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Records of bottlenose dolphins, *Tursiops* spp., in New Caledonian waters

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Observations of bottlenose dolphins, Tursiops *spp. were made opportunistically between 1993 and 2009 in New Caledonian waters (eastern Coral Sea, southwestern Pacific). Two morphotypes, defined from pigmentation patterns, were observed: morphotype-*B *individuals possessed* a *distinctive, extensive pale-grey blaze that indents the darker-grey dorsal cape towards the basis of the dorsal fin while morphotype-*A *individuals lacked it. Morphotype-*A *bottlenose dolphins occurred in pods of 2-10 individuals whereas pods of morphotype-*B *bottlenose dolphins comprised up to ~30 individuals. All morphotype-*A *bottlenose dolphin sightings were made in inshore waters, and all morphotype-*B *bottlenose dolphin sightings were made offshore. Wounds inflicted by large sharks, including the tiger shark, were documented for morphotype-*A *bottlenose dolphins. Leisure-boat traffic is likely to be the cause of additional injuries to bottlenose dolphins in the New Caledonian lagoon. Pigmentation patterns and correlated habitat preferences of morphotype-*A *and* B *bottlenose dolphins were consistent with those of, respectively,* T. aduncus *and* T. truncatus *in the western Coral Sea and elsewhere in the Pacific Ocean.*

Keywords: Coral Sea, New Caledonia, Indo-Pacific, pigmentation patterns, habitat segregation, *Tursiops aduncus*, *Tursiops truncatus*

INTRODUCTION

The diversity and distribution of marine mammals around oceanic islands in Oceania including, in particular, the New Caledonian archipelago, remain poorly known (Reeves et al. 1999; Wells and Scott 2002; Wang and Yang 2009). This is true, in particular, for bottlenose dolphins (*Tursiops* spp.) (Wang and Yang 2009). Bottlenose dolphins have a world-wide distribution, and show morphotypic variation among regions (Rice 1998; Hoelzel et al. 1998; Wells and Scottt 2002). Distinctions between coastal and pelagic populations have been documented worldwide.

Two main morphological types of bottlenose dolphins based on tooth count and cranial morphology (Perrin et al. 2007), referred to as distinct nominal species, are currently considered: *T. truncatus* (Montagu 1821) (the common bottlenose dolphin) and *T. aduncus* (Ehrenberg 1833) (the Indo-Pacific bottlenose dolphin) (Rice 1998). Useful characters for distinguishing *T. aduncus* from *T. truncatus* by external appearance are rostrum length, ratios of rostrum length to body length and to snout-to-eye length, body size, and pigmentation patterns (Hale et al. 2000; Wang et al. 2000; Wang and Yang 2009). *T. aduncus* and *T. truncatus* co-occur in the tropical Indo-Pacific, where habitat segregation has been documented, *T. aduncus* occupying inshore waters and *T. truncatus* tending to occur offshore (Ross 1977; Gao et al., 1995; Hale et al. 2000; Möller and Beheregaray 2001; Wells and Scott 2002; Wang and Yang 2009). However, currently there is not enough evidence to know whether the different ecotypes or ecomorphs of bottlenose dolphin are consistently the same species in all parts of the Indo-Pacific where they are recorded (Wang and Yang 2009). Pending further osteological and genetic evidence, it is wise to provisionally refer to the generic name '*Tursiops* spp.' in presently poorly surveyed regions of the world, such as New Caledonia.

Partly based on stranded specimens, both *T. aduncus* and *T. truncatus* bottlenose dolphins have been mentioned in a list of marine mammals from New Caledonia (Borsa 2006), but information on their relative abundance, group size, period of occurrence, and habitat segregation in New Caledonian waters are still lacking. The aim of the present report is to contribute to filling that gap by summarizing and discussing recent sightings of bottlenose dolphins from New Caledonian waters.

