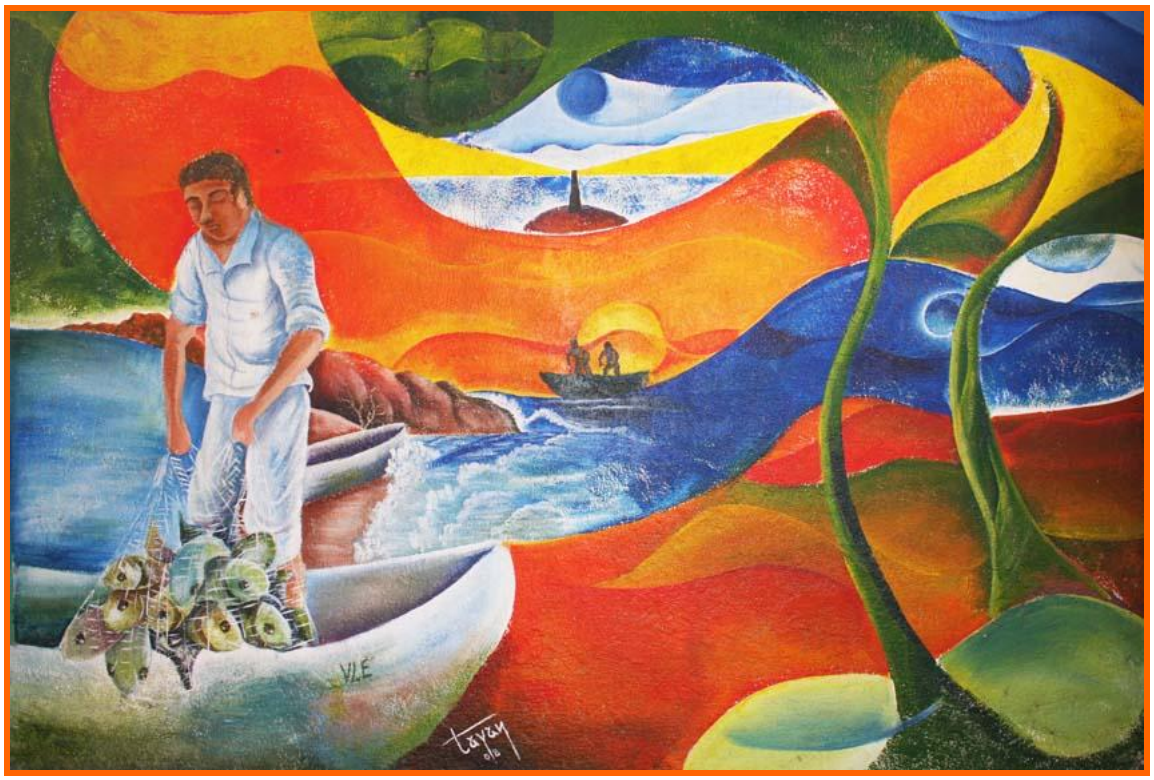
“A proposal for the spatial planning of two traditional fisheries in competition; Huaves y Zapotecas”



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Abstract

Fisheries' in Mexico are threatened. To revert this situation, the Mexican government has been promoting co-management initiatives recently. We proposed and developed a consensus–building process to support the spatial assignation of use rights in local fisheries in the Huave Lagoon System. This lagoon was selected because it provides an especially important attribute to research: it has been historically used by ethnic groups where fishermen have competed for resources but, until recently, it has demonstrated that fisheries and marine environment have been preserved. Old fishermen are dying so we need to rescue their valuable knowledge.

Resumen

Las pesquerías en México están en riesgo. Para revertir tal situación el gobierno mexicano esta impulsando recientemente el iniciativas orientadas hacia el co-manejo. Nosotros propusimos y desarrollamos un proceso con base en consensos para soportar la asignación espacial de los derechos de propiedad en las pesquerías locales del Sistema Lagunar Huave. Esta laguna fue seleccionada porque posee un atributo especial para la investigación: esta ha sido históricamente usada por grupos étnicos que han competido por recursos pero que, hasta recientemente, habían demostrado que pesquerías y el medio ambiente marino pueden se conservados. Los viejos pescadores están muriendo y necesitamos rescatar su conocimiento.

