

Domino Project

Technical Report

Foreground

Abstract

A seasonal whale shark population on the northeast corner of the Yucatan Peninsula, Mexico, is subject to non-extractive use. A tourism industry has developed over the past years involving local community members in accordance with corresponding environmental regulations. Co-management between all stakeholders has been sought from the start. Much information has been received from tourism operator's logbooks regarding the whale shark population. Important lessons have been learned in the process. Domino Project, The Mexican Atlantic Whale Shark Project, started during 2003 season, providing important information to this scarcely known species. Tagging and recapture, telemetry tracking, genetic relationship, behavior, growth, distribution, and population dynamics, are involved into this multidiscipline and international collaborating project.

Keywords: Mexico, whale shark, management, community participation, population dynamics, ecotourism, genetic, telemetry.

Introduction

Under Mexican law, there are two technical terms to describe the utilization of wild fauna: extractive use, referring to the removal of animals from their environment by means of hunting or capture and non-extractive use describing the means by which animals are admired or used without removal from their environment, such as tourism (eg. observation, swimming and diving). Other Mexican law categorizes whale sharks as vulnerable species under the NOM-059-SEMARNAT-2002. While the proposed NOM-029-PESC-2000, prohibits whale shark extraction.

In Mexico, as in other countries where whale sharks aggregate, such as Australia, Belize, Philippines and Seychelles, ecotourism activities are offered to interact with these iconic sharks.

The presence of whale shark on Mexico, distribute along most of the coast line. In particular off the coasts of the Baja California Peninsula (Sea of Cortez, Pacific Ocean) and Yucatan Peninsula (Caribbean Sea, Atlantic Ocean) where they can be easily located during certain seasons. In the northeast corner of the Yucatan Peninsula, where the waters of the Caribbean and the Gulf of Mexico come together, there is an up welling with very cold water masses, rich in nutrients which causes dramatic increments in the amount of phytoplankton and zooplankton production. This oceanic fertility triggers the whole food chain's

activity to increase; thus we find large groups of fish, sea birds, sea turtles, manta rays, dolphins and several shark species, including the whale shark. In addition, this site is located between two natural areas protected by the Mexican Government: Yum Balam and Contoy Natural Protected Areas.

Location

Two Natural Protected Areas: Contoy Island and Yum Balam are basic references for the study zone. (See map below).

A major zone was defined for this study, according to Whale shark presence:

Participants

Secretariat of Environment and Natural Resources (SEMARNAT)*
The Attorney General of Environmental Protection (PROFEPA)*
Center for Education and Training for the Sustainable Development
(Cecadesu)*
National Commission of Natural Protected Areas (CONANP)*
Yucatan Regional Direction of CONANP*
Geographical Information Sub Direction (CONANP)*
Yumbalam Flora and Fauna Protection Area*
Cancun and Isla Mujeres West Coast Marine Park*
Isla Contoy National Marine Park*
Secretariat of Tourism (SEDETUR)*
Mexican Navy (SEMAR)*
National Polytechnical Institute*
Center of Investigation and Advanced Studies (Cinvestav)*
Center of Investigation and Marine Sciences (Cicimar)*
National Council for Science and Technology (Conacyt)*
Center of Biological Investigation of the North West (Cibnor)*

World Wildlife Fund, Mexico
Pronatura, Yucatan*
Renewable Energies Society (SER de Quintana Roo)*
Mexican Association of Adventure Tourism and Ecotourism

United Nations Program for Development*
Global Environmental Facility*

Georgia Aquarium*
Mote Marine Laboratory*
Center for Shark Research*
University of South Florida*

*To date participant

Social outcome

Locally generated, the whole project is a consequence of a social movement, in the quest for alternate incomes, and in order to manage wisely this potential

resource, they were willing to participate, of course there's still certain reluctance to share valuable and tradition knowledge.
At first they only share sighting approximation sites, even tricking...
Little later they become involved in information generation about, numbers, sizes, groups, sex, behavior, visitors numbers, but still location is kind of an issue....

However, they are providing precious individual movement's information:

Sharing our outcomes and information, as well as starting a Photographic Identification Program, providing them with disposable cameras, in order to achieve and share images, keeping a credited digitalized record and giving them back their photos, has helped a lot.
Now Isla Mujeres participation seems like to be fundamental, as they are finally sharing and showing their own knowledge:
There's an important part of this aggregating population outside, outside our estimated major presence borders....

Guidelines, rules, laws...

