References

Alaee, M., P. Arias, A. Sjödin and Å. Bergman. 2003. An overview of commercially used brominated flame-retardants, their applications, their use patterns in different countries/regions and possible modes of release. Environment International 29:683-689.

Allchin, C. R., R. J. Law and S. Morris. 1999. Polybrominated diphenyl ethers in sediments and biota downstream of potential sources in the UK. Environmental Pollution 28:2247-2262.

ATSDR (Agency for Toxic Substances & Disease Registry). 2004. Polybrominated Diphenyl Ethers. Accessed 3Mar2009. http://www.atsdr.cdc.gov/tfacts68-pbde.pdf.

Berner, L. H., J. McGowan, J. H. Martin and J. Teal. 1976. Sampling marine organisms. In: Strategies for Marine Pollution Monitoring, E. D. Goldberg, (ed.). John Wiley & Sons, NY. pp. 269-73.

Bogdal, C., P. Schmid, M. Kohler, C.E. Müller, S. Iozza, T. D. Bucheli, M. Scheringer, and K. Hungerbühler. 2008. Sediment record and atmospheric deposition of brominated flame retardants and organochlorine compounds in Lake Thun, Switzerland: lessons from the past and evaluation of the present. Environmental Science and Technology. 42:6817-6822.

Booij, K., B. N. Zegers and J. P. Boon. 2002. Levels of some polybrominated diphenyl ether (PBDE) flame retardants along the Dutch coast as derived from their accumulation in SPMDs and blue mussels (*Mytilus edulis*). Chemosphere 46:683-688.

Bragigand, V., C. Amiard-Triquet, E. Parliet, P. Boury, P. Marchand and M. El Hourch. 2006. Influence of biological and ecological factors on the bioaccumulation of polybrominated diphenyl ethers in aquatic food webs from French estuaries. Science of the Total Environment. 368:615-626.

Braune, B. M., M. L. Mallory, H. G. Gilchrist, R. J. Letcher and K. G. Drouillard. 2007. Levels and trends of organochlorines and brominated flame retardants in Ivory Gull eggs from the Canadian Arctic, 1976 to 2004. Science of the Total Environment 378:403-417.

BSEF (Bromine Science and Environmental Forum). 2006. Fact Sheet: Brominated Flame Retardant Deca-BDE Decabromodiphenyl Ether. Edition 2004. Accessed 11Mar2009. http://www.bsef.com/uploads/Documents/documents/BSEF_Mini_FAQ_final_2006.pdf.

Bustnes, J. O., K. Borgå, K. E. Erikstad, S. H. Lorentsen and D. Herzke. 2008. Perfluorinated, brominated, and chlorinated contaminants in a population of lesser black-backed gulls (*Larus fuscus*). Environmental Toxicology and Chemistry 27:1383-1392.

Butt, C. M., M. L. Diamond, J. Truong, M. G. Ikonomou and F. H. ter Schure. 2004 Spatial distribution of polybrominated diphenyl ethers in Southern Ontario as measured in indoor and outdoor window organic films. Environmental Science and Technology 38:724-731.

Christensen, J. R., M. MacDuffee, R. W. MacDonald, M. Whiticar and P. S. Ross. 2005. Persistent organic pollutants in British Columbia grizzly bears: consequence of divergent diets. Environmental Science and Technology 39:6952-6960.

Christensen, J. H. and J. Platz. 2001. Screening of polybrominated diphenyl ethers in blue mussels, marine and freshwater sediments in Denmark. Journal of Environmental Monitoring. 3:543-547.

CPSC (Consumer Products Safety Commission) 2008. 2003-2005 Residential Fire Loss Estimates. Washington, DC. Acessed 3Mar2009.http://www.cpsc.gov/LIBRARY/fire05.pdf

CPSC (Consumer Products Safety Commission). 2000. 1998 Residential Fire Loss Estimates. Washington, DC. Accessed 11Mar2009. http://www.cpsc.gov/LIBRARY/fire98.pdf.

de Wit, C., M. Alaee and D. Muir. 2004. Brominated flame retardants in the Arctic – an overview of spatial and temporal trends. Organohalogen Compounds 66:3811-3816.

de Wit, C.A. 2002. An overview of brominated flame retardants in the environment. Chemosphere 46:583-624.

de Wit, C. A. 2000. Brominated flame retardants. Report 5065, Swedish Environmental Protection Agency, Stockholm Sweden.

Darnerud, P.O. 2003. Toxic effects of brominated flame retardants in man and wildlife. Environmental International 29:841-853.

Darnerud, P.O., G. Eriksen, T. Johnannesson, P. Larsen and M. Viluksela. 2001. Polybrominated diphenyl ethers: occurrence, dietary exposure and toxicology. Environmental Health Perspectives 109:49-68.

Environment Canada. 2006. Canadian Environmental Proctection Act, 1999 Ecological Screening Assessment Report on Polybrominated Diphenyl Ethers (PBDEs). 34 pp. Accessed 3Mar2009. http://www.ec.gc.ca/CEPARegistry/documents/subs_list/PBDE_SAR/PBDEs_SAR_EC_June_2006_(en).pdf.

EPA (U.S. Environmental Protection Agency). 2008. Emerging contaminants – polybrominated diphenyl ethers (PBDE) and polybrominated biphenyls (PBB). Accessed 3Mar2009. http://www.epa.gov/tio/download/contaminantfocus/epa542f07007.pdf

Farrington, J.W. 1983. Bivalves as sentinels of coastal chemical pollution: the mussel (and oyster) watch. Oceanus 26:18-29.

Farrington, J. W., J. Albaiges, K. A. Burns, B. P. Dunn, P. Eaton, J. L. Laseter, P. L. Parker and S. Wise. 1980. Fossil fuels. In: The International Mussel Watch. National Research Council. National Academy of Sciences - Office of Publications, Washington, D.C. 20418. pp. 7-77.

References

Goldberg, E. D., M. Koide, V. Hodge, A. R. Flegal and J. Martin. 1983. U.S. Mussel Watch: 1977-1978 results on trace metals and radionuclides. Estuarine Coastal Shelf Science 16:69-93.

Haglund, P. S., D. R. Zook, H. Buser and J. Hu. 1997. Identification and quantification of polybrominated diphenyl ethers and methoxy-polybrominated diphenyl ethers in Baltic biota. Environmental Science and Technology 31:3281-3287.

Hale R. C., M. J. La Guardia, E. P. Harvey, T. M. Mainor, W. H. Duff and M. O. Gaylor. 2001. Polybrominated diphenyl ether flame retardants in Virginia freshwater fishes (USA). Environmental Science and Technology 35:4585-4591.

Hardy, M. L. 2002a. A comparison of the properties of the major commercial PBDPO/PBDE product to those of major PBB and PCB products. Chemosphere 46:717-728.

Hardy, M. L. 2002b. The toxicology of the three commercial polybrominated diphenyl oxide (ether) flame retardants. Chemosphere 46:757-777.

Hayward, D., J. Wong and A. J. Krynitsky. 2007. Polybrominated diphenyl ethers and polychlorinated biphenyls in commercially wild caught and farm-raised fish fillets in the United States. Environmental Research 103:46-54.

Herbstman, J. B., A. Sjödin, B. J. Apelberg, F. R. Witter, R. U. Halden, D. G. Patterson Jr., S. R. Panny, L. L. Needham and L. R. Goldman. 2008. Birth delivery mode modifies the associations between prenatal polychlorinated biphenyl (PCB) and polybrominated biphenyl ether (PBDE) and neonatal thyroid hormone levels. Environmental Health Perspectives 116:1376-1382.

Herzke, D., U. Berger, R. Kallenborn, T. Nygård and W. Vetter. 2005. Brominated flame retardants an other organobromines in Norwegian predatory bird eggs. Chemosphere 61:441-449.

Hites, R. A. 2004. Polybrominated diphenyl ethers in the environment and in people: A meta-analysis of concentrations. Environmental Science and Technology 38:945-956.

Hites, R. A., J. A. Foran, S. J. Schwager, B. A. Knuth, M. C. Hamilton and D. O. Carpenter. 2004. Global assessment of polybrominated diphenyl ethers in farmed and wild salmon. Environmental Science and Technology 38:4945-4949.

Hoenicke, R., D. R. Oros, J. J. Oram and K. M. Taberski. 2007. Adapting an ambient monitoring program to the challenge of managing emerging pollutants in the San Francisco Estuary. Environmental Research 105:132-144.

Hoh, E. and R. A. Hites. 2005. Brominated flame retardants in the atmosphere of the east-central United States. Environmental Science and Technology 39:7794-7802.

Hooper, K. and T. A. McDonald. 2000. The PBDEs: An emerging environmental challenge and another reason for breast-milk monitoring programs. Environmental Health Perspectives 108:387-392.

Ikonomou, M. G. and R. F. Addison. 2008. Polybrominated diphenyl ethers (PBDEs) in seal populations from eastern and western Canada: An assessment of the processes and factors controlling PBDE distribution in seals. Marine Environmental Research 66:225-230.

Ikonomou, M. G., S. Rayne and R. F. Addison. 2002. Exponential increases of the brominated flame retardants, polybrominated diphenyl ethers, in the Canadian Arctic from 1981 to 2000. Environmental Science and Technology 36:1886-1892.

Jaspers, V., A. Covaci, J. Maervoet, T. Dauwe, S. Voorspoels, P. Schepens and M. Eens. 2005. Brominated flame retardants and organochlorine pollutants in eggs of little owls (*Athene notua*) from Belgium. Environmental Pollution 136:81-88.

Johnson, A. and N. Olson. 2001. Analysis and occurrence of polybrominated diphenyl ethers in Washington State freshwater fish. Archives of Environmental Contamination and Toxicology 41:339–344.

Johnston-Restrepo, B., K. Kannan, R. Addink and D. H. Adams. 2005a. Polybrominated diphenyl ethers and polychlorinated biphenyls in marine foodweb of coastal Florida. Environmental Science and Technology 39:8243-8250.

Johnston-Restrepo, B., K. Kannan, D. P. Rapaport and B. D. Rodan. 2005b. Polybrominated diphenyl ethers and polychlorinated biphenyls in human adipose tissue from New York. Environmental Science and Technology 39:5177-5182.

Jones-Otazo, H. A., J. P. Clarke, M. L. Diamond, J. A. Archbold, G. Ferguson, T. Harner, G. M. Richardson, J. J. Ryan and C. Wilford. 2005. Is house dust the missing exposure pathway for PBDEs? An analysis of the urban fate and human exposure to PBDEs. Environmental Science and Technology 39:5121-5130.

Julander A., H. Westberg, M. Engwall and B. Van Bavel. 2005. Distribution of brominated flame retardants in different dust fractions in air from an electronic recycling facility. Science of the Total Environment. 350:151-160.

Kannan, K., S. H. Yun and T. J. Evans. 2005. Chlorinated, brominated, and perfluorinated contaminants in livers of polar bears from Alaska. Environmental Science and Technology 39:9057-9063.

