EXPLORACIONES OCEANICAS PHOSPHATE SANDS DREDGING PROJECT, BCS, MEXICO

ENVIRONMENTAL IMPACT ASSESSMENT

NON-TECHNICAL EXECUTIVE SUMMARY

Exploraciones Oceánicas
S. de R. L. de C.V.

“Life can multiply until all the phosphorus has gone and then there is an inexorable halt which nothing can prevent.”

ISAAC ASIMOV

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INTRODUCTION

Phosphate is as essential to life as oxygen, water and carbon. All living cells require phosphate, as it is a component of the cell wall and DNA. Phosphate cannot be manufactured and there is no synthetic substitute to replace it. With a growing world population that is incorporating meat and dairy products to their diet, phosphorus reserves have become a critical aspect of many countries' food security. The ability of nations to feed their people in the future will depend on their access to phosphate fertilizer at affordable prices to farmers.

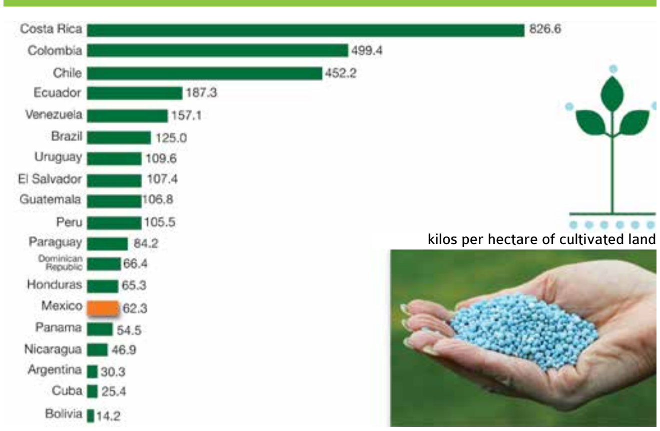
In Mexico, less than 60% of the food consumption needs in the country are produced internally. The main countries from which Mexico imports phosphate rock are Morocco, USA, Ukraine and Peru. According to statistics from INEGI (National Institute of Statistics and Geography) the country's increasing need to import phosphate stands out as a significant concern since the potential shortage of the resource would be detrimental to Mexico's agriculture industry.

An important strategic goal for Mexico is to attain self-sufficiency in the development of a rich source of essential phosphate fertilizer to feed its population over the next 100 years.

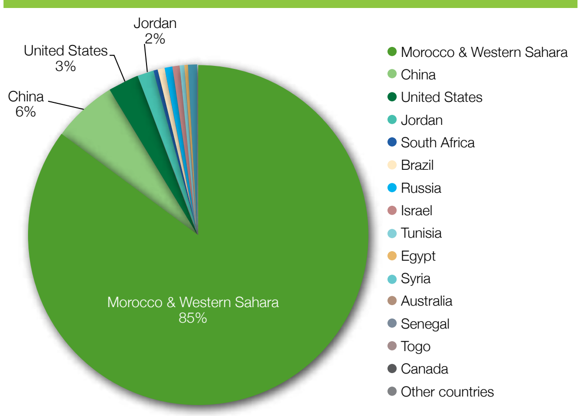
> "Due to the shocking lack of political debate around the threat of phosphorus scarcity to food security, there is an urgent need to take action now to ensure we will have sufficient phosphorus to feed humanity into the future."
>
> PROFESSOR PAUL J CRUTZEN, NOBEL PRIZE IN CHEMISTRY

FERTILISER CONSUMPTION IN LATIN AMERICA

Source: Super Industria y Comercio



PHOSPHATE RESERVES IN MOROCCO COMPARED TO THE REST OF THE WORLD



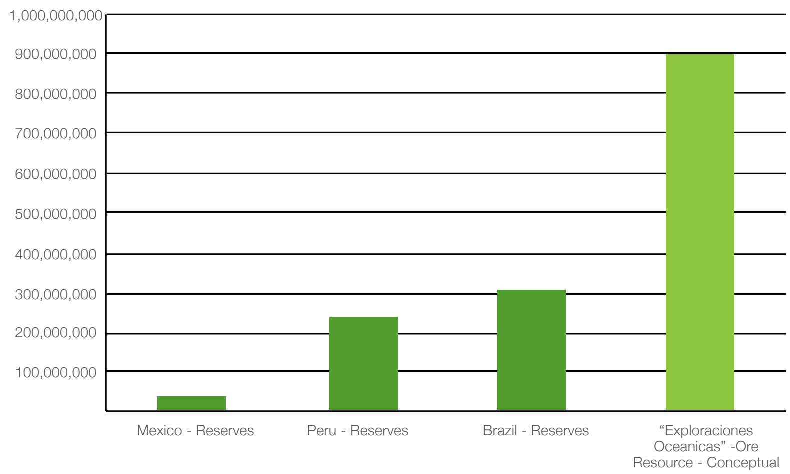
The environmental impact of performing underwater dredging of phosphate sand deposits in Ulloa Bay represents minimal risk. It is comparable to suction dredging for marine aggregates currently being undertaken in UK waters, and dredging projects on a daily basis in Mexico and throughout the world. This technology, which is being proposed for use in the Baja California Sur project, has been carried out for over 30 years throughout nearly every country in the world.

It is important to note that during this proposed phosphate extraction process, chemicals are not added. Phosphate is extracted solely by mechanical means and only shells, oversized material, and fines are returned to the seabed.

INHERENT BENEFITS OF UNDERWATER MINING VS. CONVENTIONAL LAND MINING

- Reduced infrastructure requirements
- Communities are not re-located
- Natural water sources are not affected
- Lower carbon footprint
- Very little to almost no overburden removal
- Occupational safety and health
- Less environmental impact
- Sea bottom contouring

ROCK PHOSPHATE RESERVES IN LATIN AMERICA (TONNES)



LOCATION OF THE PROJECT

Project "Exploraciones Oceanicas" will be developed in a sedimentary deposit of phosphate sands located in Mexico´s Exclusive Economic Zone (EEZ), offshore from the coast of Baja California Sur in the Pacific Ocean. The concession area of the "Exploraciones Oceanicas" project is on the continental shelf, in the embayment between Punta Abreojos in the north and Puerto San Carlos in the south.

The Trailer Suction Hopper Dredger (TSHD) will extract material in strips with an approximate length of 3.5 km and an approximate width of 200 to 300 m (approximately 1 km^2) every year. Considering that the total permit area is 912.7 km^2, the annual area affected by dredging activity would be around 1% of the total project area.

The following image shows the location of the project, within the Exclusive Economic Zone (EEZ) of Mexico in the Pacific Ocean. The majority of the area that is to be dredged lies at about 40 km from the coast. Based on the considerable distance of the project from the coast and completion of the extensive environmental testing, no impact to such remote coastal areas has been determined. It should also be pointed out that due to the water depth and environmental conditions, there is minimal vegetation on the seabed in this area.

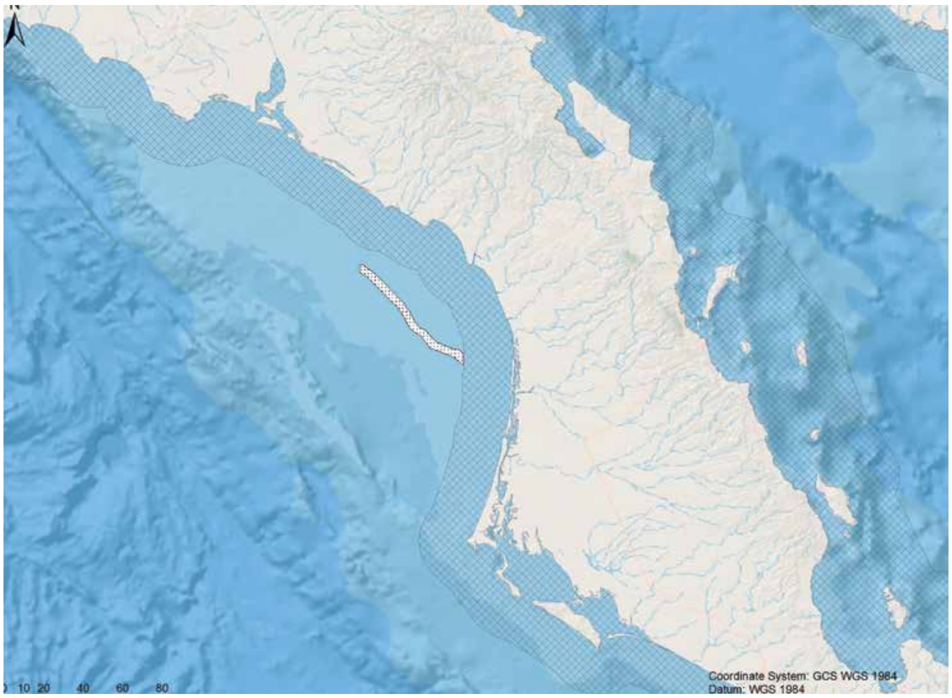


FIGURE 1. Project area "Exploraciones Oceanicas", relative to the EEZ and territorial sea.

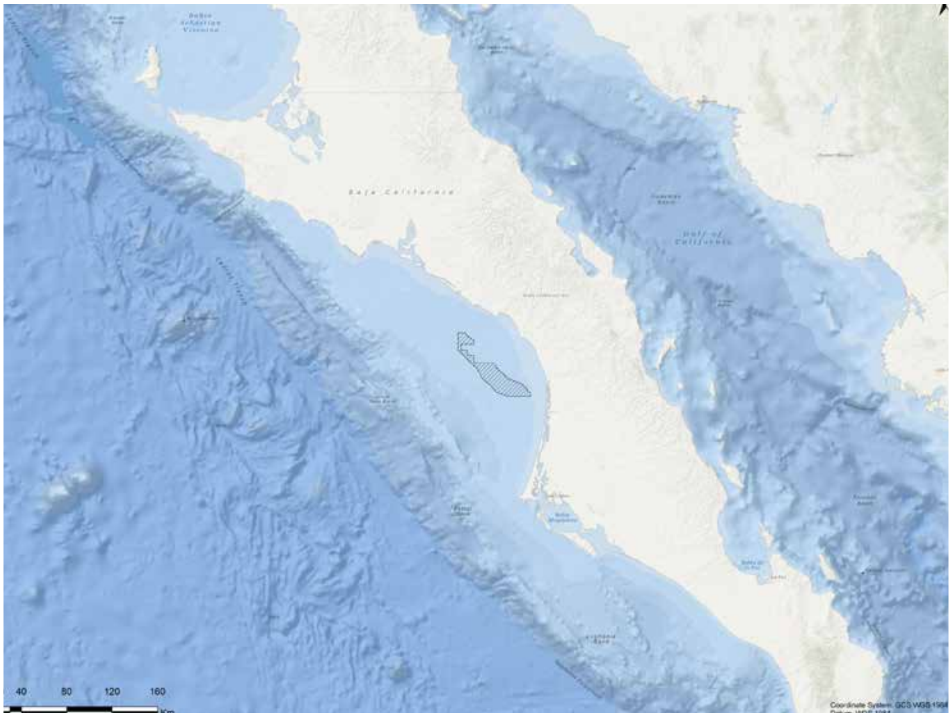


FIGURE 2. The project is located in the Exclusive Economic Zone (EEZ) of Mexico, in the Ulloa Bay, in the western coast of Baja California Sur. This map shows the reduced mining title. Dredging is only proposed in a small percentage of this area.

THE **DREDGING** PROPOSAL

LOCATION AND MANAGEMENT OF THE RESOURCE AREA

The “Exploraciones Oceanicas” mineral sands deposit is located approximately 40 km off the west coast of Baja California Sur in a depth of water of between 80-90 m, taking into account the irregularity of the seabed and the depths that would follow dredging in the operational area.

In order to facilitate sustainable management of the dredging project, the resource area has been divided into a series of five polygonal ‘Active Operational Areas’ (AAOs), each of which is intended to sustain dredging for a 10 year period based on projected production figures. The distribution of the Active Operational Areas is shown in Figure 3, together with the average water depth at each site.

Dredging will start in AAO 1 in the north of the resource area and is planned to be carried out continuously throughout the year on a basis of a 24 h and 7 days per week operation. In practice, however, dredging operations will be affected by external factors such as weather, and internal factors including mechanical problems and repairs. Based on over a century of dredging experience, Boskalis (Dragamex) estimates that the average work per year will be about 40 weeks.

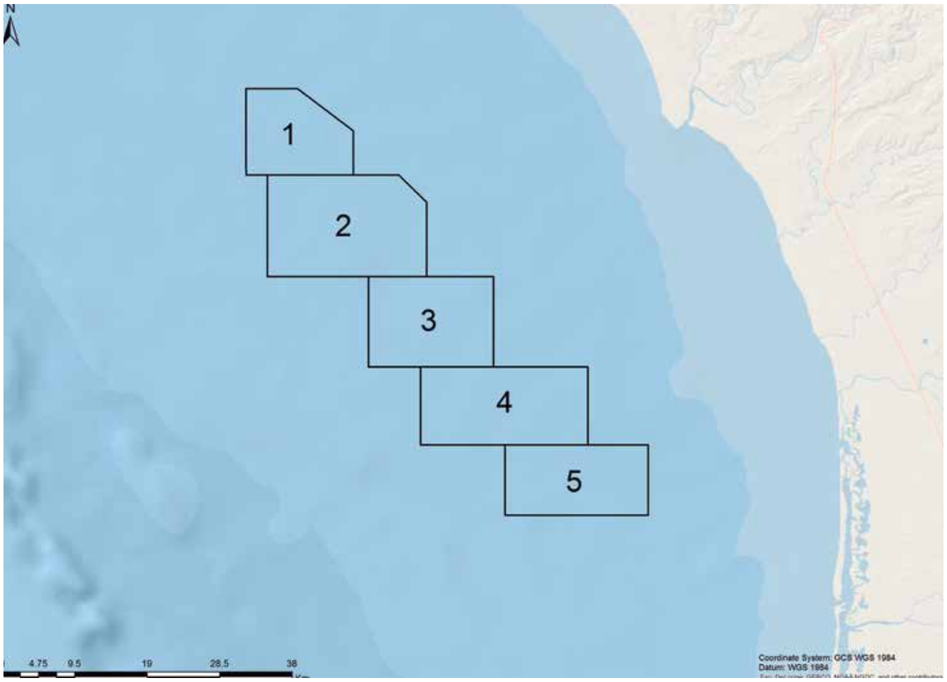


FIGURE 3. Chart showing the five Active Operational Areas (AAO s) at the "Exploraciones Oceanicas" site. Each AAO is intended to support a 10 year dredging programme at estimated production levels, with polygon 1 being the first operational area. Depth of water: Polygon 1=82.5 m; Polygon 2=83.9 m; Polygon 3=81.5 m; Polygon 4=79.5 m; Polygon 5= 80.3 m

ACCESSIBILITY OF THE RESOURCE

The main body of the phosphate sands resource varies between 2 m and more than 6 m thickness and is overlaid by a relatively thin layer of fine muddy sand. In some places the phosphorite material is exposed near the surface of the seabed but in other parts of the resource area the surface overlay is thicker, reaching as much as 3 m in some places.

For operational reasons, areas with the thinnest overlay of sand (of about 0.5 m) will be dredged first. However it is important to point out that even the so-called 'marginal areas', with a thicker overlay of sand, comprise an important phosphatite deposit which is likely to be of significant economic value in the future. Prices for phosphate rock are currently US$ 130 per ton but have historically exceeded $US 800 per ton and may considerably exceed this in the future as phosphate resources become scarcer. This may allow extraction and commercialization of the phosphate sands in 'marginal areas' in the future despite the increased costs of removal of the overburden of sand in areas where this exceeds 3 m.

MANAGEMENT OF THE DREDGING PROCESS

Dredging will be carried out with a conventional Trailer Suction Hopper Dredger (TSHD) of 5000 m^3 cargo capacity, modified to allow dredging at up to 90 m water depth. This type of dredger is used worldwide for dredging operations including channel maintenance, beach recharge and aggregate dredging operations. Seabed deposits are drawn up through a 'draghead' which creates a furrow in the seabed of up to 0.5 m depth and are transferred into the cargo hold by means of a powerful centrifugal pump.

Black mineral sands

Dredging will be carried out along a narrow strip of seabed of 3.5 km in length and 200-300 m width (1 km^2), and will lower sections of the seabed, yielding a total volume of 133,000 m^3 of dredged material per week. The annual dredged volume, including the overlay of sand will be 4-6 million m^3, yielding an annual production of 7 million metric tons of separated mineral sands based on an estimated production of 40 weeks per year.

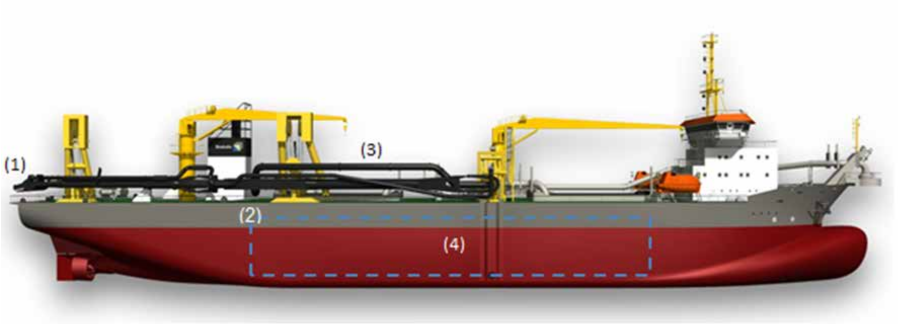


FIGURE 4. Typical Trailer Suction Hopper Dredger (TSHD) showing the draghead (1), the extent of the cargo hold (2), the suction pipe in the stowed position (3) and position of the cargo hold (4).

It may be necessary, in some parts of the mineralised area, to adjust this 'Active Dredge Area' to a shorter but wider zone of 2.5 km x 400 m depending on the local mineral deposit. In either case, the annual 'footprint' of dredging will not exceed 1 km^2. The exact orientation of the dredge path will be defined to optimise extraction, whilst ensuring the safety of navigation and operation of the vessel. For example, it may be necessary at times to dredge along the direction of the prevalent current, whilst at other times the vessel will need to dredge head-on to the swell to minimise roll and ensure that the draghead remains permanently in contact with the seabed.

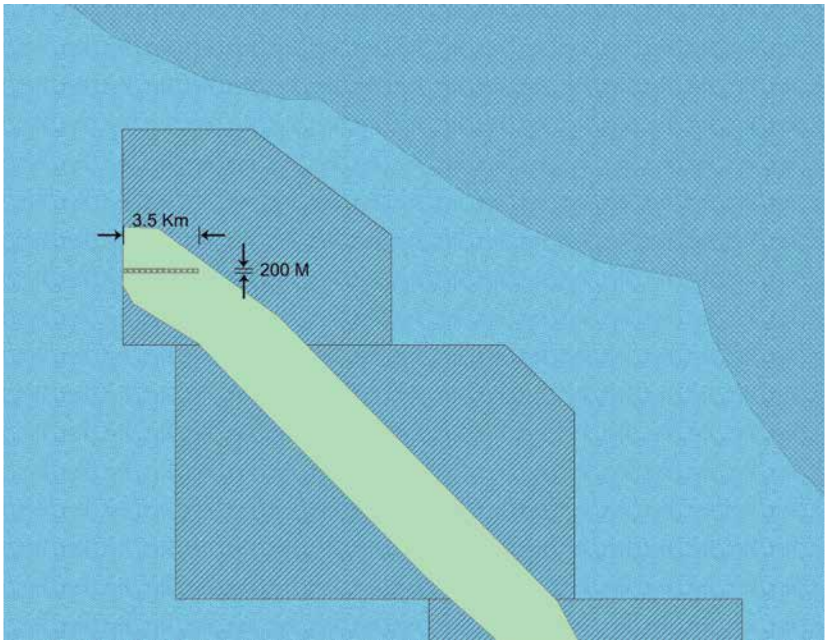


FIGURE 5. Chart of the northern part of the "Exploraciones Oceanicas" mineral sands area, showing the dimensions of the 'Active Operational Area' (AAO) and the 'Active Dredge Area' of 1 km^2 per year.

