

EFFECTS OF SUBMERGED CHANGE ON WINTERING WATERFOWL IN THE COMACCHIO AREA

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INTRODUCTION

The Comacchio area is a major wetland complex for wintering waterbirds (as well as for breeding and migrating ones). Its importance for wintering waterfowl has been emphasized by various national reports for 1975-77 (Boldreghini *et al.*, 1978; Schenk, 1979), 1975-78 (Chelini, 1979) and 1982-85 (Focardi and Spina, 1986).

Information on wintering waterfowl in the coastal wetlands of the Emilia-Romagna Region is given by Boldreghini and Montanari (1978) and recently by Boldreghini (1990). Populations of wintering ducks and *Fulica atra* in the coastal wetlands of the north-western Adriatic Sea over the period 1975-82 have been analysed by Boldreghini and Rallo (1988) and discussed in order to assess the international or national importance of these wetlands. Population trends of wintering waterfowl since 1974 are given by Boldreghini *et al.* (1992).

A strong decrease of wintering waterfowl has been recorded during the early 1980s. The aim of this paper is to discuss the ecological factors likely causing this population change.

STUDY AREA

The Comacchio area is a complex of coastal wetlands covering some 14,000 ha located in the southern part of the Po River Delta. The main wetland (some 11,000 ha) is a system of brackish lagoons (Valli di Comacchio) under controlled connection with the Adriatic Sea and a River Reno, employed since centuries for extensive rearing of euryhaline fish (*Anguilla anguilla*, *Mugilidae*, *Atherina boyeri*, *Dicentrarchus labrax*, *Sparus aurata*). These are the

remnants of wider lagoons (fishing "valli") still extended more than 50,000 ha in the last century, then reclaimed for agriculture. Drainage water is collected into canals in connection with the sea.

Presently the Valli di Comacchio are subdivided into two main basins with high salinity, one basin liable to tide and a number of minor basins, covering more than 1,000 ha and located in the southern part, mainly receiving supply of water from the River Reno. The aquacultural management of the valli is in charge of a public enterprise and a number of private owners.

North-east of the Valli di Comacchio there is a salina (620 ha), no more operative. Between the Valli di Comacchio and the Adriatic Sea a number of interdunal ponds, holding diverse salinity levels and mainly used for extensive fish-culture, are located.

METHODS

The species considered are Ducks (*Anatidae*) and *Fulica atra*, which are jointly called waterfowl. Mid-winter census data from 1974 to 1994 are analyzed. Counts coinciding with cold periods characterized by extensive frost are those of 1979, 1980, 1981 and 1985.

RESULT AND DISCUSSION

The population trend of total waterfowl is shown in Fig. 1; the observed decrease is highly significant (Kendall's $\tau = 0.54$, $p < 0.0009$). The density has varied between 37 and 746 individuals/100 hectares.

Only two species show a population trend strictly correlated with the total waterfowl: *Fulica atra* (Kendall's $\tau = 0.78$, $p < 0.0000$) and *Aythya ferina* (Kendall's $\tau = 0.64$, $p < 0.0000$). Since these species together reach high values of relative importance every year (min. 1982 52,4%; max 1979 98,1%) and show a wide variation of absolute abundance, they can explain most of the variation of total waterfowl (**Figure1**).