MATERIALS AND METHODS

'New Caledonian waters' is here defined as the area adjacent to the island of New Caledonia, eastern Coral Sea (Southwest Pacific), extending seaward from the mean low water mark to the boundary of the exclusive economic zone. Opportunistic sightings of bottlenose dolphins, *Tursiops* spp. in New Caledonian waters were recorded from mid-1994 to mid-1995 and from 2002 to mid-2009. Observations were made either from research vessels, diving boats, or sailboats, or from the shore. Position, pod size, the eventual presence of newborns, and behaviour were systematically recorded. Pigmentation patterns were noted when visual conditions were favourable. During the same period, additional observations were obtained by P.B. from fellow scuba divers and naturalists. Depth was obtained from echosounders, or a posteriori from nautical charts.

Here, two morphotypes of bottlenose dolphin, coined *A* and *B*, could be distinguished at sea from the pigmentation patterns of their back (Fig. 1A-D). Morphotype-*B* individuals exhibited a distinctive, extensive pale-grey blaze that indents the darker-grey dorsal cape towards the basis of the dorsal fin (Fig. 1C) and which was absent or unconspicuous in morphotype-*A* bottlenose dolphins (Fig. 1A, D). The body build of morphotype-*B* bottlenose dolphins also appeared stockier than that of morphotype-*A* bottlenose dolphins (Fig. 1A, B).

Many of the observations of *Tursiops* spp. that have been compiled by us, mainly from the southwestern lagoon of New Caledonia, lacked sufficiently precise information on pigmentation patterns and therefore were not included in the present report. Also excluded were two strandings of *Tursiops* sp. reported by Borsa (2006) and a sighting of a single individual *Tursiops* sp. in the Chesterfield lagoon (19°53'S 158°27'E; Borsa 2008).

RESULTS

Table 1 reports all observations of *Tursiops* spp. where the morphotype (*A* or *B*) of the individuals sighted could be determined, during the survey period. Four observations from the literature were also included, including two skulls of individuals stranded on Isle of Pines in 1977 and 1980, and identified to species (as *T. aduncus*) by D. Robineau (pers. comm.). The distribution of sightings is summarized in Fig. 2. All sightings of morphotype-*A* bottlenose dolphins (22 sightings, totalling ≥87 individuals) occurred inshore around New Caledonia's main island, within the lagoon delimitated by the barrier reef, and at depths less than ~40 m. All sightings of morphotype-*B* bottlenose dolphins (4 sightings, totalling ~36 individuals), as well as that of a live-biopsied *T. truncatus* (Table 1), were made off the barrier reef, at depths >40 m. There is no barrier reef in Baie des Tortues, where morphotype-*B* individuals were sighted closest to shore (Table 1; Fig. 2). Morphotype-*A* bottlenose dolphins occurred in small groups, from 2 to 10 individuals, whereas morphotype-*B* bottlenose dolphins occurred in groups of two up to ~30 individuals.

A proportion of morphotype-*A* individuals wore scars attributable to large sharks (Fig. 1 A, D). Other morphotype-*A* individuals had a damaged dorsal fin, seemingly a consequence of strikes from boat propellers: in one individual, the dorsal fin was separated in two by a deep and straight vertical gash in its middle (22°18'S 166°26'E; Aug. 2002) and in another individual, the dorsal fin was obliquely cut clean through (21°57'S 166°02'E; Aug. 2007).

We observed small pods of morphotype-*A* individuals chasing torpedo scads, *Megalaspis cordyla* (22°18'S 166°26'E; Aug. 2002), barracudas, *Sphyraena* sp. (22°20'S 166°24'E; 07 Sep. 2002) and mullets, Mugilidae sp. (22°18'S 166°26'E; May 2002) in shallow water close to shore. We also observed a pod of morphotype-*A* individuals foraging for more than two hours at night in very shallow water (<3 m) under

the spotlights of a built-on-piles restaurant at Anse Vata, Nouméa (Nov. 2006). The spotlights were turned towards the sea, to attract fishes and squids and entertain the customers. The same behaviour was observed by P.B. on two consecutive nights in the harbour of Sorong (West Papua) in July 2010, where a pod of three morphotype-*A* bottlenose dolphins was preying on squids and fishes attracted by the lights of an anchored vessel. Morphotype-*B* bottlenose dolphins were observed chasing flying fishes, Exocoetidae sp., in the open sea (22°35'S 166°28'E; Feb. 2002).

