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Impact of sand dredging on the coastal and artisanal fishing in estuary Sebou (Morocco)

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ABSTRACT

Morocco has a consumption of over 30 million tonnes/year of sand and needs is increasing. In front, this major need a shortage settles pushing traders or sand consumers to seek this substance by dredging in estuarine and marine riparian areas. Thus, the action of dredging on the physicochemical and biological balance of the environment, and the performance of the fishery in the estuary and riparian maritime area should be constantly evaluated. In the present study, we evaluated the qualitative and quantitative performance of the fishery in the estuary of Sebou (Morocco) and its environment. The results show that since 2005 (the beginning period of the dredging operation) and until 2016, equal to equal effort and fishing area, the fishing performance continues to decline in quantity and quality. In addition, during this period, the medium is physically damaged; the water is bad to very bad. It is therefore very probably that this dredging of sand from the middle is the main cause of biodiversity degradation of the environment studied.

Key words: Sebou Estuary, sand dredging, Fishing, Morocco

INTRODUCTION

According to the National Agency of Ports (2014), Morocco has an annual consumption of sand over 20 million m^3, which could be estimated at 30 million tonnes in 2015. Face to this important need of this vital substance for the development of the country infrastructures, the traditional resources reach inevitably their limits. So, the market uses the informal resources. Officially, 40% of the sand is used in construction comes from informal) (ANP, 2014). A shortage settles pushes so traders or consumers of sand to get this substance in many rivers, on beaches, or by dredging on the estuaries and sea. The exploitation of these various sand deposits becomes little or no controllable thus causing severe disruption of the ecological balance of many ecosystems.

Moreover, in order to reduce the pressure on the coastal environment and ecological balances, the dredging sand becomes an indispensable strategic resource. It is increasingly used as a substitute for the sand of rivers, beaches and dunes in the building and public works (BTP). In Morocco, the average annual volume of extracted materials in the basins and in port access channels from all natures is of the order of 3 to 4 million m3 (ANP, 2014). However, dredging for sand despite its abundance on all the Moroccan coastal areas continues to generate some reluctance on the part of users and the public. Indeed, many constraints were made on the possible impact made by a strong dredging on the marine and estuarine environment including its impact on other types of marine operations, in particular, the risk of conflict between the marine sand extraction and the aquaculture production or the fishing industry. Indeed, the dredging operation can influence the limitations of fishing areas, causes many problems of the dredging rejection, many other problems of the

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access restrictions to the marine environment. Thus, fishermen are facing increasing operating difficulties that may cause potential conflicts of area use. Thus, in the dredging field, evaluating the consequences of this on the environment is required.

This work aims to evaluate the impact of the dredging operation of estuarine sands on the environmental balance of the estuary of Oued Sebou in particularly its impact on the activity of small-scale coastal fishing based at the port of Mehdia, a harbour of river fishing arranged at the estuary of the Oued Sebou.

Materials and Methods

To achieve the fixed goals of our study, we have used a statistical analysis of data provided by the National Office of Fisheries of Morocco.

The statistical analyses have focused on the landings of a small-scale coastal fishing fleet in the port of Mehdia between 2005 and 2015. This analysis includes the landings of pelagic fish, white fish, cephalopods and crustaceans in connection with the effort fishing (number of vessels, the number of sea trip).

An analysis of the performance of the evolution of the landing' in species living in the background of the estuary such sole, whiting, shrimp and cephalopods, etc.

Similarly, a comparative analysis was made between the performance amendment of the Sebou estuary and the landings at ports of Larache and Tangier, which also are the subject of dredging in the estuary of Loukkos at Larache city and the port city of Tangier (Tangier Med).

