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TAMAKI PAENGA HIRA
AUCKLAND WAR MEMORIAL MUSEUM

Evan Graham Turbott M.Sc., Q.S.O. Ornithologist, museum director – 1914–2014

B.J. Gill Auckland War Memorial Museum
I.G. Thwaites Auckland
R.J. Wolfe Auckland

INTRODUCTION

Graham Turbott, former Director of Auckland War Memorial Museum, died on 12 December 2014 aged 100, severing a long link with the Museum's past. In his long retirement he retained his memory, sharp thinking and sense of humour, and was always ready to share his knowledge and recollections. He was a help and an inspiration to the current and former Museum staff who kept contact with him. This obituary emphasises Graham's museum career and Appendix 1 lists his museum-related publications. A more detailed account of his ornithological work is published elsewhere (Gill 2015).

CHILDHOOD AND EDUCATION

Graham was born at Stanley Bay, Auckland, on 27 May 1914, to Thomas and Evangeline ("Eva") Turbott. He was the eldest of three brothers, all of whom went on to achieve high office. Garth Graham Turbott (1919–2011) was for many years Registrar of the University of Canterbury, Christchurch. Sir Ian Graham Turbott (b. 1922) served in the British Colonial Service in the Pacific and Caribbean and was at one time Governor of Grenada.

Graham went to Stanley Bay and Vauxhall Primary Schools and then was a foundation pupil at Takapuna Grammar School. His father was a primary school headmaster and holidays were spent at the farm of Graham's maternal grandparents (Samuel and Hester Graham) at Mangapai, near Whangarei. With its patches of bush and scrub, the farm gave plenty of opportunity to develop an interest in natural history. As a child, Graham visited Auckland Museum when it occupied its site in Princes Street, and as a teenager in November 1929 he joined the crowds at the opening ceremony for the new museum building on the hill in Auckland Domain.

He went to Auckland Teachers' Training College and studied zoology at Auckland University College. Fieldwork, especially on New Zealand's offshore islands, was to be a major element in Graham's ornithological career. It was therefore a formative event when, while still a university student, he was invited by Robert Falla (ornithologist at Auckland Museum) to join the Museum's 1934 *Will Watch* expedition to northern islands, including the Three Kings. In 1937 Graham submitted his M.Sc. thesis on the distribution and anatomy of the native Hochstetter's frog.

CURATOR AT AUCKLAND MUSEUM, 1937–1957

Graham's long museum career began in 1937 with his appointment as Assistant Zoologist at Auckland Museum, succeeding Falla as the Museum's expert on birds. The title became Ornithologist-Entomologist in 1945. It was a curatorial role, managing the relevant collections, furthering exhibitions and other public engagement in the discipline, and conducting research. During his first summer in the job (1937–1938) Graham accompanied Charles Fleming for part of the latter's important survey of birds on the Chatham Islands.

Graham joined the staff during the first decade following the move to the new war memorial building when the Museum was newly invigorated. The shift to the Domain marked a transformation of Auckland Museum from a small-town affair to an institution appropriate to a growing city. The cramped quarters in Princes Street gave way to elegant and spacious galleries in the new building with back-of-house storage spaces. In Princes Street almost everything was exhibited, but the Museum could now adopt the modern practice of showing a selection of the finest objects and keeping the rest in accessible storage. Staff had expanded from one Curator (i.e., the Director) and an assistant, to a staff of multiple specialist curators, of which Graham was one. Publication in 1930 of the first issue of the annual serial *Records of the Auckland Institute and Museum* showed that the Museum was now a credible research organisation.

In his curatorial position Graham came under the influence of Gilbert Archey (1890–1974) who had succeeded Thomas Cheeseman as head of the Museum in 1924. Archey ensured that the Museum as an institution was thoroughly educational, by developing informative displays, a public lecture programme and organised visits by school classes. Archey was a scholar who made a mark with his research and writing in both natural history and Maori ethnology. His curators recognised that, while research was important, their first duty was to the public and their priorities were exhibition work and public enquiries. Graham found the Museum under Archey "a place of stimulating discussion on research and fieldwork

or on the Museum's current projects, of activities maintained with little or no prompting—although with ever-present leadership which could be applied firmly when need arose—and of a characteristic atmosphere over all of community goodwill" (Turbott 1975).

In 1940 Graham married Olwyn Mary Rutherford (1914–1994; Figs 1 and 2). She had joined the staff as Assistant Ethnologist in 1932 and later played a major part in developing the Museum's Pacific and Maori displays. With the effort of transferring collections from Princes Street to the new building, and minimal funding, there had been little opportunity for modernising displays. When the Carnegie Corporation made funds available for educational purposes in the late 1930s, Olwyn was able to develop a more selective and attractive approach to the presentation of the cluttered ethnological collections. Her skill for this would also benefit the Museum's increasingly active special exhibitions programme in the early 1950s. Encouraged by a visit by Paul S. Wingert, Professor of Art History and Archaeology at New York's Columbia University, Olwyn and her colleagues made changes that reflected the growing reappraisal of ethnographic objects as works of art. She thus played a pioneering part in this changing attitude towards non-European art (Wolfe 1993). While characteristically modest about her contribution, she was, like Graham, happy to discuss it with students of museological history. In their life-time together the Turbotts shared wide-ranging interests in nature, art and ethnology which were a sound foundation for Graham's later career in museum administration.

In 1943 Graham volunteered for the R.N.Z.A.F. and after early training at Linton Camp was posted to the meteorological section. He was released from air force duties in December 1943 to spend a year on the Cape Expedition to the subantarctic Auckland Islands, which involved military coast-watching duties. There was also abundant spare time to pursue natural history in an unspoiled environment. During his absence on war service, the bird collection was under the care of Major Geoffrey Buddle in the role of Acting Ornithologist. Graham returned to the Museum in 1945. In 1954 he went overseas for eight months sponsored by the British Council, and visited British museums and institutions connected with research on birds.

Graham conducted ornithological field studies, mainly on the bird faunas of offshore islands (with sustained work on the Three Kings Islands in 1946, 1948, 1951 and 1953). He undertook fieldwork in Fiordland (1949) following rediscovery of the takahe (a large flightless bird) by Geoffrey Orbell, joined an expedition to the Antipodes and Bounty Islands (1950), and was a guest of the Danish deep-sea *Galathea* expedition during trawling in the Kermadec Deep (1952). His varied fieldwork involved the study of live animals and was not for the purposes of collecting, but Graham is himself recorded as collector for about 180 specimens in the Land Vertebrates Collection. In developing the collection, Graham was fortunate that there was continuous support from a staff taxidermist (Charles Dover until May 1953, and Patrick O'Brien from July that year).

Over many years Graham made incremental improvements to exhibits in the Museum's first Bird Hall in the first-floor gallery at the north-east corner. In 1955 he curated a temporary exhibition "The Bird Book" that covered the history of bird illustration using volumes from the Museum Library. In the 1930s he wrote a nature column for "Enzed Junior", the children's supplement of the *Auckland Star*. These articles he updated and expanded as the basis for a popular bird book (Turbott 1947) illustrated with Major Buddle's pioneering bird photographs. Throughout his museum career Graham gave talks to foster awareness of nature and of the role of museums in society. During some of the war years he gave tours of the Bird Hall to American servicemen on rest and convalescent leave in Auckland. Between 1937 and 1957 he took 16-mm ciné film footage during field-trips to offshore islands. This was edited into short films that Graham showed to small audiences or lent out for screening. Many of these films, along with Graham's private papers, are now held by the Auckland Museum Library.



Figure 1. Graham and Olwyn Turbott (centre) on the day of their wedding, Auckland, 7 September 1940. Graham's brother Garth is at the left; at the right is Aralai Carr, Olwyn's cousin. *Photo: D.G. Begg Ltd.*



Figure 2. Graham and Olwyn Turbott with ethnographic displays at Auckland Museum, 1957. *Photo:* Auckland Star, *collection, Auckland Museum S1017.*

CANTERBURY MUSEUM, 1957–1964

In March-April 1957 Graham was a member of the Lake Monk (Cameron Mountains) Expedition to southern Fiordland. At this time he was preparing to move to Christchurch to take up the position of Assistant Director and Keeper of Zoology at Canterbury Museum where the Director (from 1948 to 1978) was Roger Duff. Olwyn also worked for a period at Canterbury Museum.

In November 1958, the Museum re-opened to the public after enlargement by the new Centennial Memorial Wing (marking Canterbury Province's centenary in 1950). Graham was therefore heavily involved in gallery development. He helped to develop the successful Edgar Stead Hall of New Zealand Birds with its stunning world-class dioramas by Preparator Ray Jacobs, a gallery that remains today a draw-card for visitors to Canterbury Museum. Work on the gallery had begun in 1955 and it was opened (though not completed) in 1958 (Tunnicliffe 1998). Graham also contributed to development of the Hall of New Zealand Natural History and Hall of Biology.

DIRECTOR OF AUCKLAND MUSEUM, 1964–1979

Graham returned to Auckland Museum in 1964, this time as Director succeeding his former mentor, Sir Gilbert Archey, who retired that year. The Museum Council considered Graham a worthy successor and noted that from the start "he has within the limits of finance and staff available initiated a number of progressive moves which should keep a lively image of the Museum before the public of Auckland" (*Annual Report* 1964–65). Work to almost double the building's size, with an addition to the south commemorating servicemen lost in the Second World War, had started in 1956 and the new extension opened in March 1960. Graham therefore returned to a greatly enlarged building with additional gallery spaces to be filled. Important initiatives in the Turbott years were the opening of a Coffee Lounge (November 1966) and Museum Shop (December 1970). Funds were also raised to develop an Auditorium (opened in October 1969) as an important meeting venue for the city. It completed the memorial to those from the Auckland provincial district who had fallen during the Second World War. The Auditorium seated up to 500, with a stage, projection booth, and adjoining Supper Room (with catering facilities) that could also be configured as a smaller venue seating 80. It was converted to exhibition space in the 1990s and demolished in 2004 to make way for the new Atrium and underground collection storage areas.

Graham had a complement of about 34 back-of-house staff—including some seven curators—plus around nine gallery attendants. It was a simpler time, with common sense the principal element in administration and without the burden of the excessive bureaucratic procedures and impediments that tend to hobble our museums today. However, the Museum's governing Council had some 28 members in Graham's time, so governance was perhaps more challenging than it is today. Twice-weekly morning teas of the Director with the curators were important elements in the day-to-day running of the Museum. These were held in a small room at the west end of the Library and the Director's secretary would have the cups laid out in advance and the teapot brewing. They were rather formal affairs with Graham leading the discussion of Museum business and the polite conversation that followed.

During the early years of directorship Graham continued to write for the public. He was co-author of the influential Collins *Field Guide* to New Zealand's birds (Falla *et al*. 1966), the country's first modern guide on this subject. He also edited a lavish edition of Buller's *History of the Birds of New Zealand* (Turbott 1967). Printed in Japan, this made available to the public high-quality reproductions of J.G. Keulemans' plates from Buller's second edition of 1888.

Graham was a firm proponent of exhibition development. He continued the "spirit of experiment and adventure" in the Museum's attitude to its educational function, always seeking to ensure that "the unique educational opportunity provided by its exhibition galleries is not lost, and in doing this to fulfil its aim of serving the broadest cross-section of the community" (Powell *et al*. 1967: 43). Graham upheld Archey's belief that "the success of the display should not be measured by its size and extent, but by its effectiveness in teaching" (Turbott 1975). By 1967, 40,000 visiting school children per annum attended classes by the Museum's education officers. School loan exhibits—pioneered by the Museum—were circulated to 480 schools a year in the Auckland provincial area (Powell *et al*. 1967: 41).

Bird Hall

Fresh from his work on Canterbury Museum's bird displays, Graham undertook to develop an equivalent gallery at Auckland Museum. The 1929 Hall of New Zealand Bird Life remained intact until about 1969 and the new bird hall (occupying 300 m^2) opened in 1972, with sponsorship from the Sir John Logan Campbell Trust and the Auckland Savings Bank. It was on the first floor, like its predecessor, but in the south-east corner (now occupied by botanical and ethnographic collection storage). Graham planned the gallery contents and wrote the labels. Spread throughout the hall were 12 large and small dioramas, most with fully domed backdrops and some with bird-sound activated by a button. Production of the dioramas, including background painting, was by Preparator Leo Cappel, who had held a similar position at Canterbury Museum and followed Graham north. Between the dioramas were cases exhibiting the diversity of New Zealand birds in taxonomic groups that enabled the public to identify birds they had seen.

The Bird Hall was broken up in 1996, and the Wandering Albatross Diorama, that had stood at the entrance to the hall, is the only surviving example of the excellence in domed diorama-building achieved at Auckland Museum in the Turbott years. For the hundreds of thousands of museum visitors annually the giant moa reconstruction in the Bird Hall was the Museum's second most popular attraction during this period after the Maori Gallery.

Auckland Landscapes

The final major display that Graham initiated during his career was "Auckland Landscapes: Past and Future", which occupied a narrow cross-gallery on the first floor (now the "Land Gallery"), replacing the serried rows of cases of shells which had been the domain of the Museum's Malacologist and Assistant Director A.W.B. Powell. It gave a broad narrative of Auckland's natural and human history. The new installation was sponsored by New Zealand Insurance and the Sir John Logan Campbell Trust, and designed by John Maynard, previously founding Director of the Govett-Brewster Art Gallery, New Plymouth.

Influenced by the exhibition "Britain Before Man", which opened at London's Geological Museum in October 1977, "Auckland Landscapes" was a multi-media display, combining modern and traditional approaches. There were models and dioramas, and a specially commissioned aerial film of Auckland (shot from helicopter by cameraman Leon Narbey) shown in a small theatre in what had been a disused lift shaft in the centre of the building (now the Limestone Cave exhibit). But perhaps the star of "Auckland Landscapes" was a model working volcano, ingeniously devised by Leo Cappel and utilising optics from a redundant photographic enlarger to create the effect of ejected magma. There was also a working seismograph, and both staff and the public could rush to inspect the needle-trace on the graph paper on the rare occasions when Auckland felt an earthquake.

Graham was retained part-time after retirement to continue to supervise the project and the gallery opened in November 1980. "Auckland Landscapes" dramatically anticipated one of the main subject-areas of "Volcanoes and Giants", the temporary exhibition which heralded the Museum's redevelopment project in the late 1990s and occupied the old Maritime Hall on the first floor.

Temporary exhibition programme

The Second World War extension to the Museum included its first purpose-built special exhibitions gallery. From the outset this was viewed as a community facility, for the presentation of exhibitions by outside organisations in addition to those initiated by the Museum itself. Graham inherited this busy special exhibitions programme from Archey, and it gathered pace with the appointment of Trevor Bayliss in 1972 to the new post of Curator of Display (in addition to his several other responsibilities). Regular, if not annual, fixtures of the special exhibitions programme at that time were presentations by the Handweavers' Guild and Auckland Studio Potters, while the Museum's own rich reserve collections—those from the Pacific in particular—were also the subjects of major temporary exhibitions. As a result there was little let-up for the display staff, juggling tight budgets and deadlines as they mounted a dozen or so special exhibitions each year.

RETIREMENT

Graham's last day as Director was 6 August 1979. At the official function marking his retirement the Museum Council presented him with the latest model of coloured television set, but this distraction did not appear to occupy much of his time. As Director Emeritus, Graham for many years kept a small office at the back of the Museum Library, where he was surrounded by his bird books and papers. He continued on the Hauraki Gulf Maritime Park Board until 1990, having served continuously since 1975. Between 1980 and 1990 Graham took on the task of chairing the Checklist Committee of the Ornithological Society of New Zealand (O.S.N.Z.). His last big project was to produce a memoir of his war-time experiences on the Auckland Islands published by the Department of Conservation (Turbott 2002).

Olwyn's design sense, decidedly modernist and distinguished by elegance, balance and restraint, was apparent in the décor of the Turbotts' home on a half-acre section in Cathedral Place, Parnell. This house was designed by architect Peter Middleton and built in the period before the Turbotts went to Christchurch. It was easy walking distance from the Museum. The ample garden, on a sloping ridge, was bordered by bush and large trees, so it was an ideal habitat for an ornithologist. After Olwyn died in 1994, Graham stayed on in their home for 10 more years before moving to a large apartment in an Orakei retirement village. A few years before his death he had a fall and shifted to a bed-sitting room (Fig. 3) in a wing of the retirement home where medical assistance was on-call.

Graham—born early in the reign of King George V—was almost an Edwardian. He used a camera (and even



Figure 3. Graham Turbott and Roy Clare, Orakei, 5 June 2014, shortly after Graham's 100th birthday. Roy is holding Graham's card from Her Majesty the Queen. *Photo: B. Gill.*

a ciné camera) in his early years and continued to drive a car well into retirement but otherwise had little facility with modern gadgets. Yet he was largely accepting of change and often expressed interest and delight at some new innovation that he read about. He had a longer past than most people, but seldom showed any bitterness or regret towards the modern world.

From the late 1800s until the 1980s, the directors of New Zealand's four main museums were scholars—either scientists (including Cheeseman and Turbott at Auckland; James Hector, W.R.B. Oliver, Falla, Dick Dell and John Yaldwyn at Wellington; Julius Haast, Edgar Waite and Robert Speight at Christchurch; James Hutton and Ray Forster at Dunedin) or anthropologists (like Archey, later in his career, and Stuart Park at Auckland; Roger Duff and Michael Trotter at Christchurch; H.D. Skinner at Dunedin). These men had risen through the museum ranks, which gave them broad and essential first-hand understanding of the complexities of the encyclopaedic combined natural- and human-history museums of our main cities. Their role was that of benign guardian, shepherding the museum's limited resources and supporting the staff, striving always to strengthen and consolidate the museum's steady and incremental achievements in collecting, exhibiting, researching, educating and entertaining.

Graham was a museum leader in this gentler time and he viewed with some unease the shift that he lived to see, when, from the 1990s, museum directors came to be recruited from the wider "cultural sector". The new neoliberal political environment seemed to embolden some of these new-style directors to be agents of radical change and transformation. At Auckland Museum this led to destructive rounds of staff redundancies in 1997 (some 26 positions lost) and in 2008 (46 staff shed). Graham heard the details through the media—which, again, portrayed "a lively image of the Museum before the public" but for all the wrong reasons—and he expressed, to some of us individually, his dismay at these developments which would have been unthinkable under his own watch.

HONOURS AND PUBLIC SERVICE

As a result of Graham's war-time fieldwork on Auckland Island, Lake Turbott on that island is named after him. Numerous New Zealand animal species are also named in his honour, mostly invertebrates from various offshore islands. These include the snails *Allodiscus turbotti* and *Paralaoma turbotti*; the spiders *Cambridgea turbotti*, *Pholcomma turbotti* and *Subantarctia turbotti*; the pseudoscorpion *Apatochernes turbotti*; the springtail *Dicyrtomina turbotti*; the stonefly *Apteryoperla turbotti*; the genus of cave wetas *Turbottoplectron*; the beetles *Anagotus turbotti*, *Mimopeus turbotti*, *Phaeophanus turbotti* and *Pseudopisalia turbotti*; the shield-bug *Cermatulus turbotti*; the moths *Antipodesma turbotti* and *Proterodesma turbotti*; the fly *Xenosciomyza turbotti*; and the skink *Oligosoma turbotti*.

Graham was President or Vice-president of the O.S.N.Z. in 1947–1952 and 1957–1958. He received the Falla Memorial Award of the O.S.N.Z. in 1988 and was made a Fellow in 1997. In 1956 Graham was elected F.M.A.N.Z.—Fellow of the Art Galleries and Museums Association of New Zealand (A.G.M.A.N.Z.)—in recognition of outstanding service to the museums movement. He was President of A.G.M.A.N.Z. in 1964. At various times he served on national committees concerned with wildlife and conservation, including the Animal Ecology Research Committee, the Freshwater Fisheries Advisory Council and the Fauna Protection Advisory Council.

In 1977, shortly before retirement, Graham was awarded a Queen's Service Order for public service. In total, Graham served some 35 years at Auckland Museum. On his retirement the Museum Council conferred the title of Director Emeritus as a mark of his service. In November 1999 he was made an Associate Emeritus of the Auckland War Memorial Museum. Finally, in September 2014, Auckland Museum gave Graham a special lifetime achievement award. He was too frail by then to attend the function, but Roy Clare (the Museum's Director) and William Randall (Chairman of the Trust Board) presented the certificate at Graham's retirement village. This was recorded by a professional videographer and a short version of the video was screened at the award ceremony the following day.

PERSONAL TRIBUTES

I.G. Thwaites

I came to Auckland Museum as Librarian in November 1970 and therefore was a staff member for about half of Graham Turbott's tenure as Director. Much was accomplished during the Turbott years. The Coffee Lounge and Museum Shop were installed and the Auditorium completed. Major refurbishments of several display halls took place and several outstanding new halls were established: the Hall of Asian Art, the Disney Hall of English Furniture and Centennial Street. In particular, Graham was responsible for the completely new Hall of New Zealand Birds. As Librarian, I appreciated his support in markedly increasing the annual budgets for book purchases.

Auckland Museum was, in the 1960s, still a relatively conservative institution. Its governing body, the Auckland Institute and Museum Council, comprised 20–30 often quite elderly citizens who arrived at the Museum on council day each month. There was little or no staff representation on Council, no trade union and there were no regular general staff meetings. At times, there seemed to exist an almost unspoken ethic which involved an acceptance of the *status quo*, including extremely low salaries. Much of this was a legacy of years of financial hardship, for example, 1951–52, when the Museum made ends meet financially only when three senior staff members were, for various reasons, on leave without pay. But change was inevitable and as Director, Graham was faced with considerable challenges.

Graham was a firm director, sometimes inflexible, but also one who was willing to utilise the skills of his talented staff, for example the display team headed by the very creative Trevor Bayliss. During the 1970s, staff salaries (long a bone of contention) were dramatically increased, Graham and the Council thereby correcting a long-standing historical injustice. Graham also instituted regular twice-weekly meetings with senior staff—these were extremely cordial, although they could be hardly described as forums for vigorous debate. And, just as with his successor Stuart Park, Graham always joined the general staff every day in the main staff-room at the times of morning and afternoon tea.

Graham was a real "gentleman", definitely of the old school. He did inspire respect from staff and this was reciprocal—for example, attendants were always addressed as "Mr Southworth", "Mr Fletcher" and "Mr Coker" (*etc.*). I gravitated to first-name terms with Graham only several years after his retirement. He was fair-minded, and staff problems were always listened to politely and given due consideration. Ever courteous, one outstanding characteristic, remembered by many, was Graham's unfailing support and kindness to staff in times of stress or personal loss.

After he retired, Graham became noticeably more relaxed, presumably free from the cares of directorship. Former colleague Enid Evans remarked that it was the "Graham of old", just as he had been when she worked so happily with him, arranging "The Bird Book" exhibition of 1955. I always believed that the cares of directorship inhibited Graham's opportunities for ornithological and other writing, although he refuted this when I mentioned this to him not long ago. Nevertheless his considerable writing skills were often in evidence, especially in his masterly tribute to Sir Gilbert Archey (Turbott 1975) and in the delightful (and scarce) *Year Away* (Turbott 2002).

I remember Graham Turbott for his dignity, compassion and above all, his dedication to Auckland Museum, the institution which meant so much to him.

R.J. Wolfe

In 1977 Graham appointed me Display Artist at Auckland Museum. I presume that my previous experience as Assistant Preparator at Canterbury Museum (from 1973) qualified me for the position. Shortly, with the retirement of Trevor Bayliss, I was elevated to Curator of Display, a position I held until it was made redundant in 1997. The main focus of the Display Department in the 1970s was on special exhibitions, which led to my interest in the origins of this programme and the pioneering roles played by my predecessors Trevor Bayliss, Betty Brookes and Olwyn Turbott. Following discussions with the now retired Graham, I also talked to Olwyn about her early days at the Museum, and was able to acknowledge her contribution in an article (Wolfe 1993) published shortly before she died. In 1995, at the suggestion of Christopher Johnstone (Director of the Auckland Art Gallery), the Museum mounted a small exhibition marking the centenary of the visit to Auckland by French artist Paul Gauguin. For this I researched the nature of the Maori and Pacific displays in the Princes Street Museum at the time of Gauguin's visit, and later produced a detailed reconstruction (Wolfe 2001). Graham provided much help with both projects, and also when I was commissioned to compile a publication marking the 75th anniversary of the War Memorial Building (Wolfe 2004).

In retirement mode, away from the responsibilities of museum directing, Graham was always ready for a chat, or to assist with museum-related enquiries. He was a voracious reader, a pursuit that did not slacken with advancing years. He responded enthusiastically to new ideas, a typical comment being: "I think he [Dawkins,

Gould or whoever he was currently reading] has got it" or "he is really on to something here". Graham and Olwyn were open-minded and had youthful outlooks. They mingled with artists, as well as scientists, and spoke of meeting the young Tony Fomison in Christchurch, where he was also associated with the Canterbury Museum. Graham knew New Zealand-born artist Ray Ching (who painted bird specimens borrowed from Auckland Museum), writing a foreword for his book *New Zealand Birds* (Harris-Ching 1986). When I asked Graham for a perspective on Ching's paintings he expressed his admiration but suggested, quirkily, that "the birds mightn't be too impressed". Ever the ornithologist, Graham's point was that any errors made by the taxidermist were likely to have been perpetuated unknowingly by Ching—much to the displeasure of the bird!

B.J. Gill

I met Graham in May 1982 when he came to introduce himself on my first day at work as Curator of Land Vertebrates—in the curatorial role I was one of Graham's successors. Since my immediate predecessor (part-time Associate Ornithologist Sylvia Reed) had died in office I was grateful for everyone's help in understanding what the job involved. In the years that followed I benefited greatly by having Graham at hand when I needed advice and information on museum issues. In the 1990s I began researching the history of the land vertebrates collection (Gill 2000, 2008), and was lucky that I could turn to Graham for answers to so many mysteries. He had a good memory for details and was always willing to help, often mulling a query over and then setting information down in a hand-written letter.

I served on the O.S.N.Z.'s committee, chaired by Graham in retirement, that had the 10-year project of producing a new checklist of New Zealand birds (Turbott 1990). There were no meetings, as the members were scattered widely, but Graham ran things by posting out a circular at regular intervals to report progress, resolve issues and guide committee members in producing their delegated contributions. Graham could not (or would not) use a typewriter himself—perhaps through having had a secretary in all those years of museum administration—but he paid someone to type his circulars and the successive drafts of the checklist manuscript. He read Phil Millener's important new Ph.D. thesis on the Holocene fossil record of North Island birds and made a hand-written summary of the details for each species. This was photocopied and posted out so the information could be incorporated in each member's contribution.

Graham only rarely visited the Land Vertebrates Department, and so periodically I rang him, wrote, or went to his home—where there was always a friendly welcome. In his house, books were close at hand and he read widely, buying copies of all the latest popular biology books (by R. Dawkins, S.J. Gould, J. Diamond and the like). He thought deeply about ecological and evolutionary issues and liked to give his views and interpretations on the latest developments in bird biology and conservation. Besides his admiration for native birds he had a great liking for the common introduced birds of town and countryside. At his house, or in the retirement village, he enjoyed sitting near windows where he could watch local birds in action. His special joy at the retirement home was in the distant views of islands in the Hauraki Gulf with which he had had so long an association.

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APPENDIX 1.

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Walter Oliver Cernohorsky F.L.S. Surveyor, malacologist – 1927–2014

I.G. Thwaites Auckland
B.J. Gill Auckland War Memorial Museum
W. Blom Auckland War Memorial Museum

INTRODUCTION

Walter Cernohorsky was born in Brno, in what is currently the Czech Republic, on 30 June 1927 (Macaulay 2015). He lost both parents when he was seven years old and was looked after by his brother (who was 16 years older) and sister-in-law. During the Second World War he had to endure the horrors of the German occupation which included the murder of an uncle, who was an officer in the Czech Army, the requisitioning of the family's hotel and the need to hide female cousins from marauding soldiers. He studied architecture at university, though he would have preferred to run the family's business. As a university student Walter agitated against the Russian-imposed post-war communist regime and this eventually made it unsafe for him to remain in the country. In 1948 he hid on a train and escaped to the West without having time to collect belongings or farewell relatives and friends. He never returned or saw his brother again. Walter spoke Czech, German and English, with an understanding of Russian, and he was employed for a time by the U.S. Army as a translator.

In 1949 Walter went from Italy to Australia as a refugee. There he worked in factories and brick-works, and as a cane-cutter and surveyor. Later he recalled finding a *Nautilus pompilius* on the Great Barrier Reef in 1949 that first stimulated his interest in the beauty of mollusc shells (Greene 1962). Walter met his wife Irene in Australia. They married in 1953 and the same year moved to Fiji where Walter was Chief Surveyor at the Emperor Gold Mines, Vatukoula, Viti Levu. In Fiji, Walter found the perfect circumstances to develop a passion for tropical molluscs, and he became Honorary Malacologist at the Fiji Museum. He came under the influence of a scientific mentor (Prof. Dr. Schilder), who "patiently started me off on the scientific road to conchology" and stressed "the valuable service a conchologist residing in the small islands can render malacological science" (Greene 1962). The results of his shell-collecting field-work, and growing involvement in molluscan taxonomy, were published in the *Fiji Shell News* and *Hawaiian Shell News*. In 1968 he travelled to the Smithsonian Institution, Washington, D.C., for a six-month research associateship in the Department of Mollusks, U.S. National Museum.

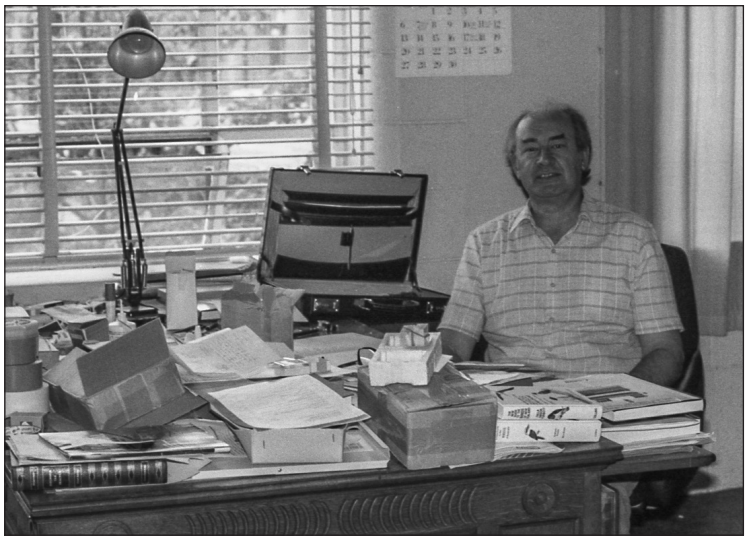


Figure 1. Walter Cernohorsky in the office of the Malacology Department at Auckland Museum, April 1986. The office (now a corridor leading to the Marine Department) is on Level 1 of the 1960 extension and the window looks down on the Courtyard (now the covered-over Atrium). *Photo: B. Gill.*

In February 1969 Walter took up the position of Malacologist at Auckland Museum (Figs 1, 2; Thwaites 2015), succeeding Dr A.W.B. Powell who had retired after 39 years' service. By this time Walter was a world authority on several families of tropical Pacific molluscs, particularly the Mitridae and Costellariidae. One of the attractions of Auckland Museum for Walter was the extensive malacological holdings of the museum's library. From Auckland he undertook numerous field trips to Pacific islands, often funded by private benefactors. Walter took part in the 1977 Royal Society of New Zealand South Pacific Expedition to the Lau Group, Fiji, in company with Auckland Museum's Entomologist Keith Wise. In 1981 he made a research trip to Australia funded by the Lottery Grants Board. In 1983 he spent two weeks in Los Angeles pursuing further research on the gastropod family Terebridae with Mrs Twila Bratcher of the Los Angeles County Museum of Natural History. In 1983 Walter also went to Portugal to advise on the setting up of a specialised malacology museum south of Lisbon.

During his time at the museum, Walter continued his distinguished record of taxonomic publishing in malacology (Appendix 1). His published work on Indo-Pacific molluscs, combined with his predecessor's publications on New Zealand molluscs, established Auckland Museum as a notable centre of malacological research for nearly 60 years. Walter's specialised subjects necessitated that he maintain a large circle of contacts at museums and research organisations around the world, giving international connections to his work at Auckland Museum. Walter's publications include popular books on tropical seashells, as well as technical papers, including numerous articles published in the Auckland Museum *Records*. He also twice wrote an Auckland Museum *Bulletin* (numbers 8 and 14), the second of which (on the family Nassariidae, 1984) runs to 356 pages, is much-quoted and continues to sell. Walter played an important role in helping to sustain the output of Auckland Museum's own scholarly publications, which in turn helped to boost the museum's profile in scientific circles at home and abroad.

