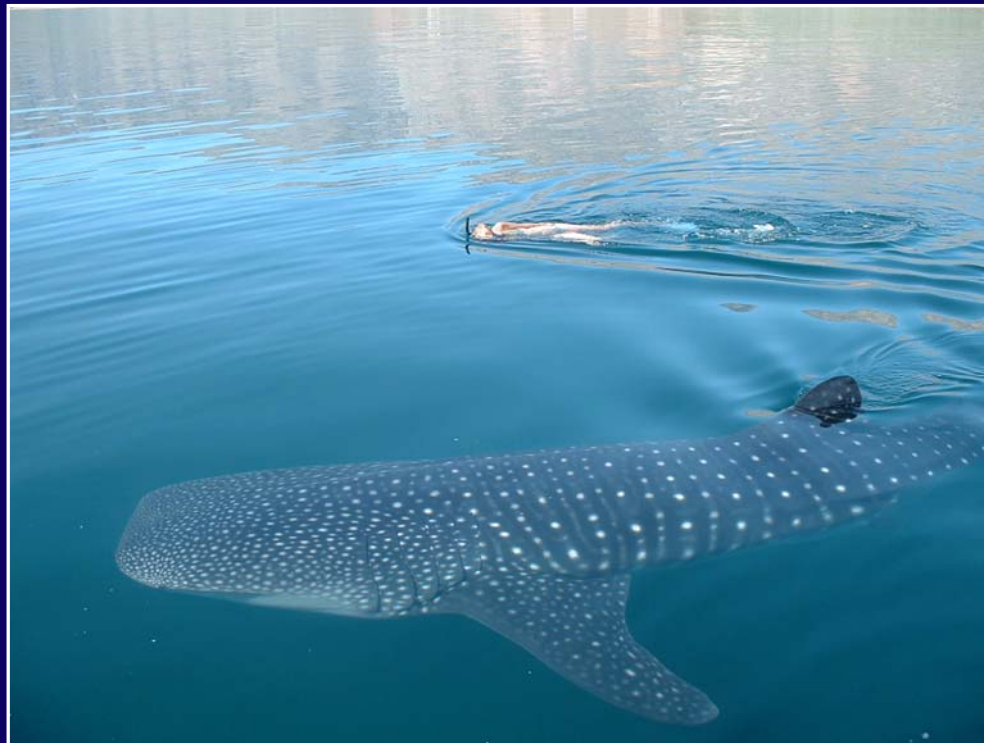


**ECOCEAN**

Collaborative monitoring of whale sharks on a global scale:  
the ECOCEAN approach



ECOCEAN is a not-for-profit, non-government organisation committed to the protection of the world's biggest fish, the whale shark.



# ECOCEAN – KEY OBJECTIVES

- Ongoing expansion and development of the ECOCEAN Whale Shark Photo – Id Library
- Actively direct additional global photo - id research effort with socio-economic benefits for developing countries
- Promote research, development and deployment of all other relevant technologies
- Facilitating cooperation between stakeholders, including data sharing
- A trusted resource for researchers, reviewers and management agencies
- A clearing house for information relevant to the species
- Advocacy for whale shark protection locally and globally, and through promotion of 'best practice' management



The ECOCEAN photo-identification library at

[www.whaleshark.org](http://www.whaleshark.org)

was developed to enhance our understanding of this animal and its needs for survival.



**ECOCEAN Whaleshark Photo-identification Library**  
research, education & conservation

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Report An Encounter NOW!

Join The Dots...  
JOIN THE DOTS...  
HELP SOLVE THE MYSTERY  
[www.whaleshark.org](http://www.whaleshark.org)

Search  
Encounter #:    
Shark #:

Recent Encounters  
New shark: M-046  
New shark: M-047  
New shark: M-048  
M-040 Resight  
M-048 Resight  
New shark: A-415  
A-333 Resight

