Interaction between waterbirds and productive activities in the Grado and Marano Lagoon: the case of the Cormorant

Mauro Cosolo, Paolo Utmar, Flavio Roppa, Stefano Sponza

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Introduction

In Friuli Venezia Giulia the fish farm system covers a total surface of 1700 ha on a total wetland coastal system of 20.000 ha. The typical fish farm is composed by a lagoonal embanked area, where the communication with the open lagoon can be modulated through a system of dikes. The embankements and the possibility to vary the water level allow the farming of several fish species. The species that are more commonly farmed and have higher commercial interest in FVG are Dicentrarchus labrax, Sparus aurata, Mugil sp., Anguilla anguilla.

In Marano lagoon there are 17 fish farm over a total of 320 ha, in Grado lagoon there are 38 fish farms over a total of 1400 ha. Marano fish farms are smaller, closer to the land, characterised by a water to total surface of about 50%. They are usually managed intensively and fish are artificially fed. Grado fish farms are bigger, extensive, scattered throughout the lagoon and the water basin is about 80% of the total surface. The annual total production is about 40 kg/ha (Scarelli & Venturi, 2001).

The destruction of fish-eating bird habitats and the persecutions suffered have lead to a strong decrease or disappearance of such species from many European sites. Now the trend shows an increase in bird numbers, due both to the protection of such species and to the restoration of suitable habitats. Also in Friuli Venezia Giulia the conflict between productive activities and conservation requirements of fish-eating birds is important. Fish eating bird species considered in this study are 67 (updated from Perco et al., 1994). In table 1 the periods of presence and the habitats are indicated for each species. The highest numbers are recorded in lagoonal and littoral areas, with 57 species 37 of which regular. This is probably due to their extension (20.000 ha) and to the high ecosystem diversity. Follow the fish farms with 41 species, 27 of which regular. Then there are the inner wetland areas (rivers and canals) with 35 species 29 of which regular and the open sea with 37 species 25 of which regular, the cultivated land with 17 species 12 of which regular and the dumping grounds and urban areas with 5 and 2 species. 48 of the 67 species show a regular presence at least in one of the mentioned environments. The species that have the highest impact on fish populations are Phalacrocorax carbo, Egretta garzetta, Casmerodius albus, Ardea cinerea and Larus michaellis. The presence of these species in fish farms is affected

by the characteristics of the structures and by their distance from the roosts and other foraging areas. Important factors of attraction are the basins' size, the water levels, the height of embankements, the type of fish that are farmed. The Cormorant is considered the species at highest impact both due to direct fish removal and to fish mortality due to stress from potential predation, termic shock and damages (WWF Italia, 2000). The increase in cormorant numbers recorded in Europe in the last 15 years has lead to conflicts between production and conservation.

The Great Cormorant (Phalacrocorax carbo)

The Great Cormorant can be found in all kind of wetlands from the sea level to 1300 m of height (Baccetti & Brichetti, 1992). All studies carried out until now have given both convergent and differential contributions to the understanding of the interaction between of fish-eating birds and fish-farming activities interactions, indicating that every fish farm is characterised by peculiar ecological, environmental and human features, and that these factors have a subsequent effect on the results obtained. In some cases, differential results have been obtained even within monitoring sites (Suter, 1995 vs Staub et al., 1998). A study carried out in Switzerland has demonstrated that Great Cormorant's predation does not affect Salmonidae populations in natural riveline environments (Suter, 1995). The situation changes completely when water bodies with intensive fish farming are taken into account. In this case in fact, if fish tanks are not properly protected, Great Cormorants can cause huge damages in terms of fish predation, removing over 25% of the final product (Draulans, 1988; Melotti et al., 1993; Melotti et al., 1994; Donati et al., 1995; Melotti et al., 1996). During the period 1991-95 an average of 40.336 birds have wintered in Italy, and an average of 56.093 individuals during the period 1996-00, indicating a 39% increase. This is probably due to the colonization of inland wetlands. The area of distribution seems however stable since the end of the Nineties (Baccetti et al., 2002). In winter 2000-01 the population was of about 60.000 individuals, with an increase of 6,5% in the last four winters (Archivio INFS). The first breeding pair has been recorded in Val Campotto (FE) in 1986. In 2000 870-880 breeding pairs were counted in Italy. A general increase in breeders is recorded everywhere except in Sardegna (Brichetti & Fracasso, 2003). Grado and Marano lagoon is of national interest for wintering, with 834 individuals for the period 1995-2000 (Baccetti et al., 2002). Since 1989 the regional population is constantly increased until a maximum in 2001 (Figure 1). The same trend has been recorded in the number of roost used. Since 1992 the species has colonized inland areas, roosting along the Isonzo river. Since 2001 the wintering population is however decreased: 2300 cormorants in 2001, 1942 in 2003, 1657 in 2004. Interestingly, the decrease in bird numbers is associated to an increase in roost numbers (Table 2).
The Northern Adriatic lagoons are included between the 0°C and 5°C isotherm, so colder winters can affect wintering bird numbers. Indeed, FVG and Veneto Region have the lowest densities of Italy, with 0,05 ind./ha (Cherubini et al., 1993; Perco et al., 2000), whereas in the rest of the nation the density is 1,2 ind./Ha (Baccetti & Corbi, 1988). In Grado lagoon the diet is mainly composed by Platichtys flesus, 38%, Mugilidae, 17% and Atherina boyeri, 14%. The predation on commercial species such as Dicentrarchus labrax and Sparus aurata seems to be low, 3-4% of the total eaten biomass (Privileggi & Volponi, 1999). The daily intake requirements are estimated on 422 g of fish per individual (Giunti et al., 2005).

