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INTERACTION BETWEEN FISH AND WATERBIRD COMMUNITIES: A CASE STUDY OF TWO GRAVEL PITS IN SOUTH-WEST FRANCE

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INTERACTION
POISSONS
GRAVIÈRES
MACROPHYTES
OISEAUX D'EAU
COMPÉTITION TROPHIQUE

RÉSUMÉ. – Des comptages de Foulques macroule (*Fulica atra*), espèce d'Oiseau d'eau herbivore et de Fuligules milouin (*Aythya ferina*), espèce consommatrice d'invertébrés, ont été réalisés pendant deux ans sur deux gravières adjacentes et aux caractéristiques physiques identiques, situées dans la plaine alluviale de la Garonne (Sud-ouest, France). Parallèlement, la composition ainsi que la densité des communautés pisciaires, d'invertébrés et de macrophytes ont été analysées dans chaque gravière. Des proportions inverses de Poissons et d'Oiseaux sont observées. Compte tenu de la similitude des différents facteurs physiques et environnementaux des deux gravières nous pouvons en déduire que les compétitions directes et indirectes entre les communautés pisciaires et aviaires seraient à l'origine des différences observées. Les Poissons benthiques comme la Carpe (*Cyprinus carpio*), la Brème bordelière (*Blicca bjoerkna*) et le Carassin (*Carassius carassius*) sont les principales espèces rentrant en compétition avec les Oiseaux d'eau vis-à-vis des invertébrés et des plantes aquatiques. La gestion des peuplements piscicoles dans les gravières est discutée afin d'améliorer les conditions d'accueil pour les Oiseaux d'eau.

INTERACTION
FISH
GRAVEL PITS
MACROPHYTES
WATERBIRDS
FOOD COMPETITION

ABSTRACT. – Counts of coots (*Fulica atra*), an herbivorous bird species, and pochards (*Aythya ferina*), an invertebrate feeder species, were realised during two years in two adjoining gravel pits, presenting the same physical factors, of the Garonne river floodplain (South-West France). At the same time, we analysed the composition and density of fish, invertebrate and macrophyte communities in each gravel pit. Inverse proportion of fish and birds were noticed in the two gravel pits. Taking into account that environmental and physical factors are the same between the two gravel pits, we can conclude that direct and indirect competition between fish and waterbirds should be at the origin of these differences. Benthic fish species such as carp (*Cyprinus carpio*), silver bream (*Blicca bjoerkna*) and crucian carp (*Carassius carassius*) are the main waterbirds competitors on benthic invertebrates and on macrophytes. Patterns of fish community management on gravel pits are discussed as a useful technique for increase waterbird numbers and diversity.

INTRODUCTION

Correlated with human population growth, urbanization and conversion of land to agriculture, the loss of natural wetlands throughout the world has made artificial wetlands such as gravel pits, dam lakes or rice fields attractive for waterbirds. In France, gravel pits cover an area of about 90 000 ha, with an estimated 5000 ha added each year (Barnaud & Le Bloch 1998).

In the Garonne river floodplain (SW France), the increasing abundance of gravel pits has allowed

several bird species to colonize the region. These "new" wetlands have become substitutes for the natural habitats of waterbirds. However, restoration is generally carried out to transform gravel pits into fishing lakes (Santoul 2000). In many wetlands, competition between fish and waterbirds can be observed. For example, fish were found to be the most important competitors with ducks concerning invertebrates in lakes (Krull 1970, Mc Nicol & Wayland 1992, Winfield *et al.* 1992), in boreal wetlands (Mallory *et al.* 1994) and in prairie pothole region (Lillie & Evrard 1994). Giles (1994) found that brood survival increases after fish re-

moval from gravel pit lakes. However, in gravel pits little is known about these interactions.

In this paper, we try to assess waterbirds and fish interactions in gravel pits and propose management patterns to improve the quality of gravel pits for waterbird conservation.

MATERIALS AND METHODS

Study site: In the Midi-Pyrénées region, most of the gravel pits are situated near Toulouse in the central part of the Garonne river floodplain. We selected two representative unmanaged gravel pits located at Saint Caprais, 25 km north of Toulouse. Total water surface area was about 20 ha for the first one (A) and 28 ha for the second one (B). The environmental factors (water depth, bank slope, bank vegetation) of these two adjoining gravel pits are very similar (see Santoul 2000 for more details).

Waterbirds population survey: Weekly censuses were carried out from October 1996 to October 1998 using binoculars (8×30) and a telescope (20×60), (for method see Santoul & Tourenq 2002). The small surface area and open character of the gravel pits permitted a full census of the avian communities (Tamisier 1972).

Assessment of fish, macrophytes and invertebrates population: Over the two-year period of our study, fish were recorded four times with gill-nets in each gravel pit. We used 30 m long and 1.7 m high clear nylon monofilament gill-nets of different mesh sizes (10, 12, 14, 17, 21, 27, 30, 40, 50 and 60 mm) in order to capture a wide range of fish specimens. Catch Per Unit Effort (CPUE), expressed as number of individual/h/100m² of gill-net, were calculated for each fish species in the two gravel pits, using Laurec methods (Laurec *et al.* 1983). Estimates of macrophytes and invertebrates abundance were carried out with an Ekman sampling device each year at the end of the spring period (May-June) in several points of each gravel pit.