Make a Donation

Area to photograph

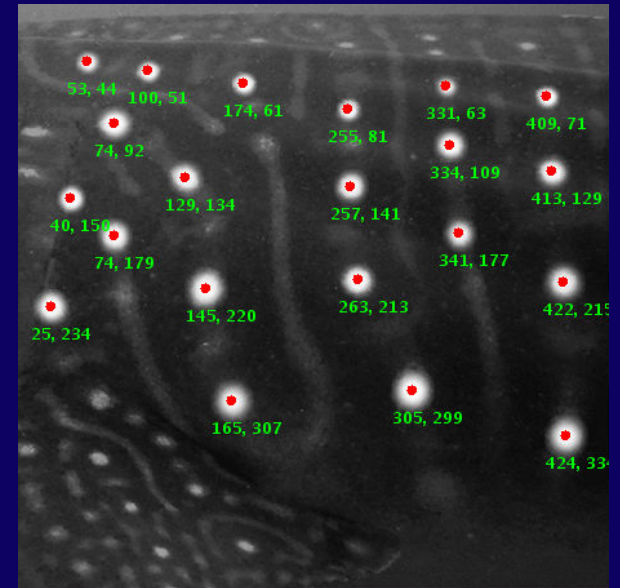
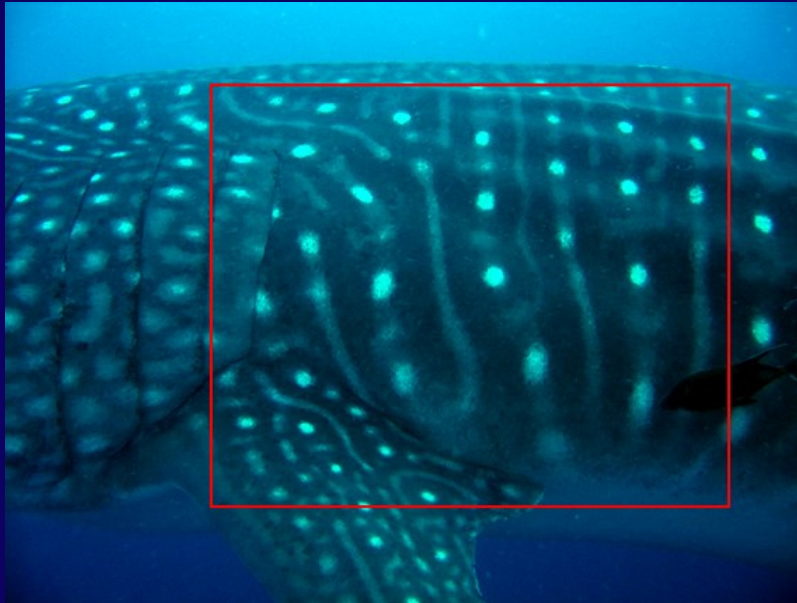
**Introducing the ECOCEAN Whale Shark Photo-identification Library**

The ECOCEAN Whale Shark Photo-identification Library is a visual database of whale shark (*Rhincodon typus*) encounters and of individually catalogued whale sharks. The library is maintained and used by marine biologists to collect and analyse whale shark encounter data to learn more about these amazing creatures.

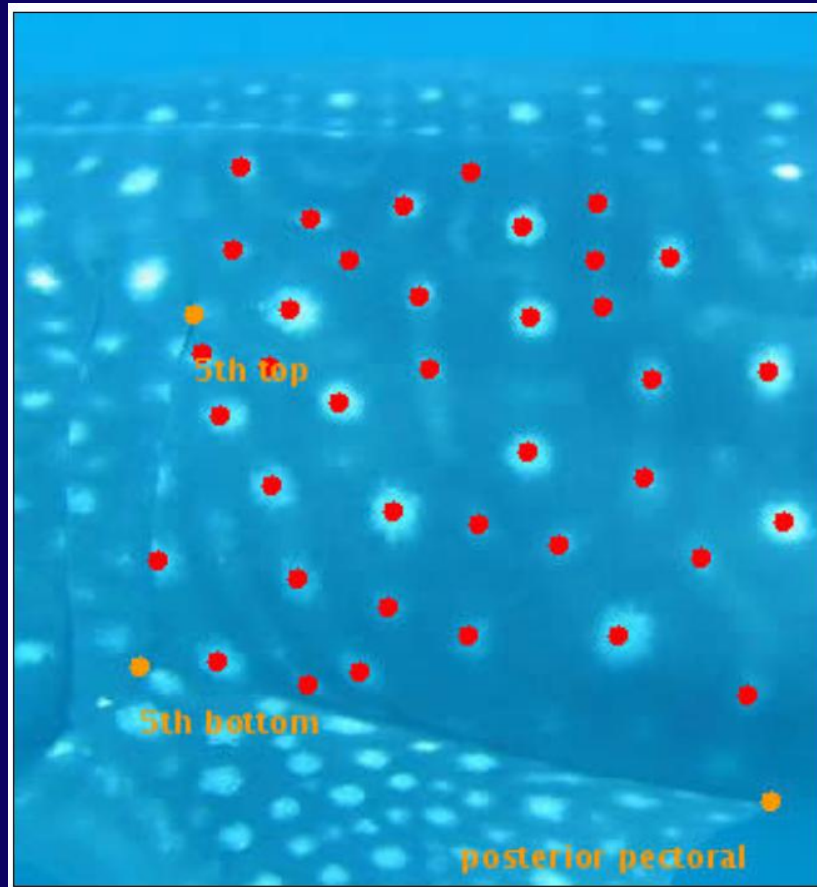
The Library uses photographs of the skin patterning behind