DISCUSSION

The similarities in pigmentation patterns and habitat characteristics of morphotype-*A* and morphotype-*B* bottlenose dolphins from New Caledonia (present report), and, respectively, *T. aduncus* and *T. truncatus* from southern Queensland (Hale et al. 2000) and from elsewhere in the Indo-Pacific (Wang and Yang 2009) are strong enough to suggest that morphotype *A* corresponds to *T. aduncus* under its current definition (Rice 1998) and morphotype *B*, to *T. truncatus*. However, pending more genetic evidence, in the following we will refer to "*T. aduncus*-like" and '*T. truncatus*-like" bottlenose dolphins in New Caledonian waters. Also, adult *T. aduncus* generally exhibit dark spots on the posterior ventral half of the body (Hale et al. 2000), but *T. aduncus* populations from New South Wales and southeastern Australia are "apparently more or less unspotted" (Ross and Cockroft 1990; Wang and Yang 2009). When present, only light spotting on the posterior part of the body was noticed by us on some New Caledonian morphotype-*A* individuals (Fig. 1D). The presence or absence of a pale-grey blaze below the dorsal fin remained the easiest way to distinguish between the two forms in the field.

The present results thus confirm that both *T. aduncus*-like and *T. truncatus*-like bottlenose dolphins are present in New Caledonian waters, where they seem to occur year-round, thereby providing new details on their distribution in the southwestern tropical Pacific relative to previous work (Reeves et al. 1999; Borsa 2006; Wang and Yang 2009). *T. aduncus*-like bottlenose dolphins apparently mainly, if not exclusively occur inside the coral-reef lagoon that surrounds New Caledonia's Grande Terre whereas *T. truncatus* like individuals have so far been sighted exclusively off the barrier reef.

Although the density of the human population in New Caledonia is low (ca. 245,000 inhabitants for a territory totalling ca. 19,000 km^2), the coral-reef lagoon of New Caledonia is under serious threat of degradation from the deforestation, land erosion and pollution caused by developing open-pit mining projects and associated ore-processing plants (Richer de Forges and Pascal 2008). Overfishing has been reported for some areas of the New Caledonian lagoon and further fishing pressure on fish stocks is expected in relation with the industrial development of once sparsely populated littoral regions (Guillemot et al. 2009). Both habitat degradation and overfishing may affect the availability of fish prey to *T. aduncus*-like bottlenose dolphins in at least some areas of the New Caledonian lagoon. Another threat to *T. aduncus*-like bottlenose dolphin populations in New Caledonia is the increased disturbance and risk of boat strike related to the rapidly increasing leisure-boat traffic: approximately 25,000 leisure boats, many of them being motorized speedboats, are currently registered in New Caledonia. That number is steadily increasing by ca. 1,000 new boats every year (Service de la marine marchande et des pêches maritimes, Nouméa, pers. comm.). Collision with boats or ships has been documented for several marine mammal species in New Caledonian waters: these include the dwarf and pygmy sperm whales, the humpback whale and, mostly, the dugong (Borsa 2006). The characteristics of some of the wounds exhibited by *T. aduncus*-like bottlenose dolphins suggest they resulted from boat propeller strikes. Monitoring the abundance and

distribution of *T. aduncus*-like bottlenose dolphins should be considered in assessing the ecological impact of developing human activities in the New Caledonian lagoon.

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Table 1. Opportunistic sightings of bottlenose dolphin, *Tursiops* spp., by morphotype (*A* and *B*), and additional strandings and observation of *T. aduncus* and *T. truncatus*, in New Caledonian waters. Depth was obtained from echosounder, or a posteriori from nautical charts. *N*, pod size (except for numbers in brackets)

