Workshop and Monitoring Training for Whale Sharks in Cendrawasih Bay National Park, West Papua

2 – 7 May 2011

Nabire, Papua

by

Brent S. Stewart, Ph.D., J.D.
Senior Research Scientist
Hubbs-SeaWorld Research Institute
2595 Ingraham Street
San Diego, CA 92109

Hubbs-SeaWorld Research Technical Report 2011-375

1 August 2011

The whale shark has become an icon species in some areas of the Indian Ocean (e.g., Ningaloo Reef in Western Australia, Donsol in the Republic of the Philippines). The benign and friendly behavior of whale sharks and their regular occurrences in some areas have made them attractive resources for development of local marine ecotourism. Consequently, they might be a potential generator of income for a marine protected area like Cendrawasih Bay Marine National Park and its local communities. The consistent presence of whale sharks there might also enhance awareness of the species, enhance its regional conservation, and promote it as an icon species for Cendrawasih Bay and the Coral Triangle generally (cf. Hoegh-Guldberg et al 2010).

The consistent sightings of whale sharks in Cendrawasih Bay and other areas in the Bird's Head, Papua, has recently become associated with the presence of lift net (i.e., *bagan*) fisheries that target small schooling fishes (Figure 1). Whale sharks are apparently attracted to these nets by the concentration of small fishes in those nets, and perhaps the scent of those fishes as they become injured in the nets (Figure 1). Consequently, whale sharks can be easily observed and closely approached there (e.g., Maldives Whale Shark Research Programme 2010, Topp 2010).

The abundance of whale sharks in Cendrawasih Bay and Bird's Head, the age and sex composition and seasonal dynamics of the aggregation there, and the relevance and relationship of this aggregation to aggregations of whale sharks elsewhere in the Indian Ocean and in Indonesia are unknown. Important questions that need to be addressed are: 1) are whale sharks present year round in this area? 2) If they leave the area for any period of time, where to they range? 3) What are the important foraging areas (geographic and vertical) for whale sharks in the area? 4) What are the local and

regional issues that may threaten the vitality of whale sharks that appear in the Cendrawasih area?

WWF-Indonesia is planning to establish a monitoring network in the Bird's Head area of West Papua to document the spatial and temporal distribution of whale sharks and to evaluate potential threats to them and the potential for developing ecotourism focused on whale sharks. This work involves capacity building for shark conservation and management related research techniques for local conservation partners (NGOs, university, park authority and dive operators).

In-class workshop, Nabire: 2-3 May 2011

To facilitate those plans, to build capacity for monitoring and research methods and techniques, and to identify potential research options a training workshop was conducted in Nabire, Papua, from 2 through 7 May 2011 . During the first two days of that workshop I presented 1) a summary of the knowledge of the biology, ecology, and conservation of whale sharks, 2) a summary of research methods that have been used in other areas where whale sharks have been studied and those that might be applied to studies in Cendrawasih Bay, and 3) a summary of the structure and function of ecotourism industries that target whale sharks in the Indian Ocean and elsewhere. This in-class orientation was followed by three days of field orientation and application of some research methods in central Cendrawasih Bay around operational *bagan* fishing operations.

Tagging and tracking demonstration: 4 May 2011

To demonstrate methods of telemetry for potential use in further studies of whale sharks in Cendrawasih Bay we tagged one whale shark ("*Guillermo*" , a 5 m –long male, Figure 2) with a pop-up satellite-linked radio transmitter (i.e., Pop-up archival tag or PAT) at 0825 hrs on 5 May at one of the local *bagans* (3.217 S, 134.9406 E). The shark did not react to the tagging and remained around the bagan for at least another hour, closely approaching the platform repeatedly to accept small fish that the fishermen dumped in the water to attract sharks and divers and snorkelers from the workshop group. We encountered *Guillermo* at a nearby *bagan (*3.185 S, 134.9324E) at 1230hrs on 5 May, where he remained for several hours at least. The tag was either removed intentionally or released for some other reason on 18 May near where the shark was tagged. The ambient light level data that the tag measured, stored, and then transmitted to the Argos Data Collection and Location Service (DCLS) indicated that *Guillermo* started travelling north on 6 May, continued north until around 11 May (about 190 nm north of the tagging site) where he remained until he started moving south on 15 May into the southern reach of central Cenderawasih Bay and then back to

where he was tagged by 18 May (Figure 13). During the 13 days while the tag was attached, *Guillermo* travelled a minimum of around 690 nm (Figure 3). The detached tag continued to drift and transmit for another 11 days, drifting first northward, then east and southward until the batteries expired on 29 May (Figure 4).