Aims of the work

The aims of this work are: i) to quantify the cormorant population in FVG coastal areas; ii) to define the importance for the species of the different environments found in Grado and Marano lagoon: the study sites show a gradient from natural areas, where human modifications are very low, to extensive fish farms; iii) to quantify the cormorant intake levels and thus the impact on fish farms.

Study area

Five different areas have been chosen. "Valle Cavanata" Reg.Nat.Res. and the coastal area in front of it called "Cancello mare", the lagoonal area in the proximity of Barbana, open towards the sea, called "Goppion", Valle Artalina and Valle Noghera fish farms. A transect throughout the lagoon was also considered, monitoring 10 sites that give a good overview of the lagoon environmental variety (Figure 3).

Methods

The roosts between Timavo and Tagliamento rivers were monitored monthly. The countings were always done at dusk. Eleven roosts were constantly monitored (Figure 4). The five study sites were monitored monthly from november 2004 to december 2005 (Figure 3). Monitoring were carried out from dawn till dusk, recording resting and feeding birds and environments used every 30 minutes. The lagoonal transect was monitored every month from november 2004 to december 2005 (Figure 4 – cormorant roosts in the study area). Every site was monitored for 10 min. The transect duration was of 9 hour or more, and the monitoring sessions were carried out both in the morning and in the afternoon, so that both low tide and high tide numbers were recorded.
The average densities were then calculated (N° individuals/Ha) for every site and every monitoring session.

Results

Wintering population

The wintering population in 2005/2006 (Figure 5) was rather stable. The highest numbers recorded in february are probably due to the cease of hunting and to the presence of individuals wintering in southern Italy areas and moving towards northern Europe. The same thing occured in 2004/2005.

The Cormorant in the study areas

Significant numbers of wintering birds are recorded only in Valle Cavanata (Figure 6 – average monthly density of wintering cormorants in the study areas). This is related to a traditional daily roost of birds on the central islets of such an area. Foraging birds (Figure 7 – average monthly density of feeding birds in the study area) are on the other hand not recorded in Valle Cavanata. The highest values are recorded in Valle Noghera in november. In january the highest densities are observed in Valle Artalina and in the lagoon at high tide. In autumn and spring the densities are rather high only inside the lagoon.

Analysis of intake and impact

We have analysed 118 foraging individuals. The most predated species are Platichtys flesus and Mugilidae. The predation rate on the two species was also calculated. Platichtys flesus was characterised by a predation rate of 0,086 fish/min, whereas Mugilidae were characterised by a predation rate of 0,031 fish/min. Recent studies in the Grado lagoon show that 38% of cormorant predation is focused on Platichtys flesus and 17% on Mugilidae (Privileggi & Volponi, 1999). The average intake value for cormorants in Grado lagoon was estimated at 450,3 grams (Privileggi & Volponi, 1999). Foraging occurs mainly in the first morning hours. This is supported by studies carried out in other European areas (Davies & Feltham, 1996; McKay et al., 1998). A secondary peak is recorded later in the day, probably due to the individuals that could not reach the total intake values in the morning (Hughes et al., 1999). We have estimated that in our study areas the cormorant reaches 2/3 of the daily food requirements in the morning, thus:

Morning intake (Pm) = (450,3 / 3) x 2 = 300,2 grams

Afternoon intake (Pp) = (450,3 / 3) x 1 = 150,1 grams

This has allowed to estimate the daily intake/ha in each of our study areas, applying the formula:

$$Ptot = Pm + Pp = \sum_{i=1}^{n} [(300,2 / Zm_i) \times Nm_i] + \sum_{i=1}^{n} [(150,1 / Zp_i) \times Np_i] / ha$$

where Zm and Zp are the morning and afternoon half-hours, Nm and Np are the cormorant numbers present in the morning and afternoon half-hours. Figure 8 shows the intake in the three fish farms, figure 9 the intake in the two tidal areas. The impact is not constant throughout the winter. The variability is highest in november and december. It is interesting to note that in january, february and march there are significant numbers of birds present (Figure 10 cormorant present in the study area in winter 2004/2005), but low intake values. In fish farms, birds focus their predation mainly in channels and wintering tanks, where fish densities are higher. However, when the climatic conditions are good, cormorants show a preference for lagoonal tidal areas, where the most appetible species are found (Atherina, Platichtys, Mugil).

Conclusions

The seasonal trends in cormorant presence are highlighted by our study, together with a spatial and temporal concentration of foraging sessions. There are therefore wide areas where only a few birds feed, and restricted areas where high numbers of individuals feed for short periods. Fish farms are used only for short periods, and the impact is significant only in november and december in channels and wintering tanks, where fish densities are high. Hence, the impacts observed in the present study could be drastically decreased, if a proper protection of the tanks used for intensive fish farming and for the wintering of fish stocks were carried out. Also, fake shooting and gas cannons could be used. With regard to the use of direct measures to manage the Great Cormorant population, for instance carrying out focused abatements, our results suggest that they may be planned only during the most critical period, that is in October and November, and in any case only within impacted fish farms. In the periods of better climatic conditions the food resource is mainly found in lagoon, and the most important species in the cormorant diet seems to be the small flatfish Platichtys flesus.