I. Introduction

The natural resources conservation has a special meaning in developing countries. Classical objectives of "no take zones" do not work in ecosystems that have been subjected to more than seven centuries of collective exploitation and that support hundreds of users with their basic and immediate needs (Alcalá 1999). Therefore, in these areas to integrate the perspectives and opinions of local fishers should be a key element in a consensual fishery administration and may represent an important step towards the future conservation of fisheries resources.

We have identified the Huave Lagoon System (HLS), Oaxaca, Mexico, where long lasting local fisheries practices seem to have contributed to nature conservation. However, the actual spatial assignation of use rights in the current Fishery Management Plan of the HLS has become inadequate because it was not done considering local conditions: cultural diversity (two Pre-Hispanic cultures: Huaves and Zapotecas), ethnic management practices, and wealth of environmental traditional knowledge. In addition, HLS needs an effective fishery management adapted to the local environmental and socioeconomic conditions before the strong growth of the fishery sector together with local and regional environmental impacts worsen. Therefore, there is a need to update spatial assignation of use rights by a consensus-building co-management process to get the essential stakeholders support of this multicultural zone. Furthermore, local knowledge on the environmental processes and resources in this area has to be rescued urgently since many of the old fishermen are dying and most of their sons are leaving the fishing sector (Espinoza-Tenorio et al. *in press*).

We like to take advantage of the recent fact that the actual Mexican Fishery Law (2007) incorporates fisheries co-management plans with a novel characteristic: the consideration of traditional administration systems in the decisions making process. We thus propose the use of Social Science techniques to gather traditional knowledge about fisheries and ecosystem dynamics to design an inclusive consensual spatial assignation representing the actual different social interests in the HLS.

Fig.1. Fishing camp, *Santa Maria del Mar*

Since our research is part of a workgroup dealing with conceptual and methodological discussions regarding co-management strategies in Mexico, we expect to respond in this work questions such as: Which part of the Traditional Knowledge is potentially useful to take nature conservation decisions? Could Traditional Knowledge be integrated into modern coastal zone management? As well, obtained results could be used in other third worldwide coastal lagoons.

1.1 Huave Lagoon System

The environmental particularity of the HLS is largely due to climatic periods well differentiated (rains and dry), but especially to the winds *Tehuanos* or Norths. These are strong winds of up to 120 km/h blowing for periods of three to five days and presented in this area because the *Sierra Madre del Sur* descends dramatically ~2000 to ~250 meters above sea level, allowing the contact between different barometric pressures of the gulfs of Mexico and *Tehuantepec*. Always perpendicular to the coast and in the direction to the sea, *Tehuanos* not only become particularly vulnerable to the territory HLS intensifying high evaporation rates (2.100 mm per year) during the dry climatic station, also form and shape constantly the enormous dune systems.

