

SECTION 4 EXPOSURE EVALUATION FOR BIOACCUMULATION

Target aquatic receptor groups for the SRA are represented by epibenthic fish (tilapia and bandtail goatfish), epibenthic crabs, and composite benthic macroinfauna (predominant components include snapping and ghost shrimp with additional contributions from polychaete worms). EPVs for these representative aquatic receptor groups are considered in the context of COPC concentrations in samples of wild-caught, whole-body tissues collected in undepurated form from Pearl Harbor as part of the SRA. Target bird receptor groups for the SRA include waterbirds (represented by the Hawaiian stilt, Hawaiian coot, Hawaiian duck, Hawaiian moorhen, and black-crowned night heron), shorebirds (represented by the wandering tattler), and piscivorous seabirds (represented by the sooty tern). All waterbirds and shorebirds have their primary focus for foraging activities in shallow water areas of the harbor (i.e., water depths of 2 meters or less), whereas seabirds, represented by the tern, are surface feeders that forage throughout the harbor.

4.1 EXPOSURES FOR AQUATIC RECEPTORS

EPVs for COPCs in aquatic receptors for the SRA are determined as whole-body tissue residues measured in samples of wild-caught organisms from the harbor. Measured tissue values represent the EPVs for each receptor. Concentrations reported as detected values by the chemistry laboratory are used as the reported concentrations. Concentrations reported as nondetected values by the laboratory are used as half the reported nondetect concentrations (Section 2.1.2).

For assessing screening level risk for aquatic receptors, maximum concentrations for COPCs in the tissue samples for a particular receptor type are compared to the appropriate lowest NOAEL or NOAEL-equivalent TRV. For example, maximum concentrations in samples of composite benthic macroinfauna and epibenthic crabs are compared to TRVs for crustacea in Table 3.3.1-1; maximum concentrations in samples of tilapia and bandtail goatfish are compared to TRVs for fish in Table 3.3.1-2.

4.2 EXPOSURES FOR BIRD RECEPTORS

EPVs for COPCs in birds for the SRA are estimated as ingestion doses from harbor-derived forage or prey items represented by the wild-caught samples of composite benthic macroinfauna, epibenthic crabs, tilapia, or bandtail goatfish or incidental ingestion of sediment by waterbirds (Hawaiian stilt, Hawaiian coot, Hawaiian duck, Hawaiian moorhen, and black-crowned night heron) and the shorebird (wandering tattler) from sediment samples in shallow water areas (i.e., water depths of 2 meters or less). Ingestion items considered for exposures for each bird receptor for the SRA have been summarized in Table 2.3-1.

For the SRA, EPVs as ingestion doses for birds are considered for 100% consumption of a particular ingestion item (i.e., sediment or composite benthic macroinfauna or epibenthic crabs or tilapia or bandtail goatfish). Consumption estimates of 100% sediment for waterbirds and shorebirds are high based on studies reporting portions of incidental ingested sediment of 30% or less for a variety of birds (Beyer et al. 1994; USEPA 1993b). For the conservative nature of the SRA, however, estimates of 100% ingestion of sediment for waterbirds and shorebirds provide upper bounding estimates for COPC exposures related to incidental ingestion of sediment. Additionally, sediment ingestion by waterbirds and shorebirds is only considered for shallow locations in the harbor (i.e., water depths of 2 meters or less) because these birds only forage in shallow water areas.

EPVs for consumption of a particular item are developed from allometric equations in USEPA's Wildlife Exposure Factors Handbook (USEPA 1993a; p. 3-4 and 3-5). EPVs for waterbirds (Hawaiian stilt, Hawaiian coot, Hawaiian duck, Hawaiian moorhen, and black-crowned night heron) and the shorebird (wandering tattler) are developed with the algorithm for "all birds" where the food ingestion rate (FI) is in units of kg of food per day and the bird body weight (W) is in units of kg (USEPA 1993a; p. 3-4).

$$EPV_{\text{bird}} = (EC_{\text{tiss/sed}} \times FI_{\text{tiss/sed}}) / W_{\text{bird}} = \\ (EC_{\text{tiss/sed}} \times [0.0582 \times W_{\text{bird}}^{0.651}]) / W_{\text{bird}}$$

EPVs for the seabird (sooty tern) are adapted from the algorithm for “seabirds” (USEPA 1993a; p. 3-5) where the identified FI rate and the bird body weight (W) are in units of g/day and g, respectively.

$$EPV_{\text{seabird}} = (EC_{\text{tiss/sed}} \times FI_{\text{tiss/sed}}) / W_{\text{seabird}} = \\ (EC_{\text{tiss/sed}} \times [0.495 \times (1000 \times W_{\text{seabird}})^{0.704}]) / (1000 \times W_{\text{seabird}})$$

Body weights (W_{seabird}) in the latter algorithm are multiplied by a factor of 1000 to convert body weight in kg to the desired unit of g. Terms in the above algorithms are the following.

EPV_{bird} = exposure point value for a COPC for a bird from ingestion of either a tissue forage item or incidental sediment (units of mg of COPC per kg of bird weight per day).

$EC_{\text{tiss/sed}}$ = concentration of the COPC in the ingested item of either tissue or sediment (units of mg of COPC per kg of tissue or sediment).

$FI_{\text{tiss/sed}}$ = food ingestion rate for a forage item (tiss) or sediment (sed) for a particular bird (kg of tissue or sediment per day).

W_{bird} = body weight of the bird (kg).

For the SRA, body weights for each bird receptor are summarized in Table 2.3-1 and are the minimum or smallest weights for adults of a species from Dunning (1993). Minimum or smallest body weights yield maximum EPVs in the above equation, which is appropriate for the conservative intent for the SRA. Also, maximum concentrations for COPCs in all samples of a particular ingestion item type (i.e., composite benthic macroinfauna, epibenthic crabs, tilapia, or bandtail goatfish for tissue forage items; sediments from water depths of 2 meters or less) are used for $EC_{\text{tiss/sed}}$ to estimate the maximum values for EPV_{bird} for a particular COPC and bird receptor.

Concentrations reported as detected values by the chemistry laboratory for a particular matrix type (i.e., composite benthic macroinfauna, epibenthic crabs, tilapia, bandtail

goatfish, or sediment) are used as the reported concentrations. Concentrations reported as nondetected values by the laboratory are used as half the reported nondetect concentrations (Section 2.1.2).

For assessing screening level risk for bird receptors, maximum concentrations for COPCs in wild-caught tissue samples for a particular forage item (composite benthic macroinfauna, epibenthic crabs, tilapia, or bandtail goatfish) or sediments from shallow depths (2 meters or less) are used to generate maximum EPVs. These maximum EPVs are compared to the appropriate lowest NOAEL or NOAEL-equivalent TRVs for birds in Table 3.3.2-1.