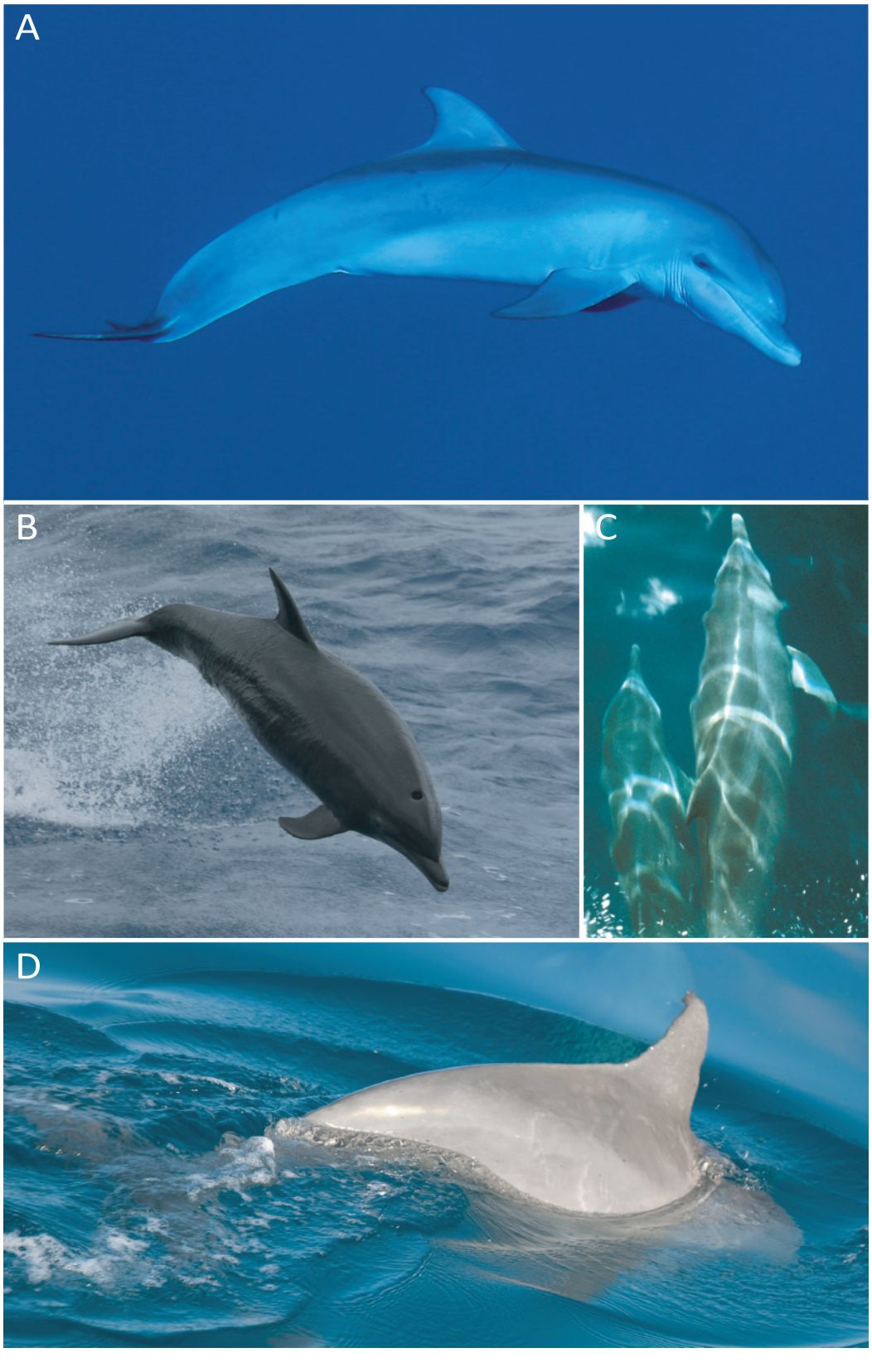
Site	Coordinates	Depth	Date	*N*	Observer
Morphotype *A*					
N of Tibarama Islet	20°54'S 165°22'E	~15 m	13 Jan. 2002	7-10	M. Ravannah
Off Poindimié	20°54'S 165°25'E	~40 m	14 Jan. 2002	7-10	G. Hoarau
Nepoui Bay	21°22'S 164°28'E	9 m	26 Sep. 2004	3	P.B.
Off Kouaoua	~21°S ~166°5E	–	–	≥6	C. Garrigue (Reeves and Brownell 2009)
Ouanno wharf	21°46'S 165°45'E	2 m	04 Sep. 2005	4	P.B., Rumini
Ouanno Bay	21°47'S 165°43'E	7 m	03 Sep. 2005	2	P.B.
NW of Puen Island	21°57'S 165°56'E	8 m	26 June 1994	5-6	J.-C. Vernus
Puen Island	21°57'S 165°58'E	6 m	08 Jan. 2002	3	P.B.
Puen Island	21°57'S 165°58'E	6 m	01 Sep. 2002	3	P.B.
Bouraké	21°57'S 165°59'E	6 m	09 Jan. 2002	4	P.B.
Saint Vincent Bay	21°57'S 166°02'E	6 m	05 Aug. 2007	4	P.B.
S of Nou Island	22°17'S 166°24'E	15 m	24 Aug. 2002	2	F. Fenoglio
Off Port Moselle	22°17'S 166°25'E	15 m	27 Aug. 1994	2	P.B.
Anse Vata	22°18'S 166°26'E	6 m	18 Aug. 2002	4-5	P.B.
Anse Vata	22°18'S 166°26'E	5 m	18 Sep. 2006	3	C. Menkes
Anse Vata	22°18'S 166°26'E	5 m	04 Nov. 2006	3-4	P.B.
Rocher à la Voile	22°18'S 166°26'E	5 m	24 Dec. 2008	2	P.B.
Baie des Citrons	22°18'S 166°26'E	8 m	– May 2002	4	C. Boulnois
Baie des Citrons	22°18'S 166°26'E	10 m	– Oct. 2002	3[a]	C. Boulnois
S Maître Islet	22°20'S 166°24'E	12 m	23 Mar. 2002	8-10	P.B.
S Maître Islet	22°20'S 166°24'E	12 m	07 Sep. 2002	2	C. Boulnois
E of Redika islet	22°27'S 166°42'E	22 m	21 June 2008	3	M.J.; Fig. 1D
N Redika Islet	22°30'S 166°36'E	~11 m	15 Dec. 2008	3	S.A.; Fig. 1A
Morphotype *B*					
Grand Passage	18°47'S 163°16'E	520 m	24 Oct. 2008	~30	P.B.; Fig. 1B
Baie des Tortues	21°37'S 165°29'E	>40 m	– Dec. 2003	2	M. Hernu
Off Kué Reef	22°35'S 166°28'E	647 m	02 Feb. 2002	2	P.B.
Cappel Bank	26°40'S 159°24'E	~300 m	22 May 2002	2	M. Planchot
Tursiops aduncus					
Gadji, Isle of Pines	22°32'S 167°25'E	–	– – 1977	(1)	D. Robineau (Borsa 2006)[b]
Isle of Pines	~22°S ~167°E	–	– – 1980	(1)	D. Robineau (Borsa 2006)[b]
Tursiops truncatus					
SW of Isle of Pines	22°51'S 167°42'E	–	–	(1)	Tezanos-Pinto et al. (2009)[c]