Field expedition for photographic method instruction and behavioral observations: 4-6 May 2011

We made daily excursions to *bagans* in south-central Cedrawasih Bay on 4, 5, and 6 May with an overnight visit to the nearby village of *Akudiomi*. During each visit to the *bagans*, the collaborative group of researchers from HSWRI, WWF-Indonesia, Ahe Island/Papua Eco Tourism (PET), Cenderawasih Bay National Park, and other government officials spent several hours in the water observing, photographing, and becoming familiar with determining the sex of whale sharks. Male whale sharks have paired sexual organs (i.e., claspers) located on the inner margins of each pelvic fin whereas females lack these (Figure 4). These claspers are rolls of cartilage that become stiffer with age as they calcify. On 4 May we tagged and photographed one shark (Guillermo, 3 m-long male) at one *bagan* (3.2175N, 134.941) and then observed 3 sharks (all adolescent males) at another nearby *bagan* (3.203N, 134.923). On 5 May we observed and photographed 5 sharks at one *bagan* (3.22N, 134.941E; 1 adolescent female, 4 adolescent males, including *Guillermo)* and one shark at a nearby *bagan* (3.185N, 134.932E). While at the village of *Akudiomi* (3.246N, 134.947E) on 5 May we conducted a group interactive review of all photographs made on 4 and 5 May and discussed needs and ways to improve or enhance photographic techniques and methods

of data collection. On 6 May we observed and photographed 3 sharks (all adolescent males) at one *bagan* (*Cakar Nalis;* 3.198N, 134.935) before concluding the field operations and workshop and returning to Nabire by 1400hrs.

Conclusions and recommendations:

Whale sharks that might occur seasonally, or perhaps year-round, in and near Cendrawasih Bay are apparently attracted to coastal lift-net (*bagan*) fishing operations by the scent produced by the injured and decomposing small fishes that the *bagans* target. They appear to become easily conditioned by behaviors (e.g., tapping or beating on the surface of the water) of the resident fisherman to approach the *bagans* closely to be hand-fed discards of these fishes and often remain swimming near the *bagans* for several hours or more and individual sharks might remain in the area for at least a couple of days. During these times, the whale sharks can be closely approached and observed by swimmers and free-divers and by divers on SCUBA with little effort, in relatively calm conditions, and for relatively long periods of time, in contrast to most other areas where whale sharks aggregate briefly, in higher energy habitats, and are substantially more active resulting in very brief encounter opportunities (e.g., Ningaloo Reef in Western Australia, Donsol in the Republic of the Philippines, the Republic of the Maldives, etc.) These characteristics could be optimal for developing a high quality ecotourism industry to engage and support locally based operators or transient live-aboard or safari marine tour operators. However, to ensure that these activities do not have adverse affects on the whale sharks, it would be prudent to develop and implement adaptive whale shark-interaction guidelines (cf. Attachment 1), training programs for

operators and tour guides (cf. http://www.thetravelfoundation.org.uk/whalesharks/), and guidance for and training of resident *bagan* operators. As the conditions at the interaction sites in Cendrawasih Bay are substantially different from all other locations that support whale shark interaction industries, the interaction guidelines and training programs will need to be substantially modified and specifically tailored to the novel characteristics of the Cendrawasih Bay system. Because awareness and promotion of the opportunities to swim with whale sharks here have developed rapidly, particularly for live-aboard operators, interactions guidelines and monitoring of this quickly developing ecotourism industry should be crafted and implemented soon to ensure that the industry and the *bagan* fisheries are compatible with immediate and long term vitality of resident and transient whale sharks (e.g., most whale sharks have signs of superficial injury from bagan structures and fish hooks and line attached to *bagans*, see Figure 6) use of marine habitats in the Cendrawasih Bay National Park (CBNP).

To facilitate the development of these guidelines and training programs and to aid in management and sustainability of whale shark interaction programs in Cendrawasih Bay National Park I recommend prompt development of a Monitoring and Research Program (MRP) that could be compatibly incorporated into ecotourism activities and industries. The MRP should also evaluate the potential effects (positive and negative) of hand feeding of whale sharks at the *bagan*. As key elements of this MRP, I suggest the following:

1. Routine monitoring of the presence and characteristics (e.g., length, sex) of whale sharks near each *bagan* during the fishing season using logbooks supplied

to the resident *bagan* fishermen and frequent visits by WWF and CBNP biologists and officials.

2. Photographic documentation of whale sharks at each *bagan* for potentially identifying individual whale sharks for short and long term behavioral and population studies.
3. Permanent tagging of whale sharks to test the key assumptions of the photographic identification method (i.e., though this method has been used and is often promoted for use, the key assumptions of uniqueness and stability of the body color patterns of individual whale sharks have yet to be tested, calibrated and validated).
4. Development of Guidelines and Codes of Conduct for whale shark interactions for local enterprises and for transient live-aboard operators and for resident *bagan* residents and operators.
5. Development of Training Workshop and briefing materials to be used to train local community participants and ecotourism operators and transient live-aboard operations.
6. Documentation of local CBNP habitat use by and behavior of whale sharks.
    a. Development of recording logs for resident *bagan* fishermen and ecotour operators to use to record the presence and behaviors of whale sharks at each *bagan*.
    b. Periodic surveys by MRP personnel and collaborations of the CBNP area, and particularly near *bagans* with opportunistic surveys and traditional line

transect surveys (visual and also perhaps using fish finders or small boat-mounted sonar transducers that can detect whale sharks and other fishes).

