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Fluorescent dyes in hydrological tracing: application methods, ecotoxicological effects, and safe application levels

Carlos J. A. Campos [1,2], Louis A. Tremblay [3]*, Olivier Champeau [4], Gregory Goblick [5]

[1] Jacobs, 47 Hereford Street Level 2, Wynn Williams Building, Christchurch 8013, Aotearoa New Zealand; carlos.campos@wrcgroup.com
[2] Water Research Centre Ltd, Frankland Road, Blagrove, Swindon, Wiltshire, SN5 8YF, UK
[3] New Zealand Institute for Bioeconomy Science Ltd, Port Nelson, Nelson 7010, New Zealand; tremblayl@landcareresearch.co.nz
[4] Environmental Protection Authority, Wellington 6011, New Zealand
[5] Human Foods Program, Office of Laboratory Operations and Applied Science, US Food and Drug Administration, Dauphin Island, AL 36528, USA; Gregory.Goblick@fda.hhs.gov
* Correspondence: tremblayl@landcareresearch.co.nz

Table S1. Toxicity of fluorescent dyes to aquatic organisms. EC50: median effective concentration; LC50: median lethal concentration; TL_{50}: median tolerance limit.

Dye	Test species	Taxon / Common name	Environment	Endpoint	Median or range effect concentration (mg/L) [confidence interval]	Exposure duration	Reference
Rhodamine B	*Raphidocelis subcapitata*	Microalga (Chlorophyta)	Freshwater	Growth inhibition (EC_{50})	14 [8.6–20]	72 h	[14]
Rhodamine B	*Daphnia (Ctenodaphnia) magna*	Crustacean (Arthropoda) / large water flea	Brackish / freshwater	Growth inhibition (EC_{50})	24 [15–32]	48 h	[14]
Rhodamine B	*Danio rerio*	Fish (Chordata) / zebrafish	Freshwater	Growth inhibition (EC_{50})	18 [14–21]	96 h	[14]
Rhodamine B	*Chlorella vulgaris*	Microalga (Chlorophyta) / green alga	Freshwater / terrestrial	IC_{50}	69.94–31.29	24–96 h	[56]
Rhodamine B	*Thamnocephalus platyurus*	Shrimp (Arthropoda) / beavertail fairy shrimp	Freshwater	LC_{50}	8.06	24 h	[55]
Rhodamine B	*Poecilia reticulata*	Fish (Chordata) / guppy	Brackish / freshwater	TL_{50}	24	30 days	[12]
Rhodamine B	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	155	96 h	[12]
Rhodamine B	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	506	48 h	[12]
Rhodamine B	*Lepomis macrochirus*	Fish (Chordata) / bluegill	Freshwater	LC_{50}	379	96 h	[12]
Rhodamine B	*Ictalurus punctatus*	Fish (Chordata) / channel catfish	Freshwater	LC_{50}	526	96 h	[12]
Rhodamine B	*Asellus (Asellus) aquaticus aquaticus*	Crustacean (Arthropoda) / water hoglouse	Freshwater	LC_{50}	550	96 h	[12]

Rhodamine B	*Artemia salina*	Crustacean (Arthropoda) / brine shrimp	Brackish	LC_{50}	180	24 h	[12]
Rhodamine B	*Daphnia (Ctenodaphnia) magna*	Crustacean (Arthropoda) / large water flea	Brackish / freshwater	LC_{50}	29	72 h	[12]
Rhodamine B	*Crassostrea virginica*	Bivalve (Mollusca) / eastern oyster	Marine	No effect development of eggs	1	48 h	[12]
Rhodamine B	*Hemicentrotus pulcherrimus*	Sea urchin (Echinodermata)	Marine	No effect development of eggs	10	48 h	[12]
Rhodamine B	*Mytilus edulis*	Bivalve (Mollusca) / blue mussel	Marine	No effect development of eggs	3.2	48 h	[12]
Rhodamine B	*Corbicula manilensis*	Bivalve (Mollusca) / Asiatic clam	Freshwater	LC_{50}	>500	96 h	[12]
Rhodamine B	*Biomphalaria glabrata*	Snail (Mollusca) / bloodfluke planorb	Freshwater	LC_{50}	1–10	120 h	[12]
Sulforhodamine B	*Poecilia reticulata*	Fish (Chordata) / guppy	Brackish / freshwater	TL_{50}	58–116	30 days	[12]
Sulforhodamine B	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	450	48 h	[12]
Sulforhodamine B	*Oryzias latipes*	Fish (Chordata) / Japanese rice fish	Brackish / freshwater	LC_{50}	>3,000	48 h	[12]
Sulforhodamine B	*Daphnia (Ctenodaphnia) magna*	Crustacean (Arthropoda) / large water flea	Brackish / freshwater	LC_{50}	139	72 h	[12]
Fluorescein	*Poecilia reticulata*	Fish (Chordata) / guppy	Brackish / freshwater	TL_{50}	752	30 days	[12]
Fluorescein	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	1,372	96 h	[12]
Fluorescein	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	3,420	48 h	[12]

