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Cage-Associated Wild Fish Assemblages at Tuna Fish Farms in the Gulf of Antalya (Turkey's Western Mediterranean coast)

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Abstract

The aim of this study was to determine the cage-associated wild fish species beneath the tuna fattening cages in the Gulf of Antalya. The composition of fishes associated within a 50 meter radius surrounding outside and inside the cages were recorded by SCUBA divers equipped with underwater video and digital photo camera. Cages and the mooring systems are observed to attract large numbers of both pelagic and demersal wild fish as feed lost from the farm and profuse fouling increase the cages' draw as Fish Attraction Devices (FADs). During the study, 53 fish species belonging to 27 families were recorded around the cages and groups of fish were not seen more than 50m away from cages. Wild fish were observed to reduce environmental impact on the benthic communities by feeding on the lost fish and fish pieces. Also, wild fish aggregation around tuna cages could have positive effects for local fisheries since the farm area may act as small pelagic no-take zone. The number of fish species and their abundance were reduced after the harvest of the tuna in the cages.

*Key Words***:** Wild fish, cage culture, tuna

1. Introduction

In the Mediterranean basin, there is a long tradition of aquaculture, mainly fish and molluscs, based on coastal areas. Currently a large number of species are cultured in sea cages. Floating fish farms are associated with important aggregations of wild fish around them. Several studies have shown that there is an important aggregation around all of the Mediterranean farms throughout (Sanchez-Jerez *et al*., 2007).

Tuna fattening refers to the direct catch of tunas with purse-seine nets and their live transportation within floating cages to farm where they are kept in large fixed cages. In the farms, tuna are fattened using small pelagic fish and then mainly exported to the Japanese market. Today more than 60 tuna fattening farms are registered throughout the Mediterranean Basin (CIESM, 2007). The main aim of fattening tuna is not to increase the biomass, but to increase the fat content and, so, improve the meat quality. This activity is based on capturing BFT in the wild by purse seine during or just after breeding, transferring them to special transport cages, towing the cages to offshore facilities (lasting from several days to weeks), and feeding the bluefin tuna *ad libitum* mainly with high lipid content fish and cephalopods. Farmed tuna are mainly fed mackerel, pilchard, herring and bogue (Aguado-Gimenez and Garcia-Garcia 2005;Yerlikaya *et al*., 2009).

In Turkish coastal waters, the bluefin tuna, *Thunnus thynnus* (Linnaeus, 1758) aquaculture started in 2002 (Oray and Karakulak, 2003). Today, there are 6 farms culturing bluefin tuna, located in Antalya and Ýzmir (Gokoglu *et al.*, 2008).

In the bluefin tuna aquaculture farms, fish are kept in the cages with a diameter of 50m and nets with a depth of 20-30m. These cages are established to the locations that have at least a depth of 50m, 0.6-1nm distance to the shore, and strong water current. Before the establishment of the farms the bottom structures are determined and the cages are anchored to the bottom by suitable anchoring techniques according to the bottom structure. Generally, plough type anchors with a weight of 750-1000 kg are used. The volume of the surface buoys used in the cage systems vary between 260 lt to 1250 lt (Gokoglu *et al.*, 2006). The bluefin tuna are fed with Atlantic herring (*Clupea harengus*), sardine (*Sardina pilchardus*), chub mackerel (*Scomber japonicus*) and Atlantic mackerel (*Scomber scombrus*) and rarely with squid (*Loligo vulgaris*). In Turkey, the bluefin tuna are fed for 4-6 months before the harvest and marketing (Oray and Karakulak, 2003; Gokoglu *et al.*, 2008).

Fish are attracted towards a high variety of natural and artificial objects which stimulate the formation of aggregations. These objects are defined generally as Fish Aggregation Devices (FADs). One of the most important artificial structures in Mediterranean pelagic systems is floating fish farms, which attract great numbers of wild fish.

In this study, one of the environmental effects of the tuna cages in the Gulf of Antalya was evaluated. The wild fish aggregation around tuna cages is observed to reduce environmental impact on the benthic communities by feeding on the lost fish and fish pieces.

2. Materials and Methods

This study was carried out in two tuna farms located in the Gulf of Antalya between the years 2006–2008. The first tuna farm is located 1 nm offshore from the coast, near the Sýçan Island (36°45’48–36°46'07"N, 30°35'30"-30°35'39"E). The second farm is located 0.66 nm offshore from the town of Gazipaºa (36°11'44"-36°11'91"N, 32°20'53"-32°21'07"E).