RESULTS AND DISCUSSION

Statistical analysis of the landings of the coastal and artisanal fishing:

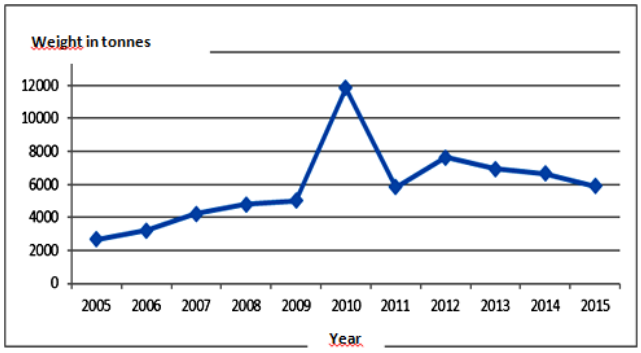
Landing overall:

Statistical analysis of the landings of major species groups in the port of Mehdia showed a net reduction in landings of whitefish and crustaceans, between 2005 and 2015 (Fig.1) (ONP, 2016). This reduction could be mainly due to the habitat disturbance and the destruction of spawning grounds or expulsion of species capable of moving or the landfill species.

For Pelagic Fish that live in the surface portion of the water column, their landings have started to decline since 2010 (ONP, 2016). This decline can be explained by the disruption of the food chain in the marine ecosystem undergoing an effect of dredging and a generated turbidity following the extraction of sand dredging or dumping of spoil dredging. Note that pelagic fish are able to escape the disturbed area and seek calmer areas rich in nutrients (Desprez, 2012).

For the cephalopods, which generally live in direct contact with the sediments, their landings have evolved due to the contribution of the fishing boats that usually target the rocky areas which are not accessible to trawlers and rich in phytoplankton and zooplankton that enrich the food web.

Figure-1: Evolution of global landings at the port of Mehdia from 2005-2015.



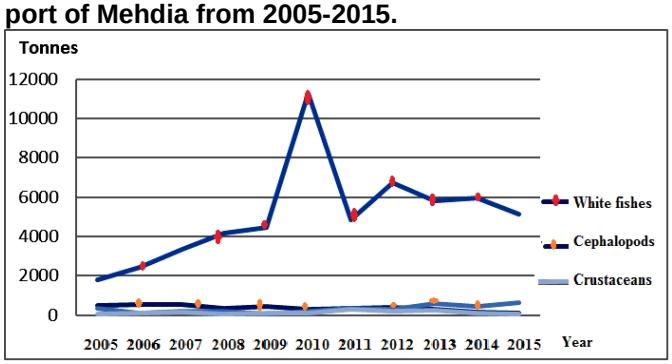
Note that the regression of groups landings of species (white fishes) at the port of Mehdia was noticed despite the virtual stagnation of the fishing effort of the fishing fleet based in the port of Mehdia between 2008 and 2015.

This reduction of catches pushes inshore vessels to explore more areas increasingly distant from their usual fishing zones and to attend to areas beyond 12 miles marine, generally reserved for fishing area deep-sea crustaceans, which greatly increases their costs (diesel, lubricant, etc.) and impact negatively the income of ship owners and fishermen.

Landings by species groups

The evolution of global landings recorded during the period from 2005 to 2015 shows a slight growth from 2005 to 2009 and a growth peak in 2010 is due primarily to landings of pelagic (11264 tonnes or more than 250% 2009 landings (Fig-2).

Figure-2: Evolution of landings groups of species of white fishes, cephalopods and crustaceans at the port of Mehdia from 2005-2015.



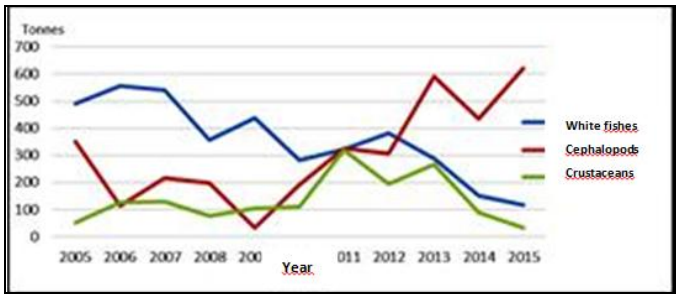
Note that changes in overall landings at the port of Mehdia (Fig-2) are in agreement with landings of pelagic fish that are the most dominant group among the catches (See figure. 1).

