



April 2010

TECHNICAL REPORT

LARGE SHARK TAGGING PROGRAM IN NEW CALEDONIA

Mission report SharkCal 04 (Southern Province, Jan. 2010)
Mission report SharkCal 05 (Northern Province, Mar. 2010)

Authors:
Jonathan WERRY
Eric CLUA
Serge PLANES

Photo: Thomas Vignaud



SPC
Secretariat
of the Pacific
Community



CRISP



Coral Reef InitiativeS for the Pacific
Initiatives Corail pour le Pacifique



Le CRISP est un programme mis en œuvre dans le cadre de la politique développée par le Programme Régional Océanien pour l'Environnement afin de contribuer à la protection et la gestion durable des récifs coralliens des pays du Pacifique.

La cellule de coordination du CRISP est un projet du Secrétariat de la Communauté du Pacifique depuis avril 2008 afin d'assurer une coordination et une synergie maximales avec les actions de la CPS touchant à la gestion des écosystèmes coralliens.

L'initiative pour la protection et la gestion des récifs coralliens dans le Pacifique (CRISP), portée par la France et préparée par l'AFD dans un cadre interministériel depuis 2002, a pour but de développer une vision pour l'avenir de ces milieux uniques et des peuples qui en dépendent. Elle vise à mettre en place des stratégies et des projets visant à préserver leur biodiversité et à développer dans le futur les services économiques et environnementaux qu'ils apportent tant au niveau local que global. Elle est conçue, en outre, comme un vecteur d'intégration entre états développés (Australie, Nouvelle-Zélande, Japon et USA), collectivités françaises de l'outre-mer et pays en développement du Pacifique.

Pour ce faire, l'initiative développe une approche spécifique qui vise à :

- associer activités de réseau et projets de terrain ;
- articuler recherche, aménagement et développement ;
- combiner les apports de disciplines scientifiques diverses, incluant la biologie, l'écologie, l'économie, la sociologie, le droit et les sciences humaines ;
- intervenir sur l'ensemble des thèmes - terrestres et marins - intéressant les récifs (y compris l'assainissement et la gestion des bassins versants) ;
- ne pas créer de structure nouvelle mais apporter des ressources financières à des partenaires déjà opérationnels et souhaitant développer leurs activités dans un esprit de coopération régionale. C'est la raison pour laquelle l'initiative a été préparée sur la base d'un appel à propositions auprès de l'ensemble des institutions et réseaux.



Cette étude s'effectue avec l'autorisation et l'appui de la Province Sud de Nouvelle-Calédonie.

La logistique des missions terrain est majoritairement fournie par l'Association Calédonienne pour la Recherche en Mer (ACREM).



Le dispositif d'intervention du CRISP se structure en trois composantes majeures :

Composante 1 : AMP et Bassins Versants

- 1A1 : Planification de la conservation de la biodiversité marine
- 1A2 : Aires Marines Protégées (AMP)
- 1A3 : Renforcement institutionnel et mise en réseau
- 1A4 : Gestion intégrée des zones côtières récifales et des bassins versants

Comp. 2 : Développement des Écosystèmes Coralliens

- 2A : Connaissance, valorisation et gestion des écosystèmes coralliens
- 2B : Restauration récifale
- 2C : Valorisation des Substances Actives Marines (SAM)
- 2D : Mise en place d'une base de données régionale (ReefBase Pacifique)

Comp. 3 : Coordination et Valorisation du Programme

- 3A : Capitalisation, valorisation et vulgarisation des acquis du programme CRISP
- 3B : Coordination, promotion et développement du Programme CRISP
- 3C : Appui aux filières économiques alternatives et durables (Capture et Culture de Postlarves)
- 3D : Conservation des espèces et écosystèmes vulnérables
- 3E : Cellule économique

Cellule de Coordination
Chef de programme : Eric CLUA
CPS - BP D5
98848 Nouméa Cedex
Nouvelle-Calédonie
Tél./Fax : (687) 26 54 71
E-mail : ericc@spc.int
www.crisponline.net

Ce projet est financé par les organisations suivantes :



Results on movement of tiger, *Galeocerdo cuvier*, and other large shark species in Southern and Northern Province, New Caledonia

Technical Report for missions SharCal 04 (field work conducted in January 2010) and SharCal 05 (field work conducted in March 2010)

Jonathan M Werry^{1,3}, Eric Clua², Serge Planes³

¹Ocean and Coast Research, Mermaid Beach, Gold Coast, Queensland, Australia 4218, and; Australian Rivers Institute and School of Environment, Griffith University, Gold Coast campus, Parklands Drive, Southport, Queensland, Australia 4222

²Secretariat of the Pacific Community, CRISP Programme, BP D5, 98848 Noumea cedex, New Caledonia

³UMS 2978 EPHE-CNRS, Centre de recherches insulaires et observatoire de l'environnement (CRIOBE), BP 1013, 98729 Moorea, French Polynesia

Abstract

Movements of large shark species (> 2m total length (TL) as adults) in New Caledonian waters are poorly understood. To address this issue an international collaborative research program (SharCal) into large sharks' movements in New Caledonian waters was initiated in early 2009. We present results of movement of tagged tiger (*Galeocerdo cuvier*) and bull (*Carcharhinus leucas*) sharks and field work conducted in Southern Province during January and February 2010 (SharCal 04) and the Northern Province of New Caledonia in March 2010 (SharCal 05). Movement of a single small tiger shark (1.92 m TL) tagged with a SPOT5 dorsal fin mounted satellite tag indicated this shark remained within the Southern Province lagoon, moving from Woodin channel towards Noumea. Alternatively, results of an archival pop-off satellite tagged large tiger (3.9 m TL) in Southern Province indicate this shark moved into and remained in oceanic waters of the Coral Sea before returning to coastal waters within 50 km of its original tagging location over a 6 month period. In the Southern Province, detections of tiger (n = 9) and bull (n = 3) sharks tagged in the area occurred on all acoustic receiver stations and most detections occurred in the Woodin Channel and at Bonne Anse. Long term acoustic tag data revealed the periodic movement of a female bull shark (3 m TL) from the Woodin Channel into the top reaches of Prony Bay. One tiger (3.8 m TL) tagged in the Southern Province in January 2009 was consistently detected moving through Woodin Channel for all of 2009. In addition, an expedition to the Northern Province resulted in the capture of four tiger (3 to 3.4 m TL) and four bull sharks (2.5 to 3 m TL). In this location SPOT5 satellite tags were deployed on two tiger sharks (3/03/2010 and 11/03/2010) and all tigers and three bull sharks were tagged with internal acoustic tags. Two acoustic stations were deployed in Petite Pass and one at d'Estrées Pass in the Northern Province. Our results provide an initial insight into the movements of tiger and bull sharks in New Caledonian waters and illustrate the connectivity of both oceanic and coastal habitats in supporting the endangered sharks.