[a] includes a newborn
[b] stranded specimen
[c] biopsied specimen, identified to species from mtDNA sequence

Captions to Figures

Fig. 1. Morphological variation among *Tursiops* spp. individuals in the Coral Sea. **A.** Morphotype-*A* bottlenose dolphin photographed in the southwestern lagoon of New Caledonia (200 m north of Redika Islet, 22°30'S 166°36'E; 15 December 2008; S.A.); we interpret the series of evenly spaced marks on the flank as scars of a superficial bite from a large shark. **B.** Morphotype-*B* bottlenose dolphin (Grand Passage, 18°47'S 163°16'E; 24 October 2008; P.B.). **C.** Bow-riding morphotype-*B* bottlenose dolphins exhibiting paler-grey blaze below dorsal fin (NE of Morinda Shoals, Great Barrier Reef lagoon, 19°05'S 147°35'E; 25 April 1991; P.B.). **D.** Posterior part of an adult morphotype-*A* individual exhibiting sparse, tiny darker spots, and de-pigmented patterns on flank determined by us as the healed scars of a wound inflicted by a tiger shark, *Galeocerdo cuvier* (E of Redika Islet, 22°27'S 166°42'E, 21 June 2008; M.J.).

Fig. 2. Distribution of bottlenose dolphin, *Tursiops* spp., sightings in New Caledonian waters. ▲, morphotype *A*; Δ, *T. aduncus*, identified from skull morphology and tooth count; ○, morphotype *B*; ●, *T. truncatus*, identified from mitochondrial-DNA haplotype. Additional details in Table 1. Topographic map from GEOMAPAPP (http://www.geomapapp.org; Ryan et al. 2009).