RETURN OF SAND TO THE SEABED BY THE DREDGER.

During dredging with a Trailer Suction Hopper Dredger (TSHD) excess water and silt overflow from the cargo hold and conventionally are either discharged at the surface of the sea through overflow chutes in older TSHDs or (in more modern vessels) through a pipe that discharges through the bottom of the hull at about 7 m depth below the sea surface. These more modern TSHDs may also use a so-called 'green valve' to reduce the entrainment of air into the exit stream, and thereby reduce the tendency of the discharge stream to come to the surface as a visible plume.

Studies carried out worldwide show that the coarse sand-sized material rejected by the screening process on TSHDs used for aggregate dredging sinks rapidly to the seabed and is deposited as a thin surface layer for a few hundred meters from the point of discharge. Silt-sized particles remain in suspension for longer, but most studies show that the 'footprint' of sediment deposition is confined to a zone not exceeding 3 km from the point of discharge (Whiteside *et al.*1995; Hitchcock & Drucker, 1996; Hitchcock *et al.* 2002; reviewed in Newell & Woodcock, 2013).

This work underpins the proposal made in the original environmental impact statement (MIA) for the "Exploraciones Oceanicas" project that discharge through the lower hull of the dredger and processing vessels conforms with international 'Best Practice'. It results in a discharge plume that is rapidly carried to the seabed as a density current with only a relatively small plume of dispersing sediment in the surface waters where light penetration is sufficient to support primary production by the phytoplankton.

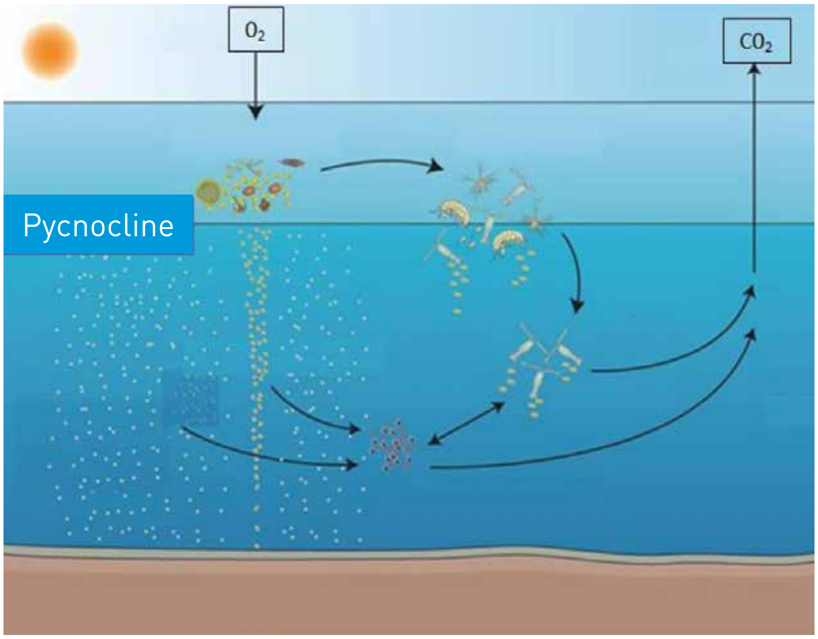


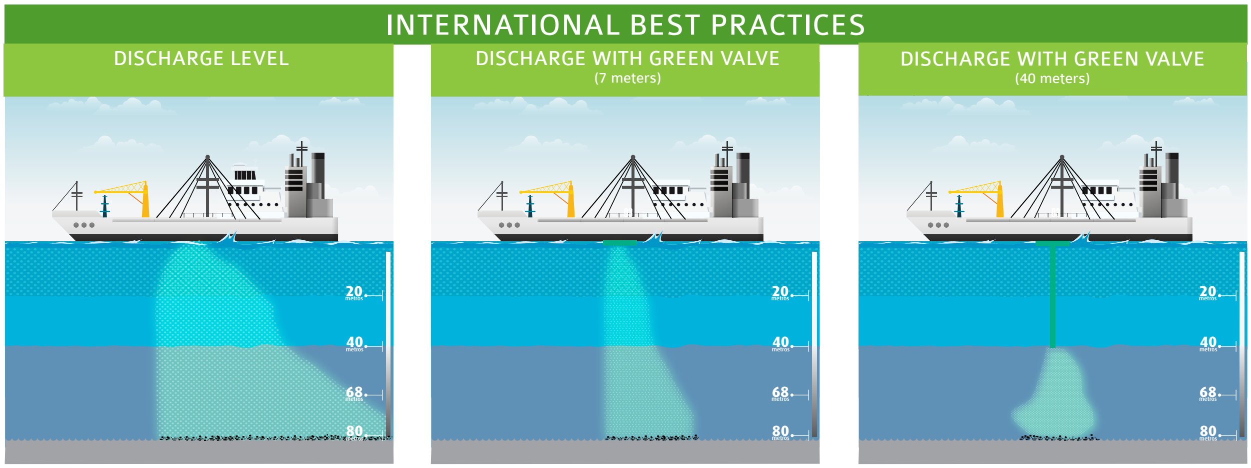
FIGURE 6. Diagram showing phytoplankton production in the surface waters of the 'euphotic zone'. These planktonic plant cells are consumed by grazing animals (zooplankton) which are in turn eaten by carnivorous zooplankton and fish at greater depths in the water column.

Three main options to minimise potential environmental impacts in the water column and on the seabed have been considered for the "Exploraciones Oceanicas" project.

- THE NORMAL INDUSTRY 'BEST PRACTICE' of discharge of overflow material through the lower hull of the vessel at 7 m depth via a 'green valve'. In the case of the "Exploraciones Oceanicas" project, discharge of shells and sands separated by hydrocyclones on the processing vessel (FPSP) would also be discharged at lower hull depth of 7 m below the surface of the sea.

- 'SUPERIOR TO INDUSTRY BEST PRACTICE' scenario of discharge of overflow water from the TSHD at 40 m depth and at 68 m depth from the FPSP. This option was considered to ensure that any impacts of dispersing overflow material from the operational vessels was carried below the temperature discontinuity layer ('pycnocline') that separates surface waters where the majority of primary production by the phytoplankton occurs. A depth of 40 m was selected for the TSHD as the maximum depth to which a discharge pipe could be safely deployed from a moving dredger whilst at the same time ensuring that discharge was below the pycnocline. A deeper water discharge from the FPSP is possible because the vessel is stationary except when manoeuvring.

- ‘BEST POSSIBLE PRACTICE’ scenario of transferring the entire cargo of sediments and water from the TSHD to the processing vessel (FPSP) and then returning the combined sediments from both vessels almost to the seabed via an ‘Eco-tube’ at 73 m depth. This option entirely eliminates discharge of suspended sediments from the TSHD and greatly reduces the ‘footprint’ of dispersion and sediment at the seabed because the column of water through which dispersion will occur is reduced to about 4 metres, rather than the whole water column depth of 80 m. Return of sediments to the near-bed through a 73 m ‘Eco-tube’ also facilitates placement of material into previously dredged strips, and minimises changes in bathymetry in the dredged areas, as can be seen in Figure 7.



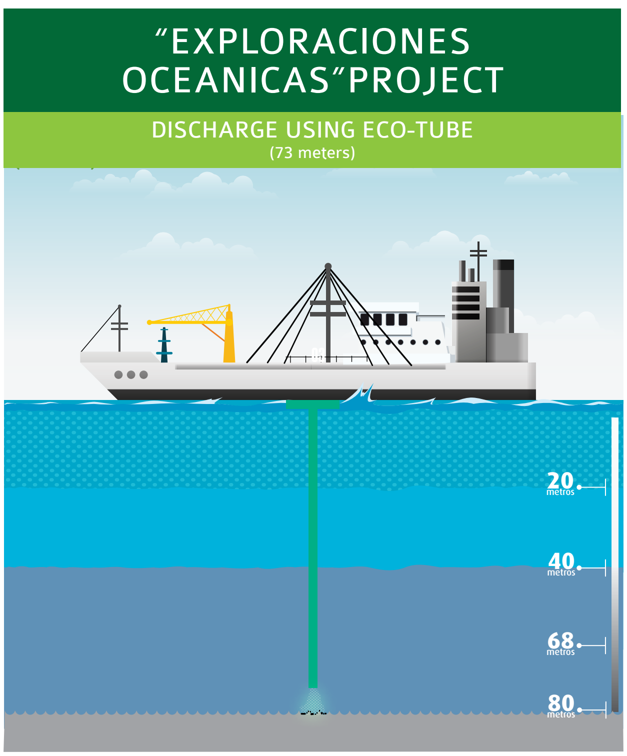


FIGURE 7. Diagrams showing the dispersion of discharged sediment for scenarios including discharge at the sea surface (left), through the bottom of the hull at 7m water depth and using a ‘green valve’ (center), through a pipeline discharge to 40 m depth (right) and through an extended pipeline at 73 m below the surface waters, as proposed for the “Exploraciones Oceanicas” project (left).

SEABED RESTORATION AND SITE ENHANCEMENT

It is important to point out that the seabed deposits in areas that have been dredged are capable of rapid recovery by the small worms and crustaceans that characterise the "Exploraciones Oceanicas" site. The polychaete, oligochaete and nematode worms that occur in the deposits are characterised by short life-cycles and rapid rates of recolonization, whilst the mobile small crustaceans actively migrate into areas where dredging has ceased. Major recovery of biodiversity can occur within weeks and months of cessation of dredging (Kenny & Rees, 1994; Newell *et al.* 1998; Foden *et al,* 2009).

The results of a study of recolonization of sandy deposits in the North Sea by Kenny & Rees (1994) are shown in Figure 8. This may be a slightly unfamiliar form of diagram, but is relatively simple to interpret for the purposes of this overview.

The community composition of the deposits was analyzed in March at a non-dredged reference site and at a site to be dredged in the southern North Sea. The closeness of the symbols to one another indicates that the communities were similar to one another prior to dredging. Samples were then taken in May, two months after dredging had taken place. In this case it can be seen that the community composition at each of the sample sites (blue symbols) was very different from one another, as well as from the pre-dredge samples and the reference site. This is shown by the wide separation of the symbols on the plot. Then by December (6 months after dredging), the communities were nearly the same as those recorded in the reference site and in the deposits prior to dredging, indicating that community composition had been restored.

In other words, recolonization at this particular site was substantially achieved within 6 months of cessation of dredging. Similar rapid rates of recolonization and recovery have been reported in fine muddy sands elsewhere. Although, the recovery times are often much longer in more complex habitats such as rocky reef communities (for review see Newell *et al.* 1998).

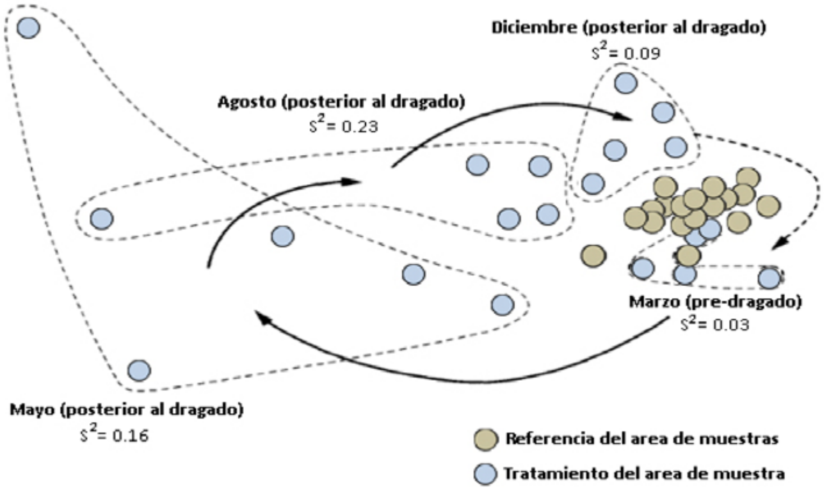


FIGURE 8. Two-dimensional MDS ordination showing the similarity of the benthic infauna in a sandy deposit at a site in the southern North Sea. The diagram shows the close similarity of samples taken prior to dredging and at a reference site. The communities at sample sites after dredging then become very dissimilar to one another and to the pre-dredge community, as shown by the wide spacing on the ordination. After 6-months, the community in the previously dredged site had substantially recovered and approached that in the reference site and in the deposits prior to dredging.

Other studies suggest that increasing the habitat complexity may result in an enhancement of the biodiversity of marine fauna and the food webs associated with the seabed communities. Figure 9 shows the increase in biomass of seabed communities that is associated with complex mixed deposits of gravel and muddy sand, compared with more uniform muds and sands.

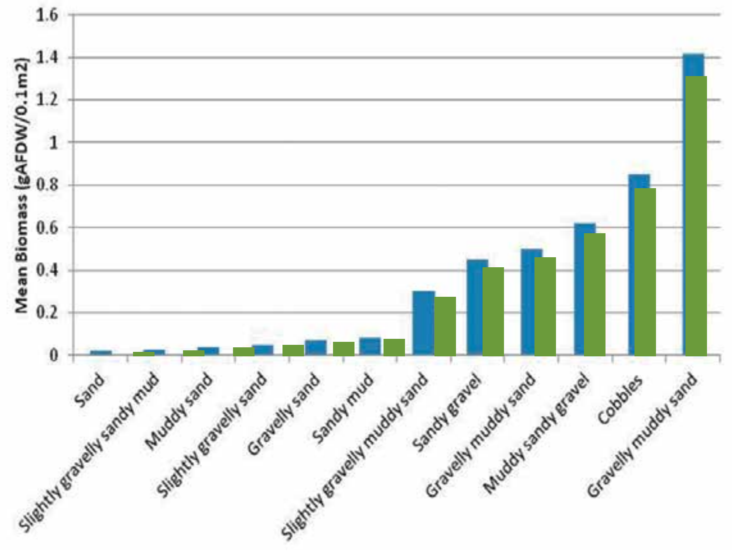


FIGURE 9. Diagram showing the increase in biomass of seabed fauna in complex deposits of the southern North Sea compared with more uniform deposits of mud and sand. (After Emu Ltd, 2009; from Newell & Woodcock, 2013).

Management of dredging works to produce more complex seabed topography has also been shown to result in enhanced biodiversity of invertebrate and fish communities in the 'Building with Nature' programme developed by Boskalis Ltd in major engineering works off the coast of the Netherlands. Therefore we propose to increase habitat complexity in dredged zones at the "Exploraciones Oceanicas" site by depositing the coarse sand and shells from the processing vessel in a series of mounds to create a more varied deposit and complex seabed topography as shown in Figure 10.

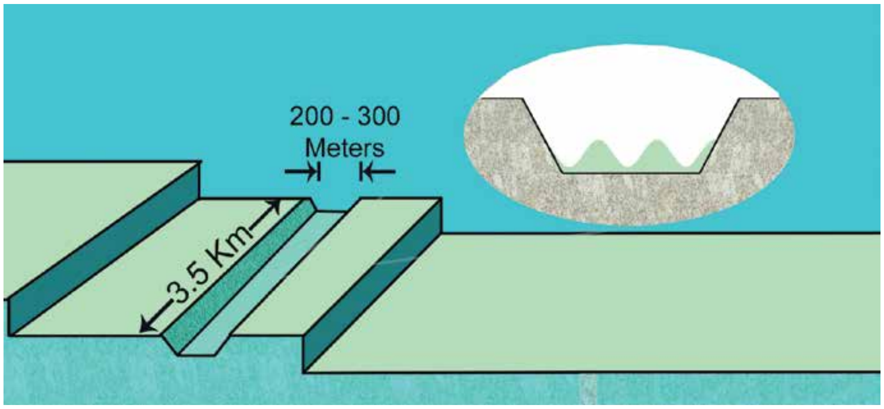


FIGURE 10. Diagram showing the dimensions of the active dredge area and the proposed infilling of the dredged area processing vessel once dredging has ceased in a particular active dredge area.

The seabed community in the "Exploraciones Oceanicas" site currently has a similar species composition to that in the deposits over much of the Gulf of Ulloa, but supports only half of the population density (number of individuals) of that in the surrounding deposits. Provision of a more complex habitat will, we believe, enhance the population density of resident invertebrates and allow substantial recolonization by a similar biodiversity to that in the surrounding deposits within months of cessation of dredging.

Interestingly, data for areas in Tampa Bay, Florida that had been dredged for oyster shell, suggest that a period of as much as 10 years be required for recovery following complete defaunation, whereas, a recovery time of only 6-12 months is required for recovery following partial dredging and incomplete defaunation (see Newell et al;1998). This suggests that areas of undisturbed deposits between dredged furrows may provide an important source of colonizing species that enable a faster recovery than might occur solely by larval settlement and growth (see also van Moorsel 1993, 1994). The concept of temporary 'set-aside' areas between the active dredging zones to enhance recolonization has been included in the following dredging proposals for the "Exploraciones Oceanicas" project.

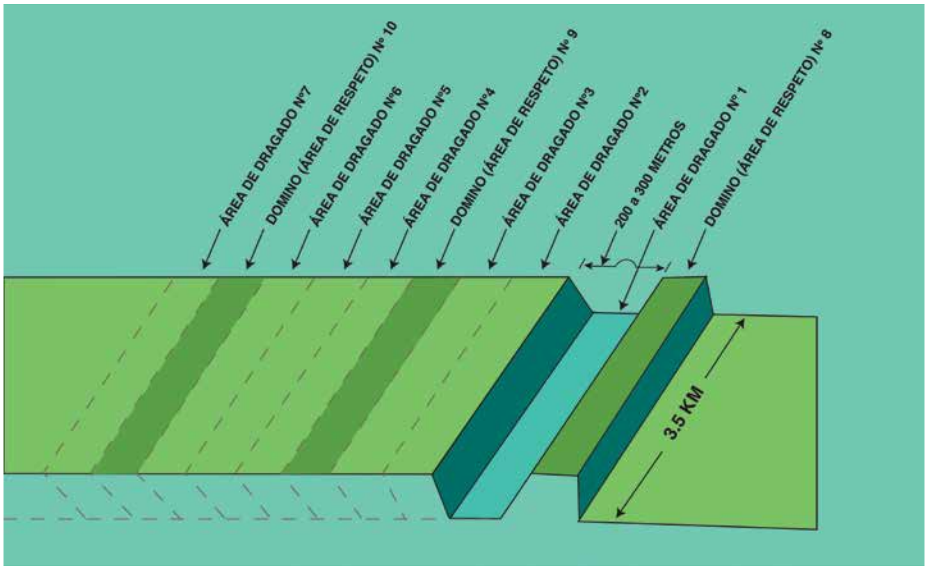


FIGURE 11. Showing the proposed Active Dredge Zone (ADZ) sequence over a 10 y period at the northern operational area of the "Exploraciones Oceanicas" site. ADZs have been arranged so that the adjacent strips provide a source of colonising individuals for the most recent dredge zone.

Seabed restoration and habitat enhancement at the "Exploraciones Oceanicas" site is therefore based on the following principles:

- In Year 1, residual sand and shell discharged from the processing vessel (FPSP) will be discharged close to the east of the ADZ to form a mound on the seabed – a feature of seabed topography that is known to provide improved habitat for fish in the 'Building with Nature' programme and elsewhere.

- From Year 2 onwards, residual sand and shell will be deposited within the ADZ following cessation of dredging from Year 1 to provide both a more varied deposit that will enhance biodiversity (see Figure 11) and a more varied seabed topography in line with the 'Building with Nature' programme.

- Dredging will be carried out in such a way that strips of seabed will be left temporarily non-dredged to enhance recolonisation rates in adjacent dredged zones. Dredging will be carried out sequentially according to the plan shown in Figure 11.