7. Document the local movements and diving behaviors of whale sharks in CBNP (for simple direct studies and also for comparative studies of behaviors of sharks that are hand fed at particular *bagans* vs behaviors of sharks near *bagans* that do not feed sharks) .
   a. Attach small acoustic tags (that transmit information on the depth of the shark at frequent intervals and that can be located geographically with a directional hydrophone and boat-based GPS receiver; Stewart and David 2011) to a statistically robust sample of whale sharks that occur near *bagans* in each of the three years of the study. Monitor these directly from small boat by following them as they move near the *bagans* and in CBNP for short periods, or establish hydrophone-equipped detections-recording stations at the *bagans* or moored at various locations in CBNP.
   b. Attach small recoverable data-recorders (depth, temperature, light levels, salinity) to a statistically robust number of whale sharks in CBNP in the first year of the study and then remove them during the 2d and 3rd years of the study as possible.
8. Document the movements and diving-foraging behaviors of whale sharks in CBNP. Supplement the high resolution archival data recorders (above) with attachment of satellite-linked data recorders (i.e., Pop-up tags or PATS) that remain attached to sharks for several months to a year or more and then automatically release, float to the sea surface and transmit data on the

geographic and vertical movements of sharks (and water temperature) during the period of tag attachment (e.g., Stewart 2008, 2009; Stewart et al. 2009; Stewart and David 2010; Wilson et al. 2006).

9. Collect small biopsy skin samples from whale sharks as possible to use in collaborative studies of population and immunogenetics (e.g., Castro et al. 2007).