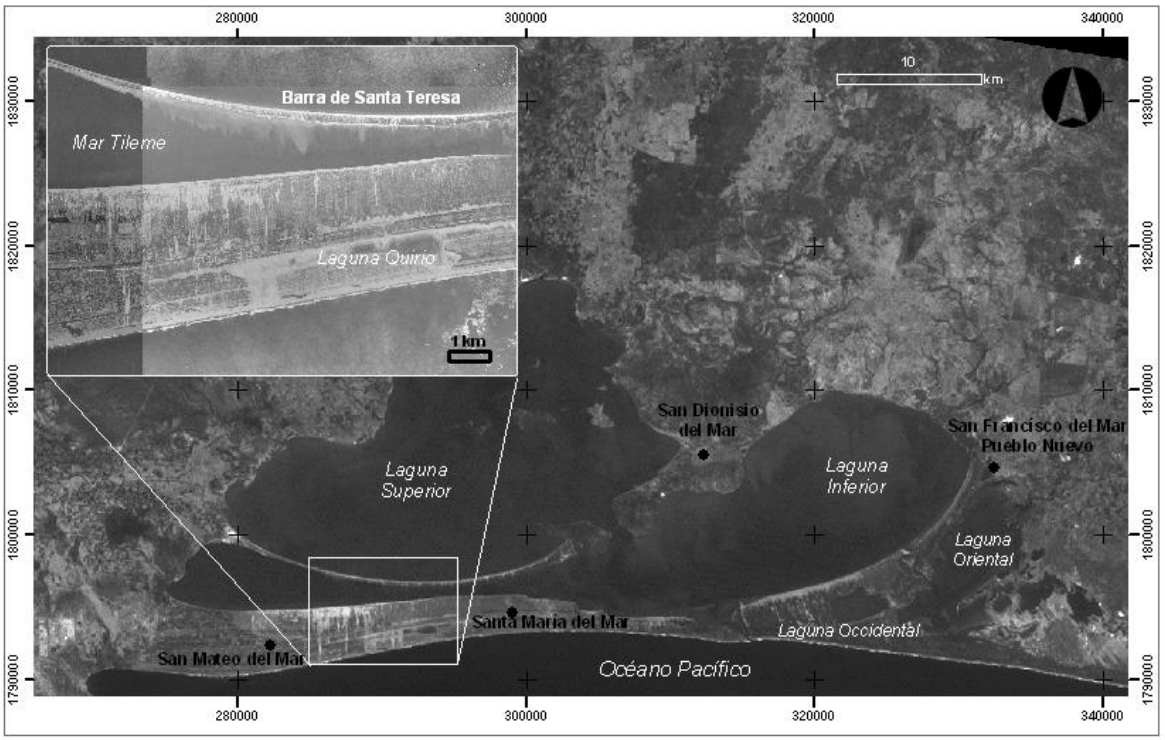

Fig. 2. Study area, System Lagoon Huave and the sandbank of Santa Teresa (square).

The main area of dunes is on an isolated coastal strip bounded by the Gulf of Tehuantepec and a system formed by the *Laguna Superior* e *Inferior*, *Laguna Oriental* and *Occidental*, and *Mar Tileme* (Fig. 2). In addition to the unique biological communities, the special of these dunes comes from the pair on coastal sandbanks on which are located. The sandbank of *Santa Teresa* is a unique and close internal barrier delimiting the Sea Tileme of the *Laguna Superior*. In accordance with Cromwell (1985), the evidence suggests that makes 6,200 – 8,500 years this barrier was extended to the east of the mouth of River Tehuantepec. As the sea level rose, this barrier was erected staying on the sea level and locking the *Laguna Superior*. Once the sea stabilized in its current position, sustains Cromwell, another hook barrier was formed on the sediments of the former barrier, in the direction of the sea. This second outer barrier is separating currently the complex lagoon of the Pacific Ocean and, since its formation, has widened about 4 km toward the sea. In it the strength of the *Tehuanos* has combined with the strands of accretion east-west to form a topography of dunes type board.

II. Methodology

To design an inclusive consensual spatial assignation representing the actual different social interests in the HLS, we used Social Science techniques to gather traditional knowledge about fisheries (resources, distribution areas, fishing gears, etc.) and ecosystem dynamics (direction and periodicity of currents and winds, climate change, bathymetry, etc.). Afterwards, with the cooperation of local, state, and federal authorities, the presidents of the fishing cooperatives in each location were identified and contacted. Once explained the objectives and scope of the project to the presidents, they identify the fishers with more expertise on lagoon and fishery resources to the interviews. In this way, 40 fishers were interviewed at seven fishing locations (*Santa Maria del Mar*, *San Dionisio del Mar*, *Santa Maria Xadani*, *Alvaro Obregon*, *Union Hidalgo*, *Chicapa de Castro* and *Juchitán*). The items were general data, description of the fishermen, major fishery resources, fishing technology, resources management, and perception of the environment (Anenex ??). Then data collected by the interviews was processed and its preliminary results showed in workshops (oral presentations and outputs from discussion) in each community.

Fig. 3. Alejandro Espinoza and workshops with the fishers, Alvaro Obregon.

The final results were represented in an educative poster, whose main achievement was to be created in conjunction with the users (fishermen, researchers, and policy-makers), even with those openly confronted. Designed in a format that provokes people's interest, 23 posters were delivered between cooperatives and major policy-makers in the region (Fig. 5).

Fig. 4. José Alberto Zepeda delivering products in *San Francisco del Mar Pueblo Viejo*

III. The whole fishery system

We found that most of fishers have born and lived around HLS, have around 50 years old, most are married and have between 1 and 6 dependents, who are currently living with them. The schooling varies between without studies and technical schooling, but the majority has one grade of elementary school. The greater part of those interviewed

has fished from the 16 years old (some started from the 10) in the lagoon; only in Santa Maria del Mar, fishers occasionally caught in open sea from the beach. The fishers have informally learned to fish through his family (parents and older brothers) and friends, who are responsible for transmit knowledge.

