

Christmas Island and Pulu Keeling expeditions 2010 to 2012: expedition report

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Abstract. This present series of scientific exploration and expeditions was carried out from 2010 to 2012, totalling six and two weeks, and covering 153 and 50 field stations (some repeated) in Christmas Island and Cocos (Keeling) Islands respectively. The expeditions were carried out by a principle team of 11 from Singapore, with participants from Australia, Japan and Taiwan. To date, five scholarly articles, three popular articles, one book and countless public talks (conducted both on Christmas Island and elsewhere) have culminated from this series of survey efforts, with more to come.

INTRODUCTION

Between 2010 and 2012, staff from the Raffles Museum of Biodiversity Research in the National University of Singapore (now reorganised into the Lee Kong Chian Natural History Museum) organised and conducted three expeditions to Christmas Island and Cocos (Keeling) Islands, which together constitute the Australian Indian Ocean Territories. These expeditions, undertaken with staff from Parks Australia and Queensland Museum, were performed primarily to survey and restudy the aquatic (freshwater and marine) fauna of these islands.

The three expeditions (21 January to 4 February 2010; 18 March to 1 April 2011; and 3 to 17 February 2012) spent over six weeks on Christmas Island, and two weeks on Cocos (Keeling) Islands (March 2011, February 2012); and involved a total of 11 researchers from Singapore, Australia, Japan and Taiwan; as well as dozens of resident researchers and colleagues based on these islands. The extensive material obtained will be the subject of many studies in the years ahead; but already, some papers have been published and many more are in the process of being written up. The material has also been sent to international colleagues revising specific groups of animals, and some papers have already been published or are in preparation as well.

The present note summarises the planning that went into these expeditions and highlights some of the key studies done. The data for all the stations where sampling took place can be found in the following chapter (Tan et al., 2014).

Organisation. Research and export permits were obtained from online sources, endorsed by Parks Australia, and submitted roughly six months to the main office in Canberra before start of the expeditions. Coordination with ground staff of the Christmas Island National Park was also initiated in 2010 to 2012, along with Pulu Keeling National Park staff in 2011 and 2012. Assistance was also sought for possible survey sites and guiding to the field sites, access to certain cave systems and necessary field equipment (e.g., machetes, rope ladders, cave helmets).

In total, 6 weeks were spent in Christmas Island, and roughly 2 weeks in Cocos (Keeling) Islands. Personnel from National University of Singapore, Singapore (NUS) were the main organisers and consisted of the main party, with collaborators from Queensland Museum, Brisbane, Australia (QM); University of Ryukyus, Okinawa, Japan (UR); and National Chung Tsing University, Taichung, Taiwan (NCTU).

Staff from QM, UR and NCTU joined us using their own funds; with NUS providing all other costs on the islands.

Accommodations were typically at the Retreat, Sunset Lodge and VQ3 Lodge along Settlement Road. The domestic logistics were handled by a local tour operator (Indian Ocean Island Explorer Holidays, Ms Lisa Preston) and dive operations by the island's resident dive operator (Christmas Island Wet 'N' Dry Adventures, Mr Teruki Hamanaka). Cocos (Keeling) logistics were met out in The Lagoon (chalet) with dive logistics handled by local dive operator (Cocos Dive, Mr Dieter Gerhard). Local transportation was through self-drive rental cars from Kiat Car Rental (Christmas Island).

Participants. The primary participants were the museum staff from NUS working on aquatic fauna. These included Peter Ng, Leo Tan, Tan Swee Hee, and Jose Mendoza (systematics of crabs), Joelle Lai Chiu Yun (crab genetics and phylogeny), Tan Siong Kiat (molluscs), and Tan Heok Hui (fish). Tan Kai Xin was the field support officer. Peter Davie, the senior curator for crustaceans in the QM and a

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long-time collaborator on decapod crustaceans with NUS, joined us for most of the surveys and is the key collaborator for many of the systematic studies on crabs. Tohru Naruse (UR), who had just finished his post-doctoral stint in NUS before joining the University of the Ryukyus in Japan, and who had participated in the early planning, also joined us for the surveys; and he brought along his colleague, Yoshihisa Fujita, a very experienced diver and collector par excellence. They focused primarily on the subtidal fauna, including species hosting decapod crustaceans. In 2011, Shih Hsi-Te from the National Chung Tsing University in Taiwan, joined us for our work in Christmas Island; he and staff from NUS had an ongoing research project on the systematics and phylogeography of land and fiddler crabs.