# Strategy: Natural tagging - photo-identification



Whale shark photographs are submitted directly by researchers and / or members of the public to the [www.whaleshark.org](http://www.whaleshark.org) website and powerful algorithms analyse images for cross-matches.



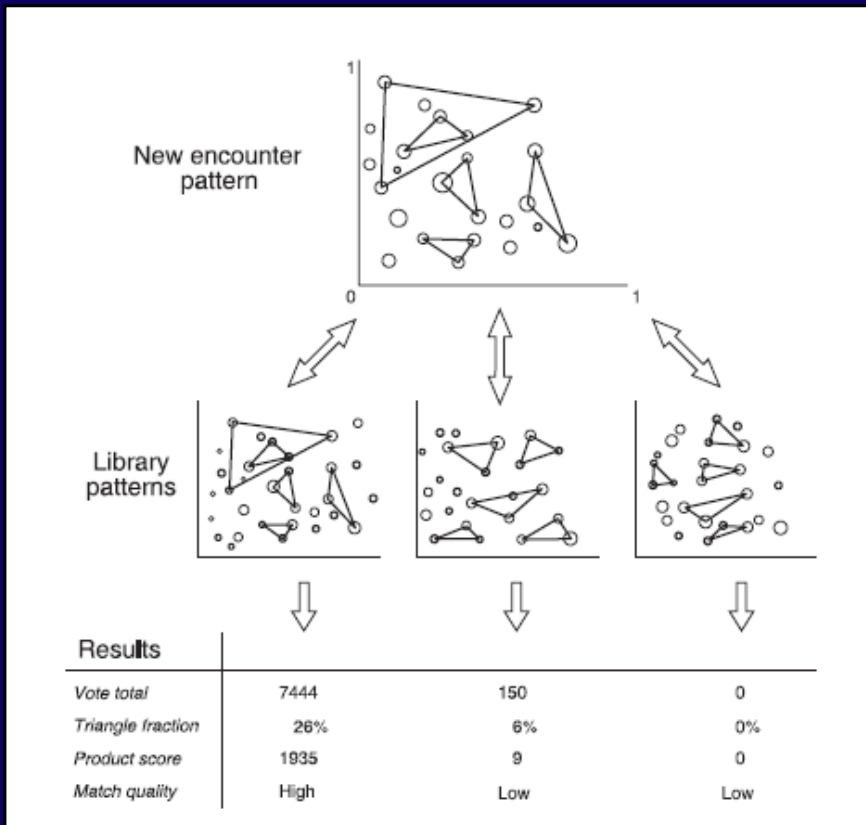
# In the beginning ....

- Focus was on Ningaloo
- the ECOCEAN Library was initiated between 1995-97 via a comprehensive photo-id study (MPhil.) supported by various stakeholders
- spot-pattern recognition
  - Jason Holmberg joined in 2002
  - Zaven Arzoumanian joined in 2003
- substantial additional input to the ECOCEAN Library has been provided by industry personnel and other researchers both at Ningaloo and throughout the world

# The Algorithms

- NB. The primary algorithm employed within the ECOCEAN Library is the Groth algorithm (developed and used by NASA).
- A second algorithm (I3S) has been included in the Library and is used to scan each appropriately oriented whale shark image.
- We do however, gain better results from the Groth algorithm.

# How the system works.....



## Spot Pattern Scans

The following encounter(s) received the highest match values against a left-side scan of encounter# 2562007115335.

⚠ Saved scan data may be old and invalid. Check the date below and run a fresh scan for the latest results.