Landings groups of species, not pelagics:

The figure-3, shows a net reduction in landings of whitefish and shellfish during the period from 2005 to

2015. For cephalopods, the evolution of landings for the same period has experienced two phases, one between 2005 and 2009 where landings in cephalopods have experienced a sharp decline and a second phase was a net increase from 34 tonnes to 622 tonnes in 2009, 2015.

Figure-3. Evolution of landings groups of species not pelagics of Mehdia port.



Fishing effort:

Overall number of active vessels:

The overall fishing effort deployed by the active fishing fleet based in the port of Mehdia knows some stagnation from 2008 and between 300 and 350 active units per year (Fig. 4).

Figure-4: Evolution of the total number of active vessels in Mehdia from 2007 to 2015

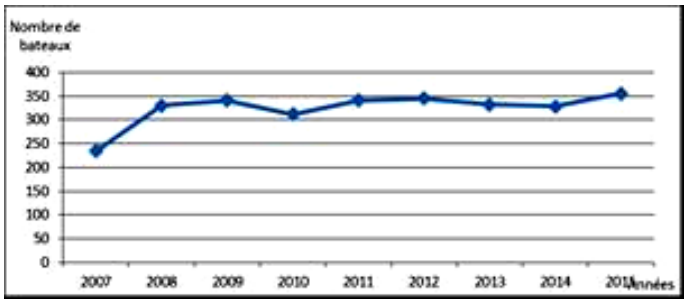
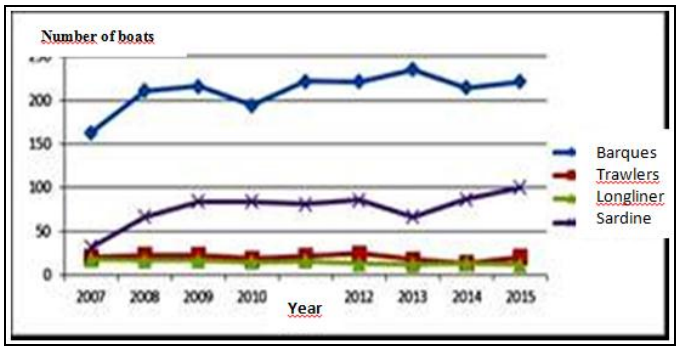


Figure-5: Evolution of fishing effort by fishery at the port of Mehdia between 2007 and 2015



Number of active fishing boats by type:

The breakdown by type of fishing the fishing fleet based in Mehdia is shown in Figure-5. We note a predominance of artisanal fishing that from 2008 is between 200 and 250 active boats per year. The sardine comes in second place with a number of units from 2008 is 50 to 100 boats. Trawlers are represented on average about twenty boats while the number of longliners generally varies between 10 and 20 units.

Number of fishing trips:

Another characteristic indicator of fishing effort is the number of boat trips. The number has fluctuated according to the availability or scarcity of fisheries resources, the distance to the fishing area from the port of Mehdia and climatic conditions (Fig. 6). Indeed, most of the fishing fleet based in the port of Mehdia is old with low power engines. So, in general, this boats and barges realise short trips which do not exceed, a day. They are forced to operate at a relatively close fishing areas fishing port. This often affects landings cause a pressure on the same fishing grounds. However, some well-equipped boats can operate at fishing zones frequented by shrimp freezer which is located beyond 12 nautical miles.