Keith, L. H. and W. A. Teillard. 1979. Priority pollutants I: a perspective view. Environmental Science and Technology 13:416-423.

References

Kimbrough, K. L., W. E. Johnson, G. G. Lauenstein, J. D. Christensen, and D. A. Apeti. 2008. Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 74. 105 pp.

Lauenstein, G. G. and A. Y. Cantillo. 1998. Analytical Methods of the National Status and Trends Program Mussel Watch Project - 1993 -1997 Update. NOAA Technical Memorandum NOS ORCA 130. Silver Spring, MD. Accessed 3Mar2009. http://www.ccma.nos.noaa.gov/publications/tm130.pdf.

Lauenstein, G. G., A. Y. Cantillo, S. Kokkinakis, J. Jobling and R. Fay. 1997. National Status and Trends Program for Marine Environmental Quality: Mussel Watch Project Site Descriptions, through 1997. NOAA Technical Memorandum, NOS ORCA 112. NOAA Silver Spring, MD. Accessed 3Mar2009. http://www.ccma.nos.noaa.gov/publications/tm112.pdf.

Lauenstein, G. G. and A. Y. Cantillo. 1993a. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Overview and Summary of Methods, Volume I NOAA Technical Memorandum NOS ORCA 71. Silver Spring, MD. Accessed 3Mar2009. http://www.ccma.nos.noaa.gov/publications/tm71v1.pdf.

Lauenstein, G. G. and A. Y. Cantillo (eds.). 1993b. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Complementary Measurements, Volume II NOAA Technical Memorandum NOS ORCA 71. Silver Spring, MD. Accessed 3Mar2009. http://www.ccma.nos.noaa.gov/publications/tm71v2.pdf.

Lauenstein, G. G. and A. Y. Cantillo (eds.). 1993c. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Elemental Analytical Methods, Volume III NOAA Technical Memorandum NOS ORCA 71. Silver Spring, MD. 3Mar2009. http://www.ccma.nos.noaa.gov/publications/tm71v3.pdf.

Lauenstein, G. G. and A. Y. Cantillo (eds.). 1993d. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992: Comprehensive Descriptions of Trace Organic Analytical Methods, Volume IV NOAA Technical Memorandum NOS ORCA 71. Silver Spring, MD. Accessed 3Mar2009. http://www.ccma.nos.noaa.gov/publications/tm71v4.pdf.

Lindberg, P., U. Sellstrom, L. Haggberg and C. A. de Wit. 2004. Higher brominated diphenyl ethers and hexabromocyclododecane found in eggs of peregrine falcons (*Falco peregrinus*) breeding in Sweden. Environmental Science and Technology 38:93-96.

Liu, Y., G. J. Zhen, H. Yu, M. Martin, B. J. Richardson, M. H. W. Lam and P. K. S. Lam. 2005. Polybrominated diphenyl ethers (PBDEs) in sediments and mussels tissues from Hong Kong marine waters. Marine Pollution Bulletin 50:1173-1184.

Litten, S., D. J. McChesney, M. C. Hamilton and B. Fowler. 2003. Destruction of the World Trade Center and PCBs, PBDEs, PCDD/Fs, PBDD/Fs, and chlorinated biphenylenes in water, sediment, and sewage sludge. Environmental Science and Technology 37:5502-5510.

Luo, Q., Z. W. Cai and M. H. Wong. 2007. Polybrominated diphenyl ethers in fish and sediment from river polluted by electronic waste. Science of the Total Environment 383:115-127.

Martin, M. 1985. State Mussel Watch: Toxics surveillance in California. Marine Pollution Bulletin 16:140-146.

McDonald, S. J., D. S. Frank, J. A. Ramirez, B. Wang and J. M. Brooks. 2006. Ancillary Methods of the National Status and Trends Program: 2000-2006 Update. NOAA Technical Memorandum NOS NCCOS 28. 17pp.

McDonald, T. A. 2002. A perspective on the potential health risks of PBDEs. Chemosphere 46:745-755.

McKinney, M. A., Cesh, L. S., Elliott, J. E., Williams, T. D., Garcelon, D. K. and Letcher, R. J. 2006. Brominated flame retardants and halogenated phenolic compounds in North American west coast bald eaglet (*Haliaeetus leucocephalus*) plasma. Environmental Science and Technology 40:6275-6281.

Norén, K. and D. Meronyté. 2000. Certain organochlorine and organobromine contaminants in Swedish human milk in perspective of past 20-30 years. Chemosphere 40:1111-1123.

O'Connor, T. P. 1992. Mussel Watch: recent trends in coastal environmental quality: results from the first five years of the NOAA Mussel Watch Project. Special publication. NOAA/NOS Office of Ocean Resources Conservation and Assessment, Silver Spring, MD. 46 pp.

Oros, D. R., D. Hoover, F. Rodigari, D. Crane and J. Sericano. 2005. Levels and distribution of polybrominated diphenyl ethers in water, surface sediments, and bivalves from the San Francisco Estuary. Environmental Science and Technology 39:33-41.

Qu, W., X. Bi, G. Sheng, S. Lu, J. Fu, J. Yuan and L. Li. 2007. Exposure to polybrominated diphenyl ethers among workers at an electronic waste dismantling region in Guangdong, China. Environment International 33:1029-1034.

Roesijadi, G., J. S. Young, A. S. Drum and J. M. Gurtisen. 1984. Behavior of trace metals in *Mytilus edulis* during a reciprocal transplant field experiment. Marine Ecology Progress Series 18:155-70.

Ross, P. S. 2006. Fireproof killer whales (*Orcinus orca*): flame-retardant chemicals and the conservation imperative in the charismatic icon of British Columbia, Canada. Canadian Journal of Fisheries and Aquatic Sciences 63:224-234.

References

Schecter, A., O. Päpke, T. Robert Harris, K.C. Tung, A. Musumba, J. Olson and L. Birnbaum. 2006. Polybrominated diphenyl ether (PBDE) Levels in an expanded market basket survey of U.S. food and estimated PBDE dietary intake by age and sex. Environmental Health Perspectives 114:1515-1520.

Schecter, A., O. Päpke, K. Chi, J. Joseph, T. R. Harris and J. Dahlgren. 2005. Polybrominated diphenyl ether flame retardants in the U.S. population: current levels, temporal trends, and comparison with dioxins, dibenzofurans, and polychlorinated biphenyls. Journal of Occupational and Environmental Medicine 47:199-211.

Schecter, A., M. Pävuk, O. Papke, J.J. Ryan, L. Birnbaum and R. Rosen. 2003. Polybrominated diphenyl ethers (PBDEs) in U.S. mothers' milk. Environmental Health Perspectives 111:1723-1729.

Sericano, J. L. 1993. The American oyster (*Crassostrea virginica*) as a bioindicator of trace organic contamination. Doctoral dissertation, Texas A&M University, College Station, TX. 242 pp.

SFEI (San Francisco Estuary Institute), 2008. PBDEs in the Bay: Rapid rise, rapid fall? Regional Monitoring News. 13:1. Accessed 28Feb2009. Http://www.sfei.org/rmp/rmp_news/RMP2008News_Vol13SpringSummer4Web.pdf.

She, J., M. Petreas, J. Winkler, P. Visita, M. McKinney and D. Kopec. 2002. PBDEs in the San Francisco Bay area: measurements in harbor seal blubber and human breast adipose tissue. Chemosphere 46:697-707.

Shen, L., F. Wania, Y.D. Lei, C. Teixera, D.C.G. Muir and H. Xiao, 2006. Polychlorinated biphenyls and polybrominated diphenyl ethers in the North American atmosphere. Environmental Pollution 144:434–444.

Siddiqi, M. A., R. H. Laessig and K. D. Reed. 2003. Polybrominated diphenyl ethers (PBDEs): new pollutants-old diseases. Clinical Medicine and Research 1:281-290.

Sjödin, A., L.-Y. Wong, R. S. Jones, A. Park, Y. Zhang, C. Hodge, E. DiPietro, C. McClure, W. Turner, L. L. Needham and D. G. Patterson, Jr. 2008. Serum concentrations of polybrominated diphenyl ethers (PBDEs) and polybrominated biphenyl (PBB) in the United States population: 2003–2004. Environmental Science and Technology 42:1377–1384.

Song, M., S. Chu, R. J. Letcher, and R. Seth. 2006 Fate, partitioning, and mass loading of polybrominated diphenyl ethers (PBDEs) during the treatment processing of municipal sewage. Environmental Science and Technology. 40:6241-6246.

Stapleton, H. M. and N. G. Dodder. 2008. Photodegradation of decabromodiphenyl ether in house dust by natural sunlight. Environmental Toxicology and Chemistry 27:306-312.

Stapleton, H. M., J. G. Allen, S. M. Kelly, A. Konstantinov, S. Klosterhaus, D. Watkins, M. D. McClean, and T. F Webster. 2008. Alternate and new brominated flame retardants detected in U.S. house dust. Environmental Science and Technology 42:6910-6916.

Stapleton, H. M., N. G. Dodder, J. R. Kucklick, C. M. Reddy, M. M. Schantz, P. R. Becker, F. Gulland, B. J. Porter and S. A. Wise. 2006. Determination of HBCD, PBDEs and MeO-BDEs in California sea lions (*Zalophus californianus*) stranded between 1993 and 2003. Marine Pollution Bulletin 52:522-531.

Stapleton, H. M., N. G. Dodder, J. H. Offenberg, M. M. Schantz and S. A. Wise. 2005. Polybrominated diphenyl ethers in house dust and clothes dryer lint. Environmental Science and Technology 39:925-931.

Strandberg, B., N. G. Dodder, I. Basu, and R. A. Hites. 2001. Concentrations and spatial variations of polybrominated diphenyl ethers and other organohalogen compounds in Great Lakes air. Environmental Science and Technology. 35:1078-1083.

Tripp, B. W. and J. W. Farrington. 1984. Using sentinel organisms to monitor chemical changes in the coastal zone: progress or paralysis. Submitted to the Coastal Society, 9th Annual Conference, October 1984, Atlantic City, NJ. Woods Hole Oceanographic Institution Contribution No. 5830.

Verreault, J., G. W. Gabrielsen, S. Chu, D. C. G. Muir, M. Andersun, A. Hamaed and R. J. Letcher. 2005. Flame retardants and methoxylated and hydroxylated polybrominated diphenyl ethers in two Norwegian Arctic top predators: glaucous gulls and polar bears. Environmental Science and Technology 39:6021-6028.

Voorspoels, S., A. Covaci, P. Lepom, V. L. B. Jaspers and P. Schepens. 2006. Levels and distribution of polybrominated diphenyl ethers in various tissues of birds of prey. Environmental Pollution 1-10.

Wan, Y., J. Hu, K. Zhang and L. An. 2008. Trophodynamics of polybrominated diphenyl ethers in the marine food web of Bohai Bay, North China. Environmental Science and Technology 42:1078-1083.

