

Risk Assessment

HAZARD ANALYSIS OF AQUATIC SPECIES INVASIONS

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Abstract

Anthropogenically supported invasions of nonindigenous species (NIS) in aquatic ecosystems seem to increase worldwide. Many aspects of invasions remain nearly unpredictable. Among them, unfortunately, are the most wanted answers to: Which species will invade, when will it arrive, where will the species invade and what impact may be caused by this new invader? Until today these questions can be answered only on a theoretical or broad scale. Accordingly an indication of habitats at risk can be given only on a limited base. We know that certain areas such as estuaries and areas with high input of NIS, such as ports, waterways and aquaculture sites, are high-risk areas for further human mediated species introductions. Matching salinity and climate conditions in donor and recipient region enable a first but incomplete estimation of the species' potential to survive in new habitats. Taking into account the voyage duration of a ship (short term voyages support the survival rate of specimens in the ballast tank) the picture comes clearer, but still is far from prediction. The need for an improved risk assessment becomes clear as one introduced species can cause severe damage to economy or environment.

1 Introduction

Scientists have tried to mathematically assess the invasion rate of nonindigenous species (NIS) since a very long time. Darwin (1900) estimated that 5% and Williamson (1989) that 10% of the (intentionally and accidentally) introduced species may form self-sustaining populations for at least several generations. It was estimated that approximately 10% of all established NIS will (periodically) occur in high or massive densities. This 10's rule was mainly based on introductions to terrestrial habitats (Holdgate 1986; Simberloff 1986, 1989; Williamson & Brown 1986). Williamson (1996) revised the 10's rule pointing out that "10" actually ranges between 5 and 20. It is not clear if this rule can be applied for aquatic ecosystems.

The number of NIS recorded in different coastal waters is significantly different, varying from less than 25 introduced species to more than 200 in other areas (Ben-Tuvia 1953; Rubinoff 1968; Ben-Eliahu 1972; Walford & Wicklung 1973; Farnham 1980; Krapp & Sconfietti 1983; Leppäkoski 1984, 1994; Knudsen 1989; Zibrowius 1991; Boudouresque et al. 1992; Utting & Spencer 1992; Galil 1994; Jansson 1994; Carlton &