Date of scan: Sat Jun 30 17:14:22 EDT 2007

### Standard Scan

For this scan, the following variables were used:

- epsilon (0.01)
- R (8)
- Sizelim (0.85)
- C (0.99)
- Max. Triangle Rotation (10)

Shark	Encounter	Fraction Matched Triangles	Match Score	logM std. dev.	Confidence
A-093	<a href="#">1712200435025</a>	0.323	157.48	0.05115	High
A-093	<a href="#">299200411825</a>	0.319	109.21	0.01794	High
A-093	<a href="#">4820041574</a>	0.165	41.169	0.05558	Moderate
A-093	<a href="#">11102006101610</a>	0.229	37.368	0.05218	Moderate
A-093	<a href="#">592005125819</a>	0.138	29.004	0.06407	Moderate
A-093	<a href="#">17112005145336</a>	0.105	16.786	0.03861	Moderate
A-093	<a href="#">128200612585</a>	0.126	11.235	0.16704	Moderate
A-340	<a href="#">1382006235010</a>	0.067	6.9083	0.30915	Low
A-172	<a href="#">6320050458</a>	0.065	6.5079	0.2598	Low
MZ-007	<a href="#">30520058225</a>	0.061	5.7430	0.28903	Low
CP-007	<a href="#">3012007205125</a>	0.061	5.7430	0.12805	Low



To date the *ECOCEAN Whale Shark Photo-identification Library* has logged:

5900 whale shark encounters



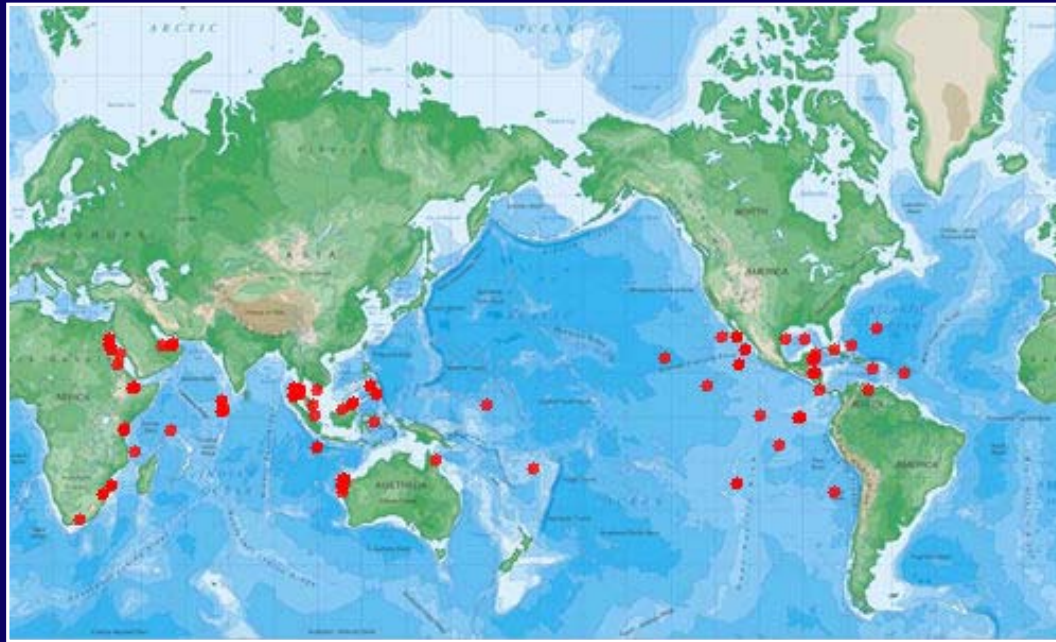
from 39 countries



identifying 1400 individual sharks

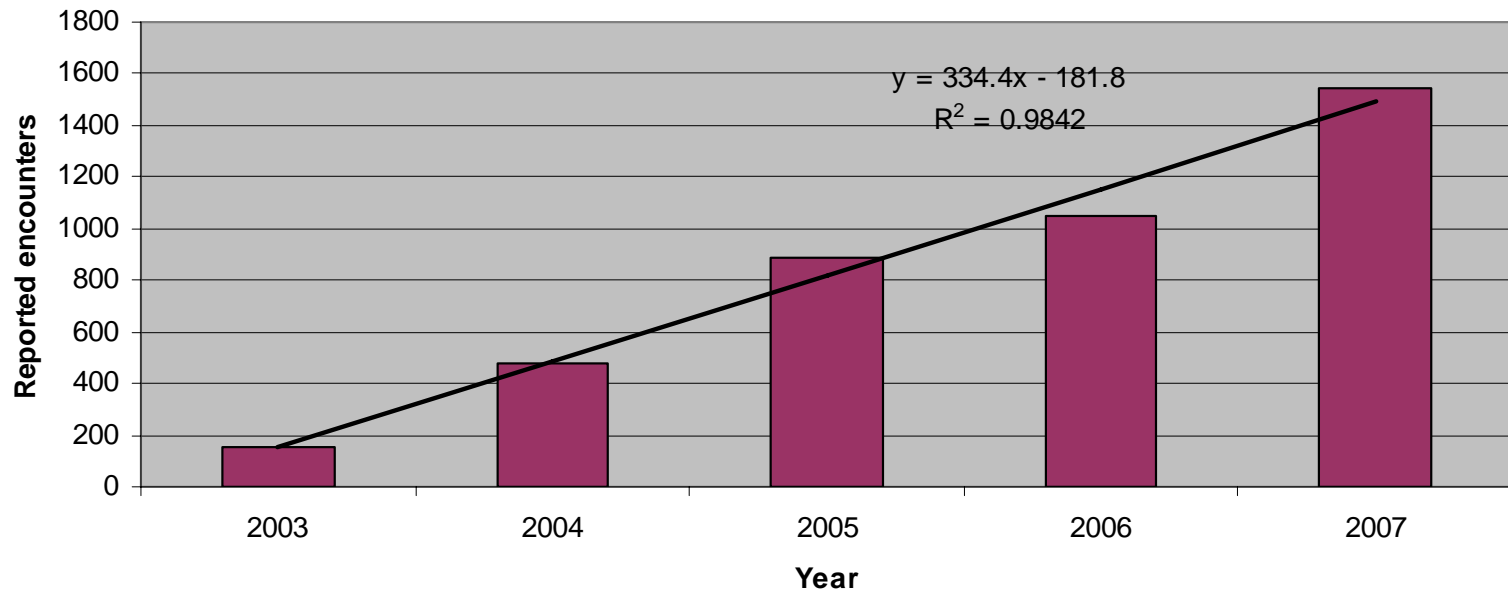


By tracking individual animals across time and space, data resolves into a picture of whale shark movements and becomes a primary tool for research and population modelling efforts.



# Uptake of the Library since 2003

Annual Growth in Whale Shark Encounter Reports since 2003  
ECOCEAN Whale Shark photo-identification Library



# Global program

As an example: the number of identified sharks within the Library include:

495 from Ningaloo (Australia)

310 from Mozambique

195 from the Philippines

70 from the Seychelles

20 from Belize

60 from the Maldives

65 from Honduras

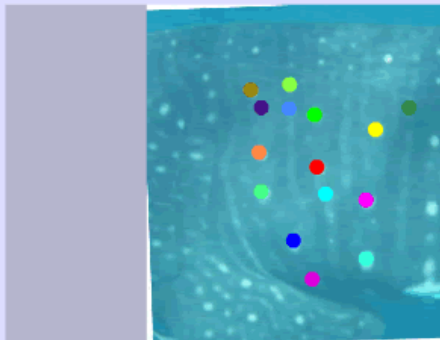
etc.



ECOCEAN developed an award-winning suite of software tools to enable analysis and discussion within scientific, conservation and management communities.

Visualizations for Potential Matches (as scored above)

Match Score: **157.48** (Match 1 of 63)



Number = **2562007115335**  
Date = 25/6/2007, 10:00  
Sex = male  
Assigned to Shark = Unassigned  
Size = 8.0 meters meters

Number = **1712200435025**  
Date = 22/4/1997, 11:00  
Sex = male  
Assigned to Shark = A-093  
Size = 5.0 meters

PREVIOUS

NEXT

Powered by [shepherdproject.org](http://shepherdproject.org)

©2006 ECOCEAN



All encounters are recorded in a managed database which can then be queried by researchers.