In order to preserve a valuable resource, when they become aware that harassment and bothering, produced an evasive behavior, asked for help!
Searching everywhere to obtain a guideline to establish a respectful way to interact with these animals, they look for whale and dolphin watching experiences, and then looking how other Whale Shark Tourism operations manage, they shape an ethic code.
Identifying the following points of concern:

- Tourist misbehaves.
- Increase in whale shark related activities
- Increasing requests by tourism providers to carry out the activity
- Lack of inspection and monitoring
- Unclear legal status
- No information on the natural history of the species and its habitat, needed for decision making
- Possible conflicts with other groups in the area, such as fishermen.

This has been the core for permits, management, rules and laws.
In Mexico, it is a matter of time, to have congress approved laws, about this whole interaction with whale sharks.

YEAR	#	# GUIDES	# OF	SEASON
------	---	----------	------	--------

	PERMITS		VISITORS	
2002	0	10 NOT CERTIFIED	1500	No season limits
2003	42	24 CERTIFIED	3000	24 June-30 Sep.
2004	53	72 CERTIFIED	6593	13 May-30 Sep
2005	122	71 CERTIFIED	9091	1 June-15 Sep

As a result of discussions, and regarding as main objective the protection of the whale sharks and the safety of visitors, the following code of conduct was established:

- activities may only be conducted during daylight hours, beginning half an hour after sunrise and finishing by half an hour before sunset
- boats must be less than 12 meters in length
- maximum boat speed within the whale shark observation zone is 3 knots
- a minimum distance of 100 m is to be kept between boats
- the number of tourists per boat would not exceed a maximum of six people plus two crew members
- boats will remain at a distance of at least 10 m from the whale shark
- only one boat is to be associated with each whale shark, for a maximum interaction of 30 minutes
- only two visitors with a guide are permitted in the water at any given time
- only snorkeling and swimming are permitted (no SCUBA)
- swimmers must maintain a minimum distance of 5 m around the shark at all times
- the use of safety vests is mandatory
- the use of non-biodegradable sunscreens and suntan lotions are not permitted
- the use of any apparatus that produces noise that could disturb the sharks are not permitted
- inspection and monitoring must be implemented to assure that the code is followed
- training is to be provided to improve the service given by tourist operators and guides in order to certify them as specialized guides

Following the 2003 whale shark season, a second workshop took place in October 2003, to upgrade the code content, based on observed results. Two amendments were made to improve the activity and decrease risks to the sharks. Firstly, as the plankton can be incredibly dense, resulting in poor visibility (less than 3 meters), the distance kept by swimmers was reduced from 5 m to 2 m. Secondly, the number of tourists per boat, would depend on the boat size. Boats of 24 ft or less are allowed to carry 5 tourists, this increasing 1

passenger per additional foot length to a maximum of 10 tourists on 29 ft boats or longer.

Tourist Operator Participative Research

Based on information provided by TOP (Tourist Operator Providers), this knowledge is invaluable and at the same time skeptical matter...

	2004	2005	2006
Total sightings	507	1627	1124
Individual reports	302	1427	893
Groups reports	205	245	231
Male:Female ratio	1:1	1:1	1.3:1
Average size	7.3	8.0	8.2
Minimum size	2	1.2	2
Maximum size	13	18	14
Sightings with known location	268	1224	828

Tourism Operator's 2006 update

Official Research

Tagging and aerial censuses

This supposes to be best obtained information from the Yucatan Peninsula Whale Shark aggregation, but we still know very few about them, based on scarce documented experiences.

The following table summarizes tagging results after 4 years:

	2003	2004	2005	2006
Total tagged	17	172	164	201
Total resighted	5	14	34	70
Male:female ratio	1.8:1	3.0:1	2.1:1	2.69:1
Minimum total length (m)		3.5	3	2.5
Maximum total length (m)		10	9	9.5
Mean total length (m)		6.5	5.5	6.2
Foto ID	17.6%	15%	80%	85%

Conventional tagging and recapture efforts have provided enough information to produce the following map:

Based on “surface” information, a transect for aerial survey was designed, using valuable experiences on marine mammals aerial censuses:

On each flight geographical position and number were obtained, e.g.:

Aerial censuses begun on **2004**, when only 4 flights were done

Month	time	N° indiv
May 04	12:00	5
Jun 27	9:00	76
Aug 17	9:00	89
Sep 19	12:00	9

During **2005**, that increased to 7 flights above the study area

Month	time	N° indiv
May 31	8:00	16
Jun 16	10:00	69
Jun 24	10:00	106
Jul 13	10:00	71
Aug 5	10:00	58
Aug 16	10:00	26
Sep 09	10:00	11

But another survey was done, following reports on an off shore multitudinary aggregation

Month	time	N° indiv
Sep 09	9:00	52

On **2006** season, aerals increased even more, and including some afternoon flights as well

