

Final Risk Evaluation for Cyclic Aliphatic Bromide Cluster (HBCD)

Systematic Review Supplemental File:

Data Quality Evaluation of Environmental Hazard Studies

CASRN:25637-99-4 CASRN:3194-55-6 CASRN:3194-57-8

September 2020

Table of Contents

HERO ID	Data Type	Reference	8
787657	Chronic (>21 days); Terrestrial; Mammalian	M. Ema, S. Fujii, M. Hirata-Koizumi, M. Matsumoto. 2008. Two-generation reproductive toxicity study of the flame retardant hexabromocyclododecane in rats. Reproductive Toxicology 25:335-351	8
938764	Other; Aquatic; other tadpole tail tip	Schriks, M., Zvinavashe, E., Furlow, J. D., Murk, A. J 2006. Disruption of thyroid hormone-mediated Xenopus laevis tadpole tail tip regression by hexabromocyclododecane (HBCD) and 2,2',3,3',4,4',5,5',6-nona brominated diphenyl ether (BDE206). Chemosphere 65:1904-1908	11
1062065	Acute (0-96 hour); Aquatic; Fish	Thienpont, B., Tingaud-Sequeira, A., Prats, E., Barata, C., Babin, P. J., Raldúa, D 2011. Zebrafish eleutheroembryos provide a suitable vertebrate model for screening chemicals that impair thyroid hormone synthesis. Environmental Science and Technology 45:7525-7532	13
1274149	Other; Aquatic; Invertebrates	Anselmo, H. M. R., Koerting, L., Devito, S., van den Berg, J. H. J., Dubbeldam, M., Kwadijk, C., Murk, A. J 2011. Early life developmental effects of marine persistent organic pollutants on the sea urchin Psammechinus miliaris. Ecotoxicology and Environmental Safety 74:2182-2192	15
1401837	Chronic (>21 days); Terrestrial; Birds	Fernie, K. J., Marteinson, S. C., Bird, D. M., Ritchie, I. J., Letcher, R. J 2011. Reproductive changes in American kestrels (Falco sparverius) in relation to exposure to technical hexabromocyclododecane flame retardant. Environmental Toxicology and Chemistry 30:2570-2575	17
1403364	Chronic (>21 days); Aquatic; Fish	Palace, V.,Park, B.,Pleskach, K.,Gemmill, B.,Tomy, G 2010. Altered thyroxine metabolism in rainbow trout (Oncorhynchus mykiss) exposed to hexabromocyclododecane (HBCD). Chemosphere 80:165-169	19
1403482	Chronic (>21 days); Terrestrial; Birds	Crump, D., Egloff, C., Chiu, S., Letcher, R. J., Chu, S., Kennedy, S. W 2010. Pipping success, isomer-specific accumulation, and hepatic mRNA expression in chicken embryos exposed to HBCD. Toxicological Sciences 115:492-500	21
1408111	Acute (0-96 hour); Terrestrial; Birds	Crump, D., Chiu, S., Egloff, C., Kennedy, S. W 2008. Effects of hexabromocyclododecane and polybrominated diphenyl ethers on mRNA expression in chicken (Gallus domesticus) hepatocytes. Toxicological Sciences 106:479-487	23
1409610	Chronic (>21 days); Aquatic; Fish	Palace, V. P., Pleskach, K., Halldorson, T., Danell, R., Wautier, K., Evans, B., Alaee, M., Marvin, C., Tomy, G. T 2008. Biotransformation enzymes and thyroid axis disruption in juvenile rainbow trout (Oncorhynchus mykiss) exposed to hexabromocyclododecane diastereoisomers. Environmental Science and Technology 42:1967-1972	25

1412194	Chronic (>21 days); Aquatic; Fish	Aniagu, S. O., Williams, T. D., Allen, Y., Katsiadaki, I., Chipman, J. K 2008. Global genomic methylation levels in the liver and gonads of the three-spine stickleback (Gasterosteus aculeatus) after exposure to hexabromocyclododecane and 17-beta oestradiol. Environment International 34:310-317	27
1412802	Chronic (>21 days); Aquatic; Fish	Kuiper, R. V., Cantón, R. F., Leonards, P. E., Jenssen, B. M., Dubbeldam, M., Wester, P. W., van den Berg, M., Vos, J. G., Vethaak, A. D 2007. Long-term exposure of European flounder (Platichthys flesus) to the flame-retardants tetrabromobisphenol A (TBBPA) and hexabromocyclododecane (HBCD). Ecotoxicology and Environmental Safety 67:349-360	30
1443861	Chronic (>21 days); Aquatic; Fish	Law, K., Palace, V. P., Halldorson, T., Danell, R., Wautier, K., Evans, B., Alaee, M., Marvin, C., Tomy, G. T 2006. Dietary accumulation of hexabromocyclododecane diastereoisomers in juvenile rainbow trout (Oncorhynchus mykiss). I: Bioaccumulation parameters and evidence of bioisomerization. Environmental Toxicology and Chemistry 25	32
1927533	Acute (0-96 hour); Aquatic; Fish	Wu, M., Zuo, Z., Li, B., Huang, L., Chen, M., Wang, C 2013. Effects of low-level hexabromocyclododecane (HBCD) exposure on cardiac development in zebrafish embryos. Ecotoxicology 22:1200-1207	34
1927579	Chronic (>21 days); Aquatic; Fish	Du, M., Lin, L., Yan, C., Zhang, X 2012. Diastereoisomer- and enantiomer-specific accumulation, depuration, and bioisomerization of hexabromocyclododecanes in zebrafish (Danio rerio). Environmental Science and Technology 46:11040-11046	36
1927583	Acute (0-96 hour); Terrestrial; other Plant: Maize	Wu, T., Wang, S., Huang, H., Zhang, S 2012. Diastereomer-Specific Uptake, Translocation, and Toxicity of Hexabromocyclododecane Diastereoisomers to Maize. Journal of Agricultural and Food Chemistry 60:8528-8534	38
1927590	Other; Terrestrial; Birds	Marteinson, S. C.,Bird, D. M.,Letcher, R. J.,Sullivan, K. M.,Ritchie, I. J.,Fernie, K. J 2012. Dietary exposure to technical hexabromocyclododecane (HBCD) alters courtship, incubation and parental behaviors in American kestrels (Falco sparverius). Chemosphere 89:1077-1083	41
1927610	Other;	Du, M., Zhang, D., Yan, C., Zhang, X 2012. Developmental toxicity evaluation of three hexabromocyclododecane diastereoisomers on zebrafish embryos. Aquatic Toxicology	43
1927624	Chronic (>21 days); Terrestrial; Birds	S. C. Marteinson, S. Kimmins, R. J. Letcher, V. P. Palace, D. M. Bird, I. J. Ritchie, K. J. Fernie. 2011. Diet exposure to technical hexabromocyclododecane (HBCD) affects testes and circulating testosterone and thyroxine levels in American kestrels (Falco sparverius). Environmental Research 111:1116-1123	45
1927629	Chronic (>21 days); Terrestrial; Birds	Fournier, A.,Feidt, C.,Marchand, P.,Vénisseau, A.,Le Bizec, B.,Sellier, N.,Engel, E.,Ratel, J.,Travel, A.,Jondreville, C 2012. Kinetic study of "-hexabromocyclododecane orally given to laying hens (Gallus domesticus). "Transfer of HBCD in laying hens". Environmental Science and Pollution Research 19:440-447	47

1927669	Chronic (>21 days); Terrestrial; Birds	S. C. Marteinson, D. M. Bird, J. L. Shutt, R. J. Letcher, I. J. Ritchie, K. J. Fernie. 2010. Multi-generational effects of polybrominated diphenylethers exposure: embryonic exposure of male American kestrels (Falco sparverius) to DE-71 alters reproductive success and behaviors. Environmental Toxicology and Chemistry 29:1740-1747	49
1927697	Chronic (>21 days); Aquatic; Invertebrates	Smolarz, K.,Berger, A 2009. Long-term toxicity of hexabromocyclododecane (HBCDD) to the benthic clam Macoma balthica (L.) from the Baltic Sea. Aquatic Toxicology 95:239-247	51
1927714	Other; Terrestrial; Birds	K. J. Fernie, J. L. Shutt, R. J. Letcher, I. J. Ritchie, D. M. Bird. 2009. Environmentally relevant concentrations of DE-71 and HBCD alter eggshell thickness and reproductive success of American kestrels. Environmental Science and Technology 43:2124-2130	53
1927716	Acute (0-96 hour); Aquatic; other	Deng, J., Yu, L., Liu, C., Yu, K., Shi, X., Yeung, L. W., Lam, P. K., Wu, R. S., Zhou, B 2009. Hexabromocyclododecane-induced developmental toxicity and apoptosis in zebrafish embryos. Aquatic Toxicology 93:29-36	56
1927732	Other; Aquatic; other Fish Post-fertilization	Hu, J., Liang, Y., Chen, M., Wang, X 2009. Assessing the toxicity of TBBPA and HBCD by zebrafish embryo toxicity assay and biomarker analysis. Environmental Toxicology 24:334-342	58
1927768	Chronic (>21 days); Aquatic; Fish	Zhang, X., Yang, F., Zhang, X., Xu, Y., Liao, T., Song, S., Wang, J. 2008. Induction of hepatic enzymes and oxidative stress in Chinese rare minnow (Gobiocypris rarus) exposed to waterborne hexabromocyclododecane (HBCDD). Aquatic Toxicology 86	60
1927821	Aquatic; other Fish in vivo, in vitro	Ronisz, D., Finne, E. F., Karlsson, H., Förlin, L 2004. Effects of the brominated flame retardants hexabromocyclododecane (HBCDD), and tetrabromobisphenol A (TBBPA), on hepatic enzymes and other biomarkers in juvenile rainbow trout and feral eelpout. Aquatic Toxicology 69:229-245	63
1927837	Acute (0-96 hour); Aquatic; other Plants: Skeletonema costatum and Thalassiosira pseudonana,	Walsh, G. E., Yoder, M. J., McLaughlin, L. L., Lores, E. M. 1987. Responses of marine unicellular algae to brominated organic compounds in six growth media. Ecotoxicology and Environmental Safety 14:215-222	65
1927837	Acute (0-96 hour); Aquatic; Plants	Walsh, G. E., Yoder, M. J., McLaughlin, L. L., Lores, E. M. 1987. Responses of marine unicellular algae to brominated organic compounds in six growth media. Ecotoxicology and Environmental Safety 14:215-222	68
1927956	Chronic (>21 days); Aquatic; other Fish Other Study- Various Life-Cycle Effects	Lower, N., Moore, A 2007. The impact of a brominated flame retardant on smoltification and olfactory function in Atlantic salmon (Salmo salar L.) smolts. Marine and Freshwater Behaviour and Physiology 40:267-284	72
1928024	Other; Aquatic; Sediment-dwelling	Zhang, H. ui,Pan, L.,Tao, Y.,Tian, S.,Hu, Y 2013. Identification and expression of differentially expressed genes in clam Venerupis philippinarum in response to environmental pollutant hexabromocyclododecane (HBCD). Journal of Experimental Marine Biology and Ecology 445:166-173	74

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1928244	Other; Aquatic; Fish	. 2000. LETTER FROM AMER CHEM CNCL SUBMITTING FLOW-THROUGH BIOCONCENTRATION TEST W/RAINBOW TROUT and END-USER SURVEYPHASE 1 STUDY OF BROMINATED FLAME RETARDANT, W/ATTCHMTS and DATED $8/28/00$.	76
1928244	Acute (0-96 hour); Aquatic; Fish	. 2000. LETTER FROM AMER CHEM CNCL SUBMITTING FLOW-THROUGH BIOCONCENTRATION TEST W/RAINBOW TROUT and END-USER SURVEYPHASE 1 STUDY OF BROMINATED FLAME RETARDANT, W/ATTCHMTS and DATED $8/28/00$.	78
1928267	Acute (0-96 hour); Aquatic; Invertebrates	Basf,. 1990. Determination of the acute toxicity of hexabromid S to the waterflea Daphnia magna straus with cover letter dated 040590.	80
1928275	Acute (0-96 hour); Aquatic; Fish	Union Carbide,. 1990. The acute toxicity of HBCD lot 990-17 to the bluegill sunfish Lepomis macrochirus Rafinesque with test data and cover letter.	82
1928289	Acute (0-96 hour); Aquatic; Fish	. 1994. INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO DYNAMAC CORP/USEPA SUBMITTING INFO RE HEXABROMOCY-CLODODECANE AND BIS(TRIBROMOPHENOXY) ETHANE W/ATTCHMTS, DATED 2/13/89.	85
1928293	Chronic (>21 days); Aquatic; Invertebrates	. 1998. HEXABROMOCYCLODODECANE (HBCD): A FLOW-THROUGH LIFE-CYCLE TOXICITY TEST WITH THE CLADOCERAN (DAPHNIA MAGNA), WITH COVER LETTER DATED $5/18/1998$.	88
1928298	Acute (0-96 hour); Aquatic; Fish	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODO-DECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.	90
1928298	Acute (0-96 hour); Aquatic; Plants	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODO-DECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.	93
1928300	Acute (0-96 hour); Aquatic; Fish	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODO-DECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.	96
2343684	Other; Aquatic; Fish	Hong, H.,Li, D.,Shen, R.,Wang, X.,Shi, D 2014. Mechanisms of hexabromocyclododecanes induced developmental toxicity in marine medaka (Oryzias melastigma) embryos. Aquatic Toxicology 152:173-185	99
2343690	Other; Aquatic; Plants	Zhang, Y.,Sun, H.,Zhu, H.,Ruan, Y.,Liu, F.,Liu, X 2014. Accumulation of hexabromocyclododecane diastereomers and enantiomers in two microalgae, Spirulina subsalsa and Scenedesmus obliquus. Ecotoxicology and Environmental Safety 104:136-142	101
2343709	Chronic (>21 days); Aquatic; other Fish Post-fertilization	Foekema, E. M., Lopez Parron, M., Mergia, M. T., Carolus, E. R., Vd Berg, J. H., Kwadijk, C., Dao, Q., Murk, A. J 2014. Internal effect concentrations of organic substances for early life development of egg-exposed fish. Ecotoxicology and Environmental Safety 101:14-22	103

2343723	Chronic (>21 days); Aquatic; other Bioaccumulation	Zhang, Y.,Sun, H.,Ruan, Y 2014. Enantiomer-specific accumulation, depuration, metabolization and isomerization of hexabromocyclododecane (HBCD) diastereomers in mirror carp from water. Journal of Hazardous Materials 264	105
2528343	Other; Aquatic; Sediment-dwelling	Zhang, H.,Pan, L.,Tao, Y 2014. Antioxidant responses in clam Venerupis philippinarum exposed to environmental pollutant hexabromocyclododecane. Environmental Science and Pollution Research 21:8206-8215	107
2965902	Other; Terrestrial; Invertebrate	Shi, Y. J.,Xu, X. B.,Zheng, X. Q.,Lu, Y. L 2015. Responses of growth inhibition and antioxidant gene expression in earthworms (Eisenia fetida) exposed to tetrabromobisphenol A, hexabromocyclododecane and decabromodiphenyl ether. Comparative Biochemistry and Physiology - Part C: Toxicology and Pharmacology	109
3350472	Acute (0-96 hour); Terrestrial; other Plant	Wu, T., Huang, H., Zhang, S 2016. Accumulation and phytotoxicity of technical hexabromocyclododecane in maize. Journal of Environmental Sciences 42:97-104	112
3350492	Other; Terrestrial; other Plant	Zhu, H.,Sun, H.,Zhang, Y.,Xu, J.,Li, B.,Zhou, Q. 2016. Uptake Pathway, Translocation, and Isomerization of Hexabromocyclododecane Diastereoisomers by Wheat in Closed Chambers. Environmental Science and Technology 50:2652-2659	114
3350507	Other; Aquatic; Fish	Hong, H.,Shen, R.,Liu, W.,Li, D.,Huang, L.,Shi, D 2015. Developmental toxicity of three hexabromocyclododecane diastereoisomers in embryos of the marine medaka Oryzias melastigma. Marine Pollution Bulletin 101:110-118	116
3350510	Chronic (>21 days); Terrestrial; Invertebrate	Li, B., Yao, T., Sun, H., Zhang, Y., Yang, J. 2016. Diastereomer- and enantiomer-specific accumulation, depuration, bioisomerization, and metabolism of hexabromocyclododecanes (HBCDs) in two ecologically different species of earthworms. Science of the Total Environment 542:427-434	118
3350537	Other; Aquatic; other Fish Post-Fertilization	Du, M., Fang, C., Qiu, L., Dong, S., Zhang, X., Yan, C 2015. Diastereoisomer-specific effects of hexabromocyclododecanes on hepatic aryl hydrocarbon receptors and cytochrome P450s in zebrafish (Danio rerio). Chemosphere 132:24-31	121
3350539	Chronic (>21 days); Terrestrial; Birds	R. J. Letcher, L. C. Mattioli, S. C. Marteinson, D. Bird, I. J. Ritchie, K. J. Fernie. 2015. Uptake, distribution, depletion, and in ovo transfer of isomers of hexabromocyclododecane flame retardant in diet-exposed American kestrels (Falco sparverius). Environmental Toxicology and Chemistry 34:1103-1112	123
3546057	Other; Aquatic; Invertebrates	Shi, D.,Lv, D.,Liu, W.,Shen, R.,Li, D.,Hong, H 2017. Accumulation and developmental toxicity of hexabromocyclododecanes (HBCDs) on the marine copepod Tigriopus japonicus. Chemosphere 167:155-162	126
3586421	Acute (0-96 hour); Aquatic; Invertebrates	Ltd, W. I 1997. Hexabromocyclododecane (HBCD): A 48-Hour Flow-Through Acute Toxicity Test with the Cladoceran (Daphnia magna) with Cover Letter Dated 06/20/1997.	128

3586422	Acute (0-96 hour); Aquatic; Fish	Ltd, W. I 1997. Letter from Chem Mfgs Assoc to USEPA Regarding: Toxicological Investigation of Hexabromocyclododecane (HBCD) with Attachments, Dated $06/27/1997$.	131
3586422	Acute (0-96 hour); Aquatic; Plants	Ltd, W. I 1997. Letter from Chem Mfgs Assoc to USEPA Regarding: Toxicological Investigation of Hexabromocyclododecane (HBCD) with Attachments, Dated $06/27/1997$.	133
3586425	Other; Aquatic; other Fish in vitro	Reindl, K. M., Kittilson, J. D., Bergan, H. E., Sheridan, M. A 2011. Growth hormone-stimulated insulin-like growth factor-1 expression in rainbow trout (Oncorhynchus mykiss) hepatocytes is mediated by ERK, PI3K-AKT, and JAK-STAT. 301:R236-R243	135
3586533	Chronic (>21 days); Aquatic; Invertebrates	Ltd, W. I 1998. Initial Submission: Hexabromocyclododecane (HBCD) - A Flow-Through Life-Cycle Toxicity Test with the Cladoceran (Daphnia magna), Final Report, with Cover Letter Dated 5/18/1998.	137
3586733	Acute (0-96 hour); Aquatic; Fish	Corp, U. C 1990. The Acute Toxicity of HBCD Lot 990-17 to the Bluegill Sunfish Lepomis macrochirus rafinesque with Test Data and Cover Letter.	140
3618094	Chronic (>21 days); Aquatic; Fish	Lower, N 2008. The Effects of Contaminants on Various Life-Cycle Stages of Atlantic Salmon (Salmo salar L.).	142
3619397	Other; Aquatic; other Xenopus in vitro, ex vivo and in vivo assays	Schriks, M 2006. Novel In Vitro, Ex Vivo and In Vivo Assays Elucidating the Effects of Endocrine Disrupting Compounds (EDCs) on Thyroid Hormone Action.	144
3809141	Chronic (>21 days); Terrestrial; other Vegetation	Porch, J. R., Kendall, T. Z., Krueger, H. O 2002. Hexabromocyclododecane (HBCD): A toxicity test to determine the effects of the test substance on seedling emergence of six species of plants.	146
3809143	Chronic (>21 days); Aquatic; Sediment-dwelling	M. Oetken, K. Ludwichowski, R. Nagel. 2001. Validation of the preliminary EU-concept of assessing the impact of chemicals to organisms in sediment by using selected substances.	152
3809153	Other; Terrestrial; Birds	MOEJ. 2009. 6-Week Administration Study of 1,2,5,6,9,10-Hexabromocyclododecane for avian reproduction toxicity under long-day conditions using Japanese Quail.	154
3809170	Acute (0-96 hour); Aquatic; Plants	D. Desjardins, J. A. MacGregor, H. O. Krueger. 2005. Final report. Chapter 1, Hexabromocyclododecane (HBCD): A 72-hour toxicity test with the marine diatom (Skeletonema costatum) using a co-solvent.	156
3809173	Chronic (>21 days); Terrestrial; Invertebrate	J. Aufderheide, A. Jones, J. A. MacGregor, W. B. Nixon. 2003. Effect of hexabro-mocyclododecane on the survival and reproduction of the earthworm, Eisenia fetida.	158
3809177	Acute (0-96 hour); Aquatic; Plants	D. Desjardins, J. Macgregor, H. Krueger. 2004. Final report: hexabromocyclododecane (HBCD): a 72-hour toxicity test with the marine diatom (Skeletomema costatum).	160

4269889	Chronic (>21 days); Aquatic; Sediment-dwelling	ACC. 2003. Hexabromocyclododecane (HBCD): A Prolonged Sediment Toxicity Test with Hyalella azteca Using Spiked Sediment with 2 percent Total Organic Carbon.	162
4269912	Chronic (>21 days); Aquatic; Sediment-dwelling	ACC. 2003. Hexabromocyclododecane (HBCD): A Prolonged Sediment Toxicity Test with Hyalella azteca Using Spiked Sediment with 5 percent Total Organic Carbon.	164
4796184	Other; Aquatic; Fish	K. R. Drottar, J. A. Macgregor, H. O. Krueger. 2001. Hexabromocyclododecane (HBCD): An early life-stage toxicity test with the rainbow trout (Onchorhynchus mykiss).	166
4796184	Chronic (>21 days); Terrestrial; other Vegetation	K. R. Drottar, J. A. Macgregor, H. O. Krueger. 2001. Hexabromocyclododecane (HBCD): An early life-stage toxicity test with the rainbow trout (Onchorhynchus mykiss).	166
4796184	Chronic (>21 days); Terrestrial; other Vegetation	K. R. Drottar, J. A. Macgregor, H. O. Krueger. 2001. Hexabromocyclododecane (HBCD): An early life-stage toxicity test with the rainbow trout (Onchorhynchus mykiss).	168
6836803	Acute (0-96 hour); Aquatic; Plants	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODO-DECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.	170

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Study Citation: Data Type: Hero ID:	hexabromo	S. Fujii, M. Hirata-Koizumi, M. Matsumoto. 2 cyclododecane in rats. Reproductive Toxicology 21 days); Terrestrial; Mammalian			on repr	oductive toxicity study of the flame retardan
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	ubstance					
	Metric 1:	Test Substance Identity	High	\times 2	2	The CASRN, purity, mixture components, and ratios were explicitly specified.
	Metric 2:	Test Substance Source	High	× 1	1	The manufacturer was specified; test substance number was reported. It was indicated that the pu- rity and stability of the test chemical were verified using liquid chromatography.
	Metric 3:	Test Substance Purity	High	× 1	1	The test substance was 99.7 percent pure; therefore effects in the study were highly likely to be due to the test substance itself (rather than any unspecified impurities).
Domain 2: Test [Design					
	Metric 4:	Negative Controls	High	\times 2	2	An appropriate concurrent control group was used (all of the conditions the same except exposure.
	Metric 5:	Negative Control Response	High	× 1	1	The response of the negative controls was reported and were adequate (e.g. there wereno histological findings in the thyroid of control rats).
	Metric 6:	Randomized Allocation	High	× 1	1	The study indicates that rats were randomly as signed into study groups.
Domain 3: Expos	ure Charact	erization				
r	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	It was indicated that the test substance was store in a sealed container under cool anddark conditions. The test substance was well-mixed in the diet (he mogeneous and stablefor at least 21 days).
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Analysis of the diet indicated that the test substance was administered at the desired feed concentration throughout the study. Animals were fed ad libitum
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	It was not reported that the exposure concentration in the diet was analytically measured, but based of the properties of HBCD, there is unlikely to be sub- stantial loss.
		Continued on next page				

Study Citation:		Fujii, M. Hirata-Koizumi, M. Matsumoto. 2 cyclododecane in rats. Reproductive Toxicology		_	on repre	oductive toxicity study of the flame retarda
Data Type: Hero ID:		21 days); Terrestrial; Mammalian	20.000-001	0.000 001		
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The exposure frequency and duration were appropr ate for the study type (and consistent with OEC guidelines). Mating was 3 weeks (rather than weeks outlined by guideline).
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	Three dose groups and a concurrent control group were used. Dosage levels were based on the results a 90-day repeated-dose toxicity study.
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	This was a feeding study.
Domain 4: Test (Organism Metric 13:	Test Organism Characteristics	High	× 2	2	The animal species, strain, sex, health, agand starting body weights were reported. Anima were purchased from a commercial laborator Crl:CD(SD) rats were used because they are the most
	Matria 14	Andimiting time and Destruction and Conditions	II: "L	1	1	commonly used in reproductive and development toxicitystudies; historical control data are available. The rat is the preferred species for testing (according to guideline).
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	Animals were housed under the same condition (at the temperature and humidityrecommended liquideline). Animals were housed individually exceduring acclimation, mating, and nursing periods.
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	No less than 20 pregnant females per group is preserved (but not always possible). The study utilize 24 rats/sex/group. Although the number of prenant animals was only 19 for high-dose F0 female the number of pregnant females was adequate for meaningfulanalyses of the desired outcomes.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Animals were housed under the same condition (at the temperature and humidityrecommended by guideline). Animals were housed individually excellent during acclimation, mating, and nursing periods.
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	\times 2	2	The outcome assessment methodology addressed the intended outcomes (mirroredguideline recommendations for a two-generation reproductive toxicity a say).