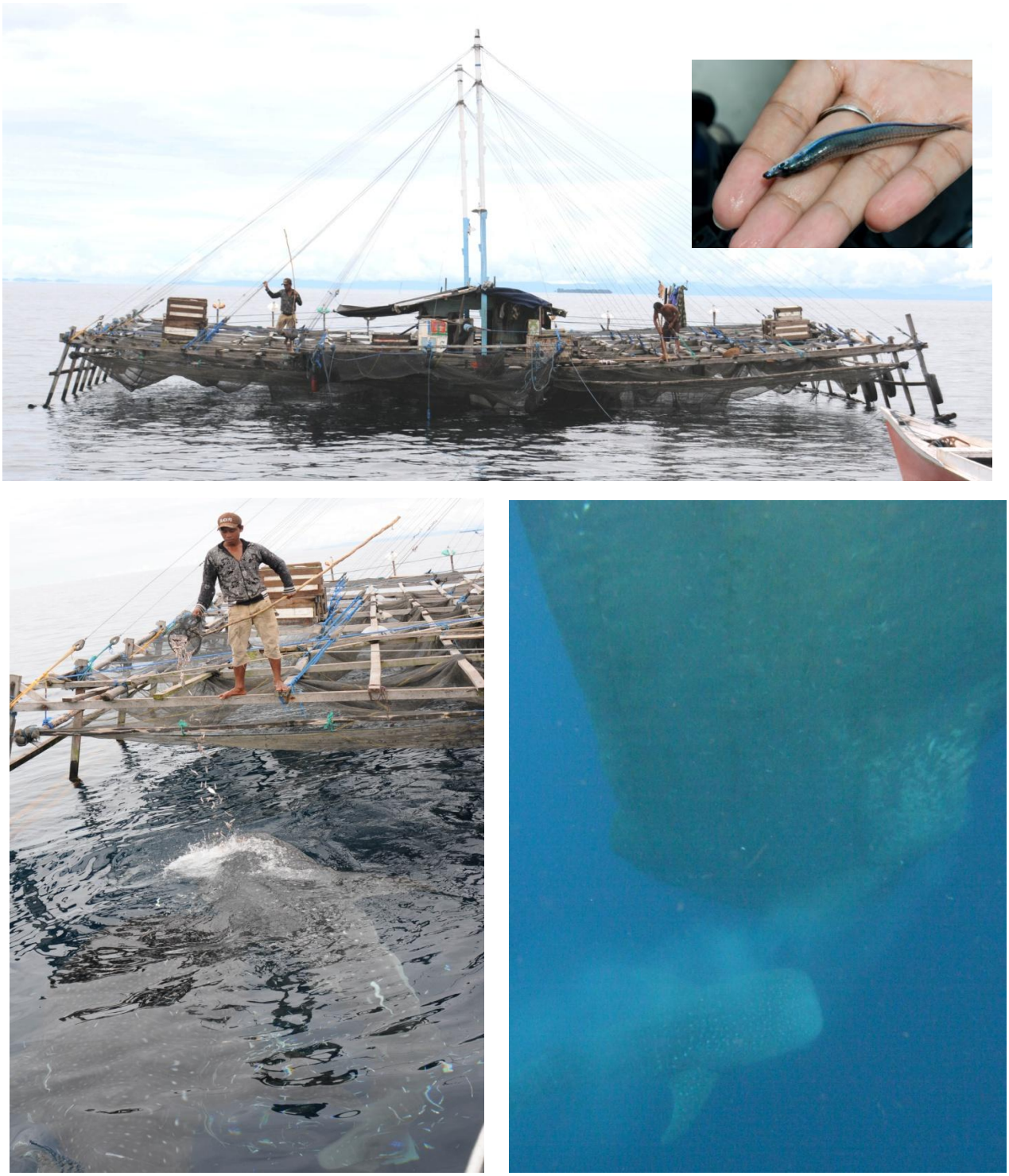

Figure 1. Lift-net (*bagan*) fishing platform in southern waters of Cendrawasih Bay (top), resident *bagan* fisherman feeding 2 whale sharks (left), fish targeted by *bagan* fisheries (top right), and whale shark approaching holding net at *bagan* loaded with fish (bottom right).

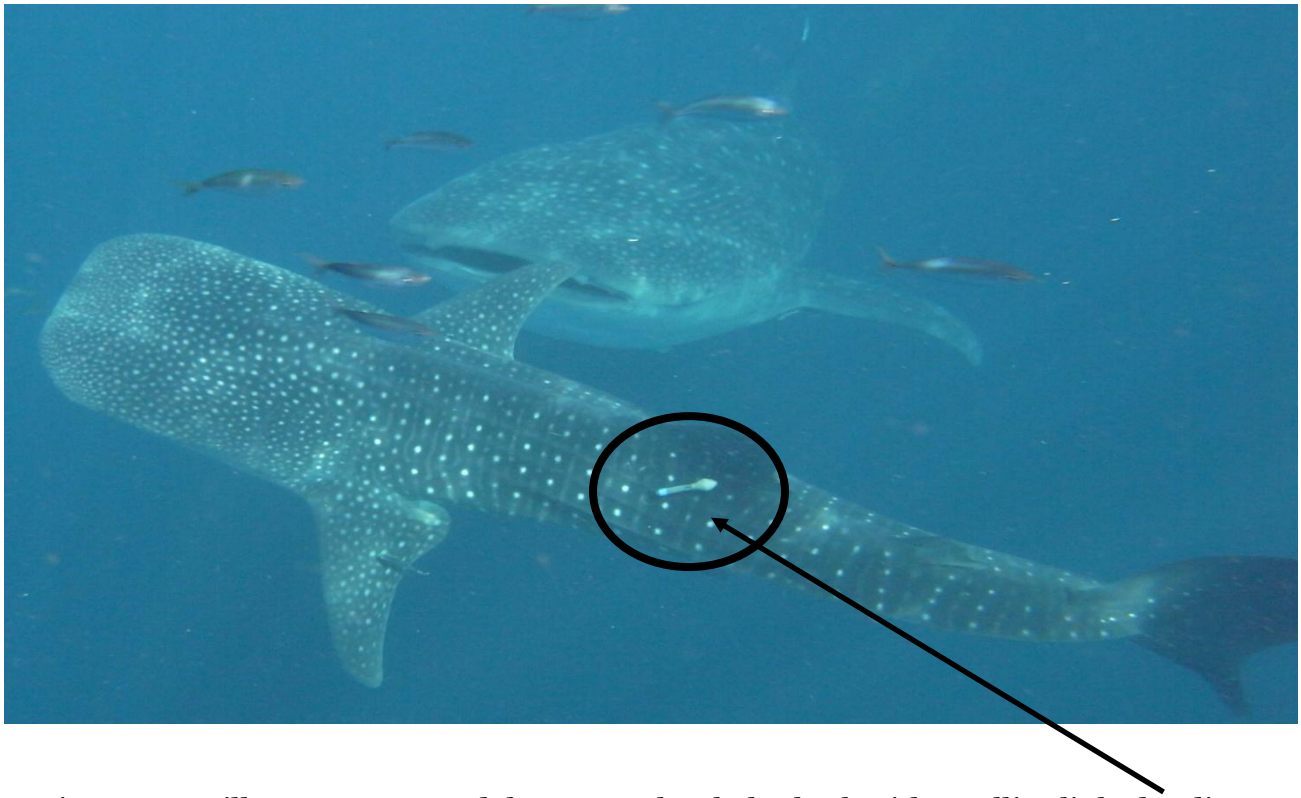

Figure 2. Guillermo, a 3-4 m adolescent male whale shark with satellite-linked radio transmitter (i.e., pop-up tag) attached to left side.

