

## Impacts of Open Placer Gold Mining on Aquatic Communities in Rivers of the Khentii Mountains, North-East Mongolia

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### Abstract

Since the political change and due to high market prices for gold the mining sector has considerably grown in Mongolia and has become one of the most important economical sectors. With increasing mining activities the mining related environmental problems also increased, especially those, which are caused by open placer gold mining. Placer gold deposits are located in the alluvial sediments of river floodplains and the exploitation of these deposits often induces severe impacts to river ecosystem and its different components. In this paper we describe the effects of open placer gold mining on diatoms, benthic invertebrates and fish in four rivers in the north-east of Mongolia. Our findings are based on a comparative analysis of these biocoenotic groups in pristine and mining affected river sections, taking into account also abiotic habitat characteristics. Our analyses revealed that placer gold mining causes multiple stressors acting on different trophic levels. The biocoenotic groups under investigation reacted differently against stressors, and we identified a wide range of direct and indirect effects. These findings are new for Mongolia and are essential to define adapted and successful strategies for an ecologically based management and monitoring of open placer gold mining pressures and ecological impacts.

**Key words:** Turbidity, suspended sediments, clogging, river continuum, fish fauna, macroinvertebrates, diatoms

### Introduction

In North-East Mongolia both extremes exist: (1) large-scaled undisturbed and pristine landscapes and (2) river ecosystems, which are faced with a rapidly growing mining industry with its diverse environmental impacts (World Bank, 2006). The majority of the gold deposits of this region are located in so called 'placer deposits' in the alluvial sediments of the river floodplains. The exploitation of these placer deposits causes diverse environmental problems influencing the river-ecosystem in multiple ways (Farrington, 2000). For Mongolia placer gold mining is seen to be responsible for the entire loss or eventually long-lasting damage of at least 29 large-scaled river eco-systems, respectively parts of it (Mongolian Ministry of Nature and Environment, 2003).

Worldwide, the effects of open placer gold

mining on aquatic ecosystems are well documented. Numerous authors have reported on the effects for the ecosystem itself (Newcombe & MacDonald, 1991) or specific components, e.g. primary production (Van Nieuwenhuysse & LaPerriere, 1986), macroinvertebrates (Wagner & LaPerriere, 1985) or fish (Pentz & Kostaschuk, 1999; McLeay *et al.*, 1987). Although in Mongolia mining is seen to be a major threat to river ecosystems and its biocoenoses (Grayson, 2003; Ocock *et al.*, 2006), little is known about the site-specific impact and the scientific basis for targeted regional management given the specific situation for Mongolia.

The main focus of this study was, therefore, to comparatively analyze the biocoenoses in pristine and mining affected sites and to estimate the effects of open placer gold mining on different biocoenotic groups (diatoms, macroinvertebrates and fish). Based on these analyses principles for an ecologically orientated monitoring and man-