United States
Environmental Protection Agency

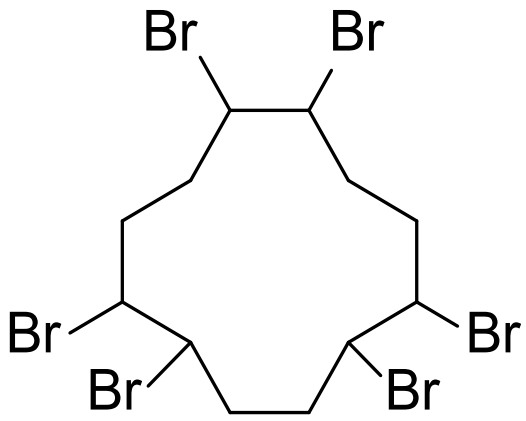
Office of Chemical Safety and
Pollution Prevention

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

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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**

1928244	Other; Aquatic; Fish	. 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.	**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 SURVEY-PHASE 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 HEXABROMOCYCLODODECANE 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 HEXABROMOCYCLODODECANE (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 HEXABROMOCYCLODODECANE (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 HEXABROMOCYCLODODECANE (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**

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 HEXABROMOCYCLODODECANE (HBCD) WITH ATTACHMENTS, DATED 06/27/1997.	**170**

Study Citation:	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
Data Type:	Chronic (>21 days); Terrestrial; Mammalian
Hero ID:	787657

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 indicatedthat the purity and stability of the test chemical were verified using liquidchromatography.
	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	× 2	2	An appropriate concurrent control group was used (all of the conditions the same exceptexposure.
	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 assigned into study groups.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	It was indicated that the test substance was stored in a sealed container under cool anddark conditions. The test substance was well-mixed in the diet (homogeneous 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 desiredfeed concentrations 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 concentrations in the diet was analytically measured, but based on the properties of HBCD, there is unlikely to be substantial loss.

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Data Type:	Chronic (>21 days); Terrestrial; Mammalian
Hero ID:	787657

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	The exposure frequency and duration were appropriate for the study type (and consistent with OECD guidelines). Mating was 3 weeks (rather than 2 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 basedon the results of 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, age, and starting body weights were reported.Animals were purchased from a commercial laboratory. Crl:CD(SD) rats were usedbecause they are the most commonly used in reproductive and developmental 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 conditions (at the temperature and humidityrecommended by guideline). Animals were housed individually except duringacclimation, 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 preferred (but not always possible). Thestudy utilized 24 rats/sex/group. Although the number of pregnant animals was only 19for high-dose F0 females, 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 conditions (at the temperature and humidityrecommended by guideline). Animals were housed individually except duringacclimation, mating, and nursing periods.
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The outcome assessment methodology addressed the intended outcomes (mirroredguideline recommendations for a two-generation reproductive toxicity assay).

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Data Type:	Chronic (>21 days); Terrestrial; Mammalian
Hero ID:	787657

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	The outcomes were measured consistently across study groups.
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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						
	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 Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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:	Other; Aquatic; other tadpole tail tip
Hero ID:	938764

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	Low	× 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 Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	How the tips were allocated to exposure groups was not explained.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	Medium	× 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	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 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	× 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						

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Study Citation:	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:	Other; Aquatic; other tadpole tail tip
Hero ID:	938764

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.4	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1062065

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 Design						
	Metric 4:	Negative Controls	High	× 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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Nominal concentrations reported.
	Metric 10:	Exposure Duration and Frequency	High	× 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 Organism						
	Metric 13:	Test Organism Characteristics	High	× 2	2	

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Study Citation:	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
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1062065

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 14:	Acclimitization and Pretreatment Conditions	Low	× 1	3	No report of acclimatization or pre-treatment conditions
	Metric 15:	Number of Organisms and Replicates per Group	Medium	× 1	2	A minimum of eighteen eleutheroembryos were exposed. Unsure of sample size for HBCD.
	Metric 16:	Adequacy of Test Conditions	Low	× 1	3	no information on experimental housing conditions.
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	Not reported.
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.5	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Other; Aquatic; Invertebrates
Hero ID:	1274149

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	Low	× 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 Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	

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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:	Other; Aquatic; Invertebrates
Hero ID:	1274149

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1401837

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	Medium	× 2	4	Modified feeding diet and only one dose concentration. However, this concentration was established in a previous study.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	
	Metric 10:	Exposure Duration and Frequency	High	× 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 Organism						
	Metric 13:	Test Organism Characteristics	Medium	× 2	4	Study used a different species that is normally recommended for this type of study.
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	

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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:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1401837

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ MWF = Metric Weighting Factor

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

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1403364

Domain		Metric	Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	Low	× 1	3	The HBCD isomer source was not provided.
	Metric 3:	Test Substance Purity	Low	× 1	3	Very little information is provided by the authors on the HBCD used in these experiments; purity not provided.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	Low	× 2	6	Experimental conditions were not explained as fully 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 removed from the tanks after the feedings.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Only nominal concentrations for oral exposure provided.
	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	N/A		N/A	HBCD was mixed in with the pellet food.
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	High	× 2	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	High	× 1	1	

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Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1403364

