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Aiming at a moving target, a slow hand fails! 75 years of fisheries management in Lake IJsselmeer (the Netherlands)

J.J. de Leeuw [a,*], W. Dekker [a], A.D. Buijse [b]

[a] *Wageningen IMARES, Institute for Marine Resources and Ecosystem Studies, P.O. Box 68, 1970 AB IJmuiden, the Netherlands*
[b] *Deltares, Department of Freshwater Ecology & Water Quality, P.O. Box 85467, 3508 AL Utrecht, the Netherlands*

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Abstract

Lake IJsselmeer is a former estuary in the Netherlands that has been cut off from the sea in 1932. Excessive fishing effort, ongoing declines in landings and low revenues indicate that 75 years of fishery have not been sustainable in terms of socio-economical and ecological stability or avoidance of over-exploitation, despite measures aiming at reductions in fishing effort throughout the management history. We review the management history with a focus on how responsible fisheries management depends on time scales of management decisions, in comparison to time scales of fish population dynamics, and ecological changes. Management actions to improve sustainability have been generally implemented with considerable delays and in small steps, to avoid short-term losses in revenues. These actions turned out to be insufficient, as their potential impact was both inadequate and counteracted over time by technical advances in fisheries and by unforeseen ecological changes.

Keywords: Sustainable fisheries; Over-exploitation; Ecological change; Management decisions; Effort reduction; Co-management

1. Introduction

Managing fisheries in a sustainable manner is notoriously difficult, especially in complex, more or less open-access fishery systems (Charles, 2001; Caddy and Seij, 2005; Hilborn et al., 2005; Beddington et al., 2007; FAO, 2007). The complexity arises from (a) multiplicity in objectives, fishing gears and fish species, (b) dynamics of the fish populations and the environment, and (c) socio-economic structures, which all act on different temporal and spatial scales (e.g., Daan, 1997; Lane and Stephenson, 1999; Welcomme, 1999; Orensanz et al., 2004; Caddy and Seij, 2005; Beddington et al., 2007). Such complex systems are often over-exploited, which leads to unpredictable, and suboptimal, economic revenues and unstable ecosystems (Beddington et al., 2007; Shertzer and Prager, 2007). Examples of successful fisheries show that effective governance in which an adaptive management can timely cope with ecological change and uncertainties is a prerequisite for sustainable exploitation (Caddy and Seij, 2005; Freon et al., 2005; Hilborn et al., 2005; Hilborn, 2007c).

We review 75 years of fishery management in Lake IJsselmeer, a former estuary (then called "Zuiderzee") in the Netherlands. The fish stocks of the lake have been considered over-exploited ever since the area was closed off from the sea in 1932 by a major dam ("Afsluitdijk") and became a freshwater lake (Van Densen et al., 1990; Dekker, 1996). From the very beginning, the official

* Corresponding author. Tel.: +31 317 487096; fax: +31 317 487326.
E-mail address: joep.deleeuw@wur.nl (J.J. de Leeuw).

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national policy has been to reduce fishing effort in order to increase individual income of fishers and to compensate for envisaged losses owing to planned land reclamations (Zuiderzeewet 1918). Ecological changes and a shift in society from a socio-economic towards a more ecosystem-based approach posed large challenges to managers to achieve sustainable exploitation. We focus on the impact of time scales of management decisions, in comparison to time scales of fish population dynamics, and ecological changes on achieving this goal.

2. The ecological setting

Lake IJsselmeer (52°40′N 5°25′E) is a former estuary in the delta of the River Rhine, that is fed by a lesser branch, the River IJssel. It became a shallow freshwater lake (mean depth 4 m with some gullies up to 8 m deep) shortly after the Afsluitdijk fenced off the marine influence through the Wadden Sea in 1932 (Fig. 1). The creation of three polders during the 1930s to 1960s reduced the lake-surface area by more than 40% to about 1900 km^2. In 1975, a dam cut off the southern part of the lake (Markermeer, ca. 700 km^2), which became less productive in terms of primary production and fish production (Van Densen et al., 1990; Mous et al., 2003). Water retention time is ca. 6 months in the northern part (IJsselmeer) and 12 months in the southern part (Markermeer). After a period of strong eutrophication in the 1960s (phosphate load 7 g m^{-2} yr^{-1}), nutrient reductions in the 1980s led to a sharp drop in phosphate concentrations (Fig. 2, data Rijkswaterstaat). A high abundance of small-sized fish, which was reinforced by strong growth overfishing on piscivorous fish (specifically perch *Perca fluviatilis* and pikeperch *Stizostedion lucioperca*; Dekker, 1991, 1996), is attractive for fish-eating water birds. The population of cormorants *Phalacrocorax carbo* strongly increased in the 1980s. A stepwise shift of the breeding colonies in the 1990s towards areas with higher fish densities in the northern part (Fig. 1 and 2, data Rijkswaterstaat) was facilitated by new breeding options created as a by-product of nature-enhancement activities. An increase in the

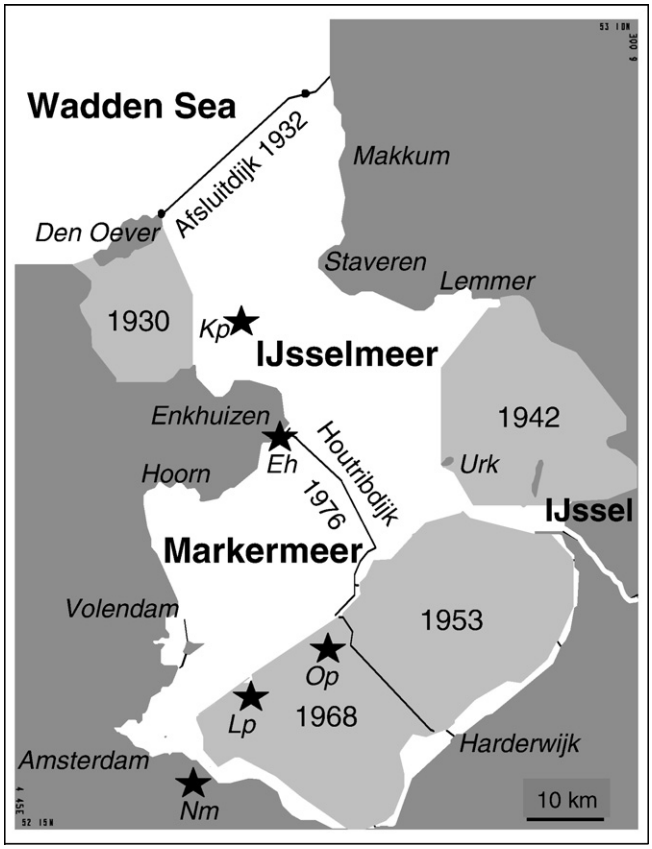

Fig. 1. Map of Lake IJsselmeer and Lake Markermeer indicating years of construction of main dams separating water compartments (Afsluitdijk and Houtribdijk) and polders. Stars indicate cormorant colonies (see Fig. 2).