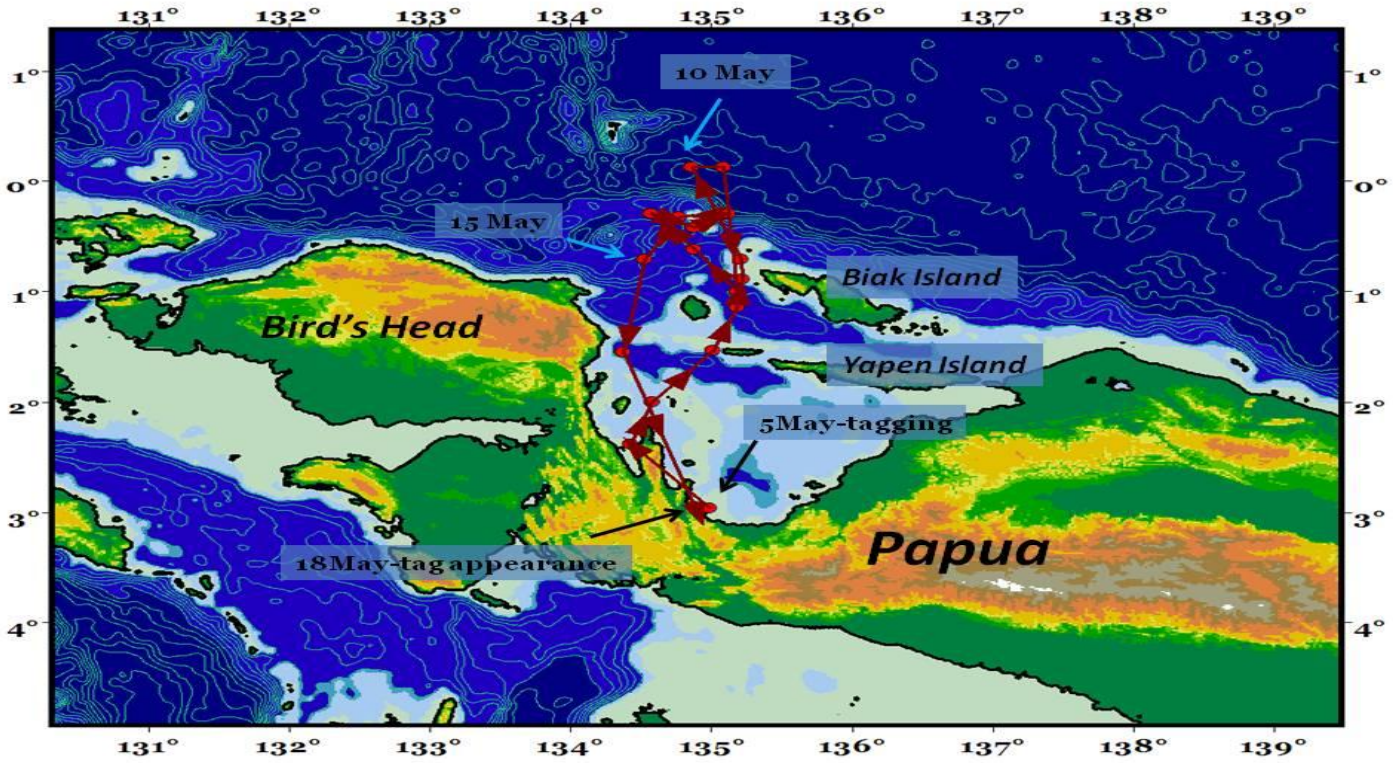

Figure 3. Movement of *Guillermo* between 5 and 18 May 2011.

