

Livestock Wastes as a Source of Estrogens and their Effects on Wildlife of Manko Tidal Flat, Okinawa

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Manko tidal flat is located in the southern part of Okinawa Island. It is an important visiting and wintering area for migratory birds and is added to the Ramsar Convention Register of Wetlands in 1999. This area used to be an inlet extending to the inner part of Naha Port, although some recent reclamation works enclosed its exit to the East China Sea.

As a typical rural region on a subtropics island, the inhabitants in the basin of Manko conduct many stock raisings (especially pig raisings) without sufficient treatment systems of wastes. As sewage treatment plants are considered to be one of the important sources of environmental estrogens in urban area, the significance of stock raising as a source of estrogens in rural area is expected to be verified.

In the present study, total estrogenic activities in water and sediment samples from Manko tidal flat and its basin were measured using the recombinant yeast screen method. Estrogenic activities (equivalent to 17 β -estradiol, E2) were detected in almost water samples at concentration around 10 ng \cdot l⁻¹ and in some of the sediment samples at concentration of more than 10 μ g \cdot kg⁻¹. In addition, the concentrations of estrone (E1) and E2 in water samples were measured with ELISA. In most samples, the majority of the estrogenic activity was found to be derived from E1 and E2, indicating the high contribution of livestock wastes to environmental estrogens.

The total amount of E2 excreted by the 5,000 sows in the basin through their urine is estimated as 160 mg \cdot day⁻¹. The total river flow of 15,000 m³ \cdot day⁻¹ may dilute it to 11 ng \cdot L⁻¹. The detected E2 concentrations in water were in the same level as this estimated value. Thus, it is suggested that the E2 excreted by the sows is carried through the river and delivered into Manko without significant loss.

In order to verify the effects of environmental estrogens on the wildlife of Manko, occurrence of vitellogenin (VTG), a female-specific protein, in the serum of male tilapias captured in this basin was measured with ELISA. VTG could be detected in nine out of 36 males in the summer and none of 24 males in the winter. This result suggests that there are some reversible effects of estrogens on the hormonal metabolism of male tilapias.

We also investigated the sex proportion of apseudes which were sampled from the sediment at various sites in Manko, and found high proportion of female at the sites with high estrogenic activity in the sediment. It is possible that the environmental estrogens from livestock influence the sexual differentiation of invertebrates as well as the hormonal balance of bird preying on them.