ECOCEAN Whale Shark Photo-identification Library  
research, education & conservation

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### Whale Shark: A-093


Sex: male [[edit](#)]

21 Encounter(s)

	Number	Date	Location	Size	Sex	Spot Data
	<a href="#">4820041574</a>	22/4/1997, 11:45	Ningaloo Marine Park	6.0 Meters	male	L
	<a href="#">1262004143959</a>	7/5/1999, 12:00	Ningaloo Marine Park (Coral Bay)	7.0 Meters	male	LR
	<a href="#">29920041145</a>	5/2004	Norwegian Bay, Ningaloo Marine Park	Unknown	unsure	L
	<a href="#">1712200435025</a>	22/4/1997, 11:00	Ningaloo Marine Park	5.0 Meters	male	LR



# Access to the Library






## ECOCEAN WHALE SHARK PHOTO-IDENTIFICATION LIBRARY WIKI

Trace: » [tapirlink](#) » [Home](#)


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- PhotoID Library
- Forum


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**USER ACTIONS**

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### Welcome to the ECOCEAN Whale Shark Photo-identification Library Wiki

This Wiki contains useful documentation for the ECOCEAN Library.


### ECOCEAN Library User Documentation

The following documentation provides assistance to ECOCEAN Library users with login access.

### Field Manual


- [1. Overview](#)
- [2. Managing encounters and sharks](#)
- [3. Approving or rejecting an encounter](#)
- [4. Extracting spot patterns](#)
- [5. Comparing spot patterns with sharkGrid](#)
- [6. Interpreting pattern match results](#)
- [7. Matching sharks](#)
- [8. Searching through the Library](#)
- [9. FAQs](#)

**Other topics**

-  [How to use Spot! for perspective correction](#)
- [TapirLink, the GBIF, and the ECOCEAN Library](#)
- [List of Photo Keywords \(Tags\)](#)
- [List of Location Codes](#)

#### Table of Contents

- Welcome to the ECOCEAN Whale Shark Photo-identification Library Wiki
- ECOCEAN Library User Documentation
  - Field Manual
- sharkGrid Documentation
- ECOCEAN Library Policies




# Access to the Library

The Management Committee of ECOCEAN looks at several criteria when reviewing a request for access, including:

- Your ability and willingness to contribute new whale shark data
- Your ability and willingness to follow the analytical techniques used in the ECOCEAN Library
- Your ability and willingness to develop new techniques for whale shark research
- Your ability and willingness to develop new science for other fields using whale shark data
- Your ability and willingness to use whale shark data collaboratively
- ECOCEAN's available resources to properly support you

# Data sharing



## ECOCEAN WHALE SHARK PHOTO-IDENTIFICATION LIBRARY WIKI

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### TapirLink and the ECOCEAN Library

Certain data from the [ECOCEAN Library](#) are shared with other biology and ecology portals, such as the [Global Biodiversity Information Facility](#) and [Fishbase](#). This sharing occurs at regular intervals via an installed [TapirLink provider](#). Information shared fits the basic [DarwinCore](#) and [Geospatial Extension](#) specifications. The specifications map cleanly to the base "encounter" data structure displayed in the ECOCEAN Library.

ECOCEAN, after consulting with some of its users, has adopted these restrictions on shared data:

- Publicly submitted data is shared by default
- Users with login access can manage which encounters are shared
- Photos are not shared due to copyright restrictions
- Spot pattern data is not shared to protect ongoing research initiatives
- Individual shark identifications are not shared to protect ongoing research initiatives
- Data is shared with the following restriction listed in the metadata: "Original photos and extracted spot patterns withheld. Please contact [info@whaleshark.org](mailto:info@whaleshark.org) regarding usage permissions." Requests for usage of data submitted by users with ECOCEAN Library login access will be routed to the library user for the ultimate decision.
- ECOCEAN as a general policy, but without strict enforcement, will not share via TapirLink publicly submitted data for the current calendar year as a precaution to protect this vulnerable species. Individual users of the ECOCEAN Library retain the right to decide which encounters to share.

**-Table of Contents**

- TapirLink and the ECOCEAN Library
- Changing an encounter's TapirLink status
- Suggesting a change to this policy

# Other possible inclusions (for individual sharks)

- Genetic profiles (see J. Schmidt)
  - Satellite tracks
  - Behavioral profiles
  - etc.
- 
- Nb. This has the opportunity to be a global clearing house for many forms of data on whale sharks

# sharkGrid.org



**ECOCEAN**  
research, education & conservation

## Whaleshark Photo-identification Library



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**sharkGrid**



Welcome to the sharkGrid! The sharkGrid allows you to donate spare cycles of your computer to whale shark research. Specifically, the processing power of your computer can be "borrowed" for resource intensive tasks, such pattern recognition or data mining. sharkGrid uses "**volunteer computing**" (a.k.a "global **grid computing**") to distribute intensive tasks between multiple computers to allow them to complete much more quickly.