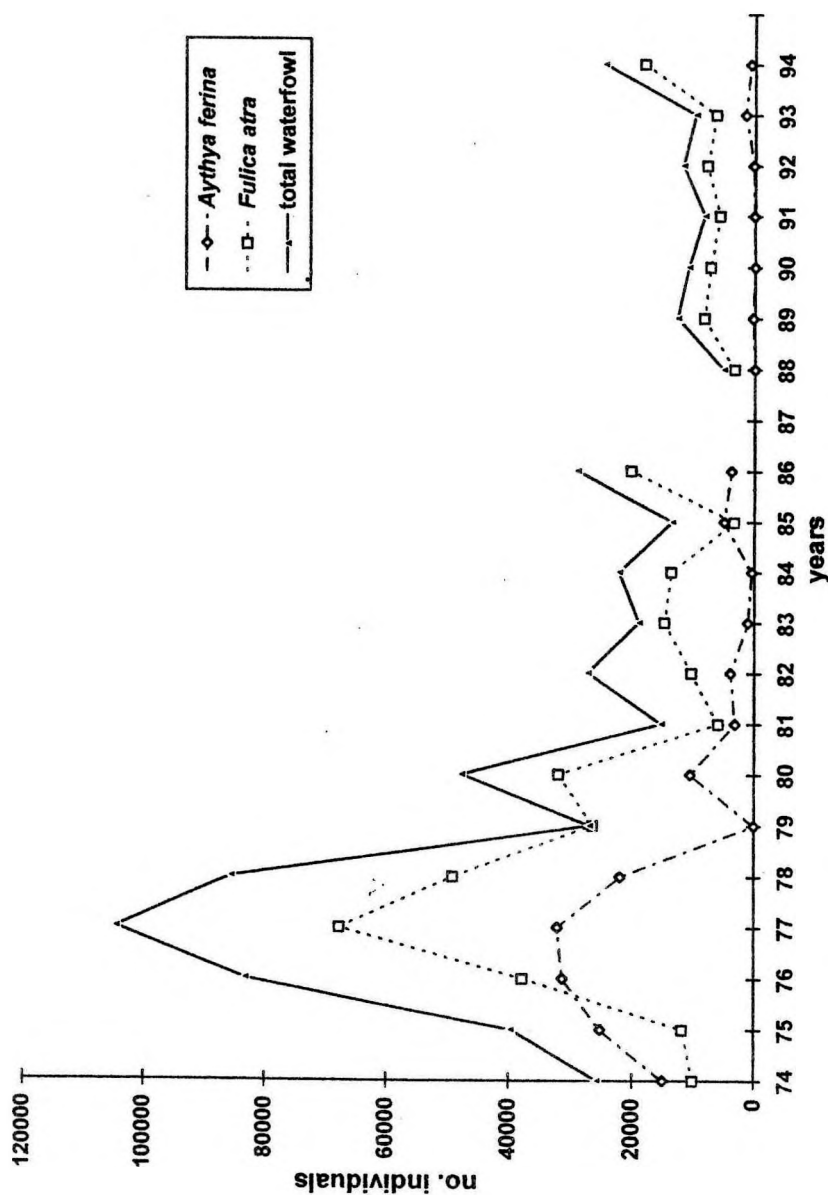


Figure 1: Population trend of total waterfowl and of selected species.

The dramatic fall of waterfowl population occurred in 1979-81: *Aythya ferina* and *Fulica atra* dropped to nearly 1/10 of the peaks previously recorded. During the following years the population level has remained rather low, especially for *Aythya ferina*. In the late 1970s the vegetation of the Comacchio Lagoon changed profoundly. Before the submerged macrophytic vegetation was formed by wide and dense beds of *Lamprothamnium papulosum* (Charophyceae) or *Ruppia spiralis* (Angiospermae) or mixed community (Ferrari *et al.*, 1972). Some species of macrophytic Chlorophyceae, such as *Valonia aegagropila*, *Chaetomorpha linum*, *Cladophora battersii* and *Cladophora socialis*, also were widespread and abundant (Giaccone and Piccoli, 1974). The phytoplankton was well diversified and mainly formed by diatoms (Boni, 1971).

Since the early 1980s the macrophytic bottom vegetation almost completely disappeared. During the same period also the phytoplankton changed and in 1988 only one species of unicellular Chlorophyceae, still unidentified, had an extraordinary abundance (Boni 1990); consequently the transparency of the water has strongly decreased. So far the situation is almost the same.

The cause of the shift of the primary productivity from benthic vegetation to phytoplankton is not clear because of lack of appropriate research. We may presume an increase of nutrients in the water, consequently a "bloom" of organisms characterized by a short life-cycle and then the death of bottom plants because of lack of light. Moreover, Cavallini (1980) has found in Valle Campo, one of the embanked basins of the Valli di Comacchio, only a clear increase of the phosphates between 1970-74 and 1978-80. This does not seem to depend on the waste-water drainage from the intensive fish-farm planted in this area. On the contrary, a relation has been found in the years 1977-79 between the increase of phosphates in the lagoon and their doubling in the coastal water of the Adriatic Sea.

Many and diverse environmental factors work in a lagoon ecosystem and the situation of the Valli di Comacchio is complicated by human management not based on deep and integrated knowledge of the functioning of the ecosystem.

The Valli di Comacchio lie in a area, the Po Plain, where surface water however is rich in nutrients, resulting from intensive agriculture, animal rearing and human settlements. In such

a situation the occurrence of dystrophic events must not surprise: they are increasingly recorded in many Mediterranean lagoons (Crivelli, 1990; Ximenes and Lieutaud, 1992).

A feasible way to reduce the amount of nutrients entering the Valli di Comacchio should be the creation of water purification systems employing aquatic plant communities.

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