Impact of *Chelicorophium curvispinum* on the concentration-discharge response of suspended sediment in the Rhine River

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Background

In an ongoing study to the decline in suspended sediment concentrations and loads in the Rhine River since the mid-1950s, the temporal changes in the power-law sediment rating curve (Fig. 1) parameters were examined.

Observed changes in sediment rating curve parameters

This revealed that the rating exponent of the rating curve increased substantially between the early and late 1980s (Fig. 2). Until the early 1980s, the ratings curves were relatively flat with values of the rating exponent *b* varying around 0.2. In the mid-1980s, the exponent suddenly increased to a value between 0.4 and 0.6 and since then has remained within this range. This change in the rating exponent was mainly caused by a decrease in suspended sediment concentrations during low discharges.

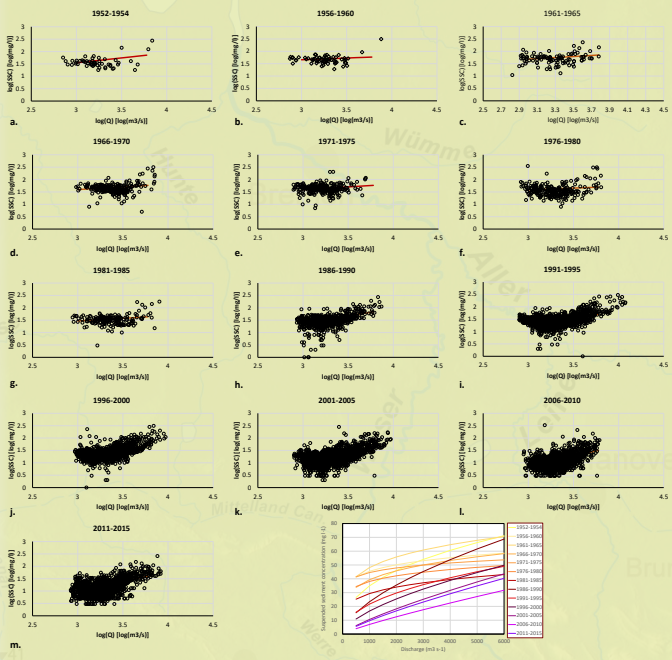

Fig. 1 Sediment rating curves for the Rhine River for 5-year periods between 1952 and 2015.

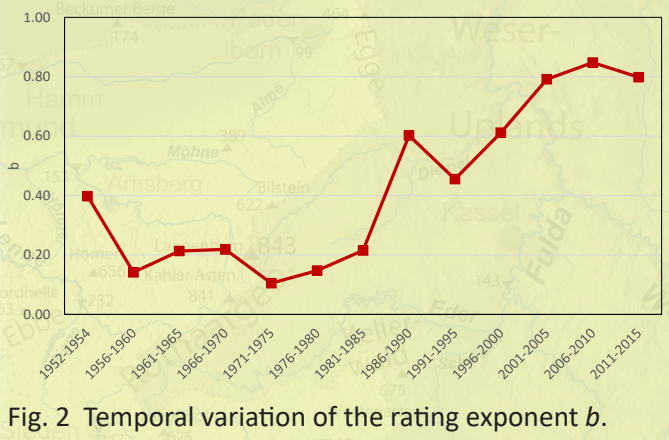

Fig. 2 Temporal variation of the rating exponent *b*.

Effect of invasion of *Chelicorophium curvispinum*?

The sudden increase of the rating exponent coincided with the period that the Ponto-Caspian *Chelicorophium curvispinum* (Caspian mud shrimp) (Fig. 3) invaded the Rhine River basin. This invasive species could spread and fill empty niches that were left after Sandoz chemical spill in November 1986 (Fig. 4).

Fig. 3 Caspian mud shrimp (*Chelicorophium curvispinum*)

Fig. 4 Sandoz disaster, Basel, 1 November 1986.

Implications

This suggests that this suspension-feeder species (Fig. 5) bears the prime responsibility for the increase in the rating coefficient, although this hypothesis requires further independent evidence. The sudden increase in the rating exponent does however not manifest itself in the long-term gradual trend of declining suspended sediment concentrations (Fig. 6) and vice versa. Apparently, the sequestration of sediment by *Chelicorophium curvispinum* is only temporary: the suspended sediment sequestered during periods of relatively low discharges is likely remobilised again during periods of high discharge. This implies that the invasion of *Chelicorophium curvispinum* has not played a significant role in the decline of suspended sediment concentrations. The precise reasons for the gradual long-term decline in suspended sediment concentration remain yet unknown.

Fig. 5 Filter-feeding and tube-dwelling *Chelicorophium curvispinum*.

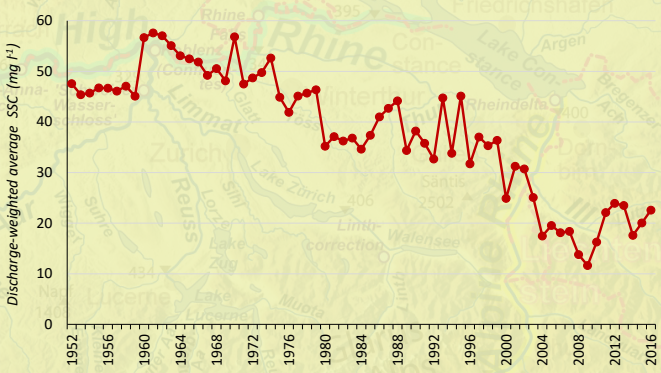

Fig. 6 Declining trend of suspended sediment concentrations in the Rhine River at Lobith, the Netherlands.