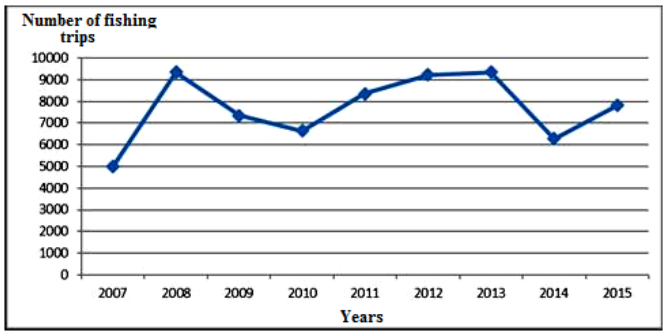
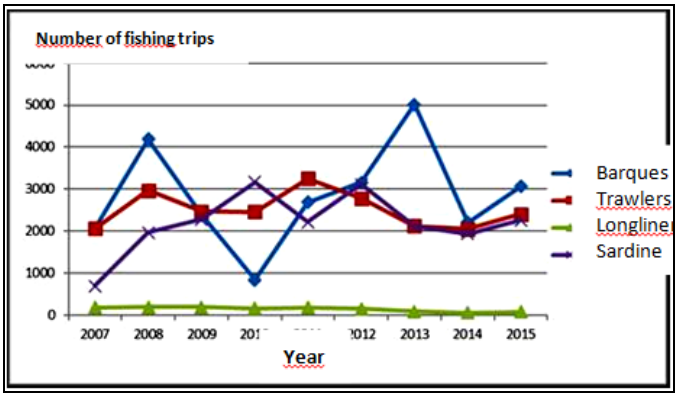


Figure-6: Evolution of the total number of fishing trips to Port Mehdia between 2007 and 2015.

The number of the trips to sea by fishing type also has known annual fluctuations depending on the year, the availability or not of the resource, its remoteness and climatic conditions (Fig-7).

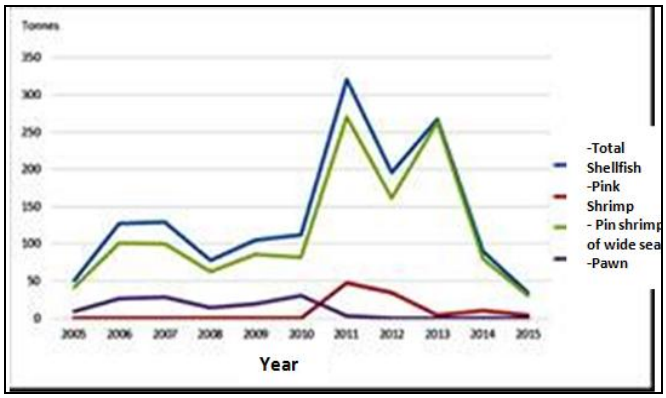
Figure-7: Evolution of the number of fishing trips by type of fishing in Port Mehdia between 2007 and 2015.



Evolution of landings of whitefish:

The main white fish species which have landed at the port of Mehdia showed a net reduction during the period from 2005 to 2011 and from 2015 (Fig-8) (ONP, 2016). This net reduction could be due to the adverse effects of the estuary sand mining for maintaining the channel of the estuary. According to Kostecki and Pape Pope (2011), extraction of marine sediments may do directly impact on the fishery resources in the dredging sector by destruction of spawning grounds and nursery of some benthic and demersal species; this extraction can also disrupt trophic relationships by changing the specific composition of preys of species and / or of their predators (fish). This activity also causes a significant turbidity affecting plankton, marine benthos flora and causes the flight of several species from their usual areas or a recolonization of these areas by other scavenger species that are nourished the remains of spécies killed in dredging (Desprez, 2012).

Figure-8: Evolution of landings of certain white fish at the port of Mehdia between 2005 and 2015.



Among white fish species most exploited by small-scale coastal fishing fleet based in the port of Mehdia we quote whiting, common bream, mullet, mullet, bream and sole. The evolution of landings of these species is experiencing a considerable decline during the period 2005 to 2015. This fall in landings could be attributed to the impacts of the operations of dredging sea sand.

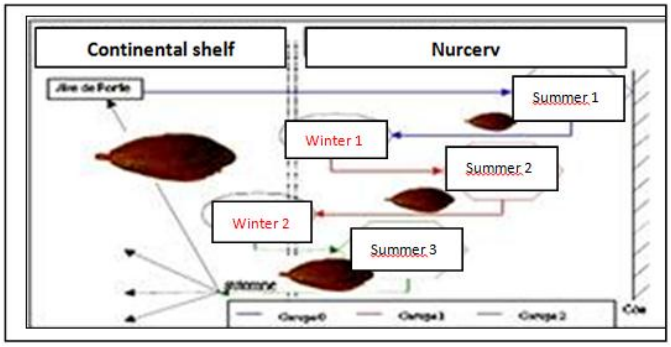
Case of *Solea solea* (L., 1758):

Solea solea form a fragile stock that coastal and estuarine ecosystems are essential for its renewal. Its life cycle requires, as the juveniles, to stay in nursery areas located in these areas. So, dredging of sand and disposal activities along rivers, estuaries and coastal areas thus affect quantitatively (destruction) and qualitatively (quality deterioration) the habitats and the renewal of the populations of *Solea solea* (Kostecki and Pape, 2011).