There are fishers organized and non-organized. In the case of the firsts, we found fishing cooperatives and local fishing groups, which lacking of legal federal figure but identified by the local-traditional authority. The time devoted to the fishing was another factor to distinguish between organized and non-organized, since most of the organized fishing throughout the year. By contrast, non-organized temporarily switch to other activities such as agriculture and construction.

Although there are variations among the areas of fishing and fishing seasons (Annex III), those interviewed mentioned that currently the main fishery resources of the system lagoon are blue and coffee shrimp, catfish, and grunts. The form of sell these products is mostly fresh and mainly through the wife at the same location or in regional markets such as the *Salina Cruz* and *Juchitán*. Only fishers organized in cooperatives sold in bulk to buyers who carry the product to national markets such as *Distrito Federal*.

The fishers carried out the activity by boat or on foot. Depending on the type of resource, until four crew members can use boats(between 20 and 27 feet made with fiberglass and with engines of between 15 and 60 HP) or *cayucos* (boats between 4 and 9 m made from wood or fiberglass and generally propelled to rowing or with small engines of up to 15 HP). The fishing gear of those who have no boat or *cayuco* are the nets. The majority of those interviewed agreed that there has been little or no developments newly developed techniques that will help them to improve the fishing.

Fig. 5. Fishery chart of the Huave Lagoon System done from traditional ecological knowledge.

3.1 Civilizations from wind and water

Tehuanos shaped the culture of all peoples of the Isthmus, particularly of *huaves* and *zapotecas*. Although the extension of its territory has varied historically, geographic barriers and strong language boundaries have isolated such cultures in a portion coastal extremely dry and little suitable for agriculture and livestock. Moreover, the major communities continue basing their livelihoods in the artisanal fisheries in the lagoon, because the strong waves make impossible fishing in the open sea.

Not to maintain a strong relationship with corn is a fact that distinguishes ethnical groups in HLS from the majority of cultures of Mesoamerica. Fisheries have allowed to incorporate water and wind as points around which revolve their daily lives and their mythology; and connects to the saints and the *naguales* (magician) with everyday situations (Millán 2003). With regard to the winds, they are associated with gender and cosmogony: the south wind is female and comes from the waves, formed by the *Virgen de la Candelaria*; the north is male, comes from earth and is associated with *San Mateo* Apostle.

The wind and water not only permeate in activities mystic or religious, such as the many marine myths and sacred sites such as the island of Cerro Christ. Daily activities of life as the language (numerous places), music (songs marine and turtle's shell as instruments), handicrafts (shells for curtains) and fisheries systems (the skit for fishing in the open sea) are also influenced. Such relationship cultural-environmental has also built an entire system of traditional knowledge that historically has helped them to adapt original and artfully their productive activities to an environment conducive to desertification. Some examples are agricultural systems that respect the capabilities of regeneration of the local ecosystems; temporal poly-cultures (sweet potatoes, beans, watermelon, pumpkin, melon) which give priority to native species to avoid the soil erosion, and systems to reduce the impact of wind and sand on their crops and homes (*e.g.,* fences alive or cover the earth with manure or stubble while not grown) (Zizumbo-Villareal and Garcia-Marin 1982). In the case of the dune vegetation, zapotecs and huaves, like other Mexican ethnic groups in arid climates such as *seri* in Sonora or *popoloca* in Puebla, as have developed a system of traditional medicine that takes the vegetation of their ecosystems (Table 1).

Table 1. Plants typical of dunes that are used with curative by huave ethnicity, Oaxaca, México.

Huave name*	Scientific name	Medicinal purposes
*Xet mbaj*** (flor para ensartar)	*Jacquinia pungens*	Anti-dysenteric
Nangachas nüic	*Opuntia decumbens*	Anti-diabetic
Mbeots	*Lantana camara*	Anti-septic
Ol müen	*Ipomoea pes-caprae*	Anti-septic, purgative
NN	*Paspalum vaginatum*	Anti-scorbutic, diuretic
Cüetch coi	*Sapianthus arenarius*	Anti-septic and veterinary use as carminative and anti-diarrheal
Nzar pots or *Mbaj palom*	*Stegnosperma halimifolium*	Cold

* According to the linguistic variation from *San Mateo del Mar*; **Used also for ceremonial purposes; NN=Not huave name. (Sources: Zizumbo-Villareal y García-Marín 1982; Torres-Colin 2004).