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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 dosing.
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.4	
Extracted			Yes			

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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1403482

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	N/A		N/A	nominal injection study
	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	N/A		N/A	nominal injection study
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1403482

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡		High		1.0	
Extracted		Yes			

⋆ MWF = Metric Weighting Factor
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‡ The overall rating is calculated as necessary. EPA may not always provide a comment for a metric that has been categorized as High.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Acute (0-96 hour); Terrestrial; Birds
Hero ID:	1408111

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	The purity was not reported.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Nominal concentrations were reported.
	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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Acute (0-96 hour); Terrestrial; Birds
Hero ID:	1408111

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1409610

Domain		Metric	Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	Medium	× 2	4	Authors reported having a reference diet, but specific methods were only referenced from another publication;.
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allocated to study groups.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	N/A		N/A	diet-exposure
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	High	× 2	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	Medium	× 1	2	Fish were acclimatized for 7 days prior to the start of the experiment. No further details reported on acclimatization.

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Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1409610

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	High	× 1	1	
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	Medium	× 1	2	Statistic methods were referred to, but not adequately described.
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	Low	× 2	6	No information provided about the toxicant.
	Metric 2:	Test Substance Source	Low	× 1	3	no source mentioned
	Metric 3:	Test Substance Purity	Low	× 1	3	source not mentioned, no information on chemical purity
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	Medium	× 1	2	Biological responses of the negative control groups (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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Only nominal concentrations were reported, but flow through system may have kept the exposure concentrations consistent throughout the exposure period.
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	High	× 1	1	Two exposure treatments represented either an environmentally-relevant concentration, or a higher concentration (magnitude higher). Solvent controls 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	× 1	1	
Domain 4: Test Organism						

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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[††]
	Metric 13:	Test Organism Characteristics	Medium	× 2	4	No information besides female fish being used for HBCD exposures (e.g., age, size).
	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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	Medium	× 2	4	It wasn't explained why HBCD treatment only used female stickleback livers.
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	Health outcomes unrelated to exposure were not reported.
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination[‡]			High		1.6	
Extracted			Yes			

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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††

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1412802

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allocated to study groups.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Low	× 2	6	Test substance was not measured in the exposure medium.
	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	N/A		N/A	Exposure was through spiked sediment and food.
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	High	× 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	

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Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1412802

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.3	
Extracted			Yes			

⋆ MWF = Metric Weighting Factor

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

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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1443861

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	Reported as an unfortified food group.
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	N/A		N/A	Diet exposure
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	Medium	× 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	
	Metric 15:	Number of Organisms and Replicates per Group	N/A		N/A	Purpose of study wasn't to get a dose response; only 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:	Chronic (>21 days); Aquatic; Fish
Hero ID:	1443861

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	none reported
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

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†† 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:	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:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1927533

Domain	Metric		Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	Embryo treatment allocation was not reported.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Nominal concentrations used, but 2 water changes per day alleviates some concern.
	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	Medium	× 1	2	Some exposure concentrations above water solubility.
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1927533

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	No differences in organism health reported.
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

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†† 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:	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		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	Percent purity not provided.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	Uncertain of whether organisms were randomly allocated to treatment groups.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	N/A		N/A	food exposure; amount of HBCD in control food was ND.
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 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).

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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		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	No health outcomes reported.
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

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†† 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:	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
Data Type:	Acute (0-96 hour); Terrestrial; other Plant: Maize
Hero ID:	1927583

Domain		Metric	Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	Identified HBCD and alpha/beta and gamma disasterioisomers 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 Design						
	Metric 4:	Negative Controls	High	× 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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	Medium	× 2	4	Although test solutions were renewed everyday, its not clear how the exposure solution was mixed into the soil.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Treatment conditions were consistent across plants, roots, seeds and seedlings.
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	The amount of HBCD in soil was not measured; only nominal concentrations were provided.
	Metric 10:	Exposure Duration and Frequency	High	× 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).

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Study Citation: 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
Data Type: Acute (0-96 hour); Terrestrial; other Plant: Maize
Hero ID: 1927583

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	Statistical methods clearly expressed and replicable. Multiple software were used to evaluate one-way 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: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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						

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Study Citation:	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
Data Type:	Acute (0-96 hour); Terrestrial; other Plant: Maize
Hero ID:	1927583

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 21:	Statistical Methods	High	× 1	1	Statistical analysis was clearly indicated and replicable.
	Metric 22:	Reporting of Data	High	× 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 Determination‡			High		1.3	
Extracted			Yes			

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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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 hexabromocyclododecane (HBCD) alters courtship, incubation and parental behaviors in American kestrels (Falco sparverius). Chemosphere 89:1077-1083
Data Type:	Other; Terrestrial; Birds
Hero ID:	1927590

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	Technical grade
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	diet exposure; measured conc in egg to indicate exposure dose
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 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 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 Group	High	× 1	1	

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Data Type:	Other; Terrestrial; Birds
Hero ID:	1927590

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	Du, M.,Zhang, D.,Yan, C.,Zhang, X.. 2012. Developmental toxicity evaluation of three hexabromocyclododecane diastereoisomers on zebrafish embryos. Aquatic Toxicology
Data Type:	Other;
Hero ID:	1927610