Weijs, L., A. C Dirtu, K. Das, A. Gheorghe, P.J. H. Reijinders, H. Neels, R. Blust and A. Covaci. 2009. Inter-species differences for polychlorinated diiphenyl ethers in marine top predators from the southern North Sea: Part 2. Biomagnification in harbour seals and harbour porpoises. Environmental Pollution 157:445-451.

Wurl, O. and J. P. Obbard. 2005. Organochlorine pesticides, polychlorinated biphenyls and polybrominated diphenyl ethers in Singapore’s coastal marine sediments. Chemosphere 58:925-933.

Xia, K., M. B. Luo, C. Lusk, K. Armbrust, L. Skinner and R. Sloan. 2008. Polybrominated diphenyl ethers (PBDEs) in biota representing different trophic levels of the Hudson River, New York: from 1999 to 2005. Environmental Science and Technology 42:4331-4337.

References

Zhu, L. Y. and R. A. Hites. 2005 Brominated flame retardants in sediment cores from Lakes Michigan and Erie. Environmental Science and Technology 39:3488-3494.

Appendix 1

Alabama

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
MBWE	30.3867	-87.8320	Mobile Bay	Weeks Bay	AL	O
MBDR	30.5917	-88.0398	Mobile Bay	Dog River	AL	O
MBHI	30.5633	-88.0750	Mobile Bay	Hollingers Is. Chan.	AL	O
MBCP	30.3155	-88.1338	Mobile Bay	Cedar Point Reef	AL	O

Low ●, Medium ●, and High ●

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
MBWE							● (Medium)	0.6
MBDR	● (High)	374	38.5	● (Medium)	149	22.0	● (Low)	0.0
MBHI	● (Medium)	136	24.6				● (Low)	0.0
MBCP	● (Medium)	29	3.6	● (Medium)	27	3.8	● (Low)	0.0

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Alaska

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
KTMP	55.2938	-131.5480	Ketchikan	Mountain Point	AK	M
CINK	59.3580	-151.9300	Kachemak Bay	Nanwalek	AK	M
NBES	59.4533	-135.3365	Nahku Bay	East Side	AK	M
CIHS	59.6145	-151.4442	Cook Inlet	Homer Spit	AK	M
RBNR	60.1021	-149.3642	Resurrection Bay	Nash Road	AK	M
RBMF	60.1130	-149.3740	Resurrection Bay	Mud Flats	AK	M
UISB	60.9608	-147.6460	Unakwit Inlet	Siwash Bay	AK	M
PVMC	61.1328	-146.4610	Port Valdez	Mineral Creek Flats	AK	M
NGEK	58.7961	-158.5325	Nushagek Bay	Nushagek Bay	AK	M

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X		Sediment 200X
	Lipid	Dry		Lipid	Dry	Dry
KTMP			●	32	3.2	
CINK			●	2	0.3	
NBES			●	79	7.9	
CIHS			●	150	9.0	
RBNR			●	35	4.5	
RBMF			●	17	1.6	
UISB			●	34	1.7	
PVMC			●	46	4.1	
NGEK			●	15	1.5	

California

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
IBNJ	32.5877	-117.1335	Imperial Beach	North Jetty	CA	M
PLLH	32.6805	-117.2488	Point Loma	Lighthouse	CA	M
SDCB	32.6865	-117.1592	San Diego Bay	Coronado Bridge	CA	M
SDHI	32.7247	-117.1947	San Diego Bay	Harbor Island	CA	M
MBVB	32.7675	-117.2420	Mission Bay	Ventura Bridge	CA	M
LJLJ	32.8515	-117.2738	La Jolla	Point La Jolla	CA	M
OSBJ	33.2017	-117.3937	Oceanside	Municipal Beach Jetty	CA	M
SCBR	33.4517	-118.4873	South Catalina Island	Bird Rock	CA	M
NBWJ	33.5910	-117.8900	Newport Beach	West Jetty	CA	M
SPFP	33.7067	-118.2742	San Pedro Harbor	Fishing Pier	CA	M
PVRP	33.7170	-118.3227	Palos Verdes	Royal Palms State Pk.	CA	M
LBBW	33.7232	-118.1735	Long Beach	Breakwater	CA	M
ABWJ	33.7335	-118.1010	Anaheim Bay	West Jetty	CA	M
RBMJ	33.8320	-118.3928	Redondo Beach	Municipal Jetty	CA	M

Low 🟢, Medium 🟡, and High 🔴

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996		Tissue 200X		Sediment 200X
	Lipid	Dry	Lipid	Dry	Dry
IBNJ			🔴 846	77.0	
PLLH			🔴 498	29.9	
SDCB			🟡 236	30.2	
SDHI			🔴 296	32.0	🟡 0.4
MBVB			🟡 153	13.8	
LJLJ			🔴 514	36.0	
OSBJ			🟡 268	16.1	🟡 1.4
SCBR	🟡 63	3.1	🟡 21	1.4	
NBWJ	🟡 228	13.2	🟡 126	7.6	🟡 2.6
SPFP			🟡 252	24.1	🟡 2.4
PVRP	🟡 234	17.8	🟡 154	12.0	
LBBW	🔴 883	47.7	🔴 432	37.4	🟡 4.1
ABWJ	🔴 1112	93.4	🔴 8202	840.8	🟡 0.5
RBMJ	🟡 253	17.7	🟡 264	22.2	

Mussels (M), Zebra Mussels (ZM), Oysters (O)

California cont'd

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
MDSJ	33.9618	-118.4580	Marina del Rey	South Jetty	CA	M
PDPD	34.0010	-118.8088	Point Dume	Point Dume	CA	M
TBSM	34.0390	-118.5972	Las Tunas Beach	Santa Monica Bay	CA	M
SCFP	34.0580	-119.9203	Santa Cruz Island	Fraser Point	CA	M
SBSB	34.3957	-119.7275	Point Santa Barbara	Point Santa Barbara	CA	M
PCPC	34.4438	-120.4570	Point Conception	Point Conception	CA	M
SLSL	35.1607	-120.7558	San Luis Obispo Bay	Point San Luis	CA	M
SSSS	35.6347	-121.1947	San Simeon Point	San Simeon Point	CA	M
PGLP	36.6272	-121.9165	Pacific Grove	Lovers Point	CA	M

Low ●, Medium ●, and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X	
		Lipid	Dry		Lipid	Dry		Dry
MDSJ	● (High)	404	37.6	● (High)	855	75.2	● (High)	87.8
PDPD	● (Medium)	236	13.7	● (Medium)	130	9.8	● (Medium)	0.2
TBSM	● (Medium)	117	13.7	● (Medium)	144	11.7	● (Medium)	0.2
SCFP	● (Medium)	22	2.6	● (Medium)	34	2.1		
SBSB	● (Medium)	62	3.2	● (Medium)	96	7.0		
PCPC	● (Low)	0	0.0	● (Medium)	33	2.7		
SLSL	● (Medium)	71	5.8	● (Medium)	77	12.2		
SSSS	● (Low)	0	0.0	● (Medium)	26	1.9		
PGLP				● (Medium)	170	11.9		

California cont'd

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
MBML	36.8012	-121.7897	Monterey Bay	Moss Landing	CA	M
MBES	36.8098	-121.7852	Monterey Bay	Elkhorn Slough	CA	M
MBSC	36.9542	-122.0247	Monterey Bay	Point Santa Cruz	CA	M
SFDB	37.5027	-122.1213	San Francisco Bay	Dumbarton Bridge	CA	M
SFSM	37.5780	-122.2537	San Francisco Bay	San Mateo Bridge	CA	M
SFYB	37.8152	-122.3715	San Francisco Bay	Yerba Buena Island	CA	M
TBSR	38.1495	-122.9040	Tomales Bay	Spenger's Residence	CA	M
BBBE	38.3050	-123.0660	Bodega Bay	Bodega Bay Entrance	CA	M
PALH	38.9530	-123.7430	Point Arena	Lighthouse	CA	M
PDSC	40.0225	-124.0733	Point Delgada	Shelter Cove	CA	M
HMBJ	40.7642	-124.2375	Eureka	Humboldt Bay Jetty	CA	M
EUSB	40.8215	-124.1713	Eureka	Samoa Bridge	CA	M
SGSG	41.7478	-124.2077	Crescent	Point St. George	CA	M

Low 🟢, Medium 🟡, and High 🔴
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
MBML			🟡	139	11.1		
MBES			🟡	83	10.0	🟢	0.0
MBSC			🟡	162	9.7		
SFDB			🔴	900	63.0	🟡	2.9
SFSM			🔴	731	65.8	🟡	1.2
SFYB			🔴	585	58.5	🟡	1.9
TBSR			🟡	220	17.6	🟡	0.3
BBBE			🟡	117	18.7		
PALH			🟡	183	11.0		
PDSC			🟡	190	11.4		
HMBJ			🟡	134	9.4		
EUSB			🔴	383	23.0	🟡	0.2
SGSG			🔴	581	46.5		

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Connecticut

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
LICR	41.2667	-72.3417	Long Island Sound	Connecticut River	CT	M
LINH	41.2542	-72.9393	Long Island Sound	New Haven	CT	M
LIHR	41.1673	-73.1083	Long Island Sound	Housatonic River	CT	M
LISI	41.0527	-73.4173	Long Island Sound	Sheffield Island	CT	M

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X		Sediment 200X
		Lipid	Dry		Lipid	Dry	Dry
LICR	● (High)	590	36.6	● (High)	350	21.1	
LINH	● (High)	333	25.0	● (High)	495	26.6	
LIHR	● (High)	493	42.9	● (Medium)	210	17.2	
LISI	● (Medium)	68	2.5	● (Medium)	74	7.1	

Delaware

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
DBKI	39.2032	-75.3590	Delaware Bay	Kelly Island	DE	O
DBCH	38.7835	-75.1205	Delaware Bay	Cape Henlopen	DE	M

Low ●, Medium ●, and High ●
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X		Sediment 200X
		Lipid	Dry		Lipid	Dry	Dry
DBKI	● (yellow)	12	1.8	● (yellow)	18	1.7	
DBCH	● (green)	0	0.0	● (yellow)	14	1.0	

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Florida

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
SJCB	30.3810	-81.4400	St. Johns River	Chicopit Bay	FL	O
MRCB	29.7640	-81.2618	Matanzas River	Crescent Beach	FL	O
IRSR	27.8295	-80.4743	Indian River	Sebastian River	FL	O
NMML	25.9377	-80.1497	North Miami	Maule Lake	FL	O
BBGC	25.5333	-80.3232	Biscayne Bay	Gould's Canal	FL	O
BHKF	24.6612	-81.2730	Florida Keys	Bahia Honda	FL	O *
FBJB	25.2122	-80.5340	Florida Bay	Joe Bay	FL	O
FBFO	25.1412	-80.9237	Florida Bay	Flamingo	FL	O
EVFU	25.9023	-81.5123	Everglades	Faka Union Bay	FL	O
RBHC	26.0270	-81.7388	Rookery Bay	Henderson Creek	FL	O
NBNB	26.1118	-81.7852	Naples Bay	Naples Bay	FL	O
CBFM	26.5583	-81.9228	Charlotte Harbor	Fort Meyers	FL	O

* BHKF is classified as O; however, it is the smooth-edged jewelbox.