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Data Type: Hero ID:		21 days); Terrestrial; Mammalian	20.000 001	-		
Domain		Metric	Rating [†]	MWF^*	Score	${\rm Comments}^{\dagger\dagger}$
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	The outcomes were measured consistently across study groups.
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	There were no differences in initial body weights or intake that could influence theoutcome assessment.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	Details regarding animal outcomes unrelated to exposure (i.e. accidental injury in thehome cage) were reported, but these differences would not influence the outcomeassessment.
Domain 7: Data	Presentation	and Analysis				
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1	Statistical methods were clearly described.
	Metric 22:	Reporting of Data	High	× 2	2	Data were provided for all exposure-related findings by dose group. The cutoff value fordecreased thyroid follicle size was not reported, but this is not likely to affect theoutcome of the study. Additional data are provided in the supplemental document (forexample, date for primordial follicles are presented graphically in the primary report; quantitative data are available in the supplemental document).
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	There were no unexpected outcomes.
Overall Quality I	Determination	n [‡]	High		1.1	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		,Zvinavashe, E.,Furlow, J. D.,Murk, A. J 20 on by hexabromocyclododecane (HBCD) and 2, 8				
Data Type: Hero ID:	Other; Aqu 938764	atic; other tadpole tail tip				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	Low	\times 2	6	Hexabromocyclododecane (HBCD technical mixture was used, with no additional information on percentages of various components or if the test substance was further analyzed.
	Metric 2:	Test Substance Source	Medium	× 1	2	Only mentioned the source (BSEF), without any other information about the batch, or product type.
	Metric 3:	Test Substance Purity	Low	× 1	3	purity not supplied by provider
Domain 2: Test 1	Design					
20 1000 1	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	How the tips were allocated to exposure groups was not explained.
Domain 3: Expo	sure Characte	erization				
Domain of Expo	Metric 7:	Experimental System/Test Media Preparation	Medium	\times 2	4	Exposures were statically renewed every other day, and took place in 26-well plates. DMSO was used as the solvent control.
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Exposure concentrations were not measured (only nominal amounts provided), however it is likely actual concentrations are similar to nominal concentrations.
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test	Organism					
	- 0	Continued on part page				
		Continued on next page				

Study Citation:	tip regression	Schriks, M., Zvinavashe, E., Furlow, J. D., Murk, A. J 2006. Disruption of thyroid hormone-mediated Xenopus laevis tadpole tail tip regression by hexabromocyclododecane (HBCD) and 2,2',3,3',4,4',5,5',6-nona brominated diphenyl ether (BDE206). Chemosphere 65:1904-1908							
Data Type: Hero ID:	Other; Aqua 938764	atic; other tadpole tail tip							
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
	Metric 13:	Test Organism Characteristics	High	\times 2	2				
	Metric 14:	Acclimitization and Pretreatment Conditions	High	$\times 1$	1				
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1				
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1				
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	unding / Var	riable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	$\overline{2}$				
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1				
Overall Quality I	Determination	ı‡	High		1.4				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

 $^{^{\}dagger\dagger}\,\mathrm{Metrics}\;\mathrm{that}\;\mathrm{are}\;\mathrm{rated}\;\mathrm{'High'}\;\mathrm{met}\;\mathrm{the}\;\mathrm{criteria}\;\mathrm{for}\;\mathrm{high}\;\mathrm{confidence}\;\mathrm{as}\;\mathrm{expected}\;\mathrm{for}\;\mathrm{this}\;\mathrm{type}\;\mathrm{of}\;\mathrm{study},\mathrm{and}\;\mathrm{may}\;\mathrm{not}\;\mathrm{require}\;\mathrm{additional}\;\mathrm{comments}.$

Study Citation:		B., Tingaud-Sequeira, A., Prats, E., Barata, C., Barat				
Data Type: Hero ID:		hour); Aquatic; Fish	id normone	Sy Horicon	3. Liivii	ommental science and reciniology 10.1020 100.
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	Medium	× 1	2	Source was reported (Sigma), but no other details on composition (or it's verification specs) or batch number was reported. The CASRN was included in the SI.
	Metric 3:	Test Substance Purity	Low	× 1	3	No information provided on test substance purity.
Domain 2: Test I)esign					
2. 1650 1	Metric 4:	Negative Controls	High	\times 2	2	stock solutions were prepared in DMSO; vehicle control embryos exposed to 0.1 percent DMSO.
	Metric 5:	Negative Control Response	High	× 1	1	Negative control (DMSO) is reported as the negative control on page 7526.
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allocated to study groups.
Domain 3: Expos	uro Characte	prization				
Bolliam 6. Expos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Nominal concentrations reported.
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Low	× 1	3	Exposures were based on MATCs, as explained in SI, but only one concentration was used. The purpose of the study wasn't to look at a dose response resulting from HBCD exposures.
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test ()rganism					
20110111 4. 1050	Metric 13:	Test Organism Characteristics	High	\times 2	2	
		Continued on next page				

vertebrate model for screening chemicals that impair thyroid hormon Acute (0-96 hour); Aquatic; Fish Hero ID: 1062065 Domain Metric 14: Acclimitization and Pretreatment Conditions Low Metric 15: Number of Organisms and Replicates per Medium Group Metric 16: Adequacy of Test Conditions Low Domain 5: Outcome Assessment Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Assessment High			
Hero ID: 1062065 Domain Metric Rating Metric 14: Acclimitization and Pretreatment Conditions Low Metric 15: Number of Organisms and Replicates per Group Metric 16: Adequacy of Test Conditions Low Domain 5: Outcome Assessment Metric 17: Outcome Assessment Methodology High			
Metric 14: Acclimitization and Pretreatment Conditions Low Metric 15: Number of Organisms and Replicates per Group Metric 16: Adequacy of Test Conditions Low Domain 5: Outcome Assessment Metric 17: Outcome Assessment Methodology High	,		
Metric 15: Number of Organisms and Replicates per Medium Group Metric 16: Adequacy of Test Conditions Low Domain 5: Outcome Assessment Metric 17: Outcome Assessment Methodology High	g^{\dagger} MW	F* Score	$\mathrm{Comments}^{\dagger\dagger}$
Metric 16: Group Adequacy of Test Conditions Low Domain 5: Outcome Assessment Metric 17: Outcome Assessment Methodology High	× 1	3	No report of acclimatization or pre-treatment conditions
Domain 5: Outcome Assessment Metric 17: Outcome Assessment Methodology High	$m \times 1$	2	A minimum of eighteen eleutheroembryos were exposed. Unsure of sample size for HBCD.
Metric 17: Outcome Assessment Methodology High	× 1	3	no information on experimental housing conditions.
8			
96	$\times 2$	2	
	× 1	1	
Domain 6: Confounding / Variable Control			
Metric 19: Confounding Variables in Test Design and High	$\times 2$	2	
Procedures			
Metric 20: Outcomes Unrelated to Exposure Medium	$m \times 1$	2	Not reported.
Domain 7: Data Presentation and Analysis			
Metric 21: Statistical Methods High	$\times 1$	1	
Metric 22: Reporting of Data High	$\times 2$	2	
Metric 23: Explanation of Unexpected Outcomes High	× 1	1	
Overall Quality Determination [‡] High		1.5	
		1.0	
Extracted Yes			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	Anselmo, H. M. R., Koerting, L., Devito, S., van den Berg, J. H. J., Dubbeldam, M., Kwadijk, C., Murk, A. J 2011. Early life developmental effects of marine persistent organic pollutants on the sea urchin Psammechinus miliaris. Ecotoxicology and Environmental Safety 74:2182-2192							
Data Type: Hero ID:	Other; Aqu 1274149	atic; Invertebrates						
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$		
Domain 1: Test S	Substance							
	Metric 1:	Test Substance Identity	Low	\times 2	6	No CASRN or purity mentioned. Only cited that it is a technical mixture.		
	Metric 2:	Test Substance Source	High	× 1	1	A gift from a professor. However, other chemicals in the study cited the source.		
	Metric 3:	Test Substance Purity	High	× 1	1			
Domain 2: Test I	Design							
	Metric 4:	Negative Controls	High	$\times 2$	2			
	Metric 5:	Negative Control Response	High	× 1	1			
	Metric 6:	Randomized Allocation	High	× 1	1			
Domain 3: Expos	sure Characte	erization						
Domain of Empos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2			
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1			
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2			
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1			
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1			
	Metric 12:	Testing at or Below Solubility Limit	High	\times 1	1			
Domain 4: Test (Organism							
Domain 4. 1680 (Metric 13:	Test Organism Characteristics	High	$\times 2$	2			
	Metric 13:	Acclimitization and Pretreatment Conditions	High	$\stackrel{\wedge}{\times} \stackrel{2}{1}$	1			
	Metric 14:	Number of Organisms and Replicates per	High	× 1 × 1	1			
		Group						
		Continued on next page						

Anselmo, H. M. R., Koerting, L., Devito, S., van den Berg, J. H. J., Dubbeldam, M., Kwadijk, C., Murk, A. J 2011. Early life developmental effects of marine persistent organic pollutants on the sea urchin Psammechinus miliaris. Ecotoxicology and Environmental Safety 74:2182-2192								
Aquatic; Invertebrates 49								
Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$				
e 16: Adequacy of Test Conditions	High	× 1	1					
essment								
: 17: Outcome Assessment Methodology	High	$\times 2$	2					
e 18: Consistency of Outcome Assessment	High	\times 1	1					
/ Variable Control								
2 19: Confounding Variables in Test Design and Procedures	High	\times 2	2					
20: Outcomes Unrelated to Exposure	High	\times 1	1					
ation and Analysis								
21: Statistical Methods	High	× 1	1					
22: Reporting of Data	High	$\times 2$	2					
23: Explanation of Unexpected Outcomes	N/A		N/A					
nation [‡]	High		1.1					
	Yes							
nation [‡]		-						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		J.,Marteinson, S. C.,Bird, D. M.,Ritchie, I. J., in relation to exposure to technical hexabromo 5				
Data Type: Hero ID:	Chronic (>2 1401837	21 days); Terrestrial; Birds				
Domain		Metric	Rating [†]	MWF*	Score	$\rm Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	erization				
1	Metric 7:	Experimental System/Test Media Preparation	Medium	\times 2	4	Modified feeding diet and only one dose concentra- tion. However, this concentration was established in a previous study.
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 1	2	Number of paired birds were not stated in this paper but the methods were referenced in a previous study.
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Source states that the level of HBCD exposure we slightly higher that the environmental concentrations.
Domain 4: Test C	Organism					
	Metric 13:	Test Organism Characteristics	Medium	\times 2	4	Study used a different species that is normally recommended for this type of study.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	\times 1	1	· · · · · · · · · · · · · · · · · · ·
		Continued on next page				

Study Citation:	Fernie, K. J., Marteinson, S. C., Bird, D. M., Ritchie, I. J., Letcher, R. J 2011. Reproductive changes in American kestrels (Falco sparverius) in relation to exposure to technical hexabromocyclododecane flame retardant. Environmental Toxicology and Chemistry 30:2570-2575								
Data Type: Hero ID:	Chronic (>: 1401837	21 days); Terrestrial; Birds							
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$			
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1				
	Metric 16:	Adequacy of Test Conditions	High	× 1	1				
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	ounding / Var	riable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	$\times 1$	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	\times 1	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	, [‡]	High		1.2				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise} \quad ,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		Park, B., Pleskach, K., Gemmill, B., Tomy, G. 20 hexabromocyclododecane (HBCD). Chemosphe			e metal	polism in rainbow trout (Oncorhynchus mykis
Data Type:		21 days); Aquatic; Fish	10 00.100-10	33		
Hero ID:	1403364	, , ,				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	Low	$\times 1$	3	The HBCD isomer source was not provided.
	Metric 3:	Test Substance Purity	Low	× 1	3	Very little information is provided by the author on the HBCD used in these experiments; purity no provided.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos	sure Characte	prization				
Bollian G. Expo	Metric 7:	Experimental System/Test Media Preparation	Low	\times 2	6	Experimental conditions were not explained as full as the acclimatization period and it isn't clear whether the experiments were run via static or flow through conditions, and if leftover food was remove from the tanks after the feedings.
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	G
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Only nominal concentrations for oral exposure provided.
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	HBCD was mixed in with the pellet food.
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
-		Continued on next page				

	c	•	
\dots continued	from	previous	page

Study Citation:					ne metal	bolism in rainbow trout (Oncorhynchus mykiss)			
Data Type: Hero ID:									
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
	Metric 15:	Number of Organisms and Replicates per Group	Medium	× 1	2	No true replicates were used. Twenty fish per exposure treatment (one rep per exposure group) were used.			
	Metric 16:	Adequacy of Test Conditions	Medium	× 1	2	No details on water conditions, temperature, etc. of the experiment. The main details in the methods specifically addressed the feed preparations and dos- ing.			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	unding / Var	riable Control							
Domain o. Come	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Procentation	and Analysis							
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1				
	Metric 21:	Reporting of Data	High	$\stackrel{\wedge}{\times} \stackrel{1}{2}$	2				
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1				
Overall Quality I	Determination	ı [‡]	High		1.4				
Extracted			Yes						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		Egloff, C., Chiu, S., Letcher, R. J., Chu, S., Kenneression in chicken embryos exposed to HBCD.				success, isomer-specific accumulation, and hepatic 492-500
Data Type: Hero ID:	Chronic (> 1403482	21 days); Terrestrial; Birds	J			
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test	Design					
2. 1000	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	$\times 1$	1	
Domain 3: Expo	sure Characte	prization				
Domain 6. Expe	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	N/A		N/A	nominal injection study
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	nominal injection study
Domain 4: Test	Organism					
_ 51110111 1. 1000	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	$\times 1$	1	
	Metric 16:	Adequacy of Test Conditions Continued on next page	High	× 1	1	

Study Citation:	Crump, D., Egloff, C., Chiu, S., Letcher, R. J., Chu, S., Kennedy, S. W. 2010. Pipping success, isomer-specific accumulation, and hepatic mRNA expression in chicken embryos exposed to HBCD. Toxicological Sciences 115:492-500								
Data Type:	-	21 days); Terrestrial; Birds	0						
Hero ID:	1403482	445, 2/1,							
	1100102								
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}			
Domain 5: Outco	ome Assessme	nt							
Domain 9. Outce	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	ounding / Var	iable Control							
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2				
		Procedures							
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Presentation	and Analysis							
Domain T. Data	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1				
		*							
Overall Quality I	Determination	‡	High		1.0				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		Chiu, S., Egloff, C., Kennedy, S. W 2008. Efression in chicken (Gallus domesticus) hepatocy				
Data Type: Hero ID:		hour); Terrestrial; Birds		.0		
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	ubstance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	The purity was not reported.
Domain 2: Test D	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	Medium	× 1	2	It wasn't reported whether cells were randomly collected from chicken embryos, and distributed into exposure treatments.
Domain 3: Expos	uro Characte	wization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentra- tion	Medium	× 2	4	Nominal concentrations were reported.
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	× 1	1	
		posure Levels	8			
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test C)rganism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
	<u> </u>	Continued on next page		<u> </u>		

Study Citation:	Crump, D., Chiu, S., Egloff, C., Kennedy, S. W 2008. Effects of hexabromocyclododecane and polybrominated diphenyl ethers on mRNA expression in chicken (Gallus domesticus) hepatocytes. Toxicological Sciences 106:479-487						
Data Type:		hour); Terrestrial; Birds	1011100	1081001 01	2011000 100	.110 101	
Hero ID:	1408111	, , ,					
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$	
Domain 5: Outco	me Assessme	nt					
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2		
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1		
Domain 6: Confo	unding / Var	iable Control					
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2		
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1		
Domain 7: Data I	Presentation	and Analysis					
	Metric 21:	Statistical Methods	High	\times 1	1		
	Metric 22:	Reporting of Data	High	$\times 2$	2		
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1		
Overall Quality D	Determination	,‡	High		1.2		
Extracted			Yes				

 $^{^\}star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	mation enzy	P.,Pleskach, K.,Halldorson, T.,Danell, R.,Waut ymes and thyroid axis disruption in juvenile ra mers. Environmental Science and Technology 4	ainbow trou	t (Oncor		
Data Type: Hero ID:	Chronic (>: 1409610	21 days); Aquatic; Fish				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	Medium	× 2	4	Authors reported having a reference diet, but spe cific methods were only referenced from anothe publication;.
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allo cated to study groups.
Domain 3: Expos	ruro Characte	prization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2	
	Wictire 1.	tion	IIIgii	^ 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentra-	High	$\times 2$	2	
		tion	6			
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	\times 1	1	
		posure Levels	-			
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	diet-exposure
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	Medium	× 1	2	Fish were acclimatized for 7 days prior to the star of the experiment. No further details reported or acclimatization.
		Continued on next page				

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Study Citation:	mation enzy		inbow trou	ıt (Oncor	,	.,Marvin, C.,Tomy, G. T 2008. Biotransforsmykiss) exposed to hexabromocyclododecane
Data Type: Hero ID:	Chronic (>: 1409610	21 days); Aquatic; Fish				
Domain		Metric	Rating [†]	MWF^{\star}	Score	${\rm Comments}^{\dagger\dagger}$
	Metric 15:	Number of Organisms and Replicates per Group	Medium	× 1	2	Only one true replicate or tank per treatment. Four fish from each tank were sacrificed on days 0, 7, 14, and 56 of the uptake phase and days 7, 14, 56, and 112 of the depuration phase.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	ome Assessme	ent.				
Bomain or o area	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	
Domain 6: Confe	ounding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1	
Domain 7: Data	Presentation	and Analysis				
Domain 7. Data	Metric 21:	Statistical Methods	Medium	\times 1	2	Statistic methods were referred to, but not adequately described.
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	‡	High		1.2	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

Overall rating =
$$\left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	of the three- Internationa	D., Williams, T. D., Allen, Y., Katsiadaki, I., Chipaspine stickleback (Gasterosteus aculeatus) after al 34:310-317			_	
Data Type: Hero ID:	Chronic (>: 1412194	21 days); Aquatic; Fish				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	Low	$\times 2$	6	No information provided about the toxicant.
	Metric 2:	Test Substance Source	Low	\times 1	3	no source mentioned
	Metric 3:	Test Substance Purity	Low	× 1	3	source not mentioned, no information on chemica purity
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	Medium	× 1	2	Biological responses of the negative control group (s) or treatment groups were reported on page 313
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allocated to study groups.
Domain 3: Expos	sure Characte	erization				
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Only nominal concentrations were reported, but flow through system may have kept the exposure concen- trations consistent throughout the exposure period
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	viations consistent throughout the exposure period
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	Two exposure treatments represented either an environmentally-relevant concentration, or a highe concentration (magnitude higher). Solvent control for both HBCD treatment groups were also used (two different concentrations of acetone). Although only two concentrations were used, these were justified by the author.
	Metric 12:	Testing at or Below Solubility Limit	High	\times 1	1	-
Domain 4: Test (Organism					
		Continued on next page				

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of the	$_{ m three}$	D., Williams, T. D., Allen, Y., Katsiadaki, I., Chipespine stickleback (Gasterosteus aculeatus) after al 34:310-317				
		21 days); Aquatic; Fish				
Hero ID: 141219	,	-1 aug 5), 11quado, 1151				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Metric	: 13:	Test Organism Characteristics	Medium	\times 2	4	No information besides female fish being used for HBCD exposures (e.g., age, size).
Metric	14:	Acclimitization and Pretreatment Conditions	High	\times 1	1	11202 exposures (e.g., age, size).
Metric	15:	Number of Organisms and Replicates per Group	High	× 1	1	
Metric	16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Ass	essme	ent				
Metric		Outcome Assessment Methodology	Medium	\times 2	4	It wasn't explained why HBCD treatment only used female stickleback livers.
Metric	18:	Consistency of Outcome Assessment	High	\times 1	1	
Domain 6: Confounding	/ Var	iable Control				
Metric	,	Confounding Variables in Test Design and Procedures	High	\times 2	2	
Metric	20:	Outcomes Unrelated to Exposure	Medium	× 1	2	Health outcomes unrelated to exposure were not reported.
Domain 7: Data Present	ation	and Analysis				
Metric		Statistical Methods	High	$\times 1$	1	
Metric	22:	Reporting of Data	High	$\times 2$	2	
Metric	23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determi	natior	‡	High		1.6	
Extracted			Yes			
		Continued on next page				

Study Citation: Aniagu, S. O., Williams, T. D., Allen, Y., Katsiadaki, I., Chipman, J. K.. 2008. Global genomic methylation levels in the liver and gonads

of the three-spine stickleback (Gasterosteus aculeatus) after exposure to hexabromocyclododecane and 17-beta oestradiol. Environment

International 34:310-317

Data Type: Chronic (>21 days); Aquatic; Fish

Hero ID: 1412194

Domain Metric Rating † MWF * Score Comments ††

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

where High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3 . If the reviewer determines that the overall rating needs adjustment, the original rating is crossed out and an arrow points to the new rating.

†† Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

 $^{^\}star$ MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

Study Citation:	D 2007. L	V., Cantón, R. F., Leonards, P. E., Jenssen, B. Mong-term exposure of European flounder (Platic cyclododecane (HBCD). Ecotoxicology and Env	chthys fles	us) to th	e flame	-retardants tetrabromobisphenol A (TBBPA) ar
Data Type: Hero ID:	Chronic (>: 1412802	21 days); Aquatic; Fish				
Domain		Metric	Rating [†]	MWF^{\star}	Score	${\rm Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allocated to study groups.
Domain 3: Expos	sure Characte	erization				
r	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentra- tion	Low	\times 2	6	Test substance was not measured in the exposure medium. $$
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	× 1	1	
		posure Levels	Ü			
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Exposure was through spiked sediment and food.
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	Low	× 1	3	It was not mentioned if the flounder were acclimated to the experiment conditions.
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	to the experiment conditions.
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		1 1 9				
Study Citation: Data Type: Hero ID:	D. 2007. L hexabromoo	V., Cantón, R. F., Leonards, P. E., Jenssen, B. Mong-term exposure of European flounder (Platic cyclododecane (HBCD). Ecotoxicology and Env 21 days); Aquatic; Fish	hthys fles	us) to th	e flame-reta	
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	ome Assessme	nt.				
Domain or o acce	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	iable Control				
Domain or Come	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	$\times 1$	1	
Domain 7: Data	Presentation	and Analysis				
Domain 7. Data	Metric 21:	Statistical Methods	High	$\times 1$	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	.‡	High		1.3	
Extracted			Yes			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	of hexabron	lace, V. P., Halldorson, T., Danell, R., Wautier, K nocyclododecane diastereoisomers in juvenile ra bioisomerization. Environmental Toxicology an	ainbow trou	it (Oncor		
Data Type: Hero ID:	Chronic (>: 1443861	21 days); Aquatic; Fish				
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	ubstance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	\times 1	1	
Domain 2: Test D	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	Reported as an unfortified food group.
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	ure Characte	erization				
Bomain o. Expos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentra-	High	$\times 2$	2	
		tion	111811	/\ <u>-</u>	-	
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Diet exposure
Domain 4: Test C	raniam					
Domain 4. 168t C	Metric 13:	Test Organism Characteristics	Medium	\times 2	4	Besides fish weight, there is no indication of source, age, gender, or other characteristics of the test organisms.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	gamoms.
	Metric 15:	Number of Organisms and Replicates per	N/A	\ I	N/A	Purpose of study wasn't to get a dose response; only
		Group	·		·	one exposure tank per isomer.
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Study Citation:	Law, K., Palace, V. P., Halldorson, T., Danell, R., Wautier, K., Evans, B., Alaee, M., Marvin, C., Tomy, G. T 2006. Dietary accumulation of hexabromocyclododecane diastereoisomers in juvenile rainbow trout (Oncorhynchus mykiss). I: Bioaccumulation parameters and evidence of bioisomerization. Environmental Toxicology and Chemistry 25					
Data Type: Hero ID:	Chronic (>2 1443861	21 days); Aquatic; Fish				
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	\times 1	2	none reported
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	$\times 1$	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	į.	High		1.1	
Extracted			Yes			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	developmen	o, Z.,Li, B.,Huang, L.,Chen, M.,Wang, C. 2013. t in zebrafish embryos. Ecotoxicology 22:1200-1		ow-level	hexabro	omocyclododecane (HBCD) exposure on cardiac
Data Type: Hero ID:	Acute (0-96 1927533	hour); Aquatic; Fish				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	${\rm Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	Low	\times 1	3	Embryo treatment allocation was not reported.
Domain 3: Expos	sure Characte	erization				
r	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Nominal concentrations used, but 2 water changes per day alleviates some concern.
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Some exposure concentrations above water solubility.
Domain 4: Test (Organism					
2 3 11 10 10 10 10 10 10 10 10 10 10 10 10	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	$\times 1$	1	

Study Citation:	Citation: Wu, M., Zuo, Z., Li, B., Huang, L., Chen, M., Wang, C. 2013. Effects of low-level hexabromocyclododecane (HBCD) exposure on cardiac development in zebrafish embryos. Ecotoxicology 22:1200-1207						
Data Type: Hero ID:	_	5 hour); Aquatic; Fish					
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$	
Domain 5: Outcome Assessment							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2		
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1		
Domain 6: Confo	ounding / Var	riable Control					
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2		
	Metric 20:	Outcomes Unrelated to Exposure	Medium	\times 1	2	No differences in organism health reported.	
Domain 7: Data Presentation and Analysis							
	Metric 21:	Statistical Methods	High	$\times 1$	1		
	Metric 22:	Reporting of Data	High	$\times 2$	2		
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1		
Overall Quality I	Determination	n [‡]	High		1.2		
Extracted			Yes				

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		, L., Yan, C., Zhang, X 2012. Diastereoisomer- cyclododecanes in zebrafish (Danio rerio). Envir				
Data Type: Hero ID:		21 days); Aquatic; Fish			14 10011	10108, 10111010 11010
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	Percent purity not provided.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	Uncertain of whether organisms were randomly allocated to treatment groups.
Domain 3: Expos	sure Characte	prization				
Domain o. Expos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	food exposure; amount of HBCD in control food was ND.
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	Medium	× 1	2	There was only one tank per exposure. No true replicates to characterize toxicological effects, but this wasn't the study goal (uptake/depuration study).
		Continued on next page				

Study Citation:	Du, M.,Lin, L.,Yan, C.,Zhang, X 2012. Diastereoisomer- and enantiomer-specific accumulation, depuration, and bioisomerization of hexabromocyclododecanes in zebrafish (Danio rerio). Environmental Science and Technology 46:11040-11046								
Data Type:		Chronic (>21 days); Aquatic; Fish							
Hero ID:	1927579								
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$Comments^{\dagger\dagger}$			
	Metric 16:	Adequacy of Test Conditions	High	× 1	1				
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1				
Domain 6: Confo	ounding / Var	iable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	Medium	\times 1	2	No health outcomes reported.			
Domain 7. Data	Duccontation	and Analysis							
Domain 7: Data	Metric 21:	Statistical Methods	Uich	× 1	1				
	Metric 21:	Reporting of Data	High High	\times 1 \times 2	$\frac{1}{2}$				
	Metric 22:	Explanation of Unexpected Outcomes	High	$\times 2 \times 1$	1				
Overall Quality I	Determination	[‡]	High		1.2				
Extracted			Yes						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

 $^{^\}dagger$ High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type: Hero ID:	Wu, T., Wang, S., Huang, H., Zhang, S 2012. Diastereomer-Specific Uptake, Translocation, and Toxicity of Hexabromocyclododecan Diastereoisomers to Maize. Journal of Agricultural and Food Chemistry 60:8528-8534 Acute (0-96 hour); Terrestrial; other Plant: Maize 1927583							
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}		
Domain 1: Test S	Substance							
	Metric 1:	Test Substance Identity	High	\times 2	2	Identified HBCD and alpha/beta and gamma dis- asterioisomers and percent composition in technical grade commercial mixture.		
	Metric 2:	Test Substance Source	High	× 1	1	Companies that produced the standards for testing were identified; including the radio-isotope HBCD standards.		
	Metric 3:	Test Substance Purity	Medium	× 1	2	Purity not reported.		
Domain 2: Test I	Dogian							
Domain 2. Test i	Metric 4:	Negative Controls	High	\times 2	2	Negative controls were used for each HBCD compound tested.		
	Metric 5:	Negative Control Response	High	× 1	1	Biological responses of maize exposed to control groups were included in data.		
	Metric 6:	Randomized Allocation	Low	× 1	3	Allocation was not reported.		
Domain 3: Expos	euro Characto	orization						
Domain 9. Expos	Metric 7:	Experimental System/Test Media Preparation	Medium	\times 2	4	Although test solutions were renewed everyday, it not clear how the exposure solution was mixed into the soil.		
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	Treatment conditions were consistent across plants roots, seeds and seedlings.		
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	The amount of HBCD in soil was not measured; only nominal concentrations were provided.		
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	96-hour exposures for seedlilngs, roots and seeds.		
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	Negative control and test concentration below water solubility of each isomer (alpha, beta and gamma were tested and adequate for the goal of this test (time-dependent accumulation).		