3.2 Fishing with kite in Santa Maria del Mar

Although arrived to Mexico approximately 500 years before, the *papalotl*, word *náhuatl* means butterfly, gave flight to the creativity of the people and conquered a site in the mythology of local cultures. This adoption cultural was particularly evident in regions where the wind was already a key element in the idiosyncrasies of the pre-Hispanic people. This is the case of communities that settled in the Isthmus.

The adoption in towns such as Santa Maria del Mar has been such that the first kite flying has been lost in the communal memory. What one remembers is that originally was incorporated in the religious festival, as a means of connection between the underworld and the celestial alive from the dead. However, this practice is no longer practiced because, among other things, Catholic believers have decreased in the community.

Fig. 6. Fling the skite to fish from the beach, *Santa María del Mar*

The kite was incorporated into other activities of *Santa Maria del Mar*. In one of the poorest areas of the country, need and creativity guided to fishers to use its vast traditional knowledge to adapt the kite as a fishing tool. This union allowed to reach the inaccessible ground sea resources "alive." Although the origin of the technique is controversial, because in *San Mateo del Mar* is also practiced, in *Santa Maria del Mar* can be traced back two decades ago, when the talent of a group of local fishermen took them to replace the plastic container (60 liter) by the kite. However, maneuvering the kite was so successful that currently represents a common additional economic input.

Although there are brave solitaries fishing with kite, its use demands of at least two fishers. The process begins with the collection and purchase of local materials, cheap and easily accessible: palm, ribs, bones, wire and nylon rope for the construction of a kite of about five feet tall. Once on the beach, the kite is hoisted and is attached to a "dead" (piece of wood buried one meter deep). The assembly of the fishing system starts with strings to tie two-tops that support buoys, one or more gill nets that may reach a hundred and three hundred meters long. One of the ropes, which join the network with the coast, remains subject to a stake firmly buried in the beach, while the seaward end that will be attached to a heavy lead (a plastic container filled with sand to prevent the kite lift completely the network) and the string of the kite. Taking as security system its ability and a knife, a fisher unleashes the kite and holds it at the waist, in order to make a controlled release of the net offshore.

IV. Current dilemmas

Some of the impacts on the HLS are the closing of the communication with the sea, urban and agricultural pollutants discharged by streams or rivers (e.g., *Rio los Perros*), , oil spills of Mexican Petroleum (PEMEX), and an increase of fishers.Moreover, the perception on climate change in the area is recognized in a climate more extreme, specifically with temperatures more warm than normal, with heaviest rains and tropical storms and hurricanes more frequent. Although it is perceived as these changes influence in a negative way, fisheries have not yet been sufficiently impacted as to cause changes in the activities of fishers.

Two of the main dilemmas that HLS is facing are described below:

4.1 Agriculture and livestock

The fragile balance between local communities and sand dunes has entered into imbalance. The dramatic population growth of the twentieth century led to the intensification of the use of resources. Then, mono-specific agriculture and intensive livestock improved living conditions in the area. However, it was not considered that the characteristics of the territory were not conducive for this type of activities. Introduced in the area in the 16th century as activity extended, livestock was the first to find serious limitations by the lack of water and food during the season of dry. Currently dominated by the transhumant cattle, livestock is considered basically as a capital investment that ensures a collection immediately in cases of necessity (Signorin 1979). With the time, it was also found that the monocultures of maize and sesame not only tired more quickly to the earth and the left exposed to the erosion, these crops also represent higher vulnerability to the local pests (Zizumbo-Villareal and Garcia-Marin 1982).

Fig. 7. Cattle feeding of vegetation of dunes, *San Francisco del Mar*

Livestock that feeds freely has led directly to the destruction of the vegetation cover in the dunes causing destabilization, whereas agriculture has led to cede land of the dry jungle low and savannah. All conjugate has led to the increase in the area of dunes. Perhaps the most dramatic example corresponds to *San Francisco del Mar Pueblo Viejo*, a town that was relocated in the 1960s by the problems of respiratory diseases caused by the sand of a huge dune. Even the term *loma blanca* (white hill) was coined

by the people to refer to such dune, which by deforestation caused by the livestock, began to move and partially cover the town for years.

