

## NRP Endocrine Disruptors

### Final Summary

Original project title <b>Hormonal activity of UV screens in aquatic ecosystems (HAUS)</b>
Project leader <b>Prof. Dr. Karl Fent</b>
Project number <b>4050-066554</b>

### Hormonal effects of UV filters in the aquatic ecosystem

*UV filters are widely used in numerous products and enter the aquatic environment. We show that many UV filters are hormonally active in vitro and in fish. Two UV filters negatively affect the reproduction of fish and the activity of UV filter mixtures is significant.*

### Research questions

We investigated the hormonal activity of UV filters towards aquatic organisms by the use of a series of in vitro and in vivo assays. The estrogenic, antiestrogenic, androgenic and antiandrogenic activity of a series of single UV filters and of mixtures thereof were evaluated in yeast systems and in fish. In addition, effects on reproduction and development were evaluated in fish and frog, in order to understand the hormonal activity and potential adverse effects of single compounds and mixtures in aquatic organisms.

### Results

All 19 UV filters were hormonally active in vitro (recombinant yeast), surprisingly most of them possessed multiple activities (10 estrogenic, 14 antiestrogenic, 6 androgenic, 17 antiandrogenic). Estrogenic activities were similar to the human and fish estrogen receptor. To our surprise, most UV filter mixtures were synergistic in vitro, especially when mixed at their no observed effect level.

Experiments in juvenile fathead minnows demonstrated the estrogenic activity of four UV filters, thereby partly confirming findings in yeast. Moreover, the estrogenic 3-benzylidene camphor (3BC) and benzophenone-2 (BP2) adversely affected the reproduction in fish. Mixtures of three estrogenic UV filters acted in an additive manner and led to a demasculinisation in male fish at low mixture levels.

Our studies reveal a novel and more detailed picture of the hormonal activity of UV filters in vitro and in fish, both as single compounds and as mixtures. The experiments disclose unexpected multiple hormonal activities and synergistic properties of UV filters in vitro. We observed pronounced effects on fish

reproduction by 3BC and mixtures of 3 UV filters at low concentrations. Hence, the diverse hormonal activities of UV filters found in our studies are of significant scientific and practical interest.

### **Perspectives**

The demonstrated hormonal activities and adverse effects on fish reproduction should further be substantiated for other UV filters entering the aquatic environment. The activities of UV filter mixtures are significant and should further be investigated. In conjunction with results of this project forthcoming studies will contribute to a better environmental risk assessment of UV filters.