Study Citation:		ng, S., Huang, H., Zhang, S 2012. Diastereomer omers to Maize. Journal of Agricultural and Foo				tion, and Toxicity of Hexabromocyclododecane		
Data Type: Hero ID:	Acute (0-96 hour); Terrestrial; other Plant: Maize 1927583							
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	${\rm Comments}^{\dagger\dagger}$		
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Nominal concentrations were used, so there is uncertainty to how much HBCD was actually present despite claiming to set the initial concentrations below water solubility.		
Domain 4: Test (Organism							
	Metric 13:	Test Organism Characteristics	High	\times 2	2	Maize is a common crop plant, well studied terrestrial plant that is relevant for studying the accumulation of HBCD in plants.		
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	All test plants and seeds for controls and exposures to the HBCD isomers were prepared and acclimated in the same manner.		
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	Five seedlings per HBCD isomer and controls and 100 seeds per control/exposure were adequate for this test.		
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Plant and seed growth conditions were adequately described and adequate for growth and maintenance of plants.		
Domain 5: Outco	ome Assessme	ent						
Johan of Guess	Metric 17:	Outcome Assessment Methodology	High	× 2	2	Statistical methods clearly expressed and replicable. Multiple software were used to evaluate oneway and two-way ANOVAs with Tukey"s multiple-comparison tests.		
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	All biological effects parameters were assessed consistently across exposure isomers and controls.		
Domain 6: Confo	unding / Var	iable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	Study did not show variations between environmental conditions that would affect results.		
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	Information on attrition unrelated to exposure were not reported.		
Domain 7: Data	Presentation	and Analysis						
		Continued on next page						

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Study Citation: Data Type: Hero ID:	Wu, T., Wang, S., Huang, H., Zhang, S 2012. Diastereomer-Specific Uptake, Translocation, and Toxicity of Hexabromocyclododecane Diastereoisomers to Maize. Journal of Agricultural and Food Chemistry 60:8528-8534 Acute (0-96 hour); Terrestrial; other Plant: Maize 1927583							
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$		
	Metric 21:	Statistical Methods	High	× 1	1	Statistical analysis was clearly indicated and replicable.		
	Metric 22:	Reporting of Data	High	\times 2	2	Biological effects (i.e. growth inhibition, biomass, etc) displayed in tables and time-dependent accumulation charts to easily follow test results and conclusions.		
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	Authors provided good discussion of test results and reasonable discussion for unexpected outcomes (i.e. highest accumulation of beta-HBCD did not induce maximum growth inhibition).		
Overall Quality I	Determination	‡	High		1.3			
Extracted			Yes					

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		, S. C.,Bird, D. M.,Letcher, R. J.,Sullivan, K. Mecane (HBCD) alters courtship, incubation and 3				
Data Type: Hero ID:	Other; Terr 1927590	estrial; Birds				
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	ubstance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	Technical grade
Domain 2: Test D	esign					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Exposi	ure Characte	erization				
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	diet exposure; measured conc in egg to indicate exposure dose
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	\times 1	2	One dose tested
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	diet exposure; measured conc in egg to indicate exposure dose
Domain 4: Test O)rganism					
Domain 4. 1est O	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 13.	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
	Michigan 19.	Group	111511	^ I	1	
		Continued on next page				

Study Citation:	Marteinson, S. C.,Bird, D. M.,Letcher, R. J.,Sullivan, K. M.,Ritchie, I. J.,Fernie, K. J 2012. Dietary exposure to technical hexabro-mocyclododecane (HBCD) alters courtship, incubation and parental behaviors in American kestrels (Falco sparverius). Chemosphere 89:1077-1083						
Data Type: Hero ID:	Other; Terro 1927590	estrial; Birds					
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1		
Domain 5: Outco	ome Assessme	\mathbf{nt}					
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2		
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1		
Domain 6: Confo	ounding / Var	iable Control					
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2		
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1		
Domain 7: Data	Presentation	and Analysis					
Domain 7. Data	Metric 21:	Statistical Methods	High	$\times 1$	1		
	Metric 22:	Reporting of Data	High	$\times 2$	2		
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A		
Overall Quality I	Determination	‡	High		1.1		
Extracted			Yes				

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise} \quad ,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		ng, D., Yan, C., Zhang, X 2012. Developmenta abryos. Aquatic Toxicology	l toxicity ev	valuation	of thre	e hexabromocyclododecane diastereoisomers o
Data Type:	Other;	ibiyos. Aquatic Toxicology				
Hero ID:	1927610					
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
Domain 2. 1630 1	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	uro Characte	prization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Preparation	Medium	\times 2	4	Unsure of volatilization, and no water concentra- tions were measured (all nominal).
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentra- tion	Medium	\times 2	4	nominal concentrations only reported
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Many exposure concentrations above water solubility of different hbcd stereoisomers.
Domain 4: Test (Iraniem					
Domain 4. 16st (Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	$\times 2 \times 1$	1	
	Metric 14:	Number of Organisms and Replicates per	High	× 1	1	
	1,100110 10.	Group	111811	/\ I	1	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

Study Citation:		ng, D., Yan, C., Zhang, X 2012. Developmenta abryos. Aquatic Toxicology	l toxicity e	valuation	of three he	exabromocyclododecane diastereoisomers on
Data Type:	Other;	v i				
Hero ID:	1927610					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	$\times 2$	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	\times 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	‡	High		1.2	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:						chie, K. J. Fernie. 2011. Diet exposure to techand thyroxine levels in American kestrels (Falco
		Environmental Research 111:1116-1123	Circulatii	ig testos	octone i	and invioxing levels in Timerican Restress (Laice
Data Type: Hero ID:		21 days); Terrestrial; Birds				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	Purity not provided.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	erization				
•	Metric 7:	Experimental System/Test Media Preparation	N/A		N/A	Oral administration.
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Oral administration.
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	\times 1	1	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

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Study Citation:	S. C. Marteinson, S. Kimmins, R. J. Letcher, V. P. Palace, D. M. Bird, I. J. Ritchie, K. J. Fernie. 2011. Diet exposure to technical hexabromocyclododecane (HBCD) affects testes and circulating testosterone and thyroxine levels in American kestrels (Falco sparverius). Environmental Research 111:1116-1123								
Data Type:	- /	21 days); Terrestrial; Birds							
Hero ID:	1927624	21 days), Terresoriai, Dirds							
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1				
Domain 6: Confo	unding / Var	iable Control							
Domain o. Como	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2				
	1,100110 101	Procedures	6	·· -	_				
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1				
Domain 7: Data		· ·							
	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	‡	High		1.1				
	5 5 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	•	8		1.1				
Extracted			Yes						

^{*} MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	study of "-h					Ratel, J., Travel, A., Jondreville, C 2012. Kinetic Transfer of HBCD in laying hens". Environmental
Data Type: Hero ID:	Chronic (> 1927629	21 days); Terrestrial; Birds				
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test l	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	erization				
•	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	N/A		N/A	Dose concentrations.
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	Dose concentrations.
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Dose concentrations.
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
		Continued on next page				

Study Citation:	Fournier, A., Feidt, C., Marchand, P., Vénisseau, A., Le Bizec, B., Sellier, N., Engel, E., Ratel, J., Travel, A., Jondreville, C 2012. Kinetic study of "-hexabromocyclododecane orally given to laying hens (Gallus domesticus). "Transfer of HBCD in laying hens". Environmental								
		Pollution Research 19:440-447							
Data Type:		21 days); Terrestrial; Birds							
Hero ID:	1927629								
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 5: Outco	A ggoggen								
Domain 5. Outco	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 17:	Consistency of Outcome Assessment	High	$\times 2 \times 1$	1				
	Metric 16.	Consistency of Outcome Assessment	IIIgii	^ 1	1				
Domain 6: Confo	unding / Var	iable Control							
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2				
		Procedures	Ü						
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	Ţ.	High		1.0				
Extracted			Yes						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

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Study Citation:						010. Multi-generational effects of polybrominated verius) to DE-71 alters reproductive success and
		Environmental Toxicology and Chemistry 29:17		tieis (ra	ico spai	vertus) to DE-71 alters reproductive success and
Data Type:		21 days); Terrestrial; Birds	10-11-11			
Hero ID:	1927669	=1 days), Tollosoilai, Blids				
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$
D : 1 TD + C	1 4					
Domain 1: Test S	ubstance Metric 1:	Test Substance Identity	II: mb	v 9	9	
	Metric 1: Metric 2:	Test Substance Identity Test Substance Source	High High	$\times 2 \times 1$	2 1	
	Metric 3:	Test Substance Purity	Low	× 1 × 1	3	Dunites was not massided
	Metric 5.	Test Substance 1 unity	LOW	× 1	<u>J</u>	Purity was not provided.
Domain 2: Test D	Oesign					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	ure Characte	erization				
Domain of Empos	Metric 7:	Experimental System/Test Media Prepara-	N/A		N/A	
		tion	,		,	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentra-	N/A		N/A	Dosing method.
		tion				
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	$\times 1$	1	
		posure Levels				
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Dosing method.
Domain 4: Test C) man niam					
Domain 4. Test C	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	\times 2 \times 1	1	
	Metric 14: Metric 15:	Number of Organisms and Replicates per	High	\times 1 \times 1	1	
	MICHIC 19.	Group	111811	^ 1	1	
	Metric 16:	Adequacy of Test Conditions	High	$\times 1$	1	
		Continued on next page				

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S. C. Marteinson, D. M. Bird, J. L. Shutt, R. J. Letcher, I. J. Ritchie, K. J. Fernie. 2010. Multi-generational effects of polybrominated diphenylethers exposure: embryonic exposure of male American kestrels (Falco sparverius) to DE-71 alters reproductive success and behaviors. Environmental Toxicology and Chemistry 29:1740-1747								
Chronic (>2	30							
1927669								
	Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$			
			_					
	30	_		2				
Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
unding / Var	iable Control							
Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1				
Presentation	and Analysis							
		High	× 1	1				
		_						
Metric 23:	Explanation of Unexpected Outcomes	N/A	A 2					
	-	•		•				
Determination	.‡	High		1.1				
		Yes						
I	me Assessme Metric 17: Metric 18: Metric 20: Metric 21: Metric 22: Metric 23:	behaviors. Environmental Toxicology and Chemistry 29:174 Chronic (>21 days); Terrestrial; Birds 1927669 Metric me Assessment Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Assessment unding / Variable Control Metric 19: Confounding Variables in Test Design and Procedures Metric 20: Outcomes Unrelated to Exposure Presentation and Analysis Metric 21: Statistical Methods Metric 22: Reporting of Data	behaviors. Environmental Toxicology and Chemistry 29:1740-1747 Chronic (>21 days); Terrestrial; Birds 1927669 Metric Rating† Metric 17: Outcome Assessment Methodology High Metric 18: Consistency of Outcome Assessment High Metric 19: Confounding Variables in Test Design and Procedures Metric 20: Outcomes Unrelated to Exposure High Presentation and Analysis Metric 21: Statistical Methods High Metric 22: Reporting of Data High Metric 23: Explanation of Unexpected Outcomes Metric 41: High Metric 23: Explanation of Unexpected Outcomes Metric 41: High Metric 42: Reporting of Data High Metric 43: Explanation of Unexpected Outcomes Metric 44: High Metric 45: High Metric 46: High Metric 47: High	behaviors. Environmental Toxicology and Chemistry 29:1740-1747 Chronic (>21 days); Terrestrial; Birds 1927669 Metric Rating† MWF* Metric 17: Outcome Assessment Methodology High × 2 Metric 18: Consistency of Outcome Assessment High × 1 unding / Variable Control Metric 19: Confounding Variables in Test Design and High × 2 Procedures Metric 20: Outcomes Unrelated to Exposure High × 1 Presentation and Analysis Metric 21: Statistical Methods High × 2 Metric 22: Reporting of Data High × 2 Metric 23: Explanation of Unexpected Outcomes Metric 31: Explanation of Unexpected Outcomes High × 1 High Metric 23: Explanation of Unexpected Outcomes High High High	behaviors. Environmental Toxicology and Chemistry 29:1740-1747 Chronic (>21 days); Terrestrial; Birds			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise} \end{array},$$

 $^{^\}dagger$ High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	from the Ba	altic Sea. Aquatic Toxicology 95:239-247	oromocycl	ododeca	ne (HB	CDD) to the benthic clam Macoma balthica (L
Data Type: Hero ID:	Chronic (>: 1927697	21 days); Aquatic; Invertebrates				
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	Low	$\times 1$	3	not provided
	Metric 3:	Test Substance Purity	High	× 1	1	technical mixture of HBCDD
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	erization				
1	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	Low	\times 2	6	nominal conc; measured gill tissue conc every 10 days
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Low	× 1	3	nominal conc; measured gill tissue conc every 10 days
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	$\times 1$	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
		Continued on next page				

Study Citation:	Smolarz, K., Berger, A 2009. Long-term toxicity of hexabromocyclododecane (HBCDD) to the benthic clam Macoma balthica (L.) from the Baltic Sea. Aquatic Toxicology 95:239-247							
Data Type:		21 days); Aquatic; Invertebrates						
Hero ID:	1927697	21 days), riquane, invertesiates						
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$		
Domain 5: Outco	ome Assessme	ent						
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2			
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1			
Domain 6: Confo	ounding / Var	riable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2			
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1			
Domain 7: Data	Presentation	and Analysis						
	Metric 21:	Statistical Methods	High	$\times 1$	1			
	Metric 22:	Reporting of Data	High	$\times 2$	2			
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A			
Overall Quality I	Determination	‡	High		1.3			
Extracted			Yes					

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type: Hero ID:	alter eggshe	e, J. L. Shutt, R. J. Letcher, I. J. Ritchie, D. M. ell thickness and reproductive success of Americ restrial; Birds				
Domain	1021111	Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
D : 1 TD + 6	1 1 4					
Domain 1: Test S	Metric 1:	Test Substance Identity	High	× 2	2	Test substance is identified by name, and relevant congeners are described: total alpha-HBCD (representing the sum of alpha-, beta-, and gamma-HBCD isomers)
	Metric 2:	Test Substance Source	High	× 1	1	Authors reported the test substance source: The DE-71 mixture was obtained from the Great Lakes Chemical Company.
	Metric 3:	Test Substance Purity	Low	\times 1	3	Test purity was not provided.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	\times 2	2	An appropriate negative control group was used. Kestrels assigned to the control group received saf- flower oil only.
	Metric 5:	Negative Control Response	High	\times 1	1	The negative control response was reported.
	Metric 6:	Randomized Allocation	High	× 1	1	Authors reported that male and female adult kestrels were randomly assigned to one of three groups: the high DE-71 exposure group (1.6 ppm), thelow DE-71 exposure group (0.3 ppm), or the control group. Each group of kestrels was fed their regular diet of frozen/thawed day-old cockerels ad libitum.
Domain 3: Expos	sure Charact	erization				
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	The experimental system and methods for preparation of test media were described in adequate detail.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Details of exposure administration were reported and exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	N/A		N/A	injection applications were applied.
		Continued on next page				

Study Citation:		K. J. Fernie, J. L. Shutt, R. J. Letcher, I. J. Ritchie, D. M. Bird. 2009. Environmentally relevant concentrations of DE-71 and HBCD alter eggshell thickness and reproductive success of American kestrels. Environmental Science and Technology 43:2124-2130							
Data Type: Hero ID:	Other; Terrestrial; Birds 1927714								
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	Duration and exposure frequency were done in accordance with OECD Test Guidelines 206. Namely adult birds were dosed for at least 20 weeks (in this study they were dosed over the course of a year) and reproductive measures were taken at 14 days after being laid, which is recommended in OECD TG 206.			
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 1	2	There are two exposure groups (a high and a low) in addition to the control. OECD TG 206 recommends 3 exposure groups, so there are minor limitations.			
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Not applicable.			
Domain 4: Test (Organism								
Domain II Tool (Metric 13:	Test Organism Characteristics	High	\times 2	2	Kestrels are an acceptable North American species to use as a model organism.			
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	Test organisms were acclimatized to test conditions, and pretreatment conditions were the same for con- trol and exposed populations.			
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	The number of test organisms and replicates were reported and sufficient to characterize toxicological effects.			
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	Organism housing conditions were adequate.			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The outcome assessment method addressed the intended outcomes. Namely, reproductive success was significantly different from controls in the HBCD-exposed birds. For example, eggshell thickness was highly and negatively associated with all of the measured PBDE and total-alpha-HBCD concentrations			
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	Outcomes were consistently assessed across study groups: high-exposure group, low-exposure group and the control.			
Domain 6: Confo	ounding / Var	iable Control							
	0,	Continued on next page							

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Study Citation:		e, J. L. Shutt, R. J. Letcher, I. J. Ritchie, D. M. ell thickness and reproductive success of Americ				ly relevant concentrations of DE-71 and HBCD Science and Technology 43:2124-2130
Data Type: Hero ID:		estrial; Birds	an Restrens.	Liiviron	meman	second and Technology 19.2121 2190
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	There were no reported differences among the study groups in env conditions. The impurities in the mixture included HBCD were measured assessed.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	Egg quality, hatching success, and fledgling success was reported for each exposure group, and possible reasons for any differences were discussed.
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	× 1	1	Statistical methods were appropriate and adequately described.
	Metric 22:	Reporting of Data	High	\times 2	2	Data for exposure related findings were presented for each treatment nd control group.
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	Unexplained outcomes were satisfactorily explained.
Overall Quality I	Determination	ı‡	High		1.1	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise} \quad ,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Domain 4: Test Organism Metric 13: Test Organism Characteristics High × 2 2 Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions High × 1 1			, L.,Liu, C.,Yu, K.,Shi, X.,Yeung, L. W.,Lam, F				09. Hexabromocyclododecane-induced develop-
Domain 1: Test Substance Metric 1: Test Substance Identity High X 2 2 2 2 2 2 2 2 3 3				ic Toxicolog	y 93:29-3	36	
Domain 1: Test Substance Metric 1: Test Substance Metric 2: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 3: Test Design Metric 4: Negative Controls Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 7: Experimental System/Test Media Preparation Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/Spacing of Exposure Groups/Spacing of Exposure Characterization Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Metric 14: Acclimitization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per High × 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		`	nour); Aquatic; other				
Domain 1: Test Substance Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Source Metric 3: Test Substance Purity Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/Spacing of Exposure Allication Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Domain 4: Test Organism Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions Metric 17: Adequacy of Test Conditions Metric 18: Adequacy of Test Conditions Metric 19: Adequ		1021110	Motnia	Patingt	MWE*	Caoro	Commentatt
Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Source Metric 3: Test Substance Purity Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/Spacing of Exposure Althout High × 1 1 Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimitization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Metric 16: Adequacy of Test Conditions	Domain		Metric	namg	IVI VV F	Score	Comments
Metric 2: Test Substance Source High × 1 1 Metric 3: Test Substance Purity High × 1 1 Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response High × 1 1 Metric 6: Randomized Allocation High × 1 1 Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration High × 1 1 Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency High × 1 1 Metric 11: Number of Exposure Groups/Spacing of Exposure Allihold Netric 12: Testing at or Below Solubility Limit Medium × 1 2 Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Metric 13: Test Organism Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Crganisms and Replicates per High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1	Domain 1: Test Su	ibstance					
Metric 3: Test Substance Purity High × 1 1 Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/Spacing of Exposure Fight N/A Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Metric 14: Acclimitization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1 Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1 Metric 16: Adequacy of Test Conditions High × 1 1 Metric 16: Adequacy of Test Conditions		Metric 1:	Test Substance Identity	High	$\times 2$	2	
Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Prepara- tion Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentra- tion Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/Spacing of Ex- posure Levels Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimitization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Metric 16: Adequacy of Test Conditions High × 1 1 High × 2 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a High × 1 1 High ×		Metric 2:	Test Substance Source	High	\times 1	1	
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Metric 6: Randomized Allocation High × 1 1 Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Prepara- tion Metric 8: Consistency of Exposure Administration High × 1 1 Metric 9: Measurement of Test Substance Concentra- tion Metric 10: Exposure Duration and Frequency High × 1 1 Metric 11: Number of Exposure Groups/Spacing of Ex- posure Levels Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Domain 4: Test Organism Metric 13: Test Organism Characteristics High × 2 2 Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions High × 1 1		Metric 5:		_	\times 1	1	
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Metric 11: Number of Exposure Groups/Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Domain 4: Test Organism Metric 13: Test Organism Characteristics High × 2 2 Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions High × 1 1			tion	,		,	
posure Levels Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Domain 4: Test Organism Metric 13: Test Organism Characteristics High × 2 2 Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions High × 1 1		Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
Metric 12: Testing at or Below Solubility Limit Medium × 1 2 Although the concentrations are above the ubility for HBCD, DMSO was used as a Domain 4: Test Organism Metric 13: Test Organism Characteristics High × 2 2 Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions High × 1 1		Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	\times 1	1	
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Metric 13: Test Organism Characteristics High × 2 2 Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions High × 1 1		Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Although the concentrations are above the water solubility for HBCD, DMSO was used as a solvent.
Metric 13: Test Organism Characteristics High × 2 2 Metric 14: Acclimitization and Pretreatment Conditions High × 1 1 Metric 15: Number of Organisms and Replicates per High × 1 1 Group Metric 16: Adequacy of Test Conditions High × 1 1	Domain 4: Test Or	rganism					
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Metric 15: Number of Organisms and Replicates per High \times 1 1 Group Metric 16: Adequacy of Test Conditions High \times 1 1				_			
Group Metric 16: Adequacy of Test Conditions High \times 1 1				_			
				S			
Continued on pout page		Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Continued on next name							
Continued on next page			Continued on next page				