A
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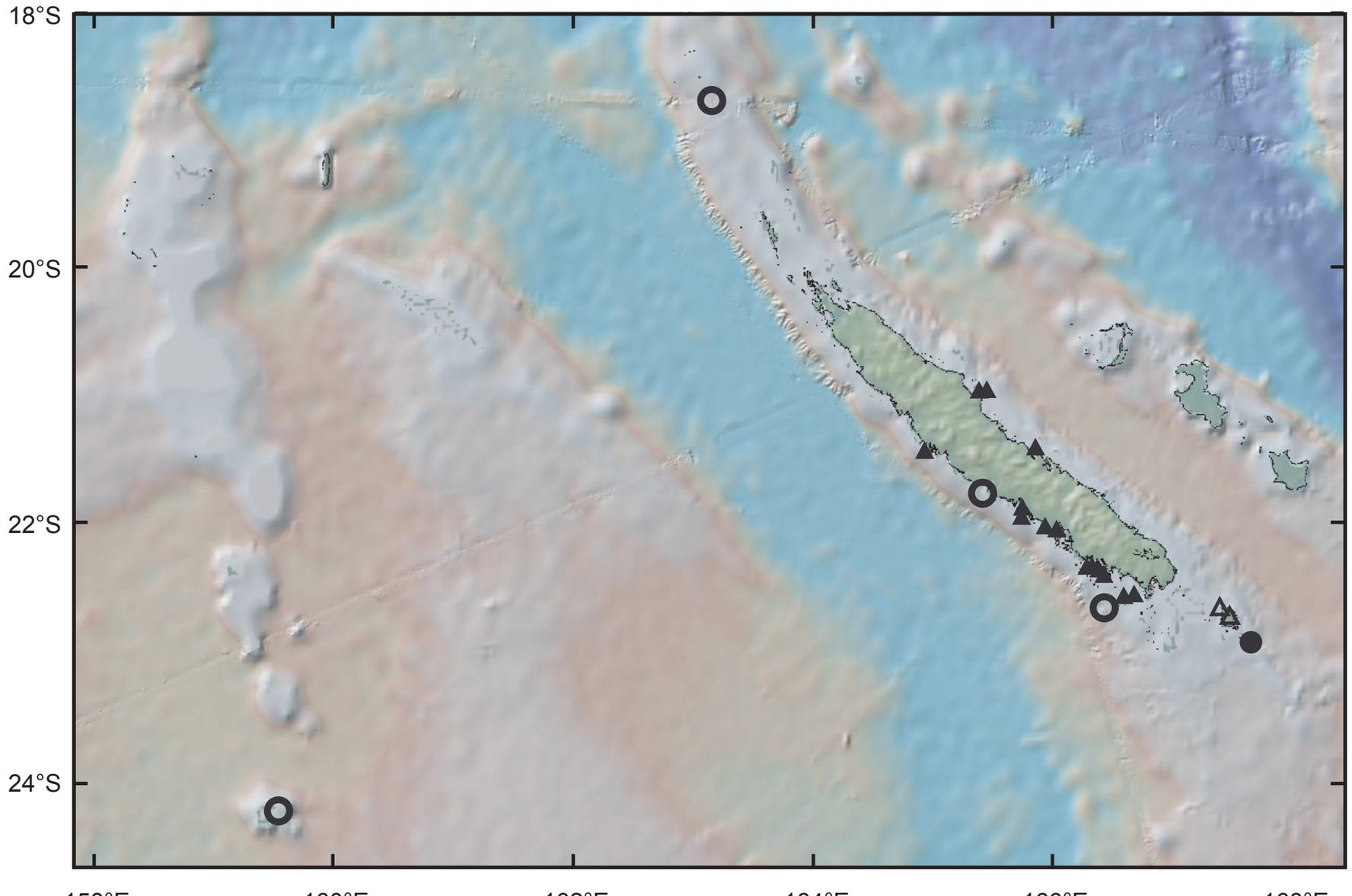
C
D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