Keywords: *Galeocerdo cuvier*, tiger shark, *Carcharhinus leucas*, bull shark, movement, acoustic tags, acoustic receiver, SPOT5 satellite tags

1.0 Introduction

Despite the critical role large sharks play in ecosystems through top-down control, little information exists on their basic ecology, movement patterns and habitat use, particularly in the Southwest Pacific. Key large shark species, such as the tiger shark, *Galeocerdo cuvier*, the bull shark, *Carcharhinus leucas*, and the Great white shark, *Carcharodon carcharias*, have been recorded in tropical waters of New Caledonia and have also been implicated in fatal attacks on humans in this region (Last & Stevens 1994). To provide recommendations for the conservation of the sharks, the management of hazardous interactions with humans and to address the lack of scientific data on these species, an international collaborative research program (SharkCal) was initiated in early 2009. This program was implemented by the Secretariat of the Pacific Community (SPC, Noumea, New Caledonia) in partnership with the CRIOBE (UMS 2978 EPHE-CNRS, Moorea, French Polynesia) and Griffith University (Gold Coast, Queensland, Australia). The aim of this program in New Caledonia is (a) the determination of centres of shark activity, (b) the proportion of time sharks spend in management zones, reef habitats and nearshore areas and (c) identification of hot spots or species specific site fidelity. Understanding potential migration pathways to and from sites with New Caledonia (i.e. connectivity with other reef habitats in the South Pacific) is also a major management issue as the size of shark home ranges beyond the waters of New Caledonia, and hence their exposure to fishing pressure, are unknown.

This technical report presents initial findings from tagging efforts of large sharks in the Southern Province of New Caledonia and details on two survey trips, one of which took place in January/February 2010 in the Southern Province and one survey trip in the Northern Province in March 2010. This report proceeds a previous report on SharCal 02 and 03 field trips in the southern Province of New Caledonia in 2009.

2.0 Materials and Methods

2.1 Study sites

This research program is comparing both local and regional connectivity of large shark (primarily tiger shark) movement in New Caledonian waters. Three study sites have been chosen. One in the Southern Province, a second in the Northern Province and a third at Chesterfield in the Coral Sea and within New Caledonia territory boundaries (Figure 1a).

2.1.1 Northern Province study site 2

Belep in the Northern Province is one of the main islands within the Northern New Caledonian lagoon (Figure 1b). Petite Pass to the west of the island is seasonally significant biological hotspot at the interface between the Northern lagoon and the Coral Sea. This pass formed the centre of the study site.

2.1.2 Southern Province study site 1

Prony Bay is situated in the Southern Province of New Caledonia (Figure 1c). The area is geographically separated from the main region of human activity, i.e. Noumea, and a large nickel mine has been established in the northeast boundary of the bay. Research efforts have focussed around this site since the inception of the program.

2.1.3 Chesterfield study site 3

Chesterfield is a series of oceanic coral reef atolls in the Coral Sea (Figure 1a). We will provide details on efforts at this study location in future reports.

2.1.4 Australian study sites 4

Study sites within the Great Barrier Reef Marine Park, Australia (Figure 1a) have been chosen at similar latitudes to those in New Caledonia.