Study Citation:	Deng, J., Yu, L., Liu, C., Yu, K., Shi, X., Yeung, L. W., Lam, P. K., Wu, R. S., Zhou, B. 2009. Hexabromocyclododecane-induced developmental toxicity and apoptosis in zebrafish embryos. Aquatic Toxicology 93:29-36								
Data Type:		Acute (0-96 hour); Aquatic; other							
Hero ID:	1927716								
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	ounding / Var	riable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	\times 1	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	‡	High		1.0				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		g, Y.,Chen, M.,Wang, X 2009. Assessing th	e toxicity of	of TBBP	A and	HBCD by zebrafish embryo toxicity assay and	
Data Thomas	biomarker analysis. Environmental Toxicology 24:334-342 Other; Aquatic; other Fish Post-fertilization						
Data Type: Hero ID:	Otner; Aqua 1927732	atic; other Fish Post-iertilization					
Hero ID.	1921132						
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$	
Domain 1: Test S	Substance						
	Metric 1:	Test Substance Identity	High	$\times 2$	2		
	Metric 2:	Test Substance Source	Medium	\times 1	2		
	Metric 3:	Test Substance Purity	Medium	× 1	2	Purity was provided from the source. but not provided in the report.	
Domain 2: Test I	Design						
	Metric 4:	Negative Controls	Medium	$\times 2$	4	Used DMSO as a solvent	
	Metric 5:	Negative Control Response	Medium	\times 1	2	Used DMSO as a solvent	
	Metric 6:	Randomized Allocation	High	\times 1	1		
Domain 2. Ermas	uma Chamaata	inotion					
Domain 3: Expos	Metric 7:	Experimental System/Test Media Prepara-	High	\times 2	2		
	Metric 7:	tion	підп	X Z	2		
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1		
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2		
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1		
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1		
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1		
Domain 4: Test (Organism						
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2		
	Metric 14:	Acclimitization and Pretreatment Conditions	High	\times 1	1		
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1		
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1		
		Continued on next page					

Study Citation:	Hu, J., Liang, Y., Chen, M., Wang, X 2009. Assessing the toxicity of TBBPA and HBCD by zebrafish embryo toxicity assay and biomarker analysis. Environmental Toxicology 24:334-342								
Data Type:	Other; Aquatic; other Fish Post-fertilization								
Hero ID:	1927732								
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1				
Domain 6: Confo	ounding / Var	riable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	\times 1	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	<u> </u>	High		1.2				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type:	rare minnov	Yang, F., Zhang, X., Xu, Y., Liao, T., Song, S., Wav v (Gobiocypris rarus) exposed to waterborne he 21 days); Aquatic; Fish	ng, J 2008 exabromocy	3. Induct clododec	ion of h ane (HE	sepatic enzymes and oxidative stress in Chines (BCDD). Aquatic Toxicology 86
Hero ID:	1927768	,, , , , , , , , , , , , , , , , , , , ,				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	Medium	× 2	4	The control fish were exposed to the nominal concentration of 0.06" DMSO, corresponding to the highest percentage volume of DMSO used in the HBCDI treatments. Unsure of DMSO concentration or percentage volume in all treatment groups.
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	Allocation not reported
Domain 3: Expos	sure Characte	erization				
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	Medium	× 1	2	Control fish were only exposed to one concentration of DMSO that corresponds with the nominal amour reported for the highest concentration of HBCD; ursure of solvent concentrations in other HBCD corcentrations.
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Only nominal concentrations used/reported.
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Some exposure concentrations exceeded water solubility.
Domain 4: Test (Organism					
		Continued on next page				

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Study Citation:		Yang, F., Zhang, X., Xu, Y., Liao, T., Song, S., Wa v (Gobiocypris rarus) exposed to waterborne he				
Data Type: Hero ID:		21 days); Aquatic; Fish			, 1	
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	Low	× 1	3	No mentioning of acclimatization and pre-treatment conditions, and DMSO concentrations may have dif- fered between treatments
Metric 15:		Number of Organisms and Replicates per Group	Low	× 1	3	45 fish were used per group, but the number of reps per exposure group was not explicitly mentioned. Also not sure if blood and serum samples were pooled for analysis between time sampling points.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	mo Assossmo	nt				
Domain 5. Outco	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
Metric 18: Consistency of Outcome Assessment			High	× 1	1	
D : C C f	1: / 37	: 11 . C 1				
Domain 6: Confo	ounding / var Metric 19:		Medium	\times 2	4	DMGO
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	× 2	4	DMSO concentration differ between treatment groups,.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Procentation	and Analysis				
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	n [‡]	High		1.5	
Extracted			Yes			
		Continued on next page				

Study Citation: Zhang, X., Yang, F., Zhang, X., Xu, Y., Liao, T., Song, S., Wang, J. 2008. Induction of hepatic enzymes and oxidative stress in Chinese

rare minnow (Gobiocypris rarus) exposed to waterborne hexabromocyclododecane (HBCDD). Aquatic Toxicology 86

Data Type: Chronic (>21 days); Aquatic; Fish

Hero ID: 1927768

Domain Metric Rating † MWF * Score Comments ††

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

where High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3 . If the reviewer determines that the overall rating needs adjustment, the original rating is crossed out and an arrow points to the new rating.

†† Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

^{*} MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

Study Citation:	Ronisz, D., Finne, E. F., Karlsson, H., Förlin, L 2004. Effects of the brominated flame retardants hexabromocyclododecane (HBCDD and tetrabromobisphenol A (TBBPA), on hepatic enzymes and other biomarkers in juvenile rainbow trout and feral eelpout. Aquat Toxicology 69:229-245						
Data Type: Hero ID:	Aquatic; ot 1927821	her Fish in vivo, in vitro					
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	${\rm Comments}^{\dagger\dagger}$	
Domain 1: Test S	Substance						
	Metric 1:	Test Substance Identity	High	$\times 2$	2		
	Metric 2:	Test Substance Source	High	$\times 1$	1	Source	
	Metric 3:	Test Substance Purity	Low	× 1	3	Grade/Purity not reported	
Domain 2: Test I	Design						
	Metric 4:	Negative Controls	High	$\times 2$	2		
	Metric 5:	Negative Control Response	High	$\times 1$	1		
	Metric 6:	Randomized Allocation	Low	× 1	3	Allocation not reported	
Domain 3: Expos	sure Characte	erization					
r	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2		
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1		
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	nominal injection studies	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1		
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1		
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	nominal injection studies	
Domain 4: Test (Organism						
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2		
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1		
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1		
	Metric 16:	Adequacy of Test Conditions	High	× 1	1		
		Continued on next page					

Study Citation: Data Type:	Ronisz, D., Finne, E. F., Karlsson, H., Förlin, L 2004. Effects of the brominated flame retardants hexabromocyclododecane (HBCDD), and tetrabromobisphenol A (TBBPA), on hepatic enzymes and other biomarkers in juvenile rainbow trout and feral eelpout. Aquatic Toxicology 69:229-245 Aquatic; other Fish in vivo, in vitro						
Hero ID:	1927821						
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}	
Domain 5: Outco			TT: 1	0	0		
	Metric 17:	Outcome Assessment Methodology	High	× 2	2		
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1		
Domain 6: Confo	ounding / Var	iable Control					
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2		
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1		
D : 7 D :	D	1 4 1 .					
Domain 7: Data		· ·	TT:1.	v. 1	1		
	Metric 21: Metric 22:	Statistical Methods	High	$\times 1 \times 2$	$\frac{1}{2}$		
	Metric 22: Metric 23:	Reporting of Data	High	X Z			
	Metric 25:	Explanation of Unexpected Outcomes	N/A		N/A		
Overall Quality I	Determination	‡	High		1.2		
Extracted			Yes				

^{*} MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type:	Walsh, G. E., Yoder, M. J., McLaughlin, L. L., Lores, E. M 1987. Responses of marine unicellular algae to brominated of compounds in six growth media. Ecotoxicology and Environmental Safety 14:215-222 Acute (0-96 hour); Aquatic; other Plants: Skeletonema costatum and Thalassiosira pseudonana,							
Hero ID:	1927837							
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}		
Domain 1: Test S	Substance							
	Metric 1:	Test Substance Identity	High	× 2	2	This study was conducted by the U.S. Environmental Protection Agency (Environmental Research Laboratory, Gulf Breeze, Florida). Although the reporting source for this study lack specific details about the test substance, the information on this metric can be found in other sources.		
	Metric 2:	Test Substance Source	High	× 1	1	Decabromobiphenyloxide (DBBO), and hexabromocyclododecane (HBCD) were obtained from Great Lakes Chemical Corp. (West Lafayette, IN).		
	Metric 3:	Test Substance Purity	Medium	× 1	2	Although there are minor uncertainties or limitations regarding the test substance purity, the information on test substance purity can be found in other sources. by the U.S. Environmental Protection Agency (Environmental Research Laboratory, Gulf Breeze, Florida).		
Di 9. Trt I	D :							
Domain 2: Test I	Metric 4:	Negative Controls	High	\times 2	2	Acetone and various sea water salinity growth media were used as negative controls.		
	Metric 5:	Negative Control Response	High	× 1	1	Study authors reported using an appropriate concurrent negative control group and the responses for al types of negative controls were comparable to each other.		
	Metric 6:	Randomized Allocation	Medium	× 1	2	Although there are uncertainties about how the study authors allocated the test organisms, these limitations were unlikely to have a substantial impact on test results.		
Domain 3: Expos	sure Charact	erization						
Бошаш Э. Бхрог	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	The study authors provided detailed descriptions of the experimental system and methods for preparation of test media and appropriately accounted for the physical-chemical properties of the test substance (e.g., low solubility).		
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Study Citation:	,	E., Yoder, M. J., McLaughlin, L. L., Lores, E. I in six growth media. Ecotoxicology and Enviro				narine unicellular algae to brominated organi
Data Type: Hero ID:	Acute (0-96 1927837	eudonana,				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Exposures were reported and administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	Exposure media were confirmed by capillary column gas-liquid chromatography.
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The exposure duration and frequency were appropriate for the experiments (e.g., 72-hr algal tests).
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 1	2	There are minor uncertainties regarding the number of exposure groups and/or spacing of exposure levels since the toxicity values were expressed as the EC5c based upon cell numbers after incubation for 72 hr, These limitations are unlikely to have a substantial impact on results.
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	The study authors used an appropriate solvent to dissolve the test substance and verified the exposure concentration with analytical testing.
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	\times 2	2	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	Specific details about the acclimatization and pre- treatment conditions for the algal test organism were reported in previous papers written by the study authors (e.g., Walsh et al., 1979).
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	Specific details about the number of organisms and replicates for the algal test organisms were reported in previous papers written by the study author (e.g., Walsh et al., 1979).
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Specific details about the test conditions for the algal test organisms were reported in previous paper written by the study authors (e.g., Walsh et al. 1979).
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The outcome assessment methodology addressed o reported in previous publications by the study au thors the intended outcome(s) of interest and was sensitive for the outcomes(s) of interest.
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Study Citation:	dy Citation: Walsh, G. E., Yoder, M. J., McLaughlin, L. L., Lores, E. M 1987. Responses of marine unicellular algorithms compounds in six growth media. Ecotoxicology and Environmental Safety 14:215-222							
Data Type: Hero ID:	Acute (0-96 hour); Aquatic; other Plants: Skeletonema costatum and Thalassiosira pseudonana, 1927837							
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$Comments^{\dagger\dagger}$		
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	Details of the outcome assessment protocol were reported and outcomes were assessed consistently across study groups in previous publications by the study authors.		
Domain 6: Confo	ounding / Var	iable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	There were no reported differences among the study groups in environmental conditions or other factors that could influence the outcome assessment.		
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no differences among test groups that could influence the outcome assessment.		
Domain 7: Data	Presentation	and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	No statistical analyses, calculation methods, and/ or data manipulation were conducted but sufficient data were provided to conduct an independent sta- tistical analysis.		
	Metric 22:	Reporting of Data	High	\times 2	2	Sufficient data for the test experiments were presented and were adequate to determine values for the endpoint(s) of interest.		
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	There were no unexpected unexpected outcomes in the study.		
Overall Quality Determination [‡]			High		1.1			
Extracted			Yes					

^{*} MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type: Hero ID:	compounds	E., Yoder, M. J., McLaughlin, L. L., Lores, E. Is in six growth media. Ecotoxicology and Enviro 6 hour); Aquatic; Plants			marine	unicellular algae to brominated organic
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	× 2	2	This study was conducted by the U.S. Environmental Protection Agency (Environmental Research Laboratory, Gulf Breeze, Florida). Although the reporting source for this study lack specific details about the test substance, the information on this metric can be found in other sources.
	Metric 2:	Test Substance Source	High	× 1	1	Decabromobiphenyloxide (DBBO), and hexabromocyclododecane (HBCD) were obtained from Great Lakes Chemical Corp. (West Lafayette, IN).
	Metric 3:	Test Substance Purity	Medium	× 1	2	Although there are minor uncertainties or limitations regarding the test substance purity, the information on test substance purity can be found in other sources. by the U.S. Environmental Protection Agency (Environmental Research Laboratory, Gulf Breeze, Florida).
Domain 2. Test 1	Dagion					
Domain 2: Test l	Metric 4:	Negative Controls	High	\times 2	2	Acetone and various sea water salinity growth media were used as negative controls.
	Metric 5:	Negative Control Response	High	× 1	1	Study authors reported using an appropriate concurrent negative control group and the responses for al types of negative controls were comparable to each other.
	Metric 6:	Randomized Allocation	Medium	× 1	2	Although there are uncertainties about how the study authors allocated the test organisms, these limitations were unlikely to have a substantial impact on test results.
Domain 3: Expos	sure Charact	erization				
3: <u></u>	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	The study authors provided detailed descriptions of the experimental system and methods for prepa- ration of test media and appropriately accounted for the physical-chemical properties of the test sub- stance (e.g., low solubility).
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Study Citation: Data Type: Hero ID:	Walsh, G. E., Yoder, M. J., McLaughlin, L. L., Lores, E. M 1987. Responses of marine unicellular algae to brominated organic compounds in six growth media. Ecotoxicology and Environmental Safety 14:215-222 Acute (0-96 hour); Aquatic; Plants 1927837								
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	${\rm Comments}^{\dagger\dagger}$			
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Exposures were reported and administered consistently across study groups.			
	Metric 9:	Measurement of Test Substance Concentration	Unacceptable	\times 2	8	The HBCD test concentrations were detected above the solubility limit in the Chlorella algal strain Consequently, the study authors were not able to report the outcomes.			
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The exposure duration and frequency were appropriate for the experiments (e.g., 72-hr algal tests).			
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 1	2	There are minor uncertainties regarding the numbe of exposure groups and/or spacing of exposure level since the toxicity values were expressed as the EC5 based upon cell numbers after incubation for 72 hr, These limitations are unlikely to have a substantia impact on results.			
	Metric 12:	Testing at or Below Solubility Limit	Unacceptable	× 1	4	The HBCD test concentrations were detected above the solubility limit in the Chlorella algal strain			
Domain 4: Test	Organism								
	Metric 13:	Test Organism Characteristics	High	\times 2	2	The test organisms were adequately described an were obtained from a reliable source.			
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	Specific details about the acclimatization and pre- treatment conditions for the algal test organism were reported in previous papers written by the study authors (e.g., Walsh et al., 1979).			
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	Specific details about the number of organisms and replicates for the algal test organisms were reported in previous papers written by the study author (e.g., Walsh et al., 1979).			
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Specific details about the test conditions for the algal test organisms were reported in previous paper written by the study authors (e.g., Walsh et al. 1979).			

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Study Citation:	compounds	E., Yoder, M. J., McLaughlin, L. L., Lores, E. I in six growth media. Ecotoxicology and Enviro	_			unicellular algae to brominated organic		
Data Type: Hero ID:	: Acute (0-96 hour); Aquatic; Plants 1927837							
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$		
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The outcome assessment methodology addressed o reported in previous publications by the study au thors the intended outcome(s) of interest and was sensitive for the outcomes(s) of interest.		
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	Details of the outcome assessment protocol wer reported and outcomes were assessed consistently across study groups in previous publications by the study authors.		
Domain 6: Confo	unding / Var	iable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	There were no reported differences among the stud groups in environmental conditions or other factor that could influence the outcome assessment.		
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no differences among test groups that could influence the outcome assessment.		
Domain 7: Data	Presentation	and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	No statistical analyses, calculation methods, and or data manipulation were conducted but sufficien data were provided to conduct an independent sta- tistical analysis.		
	Metric 22:	Reporting of Data	High	\times 2	2	Sufficient data for the test experiments were presented and were adequate to determine values for the endpoint(s) of interest.		
	Metric 23:	Explanation of Unexpected Outcomes	Unacceptable	× 1	4	The were problems with the outcomes in the Chlorella experiments.		
Overall Quality I)etermination	‡	Unacceptable -	→ High	4			

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Study Citation: Walsh, G. E., Yoder, M. J., McLaughlin, L. L., Lores, E. M.. 1987. Responses of marine unicellular algae to brominated organic

compounds in six growth media. Ecotoxicology and Environmental Safety 14:215-222

Data Type: Acute (0-96 hour); Aquatic; Plants

Hero ID: 1927837

Domain Metric Rating[†] MWF* Score Comments^{††}

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

where High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3 . If the reviewer determines that the overall rating needs adjustment, the original rating is crossed out and an arrow points to the new rating.

†† Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

^{**} Consistent with our Application of Systematic Review in TSCARisk Evaluations document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, three of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

^{*} MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

Data Type: Chronic (>21 Hero ID: 1927956 Domain Domain 1: Test Substance Metric 1: Metric 2: Metric 3: Domain 2: Test Design Metric 4: Metric 5:	L.) smolts. Marine and Freshwater Behaviour I days); Aquatic; other Fish Other Study- Variance Metric Test Substance Identity Test Substance Source Test Substance Purity		Cycle Eff	ects	${\rm Comments}^{\dagger\dagger}$
Domain 1: Test Substance Metric 1: Metric 2: Metric 3: Domain 2: Test Design Metric 4: Metric 5:	Test Substance Identity Test Substance Source		MWF*	Score	${\rm Comments}^{\dagger\dagger}$
Domain 1: Test Substance Metric 1: Metric 2: Metric 3: Domain 2: Test Design Metric 4: Metric 5:	Test Substance Identity Test Substance Source		MWF*	Score	$Comments^{\dagger\dagger}$
Metric 1: Metric 2: Metric 3: Domain 2: Test Design Metric 4: Metric 5:	Test Substance Source	High			
Metric 2: Metric 3: Domain 2: Test Design Metric 4: Metric 5:	Test Substance Source	High			
Metric 3: Domain 2: Test Design Metric 4: Metric 5:			$\times 2$	2	
Domain 2: Test Design Metric 4: Metric 5:	Test Substance Purity	High	\times 1	1	
Metric 4: Metric 5:		High	× 1	1	
Metric 4: Metric 5:					
Metric 5:	Negative Controls	High	$\times 2$	2	
	Negative Control Response	High	× 1	1	
Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Exposure Characteri	ization				
<u>*</u>	Experimental System/Test Media Prepara-	High	$\times 2$	2	
	tion				
Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Measurement of Test Substance Concentration	High	\times 2	2	
	Exposure Duration and Frequency	High	× 1	1	
	Number of Exposure Groups/Spacing of Ex-	High	\times 1	1	
	posure Levels		,, <u>-</u>	-	
·	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test Organism					
	Test Organism Characteristics	High	$\times 2$	2	
	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Number of Organisms and Replicates per	High	× 1	1	
	Group	J			
Metric 16:	Adequacy of Test Conditions	High	× 1	1	
				· · · · · · · · · · · · · · · · · · ·	

Study Citation:	Lower, N., Moore, A 2007. The impact of a brominated flame retardant on smoltification and olfactory function in Atlantic salmon (Salmo salar L.) smolts. Marine and Freshwater Behaviour and Physiology 40:267-284									
Data Type:		21 days); Aquatic; other Fish Other Study- Var								
Hero ID:	1927956									
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$				
Domain 5: Outco	Domain 5: Outcome Assessment									
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2					
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1					
Domain 6: Confo	ounding / Var	riable Control								
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2					
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1					
Domain 7: Data	Presentation	and Analysis								
	Metric 21:	Statistical Methods	High	\times 1	1					
	Metric 22:	Reporting of Data	High	$\times 2$	2					
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1					
Overall Quality I	Overall Quality Determination [‡]									
			High		1.0					
Extracted			Yes							

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Zhang, H. ui, Pan, L., Tao, Y., Tian, S., Hu, Y 2013. Identification and expression of differentially expressed genes in clam Venerupis philippinarum in response to environmental pollutant hexabromocyclododecane (HBCD). Journal of Experimental Marine Biology and Ecology 445:166-173							
dwelling							
Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
ce Identity	High	\times 2	2	Specific about test substance are provided in a previous source (i.e., hero id 2528343).			
ce Source	High	× 1	1	Specific about test substance are provided in a previous source (i.e., hero id 2528343).			
ce Purity	High	× 1	1	Specific about test substance are provided in a previous source (i.e., hero id 2528343).			
trols	High	$\times 2$	2				
trol Response	Low	× 1	3	Control animals were exposed to seawater only, water was changed completely every 24 hours. Page 167			
Allocation	High	× 1	1				
System/Test Media Prepara-	Medium	\times 2	4	Some information provided, but no details available on reducing HBCD loss.			
of Exposure Administration	Low	\times 1	3	not many details on exposure administration besides the daily static renewals			
of Test Substance Concentra-	Medium	\times 2	4	only nominal concentrations provided			
ration and Frequency	High	$\times 1$	1				
xposure Groups/Spacing of Ex-	High	\times 1	1				
Below Solubility Limit	Medium	× 1	2	Only nominal concentrations provided but one concentration reported to be above water solubility			
Ве	elow Solubility Limit	1, 1	elow Solubility Limit Medium × 1	elow Solubility Limit Medium \times 1 2			

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Study Citation:	Zhang, H. ui,Pan, L.,Tao, Y.,Tian, S.,Hu, Y 2013. Identification and expression of differentially expressed genes in clam Venerupis philippinarum in response to environmental pollutant hexabromocyclododecane (HBCD). Journal of Experimental Marine Biology and Ecology 445:166-173								
Data Type: Hero ID:	Other; Aqua 1928024	atic; Sediment-dwelling							
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$			
	Metric 13:	Test Organism Characteristics	High	\times 2	2				
	Metric 14:	Acclimitization and Pretreatment Conditions	High	$\times 1$	1				
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1				
	Metric 16:	Adequacy of Test Conditions	High	× 1	1				
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	ounding / Var	iable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	no unrelated outcomes were reported			
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	$\overline{2}$				
	Metric 23:	Explanation of Unexpected Outcomes	High	\times 1	1				
Overall Quality I	Determination	‡	High		1.3				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

 $^{^{\}dagger\dagger}\,\mathrm{Metrics}\;\mathrm{that}\;\mathrm{are}\;\mathrm{rated}\;\mathrm{'High'}\;\mathrm{met}\;\mathrm{the}\;\mathrm{criteria}\;\mathrm{for}\;\mathrm{high}\;\mathrm{confidence}\;\mathrm{as}\;\mathrm{expected}\;\mathrm{for}\;\mathrm{this}\;\mathrm{type}\;\mathrm{of}\;\mathrm{study},\mathrm{and}\;\mathrm{may}\;\mathrm{not}\;\mathrm{require}\;\mathrm{additional}\;\mathrm{comments}.$

Study Citation:		TTER FROM AMER CHEM CNCL SUBMIT				
		d END-USER SURVEY-PHASE 1 STUDY OF	F BROMI	NATED	FLAME F	RETARDANT, W/ATTCHMTS and DATED
Data Type:	8/28/00. Other; Aqu	atio, Figh				
Hero ID:	1928244	atic, Fish				
	1020211					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	ubstance					
Domain 1. Test S	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	\times 1	1	
Daniel O. Tark D	\ :					
Domain 2: Test D	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Controls Negative Control Response	High	× 2 × 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
	Wienie o.	Teatronized Tillocation	111511	× 1	1	
Domain 3: Expos	ure Characte	erization				
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentra-	High	$\times 2$	2	
		tion				
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	$\times 1$	1	
	Metric 12:	posure Levels Testing at or Below Solubility Limit	II: ada	× 1	1	
	Metric 12:	resting at or below Solubility Limit	High	X 1	1	
Domain 4: Test C	Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	\times 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	\times 1	1	
	M 10	Group	TT: 1	-	4	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
		Continued on next page				

Study Citation:	TROUT an	2000. LETTER FROM AMER CHEM CNCL SUBMITTING FLOW-THROUGH BIOCONCENTRATION TEST W/RAINBOW FROUT and END-USER SURVEY-PHASE 1 STUDY OF BROMINATED FLAME RETARDANT, W/ATTCHMTS and DATED 8/28/00.								
Data Type:	Other; Aqu	atic; Fish								
Hero ID:	1928244	,								
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$				
Domain 5: Outco	Domain 5: Outcome Assessment									
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2					
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1					
Domain 6: Confo	ounding / Var	riable Control								
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2					
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1					
Damain 7: Data	Duggantation	and Analysis								
Domain 7: Data	Metric 21:	Statistical Methods	High	× 1	1					
	Metric 21:	Reporting of Data	High	\times 1 \times 2	2					
	Metric 23:	Explanation of Unexpected Outcomes	High	$\stackrel{\wedge}{\times} \stackrel{2}{1}$	1					
Overall Quality I	Determination	n [‡]	High		1.0					
Extracted			Yes							

^{*} MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	. 2000. LETTER FROM AMER CHEM CNCL SUBMITTING FLOW-THROUGH BIOCONCENTRATION TEST W/RAINBOW TROUT and END-USER SURVEY-PHASE 1 STUDY OF BROMINATED FLAME RETARDANT, W/ATTCHMTS and DATED 8/28/00.								
Data Type: Hero ID:	Acute (0-96 1928244	5 hour); Aquatic; Fish							
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 1: Test S	Substance								
	Metric 1:	Test Substance Identity	High	$\times 2$	2				
	Metric 2:	Test Substance Source	High	\times 1	1				
	Metric 3:	Test Substance Purity	High	× 1	1				
Domain 2: Test D	Design								
	Metric 4:	Negative Controls	High	$\times 2$	2				
	Metric 5:	Negative Control Response	Low	\times 1	3				
	Metric 6:	Randomized Allocation	High	× 1	1				
Domain 3: Expos	ure Characte	erization							
1	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2				
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1				
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2				
	Metric 10:	Exposure Duration and Frequency	High	× 1	1				
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	× 1	1				
	Wicule 11.	posure Levels	111611	Λ 1	1				
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1				
Domain 4: Test C)rganism								
23110111 1. 1000 0	Metric 13:	Test Organism Characteristics	High	$\times 2$	2				
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1				
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1				
	Metric 16:	Group Adequacy of Test Conditions	High	× 1	1				
		Continued on next page				-			

