

# In situ multi-indicators for the management of pelagic fish resources in shallow water lagoons

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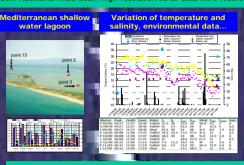
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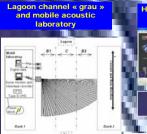
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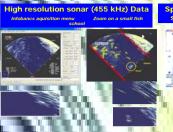
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Monitoring three shallow water Mediterranean lagoon at several levels of eutrofication. Fishing operations were carried out during autumn 9. Commercial catches were monitored the same year using monthly surveys on the three lagoons. In autumn, the fish flow and the current amplit split beam echosounder. Daily cycles were considered in September, October and November which are known as a period of occurrice of migration and not apply to be an included in the current amplit beam high-resolution sonar data were recorded simultaneously with echo sounder on two lagoons in September and November , the fish flow and the current amplitude inside the lagoon channel have been recorded usin as a period of occurnce of migration and transfer across the channel between the sea and the

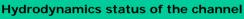


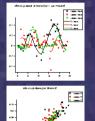




coustics data storage and analysis









Fish fluxes across the channel



General Linear Model applied to current flow data analysed by Fourier series

The results show that the data fit well with the model. The highest variations of the currents speed are recorded in Prevost lagoon, the recorded in Ingril lagoon the lowest

Lagoon 1999 Global state	10	Prevost	Ingril	Colour code Level	
Water column		8		Bad	
Phytoplankton				Medioc re	
Macrophyte				Medium	
Biological potentiality				Good	
Phosphor sediment				Excellent	

Five levels are fixed for the quality of the :

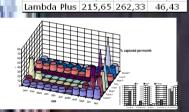
The Web based Lagoon Monitoring Network lagoons of the Langue Region (Ifremer-DEL)

### Fish species diversity and **CPUE**

Sparus Atherina Anguilla

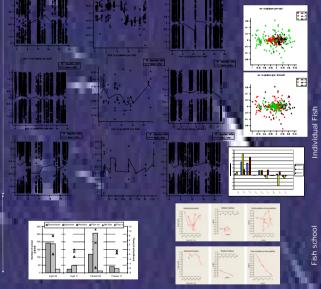
1999	Total	labrax	Mugilidae	aurata bo	yeri	anguilla
Or	575.32	0.00	3.66	3.71	7.34	200.45
Prevost	219.53	9.30	16.68	10.71	0.57	128.68
Ingril	325.57	118.00	3.99	0.41	2.40	158.74
10	Sept	t. <b>1</b> 999	Ingril	Or	Pr	evost
0.3	Nb. Species		15	16		13
	Delta Plus		87,86	90,42	9	2,95

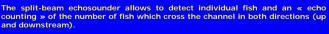
Setempher CPUE Dicentrarchus



The diversity are similar for Or and Pro lagoon, higher in Ingril. The CPUE revel that the more abundant species by lagoon.

Monthly commercial fishing data allow to follow the evolution of caught. It permit also to discriminate species caught by modality of size (large/small)



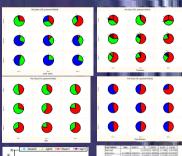


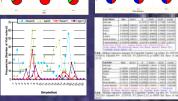
The upper set of graphics shows fish movements according to the time of the day. A continuous monitoring using echo counting allows to evaluate the biomass transfer between the lagoon and the sea but also their swimming speed for large target, small target generated wrong absolute speed

The histograms show the schools fluxes. Upstream and downstream fluxes are he histograms show the schools fluxes, upstream and downstream fluxes are nuch higher than net fluxes (upstream minus downstream fluxes), which uggest the « multi-pass hypothesis ». Therefore, the net fluxes seem to be an idicator of the real biomass transfer between the lagoon and the sea. Sonar scord allows also kinematics studies, here we show two kind of swimming ehaviour: very straight or more sinuous).

Both indicators and movement of fishes according to the time of the day can be assessed separately with reference to the schools and to the individual fish.

# Fish behaviour





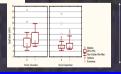
Data on 93 881 individual fish were recorded during 9 diel cycles across three lagoon channels. Acoustics data allow to assess indicators of fish behaviour, i.e.:

- flux direction: upstream and downstream
- spatial location in the channel lagoon
- period of observation (temporal variation in lagoon water temperature and salinity)

- diel behaviour: night, day, transition period, etc.

## Fish (TS) and school (Dimensions) size





Split beam echo sounder allows to measure the Target Strength of an echo of individual fish. The multi-beam sonar gives the size of the fish school recorded:

(i) the Target strength (dB) of the individual fish which can be related to fish length

(ii) the school dimensions across (Cw) along (Lw) the acoustic beams, and their st (Lw/Cw)

Data from acoustics surveys and fishing operations are an aid to - the analysis of anthropogenic effects on - the management of the pelagic fish population of shallow water lagoons. For such purpose several indicators of the state of the fish resources are performed. The method is versatile as regards its uses. The impact of eutrofication on fish resources can be measured at the level of a shallow water lagoon using specifics indicators. In situ behaviour of individual fish and schools can be approached using comparative approaches. Improvement of the accuracy of biomass estimates using echo-integration or fishing methods required improving knowledge on fish behaviour as well as on lagoon ecosystem functioning. In such complex system often declared as protected area and important nurseries of numerous fishes, the variety of available indicator allows now the fisheries scientist to propose adapted sensitive responses to local authorities for « decision making ».