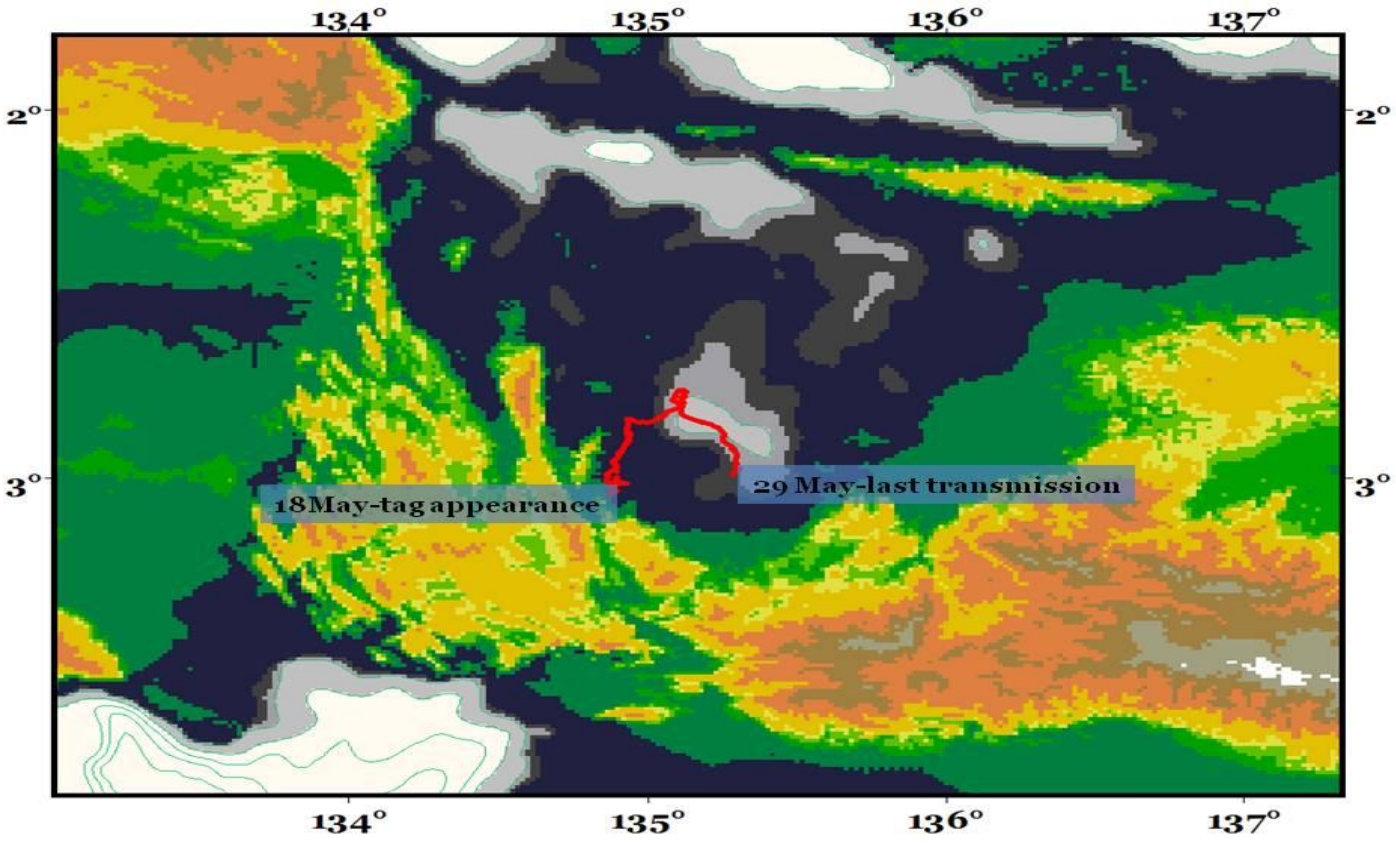

Figure 4 . Drift of *Guillermo's* PAT tag from detachment on 18 May through 29 May 2011.