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	Medium	× 2	4	Unsure of volatilization, and no water concentrations were measured (all nominal).
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	nominal concentrations only reported
	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	Medium	× 1	2	Many exposure concentrations above water solubility of different hbcd stereoisomers.
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	Du, M.,Zhang, D.,Yan, C.,Zhang, X.. 2012. Developmental toxicity evaluation of three hexabromocyclododecane diastereoisomers on zebrafish embryos. Aquatic Toxicology
Data Type:	Other;
Hero ID:	1927610

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1927624

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	Purity not provided.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	N/A		N/A	Oral administration.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	N/A		N/A	Oral administration.
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 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:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1927624

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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†† 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:	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
Data Type:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1927629

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	N/A		N/A	Dose concentrations.
	Metric 10:	Exposure Duration and Frequency	High	× 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	× 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	

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Data Type:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1927629

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

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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.

Study Citation:	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
Data Type:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1927669

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	Purity was not provided.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	N/A		N/A	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	N/A		N/A	Dosing method.
	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	N/A		N/A	Dosing method.
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	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
Data Type:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	1927669

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

⋆ MWF = Metric Weighting Factor

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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Chronic (>21 days); Aquatic; Invertebrates
Hero ID:	1927697

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	Low	× 1	3	not provided
	Metric 3:	Test Substance Purity	High	× 1	1	technical mixture of HBCDD
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Low	× 2	6	nominal conc; measured gill tissue conc every 10 days
	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	Low	× 1	3	nominal conc; measured gill tissue conc every 10 days
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Data Type:	Chronic (>21 days); Aquatic; Invertebrates
Hero ID:	1927697

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡		High		1.3	
Extracted		Yes			

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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Other; Terrestrial; Birds
Hero ID:	1927714

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	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	× 1	3	Test purity was not provided.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	An appropriate negative control group was used. Kestrels assigned to the control group received safflower oil only.
	Metric 5:	Negative Control Response	High	× 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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 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.

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Data Type:	Other; Terrestrial; Birds
Hero ID:	1927714

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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						
	Metric 13:	Test Organism Characteristics	High	× 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 control 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	× 1	1	Organism housing conditions were adequate.
Domain 5: Outcome Assessment						
	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: Confounding / Variable Control						

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Data Type:	Other; Terrestrial; Birds
Hero ID:	1927714

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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	× 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 Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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	Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	N/A		N/A	
	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	Medium	× 1	2	Although the concentrations are above the water solubility for HBCD, DMSO was used as a solvent.
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	Medium	× 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 Design						
	Metric 4:	Negative Controls	Medium	× 2	4	Used DMSO as a solvent
	Metric 5:	Negative Control Response	Medium	× 1	2	Used DMSO as a solvent
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test 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 HBCDD treatments. Unsure of DMSO concentration or percentage volume in all treatment groups.
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	Allocation not reported
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 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 amount reported for the highest concentration of HBCD; unsure of solvent concentrations in other HBCD concentrations.
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Only nominal concentrations used/reported.
	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	Medium	× 1	2	Some exposure concentrations exceeded water solubility.
Domain 4: Test Organism						

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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††
	Metric 13:	Test Organism Characteristics	High	× 2	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	Low	× 1	3	No mentioning of acclimatization and pre-treatment conditions, and DMSO concentrations may have differed 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	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 Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.5	
Extracted			Yes			

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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††

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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. Aquatic Toxicology 69:229-245
Data Type:	Aquatic; other Fish in vivo, in vitro
Hero ID:	1927821

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	Source
	Metric 3:	Test Substance Purity	Low	× 1	3	Grade/Purity not reported
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	Allocation not reported
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	nominal injection studies
	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	Medium	× 1	2	nominal injection studies
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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. Aquatic Toxicology 69:229-245
Data Type:	Aquatic; other Fish in vivo, in vitro
Hero ID:	1927821

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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; other Plants: Skeletonema costatum and Thalassiosira pseudonana,
Hero ID:	1927837

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test 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 Design						
	Metric 4:	Negative Controls	High	× 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 all 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: Exposure Characterization						
	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:	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; other Plants: Skeletonema costatum and Thalassiosira pseudonana,
Hero ID:	1927837

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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 EC5o 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	× 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 pretreatment conditions for the algal test organisms 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 authors (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 papers written by the study authors (e.g., Walsh et al., 1979).
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The outcome assessment methodology addressed or reported in previous publications by the study authors the intended outcome(s) of interest and was sensitive for the outcomes(s) of interest.