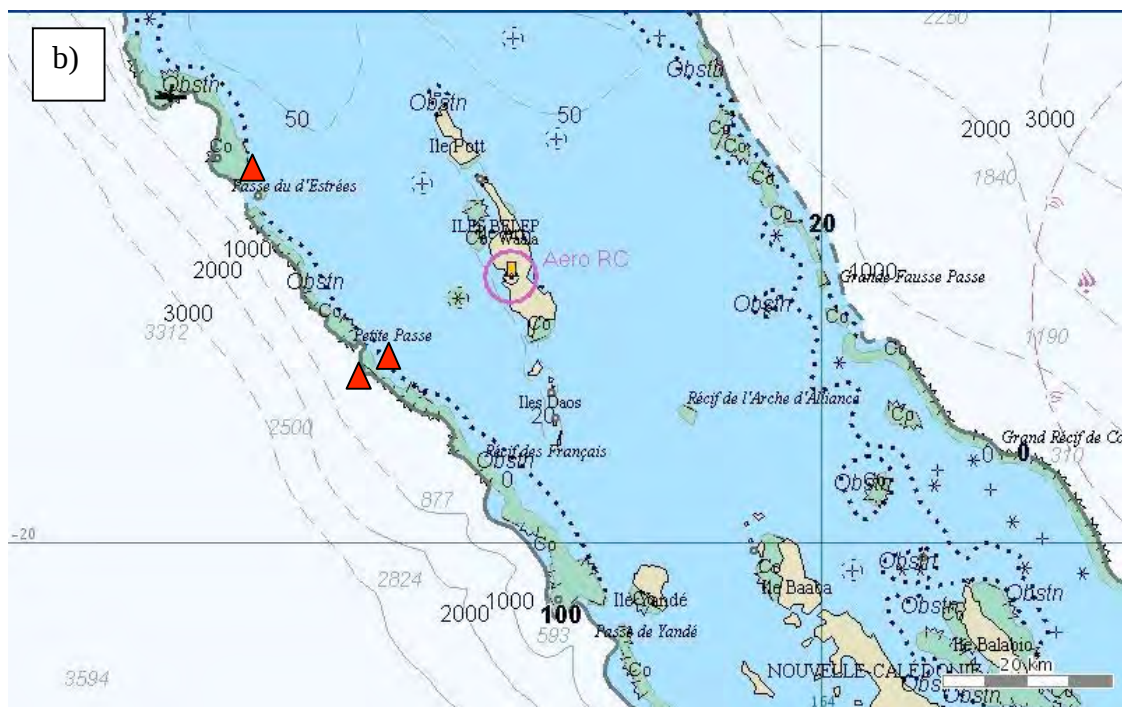
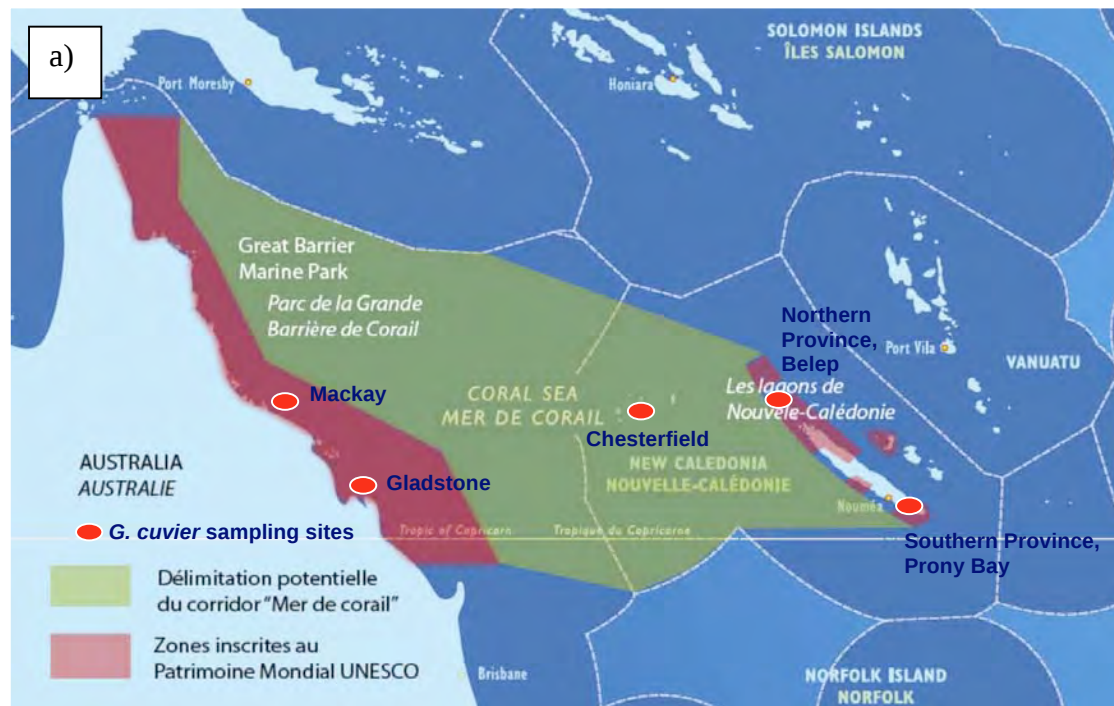




Figure 1. New Caledonia and surrounding territorial waters with study sites (a) indicated by ●. Red triangles ▲ represent locations of VR2W acoustic receivers in the Southern Province study site (c) and Northern Province study site (b). Maps in (b) and (c) extracted from <http://www.argos-system.org>.

2.2 Shark Capture

Drumlines with two or three 20L floats attached using 8 to 12mm rope to a large weight lowered onto the sea floor were used to capture large sharks. A large trace and tuna hook (8/O) were attached to rope close to the float that was furthest from the main rope to the weight and arranged to enable the shark to maintain a swimming position while hooked. Hooks were baited with tuna or meat and checked every 2 to 5 hr. This method was used at both sites in New Caledonia. Upon capture, sharks were restrained in a harness tied to the research vessel and morphometrics, i.e. total length and gender of sharks caught were recorded. The condition of all sharks was monitored during the capture, restraint and tagging efforts. Refer to Werry et al. (2009) for a full description.

2.4 Shark tracking technologies

Complementary tracking technologies of acoustic and satellite telemetry were used to provide insight into the long-range and long-term movement patterns/occurrence of large sharks.

2.4.1 Acoustic receiver arrays and long-term tags

Acoustic VR2W Vemco receivers were deployed (Figure 2) to determine the long-term movement patterns and site fidelity of large *G. cuvier* in Prony Bay, since January 2009 (Figure 1 b) and in the Northern Province in March 2010 (Figure 1 c). Receivers were either attached to existing navigational markers or to metal poles

embedded in large tyres filled with concrete deployed on the sea floor at depths of 5 to 20 metres. As detection range was found to be between 200 to 300 m, receivers were used to provide an indication of frequency of occurrence at sites of particular interest. Vemco acoustic tags (V16) were internally inserted into the body cavity of tiger (n = 2) and bull (n = 1) sharks in Southern Province during January/February 2010 and also for tigers (n = 4) and bull (n = 3) bull sharks captured in the Northern Province in March 2010. The acoustic tags are designed to last for 2 to 10 years depending on configuration.

(underwater photo of VR2 might be usefull for the northern province p
Figure 2. VR2W receiver attached to an anchor (concrete filled tyre) and deployed underwater

2.4.2 Archival pop-off and SPOT5 satellite tags

Wildlife computers archival pop-off satellite tags were applied to three large tiger sharks and a stitch was used to secure the tag in the dorsal musculature during January and July 2009 in the Southern Province (Figure 3 a). These tags were set for release for between 3 to 11 months from capture and one satellite tag pop-off a tiger shark in February 2010. Position only (SPOT5) Wildlife satellite tags (Figure 3 b) were also mounted to the dorsal fin of tiger sharks in the Southern and Northern Provinces. SPOT5 tags enable data on the movements of the sharks to be obtained in almost real time via the ARGOS satellite wildlife monitoring system, whereas archival pop-off tags require the sharks movement to be “retraced” using an algorithm that reconstructs movement from light, temperature and bathymetry data.