Low ●, Medium ● , and High ●
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996		Tissue 200X			Sediment 200X	
	Lipid	Dry		Lipid	Dry		Dry
SJCB			● Medium	153	6.1	● Low	0.0
MRCB			● High	322	16.1	● Low	0.0
IRSR			● Medium	199	29.9		
NMML			● Medium	138	16.5		
BBGC			● Medium	136	10.9	● Medium	0.6
BHKF			● Medium	9	0.8		
FBJB			● Medium	2	0.3	● Low	0.0
FBFO			● Medium	4	0.6	● Low	0.0
EVFU			● Medium	20	2.3	● Low	0.0
RBHC			● Medium	10	1.2	● Medium	0.2
NBNB			● Medium	46	5.0	● Low	0.0
CBFM			● Medium	166	13.3		

Florida Cont'd

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
CBBI	26.5143	-82.0345	Charlotte Harbor	Bird Island	FL	O
TBHB	27.8548	-82.3947	Tampa Bay	Hillsborough Bay	FL	O
TBKA	27.9097	-82.4538	Tampa Bay	Peter O. Knight Airport	FL	O
TBCB	27.6810	-82.5177	Tampa Bay	Cockroach Bay	FL	O
TBPB	27.8443	-82.6115	Tampa Bay	Papys Bayou	FL	O
TBOT	28.0237	-82.6328	Tampa Bay	Old Tampa Bay	FL	O
TBMK	27.6208	-82.7265	Tampa Bay	Mullet Key Bayou	FL	O
TBNP	27.7872	-82.7540	Tampa Bay	Navarez Park	FL	O
CKBP	29.2067	-83.0695	Cedar Key	Black Point	FL	O
SRWP	29.3292	-83.1742	Suwannee River	West Pass	FL	O
AESP	30.0633	-84.3220	Apalachee Bay	Spring Creek	FL	O

Low 🟢, Medium 🟡, and High 🔴
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X	
		Lipid	Dry		Lipid	Dry		Dry
CBBI				🔴	352	21.1	🟡	6.1
TBHB	🟡	24	3.8	🟡	22	3.2	🟡	0.6
TBKA	🟡	196	46.5	🟡	220	26.4	🟡	0.5
TBCB	🟢	0	0.0	🟡	9	1.0	🟢	0.0
TBPB	🟢	0	0.0	🟡	8	1.1	🟡	0.1
TBOT	🟡	53	6.2	🟡	55	7.9	🟢	0.0
TBMK	🟡	8	1.5	🟡	10	1.2		
TBNP	🟢	0	0.0	🟡	16	1.6	🟡	0.2
CKBP				🔴	436	43.6	🟡	0.3
SRWP				🟡	152	13.7	🟢	0.0
AESP				🔴	361	32.5	🟢	0.0

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Florida Cont'd

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
APCP	29.7242	-84.8842	Apalachicola Bay	Cat Point Bar	FL	O
APDB	29.6725	-85.0657	Apalachicola Bay	Dry Bar	FL	O
SAWB	30.1425	-85.6322	St. Andrew Bay	Watson Bayou	FL	O
CBSR	30.4120	-86.2037	Choctawhatchee Bay	Off Santa Rosa	FL	O
CBPP	30.4823	-86.4793	Choctawhatchee Bay	Postil Point	FL	O
CBJB	30.4108	-86.4908	Choctawhatchee Bay	Joe's Bayou	FL	O
PBIB	30.5167	-87.1117	Pensacola Bay	Indian Bayou	FL	O
PBSP	30.3498	-87.1547	Pensacola Bay	Sabine Point	FL	O
PBPH	30.4137	-87.1913	Pensacola Bay	Public Harbor	FL	O

Low 🟢, Medium 🟡 , and High 🔴
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996		Tissue 200X		Sediment 200X
	Lipid	Dry	Lipid	Dry	Dry
APCP			🟡 25	3.5	🟢 0.0
APDB			🟡 25	3.3	🟡 6.7
SAWB			🟡 59	8.2	
CBSR			🟡 27	3.8	🟢 0.0
CBPP	🟡 27	2.9	🟡 33	4.7	
CBJB	🟡 62	8.1	🟡 125	14.3	🟡 1.5
PBIB			🟡 30	4.6	🟡 0.1
PBSP	🟡 24	1.8	🟡 23	2.0	
PBPH	🟡 48	5.9	🟡 53	6.7	

Georgia

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
SRTI	32.0165	-80.8825	Savannah River Estuary	Tybee Island	GA	O
SSSI	31.3928	-81.2880	Sapelo Sound	Sapelo Island	GA	O
ARWI	31.3242	-81.3108	Altamaha River	Wolfe Island	GA	O

Low ●, Medium ●, and High ●

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996		Tissue 200X			Sediment 200X	
	Lipid	Dry		Lipid	Dry		Dry
SRTI			● (Medium)	30	2.7	● (Medium)	0.1
SSSI			● (Medium)	37	2.6	● (Low)	0.0
ARWI			● (Medium)	64	4.5	● (Low)	0.0

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Hawaii

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
HHKL	21.3167	-157.8858	Honolulu Hrb.	Keehi Lagoon	HI	O
HHKB	21.4118	-157.7788	Hawaii	Kaneohe Bay	HI	O

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X		Sediment 200X
		Lipid	Dry		Lipid	Dry	Dry
HHKL				●	319	35.1	
HHKB	●	139	11.1	●	65	6.0	

Illinois-Indiana

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
LMNC	42.3047	-87.8273	Lake Michigan	North Chicago	IL	ZM
LMHM	41.6987	-87.5083	Lake Michigan	Hammond Marina	IN	ZM
LMCB	41.7272	-87.4950	Lake Michigan	Calumet Breakwater	IN	ZM

Low ●, Medium ●, and High ●
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X		Sediment 200X
	Lipid	Dry		Lipid	Dry	Dry
LMNC			● (Medium)	6	0.5	
LMHM			● (Medium)	189	18.7	
LMCB			● (Medium)	20	1.4	

Louisiana

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
MRPL	29.0895	-89.0748	Mississippi River	Pass A Loutre	LA	O
MRTP	29.1450	-89.4273	Mississippi River	Tiger Pass	LA	O
BSSI	29.4057	-89.4838	Breton Sound	Sable Island	LA	O
BSBG	29.5980	-89.6208	Breton Sound	Bay Gardene	LA	O
LBMP	29.8670	-89.6785	Lake Borgne	Malheureux Point	LA	O
LBGO	29.9448	-89.8353	Lake Borgne	Gulf Outlet	LA	O
BBMB	29.2767	-89.9420	Barataria Bay	Middle Bank	LA	O
BBSD	29.4048	-89.9988	Barataria Bay	Bayou Saint Denis	LA	O
LPNO	30.0363	-90.0413	Lake Pontchartrain	New Orleans	LA	O
BBTB	29.5112	-90.0833	Barataria Bay	Turtle Bay	LA	
TBLF	29.2642	-90.3982	Terrebonne Bay	Lake Felicity	LA	O
TBLB	29.2595	-90.5943	Terrebonne Bay	Lake Barre	LA	O
CLCL	29.2532	-90.9267	Caillou Lake	Caillou Lake	LA	O
ABOB	29.2555	-91.1362	Atchafalaya Bay	Oyster Bayou	LA	O

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
MRPL	●	33	5.3				●	0.8
MRTP	●	80	5.5				●	0.4
BSSI	●	22	3.2	●	55	7.9	●	0.3
BSBG	●	0	0.0	●	12	1.5	●	1.1
LBMP	●	0	0.0	●	17	1.9	●	1.3
LBGO	●	14	1.7	●	11	1.3	●	0.5
BBMB				●	133	12.8	●	0.8
BBSD				●	26	2.7	●	0.7
LPNO	●	250	48.8	●	79	9.9	●	3.9
BBTB							●	0.2
TBLF	●	0	0.0	●	39	3.3	●	0.2
TBLB	●	0	0.0	●	13	1.6	●	0.2
CLCL				●	21	2.2	●	0.1
ABOB				●	27	3.0	●	0.2

Louisiana cont'd

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
VBSP	29.5795	-92.0510	Vermilion Bay	Southwest Pass	LA	O
JHJH	29.6368	-92.7668	Joseph Harbor Bayou	Joseph Harbor Bayou	LA	O
CLLC	30.0587	-93.3075	Calcasieu Lake	Lake Charles	LA	O
CLSJ	29.8290	-93.3840	Calcasieu Lake	St. Johns Island	LA	O
SLBB	29.7908	-93.9063	Sabine Lake	Blue Buck Point	LA	O

Low ●, Medium ●, and High ●

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
VBSP			●	39	5.2	●	0.0
JHJH			●	57	6.0	●	0.0
CLLC			●	67	7.5	●	0.1
CLSJ			●	73	8.0	●	0.0
SLBB			●	26	3.2	●	0.1

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Maine

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
PBSI	44.4567	-68.8832	Penobscot Bay	Sears Island	ME	M
MSSP	43.7578	-69.9977	Merriconeag Sound	Stover Point	ME	M
CAKP	43.3453	-70.4743	Cape Arundel	Kennebunkport	ME	M

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
PBSI			●	143	17.2	●	0.0
MSSP			●	21	2.1		
CAKP			●	54	4.3		

Maryland

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
CBBO	39.1573	-76.4048	Chesapeake Bay	Bodkin Point	MD	O
CBHP	38.9695	-76.4147	Chesapeake Bay	Hackett Point Bar	MD	O
CBCP	38.6073	-76.1200	Chesapeake Bay	Choptank River	MD	O
CBHG	38.3123	-76.3978	Chesapeake Bay	Hog Point	MD	O
PRSP	38.2817	-76.9337	Potomac River	Swan Point	MD	O
CBMB	38.2030	-75.8812	Chesapeake Bay	Monie Bay	MD	O

Low ●, Medium ●, and High ●

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
CBBO			●	185	24.1	●	0.0
CBHP			●	94	10.3	●	0.3
CBCP			●	88	8.8	●	0.0
CBHG			●	43	8.2	●	0.0
PRSP			●	78	8.6	●	0.1
CBMB			●	37	7.1	●	0.0

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Massachusetts

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
CAGH	42.6577	-70.5973	Cape Ann	Gap Head	MA	M
SHFP	42.5135	-70.8442	Salem Harbor	Folger Point	MA	M
MBNB	42.4198	-70.9072	Massachusetts Bay	Nahant Bay	MA	M
BHDI	42.3573	-70.9730	Boston Harbor	Deer Island	MA	M
BHDB	42.3022	-71.0363	Boston Harbor	Dorchester Bay	MA	M
BHHB	42.2760	-70.8833	Boston Harbor	Hingham Bay	MA	M
MBNR	42.1603	-70.7425	Massachusetts Bay	North River	MA	M
DBCI	42.0137	-70.6365	Duxbury Bay	Clarks Island	MA	M
CCNH	41.7958	-69.9462	Cape Cod	Nauset Harbor	MA	M