The following species of molluscs are those described by Walter during his malacological career and for which the primary type specimens are held in the Auckland Museum collection:

Bernaya chathamensis Cernohorsky, 1971
Boreotrophon shirleyi Cernohorsky, 1980
Cancilla (Ziba) cloveri Cernohorsky, 1971
Cantharus (Pollia) wrightae Cernohorsky, 1974
Engina mactanensis Cernohorsky, 1985
Latirus martinorum Cernohorsky, 1987
Mitra deynzeri Cernohorsky, 1980
Mitra dondani Cernohorsky, 1985
Mitra hilli Cernohorsky, 1976
Mitra (Nebularia) earlei Cernohorsky, 1976
Mitrolumna salisburyi Cernohorsky, 1978
Morula parvissima Cernohorsky, 1987
Muricopsis orri Cernohorsky, 1976

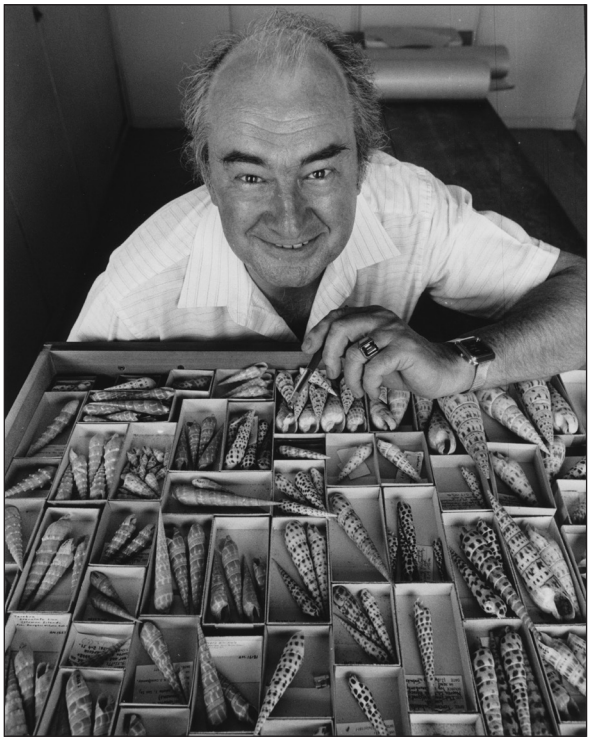


Figure 2. Walter Cernohorsky with auger shells (*Terebra*) in the Malacology Department at Auckland Museum, January 1987. New Zealand Herald *photo (Auckland Museum AM93-A891-13a).*

Nassarius rehderi Cernohorsky, 1980
Nassarius troendleorum Cernohorsky, 1980
Nassarius (Plicarcularia) maccauslandi Cernohorsky, 1984
Neocancilla kayae Cernohorsky, 1978
Notoluponia (Notadusta) clifdenensis Cernohorsky, 1971
Peculator bacatus Cernohorsky 1980
Primovula eilatensis Cernohorsky, 1972
Scabricola vicdani Cernohorsky, 1980
Strombus (Dolomena) kleckhamae Cernohorsky, 1971
Terebra parkinsoni Cernohorsky, 1976
Thala maxmarrowi Cernohorsky, 1980
Vexillum (Costellaria) adamsianum Cernohorsky, 1978
Vexillum (Costellaria) choslenae Cernohorsky, 1982
Vexillum (Costellaria) martinorum Cernohorsky, 1986
Vexillum (Costellaria) takakuwai Cernohorsky & Azuma, 1974
Vexillum (Costellaria) wolfei Cernohorsky, 1978
Vexillum (Pusia) salisburyi Cernohorsky, 1976
Viriola samoana Cernohorsky, 1976

The following molluscs were named by researchers in honour of W.O. Cernohorsky in recognition of his contribution to the discipline:

Austromitra cernohorskyi Turner, 2008 (south coast of New Caledonia);
Conus cernohorskyi da Motta, 1983 (Borogon, Philippines);
Cyllene cernohorskyi Fernandes & Rolan, 1992 (Palmeirinhas Point, Angola);

Hastula (*Punctoterebra*) *cernohorskyi* Burch, 1965 (Natadola, Fiji);
Morula cernohorskyi Houart & Troendle, 1997 (Mururoa Atoll, Tuamotu Archipelago, French Polynesia);
Nassarius cernohorskyi Kool, 2005 (Hiva Oa, Marquesas Group, French Polynesia);
Vexillum (*Costellaria*) *cernohorskyi* Ladd, 1966 (Eniwetok Atoll; Late Miocene);
Ziba cernohorskyi Rehder & Wilson, 1975 (Pitcairn Island).

During his time as curator, Walter continued in Powell's role as facilitator of the activities of the Auckland Shell Club (the museum's Conchology Section), which kept its library and held its meetings in a dedicated area at one end of the Malacology Department. Walter was also interested in numismatics, philately (he curated Auckland Museum's postage stamp collection during his natural history curatorship) and heraldry (see Macaulay 2015). In 1968 he designed three values in an issue of Fijian stamps depicting marine shells.

Walter left the museum on 13 May 1988, but did not retire officially from the post until mid-1989 after using up accumulated leave. Besides his knowledge of malacology, Walter was also respected by staff at Auckland Museum for his courtesy, his impeccable manners, his warm personality and his skills as a raconteur. He is survived by his son Roy and daughter Diana.

ACKNOWLEDGEMENTS

We thank Diana Cernohorsky for help with details of Walter's family background.

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W. Blom, Auckland War Memorial Museum. wblom@aucklandmuseum.com

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The Conidae of Fiji (Mollusca: Gastropoda). *The Veliger* 7(2): 61–94.

1965

The Mitridae of Fiji. *The Veliger* 8(2): 70–160.
A note on *Conus sowerbyi* Reeve, 1849. *Journal of Conchology* 25: 334–335.
Voluta pertusa Linnaeus, 1758; *Voluta morio* Linnaeus, 1767; *Voluta ruffina* Linnaeus, 1767; *Bulla conoidea* Linnaeus, 1767 (Mollusca, Gastropoda): proposed suppression under the plenary powers. *Bulletin of Zoological Nomenclature* 22: 198–203.

1966

(Cernohorsky, W.O. and A. Jennings) The Terebridae of Fiji (Mollusca: Gastropoda). *The Veliger* 9(1): 37–67.
Comments on the proposed validity of *Voluta episcopalis* Linnaeus, 1795. Z.N. (S.) 1728. *Bulletin of Zoological Nomenclature* 23: 80–81.
Mitra perlata (Roding) 1798 (Mollusca, Gastropoda): proposed rejection as a *nomen oblitum*. Z.N. (S.) 1726. *Bulletin of Zoological Nomenclature* 22: 334.
The radula, egg capsules and young of *Murex (Chicoreus) torrefactus* Sowerby (Mollusca: Gastropoda). *The Veliger* 8: 231–233.
A study of mitrid radulae and a tentative generic arrangement of the family Mitridae (Mollusca: Gastropoda). *The Veliger* 9: 106–126.

1967

Marine Shells of the Pacific. An Authoritative Handbook for all Collectors. Pacific Publications, Sydney. 248 pp.
Voluta citrina Gmelin, 1791; *V. strigose* Gmelin, 1791; *V. leucostoma* Gmelin, 1791 (Gastropoda): proposed designation of type-species under the plenary powers. Z.N. (S.) 1977. *Bulletin of Zoological Nomenclature* 24(1): 53–54.
Strombus aratrum (Roeding) from North Borneo. *Hawaiian Shell News* 15(10): 5.
The Muricidae of Fiji (Mollusca: Gastropoda). Part I. Subfamilies Muricinae and Tritonaliinae. *The Veliger* 10(2): 111–132.
A note on three species of Mitridae (Mollusca: Gastropoda). *The Veliger* 9: 441–442.
The Bursidae, Cymatiidae and Colubrariidae of Fiji (Mollusca: Gastropoda). *The Veliger* 9: 310–329.

1968

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Conus capitaneus Linnaeus and *C. mustelinus* Hwass in Bruguiere. *Hawaiian Shell News* 16(2): 4.
The date of publication of Kiener's *Mitra* monograph in the 'Species general et iconographie des coquilles vivantes'. *The Veliger* 10: 349.

1969

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The Muricidae of Fiji. Part II. Subfamily Thaidinae. *The Veliger* 11(4): 293–315.

The type of the Lamarck collection of the Museum d'Histoire Naturelle in Geneva. Recent Mollusca of the genera *Mitra, Columbella* (part) and *Cancellaria* (part). *Revue Suisse de Zoologie* 76(4): 953–994.

Type specimens of Mitridae (Mollusca: Gastropoda) described by Linnaeus in the genera *Voluta*, *Buccinum* and *Bulla* between 1758 and 1771. *Zoological Journal of the Linnean Society* 48(3): 351–362.

1970

The littoral marine molluscs of Niue Island. *Records of the Auckland Institute & Museum* 7: 175–186.

The taxonomy of some austral-neozelanic Cymatiidae (Mollusca: Gastropoda). *Records of the Auckland Institute & Museum* 7: 187–191.

Systematics of the families Mitridae and Volutomitridae (Mollusca: Gastropoda). *Bulletin of the Auckland Institute & Museum* 8: 1–190.

Drupella Thiele, 1925 (Gastropoda): proposed designation of type-species under the plenary powers. Z.N. (S.) 1891. *Bulletin of Zoological Nomenclature* 26(5/6): 233.

New Mitridae and Volutomitridae. *Nautilus* 83(3): 95–108.

1971

Fossil and recent Cypraeacea (Mollusca: Gastropoda) of New Zealand with descriptions of new species. *Records of the Auckland Institute & Museum* 8: 103–129.

New molluscan species of *Strombus* (Strombidae) and *Cancilla* (Mitridae) from New Britain and Taiwan. *Records of the Auckland Institute & Museum* 8: 131–135.

Indo-Pacific Pisaniinae (Mollusca: Gastropoda) and related buccinid genera. *Records of the Auckland Institute & Museum* 8: 137–167.

The family Naticidae (Mollusca: Gastropoda) in the Fiji Islands. *Records of the Auckland Institute & Museum* 8: 169–208.

Contribution to the taxonomy of the Muricidae (Gastropoda: Prosobranchia). *The Veliger* 14(2): 187–191.

Comment on the suppression of *Ametistina* Schinz, 1825. Z.N. (S.) 1894. *Bulletin of Zoological Nomenclature* 27: 212.

Comments on the proposed designation of a type species *Littorina* Ferussac, 1822. Z.N. (S.) 1901. *Bulletin of Zoological Nomenclature* 27: 210.

Contribution to the taxonomy of the Muricidae Gastropoda Prosobranchia. *The Veliger* 14: 187–191.

Cymatiidae Iredale, 1913 (Gastropoda): proposed conservation under the plenary powers. Z.N. (S.) 1939. *Bulletin of Zoological Nomenclature* 28: 59–61.

1972

Indo-Pacific Nassariidae (Mollusca: Gastropoda). *Records of the Auckland Institute & Museum* 9: 125–194.

The taxonomy of some Indo-Pacific Mollusca with descriptions of new species. *Records of the Auckland Institute & Museum* 9: 195–204.

A taxonomic evaluation of recent and fossil non-mitrid species proposed in the family Mitridae (Mollusca: Gastropoda). *Records of the Auckland Institute & Museum* 9: 205–229.

Type specimens of recent and fossil Mollusca described by H.J. Finlay. Part 1. (Scissurellidae-Turbinidae). *Records of the Auckland Institute & Museum* 9: 231–247.

Nassariidae Iredale, 1916 (Gastropoda): proposed conservation under the plenary powers. Z.N.(S). 1987. *Bulletin of Zoological Nomenclature* 29(1): 62–63.

Marine Shells of the Pacific. Volume II. Pacific Publications, Sydney. 411pp.

Comments on the authorship of some subfamilial names in the Turridae Mollusca Gastopoda. *The Veliger* 15: 127–128.

Oniscidia H. & A. Adams, 1853 (Mollusca): proposed addition to the official list of generic names in zoology. *Bulletin of Zoological Nomenclature* 29: 41–43.

1973

The taxonomy of *Benthovoluta hilgendorfi* (von Martens) and allied turbinellid genera (Mollusca: Volutacea). *Records of the Auckland Institute & Museum* 10: 123–131.

Description of new West Australian Mitridae and Vexillidae (Mollusca: Gastropoda). *Records of the Auckland Institute & Museum* 10: 133–142.

(Emerson, W.K. and W.O. Cernohorsky) The genus *Drupa* in the Pacific. *Indo-Pacific Mollusca* 3(13): 1–40.

1974

The taxonomy of some Indo-Pacific Mollusca with description of a new species. Part 2. *Records of the Auckland Institute & Museum* 11: 121–142.

Type specimens of Mollusca in the University Zoological Museum, Copenhagen. *Records of the Auckland Institute & Museum* 11: 143–192.

Amendments to an application on Nassariidae Iredale, 1916 (Gastropoda): proposed conservation under the plenary powers. Z.N.(S). 1987. *Bulletin of Zoological Nomenclature* 31(4): 212–214.

(Cernohorsky, W.O. and M. Azuma) Description of a new species of Vexillidae (Mollusca: Gastropoda) from Japan. *Venus, Japanese Journal of Malacology* 33(1): 7–10.

Remarks on the taxonomy of Japanese Nassariidae. *Venus, Japanese Journal of Malacology* 33(2): 51–64.

Request for a ruling on the authorship of *Conus moluccensis* (Mollusca: Gastropoda) Z.N. (S). *Bulletin of Zoological Nomenclature* 31(6): 156.

1975

The taxonomy of some West American and Atlantic Nassariidae based on their type-specimens. *Records of the Auckland Institute & Museum* 12: 121–173.

Supplementary notes on the taxonomy of buccinid species of the subfamily Pisaniinae (Mollusca: Gastropoda). *Records of the Auckland Institute & Museum* 12: 175–211.

The taxonomy of some Indo-Pacific Mollusca. Part 3. With descriptions of new taxa and remarks on an Ecuadorian fossil species of Turridae. *Records of the Auckland Institute & Museum* 12: 213–234.

1976

The taxonomy of some Indo-Pacific Mollusca. Part 4. With descriptions of new taxa and remarks on *Nassarius coppingeri* (Smith). *Records of the Auckland Institute & Museum* 13: 111–129.

(Cernohorsky, W.O. and T. Bratcher). Notes on the taxonomy of Indo-Pacific Terebridae (Mollusca: Gastropoda), with description of a new species. *Records of the Auckland Institute & Museum* 13: 131–140.

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1977

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Corrections of nomenclature for European and East Atlantic Nassariidae. *La Conchiglia* 9(99/100): 3–4.

Amendments to an application for the designation of a type-species under the plenary powers for *Drupella* Thiele, 1925 (Gastropoda). Z.N. (S.) 1891. *Bulletin of Zoological Nomenclature* 33: 190–191.

A study of *Scutus antipodes* Montfort (Gastropoda: Fissurellidae). *Auckland Museum Conchology Bulletin* 2 (New Series): 18–24.

Correction to the nomenclature of *Bullia* (Gastropoda: Nassariidae). *Auckland Museum Conchology Bulletin* 2 (New Series): 25–27.

Note on two Pacific gastropods. *Auckland Museum Conchology Bulletin* 2 (New Series): 28–31.

1978

New records of neogastropod Mollusca from the Kermadec Islands. *Records of the Auckland Institute & Museum* 15: 55–65.

The taxonomy of some Indo-Pacific Mollusca. Part 6. *Records of the Auckland Institute & Museum* 15: 67–86.

The taxonomy of Caribbean-Atlantic Costellariidae (Mollusca: Gastropoda). *Records of the Auckland Institute & Museum* 15: 87–109.

New species of Mitridae, Costellariidae and Turridae from the Hawaiian Islands with notes on *Mitra sphoni* in the Galapagos Islands. *The Nautilus* 92(2): 61–67.

Tropical Pacific Marine Shells. Pacific Publications, Sydney. 352pp.

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1979

Conus fergusoni G.B. Sowerby III, 1873 (Gastropoda): comment on proposed validity. Z.N. (S.) 2239. *Bulletin of Zoological Nomenclature* 36: 147–148.

1980

New species of bathyal gastropods from Australia and New Zealand. *Records of the Auckland Institute & Museum* 16: 105–108.

Revision of the Australian and New Zealand Tertiary and Recent temperate species of the family Costellariidae (Mollusca: Gastropoda). *Records of the Auckland Institute & Museum* 16: 109–169.

The taxonomy of some Indo-Pacific Mollusca. Part 7. *Records of the Auckland Institute & Museum* 16: 171–187.

Taxonomic notes on Polynesian Mollusca with descriptions of new species of Nassariidae. *Records of the Auckland Institute & Museum* 17: 113–125.

Systematics of some West Pacific *Lyria* (Mollusca: Volutidae) with description of a new species. *Records of the Auckland Institute & Museum* 17: 127–134.

The taxonomy of some Indo-Pacific Mollusca. Part 8. *Records of the Auckland Institute & Museum* 17: 135–152.

(Willan, R.C., Marshall, B.A., Climo, F.M. and W.O. Cernohorsky) Rectification of nomenclature of *Melagraphia aethiops* (Gmelin) and *Diloma bicanaliculata* (Dunker) (Mollusca: Trochidae). *New Zealand Journal of Marine and Freshwater Research* 14: 413–415.

1981

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Cook map samplers: women's Endeavours

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Abstract

Between 1770 and 1840 Double Hemisphere embroidered maps of the world were made by English and European-encultured women. To the women who made them they represented, for the most part, large, decorative, and cutting-edge works displaying their knowledge of the world and their place in it.

The undated sampler attributed to Elizabeth Cook, the widow of Captain James Cook, held in the Australian National Maritime Museum collection, records the cartographic achievements of her late husband's monumental maritime career in a woman's accomplished and well-recognised form of artistic expression.

By benchmarking this sampler against other extant similar map samplers, connections to the Cook voyages of discovery can be made. A sampler made in 1784 displays the first recorded handcrafted example of Cook-recorded *Te Reo* in the hand of an English-speaking woman. A sampler made in 1804 displays an embroidered *kowhai* flower "discovered by Joseph Banks", beside the stitched New Zealand.

With English women immediately assimilating their own newly-gained knowledge into their artistic endeavours, this paper shows evidence of small but profound expressions of women's art that represent "new discoveries".

Keywords

Captain James Cook; Mrs Elizabeth Cook; Joseph Banks; sampler; map; embroidery.

Embroidered Hemispherical Map Samplers made in England between 1770 and 1840 exhibit some of the earliest evidence of New Zealand to be found in an English-speaking woman's handcrafted world. The largest of the map samplers are Double Hemisphere maps which have been either stitched or printed onto cloth, and sometimes labelled Old and New Worlds, or Eastern and Western Hemispheres. Sometimes the same information has been worked on matching pairs of Single Hemisphere samplers. Map specialists have historically tended to see these embroidered map samplers as a "cartographical oddity" (Hodgkiss 2007: 100-110), while sampler researchers have considered them a "fashion" (Scott 2009: 57), or simply a means by which "capes and bays were given visual form" (Kay 1979: 74). Recent research has collated some of these maps and samplers, and placed them into men's cartographic[1] and women's educational contexts,[2] as well as the world of women's art.[3] These samplers portray unique glimpses both of new horizons and new worlds being introduced into the consciousness of English and European-encultured society, as well as illuminating the specific worlds of the women by whose hands they were made.

By the end of the eighteenth century a needlework sampler functioned as an artistic diploma of educational accomplishment, no longer merely a record of stitched pattern and technique. A marking sampler, with its rudimentary "marks" of letters, numbers, words and ornament, was likely to be the first sampler made in the course of a woman's education. A map sampler was likely one of the last, recording knowledge of geography, art and current events, in a socially acceptable means of gendered self-expression. Many extant hemispherical samplers were left unsigned or have become separated from their provenance, but their size guarantees that they must have been worked by embroiderers who not only were well educated, but also had sufficient means to commit to their completion. They comprise an art form that must have been considered cutting-edge and modern at the time of their creation, and provided spectacular diplomas and/or exhibition pieces.

Most hemispherical map samplers display the stitched words "Cook Tracks", or "Cooks Track", or similar, against a stitched line through the Pacific, sometimes in more than one place. Read in combination with the words "New Discoveries" or "A Map of the World" which often appear in the embroidered cartouche, these words highlighted the national pride and excitement the voyages engendered in Britain. That these samplers may have been originally created, sold and embroidered specifically as Cook souvenirs at any time after 1771, but especially after 1780, is supported by the existence of a small number of "Nelson Samplers" which celebrated and commemorated Lord Horatio Nelson.[4]

No European women physically accompanied Cook to the Southern New World, but this did not preclude them from either travelling with him in their imagination or expressing their own understandings of his discoveries afterward in their own ways. Much has been made in the official Cook legacies of the work of the male artists who travelled with him and both imaged and imagined the Pacific. Art historian Bernard Smith (1992: ix) defined this "imaging" as constructing an image in its presence, and took particular notice of the work of artists who travelled with Cook. He defined this "imagining" as constructing the image while not in direct sensory contact with it, taking further interest in the ways artists continued to shape Cook's legacy after they returned home. The transference and assimilation of new knowledge to both English men and women began immediately after the return of the *Endeavour* to Britain in mid-1771.

JOSEPH BANKS AND MARY DELANY

Joseph Banks made the earliest-known recorded reference to samplers in a New Zealand context. On 30 March 1770, his penultimate day in New Zealand, he described a cloak with a decorative border (probably a kaitaka with taniko border) then in his possession, in great detail. This description included comments on the garment's structure, being "formd by Many threads running lengthwise and a few only crossing them which tie them together" (Beaglehole 1962. Banks Journal II: 14–15), its inherent pattern, which was "sometimes stripd" (*Ibid*.), its fibres, "the threads that compose it are prepard so as to shine almost as much as silk" (*Ibid*.), and that "they [Māori] work borders of different colours in fine stitches something like Carpeting or Girls Samplers" (*Ibid*). His concluding phrase, concerning how the embellishment could have been attached "with an ingenuity truly surprizing to any one who will reflect that they are without needles" (*Ibid*.) revealed that he had neither seen the borders being created, nor one of these garments with borders in the process of construction, which he later confirms: "But they have besides this several other kinds of cloth and work borders to them all, which I have before mentioned, but as to their manner of doing I must confess myself totally ignorant." (Beaglehole 1962. Banks Journal II: 25). Banks' iconic 1773 commissioned portrait by Benjamin West, surrounded by his travel souvenirs, depicts him wearing this garment, or one similar to it, and pointing to the feature he confessed he didn't understand and that, to his eyes was similar to girls' samplers.[5]



Figure 1. Sir Joseph Banks. Painted by Benjamin West. Engraved by J. R. Smith. London Molteno Colnaghi, 1788. Alexander Turnbull Library, Wellington, New Zealand. C-017-016. http://natlib.govt.nz/records/22796842.



Figure 2. "Otahetian Gown". Mary Delany. 18 December 1771.

Two extant family letters written by Mrs Mary Delany in December 1771 reveal that Banks' new discoveries found an immediate female audience at the elite level of society. Mrs Delany was a friend and companion of the Dowager Duchess of Portland, who in turn was patron to botanist Daniel Solander, and owner of a vast natural history collection. Banks and Solander visited the two women soon after the return of the *Endeavour* (Llanover

1862: 369-370). On 16 December, 1771, the women made a return visit to the Banks's home in London. To her brother the next day, Mrs Delany noted "the fruits of [Banks's] travels" in natural science and art, having seen paintings, seeds and blossoms (*Ibid.*: 384). To her niece, she recorded seeing "a charming entertainment of oddities" (*Ibid.*: 387) and garments (*Ibid.*).[6] Her accompanying sketch (Fig. 2) showed her understanding of a garment and headdress worn by an "Otaheitian" [Tahitian] and is the earliest-known artistic depiction of Pacific textiles by an English woman.

THE COOK MAP SAMPLER

The definitive sampler of all the hemispherical map samplers which name Cook is the Cook Map Sampler. 'The Cook Map Sampler' refers to the specific sampler (Fig. 3) which is attributed to Mrs Elizabeth Cook. 'Cook Map Samplers' include any hemispherical map sampler with the name 'Cook' on it. For many years the attributed sampler-maker has been Elizabeth Cook, widow of Captain James Cook, although neither her name nor a date of making are stitched into the cloth. This specific sampler, a single Western Hemisphere sampler with four embroidered floral corners, has been in the collection of the Australian National Maritime Museum since 1988. A black and white image[7] has been held in Sydney's Mitchell Library for a longer period, and the associated provenance with the image relates to an undated sale catalogue: "Tyrrells/ A Relic of Captain Cook/ A chart of the Western Hemisphere, embroidered in silk by /Mrs Cook, wife of the great circumnavigator./ This is a most interesting relic, as it shows how Mrs Cook/ followed the navigator's track around the Western Hemisphere,/ including New Zealand. It came from the home of Mrs Cook at/ Clapham where she lived for many years after Cook's death./ The original frame is preserved, and the whole now enclosed/ in a glazed hanging case. Size 14"x17½'. Price £100."[8]

The reputation of Elizabeth Cook as an embroiderer without the visual presence of her signature is well established. Two unfinished waistcoat front panels on *tapa* cloth, reputedly sourced by her husband on his second Pacific voyage and worked while he was away on the third voyage, now form part of Sydney's Mitchell Library collection.[9] These two panels have been exhibited regularly and they indicate for some the poignancy of Elizabeth Cook's grief when she learned of her husband's death (Bushnell 1991: 4–5).[10] Her undated sampler records events that occurred after her husband's death in 1779. The correct placement of the continuing tracks of her husband's final ship the *Resolution*, coupled with her use of the name "United States" which first occurred in the 1776 Declaration of Independence, and which was ratified in 1783, enables dating of her sampler to be definitely after 1779 and probably after 1783.

Attempting to be more specific about the date of making requires knowledge of both written sources and other map samplers. Of the currently-known examples of map samplers with 'Cook flowers' floral corners embroidered with identical surface fibres to those used by Elizabeth Cook, only two are dated, both to 1784. This is too small a sample from which to draw definite conclusions. Captain Cook's personal coat of arms, granted by the College of Arms in London in 1785, displayed a single hemisphere showing tracks through the Pacific including the east coast of the country now known as Australia, but as there is no known surviving example of this as an embroidered hemisphere, few conclusions are possible.

Whenever Elizabeth Cook embroidered her sampler, it was likely to have been promoted as a complete sampler package suitable for stitching which included a map printed on cardstock, ground cloth and surface fibres. Although no advertisements or unembroidered commercial packages for this specific sampler have been found, other identically-cornered map samplers to Elizabeth Cook's one confirm that hers will have originated as a commercial design. Their observable technical similarities, such as placement of specific text and use of layered ground cloths, suggest a common source map. Other similar map samplers, also commercial packages, survive as fully printed maps on ground cloth, upon which an embroiderer added her own overstitching with her choice of surface fibres, and printed or freehand embroidered corners. Few of these samplers survive with a full provenance. Many lines of explorers' tracks across oceans would have been placed on the source maps by the publishers with the expectation that an individual embroiderer would trace or otherwise transfer them onto the ground cloth herself as she so chose.

Elizabeth Cook's choices of tracks, land and sea features, therefore, would have been printed on the accompanying source map, and she chose which of them she would embroider. The tracks of the *Endeavour* are named on her sampler, once on the South American east coast and again in the Great South Sea. All three tracks of Captain Cook's ships through the Pacific are stitched, but are not named similarly. Mrs Cook is likely to have used the prick-and-pounce method to transfer her choices to her ground cloth, the same stitched technique found on the Cook *tapa* waistcoat fronts.

The presence of the unnamed tracks of English Lord Anson, the Spanish galleons he pursued across the Pacific from the 1740s, and Frenchman Louis-Antoine de Bougainville travelling down the South American coast and across the Pacific were chosen because they too could be found printed on the source map. These tracks are selectively represented on a number of similarly embroidered map samplers. Lord Anson had been First Lord of the Admiralty after his successful return to Britain, and Bougainville was Cook's contemporary. All their voyages were to the forefront of popular English and European imagination in the late eighteenth century.

The awkward spacing of the word "Newfoundland" provides a clue to the provenance of the source map. It had been similarly published on a double hemispherical map engraved by George Rollos as early as 1753.[11] Rollos was active in both France and England in the second half of the eighteenth century. This duality

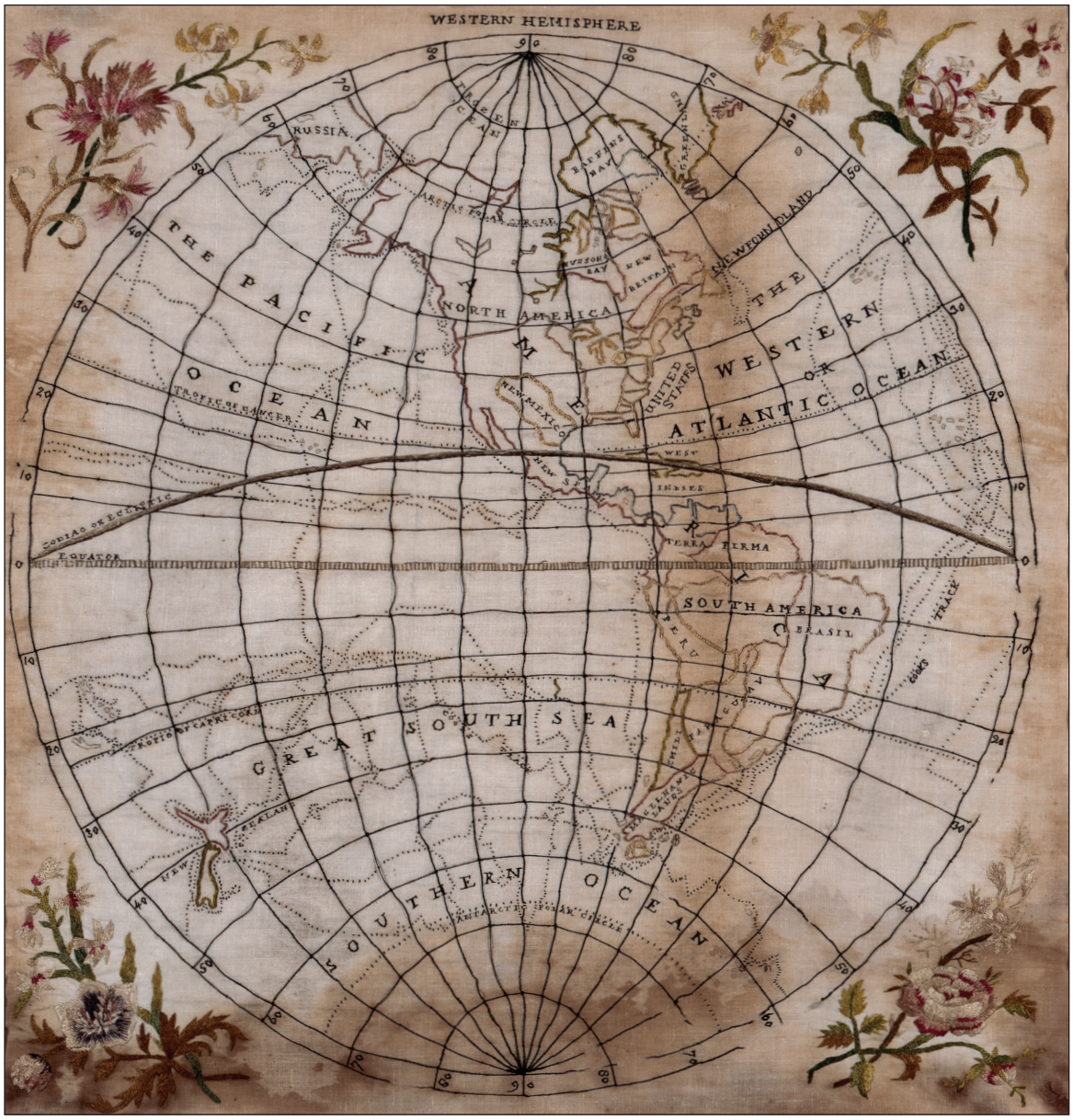


Figure 3. Elizabeth Cook, attributed (1741-1835). Embroidered Map of the Western Hemisphere Showing the Tracks of the Voyages of Captain James Cook. Linen, silk 745mm x 550mm, United Kingdom. Australian National Maritime Museum. Reproduced courtesy of the museum. 00004991.

of country of origin is substantiated with the naming of 'Magelhanic Lands' in South America, a direct translation of the French 'Terre Magellanique', and not its English alternative. "Patagonia" is the name Cook recorded for the region. The 1753 map excludes the three Pacific land masses yet to be charted by European navigators; New Zealand, the east coast of Australia, and the Pacific North West coast of North America; as well as most of the Pacific island groups. The naming of the oceans and their placement on the 1753 Rollos-engraved map is consistent with its possible later retooling for use by embroiderers, including Elizabeth Cook.

This retooling may have happened in Britain to coincide with both the safe return of the *Endeavour* in 1771 and the publication of Bougainville's Journals, translated into English, in 1772. New Zealand was now visible in the manner Cook had charted it in 1770. It showed only two main islands with the southern one elongated and thin. This reflected Cook's errors, with the incorrectly named Banks Peninsula indicated as an island, and the omission of the strait separating what we now know as Stewart Island from the mainland. The fabled *Terra Australis Incognita* had yet to be disproved, and the approaches to the famed North-West passage had yet to be charted, the results of the two later Cook voyages.

Cook's maps and charts were the property of his employer, the Admiralty, but were not published by them. They were sent out to separate publishers. To prepare the charts for publication the chart needed to be engraved onto plates. This resulted in names of both a publisher

and an engraver often appearing somewhere on the finished work.[12] These plates were constantly updated, with information added and subtracted, throughout the decades the samplers were embroidered.[13] Elizabeth Cook's map sampler probably had the four decorative corners added by a publisher or engraver, hence their consistency in other samplers. The 1753 Rollos-engraved map reveals that one upper cartouche was in place and that the corners of the map were empty in that year.

The intertwined flowers in the four corners of the Elizabeth Cook map sampler appear to be English garden flowers, not specific Cook-discovered or collected botanical specimens. Hers is the only currently-known single hemisphere sampler to show these four corners. A matching Eastern Hemisphere sampler may have also been worked, but if so, its current whereabouts is unknown.

The two extant 1784 double hemisphere samplers with Cook flower corners showed a 1772 retooling, with part of the landmass now known as Alaska as a 'globular tongue' rather than a tail of islands.[14] Cook scholar Glyn Williams described this depiction as a "bloated peninsula" (Williams 2002: 291). The shape of this landmass has been updated and redrawn on Elizabeth Cook's map sampler and may represent the use of a later retooled map published after 1784. Confirmation of this on samplers with both Cook flowers and later dates has yet to be found. Alternatively this cartographical change may reflect Elizabeth Cook's privileged knowledge of her husband's extensive Pacific legacy before 1784, the year of publication of her late husband's final journals. If so, this altered coastline provides likely confirmation of both a purpose for the sampler's creation; the correction of a cartographical error she may have considered a contributing factor to her late husband's death, and a correspondence of profound significance.

MRS COOK'S LETTER

The journal of David Samwell, surgeon on the *Discovery* during Cook's third voyage, provides a possible clue. On 'Monday Oct^{r} 19th 1778', in Unalaska, Samwell concluded his journal entry with a summary of the day's events. "Capt^{n} Cook drew up a summary Account of our Transactions since we left England & the Discoveries we had made & committed them to [the care of Greg. Ismiloff], to be transmitted by the first opportunity the ensuing Summer to Kamtchatka & from thence by Land through Russia to England, for Lord Sandwich the 1st Lord of the Admiralty, with a Letter for M^{rs} Cook." (Beaglehole 1967. Volume 3: 1141). Cook, in his journal, stated "I intrusted a letter to the Admiralty in which was inclosed a chart of all the Northern coasts I had Visited." (*Ibid.*: 457)

Other shipboard journals confirmed these official events. This was the last day, indeed the only day, in which Cook was recorded as writing and sending a letter to his employers, the Admiralty, since the end of November 1776 when the expedition left the Cape of Good Hope. Samwell's journal records the only observation of the parallel and unofficial existence of Cook's last letter to his wife.

