

Impaired Health in Flounder, *Paralichthys* spp. Inhabiting Coastal Chile

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Received: 3 June 1999/Accepted: 16 November 1999

Prolonged exposure of fish to a variety of pollutants can induce stress (Adams 1990). These include municipal effluent, PCBs, pesticides, polycyclic aromatic hydrocarbons (PAHs), heavy metals in mine tailings, effluent from pulp and paper mills, etc. Manifestations of stress, which might culminate in a change of homeostasis, include reduced feed intake and impairment of growth and reproductive potential accompanied by immunosuppression. All of these factors could influence survival. Biomonitoring methods have been devised to assess the impact of pollution on fish health by comparing potentially contaminated and reference samples of the same species. These include body and organ indices, histopathological and hematological methods and the prevalence, abundance and diversity of parasites (Adams 1990; Khan and Thulin 1991; Overstreet 1993).

Several contaminants of industrial and municipal origin are discharged without treatment along the coastline of central Chile (Ahumada 1992, Carrasco and Gallardo 1994; Ahumada et al. 1983). A study conducted with sediment originating from Concepción Bay revealed lesions in two species of flatfish, *Paralichthys* species (Leonardi and Tarifeño 1996). This embayment is a repository for effluent originating from two municipalities, a fish meal plant plus petroleum hydrocarbons of unknown origin (Ahumada 1992). Decomposition of organic matter contributes to an anoxia of the bottom waters. A second embayment, San Vicente, receives from a steel mill effluent which includes several heavy metals and also petroleum hydrocarbons from an oil refinery (Ahumada 1992, 1994; Larrain et al. 1998). Further southwards, untreated pulp and paper mill effluent is discharged into the Gulf of Arauco. All three areas provide habitats for several commercial fish species. Rudolph and Rudolph (1999) reported recently elevated levels of a detoxicating enzyme, benzo(a) pyrene hydroxylase, in the liver of a flounder, *Paralichthys microps* (Gunther 1881) taken from Concepción Bay and attributed these to PAHs. In view of this and other reports of pollutants occurring along the coastline of Chile, the present study was initiated to ascertain if some of the above-mentioned biomarkers could detect and prioritise differences in pollution effects in two sympatric species of flounder, *P. microps* and *P. adspersus* (Steindachner 1867) originating from Concepción and San Vicente Bays and the Gulf of Aranco. Reference samples were obtained from an area external to Concepción Bay. The results of this study are reported herein.

MATERIALS AND METHODS

Study area: This area is located off the coast of central Chile in the south Pacific Ocean (Fig. 1). Concepción Bay is shallow (~45m in depth) with three ports receiving discharges from two municipalities and several industries. Penco, a site

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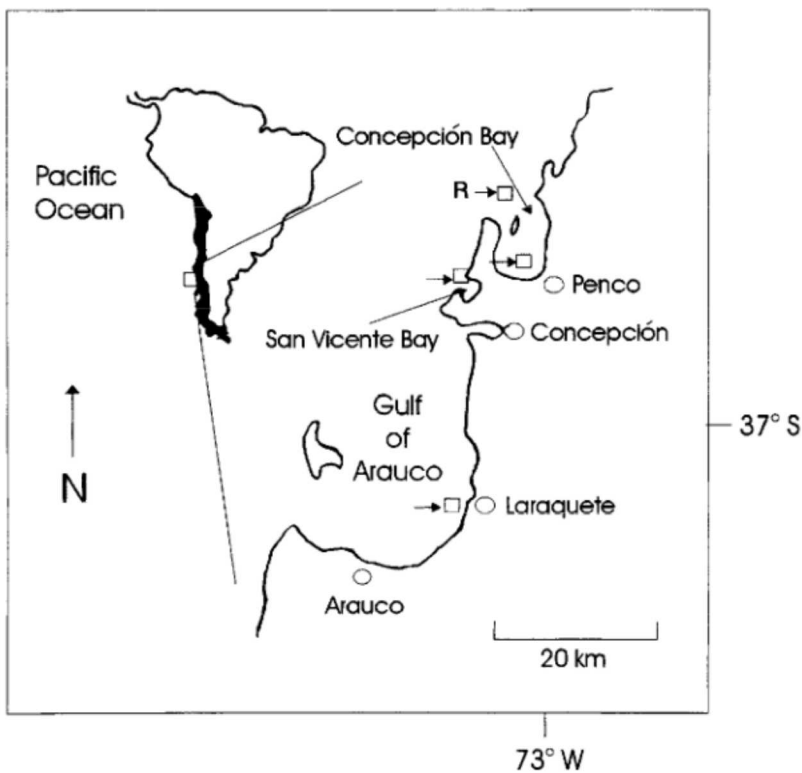


Figure 1. Locations (arrows) where flounder were sampled off the coast of Chile. R is the reference site.

where fish samples were obtained, is contaminated with organic matter originating from a fish meal plant, sewage and unknown sources of petroleum hydrocarbons. Oxygen deficiency occurs in the water column during summer and water temperatures vary from 8- 17°C throughout the year (Ahumada 1992; Carrasco and Gallardo 1994). San Vicente Bay, with a similar depth and water temperature but considerably smaller, receives discharges predominantly from a steel mill, small quantities of domestic effluent and petroleum hydrocarbons via a river. A gyre of water from the continental shelf flushes the bay daily in contrast to the three-day flushing which occurs in Concepción Bay. Laraquete, in the Gulf of Arauco, a third location which is confluent with the Pacific Ocean, receives effluent from the municipality but most important is the discharge from a chlorine-bleaching pulp and paper mill (BKME) and it can be observed as a brownish-turbid surface layer for at least three km along the shoreline (Khan, unpubl. data). Since operations expanded in the 1990s, groundfish catches have been reported to decrease considerably in the southwestern coastal area. Sediment in the area consists of a dark, muddy texture containing bark and decomposing wood derivatives.

Fish sampling: Flounder, *Pardichthys* spp. were captured primarily by gillnet and less often by otter trawl (only San Vicente Bay) at depths of 8- 15 m at Penco, San Vicente Bay and Laraquete during spring in November and December, 1998. A fourth site was considered a reference area because of its location just external to Concepción Bay. The fish were bled from the caudal artery after capture for determination of hemoglobin, total plasma protein and lymphocytic levels (no./1000 erythrocytes) and prevalence of a blood protozoan from Giemsa-stained blood smears (see Khan 1987).