Expedition periods.

2010 – 21 January to 4 February

Persons involved (Fig. 1): Peter Ng Kee Lin, Tan Heok Hui*, Tan Swee Hee, Tan Siong Kiat, Tan Kai-xin (NUS), Tohru Naruse*, Yoshihisa Fujita* (UR), Peter Davie (QM), Max Orchard (CINP). Asterisk denotes participants involved in subtidal surveys (Fig. 2).



Fig. 1. Team 2010 (left to right): Tan Heok Hui, Tan Siong Kiat, Tohru Naruse, Yoshihisa Fujita, Peter Ng, Tan Swee Hee, Max Orchard, Tan Kai-xin, Lisa Preston and Peter Davie. Expedition barbecue organised by Lisa Preston.



Fig. 2. Underwater team (left to right): Yoshihisa Fujita, Tohru Naruse, Tan Heok Hui.

2011 – 18 March to 1 April

Persons involved (Fig. 3): Peter Ng Kee Lin, Tan Heok Hui*, Tan Siong Kiat, Tan Kai-xin, Joelle Lai Chiu Yun* (NUS), Tohru Naruse*, Yoshihisa Fujita* (UR), Peter Davie (QM), Shih Hsi-te (NCTU), Max Orchard (CINP). Asterisk denotes participants involved in subtidal surveys.



Fig. 3. Team 2011 (left to right): Tan Heok Hui, Yoshihisa Fujita, Peter Davie, Peter Ng, Tan Siong Kiat, Tohru Naruse, Shih Hsi-te, Max Orchard, Tan Kai-xin, Joelle Lai. Just before departure from Christmas Island.

2012 – 3 to 17 February

Persons involved (Fig. 4): Peter Ng Kee Lin, Leo Tan Wee Hin, Tan Heok Hui*, Tan Siong Kiat, Joelle Lai Chiu Yun, Jose Christopher Mendoza (NUS), Tohru Naruse*, Yoshihisa Fujita* (UR). Asterisk denotes participants involved in subtidal surveys.



Fig. 4. Team 2012 (left to right): Jose Christopher Mendoza, Tan Siong Kiat, Tohru Naruse, Joelle Lai, Tan Heok Hui, Peter Ng, Max Orchard, Leo Tan, Yoshihisa Fujita. Just before departure from Christmas Island.

MATERIAL AND METHODS

Field work and logistics were conducted with participation and contributions in kind from Christmas Island National Park staff and Pulu Keeling National Park staff. These include facilities, vehicles and boats as well as support staff.

Specimens were typically hand collected on land and intertidal habitats; using scoop nets and baited traps in aquatic and cave habitats; hand picking, baited traps and clove oil-ethanol emulsion in subtidal habitats using SCUBA gear. Invertebrate specimens (crustaceans, echinoderms, gastropods) were chilled or frozen, life colour notes documented using digital photography, and usually preserved in 75 or 95% ethanol.

Vertebrate specimens (fishes) were euthanised using an overdose of MS-222, photographed and preserved in formalin before storage in ethanol.

Specimens collected are deposited in the Queensland Museum (QM), Brisbane; Western Australian Museum (WAM), Perth; and the Zoological Reference Collection (ZRC) of the Lee Kong Chian Natural History Museum, National University of Singapore. Primary types of new taxa are kept in the QM.

HISTORICAL REFERENCES

Previous scientific surveys of aquatic inhabitants of Christmas Island had been conducted in the 1930s and subsequently published in the following:

Bulletin of the Raffles Museum volume 8 in 1933 (<http://lkcnmh.nus.edu.sg/nus/index.php/62/19-research/research-publications/past-volumes/149-rbz-61-2-453-893-30-august-2085>);

volume 9 in 1933 (<http://lkcnmh.nus.edu.sg/nus/index.php/62/19-research/research-publications/past-volumes/147-rbz-61-2-453-893-30-august-2083>);

volume 10 in 1935 (<http://lkcnmh.nus.edu.sg/nus/index.php/62/19-research/research-publications/past-volumes/148-rbz-61-2-453-893-30-august-2084>);

and volume 18 in 1947 (see <http://lkcnmh.nus.edu.sg/nus/index.php/62/19-research/research-publications/past-volumes/142-rbz-61-2-453-893-30-august-2078>).