There are two extant copies of Cook's last official Summary Account, one unsigned which reached Lord Sandwich on 10 January 1780 and the other, signed, which arrived nearly two months later (*Ibid.*: 1533). News of Cook's death also arrived in London in January. It is unclear when Mrs Cook received her last letter from her husband, but regardless of whether it was in January or March, she would have known that her husband was deceased when the letter reached her and was read for the first time.

The letter's full contents remain unknown and unknowable, yet questions abound. Did Cook outline his disappointment of not yet successfully accomplishing the Admiralty's mission, and his somewhat dashed hopes for success in the future? Did he tell her about his discovery of new islands which he had named 'Sandwich Islands', and to which he would be returning? Did he mention the stores and provisions on board the vessels? Did he sketch and name the discrepancies between the confusing Alaskan charts with which he was sent out, which he may have shared at home before the voyage, and his newly-charted coastline? Did he speak of his fellow travellers at all? As this was discussed in his recorded summary account for the Admiralty, he may well have repeated himself in his letter to his wife Elizabeth, written on the same day.

Scholars have also noted Cook's apparently altered temperament on his last voyage: "it is possible that, just as an unexpected strain on his mind was beginning to affect his attitude to the human situation, so, in relation to unexpected geographical possibilities, he was beginning to experience a certain tiredness?" (*Ibid.*: cvii). If Cook had somehow also communicated this state, how would his widow have received and understood it? With the wisdom of hindsight, if she recognised it, how would she then have chosen to act? Did these final words also include words of love, support and encouragement only ever intended for herself and their family? Did this embroidered map reflect the contents of her late husband's last letter to her, subsequently recorded on cloth? Unfortunately, we will never know. For reasons known only to Mrs Cook, the letter has not remained part of her husband's legacy.

What can be known is that the purpose for stitching the sampler was most probably not to make a public statement. Unlike the *tapa* cloth waistcoat fronts, embroidered by a hopeful and optimistic wife, the three stitched Cook tracks illuminate Mrs Cook, the embroiderer, as a grieving widow.

MOURNING SAMPLERS

Samplers are made to commemorate many events, including deaths. Mourning samplers tend to commemorate specific people, often family members, with the deceased identified by name, often using black thread to do so. Sometimes the embroiderer's name and the date of creation are also included. Read in this light, Elizabeth Cook's map sampler displays some personal family choices.

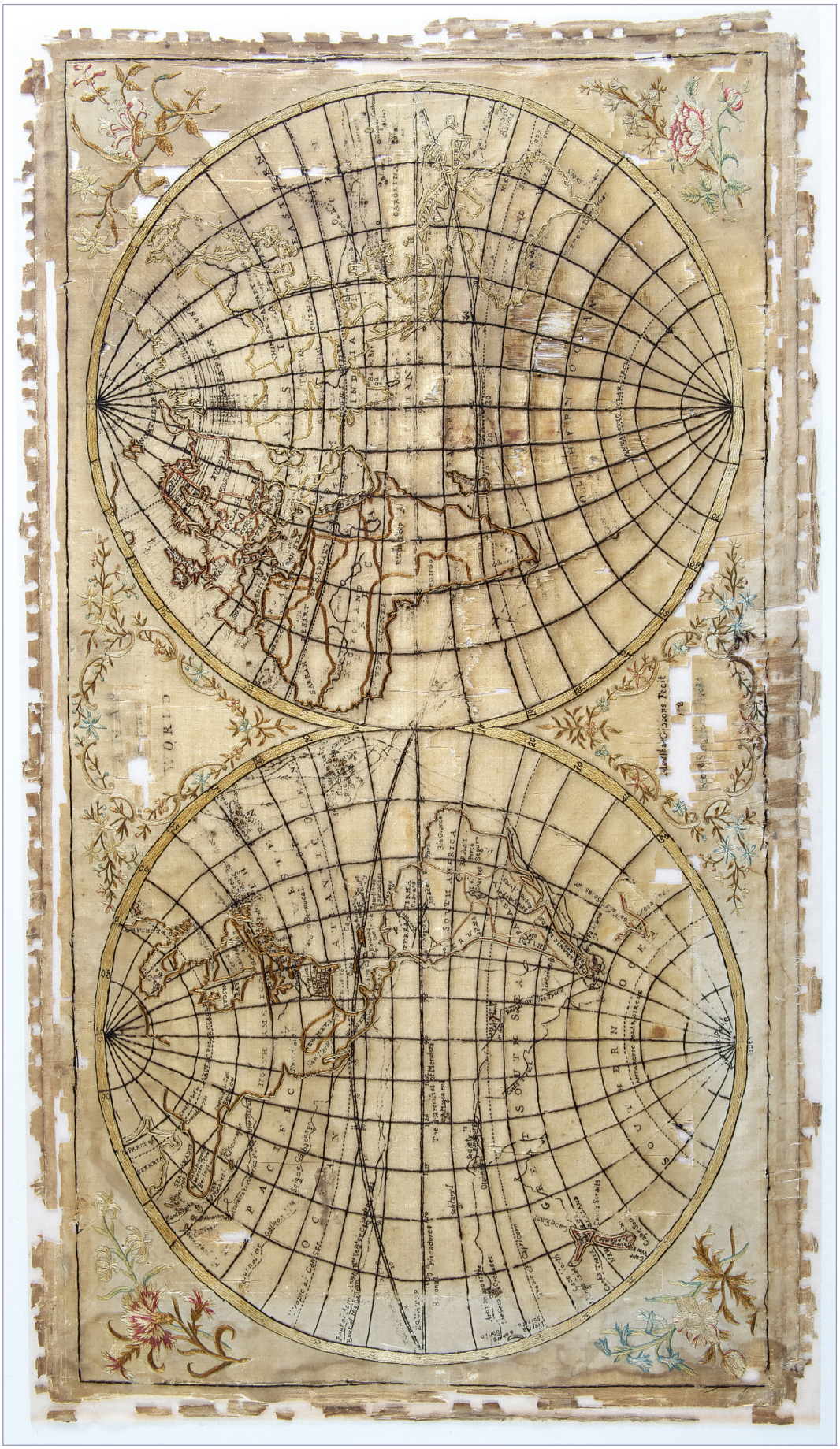


Figure 4. Martha Gibbons. Sampler, 1784. Silk, 406 x 810mm. Image courtesy of the Auckland War Memorial Museum, Tamaki Paenga Hira. 2014.1.1.

Newfoundland, with its irregularly-spaced stitching, speaks clearly of her husband's work in the Royal Navy after their marriage and prior to the voyages of discovery. The name "West Indies", used on the Cook Map Sampler, is where Nathaniel, the Cooks' second son, a midshipman, lost his life in the Great Hurricane of October 1780, a meteorological event estimated to have cost over 20,000 lives, many of them British. Given that so many lives were lost, the name West Indies would be a poignant one for many after 1780, and subsequent retoolings of the plates may have included this addition.

The place where the tracks of the third voyage intersect in the northern Pacific, a series of small stitched dots hardly visible and given no name on the sampler, would be known for the next half-century as the 'Sandwich Islands', the name Cook gave them (*Ibid.*: 278). They were also known as 'Owhyhee' [Hawaii], the native name as heard, or misheard, and recorded by Cook (*Ibid.*: 604) or, according to many European map publishers, simply 'the place Captain Cook was killed'. For Elizabeth Cook, no name was needed here. This was her husband's burial place. Cook's journals record that her husband's remains were committed to the deep there on 21 February 1779, while his ship the *Resolution* was still at anchor (*Ibid.*: 567).

These final two places represent in visual form the two family burial places Mrs Cook was unable to visit in person. In conceptual terms, the flowers at the corners could be seen as flowers left by a grieving widow and mother at these watery graves. All other Cook burial places – and Mrs Cook, in her long years of both widowhood and childlessness, would have known them all – were able to be visited.[15] Only one hemisphere was required for this specific purpose.

In her widowed world the artistic images she imagined, understood, and inherently trusted were less likely to be those which her husband's fellow travellers either brought home with them or subsequently remembered. They were more likely to be the maps charted by her husband. The embroidered map sampler simultaneously reflected *his* mapped world, the culmination of *his* monumental career, and *her* personal commemoration of their marriage and his death, in *her* accomplished fashion.

MARTHA GIBBONS 1784

The sampler (Fig. 4) worked by Martha Gibbons incorporates embroidered silk threads on a silk background, and at each corner is a floral motif while at the centre, top and bottom, two cartouches displaying the title and maker's name. This sampler was generously gifted to the Auckland War Memorial Museum Tamaki Paenga Hira by Sue Horn-Caskey, of Oregon, and after significant conservation work funded by the Auckland Museum Circle, it was accessioned into the museum's collection in 2014.

The double hemisphere map sampler of Martha Gibbons displays a snapshot of one Englishwoman's view of the world in 1784. Martha Gibbons was either Mrs Martha Gibbons, wife of Richard Gibbons, Stoney Stratford's Surgeon and Apothecary, or their fifteen year old daughter Martha.[16] The family would have known, through its apothecary connections, that Banks brought his botanical species back to Kew and the Chelsea Physic Garden, also known as the Apothecaries' Garden.[17] The four stitched capes of New Zealand on Gibbons' sampler were Capes North, South, East and West, named by Cook on the *Endeavour*,[18] and the words "Cook's Straits" separating the two islands were stitched.

While the Gibbons cartography reflected the New World of 1772, rather than 1784, the addition of indigenous language currently provides the earliest-known rendition of Cook's recorded Māori language, *Te Reo*, in the hand of a woman. Although Gibbons would have copied this from the source map, to choose to include it was her decision.[19] Gibbons added the Māori names for the two islands "*Fahe(_)/No M(_)awe*" in the north, and the south, "*Ta Veia Poenamoo.*" On 31 January 1770, while at Queen Charlotte Sound, Cook noted in his journal that he had been told, by an old man there, that the names of two of three islands were "*Tovy-poenammu"* and *"Aeheino mouwe"*(Beaglehole 1967. Vol I: 243).[20] These spellings were his best approximations of what he, or others with him, heard. Thereafter he struggled for consistency with them. These first attempts at the Māori names for the islands began to appear on published maps after the return of the *Endeavour*, in both English and continental publications with a variety of spellings, even when they all originated from Cook himself.[21]

In 1784 Gibbons was unlikely to have heard anyone speak these words. She well understood their meaning, given their placement, but it is unknowable whether she stitched these words as they had been presented to her on the source map. Today's standardised spellings, *"Te Ika A Maui"* and *"Te Wai Pounamu"*, were not introduced for these sounds and these places until well into the nineteenth century.



Figure 5. Detail showing New Zealand and Te Reo. Martha Gibbons, 1784. Image courtesy of the Auckland War Memorial Museum, Tamaki Paenga Hira. 2014.1.1.

ALICE SWAIN, 1804

Alice Swain's 1804 double hemisphere map sampler (Fig. 6) now in the collection of the Whitby Museum, is another specific creative response making a distinctive New Zealand-sourced connection. Swain, whose life-story is lost but for this sampler, stitched a *kowhai* flower beside New Zealand in the lower left corner.[22] The *kowhai* (*Sophora tetraptera*) was collected by Joseph Banks and Daniel Solander, drawn by Sydney Parkinson, taken to England and propagated at Chelsea Physic Garden, and today *Sophora tetraptera (Leguminosae)* is Plate 430 in the Banks Florilegium. Swain's stitched cartography was embroidered with black thread with an unstable dye, which has bled profusely in the last two centuries. Cook's first and third voyages only were tracked, and unfortunately they are now difficult to distinguish.

Swain's sampler has full floral corners and borders yet to be found on any other double hemisphere map sampler. Her *kowhai* is not based on that drawn by Parkinson. Its direct line to the *Endeavour* is still via Banks, through Curtis's Botanical Magazine. This periodical was started by William Curtis, an employee at Kew, and first published in 1787 with copper-plated colour engravings. Women interested in botanical pursuits, either professionally or recreationally, with sufficient means to purchase the periodicals, were able to see and learn about new plants brought from around the globe to Britain. Alice Swain's embroidered *kowhai* is sourced from the drawing of a *kowhai* plant found in Curtis's Botanical Magazine.



Figure 6. Alice Swain (unconfirmed birthdate). Double Hemisphere Sampler, 1804, detail. Linen, silk, 535mm x 890mm. United Kingdom, Whitby Literary and Philosophical Society Museum, Yorkshire, CBE84.

In 1791 the magazine published information about the first New Zealand plant to be featured in its pages: "The magnificent and highly curious species of Sophora here represented, is one of many plants discovered by Sir Joseph Banks at New Zealand, where it forms a tree of a considerable size. A finer sight can scarcely be imagined than a tree of this sort, extending to a great breadth on a wall with a western aspect, in the Apothecaries Garden at Chelsea, where it was planted by Mr. Forsyth about the year 1774, and which at this moment (April 28, 1791) is thickly covered with large thickly covered branches of yellow, I had almost said golden flowers; for they have a peculiar richness, which it is impossible to represent in colouring." (Curtis Volume V 167, 1791)

Of the eight major plants bordering the map, three are from England and Europe. The three other corner plants include Virginia Lungwart and Robinia from the continent of North America, and the China-Rose Hibiscus from the continent of Asia. The Clammy Crane's Bill placed in the lower centre is sourced from the continent of Africa. Every flower embroidered by Alice Swain is sourced to Curtis' Botanical Magazine.[23]

Despite the lack of provenance for Alice Swain and her sampler, some conclusions about her life-story can be drawn. Swain, whatever her age, was well-educated, well-read, had a wide range of accomplishments, and must have had access to means with which to keep herself up-to-date with modern discoveries. Although Cook's maritime adventures were not open to English women as participants, the opportunity to participate in words, objects, images, and imaginings of the travellers thereafter was open to anyone who was culturally literate.

ANNE MARGARET HAMMOND, 1812

The sampler (Fig.7) of Anne Margaret Hammond, dated 1812, now in the collection of Museum of New Zealand, Te Papa Tongarewa, displays continental corners, placing the four continents of the world into the four corners of the world. While Hammond's cartography appears to be an updated rendition of the source map embroidered by Elizabeth Cook, her continental corners have thus far been located on other map samplers from 1783 to 1823.[24] These concepts were already to be found in seventeenth-century women's art, both in beadwork and embroidery.[25] As with the Alice Swain sampler, there is very little accompanying provenance for the Hammond sampler.

America was the fourth continent to be discovered by Europeans, in 1492. Prior to this, European understanding of the world's geographical features was

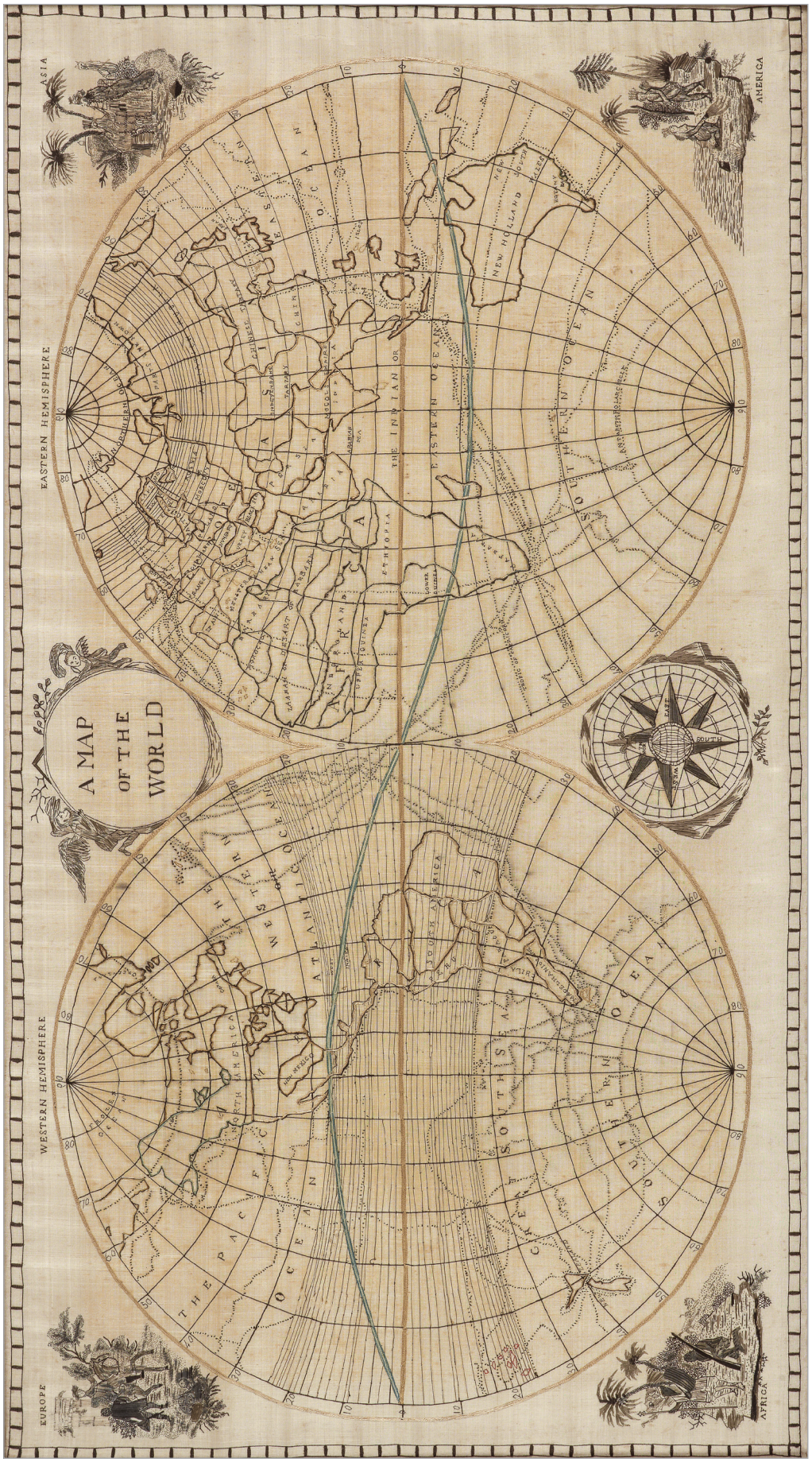


Figure 7. Anne Margaret Hammond (unconfirmed birthdate). Double Hemisphere Sampler, 1812. Silk, cotton, 419 x 722mm. United Kingdom. Museum of New Zealand Te Papa Tongarewa (purchased 2010), GH016925.

historically limited by the concept that the earth was defined by the three continents of Europe, Africa and Asia. Renaissance thought developed to include America and depict four continents visually, in conjunction with four seasons, four corners of the earth, four earth elements, four muses, four winds and four human temperaments.[26] By the late eighteenth century these concepts were well established in educated and literate popular culture. The four stitched continents, Europe, Africa, Asia, and America, with recognisable selections of animals, headdresses, weapons, surrounding foliage, costume, skin colour, and accompaniments would be readily understood by those literate in European popular culture. The images depicted a shared story and every detail served to underscore the superiority of Europe through its power, wisdom, technology and accoutrements of civilisation.

Enlightenment thought, including growing awareness of Australasia and the Pacific region, would embrace, enlarge and challenge these concepts, observable in the continental corners. The recorded glimpses by Cook of the primitive Pacific world of the "noble savage" have been described as reading "as if he had spent the voyage reading Rousseau" (Beaglehole 1974: 251). Influential French philosopher Jean-Jacques Rousseau's "noble savage" concept held that in a state of nature, humans were essentially good. Equally, "primitivism" held that life was essentially better or more moral during early stages of mankind or among primitive peoples and which had deteriorated with the growth of civilisation, generally understood within a European context.

How the audience for a sampler may have understood these stitched images remains open to question, especially as growing knowledge of the South Pacific presented a new continental enigma. Could there be more than four continents? Yet these four stitched images represented the official understanding of the British Colonial Office, which from around 1822 until 1843 was organised into four main departments, the Mediterranean, African, West Indian, and Eastern departments, which included New Zealand (Moon 2002: 14). In 1843 a fifth department was proposed, to be known as the catch-all "Miscellaneous" (*Ibid.*: citing Pugh 1962: 9).

However the concepts were understood, the realities of English life meant that the newly charted lands in the Pacific were not only imaged and imagined, but also understood geo-politically as potential territorial expansions of the British Empire. As a consequence of wars, revolutions, and changing circumstances in Britain, travellers with Cook not only provided the British people with glimpses of the New World inhabited by "noble savages", but also provided the British Government with assurances that the newly charted lands around the Antipodes could sustain human life. English women physically travelled to settle, voluntarily, and involuntarily, in these otherwise non-European-encultured lands from 1788 onwards.[27]

CONCLUSION

The years from 1770 until 1840 were tumultuous ones politically, geopolitically, educationally and commercially in the English and European world, and these samplers strongly hint at these profound societal changes. The South Pacific was first introduced to those English women who were in a position to learn of it directly from Cook and his fellow travellers. These men charted the new world, collected scientific knowledge, traded English goods for 'curiosities' and took them to England. These were disseminated in commercially successful travelogues and other media to a wider literate public. Those men in a position to do so immediately expressed a desire to return on another voyage into the unknown. The options for translating this new knowledge into creative endeavours by women were limited to their experiences and understandings within their home culture until 1788 and beyond.

By the time Hammond worked her 1812 sampler Dinah Hall, wife of missionary William Hall, the earliest-recorded English woman to leave Britain with the stated intention of settling permanently in New Zealand, had arrived in New South Wales, and Hannah King had married John King, a missionary-in-waiting in Parramatta, New South Wales.[28] In 1814 an English woman's handcrafted world changed again as English missionary wives now resided in New Zealand. On 22 June 1815 an English woman, Hannah King, taught a Māori woman, Ehura, to make a European-styled garment for the Māori woman to wear (Elder 1934: 99), and in 1820 a "sampler" made in the King home by "Oreo", a Māori woman, was sent to England (King 1820). By the time Elizabeth Cook died 13 May, 1835, aged approximately 93 years, English women had lived and communicated with embroidered samplers across cultures and across oceans from the Old World to the New, and back again.

Map samplers that name Cook hint at a much larger world opening up for eighteenth century European-encultured women. These proofs illuminate women embroidering and weaving who not only commemorated an event, but who also shared an excitement of the new, a desire to confront and understand the possibly confusing information now before them, and a pride in all their achievements. Further examples of these samplers and these garments, and similar objects, wherever they are found, are likely to underscore these worldviews even more clearly.

Women's textiles provide evidence of unheralded women's worlds in unsung women's words and unnoticed women's ways. These Cook-named map samplers *are* women's Endeavours.

NOTES

1. For further context regarding maps in the Age of Enlightenment, based on twenty-four maps from the British Library collection, see Geoff Armitage, 2012. *The World at their Fingertips: Eighteenth-Century British Two-Sheet Double Hemisphere World Maps.*

Sylvia Ioannou Foundation and The British Library, London. Pp. 6–7. Armitage's well-reasoned conclusions have limitations with respect to map samplers, given that the number of British maps published in the 18th century upon which to base any study is "almost certainly upwards of two hundred and fifty" and the society in which he places them seems not to include women.

2. For further context on map samplers as part of a woman's education, see Judith A. Tyner, 2015. *Stitching the World: Embroidered Maps and Women's Geographical Education*. Ashgate, London. This is only the second publication known devoted to this field of research after 'Mapped and Charted: Samplers and Historic Embroideries.' Witney Antiques Catalogue, 2005. Witney, Oxfordshire. California-based Tyner bases many of her conclusions on samplers with the sampler-maker and her school identified.
3. For further context regarding a specific map sampler by an English woman, as an expression of women's art, see Vivien Caughley, 2013. 'The Cook Map Sampler: A Widow's Embroidered Response to her Husband's Voyages of Discovery.' Pp. 126–135; *In* Gardner, Anthony (ed.). *Mapping South: Journeys in South-South Cultural Relations*. The South Project, Melbourne.
4. Examples: Sampler. Mary Gill. 1808, TXT 0031; Sampler. Mary Lupson, (n.d). "Nelson/ hero of the Nile/1799." TXT0029. National Maritime Museum, Greenwich.
5. Of the several extant kaitaka with tāniko border known to have been collected by Banks, the exact garment modelled in his portrait is unconfirmed, although scholars claim that honour for one in the Pitt Rivers Museum collection in Oxford, England.
6. "In the first place we saw the Otaheite dress, something more simple, but not so well suited to our climate, as our compounded dress, They only wear a mantle, which they tie about their neck, much of a square that hangs almost to the ground, so, one arm bare and the hair tied up in a knot; this is their common dress, their commanders are distinguished, with a little more ornament, a gorget made of pigeon's feathers and dog-fish teeth. Feathers in their heads, and caps almost as gallant as a modern English lady's."
7. Map Image. SLNSW M1 120/1779/1. Mitchell Library, Sydney.
8. James Robert Tyrrell (1875-1961) was a Sydney bookseller and collector who diversified into Cook memorabilia, amongst other objects, after the late 1920s.W.S. Ramson, 'Tyrrell, James Robert (1875–1961)'. Australian Dictionary of Biography, National Centre of Biography, Australian National University. http://adb.anu.edu.au/biography/tyrrell-james-robert-8894/text15623, accessed 14 August, 2013. The work is now separated from its original glazed hanging case.
9. Waistcoat. SLNSW R198. Mitchell Library, Sydney.
10. "With a sigh, perhaps even with a tear, she put away forever the needlework she had planned as a loving surprise against the time of her husband's return ... Of all the 900 items among the "Artificial Curiosities" that were exhibited at the Bernice Pauahi Bishop Museum in 1978, to commemorate the 200th anniversary of the Europeans' landing in Hawai'i, this one was the most saddening." (Bushnell 1991:4–5)
11. SLNSW M1 100/1753/1 Rollos : An Accurate Map of the World; London, 1753: Rollos/Brooks
12. For example in the 1784 reprint of Sydney Parkinson's "Journal of a Voyage to the South Seas", originally published in 1773, the accompanying hemispherical maps acknowledge the publishers Dilly and Phillips, of London, but credit the engraver as Samuel John Neele of The Strand. Auckland Museum Library G460.
13. This remodelling occurred also with the plates for globes. Elly Dekker, in 'Globes at Greenwich: A catalogue of the Globes and Armillary Spheres in the National Maritime Museum' Oxford University Press and National Maritime Museum, Oxford, 1999, p132. Table 9.1, published a sequence of the "Editions of the Ferguson-Dudley Adams-Lane" pocket globe with additions and subtractions to the base information on ten consecutive publications of the same plates between 1756 and c.1840. I (1756) has Australia drawn to Dutch discoveries, with Anson's Voyage depicted; II (1756) adds the name of the engraver; III (1775) is the same with the addition of Cook's First Voyage; IV (c.1795) is the first time Cook's third voyage is added; apart from Variation VII of the ten (c.1825), which separates Tasmania from the Australian mainland for the first time, the additions and subtractions tend to focus on publisher's details and names of engravers, instead of the updating of cartographic information.
14. Sampler, Martha Gibbons, Stoney Stratford, 1784. Auckland Museum Tamaki Paenga Hira 2004.1.1; Sampler. Mary Mullins, 1784, Private Collection.
15. Captain James Cook and his second son Nathaniel were buried at sea. Elizabeth Cook, her eldest son James and youngest son Hugh were buried in Cambridge; their other three children died in infancy and were buried in London.
16. Miss Martha Hallifax, daughter of an apothecary, married Richard Gibbons in 1762 in St John's, Coventry. Their son John was born three years later and christened at Holy Trinity, Coventry, as was their daughter Martha in 1769. In 1773 the family moved to Stoney Stratford and took up a business there. Stoney Stratford is a village in Buckinghamshire. For genealogical information see www.ancestry.com.
17. The Chelsea Physic Garden remains open today, with a Joseph Banks garden in pride of place.
18. East Cape, Cook Journal I. 187. 31 October 1769; North Cape, Cook Journal I. 224.19 December 1769; South Cape, Cook Journal I. 262. 10 March 1770; West Cape, Cook Journal I. 265. 14 March 1770.
19. The other located 1784-dated map sampler, with Cook flower corners does not include this feature. It is in a private collection.
20. Beaglehole's footnote contains many suggestions, in standardised Māori, for the exact phrases and spellings Cook may have heard.

21. The same chart as in Hawkesworth. 1773. *In* Andrew C. F David (ed.). *The Charts and Coastal Views of Captain Cook's Voyages attributed to Cook, James. 1728-1779*. London, Hakluyt Society, 1988-1997 shows this map with B. Longmalo as engraver, showing "Toai Poonamoo" and "Ea Heinom Auwe". The 1776 map, officially published by Antonio Zatta in Venice, Italy, entitled "New Discoveries Made in 1765, 67, and 69 in the Southern Seas" included the tracks of Byron (1764-1766), Wallis, Carteret, and those of Cook's First Voyage, and significantly included the phrases "Tavai Poenammoo" and "Fahei Nomawe", as well as the "bloated Alaskan Peninsula." Collection of Captain Cook Memorial Museum, Whitby.
22. Although this sampler is in the Whitby collection, there is no other provenance for it. Neither the identity of its maker nor when and how it comes to be in the Whitby collection is known.
23. Wing-podded sophora, [New Zealand; Kowhai], *Sophora tetraptera,* Curtis's Bot. Mag. Volume V, p.167, 1791 sampler lower left corner; Virginia Lungwort, [America; Virginia] *Pulmoneria Virginica,* Curtis's Bot. Mag. Volume V, p.160, 1791, sampler upper left corner; China-Rose Hibiscus [Asia; India], *Hibiscus Rosa Sinensis,* Curtis's Bot. Mag. Volume V, p. 158, 1791, sampler upper right corner; Rough Stalked Robinia or Rose Acacia [America; Carolina], *Robinia Hispida,* Curtis's Bot. Mag. Volume IX, p.311, 1795, sampler lower right corner; *Adonis Vernalis* (the only name given) [Europe; England], Curtis's Bot. Mag. Volume IV, p. 134, 1791, sampler upper centre; Heath-leav'd St John's Wort [Europe; Crete], *Hypericum Coris,* Curtis's Bot. Mag. Volume V, p. 138, 1792, sampler left centre; Clammy Crane's Bill [Africa; Cape of Good Hope], *Pelargonium Glutinosum,* Curtis Botanical Volume IV, p.143, 1791, sampler lower centre; Italian Pimpernel [Europe; Italy], *Anagallis Monelli,* Curtis Botanical Volume IX, p. 319, 1795, sampler right centre
24. 1783 Sampler, 57.122.212, Metropolitan Museum of Art, New York; 1823 Sampler, Private Collection.
25. Two examples include 1649 English Pictorial Embroidery, "The Four Continents and The Sacrifice of Isaac", 47;1032. Museum of Fine Arts, Boston; and 1651 English Pictorial Embroidery, "Lady and cavalier surrounded by the four continents". 59.208.68. Metropolitan Museum of Art, New York.
26. For further reading on this body of understanding, refer in the first instance to books such as James Hall, with Introduction Kenneth Clark, "Hall's Dictionary of Subjects and Symbols in Art" (London, John Murray, 1974) pp. 128–131 (page numbers refer to revised ed. 1996).
27. There were 222 females, including 188 convicts, recorded in the 1788 New South Wales census.
28. For further information, see Vivien Caughley. *New Zealand Historic Samplers: Our Stitched Stories*. Batemans, Auckland. 2014. Pp 23–31.

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EMBROIDERED WORK

Embroidered map on linen depicting the voyages of Captain James Cook in the Western Hemisphere, [Sampler, Elizabeth Cook (attributed), n.d.], ANMM 0004991, Australian National Maritime Museum, Sydney.

Sampler. Martha Gibbons, Stoney Stratford, 1784; 2014. 1.1, Auckland War Memorial Museum, Auckland.

Sampler. Mary Mullins, 1784; Private Collection.

Sampler, Alice Swain, 1804; WHITM:CBE84, Whitby Literary and Philosophical Society Museum , Whitby.

Sampler. Anne Margaret Hammond, 1812; GH016925, Collection of Museum of New Zealand, Te Papa Tongarewa, Wellington.

Sampler. Mary Lupson, n.d.(after 1799); TXT0029, National Maritime Museum, Greenwich.

Sampler. Mary Gill, 1808; TXT0031, National Maritime Museum, Greenwich.

Waistcoat. SLNSW R198, Mitchell Library, State Library of New South Wales, Sydney.

MAPS

Map, New Zealand charted by Cook; F0293, G263:1/2; National Maritime Museum, Greenwich, London; first published by Hawkesworth, 1773.

Map, An Accurate Map of the World; London, 1753; SLNSW M1 100/1753/1 George Rollos engraver.

OTHER

Image. The Cook Map Sampler. SLNSW/Mitchell Library/ M1 120/1779/1.

Letterbook, Church Missionary Society, London, John King. Microfilm 014 Reel 5. CMS [AJCP M225].

Paper Collage. Mary Delany. "Philadelphus Aromaticus Solander" "New Zeland Tea". AN331443001, The Trustees of the British Museum, Prints & Drawings, Registration number 1897 0505.661; British Delany Vol.07 PIIIa.

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Vivien Caughley is an Honorary Research Associate at Auckland War Memorial Museum, Auckland, New Zealand. This paper is based on her keynote address "Cook Map Samplers: Women's Endeavours", given on 22 March 2013 at the Costume and Textile Association of New Zealand Annual Symposium, held at Auckland Museum. It incorporates her ground-breaking research, "The Cook Map Sampler: A Widow's Embroidered Response to Her husband's Voyages of Discovery" which was published in Melbourne, Australia in April 2013. It further incorporates research undertaken for her book, "New Zealand's Historic Samplers: Our Stitched Stories", published in Auckland in 2014, and includes more recent research. Her research interests include embroidered maps and cross-cultural needlework, needlework reflecting southern discovery, immigration and settlement patterns, and the intersection of art, craft and embroidery.