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
CAGH			● (Medium)	70	4.9		
SHFP			● (Medium)	125	7.5		
MBNB			● (Medium)	160	11.2		
BHDI			● (Medium)	159	14.3		
BHDB			● (Medium)	130	9.1	● (Low)	0.0
BHHB			● (Medium)	64	5.1		
MBNR			● (Medium)	189	15.1	● (Low)	0.0
DBCI			● (Medium)	102	6.1		
CCNH			● (Medium)	32	3.5	● (High)	14.4

Massachusetts cont'd

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
BBCC	41.7402	-70.6157	Buzzards Bay	Cape Cod Canal	MA	M
BBWF	41.6067	-70.6528	Buzzards Bay	West Falmouth	MA	M
BBAR	41.5797	-70.8590	Buzzards Bay	Angelica Rock	MA	M
WBER	41.5507	-70.5479	Waquoit Bay	Estuarine Reserve	MA	M
BBRH	41.5397	-70.9283	Buzzards Bay	Round Hill	MA	M
BBNI	41.5142	-70.7397	Buzzards Bay	Naushon Island	MA	M
BBGN	41.4817	-71.0373	Buzzards Bay	Goosebury Neck	MA	M

Low ●, Medium ●, and High ●

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
BBCC				●	44	5.2	●	0.0
BBWF				●	22	1.8		
BBAR	●	804	107.7	●	109	12.6	●	0.0
WBER				●	720	57.6		
BBRH				●	48	5.7	●	3.5
BBNI	●	36	3.5				●	2.1
BBGN	●	0	0.0	●	11	1.0	●	0.0

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Michigan

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
LMMU	43.2258	-86.3470	Lake Michigan	Muskegon	MI	ZM
LMHB	42.7732	-86.2150	Lake Michigan	Holland Breakwater	MI	ZM
TBLL	45.2057	-85.5368	Traverse Bay	Leelanau State Park	MI	ZM
SBSR	43.6735	-83.8367	Saginaw Bay	Saginaw River	MI	ZM
LHTB	44.9222	-83.4135	Lake Huron	Thunder Bay	MI	ZM
SBSP	43.9098	-83.4002	Saginaw Bay	Sandpoint	MI	ZM
LESP	41.9587	-83.2330	Lake Erie	Stony Point	MI	ZM
LSAB	42.6492	-82.7110	Lake St. Clair	Anchor Bay	MI	
LHBR	43.0443	-82.4387	Lake Huron	Black River Canal	MI	ZM

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
LMMU			● (Medium)	80	12.8		
LMHB			● (Medium)	128	24.5		
TBLL			● (Medium)	54	4.0		
SBSR			● (Medium)	115	9.0		
LHTB			● (Low)	0	0.0		
SBSP			● (Medium)	24	2.1		
LESP			● (High)	310	39.4	● (High)	13.5
LSAB						● (Medium)	3.0
LHBR			● (Medium)	73	6.1		

Mississippi

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
MSPB	30.3360	-88.5892	Mississippi Sound	Pascagoula Bay	MS	O
MSBB	30.3925	-88.8575	Mississippi Sound	Biloxi Bay	MS	O
MSPC	30.3023	-89.3272	Mississippi Sound	Pass Christian	MS	O

Low ●, Medium ●, and High ●
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
MSPB	● (Medium)	71	7.2	● (Medium)	79	8.6	● (Low)	0.0
MSBB				● (High)	438	52.4	● (Medium)	0.5
MSPC	● (Medium)	40	5.1	● (High)	389	42.2	● (Medium)	5.6

Mussels (M), Zebra Mussels (ZM), Oysters (O)

New Hampshire

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
GBDP	43.1207	-70.8265	Great Bay	Dover Point	NH	M

Low ●, Medium ● , and High ●
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X		Sediment 200X
	Lipid	Dry		Lipid	Dry	Dry
GBDP			● (Medium)	167	15.0	

New Jersey

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
NYSH	40.4875	-74.0333	New York Bight	Sandy Hook	NJ	M
NYLB	40.2948	-73.9787	New York Bight	Long Branch	NJ	M
NYSR	40.1870	-74.0090	New York Bight	Shark River	NJ	M
BIBL	39.7617	-74.0950	Barnegat Inlet	Barnegat Light	NJ	M
DBHC	39.4267	-75.4933	Delaware Bay	Hope Creek	NJ	
DBAP	39.3833	-75.4500	Delaware Bay	Arnolds Point Shoal	NJ	O
AIAC	39.3672	-74.4112	Absecon Inlet	Atlantic City	NJ	M
DBBD	39.2523	-75.3028	Delaware Bay	Ben Davis Pt. Shoal	NJ	O
DBFE	39.2117	-75.1917	Delaware Bay	False Egg Island Point	NJ	O
DBCM	38.9822	-74.9613	Delaware Bay	Cape May	NJ	M

Low 🟢, Medium 🟡, and High 🔴
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X	
		Lipid	Dry		Lipid	Dry		Dry
NYSH				🔴	784	49.6		
NYLB				🔴	426	31.1		
NYSR				🔴	439	30.3		
BIBL	🟡	103	8.2	🟡	75	5.5	🟡	0.1
DBHC							🟡	4.9
DBAP	🟡	60	4.2	🟡	102	7.3	🟡	3.3
AIAC				🟡	168	11.9		
DBBD	🟡	77	12.8	🟡	168	16.2	🟡	0.6
DBFE	🟢	0	0.0					
DBCM	🟡	13	1.1	🟡	111	7.0		

Mussels (M), Zebra Mussels (ZM), Oysters (O)

New York

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
HRCI	42.0338	-73.9293	Hudson River	Cruger Island	NY	
LIGB	40.9982	-72.1162	Long Island	Gardiners Bay	NY	M
LIPJ	40.9573	-73.0937	Long Island Sound	Port Jefferson	NY	M
LIMR	40.9418	-73.7032	Long Island Sound	Mamaroneck	NY	M
LIHU	40.9220	-73.4285	Long Island Sound	Huntington Harbor	NY	M
LIHH	40.8558	-73.6753	Long Island Sound	Hempstead Harbor	NY	M
LITN	40.8167	-73.7983	Long Island Sound	Throgs Neck	NY	M
MBTH	40.7767	-72.7558	Moriches Bay	Tuthill Point	NY	M
HRHT	40.7263	-74.0148	Hudson-Raritan	Holland Tunnel	NY	
HRWT	40.7127	-74.0170	Hudson-Raritan	World Trade Center	NY	
HRBP	40.7046	-74.0183	Hudson-Raritan	Battery Park	NY	M
HREI	40.6993	-74.0426	Hudson-Raritan	Ellis Island	NY	
HRGI	40.6933	-74.0190	Hudson-Raritan	Governor's Island	NY	M

Low ●, Medium ● , and High ●
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
HRCI							Medium	6.7
LIGB	Medium	28	1.0	Medium	23	1.5		
LIPJ	Medium	119	10.8	Medium	111	7.4		
LIMR	High	300	19.5	Medium	169	11.0		
LIHU	Medium	106	8.5	Medium	96	6.6		
LIHH	Medium	264	23.2	High	334	26.3		
LITN	High	601	55.3	High	697	60.2		
MBTH				Medium	112	8.6		
HRHT							High	27.9
HRWT							High	41.3
HRBP				High	1946	130.4		
HREI							High	19.0
HRGI				High	2189	194.8		

New York cont'd

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
HRUB	40.6893	-74.0432	Hudson-Raritan	Upper Bay	NY	M
LIFI	40.6252	-73.2795	Long Island	Fire Island Inlet	NY	M
HRFW	40.6150	-74.0614	Hudson-Raritan	Fort Wadsworth	NY	M
HRSR	40.6081	-74.0348	Hudson-Raritan	Shore Road	NY	M
LIJI	40.5955	-73.5867	Long Island	Jones Inlet	NY	M
HRJB	40.5667	-73.8953	Hudson-Raritan	Jamaica Bay	NY	M
HRLB	40.5660	-74.0508	Hudson-Raritan	Lower Bay	NY	M
HRRB	40.5190	-74.1845	Hudson-Raritan	Raritan Bay	NY	M
LEDK	42.5292	-79.2777	Lake Erie	Dunkirk	NY	ZM
NRNF	43.0468	-78.8920	Niagara River	Niagara Falls	NY	
LOOC	43.3553	-78.6867	Lake Ontario	Olcott	NY	ZM
LORC	43.2578	-77.4953	Lake Ontario	Rochester	NY	ZM
LOCV	44.1442	-76.3247	Lake Ontario	Cape Vincent	NY	ZM

Low ●, Medium ●, and High ●

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
HRUB				High	653	96.6	High	31.4
LIFI	Medium	71	4.4	Medium	140	9.0		
HRFW				High	1287	118.4		
HRSR				High	1550	145.7		
LIJI	High	360	18.0	Medium	154	11.9		
HRJB				High	899	62.7		
HRLB				High	1191	70.5	High	21.6
HRRB				High	594	36.9	Medium	3.1
LEDK				Medium	33	3.3	Medium	2.9
NRNF							Medium	4.0
LOOC				Medium	57	7.9	Medium	5.8
LORC				Medium	73	10.1	Medium	5.0
LOCV				Medium	7	0.7	Medium	3.6

Mussels (M), Zebra Mussels (ZM), Oysters (O)

North Carolina

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
RSJC	35.8898	-75.6337	Roanoke Sound	John Creek	NC	O
PSWB	35.4123	-76.0397	Pamlico Sound	Wysocking Bay	NC	O
PSPR	35.2960	-76.4392	Pamlico Sound	Pungo River	NC	O
PSCH	35.2028	-75.7162	Pamlico Sound	Cape Hatteras	NC	O
PSNR	35.0897	-76.5290	Pamlico Sound	Neuse River	NC	O
BIPI	34.7183	-76.6755	Beaufort Inlet	Pivers Island	NC	O
CFBI	33.9158	-78.0035	Cape Fear	Battery Island	NC	O

Low ●, Medium ● , and High ●
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X	
		Lipid	Dry		Lipid	Dry		Dry
RSJC				● (medium)	27	3.5	● (low)	0.0
PSWB				● (medium)	35	5.2	● (low)	0.0
PSPR				● (medium)	7	1.2	● (low)	0.0
PSCH				● (medium)	11	0.8		
PSNR				● (medium)	4	0.6	● (medium)	0.1
BIPI	● (medium)	37	5.6	● (medium)	21	1.7	● (low)	0.0
CFBI	● (low)	0	0.0	● (medium)	29	2.1	● (medium)	5.4

Ohio

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
LERB	41.6745	-83.2262	Lake Erie	Reno Beach	OH	
SBPP	41.6597	-82.8250	Lake Erie	Peach Orchard Pt.	OH	ZM
LELR	41.4612	-82.2070	Lake Erie	Lorain	OH	ZM
LEAB	41.9247	-80.7183	Lake Erie	Ashtabula	OH	ZM