- The dredger will then return to the first of the non-dredged zones, by which time the adjacent zones will have recolonized and will provide a source of colonising species for the adjacent dredged zone. We refer to this as a "domino effect".

ENVIRONMENTAL BENEFITS ACHIEVED WITH EXTENDED PIPELINE DISCHARGE

Additional simulations have now been undertaken to determine the environmental benefits achieved by the two proposed pipeline discharge options compared with standard 'Best Practice' for the dredging industry of discharge through the lower hull of the TSHD at a nominal 7 m depth.

The third option that was considered is to combine the discharges from the TSHD and the FPSP and to discharge close to the seabed at 73 m depth. Figure 12 shows the mean increase in suspended sediment concentration in dredge strip 1 at any one moment in time at the seabed near the discharge point from the combined FPSP discharge pipeline. Clearly discharge near the seabed results in virtual elimination of a dispersing plume in the water column. The plume does not extend beyond 200 m from the point of discharge and no plume of dispersing sediment is predicted to occur at all more than 4 m above the seabed.

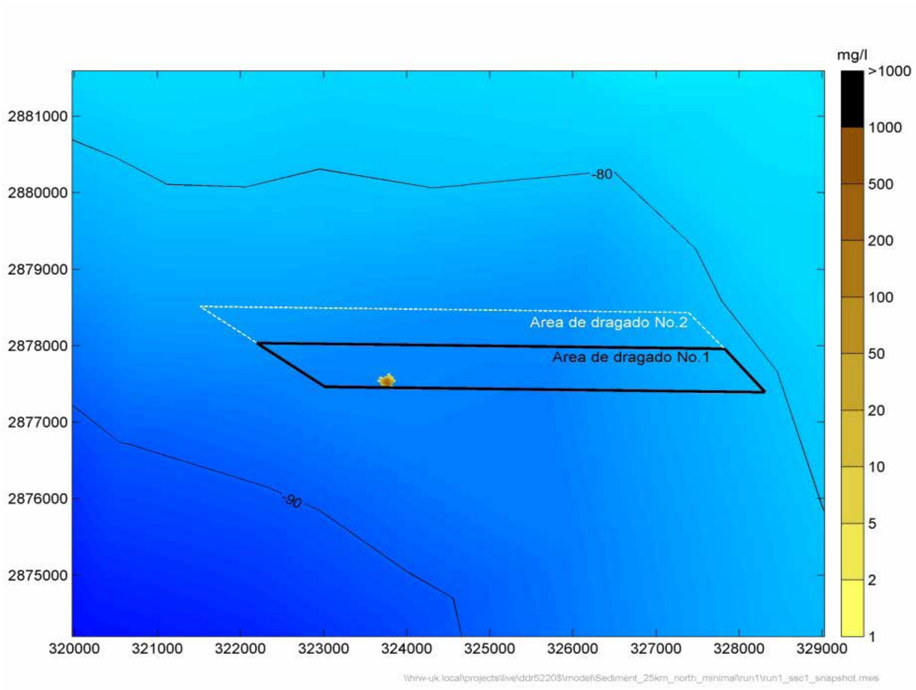


FIGURE 12. Snapshot of the predicted increase in suspended sediment at a given moment in time from a 73 m combined pipeline discharge from the processing vessel (FPSP).

The predicted peak in near-bed suspended sediment concentration less than 4 m above the seabed over a two-week period of dredging during the north-west current is shown in Figure 13. This shows essentially that the very small zone of increased suspended solids concentration follows the track of the FPSP which in this case has been assumed to move eastwards by 50 m every 12 hours to infill the previously dredged area.

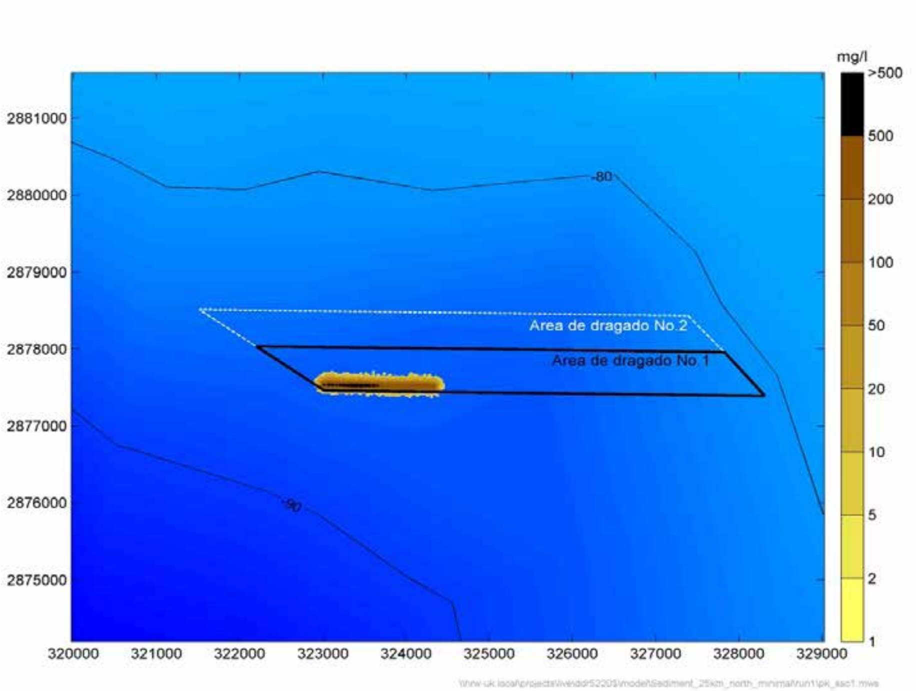


FIGURE 13. Predicted peak increase in near bed (up to 4m above the bed) suspended sediment concentration over the 2 week period of dredging

The use of extended pipelines thus clearly confines dispersion to the immediate vicinity of the discharge point at the sediment-water interface eliminates the possibility of any impacts on primary production by the phytoplankton in the surface waters.

THE EFFECTS OF DISCHARGE OF SEDIMENT ON THE SEABED

The reduction of the 'Footprint' of sediment deposited on the seabed from a long pipeline discharging at 73 meters below the surface of the sea can also be investigated with the simulation model. Figure 14 shows the contours of deposition predicted over a 2-week period, during which the FPSP moves east along a previously-dredged strip of seabed.

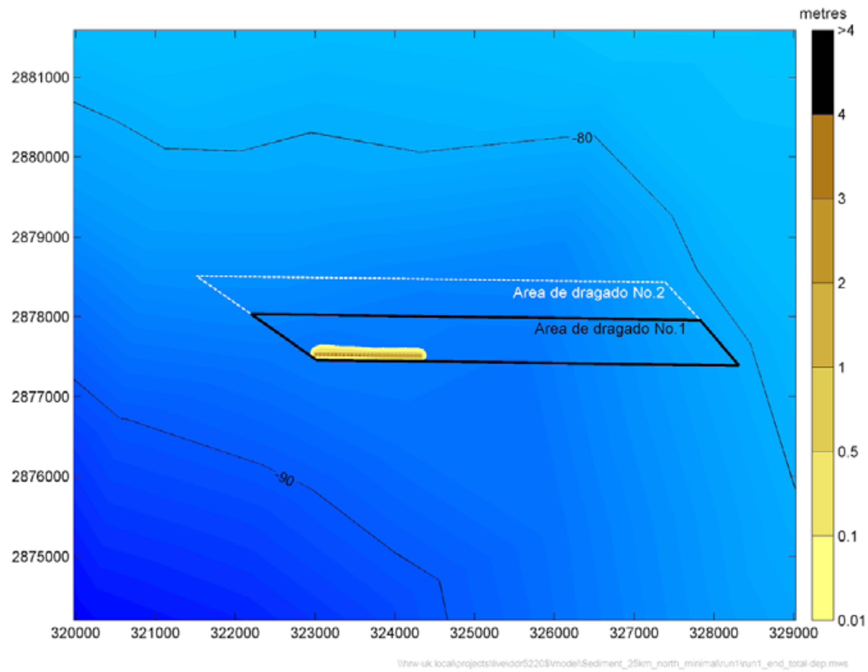


FIGURE 14. The predicted foot print of deposition of sediment from a 73 meter pipeline discharging from the FPSP over a 2-week period.

A simulation of the net deposition after 1 year is shown in Figure 15. All the deposited sediment from the FPSP will be contained within the 1 km² boundary of the previously dredged area (in this case Dredging area 1) while the current area (in this case Dredging Area 2) is being dredged. The brown area represents an initial lowering of the bed level (from dredging) of around 3-4 m followed by a rise in bed level (from placement) of between 1.5-4 m.

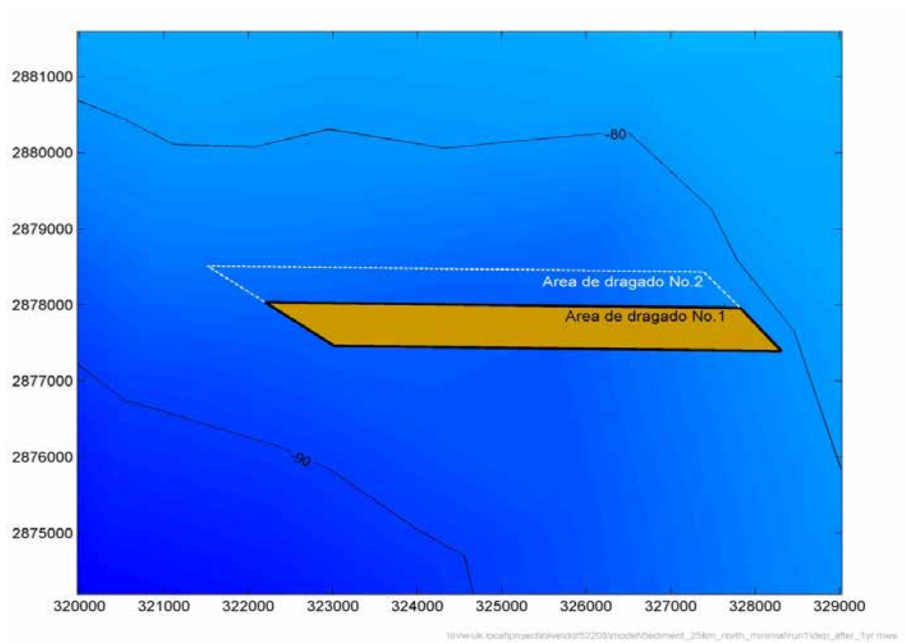


FIGURE 15. Summary of deposition after 1 year from the FPSP using a combined deep water pipeline discharging near to the seabed.

It is clear that the 'footprint' of deposition of material from a pipeline discharging a combination of silt from the TSHD and sand and shells from the FPSP at 73 m near to the seabed is contained within the 1 km^2 dredge zones. This may be compared with a deposition 'footprint' of as much as 49.2 km^2 achieved by industry 'Best Practice' of discharge through the lower hull of the TSHD at a nominal 7 m depth.

Despite the engineering and operational challenges posed by combining the material from the TSHD and the sand and shells from the FPSP, and discharging these through a pipeline extending close to the seabed, this option evidently confers significant environmental benefits for the "Exploraciones Oceanicas" mineral sand project and has therefore been adopted as part of the formal proposal in the MIA.

RESOURCES OF CONSERVATION SIGNIFICANCE: **WHALES**

It is widely recognised that the Baja California peninsula supports a variety of species of conservation significance, particularly within the lagoons on the Pacific coast. Coastal lagoon systems include San Ignacio Lagoon in the north of the Gulf of Ulloa and Bahía Magdalena to the south. These lagoons are important breeding grounds for the Gray whale (*Eschrichtius robustus*) which migrates south from feeding grounds in the northern Pacific. Other whale species including the blue whale (*Balaenoptera musculus*) also migrate southwards along the Pacific coast of the Baja peninsula in the autumn-winter and return north from southern breeding areas in the spring.

The Peninsula also supports a variety of turtle species including the loggerhead turtle (*Caretta caretta*) which breeds in Japan and feeds in the shallow waters of the Baja California Peninsula. Indigenous species which nest in the region include the leatherback turtle (*Dermochelys coriacea*), the olive ridley turtle (*Lepidochelys olivacea*) and Pacific black sea turtle (C*helonia mydas agassizii*).

Because the mineral sands dredging project at the "Exploraciones Oceanicas" site is located at a considerable distance offshore, and the 'footprint' of dredging is very small (1 km^2 per year), there is no possibility of impacts on resources of conservation significance on the coastline approximately 40 km to the east, or on the coastal lagoons of San Ignacio and Bahía Magdalena which are almost 100 km from the dredge site. Nevertheless, we have given particular attention to assessment of potential impacts on marine mammals and on turtles in the MIA prepared in support of the "Exploraciones Oceanicas" dredging project, and this has been supplemented by specialist reports on the sound contours in relation to seasonal whale migration patterns in the Gulf of Ulloa.

RESPONSES TO SOUND

One concern has been whether increased shipping activity might result in 'disturbance' to migratory whale species, particularly at times when they are in transit through the Gulf of Ulloa. A significant study of the effects of sound on a range of local marine mammal species, including migratory whales has therefore been carried out as part of the MIA, and in a supplementary response to the SEMARNAT document.

This work has involved the development of a sound propagation model using measured sound source terms for operating Trailer Suction Hopper Dredgers (TSHD) combined with a wide range of local physical data including water depth, substrate type and oceanographic water quality data obtained in surveys at the "Exploraciones Oceanicas" site. The 'sound contours' show that in all instances the sound levels from a TSHD of the type that will be used at the "Exploraciones Oceanicas" site are less than 140dB re 1μPa - a value that is similar to those of comparable-sized vessels in transit through the area and well below those that pose any potential damage to marine life (see table 1).

CRAFT	RANGE DB A 1M
Cargo vessel	188dB
Tanker	186dB
Fishing boat	170dB
Whale-watchers	145 to 169dB depending on speed
Dredger	**175dB**

TABLE 1. Table showing the frequency and decibel range of sound generated by a variety of shipping vessels.

Importantly, these sound thresholds can be combined with known responses of marine mammals to sound in order to produce 'sound response contours', within which some behavioural response (however small) might occur. The results show that for most marine mammal species that occur on the coast of Baja California Sur, there will be no behavioural response to sound even within a few hundred metres of the dredger. Although the blue whale (*Balaenoptera musculus*) can respond to high-frequency sounds, it shows no response to the sounds at the frequency generated by a dredger, which are below the threshold of sensitivity for this whale species. The most sensitive whale species are the Gray whale (*Eschrichtius robustus*) and the humpback whale (*Megaptera novaeangliae*) but even these are unlikely to show any behavioural response except within a distance of 3-5 km from the operating dredger.

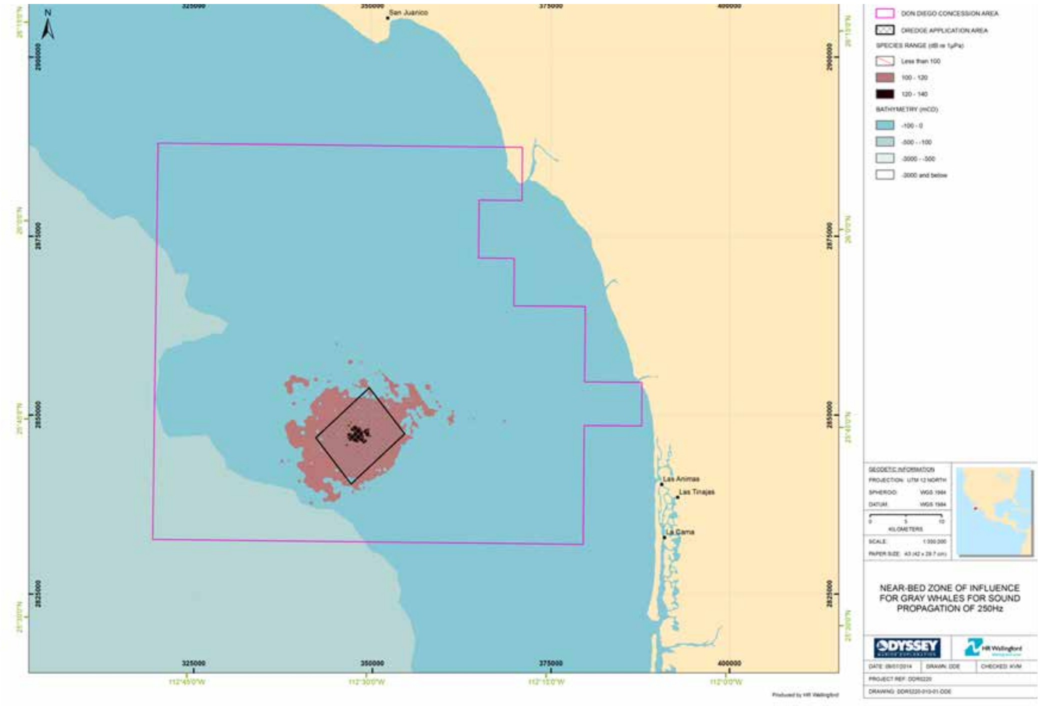


FIGURE 16. Sound response contour for the Gray whale superimposed on the proposed 10 km x 10 km operational dredging zone.

Figure 16 shows the sound response contour for the Gray whale superimposed on the proposed 10 km x 10 km operational dredging zone. The dark central response area is one within which avoidance response might be anticipated, whilst the larger outer response area is one where some response (however small) might occur. From this, it is clear that an avoidance response is unlikely to occur except within 1-2 km of the dredger and that the zone within which some minor response (however small) might occur extends only some 5 km from the point source of sound. We emphasise that these sound levels are well below those which cause any temporary or permanent injury even within the stronger response zone close to the point source of sound.

MIGRATION ROUTES IN RELATION TO THE "EXPLORACIONES OCEANICAS" DREDGE SITE

These results have important implications for the assessment of potential impacts of sound on local whale species, particularly the gray whales and blue whales that migrate in transit through the Bay of Ulloa in the winter months and return northwards in early spring.

GRAY WHALE (*ESCHRICHTIUS ROBUSTUS*)

The Gray whale is a coastal species which spends most of its life close to the coastline on the continental platform. During the fall, about a third of the population of the northeast Pacific travels southwards at a distance of 1-2 km from the shore from the feeding zones located in the north Pacific to breeding grounds in the coastal lagoons of Baja California. The information that is available from satellite tracking indicates that in the Ulloa Gulf the whales move quickly at an average speed of 2-4 km/h during their migration from north Pacific to the San Ignacio Lagoon and Bahía Magdalena which the most southern reproduction area and is less visited by the whales.

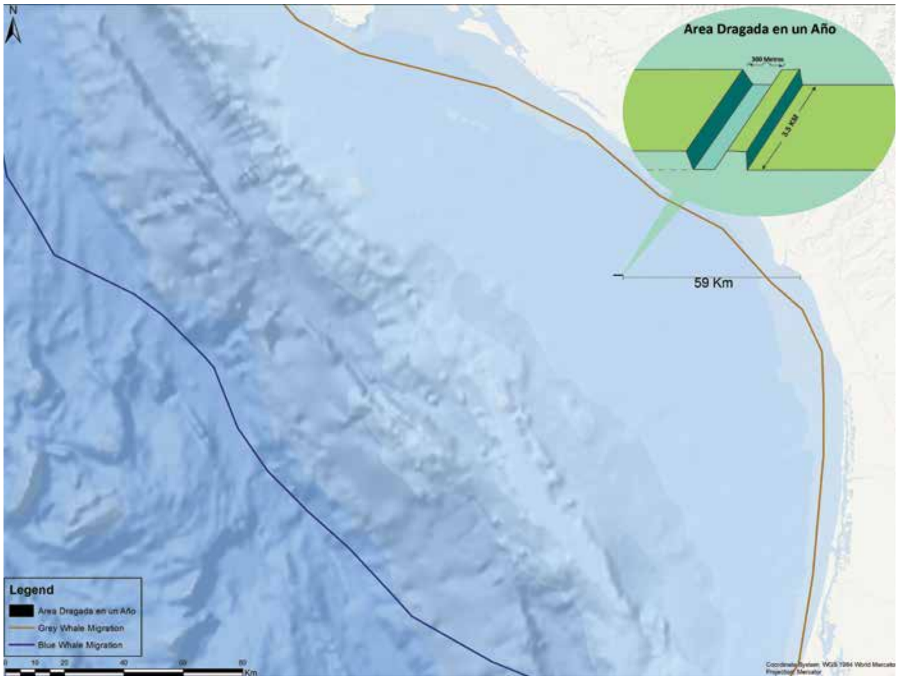


FIGURE 17. Migration routes of gray whales (brown line) and blue whales (blue line) in the Ulloa Gulf based on satellite tracking. These whales swim very close to shore on their northerly and southerly migration. The position of the "Exploraciones Oceanicas" mineral sands resource area is shown.