A Predynastic vessel with a potmark in the Auckland War Memorial Museum

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Abstract
A unique potmark was identified on a ceramic vessel (49357) in the Auckland War Memorial Museum Tamaki Paenga Hira. The vessel was acquired by Lt. Col. F. Waite in Egypt during the early twentieth century. Potmarks are found on ceramic vessels from the Predynastic and Early Dynastic periods of Egypt. Previous studies have examined potmarks to identify what they may refer to. The previously unrecognised potmark on 49357 has no direct parallel in existing corpora. The existence of this potmark raises issues regarding the interpretation of potmarks on ceramic vessels and the interpretations that can be drawn from them.

Keywords
Potmark; pre-dynastic Egypt; museum collections; Fred Waite.

INTRODUCTION

A previously unrecognised potmark was identified on the ceramic vessel 49357 in the Auckland War Memorial Museum Tamaki Paenga Hira, New Zealand (Fig. 1). Potmarks occur frequently on ceramic vessels and sherds from the Badarian period onwards (c.4500-4000 B.C.E.) (Bard 2008:88). Generally considered as different from decoration, a potmark is a small symbol on the surface of the vessel. The mark can be inscribed when on the vessel pre or post firing, or painted. While a potmark could have a decorative purpose, they are interpreted as having the purpose of conveying a specific meaning.

The interpretation of meaning varies, but to date they are thought to be either a potter's mark (e.g. Tassie *et al.* 2008), to indicate the contents of a vessel or the owner of the contents (e.g. Wengrow 2006: 236-9; Tassie *et al.* 2008), or where the vessel was made (e.g. Wengrow 2006: 238-9). Potmarks are also related to symbolic development, particularly the development of writing (e.g. Bard 1992; Wilkinson 1999: 33-4; Tassie *et al.* 2008: 217). The interpretation of a particular potmark is inferred based on the form of the vessel it is on and how it was inscribed on the vessel. For example a potmark on what is interpreted as a storage vessel is likely indicating the contents of the vessel or owner of the vessel, while a potmark applied to the vessel pre-firing is likely a potter's mark or indication of where the vessel was made. Meaning is also assigned to potmarks based on how stylistically similar they are to dynastic hieroglyphics (e.g. Bard 1992).

Typically potmarks encountered in archaeological excavations are published together in a corpus of all examples of potmarks found from a particular site or area (e.g. Petrie 1900). These are fitted into typologies based on the form of vessel particular marks are usually found on and the perceived complexity of the potmark (e.g. Tassie *et al.* 2008).

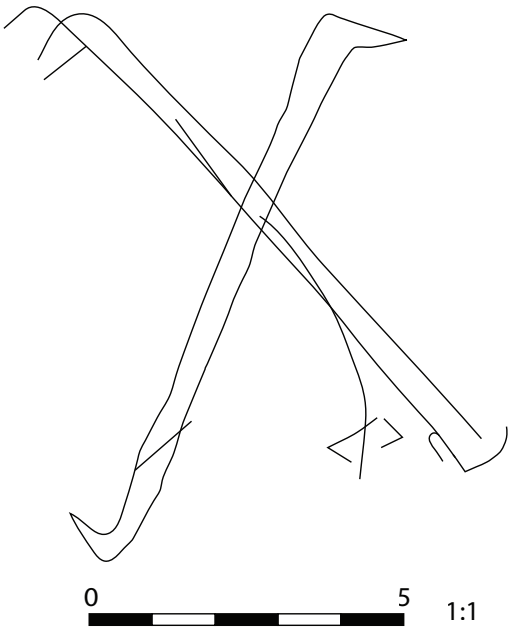


Figure 1. The potmark identified on 49357.

BACKGROUND OF THE VESSELS ACQUISITION

The vessel in the Auckland War Memorial Museum was donated by Lt. Col. F. Waite, an honorary keeper of Middle Eastern Archaeology at the Otago Museum (Green 2012). Waite first visited Egypt when he was training for the Gallipoli Campaign during World War I (Green 2012). During World War II Waite was based in Cairo from 1941-1944 as the overseas commissioner for the National Patriotic Fund Board (Green 2012). It was during his time in Egypt that Waite obtained a number of artefacts that were subsequently transported back to New Zealand and are now housed in the Otago Museum, Auckland War Memorial Museum, Museum of New Zealand Te Papa, and Canterbury Museum.

The artefacts collected by Waite came from a number of sources. Some were obtained from Guy Brunton from Badari, and King Farouk gifted 100 artefacts from Helwan (Fig. 2) (Skinner 1952). In addition to these, Waite collected a number of artefacts from antiquities dealers around Egypt (Skinner 1952; Collins 1952). Waite (*undated*) became skilled in identifying forgeries and was cautious not to send any such items back to New Zealand. The artefacts gifted by Brunton to Waite are recorded in the distribution lists of excavation reports under those sent to Dunedin (Otago Museum) (Brunton 1927; Brunton and Caton-Thompson 1928).

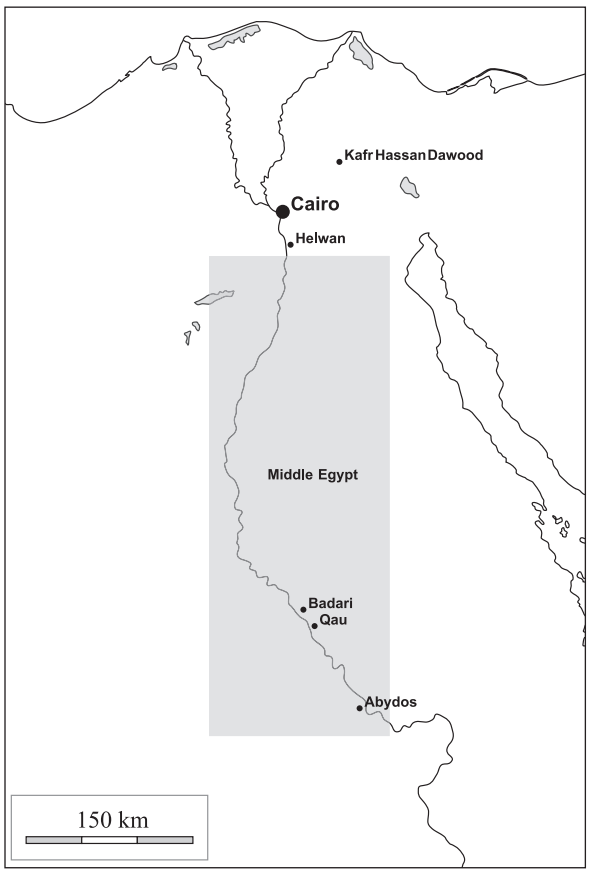


Figure 2. Map of Egypt with the places mentioned in the text. The area along the Nile River in the grey box is Middle Egypt.

Based on the above it is possible that this vessel was acquired from one of Brunton's digs at Qau or Badari (Fig. 2) (Brunton 1927; Brunton and Caton-Thompson 1928). However, neither the vessel nor the potmark could be identified in the corpus of finds published from those excavations. It is possible that this vessel was excavated by grave robbers and subsequently sold to Waite, who was known to not ask questions about how artefacts were acquired when purchasing them (Bowie 1952). The archaeological provenance of the vessel, whether it was from a village or burial assemblage, is now lost, although the relatively good state of preservation of the vessel may suggest it was likely acquired from a burial context.

THE VESSEL AND POTMARK

The vessel is 14 cm high and 13.5 cm in diameter (Fig. 3). It has a circular rim and is in the shape of an unrestricted conical frustum with a flat base. The vessel has a red slip on it, which was applied with a brush. The slip was also applied over the reduced black top of the vessel. The base and lower quadrants of the vessel are eroded. The vessel has an oxidized body and base with a reduced band around the rim. This black topped style of firing is typical of that found from the Badarian, Naqada I, and Naqada II periods of Egypt (c.4500-3200 B.C.E.) (Baba and Saito 2004; Bard 2008: 88,104). There is no evidence of the characteristic Badarian ripple which occurs on some Badarian vessels. As a result of this it is more likely that the vessel originates from the Naqada II period, and spatially from Middle Egypt (Fig. 2).

The potmark is in the form of a cross with hooks at each end. It measures approximately 8.75 cm in length and 7.5 cm in width from the uppermost point to the lowermost. The mark is a shallow incision, made on the outside of the beaker with a pointed tool. This occurred after the vessel was fired, as the incisions have removed the red slip from the surface. Also, near the black area of the vessel, the incision has revealed the reduced core of the vessel; if the incision was before firing the incision in these areas would oxidized. The bottom right of the potmark has eroded away but appears to have finished in a hook as the other ends do, 1 cm into the eroded area.

In the bottom middle section of the potmark there are four lines which together almost form a rectangle (dark grey, Fig. 4). Across the potmark there are lines which intersect the main lines. Some of these lines may be accidental where the inscriber has run the inscribing instrument off course or too far. In other cases they may be working lines where the inscriber is roughing out a design (light grey, Fig. 4).

DISCUSSION

The cross potmark is predominantly a simple graphic element of two lines crossing each other, and is ubiquitous throughout the corpora of potmarks. The potmark on 49357 was inscribed post-firing which would suggest that it is not a potter's mark, which were usually applied prefiring (Friedman 1994: 200). Wodzińska (2009: 244) has noted that prefired potmarks



Figure 3. Vessel 49357 with potmark.

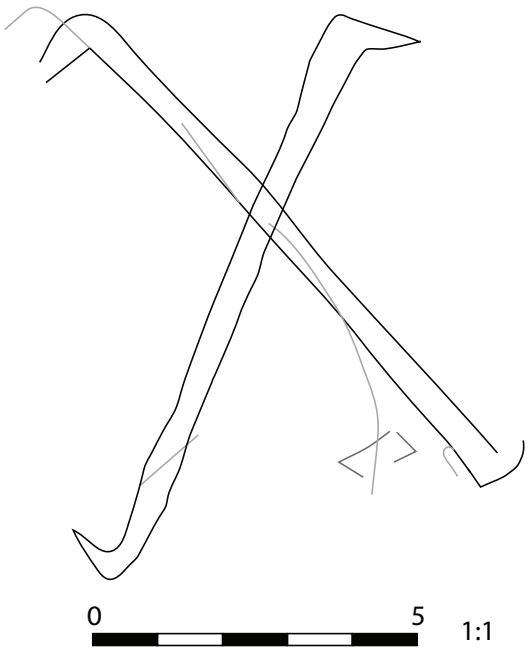


Figure 4. The different elements of the potmark. Black lines are the main symbol, the dark grey lines are the rectangular symbol, and the light grey lines may be working lines or errors.

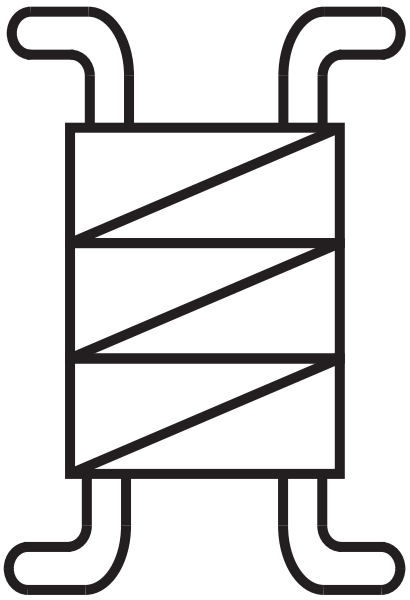


Figure 5. Old Kingdom hieroglyphic symbol for Neith. R25 (right) on Gardiner's (1950:503) sign list.

were part of the pot's creation, and were therefore inevitably linked with the place of production. When the potmark is applied post-firing, this cannot be assumed. It is not known when exactly the potmark was applied to 49357. As the potmark on 49357 continues into the eroded surface, therefore, it is clear that its inscription occurred pre-erosion and is therefore "ancient".

The post-firing potmark is called an "owners mark" (Friedman 1994: 200, see Fairservis 1983 and van den brink 1992). Owner's marks as a name would suggest usually denotes the ownership of the vessel. Post-firing potmarks could also be used to identify the contents of the vessel or where those contents originated from, as has been suggested for vessels with potmarks found in Tomb U-j at Abydos (Dreyer 1992).

With a few exceptions from Kafr Hassan Dawood (Tassie *et al.* 2008), the cross on 49357 is more detailed than any in corpora thus far examined (Brunton and Caton-Thompson 1928; Bréand 2009; Jucha 2008; Kroeper 2000; Mawdsley 2009; Payne 1993; Petrie 1900; Tassie *et al.* 2008; van den Brink 1992, 2001; Wodzińska 2009). The majority of potmarks, both owners and potters, examined consist of lines which combine to make a shape such as a cross. Often they only take up a small proportion of the surface area of the vessel, usually on the shoulder. The potmark on 49357 consists of two polygons which make up the cross. It is a relatively large mark, as well, covering much more area than the usual shoulder. As well as this the hooks on the ends of the crossed polygons are a detail which is not noted elsewhere. Thus, the fact of the mark's size and detail, and that it is on this type of vessel makes the Auckland Museum example rare.

In the corpus of potmarks from Kafr Hassan Dawood (Fig. 2), the cross is categorized as a "preformal hieroglyph" on the basis that it appears to be an ancestor of a later hieroglyphic sign (Tassie *et al.* 2008: 218;). This could apply to 49357 if the hooks on the ends of the crosses are ignored. Another possibility is that it is visually similar to the earliest hieroglyphic forms for Neith from the Old Kingdom (Fig. 5) (Gardiner 1950: 503). 49357 is lacking several key aspects however, namely the shield-like element that is placed in front a hooked cross, making this association with Neith unlikely.

The connection between pot marks and hieroglyphs is often suggested in literature (e.g. Dreyer 1992; Graff 2013; Hassan 1983; O'Connor 2009: 143-7; Petrie 1900: 29-32; Tassie *et al.* 2008). The issue with arguments that attempt to identify a relationship between potmarks and hieroglyphs that later develop is that an interpretation based on a script that is not yet developed is imposed on them. At the time of their creation the potmarks may have formed the beginnings of hieroglyphic symbols, but this is not necessarily a conscious notion by the inscriber, even if we can interpret that association now. By placing potmarks along a line of development in which they develop into the hieroglyphic script, it goes against Time's Arrow by using future events to interpret the past (Finlayson 2013: 133).

Without a secure archaeological context the vessel and potmark from the Auckland War Memorial Museum cannot be used to contribute much to the wider studies of potmarks in Egypt. However, this study highlights issues with some of the ways that potmarks are currently interpreted and studied. Future research into potmarks should focus more on what they mean in terms of their spatial-temporal context and not what they may become. Through this course of study it may be possible to better interpret potmarks on vessels with insecure contexts such as 49357.

CONCLUSION

The potmark on vessel 49357 in the Auckland War Memorial Museum Tamaki Paenga Hira is a unique example amongst the corpus of potmarks from the Naqada II period. Without an exact provenance of the vessel, it is not possible to establish the original context of this vessel; that it is from Egypt and likely originates from Middle Egypt in the Naqada II period is all the information available. A vessel without an exact provenance and with a unique potmark has limited interpretational value. Only when multiple examples of similar potmarks are found from the same archaeological context is it possible to interpret what these marks may have meant. Likewise, when single potmarks are found within archaeological assemblages, it is not possible to make assessments regarding the trade and exchange of vessels without multiple lines of evidence to support this interpretation, such as residue analysis or sourcing studies which indicate where the vessel was made.

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Clay – a lesser known medium for Maori artefacts

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Abstract
Examples of shaped and fire-hardened clay objects held in Auckland Museum archaeology collections are described and illustrated. Found in Maori occupation sites from the fourteenth to the eighteenth century, they are mainly from the Auckland area but not exclusively. Several are similar in shape, and have no known purpose or parallels in Maori material culture. They are an interesting use of a pliable natural material, modified deliberately in some instances by heating.

Keywords
Clay; Maori; material culture.

INTRODUCTION

The short paper by Michael Trotter (2012) on clay balls in *Archaeology in New Zealand* prompted a review of research undertaken after excavation of several artefacts made of clay at the archaeological site of Westfield (R11/898), Auckland. These previously unknown artefacts, although not common, expand the range of Maori material culture and material use. All items described are in the collections of Auckland War Memorial Museum.

Trotter described small clay balls from South Island archaeological sites of Awamoa, Tai Rua and Shag Point in North Otago; Redcliffs and Hohopounamu in Canterbury; and Fyffe's site in Kaikoura. All of these sites date to between the fourteenth and sixteenth centuries, that is, at the early to middle period of the Maori sequence. The balls were shaped wet clay made hard by placing in or near a fire, and had no decoration. Trotter did not have a functional interpretation for these balls, and context within the sites offered few clues as in all cases they were found in the discarded midden. Walter Mantell in 1852 found a clay ball in the Awamoa site, south of Oamaru, and imaginatively speculated on its origin: "The only human manufacture we found was a small ball of baked clay, the work most likely of some ingenious young savage stopped on the thresh-hold of the invention of pottery by a vindictive tibia thrown at his head by his enraged parent with a concise order to go egg hunting, and not waste his time that way" (Mantell 1853 reported in Trotter 2012: 167). Mantell's flippant conjecture that Maori were on the cusp of a technological development was premature; there is no linear progression from forming a ball of wet clay to creating pots then successfully firing them at the correct temperature.

The only direct account of Maori using clay is related by Trotter (2012). The South Island reference is to the carcass of a rat being enclosed in clay before placing it in the fire: the fur and skin of the cooked rat adhered to the clay covering upon opening. This method of cooking does not appear to have been common practice and may have been use of an older European tradition of cooking wildlife such as hedgehogs and other animals. In an earlier paper Trotter (1965: 177) suggested that a clay covering may have been to collect melting fat during cooking and bird preservation. The balls would however not have been suitable for this task.

The archaeological literature revealed two instances of clay being used in settlements. At the swamp pa of Mangakaware in the Waikato, two circular to oval features lined with sandy clay were reported from the central part of the site, and the cooking area, and interpreted as fire pits (Bellwood 1978: 22). No further details were provided and a calculation off the plan scale indicates they were more than 50 cm diameter. A very similar feature was reported in more detail from a pa, Raupa, near Paeroa (Prickett 1992: 44, 46–48). It was a clay lined bowl, oval in shape measuring 550 x 480 mm and set 280–320 mm into the ground. Situated within a house, on the centreline, the feature contained no ash or charcoal and was filled with water-deposited sand. In the absence of any other evidence it was interpreted, from its location, as a hearth.

The clay objects described below are more varied than those reported by Trotter. While they are referred to throughout as having been fired, which changed the state of the clay from soft and pliable to hard, the objects cannot be interpreted as the start of a pottery tradition, or of evoking a memory of pre-Polynesian ancestors making pottery over one thousand years prior to Maori arriving in New Zealand.

Rice (1987: 4) distinguishes between pottery, a term used in archaeology to describe low fired objects such as vessels and other objects, and ceramics, which were fired at a high temperature and often glazed.

Pottery vessels were fired in specially created fires intended for the purpose with temperature being a key factor in success. The objects described here are unlikely to have been fired according to a rigorously tested and repeatedly applied methodology, and were instead accidentally or deliberately placed in or near a domestic fire. The items are therefore not pottery. The preferred term of 'fired clay' refers to the object having been subjected to a high temperature, and the clay's physical characteristics altered through water evaporation and chemical transformation, but without preparation such as the addition of a temper which usually occurs in pottery manufacture. The act of firing ensured object durability and survival although this was almost certainly not the intention. There may have been use of similar, unfired, objects but shaped dried or wet clay forms without heating have not been reported (with the exception of examples from Houhora described below). It is likely that unfired pieces would lose their shape unless particular conditions were present to ensure their survival.

The undefended occupation site of Westfield (R11/898) located on the western side of the Southern Motorway opposite the landmark Tip Top factory at Mt Wellington, Auckland, produced four shaped clay pieces (Furey 1986). Two had incised decoration and two additional pieces of different form were also recovered. Examination of archaeological collections at Auckland War Memorial Museum revealed a number of pieces (Table 1) which can be grouped according to type. The majority of these objects were recovered through controlled archaeological excavation, but there are two non-excavated examples donated to the museum. Unfortunately one has no recorded find locality.

The objects group as recognisably formal objects, incised or plain pieces of similar shapes, and balls like those reported from South Island sites. There are also fragments of irregularly shaped clay pieces of no particular form with some working such as a flattened surface or edge. Other pieces have one smooth surface consistent in appearance with a cut mark on wet clay but are otherwise unaltered. The geographic attribution of all pieces extends from Mt Camel Houhora, in the Far North to Oruarangi on the Waihou River south of Thames. However, the majority of the pieces come from Auckland contexts within a close geographic area (Fig. 1). Chronologically the sites cover almost the entire Maori occupation sequence.

DESCRIPTION OF OBJECTS

The formally-shaped objects include two nguru (flute) from Oruarangi on the Waihou River, south of Thames. Auckland Museum ethnologist Vic. Fisher (1937) drew attention to clay nguru and kōauau (flute) from Oruarangi in his article on musical instruments. The examples referred to as clay are in fact made from a very fine-grained sedimentary stone which in one example has an incised decorative design around the circumference of the wide end (Furey 1996). However there are two Oruarangi nguru fashioned from wet clay: the snout and upper area of a broken nguru is in Auckland Museum (Fig. 2), and an apparently unfired complete nguru is in a private collection. Fisher referred to the nguru being fashioned from 'baked clay' (as opposed to wet clay which had been heated or fired), implying that the material was naturally occurring and shaped. The partial nguru made of clay is burnished on the smooth outer



Figure 1. Places mentioned in the text, Auckland area.

Table 1. Summary of all clay pieces referred to in the text.

Cat. No.	Type	Location	Site no.	Dimensions	Comment
21980.1	Nguru	Oruarangi	T12/192	42 mm length	Fragment of snout
	Nguru	Oruarangi	T12/192	74 mm	Complete nguru
AR7468.22	Clay object	Westfield	R11/898	22 x 14 x 6 mm	Incised lines
AR8298	Clay object	St Heliers		16 x 16 x 6 mm	Incised lines
FS133	Clay object	Motutapu I	R10/494	9 mm	Incised lines
AR7468.25	Clay object	Westfield	R11/898	45 x 47 x 27 mm	Coiled clay with grooves
54489	Clay object	Oruarangi	T12/193	32 mm length	Net weight
6320	Clay ball	Ōhuiarangi Pigeon Mountain	R11/38	27 mm diameter	Incised lines
AR6190 #74	Clay ball	Mutukaroa Hamlins Hill	R11/142	25 mm diameter	Incised lines
AR6190 #73	Clay ball	Mutukaroa Hamlins Hill	R11/142	31 mm diameter	Incised lines
AR7468.23	Clay ball	Westfield	R11/898	14 x 16 x 17 mm	Incised lines
54451.3	Clay ball	Oruarangi	T12/192	35 mm diameter	Plain, shell inclusions
54451.5	Clay ball	Oruarangi	T12/192	38 mm diameter	Plain, shell, unbaked
54451.8	Clay ball	Oruarangi	T12/192	34 mm diameter	Plain, flattened base
54451.9	Clay ball	Oruarangi	T12/192	38 mm diameter	Plain, shell inclusions
54451.10	Clay ball	Oruarangi	T12/192	36 mm diameter	Plain, burnt, shell
AR7491.373	Clay ball	Houhora	N3/59	44 x 38 mm	Plain, shell, not fired
AR7491.212	Clay ball	Houhora	N3/59	29 x 26 x 15 mm	Plain
AR6190 #75	Clay ball	Mutukaroa Hamlins Hill	R11/142	31 x 23 x 25 mm	Plain
AR6190 #71	Clay ball	Mutukaroa Hamlins Hill	R11/142	25 x 22 x 21 mm	Plain
49938.2	Clay ball	Unlocalised		55 x 52 x 47 mm	Decoration
AU760.2	Object	Puketapapa Mt Roskill	R11/19	25 mm diameter	Central perforation
AU760.3	Object	Puketapapa Mt Roskill	R11/19	26 mm diameter	Central perforation
AR7616	Object	Taurere Taylors Hill	R11/96	41 mm diameter	Central perforation
AR7468.34	Object	Westfield	R11/898	40 mm length	Central perforation
AU760.1	Object	Puketapapa Mt Roskill	R11/19	24 mm length	Shaped
AR6190 #70	Object	Mutukaroa Hamlins Hill	R11/142	31 x 24 x 25 mm	One flat surface, irregular shape
AR6190 #72	Object	Mutukaroa Hamlins Hill	R11/142	22 x 19 x 13 mm	Curved, two small holes
AR6190 #69	Object	Mutukaroa Hamlins Hill	R11/142		Flat, with rounded edge. Fragment.
AR6190 #77	Object	Mutukaroa Hamlins Hill	R11/142		Flat, fragment
ICI/R/9	Object	ICI site, Tamaki River	R11/1506	32 x 18 x 7 mm	Flat with broken perforation
FS331	Clay object	Motutapu I	R10/494	13 x 13 x 12 mm	Clay piece flattened on broad surfaces, with edges rounded and smoothed. Reddish clay
AR856	Clay	Motutapu I	R10/31	31 mm	One smooth surface, 3 pieces
AR872	Clay	Motutapu I	R10/31		One smooth surface, 2 pieces
FS266.4, FS265.4	Clay object	Motutapu I	R10/494	28 x 29 x 4 mm	Two pieces of curved clay which join and have a smooth edge.
FS266.2, FS266.1, FS266.3, FS94, FS86	Clay	Motutapu I	R10/494		Five pieces of clay with curved surface, thin, with fractured edges
	Clay	Oue	S11/53	69 x 62 x 16 mm	Curved piece of clay

surface and is a reddish colour compared to the greyish white of Fisher's (1937) illustrated examples. Although generally the expected survivability of unfired clay is low, the environment within Oruarangi provided suitably moist conditions to ensure an unfired piece survived.

There are two shaped clay pieces from Westfield R11/898. One is a half crescent shape and is a fragment of a larger object of undetermined shape and size (Fig. 3). The long edges are finished and smooth and the broad flat surfaces have incised decoration of curved lines which join at each end to make oval shapes. The clay is of a fine texture and greyish white in colour, similar to the fragment of incised clay ball from the same site. According to a geologist at the now defunct Western Potteries in New Lynn, who viewed the objects in 1983, this type of clay is not found in the Auckland area and is possibly from the vicinity of Port Waikato (Furey 1986: 16). Another piece is roughly circular with grooves on the top, formed from a curved coil of wet clay and the ends pressed together forming a slightly raised upper surface (Fig. 4). A partial finger print and two crescent shaped fingernail impressions are on the underside. Grooves present on the upper conical surface radiate out from the centre of the object but are too irregular to form part of a decorative pattern. The width of the grooves is however consistent and it is suggested they were



Figure 3. Incised object. AR7468.22, Westfield.



Figure 2. Nguru. 21980.1, Oruarangi.



Figure 4. Grooved object. AR7468.25, Westfield.

possibly for shaping or sharpening small bone objects such as needles (Furey 1986: 16).

The piece from Waimarie Street, St Heliers (Fig. 5) has parallel incised lines on one broad surface and on the finished edge. The reverse side is plain and smooth, as is another finished edge and the piece is a fragment of a larger, possibly semi-circular object. The clay is distinctive with darker red streaks evident. A number of artefacts were found in the 1940s at this location in Waimarie St, adjacent to site R11/356, recorded as shell midden, terraces and storage pits on the volcanic crater rim of Glover Park or St Heliers (Whakamuhu). According to the site record description, several properties in Waimarie Street have, or had, shell midden in the back yard suggesting an extensive occupation site.

A small conical shaped piece only nine millimetres in length is from R10/494, Motutapu Island (Ladefoged and Wallace 2009). It is incised with grooves around the circumference but the flattened base and top are plain (Fig. 6).

The majority of the clay objects are balls, mostly plain, but there are incised examples from three sites: Westfield, Mutukaroa Hamlins Hill (Fig. 7) and Ōhuiarangi Pigeon Mountain. The fragment from Westfield is similar greyish-white clay to the two pieces described above, and has deeply incised curved lines forming part of a circular or spiral pattern. The design is similar to two partial balls from Mutukaroa Hamlins Hill, one of which (AR6190#74) has a smooth, possibly burnished, outer surface with two opposing patterns formed by the incised curved lines. The other ball (AR6190#73) has two well-defined curved incised lines but a less regular surface. A fragment of an incised ball from Ōhuiarangi Pigeon Mountain, a volcanic cone in East Tamaki, also has two opposing curved patterns (Fig. 8). This piece was not excavated but found in disturbed ground where scoria was being removed in 1920. Another circular object with no location or acquisition information is larger than other known examples. It is a slightly flattened ball, uneven on the outer surface, with incised curved lines in no particular pattern over more than half of the curved area (Fig. 9) and is blackened around the circumference. There are also inclusions of small pieces of stone. The piece is notably different to the other incised balls.

Undecorated clay balls, totalling ten, are from widely spaced localities (Mutukaroa Hamlins Hill, Oruarangi, Houhora) in the upper North Island. The geographic area reflects the main collecting focus of Auckland Museum and the predominance of northern site excavations, but their presence also in South Island sites as reported in Trotter (2012) suggest the balls have a wider geographic distribution. Fragments of two plain examples (AR6190#71, 75) from Mutukaroa Hamlins Hill are of similar size to the incised examples from the same site. Five complete balls from Oruarangi are slightly larger at 34–38 mm (Fig. 10). Four are flattened on part of the curve while the other is quite round. Shell and charcoal is embedded into three of the balls, and kokowai adheres to another. One ball is blackened and burnt, and the other four are grey in colour. There is also a partial fired ball with a curved



Figure 5. Incised object. AR8299, St Heliers.



Figure 6. Incised object. Motutapu Island.
Photo: Tim Mackrell, Auckland.



Figure 7. Incised clay balls. From top: AR7468.23, Westfield; AR6190#73, Mutukaroa Hamlins Hill.



Figure 8. Incised clay ball. 6320, Ōhuiarangi Pigeon Mountain.



Figure 9. Decorated clay ball. 49938.2, unlocalised.



Figure 10. Clay balls. Oruarangi.



Figure 11. Clay objects. From top: AU760.2, AU760.3, Puketapapa.



Figure 12. Clay disc. From top: AR7616, Taurere; AR7468.34, Westfield.



Figure 13. Clay net weight? 54489, Oruarangi.



Figure 14. Clay object. R10/494, Motutapu Island. *Photo: Tim Mackrell, Auckland.*

plain surface from Mt Camel, Houhora, and fragments of two larger balls which are crumbly and have not been fire hardened.

Another consistent group of objects are circular in shape, with flattened surfaces top and bottom, or slightly conical on the top surface. The common feature is a central perforation. The two examples from Puketapapa Mt Roskill were recovered during salvage excavations on the rim of the volcanic cone in 1961 (Fig. 11). AU760.2 is complete but neither the perforation nor the outside edges are completely round. Polish is visible under magnification on the upper and lower surfaces. There is also a heavy burnish or polish around the edges of the perforation. The outer edges of the object have some polish but it is not as pronounced or widespread as that on the broad surfaces. The hole is not completely round and has one flat edge which is smooth with some polish apparent but there are no striations evident on the sides of the hole. The second example (AU760.3) is not complete. One surface, with polish, is slightly concave within which there is an elongated central hole with worn edges, but unlike AU760.2 the hole is on an angle. While well formed at entry, the exit is very narrow and irregular, and there is no evidence of attempted enlargement of the hole from this side.

A similarly perforated object (AR7616) was recovered from the 1954 excavation on Taurere Taylors Hill (Leahy 1991: 37–8). The object has fractured through the central perforation (Fig. 12). The 4.5 mm diameter hole has vertical striations on the walls and the edges are rounded and worn. One side of the object is flat, the other is convex so that the thickness at the hole is ten millimetres and at the outer edge is five millimetres. The convex surface has no polish but the opposing flat surface has polish from use, as do the flattened edges but to a lesser degree. The complete object would have a diameter of approximately 42 mm. A similar object, not previously reported from the 1981 Westfield excavation, was located in the miscellaneous non-artefact stone material during sorting for storage (AR7468.34). Like the Taurere Taylors Hill item it has a central perforation 4.5 mm in diameter (Fig. 12). The outer curved edge has been smoothed as has one of the broad surfaces which is also blackened. The other side is irregular but is concave in profile and there is polish evident on the smooth surface. The hole has vertical striations. The complete diameter would be 50 mm, slightly larger than the Taurere Taylors Hill item. A fragment of another item, again with the remnant of a central perforation, was recovered from the ICI site (R11/1506) adjacent to

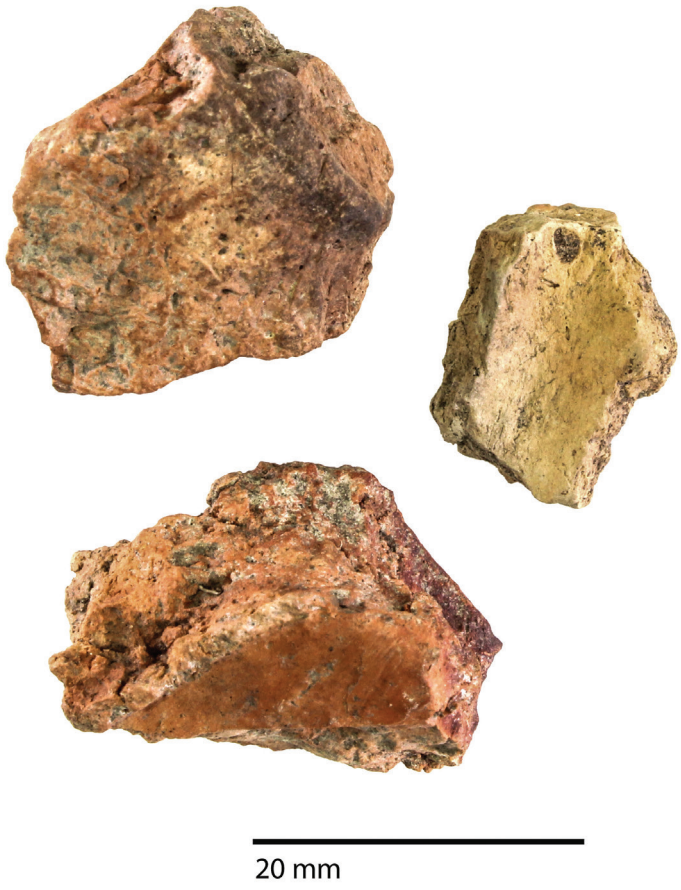


Figure 15. Clay fragments. AR856, R10/31, Motutapu Island.