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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; other Plants: Skeletonema costatum and Thalassiosira pseudonana,
Hero ID:	1927837

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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 statistical analysis.
	Metric 22:	Reporting of Data	High	× 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
† 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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††
Domain 1: Test 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 Design						
	Metric 4:	Negative Controls	High	× 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 all 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: Exposure Characterization						
	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: 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††
	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	× 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 number of exposure groups and/or spacing of exposure levels since the toxicity values were expressed as the EC5o 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	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	× 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 pretreatment conditions for the algal test organisms 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 authors (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 papers written by the study authors (e.g., Walsh et al., 1979).
Domain 5: Outcome Assessment						

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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††
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The outcome assessment methodology addressed or reported in previous publications by the study authors 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 were reported and outcomes were assessed consistently across study groups in previous publications by the study authors.
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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 statistical analysis.
	Metric 22:	Reporting of Data	High	× 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 Determination‡			~~Unacceptable~~ ⟶ High		4	
Extracted			Yes			

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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††

** 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Chronic (>21 days); Aquatic; other Fish Other Study- Various Life-Cycle Effects
Hero ID:	1927956

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Chronic (>21 days); Aquatic; other Fish Other Study- Various Life-Cycle Effects
Hero ID:	1927956

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡		High		1.0	
Extracted		Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Other; Aquatic; Sediment-dwelling
Hero ID:	1928024

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	Specific about test substance are provided in a previous source (i.e., hero id 2528343).
	Metric 2:	Test Substance Source	High	× 1	1	Specific about test substance are provided in a previous source (i.e., hero id 2528343).
	Metric 3:	Test Substance Purity	High	× 1	1	Specific about test substance are provided in a previous source (i.e., hero id 2528343).
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	Low	× 1	3	Control animals were exposed to seawater only, water was changed completely every 24 hours. Page 167
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	Medium	× 2	4	Some information provided, but no details available on reducing HBCD loss.
	Metric 8:	Consistency of Exposure Administration	Low	× 1	3	not many details on exposure administration besides the daily static renewals
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	only nominal concentrations provided
	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	Medium	× 1	2	Only nominal concentrations provided but one concentration reported to be above water solubility
Domain 4: Test Organism						

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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:	Other; Aquatic; Sediment-dwelling
Hero ID:	1928024

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.3	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Other; Aquatic; Fish
Hero ID:	1928244

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Other; Aquatic; Fish
Hero ID:	1928244

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928244

Domain	Metric		Rating[†]	MWF[⋆]	Score	Comments[††]
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	Low	× 1	3	
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928244

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			~~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			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Acute (0-96 hour); Aquatic; Invertebrates
Hero ID:	1928267

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Only nominal concentrations are reported but a solvent was used.
	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	Medium	× 1	2	only nominal concentrations were reported but a solvent was used.
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Acute (0-96 hour); Aquatic; Invertebrates
Hero ID:	1928267

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			~~High~~ ⟶ Low		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	Union Carbide,. 1990. The acute toxicity of HBCD lot 990-17 to the bluegill sunfish Lepomis macrochirus Rafinesque with test data and cover letter.
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928275

Domain		Metric	Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 Design						
	Metric 4:	Negative Controls	High	× 2	2	Acetone was the solvent control for this test.
	Metric 5:	Negative Control Response	High	× 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: Exposure Characterization						
	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 analytical 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 1 mg/L, measure concentrations are required in order 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.

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Study Citation:	Union Carbide,. 1990. The acute toxicity of HBCD lot 990-17 to the bluegill sunfish Lepomis macrochirus Rafinesque with test data and cover letter.
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928275

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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 exposed 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 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: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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						

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Study Citation:	Union Carbide,. 1990. The acute toxicity of HBCD lot 990-17 to the bluegill sunfish Lepomis macrochirus Rafinesque with test data and cover letter.
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928275

Domain	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 measured concentrations.
	Metric 22:	Reporting of Data	High	× 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 Determination‡			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.

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation: . 1994. INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO DYNAMAC CORP/USEPA SUBMITTING INFO RE HEXABROMOCYCLODODECANE AND BIS(TRIBROMOPHENOXY) ETHANE W/ATTCHMTS, DATED 2/13/89.
Data Type: Acute (0-96 hour); Aquatic; Fish
Hero ID: 1928289

Domain	Metric		Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 Design						
	Metric 4:	Negative Controls	High	× 2	2	Acetone was the solvent control for this test.
	Metric 5:	Negative Control Response	High	× 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: Exposure Characterization						
	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 analytical 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 1 mg/L, measure concentrations are required in order to establish an appropriate dose response at the solubility limit of HBCD.

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Study Citation: . 1994. INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO DYNAMAC CORP/USEPA SUBMITTING INFO RE HEXABROMOCYCLODODECANE AND BIS(TRIBROMOPHENOXY) ETHANE W/ATTCHMTS, DATED 2/13/89.
Data Type: Acute (0-96 hour); Aquatic; Fish
Hero ID: 1928289

Domain	Metric		Rating†	MWF*	Score	Comments††
	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 Organism						
	Metric 13:	Test Organism Characteristics	High	× 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 exposed 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 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: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	The study reported no differences among the study groups with respect to environmental conditions.

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Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928289

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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						
	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	× 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 Determination‡			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.