Captured sharks were also externally tagged with plastic dart tags and/or notches on the dorsal fin in order to identify recaptured individuals. A tissue sample was taken from the dorsal fin of sharks for future DNA analysis.

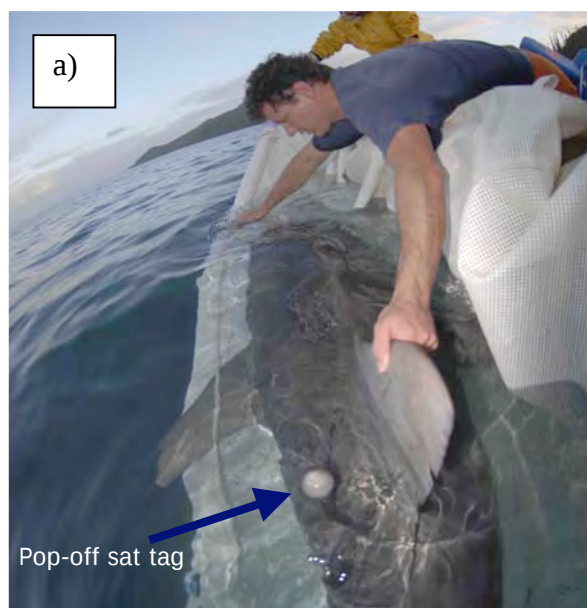


Figure 3. Archival pop-off tag (a) and SPOT5 (b) satellite tags deployed on large tiger sharks in New Caledonia. Note the SPOT5 tags are attached to the dorsal fin and archival pop-off tags are attached via dart to the sharks body wall.

3.0 Results

3.1 Catch statistics

Throughout the surveys undertaken in January (25/01/2010 to 01/02/2010) in the Southern Province, Prony Bay, two tiger sharks (1.5 and 1.92 m TL) and one bull shark (3 m TL) were tagged (Table 1). During survey and tagging efforts in Northern Province, four tiger (3 to 3.4 m TL) and four bull (2.5 to 3 m TL) sharks were tagged (Table 2). All sharks were tagged with internal acoustic tags and one tiger shark (1.9 m TL) was also tagged with a SPOT5 satellite tag in Southern Province. Two tiger sharks (both 3 m TL) were also tagged in the Northern Province with SPOT 5 satellite tags.

Common Name	Species Name	Date of Capture	Gender	Total Length (m)	Stream Tag No. and dorsal fin notches	Acoustic Tag ID. No.
Tiger	<i>G. cuvier</i>	26/01/2009	M	2.1	196	-
Tiger *	<i>G. cuvier</i>	26/01/2009	F	3	155	54338
Tiger	<i>G. cuvier</i>	28/01/2009	M	3.8	183	54345
Tiger	<i>G. cuvier</i>	7/07/2009	F	1.64	174	54339
Bull	<i>C. leucas</i>	8/07/2009	F	2.95	na	54343
Tiger	<i>G. cuvier</i>	9/07/2009	F	2.7	200	54344
Bull	<i>C. leucas</i>	9/07/2009	F	3	195	54342
Tiger	<i>G. cuvier</i>	13/07/2009	M	3.12	1 Notch at top	54341
Tiger *	<i>G. cuvier</i>	13/07/2009	M	3.4	1 Notch midway	54340
Tiger *	<i>G. cuvier</i>	15/07/2009	M	3.9	1 Notch at bottom	55428
Bull	<i>C. leucas</i>	30/01/2010	F	3	na	1067143
Tiger	<i>G. cuvier</i>	31/01/2010	F	1.54	na	1067145
Tiger #	<i>G. cuvier</i>	1/02/2010	F	1.92	na	1067149

Table 1. Catch statistics for all tagged tiger and bull sharks in Southern Province, Prony Bay, since the inception of the research program in January 2009. Sharks captured during early 2010 are can be determined from date of capture. Archival pop-off tagged sharks are indicated by * and SPOT5 tagged tigers are indicated by #.

Common Name	Species Name	Date of Capture	Gender	Total Length (m)	Stream Tag No. and dorsal fin notches	Acoustic Tag ID. No.
Tiger	<i>G. cuvier</i>	3/03/2010	F	3.38	na	64960
Tiger #	<i>G. cuvier</i>	3/04/2010	F	2.9	na	64949
Tiger	<i>G. cuvier</i>	3/04/2010	F	2.86	na	64951
Bull	<i>C. leucas</i>	3/07/2010	M	2.7	na	64966
Bull	<i>C. leucas</i>	3/08/2010	na	app. 2.7	na	na
Bull	<i>C. leucas</i>	3/08/2010	M	2.5	na	64964
Bull	<i>C. leucas</i>	3/10/2010	F	2.91	na	64965
Tiger #	<i>G. cuvier</i>	3/11/2010	M	2.94	na	64963

Table 2. Catch statistics for all tagged tiger and bull sharks in Northern Province. SPOT5 tagged tigers are indicated by #.

Overall catch statistics for tiger and bull sharks tagged as part of this research in New Caledonia indicate a size range 1.5 to 3.9 m TL with >60 % of the catch over 3 m TL (Figure 4 a). Bull sharks caught across the sites varied from 2.5 to 3 m TL (Figure 4 b).