The Gray whales start arriving to the breeding areas from November to December and continue until February. There are three lagoons in the west coast of Baja California that serve as habitats during the winter: Ojo de Liebre Lagoon-Guerrero Negro, San Ignacio Lagoon and Bahía Magdalena-Almejas Bay. The majority of the adults go to Ojo de Liebre and San Ignacio lagoons. A census carried out on behalf of SEMARNAT shows that since 1995 there has been a large annual variability in the number of adults that arrive to breed. Out of the three lagoons the Bahía Magdalena has the lowest percentage of births.

Large scale environmental changes such as El Niño and La Niña can have an important impact on whale populations, and affect not only food supply and reproductive success, but also the timing of the main migration patterns of the gray whales that arrive to Baja California. The highest numbers of Gray whales in the San Ignacio and Bahía Magdalena lagoons is in mid-February. In the San Ignacio Lagoon, the females with calves gather in the interior regions of the lagoons when the calves are first born and then they move closer to the mouth of the lagoon when the calves are bigger. The same happens in Bahía Magdalena, where the females with newborns gather in the interior at Matancitas in protected, placid waters, moving to areas closer to open sea by the end of the reproductive season at the end of February.

The return voyage to the feeding zones starts in the spring along the same route as the southern migration. The majority of the whales leave the lagoons on their northward journey between the end of January and the end of March. They leave the lagoons in groups that are characterized by age, sex and their reproductive condition. Whales without newborns travel north earlier and at a faster rate than the ones with newborns which emerge from the lagoons at the end of the spring and take longer to arrive at the feeding zones in the northern Pacific.

BLUE WHALE (*BALAENOPTERA MUSCULUS*)

The blue whale is the largest of the whale species, reaching as much as 30 m in length. The largest known population, consisting of about 2,800 individuals, is the northeast Pacific population of the northern blue whale (*B. m. musculus*) subspecies which ranges from Alaska to Costa Rica. Blue whales can be seen off Baja California Sur, arriving from feeding grounds in Canada and the U.S.A. as early as March and April, with the peak between July and September. They tend to migrate along deeper waters following the edge of the continental shelf before making relatively straight movements to and from breeding areas at the coast.

Blue whales feed almost exclusively on shrimp-like crustaceans known as krill (Euphausids) which occur in dense swarms in plankton-rich waters of the Arctic and Antarctic. Blue whales have pleats along their throat which allow them to expand their throat while feeding, and then expel seawater through their baleen, which acts as a sieve. The whale feeds by targeting a swarm of krill, and taking the animals and a large quantity of water into the mouth. The water is then squeezed out through the baleen plates by pressure from the ventral pouch and tongue, leaving the krill to be swallowed, along with small fish, crustaceans and squid. Because of their enormous size, the whales require large quantities of food. They therefore feed in areas with the highest concentration of krill, sometimes eating up to 3,600 kg of krill in a single day and building up significant energy reserves before migrating to their breeding grounds in the warmer, less-rich waters nearer the equator. During their southward migration, the adult whales eat virtually nothing for at least 4 months and live on body reserves accumulated in the rich summer feeding grounds of the Arctic.

No breeding grounds for the blue whale are known in the world, but it is believed that reproduction happens in the winter in tropical/sub-tropical waters. Females and calves are often spotted in the Gulf of California (Sea of Cortez), and this is likely to be a significant breeding area. Blue whales reach sexual maturity between 5 and 15 years of age and give birth at intervals of 2-3 years to a single calf about 7m long and weighing 2.5 tonnes. The calves are then suckled for 7 months and follow their mothers on the spring migration towards the polar seas once they have built up a sufficient layer of blubber to protect them from the cold waters of the Arctic summer feeding areas. Once they have been weaned, the calves feed on krill like the adults, and follow the migration pathways between summer feeding grounds in the Arctic and winter breeding grounds in the tropics.

WHALE CONCLUSIONS

This brief review shows that the principle breeding area for Gray whales in the north of the Ulloa Gulf at San Ignacio Lagoon is at least 80 km from the ″Exploraciones Oceanicas″ dredge site and almost 100 km from the less important breeding and calving area at Bahía Magdalena. The breeding and calving areas for the blue whale are not known in detail, but are likely to be in the Gulf of California many kilometres to the south and east of the Baja California peninsula. It is also clear that Gray whales migrate close to the shore (within 1-2 km) to arrive at, and return from the winter breeding and calving areas. This places their main distribution at least 35 kilometres from the ″Exploraciones Oceanicas″ dredge site which is located approximately 40 km from the shore.

Blue whales are insensitive to the frequencies generated by ships whilst the contour within which an avoidance response of Gray whales might be anticipated, is confined to a zone within 3 km of a ship such as a dredger. In other words, there is a ten-fold margin between even a minor behavioural sound response contour from a dredger operating at the ″Exploraciones Oceanicas″ site and the migratory pathway for Gray whales, whilst the migratory pathway for blue whales is in deeper water to the west of the ″Exploraciones Oceanicas″ site. There is thus no likelihood of disturbance from sound by a dredger operating at the ″Exploraciones Oceanicas″ site on the migratory pathways of these two whale species.

There is also no likelihood of sound from a dredger operating at the ″Exploraciones Oceanicas″ site 40 km off the shore in the Gulf of Ulloa having an effect on breeding and calving areas for Gray and blue whales. The calving sites for Gray whales are found in coastal lagoons located at least 80 km to the north at San Ignacio and at Bahía Magdalena as much as 100 km to the south, whereas, those for the blue whale are in the Gulf of California, not on the west coast of the Baja California peninsula.

It should be pointed out that the dredging vessel operates at a slow speed of only 1.5-3 knots (a slow walking pace) whilst the processing vessel will be at anchor except when manoeuvring. There is thus a minimal likelihood of risk of collision with any species of marine mammals that might be in the vicinity during dredging operations carried out in a very small area of <1 km^2 of seabed (3.5 km x 500 m) at the ″Exploraciones Oceanicas″ site.

Despite the lack of disturbance to migrating whale species, Exploraciones Oceánicas proposes as a Precautionary Measure, the voluntary suspension of dredging operations during the main weeks each year that whales migrate in transit through the Bay of Ulloa. Because there are likely to be year-on-year variations in the peak migration times, our proposal will suspend dredging operations up to two weeks in December in the observed peak period when whales migrate south and for a similar period in March during the main period of northward migration. This is discussed later as part of the mitigation and compensation proposals.

IMPACTS ON **TURTLES**

THE 'HABITAT' OF LOGGERHEAD TURTLES

It is well-known that the Gulf of Ulloa supports a variety of turtle species, some of which feed in the surface waters of the pelagic zone and others in the shallow water coastal lagoons and reefs close to the shore. The species of main concern is the loggerhead turtle (*Caretta caretta*). An important food resource for this turtle species is the pelagic red crab (*Pleuroncodes planipes*) which forms dense swarms in the water column following periods of upwelling and enhanced phytoplankton growth. This pelagic crab species is regarded as an important link between primary production by the plant cells of the phytoplankton and higher trophic levels in the food web, including loggerhead turtles and tuna. A common misconception, however, is the assumption that because the recorded surface distribution of loggerhead turtles in particular overlaps with the seabed area defined by the "Exploraciones Oceanicas" mineral sands deposit, then it follows that dredging activity will necessarily damage the 'Habitat' and food resources upon which the turtle populations depend. This assertion is based not only on a misunderstanding of the food resources available to loggerhead turtles in the Bay of Ulloa, but also on a misinterpretation of the available maps of loggerhead turtle distribution.

The important point to note at the outset is that the existing maps that plot the distribution of loggerhead turtles show the turtle SURFACE CONCENTRATIONS. They are not a 3-dimensional format that includes depth distribution as well as horizontal distribution at the sea surface. Most observations are from vessels operating at the surface of the sea or more recently from satellite data as well as airplane data that at most detect a large turtle at 1-2 meters below the surface. A recent paper by Seminoff *et al* (2014) plotted the surface distribution of loggerhead turtles in the Bay of Ulloa from aerial flight data between 2005 & 2007.

The results for surface sightings in 2005, 2006 and 2007 from Seminoff *et al* (2014) are shown in Figure 18. It is interesting to note that while the survey area remains mostly constant between the years 2005 through 2007, the survey only considers the Gulf of Ulloa and therefore relative turtle concentrations are only relevant within the scope of the study. The survey results, while valid, do not offer a tangible comparison of turtle population density between the Gulf of Ulloa and additional habitat range in locations such as Bahia Magdalena or Los Cabos. Furthermore, it is important to note that the area of highest concentration within the survey fluctuates between 2005, 2006 and 2007 - all years in which no exploration was being conducted in the region by the applicant. It is therefore logical to conclude that turtles are not, at any given time or in any given year, dependent on one specific location within the region of Baja California Sur's Pacific coast.

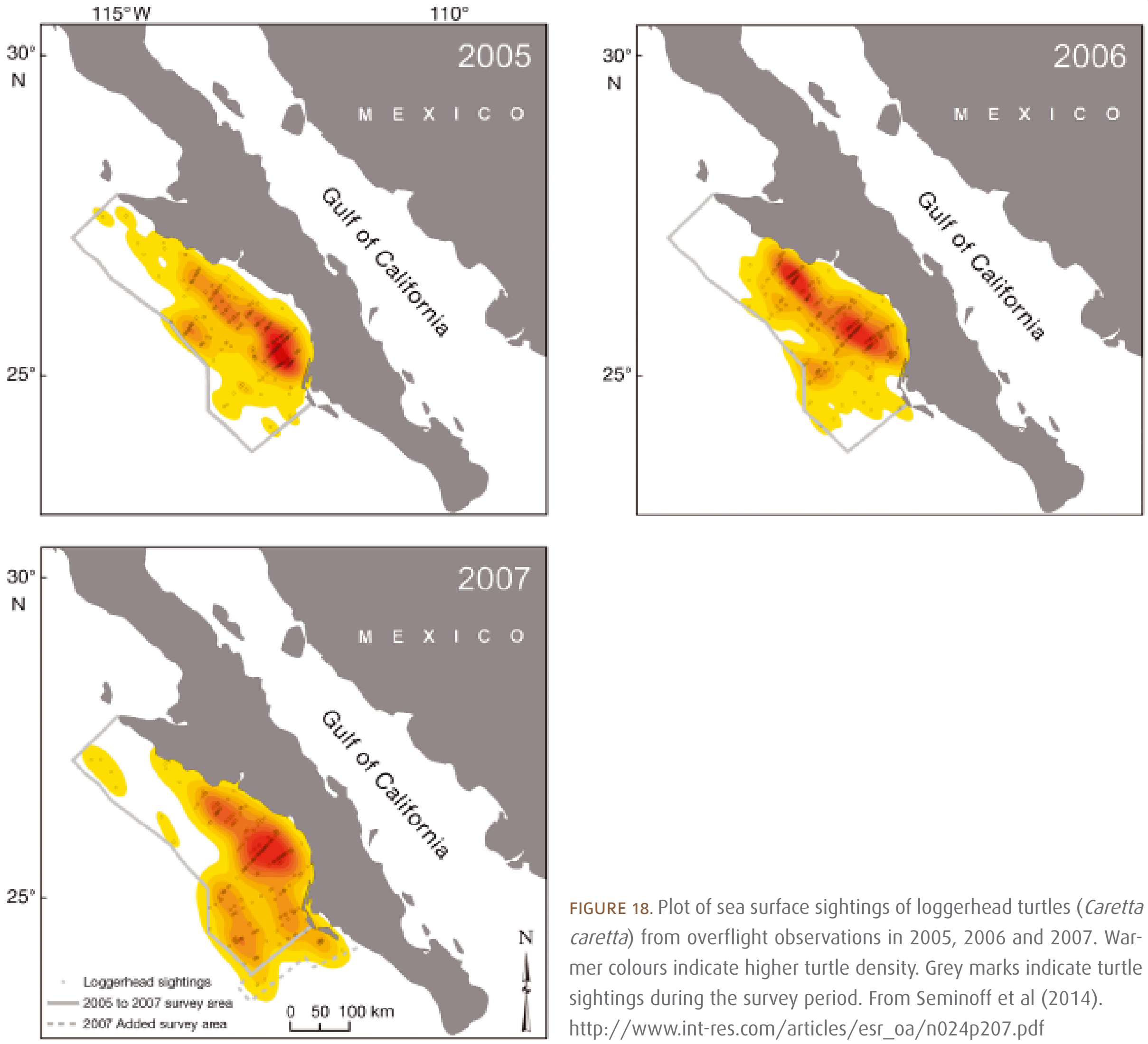


FIGURE 18. Plot of sea surface sightings of loggerhead turtles (*Caretta caretta*) from overflight observations in 2005, 2006 and 2007. Warmer colours indicate higher turtle density. Grey marks indicate turtle sightings during the survey period. From Seminoff et al (2014). http://www.int-res.com/articles/esr_oa/n024p207.pdf

Observations similar to these are well-known for the coastal waters off Baja California Sur, and are clearly the basis for the mistaken view by some that turtle habitat extends to the seabed, and must therefore be affected by dredging at the "Exploraciones Oceanicas" site. In fact loggerhead turtles spend much of their time in the surface waters, and are likely to occur on the seabed only in waters immediately adjacent to the coast. Certainly they are unlikely to spend significant time at 80 meters depth near the seabed at the "Exploraciones Oceanicas" site where water temperatures are below the preferred range of 17-18ºC and where there is an absence of suitable food resources.

A recent presentation by Swimmer *et al* (2003) showed that loggerhead turtles tagged with depth transmitter sensors spend up to 75% of their time in the 0-10 meter depth range and only 25-42% of their time at depths in excess of 10.5 meters, as indicated in figure 19. Similar studies indicate that in Japan the majority of loggerhead turtles are to be found in water depths <5 meters (Shingo *et al*, 2000: http://jeb.biologists.org/content/jexbio/203/19/2967.full.pdf), and that in the Gulf of Mexico loggerhead turtles spend nearly all time at depths <50 m, as shown in figure 20 (Foley *et al,* 2014). Foley *et al* also suggest a preference for habitation of waters overlying coarser sediment such as gravel and rock rather than the finer sediments and mud that characterise the deposits at the "Exploraciones Oceanicas" site.

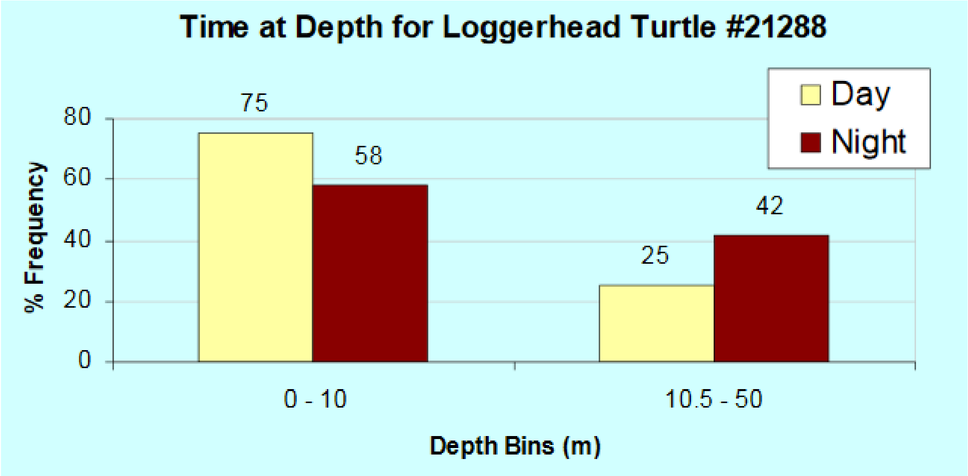


FIGURE 19. Histograms showing the recorded depths of loggerhead turtles tagged with depth-pressure sensors and recorded by the main Hawaiian islands by Swimmer *et al* (2003).
http://www.soest.hawaii.edu/PFRP/dec03mtg/swimmer.pdf

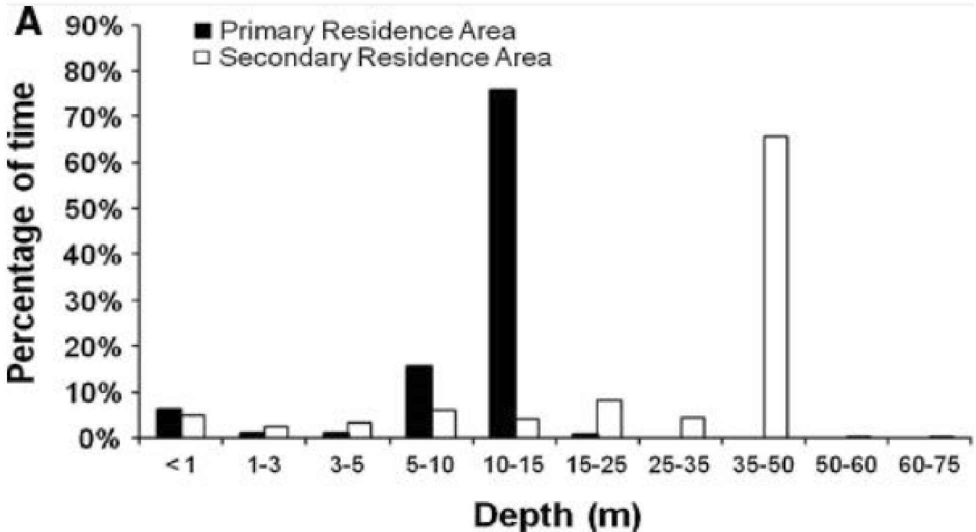


FIGURE 20. Histograms showing time spent at depth by loggerhead turtles studied in the Gulf of Mexico (Foley *et al*, 2014).
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4033788

Similar conclusions have been reached by Swimmer *et al* (2003) who estimate that loggerhead turtles spend 100% of their time at less than 50 metres. A correct 'Habitat Map' for loggerhead turtles in the Gulf of Ulloa that includes their vertical distribution in the water column shown in Figure 21 thus indicates that the turtles are to be found on or near the seabed only in shallow waters close to the coastline, and are completely spatially separate from the seabed in the 80 meters depth at the "Exploraciones Oceanicas" site. There is thus no possibility of dredging in the 80 meter water depth at the "Exploraciones Oceanicas" site having an impact on the 'Habitat' of turtles in the surface waters of the pelagic zone.

The greatly reduced occurrence of turtles at depth compared with that in the surface waters is endorsed in a recent communication dated June 18th 2014 from the National Marine Fisheries Service (NMFS) of the United States of America Regional Fisheries Management Council for the Gulf of Mexico. Here they state "*Turtle Excluder Devices (TEDs) are required in all shrimp otter trawls in the Gulf of Mexico (with the exception for royal red shrimp trawls in depths exceeding 100 meters).*" (http://www.mafmc.org/newsfeed/wasted-catch). Clearly the NMFS consider that in the Gulf of Mexico, turtle densities are so low at depth that TEDs are no longer required by vessels using trawls at depths of 100 meters.