Month	time	N° indiv
May 19	10:00	15
Jul 12	14:00	10
Jul13	9:00	58
Jul 14	10:00	134
Jul 15	9:00	145
Jul 27	11:00	70
Jul 28	9:00	125
Jul 29	9:00	118
Jul 31	11:00	43
Aug 1	10:00	59
Aug 10	14:00	102
Aug 11	10:00	59
Aug 12	13:00	42
Aug 13	11:00	60

And “afuera” aggregation was tracked during several days, also morning and afternoon censuses were done

Month	time	N° indiv
Sep 8	10:00	20
Sep 9	9:00	207
Sep 10	13:00	32
Sep 11	9:00	60
Sep 12	9:00	50
Sep 12	14:00	2

The purple encircled area shows where this “afuera” aggregation is

The whole pathway is then plotted into maps:

Group sizes:

Cumulative aerial censuses:

And then, compared with “surface” data:

Other species sighted are registered, as an example; the next table shows the sum of them during 2005 aerial survey:

Group	Individuals sighted
Manta rays	123
Turtles	343
Dolphins	93
Cow nose rays	1185

Other species were also considered important

Hydrology

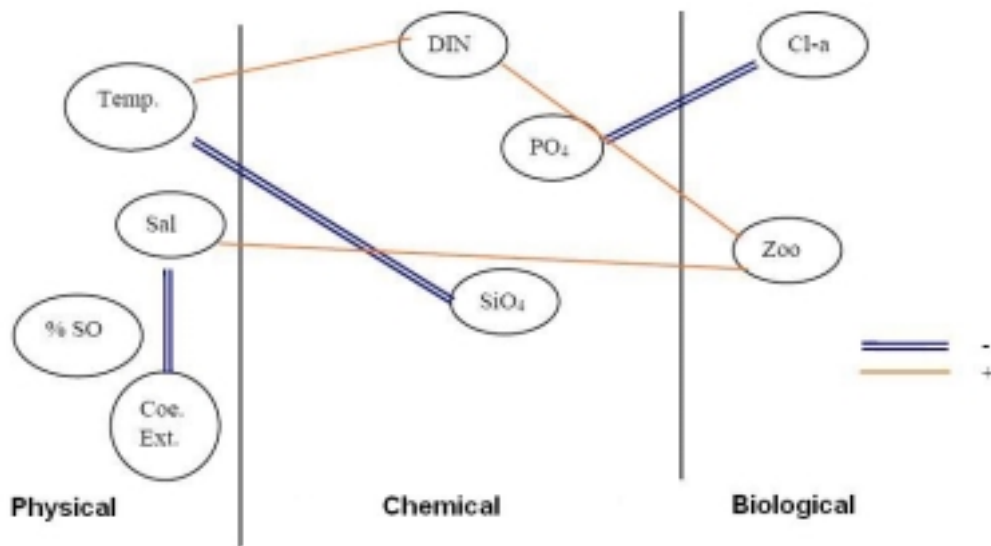
26 point pattern (stations), were designed to collect information, while continuous flow analyzed some parameters, other were measured on surface at each station, while the water column was evaluated only on the "intermediate" stations (3, 5, 7, etc.)

Light, Temperature, Salinity, Dissolved Oxygen, Phosphates, Silicates, Dissolved Inorganic Nitrogen and Chlorophyll were analyzed on 8 sessions from April to December 2005, to continue along 2006.

Differences allow establishing 3 specific periods: the rainy season, the drought and north front season.

But relating this with the Whale Shark's presence, it was determined to compare the two situations.

Correlating Physical – Chemical – Biological parameters



Plankton

Phytoplankton diversity

Period	Month	Species	Season
Without WS	April	54	Drought
Whit WS	May	67	
Whit WS	June	30	Rainy
Whit WS	July	27	
Whit WS	August	50	North
Without WS	September	47	
Without WS	November	61	
Without WS	December	60	

Temporary variation

And upwelling indicator's presence

Skeletonema costatum

Zooplankton

Zooplankton biomass by month

Web Page

www.domino.conanp.gob.mx

Is on the internet since 2005, were most of the information concerning this project is exposed.

Adjacent Studies

Genetic studies.

The hypervariable region, from the DNAm region, was amplified and sequenced, in order to analyze the genetic structure from two oceanic isolated areas: Baja California Gulf (Sea of Cortez) and the Mexican Caribbean. 35 haplotypes. 23 found on Baja and 15 on Holbox, therefore a higher haplotype diversity on Baja than on Holbox.

Now analyzing which polymorphic microsatellites could be used to provide valuable knowledge on the population structure on both zones.

Genetic studies may confirm which appears to be philopatry.

.