Study Citation:	. 2000. LETTER FROM AMER CHEM CNCL SUBMITTING FLOW-THROUGH BIOCONCENTRATION TEST W/RAINBOW TROUT and END-USER SURVEY-PHASE 1 STUDY OF BROMINATED FLAME RETARDANT, W/ATTCHMTS and DATED $8/28/00$.							
Data Type: Hero ID:		hour); Aquatic; Fish						
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$		
Domain 5: Outco	ome Assessme	ent						
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2			
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1			
Domain 6: Confo	ounding / Var	riable Control						
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2			
		Procedures	, ,					
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1			
Domain 7: Data	Presentation	and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1			
	Metric 22:	Reporting of Data	High	$\times 2$	2			
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A			
Overall Quality I	Determination	i [‡]	High —	→ Medium	1.1	The primary purpose for this study was to determine the potential of HBCD to bioconcentrate in fish. However, preliminary information about the toxicity is always reported with this type of test. Although limited information is available in the reporting document, supplementary informations on the acute toxicity endpoint has been reported.		
Extracted			Yes					

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

 $^{^{\}dagger}$ High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	Bast,. 1990 040590.	Determination of the acute toxicity of hexa	bromid S to	o the wa	terflea .	Daphnia magna straus with cover letter date
Data Type:		hour); Aquatic; Invertebrates				
Hero ID:	1928267	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	\times 1	1	
Domain 2: Test	Design					
2. 1000	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expo	ouro Chorocto	orization				
Domaii 5. Expe	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Only nominal concentrations are reported but a so vent was used.
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	only nominal concentrations were reported but a so vent was used.
Domain 4: Test	Organism					
20110111 1. 1000	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

Study Citation:	Basf,. 1990. Determination of the acute toxicity of hexabromid S to the waterflea Daphnia magna straus with cover letter dated 040590.								
Data Type: Hero ID:	Acute (0-96 1928267	hour); Aquatic; Invertebrates							
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	Domain 6: Confounding / Variable Control								
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	<u> </u>	High -	\rightarrow Low	1.1				
Extracted			Yes						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type:	Union Carbide,. 1990. The acute toxicity of HBCD lot 990-17 to the bluegill sunfish Lepomis macrochirus Rafinesque with test data and cover letter. Acute (0-96 hour); Aquatic; Fish									
Hero ID:	1928275		- · · · ·			~ **				
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}				
Domain 1: Test S	Substance									
	Metric 1:	Test Substance Identity	High	\times 2	2	Test substance was identied throughout the study The CASRN for the test substance is 3194-55-6 Lot# 990-17.				
	Metric 2:	Test Substance Source	High	× 1	1	The source was reported. the source location is Nebraska but no company name was provided.				
	Metric 3:	Test Substance Purity	High	× 1	1	The test purity was provided in the attached water solubility study as was reported as greater than 98 percent.				
Domain 2: Test I	Design									
	Metric 4:	Negative Controls	High	\times 2	2	Acetone was the solvent control for this test.				
	Metric 5:	Negative Control Response	High	\times 1	1	Acetone was the solvent control for this test.				
	Metric 6:	Randomized Allocation	High	× 1	1	The results of the negative control was provide. No effects for the acetone control.				
Domain 3: Expos	sure Characte	erization								
	Metric 7:	Experimental System/Test Media Preparation	Unacceptable	× 2	8	Test concentration were based on nominal concentrations. Measured concentrations were not established. Since the solubility of HBCD is less than 1 mg/L, measure concentrations are required in order to establish an appropriate dose response at the solubility limit of HBCD.				
	Metric 8:	Consistency of Exposure Administration	nan	× 1	0	Although the study did not conduct any analytica measurements of the test substance, the nominal ex posure concentrations were consistent.				
	Metric 9:	Measurement of Test Substance Concentration	Unacceptable	× 2	8	Test concentration were based on nominal concentrations. Measured concentrations were not established. Since the solubility of HBCD is less than mg/L, measure concentrations are required in orde to establish an appropriate dose response at the solubility limit of HBCD.				
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The duration was acceptable for this study. The fish were exposure for 24, 48, 72, and 96 hours.				
		Continued on next page								

Study Citation:	Union Carb	oide,. 1990. The acute toxicity of HBCD lot 990 etter.	0-17 to the blues	gill sunfis	h Lepor	nis macrochirus Rafinesque with test data
Data Type: Hero ID:	Acute (0-96 1928275	5 hour); Aquatic; Fish				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$Comments^{\dagger\dagger}$
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	The duration was acceptable for this study. The fish were exposure for 24, 48, 72, and 96 hours.
	Metric 12:	Testing at or Below Solubility Limit	Unacceptable	× 1	4	Test concentration were based on nominal concentrations. Measured concentrations were not established. Since the solubility of HBCD is less than 1 mg/L, measure concentrations are required in order to establish an appropriate dose response at the solubility limit of HBCD.
Domain 4: Test	Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	Test organisms were identied sufficiently.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	There were no differences in acclimatization and/ or pretreatment conditions between control and ex- posed groups.
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	The number of test organisms and/or replicates was sufficient to characterize toxicological effects and/or provided
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Organism housing and/or environmental conditions and/or food, water, and nutrients and/or biomass loading were conducive to maintenance of health.
Domain 5: Outco	ome Assessme	ent.				
Bomain or outer	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	The outcome assessment methodology was reported.
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	There were consistencies in the execution of study protocols for outcome assessment across study groups.
Domain 6: Confe	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	The study reported no dierences among the study groups with respect to environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no study groups that experienced serious test organism attrition or health outcomes unrelated to exposure.
Domain 7: Data	Presentation	and Analysis				
		Continued on next page				

Study Citation:	Union Carb and cover le	oide,. 1990. The acute toxicity of HBCD lot etter.	990-17 to the blueg	ill sunfis	h Lepon	nis macrochirus Rafinesque with test data
Data Type: Hero ID:	Acute (0-96 1928275	5 hour); Aquatic; Fish				
Domain	10202.0	Metric	Rating [†]	MWF*	Score	Comments ^{††}
	Metric 21:	Statistical Methods	Medium	× 1	2	Limited statistical methods were provided for this study. There was no analytical monitoring for mea sured concentrations.
	Metric 22:	Reporting of Data	High	\times 2	2	Data presentation was adequate. There were no in consistencies were present in reporting of results.
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	The were no unexpected outcomes.
Overall Quality I	Determination	n [‡]	Unacceptable		4	
Extracted			No			

^{**} Consistent with our Application of Systematic Review in TSCARisk Evaluations document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, three of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

 $^{^{\}star}$ MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	INFO RE I	ITIAL SUBMISSION: LETTER FROM GREATHEXABROMOCYCLODODECANE AND BIS				
Data Type: Hero ID:	Acute (0-96 1928289	5 hour); Aquatic; Fish				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	Test substance was identified throughout the study. The CASRN for the test substance is 3194-55-6. Lot# 990-17.
	Metric 2:	Test Substance Source	High	× 1	1	The source was reported. the source location is Nebraska but no company name was provided.
	Metric 3:	Test Substance Purity	High	× 1	1	The test purity was provided in the attached water solubility study as was reported as greater than 98 percent.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	\times 2	2	Acetone was the solvent control for this test.
	Metric 5:	Negative Control Response	High	\times 1	1	The results of the negative control was provide. No effects for the acetone control.
	Metric 6:	Randomized Allocation	High	× 1	1	The source, conditioning, culture, observation and monitoring were provided for this study.
Domain 3: Expos	sure Charact	erization				
·	Metric 7:	Experimental System/Test Media Preparation	Unacceptable	× 2	8	Test concentration were based on nominal concentrations. Measured concentrations were not established. Since the solubility of HBCD is less than 1 mg/L, measure concentrations are required in order to establish an appropriate dose response at the solubility limit of HBCD.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Although the study did not conduct any analytica measurements of the test substance, the nominal exposure concentrations were consistent.
	Metric 9:	Measurement of Test Substance Concentration	Unacceptable	× 2	8	Test concentration were based on nominal concentrations. Measured concentrations were not established. Since the solubility of HBCD is less than mg/L, measure concentrations are required in orde to establish an appropriate dose response at the solubility limit of HBCD.
		Continued on next page				

Study Citation:		TIAL SUBMISSION: LETTER FROM GREA' IEXABROMOCYCLODODECANE AND BIS(
Data Type: Hero ID:		hour); Aquatic; Fish	TRIBROMOFII	ENOAT	EIHA	NE W/AITCHMIS, DAIED 2/13/89.
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The duration was acceptable for this study. The fish were exposure for 24, 48, 72, and 96 hours.
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	The duration was acceptable for this study. The fish were exposure for 24, 48, 72, and 96 hours.
	Metric 12:	Testing at or Below Solubility Limit	Unacceptable	× 1	4	Test concentration were based on nominal concentrations. Measured concentrations were not established. Since the solubility of HBCD is less than 1 mg/L, measure concentrations are required in order to establish an appropriate dose response at the solubility limit of HBCD.
Domain 4: Test (0					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	Test organisms were identified sufficiently.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	There were no differences in acclimatization and/ or pretreatment conditions between control and ex- posed groups.
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	The number of test organisms and/or replicates was sufficient to characterize toxicological effects and/or provided
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Organism housing and/or environmental conditions and/or food, water, and nutrients and/or biomass loading were conducive to maintenance of health.
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	\times 2	2	The outcome assessment methodology was reported.
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	There were consistencies in the execution of study protocols for outcome assessment across study groups.
Domain 6: Confo	unding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	The study reported no differences among the study groups with respect to environmental conditions.
		Continued on next page				

Study Citation:		TIAL SUBMISSION: LETTER FROM GR IEXABROMOCYCLODODECANE AND E				,
Data Type: Hero ID:		hour); Aquatic; Fish	ns(Thibhomor ii	ENOAT	EIHA	NE W/AITCHWITS, DATED 2/15/69.
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$Comments^{\dagger\dagger}$
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no study groups that experienced serious test organism attrition or health outcomes unrelated to exposure.
Domain 7: Data	Presentation	and Analysis				
Bollium T. Busu	Metric 21:	Statistical Methods	Medium	× 1	2	Limited statistical methods were provided for this study. There was no analytical monitoring for measured concentrations.
	Metric 22:	Reporting of Data	High	\times 2	2	Data presentation was adequate. There were no inconsistencies were present in reporting of results.
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	The were no unexpected outcomes,.
Overall Quality l	Determination	ı‡	Unacceptable		4	
Extracted			No			

^{**} Consistent with our Application of Systematic Review in TSCARisk Evaluations document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, three of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

^{*} MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		XABROMOCYCLODODECANE (HBCD): A F APHNIA MAGNA), WITH COVER LETTER				TOXICITY TEST WITH THE CLADO-
Data Type:		21 days); Aquatic; Invertebrates	DATED	0/10/198	90.	
Hero ID:	1928293	· // · · ·				
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
20110111 11 1000 1	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test 1	Design					
Domain 2. Test i	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	cura Characte	wizetion				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Prepara-	High	\times 2	2	
	Wictife 7.	tion	IIIgii	A 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentra-	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test (Organism					
20110111 1. 1000	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
		Group	J			
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	
		Continued on next page				

Study Citation:		XABROMOCYCLODODECANE (HBCD): A F APHNIA MAGNA), WITH COVER LETTER				YCLE TOXICITY TEST WITH THE CLADO-
Data Type:		21 days); Aquatic; Invertebrates	DATED	0/10/100		
Hero ID:	1928293					
Domain		Metric	Rating [†]	MWF^{\star}	Score	$Comments^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	\times 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality I	Determination	[‡]	High		1.0	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.									
Data Type: Hero ID:		5 hour); Aquatic; Fish	_	/						
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$				
Domain 1: Test S	Substance									
	Metric 1:	Test Substance Identity	High	\times 2	2	The chemical name is provided throughout the study.				
	Metric 2:	Test Substance Source	High	× 1	1	The source of the chemical(s) are provided (Great Lakes Chemical Corp, Albermarle, Corp and Bromine Compounds Ltd.)				
	Metric 3:	Test Substance Purity	High	× 1	1	Purity was provided by the company.				
Domain 2: Test I	Design									
	Metric 4:	Negative Controls	High	\times 2	2	The negative control group were reported for this study.				
	Metric 5:	Negative Control Response	High	× 1	1	A concurrent negative control and vehicle control were used required to ensure that any observed effects are attributable to substance exposure.				
	Metric 6:	Randomized Allocation	High	× 1	1	This study reported the use of control groups and randomization in allocation to ensure that the effect of exposure is isolated.				
Domain 3: Expos	sure Charact	erization								
3. <u></u>	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	The design of the test system and methods of test media preparation must take into account the physical-chemical properties and reactivity of the test substance (e.g., hydrolysis, biodegradation, bioaccumulation, adsorption) to ensure confidence in test substance concentrations, which will allowed for determination of a concentration-response relationship and enable valid comparisons across studies.				
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	The low water solubility of HBCD was considered and the use of a solvent was applied to the concentration-response relationship to enable valid comparisons across studies.				
		Continued on next page								

Study Citation:		l LTD. 1997. LETTER FROM CHEM MFGS A BROMOCYCLODODECANE (HBCD) WITH A								
Data Type: Hero ID:	Acute (0-96 hour); Aquatic; Fish 1928298									
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$				
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	measurement of test substance concentrations were determined for the concentration-response relationship in order to enable valid comparisons across studies.				
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The exposure duration (i.e., 24, 48, 72 and 96-hour) were reported to compare effects over time.				
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	The number of exposure groups were reported (i.e., the range of concentrations tested to observe a concentration-response relationship, a LOAEC, NOAEC, LC50, or EC50).				
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	All exposure concentrations were test at the chemicals water solubility limit (or dispersibility limit if applicable) and the range of exposure concentrations tested was sufficient to characterize a concentration-response relationship.				
Domain 4: Test (Organism									
	Metric 13:	Test Organism Characteristics	High	\times 2	2	The test organisms were appropriate for the evaluation of the specific outcome.				
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	There were no differences in acclimatization and/or pretreatment conditions between control and experimental groups.				
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	The test replicates were sufficient to characterize toxicological effects adequate power for statistical analysis.				
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	The environmental conditions nutrients and/or biomass loading were conducive to maintenance of the growth culture.				
Domain 5: Outco	ome Assessme	ent								
	Metric 17:	Outcome Assessment Methodology	High	\times 2	2	The reported outcome assessment was adequate for the outcome(s) of interest.				
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	The studies outcome were adequately reported for interpretation of results.				

Continued on next page ...

Domain 6: Confounding / Variable Control

Study Citation:	on: Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.							
Data Type:		hour); Aquatic; Fish		WILLIVID,	DALL	00/21/1001.		
Hero ID:	1928298	nour), riquitie, r ion						
Domain		Metric	Rating [†]	MWF^{\star}	Score	$Comments^{\dagger\dagger}$		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	The study did not reported significant differences among the study groups with respect to environmental conditions or other non-treatment-related factors and these preventmeaningful interpretation of the results.		
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no study groups that experienced any serious test organism attrition or outcomes unrelated to exposure.		
Domain 7: Data	Presentation	and Analysis						
	Metric 21:	Statistical Methods	High	$\times 1$	1	Statistical methods used were appropriate.		
	Metric 22:	Reporting of Data	N/A		N/A	Data presentation were provided and are adequate for this study.		
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	The were no unexpected outcomes regarding within- study variability and/or variation from historical measures, are considered serious flaws that make the study unusable.		
Overall Quality I	Determination	‡	High		1.0			
Extracted			Yes					

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.									
Data Type: Hero ID:		5 hour); Aquatic; Plants	_	,						
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$				
Domain 1: Test S	Substance									
	Metric 1:	Test Substance Identity	High	\times 2	2	The chemical name is provided throughout the study.				
	Metric 2:	Test Substance Source	High	× 1	1	The source of the chemical(s) are provided (Great Lakes Chemical Corp, Albermarle, Corp and Bromine Compounds Ltd.)				
	Metric 3:	Test Substance Purity	High	× 1	1	Purity was provided by the company.				
Domain 2: Test I	Design									
	Metric 4:	Negative Controls	N/A		N/A	The negative control groups were reported for this study.				
	Metric 5:	Negative Control Response	High	× 1	1	A concurrent negative control and vehicle control were used required to ensure that any observed effects are attributable to substance exposure.				
	Metric 6:	Randomized Allocation	High	× 1	1	This study reported the use of control groups and randomization in allocation to ensure that the effect of exposure is isolated.				
Domain 3: Expos	sure Charact	erization								
3. <u></u>	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	The design of the test system and methods of test media preparation must take into account the physical-chemical properties and reactivity of the test substance (e.g., hydrolysis, biodegradation, bioaccumulation, adsorption) to ensure confidence in test substance concentrations, which will allowed for determination of a concentration-response relationship and enable valid comparisons across studies.				
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	The low water solubility of HBCD was considered and the use of a solvent was applied to the concentration-response relationship to enable valid comparisons across studies.				
		Continued on next page								

Study Citation:		l LTD. 1997. LETTER FROM CHEM MFGS A BROMOCYCLODODECANE (HBCD) WITH A								
Data Type: Hero ID:	Acute (0-96 hour); Aquatic; Plants 1928298									
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$Comments^{\dagger\dagger}$				
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	measurement of test substance concentrations were determined for the concentration-response relationship in order to enable valid comparisons across studies.				
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The exposure duration (i.e., 24, 48, 72 and 96-hour) were reported to compare effects over time.				
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	The number of exposure groups were reported (i.e., the range of concentrations tested to observe a concentration-response relationship, a LOAEC, NOAEC, LC50, or EC50).				
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	All exposure concentrations were test at the chemicals water solubility limit (or dispersibility limit if applicable) and the range of exposure concentrations tested was sufficient to characterize a concentration-response relationship.				
Domain 4: Test (Organism									
	Metric 13:	Test Organism Characteristics	High	\times 2	2	The test organisms were appropriate for the evaluation of the specific outcome.				
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	There were no differences in acclimatization and/or pretreatment conditions between control and experimental groups.				
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	The test replicates were sufficient to characterize toxicological effects adequate power for statistical analysis.				
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	The algae environmental conditions nutrients and/ or biomass loading were conducive to maintenance of the growth culture.				
Domain 5: Outco	ome Assessme	ent								
	Metric 17:	Outcome Assessment Methodology	High	\times 2	2	The reported outcome assessment was adequate for the outcome(s) of interest.				
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	The studies outcome were adequately reported for interpretation of results.				

Domain 6: Confounding / Variable Control

Continued on next page ...

Study Citation:			Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.								
Data Type: Hero ID:		hour); Aquatic; Plants		•		, ,					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$					
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	The study did not reported significant differences among the study groups with respect to environmental conditions or other non-treatment-related factors and these preventmeaningful interpretation of the results.					
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no study groups that experienced any serious test organism attrition or outcomes unrelated to exposure.					
Domain 7: Data	Presentation	and Analysis									
	Metric 21:	Statistical Methods	High	\times 1	1	Statistical methods used were appropriate.					
	Metric 22:	Reporting of Data	N/A		N/A	Data presentation were provided and are adequate for this study.					
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	The were no unexpected outcomes regarding within- study variability and/or variation from historical measures, are considered serious flaws that make the study unusable.					
Overall Quality I	Determination	ı‡	High		1.0						
Extracted			Yes								

 $^{^\}star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	1: Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGAT OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.								
Data Type: Hero ID:		5 hour); Aquatic; Fish		,					
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 1: Test S	Substance								
	Metric 1:	Test Substance Identity	High	\times 2	2	The chemical name is provided throughout the study.			
	Metric 2:	Test Substance Source	High	× 1	1	The source of the chemical(s) are provided (Great Lakes Chemical Corp, Albermarle, Corp and Bromine Compounds Ltd.)			
	Metric 3:	Test Substance Purity	High	× 1	1	Purity was provided by the company.			
Domain 2: Test I	Design								
	Metric 4:	Negative Controls	High	\times 2	2	The negative control group were reported for this study.			
	Metric 5:	Negative Control Response	High	× 1	1	A concurrent negative control and vehicle control were used required to ensure that any observed effects are attributable to substance exposure.			
	Metric 6:	Randomized Allocation	High	× 1	1	This study reported the use of control groups and randomization in allocation to ensure that the effect of exposure is isolated.			
Domain 3: Expos	sure Charact	erization							
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	The design of the test system and methods of test media preparation must take into account the physical-chemical properties and reactivity of the test substance (e.g., hydrolysis, biodegradation, bioaccumulation, adsorption) to ensure confidence in test substance concentrations, which will allowed for determination of a concentration-response relationship and enable valid comparisons across studies.			
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	The low water solubility of HBCD was considered and the use of a solvent was applied to the concentration-response relationship to enable valid comparisons across studies.			
		Continued on next page							

Study Citation:	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.								
Data Type:		hour); Aquatic; Fish	AI IAOII.	WIEIVIO,	DAIE.	D 00/21/1991.			
Hero ID:	1928300								
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$			
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	measurement of test substance concentrations were determined for the concentration-response relation- ship in order to enable valid comparisons across studies.			
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	The exposure duration (i.e., 24, 48, 72 and 96-hour) were reported to compare effects over time.			
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	The number of exposure groups were reported (i.e., the range of concentrations tested to observe a concentration-response relationship, a LOAEC NOAEC, LC50, or EC50).			
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	All exposure concentrations were test at the chem icals water solubility limit (or dispersibility limit i applicable) and the range of exposure concentration tested was sufficient to characterize a concentration response relationship.			
Domain 4: Test (Organism								
Domain 1. Tost (Metric 13:	Test Organism Characteristics	High	\times 2	2	The test organisms were appropriate for the evaluation of the specific outcome.			
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	There were no differences in acclimatization and/or pretreatment conditions between control and experimental groups.			
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	The test replicates were sufficient to characterize toxicological effects adequate power for statistica analysis.			
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	The environmental conditions nutrients and/o biomass loading were conducive to maintenance o the growth culture.			

Domain 6: Confounding / Variable Control

Continued on next page ...

Metric 18: Consistency of Outcome Assessment

High

 $\times 1$

the outcome(s) of interest.

interpretation of results.