## How to Join sharkGrid

---

Welcome to the sharkGrid! The sharkGrid allows you to donate spare cycles of your computer to whale shark research. Specifically, the processing power of your computer can be “borrowed” for resource intensive tasks, such pattern recognition or data mining. sharkGrid uses “global volunteer computing” to distribute intensive tasks between multiple computers to allow them to complete much more quickly.

There are a few quick things you should know before participating in sharkGrid.

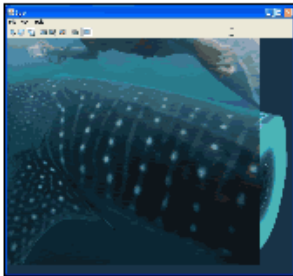
1. Once running, the sharkGrid client must stay open to allow your computer to aid in whale shark spot pattern processing. If for any reason you want to leave the grid, close the client. If you restart your computer, you must restart sharkGrid to participate.
2. Your Internet connection must remain open to participate in sharkGrid. sharkGrid obtains all patterns to compare from the World Wide Web.
3. Your computer must have a Java Runtime Environment (JRE) 5 or higher installed. You can download a JRE from the [Sun Microsystems Java web site](#). The JRE is different from the Java Virtual Machine (JVM) that runs in your browser. The JRE allows Java applications to run as programs on your desktop.
4. Please disable any power saving features enabled on your computer. For example, many PCs will enter a suspended state (a.k.a. “System standby”) after a period of time with no user interaction. Other power saving schemes stop the hard drive(s), which will also interfere with the sharkGrid client.
5. sharkGrid participation is subject to the [ECOCEAN Library Visitor Agreement](#). By visiting this web site and joining sharkGrid, you are agreeing to the terms and conditions therein.
6. sharkGrid can run in the background while you perform other tasks on your computer. However, sharkGrid is used for intensive computation, and other applications running on your computer simultaneously with sharkGrid may slow down.
7. sharkGrid requires significant computing power. We recommend you only run sharkGrid on computers with 1 gigabyte (GB) of RAM or more.

## Downloading the sharkGrid client

---

# SPOT!

## Spot! Online Help

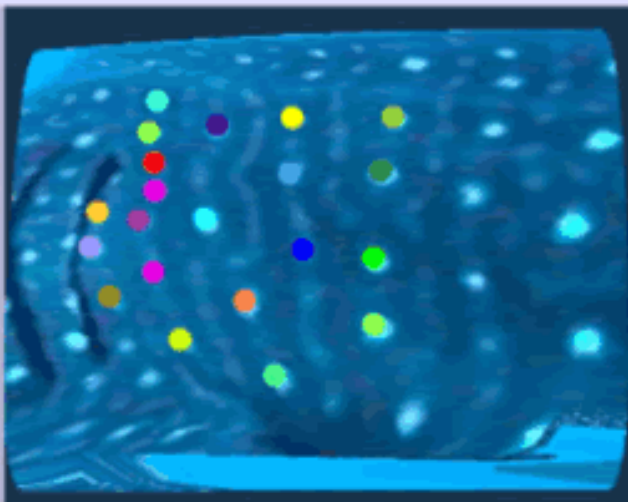


The spot pattern recognition algorithms used in whale shark mark-recapture (Modified Groth and I3S) assume a flat, two-dimensional surface when analyzing the relationships between spots. While each algorithm has some tolerance for skew in an image, both quickly degrade in their ability to match identical patterns as the angles between those patterns increases.

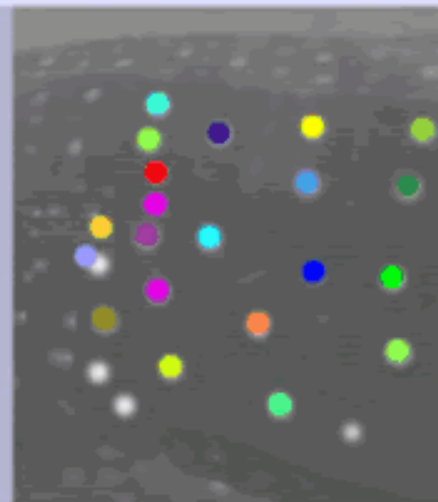
**Spot!** allows you to map a skewed 2D image to a 3D whale shark model and obtain a properly-oriented left- or right-side pattern for use with the Modified Groth and I3S algorithms. This perspective correction has been used in the ECOCEAN Library to match images taken from very extreme angles to previously tagged whale sharks. For example, Spot! was used to make this match for shark [M-025](#) in the ECOCEAN Library.