Figure 16. Clay piece. Oue Pa.

the Tamaki River (Foster and Sewell 1997). This piece differs from the other examples in that the outside edge is straight, not curved, but has been smoothed.

From Oruarangi there is also a flattened slab of clay which has a groove around the circumference and a groove at right angles on one side and both edges (Fig. 13). The surfaces are smooth and faceted, perhaps reflecting cutting or smoothing of the clay in a leather hard state rather than when wet and pliable. The surfaces have a polish from wear. Apart from the nguru from the same site, this is the only object to have an identifiable function. Although not very heavy it was probably used as a net sinker: there are similarly sized stones in the Auckland Museum collection which still have fibre tied around them for attachment to a small light fishing net.

Another group of objects do not form recognizable shapes, nor have they been altered by decoration. A piece from Puketapapa Mt Roskill is a segment of a coil cut at both ends and has a roughly circular cross section. The clay is the same colour as the other pieces from the site. From Hamlins Hill there is a piece (AR6190#72) which has a curved surface, too irregular to be from a ball, and has two small holes, not natural, which penetrate only a few millimetres into the clay; another irregularly shaped piece from the same site (AR6190 #70) has a flattened surface. The 1990 Westfield excavation, approximately 50 m from the 1981 excavation, also produced a piece described as being "flattened to a rough diamond shape then rolled to a point" (Sewell 1992). It is similar in colour to the red clay pieces from Hamlins Hill. A small square piece with rounded smooth edges reminiscent of a cube is from Motutapu Island site R10/494 (Fig. 14).

There are also pieces with no obviously deliberate shaping yet have one smooth surface resulting from a cut through wet clay. Pieces of this type are not common in excavated collections and it is likely that similar items have been discarded during excavations as, on cursory examination, they can resemble fragments of shattered oven stone or burnt local debris. There are five pieces from Motutapu Island open settlement site (Leahy 1970) (Fig. 15) and two from Mutukaroa Hamlins Hill. This class of object is probably the result of peeling wet sticky clay off a digging stick or similar object and the impression preserved through accidental firing. Flattened curved pieces of fired clay with ragged unworked edges were also recovered from R10/494 on Motutapu Island.

Finally a piece of clay from Oue Pa has a curved moulded surface. It is pinkish grey on the inside and orange pink on the outside. The texture is not smooth or evenly worked, has no foreign material adhering to it, and has possibly been formed by moulding wet clay over a small cobble (Fig. 16). Despite its colour which indicates heating, the object is crumbly and fragile.

Reference to baked clay artefacts at the Hauraki sites of Paterangi, near Oruarangi (Shawcross and Terrell 1966), and Kopuarahi (Murdock 1963) are material misidentifications. These objects, nguru in the case of Paterangi, and a stopper from Kopuarahi, are similar material to the 'baked clay' nguru from Oruarangi (Fisher 1937). The material is stone, not clay.

SITE CONTEXT

The majority of the clay pieces are localised to the Auckland area, or the wider Hauraki area. The exception is Mt Camel Houhora in the Far North on the Aupouri Peninsula.

Little is known of the internal site context in which the majority of these items were found as the information has not been reported in publications. However the majority are from undefended sites, with pieces from five pa (Puketapapa Mt Roskill, Ōhuiarangi Pigeon Mountain, Taurere Taylors Hill, R11/1506 (name unknown) in Auckland, and Oruarangi in Hauraki).

The Westfield pieces are from Area 6, and adjacent Area 1, where numerous postholes and the outline of a small structure were in Occupation II below the turf and topsoil layer (Furey 1986: 7). Obsidian and greywacke flakes were also present in this area. The pieces are from an undated context, but later than Occupation I dated to 300−400 years BP. There may not however have been a significant time interval between the two occupations.

The Mutukaroa Hamlins Hill pieces were all found in Square O31, at the interface of the topsoil and the clay layer. There is little information on what was present in this square, on a terrace to the east of the main excavation area, but all of the obsidian flakes from the 1976 excavation were found in this square (Walton 1979: 112). Only two postholes are evident on the site plan (Walton 1979: Fig. 3). The single radiocarbon date (NZ6156) (Pearce and Walton 1983) suggests occupation at around the same time as the settlement at Westfield.

The clay pieces from Mt Roskill Puketapapa are from Square A108, Area 1, on the inner edge of the crater rim on the northern side. A108 was a test square to the north of the main excavation, and from the presence of pits seems to have functioned primarily as a storage area. No further details have been published about this square. Although only two pieces are referred to in Fox (1980: 57), three pieces are catalogued in the museum collection from the same square. There is no direct dating of the context in which these pieces were found but the radiocarbon dates from the site suggest occupation in the broad range of 300−500 years BP.

Oruarangi is a flatland pa site adjacent to the Waihou River south of Thames. The museum collection was acquired from several individuals who dug over the site in the 1930s (Furey 1996). The nguru fragment was purchased from Sonny Hovell. The balls and net weight were catalogued in the 1980s as previously uncatalogued material; the source of the objects may have been Vic. Fisher, Sonny Hovell or Jim Liggins, all of whom dug on the site. Oruarangi was occupied on more than one occasion and dates range from the fifteenth−eighteenth centuries, with documented occupation up until the early nineteenth century (Furey 1996: 31−32). It is not known where in the site the clay pieces came from, or from what level.

R11/1506 on the west bank of the Tamaki River in Auckland was a large settlement with storage pits, houses, shell midden and cooking areas enclosed by

a single and double row of fencing which has been interpreted as a pa. The location of the clay piece within the site is unknown. Radiocarbon dates indicate occupation in the sixteenth–seventeenth centuries, very similar to Hamlins Hill and Westfield.

Leahy (1991: 37–8) reported that few artefacts were recovered from the lower terrace (Square K100) on the slope of the volcanic cone Taurere Taylors Hill. The square had a shell layer, and the terrace had been extended and artificially built up. There is no age estimate for the occupation. Oue Pa is also undated but the similarity in material culture (adzes, fish hooks) between Oruarangi and Oue suggests they were both occupied at broadly the same time (Harsant 1981). Ōhuiarangi Pigeon Mountain and St Heliers sites were not excavated, and nothing is known of the range of occupation evidence.

Site R10/494 in the northern part of Motutapu Island is an undefended pit and terrace site. A house containing internal and external drains, stone alignments, and postholes was defined on the terrace. Associated artefacts include an andesite slab with red kokowai, an autoru (cobble for grinding kokowai), grind stones, hammer stones, and a large quantity of obsidian. The incised piece of fired clay was found in the south east corner of the house and the remaining pieces were in the southwest corner (Ladefoged and Wallace 2009). The site is also undated.

The clay fragments from another pit and terrace site T10/31 on Motutapu Island were found in Square 2, Layer 4. Leahy (1970: 74) noted that the flattish mark on one of the pieces matched the blade impression of an adze and that small adzes may have been used in digging out structures such as the storage pits present on the site.

The fired clay ball from Houhora was in Square A13 Layer 2c, while the unfired fragments with the curved outer surface are from Square E4 Layer 2c, and an unknown location (the attributed Square D5 was not excavated). The lowest layer of the site (Layer 3) is dated to the early to mid-1300s (Anderson and Wallace 1993; Furey 2002), and Layer 2c was part of the same occupation.

DISCUSSION

Writers have generally offered little speculation on the function of the objects, or they were not described in detail in the excavation reports. Fox (1980: 57) referred to the perforated items from Puketapapa Mt Roskill as "roundels… baked hard probably by volcanic action", and suggested they were intended as beads. Likewise the Taurere Taylors Hill object was interpreted as an ornamental bead, "…probably carved from very hard clay rather than hand moulded and baked" (Leahy 1991: 39). An alternative interpretation put forward by Leahy that the object was possibly a spindle whorl, can be dismissed. The object looks remarkably like a spindle whorl, used in Neolithic European sites for spinning of wool fibres for textiles, but this is not a technology associated with Maori culture, and several thousand years removed. Use as a weight for a pump drill is not feasible for several reasons: Maori did not use drill weights, and the pieces are not large enough or heavy enough to have been used this way. Although Fox and Leahy interpreted these objects as either natural or naturally obtained and modified material, examples from other sites suggest all of the described objects were made from wet and fire hardened clay.

The nguru of clay in the Oruarangi site can be compared to Otago Museum's modified ceramic smoking pipe bowl of European import made into a kōauau, from the same site. These pieces collectively suggest a European influence on the idea of using clay as a medium. Oruarangi was occupied in the 1790s–1830s when there were a number of European ships spending lengthy periods of time adjacent to the site, or traders resident within Maori villages on or near the river (Furey 1996).

The perforated discs consistently have use wear around the perforations. Threading onto a fibre cord is a likely option. Inserting a thin stick or peg through the hole is also a possibility but there are no parallels in shape except the paua shell eye inserts for carvings, in which case the clay items with one convex side may have provided an opportunity for greater relief for the eyes, but if this was the intended use, the practice did not catch on.

Presence of small pebbles within sites have sometimes been interpreted by archaeologists as jack-stones, similar to knuckle bones, but it is unlikely the balls would have been used that way as the curved surface would not rest on an outstretched hand. No other game described in Best (1925) or Buck (1950) appears to be a suitable fit.

Whether any of the clay pieces were used in games or for other activities cannot be deduced from either the objects themselves or their contexts. The predominance in the Auckland area, particularly the perforated disks in three or four sites, suggests the objects were made around the same time and that the Tamaki sites, particularly Taurere Taylors Hill to the north, and Westfield had some communication of ideas among people living on these sites. Use of non-Auckland clay in the Westfield sites suggests the occurrence of some of the incised pieces may be more widespread in the region. The clay balls are more problematic and the incised balls may have had a different purpose to the plain balls which are more geographically widespread.

Were these objects the result of accidental or deliberate manufacture? The small informal pieces of irregular shape may well have been the equivalent of doodling on paper, but the balls with their widespread distribution suggest they were made with a purpose over a long period of time. The almost identical perforated pieces from Taylors Hill and Westfield do suggest deliberate action of placing the clay in a fire to harden it but whatever use these pieces were intended for was not adopted widely.

None of the objects have added temper, the purpose of which is to alter the physical properties of the clay. The charcoal and shell fragments in the Oruarangi pieces are likely to have been incorporated into the clay matrix as general occupation debris. Blackening on some objects suggests they were placed directly into a fire.

Burnishing was evident on only two objects (nguru and incised ball from Mutukaroa Hamlins Hill), reflecting a secondary stage of work. The soft wet clay objects would have been left to air dry then rubbed in a hardened state to produce sheen. The incised design on two of the Westfield pieces also infers a second stage of handling to form the design, and therefore a pre-determined use for the objects. The majority of the pieces were however the product of a single event before placing in the fire.

Use of fire-hardened clay was not common but there appears to have been a concentration of the activity in the Auckland area 300−400 years ago. Identifying and describing the pieces and the manufacture of them allows them to be grouped in several ways. It is almost inevitable that further archaeological investigations in the Auckland area will uncover more pieces to add to current understanding.

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Intertidal records of 'sea slugs' (nudibranchs and allied opisthobranch gastropods) from northern North Island, New Zealand

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Abstract
We record the intertidal or shallow subtidal (<2–3 m) occurrence of 78 species of 'sea slug' from northern North Island of New Zealand. One (*Goniodoris* n.sp.) is recorded for the first time. The majority are briefly described, illustrated and their records plotted on maps. Three taxa are probably undescribed new species. All except two (*Aphelodoris* sp., *Trinchesia reflexa*) of the species have been recorded from along the east coast (warmer water Aupourian Province) but only 44% (34 spp.) have been recorded from the west coast (cooler Cookian Province). The highest diversity of intertidal/shallow water 'sea slugs' has been recorded from the Leigh area (47 spp.), Bay of Islands (42 spp.) and Great Barrier Island (38 spp.) reflecting the intensity of survey (Leigh) and diversity of habitats on the warmer coast (latter two). Of the harbours, 33 spp. are recorded from the Waitemata, 27 spp. from Parengarenga and 24 spp. from the Manukau, reflecting the intensity of survey (Waitemata, Manukau) and unusual warm conditions of far north Parengarenga. Of the 'sea slugs' recorded herein, 45% are endemic to New Zealand and nine of these are endemic to northern New Zealand.

Keywords
New Zealand; Hauraki Gulf; Northland; nudibranchs; 'sea slugs'; biogeography.

INTRODUCTION

The common name 'sea slug' conjures up repulsive images of dull, slimy creatures, but in reality, while some are cryptic, many display brilliant colours and dramatic colour combinations more like butterflies. Readers are strongly recommended to complement the black and white images presented here with the coloured images in Willan *et al.* (2010) or online sites (http://www.seaslugforum.net/, http://www.nudipixel.net/, http://www.ianskipworth.com/suig/nudis.html). Detailed descriptions of anatomy, feeding and reproduction are given in Willan and Morton (1984) and Willan *et al.* (2010). Enderby and Enderby (2005) presented an illustrated account of endemic nudibranchs in New Zealand.

Sea slugs seen by scuba divers at subtidal depths down to ~30 m have been well reported (Willan and Morton 1984; Willan *et al.* 2010; http://www.seaslugforum.net/), but intertidal and shallow subtidal species from snorkel depths (0–3 m) have not been documented so fully. Those sea slug species that have been recorded from northern New Zealand, but only from subtidal scuba depths (> 3 m) have not been included here. Abundances of some species appear to differ between intertidal and subtidal populations, e.g. *Ceratosoma amoenum* and aeolids are more common subtidally than intertidally (pers. obs.), so this compilation of our observations over many years compliments what is already well known and helps advance our knowledge of the geographic distribution, ecology and in some instances the life history of sea slugs in northern New Zealand.

What is meant by a 'sea slug'

The name 'sea slug' is usually applied to a number of marine gastropods that are shell-less or outwardly appear to have no shell. It seems that reduction in size or loss of a shell has occurred on a number of occasions in different evolutionary lineages of opisthobranch gastropods. Here we adopt a pragmatic approach for our more general readers and use the term 'sea slug' for slug-like marine opisthobranch gastropods that have no shell, or their shell is internal or where their shell is too small for the soft parts to be retracted into it. The largest group numerically is the Nudibranchia, where there is no shell as an adult and the often brightly-coloured animal has external gills. Some of the sea slugs included here (Family Aplysiidae) are also known as sea hares because of their apparent resemblance to a sitting hare.

They usually have a long neck bearing a head with a pair of enrolled rhinophores and enrolled tentacles on each side of the mouth. In addition there is one other common intertidal slug-like gastropod (*Scutus*) in northern New Zealand that is not an opisthobranch but an unrelated fissurellid which we have included.

Survey area, methods and sources of records

The area covered by this study is northern New Zealand and extends northwards from the Manukau Harbour, Firth of Thames and northern Coromandel Peninsula and includes Great Barrier Island, but not the Three Kings or Kermadec Islands (Fig. 1). The majority of the records reported here have been made by MSM and BWH since 1995 while undertaking semi-quantitative assessments of the intertidal biota of different parts of the shoreline of the region (Appendix 1). The surveys were not specifically targeted for nudibranchs. Each record placed on the maps (Figs 1–24) relates to one or more findings within a coastal stretch of 0.5–2 km that was typically surveyed over a 2–4 hr period either side of a spring low tide. This paper also includes records from major study areas where the total biota has already been documented and published. These are, from north to south: Parengarenga Harbour (Hayward *et al*. 2001), Ahipara (Hayward *et al*. 2004), Kawerua (Hayward *et al. 1*995), Bay of Islands (Morley and Hayward 1999), Whananaki (Hayward *et al. 2*012), Great Barrier Island (Morley and Hayward 2009), Whangapoua, Coromandel Peninsula (Hayward *et al. 2*014), Waitemata Harbour (Hayward *et al*. 1999), Tamaki Estuary (Hayward and Morley 2008), Waitakere Ranges and northern Manukau Harbour (Hayward and Morley 2004). Many additional sites in the southern half of the region have also been

Table 1. Published name combinations used for some intertidal New Zealand sea slugs that have been changed since 1980. For earlier synonymies refer to Powell (1979).

Former name	Present name
Aeolidiella indica (Bergh, 1888)	*Anteaeolidiella lurana*
Aplysia dactylomela Rang, 1828	*Aplysia argus*
Archidoris wellingtonense Abraham, 1877	*Doris wellingtonensis*
Bouvieria ornata (Cheeseman, 1878)	*Berthella ornata*
Bulla angasi	*Bulla vernicosa*
Bursatella glauca (Cheeseman, 1878)	*Bursatella leachii*
Chromodoris amoena Cheeseman, 1886	*Ceratosoma amoenum*
Chromodoris aureomarginata Cheeseman, 1881	*Goniobranchus aureomarginatus*
Ctenodoris flabellifera (Cheeseman, 1881)	*Doris granulosa*
Cuthona beta (Baba & Abe, 1964)	*Trinchesia beta*
Cuthonia reflexa Miller, 1977	*Trinchesia reflexa*
Dendrodoris denisoni (Angas, 1864)	*Dendrodoris krusensternii*
Dendrodoris gemmacea (Alder & Hancock, 1864)	*Dendrodoris krusensternii*
Dermatobranchus pulcherrimus Miller & Willan, 1986	*Dermatobranchus rubidus*
Doriopsis flabellifera (Cheeseman, 1881)	*Doris granulosa*
Glossodoris amoena (Cheeseman, 1886)	*Ceratosoma amoena*
Glossodoris aureomarginata (Cheeseman, 1881)	*Goniobranchus aureomarginatus*
Hydatina albocincta (van der Hoeven, 1839)	*Hydatina zonata*
Okadaia cinnabarea (Ralph, 1944)	*Vayssierea cinnabarea*
Placida aoteana (Powell, 1937)	*Placida dendritica*
Pleurobranchaea novaezealandiae Cheeseman, 1878	*Pleurobranchaea maculata*
Pupa kirki (Hutton, 1873)	*Pupa affinis*
Rostanga rubicunda (Cheeseman, 1881)	*Rostanga muscula*
Scutus antipodes Montfort, 1810	*Scutus breviculus*
Spurilla drusilla (Bergh, 1900)	*Aeolidia drusilla*
Trippa molesta Miller, 1989	*Atagema molesta*
Umbraculum sinicum (Gmelin, 1791)	*Umbraculum umbraculum*

surveyed by the authors but the results have not yet been published (Appendix 1).

Where the identification of a specimen was not immediately obvious, it was placed in sea water to encourage extension and movement. This allowed observation of its colour, shape, gill, cerata, rhinophores and tentacles. These characteristics were recorded and sometimes the specimen was photographed. A few unfamiliar specimens were collected as vouchers, narcotised, preserved and placed in the wet collections of the Marine Department of the Auckland War Memorial Museum (specimens prefixed by MA in Appendix 1).

Historical locality records dating back to 1980 made by one of us (MSM, Appendix 1) have also been included, and include observations of species made during snorkelling at shallow subtidal depths down to 1–3 m. These unpublished records consist of drawings, photographs and notes. A number of additional locality records have been added from the collection database of the Marine Department, Auckland Museum and Te Papa Museums' web-based database as detailed in Appendix 1.

Drawings

Most of the recorded species are accompanied by a drawing usually by MSM. These are generally based on actual live specimens that were placed in sea water and sketched. In some instances these sketches have then been augmented by observations made on live specimen photographs on the internet. A few species were not available for drawing from either our specimens or notes, and these have been redrawn from Willan and Morton (1984). Where there is no locality given in the caption to a drawing, the specimen drawn was not found live by us, and has been drawn from a photograph from elsewhere.

Previous work

Most of the more common larger sea slugs seen intertidally around northern New Zealand were described in the 19th century. Of particular interest are six that were described by the then Director of Auckland Museum, Thomas Cheeseman between 1878 and 1886. Because it was impossible to preserve their colour, he had his sister Emma Cheeseman draw iconotypes of some of these in 1881-2, which are held by the Museum (Powell 1941). In 1979, Auckland Museum's Arthur 'Baden' Powell recorded a total of 73 species of 'sea slugs' from New Zealand, but some of these have subsequently been synonomised. Since then Univeristy of Auckland professor Michael Miller and his graduate students, Derek Challis, Bill Rudman and Richard Willan, have published over twenty papers on the nudibranchs of New Zealand, a number of them described as new. In 1984, Richard Willan and John Morton provided general descriptions and illustrated 150 species of 'sea slugs' from New Zealand. Updated information and colour photographs of 87 New Zealand 'sea slugs' were provided in Willan *et al.* (2010). With molecular studies the taxonomy of sea slugs continues to change and we have tried to use the latest synonymies (Table 1).

SEA SLUGS RECORDED INTERTIDALLY FROM NORTHERN NEW ZEALAND

Classification follows Spencer *et al*. (2014) and the World Register of Marine Species (http://www.marinespecies.org/). The species recorded below are summarised in Appendix 2. The known global distribution of species is mostly taken from Willan and Morton (1984) and Willan *et al*. (2010).

Opisthobranchia

Acteonidae

Pupa affinis (A. Adams, 1855) Fig. 1
Average animal length 15 mm. The shell is elongate-conic, with narrow punctate spiral grooves cutting the surface into uneven flat-topped ribs. The interstices are crossed by fine axial threads and a double fold is prominent at the base of the columella (Powell 1979, p 269). The animal is translucent and creamy white. This species is rare intertidally, where it lives buried in low tidal sediment. It is more common in dredged material below low tide to depths of 300 m. In our records we have found it on semi-protected and open sandy coasts along the full length of eastern Northland but only off Ahipara (dredged at 40 m) on the west side, although it has been collected by others from off Awhitu Peninsula. Its recorded range extends south to Raglan on the west coast and down to East Cape on the east coast (Te Papa Museum records). It is widespread in the southern hemisphere.

Bullinidae

Bullina lineata (Gray, 1825) Fig. 1
Average animal length 20 mm. The fragile shell is white with delicate red axial and spiral lines and a sculpture of incised spirals. The luminous animal is blue, with its mantle and head shield exquisitely margined by iridescent greenish-blue. It is thought to prey on polychaete worms (Rudman 1998). A pair of live specimens was observed laying spawn at Paua, Parengarenga Harbour at a depth of 2 m. *B. lineata* is rare intertidally in New Zealand, but common in Australia and the Indo-Pacific on fine sandy substrates down to depths of 10 m. Here we record it in sporadic occurrences down the full length of the east coast of Northland and on Great Barrier Island. Its southernmost record is the Aldermen Islands (Te Papa Museum records). Dead shells have washed in at East Cape.

Aplustridae

Hydatina physis (Linnaeus, 1758) Fig. 1
Average animal length 75 mm. Its common name rose-petal bubble shell is well chosen; the pink animal is much larger than its fragile shell and its intense blue margin is exquisitely gathered into numerous ruffles. The ground colour of the globose shell is buff, with thin brown spiral lines and a sunken spire. In August 1986, a

pair was observed mating in channel mud in a depth of 2 m at Paua, Parengarenga Harbour (MSM pers. obs.). In August 2000 over 100 specimens of a range of sizes were found alive over a two day period. Some of these were floating, some crawling on the mud. The animals all had light lemon coloured bodies with a white border to the mantle (Raven 2000). This species lives intertidally down to 10 m in semi-sheltered localities and only rarely washed ashore. We have records of dead shells washed in at four localities along the northeast coast of Northland – Parengarenga, Rangiputa, Bay of Islands and Tutukaka. It is widespread throughout the tropical and subtropical Indo-Pacific and Atlantic Oceans.

Hydatina zonata (Lightfoot, 1786) Fig. 1

Average animal length c. 35 mm. The fragile inflated shell is very variable in coloration. Some have four dark brown radial stripes on a white ground (Powell, 1979), while others have various combinations of narrow brown and and white spirals (Rudman 2004). A single empty shell of this species was recorded from Tutukaka in April 1970 by Powell (1979, p. 270). For 3 to 4 years from 2003-2006, extremely rare dead shells were washed in at Rangiputa and Rangaunu Harbour in the Far North (Peter Poortman pers. comm.). The only recorded live specimen in New Zealand was found at Paua, Parengarenga Harbour in 2000 (Raven 2000). The animal was pinkish mauve with a white border. There are no recent records of this species in New Zealand. It is also known from Japan and northern Australia.

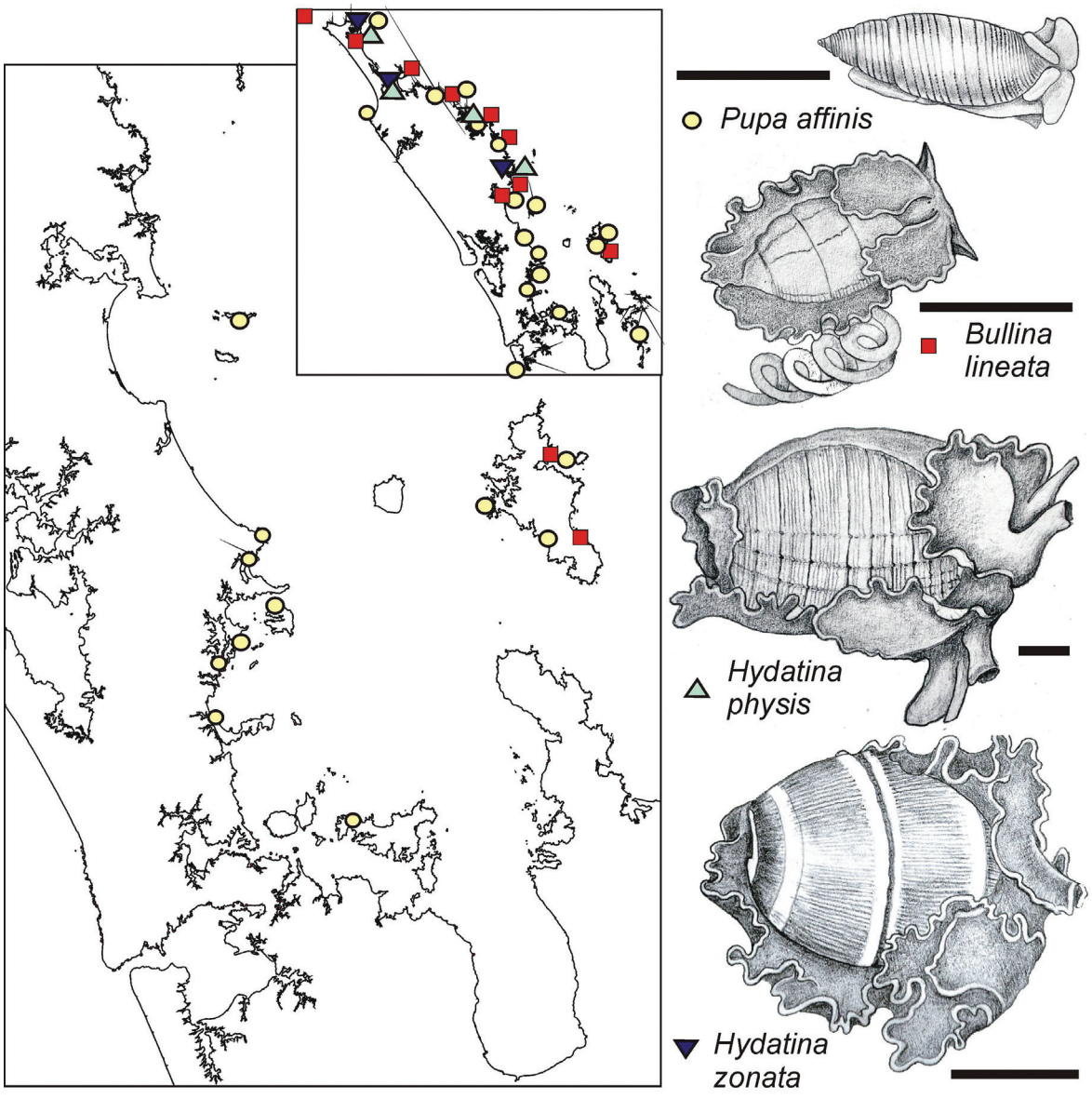


Figure 1. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Pupa affinis* (Great Barrier, Tryphena), *Bullina lineata* (Parengarenga, Paua), *Hydatina zonata* (Northland, Rangiputa) and *Hydatina physis* (Parengarenga, Paua). Scale bars 10 mm long.

Cephalaspidea
Cylichnidae

Cylichna thetidis Hedley, 1903 Fig. 2
Average animal length 10 mm. The shell is small, white with sub-parallel sides and a low spire. There are usually fine spiral lines present. It lives in sand intertidally down to 55 m (Willan and Morton 1984). We have found it in low numbers in our surveys in shell sand throughout the east coast of Northland and Auckland, but not in the inner gulf. We have occasionally sieved it alive in low tide sediment. It is also known from further south around the North Island and in Australia.

Philinidae

Philine angasi (Crosse and Fischer, 1865) Fig. 2
Average animal length 50 mm. The animal is a firm, white, carnivorous slug that buries in soft sediment at or below low tide down to 7 m (Willan and Morton 1984). The internal shell is smooth, thin and fragile with a large body whorl. We have found specimens buried in extreme low tidal sandy mud at Cornwallis and Wattle Bay, in the Manukau Harbour. We have scattered records from right around Northland and Auckland with its range extending south to East Cape. It also occurs in Australia.

Philine auriformis Suter, 1909 Fig. 2
Average animal length 25 mm. This smaller relative of *P. angasi* is distinguished from it by delicate spiral

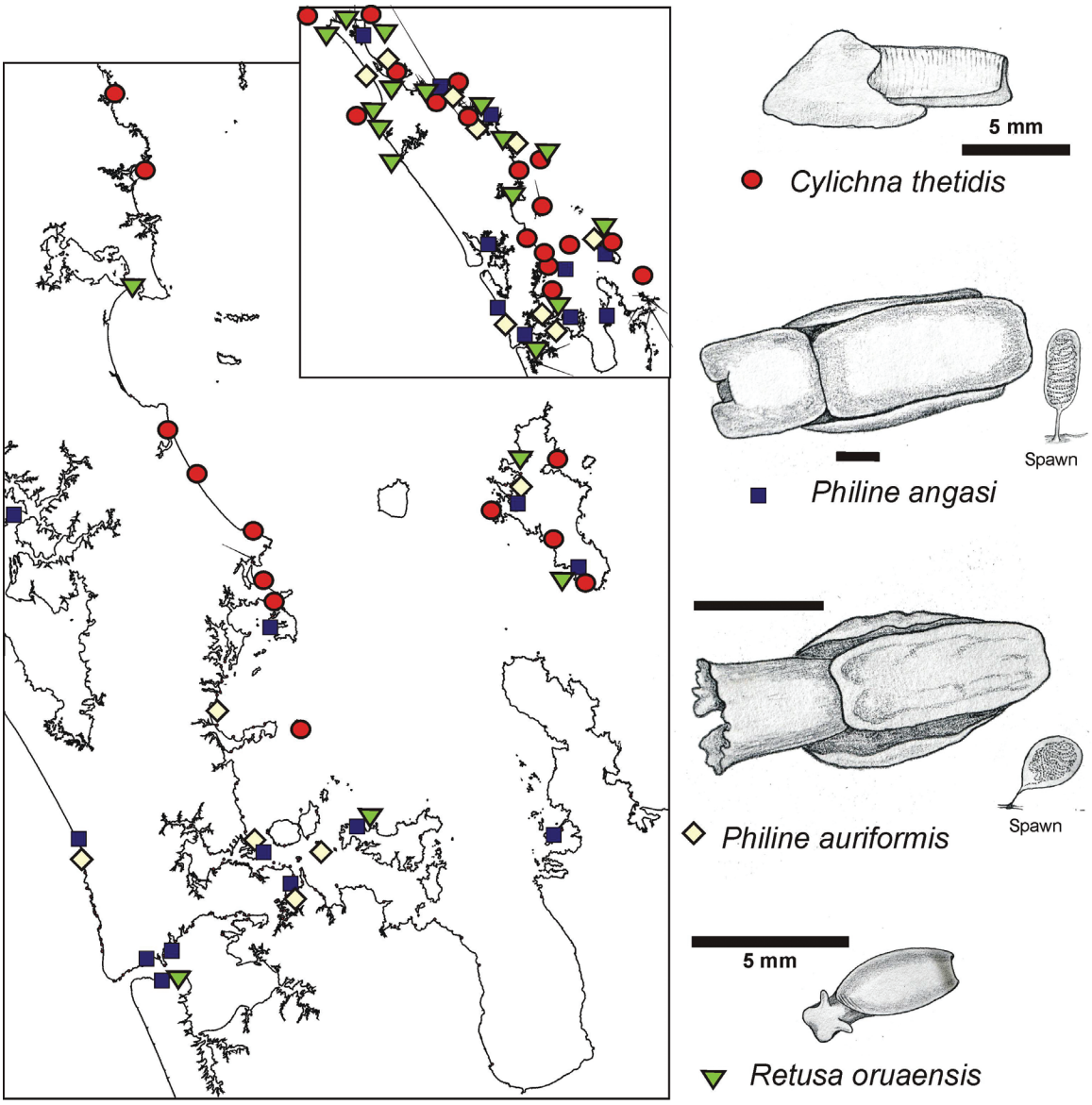


Figure 2. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Cylichna thetidis* (Great Barrier, Whangaparapara), *Philine angasi* (Manukau Harbour, Cornwallis), *Philine auriformis* (Tamaki Estuary, Farm Cove) and *Retusa oruaensis* (Northland, Bland Bay). Scale bars 10 mm long unless stated otherwise.

sculpture on the internal shell. This can be seen under the microscope through the tissues of the living animal. It lives buried in sediment at low tide and deeper. We have scattered records from right around Northland and Auckland. It occurs right around the three largest islands of New Zealand. It is an invader on the west coast of United States of America (Krug *et al.* 2012).

Retusidae

Retusa oruaensis (Webster, 1908) Fig. 2
Average animal length 3 mm. The tiny, white cylindrical shell is parallel-sided, and the animal creamy white. This endemic species lives buried in sediment usually below low tide and down to 200 m (Willan and Morton 1984). At Bland Bay, Northland it was live in sediment in a water depth of 1 m at low tide. We have records of washed up dead shells from right around northern New Zealand and its range extends around the South Island and out to the Chatham Islands. Type locality is Orua Bay, Manukau Harbour.