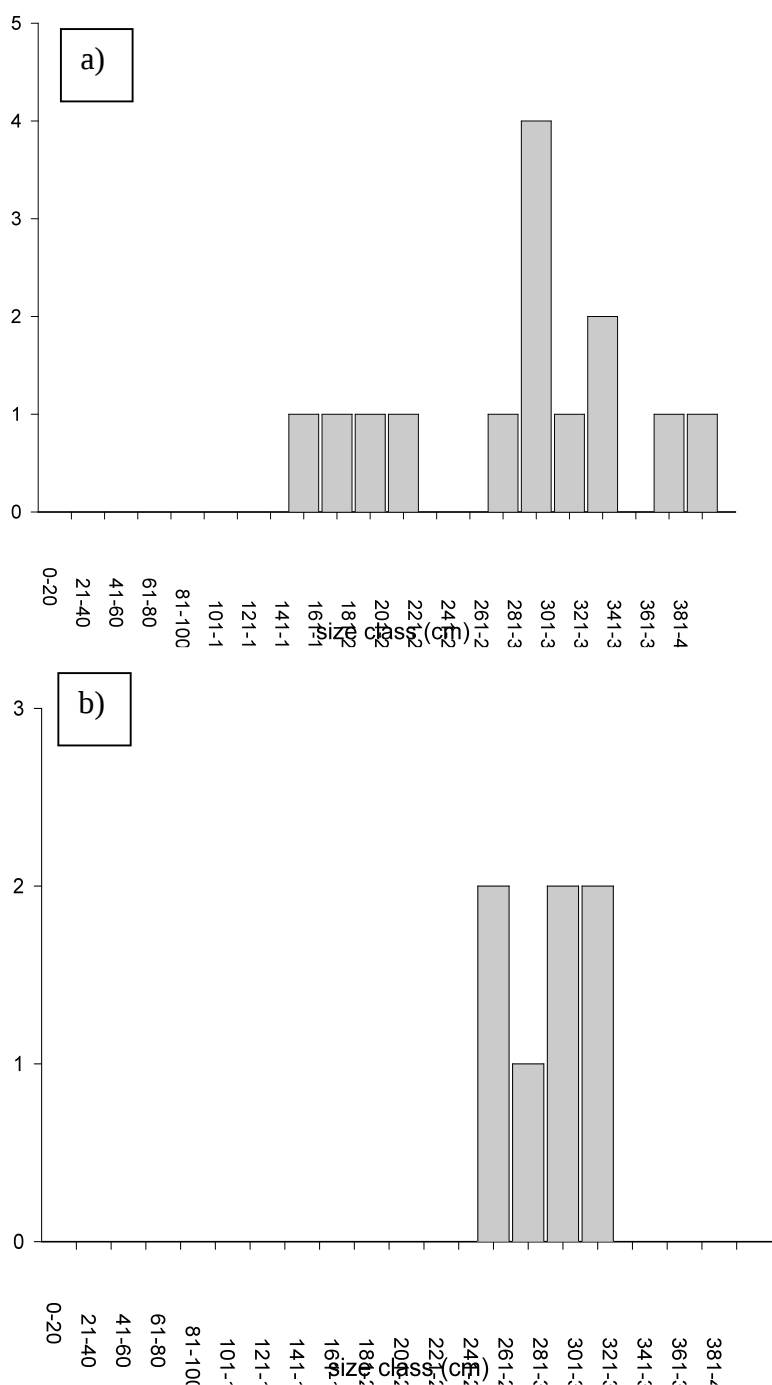


Figure 4. Size distribution of tiger (a) and bull (b) sharks caught and tagged in New Caledonia since January 2009.

Detections of acoustic tagged tiger and bull sharks in Prony Bay, Southern Province, occurred across all receiver stations deployed in Prony Bay between January 2009 and January 2010 with over recorded 2,000 detections. All sharks were detected on at least one station. A 3.8 m tiger tagged in January 2009 was repeatedly detected on the Woodin channel and Bonne Anse receivers suggesting consistent movement through the Woodin channel throughout 2009 (Figure 5). One 3 m TL bull shark was also recorded periodically (Figure 6) on the receiver in the top reaches of Prony Bay (Figure 1c).

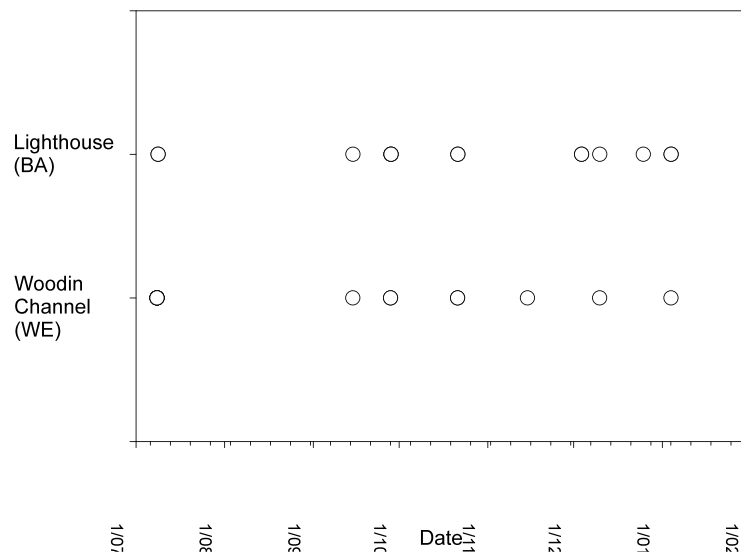


Figure 5. Acoustic detections (i.e. presence) of large tiger (3.8m TL) in Woodin channel and the lighthouse (Bonne Anse) for the period of July 2009 to January 2010. Presence is indicated by the circles.