The studies outcome were adequately reported for

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\dots continued	from	previous	page

Study Citation:	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.								
Data Type: Hero ID:		hour); Aquatic; Fish		WILIVID,	DITTE	0.00/21/1001.			
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$			
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	The study did not reported significant differences among the study groups with respect to environmental conditions or other non-treatment-related factors and these preventmeaningful interpretation of the results.			
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no study groups that experienced any serious test organism attrition or outcomes unrelated to exposure.			
Domain 7: Data l	Presentation	and Analysis							
Bolliam (. Bata :	Metric 21:	Statistical Methods	High	\times 1	1	Statistical methods used were appropriate.			
	Metric 22:	Reporting of Data	N/A		N/A	Data presentation were provided and are adequate for this study.			
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	The were no unexpected outcomes regarding within- study variability and/or variation from historical measures, are considered serious flaws that make the study unusable.			
Overall Quality Determination [‡]		High		1.0					
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type:	Hong, H.,Li, D.,Shen, R.,Wang, X.,Shi, D. 2014. Mechanisms of hexabromocyclododecanes induced developmental toxicity in marine medaka (Oryzias melastigma) embryos. Aquatic Toxicology 152:173-185 Other; Aquatic; Fish								
Hero ID:	2343684	,							
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$			
Domain 1: Test S	ubstance								
	Metric 1:	Test Substance Identity	High	$\times 2$	2				
	Metric 2:	Test Substance Source	High	\times 1	1				
	Metric 3:	Test Substance Purity	High	× 1	1				
Domain 2: Test D)esion								
2. 1000 E	Metric 4:	Negative Controls	High	$\times 2$	2				
	Metric 5:	Negative Control Response	High	× 1	1				
	Metric 6:	Randomized Allocation	High	× 1	1				
Domain 3: Expos	uro Characto	prization							
Domain 6. Expos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2				
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1				
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Nominal concentrations were reported for exposure treatments, but daily renewals did occur, alleviating some concerns.			
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1				
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1				
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Nominal concentrations reported and most of the exposure concentrations are below water solubility of HBCD.			
Domain 4: Test C)rganism								
20110111 1. 1000 0	Metric 13:	Test Organism Characteristics	High	$\times 2$	2				
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1				
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1				
		Group	J						
		Continued on next page							

Study Citation:		Hong, H.,Li, D.,Shen, R.,Wang, X.,Shi, D 2014. Mechanisms of hexabromocyclododecanes induced developmental toxicity in marine medaka (Oryzias melastigma) embryos. Aquatic Toxicology 152:173-185									
Data Type:	Other; Aqua		y 102.110 10	30							
Hero ID:	2343684										
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$					
	Metric 16:	Adequacy of Test Conditions	High	× 1	1						
Domain 5: Outco	ome Assessme	nt									
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2						
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1						
Domain 6: Confo	unding / Var	iable Control									
Domain o. Como	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2						
		Procedures	0								
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	no unrelated outcomes were reported					
Domain 7: Data	Presentation	and Analysis									
Domain 1. Data	Metric 21:	Statistical Methods	Low	\times 1	3	statistical methods were not reported but how com-					
						parisons were made for each endpoint are discussed					
	Metric 22:	Reporting of Data	High	$\times 2$	2						
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1						
Overall Quality I	Determination	‡	High		1.2						
Extracted			Yes								

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		Sun, H.,Zhu, H.,Ruan, Y.,Liu, F.,Liu, X 2014. oalgae, Spirulina subsalsa and Scenedesmus obl							
Data Type: Hero ID:	Other; Aquatic; Plants 2343690								
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$			
Domain 1: Test S	Substance								
	Metric 1:	Test Substance Identity	High	$\times 2$	2				
	Metric 2:	Test Substance Source	High	\times 1	1				
	Metric 3:	Test Substance Purity	Low	× 1	3	Purity not reported.			
Domain 2: Test I	Design								
	Metric 4:	Negative Controls	Low	$\times 2$	6	Controls specified by noted on page 137.			
	Metric 5:	Negative Control Response	N/A		N/A	no control results provided. However, the experiment was reporting accumulation of HBCD's enantiomers.			
	Metric 6:	Randomized Allocation	Low	× 1	3	Exposure treatment group allocation was not reported.			
Domain 3: Expos	uro Characte	orization							
Domain 5. Expos	Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2				
	Wictile 1.	tion	111611	X 2	_				
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1				
	Metric 9:	Measurement of Test Substance Concentra-	High	\times 2	2				
		tion	O						
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1				
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 1	2	Only one exposure concentration ($2~{\rm ng/mL})$ used for each stereoisomer, for both algal species.			
	Metric 12:	Testing at or Below Solubility Limit	High	\times 1	1				
Domain 4: Test C)rganism								
20110111 1. 1000	Metric 13:	Test Organism Characteristics	High	$\times 2$	2				
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1				
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1				
		Group							
		Continued on next page							

Study Citation:	Zhang, Y.,Sun, H.,Zhu, H.,Ruan, Y.,Liu, F.,Liu, X 2014. Accumulation of hexabromocyclododecane diastereomers and enantiomers in two microalgae, Spirulina subsalsa and Scenedesmus obliquus. Ecotoxicology and Environmental Safety 104:136-142								
Data Type:	Other; Aqua		iquus. Ecoi	oxicology	and Enviro	mmental Safety 104.150-142			
Hero ID:	2343690								
	2010000								
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$			
	Metric 16:	Adequacy of Test Conditions	High	× 1	1				
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	ounding / Var	riable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	\times 1	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	High	\times 1	1				
Overall Quality I	Overall Quality Determination [‡]				1.3				
Extracted			Yes						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		2. M.,Lopez Parron, M.,Mergia, M. T.,Carolus, I cons of organic substances for early life developm				
Data Type: Hero ID:	Chronic (>2 2343709	21 days); Aquatic; other Fish Post-fertilization				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test l	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	Survival were higher that the experimental groups
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	erization				
Domain of Empor	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Low	× 1	3	Used DMSO as a solvent
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	Medium	$\times 2$	4	Not on the list of recommended species.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

Study Citation:	Foekema, E. M., Lopez Parron, M., Mergia, M. T., Carolus, E. R., Vd Berg, J. H., Kwadijk, C., Dao, Q., Murk, A. J. 2014. Internal effect concentrations of organic substances for early life development of egg-exposed fish. Ecotoxicology and Environmental Safety 101:14-22								
Data Type:		21 days); Aquatic; other Fish Post-fertilization	CIT 01 C66 (лровеч 1.	ion. Ecoto2	decology and Environmental salety 101.11 22			
Hero ID:	2343709	21 days), riquatio, other rish rest for inzation							
	2010.00								
Domain		Metric	$Rating^{\dagger}$	MWF^{\star}	Score	$Comments^{\dagger\dagger}$			
Domain 5: Outco									
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	$\times 1$	1				
Domain 6: Confo	unding / Vor	iable Centrel							
Domain 6. Como	Metric 19:	Confounding Variables in Test Design and	High	\times 2	2				
	Metric 19.	Procedures	High	A 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Procentation	and Analysis							
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1				
		D 1311-01-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-1-131-	0		_				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Octommination	.‡	Uigh		1.1				
Overall Quality I	Jeter IIIIIatioi	1'	High		1.1				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		Sun, H.,Ruan, Y 2014. Enantiomer-specific acc					nd isomerization of hexabromoc
Data Type:		e (HBCD) diastereomers in mirror carp from wa 21 days); Aquatic; other Bioaccumulation	ater. Jour	nal of Ha	azardou	s Materials 264	
Hero ID:	2343723	21 days), Aquatic, other bloaccumulation					
Domain	2010120	Metric	Rating [†]	MWF*	Score		Comments ^{††}
Domain 1: Test S	Substance						
	Metric 1:	Test Substance Identity	High	$\times 2$	2		
	Metric 2:	Test Substance Source	High	\times 1	1		
	Metric 3:	Test Substance Purity	High	× 1	1		
Domain 2: Test I	Docien						
Domain 2. Test I	Metric 4:	Negative Controls	High	\times 2	2		
	Metric 5:	Negative Control Response	High	× 1	1		
	Metric 6:	Randomized Allocation	High	× 1	1		
D D	CI.						
Domain 3: Expos			TT: 1		0		
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2		
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1		
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2		
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1		
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1		
	Metric 12:	Testing at or Below Solubility Limit	Low	× 1	3	not addressed	
Domain 4: Test (Organism						
Domain 4. 16st (Metric 13:	Test Organism Characteristics	High	$\times 2$	2		
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1		
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1		
		Group			-		
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1		
		Continued on next page					

Study Citation:		un, H.,Ruan, Y 2014. Enantiomer-specific acce (HBCD) diastereomers in mirror carp from wa				etabolization and isomerization of hexabromocy- Materials 264			
Data Type: Hero ID:	Chronic (>21 days); Aquatic; other Bioaccumulation 2343723								
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
-	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	Domain 6: Confounding / Variable Control								
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1				
Overall Quality I	Determination	‡	High		1.1				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	Zhang, H., Pan, L., Tao, Y 2014. Antioxidant responses in clam Venerupis philippinarum exposed to environmental pollutant hexabro-mocyclododecane. Environmental Science and Pollution Research 21:8206-8215					
Data Type: Hero ID:	Other; Aquatic; Sediment-dwelling 2528343					
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	substance purity not reported
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allocated to study groups.
Domain 3: Expos	sure Characte	erization				
Domain o. Lapor	Metric 7:	Experimental System/Test Media Preparation	Low	\times 2	6	exposure system and water quality details/conditions were not reported
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	nominal concentrations reported
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Two exposure concentrations above water solubility
Domain 4: Test ()rganism					
	Metric 13:	Test Organism Characteristics	Low	\times 2	6	Clams are an appropriate test organism for sediment/legacy contaminants, but there is a deficiency in organism age/characteristics.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	\times 1	1	0 1047 - 1 1111 - 11
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
		Continued on next page				

Study Citation:	Zhang, H., Pan, L., Tao, Y 2014. Antioxidant responses in clam Venerupis philippinarum exposed to environmental pollutant hexabro-mocyclododecane. Environmental Science and Pollution Research 21:8206-8215								
Data Type: Hero ID:		atic; Sediment-dwelling							
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
	Metric 16:	Adequacy of Test Conditions	Medium	× 1	2	Some uncertainties about diet/water conditions during the exposure since information was provided for the acclimation period.			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confe	ounding / Var	iable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	no unrelated outcomes were reported			
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1				
Overall Quality l	Determination	‡	High		1.5				
Extracted			Yes						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise} \end{array} ,$$

 $^{^{\}dagger}$ High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	and antioxidant gene expression in earthworm romodiphenyl ether. Comparative Biochemistr					
Data Type: Hero ID:		logy - Part C: Toxicology and Pharmacology estrial; Invertebrate				
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	Hexabromocyclododecane (CAS No. 3194-55-6) is listed.
	Metric 2:	Test Substance Source	High	\times 1	1	The test substance was produced by TCI Chemicals (Japan).
	Metric 3:	Test Substance Purity	High	× 1	1	95.0 percent purity
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	\times 2	2	Controls and solvent controls used are deionized water or acetone.
	Metric 5:	Negative Control Response	High	\times 1	1	Controls and solvent controls were included in Fig. 1 graph
	Metric 6:	Randomized Allocation	Medium	× 1	2	Samples were randomly selected for destructive sampling at different time points, but it was not mentioned whether organisms were randomly allocated to treatment groups.
Domain 3: Expos	sure Characte	erization				
	Metric 7:	Experimental System/Test Media Preparation	Medium	× 2	4	No report on soil renewals (likely only dosed once at the beginning), and there were not measured data on soil HBCD concentrations following various sam- pling time points.
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	Before and during the test period, the same exposure protocol is used.
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Only nominal concentrations are reported.
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The period of exposure and frequency information is provided.
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1	Information is provided.

	c	•	
\dots continued	from	previous	page

Data Type: Hero ID:		ogy - Part C: Toxicology and Pharmacology	nocyclodod			and antioxidant gene expression in earthworm romodiphenyl ether. Comparative Biochemistry
Tero id:	Other; Terr 2965902	estrial; Invertebrate				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	soil exposure
Domain 4: Test O	rganism					
	Metric 13:	Test Organism Characteristics	High	\times 2	2	Mature earthworms (E. fetida) of age 3 months with a welldeveloped clitellumwere obtained.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	Removed from the soil 24 h before use and stored in Petri dishes on dampfilter paper (in the dark at 20 " 1 "C) to void their gut contents.
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	10 organisms, 4 replicates, and 5 concentrations
	Metric 16:	Adequacy of Test Conditions	Low	× 1	3	Limited details available on feeding, and conditions of the exposure, but authors cited OECD 1984 for cultivation (not experiment protocol).
Domain 5: Outcor	me Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	all reported
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	Yes
Domain 6: Confou	ınding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	Minimized the variability to the level of 10 earthworms used are $0.35\text{-}0.45$ g each.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	Health outcomes unrelated to exposure for each study group were not reported.
Domain 7: Data P	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	\times 1	1	Several statistical analyses were performed.
	Metric 22:	Reporting of Data	High	$\times 2$	2	The data for all outcomes are reported
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	There were no unexpected outcomes.
Overall Quality De	etermination	į [‡]	High		1.3	

Study Citation:	Shi, Y. J., Xu, X. B., Zheng, X. Q., Lu, Y. L 2015. Responses of growth inhibition and antioxidant gene expression in earthworms
	(Eisenia fetida) exposed to tetrabromobisphenol A, hexabromocyclododecane and decabromodiphenyl ether. Comparative Biochemistry

and Physiology - Part C: Toxicology and Pharmacology

Data Type: Other; Terrestrial; Invertebrate

Hero ID: 2965902

Domain	Metric	Rating [†] MWF* Score	Comments ^{††}

Extracted Yes

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

^{*} MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		ang, H.,Zhang, S 2016. Accumulation and patal Sciences 42:97-104	phytotoxio	city of to	echnical	hexabromocyclododecane in maize. Journal of
Data Type:	,	hour); Terrestrial; other Plant				
Hero ID:	3350472					
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test l	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos	cura Characta	wizetion				
Domain 5: Expos	sure Characte Metric 7:	Experimental System/Test Media Prepara-	High	\times 2	2	
	Medic 7.	tion	IIIgii	^ 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Low	\times 2	6	Nominal daily renewal
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Low	× 1	3	not addressed; nominal daily renewal
Domain 4: Test (Organism					
20mmin 1. 1050 V	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
	1.100110 10.	Group		, , <u>+</u>	*	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

Study Citation:		ang, H.,Zhang, S 2016. Accumulation and partal Sciences 42:97-104	phytotoxic	city of t	echnical	hexabromocyclododecane in maize. Journal of
Data Type: Hero ID:	Acute (0-96 3350472	hour); Terrestrial; other Plant				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
-	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	\times 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality I	Determination	‡	High		1.2	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[†] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	Diastereoisomers by Wheat in Closed Chambers. Environmental Science and Technology 50:2652-2659								
Data Type: Hero ID:	Other; Terr 3350492	estrial; other Plant							
Domain	3330432	Metric	Rating [†]	MWF*	Score	Comments ^{††}			
Domain 1: Test S									
	Metric 1:	Test Substance Identity	$_{ m High}$	$\times 2$	2				
	Metric 2:	Test Substance Source	$_{ m High}$	$\times 1$	1				
	Metric 3:	Test Substance Purity	High	× 1	1				
Domain 2: Test I	Design								
2. 1000 1	Metric 4:	Negative Controls	High	$\times 2$	2				
	Metric 5:	Negative Control Response	High	× 1	1				
	Metric 6:	Randomized Allocation	High	\times 1	1				
D	Cl								
Domain 3: Expos	Metric 7:		II: ada	\times 2	2				
	Metric 7:	Experimental System/Test Media Preparation	High	X Z	2				
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1				
	Metric 9:	Measurement of Test Substance Concentra-	High	$\times 2$	2				
		tion	Ü						
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1				
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	$\times 1$	1				
		posure Levels							
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1				
Domain 4: Test (Organism								
Domain 4. 1650 (Metric 13:	Test Organism Characteristics	High	$\times 2$	2				
	Metric 14:	Acclimitization and Pretreatment Conditions	Medium	$\times 1$	2	Acclimation not reported			
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	recommends not reported			
	1,100110 10.	Group		/\ <u>1</u>	_				
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1				
		Continued on next page							

Study Citation:	Zhu, H., Sun, H., Zhang, Y., Xu, J., Li, B., Zhou, Q. 2016. Uptake Pathway, Translocation, and Isomerization of Hexabromocyclododecane Diastereoisomers by Wheat in Closed Chambers. Environmental Science and Technology 50:2652-2659								
Data Type:		estrial; other Plant	nemai sciei	ice and i	ecimology 50	J.2002-2009			
Hero ID:	3350492								
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1				
Domain 6: Confo	ounding / Var	riable Control							
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Presentation	and Analysis							
Bolliam T. Bata	Metric 21:	Statistical Methods	High	$\times 1$	1				
	Metric 22:	Reporting of Data	High	$\times 2$	$\overline{2}$				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	ı [‡]	High		1.0				
Extracted			Yes						

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[†] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:						$\ \ hree\ hexabromocyclododecane\ diastereo isomers$
Data Trunci		of the marine medaka Oryzias melastigma. Ma	rine Pollutio	on Bullet	in 101:1	110-118
Data Type: Hero ID:	Other; Aqu 3350507	auc, risii				
nero ib.	3300001					
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I)esign					
2. 1000 1	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos	uro Chorocto	orization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Prepara-	Medium	$\times 2$	4	No mentioning of whether the testing media re-
	Metric 7.	tion	Wicdiani	^ <u>2</u>	4	newals accounted for maintaining HBCD exposure concentration consistency.
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Ex-	High	× 1	1	
		posure Levels	8		_	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	All HBCD concentrations are above water solubility (except for the control).
D)					
Domain 4: Test (_	That Ownering Change is	М	V 0	4	
	Metric 13:	Test Organism Characteristics	Medium	$\times 2$	4	Source not revealed, although it is assumed by "collected daily" that there is a lab culture.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	$\times 1$	1	
	Metric 15:	Number of Organisms and Replicates per	High	\times 1	1	
		Group				
		Continued on next page	<u> </u>			

Study Citation:	Hong, H., Shen, R., Liu, W., Li, D., Huang, L., Shi, D. 2015. Developmental toxicity of three hexabromocyclododecane diastereoisomers in embryos of the marine medaka Oryzias melastigma. Marine Pollution Bulletin 101:110-118									
Data Type:	Other; Aquatic; Fish									
Hero ID:	3350507									
	9999991									
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}				
	Metric 16:	Adequacy of Test Conditions	High	× 1	1					
Domain 5: Outco	ome Assessme	ent								
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2					
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1					
D : C C (1. / 3.7	: 11								
Domain 6: Confo	- '		TT: 1	0	0					
	Metric 19:	Confounding Variables in Test Design and Procedures	High	$\times 2$	2					
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1					
Domain 7: Data	Presentation	and Analysis								
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1					
	Metric 22:	Reporting of Data	High	$\times 2$	2					
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1					
Overall Quality I	Determination	+	High		1.2					
Extracted			Yes							

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	and metabe Environment	T.,Sun, H.,Zhang, Y.,Yang, J 2016. Diastere olism of hexabromocyclododecanes (HBCDs) int 542:427-434				
Data Type: Hero ID:	Chronic (> 3350510	21 days); Terrestrial; Invertebrate				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	Medium	\times 2	4	The percentage of each isomer was not mentioned, only the source and previous work has characterized the percentage of each isomer.
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	\times 1	1	
Domain 2: Test I	Design					
100mam 2. 1000 F	Metric 4:	Negative Controls	Medium	\times 2	4	Uncertainty regarding the control clean sediment, specifically if the same carrier solvent used in the HBCD treatments was used in the clean soil used for the control.
	Metric 5:	Negative Control Response	Unacceptable	\times 1	4	biological responses were not reported
	Metric 6:	Randomized Allocation	Low	× 1	3	Allocation method not reported
Domain 3: Expos	sure Characte	erization				
r	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 1	2	Only one exposure concentration per HBCD isomer was used, but the purpose of the study is to evaluate HBCD uptake and depuration. However different numbers of each type of earthworm were used.
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	soil exposure
Domain 4: Test (Organism					
20mm 1. 1050 (Metric 13:	Test Organism Characteristics	High	\times 2	2	
		Continued on next page				

		continued from previous page				
Study Citation:	and metabo	T.,Sun, H.,Zhang, Y.,Yang, J. 2016. Diastere olism of hexabromocyclododecanes (HBCDs) int 542:427-434				
Data Type: Hero ID:	Chronic (> 3350510	21 days); Terrestrial; Invertebrate				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Vai	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	\times 2	4	No explanation for different number of organisms used.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	\times 1	2	no data on health outcomes were reported
Domain 7: Data	Presentation	and Analysis				
Domain , Dava	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	$\overline{2}$	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	n^{\ddagger}	Unacceptable	\longrightarrow Low	4	Although biological responses weren't reported for the earthworms, nor was it reported whether a sol- vent was used in the negative control, this study doesn't necessarily mean it didn't capture it. The goal of the study wasn't to look at toxicity necessar- ily, but uptake and depuration.
Extracted			Yes			
		Continued on next page				

Study Citation: Li, B., Yao, T., Sun, H., Zhang, Y., Yang, J. 2016. Diastereomer- and enantiomer-specific accumulation, depuration, bioisomerization,

and metabolism of hexabromocyclododecanes (HBCDs) in two ecologically different species of earthworms. Science of the Total

Environment 542:427-434

Chronic (>21 days); Terrestrial; Invertebrate

Hero ID: 3350510

Data Type:

Domain Metric Rating † MWF * Score Comments ††

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

where High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3 . If the reviewer determines that the overall rating needs adjustment, the original rating is crossed out and an arrow points to the new rating.

†† Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

^{**} Consistent with our Application of Systematic Review in TSCARisk Evaluations document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

 $^{^{\}star}$ MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

Study Citation:		g, C.,Qiu, L.,Dong, S.,Zhang, X.,Yan, C. 2015 arbon receptors and cytochrome P450s in zebra				
Data Type: Hero ID:		atic; other Fish Post-Fertilization	nsii (Dan	io rerioj.	Chemosphere	102.24-01
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
2. 1000 1	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	$\times 1$	1	
Domain 3: Expos	suro Characto	prization				
Domain 5. Expo.	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	$\times 1$	1	
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

Study Citation:		Du, M., Fang, C., Qiu, L., Dong, S., Zhang, X., Yan, C 2015. Diastereoisomer-specific effects of hexabromocyclododecanes on hepatic aryl hydrocarbon receptors and cytochrome P450s in zebrafish (Danio rerio). Chemosphere 132:24-31								
Data Type: Hero ID:		atic; other Fish Post-Fertilization		,		•				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$				
Domain 5: Outco	ome Assessme	ent								
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2					
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1					
Domain 6: Confo	ounding / Var	riable Control								
	Metric 19:	Confounding Variables in Test Design and Procedures	High	$\times 2$	2					
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1					
Domain 7: Data	Presentation	and Analysis								
	Metric 21:	Statistical Methods	High	\times 1	1					
	Metric 22:	Reporting of Data	High	$\times 2$	2					
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A					
0 110 124 1		†	TT: 1		1.0					
Overall Quality I	Determination	1"	High		1.0					
Extracted			Yes							

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	transfer of	er, L. C. Mattioli, S. C. Marteinson, D. Bird, I. isomers of hexabromocyclododecane flame retar and Chemistry 34:1103-1112				
Data Type: Hero ID:	Chronic (> 3350539	21 days); Terrestrial; Birds				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	HBCD isomers were identified as the test substance for this study.
	Metric 2:	Test Substance Source	High	× 1	1	HBCD technical mixture and individual isomers were obtained from Wellington Laboratories.
	Metric 3:	Test Substance Purity	Medium	× 1	2	Technical grade and isotopically enriched isomers of HBCD was reported to have been used,.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	× 2	2	Separate cohorts of control and HBCD-exposed kestrels were exposed to prey that either had HBCD- containing safflower oil, or just safflower oil. (con- trol)
	Metric 5:	Negative Control Response	High	\times 1	1	Negative control responses were reported for Kestrels exposed to a diet without HBCD.
	Metric 6:	Randomized Allocation	Low	× 1	3	The authors did not report how organisms were allocated to study groups.
Domain 3: Expos	sure Charact	erization				
F	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	HBCD was dissolved in safflower oil, which was then injected into the brains of cockerel brains to ensure Kestrel consumption of the HBCD.
	Metric 8:	Consistency of Exposure Administration	Medium	× 1	2	HBCD ingested by Kestrels may have varied based on the amount of cockerel food consumed by each bird, despite the same concentration of HBCD being injected into the cockerel brains.
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Nominal concentrations of 0.32 mg/mL of safflower oil was injected into cockerel brains, which results in an average of 51 ug HBCD/d ingested by Kestre based on a mean cockerel weight and average consumption rate.

Ctd., Citati	D I I at -1.	on I C Mattieli C C Mantaingan D Died I	I Dital:	IZ I D-	i. 00	115 Tintoles distribution doubtion 1:
Study Citation: Data Type: Hero ID:	transfer of i	er, L. C. Mattioli, S. C. Marteinson, D. Bird, I. isomers of hexabromocyclododecane flame retar and Chemistry 34:1103-1112 21 days); Terrestrial; Birds				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	Since HBCD uptake, depuration and in ovo uptake were the study goals, the exposure of HBCD for the 3 weeks prior to pairing, through incubation makes sense.
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	N/A		N/A	A dose-dependent effect was not the purpose of the study, so multiple exposure groups are not inherently necessary.
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	This study is a diet-exposure, and the HBCD was fully dissolved in safflower oil that was then injected into the cockerel brain.
Domain 4: Test	Organism					
Domain 4. Test	Metric 13:	Test Organism Characteristics	Medium	\times 2	4	The captive kestrels age and pedigree are described as following the Canadian Council on Animal Care Guidelines, but specific details regarding organism characteristics, besides gender, were not provided. Since this was a reproductive test, the kestrels used in the experiment were based on their previous breeding experience, and were paired with another bird that was genetically unrelated within the past six generations.
	Metric 14:	Acclimitization and Pretreatment Conditions	Low	\times 1	3	The study did not report whether the organisms were acclimatized.
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	Eleven control pairs, and twenty HBCD-exposed pairs were allowed to breed.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Housing and feeding regiment were reported and adequate for the study.
Domain 5: Outco	ome Assessme	ent.				
Domain o. Outo	Metric 17:	Outcome Assessment Methodology	High	\times 2	2	The assessment methodology does address the intended outcome of interest (uptake and depuration of HBCD).
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	The outcome assessments were consistent across the control and exposure group.

	c	•	
\dots continued	trom	previous	page

Study Citation:	transfer of i					115. Uptake, distribution, depletion, and in ovo ican kestrels (Falco sparverius). Environmental
Data Type: Hero ID:	Chronic (>: 3350539	21 days); Terrestrial; Birds				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$Comments^{\dagger\dagger}$
Domain 6: Confe	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	\times 2	4	The authors did address potential issues due to varying feeding amounts by each bird. The nominal concentration of HBCD, normalized to the average feeding rate is an adequate method for reporting exposure.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	Data on attrition or health outcomes unrelated to exposure were not reported because only substantial differences among groups were noted.
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	× 1	1	Statistical methods were clearly described and appropriate for the data measured.
	Metric 22:	Reporting of Data	High	\times 2	2	Data for each exposure group were reported consistently.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	× 1	2	Variability in the data was provided, and minor uncertainties regarding the exposure concentration (nominal) were presented.
Overall Quality l	Determination	[‡]	High		1.5	
Extracted			Yes			

^{*} MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	(HBCDs) or	n the marine copepod Tigriopus japonicus. Che				elopmental toxicity of hexabromocyclododecane
Data Type:	, -	atic; Invertebrates				
Hero ID:	3546057					
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	Low	$\times 2$	6	purity/grade not reported
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test l	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	Low	\times 1	3	allocation not reported
Domain 3: Expos	sure Characte	prization				
Domain 6. Expo	Metric 7:	Experimental System/Test Media Prepara-	High	\times 2	2	
	Metric 8:	tion Consistency of Exposure Administration	II: odo	v 1	1	
	Metric 9:	Measurement of Test Substance Concentra-	High High	$\times 1 \times 2$	$\frac{1}{2}$	
	Menic 9.	tion	mgn	A 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	$\times 1$	1	
Domain 4: Test	Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
	_	Group	J			
	Metric 16:	Adequacy of Test Conditions	High	$\times 1$	1	

Study Citation:		Shi, D.,Lv, D.,Liu, W.,Shen, R.,Li, D.,Hong, H. 2017. Accumulation and developmental toxicity of hexabromocyclododecanes (HBCDs) on the marine copepod Tigriopus japonicus. Chemosphere 167:155-162							
Data Type:	, ,	atic; Invertebrates	mosphere	: 107.100	-102				
Hero ID:	3546057	auto, 111 volvoziavos							
		26	- · · · · ·	3.000		G			
Domain		Metric	Rating	MWF*	Score	Comments ^{††}			
Domain 5: Outco	ome Assessme	ent							
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2				
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1				
Domain 6: Confo									
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2				
		Procedures							
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1				
Domain 7: Data	Presentation	and Analysis							
	Metric 21:	Statistical Methods	High	\times 1	1				
	Metric 22:	Reporting of Data	High	$\times 2$	2				
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A				
Overall Quality I	Determination	n [‡]	High		1.2				
Extracted			Yes						
			168						

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	magna) wit	1997. Hexabromocyclododecane (HBCD): A 4 h Cover Letter Dated 06/20/1997.	48-Hour Flo	w-Throug	gh Acut	te Toxicity Test with the Cladoceran (Daphni
Data Type: Hero ID:	Acute (0-96 3586421	hour); Aquatic; Invertebrates				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	Medium	× 1	2	Unsure of what the impurities are among the three samples that were submitted. The HBCD used in the experiment is a composite of samples from three different manufacturers:.
Domain 2: Test l	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos	suro Characte	orization				
Domain 5. Expo	Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2	
	Medic 7.	tion	IIIgii	^ 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	The selection of HBCD exposure concentrations higher than the water solubility is explained (solubility enhanced by the use of carrier solvent), but the test parameters were explained so that it is likely that the exposure concentrations were consistent throughout the experiment and the test organisms were healthy in all the control treatments.