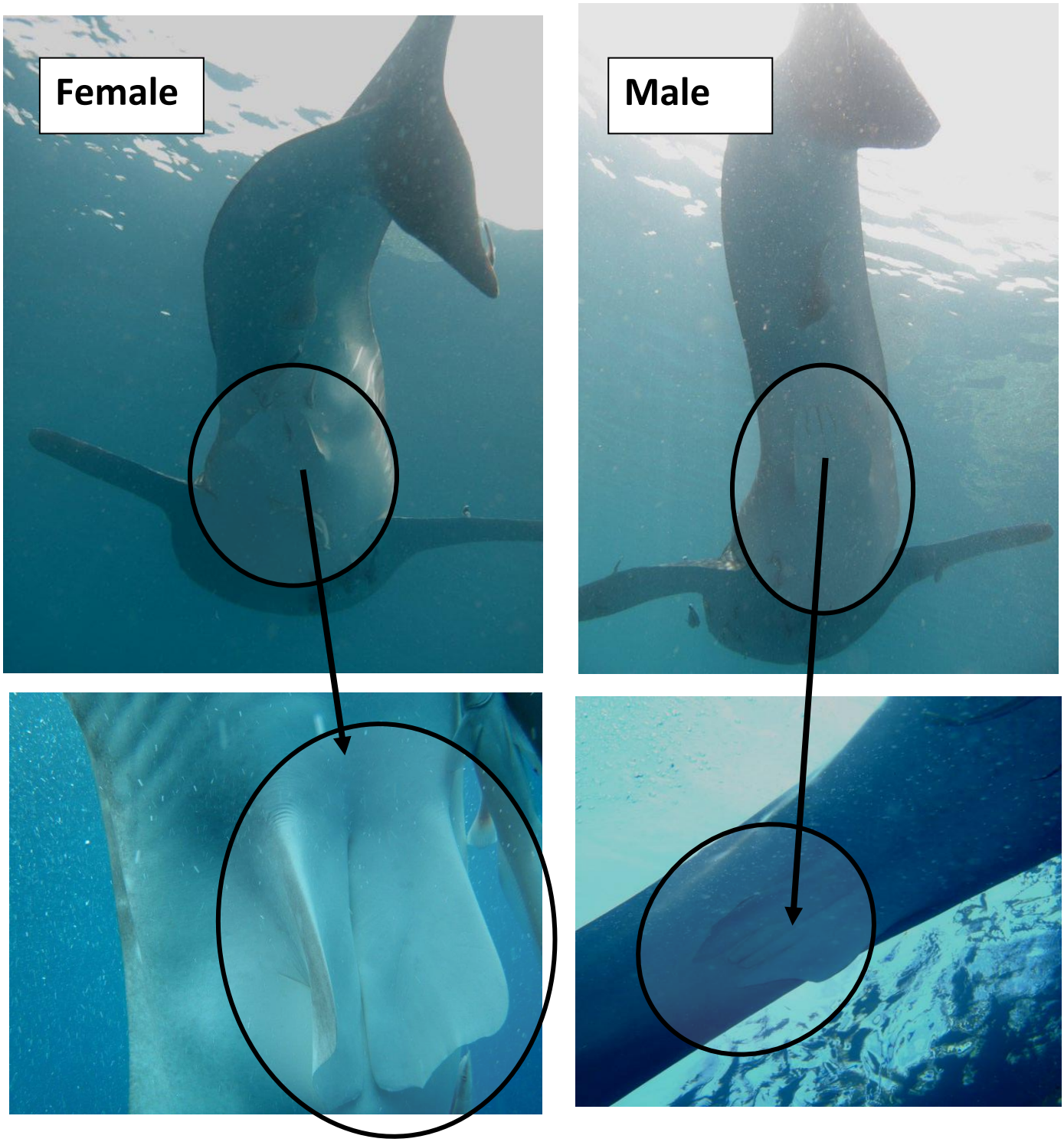

Figure 5. Presence and location of claspers on whale sharks for determination of sex.

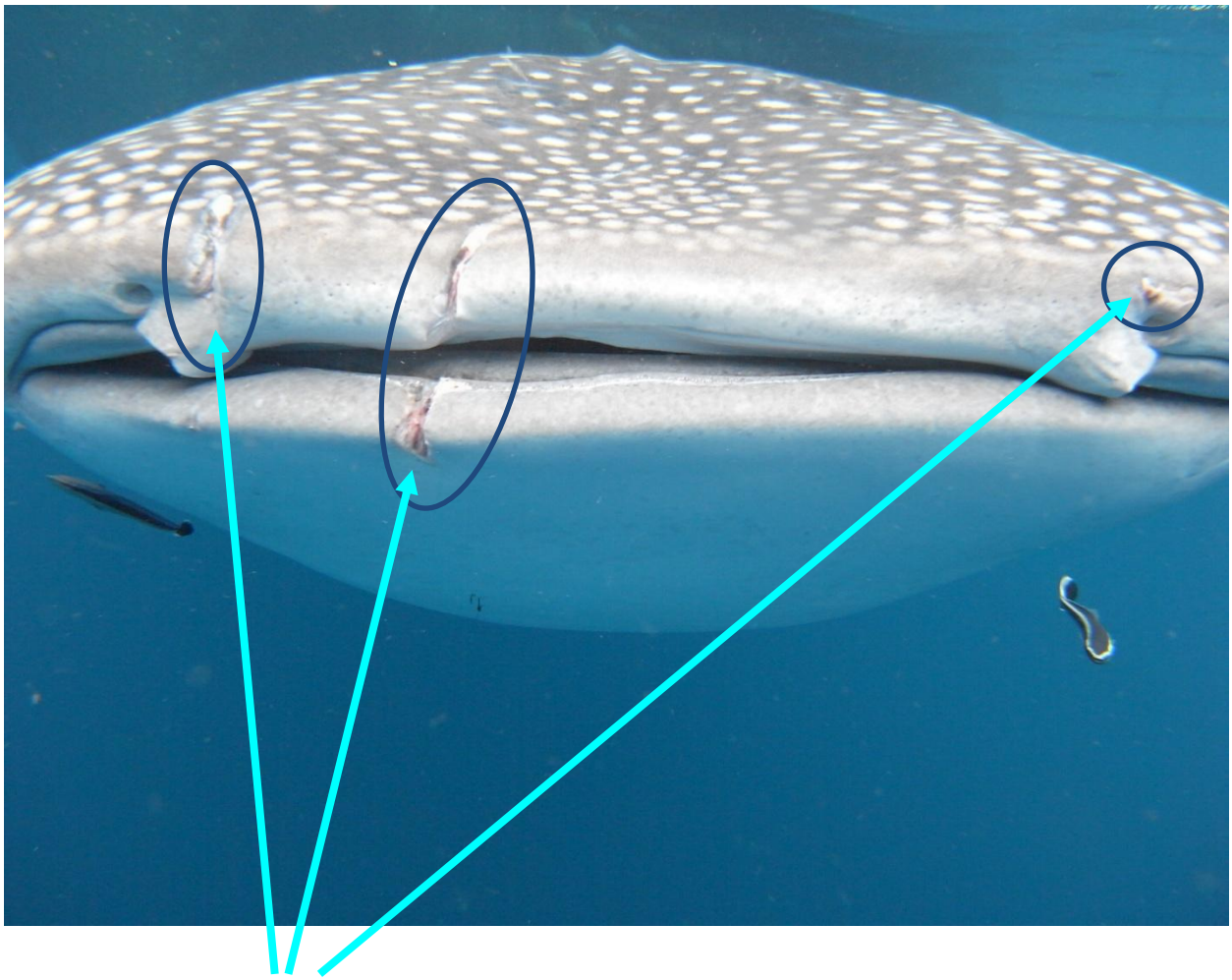

Figure 6. Typical injury to whale sharks near Cendrawasih Bay *bagans* from collisions with *bagan* structures, fishing lines, and attending boats.