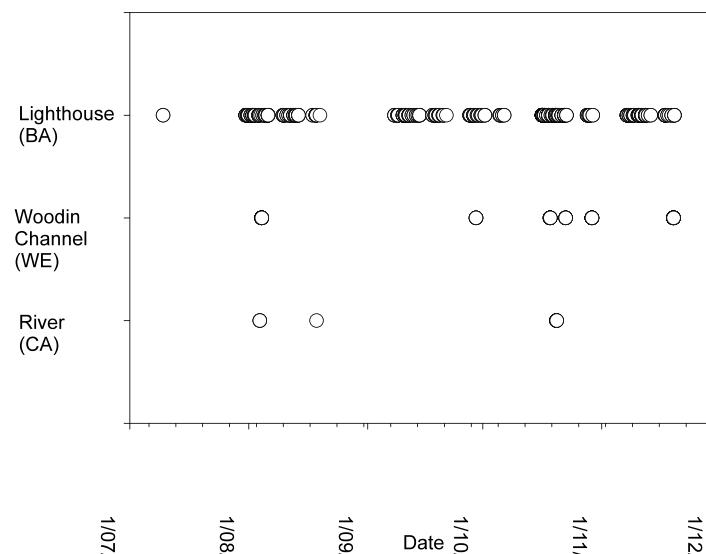


Figure 6. Acoustic detections (i.e. presence) of large bull shark (3 m TL) in Woodin channel, the lighthouse (Bonne Anse) and the top reaches of Prony Bay for the period of July 2009 to January 2010. Presence is indicated by the circles.

In the Northern Province, release of a large bull shark (2.7 m TL) occurred in very shallow habitat, requiring underwater assistance to bring the animal out of tonic immobility (an asleep state) and back into swimming mode (Figure 7).

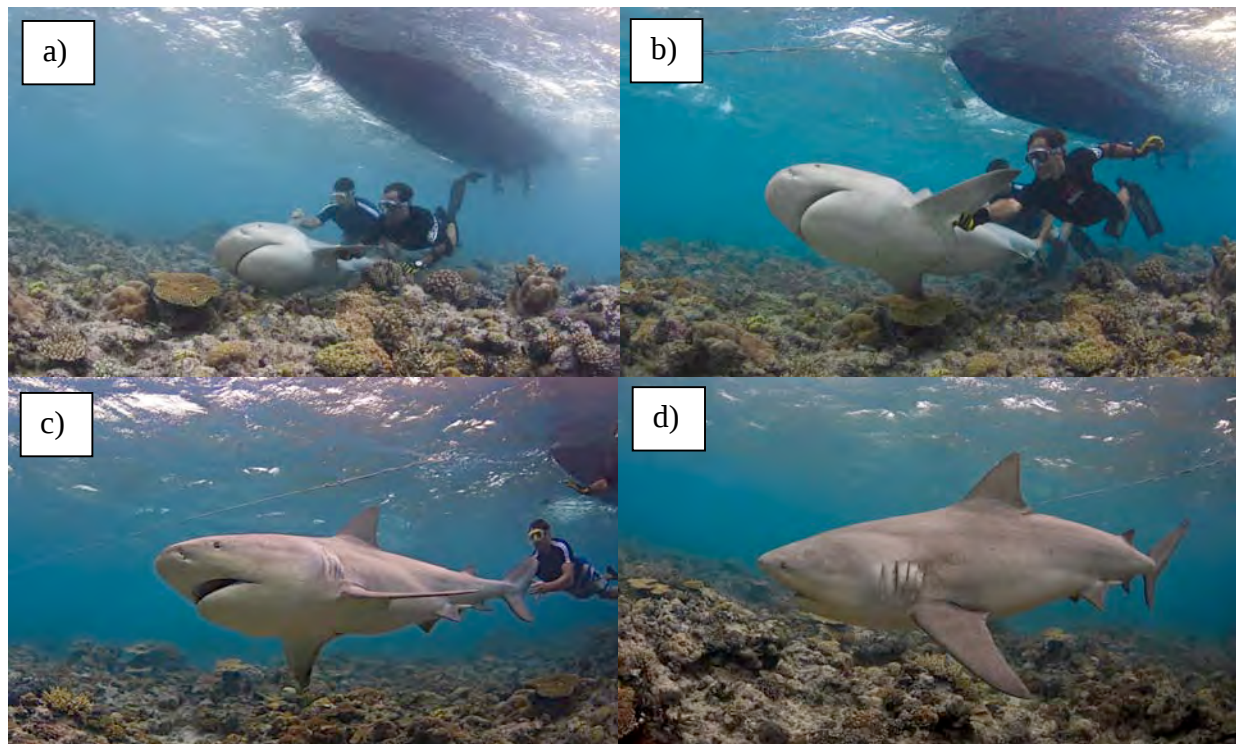


Figure 7. Underwater assisted release (a to c) by Werry and Clua of an acoustic tagged bull shark (2.7 m TL).

3.3 Satellite data – pop-off archival satellite tag

Recent data from the 3.9 m tiger shark (Figure 8a) tagged with an archival pop-off satellite tag in July 2009 within Woodin channel, Prony Bay, indicated movement out into the Coral Sea. The shark remained in oceanic conditions for the period of the track returning within 50 km of the sharks tagging location after six months (Figure 8b).



