish are good object for electrophysiological studies of GCs reactions upon presentation of various stimuli. The experiment takes place on a practically intact animal with a preserved eye optics. The reactions are recorded from the axonal terminals of the GCs in the tectum itself.

Many types of specialized detectors (GCs) unknown for the frog have been described for fish. First of all, six types of detectors of the direction were detected for fish. These cells can be on- or off-type with one of the three preferred directions: caudorostral. dorsoventral and ventrodorsal. In the next layer it is possible to record the reactions of detectors of oriented lines - vertical and horizontal edges, as well as one more type of detectors - spot detectors. Spot detectors don’t have preferences in the direction of stimulus movement and its orientation, and also background activity is absent. A big reaction occurs only when small contrasting spots are presented in the receptive field (RF) of these cells. This work is devoted to the description of the properties of spot detectors in comparison with other retinal elements in the fish and other animals. Experiments were carried out on *Cyprinus carpio* and *Carassius auratus.*

The properties of fish and frog’s spot detectors and rabbit’s local edge detectors (LED) are very similar. The structure of the RF can be investigated by presenting two spots simultaneously: one in the center of the RF, the second in random order in different places in the presentation area. It turned out that the zone of summation, that is the area with the greatest reaction (two closely spaced spots cause a stronger reaction than one spot in the center) is surrounded by a zone of inhibition. Thus, the response to a small spot is greater than to a large one. This also explains the lack of response to diffuse light, as well as a stronger response to a moving spot, than to stimuli such as a "strip" or "edge". The morphological organization of this local inhibition isn’t clear yet.

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# SPECTRAL SENSITIVITY TUNING IN THE EYE OF THE OPOSSUM SHRIMP *(MYSIS RELICTA)*

## INSIGHTS FROM PROJECT 10 OF THE RUSSIAN ACADEMY OF SCIENCES AND THE ACADEMY OF FINLAND 2002-2017

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**Background.**

Our collaborative studies have focussed on two Finnish populations of *Mysis relicta* that offer an attractive model pair for studying spectral adaptation. One (denoted $L_p$) inhabits the dark brown Lake Pääjärvi in Lammi, the other (denoted $S_p$) the less dark and greenish Pojoviken Bay of the Baltic Sea near Tvänninne. Both dwell at great depths where there is very little light and need to maximize photon catch to see anything. At the outset, it was known that the sensitivity spectra based on ERG recordings of light responses from excised eyes differ between the two populations, peaking around 600 nm in $L_p$ and 570 nm in $S_p$, in nice correlation with the difference in illumination spectra in the two habitats, peaking at c. 680 and 580 nm, respectively. Both $L_p$ and $S_p$ were thought to possess a single visual pigment.

**Question.**

The populations have been separated for less than 10000 years, since the end of the latest glaciation. On an evolutionary time scale, this is a very short time. By what mechanisms has such remarkable adaptation to different light conditions occurred?

**Methods.**

Whole-eye electroretinography (ERG), microspectrophotometry (MSP).