Since then, there had been no collective reports published. Sporadic papers describing new species had been published.

RESULTS

Publications resulting from the 2010 to 2012 expeditions:

Range extension for *Metabetaeus minutus* in Anker A (2010) *Metabetaeus* Borradaile, 1899 revisited, with description of a new marine species from French Polynesia (Crustacea: Decapoda: Alpheidae). *Zootaxa*, 2552: 37–54.

Description of two new species: *Orcovita hicksi*, *Orcovita orchardorum* in Davie PJF & Ng PKL (2012) Two new species of *Orcovita* (Crustacea: Decapoda: Brachyura: Varunidae) from anchialine caves on Christmas Island, Eastern Indian Ocean. *Raffles Bulletin of Zoology*, 60(1): 57–70.

Description of one new species: *Chiromantes garfunkel* in Davie PJF & Ng PKL (2013) A review of *Chiromantes obtusifrons* (Dana, 1851) (Decapoda: Brachyura: Sesarmidae), with descriptions of four new sibling-species from Christmas Island (Indian Ocean), Guam and Taiwan. *Zootaxa*, 3609(1): 1–25.

Description of one new species: *Labuanium vitatum* in Ng PKL & Davie PJF (2011) *Labuanium vitatum* (Crustacea: Decapoda: Brachyura: Sesarmidae), a new Indo-West Pacific species of arboreal crab. *Zootaxa*, 2889: 35–48.

Description of one new species: *Discoplax celeste* in Ng PKL & Davie PJF (2012) The blue crab of Christmas Island, *Discoplax celeste*, new species (Crustacea: Decapoda: Brachyura: Gecarcinidae). *Raffles Bulletin of Zoology*, 60(1): 89–100.

Popular article in Davie PJF (2011) No asylum for vulnerable Christmas Island Robber Crabs. *Turning the Tide*, 12(3): 14.

Popular article in Fujita Y & Naruse T (2011) Some topics of land crabs in the Christmas Islands, Australia. *Cancer*, 20: 57–64. [in Japanese]

Popular article in Shih H-T (2013) Introduction of the gecarcinid land crabs of the world. *Taiwan Natural Science*, 119: 22–37. [in Chinese]

Popular book in Orchard M (2012) *Crabs of Christmas Island*. Christmas Island Natural History Association, 287 pp.

Work is now in progress by the expedition participants on a wide variety of topics, including descriptions of more new species (some in this present volume), clarification of problem taxonomies, better understanding of genetic limits and species delimitations, biogeographic patterns etc. Some major highlights include the genetic structure of the three species of land crabs (*Gecarcoidea natalis*, *G. lalandii* and *G. humei*) on the island; the genetic integrity of the limestone land crab (*Discoplax celeste* and *D. aff. hirtipes*, which will be described later as a new species); the phylogeny of the species-group associated with *Chiromantes garfunkel* and associated sister species; numerous new records of xanthoid and pseudozioid species; the taxonomy and phylogeny of the six species of ghost crabs (*Ocypode* spp.) on the islands, including one new cryptic species; many new records of lobsters and associated taxa from the reefs; and the most remarkable discovery of all, a new species, new genus and new family of pseudozioid crab from submarine caves (see Naruse & Ng, 2014, within this volume).

In addition, specimens of some problem galatheids of the genus *Allogalathea* have been sent to Enrique Macpherson (Centro d'Estudios Avançats de Blanes, Spain) for a subsequent study. At the same time, a number of unusual porcellanids as well as some new hermit crabs have been loaned to Masayuki Osawa (Shimane University, Japan) as part of his larger studies and results will be forthcoming.

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LITERATURE CITED

- Naruse T & Ng PKL (2014) A new family, genus and species of cavernicolous crab (Crustacea: Decapoda: Brachyura: Pseudozioidea) from Christmas Island, Australia. *Raffles Bulletin of Zoology*, Supplement 30: this issue.
- Tan HH, Tan SK, Tan KX, Lai JCY, Mendoza JC & Tan SH (2014) Christmas Island and Pulu Keeling Expeditions 2010 to 2012. Field Work and Locality Records. *Raffles Bulletin of Zoology*, Supplement 30: this issue.