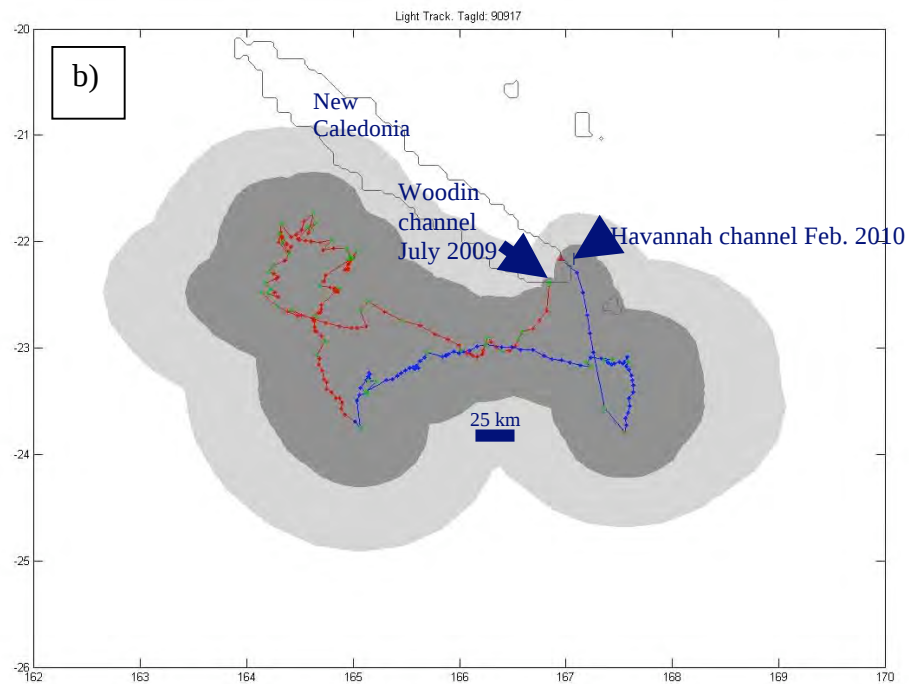


Figure 8. 3.9 m TL tiger shark tagged in Woodin channel, Prony Bay, in July 2009 (a) with an archival pop-off satellite tag. The subsequent track indicated movement into oceanic conditions before returning to the coastal area of Southern Province (b).

3.4 Satellite data – SPOT5 satellite tag

Recent data from the 1.9 m tiger shark (Figure 9a) tagged with a SPOT5 dorsal fin mounted satellite tag in February 2010 within Woodin channel, Prony Bay, indicated movement remaining within the lagoon of Southern Province (Figure 9b).



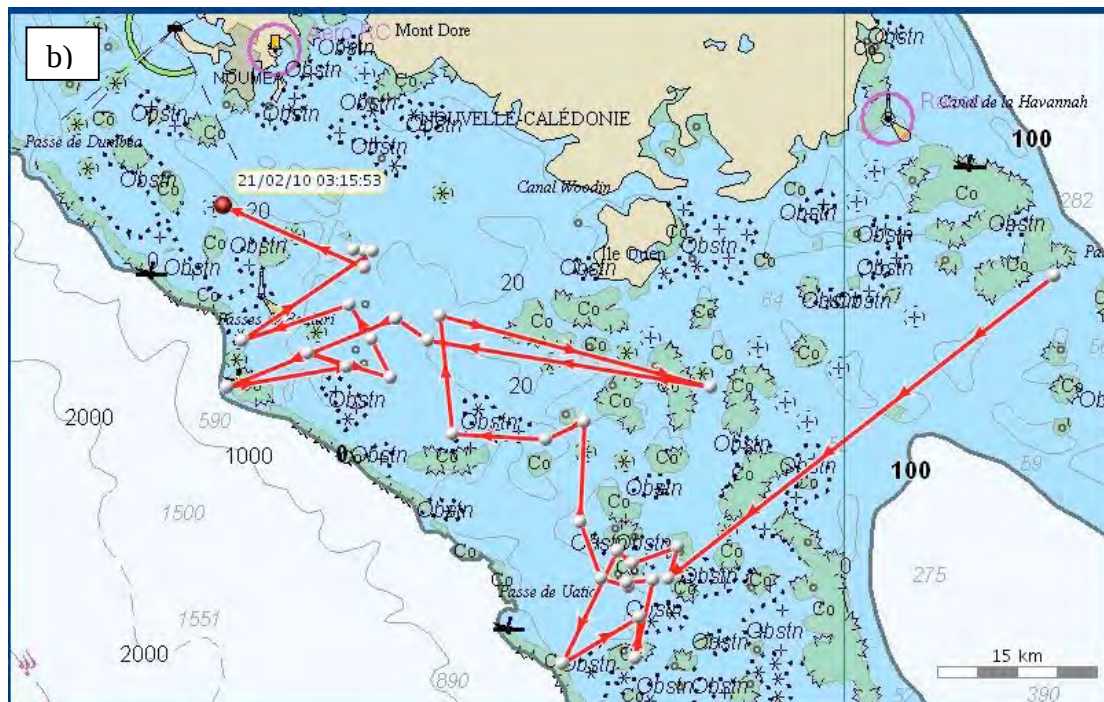


Figure 9. 1.9 m TL tiger shark (a) tagged in Woodin channel, Prony Bay, in February 2010 with a SPOT5 satellite tag. The subsequent track until 21/02/2010 indicated movement within the Southern Province lagoon before moving towards Noumea (b). White points indicate a position of the shark through time determined via a satellite fixed position. The arrows indicate the direction of movement from one position to the next.

4.0 Discussion

4.1 Catch statistics

Trends in catch of large sharks in the Northern and Southern Province provide an important base-line dataset for large shark management in New Caledonia, particularly for the identification of hotspots or sites of frequent shark catch. Over 60% of the tiger shark catch was greater than 3 m TL, indicating that the areas sampled is of potential importance to large adult tiger sharks. The occurrence of large tiger and bull sharks at both sampling locations, including the unusual large bull shark hotspot at the interface between the open ocean and the lagoon in the Northern Province (D'Estrées pass) provides important insight into the biology of these species in New Caledonian waters. The bull shark is generally considered a coastal species, however this hotspot suggests adults may rely on these offshore areas in addition to nearshore coastal areas.

4.2 Habitat use in New Caledonia

Understanding how tiger and bull sharks use nearshore, lagoon and oceanic habitats (and thus habitat connectivity) is essential for the management and conservation of shark populations and the coral reef habitats they regulate. Our initial results indicate that large tiger sharks tagged in the Southern Province return periodically to the tagging location and this is further confirmed by the return of a satellite tagged 3.9 m tiger after 6 months. Satellite data also confirms the use of oceanic habitat by the large

tiger, with majority of oceanic activity occurring at a potential upwelling site. The movements of the small SPOT5 tagged tiger that remained in the Southern Province lagoon and didn't venture into oceanic habitat for significant periods suggests small and large tigers, while co-occurring in the Southern Province, are probably utilising different prey and have different habitat requirements. Tiger sharks undergo an ontogenetic shift in diet to include larger and more varied prey which may explain their need to include oceanic habitat in their home range (Simpfendorfer et al. 2001).

