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Using fallout radio-nuclide ^{137}Cs to assess the magnitude and spatial extent of soil erosion and sediment production areas in the Boyer River watershed (Québec, Canada).

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The Boyer River (Québec, Canada) drains a 217 km^2 watershed which once hosted the most important spawning area for the Rainbow Smelt (*Osmerus mordax*) population of the St.Lawrence River estuary. The fish population gradually declined and became almost completely extinguished in the 1980's. Siltation and excessive algal growth in the spawning area were identified as the major causes of the fish population decline, suggesting that soil erosion, and resulting sediment and nutrient loadings, were the major processes involved in this environmental problem. In order to provide information on the spatial origin of these pollutants, measurements of the redistribution in the landscape of ^{137}Cs, a fallout radio-nuclide, were performed. Given the size of the studied area and the spatial variability of soil type, slope and land use encountered, a GIS was used to divide the watershed area into six classes, based on soil texture and slope angle. Twenty-four individual fields, randomly selected from these six classes, were sampled for ^{137}Cs determination on a flexible grid pattern, to integrate the local variability and to provide reliable estimates of erosion, deposition and sediment production rates. Fourteen uneroded forested sites, distributed across the watershed, were also sampled to establish the residual level of ^{137}Cs fallout against which the inventories in cultivated fields were compared to derive soil movement rates. Since the contribution of bank erosion as a potential source of sediments in the spawning area could not be ignored, bank soils were also sampled in twelve different locations in the watershed. Finally, sediment samples were collected in the spawning area and counted

for ^{137}Cs. The reference fallout inventories ranged from 2300 to 3275 Bq m^{-2} (values adjusted at January 1st 2002), showing a strong gradient in the watershed, as a result of spatial variability of annual precipitation. The ^{137}Cs activities varied between 0 and 20 Bq kg^{-1} for bank soils, from 4,8 to 11 Bq kg^{-1} for the surface layer of field soils, and between 0,8 and 1,5 Bq kg^{-1} for bottom sediments. For individual fields, the net soil losses, as estimated from ^{137}Cs data, ranged between 0,2 and 13 t ha^{-1} yr^{-1} and were influenced by soil texture, slope angle and land use. Through the GIS, the results were generalized to the whole watershed. Sub-watersheds with intensive land use clearly exhibited higher erosion and sediment production rates, and vice-versa. The comparison of the ^{137}Cs content of the sediments from the spawning area to that of bank and field soils suggests that 75% of these sediments originate from cultivated fields and 25% from eroding banks. The investigation of the spatial redistribution of fallout ^{137}Cs in the landscape made possible the identification of the sectors of the Boyer River watershed where soil erosion and sediment production are important and the quantification of the processes. These areas are likely to produce the highest specific loadings of pollutants to the river and thus contribute the most to the degradation of the fish habitat. The identified areas should then be considered as prioritised sites for implementing conservation measures. This way, a significant decrease of soil loss and sediment production within the Boyer River watershed can be achieved, resulting in a maximum environmental recovery at a minimal cost.