

## Recent Advances in Network Electrophysiology Using Multi-Electrode Arrays

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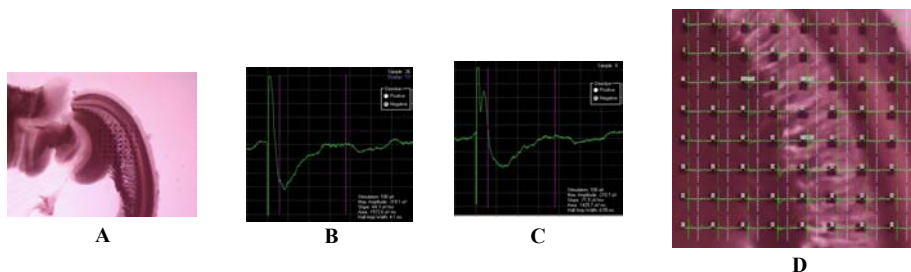
Convention Center, Room 253, New Orleans, LA

### Use of A Planar Microelectrode Array System for Evaluation of Changes in Potentials Evoked in Acute Brain Slices from Bluegill Sunfish (*Lepomis Macrochirus*), Induced by Neurobehavioral Toxicants in Drinking Water.

John Rossi III; Shawn McInturf; Freddy McDougale and Marni Bekkedal  
Neurobehavioral Effects Laboratory, NHRC/EHEL, WPAFB, OH, USA

Existing electro-chemical water monitoring systems recognize only specific threats or categories of threats. In order to develop a more flexible detection instrument that can respond over a wide range of toxicant types and concentrations, we have developed a system currently based on acute slices taken from the optic tectum of the bluegill sunfish. The fish slice was chosen because of its relative insensitivity to temperature changes when compared to slices taken from rodent brain. Additionally, the optic tectum slice provides an astonishingly rich subset of receptors to neurotransmitters and neuromodulators.

The development system consisted of a commercially available, planar microelectrode array system (Panasonic MED64). Before committing to the fish slice as an adequate detector, it was first necessary to determine that fish brain would provide viable slices for use with the MED64 System, previously demonstrated to work only with mammalian brain slices. Initially, thirty two 500  $\mu\text{M}$  slices obtained from the optic tectum of bluegill sunfish were attached to the MED64's 64-electrode microelectrode arrays and bathed in continuous perfusion of fish artificial cerebrospinal fluid (F-CSF). The brain slices were placed on the array so that the microelectrode elements of the array maximally covered the areas believed to be the most active for sensory input integration. Electrode sites were successively stimulated with 50  $\mu\text{A}$



A: Fish optic tectum slice - B: EP @ 19 degC - C: EP @ 10 degC - D: MEA EP @ 20 degC

biphasic pulses with a pulse duration of 100  $\mu\text{s}$ . The presence of evoked response activity was then assessed at each of the 63 remaining electrode sites. This process was repeated until the entire array was mapped. Test electrode pairs were then chosen for each brain slice. The gain in evoked response (ER) amplitude averaged 5-10x for all of the slices. The biological nature of the responses was initially tested by treatment with 10  $\mu\text{M}$  of the sodium channel blocker tetrodotoxin (TTX). TTX reversibly eliminated the ERs. Subsequently, slices were treated with ethanol (20-80  $\mu\text{M}$ ), and dose dependent reductions in evoked response amplitude were observed. Slices were then treated with a myriad of neuropharmacologically active agents in order to assess the changes in the characteristics of the ERs associated with each type of challenge. Response profiles obtained suggest that the fish brain slice detector element is very reliable and selective over a wide range of challenges.

Currently a model is being developed for use in predicting human neurobehavioral compromise based on the output of the fish brain bio-detector. Additionally, culturing efforts are also underway with the aim of providing a slice preparation that has a life expectancy reasonable enough for application in real-world water monitoring situations.