Researches were conducted regularly once or twice each month in the first farm and a total five dives were conducted in the second farm. To determine the composition of fishes associated within a 50 meter radius surrounding outside and inside the cages all fishes were counted and visually estimated using SCUBA diving. The divers were equipped with underwater video (DCR PC350E SONY) and digital photo camera (Sea & Sea DX-1 G) and also used the visual census technique, recording the fish species to the plates during the dives. To catch some fish species in the vicinity of the cages, handline for chub mackerel with seven hooks and feather, fishing line with bait and fishing spear were used.

3. Results

During the study, 53 fish species belonging to 27 families were recorded around the cages and groups of fish were not seen more than 50m away from the cages. The fish species recorded under and around the cages are given in Table 1 and 2.

The number of fish species and their abundance were observed to increase with the presence of the tunas in the cages and reduced after their harvest. Wild fish are observed to reduce environmental impact on the benthic communities by feeding on the lost fish and fish pieces. Also, some fish species (*Balistes carolinensis*) were observed to use the cages and mooring systems as a shelter and feeding ground for all seasons.

Filter feeder organisms (oysters, tunicates, sponges) were also observed on the cages and the mooring systems. These fouling organisms seem to enhance the fishes and fish larvae populations that feed on them. For example an alien oyster, *Pinctada radiata*, which is very abundant on the cages, feeds on *B. carolinensis*.

4. Discussion

Tuna farming has direct and indirect effects on the environment. The accumulation of dead fish on the bottom under the tuna cages might cause a shift in the benthic community composition from omnivores and carnivores to scavengers and lead to an increase in the mean trophic level of local communities. The tuna cages and the mooring systems are associated with important aggregations of wild fish around them. The most abundant families are clupeids, sparids, carangids, mugillids, and pomatomids, although the dominant species markedly varied among farms and seasons (CIESM, 2007).

The bluefin tuna are fed with Atlantic herring (*Clupea harengus*), sardine (*Sardina pilchardus*), chub mackerel (*Scomber japonicus*) and Atlantic mackerel (*Scomber scombrus*) and rarely with squid (*Loligo vulgaris*). In Turkey, the bluefin tuna are fed for 4-6 months before the harvest and marketing (Oray and Karakulak, 2003; Gokoglu *et al.*, 2008). The feeding is realizing two times (in the morning & afternoon) per day. The fish are fed until satiation (*ad libitum*), and the divers observed the fish and made sure that they got the feed. Because of the strong currents around cages, the bait fish and the small pieces were going out the cages. Cages and the mooring systems were observed to attract large numbers of both pelagic and demersal wild fish as feed lost from the farm and profuse fouling increase the cages’ draw as Fish Attraction Devices (FADs). Aggregated wild fish feed on the lost baits and reduced the sedimentation of the total organic wastes. They influenced the environmetal impact by excreting nitrogen and carbon to the water column, thereby reducing the input to the benthos.

Table 1: The benthic and benthopelagic fish species recorded under the bluefin tuna cages

Species
Mugil sp.
Balistes carolinensis
Alectis alexanderinus
Diplodus annularis
Pagellus acarna
Pagellus erythrinus
Upeneus moluccensis
Upeneus pori
Mullus barbatus
Pempheris vanicolensis
Xyrichthys novacula
Lagocephalus sceleratus
L .suezensis
Bothus podas
Hemiramphus far
Serranus cabrilla
S. hepatus
S. scriba
Epinephelus aeneus
Polyprion americanus
Saurida undosquamis
Synodus saurus
Gymnura altavela
Myliobatis aquila
Dasyatis pastinaca
Rhinoptera marginata
Dasyatis chrysonota
Raja miraletus
Raja clavata
Hexanchus griseus
Lobotes surinamensis

Table 2: The pelagic fish species recorded around the bluefin tuna cages

Species
Euthynnus alleteratus
Sardina aurita
Scomber japonicus
Boops boops
Etrumeus teres
Coryphaena hippurus
Seriola dumerilii
Trachinotus ovatus
Thunnus thynnus
Belone belone
Tylosurus acus imperialis
Sphyraena sphyraena
S. viridensis
S. chrysotaenia
Trachurus picturatus
Alepes djedab
Caranx crysos
Spicara maena
S. smaris
Schedophilus ovalis
Centrolophus niger
Echeneis naucrates

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