Low ●, Medium ●, and High ●

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996		Tissue 200X			Sediment 200X	
	Lipid	Dry		Lipid	Dry		Dry
LERB						●	5.3
SBPP			●	185	19.4	●	6.3
LELR			●	45	5.5		
LEAB			●	24	1.7	●	3.3

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Oregon

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
CBCH	43.3500	-124.3308	Coos Bay	Coos Head	OR	M
CBRP	43.4313	-124.2212	Coos Bay	Russell Point	OR	M
YBOP	44.5752	-123.9890	Yaquina Bay	Oneatta Point	OR	M
YHFC	44.8370	-124.0520	Yaquina Bay	Fogarty Creek	OR	M
TBHP	45.5472	-123.9075	Tillamook Bay	Hobsonville Point	OR	
CRSJ	46.2287	-124.0232	Columbia River	South Jetty	OR	M

Low ●, Medium ● , and High ●
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
CBCH	● (Medium)	22	1.7	● (Medium)	42	3.1	● (Low)	0.0
CBRP	● (Low)	0	0.0	● (High)	299	18.8	● (Low)	0.0
YBOP				● (Medium)	92	5.5	● (Medium)	0.7
YHFC				● (Medium)	41	3.3		
TBHP							● (Medium)	0.2
CRSJ				● (Medium)	255	20.4		

Puerto Rico

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
PRBB	18.0078	-67.1752	Puerto Rico	Bahia de Boqueron	PR	O
PRBM	17.9710	-66.9895	Puerto Rico	Bahia Montalva	PR	O
PRBJ	17.9392	-66.1813	Puerto Rico	Bahia de Jobos	PR	O

Low ●, Medium ●, and High ●
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
PRBB			● (Medium)	89	4.8	● (Medium)	4.4
PRBM			● (Medium)	25	1.7	● (Low)	0.0
PRBJ			● (Medium)	13	0.5	● (Low)	0.0

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Rhode Island

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
NBPI	41.6523	-71.3567	Narragansett Bay	Patience Island	RI	M
NBDI	41.6048	-71.3052	Narragansett Bay	Dyer Island	RI	M
NBDU	41.5013	-71.3928	Narragansett Bay	Dutch Island	RI	M
BIBI	41.1982	-71.5922	Block Island Sound	Block Island	RI	M

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996			Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry		Dry
NBPI			●	216	17.3	●	0.0
NBDI			●	140	14.0	●	12.2
NBDU			●	51	4.1	●	2.4
BIBI			●	36	2.5		

South Carolina

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
WBLB	33.2433	-79.1972	Winyah Bay	Lower Bay	SC	O
SRNB	33.1683	-79.2417	Santee River	North Bay	SC	O
CHSF	32.7735	-79.9122	Charleston Harbor	Shutes Folly Island	SC	O
CHFJ	32.7505	-79.9003	Charleston Harbor	Fort Johnson	SC	O
ABBI	32.4894	-80.5283	Ace Basin	Bass Island	SC	O

Low ●, Medium ●, and High ●
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
WBLB				●	13	1.0		
SRNB				●	4	0.4		
CHSF	●	0	0.0	●	41	3.0		
CHFJ				●	73	6.0		
ABBI				●	104	8.3	●	0.0

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Texas

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
GBHR	29.4803	-94.7418	Galveston Bay	Hanna Reef	TX	O
GBOB	29.2840	-94.8363	Galveston Bay	Offatts Bayou	TX	O
GBTD	29.5030	-94.8960	Galveston Bay	Todd's Dump	TX	O
GBCR	29.2633	-94.9163	Galveston Bay	Confederate Reef	TX	O
GBSC	29.7045	-94.9930	Galveston Bay	Ship Channel	TX	O
GBYC	29.6220	-94.9958	Galveston Bay	Yacht Club	TX	O
BRFS	28.9212	-95.3395	Brazos River	Freeport Surfside	TX	O
BRCL	28.8580	-95.4647	Brazos River	Cedar Lakes	TX	O
MBEM	28.7112	-95.8833	Matagorda Bay	East Matagorda	TX	O
MBTP	28.6663	-96.2335	Matagorda Bay	Tres Palacios Bay	TX	O
MBCB	28.6650	-96.3830	Matagorda Bay	Carancahua Bay	TX	O
ESBD	28.4118	-96.4490	Espiritu Santo	Bill Days Reef	TX	O
MBGP	28.5788	-96.5630	Matagorda Bay	Gallinipper Point	TX	O
MBLR	28.6603	-96.5845	Matagorda Bay	Lavaca River Mouth	TX	O

Low ●, Medium ● , and High ●
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
GBHR				Medium	66	7.8	Low	0.0
GBOB				Medium	269	30.1	Low	0.0
GBTD				Medium	119	14.6	Low	0.0
GBCR				Medium	166	14.9	Low	0.0
GBSC				Medium	246	31.7	High	14.5
GBYC				Medium	227	25.4	Low	0.0
BRFS				Medium	136	8.3	Medium	0.2
BRCL				Medium	151	14.2	Low	0.0
MBEM				Medium	187	14.8	Low	0.0
MBTP				Medium	202	20.8	Medium	0.2
MBCB				High	355	38.3	Medium	0.1
ESBD	Low	0	0.0	Medium	11	1.4	Medium	1.2
MBGP				Medium	126	14.8	Low	0.0
MBLR				Medium	160	15.0	Low	0.0

Texas

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
ESSP	28.2982	-96.6220	Espiritu Santo	South Pass Reef	TX	O
SAPP	28.2323	-96.7082	San Antonio Bay	Panther Point Reef	TX	O
SAMP	28.3440	-96.7123	San Antonio Bay	Mosquito Point	TX	O
MBAR	28.1730	-96.8350	Mesquite Bay	Ayres Reef	TX	O
ABLR	28.0548	-96.9512	Aransas Bay	Long Reef	TX	O
CBCR	28.1420	-97.1280	Copano Bay	Copano Reef	TX	O
LMSB	26.0432	-97.1760	Lower Laguna Madre	South Bay	TX	O
LMPI	26.0748	-97.1995	Lower Laguna Madre	Port Isabel	TX	O
LMAC	26.2825	-97.2853	Lower Laguna Madre	Arroyo Colorado	TX	O
CCNB	27.8522	-97.3598	Corpus Christi	Nueces Bay	TX	O

Low 🟢, Medium 🟡, and High 🔴
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996		Tissue 200X		Sediment 200X
	Lipid	Dry	Lipid	Dry	Dry
ESSP	🟢 0	0.0	🟡 16	1.1	🟡 0.1
SAPP	🟢 0	0.0	🟡 2	0.3	🟡 0.4
SAMP	🟢 0	0.0	🟡 2	0.5	🟡 0.1
MBAR			🔴 292	22.8	🟡 0.5
ABLR			🔴 728	55.3	🟢 0.0
CBCR			🟡 68	10.1	🟡 0.1
LMSB	🟢 0	0.0	🟡 17	1.1	🟡 0.3
LMPI	🟡 13	1.0	🔴 293	14.4	🟢 0.0
LMAC	🟢 0	0.0	🟡 7	0.7	🟡 0.3
CCNB			🔴 387	23.2	🟡 1.6

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Virginia

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
PRMC	38.2233	-76.9615	Potomac River	Mattox Creek	VA	O
CBCI	37.9385	-75.3758	Chincoteague Bay	Chincoteague Inlet	VA	O
RRRR	37.9020	-76.7878	Rappahannock River	Ross Rock	VA	O
QIUB	37.5250	-75.7138	Quinby Inlet	Upshur Bay	VA	O
CBCC	37.2845	-76.0153	Chesapeake Bay	Cape Charles	VA	O
CBDP	37.0983	-76.2948	Chesapeake Bay	Dandy Point	VA	O
CBJR	37.0653	-76.6322	Chesapeake Bay	James River	VA	O

Low ●, Medium ● , and High ●
Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
PRMC				● (Medium)	78	8.6	● (Medium)	0.1
CBCI	● (Low)	0	0.0	● (Medium)	11	1.2		
RRRR				● (Medium)	82	9.8	● (Low)	0.0
QIUB	● (Low)	0	0.0	● (Low)	0	0.0	● (Low)	0.0
CBCC				● (Medium)	106	14.8		
CBDP				● (Medium)	120	13.2	● (Low)	0.0
CBJR				● (Medium)	170	8.5	● (Medium)	0.4

Washington

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
WBNA	46.4992	-124.0272	Willapa Bay	Nahcotta	WA	M
GHWJ	46.9097	-124.1177	Gray's Harbor	Westport Jetty	WA	M
SSBI	47.0993	-122.8942	South Puget Sound	Budd Inlet	WA	M
CBTP	47.3312	-122.5043	Commencement Bay	Tahlequah Point	WA	M
PSSS	47.5233	-122.3937	Puget Sound	South Seattle	WA	
SIWP	47.5852	-122.5708	Sinclair Inlet	Waterman Point	WA	M
EBDH	47.5958	-122.3867	Elliott Bay	Duwamish Head	WA	M
EBFR	47.6388	-122.4138	Elliott Bay	Four-Mile Rock	WA	M
PSEF	47.8140	-122.3823	Puget Sound	Edmonds Ferry	WA	M
PSHC	47.8318	-122.6883	Puget Sound	Hood Canal	WA	M
WIPP	47.9053	-122.3770	Whidbey Island	Possession Point	WA	M
PSMF	47.9497	-122.3016	Puget Sound	Mukilteo	WA	M
PSEH	47.9727	-122.2303	Puget Sound	Everett Harbor	WA	M
PSPT	48.1047	-122.7780	Puget Sound	Port Townsend	WA	M

Low ●, Medium ●, and High ●
Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
WBNA				Medium	65	4.9	Medium	0.6
GHWJ	Medium	102	8.5	Medium	86	7.2		
SSBI	Medium	223	19.6	Medium	226	25.6	Medium	1.6
CBTP	High	342	33.2	High	427	38.3	Medium	1.5
PSSS							Medium	0.4
SIWP	High	456	37.4	High	287	29.1	Medium	1.1
EBDH	High	453	36.7	High	389	28.0	Low	0.0
EBFR	High	895	56.4	High	405	29.8	Medium	0.2
PSEF				High	567	50.4		
PSHC	Medium	28	2.4	Medium	26	1.7	Low	0.0
WIPP				Medium	85	7.3	Medium	0.2
PSMF				High	345	19.0		
PSEH				High	296	20.7	Medium	2.0
PSPT				Medium	53	8.2	Medium	0.4

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Washington cont'd

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
PSPA	48.1397	-123.4202	Puget Sound	Port Angeles	WA	M
PSCC	48.1752	-122.4784	Puget Sound	Cavalero County Park	WA	M
JFNB	48.3743	-124.6160	Strait of Juan de Fuca	Neah Bay	WA	
JFCF	48.3825	-124.7280	Strait of Juan de Fuca	Cape Flattery	WA	M
BBSM	48.7522	-122.4978	Bellingham Bay	Squalicum Marina Jet.	WA	M
PRPR	48.9903	-123.0883	Point Roberts	Point Roberts	WA	M

