

Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota

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ater and sediment quality guidelines have proven to be valuable management tools for chemical and physical parameters of concern in aquatic systems. The protection of wildlife in aquatic ecosystems (e.g., mammals and birds), however, is not formally addressed in the protocols for the development of water and sediment quality guidelines for the protection of aquatic life (CCME 1991, 1995). Moreover, owing to their chemical and physical properties, highly persistent, bioaccumulative compounds such as polychlorinated biphenyls (PCBs), DDT, and toxaphene are often not detectable in water because they readily partition into other environmental media (including sediment and biota). Thus, water quality guidelines for these substances may not be applicable. Furthermore, though sediment is a significant route of contaminant exposure for benthic species, it may not be important for many aquatic-based species that have minimal contact with sediment, particularly terrestrial mammals and birds preying on aquatic life. The primary route of exposure for these wildlife species is through consumption of contaminated aquatic biota such as fish, invertebrates, and aquatic plants.

In order to address those substances for which aquatic food sources are the main route of exposure, guidelines for contaminant concentrations in aquatic prey items are developed to protect, restore, and sustain the wildlife that consume them. These guidelines are termed tissue residue guidelines (TRGs) because they refer to the maximum concentration of a chemical substance in the tissue of aquatic biota that is not expected to result in adverse effects in wildlife. TRGs can apply to any aquatic species consumed by wildlife, including fish, shellfish, other invertebrates, or aquatic plants. To protect all wildlife, the guidelines should be applied to the aquatic species at the highest end of the trophic level, though species-specific or site-specific objectives are possible.

TRGs, together with other environmental quality guidelines, provide benchmarks, or reference points, to help interpret biological monitoring data, (e.g., in remediation of contaminated sites) and serve as the scientific basis for determining interim management objectives and performance indicators to measure progress in virtual elimination strategies. TRGs and their corresponding species-specific values (or reference concentrations) can be routinely applied as screening tools to assess the potential risk of exposure through consumption of contaminated prey items.

The Protocol for the Derivation of Canadian Tissue Residue Guidelines for the Protection of Wildlife that Consume Aquatic Biota (CCME 1998) provides a consistent, scientifically defensible approach. It stipulates the chemical-specific information to be examined for a given substance, including physical properties, fate and persistence, and environmental levels. Toxicity studies that examine ecologically important adverse effects (e.g., reduced reproductive capabilities) from consumption of a contaminated diet are compiled and evaluated following recognized criteria. Moreover, minimum data requirements have been set; where data are lacking, interim guidelines may be derived. At this time, data for mammalian and avian species are required, while data for amphibians and reptiles may be considered when information is available. First, a lowest effect threshold is calculated for each mammalian and avian species. This is then used in conjunction with body size and food intake data for typical Canadian wildlife species to derive a contaminant level in prey items considered to be protective of predators; i.e., reference concentration values (the lowest RC is recommended as the TRG).

For the purposes of deriving national TRG values, the mammalian and avian RCs must be as inclusive as possible to accommodate all species and regions in Canada. Therefore, the derivation is based on the highest mammalian and avian FI:bw (food intake: body weight) ratios known for Canadian wildlife, namely, 0.24 for female mink and 0.94 for Wilson's storm petrel (see the protocol at the end of Chapter 8). It is recognized that use of the highest FI:bw ratios may not always be appropriate, e.g., in areas where Wilson's storm petrel is not found. In such cases, RCs for resident wildlife may be applied. To this end, a list of suggested RCs for a suite of mammalian and avian receptors is available in the full report, or upon request to the Guidelines and Standards Division of Environment Canada.

Guidelines are considered protective of only those classes of species for which acceptable data were available. It is important to recognize that Canadian TRGs are intended to be used in concert with other supporting documentation such as site-specific background concentrations, concentrations of other substances, either naturally occurring or anthropogenic, and environmental quality guidelines for other media (e.g., water, sediment, and soil).

The approach to developing environmental quality guidelines for wildlife based on tissue concentrations

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(residues) of contaminants in their diet items, though loosely based on the method developed by the New York State Department of Environmental Conservation (Newell et al. 1987), is unique to Canada. In contrast to the Canadian approach, other jurisdictions often calculate a threshold contaminant body burden in wildlife, then backcalculate to an equivalent concentration in fish or water using a complex combination of food and chemical assimilation efficiencies and bioconcentration/ bioaccumulation factors. For example, under the Great Lakes Initiative, the USEPA derives ambient water quality criteria (guidelines) for the protection of wildlife using dietary threshold levels (USEPA 1995). There may be instances when such an ambient water-based value, rather than the TRG, is preferred for the chemicals presented in this chapter. In these cases, an ambient water value may be estimated by dividing the substance's Canadian TRG value by its bioaccumulation factor (BAF) or bioconcentration factor (BCF). The difficulty is that BAFs and BCFs vary, even for the same compound, among different species. Moreover, for complex mixtures such as PCBs, individual BAFs and BCFs exist for each congener. The USEPA has developed a methodology for deriving an average BAF for each trophic level which may be helpful for this application (USEPA 1995). A similar approach may be used to obtain a sediment-based value.

The TRG protocol has been published as a working document to test its approach and methodology. The CCME recognizes that some refinements or changes may be necessary. Readers who wish to comment on or provide constructive suggestions to the protocol are encouraged to do so. All comments will be carefully considered, and amendments to the protocol made if warranted.

In summary, this chapter on tissue residue guidelines summarizes guidelines for the protection of wildlife consumers of aquatic biota for some of the most bioaccumulative, persistent, and toxic chemicals found in aquatic systems. Tissue residue guidelines play an integral role in environmental quality management and should be considered in conjunction with other supporting data including environmental quality guidelines for other media.

References

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