# Ecological effects and fate of a new antifouling compound in marine ecosystem

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## Summary

A newly developed herbicidal additive Irgarol 1051 (2-methylthio-4-*tert*-butylamino-6-cyclopropylamino-s-triazine) is intended as replacement for the highly toxic antifouling agent tributyltin, which has been regulated internationally. With the recent fall in ambient concentrations of organotins, Irgarol 1051 has emerged as a new aquatic contaminant in Europe, Australia, and Japan. Our survey conducted in 1996-1998 revealed the presence of Irgarol 1051 in the Seto Inland Sea. Irgarol 1051 degraded via three different pathways including biodegradation by white rot fungi, mercuric chloride-catalyzed hydrolysis, and sunlight degradation. It is noteworthy that the degradation product M1 identified as 2-methylthio-4-*tert*-butylamino-6-amino-*s*-triazine was the major product in each degradation pathway and identified in the same seawater samples analyzed for Irgarol, at concentrations of approximately 1,870 ng/L. Both Irgarol and M1 were frequently found in fishery harbours as well as in marinas, suggesting that ship bottom paint is a possible source of contamination. M1 is likely more stable than the parent compound because higher concentrations were identified in several seawater samples. Phytotoxicity bioassay revealed that Irgarol was more toxic than M1 to various aquatic plant species such as seaweed, algae, and duckweed. In contrast, M1 showed a higher toxicity than Irgarol to root elongation of terrestrial plant seeds. According to the results of the bioassay and residue analyses, both Irgarol and its major degradation product M1 may potentially damage the primary producer community in aquatic ecosystem.