Aglajidae

Melanochlamys cylindrica Cheeseman, 1881 Fig. 3
Average animal length 25 mm. This black cylindrical slug looks like a twig, making it easily overlooked as it crawls on coralline turf. The parapodia are closely wrapped round the body. It preys on nereid worms (Willan and Morton 1984). There is a small, vestigial, internal shell. This endemic slug is often found in low numbers during our searches in mid to low intertidal

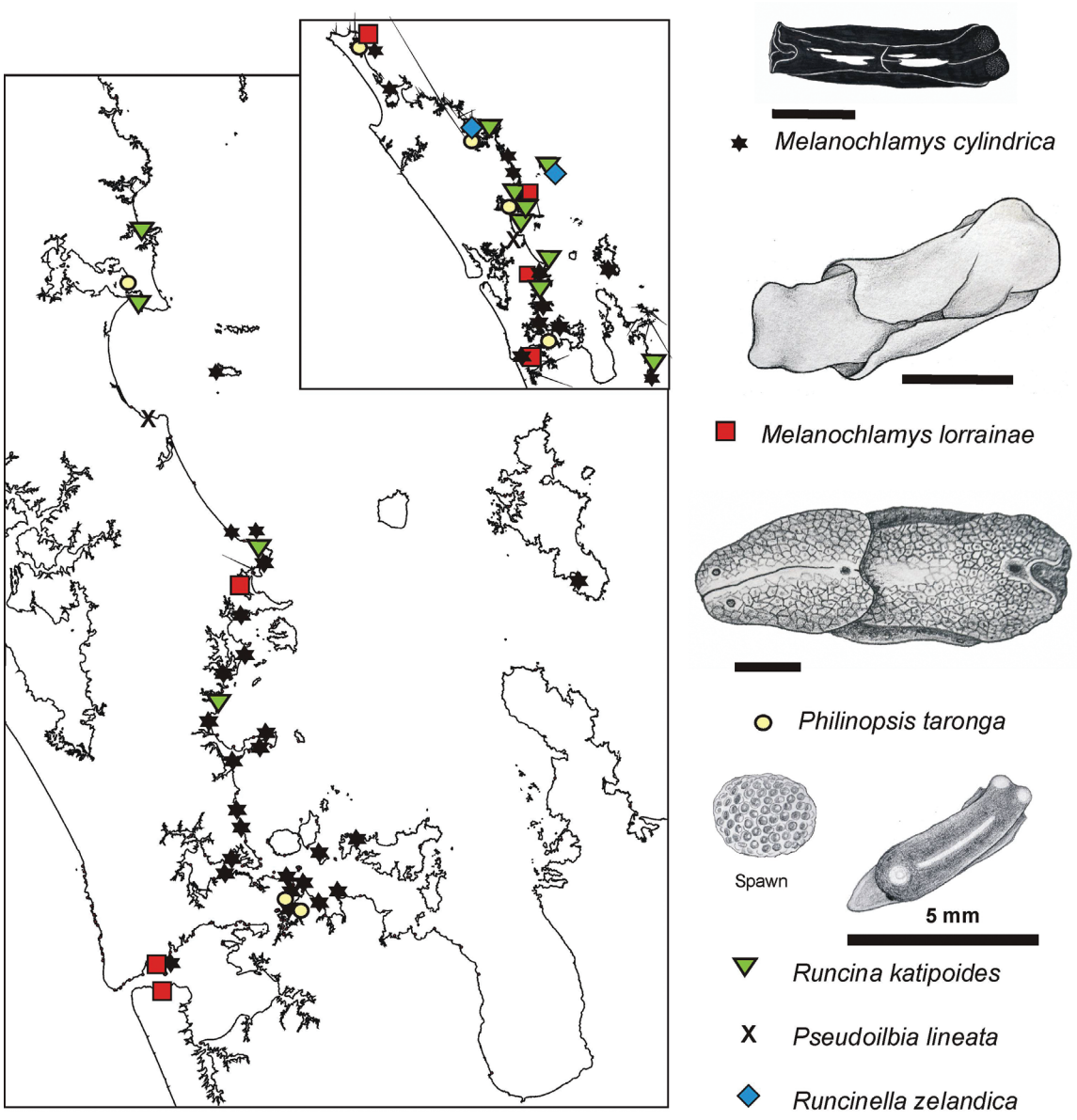


Figure 3. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Melanochlamys cylindrica* (Whangaparaoa, Fishermans Rock), *Melanochlamys lorrainae* (Parengarenga, Paua), *Philinopsis taronga* (Tamaki Estuary, Farm Cove), *Runcina katipoides* (Northland, Pataua), *Pseudoilbia lineata* and *Runcinella zelandica*. Scale bars 10 mm long unless stated otherwise.

pools both on muddy shore platforms and on the open coast. We have scattered records along the east coast of Northland and Auckland and in Manukau Harbour, with its most common occurrence on the west coast of the Hauraki Gulf. It occurs right around both main islands of New Zealand.

Melanochlamys lorrainae (Rudman, 1968) Fig. 3
Average animal length 25 mm. Unlike *M. cylindrica, M. lorrainae* is rare. The animal is white to grey with yellowish tinges and has only been recorded in soft sediment. The type locality is from dredged sediment off Wattle Bay, Awhitu Peninsula, Manukau Harbour. A specimen, observed by MSM at Paua, Parengarenga Harbour, emerged covered in mucus from the low tidal muddy sand on the turning tide. Molecular phylogenic analysis on another specimen collected from low tide sand at Wattle Bay showed that this is a distinct species from *M. cylindrica* (Krug *et al.* 2008). The endemic *M. lorrainae* has been recorded in harbour sediment from scattered localities down the east side of northern New Zealand and in Manukau Harbour. Its southern most record is in the Marlborough Sounds (Te Papa Museum database).

Philinopsis taronga Allan, 1933 Fig. 3
Average animal length 30 mm. This uncommon aglajid is brown with an irregular, black, reticulated pattern enclosing yellow spots. The parapodia and head shield are edged with yellow to orange. The body is often folded centrally resulting in a semi-curled position. There is an internal shell. It is found living in low tide mud or sand on sheltered beaches A possible prey species is *Haminoea zelandiae* which is common in the same area of the Tamaki Estuary. We have sporadic records from the east coast of northern New Zealand. It is also known from Australia.

Runcinidae

Pseudoilbia lineata Miller and Rudman, 1968 Fig. 3
Average animal length 3 mm. The front and back of the animal are pale white and the remainder has fine black longitudinal bands. There is a narrow orange-red bar behind these bands. It lacks a gill, shell and gizzard plates. The holotype was found in an intertidal pool on coralline turf at Langs Beach, Bream Tail, in 1963 (Miller and Rudman 1968). No further specimens have been found.

Runcina katipoides (Miller and Rudman, 1968) Fig. 3
Average animal length 5 mm. This tiny elongate nudibranch is seldom seen unless its habitat in coralline turf is carefully examined. It is a herbivore (Sea Slug Forum). The digestive gland shows as a bright red, central stripe on the dorsum of the dark grey body. At the rear of the notum a white patch denotes the internal shell. The anterior area around the eyes is clear. The margin of the body has a narrow blue phosphorescent border (MSM pers. obs.). This species is a direct developer. Spawn is laid, with the black centred eggs in a ball of clear jelly with a diameter of 2 mm (MSM pers. obs.). It is found on hard substrates from protected harbours to open coastal localities intertidally down to 14 m depth (Willan and Morton 1984). This endemic species is only known from the east coast of northern Northland between the Bay of Islands and Opoutere on the east coast of Cormandel Peninsula. Its type locality is Taurikura Bay, Whangarei Harbour.

Runcinella zelandica Odhner, 1924
Average animal length 5 mm.The animal has a dark green background with irregular salmon pink longitudinal bands and sometimes irregular white patches. Corners of the head are folded into tentacular processes that give it a bilobed appearance. It has large gills that project out from under the posterior edge of the mantle. This endemic species is most commonly seen feeding on the green alga *Codium dichotomum* in the sublittoral fringe down to about 3 m depth (Willan 1981). It was described from Cape Brett (Bay of Islands) but is most commonly seen at the Poor Knights Islands.

Bullidae

Bulla quoyii Gray, 1843 Fig. 4
Average animal length 50 mm. The distinguishing features of this brown shell are the spiral grooves at the anterior end. It is common and widespread in our study area on sheltered beaches buried in muddy pockets among coralline algae or in seagrass. Empty, brown shells are often washed up on beaches, but the animal is seen less often since it is nocturnal. It occurs right around northern New Zealand, being most abundant on the more sheltered harbour shores. It is also known from southern Australia.

Bulla vernicosa Gould, 1859 Fig. 4
Average animal length 30 mm. The shell is more solid than *B. quoyii* and has a glossy surface. There are no spiral striations around the base of the shell and the outer lip is flattened to slightly concave rather than convex. The dark speckles often form two or three spirals bands on the shell (Willan *et al.* 2010). It lives subtidally at 2–10 m depth on semi-exposed soft shores with rare empty shells washed ashore on Northland's east coast. It also occurs at the Three Kings and Kermadec Islands and elsewhere in the subtropical Pacific.

Haminoeidae

Haminoea zelandiae (Gray, 1843) Fig. 5
Average animal length 30 mm. The dark grey animal shows through the thin, fragile, white shell, so living specimens often go unnoticed. This intertidal grazer is common on protected harbour shores. It lives in muddy patches between coralline turf and also in eel grass *Zostera,* feeding among filamentous algae, probably on their epiphytic diatoms (Willan and Morton 1984). This endemic species is widespread on sheltered coasts right around northern New Zealand as far south as the northern South Island.

Aplysiomorpha
Aplysiidae

Aplysia argus (Ruppell and Leuckart, 1830) Fig. 6
Average animal length 300 mm, internal shell 70 mm. This large handsome sea hare is olive green with a network of black reticulating lines. Its distinguishing feature is the black patch on the tail. The erect parapodia are connected low down posteriorly (Willan *et al.* 2010). It lives predominantly intertidally on open rocky coasts where it grazes on red and green algae (Willan 1979a). The animal secretes purple ink if disturbed. We have sporadic records of single specimens on the east coast of northern New Zealand and from Ahipara on the west coast. It is cosmopolitan in warm temperate and tropical seas.

Aplysia juliana (Quoy and Gaimard, 1832) Fig. 6
Average animal length to 250 mm, internal shell 30 mm. This uncommon sea hare varies in colour from chocolate brown to black with a scattering of white spots on the external surface of the parapodia, head and tail. It crawls like an inch worm and lives from low tide to 3 m. We have tidal pool records of several specimens at Sentinel Rock, Mangawhai Heads and several snorkelling records also from the east coast of northern New Zealand as far south as Wellington (Te Papa Museum database). It is cosmopolitan in warm temperate and tropical seas.

Aplysia keraudreni Rang, 1828 Fig. 6
Average animal length 250 mm. This large sea hare is kelp-brown with white streaks and mottles overlaid by a black netted pattern. There is a small internal shell.

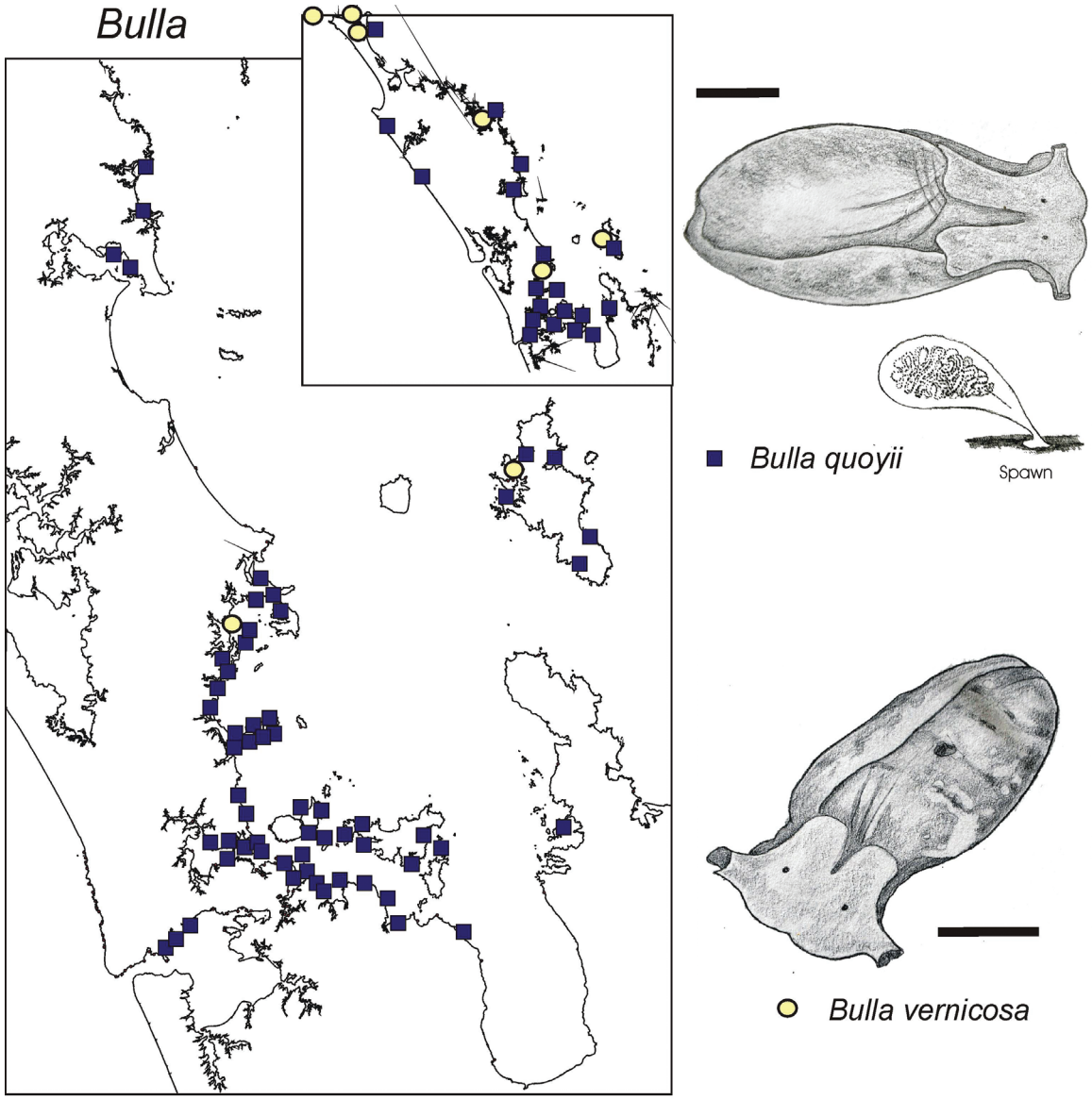


Figure 4. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Bulla quoyi* (Waitemata Harbour, Musick Pt) and *Bulla vernicosa* (Northland, Spirits Bay). Scale bars 10 mm long.

Its habitat is on open rocky coasts and harbour mouths from intertidal down to 18 m depth. It feeds on red algae. We have scattered intertidal records from the east coast of northern New Zealand, but it also occurs in central and southern parts of the country. Its range is the south-western Pacific, including Australia.

Aplysia parvula Guilding, 1863 Fig. 6
Average animal length 60 mm. This is the smallest sea hare in New Zealand. It is kelp-brown dotted with white, and the parapodia, rhinophores and oral tentacles are edged with a narrow black line. The parapodia are continuous forming a cup, only open in the front. It has the largest eye spots of all the *Aplysia* species. All our records are from the east coast of northern New Zealand but it is known from right around the two main islands. It is cosmopolitan in warm temperate and tropical seas.

Bursatella leachii Blainville, 1817 Fig. 7
Average animal length 80 mm. This common sea hare is camouflaged by feather-like processes. The body is brownish-green, decorated with black speckles and vivid emerald green patches. It can be found in high numbers in protected situations such as harbours, estuaries and on *Zostera* beds, especially in summer when they come inshore to breed (Willan and Morton 1984). All our records are from the east coast of northern New Zealand, particularly around the inner Hauraki Gulf. In 2000 there was a population explosion at Howick Beach, Waitemata Harbour following a major algal bloom (Morley *et al.* 2001 p.16). Its southernmost New Zealand record is Cape Kidnappers, Hawkes Bay (Te Papa Museum database). Its range includes tropical and subtropical waters of the South Pacific.

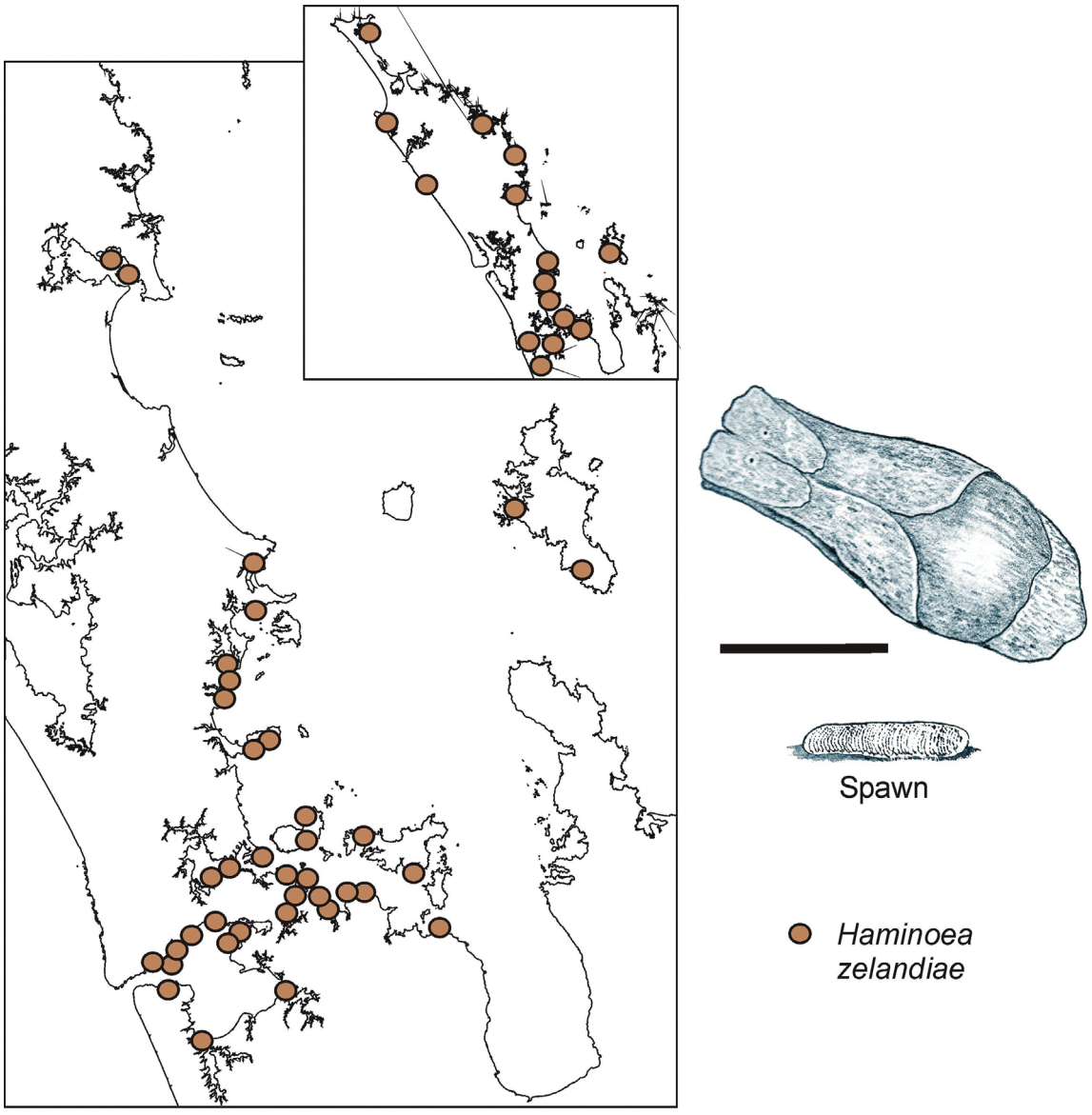


Figure 5. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Haminoea zelandiae* (Tamaki Estuary, Farm Cove). Scale bars 10 mm long.

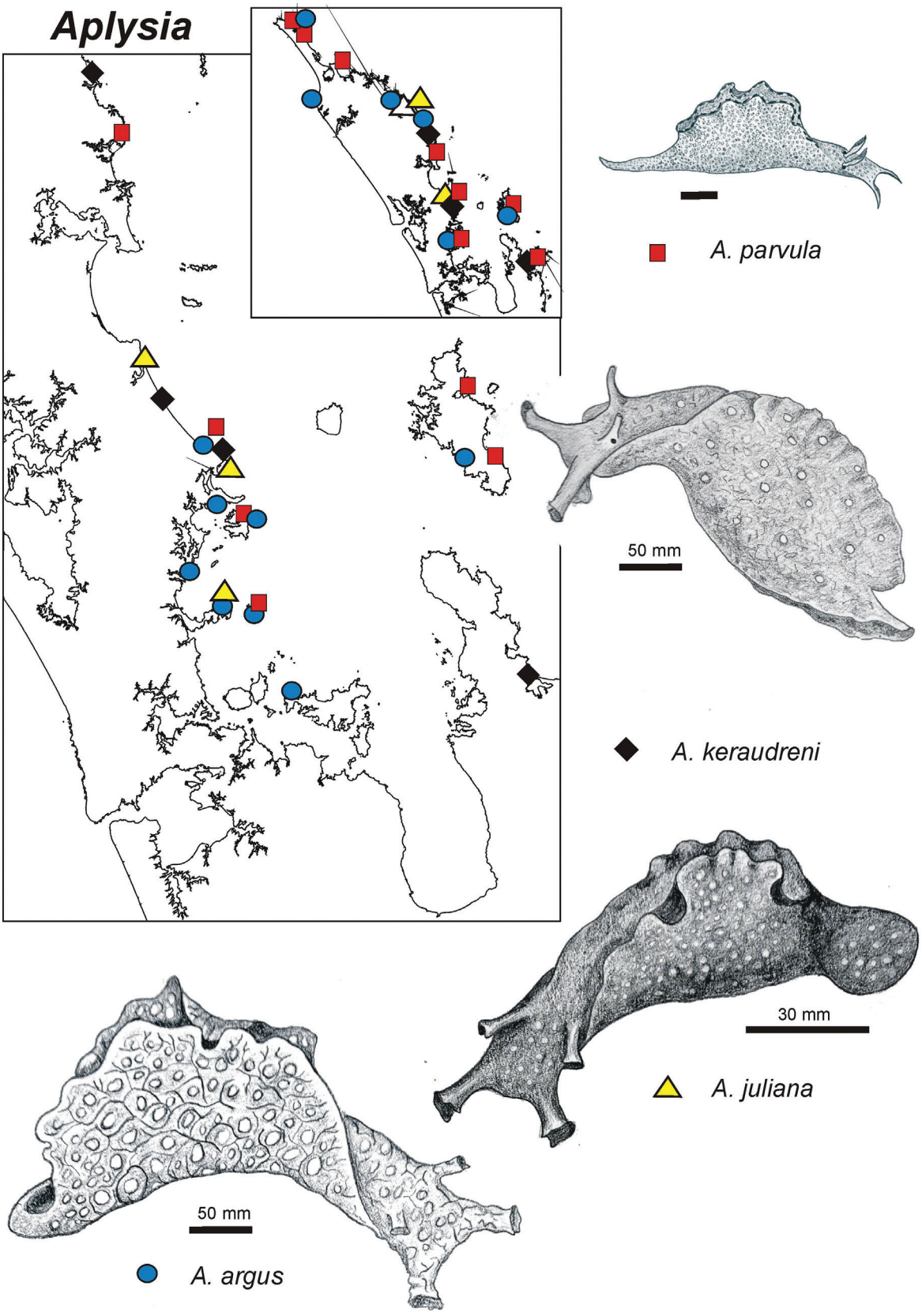


Figure 6. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Aplysia argus* (Waiheke Is, W Bay), *Aplysia juliana* (Northland, Mangawhai Heads), *Aplysia keraudreni* (after Willan and Morton, 1984, p. 32) and *Aplysia parvula* (Northland, Bland Bay). Scale bars 10 mm long unless stated otherwise.

Dolabrifera brazieri G.B. Sowerby II, 1870 Fig. 7
Average animal length 80 mm, shell 8 mm. A distinguishing feature of this sea hare is its flattened shape and wide foot allowing it to closely conform to the rock, often in intertidal pools. Its green body is marbled with brown, white and pink on low rounded papilli (Willan and Morton 1984). It has only been found on the open eastern coast of northern New Zealand. This tropical species arrived in New Zealand in the 1970s (Willan and Morton 1984, p 37)).

Stylocheilus longicauda (Quoy and Gaimard, 1825) Fig. 7
Average animal length 60 mm. This is a rare sea hare with an elongate body and a long narrow tail. It can occur with *Bursatella leachii* and has similar dendritic processes. The green body has fine longitudinal brown lines and spots that are ringed with black. It lives intertidally down to 30 m, on protected to semi-exposed coasts where it feeds on filamentous green and blue green algae. It occurs rarely along Northland and Auckland's east coast (Willan and Morton 1984). It is cosmopolitan in warm temperate and tropical seas.

Sacoglossa

Sacoglossans are suctorial herbivores on green algae (Powell 1979, p. 283). Most saccoglossans are green, the pigment being derived from their food. The radula is adapted into a single line of teeth ideal for piercing the algal cells.

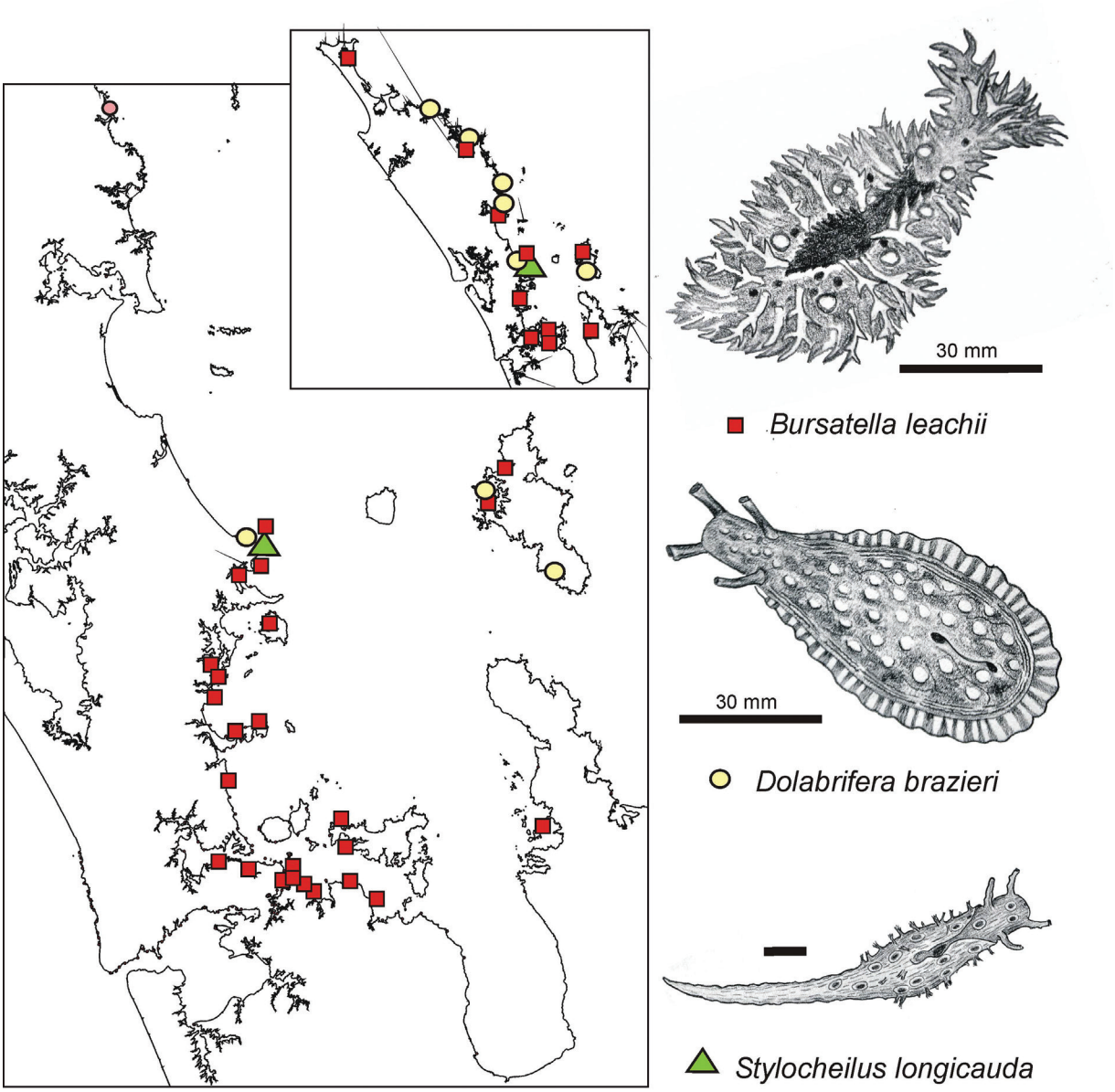


Figure 7. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Bursatella leachii* (Tamaki Estuary, Bucklands Beach), *Dolabrifera brazieri* (Northland, Taupo Bay) and *Stylocheilus longicauda* (after Willan and Morton, 1984). Scale bars 10 mm long unless stated otherwise.

Limapontiidae

Ercolania felina (Hutton, 1882) Fig. 8
Average animal length 10 mm. This small sacoglossan is grey to black with a central white strip on the dorsum and around the eyes. There are two rows of club-shaped appendages similar to cerata down each side of the body. Grooves are present on the underside of the head, body and rhinophores to secure it to the bright green strands of the green alga *Chaetomorpha aerea* on which it feeds and lays its spawn coils (Morley 2004). It lives in high tidal rock pools on exposed coasts. In northern New Zealand this endemic species has been recorded from both coasts of Auckland, common at times on the Waitakere coast. It occurs right around both main islands of New Zealand.

Stiliger smaragdinus Baba, 1949 Fig. 8
Average animal length 15 mm. A seldom seen sacoglossan because it is almost invisible on its food source. Its bright green bulbous appendages are a perfect match for the alga *Caulerpa geminata.* The rhinophores have white tips. The algal pigments are retained in the digestive system and help colour the animal. In New Zealand it has only been recorded from Goat Island, Leigh. It is also found in Japan and Australia (Sea Slug Forum).

Placida dendritica (Alder and Hancock, 1843) Fig. 8
Average animal length 10 mm. This small sacoglossan is a suctorial feeder on green alga, most commonly on *Codium convolutum.* It has a flattened green body

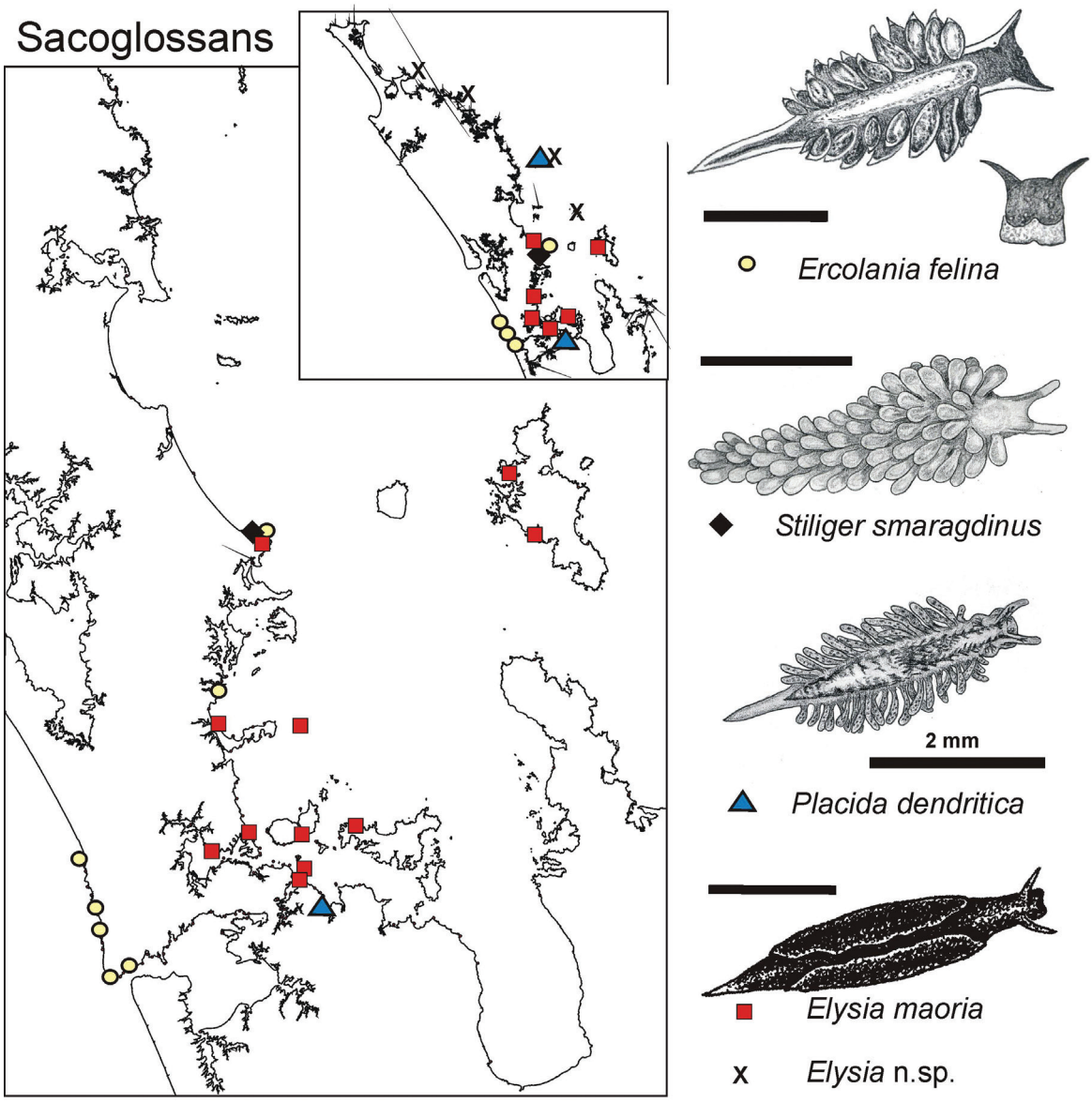


Figure 8. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Ercolania felina* (Waitakere coast, Powell Bay), *Steliger smaragdinus* (redrawn from Sea Slug Forum web site), *Placida dendritica* (Waitemata Harbour, Mangemangeroa Estuary) and *Elysia maoria* (Kauri Point, Waitemata Harbour) and *Elysia* n.sp. Scale bars 10 mm long unless stated otherwise.

with numerous slender cerata. It lives on rocky reefs in semi-sheltered localities, from low intertidal to 14 m depth (Willan *et al.* 2010). This species occurs right around New Zealand. It is cosmopolitan in warm to cool temperate seas.