Low ●, Medium ● , and High ●

Concentrations Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site		Tissue 1996			Tissue 200X			Sediment 200X
		Lipid	Dry		Lipid	Dry		Dry
PSPA	Medium	87	7.4	Medium	70	6.5	Low	0.0
PSCC				Medium	100	6.3		
JFNB							Medium	0.2
JFCF	Low	0	0.0	Medium	7	0.6		
BBSM				High	316	24.7	Medium	0.8
PRPR				Medium	54	2.8	Low	0.0

Wisconsin

Mussels (M), Zebra Mussels (ZM), Oysters (O)

Site	Latitude	Longitude	General Location	Specific Location	State	Bivalve
LMMB	43.0322	-87.8952	Lake Michigan	Milwaukee Bay	WI	ZM
GBBS	44.6370	-87.8082	Green Bay	Bayshore Park	WI	ZM

Low ● (green), Medium ● (yellow), and High ● (red)

Concentrations: Lipid = ppb lipid weight, Dry = ppb dry weight, 200X = 2004 through 2007

Site	Tissue 1996		Tissue 200X			Sediment 200X
	Lipid	Dry		Lipid	Dry	Dry
LMMB			● (red)	374	68.0	
GBBS			● (yellow)	36	2.8	

Appendix 2

QUANTITATIVE DETERMINATION OF POLYBROMINATED DIPHENYL ETHERS USING SELECTED ION MONITORING GAS CHROMATOGRAPHY/MASS SPECTROMETRY 1999 – 2006

Thomas J. McDonald, Yiwei Miao, Susanne J. McDonald and James M. Brooks
TDI-Brooks International/B&B Laboratories Inc.
College Station, Texas 77845

ABSTRACT

Selected polybrominated diphenyl ethers (PBDEs) are detected using a gas chromatograph/mass spectrometer in selected ion monitoring mode. This method is capable of detecting ppb concentrations of PBDEs in complex matrices such as tissues and sediments.

1.0 INTRODUCTION

A gas chromatograph/mass spectrometer (GC/MS) in selected ion mode (SIM), coupled to a capillary column, is used to resolve and detect polybrominated diphenyl ethers in tissues and sediments at ppb. Samples are injected into a temperature-programmed GC/MS, operated in splitless mode. The capillary column is a DB-XLB (30 m x 0.25 mm ID and 0.1 µm film thickness). The mass spectrometer is capable of scanning from 35 to 500 AMU every second or less and uses 70 electron volts energy in electron impact ionization mode. The data acquisition system continuously acquires and stores all data for quantitation.

2.0 APPARATUS AND MATERIALS

2.1 EQUIPMENT

- Gas chromatograph, split/splitless injection port and electronic pressure control, Agilent Technologies 5890-II
- Mass spectrometer, capable of scanning from 35 to 500 AMU, utilizing 70 electron volts of energy in impact ionization mode, Agilent Technologies 5972-MSD
- Data acquisition system, Agilent Technologies ChemStation, capable of continuous acquisition and storage of all data during analysis
- Autosampler, capable of making 1 to 5 µL injections
- Capillary column, Agilent Technologies DB-XLB (30 m x 0.25 mm ID and 0.10 µm film thickness)
- Micropipetters, calibrated, 1% accuracy, disposable tips

2.2 REAGENTS

- Dichloromethane (CAS 75-09-02), pesticide grade or equivalent purity
- Helium (CAS 7440-59-7), 99.8% purity

2.3 STANDARDS

2.3.1 SURROGATE SPIKING SOLUTION

Surrogate spiking solution is prepared from aliquots of pure compounds (Wellington Laboratories) that are diluted with dichloromethane to a final concentration of 1.0 µg/mL. The surrogate spiking solution includes 2,4,4'-TriBDE (13C12) and 2,2'3,4,4',6-HexaBDE (13C12). The surrogate spiking solution (100 µL) is added to all samples and quality control samples prior to extraction. Surrogate compounds are resolved from, but elute in close proximity to, the analytes of interest. Individual surrogate recoveries are used to correct specific analyte concentrations based on retention time.

2.3.2 INTERNAL STANDARD SOLUTION

The internal standard solution is made from a solution purchased from a commercial vendor (Wellington Laboratories, Guelph, Ontario, Canada) and diluted with dichloromethane to a final concentration of 1.0 µg/mL. The internal standard solution includes 2,2'4,4'-TetraBDE (13C12). The internal standard compound is resolved from, but elutes in close proximity to, the analytes of interest. The internal standard solution (100 µL) is added to all samples and quality control samples just prior to instrument analysis. Internal standards are used to calculate relative response factors and specific analyte concentrations based on retention time.

2.3.3 MATRIX SPIKING SOLUTION

A certified solution containing tri to deca PBDE compounds is purchased from a commercial vendor (Cambridge Isotope Laboratories, Inc. Andover, MA) and diluted with dichloromethane to prepare the matrix spiking solution (Table 1). The matrix spiking solution is diluted to approximately 10 times the method detection limit (MDL) and is added to all matrix spike samples.

2.3.4 CALIBRATION SOLUTION

Calibration solutions are prepared at 5 concentrations ranging from approximately 0.05 to 1 µg/mL (Table 2) by diluting a commercially available certified solution (Cambridge Isotope Laboratories, Inc.) containing the analytes of interest.

Appendix 2

Table 1. Polybrominated Diphenyl Ethers Contained in the Matrix-Spiking Solution.

Analyte	CAS	Spiking Solution Concentration (µg/mL)
2,2'4-TriBDE (BDE-17)	NA	1.00
2,4,4'-TriBDE (BDE-28)	41318-75-6	1.00
2,2',4,4'-TetraBDE (BDE-47)	5436-43-1	1.00
2,3'4,4'-TetraBDE (BDE-66)	NA	1.00
2,3',4',6-TetraBDE (BDE-71)	NA	1.00
2,2'3,4,4'-PentaBDE (BDE 85)	182346-21-0	1.00
2,2'4,4',5-PentaBDE (BDE-99)	60348-60-9	1.00
2,2'4,4',6-PentaBDE (BDE-100)	189084-64-8	1.00
2,2'3,4,4'5'-HexaBDE (BDE-138)	NA	1.00
2,2'4,4'5,5'-HexaBDE (BDE-153)	68631-49-2	1.00
2,2'4,4'5,6'-HexaBDE (BDE-154)	NA	1.00
2,2'3,4,4'5',6-HeptaBDE (BDE-183)	NA	1.00
2,3,3'4,4'5,6-HeptaBDE (BDE-190)	68928-80-3	1.00

Table 2. Polybrominated Diphenyl Ethers Contained in Calibration Solutions and their Approximate Concentrations.

Compounds Contained in Calibration Solutions	CAS	Level 1 (µg/mL)	Level 2 (µg/mL)	Level 3 (µg/mL)	Level 4 (µg/mL)	Level 5 (µg/mL)
Internal Standards						
2,2'4,4'-TetraBDE (13C12)	NA	0.1	0.1	0.1	0.1	0.1
Surrogates						
2,4,4'-TriBDE (13C12)	NA	0.05	0.10	0.25	0.50	1.0
2,2'3,4,4',6-HexaBDE (13C12)	NA	0.05	0.10	0.25	0.50	1.0
Analytes						
2,2'4-TriBDE (BDE-17)	NA	0.05	0.10	0.25	0.50	1.0
2,4,4'-TriBDE (BDE-28)	41318-75-6	0.05	0.10	0.25	0.50	1.0
2,2',4,4'-TetraBDE (BDE-47)	5436-43-1	0.05	0.10	0.25	0.50	1.0
2,3'4,4'-TetraBDE (BDE-66)	NA	0.05	0.10	0.25	0.50	1.0
2,3',4',6-TetraBDE (BDE-71)	NA	0.05	0.10	0.25	0.50	1.0
2,2'3,4,4'-PentaBDE (BDE 85)	182346-21-0	0.05	0.10	0.25	0.50	1.0
2,2'4,4',5-PentaBDE (BDE-99)	60348-60-9	0.05	0.10	0.25	0.50	1.0
2,2'4,4',6-PentaBDE (BDE-100)	189084-64-8	0.05	0.10	0.25	0.50	1.0
2,2'3,4,4'5'-HexaBDE (BDE-138)	NA	0.05	0.10	0.25	0.50	1.0
2,2'4,4'5,5'-HexaBDE (BDE-153)	68631-49-2	0.05	0.10	0.25	0.50	1.0
2,2'4,4'5,6'-HexaBDE (BDE-154)	NA	0.05	0.10	0.25	0.50	1.0
2,2'3,4,4'5'6-HeptaBDE (BDE-183)	207122-16-5	0.05	0.10	0.25	0.50	1.0
2,3,3'4,4'5,6-HeptaBDE (BDE-190)	68928-80-3	0.05	0.10	0.25	0.50	1.0

Appendix 2

3.0 QUANTITATIVE DETERMINATION OF PBDES BY GC/MS-SIM

3.1 MASS SPECTROMETER TUNING

Prior to calibration, the MS is autotuned to perfluorotributylamine (PFTBA) using criteria established by the instrument manufacturer.

3.2 INITIAL CALIBRATION

A 5-point relative response factor (RRF) calibration curve is established for analytes of interest prior to the analysis of samples and quality control (QC) samples. A RRF is determined, for each analyte, for each calibration level using the following equation:

$$RRF = \frac{(A_A)(C_{IS})}{(A_{IS})(C_A)}$$

Where:

A_A = the area of the characteristic ion for the analyte to be measured
A_{IS} = the area of the characteristic ion for the specific internal standard
C_A = the known concentration of the analyte in the calibration solution (μg/mL)
C_{IS} = the known concentration of the internal standard in the calibration solution (μg/mg)

The response factors determined for each calibration level are averaged to produce a mean relative response factor ($\overline{RRF}_i$) for each analyte. The percent relative standard deviation (%RSD) for the 5 response factors must be less than or equal to 15%, for each analyte.

$$\%RSD = \frac{\text{Standard Deviation of the RRFs}}{\text{Average of the RRFs}} \times 100$$

Where:

$$\text{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^{n} (\mathbf{X}_i - \overline{\mathbf{X}})^2}{(n-1)}}$$

x_i = each RRF value used to calculate the mean RRF

$\overline{X}$ = the mean of n values

n = total number of values (5)

3.3 CONTINUING CALIBRATION

A mid-level calibration standard is analyzed at the beginning and end of each analytical set or every 10 samples (whichever is more frequent). The daily relative response factor for each compound is compared to the mean relative response factor from the initial calibration curve and the average relative percent difference (RPD) of all analytes must be less than 25%. If the calibration check does not meet this criterion then the initial five-point calibration is repeated.

$$RPD = \frac{RRF_c - \overline{RRF_i}}{\overline{RRF_i}} \times 100$$

Where:

$\overline{RRF_i}$ = mean relative response factor from the most recent initial calibration (meeting technical acceptance criteria)

$\overline{RRF_c}$ = relative response factor from the continuing calibration standard

3.4 GC/MS-SIM ANALYSIS

The initial calibration of the GC/MS must meet the previously described criteria prior to sample analysis. Samples are analyzed in analytical sets that consist of standards, samples and QC samples. Quality control samples are method blanks, laboratory duplicates, blank spikes, and matrix spikes. An autosampler is used to inject 1 or 2 µL of all samples, standards and QC samples into the capillary column of the GC using the following instrument conditions. Slight modifications may be necessary depending upon the analysis.
Inlet: Splitless
Carrier gas: Helium, 1 mL/min

Temperatures
Injection port: 300°C/ splitless
Transfer line: 290°C

Oven program

Initial oven temp:	60°C
Initial hold time:	0 minutes
Ramp rate:	7°C/min
Final oven temp:	315°C
Final hold time:	22 minutes
Total run time:	56 minutes

The effluent from the GC capillary column is routed directly into the ion source of the MS. The MS is operated in the selected ion monitoring mode (SIM) and includes the quantitation masses for the PBDEs listed in Table 3.