RESULTS

In gravel pit A, the number of pochards varied from 0 to 285 with a mean of 46 birds/count, in B the number varied from 0 to 72 with a mean of 2 birds/count. For coots, the same tendencies were observed. In A, the number varied from 5 to 514 with a mean of 149 birds/count, in B the number varied from 0 to 190 with a mean of 48 birds/count.

Concerning fish composition and diversity, high differences between the two gravel pits were noted. In A, only two species were counted: the rudd (*Scardinius erythrophthalmus*) and the pikeperch (*Stizostedion lucioperca*), no benthic fish were censused. In term of density, calculated CPUE are low, 2,2 ind/h/100m² for rudd and 1 ind/h/100m² for pikeperch (Fig. 1). In B, the species richness

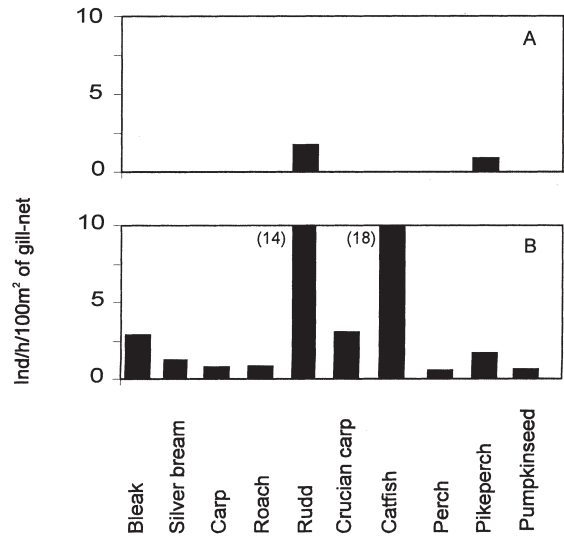


Fig. 1. – Catch Per Unit Effort (CPUE) calculated for each fish species in the two gravel pits. Gravel pit one (A), gravel pit two (B).

was greater with 10 fish species. Catfish (*Ictalurus melas*) with 18 ind/h/100m² and rudd with 14 ind/h/100m² are the more numerous species. Benthic fish, carp (*Cyprinus carpio*), silver bream (*Blicca bjoerkna*) and crucian carp (*Carassius carassius*), are present with a total of 6 ind/h/100m². Bleak (*Alburnus alburnus*) and pikeperch were also frequent. Concerning macrophytes in A, *Nitella* sp (Characeae) represent more than 90% of percentage cover. Several patches of *Myriophyllum spicatum* (<5% of percentage cover) and *Ranunculus trichophyllus* (<5%) could be noted. In B, *Nitella* sp is absent, few patches of *Ranunculus trichophyllus* (<5%) are present near banks. For the invertebrates in A, molluscs (*Physa* sp) and chironomids larvae species are the most abundant macro invertebrates (wet average biomass 21 g/m²). In B, molluscs are absent and chironomids larvae are little abundant (wet average biomass 5 g/m²).

DISCUSSION

In A, the birds were present in great numbers associated with a very low density of fishes. In B, pochards and coots were less numerous associated with higher density of benthic fish. This is probably due to a direct competition on benthic invertebrates between pochards and benthic fish such as Carp, silver bream and crucian carp. These fish species have the same diet composed especially of invertebrates like chironomids larvae (Wright 1990) and benthic invertebrates are the principal food resource of pochards (Phillips 1992).

In B, bream, carp and crucian carp prevent the establishment of macrophyte seedlings by constantly disturbing sediments whilst feeding. Moreover the increase of water turbidity made the photosynthetic process lower, preventing macrophyte development (Billard 1995). The abundance of submerged vegetation was inversely proportional to fish density (Hill *et al.* 1987). Coots feed significantly on gravel pits with macrophytes (Santoul 2002), moreover in winter, pochards prefer also macrophyte zones (Fox *et al.* 1994). This indirect competition on macrophytes causes a decrease in coot and pochard populations. Crivelli (1983) found that vegetation destruction by carp in Europe is less important than in North America because of lower biomass of European populations and higher weight of carp in North America. However in particular restricted wetlands such as the gravel pits studied here, fish density is sufficiently high to disturb the growth of macrophytes (Santoul 2000). Moreover, Rudds, a pelagic species abundant in B, are known to forage on both invertebrates and macrophytes (Keith & Allardi 2001) which might explain also the differences observed between A and B. In the wetlands studied, the origin of fish stocks is unknown, however human releases, rising river are the main contributions of these stocks. Despite the small water surface area of the gravel pits, these areas constitute a significant place for waterbirds conservation in the Midi-Pyrénées region. However, fish community control must be considered to better manage gravel pits as nature reserves for waterbirds. Species like carp, silver bream and crucian carp should be excluded from management plan.

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