Match Score: 556.90 (Match 1 of 33)



Number = **182200825816**  
Date = 9/2/2008, 11:00  
Sex = Unknown  
Assigned to Shark = Unassigned  
Size = 5.0 meters meters



Number = **289200675324**  
Date = 11/5/2006, 14:45  
Sex = male  
Assigned to Shark = M-025  
Size = 6.0 meters

PREVIOUS

NEXT

# Let's centralise data....

- With increased uptake we continue to develop improved functionality (something ECOCEAN would like to explore further with the establishment of a Library 'stakeholder council')
- What other data-sets could be / should be included within this ECOCEAN database?

## OPEN FOR DISCUSSION

NB. ECOCEAN (primarily a volunteer organisation) has developed a 'User Policy' (see wiki) and links with the following initiatives (e.g. GBIF, FishBase etc.)

# Collaborations

Whale shark ecotourists worldwide  
Whale shark researchers worldwide  
Whale shark industry worldwide

Murdoch University  
Carl Schwarz (Simon Frazer University)  
British Ecological Society  
Project Aware  
National Geographic Society  
WA Department of Environment and Conservation  
Wildlife Trust of India  
WWF (Denmark, Philippines)

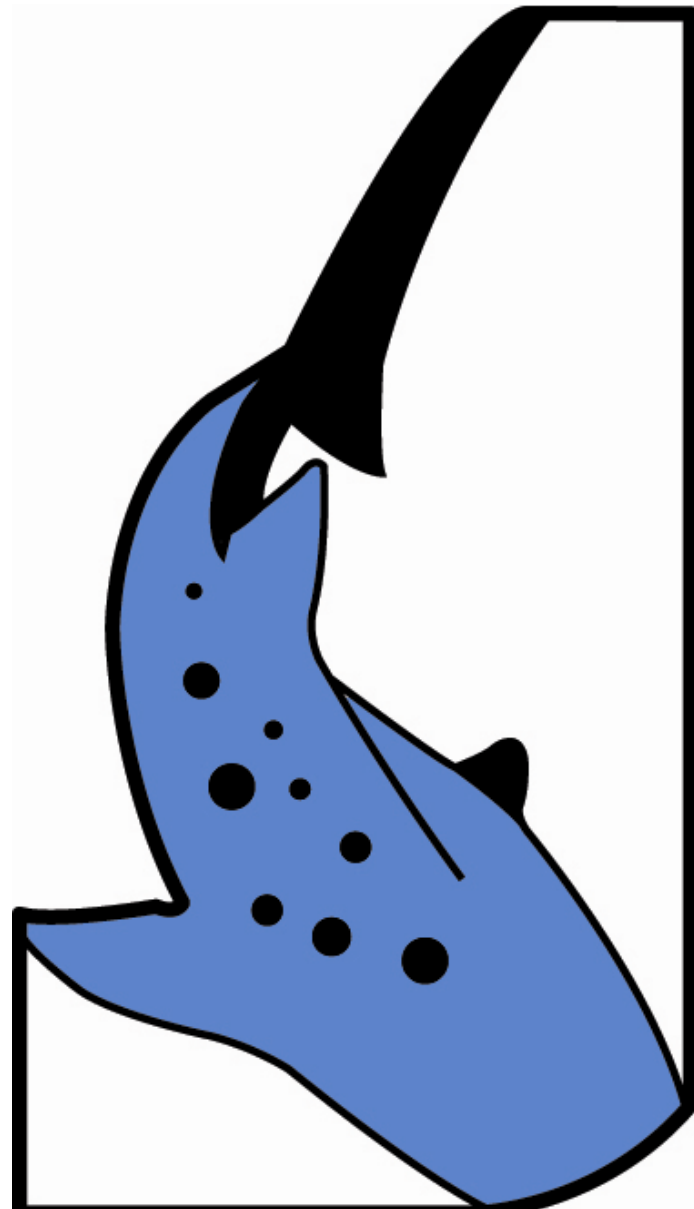


The ECOCEAN Library program has continued to receive considerable media exposure

.... Which has enabled the program to record significant growth....

Major sponsors include





**ECOCEAN**