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	. 1998. HEXABROMOCYCLODODECANE (HBCD): A FLOW-THROUGH LIFE-CYCLE TOXICITY TEST WITH THE CLADOCERAN (DAPHNIA MAGNA), WITH COVER LETTER DATED 5/18/1998.
Data Type:	Chronic (>21 days); Aquatic; Invertebrates
Hero ID:	1928293

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	. 1998. HEXABROMOCYCLODODECANE (HBCD): A FLOW-THROUGH LIFE-CYCLE TOXICITY TEST WITH THE CLADOCERAN (DAPHNIA MAGNA), WITH COVER LETTER DATED 5/18/1998.
Data Type:	Chronic (>21 days); Aquatic; Invertebrates
Hero ID:	1928293

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
Metric 17:	Outcome Assessment Methodology	High	× 2	2	
Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
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	× 2	2	
Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡		High		1.0	
Extracted		Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928298

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 Design						
	Metric 4:	Negative Controls	High	× 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: Exposure Characterization						
	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.

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Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928298

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 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: Confounding / Variable Control						

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Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928298

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	1928298

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 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: Exposure Characterization						
	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.

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Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	1928298

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 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: Confounding / Variable Control						

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Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	1928298

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928300

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 Design						
	Metric 4:	Negative Controls	High	× 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: Exposure Characterization						
	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.

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Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928300

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 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: Confounding / Variable Control						

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Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	1928300

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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; Aquatic; Fish
Hero ID:	2343684

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Nominal concentrations were reported for exposure treatments, but daily renewals did occur, alleviating some concerns.
	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	Medium	× 1	2	Nominal concentrations reported and most of the exposure concentrations are below water solubility of HBCD.
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 Group	High	× 1	1	

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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; Aquatic; Fish
Hero ID:	2343684

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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	Low	× 1	3	statistical methods were not reported but how comparisons were made for each endpoint are discussed
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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; Aquatic; Plants
Hero ID:	2343690

Domain		Metric	Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	Purity not reported.
Domain 2: Test Design						
	Metric 4:	Negative Controls	Low	× 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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	
	Metric 10:	Exposure Duration and Frequency	High	× 1	1	
	Metric 11:	Number of Exposure Groups/Spacing of Exposure Levels	Medium	× 1	2	Only one exposure concentration (2 ng/mL) used for each stereoisomer, for both algal species.
	Metric 12:	Testing at or Below Solubility Limit	High	× 1	1	
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 Group	High	× 1	1	

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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; Aquatic; Plants
Hero ID:	2343690

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.3	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Chronic (>21 days); Aquatic; other Fish Post-fertilization
Hero ID:	2343709

Domain	Metric		Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	Survival were higher that the experimental groups.
	Metric 6:	Randomized Allocation	High	× 1	1	
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	Low	× 1	3	Used DMSO as a solvent
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	Medium	× 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	× 1	1	

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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:	Chronic (>21 days); Aquatic; other Fish Post-fertilization
Hero ID:	2343709

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; other Bioaccumulation
Hero ID:	2343723

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	Low	× 1	3	not addressed
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	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
Data Type:	Chronic (>21 days); Aquatic; other Bioaccumulation
Hero ID:	2343723

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡		High		1.1	
Extracted		Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Other; Aquatic; Sediment-dwelling
Hero ID:	2528343

Domain	Metric		Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Low	× 1	3	substance purity not reported
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	There was no report on how organisms were allocated to study groups.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	Low	× 2	6	exposure system and water quality details/ conditions were not reported
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	nominal concentrations reported
	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	Medium	× 1	2	Two exposure concentrations above water solubility
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	Low	× 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	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	

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Study Citation:	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
Data Type:	Other; Aquatic; Sediment-dwelling
Hero ID:	2528343

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.5	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	Hexabromocyclododecane (CAS No. 3194-55-6) is listed.
	Metric 2:	Test Substance Source	High	× 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 Design						
	Metric 4:	Negative Controls	High	× 2	2	Controls and solvent controls used are deionized water or acetone.
	Metric 5:	Negative Control Response	High	× 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: Exposure Characterization						
	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 sampling time points.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	Before and during the test period, the same exposure protocol is used.
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 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	× 1	1	Information is provided.

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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††
	Metric 12:	Testing at or Below Solubility Limit	N/A		N/A	soil exposure
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	High	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	all reported
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	Yes
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	Minimized the variability to the level of 10 earthworms used are 0.35-0.45 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 Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	Several statistical analyses were performed.
	Metric 22:	Reporting of Data	High	× 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 Determination‡			High		1.3	

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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			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	Wu, T.,Huang, H.,Zhang, S.. 2016. Accumulation and phytotoxicity of technical hexabromocyclododecane in maize. Journal of Environmental Sciences 42:97-104
Data Type:	Acute (0-96 hour); Terrestrial; other Plant
Hero ID:	3350472

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Low	× 2	6	Nominal daily renewal
	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	Low	× 1	3	not addressed; nominal daily renewal
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	Wu, T.,Huang, H.,Zhang, S.. 2016. Accumulation and phytotoxicity of technical hexabromocyclododecane in maize. Journal of Environmental Sciences 42:97-104
Data Type:	Acute (0-96 hour); Terrestrial; other Plant
Hero ID:	3350472

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Other; Terrestrial; other Plant
Hero ID:	3350492

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	Metric 13:	Test Organism Characteristics	High	× 2	2	
	Metric 14:	Acclimitization and Pretreatment Conditions	Medium	× 1	2	Acclimation not reported
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Other; Terrestrial; other Plant
Hero ID:	3350492

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

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† 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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