3.5 ANALYTE IDENTIFICATION

The extracted ion current profiles of the primary m/z and the confirmatory ion for each analyte must meet the following criteria:

- The characteristic masses of each analyte of interest must be in the same scan or within one scan of each other. The retention time must fall within +/- 5 seconds of the retention time of the authentic compound determined by the analysis of the daily calibration check or PBDE Reference solution.
- The relative peak heights of the primary mass ion, compared to the confirmation or secondary mass ion, must fall within +/-30 percent of the relative intensities of these masses in a reference mass spectrum (Table 3). The reference mass spectrum is obtained from the continuing calibration solution. In some instances, a compound that does not meet secondary ion confirmation criteria may still be determined to be present in a sample after close inspection of the data by a qualified mass spectrometrist. Supportive data includes the presence of the confirmation ion, but at a ratio different then that indicated in Table 3.
- Data not meeting the criteria established in this section are appropriately qualified or re-analyzed.

Table 3. Target Analyte Parameters.

Analyte	CAS	Reference to	Ion
Internal Standard and Surrogate			
2,2'4,4'-TetraBDE (13C12) (I-1)	NA	I-1	338.0
2,4,4'-TriBDE (13C12) (S-1)	NA	S-1	418.0

Analyte	CAS	Reference to	**Ion**
BDE 2 (3-MonoBDE)	6876-00-2	I-1, S-1	248.0
BDE 3 (4-MonoBDE)	101-55-3	I-1, S-1	248.0
BDE 4 (2,2'-DiBDE)	NA	I-1, S-1	248.0
BDE 7 (2,4-DiBDE)	NA	I-1, S-1	327.9
BDE 8 (2,4'-DiBDE)	147217-71-8	I-1, S-1	327.9
BDE 10 (2,6-DiBDE)	NA	I-1, S-1	327.9
BDE 11 (3,3'-DiBDE)	6903-63-5	I-1, S-1	327.9
BDE 12 (3,4-DiBDE)	NA	I-1, S-1	327.9
BDE 13 (3,4'-DiBDE)	83694-71-7	I-1, S-1	327.9
BDE 15 (4,4'-DiBDE)	2050-47-7	I-1, S-1	327.9
BDE 17 (2,2',4-TriBDE)	NA	I-1, S-1	405.8
BDE 25 (2,3',4-TriBDE)	NA	I-1, S-1	405.8
BDE 28 (2,4,4'-TriBDE)	41318-75-6	I-1, S-1	405.8
BDE 30 (2,4,6-TriBDE)	NA	I-1, S-1	405.8
BDE 32 (2,4',6-TriBDE)	NA	I-1, S-1	405.8
BDE 33 (2',3,4-TriBDE)	NA	I-1, S-1	405.8
BDE 35 (3,3',4-TriBDE)	NA	I-1, S-1	405.8
BDE 37 (3,4,4'-TriBDE)	NA	I-1, S-1	405.8

Appendix 2

Table 3 cont'd.

Analyte	CAS	Reference to	Ion
BDE 47 (2,2',4,4'-TetraBDE)	5436-43-1	I-1, S-1	485.7
BDE 49/71 (2,2',4,5'-TetraBDE/2,3',4',6-TetraBDE)	NA/NA	I-1, S-1	485.7
BDE 66 (2,3',4,4'-TetraBDE)	NA	I-1, S-1	485.7
BDE 75 (2,4,4',6-TetraBDE)	NA	I-1, S-1	485.7
BDE 77 (3,3',4,4'-TetraBDE)	93703-48-1	I-1, S-1	485.7
BDE 85 (2,2',3,4,4'-PentaBDE)	182346-21-0	I-1, S-1	563.6
BDE 99 (2,2',4,4',5-PentaBDE)	60348-60-9	I-1, S-1	563.6
BDE 100 (2,2',4,4',6-PentaBDE)	189084-64-8	I-1, S-1	563.6
BDE 116 (2,3,4,5,6-PentaBDE)	NA	I-1, S-1	563.6
BDE 118 (2,3',4,4',5-PentaBDE)	NA	I-1, S-1	563.6
BDE 119 (2,3',4,4',6-PentaBDE)	NA	I-1, S-1	563.6
2,2'3,4,4',6-HexaBDE (13C12) (S-2)	NA	S-2	496.0
BDE 126 (3,3',4,4',5-PentaBDE)	NA	I-1, S-2	563.6
BDE 138 (2,2',3,4,4',5'-HexaBDE)	NA	I-1, S-2	643.5
BDE 153 (2,2',4,4',5,5'-HexaBDE)	68631-49-2	I-1, S-2	643.5
BDE 154 (2,2',4,4',5,6'-HexaBDE)	NA	I-1, S-2	643.5
BDE 155 (2,2',4,4',6,6'-HexaBDE)	NA	I-1, S-2	643.5
BDE 166 (2,3,4,4',5,6-HexaBDE)	NA	I-1, S-2	643.5
BDE 181 (2,2',3,4,4',5,6-HeptaBDE)	NA	I-1, S-2	563.6
BDE 183 (2,2',3,4,4',5',6-HeptaBDE)	207122-16-5	I-1, S-2	563.6
BDE 190 (2,3,3',4,4',5,6-HeptaBDE)	68928-80-3	I-1, S-2	563.6

(I-#) = Internal reference number
(S-#) = Surrogate reference number

4.0 QUANTITATION CALCULATIONS

Sample analyte concentrations are calculated based on the concentration and response of the internal standard compounds (Table 2). The equations in Section 3.2 are used to calculate the RRF of each analyte relative to the concentration and area of the internal standard in the initial calibration. Response factors for target analytes not contained in the initial calibration solution are presumed equal to the response factor of a respective similar PBDE compound.

The mass (MA) of each target analyte (ng) is calculated using the following equation:

$$MA = \frac{(A_A \, M_{IS})}{(A_{IS} \, \overline{RRF}_i)}$$

Where:
A_A = the area of the characteristic ion for the analyte measured
A_{IS} = the area of the characteristic ion for the specific internal standard
M_{IS} = mass of internal standard added to the extract (ng)

$\overline{RRF}_i$ = average relative response factor for the analyte from the current calibration

The concentration of each target analyte in a sample (ng/g) is calculated using the following equation:

$$C = \frac{(M_A \, DF)}{(W)}$$

Where:

DF = the dilution factor applied to the extract

$$DF = \frac{\text{Volume of Extract } (\mu L)}{\text{Volume of Extract used to make dilution } (\mu L)}$$

W = the sample weight (g)

Analyte concentrations are reported as corrected for individual surrogate recoveries. The corrections for each compound are based on the surrogates referenced in Table 3. Percent surrogate recoveries (SURecovery) for each surrogate are calculated using the following equation:

$$SU_{Recovery} = \frac{C_{ESU}}{C_{SU}} \times 100$$

Where:
CESU = calculated surrogate concentration in the extract
CSU = known concentration of surrogate added to extract

Analyte concentration corrections (corrected for surrogate recovery) are calculated using the following equation:

$$C_{Corrected} = \frac{C}{SU_{Recovery}} \times 100$$

5.0 QUALITY CONTROL (QC)

Samples are analyzed in analytical batches consisting of 19 samples or fewer and QC samples. The QC samples are a method blank, laboratory duplicate, matrix spike, and matrix spike duplicate. A method blank is a reagent blank prepared in the laboratory. A duplicate is a sample for which a second aliquot is analyzed. Matrix spikes are samples that are spiked with known concentrations of known analytes.

The validity of the data is monitored using defined QC criteria. The following QC criteria are used to evaluate analytical batches:

1) Calibration
- The calibration criteria (Section 3.2) must be met prior to data analyses. If the calibration criteria are not met, then the run is aborted and the instrument re-calibrated before further sample analysis.

2) Method Blank
- No more than two target analytes exceed 3 times the concentration of the MDL. Exceptions are that if an analyte detected in the method blank exceeds 3 times the concentration of the MDL, but is not present in the associated samples or if a sample analyte concentration is greater than 10 times that analyte concentration in the method blank, the result is qualified and reported.
- If a method blank exceeds these criteria then the source of contamination is determined and corrective action is taken before further sample analysis.

3) Matrix Spikes
- Analytes spiked into a matrix are considered valid only if they are spiked at concentrations equivalent to levels found in the sample.
- The average recovery for all valid spiked analytes in a matrix spike is between 60% and 120%. No more than two individual spiked analyte (valid) recoveries may exceed 40%-120%.
- If the QC criteria are not met then the matrix spike sample failing the criteria will be re-

analyzed and if the re-analyzed spike meets the criteria then the data are reported. If an analyte exceeds the criteria and is not present in the associated samples analyzed with the analytical batch, the result is qualified and reported.

- If upon re-analysis, QC criteria are still not met, the entire batch of samples is reanalyzed. If sufficient sample is unavailable to re-extract the matrix-spike, another sample may be selected or a blank-spike may be substituted.
- The average RPD for a valid matrix spike/matrix spike duplicate or blank spike/blank spike duplicate pair is 30%. No more than two individual analyte RPDs may exceed 35%.

4) Duplicate

- The average RPD between the duplicate and original sample, for analytes greater than 10 times the concentration of the MDL, is 30%. The RPD for no more than two individual analytes may exceed 35%.
- If the QC criteria are not met then the sample pair failing the criteria will be re-analyzed and if the re-analyzed samples meet the criteria then the data are reported.
- If an analyte exceeds the criteria and is not present in the associated samples analyzed with the analytical batch, the result is qualified and reported.
- If upon re-analysis, QC criteria are still not met, the entire batch of samples is reanalyzed. If sufficient sample is unavailable to re-extract the duplicate pair, another sample may be selected.

5) Surrogates

- The average recovery of surrogate compounds is between 50% and 150%.
- Exceptions are analytical interferences with the surrogates and diluted samples.
- If the average recovery of surrogates exceeds the criteria, and calculation and analytical errors are eliminated, the sample is re-analyzed. If sufficient sample is unavailable for re-extraction, the data are qualified and reported.

6) Method Detection Limit

- The method detection limit (MDL) is determined following the procedures outlined in Federal Register (1984), Vol. 49, No. 209: 98-199.