Fluorescein	*Lepomis macrochirus*	Fish (Chordata) / bluegill	Freshwater	LC_{50}	3,433	96 h	[12]
Fluorescein	*Ictalurus punctatus*	Fish (Chordata) / channel catfish	Freshwater	LC_{50}	2,267	96 h	[12]
Fluorescein	*Oryzias latipes*	Fish (Chordata) / Japanese rice fish	Brackish / freshwater	LC_{50}	3,000	48 h	[12]
Fluorescein	*Artemia salina*	Crustacean (Arthropoda) / brine shrimp	Brackish	LC_{50}	100–300	24 h	[12]
Fluorescein	*Daphnia (Ctenodaphnia) magna*	Crustacean (Arthropoda) / large water flea	Brackish / freshwater	LC_{50}	165	72 h	[12]
Fluorescein	*Hemicentrotus pulcherrimus*	Sea urchin (Echinodermata)	Marine	No effect development of eggs	10	48 h	[12]
Fluorescein	*Mytilus edulis*	Bivalve (Mollusca) / blue mussel	Marine	No effect development of eggs	1	48 h	[12]
Fluorescein	*Biomphalaria glabrata*	Snail (Mollusca) / bloodfluke planorb	Freshwater	LC_{50}	1–10	120 h	[12]
Rhodamine WT	*Poecilia reticulata*	Fish (Chordata) / guppy	Brackish / freshwater	TL_{50}	1,360	30 days	[12]
Rhodamine WT	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	>320	96 h	[12]
Rhodamine WT	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	>320	48 h	[12]
Rhodamine WT	*Asellus (Asellus) aquaticus aquaticus*	Crustacean (Arthropoda) / water hoglouse	Freshwater	LC_{50}	>2,000	96 h	[12]
Rhodamine WT	*Daphnia (Ctenodaphnia) magna*	Crustacean (Arthropoda) / large water flea	Brackish / freshwater	LC_{50}	170	72 h	[12]
Rhodamine WT	*Magallana gigas*	Bivalve (Mollusca) / Pacific oyster	Marine / brackish	LC_{50}	10	48 h	[12]
Rhodamine WT	*Thamnocephalus platyurus*	Shrimp (Arthropoda) / beavertail fairy shrimp	Freshwater	LC_{50}	1,698	24 h	[12]

Eosin	*Poecilia reticulata*	Fish (Chordata) / guppy	Brackish / freshwater	TL_{50}	138	30 days	[12]
Eosin	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	>100	96 h	[12]
Eosin	*Oncorhynchus mykiss*	Fish (Chordata) / rainbow trout	Marine / brackish / freshwater	LC_{50}	>100	48 h	[12]
Eosin	*Oryzias latipes*	Fish (Chordata) / Japanese rice fish	Brackish / freshwater	LC_{50}	1,800	48 h	[12]
Eosin	*Daphnia (Ctenodaphnia) magna*	Crustacean (Arthropoda) / large water flea	Brackish / freshwater	LC_{50}	90	72 h	[12]
Sodium naphtionate	*Daphnia (Ctenodaphnia) magna*	Crustacean (Arthropoda) / large water flea	Brackish / freshwater	EC_{50}	2,791	48 h	[20]
Sodium naphtionate	*Raphidocelis subcapitata*	Microalga (Chlorophyta)	Freshwater	EC_{50}	63.2	72 h	[20]

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