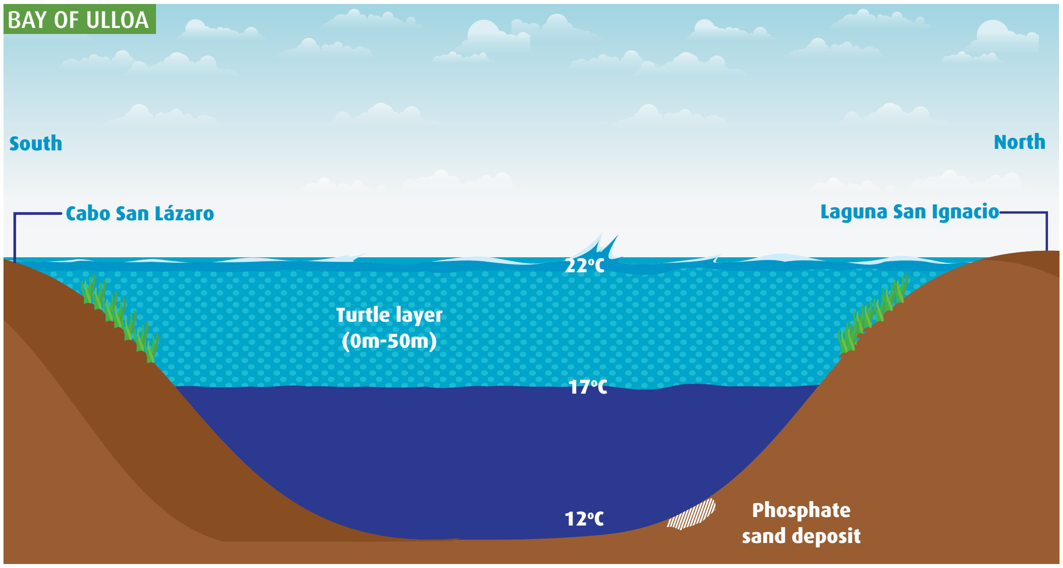


FIGURE 21. Vertical section through the water column in the Gulf of Ulloa showing distribution of loggerhead turtles in the surface waters. Depth range of the black sand deposit is 80-90 meters. Approximate corresponding temperatures at depth are depicted, as derived from empirical measurements at the deposit site. Note turtles are to be found at the seabed only in shallow waters close to the coastline and spatially separated from the seabed at 80 meters depth in the mineral sands deposit area.

A comprehensive Consultation Report carried out by Atta & Dalzell on behalf of NOAA and the Western Pacific Fisheries Management Council identified a similar 'turtle layer' in the surface waters of the North Pacific (Figure 22). This has important implications for the management of longline fisheries and the depths at which significantby-catch of turtles might be anticipated in the 'turtle layer' in the surface waters and avoided or minimised by setting longlines at greater depths. (http://animals.mom.me/habitat-climate-loggerhead-turtle-4400.html)

HAWAII DEEP-SET VS. SHALLOW-SET LONGLINES:

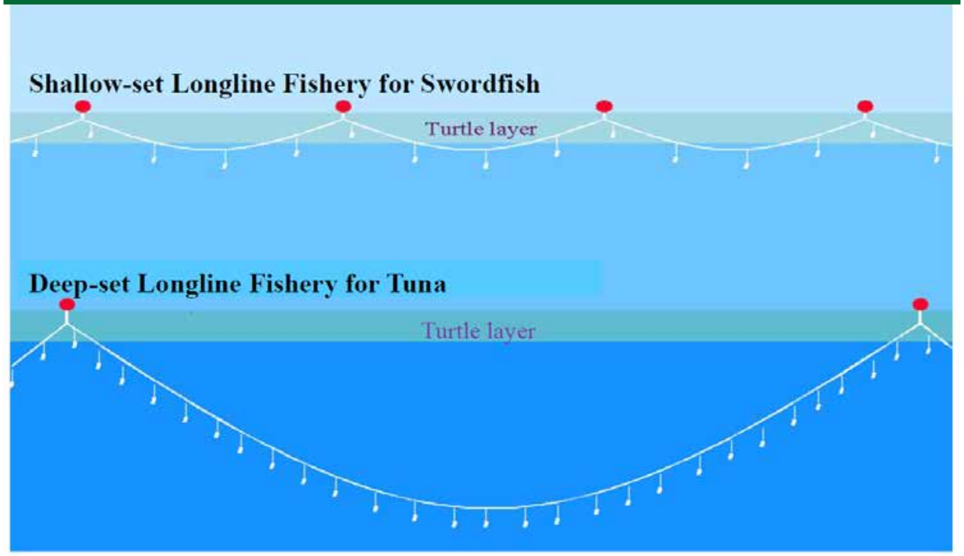


FIGURE 22. Diagram from the NOAA and Western Pacific Regional Fisheries Council Consultation Report showing the surface 'turtle layer' in the water column and implications on Hawaii-based longline fisheries. (http://animals.mom.me/habitat-climate-loggerhead-turtle-4400.html)

A recent article by Michelle A. Rivera emphasises the significance of temperature in controlling the habitat preferences of loggerhead turtles. She states "*Turtles, however, are cold-blooded reptiles with no blubber and rely heavily on the ambient temperature to keep their metabolism going. Loggerheads can run into trouble if they happen to be passing through an unusually warm location warm surface waters that suddenly turns cold. This tragic situation, called "cold-stunning" happened to a bale of 55 sea turtles caught in the Adriatic Sea when the temperature suddenly dropped, leaving 20 turtles dead and 35 fighting for their lives. Cold-stunning causes turtles to move too slowly to dive or hunt, causing severe debilitation*. (http://animals.mom.me/habitat-climate-loggerhead-turtle-4400.html)

There are good reasons why loggerhead turtles remain largely in the surface waters, rather than at depth in excess of 50 meters. Firstly their food resources comprise mainly pelagic species including salps, jellyfish and other larger plankton, as well as pelagic red crab (*Pleuroncodes planipes*) and floating fish discards in the Gulf of Ulloa. Secondly the water temperature at a depth of 80 meters at the "Exploraciones Oceanicas" site is likely to be well below the 17-18ºC preferred by loggerhead turtles, irrespective of the absence of suitable food resources in the deposits at the "Exploraciones Oceanicas" mineral sands area.

Severe hypothermia in turtles causes a decrease in metabolic processes, particularly in the brain and spinal centers. It affects the tissues by crystallization of intra and extracellular water and the high concentrations of salt, plus indirect effects by circulatory changes, skin lesions, decreases the ability of the immune system, cause bradycardia, myocardial affectations in the electrolyte balance and causes the turtles not to feed, and are prone to diseases or predators and eventually they die (Turnbull *et al.*, 2002).

In a recent study by Smolowicz & Weeks (2010) at the Stellwagen Bank National Marine Sanctuary, it is reported that loggerhead turtles become lethargic at temperatures below 12ºC (http://www.nefsc.noaa.gov/coopresearch/pdfs/FR-8-0663.pdf) and may not be able to actively swim or digest food if exposed for long periods to temperatures below 12ºC. Other sources including the New England Aquarium website state that exposure to low seawater temperatures of below 10ºC cause loggerhead turtles to become lethargic and float to the surface of the water. The water temperatures recorded at the 80 metres recorded at the "Exploraciones Oceanicas" site are therefore highly relevant to whether the seabed at this site could be suitable as a 'Habitat' for loggerhead turtles.

At the "Exploraciones Oceanicas" project area and in the larger associated Regional Environmental System (or SAR- Sistema Ambiental Regional), Conductivity-Temperature-Depth (CTD) data indicate a general temperature range of 12.0° – 23.5° C. Below 30 meters water depth, observed temperatures are predominately <17° C (Figure 23).

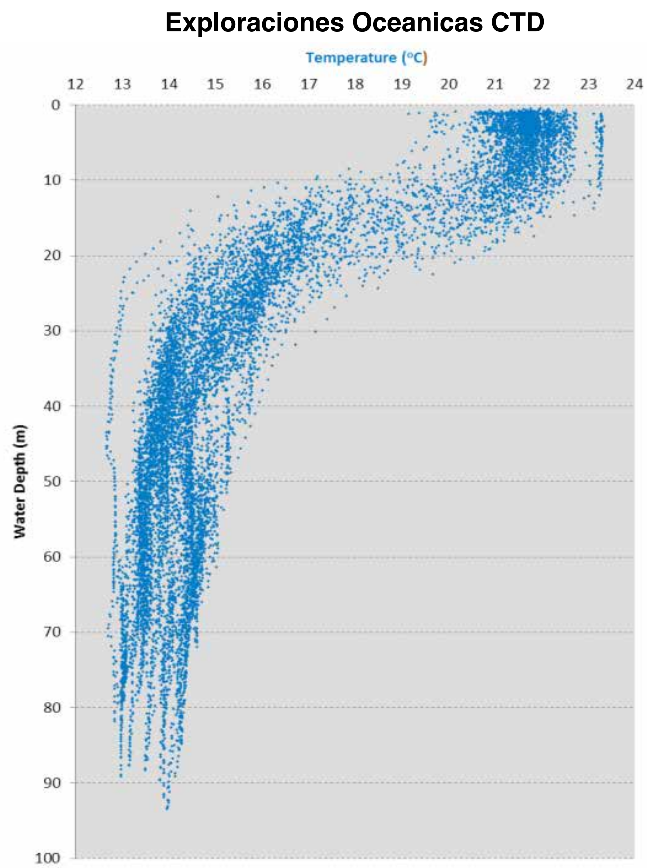


FIGURE 23. Temperature profile as derived from Conductivity-Temperature-Depth (CTD) casts for the water column at the "Exploraciones Oceanicas" site as part of the baseline oceanographic surveys carried out by Odyssey Marine Exploration in August 2013. (From the supporting documentation for the MIA). The record shows the rapid decrease in temperature from 21-22ºC in the upper 10 meters down to 16oC at 20 meters and only 13-14ºC near the seabed at 80-90 meters.

It is clear that the water temperature at depth approaches the value at which cold-stunning is likely to occur in loggerhead turtles, even during the warmest period of the year at the “Exploraciones Oceanicas” site. Site-specific empirical data has not yet been acquired for the winter period, but it is very unlikely that loggerhead turtles will be capable of more than short excursions from the surface waters to the seabed at 80 meters depth, and even more unlikely bearing in mind the absence of any suitable food resources available on the seabed deposits at the “Exploraciones Oceanicas” site. The likelihood of direct impact to individual turtles by the dredge at the site is therefore minimal.

Oceanographic studies carried out as part of the program Investigaciones Mexicanas de la Correinte de California (IMECOCAL) support the information supplied in the MIA from baseline studies at the “Exploraciones Oceanicas” site shown in Figure 23. The program in which CICESE, UABC, UNAM, CIBNOR, SEP and CONACYT cooperated together, has led to the acquisition of a variety of data, including temperature, for Pacific waters off the Baja peninsula. Figure 24 shows temperature characteristics at water depth for IMECOCAL sample stations that generally correspond to the approximate “Exploraciones Oceanicas” project area coordinates; note that at water depths of ~40 meters water temperature decreases to ~17° C.

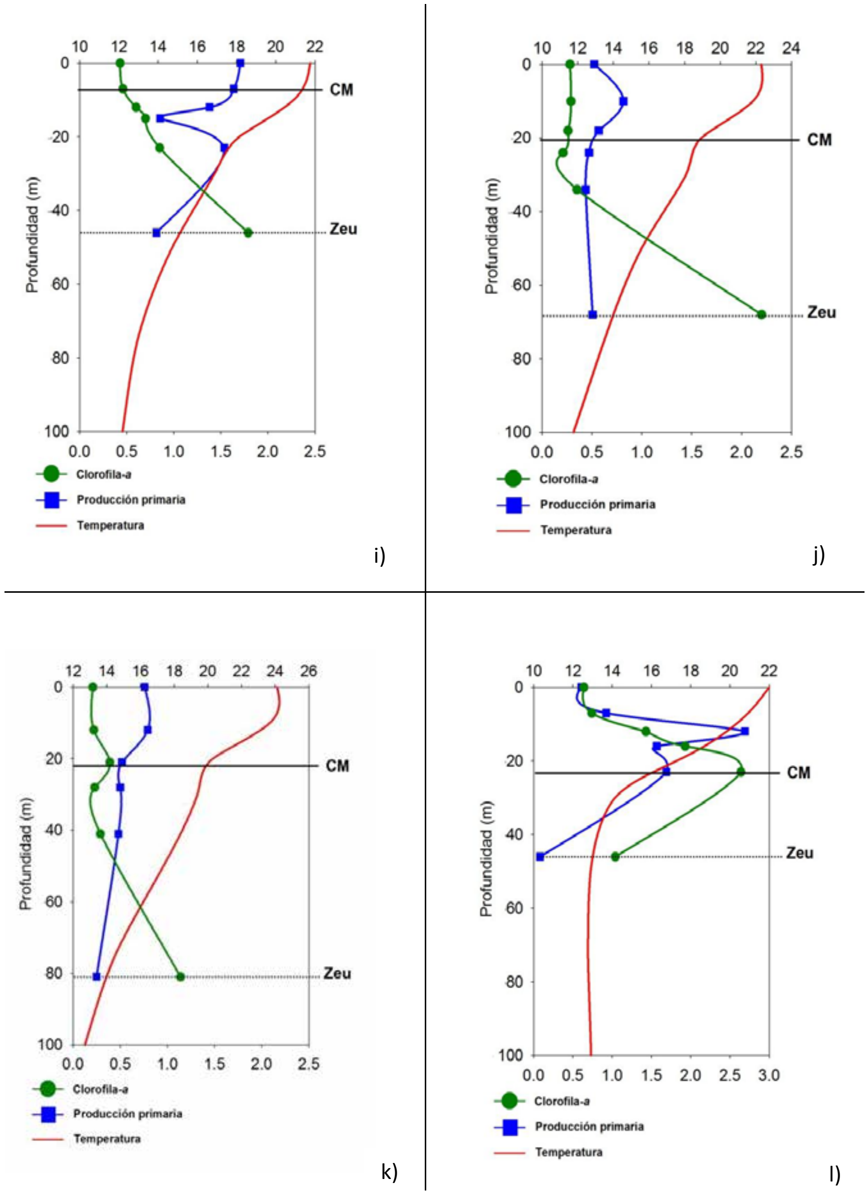
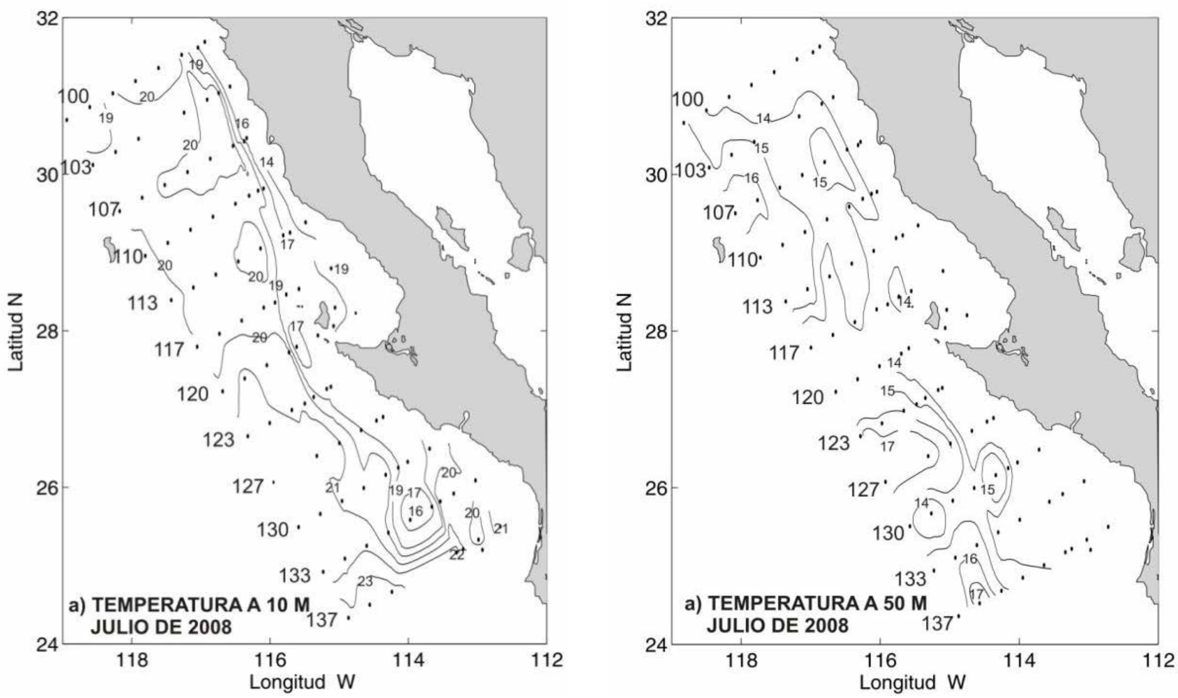


FIGURE 24. The temperature profiles in relation to water depth for IMECOCAL sample stations that generally correspond to the approximate “Exploraciones Oceanicas” project area coordinates. ‘CM’ indicates the mixed layer boundary; ‘Zeu’ indicates the approximate limit of the euphotic zone. From Valdez-Diarte (2008).



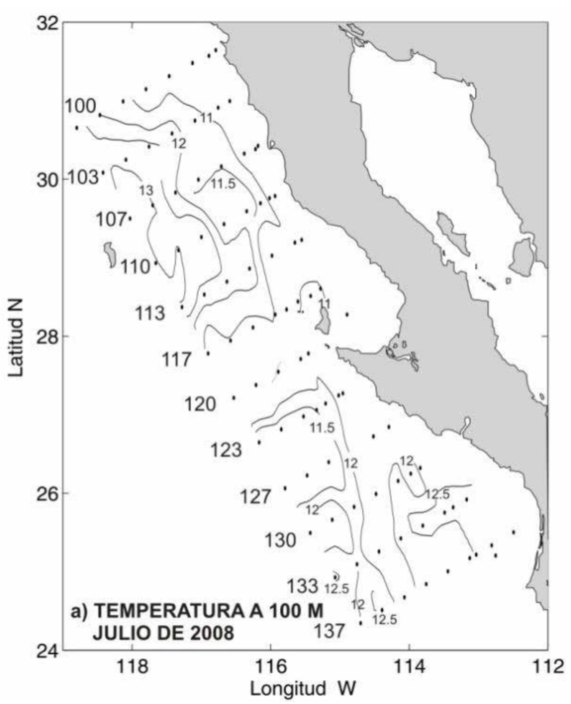


FIGURE 25. IMECOCAL sample stations for July 2008 at water depth. Adapted from Valdez-Diarte, 2008.

TURTLE PROTECTION MEASURES

It has been shown above that turtle distribution is primarily in the surface waters of the Gulf of Ulloa, and not on the seabed at the 80 meters depth at the "Exploraciones Oceanicas" site. Nevertheless established 'Best Practice' methods will be used to ensure as a strictly precautionary measure, that any possibility of entrainment of turtles during dredging is minimised.

Potential methods to minimize entrainment of turtles during dredging have been widely researched, especially in the U.S.A. in relation to the capital and maintenance dredging in shallow waters for approach channels to ports and harbors. Experience in these projects suggests that the most effective approach is to ensure that the draghead of the dredger remains in contact with the seabed while the suction pumps are operating. This includes turning the pumps off when the dredge ship is turning, and ensuring that the dredging vessel is operated in a manner to prevent excessive roll when operating in a significant wave swell.

Operational management of the dredging vessel is clearly an important component of minimizing entrainment of turtles on the seabed, and is particularly important in shallow waters (less than 30 m) where turtles may spend a significant proportion of time on the seabed. Other measures are, however, important and have resulted in a major reduction of losses by entrainment in the U.S.A. and elsewhere. Such measures include use of so-called 'tickler chains' to encourage turtles to move from the seabed ahead of the draghead, as well as a wide variety of turtle exclusion devices that may be fitted to the draghead itself.