Biology of Solea:

Solea solea (L., 1758) is a benthic species whose distribution extends from the West African coasts to the Baltic Sea on soft bottom (mud and sand) having a bathymetry between 0 and 150 m. Its life cycle includes a pelagic larval phase followed by a benthic juvenile phase occurring in the coastal and estuarine nursery. At maturity, the young solea aged 2 to 3 years are moving to the continental shelf from the coast to a depth of approximately 150 m and vie for reproduction (Fig-9), (Pope, 2005).

Figure-9: General diagram of the sole life cycle in the Bay of Biscay (Holley, 2002).



Solea solea feeds almost exclusively benthic invertebrates (Beyst et *al*., 1999; Amara et *al*., 2001). Having a high commercial value, it is the subject of substantial fisheries exploitation (ICES, 2010 ; Kostecki and Pape, 2011).

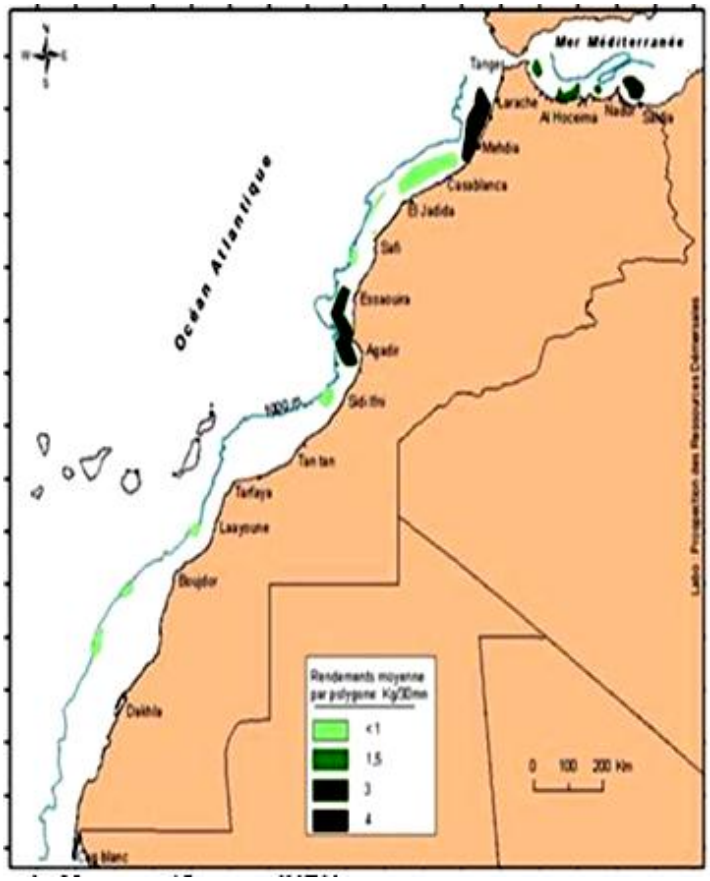
Dredging impact on Solea:

The extraction of marine sediments has no an impact on the diet of the solea. It is able to adapt to changes in the prey availability. However, direct mortality may be locally important during extractions in the areas having high concentrations of individuals such as nursery areas and the spawning grounds in spawning periods. (Kostecki & Pape, 2011). It is important to protect spawning grounds, especially during the winter spawning period, especially the coastal and estuarine nursery, which have a high concentration of juveniles during the first years of Solea life and where human pressures including dredging and disposal activities are particularly strong.