To try to reverse the trend of deterioration, people are taking advantage of their ancestral knowledge of the dunes. Designate increasingly protection zones for community that native flora that achieves stabilize the dunes, has led to believe in the obviousness of this traditional solution. But its crossroads continues; the urgent needs of these cultures grow and the options that do not mean the intensive use of its resources are few. Therefore, they are looking for a new and wise balance with the dunes.

4.2 Dunes or wind energy?

Since Pre-hispanic times the barriers of dunes have remained in a fragile balance with the people in the HLS. However, such environmental philosophy has been immersed in recent decades in a dynamic of accelerated growth of the Isthmus of Tehuantepec where, by considered an area geostrategic for Mexico, federal government has tried to establish multiple development projects (e.g, the refinery of PEMEX, the fishing port in Salina Cruz, the Irrigation District 19). While in previous plans for development dunes were involved indirectly, in the most recent project are the main actors; the force generated by wind *Tehuanos* wants to be exploited by wind farms. One of the most promising areas is located on the particular bars of dunes of the territory *huave*.

Justified in the environmental conveniences of the wind farms on another type of energy production, the impacts of the new infrastructure have not been discussed in depth. At the moment, it is not clear as the design of the farms (location, type and number of generators) is considering the local attributes, not even those impacts well documented at other sites such as the change of scenery, the spillage of oil and the danger of collision for birds and bats (Kuvlesky et al. 2007). Only in the case of birds, in the territory huave the choice of height and the type of generator gains importance, because the flight of the birds happens throughout the year and at various altitudes. In the area there is a great diversity of birds (*e.g*., ducks, eagles, hawks) and it also form part of up to four migratory routes (from the Gulf of Mexico, the west coast of USA and Canada, the interior of the country, and the rest of the Pacific coasts) (J. F. Meras-Hernando, personal communication, February 22, 2010).

The impact of infrastructure wind on the bars sandy may be the most at risk, but also where less is known. For example, if the fragile structure of the dunes is especially vulnerable to erosion by the strong *Tehuanos* then what could be the impact on the bars of dunes by the construction of the towers of the wind generators? The wind farms in dune areas could lead to a destabilization of the bars and thus allows the communication between lagoons, changing the hydrodynamic of the HLS.

Moreover, unlike other places in the world, where this type of wind fields are located in distant places and generally uninhabited, in Mexico and in particular to the area *huave* the social factor is the key to the feasibility of any project. In a culture with strong attachment to the administration of its resources, decisions without local consensus can be a catalyst for historical conflicts between peoples. Thus, the financial reward for the use of its resources is the first case to negotiate, because there are those who disagree and considered unfair pay they receive by the use of their land, as well as the time of the contracts. Also should be discussed publicly, potential impacts on the settlers, as the effect mobile of the shadows of generators (effect discotheque) and the noise of the rotors, which generates stress in the inhabitants close to the generators.

The use of wind potential in the dune area is a good and economically necessary project. However, it runs the same risk that other federal government's plans in the area: it could be imposed without considering the environmental capacity of local ecosystems, and without a transparent social consensus. By the inexperience of Mexico in the production of wind energy, the lack of specific studies of the area and the fragile ecosystems of dunes, cautious decisions should be taken.

V. Conclusions

The work exceeded our expectations. Being respectful of the traditional organizational systems and summing expertise and capacities through multi- disciplinary and institutional work, allowed us to operate successfully in a site where prevailing complex social processes that limited previous researches efforts. By more than six months, we participated intensively in communal meetings, research projects, and local assemblies, in which talked about our work and related items that were of interest to the community. Thus, as was the objective of the project, we collected an important part of the traditional knowledge of fishing communities.

With the idea that the knowledge compiled is not only as a source of academic information, we designed and generated a series of products of disclosure. Particularly, we believe that the map have great potential as a tool of driving to the local fisheries therefore to be inclusive (in spanish, zapotec and huave with their linguistic variants) achieved describe the knowledge and forms of access to the appeal of all users (areas and fishing seasons and reproduction, fishing gear, common names of resources and geographic features, etc.) In addition, is a tool of environmental education since in an area with low rates of schooling, and hence where the written reports are seldom read, the display of the data is an excellent way to convey ideas and information.

Fig. 8. Sunrise, *Santa María del Mar*

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