Placobranchidae

Elysia maoria Powell, 1937 Fig. 8
Average animal length 16 mm. This sacoglossan is dark green with parapodia that meet in the midline. Under the microscope a detailed pattern of red and white spots is visible. It is found, intertidally to 4 m, on rocky reefs in semi-sheltered localities where it lives on and under *Codium convolutum* and *C. fragile* ssp. *tomentosoides.* The animal blends so well among the green alga it can only be detected by the presence of its white spiral spawn coil. In our studies we have found it around the sheltered shores of Hauraki Gulf, being most common in the Waitemata Harbour, especially at Bucklands Beach, Tamaki Estuary. Its range includes Australia.

Elysia n.sp. Fig. 8
This is an undescribed species which differs from *E. maoria* by its colouration of pale green parapodia with blue spots and a brilliant blue-green margin. It is recorded from offshore islands, east of Northland (Fig. 8) by Willan *et al.* (2010; pers. comm.). Also recorded from Australia and Norfolk Island.

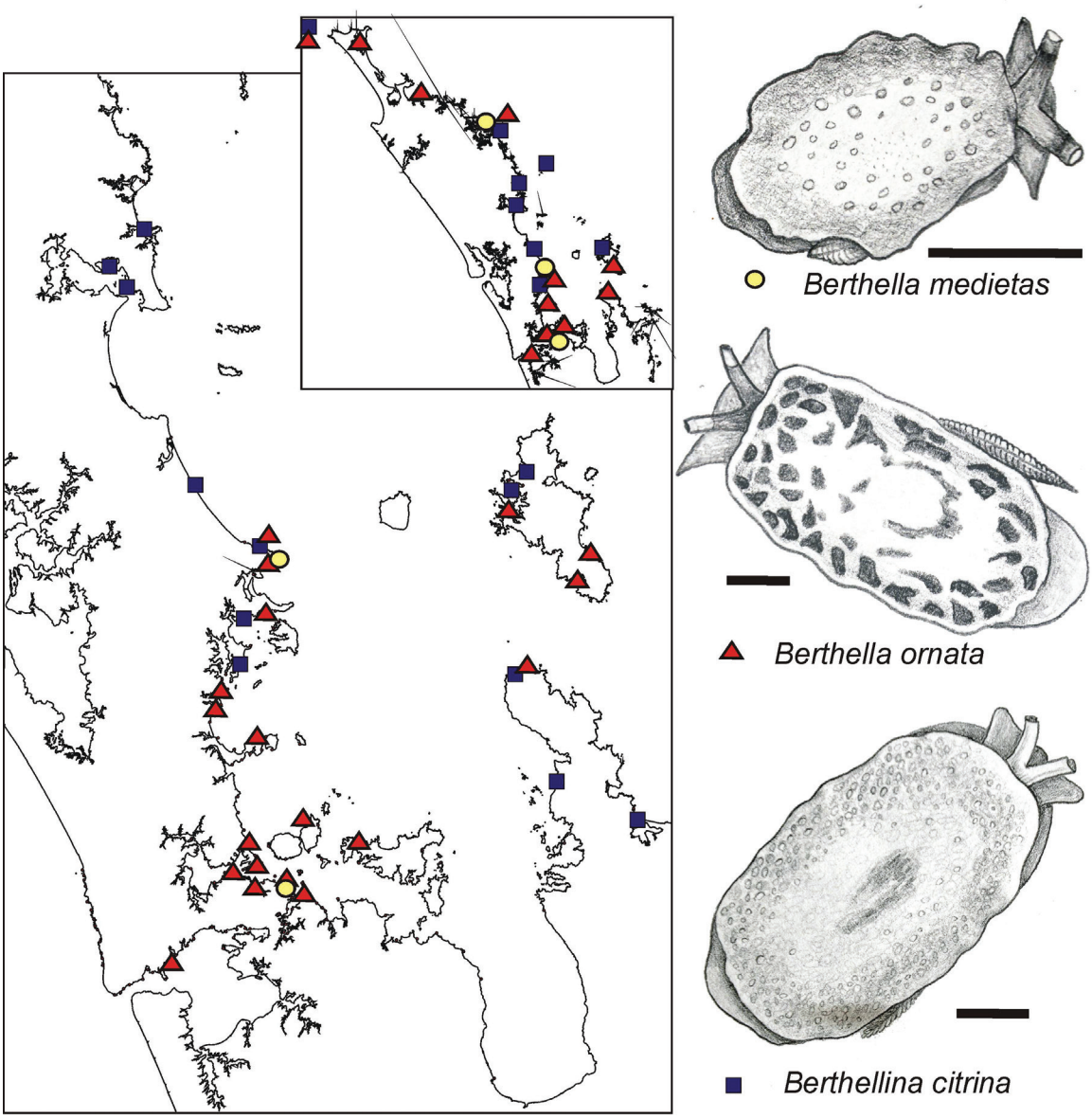


Figure 9. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Berthella medietas* (Waitemata Harbour, Achilles Pt), *Berthella ornata* (Waitemata Harbour, Musick Pt) and *Berthellina citrina* (Coromandel Peninsula, Fletchers Bay). Scale bars 10 mm long.

Pleurobranchomorpha
Pleurobranchidae

Characteristics of pleurobranchs are their triangular oral veil, rolled rhinophores, either arising close together or separated, and a gill on the right side.

Berthella medietas Burn, 1962 Fig. 9
Average animal length 25 mm. It has a small internal shell. This orange to bronze pleurobranch has a characteristic porous texture which distinguishes it from *Berthellina citrina.* Under the microscope glassy spicules can be seen interspersed between the pores. The rhinophores are conjoined above a wide oral veil. It lives on partly sheltered and open rocky coasts, down to depths of 5 m. We have found it in low numbers under low tidal boulders at several localities on the east coast of northern New Zealand. It occurs throughout New Zealand and also in Australia.

Berthella ornata (Cheeseman, 1878) Fig. 9
Average animal length 60 mm. This large attractive species has a base colour of white to cream and is marked with dark reddish brown blotches. The skin is smooth and slippery to touch, but there are microscopic calcareous spicules present. The large gill is long, extending as far as the tail. There is a small internal shell. The soft spiral spawn coils have a diameter of up to 15 mm, are peach to cream in colour and attached under low tidal rocks (pers. obs.).This endemic pleurobranch is rare intertidally to 6 m, preferring partially sheltered and open coasts, but not harbours (Willan and Morton

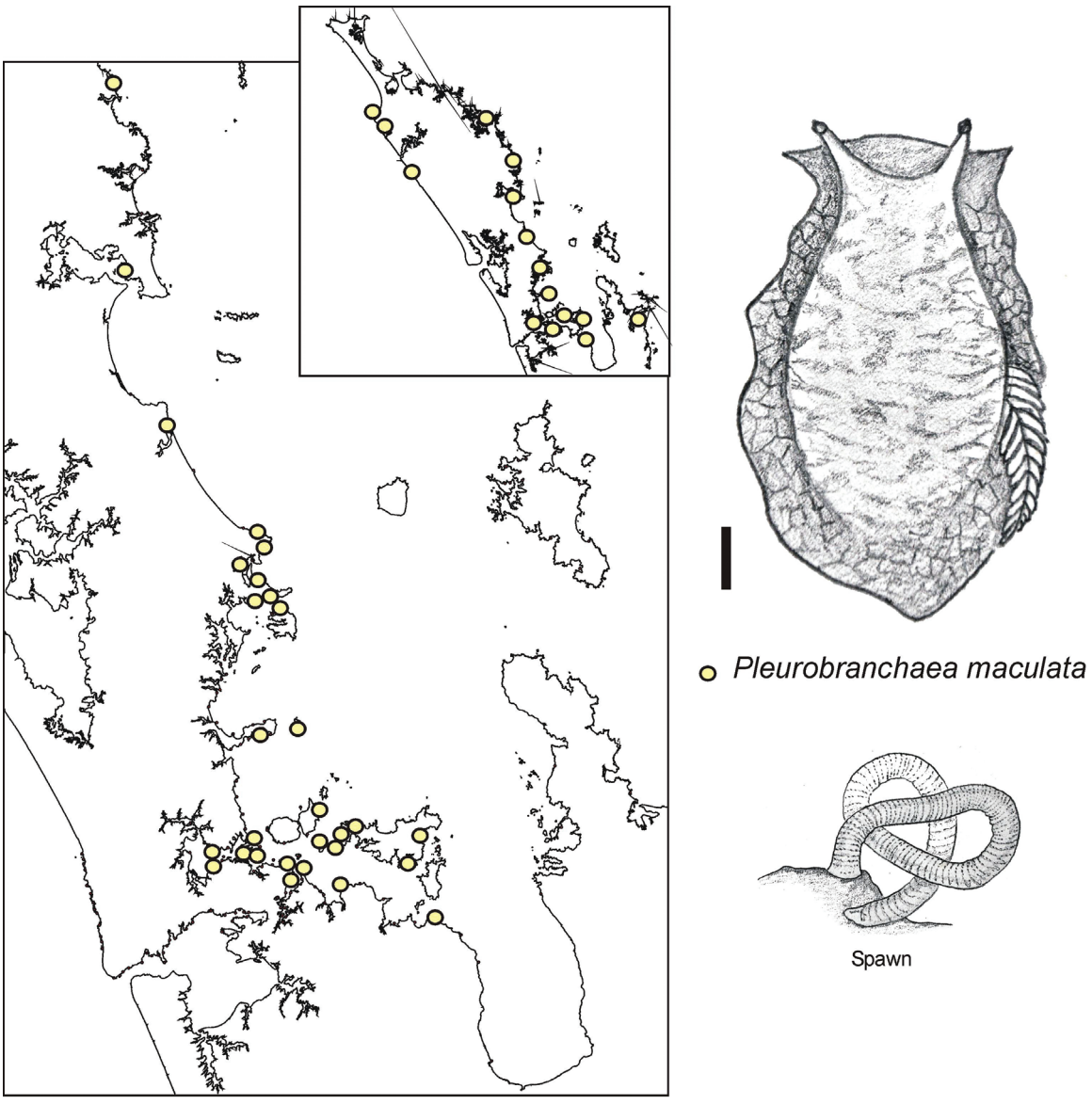


Figure 10. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Pleurobranchaea maculata* (Motuihe Island). Scale bars 10 mm long.

1984). We have found it in low numbers on exposed and sheltered coasts along the east side of northern New Zealand with one record from Manukau Harbour on the north west side. It occurs right around mainland New Zealand and on the Chatham Islands.

Berthellina citrina (Ruppell and Leuckart, 1828) Fig. 9
Average animal length 50 mm. It is usually orange in colour though can range from pale yellow to bright red. The back is covered with small, white gland cells. The animal has a small internal shell. It has been reported feeding on sponges (Willan and Morton 1984) and corals (Sea Slug Forum). We have found occasional specimens under low tidal stones on moderately sheltered coasts on the east coast of northern New Zealand and in Manukau Harbour. It is also known from the Three Kings Islands and Wellington (Te Papa Museum database) and is common throughout the Indo-Pacific Ocean.

Pleurobranchaea maculata (Quoy and Gaimard, 1832) Fig. 10
Average animal length 80 mm. This large species is the only pleurobranch without an internal shell. It varies from pale grey to almost black with anastomosing dark wavy lines. It occurs on all substrates from silty harbours to open rocky coasts, even to continental slopes in depths of 250 m (Willan and Morton 1984). Although not common, we have found *P. maculata* widespread on the east and west coasts of Northland, and in many localities along the west side of the Hauraki Gulf and in Waitemata Harbour. In 2009 it washed up in large numbers on the east coast bays of Auckland's North Shore. The population

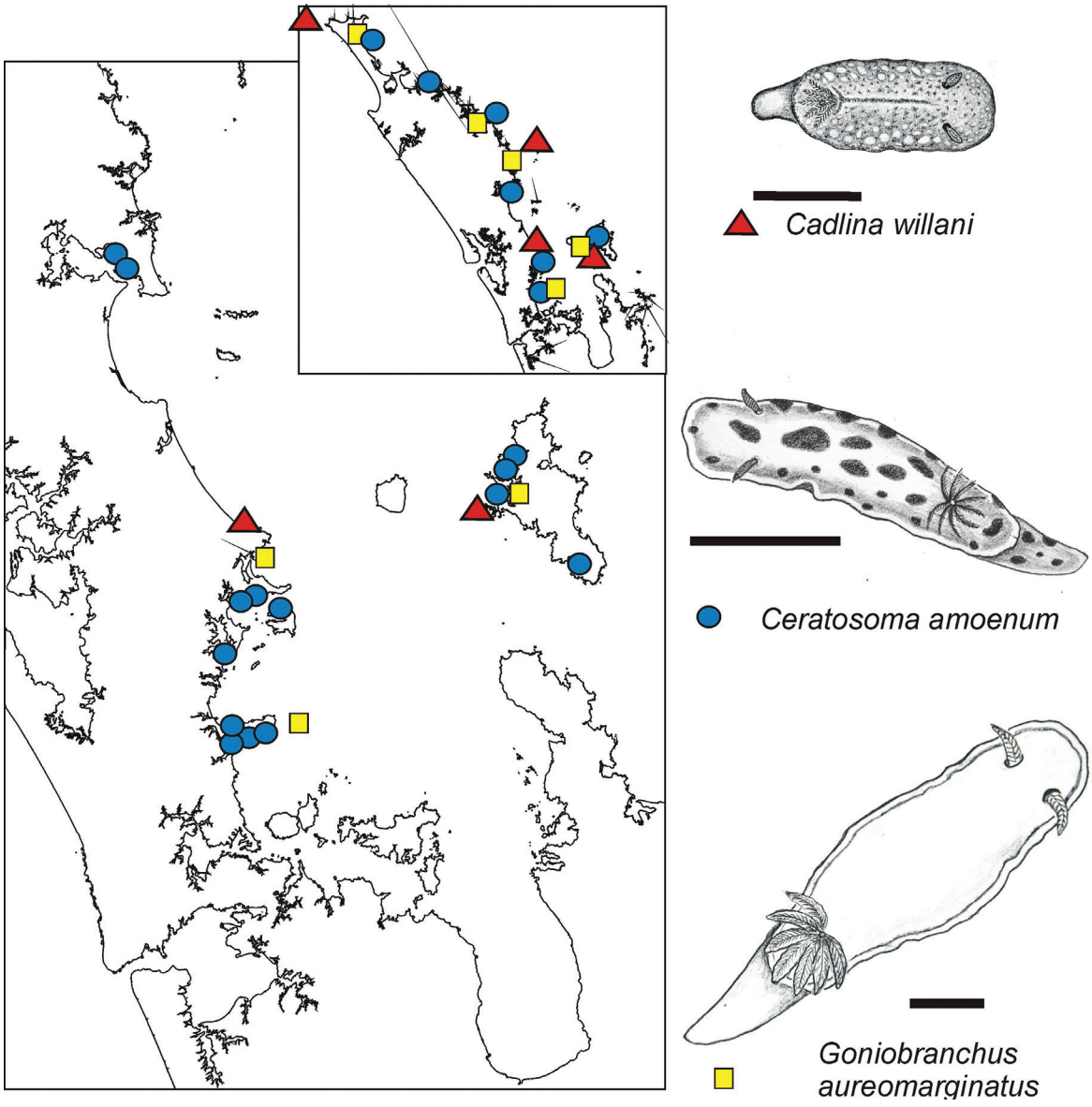


Figure 11. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Cadlina willani* (Great Barrier, Rangiahua Is), *Ceratosoma amoenum* (Sentinel Rock, Mangawhai Heads) and *Goniobranchus aureomarginatus* (Parengarenga Harbour, Paua). Scale bars 10 mm long.

had peaked as a result of feeding on the introduced Asian mussel, *Arcuatula senhousia.* Several dogs died after eating specimens, and subsequent investigations showed that all parts of the slugs contains a neurotoxin, tetrodotoxin (McNabb *et al.* 2010). It is widespread in temperate waters of the Indian and Pacific Oceans.

Nudibranchia
Cadlinidae

Cadlina willani Miller, 1980 Fig. 11
Average animal length 14 mm. This small nudibranch is white with a central yellow stripe and border. It has a rough mantle and the foot extends beyond the body. It lives among encrusting organisms in open localities and channels. It is probably the most common subtidal nudibranch in New Zealand (Willan *et al.* 2010) and extremely rare intertidally, with only one such record from all our studies – Rangiahua Island, off the west coast of Great Barrier Island (Morley 1991). This endemic species occurs around the North Island and south to Banks Peninsula.

Chromodorididae

Ceratosoma amoenum (Cheeseman, 1886) Fig. 11
Average animal length 30 mm. The common name, clown nudibranch, is well chosen as the ground colour of the animal is white with vivid orange patches, purple rhinophores and gill. The details of the design vary with each individual. The body is soft and slippery. Cheeseman's iconotype (MA70169) is from the Waitemata Harbour. We have found it frequently at many locations along the east side of northern New Zealand, with the majority of records from shallow depths of 2–3 m where it appears to be most common. The full depth range is from low tidal to 40 m on semi-sheltered shores (Willan and Morton 1984). The range is the northern half of the North Island to East Cape and Taranaki on the west coast. It also occurs on Lord Howe and Norfolk islands and temperate southern Australia.

Goniobranchus aureomarginatus (Cheeseman, 1881) Fig. 11
Average animal length 35 mm. The body is white with a golden line close to the border of the mantle. It is less common than *Ceratosoma amoenum* and rarely found intertidally where it sometimes crawls exposed on sponges under low tidal rocks. It lives from low tide to 24 m on rocky reefs in open situations (Willan *et al.* 2010). Our records of this endemic species are all from semi-exposed eastern locations, but it has been recorded from around the main islands of New Zealand and the Chatham Islands.

Discodorididae

Alloiodoris lanuginata (Abraham, 1877) Fig. 12
Average animal length 60 mm. This large nudibranch varies from reddish brown to grey with a pattern of brown and white spots. The mantle is rough due to minute tubercles with projecting spicules. The rhinophores are yellow and the gills greenish with darker markings (Willan and Morton 1984). The spawn coil is yellowish tan (pers. obs.). Its habitat is from sheltered to exposed shores from intertidal down to depths of 10 m where it feeds on sponges. Single specimens or pairs have been found at our study sites on both east and west coasts of northern New Zealand, but not in the Far North. This endemic species occurs around all the main islands and the Chatham Islands.

Atagema molesta (Miller, 1989) Fig. 12
Average animal length 20 mm. This nudibranch is fawn with brown spots and has a soft mantle covered in spiculose tubercles. Those near the mid-dorsal ridge are opaque white. It is uncommon and occurs beneath stones in tide pools on semi-sheltered coasts. It has only been recorded from Goat Island Bay, the type locality, and the Whangaparaoa Peninsula.
(Miller 1989, Willan *et al.* 2010).

Hoplodoris nodulosa (Angas, 1864) Fig. 12
Average animal length 35 mm. This uncommon nudibranch is yellow, brown or grey with brown blotches, white pustules, brown gills and rhinophores. There is an unpigmented area around each pustule. We have found this at only three study localities – on the sheltered east and west coasts of Auckland. It was most frequent on the compound ascidian *Alcyonium aurantiacum* at Jenkins Beach, Manukau Harbour. This species also occurs around the main islands of New Zealand and along the coast of southern Australia.

Jorunna pantherina (Angas, 1864) Fig. 12
Average animal length 15 mm. A pale peachy buff nudibranch with marbled ring patches which grade smaller towards the margins. The colour can vary from yellow to black according to the sponge eaten (Willan and Coleman 1984). The gill has overlapping sections like petals on a rose. The dorsum is thickly beset with short tubercles. It has been found in just a few shallow, relatively sheltered locations on the east side of Auckland and southern Northland. We have found only one intertidal specimen – at Meola Reef, Waitemata Harbour on low tidal rocks with a grey sponge. It is also found in Australia (Sea Slug Forum).

Rostanga muscula (Abraham, 1877) Fig. 12
Average animal length 18 mm. This small nudibranch is tomato red with scattered dark spots. It is often found at low tide on its host, a red sponge. It lays a delicate red spawn coil with a diameter of 12 mm. We have found this endemic species in low numbers in a wide range of mid to low tidal semi-sheltered to exposed sites on both sides of northern New Zealand. It has been recorded as far south as the Marlborough Sounds (Willan *et al.* 2010).

Doridinae

Aphelodoris luctuosa (Cheeseman, 1882) Fig. 13
Average animal length 50 mm. A graceful dorid with a ground colour of cream variably ornamented with

radial brown, wide stripes, mid dorsal blotches and fine concentric lines around the mantle edge. The rhinophores and gills are chocolate-brown, rimmed with yellow. The pale peach spawn coil in a depth of 2 m at Rangiputa measured 70 mm in diameter (pers. obs.). It crawls exposed on rocky coasts down to 40 m depth (Willan and Morton 1984) and is only seen occasionally intertidally. The unpublished iconotype from the Waitemata Harbour was painted by Emma Cheeseman (MA70246). We have records from exposed and sheltered shores on both sides of northern New Zealand. This endemic species occurs around the main islands and the Chatham Islands.

Aphelodoris sp. Fig. 13
Average animal length 35 mm. This undescribed dorid has an encircling pattern of tan blotches on cream but lacks the dark concentric lines of *A. luctuosa*. The gills and rhinophores are white, there is a pinkish tinge on the underside of the mantle edge (pers. obs.). All records of this endemic species are from the exposed to semi-sheltered west coast of northern New Zealand (e.g. Hayward and Morley 2004).

Doris granulosa (Pease, 1860) Fig. 14
Average animal length 25 mm. A distinguishing feature of this yellow nudibranch is the posterior facing, horizontal gill which can be withdrawn under a flap of the mantle. There are low rounded tubercles over the whole of the mantle. It is often found feeding on sponges. It lives from mid to low tide on rocky reefs in semi-protected localities right around New Zealand. It also occurs in New Caledonia and temperate Australia.

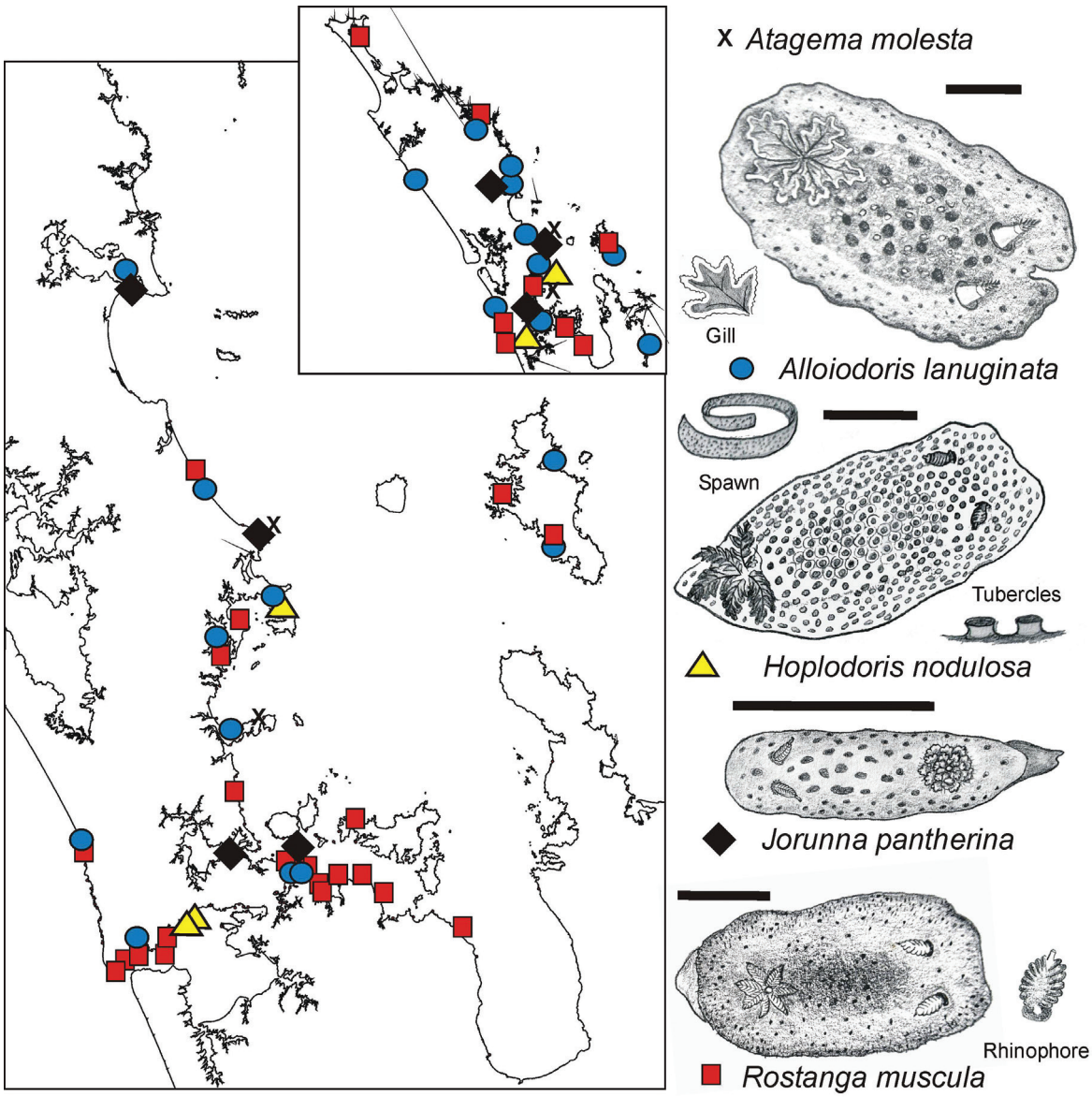


Figure 12. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Atagema molesta*, *Alloiodoris lanuginata* (Kawau Island, Mansion House Bay), *Haplodoris nodulosa* (Manukau Harbour, Jenkins Bay), *Jorunna pantherina* (Waitemata Harbour, Meola Reef) and *Rostanga muscula* (Bay of Islands, Tapeka Pt). Scale bars 10 mm long.

Doris wellingtonensis Abraham, 1877 Fig. 14
Average animal length 100 mm. This is New Zealand's largest dorid. The fleshy body is covered with rounded pustules. It is khaki brown to yellowish above, and the foot and rhinophores are orange (Willan and Morton 1984). We have seen four specimens with three bright orange spawn masses 30–60 mm diameter in low tidal pools at Maori Bay, Waitakere coast. This species lives on exposed to semi-sheltered rocky shores ranging from intertidal down to 20 m, feeding on yellow encrusting sponges. It occurs on both sides of northern New Zealand and around the main islands of New Zealand as well as eastern Australia.

Dendrodoridae

Dendrodoris citrina (Cheeseman, 1881) Fig. 15
Average animal length 55 mm. This lemon yellow to orange nudibranch is distinguished from all other similarly coloured New Zealand species by the presence of numerous small white dots throughout its length. The unpublished iconotype (MA70244) is a water colour painting by Emma Cheeseman. This is the most commonly encountered and most abundant sea slug in the intertidal zone of northern New Zealand, where it occurs ~~on~~ in more shaded locations on mid-low tide rocky reefs on moderately exposed to harbour shorelines. It has not been recorded from along the exposed west coast. It appears to be most common in the inner Hauraki

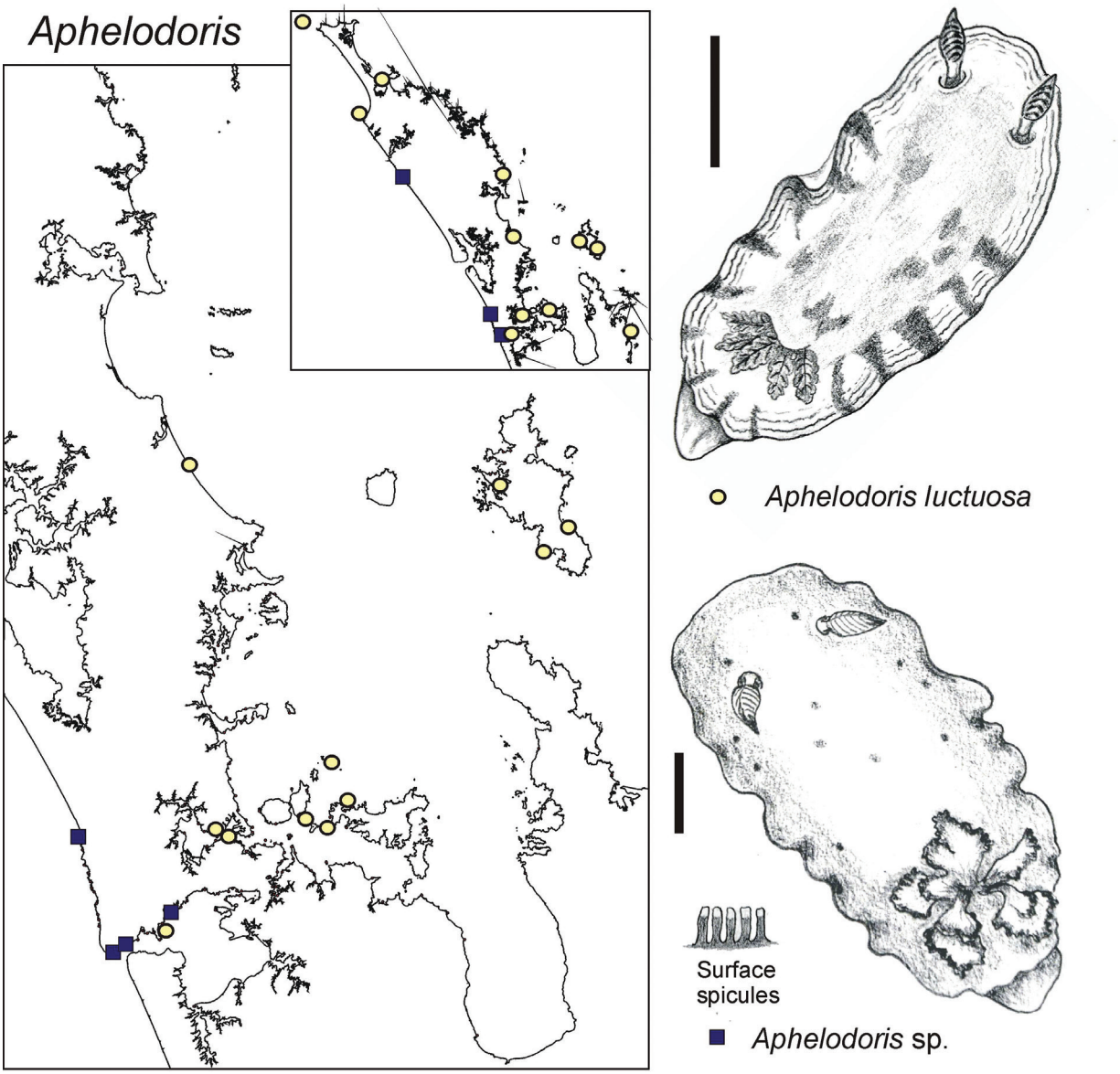


Figure 13. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Aphelodoris luctuosa* (Waiheke Is, Oneroa) and *Aphelodoris* sp. (Muriwai, Maori Bay). Scale bars 10 mm long.

Gulf, especially along the shores of the middle and outer Waitemata Harbour and the Tamaki Estuary. This endemic species is recorded from around the two main islands of New Zealand.

Dendrodoris krusensternii (Gray, 1850) Fig. 16
Average animal length 60 mm. Its vibrant colouring makes this large dorid conspicuous on low tidal rocks down to depths of 5 m. The ground colour of the mantle is light brown with large pale protuberances and folds. Smooth areas between the folds are peacock blue (Willan and Morton, 1984). The pale mantle edge has prominent concentric brown lines. In New Zealand this species occurs on semi-sheltered coasts on the east side of northern New Zealand, mainly in the inner Hauraki Gulf and Waitemata Harbour. Since 2010 specimens have become more common at more southern localities than previously found, especially in the Waitemata. It is widespread throughout the tropical and subtropical Indo-Pacific Oceans.

Dendrodoris nigra (Stimpson, 1855) Fig. 16
Average animal length 40 mm. This smooth black dorid has rhinophores tipped with white. The edge of the mantle is frilled. It lays spirals of orange spawn. Specimens usually are seen intertidally on sheltered and semi-open rocky shores on the east coast of northern New Zealand, mainly within the Hauraki Gulf. It is widespread throughout the temperate waters of the Indo-Pacific Ocean.