Case of other species of benthic and demersal fish

Fisheries interests are most seriously affected by the dredging process when the extracting zone of aggregates coincident with the areas of spawning or nursery or the benthic and he demersal species which have a same life cycle with *Solea solea* such as Pleuronectes platessa (Bolle et *al*., 1994), and other flatfish (Shi et *al*., 1997). These mechanisms concern flatfishes and other species such as whiting Merlangius merlangus (Carpenter, 1995), the bar Decentrarchus labrax (Claridge and Potter, 1983) and mullet (Guerault et *al*., 1996). In addition, some fish species that need to observe for to hunt their prey, such as mackerel and turbot, can avoid the high turbidity areas. Other characteristic species of bottom: such as the Ray, the great bright and dogfish are closely dependent on the

Figure-10. Abundance areas of pink shrimp in Morocco (Source: INRH, 2015).



ecological characteristics of the bottom. Strictly benthic, they are in almost constant contact with clean coarse sand they burrow. They carry their entire life cycle on this type of background, and in particular, reproduce. Their diet consists solely of benthic organisms: crustaceans, molluscs and fish. These species sought by anglers or bottom trawling may disappear because of the significant disturbance of their habitat.

Evolution of landings of crustaceans: Target species and fishing areas:

Two groups of shrimp are usually landed at the port of Mehdia and have great commercial importance: pink shrimp (*Parapenaeus longirostris*) and the prawns *Aristeus antennatus, Plesiopenaeus edwardsianus, Aristaeomorpha folicea*, and the brown shrimp *(Crangon crangon*).

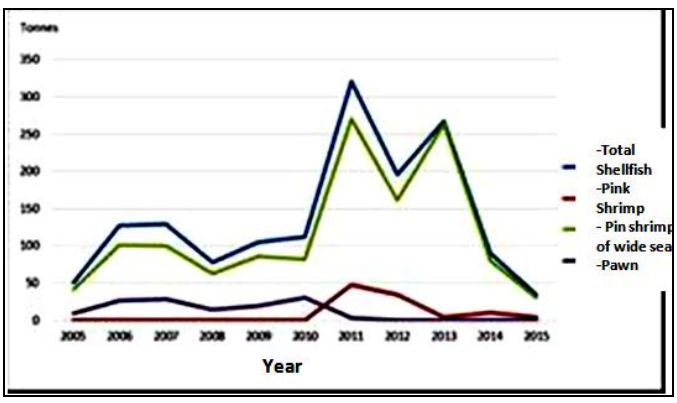
The rose shrimp belongs to the class of the Crustaceans, the order Decapoda and family Penaeid. It lives on sandy and muddy bottoms at depths ranging from 20 to 700 m. However, it is between 150 and 300 m where the density of the population is high (Crosnier 1964; Frecette and Driver, 1981), Reports of bottom trawl surveys in the Mediterranean and Atlantic).

In Moroccan Atlantic, the rose shrimp is encountered between Larache and El Jadida with high concentrations at the large mudflat in front of Rabat and Kenitra (Fig. 10) (NHRI, 2015).

Fishing effort Fisheries crustaceans

The shrimp fishing and mainly that of the pink shrimp (Parapenaeus longirostris) is exercised only by trawlers. Nationally, the effort of the inshore fleet is characterised by a large increase from 2000 to 2007 where this fleet has exerted an effort of 57 900 fishing days. This year, the effort of the fishing segment has remained around 50 000 fishing days. From 2012, there was a significant reduction in fishing effort. In 2013, 35000 fishing days were carried out by the coastal segment (NHRI, 2015).

Figure 11: Evolution of landings of some shellfish at the port of Mehdia between 2005 and 2015.



As for shrimp freezer, changes in the fishing effort show a harvesting between 2001 and 2008 around 16,000 to 18,000 fishing days. However, this effort has a significant decrease from 2009 due primarily to the significant decrease in the number of active vessels (20%) in 2010 and the shutdown period observed with the implementation of fishery management plan shrimp. For inshore freezer trawlers fishing the effort has remained relatively stable and the effort of this last segment follows the same trend as the freezer shrimp (NHRI, 2015). At the port of Mehdia, the fishing effort exerted by coastal trawlers remained relatively stable on average 21 ships a year. However, this despite the near stability of fishing effort, landings of crustaceans have continued to decline (Fig-11) pushing the trawlers to fetch the resource at depths more and more important.