Domain	Metric		Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	Medium	× 2	4	No mentioning of whether the testing media renewals accounted for maintaining HBCD exposure concentration consistency.
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	Medium	× 1	2	All HBCD concentrations are above water solubility (except for the control).
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	Medium	× 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	× 1	1	
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	

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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

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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
Data Type:	Chronic (>21 days); Terrestrial; Invertebrate
Hero ID:	3350510

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	Medium	× 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	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	Medium	× 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	× 1	4	biological responses were not reported
	Metric 6:	Randomized Allocation	Low	× 1	3	Allocation method not reported
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 2	2	
	Metric 10:	Exposure Duration and Frequency	High	× 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						
	Metric 13:	Test Organism Characteristics	High	× 2	2	

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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
Data Type:	Chronic (>21 days); Terrestrial; Invertebrate
Hero ID:	3350510

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	× 2	4	No explanation for different number of organisms used.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	no data on health outcomes were reported
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			~~Unacceptable~~ ⟶ Low		4	Although biological responses weren't reported for the earthworms, nor was it reported whether a solvent 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 necessarily, but uptake and depuration.
Extracted			Yes			

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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
Data Type:	Chronic (>21 days); Terrestrial; Invertebrate
Hero ID:	3350510

Domain	Metric	Rating†	MWF⋆	Score	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.

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Other; Aquatic; other Fish Post-Fertilization
Hero ID:	3350537

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Other; Aquatic; other Fish Post-Fertilization
Hero ID:	3350537

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	3350539

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 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. (control)
	Metric 5:	Negative Control Response	High	× 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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 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 Kestrel based on a mean cockerel weight and average consumption rate.

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Study Citation:	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
Data Type:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	3350539

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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						
	Metric 13:	Test Organism Characteristics	Medium	× 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	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The assessment methodology does address the intended outcome of interest (uptake and depuration of HBCD).
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	The outcome assessments were consistent across the control and exposure group.

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Study Citation:	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
Data Type:	Chronic (>21 days); Terrestrial; Birds
Hero ID:	3350539

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	Medium	× 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	× 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 Determination‡		High		1.5	
Extracted		Yes			

⋆ MWF = Metric Weighting Factor

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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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:	Other; Aquatic; Invertebrates
Hero ID:	3546057

Domain	Metric		Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	Low	× 2	6	purity/grade not reported
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	Metric 5:	Negative Control Response	High	× 1	1	
	Metric 6:	Randomized Allocation	Low	× 1	3	allocation not reported
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Other; Aquatic; Invertebrates
Hero ID:	3546057

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡		High		1.2	
Extracted		Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 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 Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	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.
Domain 4: Test Organism						

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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††
	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 Group	Medium	× 1	2	Only two reps per treatment group.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	× 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	× 1	3	No statistical methods were outlined.
	Metric 22:	Reporting of Data	High	× 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 concentrations in a few of the treatment groups were explained.
Overall Quality Determination‡			High		1.3	
Extracted			Yes			

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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††

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	Ltd, W. I.. 1997. Letter from Chem Mfgs Assoc to USEPA Regarding: Toxicological Investigation of Hexabromocyclododecane (HBCD) with Attachments, Dated 06/27/1997.
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	3586422

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Medium	× 1	2	Unsure of what the impurities are in the HBCD exposure.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	Medium	× 1	2	Some concentrations wereabove HBCD's water solubility, but all exposure concentrations were measured.
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 Group	Medium	× 1	2	Only two true replicates per treatment group.

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Study Citation:	Ltd, W. I.. 1997. Letter from Chem Mfgs Assoc to USEPA Regarding: Toxicological Investigation of Hexabromocyclododecane (HBCD) with Attachments, Dated 06/27/1997.
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	3586422

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	× 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 Presentation and Analysis						
	Metric 21:	Statistical Methods	Low	× 1	3	Statistical methods are unclear.
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.2	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	Ltd, W. I.. 1997. Letter from Chem Mfgs Assoc to USEPA Regarding: Toxicological Investigation of Hexabromocyclododecane (HBCD) with Attachments, Dated 06/27/1997.
Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	3586422

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	Medium	× 1	2	Uncertainty with impurities present .
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	Medium	× 1	2	Some exposure concentrations are above water solubility limits.
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 Group	Low	× 1	3	Uncertainty with number of replicates used per exposure concentration.
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	Ltd, W. I.. 1997. Letter from Chem Mfgs Assoc to USEPA Regarding: Toxicological Investigation of Hexabromocyclododecane (HBCD) with Attachments, Dated 06/27/1997.
Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	3586422

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

⋆ MWF = Metric Weighting Factor
† High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.
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$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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
Data Type:	Other; Aquatic; other Fish in vitro
Hero ID:	3586425

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	nominal in vitro cell exposure
	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	Medium	× 1	2	nominal in vitro cell exposure
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	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
Data Type:	Other; Aquatic; other Fish in vitro
Hero ID:	3586425

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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.
Data Type:	Chronic (>21 days); Aquatic; Invertebrates
Hero ID:	3586533

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 Chemical 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 mixture used in exposures.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 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 and solvent control are adequate for a valid test (no significant difference between the negative and solvent control responses, and they were adequate for a valid test).
	Metric 6:	Randomized Allocation	High	× 1	1	Test chambers were randomly positioned, and daphnid neonates were randomly assigned to treatment groups and exposure chambers.
Domain 3: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 2	2	A continuous-flow diluter was used to provide test 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 test substances, the negative and solvent control into the test chambers.