4.3 Co-occurrence of tiger and bull shark

Clua (Pers. Obs.) noted in 2002 a sequential feeding order between large sharks on a blue whale carcass in Prony Bay. He noted that large bull sharks were the first to occur at the carcass, suggesting they were already in the Bay. This is supported by the long-term acoustic detections of bull and tiger sharks in this study, as only the bull shark was detected in the top reaches of the bay, whereas tiger sharks occurred only in the Woodin channel and outer lagoon areas of the study site. Clua went on to note that large tiger sharks were the next to occur at the carcass and their presence coincided with the absence of the initial large bull sharks. White sharks, *Carcharodon carcharias*, also occurred around a pygmy sperm whale carcass in the same area (Ugo islet) in 2006 two days, after the appearance of a young tiger shark. The sequential occurrence of these large shark species around these carcasses probably reflects the habitat occupancy and degree of overlap between large shark species in this region. Bull sharks in Southern Province appear to occupy lagoon to nearshore bay areas whereas tigers use the nearshore and outer lagoon. The White sharks, in spite of their known affinity for pelagic ecosystems, also reach these coastal areas. Our study is providing important scientific data on the movement patterns, habitat requirements, extent of connectivity between habitats and co-occurrence of large sharks in the South Pacific. These data are essential to ensure their effective conservation and provide protection at the spatial level of their home range.

4.4 Future Research

Our research is aiming to identify potential migration 'highways' for marine megafauna in New Caledonian waters, the patterns of occurrence of large sharks at sites of interest and the species habitat connectivity at both local and regional scales. Future research will focus on increasing the tagged population of tiger sharks in the Northern Province to $n = 10$, further deployment of satellite tags and additional efforts at Chesterfield. A study (master degree) was also recently initiated involving a new caledonian student temporarily seconded at the Griffith University. The aim of this study is to use photo-identification of Tiger sharks as a mark-recapture tool.

5.0 Conclusion

Our initial results on the movement of tiger and bull sharks in New Caledonian waters indicates the importance of lagoonal areas to these species, the interconnectedness of lagoon and coastal habitats and the co-occurrence of these large species. The potential importance of oceanic habitat to large tiger sharks suggests identification of oceanic "hotspots" in addition to coastal "hotspots" is important for the management and conservation of the species.

This work was conducted under permit No. 6024-4916/DENV/SMer (New Caledonia) and ethics ENV/16/08/AEC and ENV/17/09/AEC (Griffith University). Add ref of authorization from Northern Province (I will provide)

6.0 Acknowledgments

We gratefully extend thanks to Prof Claude Chauvet and ACREM for support for the project through providing access to research vessels and useful advice for the field. We gratefully acknowledge the support of the Northern and Southern Province natural resource management bodies and the numerous volunteers who assisted with field work: Juergen Zier, Tyffen Read, Thomas Vignaud, Mael Imirizaldu, Augustin Torres. Administrative assistance was gratefully provided by Aude Chenet and Claire Dupre (CRISP). We also extend thanks to the SPC pelagic fisheries group (including Shelly Dole) for helpful comments on our satellite tracking results.

7.0 References

- Last, P. & J. Stevens. 1994. Sharks and Rays of Australia. Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia.
- Simpfendorfer, C.A., A.B. Goodreid & R.B. McAuley. 2001. Size, Sex And Geographic Variation in the Diet of the Tiger Shark, *Galeocerdo Cuvier*, From Western Australian Waters. *Environmental Biology of Fishes* 61: 37-46.
- Werry, J.M., E. Clua, & S. Planes. 2009. Preliminary results for the study on movement of tiger, *Galeocerdo cuvier*, and other large shark species in Prony Bay, New Caledonia. Technical Report (Field work conducted in January and July 2009). 10 pp.



Large shark tagging program in New Caledonia

ABSTRACT

Movements of large shark species (> 2m total length (TL) as adults) in New Caledonian waters are poorly understood. To address this issue an international collaborative research program (SharCal) into large sharks' movements in New Caledonian waters was initiated in early 2009. We present results of movement of tagged tiger (*Galeocerdo cuvier*) and bull (*Carcharhinus leucas*) sharks and field work conducted in Southern Province during January and February 2010 (SharCal 04) and the Northern Province of New Caledonia in March 2010 (SharCal 05). Movement of a single small tiger shark (1.92 m TL) tagged with a SPOT5 dorsal fin mounted satellite tag indicated this shark remained within the Southern Province lagoon, moving from Woodin channel towards Noumea. Alternatively, results of an archival pop-off satellite tagged large tiger (3.9 m TL) in Southern Province indicate this shark moved into and remained in oceanic waters of the Coral Sea before returning to coastal waters within 50 km of its original tagging location over a 6 month period. In the Southern Province, detections of tiger (n = 9) and bull (n = 3) sharks tagged in the area occurred on all acoustic receiver stations and most detections occurred in the Woodin Channel and at Bonne Anse. Long term acoustic tag data revealed the periodic movement of a female bull shark (3 m TL) from the Woodin Channel into the top reaches of Prony Bay. One tiger (3.8 m TL) tagged in the Southern Province in January 2009 was consistently detected moving through Woodin Channel for all of 2009. In addition, an expedition to the Northern Province resulted in the capture of four tiger (3 to 3.4 m TL) and four bull sharks (2.5 to 3 m TL). In this location SPOT5 satellite tags were deployed on two tiger sharks (3/03/2010 and 11/03/2010) and all tigers and three bull sharks were tagged with internal acoustic tags. Two acoustic stations were deployed in Petite Pass and one at d'Estrées Pass in the Northern Province. Our results provide an initial insight into the movements of tiger and bull sharks in New Caledonian waters and illustrate the connectivity of both oceanic and coastal habitats in supporting the endangered sharks.

Keywords: *Galeocerdo cuvier*, tiger shark, *Carcharhinus leucas*, bull shark, movement, acoustic tags, acoustic receiver, SPOT5 satellite tags