References

Brillinger, D. R., and B. S. Stewart. 2010. Stochastic modeling of particle movement with application to marine biology and oceanography. Journal of Statistical Planning and Inference. 140:3597-3607.

Castro, A. L. F., B. S. Stewart, S. G. Wilson, M. G. Meekan, R. H. Hueter, A. L. Bass, P. J. Mota, B. W. Bowen, S. A. Karl. 2007. Population genetic structure of the world's largest fish, the whale shark (*Rhincodon typus*). Molecular Ecology 16:5183-5192.

Eckert, S. A. and B. S. Stewart. 2001. Telemetry and satellite tracking of whale sharks, *Rhincodon typus* in the Sea of Cortez, Mexico, and the North Pacific Ocean. Environmental Biology of Fishes 60:299-308.

Hoegh-Guldberg, O., H. Hoegh-Guldberg, J. E. N. Veron, A. Green, E.D. Gomez, J. Lough, M. King, H. Ambariyanto, L. Hansen, J. Cinner, G. Dews, G. Russ, H.Z. Schuttenberg, E. L. Penaflor, C. M. Eakin, T. R. L. Christensen, M. Abben, F. Areki, R. A. Kosaka, A. Tewfik, J. Oliver. 2009. The Coral Triangle and Climate Change: Ecosystems, people and societies at risk. WWF Australia, Brisbane, 276 pp.

Maldives Whale Shark Research Programme. 2010. Trip Report, Cenderawasih Bay, 10-24 June 2010. 3 pp.

Sleeman, J.C., M. G. Meekan, B. S. Stewart, S. G. Wilson, J. J. Polovina, J. D. Stevens, G. S. Boggs, C. J. A. Bradshaw. 2010. To go or not to go with the flow: Environmental influences on whale shark movement patterns. Journal of

Experimental Biology and Ecology. 390: 84-98.

Stewart, B.S. 2008. Collaborative research on whale sharks (*Rhincodon typus*) at Ningaloo Reef: Tag deployment, June 2008. Hubbs-SeaWorld Research Institute Technical Report 2008-363:1-12.

Stewart, B.S. 2009. Collaborative research on whale sharks (*Rhincodon typus*) at Ningaloo Reef: Tag Deployment, June 2009. HSWRI Tech. Rept. 2009-36: 1-13.

Stewart, B. S. 2010. Movements, Diving Patterns, and Habitats of Whale Sharks (*Rhincodon typus*) at Nin9aloo Reef, June 2010. Hubbs-SeaWorld Research Institute Technical Report 2010-372: 1-13.

Stewart, B.S., E. Aca, D. David, L. Topp, C. Topp. 2009. Movements and habitats of whale sharks from Donsol of the Republic of the Philippines: Satellite tag deployments, 2009. HSWRI Technical Report 2009-367:1-27.

Stewart, B. S. and D. David. 2010. Movements and habitats of whale sharks from Donsol, Republic of the Philippines: Tagging Studies, 2010. HSWRI Technical Report 2010-371: 1-14.

Stewart, B. S. and D. David. 2011. Acoustic telemetry of movements and diving behavior of a whale shark near Donsol, Republic of the Philippines. *In Review*.

Stewart, B. S. and S. G. Wilson. 2005. Threatened fishes of the world: *Rhincodon typus* (Smith 1828), Rhincodontidae. Environmental Biology of Fishes 71:184-185.

Stewart, B. S., S. G. Wilson, and J. Polovina. 2003. Satellite tracking of and oceanographic surveys by whale sharks (*Rhincodon typus*), Ningaloo Reef, Western Australia. Field Deployments: 1-12 May 2003. Hubbs-SeaWorld Research Institute Technical Report 2003-345:1-12.

Topp, L. 2010. A rapid assessment of the presence of whale sharks in Cendrawasih Bay National Park. 8 pp.

Wilson, S. G., Polovina, J. J., B. S. Stewart, and M. G. Meekan. 2006. Movements of whale sharks (*Rhincodon typus*) tagged at Ningaloo Reef, Western Australia. Marine Biology. 148:1157-1166.

Participants in workshop on whale sharks and ecotourism in

Cendrawasih Bay National Park, 2-7 May 2011

Appendix 1: Codes of Conduct and guidelines for interacting with whale sharks as implemented by various whale shark eco-tour operations, mostly modeled after the policies and practices at Ningaloo Reef, Western Australia, by the Western Australia Department of Environment and Conservation.