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Study Citation: 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.
Data Type: Chronic (>21 days); Aquatic; Invertebrates
Hero ID: 3586533

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	The methodology used for the study did address the intended outcomes of interest (mortality, growth, and reproduction).

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Study Citation:	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.
Data Type:	Chronic (>21 days); Aquatic; Invertebrates
Hero ID:	3586533

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	The same protocols were used across the study groups.
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 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	× 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 Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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.
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	3586733

Domain	Metric		Rating†	MWF*	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	Unacceptable	× 2	8	Only reported reagent grade HBCD.
	Metric 2:	Test Substance Source		× 1	0	
	Metric 3:	Test Substance Purity	Unacceptable	× 1	4	Not reported.
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	Low	× 2	6	Excessive amount of solvent used.
	Metric 8:	Consistency of Exposure Administration	Unacceptable	× 1	4	Concentrations were over the solubility limit and an excessive amount of solvent was used .
	Metric 9:	Measurement of Test Substance Concentration	Low	× 2	6	Only nominal concentrations were used.
	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	Low	× 1	3	nominal, precipitate present
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	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.
Data Type:	Acute (0-96 hour); Aquatic; Fish
Hero ID:	3586733

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure		× 1	0	
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			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.

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	Lower, N.. 2008. The Effects of Contaminants on Various Life-Cycle Stages of Atlantic Salmon (Salmo salar L.).
Data Type:	Chronic (>21 days); Aquatic; Fish
Hero ID:	3618094

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	
Domain 5: Outcome Assessment						

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Study Citation: Lower, N.. 2008. The Effects of Contaminants on Various Life-Cycle Stages of Atlantic Salmon (Salmo salar L.).
Data Type: Chronic (>21 days); Aquatic; Fish
Hero ID: 3618094

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	Schriks, M.. 2006. Novel In Vitro, Ex Vivo and In Vivo Assays Elucidating the Effects of Endocrine Disrupting Compounds (EDCs) on Thyroid Hormone Action.
Data Type:	Other; Aquatic; other Xenopus in vitro, ex vivo and in vivo assays
Hero ID:	3619397

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	Dose concentrations
	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	N/A		N/A	not addressed; dose concentrations
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 Group	Medium	× 1	2	Number of organisms reported but not replicates
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	Schriks, M.. 2006. Novel In Vitro, Ex Vivo and In Vivo Assays Elucidating the Effects of Endocrine Disrupting Compounds (EDCs) on Thyroid Hormone Action.
Data Type:	Other; Aquatic; other Xenopus in vitro, ex vivo and in vivo assays
Hero ID:	3619397

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

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

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 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: Exposure Characterization						
	Metric 7:	Experimental System/Test Media Preparation	High	× 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.

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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

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	× 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

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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

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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 (Allum 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.

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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

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 15:	Number of Organisms and Replicates per Group	High	× 1	1	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. 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.
	Metric 16:	Adequacy of Test Conditions	High	× 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. Sub-irrgation 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. Thetemperature 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

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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

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	Metric 17:	Outcome Assessment Methodology	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 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.
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	One sample was collected from the control group. Samples were stored at ambient room conditions until analysis was conducted.
	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.
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	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 (p..0.05). Dunnett"s test was used to aid in establishing the NOEC by determining which treatment groups differed significantly from the control group.

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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

Domain	Metric	Rating†	MWF⋆	Score	Comments††
	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 Determination‡		High		1.0	
Extracted		Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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.
Data Type:	Chronic (>21 days); Aquatic; Sediment-dwelling
Hero ID:	3809143

Domain		Metric	Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	Low	× 1	3	not reported
	Metric 3:	Test Substance Purity	Low	× 1	3	not reported
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	N/A		N/A	Sediment exposure
Domain 4: Test Organism						
	Metric 13:	Test Organism Characteristics	High	× 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	

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Study Citation:	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.
Data Type:	Chronic (>21 days); Aquatic; Sediment-dwelling
Hero ID:	3809143

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Low	× 1	3	not reported
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	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 Determination‡			High		1.4	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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.
Data Type:	Other; Terrestrial; Birds
Hero ID:	3809153

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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	N/A		N/A	Oral administration.
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	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.
Data Type:	Other; Terrestrial; Birds
Hero ID:	3809153

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	N/A		N/A	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i \left(\text{Metric Score}_i \times \text{MWF}_i\right) / \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	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.
Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	3809170

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	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.
Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	3809170

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.

Study Citation:	J. Aufderheide, A. Jones, J. A. MacGregor, W. B. Nixon. 2003. Effect of hexabromocyclododecane on the survival and reproduction of the earthworm, Eisenia fetida.
Data Type:	Chronic (>21 days); Terrestrial; Invertebrate
Hero ID:	3809173

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	J. Aufderheide, A. Jones, J. A. MacGregor, W. B. Nixon. 2003. Effect of hexabromocyclododecane on the survival and reproduction of the earthworm, Eisenia fetida.
Data Type:	Chronic (>21 days); Terrestrial; Invertebrate
Hero ID:	3809173

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡		High		1.0	
Extracted		Yes			

⋆ MWF = Metric Weighting Factor
† High = 1; Medium = 2; Low = 3; Unacceptable = 4; N/A has no value.
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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.