There is some dispute among operating dredging organizations on which approach is preferred. Experience in the shallower water (less than 20 meters) dredging operations in the U.S.A. suggests that a combination of operational management of the draghead and use of a 'ploughshare' type of deflector can be an effective approach to minimize losses by entrainment. This system involves the creation of a wave of seabed deposits at the leading edge of the draghead which displaces a turtle sideways out of the path of the seabed equipment with no physical contact.

Our primary dredging contractor has been on the front lines of turtle protection measures in several countries and has modern techniques using jetting, with a submerged draghead, whereby there is no suction in front of the draghead. Jets mounted on the draghead create disturbance in front of the draghead warning off turtles.

Our contractor has tested several methods (including deflector, ticklers and cameras) in the "*Gorgon*" project in Australia, and the 'ticklers' provided the best results without any negative impact on production.

CONSIDERATION OF TURTLE DEFLECTOR

Many of the turtle protection measures, including the use of turtle deflectors, come from information originating from work undertaken by the U.S. Army Corps of Engineers (USACE) based on their extensive research in the U.S.A.

Care should be taken when comparing the literature from the U.S.A. with the works in Mexico. The major differences between the "Exploraciones Oceanicas" project and dredging in the referred literature are listed below:

- In Mexico, we are carrying out capital dredging, while USACE applies to maintenance dredging;
- In Mexico, we are in an open ocean environment and not in an estuary and river ports (USACE);
- In Mexico, we will use considerably larger TSHD (5,000 to 35,000 m^3 hopper capacity) and more powerful than TSHDs used by the USACE (200 to 5000 m^3);
- The dragheads are submerged in the material to be dredged, and are not resting on the surface using erosion techniques as is the case with the USACE dragheads.
- Our contractor's dredgers have modern production techniques using jetting so there is no suction in front of the draghead as is the case with the USACE dragheads. The jets create more disturbance in front of the draghead which provide warning to the turtles.

Several well-tried options proven worldwide by industry leaders have been adopted by Exploraciones Oceánicas to eliminate any likelihood of damage to turtles in the vicinity of the dredging area (see the flow-chart on p.33). Normally, one would select only one of the two dominant turtle protection devices as they are equally effective by themselves.

TICKLER CHAINS

FIGURE 26. 'Tickler chain' device

Some contractors prefer to use the so-called 'tickler chains' that hang three meters ahead of the draghead gently scouring the surface, causing any turtle on the path of the dredge to move away from the path of the draghead. For the "Exploraciones Oceanicas" dredging project, management has decided to adopt a turtle protection system that incorporates both deflectors and tickler chains, to ensure that any likelihood of entrainment of turtles is minimised.

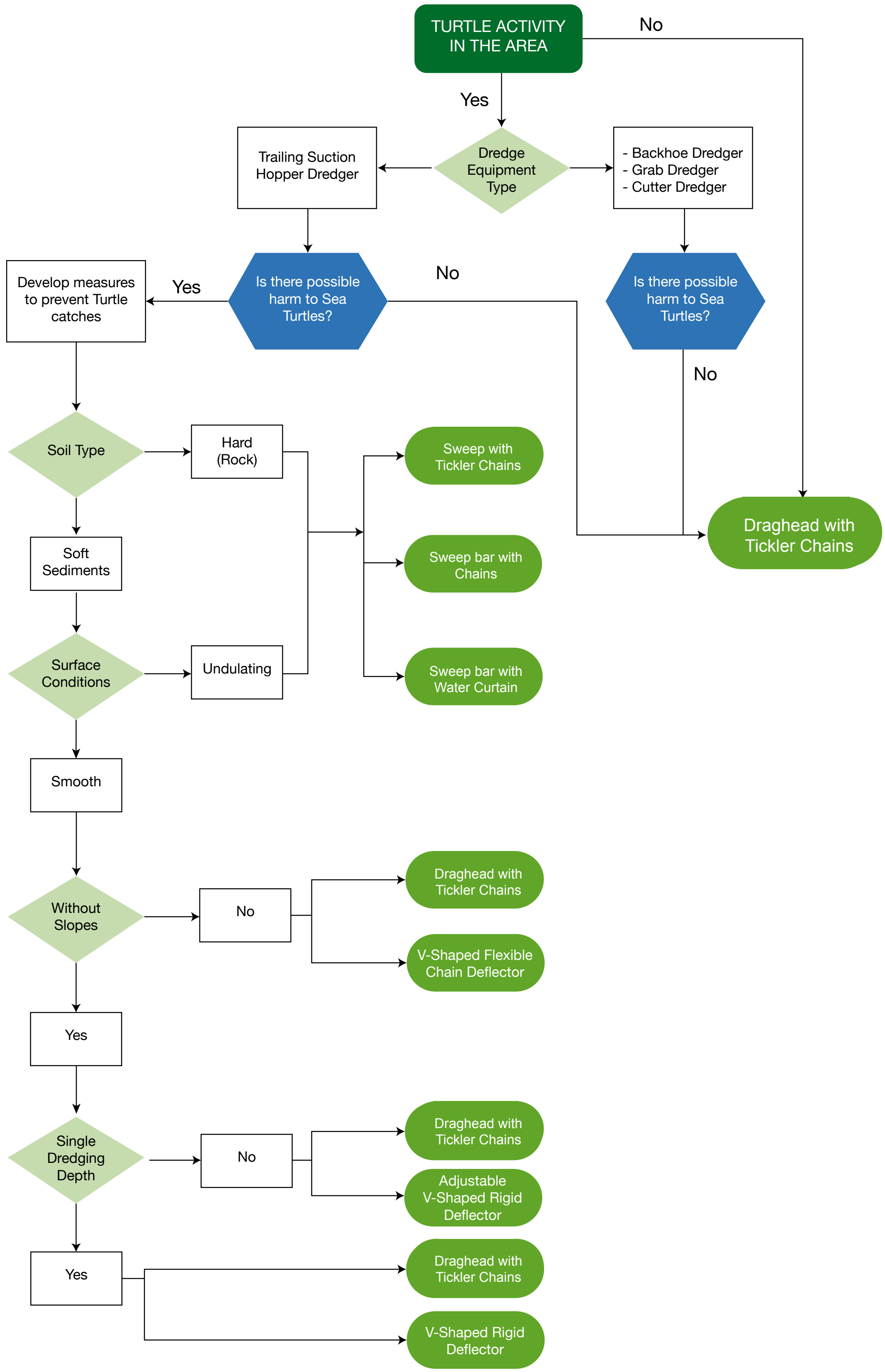
FIGURE 27. Turtle deflectors

The main principle of a tickler chain (Figure 26) is dispersion of any turtles. The tickler chains are connected to the dredge pipe and hang approximately 3 m in front of the draghead, alerting the turtle of the draghead's presence and gently pushing aside turtles. At the dredge ship's very slow speed, turtles will have sufficient response time to move out of the way of the dredge. This flexible dispersal method works in the varying undulating conditions of the area.

This type of 'tickler chain' has been used with success in other projects, e.g. in U.S.A. and in the "*Pluto*" project in West Australia and the North West Channel works of Brisbane in Queensland.

Monitoring for possible injuries and turtle catches will be undertaken at all times during dredging, in order to assess the effectiveness of the system and modify it where necessary.

FLOWCHART FOR TYPE OF TURTLE DEFLECTOR



PROPOSALS FOR THE "EXPLORACIONES OCEANICAS" DREDGE SITE

The following management of dredging is proposed to prevent entrainment of turtles that may be on the seabed at the dredge site:

- The dredging operation will be managed so that the suction pumps will be switched off when the draghead is not in contact with the seabed, for instance, during turning or other maneuvers.

- The vessel will be operated to minimize roll and loss of contact between the draghead and seabed surface during dredging operations.

- Tickler chains will be fitted to the dredge system as outlined above to minimize the risk of turtles being in the path of the draghead; in combination with this system, water jet and other deflection equipment will be used in order to avoid any potential entrainment.

- The dredging vessel will be fitted with screens as part of the operational system for separation of phosphatite material.

- We propose that a record should be kept of any turtles that are entrained during dredging operations so that additional mitigation measures can be implemented if necessary. Compared with dredging operations in shallow nearshore waters such as estuaries and lagoons, the risk of entrainment is significantly reduced at the "Exploraciones Oceanicas" site. Nevertheless, observational records of turtle entrainment on the screens of the dredger will be an important management tool to ensure that the tickler chain system and turtle deflectors are effective.

TURTLE CONCLUSIONS

We conclude that the use of two-dimensional plots to estimate the presumed 'Habitat' of loggerhead turtles on the seabed can lead to a very serious misinterpretation of the presumed impacts on loggerhead turtles. It is abundantly clear from all recent literature, some of which is cited here for illustration, that loggerhead turtles spend the vast majority of their time at depths of 0-10 metres, and only rarely spend a significant proportion of time at depths below 50 metres. The water depth at the "Exploraciones Oceanicas" site is ~80 metres at a minimum – far in excess of the habitat requirements of *Caretta caretta*. Furthermore, the water temperatures at the benthic dredge site are well below the preferred range of 17-18ºC favored by loggerhead turtles and the seabed is devoid of benthic animals that could be exploited as a food resource by turtles.

It is clear that the seabed at the "Exploraciones Oceanicas" site does not represent a 'Habitat' for turtles, neither is there any possibility of impacts on the pelagic food web (including the red tuna crab, *Pleuroncodes planipes*). The seabed does not represent a potential food resource for turtles and there is no possibility of an indirect impact on the pelagic food web – a resource that is specifically excluded from any impacts by means of careful placement of excess inert sand and shells from the separation process as part of detailed proposals for seabed restoration and habitat enhancement.

To summarise, the overwhelming evidence in the MIA and supporting documents shows that the seabed at the "Exploraciones Oceanicas" site is completely unsuitable as a 'Habitat' for turtles. The seabed is too deep at 80 metres depth, the temperatures are well below those that would cause cold stunning under prolonged exposure, and the seabed community of microscopic nematodes and small polychaete worms is completely unsuitable as a food resource for turtles. Added to which, the "Exploraciones Oceanicas" project has been developed to the highest environmental standards specifically with protection of turtles and their pelagic food resources as a primary concern, including internationally proven protection measures such as tickler chains and deflectors to ensure that impacts on occasional turtles that may make a dive to the seabed are avoided.

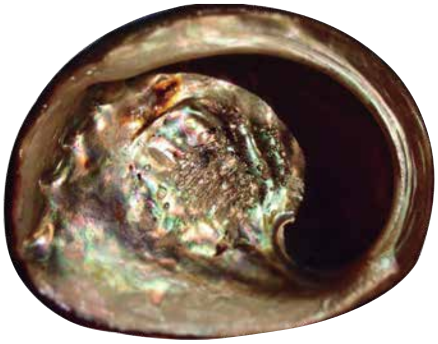
FISHERIES

Despite the minimal effects that this dredging project will have on environmental resources of economic and conservation significance, we are aware of concerns that the Public may have over even small-scale dredging operations off the Bay of Ulloa. These relate mainly to concerns over potential impacts on resources of economic significance such as fisheries, and on those of conservation significance including marine mammals and turtles.

The Baja California Peninsula is regarded as a highly productive area in terms of commercial fisheries. Very few quantitative assessments of the economic importance of this region exist, however, partly because of the difficulty of assessing the value of artisanal fisheries. The artisanal fishing community operates with traditional small vessels and is confined to the immediate coastal zone. Target species include sharks and rays, as well as finfish and a range of invertebrate species such as the abalone, mainly the red abalone (*Haliotis rufescens*) and the green abalone (*Haliotis fulgens*), shrimps, and rock lobster (*Panulirus interuptus*). In 2008, as many as 102,807 vessels were recorded in Mexican artisanal fisheries, exploiting mainly coastal finfish, sharks, crustaceans, molluscs, and echinoderms. This fishery thus represents an important source of employment, providing both sustenance and income for some of the poorest sectors of Mexican society.

As far as offshore fisheries are concerned, by far the most important area is the Gulf of California (Sea of Cortez), the coastline along the south-eastern part of the Gulf of California and all of the Gulf of Tehuantepec. These areas support major shrimp fisheries. The average value of the shrimp industry exceeds US$260 million and the fleet comprises as many as 750 bottom trawlers and about 16,000 small artisanal vessels. Over 75% of the shrimp trawling fleet is based at Guaymas and Mazatlan, with only 2.5% of the fleet from Baja California Sur which is of minor significance for the offshore shrimp industry compared with the Gulf of California.

KEY FISHERIES RESOURCES - ABALONE



The red abalone (*Haliotis rufescens*) is the largest of the abalone species reaching 31 cm in length. It ranges from British Columbia to Baja California Sur, Mexico. This species feeds on large kelp algae associated with shallow water reefs on open coasts. It is most common from the lower shore down to depths of 20-40m but has been reported occasionally at as much as 180 m depth.

Abalone flesh has a high market value of 300-500 pesos per kg, compared with typical values for finfish of 20-60 pesos per kilo (depending on species) and only 7-14 pesos per kilo for sharks. There have therefore been considerable efforts to enhance abalone production by mariculture and fisheries enhancement schemes for wild stocks. Several farms culture abalone (mostly the green abalone *H. fulgens*) to market size (approximately >7 cm), and a restocking programme involving the release of larvae and 'seed' stock (>15 mm) into the wild has also been undertaken by some hatcheries. From 2005 to 2011, 2.2 million seeds (>15 mm) and 692 million larvae were produced by 6 cooperative hatcheries and released in their fishing grounds. Of these, 90.1% of the seeds and 80.7% of the larvae were for the green abalone, *Haliotis fulgens* (Searcy-Bernal, *et al.*, 2010). Preliminary evaluation of the success of restocking in Mexico results suggest that less than 5% of the seeds stocked were incorporated into commercial catches, although this is probably not unusual for the settlement success of mollusc species.

POTENTIAL IMPACT OF DREDGING AT THE "EXPLORACIONES OCEANICAS" SITE

The abalone is a grazing mollusc that feeds mainly on kelp associated with relatively shallow water reefs at 20-40m depth, and the main fishery is through aquaculture systems located at the shore. The nearest natural reef habitats for abalone in the Bay of Ulloa are located close to the shore at least 50km from the "Exploraciones Oceanicas" dredge site. There is no possibility of any impact on abalone that occur on reefs close to the shore.

KEY FISHERIES RESOURCES - SHRIMP

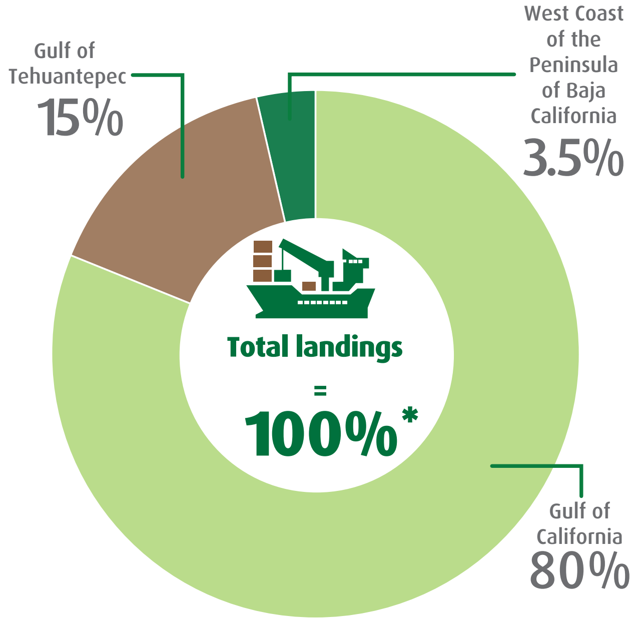
The Pacific shrimp fishery is the most important fishery for Mexico with more than 80% of the catch being exported. The average value of the industry exceeds US$260 million and the fleet comprises as many as 750 bottom trawlers and about 16,000 small artisanal vessels. An estimated 37,000 direct jobs and 75,000 indirect jobs are involved in the industry which runs from September through to March (Magallon-Barajas, 1987).

The industry comprises an offshore and a lagoon component and is based mainly on three species: the brown shrimp (*Penaeus californiensis*), the blue shrimp (*Litopenaeus stylirostris*), and the white shrimp (*Penaeus vannamei*). Other species commonly found in the catch are the red shrimp (*Penaeus brevirostris*) and other species of Penaeid shrimps.

THE OFFSHORE FISHERY

The offshore shrimp trawling fleet is the largest in the country and operates mainly in the Gulf of California. The total catch from the offshore fleet approaches 60,000 MT, of which more than 80% is caught in the Gulf of California, 15% in the Gulf of Tehuantepec and only 2-5% on the west coast of Baja California Sur. The target species is mainly brown shrimp (*Penaeus californiensis*) which occurs at depths of 9-90 meters southwards along the coast from Baja California to the Guatemalan border. Red shrimp (*Penaeus brevirostris*) is caught over a similar depth range in the south-eastern part of the Gulf of California and all of the Gulf of Tehuantepec. The fleet operates mainly from September to April, with the majority of the landings (60-70%) obtained during the first three months of the open season. Normally, when the season opens, the fleet concentrates fishing efforts in the central and eastern parts of the Gulf of California, then as catches decrease the fleet spreads its operations to other parts of the Pacific coast. Within the Gulf of California, Sonora, and Sinaloa support as much as 76% of the total catch, mainly because of the number of coastal lagoon areas and good trawling grounds.

Partly for this reason, over 75% of the shrimp trawling fleet are based at Guaymas and Mazatlan, with only 2.5% of the fleet from Baja California Sur. From this, it is clear that the waters offshore from the Bay of Ulloa and in the vicinity of the "Exploraciones Oceanicas" dredge site are of minor importance for the Pacific coast offshore shrimp fisheries compared with those within the Gulf of California and southwards along the Pacific coast.



*Catch share percentages are +/- 0.5%

THE LAGOON FISHERY

This is mainly an artisanal fishery, although increasing production has been achieved in recent years by the development of extensive mariculture projects associated with lagoons and wetlands in Bahía Magdalena and along the south-east coast of the Gulf of California. Traditional artisanal fishing is carried out by the 'atarraya' (throw-net) and the 'suripera' (cast-net) operated from small boats powered by outboard engines. More recently, the fishery is carried out from 27-foot-long vessels equipped with outboard motors and a 35 foot head rope bottom trawl operated by two fishermen who fish during the night, usually starting at sunset and finishing at sunrise.