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Study Citation:	Ltd, W. I	1997. Hexabromocyclododecane (HBCD): A 4	8-Hour Flo	w-Throu	gh Acu	te Toxicity Test with the Cladoceran (Daphnia
	0 /	h Cover Letter Dated 06/20/1997.				
Data Type:	Acute (0-96	hour); Aquatic; Invertebrates				
Hero ID:	3586421					
Domain		Metric	Rating [†]	MWF^{\star}	Score	Comments ^{††}
	Metric 13:	Test Organism Characteristics	High	× 2	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	\times 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	Medium	× 1	2	Only two reps per treatment group.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	
Domain 6: Confo	ounding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	\times 2	4	Study reported minor differences among the treatment groups in regards to HBCD concentrations.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	Low	$\times 1$	3	No statistical methods were outlined.
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	Medium	× 1	2	The death in one treatment group was not explained but was reported, and the differences in HBCD con- centrations in a few of the treatment groups were
						explained.
Overall Quality I	Determination	‡	High		1.3	
Extracted			Yes			

Continued on next page ...

Study Citation: Ltd, W. I.. 1997. Hexabromocyclododecane (HBCD): A 48-Hour Flow-Through Acute Toxicity Test with the Cladoceran (Daphnia

magna) with Cover Letter Dated 06/20/1997.

Data Type: Acute (0-96 hour); Aquatic; Invertebrates

Hero ID: 3586421

Domain Metric Rating † MWF * Score Comments ††

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

where High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3 . If the reviewer determines that the overall rating needs adjustment, the original rating is crossed out and an arrow points to the new rating.

†† Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

^{*} MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

Study Citation:		1997. Letter from Chem Mfgs Assoc to US	EPA Regar	ding: To	oxicolog	ical Investigation of Hexabromocyclododecan
.		th Attachments, Dated 06/27/1997.				
Data Type:	`	hour); Aquatic; Fish				
Hero ID:	3586422					
Domain		Metric	Rating [†]	MWF^*	Score	${\rm Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	Medium	× 1	2	Unsure of what the impurities are in the HBCD exposure.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos						
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Some concentrations were above HBCD's water solubility, but all exposure concentrations were measured.
Domain 4: Test C	Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	\times 1	1	
	Metric 15:	Number of Organisms and Replicates per	Medium	\times 1	2	Only two true replicates per treatment group.
		Group				
		Continued on next page				

Study Citation:	,	1997. Letter from Chem Mfgs Assoc to US th Attachments, Dated 06/27/1997.	SEPA Rega	rding: T	oxicolog	ical Investigation of Hexabromocyclododecane
Data Type:	,	hour); Aquatic; Fish				
Hero ID:	3586422	,, 1				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	me Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	
Domain 6: Confo	unding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	\times 2	4	Some uncertainty with the HBCD concentrations in the exposure treatment groups. Mentioning of co- eluting artifacts.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data l	Presentation	and Analysis				
Zomam (, Zata :	Metric 21:	Statistical Methods	Low	$\times 1$	3	Statistical methods are unclear.
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	\times 1	1	
Overall Quality I	Determination	‡	High		1.2	
Extracted			Yes			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[†] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		1997. Letter from Chem Mfgs Assoc to US	SEPA Regai	rding: T	oxicolog	gical Investigation of Hexabromocyclododecane
Data Thomas		th Attachments, Dated 06/27/1997.				
Data Type: Hero ID:	3586422	5 hour); Aquatic; Plants				
nero iD:	3380422					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	Medium	× 1	2	Uncertainty with impurities present .
Domain 2: Test l	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	erization				
r	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	Some exposure concentrations are above water solubility limits.
Domain 4: Test	Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	Low	× 1	3	Uncertainty with number of replicates used per ex-
	Metric 16:	Group Adequacy of Test Conditions	High	× 1	1	posure concentration.
		A V				
		Continued on next page				

Study Citation:		1997. Letter from Chem Mfgs Assoc to US th Attachments, Dated 06/27/1997.	EPA Regai	rding: To	oxicologica	l Investigation of Hexabromocyclododecane
Data Type:	` '	hour); Aquatic; Plants				
Hero ID:	3586422	nour), riquatic, riames				
TICIO ID.	3000422					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent.				
Bomain o. Outee	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	- '					
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2	
		Procedures				
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	$\times 1$	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	Į [‡]	High		1.1	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		M.,Kittilson, J. D.,Bergan, H. E.,Sheridan, M. A trout (Oncorhynchus mykiss) hepatocytes is me				
Data Type: Hero ID:	Other; Aqua 3586425	atic; other Fish in vitro				
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	prization				
Domain of Expos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	nominal in vitro cell exposure
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	nominal in vitro cell exposure
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	\times 1	1	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

Study Citation:		M.,Kittilson, J. D.,Bergan, H. E.,Sheridan, M. Atrout (Oncorhynchus mykiss) hepatocytes is me				
Data Type:		atic; other Fish in vitro	diated by 1	21014, 1 10	к-акт, а	ing 3AX-51A1. 501.1(250-1(245
Hero ID:	3586425					
Domain		Metric	Rating [†]	MWF*	Score	$\rm Comments^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	\times 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality I	Determination	n [‡]	High		1.1	
Extracted			Yes			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Data Type:	ceran (Dap	1998. Initial Submission: Hexabromocyclododohnia magna), Final Report, with Cover Letter I 21 days); Aquatic; Invertebrates			Flow-Th	rough Life-Cycle Toxicity Test with the Clade
Domain		Metric	Rating [†]	MWF^{\star}	Score	$Comments^{\dagger\dagger}$
Domain 1: Test Su	bstance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	The test substance (HBCD) was identified by name
	Metric 2:	Test Substance Source	High	× 1	1	The test substance is a composite of HBCD samples from three manufacturers (Great Lakes Chemica Corp., Albemarle Corp., and Bromine Compounds Ltd.). The batch numbers and percentage of each isomer within the composite mixture was categorized (6, 8.5, and 79.1 percent of the mixture was comprised of alpha-, beta-, or gamma-HBCD, respectively).
	Metric 3:	Test Substance Purity	Medium	× 1	2	Unsure of what the impurities are in the HBCD mix ture used in exposures.
Domain 2: Test De	esign					
	Metric 4:	Negative Controls	High	\times 2	2	Appropriate negative and solvent control (0.1 mg/l DMF) treatment groups were included.
	Metric 5:	Negative Control Response	High	× 1	1	Biological responses (mortality) for the negative an solvent control are adequate for a valid test (no sig- nificant difference between the negative and solven control responses, and they were adequate for a vali- test).
	Metric 6:	Randomized Allocation	High	× 1	1	Test chambers were randomly positioned, and daph nid neonates were randomly assigned to treatmen groups and exposure chambers.
Domain 3: Exposu	re Characte	erization				
•	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	A continuous-flow diluter was used to provide tes substances, the negative and solvent control into the test chambers. The experimental system was well characterized. The test media preparation was fully explained (mixture preparation and storage).
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	A continuous-flow diluter was used to provide tes substances, the negative and solvent control into the test chambers.
		Continued on next page				

Study Citation: Data Type: Hero ID:	ceran (Dapl	1998. Initial Submission: Hexabromocyclodode hnia magna), Final Report, with Cover Letter I 21 days); Aquatic; Invertebrates			Flow-Th	rough Life-Cycle Toxicity Test with the Clado
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	Water samples were analytically measured (LC/MS) for the test substance from each exposure chamber from the lowest and highest concentrations at the start of the exposure. All exposure concentrations were analytically measured on a weekly basis during and at the end of the test. Samples were collected from the mid-depth from each test chamber and immediately analyzed or stored in a glass container and refrigerated until analyzed.
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The duration of the exposure was reported (21-d exposure).
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	There is a negative control, solvent control, and five concentrations of HBCD (0.87, 1.6, 3.1, 5.6 and 11 "g HBCD/L).
	Metric 12:	Testing at or Below Solubility Limit	Medium	× 1	2	There is only one exposure concentration above the water solubility limit of HBCD (66 ug/L).
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	\times 2	2	The daphnid neonate characteristics are less than 24-hours old. The identity of the original culture was done using taxonomic keys.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	The test water was the same as that used for the daphnid culture. (except for the lack of selenium in the exposure water). Daphnids in cultures that produce neonates for the exposure were held for ten days before the collection of neonates, and the only neonates used were from healthy adults.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	× 1	2	Only two replicates per treatment group.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	Environmental chambers, conditions, and food used in the exposure were all appropriate.
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	\times 2	2	The methodology used for the study did address the intended outcomes of interest (mortality, growth, and reproduction).
		Continued on next page				

Study Citation:		1998. Initial Submission: Hexabromocyclododomia magna), Final Report, with Cover Letter I			Flow-Th	rough Life-Cycle Toxicity Test with the Clado-
Data Type:	Chronic (>	21 days); Aquatic; Invertebrates	, ,			
Hero ID:	3586533					
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	The same protocols were used across the study groups.
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	The environmental conditions (water quality), size and age of test organisms (<24-hr old neonates) were the same across all treatment groups.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	The study reported that there were no health outcomes unrelated to the exposure that occurred.
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	× 1	1	Statistical analysis was performed using SPSS/PC + Version 2.0 or TOXSTAT Version 3.5 statistical software.
	Metric 22:	Reporting of Data	High	\times 2	2	Data were reported for each outcome and treatment group.
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	There were no unexpected outcomes reported.
Overall Quality I	Determination	‡	High		1.1	
Extracted			Yes			

^{*} MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise} \quad ,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Our); Aquatic; Fish Metric Test Substance Identity Test Substance Source Test Substance Purity	Rating [†] Unacceptable	MWF*	Score	${ m Comments}^{\dagger\dagger}$
Test Substance Identity Test Substance Source		MWF*	Score	$Comments^{\dagger\dagger}$
Test Substance Source	Unacceptable			
Test Substance Source	${\bf Unacceptable}$			
		$\times 2$	8	Only reported reagent grade HBCD.
Test Substance Purity		$\times 1$	0	
	Unacceptable	× 1	4	Not reported.
Negative Controls	High	$\times 2$	2	
Negative Control Response	High	$\times 1$	1	
Randomized Allocation	High	× 1	1	
zation				
Experimental System/Test Media Prepara-	Low	\times 2	6	Excessive amount of solvent used.
Consistency of Exposure Administration	${\bf Unacceptable}$	\times 1	4	Concentrations were over the solubility limit and a excessive amount of solvent was used .
Measurement of Test Substance Concentra-	Low	\times 2	6	Only nominal concentrations were used.
Exposure Duration and Frequency	High	$\times 1$	1	
Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
Testing at or Below Solubility Limit	Low	× 1	3	nominal, precipitate present
Test Organism Characteristics	High	$\times 2$	2	
Acclimitization and Pretreatment Conditions		× 1	1	
Number of Organisms and Replicates per Group	High	× 1	1	
Adequacy of Test Conditions	High	× 1	1	
Ac Nu Gr	climitization and Pretreatment Conditions umber of Organisms and Replicates per oup lequacy of Test Conditions	cclimitization and Pretreatment Conditions High umber of Organisms and Replicates per High oup lequacy of Test Conditions High	cclimitization and Pretreatment Conditions High × 1 umber of Organisms and Replicates per High × 1 oup lequacy of Test Conditions High × 1	climitization and Pretreatment Conditions High $\times 1$ 1 mber of Organisms and Replicates per High $\times 1$ 1 oup

		continued from previous page				
Study Citation:	Corp, U. C.	1990. The Acute Toxicity of HBCD Lot 990-	-17 to the Bluegi	ill Sunfisl	Lepomis 1	macrochirus rafinesque with Test Data
Data Type:	Acute (0-96	hour); Aquatic; Fish				
Hero ID:	3586733	1				
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	$\times 2$	2	
	Metric 20:	Outcomes Unrelated to Exposure		× 1	0	
Domain 7: Data	Procentation	and Analysis				
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 21:	Reporting of Data	High	$\stackrel{\wedge}{\times} \stackrel{1}{2}$	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A	^ 2	N/A	
Overall Quality I	Determination	ı [‡]	Unacceptable		4	
Extracted			No			

^{**} Consistent with our Application of Systematic Review in TSCARisk Evaluations document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, three of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

 $[\]star$ MWF = Metric Weighting Factor

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type: Hero ID:		2008. The Effects of Contaminants on Various l 21 days); Aquatic; Fish	Life-Cycle	Stages o	of Atlantic Sal	lmon (Salmo salar L.).
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	\times 2	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	uro Characte	prization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	\times 1	1	
Domain 4: Test C)rganism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outco	me Assessme	ent				
		Continued on next page				

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Study Citation: Data Type: Hero ID:	ata Type: Chronic (>21 days); Aquatic; Fish						
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$	
	Metric 17:	Outcome Assessment Methodology	High	\times 2	2		
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1		
Domain 6: Confo	ounding / Var	riable Control					
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2		
	Metric 20:	Outcomes Unrelated to Exposure	High	$\times 1$	1		
Domain 7: Data	Presentation	and Analysis					
	Metric 21:	Statistical Methods	High	$\times 1$	1		
	Metric 22:	Reporting of Data	High	$\times 2$	2		
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A		
Overall Quality Determination [‡]			High		1.0		
Extracted			Yes				

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		. 2006. Novel In Vitro, Ex Vivo and In Vivo A Hormone Action.	ssays Elucio	dating th	e Effect	s of Endocrine Disrupting Compounds (EDC
Data Type: Hero ID:	Other; Aqu 3619397	atic; other Xenopus in vitro, ex vivo and in vivo	o assays			
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test l	Design					
20110111 21 1050	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expo	sure Characte	prization				
Domain o. Expo	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	Dose concentrations
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	not addressed; dose concentrations
Domain 4: Test	Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	Medium	× 1	2	Number of organisms reported but not replicates
		Group				. O
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

Study Citation:		. 2006. Novel In Vitro, Ex Vivo and In Vivo A Hormone Action.	ssays Eluci	dating th	e Effects	of Endocrine Disrupting Compounds (EDCs)
Data Type: Hero ID:	· ·	atic; other Xenopus in vitro, ex vivo and in vivo	o assays			
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1	
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	\times 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality I	Determination	n [‡]	High		1.1	
Extracted			Yes			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation: Data Type: Hero ID:	test substan	, Kendall, T. Z., Krueger, H. O 2002. Hexabine on seedling emergence of six species of plant 21 days); Terrestrial; other Vegetation		dodecan	e (HBC	D): A toxicity test to determine the effects of t
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	The CASRN, purity, mixture components, and ratios were explicitly specied.
	Metric 2:	Test Substance Source	High	× 1	1	The manufacturer was specied; test substance number was reported. It was indicated that the purity and stability of the test chemical were veried using liquid chromatography.
	Metric 3:	Test Substance Purity	N/A		N/A	Test substance purity was reported. The test substance was between 98.7 and 100 percent pure; therefore, eects in the study were highly likely to be due to the test substance itself (rather than any unspecied impurities).
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	× 2	2	An appropriate concurrent control group was used. The negative control soil was prepared in the same manner as the other test groups, but no test substance was added.
	Metric 5:	Negative Control Response	High	× 1	1	Negative control response was reported. The experimental design for this study consisted of a negative control and five treatment groups. (THF) solvent was reported.
	Metric 6:	Randomized Allocation	High	× 1	1	Randomized allocation metrics was reported. Seeds were impartially assigned to prelabeled growth pots on the day of test initiation. The replicate pots were placed in a randomized block design on a greenhouse table after planting.
Domain 3: Expos	sure Characte	erization				
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	Test preparation was reported. The test soil was prepared by mixing HBCD into bulk test soil with a measured soil moisture of 14 percent.
		Continued on next page				

	continued from previous page			
Study Citation:	Porch, J. R., Kendall, T. Z., Krueger, H. O 2002. He test substance on seedling emergence of six species of	v	(HBCD): A toxicity	y test to determine the effects of the
Data Type: Hero ID:	Chronic (>21 days); Terrestrial; other Vegetation 3809141			
Domain	Metric	Rating [†] MWF*	Score	Comments ^{††}

Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Concentration exposures were reported. Test substance for treatment groups 40, 105, 276, 725, 1904, and 5000 mg HBCD/kg was prepared by weighing five known weights (2.1, 5.4, 14.2,37.3,98.1, and 257.5 g) of HBCD.
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	Mean measured concentrations were reported. The test soil was prepared by mixing HBCD into bulk test soil with a measured soil moisture of 14 percent. Test substance for treatment groups 40, 105, 276, 725, 1904, and 5000 mg HBCD/kg was prepared by weighing five known weights (2.1, 5.4, 14.2, 37.3, 98.1, and 257.5 g) of HBCD.
	Metric 10:	Exposure Duration and Frequency	N/A		N/A	Exposure durations were reported for chronic toxicity in days and weeks. Seeds were impartially assigned to prelabeled growth pots on the day of test initiation. The replicate pots were placed in a randomized block design on a greenhouse table after planting. Observations of emergence were made on Days 7, 14, and 21. A general assessment of seedling condition was made on Day 7, while observations of height, shoot dry weight, and assignment of plant condition scores were made only on Day 21.
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	nan	× 1	0	The experimental design for this study consisted of a negative control and five treatment groups. Each group had four replicate pots with ten seeds planted in each pot. Application of test concentrations of HBCD was made by soil incorporation to each treatment group prior to the planting of seeds. Test data were evaluated to determine the no-observed-effect-concentration (NOEC) and lowest observable-effect-concentration (LOEC) for condition and growth.
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	Exposure concentrations were based on mean measured concentration of HBCD in dry soil.

Domain 4: Test Organism

Continued on next page ...

Study Citation:	test substar	., Kendall, T. Z., Krueger, H. O 2002. Hexabrace on seedling emergence of six species of plant		dodecan	e (HBC	D): A toxicity test to determine the effects of
Data Type: Hero ID:	3809141	21 days); Terrestrial; other Vegetation				
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 13:	Test Organism Characteristics	N/A		N/A	The common and scientific names for the six species tested, the seed source, and their approximate planting depths are;Com (Zea mays)Onion (Alum cepa)Ryegrass (Lolium perenne)Cucumber (Cucumis sativa)Soybean (Glycine max)Tomato (Lycopersicon esculentum)These species were chosen because they represent ecologically important families, and are readily cultivated test organisms that are widely used in research. Seeds were selected from a single size class within each species in order to reduce the potential for bias from differing seed sizes Seeds used in this study were not treated with fungicides, insecticides or repellents prior to test initiation.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	The soil used for the test represented a loam soil and was composed of kaolinite clay, industrial quartz sand, and peat mixed in a 4:50:2 ratio (w:w:w) Crushed limestone was added to buffer the pH of the soil, and a slow-release fertilizer was added to provide nutrients essential for plant growth. A sample of soil representative of that used in this study was sent to Agvise Laboratories, Inc., in Northwood North Dakota, for analysis of the particle size distribution and organic matter content of the soil. The soil was determined to consist of 53 percent sand 30 percent silt, and 17 percent clay, with an organic matter content of 1.9 percent, and a soil pH of 7.5 A copy of the complete report from Agvise Laboratories, Inc. was filed in the archives at Wildlife International, Ltd.along with the raw data for this study.

... continued from previous page Study Citation: Porch, J. R., Kendall, T. Z., Krueger, H. O.. 2002. Hexabromocyclododecane (HBCD): A toxicity test to determine the effects of the test substance on seedling emergence of six species of plants. Data Type: Chronic (>21 days); Terrestrial; other Vegetation Hero ID: 3809141 $Comments^{\dagger\dagger}$ Domain Metric Rating[†] MWF* Score Number of Organisms and Replicates per High Metric 15: $\times 1$ The experimental design for this study consisted of a negative control and five treatment groups. Each Group group had four replicate pots with ten seeds planted in each pot. Application of test concentrations of HBCD was made by soil incorporation to each treatment group prior to the planting of seeds. The nominal test substance concentrations were 40, 105, 276, 725, 1904, and 5000 mg of HBCD per kilogram of dry soil (mg HBCD/kg). A control group, which received no test substance incorporation, was maintained concurrently. Adequacy of Test Conditions Metric 16: High $\times 1$ 1 Seeds were planted in plastic pots (approximately 16 cm in diameter and 12 cm deep) on the day of test substance application. A template was used to gently compact the soil and leave ten uniform holes for planting. One indiscriminately selected seed was then planted in each hole, for a total of ten seeds in each pot. Holes were then closed by slightly depressing the soil surface. Water lost through transpiration and evaporation was replaced by sub-irrgation with well water from the greenhouse facility. Seedlings were sub-irrgated to minimize the potential for the leaching of the test substance through the soil. Subirrgation trays were filled to a predetermined depth to help standardize the amount of water delivered to each tray. The temperature within the greenhouse was controlled with a Wadsworth MicroStep S/A Environmental Control System. Artificial lighting (high pressure sodium) was used to supplement natural sunlight in order to provide a uniform 14-hour photoperiod. The temperature and relative humidity within the greenhouse were continuously monitored during the test with the Wadsworth control system. The well water and soil used for plant studies are analyzed periodically for pesticides and metals. No analytes were measured at levels that were expected to have an impact on the study. Domain 5: Outcome Assessment Continued on next page ...