The peaks recorded in 2011 and 2013 correspond to the period of change from the usual fishing areas frequented by trawlers targeting pink shrimp to other more remote areas usually frequented by shrimp freezer having considerable autonomy at sea. This change in the fishing area by trawlers induces high loads negatively impacting income crews such an increase of diesel consumption, lubricants.

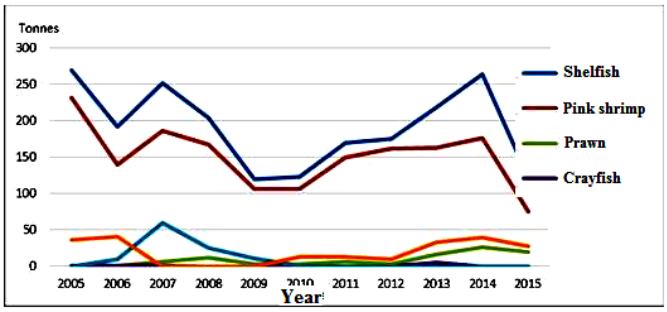
Evolution of landings in the ports of Tangier and Larache:

To know if this decline in landings of crustaceans is a specific case of Mehdia port or if this decline affects other fishing ports undergoing maintenance by dredging or by exploitation of marine sands, we studied the landings of crustaceans at the Tanger fishing ports and Larache during the same period 2005-2015.

Landings of shellfish at the port of Tangier:

The analysis of the landings of Crustaceans at the port of Tangiers showed that shrimp is the main target of the coastal trawlers based in the port of Tangier. In addition, landings of crustaceans began to decline from 2005 to 2009 or 2010 which is the period of operation of the usual fishing areas or traditional fishing grounds for shrimp. From 2010, landings of crustaceans begin to take an upward trend (Fig-12).

Figure-12: Evolution of landings of the main shellfish species at the port of Tangier between 2005 and 2015.



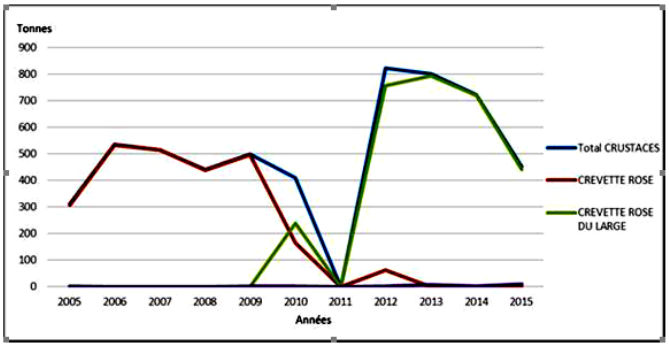
From 2010, landings of crustaceans begin to take an upward trend (Fig-12) corresponding to the exploitation of coastal vessels fishing areas crustaceans in areas which are more and more far from the port, and usually the trawlers freezers have operated.

From 2015, there is a further decline in landings and which corresponds to the scarcity of taken in these fishing areas due to the excessive fishing effort (coastal trawlers and ocean-going trawlers freezers) (ONP, 2016).

Landings of shellfish at the port of Larache:

Landings of shellfish at Larache to show that in the scarcity of prawns of the usual fishing grounds from 2009, the fishing boats are forced to go further offshore to the target of the rose shrimp especially from 2010 to 2014 (Fig-13), when this type of fishery has beginning to fall. This trend is similar to that noted at the port of Tangier.

Figure-13: Evolution of landings of the main shellfish species at the port of Larache between 2005 and 2015.



In the port of Larache, for the trawlers of coastal fishing, we note the same trend. From 2011, they were obliged to change fishing grounds because of the scarcity of the resources.

