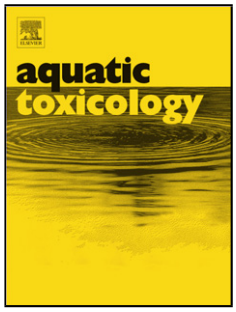

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Environmental concentrations of anti-androgenic pharmaceuticals do not impact sexual disruption in fish alone or in combination with steroid oestrogens

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Highlights

- A combined exposure of fish to pharmaceutical anti-androgens and steroid oestrogens.
- Concentrations determined by predictive modelling of environmental scenarios.
- The anti-androgens had no significant impact on sexual disruption in fish.
- A mixture of steroid oestrogens induced intersex at environmental concentrations.
- A control treatment unexpectedly contained 100% phenotypic male fish.

Abstract

Sexual disruption in wild fish has been linked to the contamination of river systems with steroid oestrogens, including the pharmaceutical 17α-ethinylestradiol, originating from domestic wastewaters. As analytical chemistry has advanced, more compounds derived from the human usage of pharmaceuticals have been identified in the environment and questions have arisen as to whether these additional pharmaceuticals may also impact sexual disruption in fish. Indeed, pharmaceutical anti-androgens have been shown to induce such effects under laboratory conditions. These are of particular interest since anti-androgenic biological activity has been identified in the aquatic environment and is potentially implicated in sexual disruption alone and in combination with steroid oestrogens. Consequently, predictive modelling was employed to determine the concentrations of two anti-androgenic human pharmaceuticals, bicalutamide and cyproterone acetate, in UK sewage effluents and river catchments and their combined impacts on sexual disruption were then assessed in two fish models. Crucially, fish were also exposed to the anti-androgens in combination with