Stable Isotope studies

This study correlates nutrient ratios, (carbon – nitrogen) found on plankton collected in situ with those found into Whale Shark skin tissue biopsies, trying to determine, where specific individuals or a group of them, has been feeding on.

Feeding and nutrient studies.

Photographic Identification studies.

Starting a photographic catalog from 2004 field studies has allow to identify very particular individuals, but today's tools will facilitate to know more accurately whether an individual is resight or a "new" visitor.

At least three different software programs have been developed to scan for recorded ones into a database.

Efforts to connect authors in order to look for compatibility are under process.

Ecocean is today's larger library in the world, and the catalog is being uploaded.

While using the other one too.

Behavior

Tagging related studies: duration, reaction, use of different materials, size, color, number position, etc.

Heavy Metal detection.

Using as much as possible the same little skin sample, concentration of some metals as Cadmium, Lead or Mercury, would be detected, Mexico University UNAM, has spent over three years analyzing metal concentration in sea grass

and marine animals, so this year 2007, Whale Shark heavy metal detection is about to start, with the available previous background.

External Relationship

Electronic global communication has provided an excellent tool to share and use elsewhere findings. This soon will help us to consider this fish worldwide as an emblematic conservation species.

So far we have communication with at least one team working on each of the following countries:

Canada
United States
Mexico
Cuba
Guatemala
Belize
Honduras
Panama
Costa Rica
Colombia
Ecuador
India
Australia
South Africa
Mozambique
Holland
Austria
New Zealand
Seychelles
Hawaii

Publications

International Whale Shark Conference, on 2004, held on Perth, Australia; honored Domino Project by exposing a poster:

Whale shark management strategies with the participation of local stakeholders in Yum Balam, Mexico

On 2005, two papers were published.

But on 2006, a whole article in a conservation Mexican Journal: "Especies", was the first of 6 different published internationally. Domino Project is looking forward to make public this four year information, and to publish the whole photographic catalogue.

Documentaries

Underwater Expeditions, Mexico:
"Whale Shark"

BBC – Discovery Chanel, England - USA:
"Perfect Shark"

Jennifer Hile / Wild Aid, USA.

Light House Foundation / Wunsch Media, Germany, Switzerland, USA.

Deyco Productions, Mexico:
"Domino, Mexican Atlantic Whale Shark Project"
"Tourist basic Rules, in English"
"Tourist basic Rules, in Spanish"

Monterrey, Nuevo León, México TV

Televisa News, Mexico.

Meeting Attendance

Perth, Australia
Ensenada, BC. México
Belice, Belice. PST
Antigua Guatemala. TNC
San Pedro Sula, Honduras. TNC
Belice city, Belice. TNC
Plasencia. Belice. TNC
La Paz, BCS. México
Belice city, Belice. GCFI

Workshop sessions, course and lectures given.

Several events...

Thesis

College:

Norma Alicia Perea, Biologist, plankton.
Catalina Pimiento, Biologist, WS occurrence.
Sally Herrera, Biologist, plankton.

Master:

Natali Cárdenas, Ecologist, plankton hydrology relationship.
Dení Ramírez, Genetist.
Mariana Ruíz , Social ecologist.

Finances:**Conanp:**

Yumbalam, Contoy and Cancun Natural Protected areas have provided most of the finances, which include:
Directors, sub directors, analysts, technicians, consultants, boat crews and

Conclusion

After four years we can barely say:

During summertime, nutrient availability from a temporary upwelling produces plankton blooms, attracting diverse marine life species to benefit from.
Hydrological conditions and plankton seem to concentrate in two major areas.
Whale sharks are here, basically for feeding reasons.
Surface morning feeding is preferred.
They are synchronic with the upwelling phenomena and seem to use some spags off the study area.
Sometimes they feed during afternoon and been seen on nighttime on the surface.
They show no size or sex segregation.
Length ranges from 2 to 15 m.
Genetic variation differs from Mexican pacific coast population.
They may use this congregation for reproductive activities.
Some get into the Gulf, some travel east and some go down to the central – south Caribbean.
There are at least, twice as much males than females.
The big ones, if present, are farther than study geographical limits.
They are vulnerable to ship collisions and boat propellers damages.
Like other shark species, heal rapidly.
Apparently they congregate prior to migrate or disperse.
They may react to human harassment.

Perspectives:

Feeding details

North East Yucatan population dynamics.

Movements and possible routes.

Genetic structure details, worldwide.

Where do they come from, where do they go.

Acoustic Telemetry

Aerial survey, (larger scale).

Satellite, position only, (actual time).

Reproduction.

Halometric ratio ranges.

Socio Economic Valoration.

Blood and physiological characteristics.

In captivity background.

Any Etcetera.....