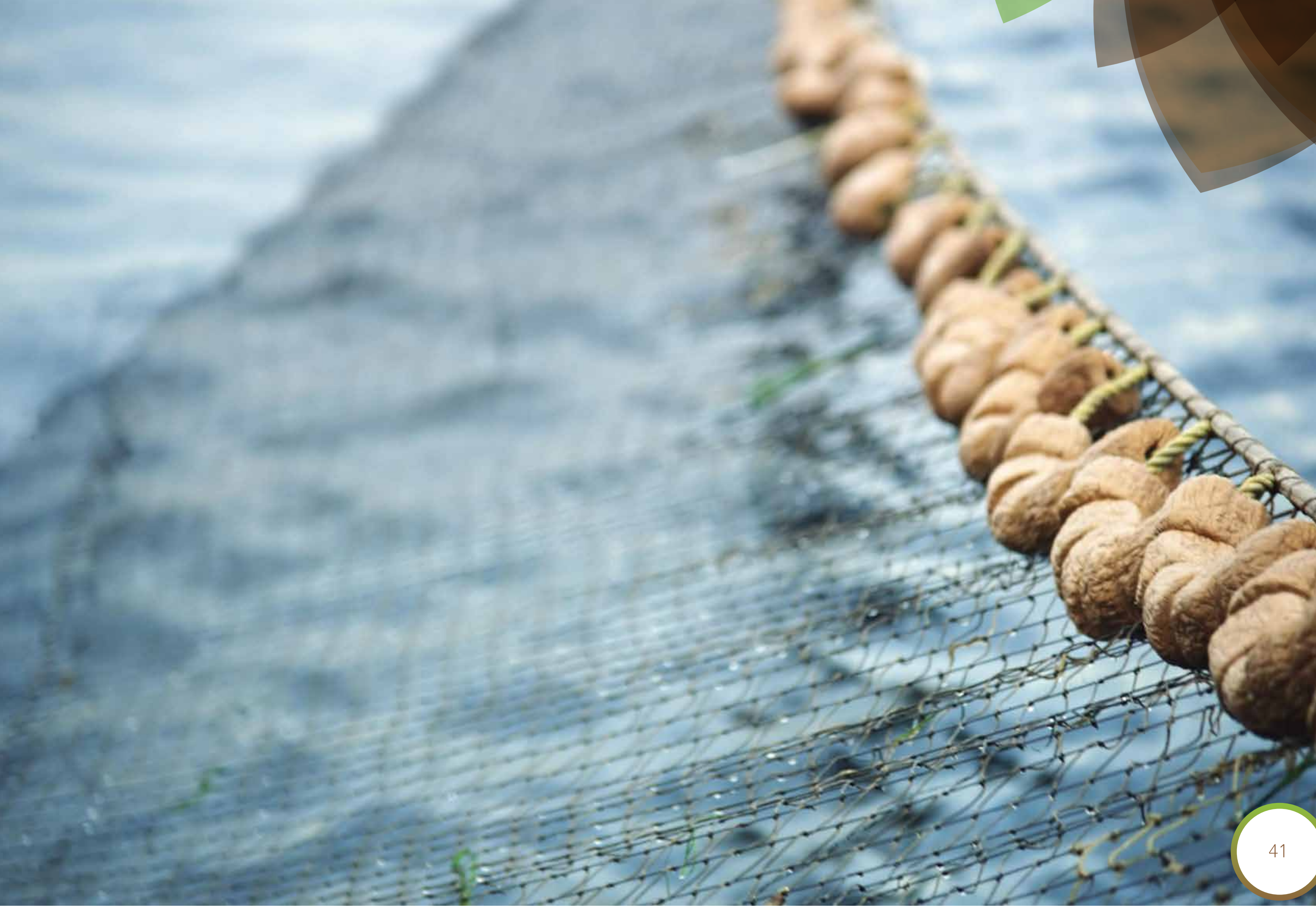
Lagoon fisheries of the northern part of the Gulf of California and Bahía Magdalena are mainly based on the catch of juvenile blue shrimp (*Litopenaeus stylirostris*), but in the southern part the catch also includes juveniles of the white shrimp (*Penaeus vannamei*). The season varies somewhat from September-December in the north to August-February in the south, due mainly to regional variations in the breeding and recruitment season.

During the past several decades, the catch from these artisanal fisheries have remained stable at about 5,000 MT, representing about 8% of the total shrimp catch for Mexico from offshore and lagoon sources. Recent fisheries enhancement projects at Bahía Magdalena include stock enhancement of the yellow-leg shrimp (*Farfantepenaeus californiensis*) and the Pacific blue shrimp (*Litopenaeus stylirostris*). The Bahía Magdalena shrimp fishery now generates annual landings of 1,395 tons with a value of US$7.8 million. Seventy percent of the total landings are yellow-leg shrimp (*Farfantepenaeus californiensis*) and 30 percent are Pacific blue shrimp (*Litopenaeus stylirostris*). Recent estimates suggest that lagoon fisheries comprise up to 28% of the shrimp capture of the state, contributing over US$15.5 million to the economy of the country (Sustainable Fisheries Partnership, 2015).

POTENTIAL IMPACT OF DREDGING ON SHRIMP

This brief review of the Pacific shrimp fishery shows that the total catch from the offshore fleet approaches 60,000 MT, of which more than 80% is caught in the Gulf of California, 15% in the Gulf of Tehuantepec, and only 2-5% on the west coast of Baja California Sur. Over 75% of the shrimp trawling fleet are based at Guaymas and Mazatlan, with only 2.5% of the fleet from Baja California Sur. It is therefore clear that the majority of offshore shrimp trawling is located within the Gulf of California and southwards towards the border with Guatemala, not in the vicinity of the "Exploraciones Oceanicas" dredge site which will occupy a small area of only 1 km^2 off the west coast of the Bay of Ulloa.

Likewise, the nearest lagoon systems that are of importance for commercial fisheries of shrimp are more than 50 km away on the coast at Bahía Magdalena. There is no possibility that dredging within a small area of only 3.5km x 300m of seabed at the "Exploraciones Oceanicas" site could have a direct or indirect impact on shrimp fisheries within the coastal lagoons of Baja California Sur.



KEY FISHERIES RESOURCES - PELAGIC AND DEMERSAL FISH

The nature and scale of fisheries activities for the Pacific coast of Mexico have been described in some detail in a special report to supplement the information supplied in the MIA for the "Exploraciones Oceanicas" project. Fishing effort on the Pacific coast of Baja California Sur is dominated by artisanal fisheries operating from small vessels from the shore. In Mexico, artisanal fisheries account for approximately 40% of the total national catch and comprise up to 80% of the elasmobranch fishing effort. Mexico is amongst the most important elasmobranch fishing nations in the world and in 2007 had the sixth largest catch of sharks and rays at 34,638 T, representing 4.3% of total world catch (Arreguin-Sanchez, F. *et al.*, 2004).

The artisan fishery is conducted from small open-hulled vessels of less than 10.5 m length and powered by outboard motors, locally called "pangas". The most common fishing gear used for demersal species are monofilament gill-nets (often 2 per vessel) each of 200-800m length and with a mesh size ranging from 8-25 cm and deployed on the seabed at depths of less than 100m. Pelagic fish are mainly targeted with long-lines up to 3 km in length baited with up to 400 hooks and set in relatively shallow water of 5-10 meters depth. Essentially, therefore, the long-line fishery for pelagic species is strictly confined to shallow waters close to the shore, whilst gill-nets are used mainly to target bottom-dwelling species in deeper waters.

In most artisanal communities, the catch is sold fresh to local buyers or cooperatives but in some of the more remote communities fish are filleted, dried and salted. The catch for sharks and rays is relatively low value compared with many mollusc, crustacean and finfish species, and typically ranges between 7 - 14 Pesos per kilogram. By comparison, California flounder (*Paralichthys californicus*) fetches 20-40 Pesos per kg, white seabass (*Atractoscion nobilis*) 40-60 Pesos per kg, abalone 300-500 Pesos per kg, and lobster 120-250 Pesos per kg.

POTENTIAL IMPACTS OF DREDGING AT THE "EXPLORACIONES OCEANICAS" SITE

The assessment of the nature and scale of potential impacts on fisheries resources in the MIA for the "Exploraciones Oceanicas" mineral sands project may be summarised as follows:

- Fisheries resources of importance to the local economy on the Pacific coast of the Baja Peninsula are mainly confined to the coastline and lagoons.

- The seabed fauna at the "Exploraciones Oceanicas" site is relatively impoverished and supports a population density which is less than 50% of that in the surrounding deposits in the Bay of Ulloa. It is therefore unlikely to be a preferred or important feeding area for demersal fish compared with the broad area of the Bay of Ulloa.

- There is no evidence that the site is of importance as a spawning area or nursery ground for juvenile fish – probably reflecting the relatively sparse seabed fauna in the resource site.

Any potential impacts on this impoverished seabed fauna are in any case certain to be restricted to the small 'footprint' of the Active Dredge Zone (ADZ) and the small zone of deposition of sediment discharged at 73m close to the seabed. Detailed studies based on the environmental conditions at the site, and extensive knowledge of dredging elsewhere worldwide show the following:

- The 'primary' effect of dredging is confined to the area under the path of the draghead. The Primary Impact Zone (PIZ) is restricted at the "Exploraciones Oceanicas" site to a very small zone of less than 1 km^2 per year and supports an impoverished seabed fauna.

- The effects of sediment dispersion from discharge of the fine material from the TSHD as well as sand and shell material separated by the processing vessel (FPSP) through a pipeline discharging at 73 m depth are strictly limited to the immediate vicinity of the discharge point and extend less than 4 m above the surface of the seabed. There is no dispersion of suspended sediments into the water column and no possibility of impacts on primary production by the phytoplankton or on fish or fish larvae (ichthyoplankton) in the water column.

- The 'secondary' effects of mobilisation and deposition of material deposited during the dredging and separation processes following discharge through the proposed 73 m deep water pipeline is strictly limited to the immediate vicinity of the discharge pipe. It is proposed to use this material to sequentially infill previously dredged areas and for this reason the FPSP will be moved along these areas to restore seabed bathymetry and habitat within a zone of less than 1 km^2 per year. There will be no deposition outside the boundaries of the previously-dredged strips and no possibility of impacts on fisheries resources in the Ulloa Bay.

- Detailed studies on the survival of a variety of test organisms exposed to both sediment and seawater which had been vigorously eluted with sediment from the "Exploraciones Oceanicas" dredge site show no evidence of any contaminants that have an effect on marine fauna.

- Bearing in mind that the dredge site is about 40 km from the shore, there is no possibility of either 'primary' or 'secondary' impacts affecting areas where commercial fisheries are undertaken at the shore.

FISHERY CONCLUSIONS

The annual 'footprint' of dredging at the "Exploraciones Oceanicas" site comprises a very small area of seabed of 3.5km x 200-300m width (1 km^2) located approximately 40 km from the nearest point on the coast, and in 80 m of water on the edge of the continental shelf. Even so-called 'secondary' effects of dispersion and settlement of silt and sand mobilised during the dredging and separation process are strictly confined to the immediate vicinity of the discharge point when the preferred option of a combined discharge at 73 m depth is used. There will be no impacts in the water column above the benthic boundary layer 4 m from the seabed and there will be no impacts outside the boundaries of the dredge site of 1 km^2 in any one year. Detailed assessment of both the nature and location of fisheries resources off the west coast of Baja California Sur, and the potential 'footprint' of dredging a small area of less than 1 km^2 per year of seabed 40 km off the coast at the "Exploraciones Oceanicas" site shows that there will be no impact on fisheries resources on the coastline or in the coastal lagoons that support local artisanal communities.

SAMPLE QUESTIONS THAT HAVE BEEN PRESENTED TO EXPLORACIONES OCEANICAS ON ENVIRONMENTAL ISSUES

This Non Technical Executive Summary reviews in some detail the proposals which we have made to ensure that environmental resources of conservation and economic significance are protected in the vicinity of the "Exploraciones Oceanicas" site which is located approximately 40 km west of the Bay of Ulloa coastline. The welfare of local communities is also of central importance in our corporate responsibility policy and with that in mind we have undertaken an extensive stakeholder consultation process to ensure that the nature and scale of the "Exploraciones Oceanicas" mineral sands dredging project is well-understood. On March 6th, 2015, we responded to a request for clarification from SEMARNAT on as many as 37 points in the MIA that had been submitted in support of the "Exploraciones Oceanicas" mineral sands project. The request for clarification from SEMARNAT included numerical inconsistencies in the original MIA, requests for clarification of technical issues related to the dredging programme as well as requests for clarification on more general potential environmental issues raised by both SEMARNAT and their technical advisors.

Some of these more general issues were appropriate and relevant to the "Exploraciones Oceanicas" project, but others were not relevant to dredging at offshore deposits, and some apparently misunderstood the chemistry of the sediments that will be dredged. We have therefore prepared a detailed voluntary clarification of these additional issues that have been raised during the stakeholder consultation process in a 427 page document known as 'en alcance'.

Some of the commonly expressed issues and our responses are summarised as follows:

Question: ***Has the method of dredging proposed for this project been selected to minimise environmental impacts?***
Answer: Dredging will be carried out with what is known as a Trailer Suction Hopper Dredger (TSHD). This is a vessel of about 5000 m^3 cargo capacity which is fitted with a draghead on the seabed. Material is pumped up through a suction pipe rather like a vacuum-cleaner and creates furrows on the seabed of about 2 metres width and up to 50 cm depth. This method of dredging is used worldwide including numerous projects in Mexican waters for dredging activities including channel works, marine sand and gravel extraction, and infrastructure projects such as sea defences and construction of ports. The impacts are well-understood and strictly localised. The annual 'footprint' of dredging under the draghead at the "Exploraciones Oceanicas"site will be over a very small area of 3.5 km x 200-300 m width – which is less than 1 km^2 per year. The operating company (Boskalis) is a leading expert in dredging techniques that minimise environmental impacts, and has also developed innovative methods of seabed restoration and enhancement that have been incorporated into the "Exploraciones Oceanicas" site restoration proposals. An innovative feature of the "Exploraciones Oceanicas" project that is specifically designed to minimise environmental impacts is that any non-phosphate sand and silt in the dredged material will be retained in the cargo hold of the dredger (TSHD) and transferred to the processing vessel (FPSP) for subsequent discharge through a long pipeline extending to 73 m below the surface of the sea to minimise any possibility of an impact in the surface waters where primary production by the phytoplankton occurs.

Question: ***Is there any likelihood that disturbance of the sediments by dredging will result in an increase in bacterial activity or phytoplankton blooms in the water column?***
ANSWER: A very detailed analysis of the microscopic animals (zooplankton) and plants (phytoplankton) that occur in the water column at the "Exploraciones Oceanicas" site has been carried out as part of a comprehensive environmental monitoring programme for this project. There are no toxic phytoplankton species (Dinoflagellates) of the type that can cause 'red tides'. Further, the deposits do not have the high concentrations of nutrients that can occur in near-shore muds, so there is no possibility of a phytoplankton 'bloom' associated with dredging mineral sands at the "Exploraciones Oceanicas" site. Neither, for the same reason, is there likely to be any increase in microbial activity that could conceivably result in a reduction of oxygen in the vicinity of the dredge site. These concerns are mainly related to dredging of black organic-rich sediments in estuaries and lagoons, not for offshore mineral sands.

QUESTION: ***Is there any likelihood that dredging of mineral sands will result in the release of contaminants that may be toxic to marine life?***
ANSWER: The mineral sands at the "Exploraciones Oceanicas" site are not soluble in seawater and comprise phosphate (mainly sedimentary carbonate fluorapatite), quartz sand, and shell fragments. Quartz sand is not soluble even in acid whilst shell

fragments and phosphate rock are insoluble in seawater under the conditions that occur at the "Exploraciones Oceanicas" site. In order for sedimentary fluorapatite to dissolve, the pH (acidity) levels must be below 6 whereas the pH levels measured at the "Exploraciones Oceanicas" site are alkaline, ranging between 7.68 and 8.06. There is no possibility that either the phosphate ore or returned materials will dissolve in seawater at the pH levels observed at the "Exploraciones Oceanicas" site. Furthermore, metallic components such as transition metals in phosphate ore are bound primarily to the phosphate mineral. The extraction of these metals would require complex chemical processing, including extraction with acid. As such, they are not soluble in seawater under the ambient conditions at the "Exploraciones Oceanicas" site whether in the ore, dispersing sediment plume, or in the material returned to the seabed.

Question: ***Is there any likelihood of an adverse impact of dredging at the "Exploraciones Oceanicas" site on offshore shrimp fisheries or those in coastal lagoons?***

Answer: The offshore trawling fleet operates mainly in the Gulf of California and southwards along the Pacific coast. Of the total catch of shrimp by the offshore fleet, more than 80% is caught in the Gulf of California, 15% in the Gulf of Tehuantepec, and only 2-5% on the west coast of Baja California Sur. There is also a significant artisanal shrimp fishery that mainly targets young shrimp in the coastal lagoons on the coast of Baja California Sur and in the Gulf of California. There are also significant shrimp aquaculture operations in the Gulf of California but only one located in Bahía Magdalena, at more than 80 km from the "Exploraciones Oceanicas" dredge site. Any effects of dredging are strictly confined to the immediate vicinity of the 1 km^2 'footprint' to be dredged per year. There will be no dispersion or settlement of material outside the boundaries of the site being dredged, and no dispersion of suspended sediments into the water column above the immediate 4 m boundary layer within the dredge zone of 3.5 km x 300 m (1 km^2) in any one year. The offshore shrimp industry is at least 100-150 km to the south and east of the dredge site. There is therefore no possibility of any impacts of dredging in annual area of <1 km^2 at the "Exploraciones Oceanicas" site on either the offshore shrimp fishery in the Gulf of California or on artisanal and aquaculture of shrimp in the coastal lagoons of Baja California Sur.

OVERALL CONCLUSIONS

The “Exploraciones Oceanicas” mineral sands dredging project occupies a small annual dredge area of only 1 km^2 located approximately 40 km off the coast of Ulloa Bay, Baja California Sur. The project is of national significance for Mexico and will provide a secure and strategically important resource to support agricultural food production for the country now and for the foreseeable future.

The MIA which has been prepared in support of the project has involved extensive studies of the physical oceanography of the area as well as comprehensive reports on the nature and distribution of resources of economic and conservation significance. This information provides a firm evidence-base for studies which show the very small ‘footprint’ of impact of dredging at the site, and the likely rapid rate of recolonization and recovery of dredged deposits following cessation of dredging.

Despite the minimal effects that this dredging project will have on environmental resources of economic and conservation significance, we have developed a series of additional proposals to emphasize our firm commitment to responsible corporate citizenship. These proposals expand upon documentation previously submitted in the MIA, with amendment or adaptation where necessary to better identify key points of impacts and mitigation.

THESE INCLUDE THE FOLLOWING:

Discharge of suspended solids from the dredger and separated non-phosphatic sand and shells from the processing vessel. Despite the fact that discharge of overflow and process water through the lower hull of dredgers is widely used as industry ‘Best Practice’ in dredging operations elsewhere, we propose to eliminate any discharge of overflow water and silt from the dredger (TSHD) by transferring the entire cargo of dredged material and associated water to the processing vessel (FPSP) and discharging separated sand and shells along with water from the dredger through a long pipeline close to the seabed at 73 m depth. This eliminates any possibility of dispersing suspended solids affecting the surface waters where primary production by the phytoplankton occurs. Simulation models show that there will be no increase in suspended solids more than 4 m above the seabed surface in the immediate vicinity of the discharge pipeline.

The use of extended discharge pipelines from the dredger and processing vessels also confers significant environmental benefits on the seabed. The area within the 0.01 m annual deposition contour is 49.2 km^2 for discharge from the hull in accordance with industry ‘Best Practice’, whereas the corresponding area of seabed deposition is strictly confined to the boundaries of the annual dredge strips of 3.5 km x 300 m (1 km^2) when the material from the dredger (TSHD) and the processing vessel (FPSP) are combined and discharged near to the seabed at a depth of 73 m. We conclude that despite the engineering and operational challenges posed by combining the material from the TSHD and the sand and shells from the processing vessel, and discharging these through a pipeline extending close to the seabed, that this option confers significant environmental benefits for the “Exploraciones Oceanicas” mineral sand project and has therefore been adopted as part of the formal proposal in the MIA.

Whales – Sound levels from dredging operations are no greater than that of ships of similar size passing in transit through the area, and are below those that cause harm to marine mammals. Even in the case of the most sensitive whale species, behavioral response contours are confined to a distance of less than 3 km from the dredging vessel. The "Exploraciones Oceanicas" dredge site is located about 40 km from the shore, whereas the migration routes of the Gray whale (*Eschrichtius robustus*) are confined to the immediate coastal zone, at least 30 km to the east of the dredge site. The blue whale (*Balaenoptera musculus*) is reported to be insensitive to sounds at the frequency generated by shipping, and responds by visual means. There is thus no possibility that sound from an operational vessels at the dredge site will result in disturbance to blue whales. Their migration route is in deeper water well to the west of the dredge site. The distance of the dredge site from migration routes of these principle migratory whale species also precludes the likelihood of any potential collision risk. It should be pointed out that dredging takes place at a speed of only 1.5 - 3 knots (a slow walking pace) and the processing vessel will be at anchor except when manoeuvring, so the risk of collision with any marine mammals is absolutely minimal.