CONCLUSION

In light of this statistical analysis of landings of small-scale coastal fishing fleet at the Mehdia fishing port between 2005 and 2015, it appears that apart from the high landings of pelagic fish, white fish, mainly benthic species demersal and shellfish, species closely with the background, experience landings declining. Since the overall fishing effort has virtually stagnated since 2008, this reduction in landings of these two species groups could be attributed to maintenance dredging at the mouth and the access channel to the commercial port Kenitra and sea sand dredging operations in the coast of Mehdia which is one of the most important anthropogenic pressures that knows the marine environment lately. So, if marine sand mining is necessary to meet the growing need for urban and

economic development, it can be done in the context of a line with sustainable development and consideration of other activities having relationship with the marine environment, primarily the sea fishing and aquaculture hence the need for an integrated policy to complement the sectoral policies.

Moreover, environmental concerns must be explained by a reducing of the impact of human activities that require to the industrials and all actors in relation to the marine environment a greater involvement on these issues and an optimisation of the efforts already undertaken. Similarly, improving the overall knowledge of the marine environment concerning the the impacts associated with extraction techniques at sea and dredging remains necessary in order not to affect the overall balance of the marine environment that is essential to the maintenance of ecosystem services which should continue for the interest of all the stakeholders who exploit marine resources or use the sea.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1]. **Agence Nationale des Ports (ANP), (2014).** In press. Libération, 10 Février 2014.

[2]. **Amara R., Laffargue P., Dewarumez JM., Maryniak C., Lagardere F., Luczac C., (2001).** J Fish Biol. 58: 788-803

[3]. **Beyst, B., Hostens, K. & Mees, J., 2001.** J. Sea Res. 46 : 281–294.

[4]. **Desprez M. (1993**). Ifremer, Groupe d'Etude des Milieux Estuariens et Littoraux.

[5]. **Desprez M. (2008**). Report. 22 p. Available at:http://fr.calameo.com/read/0025593520990efc9ec29 accessed in 15 February 2016.

[6]. **Desprez M. (2012)**. Report of Union Nationale des producteurs de granulats Ref : NP-D1-12-G, 95p.

[7]. **Drapor (2003).** Central Dredging Association (CEDA) Africain Section, Ecole Hassania des Travaux Publics, 25-26 juin 2003, Casablanca.

[8]. **Drapor, (2006).** Référence Dragage & Environnement. Revue n°61, novembre- décembre.

[9]. **Holley J.F. (2002).** Ecole Nationale d'Agronomie de Rennes, 27p.

[10]. **ICES. (2007).** ICES Document CM 2007/MCH: 08, 96pp.

[11]. **ICES. 2001.** ICES Cooperative Research Report No. 247. 80 pp.

[12]. **Ifremer, (2011).**, Report, version du 09 Février 201, 12 pp.

[13]. **Institut National de la Recherche Halieutique, (2015).** Report, 210pp.

[14]. **Institut Scientifique et Technique des Pêches Maritimes (ISTPM), (1981).** Report Ref : BRGM!ISTPM n° 27-44-06, Nantes.

[15]. **Kostecki C., LE PAPE O. (2011)**. Scientific Report. *J. Agrocampus Ouest.* 4, 7 p.

[16]. **Le Pape O. (2005).** Thesis. Université de Bretagne occidentale., Ifremer, Agrocampus, Rennes.

[17]. **Massik Z. ; Idrissi L.J. & Zizah S. (2003).** Seminar International, Central Dredging Association (CEDA), 25-26 juin 2003, Casablanca.

[18]. **Morin J., Gilliers C., Schreiber N., Le Pape O., Amara R., Schlaich I., Cochard M.L., Bergeron J.P. (2001)**. Report of avril 2001. Available at: http://seine-aval.crihan.fr/web/attached_file/componentId/kmelia63/attachmentId/2949/lang/fr/name/04939566092001_Morin_Th4.pdf accessed in mars 2016.

[19]. **SIEGMA (2009).** Report, 86 pp.

[20]. **Sogreah, (2011).** Final Reprot N° 1712781. 73pp.

[21]. **Westerberg, H., Ronnback, P., and Frimansson, H. 1996.** ICES CM 1996/E: 26.