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test substance on seedling emergence of six species of plants. a Type: Chronic (>21 days); Terrestrial; other Vegetation 3809141 Domain Metric Rating† MWF* Score Metric 17: Outcome Assessment Methodology High × 2 2 On three 276 grown min carr Metric 18: Consistency of Outcome Assessment High × 1 1 One San til a main 6: Confounding / Variable Control Metric 19: Confounding Variables in Test Design and Procedures Metric 20: Outcomes Unrelated to Exposure High × 1 1 One San til a main 7: Data Presentation and Analysis Metric 21: Statistical Methods N/A N/A Dat in the plic show were seece seece the with of the confounding of the plic show were seece seece the with of the confounding the plic show were seece seece the with of the confounding the plic show were seece seece the with of the confounding the plic show were seece seece the with of the confounding the plic show were seece seece seece seece the with of the confounding the plic show were seece seece seece the with of the confounding the plic show were seece the with of the confounding the plic show were seece seec	ıdy Citation:	Porch, J. R.	, Kendall, T. Z., Krueger, H. O., 2002. Hexab	romocyclo	dodecan	e (HBC	D): A toxicity test to determine the effects of t
Metric 17: Outcome Assessment Methodology High × 2 2 On three 276 grown min carr Metric 18: Consistency of Outcome Assessment High × 1 1 One San til z main 6: Confounding / Variable Control Metric 19: Confounding Variables in Test Design and High × 2 2 One Procedures High × 1 1 One San til z Metric 20: Outcomes Unrelated to Exposure High × 1 1 One San til z main 7: Data Presentation and Analysis Metric 21: Statistical Methods N/A N/A Dat in the plic shower were seed the with of the control of the plic shower were seed the with of the control of the plic shower seed the with of the control of the plic shower seed the with of the control of the plic shower seed the with of the control of the plic shower seed the with of the control of the plic shower seed the with of the plic shower seed the plic shower seed the with of the plic shower seed the plic show	ta Type:	test substan Chronic (>2	ce on seedling emergence of six species of plan		40400011	0 (1120	2), 11 contactly control to describing the enects of the
thre 276 grot min carr Metric 18: Consistency of Outcome Assessment High × 1 1 One San til z main 6: Confounding / Variable Control Metric 19: Confounding Variables in Test Design and High × 2 2 One Procedures Metric 20: Outcomes Unrelated to Exposure High × 1 1 One San til z main 7: Data Presentation and Analysis Metric 21: Statistical Methods N/A N/A N/A Data plic show were seed the with of the with of the policy of the plic show were seed the with of the plic show were seed the plic show were seed the with of the plic show were seed the plic show were shown as a sho	Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
main 6: Confounding / Variable Control Metric 19: Confounding Variables in Test Design and High × 2 2 One San til a Metric 20: Outcomes Unrelated to Exposure High × 1 1 One San til a main 7: Data Presentation and Analysis Metric 21: Statistical Methods N/A N/A Dat in the with of				High	× 2	2	On the day of test soil preparation (May 8, 2002), three soil samples were collected from the 40, 105, 276, 725, 1904, and 5000 mg HBCD/kg treatment groups to verify the test concentrations and determine the homogeneity of the test substance in the carrier (soil).
Metric 19: Confounding Variables in Test Design and High × 2 2 One Procedures Metric 20: Outcomes Unrelated to Exposure Metric 20: Outcomes Unrelated to Exposure Metric 21: Statistical Methods N/A N/A N/A N/A N/A N/A N/A N/		Metric 18:	Consistency of Outcome Assessment	High	× 1	1	One sample was collected from the control group. Samples were stored at ambient room conditions until analysis was conducted.
Metric 19: Confounding Variables in Test Design and High × 2 2 One Procedures Metric 20: Outcomes Unrelated to Exposure Metric 20: Outcomes Unrelated to Exposure Metric 21: Statistical Methods N/A N/A N/A N/A N/A N/A N/A N/	main 6: Confou	nding / Var	iable Control				
main 7: Data Presentation and Analysis Metric 21: Statistical Methods N/A N/A Dat in t plic show wer seec the with of th vers leve aid trea		- '	Confounding Variables in Test Design and	High	\times 2	2	One sample was collected from the control group. Samples were stored at ambient room conditions until analysis was conducted.
Metric 21: Statistical Methods N/A N/A Dat in to plic show were seet the with of the verse lever aid treaters.		Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	One sample was collected from the control group. Samples were stored at ambient room conditions until analysis was conducted.
Metric 21: Statistical Methods N/A N/A Dat in to plic show were seet the with of the verse lever aid treaters.	main 7: Data P	resentation	and Analysis				
			· ·	N/A		N/A	Data Analyses:Statistical analyses were used to aid in the evaluation of effects of test substance application on seedling emergence, survival, mean shoot weight, and seedling height. These variables were defined for statistical analysis as follows:Mean seedling emergence, survival, weight, and height of the control and treatment groups were compared with Dunnett's t-test, using the DUNNETT option of the GLM (general linear model) procedure of SAS version 8 (5). Significance was determined at the level of 0.05 (p0.05). Dunnett's test was used to aid in establishing the NOEC by determining which treatment groups differed significantly from the control group.
Continued on next page			Continued on next page				

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\dots continued	trom	previous	page

Study Citation:	,	., Kendall, T. Z., Krueger, H. O 2002. Hence on seedling emergence of six species of p	•	ane (HBC	D): A toxicity test to determine the effects of the
Data Type: Hero ID:		21 days); Terrestrial; other Vegetation	Tallos.		
Domain		Metric	Rating [†] MW	F* Score	$Comments^{\dagger\dagger}$
	Metric 22:	Reporting of Data	N/A	N/A	Seedling Emergence:The number of emerged seedlings per ten planted seeds in each pot.Survival:The number of emerged seedlings in each pot that were living at test termination per ten planted seeds.Mean Shoot Weight:The average dry shoot weight of living emerged seedlings in each pot.Height:The average height of living emerged seedlings in each pot.
	Metric 23:	Explanation of Unexpected Outcomes	N/A	N/A	
Overall Quality I	Determination	[‡]	High	1.0	
Extracted			Yes		

^{*} MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		R. Ludwichowski, R. Nagel. 2001. Validation sediment by using selected substances.	on of the pr	eliminar	y EU-co	oncept of assessing the impact of chemicals to
Data Type:		21 days); Aquatic; Sediment-dwelling				
Hero ID:	3809143					
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
20110111 1. 1000 8	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	Low	$\times 1$	3	not reported
	Metric 3:	Test Substance Purity	Low	× 1	3	not reported
Domain 2: Test I	Dogiera					
Domain 2. Test i	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
D : 9 E	CI.	. ,.				
Domain 3: Expos			TT:l.	v. 0	0	
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	$_{ m High}$	$\times 1$	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Sediment exposure
Domain 4: Test (Organism					
1000 (Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	Low	× 1	3	not reported
	Metric 15:	Number of Organisms and Replicates per Group	Low	× 1	3	number of replicates per exposure group was not reported
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

Study Citation:		K. Ludwichowski, R. Nagel. 2001. Validation sediment by using selected substances.	n of the pr	reliminar	y EU-co	oncept of assessing the impact of chemicals to
Data Type:		21 days); Aquatic; Sediment-dwelling				
Hero ID:	3809143					
Domain		Metric	$\mathrm{Rating}^{\dagger}$	MWF*	Score	${\rm Comments}^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Low	× 1	3	not reported
Domain 7: Data	Presentation	and Analysis				
Domain 1. Data	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	$\overset{-}{2}$	
	Metric 23:	Explanation of Unexpected Outcomes	Medium	× 1	2	Unexpected outcomes such as control organisms taking longer to emerge than organisms exposed to HBCD were not explained.
Overall Quality I	Determination	±	High		1.4	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:	conditions u	sing Japanese Quail.)-Hexabro	mocyclo	dodecan	ne for avian reproduction toxicity under long-day
Data Type: Hero ID:	3809153	estrial; Birds				
Hero ID:	3009133					
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	euro Characto	vization				
Domain 5. Expo.	Metric 7:	Experimental System/Test Media Prepara-	High	\times 2	2	
	Metric 8:	tion	TT:l.	1	1	
	Metric 8: Metric 9:	Consistency of Exposure Administration Measurement of Test Substance Concentra-	High	$\times 1 \times 2$	$\frac{1}{2}$	
	Metric 9:	Measurement of Test Substance Concentra- tion	High	× 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	Oral administration.
Domain 4: Test (Organism					
1000 (Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
		Continued on next page				

		continued from previous page				
Study Citation:		9. 6-Week Administration Study of 1,2,5,6,9,10 using Japanese Quail.)-Hexabro	mocyclo	dodecane	for avian reproduction toxicity under long-day
Data Type:	Other: Terre	estrial; Birds				
Hero ID:	3809153	,				
Domain		Metric	Rating [†]	MWF^{\star}	Score	$Comments^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	$\times 1$	1	
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
Domain (1 Data :	Metric 21:	Statistical Methods	High	$\times 1$	1	
	Metric 22:	Reporting of Data	High	$\times 2$	$\overline{2}$	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
		+		<u> </u>		
Overall Quality I	Determination	1 ⁺	High		1.0	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		ns, J. A. MacGregor, H. O. Krueger. 2005. Fina			1, Hexabromocy	yclododecane (HBCD): A 72-hour toxicity
Data Type:		ne marine diatom (Skeletonema costatum) using is hour); Aquatic; Plants	a co-solv	ent.		
Hero ID:	3809170	,, ,				
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
2. 1000 1	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Expos	sure Characte	orization				
Domain 5. Expo.	Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2	
	11100110 11	tion		^ -	-	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentra-	High	\times 2	2	
	Metric 10:	tion Exposure Duration and Frequency	High	× 1	1	
	Metric 10:	Number of Exposure Groups/Spacing of Ex-	High	\times 1 \times 1	1	
	Metric 11.	posure Levels	IIIgii	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test (Organism					
2022011 1. 1000	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
		Group	J			
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
		Continued on next page				

Study Citation:	•	ns, J. A. MacGregor, H. O. Krueger. 2005. Fina te marine diatom (Skeletonema costatum) using		-	1, Hexal	promocyclododecane (HBCD): A 72-hour toxicity
Data Type:		5 hour); Aquatic; Plants	, a co 501v	ciii.		
Hero ID:	3809170	11041), 11444010, 114110				
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 5: Outco	то Авравата	ont.				
Domain 5. Outco	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	$\times \frac{2}{1}$	1	
	11100110 10.	Consistency of Outcome Historian	****	, , <u>, , , , , , , , , , , , , , , , , </u>		
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2	
		Procedures	, ,			
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1	
Domain 7: Data		· ·				
	Metric 21:	Statistical Methods	$_{ m High}$	$\times 1$	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	1^{\ddagger}	High		1.0	
Extracted			Yes			

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		eide, A. Jones, J. A. MacGregor, W. B. Nixon.	2003. Eff	ect of he	xabromocyclod	odecane on the survival and reproduction
Data Type:		worm, Eisenia fetida. 21 days); Terrestrial; Invertebrate				
Hero ID:	3809173	,				
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
Domain 1. 1000 k	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test 1	Docion					
Domain 2. Test i	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	High	× 1	1	
D : 9 E	CI .	. ,.				
Domain 3: Expos	sure Characte Metric 7:		II: mb	v 9	9	
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	$\times 1$	1	
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	
		Continued on next page				

Study Citation:		ide, A. Jones, J. A. MacGregor, W. B. Nixon. worm, Eisenia fetida.	2003. Eff	ect of he	xabromo	cyclododecane on the survival and reproduction
Data Type:		21 days); Terrestrial; Invertebrate				
Hero ID:	3809173					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 5: Outco	ome Assessme	ent				
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confo	ounding / Var	iable Control				
	Metric 19:	Confounding Variables in Test Design and Procedures	High	\times 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	\times 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality I	Determination	‡	High		1.0	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		ns, J. Macgregor, H. Krueger. 2004. Final recom (Skeletomema costatum).	port: hex	abromoc	yclododecane	(HBCD): a 72-hour toxicity test with the
Data Type:	Acute (0-96	hour); Aquatic; Plants				
Hero ID:	3809177					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	ubstance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test D	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos	uro Characte	vization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2	
		tion	Ü			
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test C)rganism					
550	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	$\times 1$	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	$\times 1$	1	

Study Citation:	•	ns, J. Macgregor, H. Krueger. 2004. Final reom (Skeletomema costatum).	port: hex	abromod	yclodode	ecane (HBCD): a 72-hour toxicity test with the
Data Type:		hour); Aquatic; Plants				
Hero ID:	3809177	nour), riquate, riams				
	0000111					
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}
Domain 5: Outco	ma Aesasema	ont				
Domain 5. Outce	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2	
	Metric 18:	Consistency of Outcome Assessment	High	$\times 2 \times 1$	1	
	11100110 10.	consistency of outcome rispessment	111.611	/\ I		
Domain 6: Confo	ounding / Var	riable Control				
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2	
		Procedures				
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1	
Domain 7: Data	Presentation	and Analysis				
Bomain II Bata	Metric 21:	Statistical Methods	High	\times 1	1	
	Metric 22:	Reporting of Data	High	$\times 2$	$\overline{2}$	
	Metric 23:	Explanation of Unexpected Outcomes	High	\times 1	1	
Overall Quality I	Determination	[‡]	High		1.0	
Extracted			Yes			
DATACOCC			105			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Rating [†] High High High	MWF* × 2	Score	$ m Comments^{\dagger\dagger}$
High High	× 2	Score	$Comments^{\dagger\dagger}$
High			
High			
_		2	
High	$\times 1$	1	
	× 1	1	
High	$\times 2$	2	
High	$\times 1$	1	
High	× 1	1	
High	\times 2	2	
High	$\times 1$	1	
Medium	\times 2	4	only the control, lowest and highest exposure concentrations were measured
High	$\times 1$	1	
High	× 1	1	
N/A		N/A	sediment exposure
High	$\times 2$	2	
High	\times 1	1	
High	× 1	1	
High	× 1	1	
	High		

Study Citation:		Hexabromocyclododecane (HBCD): A Prolongodal Organic Carbon.	ed Sedimen	t Toxicity	Test w	rith Hyalella azte	eca Using Spiked Sediment with
Data Type:		21 days); Aquatic; Sediment-dwelling					
Hero ID:	4269889	21 days), riquatic, sediment dwelling					
-							
Domain		Metric	Rating [†]	MWF^*	Score		Comments ^{††}
Domain 5: Outco	ma Aggagama	not.					
Domain 5: Outco	Metric 17:	Outcome Assessment Methodology	High	\times 2	2		
	Metric 18:	Consistency of Outcome Assessment	High	× 2 × 1	∠ 1		
	Metric 18:	Consistency of Outcome Assessment	підіі	X 1	1		
Domain 6: Confo	ounding / Var	riable Control					
	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2		
		Procedures					
	Metric 20:	Outcomes Unrelated to Exposure	Medium	\times 1	2	not reported	
Domain 7: Data	Procentation	and Analysis					
Domain 7: Data	Metric 21:	Statistical Methods	II: ada	v 1	1		
			High	× 1	1		
	Metric 22:	Reporting of Data	High	$\times 2$	2		
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1		
Overall Quality I	Determination	n^{\ddagger}	High		1.1		
_							
Extracted			Yes				

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		Hexabromocyclododecane (HBCD): A Prolong	ed Sedimen	t Toxicity	Test w	vith Hyalella azteca Using Spiked Sediment with
Data Type:		otal Organic Carbon. 21 days); Aquatic; Sediment-dwelling				
Hero ID:	4269912	21 days), riquatic, bediment-dwelling				
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}
Domain 1: Test S		T + C 1 + 11 + 11	TT: 1	0	0	
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	$\times 1$	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos	euro Characto	orization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2	
	Medile 1.	tion	111611	X 2	_	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	\times 2	4	only the control, lowest and highest exposure concentration was measured $$
	Metric 10:	Exposure Duration and Frequency	High	$\times 1$	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	sediment exposure
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
		Group	G			
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
		Continued on next page				

	Hexabromocyclododecane (HBCD): A Prolongental Organic Carbon.	ed Sedimen	t Toxicity	Test w	vith Hyalella azte	ca Using Spiked Sediment with
,	ar augs), requare, seament awening					
1200012						
	Metric	Rating [†]	MWF*	Score		Comments ^{††}
ne Assessme	nt					
		High	× 2	2		
Metric 18:	30	_	× 1	1		
	v					
inding / Var	iable Control					
Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2		
	Procedures					
Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	not reported	
Presentation	and Analysis					
Metric 21:	Statistical Methods	High	× 1	1		
Metric 22:	Reporting of Data	0		2		
Metric 23:	Explanation of Unexpected Outcomes	High	\times 1	1		
etermination	‡	High		1.1		
		Yes				
r ::	Chronic (>2 4269912 The Assessme Metric 17: Metric 18: Metric 19: Metric 20: Metric 20: Metric 21: Metric 22: Metric 23:	Chronic (>21 days); Aquatic; Sediment-dwelling 4269912 Metric Metric Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Assessment Inding / Variable Control Metric 19: Confounding Variables in Test Design and Procedures Metric 20: Outcomes Unrelated to Exposure Metric 21: Statistical Methods Metric 22: Reporting of Data	Chronic (>21 days); Aquatic; Sediment-dwelling 4269912 Metric Rating† Metric 17: Outcome Assessment Methodology High Metric 18: Consistency of Outcome Assessment High Inding / Variable Control Metric 19: Confounding Variables in Test Design and Procedures Metric 20: Outcomes Unrelated to Exposure Medium Metric 21: Statistical Methods High Metric 22: Reporting of Data High Metric 23: Explanation of Unexpected Outcomes High Metric 24: High Metric 25: High Metric 26: High Metric 27: High Metric 28: Explanation of Unexpected Outcomes High Metric 29: High	Chronic (>21 days); Aquatic; Sediment-dwelling 4269912 Metric Rating† MWF* Metric 17: Outcome Assessment Methodology High × 2 Metric 18: Consistency of Outcome Assessment High × 1 Inding / Variable Control Metric 19: Confounding Variables in Test Design and High × 2 Procedures Metric 20: Outcomes Unrelated to Exposure Medium × 1 resentation and Analysis Metric 21: Statistical Methods High × 2 Metric 22: Reporting of Data High × 2 Metric 23: Explanation of Unexpected Outcomes High × 1 Petermination‡ High High	Chronic (>21 days); Aquatic; Sediment-dwelling $\frac{4269912}{4269912}$ Metric Rating [†] MWF* Score Metric 17: Outcome Assessment Methodology High \times 2 2 Metric 18: Consistency of Outcome Assessment High \times 1 1 Inding / Variable Control Metric 19: Confounding Variables in Test Design and High \times 2 2 Procedures Metric 20: Outcomes Unrelated to Exposure Medium \times 1 2 resentation and Analysis Metric 21: Statistical Methods High \times 2 2 Metric 22: Reporting of Data High \times 2 2 Metric 23: Explanation of Unexpected Outcomes High \times 1 1 Metric 23: Explanation of Unexpected Outcomes High \times 1 1 Metric 23: Explanation of Unexpected Outcomes High \times 1 1 Metric 23: Explanation of Unexpected Outcomes High \times 1 1	Chronic (>21 days); Aquatic; Sediment-dwelling Metric Rating† MWF* Score Metric 17: Outcome Assessment Methodology High \times 2 2 Metric 18: Consistency of Outcome Assessment High \times 1 1 Inding / Variable Control Metric 19: Confounding Variables in Test Design and Procedures Metric 20: Outcomes Unrelated to Exposure Medium \times 1 2 not reported Metric 21: Statistical Methods High \times 2 2 Metric 22: Reporting of Data High \times 2 2 Metric 23: Explanation of Unexpected Outcomes High \times 1 1 Metric 23: Explanation of Unexpected Outcomes High \times 1 1 Metric 23: High \times 1 1

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} \end{array} \right. \\ \text{(round to the nearest tenth) otherwise}$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		sar, J. A. Macgregor, H. O. Krueger. 2001. Heut (Onchorhynchus mykiss).	exabromoc	yclodode	ecane (HBCD):	An early life-stage toxicity test with the
Data Type:	Other; Aqua					
Hero ID:	4796184					
Domain		Metric	Rating [†]	MWF*	Score	Comments ^{††}
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	\times 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I)esign					
2. 1050 I	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
D	Ol + -					
Domain 3: Expos	ure Characte Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2	
	Metric 7.	tion	mgn	A 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	\times 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test ()roanism					
25110111 1. 1000	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
		Group	G			
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	

Study Citation:	K. R. Drottar, J. A. Macgregor, H. O. Krueger. 2001. Hexabromocyclododecane (HBCD): An early life-stage toxicity test with the rainbow trout (Onchorhynchus mykiss).							
Data Type:	Other; Aqu							
Hero ID:	4796184	,						
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$		
Domain 5: Outco	ome Assessme	ent						
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2			
	Metric 18:	Consistency of Outcome Assessment	High	\times 1	1			
Domain 6: Confo	unding / Var	siable Central						
Domain o. Come	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2			
		Procedures	6		_			
	Metric 20:	Outcomes Unrelated to Exposure	High	\times 1	1			
Domain 7: Data	Procentation	and Analysis						
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1			
	Metric 22:	Reporting of Data	High	$\times 2$	2			
	Metric 23:	Explanation of Unexpected Outcomes	High	\times 1	1			
-								
Overall Quality I	Determination	n [‡]	High		1.0			
Extracted			Yes					

 $[\]star$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		tar, J. A. Macgregor, H. O. Krueger. 2001. He	exabromo	cyclodod	ecane (HBC	CD): An early life-stage toxicity test with the
Data Type:		out (Onchorhynchus mykiss). 21 days); Terrestrial; other Vegetation				
Hero ID:	4796184	21 days), Terrestriai, other vegetation				
TIETO ID.	4730104					
Domain		Metric	Rating [†]	MWF*	Score	$Comments^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	$\times 2$	2	
	Metric 2:	Test Substance Source	High	$\times 1$	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	High	$\times 2$	2	
	Metric 5:	Negative Control Response	High	\times 1	1	
	Metric 6:	Randomized Allocation	High	\times 1	1	
Domain 3: Expos	euro Characto	prization				
Domain 5. Expos	Metric 7:	Experimental System/Test Media Prepara-	High	$\times 2$	2	
	Wictife 1.	tion	111611	A 2	2	
	Metric 8:	Consistency of Exposure Administration	High	\times 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	\times 2	2	
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
Domain 4: Test 0	Organism					
20110111 1. 1000	Metric 13:	Test Organism Characteristics	High	$\times 2$	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	
	Metric 15:	Number of Organisms and Replicates per	High	× 1	1	
		Group	0		-	
	Metric 16:	Adequacy of Test Conditions	High	\times 1	1	
		Continued on next page				

Study Citation:	K. R. Drottar, J. A. Macgregor, H. O. Krueger. 2001. Hexabromocyclododecane (HBCD): An early life-stage toxicity test with the rainbow trout (Onchorhynchus mykiss).						
Data Type:		21 days); Terrestrial; other Vegetation					
Hero ID:	4796184	,,					
	-,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
Domain		Metric	Rating [†]	MWF^{\star}	Score	$Comments^{\dagger\dagger}$	
Daniel T. Oataa	Λ	4					
Domain 5: Outco			TT:1.	v. 0	0		
	Metric 17:	Outcome Assessment Methodology	High	$\times 2$	2		
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1		
Domain 6: Confo	unding / Var	iable Control					
Bomain or como	Metric 19:	Confounding Variables in Test Design and	High	$\times 2$	2		
	11100110 10.	Procedures	111811	^ 2	-		
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1		
Domain 7: Data	Presentation	and Analysis					
Domain 7. Data	Metric 21:	Statistical Methods	High	× 1	1		
	Metric 22:	Reporting of Data	High	$\times 2$	2		
	Metric 23:		_		1		
	Metric 25:	Explanation of Unexpected Outcomes	High	× 1	1		
		4					
Overall Quality I	Determination	1 ⁺	High		1.0		
Extracted			Yes				
Extracted			168				

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left[\sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right]_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.

Study Citation:		ELLTD. 1997. LETTER FROM CHEM MFGS A BROMOCYCLODODECANE (HBCD) WITH .				
Data Type: Hero ID:		6 hour); Aquatic; Plants	AI IACH.	MEN 15,	DAIE	D 00/21/1991.
Domain		Metric	Rating [†]	MWF*	Score	$\mathrm{Comments}^{\dagger\dagger}$
Domain 1: Test S	Substance					
	Metric 1:	Test Substance Identity	High	\times 2	2	The chemical name is provided throughout the study.
	Metric 2:	Test Substance Source	High	× 1	1	The source of the chemical(s) are provided (Great Lakes Chemical Corp, Albermarle, Corp and Bromine Compounds Ltd.)
	Metric 3:	Test Substance Purity	High	× 1	1	Purity was provided by the company.
Domain 2: Test I	Design					
	Metric 4:	Negative Controls	N/A		N/A	The negative control groups were reported for this study.
	Metric 5:	Negative Control Response	High	× 1	1	A concurrent negative control and vehicle control were used required to ensure that any observed ef- fects are attributable to substance exposure.
	Metric 6:	Randomized Allocation	High	× 1	1	This study reported the use of control groups and randomization in allocation to ensure that the effect of exposure is isolated.
Domain 3: Expos	sure Charact	erization				
	Metric 7:	Experimental System/Test Media Preparation	High	\times 2	2	The design of the test system and methods of test media preparation must take into account the physical-chemical properties and reactivity of the test substance (e.g., hydrolysis, biodegradation, bioaccumulation, adsorption) to ensure confidence in test substance concentrations, which will allowed for determination of a concentration-response relationship and enable valid comparisons across studies.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	The low water solubility of HBCD was considered and the use of a solvent was applied to the concentration-response relationship to enable valid comparisons across studies.
-		Continued on next page				

Study Citation: Data Type:	OF HEXA	l LTD. 1997. LETTER FROM CHEM MFGS A BROMOCYCLODODECANE (HBCD) WITH . 5 hour); Aquatic; Plants				
Hero ID:	6836803	nour), Aquatic, Fiants				
Domain		Metric	Rating [†]	MWF*	Score	${\rm Comments}^{\dagger\dagger}$
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	measurement of test substance concentrations were determined for the concentration-response relationship in order to enable valid comparisons across studies.
	Metric 10:	Exposure Duration and Frequency	High	\times 1	1	The exposure duration (i.e., 24, 48, 72 and 96-hour) were reported to compare effects over time.
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	The number of exposure groups were reported (i.e., the range of concentrations tested to observe a concentration-response relationship, a LOAEC, NOAEC, LC50, or EC50).
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	All exposure concentrations were test at the chemicals water solubility limit (or dispersibility limit if applicable) and the range of exposure concentrations tested was sufficient to characterize a concentration-response relationship.
Domain 4: Test (Organism					
	Metric 13:	Test Organism Characteristics	High	\times 2	2	The test organisms were appropriate for the evaluation of the specific outcome.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	There were no differences in acclimatization and/or pretreatment conditions between control and experimental groups.
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	The test replicates were sufficient to characterize toxicological effects adequate power for statistical analysis.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	The algae environmental conditions nutrients and/or biomass loading were conducive to maintenance of the growth culture.
Domain 5: Outco	ome Assessme	ent.				
	Metric 17:	Outcome Assessment Methodology	High	\times 2	2	The reported outcome assessment was adequate for the outcome(s) of interest.
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	The studies outcome were adequately reported for interpretation of results.
Domain 6: Confo	ounding / Var	riable Control				
	37	Continued on next page				

Study Citation:	Wildlife Intl LTD. 1997. LETTER FROM CHEM MFGS ASSOC TO USEPA REGARDING: TOXICOLOGICAL INVESTIGATION OF HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.					
Data Type: Hero ID:		hour); Aquatic; Plants	ar mon	WILIVID,	DATE	5 00/21/1001.
Domain		Metric	Rating [†]	MWF^{\star}	Score	$\mathrm{Comments}^{\dagger\dagger}$
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	The study did not reported significant differences among the study groups with respect to environmen- tal conditions or other non-treatment-related factors and these preventmeaningful interpretation of the results.
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	There were no study groups that experienced any serious test organism attrition or outcomes unrelated to exposure.
Domain 7: Data	Presentation	and Analysis				
	Metric 21:	Statistical Methods	High	$\times 1$	1	Statistical methods used were appropriate.
	Metric 22:	Reporting of Data	N/A		N/A	Data presentation were provided and are adequate for this study.
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	The were no unexpected outcomes regarding within- study variability and/or variation from historical measures, are considered serious flaws that make the study unusable.
Overall Quality I	Determination	‡	High		1.0	
Extracted			Yes			

 $^{^{\}star}$ MWF = Metric Weighting Factor

$$\text{Overall rating} = \left\{ \begin{array}{ll} 4 & \text{if any metric is Unacceptable} \\ \\ \left\lfloor \sum_{i} \left(\text{Metric Score}_{i} \times \text{MWF}_{i} \right) / \sum_{j} \text{MWF}_{j} \right\rfloor_{0.1} & \text{(round to the nearest tenth) otherwise} \end{array} \right.,$$

[†] High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.

[‡] The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

^{††} Metrics that are rated 'High' met the criteria for high confidence as expected for this type of study, and may not require additional comments.