Despite the lack of disturbance to migrating whale species Exploraciones Oceánicas proposes as a precautionary measure, the voluntary suspension of dredging operations during the main weeks each year that whales migrate in the Ulloa Bay. Because there are likely to be year-on-year variations in the peak migration times, our proposal is to suspend dredging operations up to two weeks in December in the observed peak period when whales migrate south and for a similar period in March during the main period of northward migration.

Turtles – Loggerhead turtles (*Caretta caretta*) are unlikely to spend significant periods on the seabed at the "Exploraciones Oceanicas" site because the water depth is 80-90 meters, and the food resources are sparse compared with those in the shallow coastal waters to the east. Nevertheless, a comprehensive series of engineering and management proposals have been made to ensure that any entrainment of turtles is minimized by the use of 'tickler chains' and turtle deflectors that have proven success in shallow water sites where turtle densities are high. We propose to establish a payment scheme for any turtle losses from dredging operations that exceed three individuals per year as reported from a turtle observation programme.

Voluntary Reduction of our Concession Area – We propose to voluntarily relinquish a significant part of our current concession area which lies to the east of the dredging 'boxes' defined in our dredging plan. This will eliminate any overlap with fishing concession areas in the shallower waters to the east and reduce potential conflicts of interests with other legitimate

users of the seabed. Relinquishment of parts of the mineral concession area to the west will minimize any potential intrusion on whale migration routes in deeper waters used by the blue whale.

Fishermen's Compensation Scheme - We have made comprehensive proposals for a scheme to compensate fishermen for losses that can be proven to be caused by the dredging operation, based on independent adjudication of the nature and scale of any losses.

Job creation. We understand the need to provide a direct benefit to local communities as well as at the national level. We are therefore committed to create significant numbers of direct and indirect jobs for local residents and fishermen in the area in which we operate. We propose to provide training to allow local residents to participate in a variety of different employment opportunities including jobs aboard the dredge ship to the use of local boat operators to shuttle personnel, food and other supplies to the ships at sea. We will also commit to a program of buying services and supplies locally.

COMMENTS REGARDING THE SEMARNAT DENIAL OF CONSENT OF THE MIA-R

An application for Consent to carry out dredging works in a small area of seabed in the EEZ of Mexico in the Bay of Ulloa, known as the "Exploraciones Oceanicas" phosphate sands site, approximately 40 km off the west coast of Baja California Sur, was refused by SEMARNAT on April 8, 2016. The main reason for refusal of Consent for the project was that the "habitat" for turtles, particularly Loggerhead turtles (*Caretta caretta*), was thought to coincide with the area of the phosphate sands deposit that will be dredged. The justification for this decision assumed that dredging of the seabed would therefore damage both the seabed "habitat" for loggerhead turtles and the food web that supports them.

THE LOGGERHEAD HABITAT, PREFERRED TEMPERATURES AND "COLD STUNNING"

The use of two-dimensional maps to estimate the presumed 'Habitat' of loggerhead turtles on the seabed has led SEMARNAT to a very serious misinterpretation of the available scientific and academically published information on the distribution of the Loggerhead turtles in the Bay of Ulloa. This has subsequently led to completely unwarranted and unsupported assertions on the presumed impacts on seabed food resources for loggerhead turtles, in spite of the fact that elsewhere in the SEMARNAT document, it is conceded that the principle food resource for loggerhead turtles is the pelagic red crab (*Pleuroncodes planipes* also known as langostilla or red crab) – a species that feeds on phytoplankton and is independent of the seabed for dietary requirement.

It is abundantly clear from scientific literature that loggerhead turtles spend the vast majority of their time at depths of 0-10 metres, and only rarely spend a significant proportion of time at depths below 50 metres. A recent study by Swimmer et al (2003) showed that loggerhead turtles tagged with depth transmitter sensors spend up to 75% of their time in the 0-10 metre depth range and only 25-42% of their time at depths in excess of 10 metres. Similar studies indicate that in Japan the majority of loggerhead turtles are to be found in water depths less than 5 metres, and other relevant studies state that in the Gulf of Mexico loggerhead turtles spend nearly all time at depths less than 50 metres. The water depth at the "Exploraciones Oceanicas" site is greater than 80 metres, this is too deep and too cold for an ectothermic species that regulates its body temperature by the ambient temperature, that is to say that of the surrounding water.

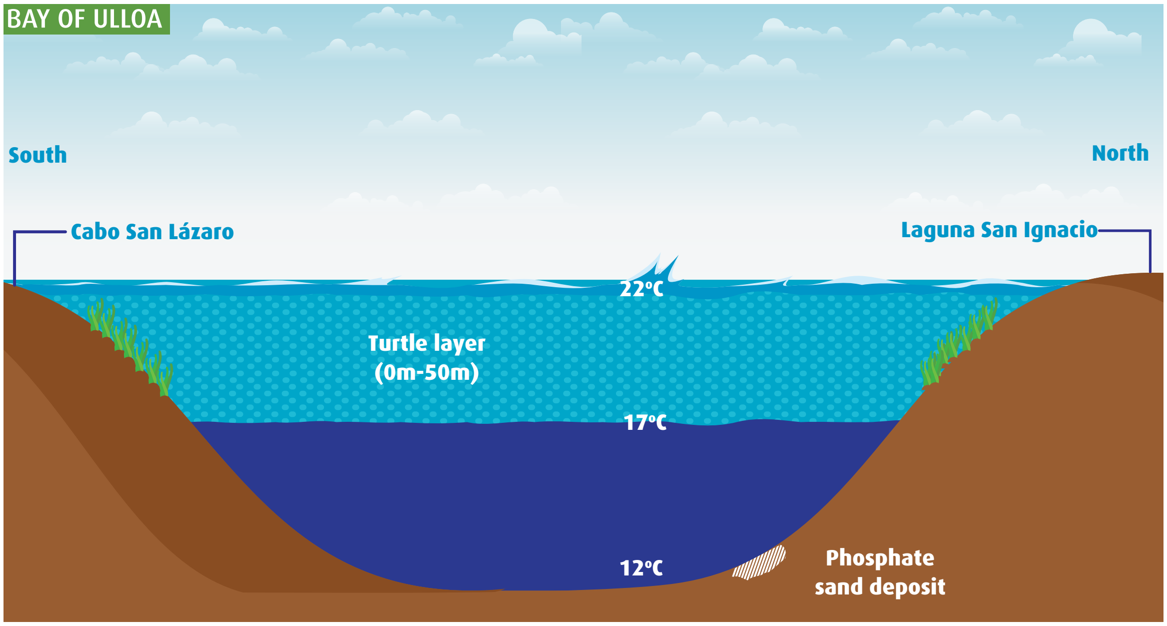


FIGURE 28. Vertical section through the water column in the Gulf of Ulloa showing distribution of loggerhead turtles in the surface waters. Depth range of the black sand deposit is 80-90 meters. Approximate corresponding temperatures at depth are depicted, as derived from empirical measurements at the deposit site. Note turtles are to be found at the seabed only in shallow waters close to the coastline and spatially separated from the seabed at 80 meters depth in the mineral sands deposit area.

The seabed at the "Exploraciones Oceanicas" site does not represent a 'Habitat' for turtles as mistakenly claimed in the SEMARNAT decision, neither is there any possibility of impacts on the pelagic food web including the "langostilla" or red crab, (*Pleuroncodes planipes*). There is no possibility of an indirect impact on the pelagic food web – a resource that is specifically excluded from any impacts by means of careful placement of excess inert sand and shells from the separation process as part of detailed proposals for seabed restoration and habitat enhancement.

The temperature of the water has immense importance for the habitat preferences of loggerhead turtles. Turtles are cold-blooded reptiles, without fat, and rely heavily on the ambient temperature to maintain their metabolism. Loggerheads may encounter difficulties if they re-locate into areas where the temperature is below 12ºC. This tragic situation, is called "cold stunning". Low temperatures cause a decrease in the metabolic processes, particularly in the brain and spinal centers. It affects the tissues by crystallization of intra and extra-cellular fluids and raised concentrations of salt, plus indirect effects by circulatory changes, skin lesions, decreases the ability of the immune system, and bradycardia, myocardial effects on the electrolyte balance reduces feeding and makes turtles prone to diseases or predators and eventually they die. At the "Exploraciones Oceanicas" project area and in the larger associated Regional Environmental System, CTD data indicates a general temperature at the sea bottom (80 to 90 metres) is very close to 12.0°C in the summer months and lower in the winter. At 40 meters water depth, which is the lower limit of the "turtle layer", the observed temperatures are predominately close to 17° C.

To summarize, the overwhelming evidence in the MIA-R and supporting documents shows that the seabed at the "Exploraciones Oceanicas" site is completely unsuitable as a 'Habitat' for turtles as claimed in the SEMARNAT document. The seabed is too deep at 80 metres depth, the temperatures are well below those that would cause "cold stunning" under prolonged exposure, and the seabed community of microscopic nematodes and small polychaete worms is completely unsuitable as a food resource for turtles. In addition, the "Exploraciones Oceanicas" project has been developed to the highest environmental standards specifically with protection of turtles and their pelagic food resources as a primary concern, including internationally proven protection measures such as tickler chains and deflectors to ensure that impacts on occasional turtles that may make a dive to the seabed are avoided.

MAIN FOOD SOURCE FOR THE LOGGERHEAD TURTLES IN THE BAY OF ULLOA

Despite the fact that turtles occur primarily in the Surface waters and exploit food resources in the pelagic zone, rather than on the seabed, we have adopted 'Best Practice' methods developed for coastal waters where turtles occur on the seabed to ensure as a strictly precautionary measure that turtles cannot be affected by dredging at the "Exploraciones Oceanicas" site.

The Loggerhead turtles (*Caretta caretta*) are primarily carnivorous, consuming a wide variety of invertebrate (i.e. crustacean) prey (Peckham et al. 2011). The bulk of literature supports *Pleuroncodes planipes* (also known as langostilla or red crab) as the primary and perhaps natural food source of this turtle specie, with scavenging of discarded fish forming a more recent strategy during the years that are spent in the area of the Bay of Ulloa during maturity. It is believed that *Caretta caretta* target the pelagic phase of *Pleuroncodes planipes* during the spring and summer months when *Pleuroncodes planipes* forms large patchily distributed aggregations in the nearshore waters, often concentrating in the Gulf of Ulloa (Nichols 2003). While there are large populations near the "Exploraciones Oceanicas" area, the important breeding center for the region lies elsewhere in the Bahía Magdalena (Boyd 1960) not near the "Exploraciones Oceanicas" concession. This project will pose no threat to this vital food source of the *Caretta caretta*.

PROPOSED PROTECTIVE DREDGING MEASURES

Dredging is an activity that plays a vital role in the building of a robust economic platform that allows countries to leverage opportunities to move forward in the global world economy. When done in a responsible way and respecting 'best practice' guidelines with the goal of preserving and protecting the ocean community where the dredging takes place, successful dredging projects have made enormous contributions in this regard.

A wide body of work has been gathered in this subject over the last 30 years and the ″Exploraciones Oceanicas″ project is well positioned to take advantage of the great strides that have been made utilizing 'best practices' from around the world.

Turtle observers deployed on dredgers working in tandem with requirements to screen the discharges in the dredging process have substantially reduced incidental turtle entrainment. Other successful innovations have included fitting deflectors over the draghead with the primary purpose to move turtles out of the way have also made substantial reductions regarding entrainment. Careful selection of the appropriate draghead also plays a key role reducing turtle interactions. In addition, the ″Exploraciones Oceanicas″ project will set a precedent in testing a combined configuration of both a deflector and a tickler chain. The theoretical basis for tickler chains is that turtles near the seabed in front of the advancing draghead would first come into contact with the flexible chains, be stimulated to swim away from the draghead, and avoid blunt trauma injury or entrainment. This project will use all of these methods.

Dredge pumping protocols, as demonstrated to be effective in the United States and elsewhere, will be a standard practice. The ″Exploraciones Oceanicas″ project will institute procedures whereby the pumps will not be engaged when the draghead is not in direct contact with the seabed to avoid accidental entrainment.

In summary, sea turtle protection measures to be implemented as a strictly precautionary measure by the ″Exploraciones Oceanicas″ project take advantage of the latest science and engineering technologies available. The observer monitoring and forensics components of the program will ensure that turtles will be maximally protected throughout the life of the project. The multiple layers of protection integrated into the overall project will not only ensure full and adequate protection in the unlikely event that a turtle makes a temporary dive to the seabed, but will provide an opportunity to further refine truly effective management practices. The observer component of the program will provide timely data to ensure that adaptive management steps, including mitigation and corrective practices, will be followed whenever necessary. We believe that the ″Exploraciones Oceanicas″ project will serve as a model for future dredging projects in coastal waters occupied by sea turtles.

RELEVANT COMMENTS ON THE "EXPLORACIONES OCEANICAS" PROJECT BY BOSKALIS

Boskalis and its Mexican affiliate Dragamex, world leaders in environmentally friendly dredging operations, have conducted operations in thousands of localities hosting populations of sea turtles, and has done so with recognized '*best practice'* techniques to ensure species of concern undergo minimal or no risk. They remain committed to fully comply with all requests for use of mechanical systems for turtle preservation, developing audits as industry standard and implementing observation programs, as well as environmentally sensitive operational techniques; this commitment remains, despite any additional operating expenses or loss of efficiency in the development of the project.

In the MIA-R it was clarified that one of the purposes of the "onboard observer" is to observe and alert the crew of any sightings of marine animals such as turtles or whales with whole purpose of averting any impacts on these animals during the dredging process.

OTHER SPECIES OF TURTLES PRESENT IN THE BAY OF ULLOA

The Baja region supports 5 species of marine turtle (Nichols 1999): the hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*), black (*Chelonia mydas*), loggerhead *(Caretta caretta*) and olive ridley (*Lepidochelys olivacea*). None of these turtle species is likely to occur on the seabed at the ″Exploraciones Oceanicas″ site, because the depth of the water, the low temperature at 80 meters depth and the absence of suitable food resources for these turtle species. Their habitats and distribution are summarised below.

Lepidochelys olivacea

This turtle is a carnivorous species that feeds primarily in shallow, estuarine waters. Its diet includes bryozoans, urchins, mussels, crabs, lobsters and other invertebrates. Less commonly, *L. olivacea* has been shown to feed on filamentous algae when food resources are scarce and opportunistically feed on jellyfish when in open water. Because this species does not feed on the small soft-sediment infauna that dominates the Project Site and has not been observed feeding at the depths present within the project footprint (~80 m) it is at low risk of adverse impacts resulting from the "Exploraciones Oceanicas" project.

Dermochelys coriacea

This turtle is an oceanic species that feeds exclusively on jellyfish, tunicates and cephalopods in epipelagic waters. Because it does not interact with the benthos at 80 m or require food resources dependent on benthic productivity it is unlikely that there will be any impact of dredging a small area of seabed at 80 meters depth at the "Exploraciones Oceanicas" site on this pelagic turtle species.

Chelonia mydas

This species feeds exclusively on seagrass and benthic macroalgae in shallow coastal and estuarine environments. Lack of benthic macrophytes in the Gulf of Ulloa at project depths (~80m) precludes significant interaction between *C. mydas* and active dredging operations.

Eretmochelys imbricata

This turtle is found in shallow coastal waters supporting hardbottom, coral reef and mangrove habitat types. It feeds preferentially on sponges, but its diet can also include crustaceans, macroalgae, and fish. None of these food resources have been documented within the proposed Project Site and so active dredging of soft-sediments at 80 m is not anticipated to result in direct impacts to *E. imbricata*.

BASELINE STUDIES FOR THE ″EXPLORACIONES OCEANICAS″ PROJECT

The central role of so-called 'Baseline' studies in the environmental impact assessment process is to provide information on the environmental resources that may potentially be affected by an infrastructure or development proposal, and the extent to which these may be unique or different from those in the wider environment. Such studies provide the 'context' against which potential impacts can be assessed. This then allows development of appropriate mitigation measures to minimise any impacts, such as the design and operation of the ″Exploraciones Oceanicas″r edging project, and can be combined with proposals to compensate for impacts that cannot be appropriately minimised.

Baseline studies carried out as part of the Environmental Impact Assessment (EIA) process for the ″Exploraciones Oceanicas″ project thus involve a combination of wide-ranging oceanographic and biological resource surveys in the Gulf of Ulloa, combined with a requirement for more detailed 'pre-dredge' surveys based on a thorough understanding of the nature and scale of impacts of Trailer Suction Hopper Dredging (TSHD) on the marine environment.

The steps in the MIA-R (EIA) process for the ″Exploraciones Oceanicas″ site may be summarised as follows:

- A comprehensive study of the physical environment and associated biological communities in the area that could potentially be affected by the project.
- An assessment of the sensitivity and resilience of the biological communities to disturbance from dredging.
- Proposals on how potential impacts can be mitigated by design of the project to eliminate or minimise predicted impacts. They include elimination of any impacts on the water column and restriction to impacts on the seabed by discharging residual sand and shells through a long 'Eco-tube' extending nearly to the seabed at 73 metres depth.
- Proposals on habitat enhancement that can be used to compensate for impacts that could occur as a result of the project. These include restoration of the seabed bathymetry by placement of residual sand and shells within the confines of previously-dredged strips, and improvement in the range of particle size composition of the seabed deposits to enhance biodiversity.
- Proposals for monitoring the impacts of the project to ensure that the nature and scale of impacts and recovery of biological resources is in line with predictions made in the Environmental Impact Assessment. They comply with international Best Practice recommended in *Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites* (Ware & Kenny, 2011) and are included in detail in the MIA-R and associated documentation.

CONCLUSIONS ON SEMARNAT DENIAL

1 The ”Exploraciones Oceanicas” site is located 40 kilometres from the coast and in 80 metres of water depth. It is not a habitat for turtles, including the loggerhead turtle (*Caretta caretta*) and the biological resources on the seabed comprise species that are a few millimetres in length and sparse in numbers. They are unsuitable either in quality or quantity to comprise a food resource for loggerhead turtles, neither does the site provide food resources for other turtle species which either characterize offshore oceanic ecosystems or inhabit coastal lagoons and reefs. In fact, the ambient temperature at 80 m depth is far less than the preferred temperature for the loggerhead turtles of 17º-18ºC that occurs as the minimum temperature in the ‘turtle layer’. On the phosphatic sand deposit in the Bay of Ulloa, water temperatures are dangerously close to 12°C during summer times and are cooler during the winter, being able to produce the ‘cold stunning’.

2 The project has been specifically designed to eliminate any impacts in the water column where primary production by the phytoplankton in the surface waters at the ”Exploraciones Oceanicas” site drives the pelagic food web. Dredging will take place over a small area of 3.5 km length and 200-300 metres width (1 km^2) per year. Placement of inert sand and shells from the sorting process through a long ‘Eco-tube’ extending to 73 metres depth will allow restoration of seabed bathymetry in previously-dredged strips, and provide a suitable substrate for enhanced biodiversity following cessation of dredging. The project will therefore have a minimal effect on an area of seabed of about 1 km^2 and no impact on the water column.

3 Notwithstanding the lack of potential impacts on either turtle habitat or food availability, we recognize the concerns associated with the significant mortalities of turtles recorded in the Gulf of Ulloa in recent years. The reasons for this are likely to be complex and related to both environmental deterioration of coastal habitats including seagrasses in the lagoon ecosystems that characterize the coastline of the Gulf of Ulloa, and bycatch from artisanal fishing methods such as gill netting and longlining.

4 Proposals are made for a programme of habitat restoration in the coastal lagoons, and reduction of by-catch by a combination of fisheries buyback schemes and changes in the type of hooks used in traditional longlining methods used by the artisanal fishermen. Significant progress has already been made with artisanal support for the ”Exploraciones Oceanicas” project by the fishermen’s co-operatives on the coastline of the Gulf of Ulloa, and we anticipate further stakeholder engagement in addressing improvements to turtle protection and habitat enhancement once the project is approved.

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