Study Citation:	D. Desjardins, J. Macgregor, H. Krueger. 2004. Final report: hexabromocyclododecane (HBCD): a 72-hour toxicity test with the marine diatom (Skeletomema costatum).
Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	3809177

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	D. Desjardins, J. Macgregor, H. Krueger. 2004. Final report: hexabromocyclododecane (HBCD): a 72-hour toxicity test with the marine diatom (Skeletomema costatum).
Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	3809177

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡		High		1.0	
Extracted		Yes			

⋆ MWF = Metric Weighting Factor
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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.

Study Citation:	ACC. 2003. Hexabromocyclododecane (HBCD): A Prolonged Sediment Toxicity Test with Hyalella azteca Using Spiked Sediment with 2 percent Total Organic Carbon.
Data Type:	Chronic (>21 days); Aquatic; Sediment-dwelling
Hero ID:	4269889

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	only the control, lowest and highest exposure concentrations were measured
	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	N/A		N/A	sediment exposure
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	ACC. 2003. Hexabromocyclododecane (HBCD): A Prolonged Sediment Toxicity Test with Hyalella azteca Using Spiked Sediment with 2 percent Total Organic Carbon.
Data Type:	Chronic (>21 days); Aquatic; Sediment-dwelling
Hero ID:	4269889

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	not reported
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

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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.

Study Citation:	ACC. 2003. Hexabromocyclododecane (HBCD): A Prolonged Sediment Toxicity Test with Hyalella azteca Using Spiked Sediment with 5 percent Total Organic Carbon.
Data Type:	Chronic (>21 days); Aquatic; Sediment-dwelling
Hero ID:	4269912

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	Medium	× 2	4	only the control, lowest and highest exposure concentration was measured
	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	N/A		N/A	sediment exposure
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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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Study Citation:	ACC. 2003. Hexabromocyclododecane (HBCD): A Prolonged Sediment Toxicity Test with Hyalella azteca Using Spiked Sediment with 5 percent Total Organic Carbon.
Data Type:	Chronic (>21 days); Aquatic; Sediment-dwelling
Hero ID:	4269912

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	× 1	2	not reported
Domain 7: Data Presentation and Analysis						
	Metric 21:	Statistical Methods	High	× 1	1	
	Metric 22:	Reporting of Data	High	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.1	
Extracted			Yes			

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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.

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; Aquatic; Fish
Hero ID:	4796184

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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; Aquatic; Fish
Hero ID:	4796184

Domain	Metric	Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment					
	Metric 17: Outcome Assessment Methodology	High	× 2	2	
	Metric 18: Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control					
	Metric 19: Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23: Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡		High		1.0	
Extracted		Yes			

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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.
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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:	Chronic (>21 days); Terrestrial; other Vegetation
Hero ID:	4796184

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 2	2	
	Metric 2:	Test Substance Source	High	× 1	1	
	Metric 3:	Test Substance Purity	High	× 1	1	
Domain 2: Test Design						
	Metric 4:	Negative Controls	High	× 2	2	
	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	High	× 2	2	
	Metric 8:	Consistency of Exposure Administration	High	× 1	1	
	Metric 9:	Measurement of Test Substance Concentration	High	× 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						
	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 Group	High	× 1	1	
	Metric 16:	Adequacy of Test Conditions	High	× 1	1	

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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:	Chronic (>21 days); Terrestrial; other Vegetation
Hero ID:	4796184

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 5: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 2	2	
	Metric 18:	Consistency of Outcome Assessment	High	× 1	1	
Domain 6: Confounding / Variable Control						
	Metric 19:	Confounding Variables in Test Design and Procedures	High	× 2	2	
	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	× 2	2	
	Metric 23:	Explanation of Unexpected Outcomes	High	× 1	1	
Overall Quality Determination‡			High		1.0	
Extracted			Yes			

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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.

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:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	6836803

Domain	Metric		Rating†	MWF⋆	Score	Comments††
Domain 1: Test Substance						
	Metric 1:	Test Substance Identity	High	× 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 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: Exposure Characterization						
	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.

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Data Type:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	6836803

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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: Outcome Assessment						
	Metric 17:	Outcome Assessment Methodology	High	× 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: Confounding / Variable Control						

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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:	Acute (0-96 hour); Aquatic; Plants
Hero ID:	6836803

Domain	Metric		Rating†	MWF⋆	Score	Comments††
	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	× 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			

⋆ 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.

$$\text{Overall rating} = \begin{cases} 4 & \text{if any metric is Unacceptable} \\ \left\lfloor \sum_i (\text{Metric Score}_i \times \text{MWF}_i) \,/\, \sum_j \text{MWF}_j \right\rceil_{0.1} & \text{(round to the nearest tenth) otherwise} \end{cases},$$

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.