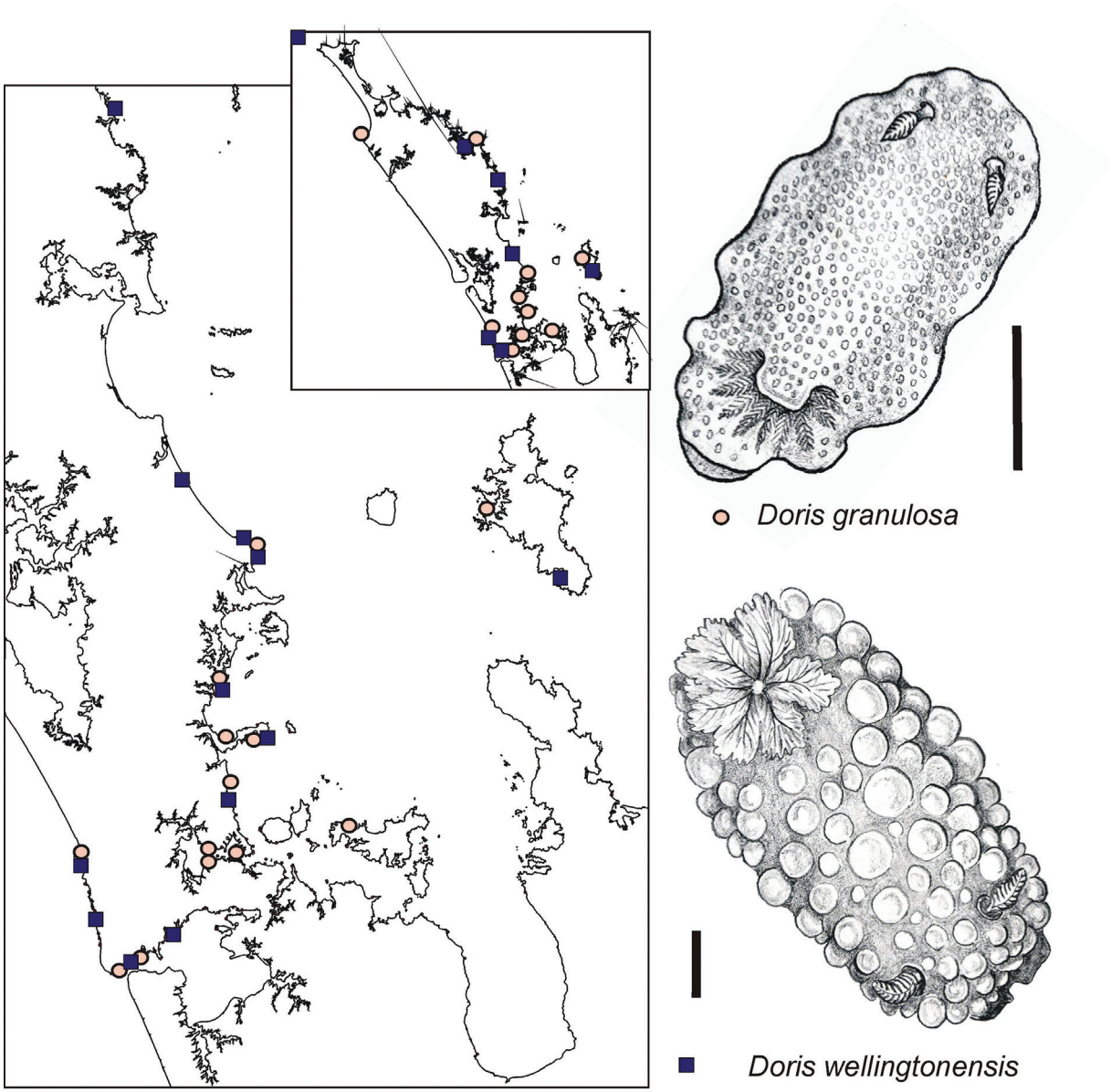


Figure 14. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Doris granulosa* (Auckland, Te Arai Pt) and *Doris wellingtonensis* (North-west Nelson, Tata Bay). Scale bars 10 mm long.

Polyceridae

Plocamopherus imperialis Angas, 1864 Fig. 17
Average animal length 70 mm. This is a large dramatic nudibranch that was first seen in New Zealand about 50 years ago (M. Miller pers. comm.). The animal is scarlet with small dark spots and two longitudinal cream stripes. The rhinophores are a flambuoyant orange with bulbous purple tips. Posterior to the gills are two globes, which flash light if the animal is disturbed. The oral shield has small compound papilli around the margin. The large brown brachial plume is attached to the body on a pedestal (Morley 1996). We found this species in low numbers at Dysons Beach, Parengarenga Harbour. One specimen was laying an orange spawn coil on a low tide frond of brown sea weed, *Carpophyllum* sp. Another pair was crawling on sand flats in depths of 3 m. When disturbed the animal turns sideways and swims strongly with muscular contractions of the body and tail (pers. obs.). This species is widespread throughout the tropical and subtropical Indo-Pacific and is recorded here from the Three Kings Islands and two localities on the east coast of Northland.

Polycera hedgpethi Er. Marcus, 1964 Fig. 17
Average length 13 mm. This long, narrow species has a cream body peppered with black. The head has four elongate papilli and there is a cluster of two or three papilli beside the gills. These are translucent white with a broad gold ring near the centre and a dark zone above. The tip of the tail is also gold (Willan *et al.* 2010, p.438). It is recorded from low intertidal to 10 m depth but mostly

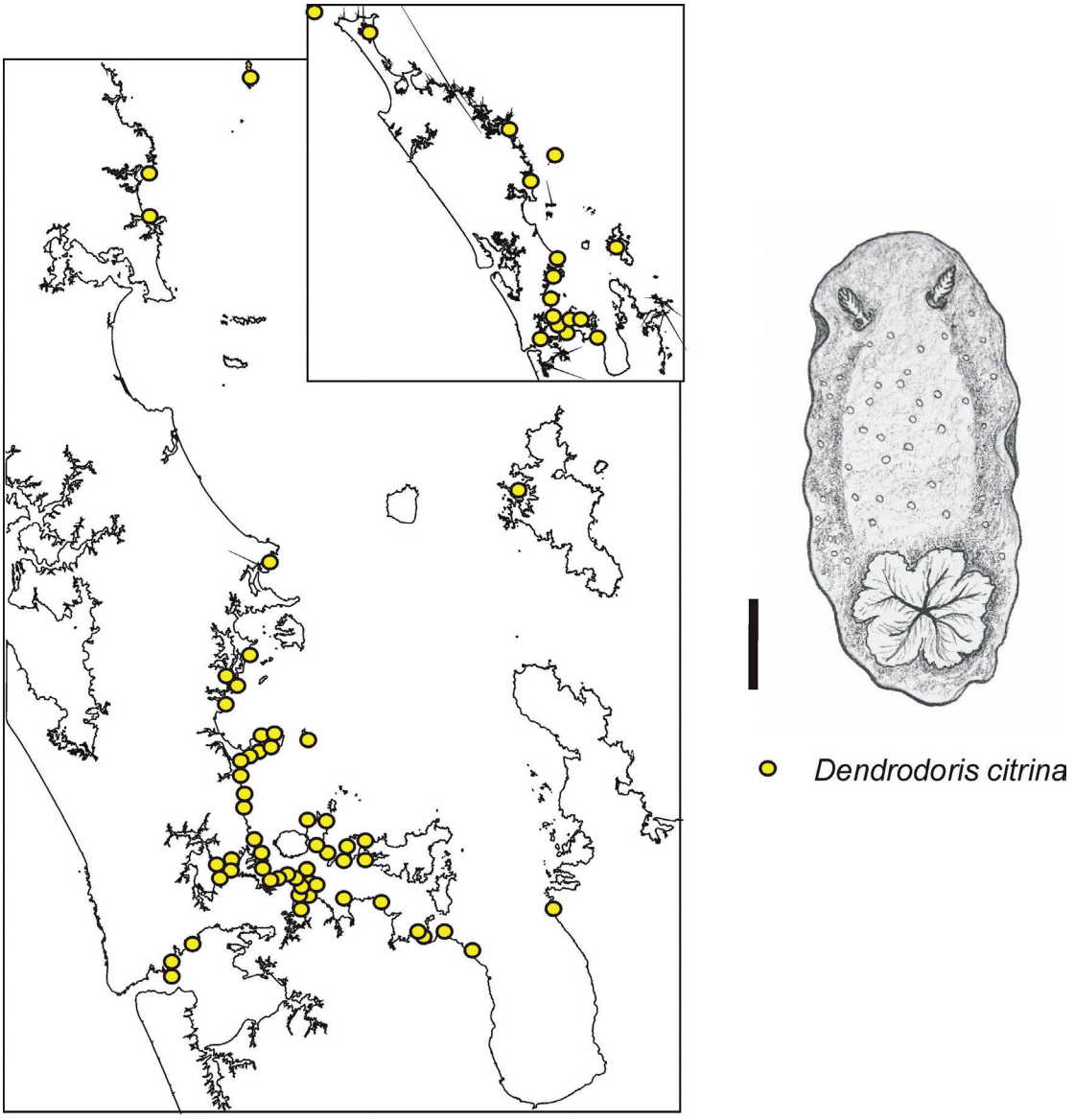


Figure 15. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Dendrodoris citrina* (Waiwera). Scale bar 10 mm long.

from the sublittoral fringe. It was probably introduced into New Zealand in the 1960s living on bryozoa attached to a ship's hull (Willan *et al.* 2010). It is recorded from the Waitemata Harbour, Cavalli Islands and the Marlborough Sounds. It is cosmopolitan in warm temperate seas.

Polycera melanosticta Miller, 1996 Fig. 17
Average animal length 14 mm. This is the species recorded in Morton & Miller (1968) as *Polycera* sp. The body is elongated bearing tubercles on the head veil, gill circlet and variously along the body. It is white, grey or greyish brown patterned with white, black and orange spots widely spaced over the body (Miller 1996). It was formally described by Miller (1996) from a number of specimens collected from a paint raft at the type locality at Devonport naval base, Waitemata Harbour in 1962. It may have been introduced to New Zealand on a ship's hull. It also occurs in Victoria, Australia (Burn 2006).

Thecacera pennigera (Montagu, 1815) Fig. 17
Average animal length 12 mm. A small high bodied nudibranch with a deep pit in front of each rhinophore. The rhinophores are surrounded by flanged sheaths and two finger-like processes arise behind the gills. Each individual has a unique pattern of orange and black spots on the white body. It was recorded commonly in the upper Waitemata Harbour and Tamaki Estuary in the 1970s, but has not been seen more recently. It was found on hard substrate in the sublittoral fringe and subtidal where it feeds on bryozoa. It is presumed to have been introduced by shipping (Willan 1976) but may not have survived (Willan *et al.* 2010).

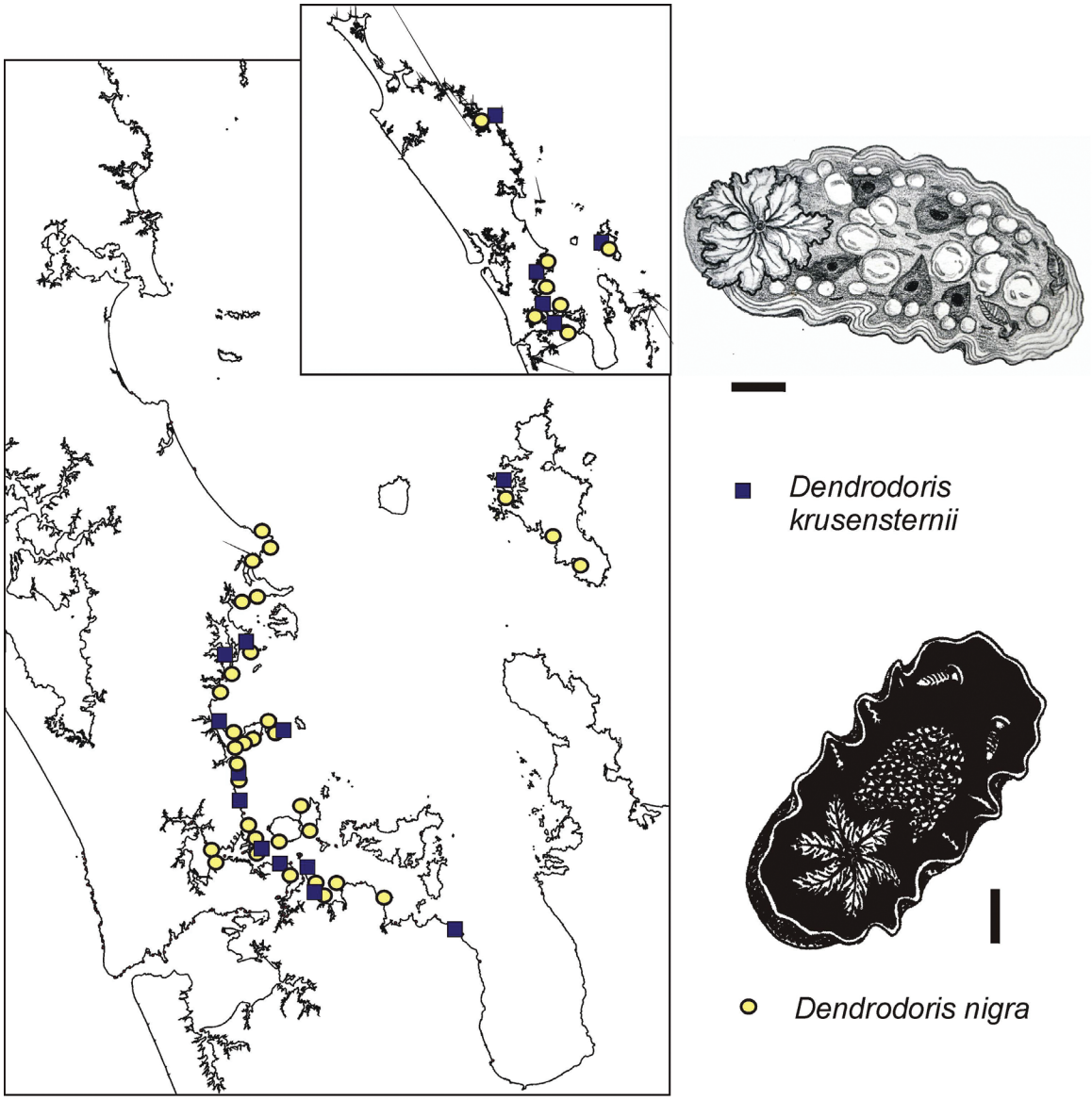


Figure 16. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Dendrodoris krusensternii* (Kohimarama, Waitemata Harbour) and *Dendrodoris nigra*. Mellons Bay). Scale bars 10 mm long.

Proctonotidae

Caldukia rubiginosa Miller, 1970 Fig. 17
Average animal length 10 mm. This small reddish-brown nudibranch has cerata on the body and around the head. The upper part of each ceras is yellow and the central section iridescent blue. It is occasionally found among encrusting organisms under stones in the low intertidal and sublittoral zones down to 13 m on open coasts (Willan *et al.* 2010). It was not found in our surveys but this endemic species has been recorded from the Three Kings Islands and sporadically along the east coast of northern New Zealand as far south as Hahei, Coromandel Peninsula. The type locality is Goat Island Bay, Leigh.

Janolus novozealandicus (Eliot, 1907) Fig. 17
Average animal length 20 mm. The translucent body has opaque white marks down the centre and brown and white speckles over the sides. Inside each ceras can be seen the orange and blue digestive diverticulum (Willan *et al.* 2010). This endemic species is found beneath stones on exposed to semi-sheltered reefs and channels at low tide to depths of 15 m along the east coast of northern New Zealand, and has been recorded around all three major islands (Miller and Willan 1986). It is uncommon, but more frequent in South and Stewart Islands (Willan *et al.* 2010).

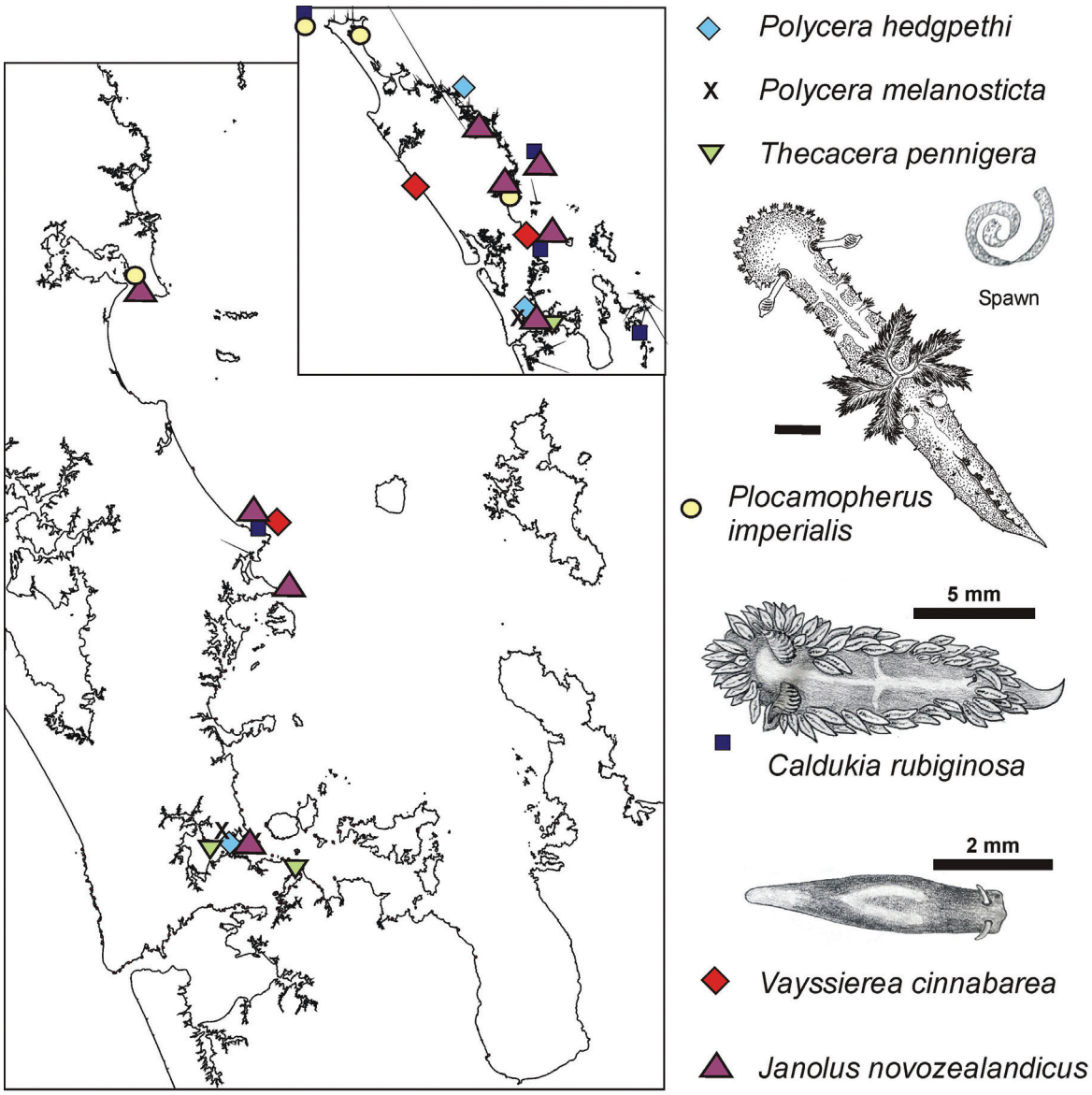


Figure 17. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Plocamopherus imperialis* (Parengarenga, Dysons Beach), *Polycera hedgpethi*, *Polycera melanosticta*, *Thecacera pennigera*, *Caldukia rubiginosa* (redrawn after Willan and Morton, 1984, p. 68; Leigh, Goat Island Bay), *Janolus novozealandicus* and *Vayssierea cinnabarea* (Northland, Kawerua). Scale bars 10 mm long unless stated otherwise.

Vayssiereidae

Vayssierea cinnabarea (Ralph, 1944) Fig. 17
Average animal length 4 mm. This small slender dorid nudibranch is dull red, it has no gill or retractable rhinophores (Willan and Morton 1984). It lives on the undersurface of intertidal stones on open rocky coasts in the presence of *Spirorbis* tube worms on which it feeds (Willan and Morton 1984). In this study this endemic species is recorded from one locality on either side of northern New Zealand. It is probably more common than this but overlooked due to its small size. Its type locality is Wellington.

Fionidae

Fiona pinnata (Eschscholtz, 1831) Fig. 18
Average animal length 17 mm. This pelagic nudibranch is usually cream or buff in colour with an orange patch between the rhinophores. It becomes blue when feeding on by-the-wind sailor, *Velella velella* and Portuguese man-of-war, *Physalia physalis*. The cerata are in oblique rows with a membranous attachment on the inner margin. There are pairs of rhinophores and oral tentacles. It attaches to floating wood or *Durvillaea* kelp which host the barnacles *Lepas* spp. *F. pinnata* can feed on several different species of *Lepas* (Willan 1979b). Amazingly for a pelagic species *F. pinnata* cannot swim. The species

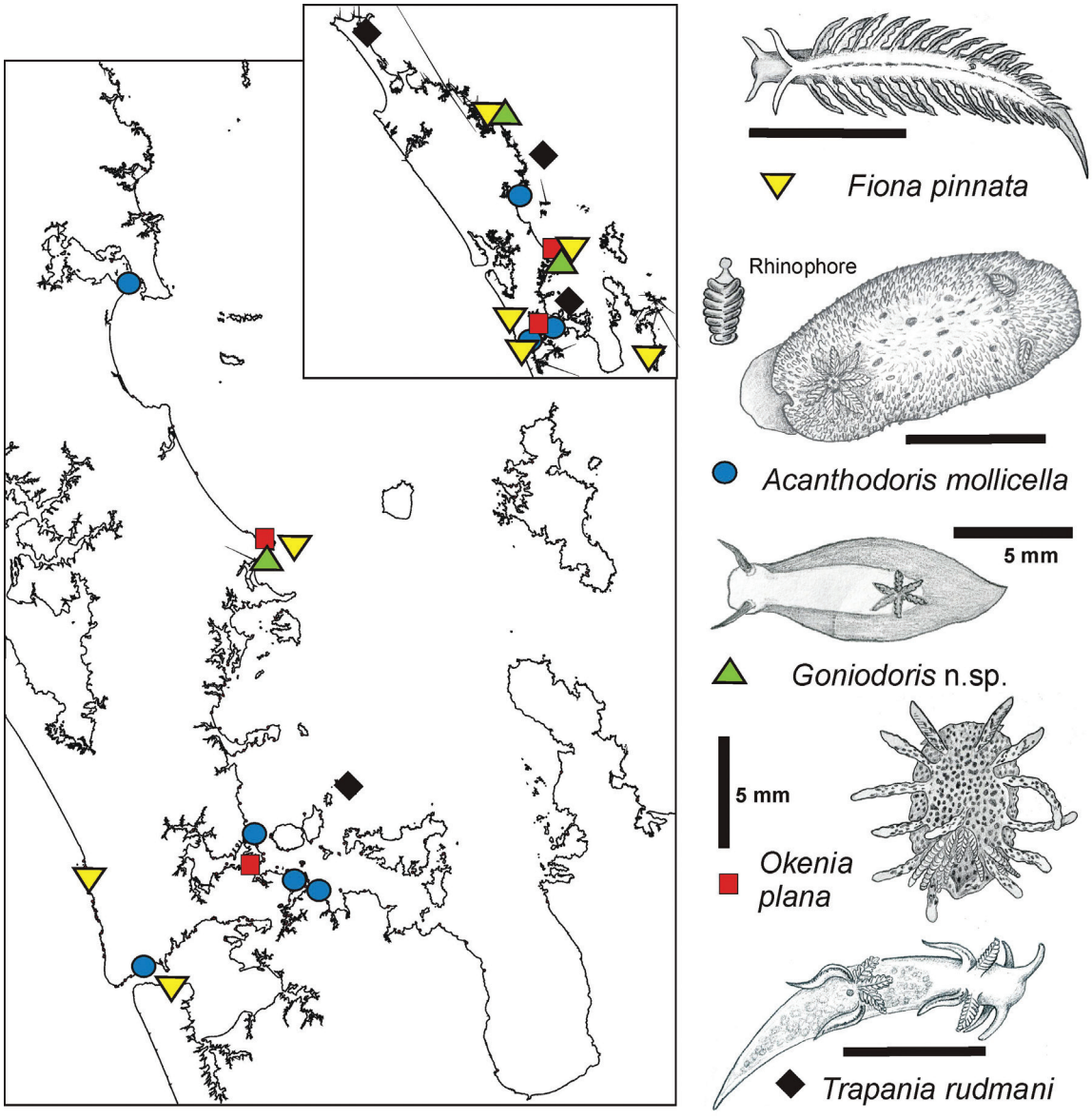


Figure 18. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Fiona pinnata* (redrawn after Willan and Morton, 1984, p. 81), *Acanthodoris mollicella* (Manukau Harbour, Kaitarakihi Bay), *Goniodoris* n.sp. (Bay of Islands, Deep Water Cove), *Okenia plana* (redrawn after Willan and Morton, 1984, p. 91) and *Trapania rudmani* (Parengarenga, Paua). Scale bars 10 mm long unless stated otherwise.

has been found occasionally washed up on open coasts following prolonged on-shore winds, right around New Zealand including the Chatham and Subantarctic islands. It is cosmopolitan in tropical and temperate seas.

Onchidorididae

Acanthodoris mollicella Abraham, 1877 Fig. 18
Average animal length 25 mm. This small nudibranch is cryptically coloured in mottled black, brown and ochre yellow. The dorsum is covered in numerous papilli, and it has transparent feathery gills which tend to point backwards. The tips of the rhinophores are white. This endemic species lives in protected channels and harbours. We have found solitary specimens under low tidal rocks in Manukau, Waitemata and Whangarei Harbours. It is also known from around most of New Zealand.

Goniodorididae

Goniodoris n.sp. Fig. 18
Animal length 10 mm. This species has an unusual exposure of the tail and is only known from a single specimen found under a rock in depth of 2 m at low tide in Deep Water Cove, Bay of Islands. The specimen is preserved in ethanol and its original colour is unknown. A second species, *G. castanea,* is also represented by only one specimen, dredged in Otago Harbour, South Island. This North Island record may prove to be a subspecies *G. castanea* (Michael Miller pers. comm.). *Goniodoris* spp. are also found in North America and Japan.

Okenia plana Baba, 1960 Fig. 18
Average animal length 8 mm. This nudibranch has a body copiously spotted with lilac and reddish-brown. It has a broad foot, large rhinophores and a mantle edge with a row of tentacle-like projections. Its habitat is among brown algae and bryozoans in protected situations and silty harbours (Willan and Morton 1984). It has been recorded in the Waitemata Harbour and at Leigh, but has not been found in our studies. It is also found in Australia, Hawaii, Japan and Malaysia (Sea Slug Forum).

Trapania rudmani Miller, 1981 Fig. 18
Average animal length 18 mm. The body of this slender nudibranch gradually tapers to a long tail. There are two pairs of dorso-lateral finger-like processes. The body is translucent white with yellow stripes on the outside of the four processes. It is rare intertidally and often lives on vertical walls among encrusting organisms in open localities down to depths of 20 m (Miller 1981). We record it here from wharf piles at 1 m depth at Paua, Parengarenga Harbour, Northland. This endemic species has been recorded subtidally along the east coast of northern New Zealand (Sea Slug Forum).

Arminidae

Dermatobranchus rubidus (Gould, 1852) Fig. 19
Average animal length 20 mm. The mantle is dark orange while the longitudinal ridges, rhinophores and oral veil are highlighted in white. The foot is wider than the mantle and has tentacles at the front corners (Willan *et al.* 2010). The species lives in semi-sheltered localities on sand from the sublittoral fringe to 65 m. Only two specimens of this rare nudibranch were previously known from New Zealand. We have found a third specimen in a depth of 2 m at Otupoho Bay, Bay of Islands. There is a record from McDonald Bank, Whangarei Harbour. It is also found in Australia.

Tritoniidae

Tritonia incerta Bergh, 1904 Fig. 19
Average animal length 100 mm. This large uncommon nudibranch has three colour forms, pale rose-pink, apricot orange and red with white gills and foot. The gills consist of tufts along each side of the notal ridge and the oral veil has ten or twelve tentacles (Willan *et al.* 2010). The depth range this endemic species extends down to 250 m. It has been recorded intertidally from the exposed Waitakere coast at Maori Bay, Muriwai (Powell 1979, p. 287) and Whatipu, Manukau Heads. It has not been found it in our systematic surveys. It also occurs further south in New Zealand on both the east and west coasts of the North Island and the west coast of the Soiuth Island as far south as Westport (Te Papa Museum database).

Dotidae

Doto pita Er. Marcus, 1955 Fig. 19
Average animal length 8 mm. This small slender nudibranch has up to seven pairs of finger-like cerata on either side of its body. The body is translucent white mottled with yellow, brown and lilac spots (Willan *et al.* 2010). It is mostly found feeding on hydroids and can be common at low tide on open rocky reefs and in semi-sheltered locations. It also extends to depths of 30 m. It is known in New Zealand from the east coast, north of Auckland and elsewhere from Brazil, Japan and Australia (Willan *et al.* 2010).

Flabellinidae

Flabellina albomarginata (Miller, 1971) Fig. 19
Average animal length 18 mm. This species has a transparent whitish body with a white border on the foot, and red cerata tipped with white. It lives from intertidal down to depths of 20 m in open to semi-sheltered localities. In northern New Zealand this endemic species has been found intertidally on the Waitakeres' west coast between Whatipu and Muriwai, but not on our systematic surveys. The type locality is Piha. This endemic species is more common on the Canterbury and Otago coast of the South Island.

Tularia bractea (Burn, 1962) Fig. 19
Average animal length 15 mm. This nudibranch has a white to yellowish brown body with pointed corners to the anterior of the foot, long rhinophores and oral tentacles. The seven clusters of cerata arise from brackets. The red spots along the edge of the cerata perfectly match the

lolly-pink of coralline algae on which we have found it living. It lives intertidally down to depths of 25 m and is more common subtidally. We have found one specimen at Musick Point, Tamaki Estuary on coralline algae in mid-tidal pools. It occurs around both North and South Islands and is also known from Victoria, Australia (Willan *et al.* 2010).

Eubranchidae

Eubranchus agrius Er. Marcus, 1959 Fig. 19
Average animal length 6 mm. The body of this small transparent nudibranch has small patches of gold, yellow, brownish-orange, pale ruby or purplish red. It lives on hydroids in tidal pools on open coasts. We have not

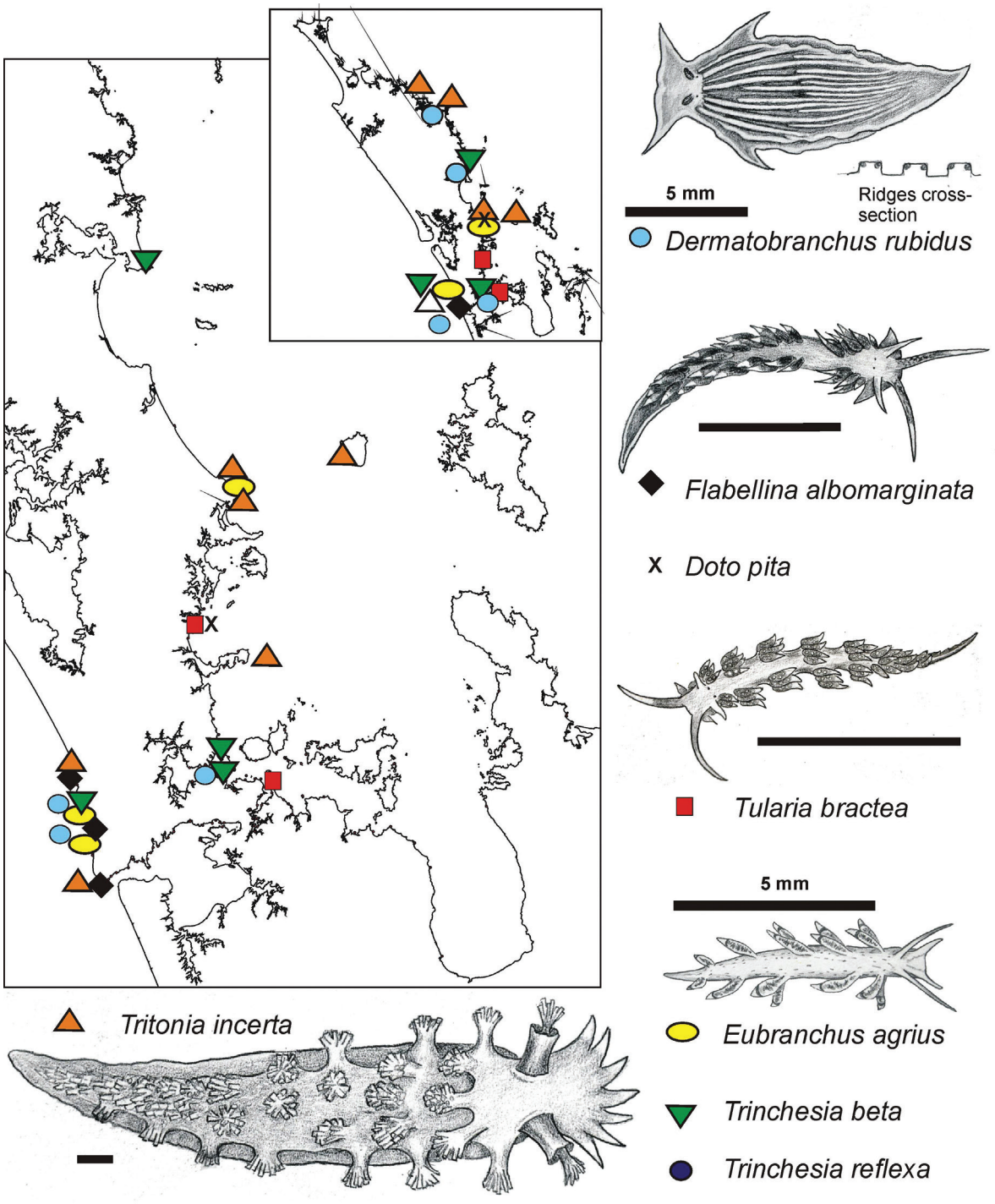


Figure 19. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Dermatobranchus rubidus* (Bay of Islands), *Flabellina albomarginata* (Waitakere coast, Piha), *Doto pita*, *Tularia bractea* (Waitemata Harbour, Musick Pt), *Eubranchus agrius* (after Willan and Morton, 1984, p. 79), *Trinchesia beta*, *Trinchesia reflexa* and *Tritonia incerta* (Waitakere coast, Whatipu). Scale bars 10 mm long unless stated otherwise.

found this species in our studies, but it has been reported from both the west and east sides of the Auckland region and occurs around both main islands of New Zealand. It is also known from Chile.

Tergipedidae

Trinchesia beta (Baba & Abe, 1964) Fig. 19
Average animal length 6 mm. The wide foot extends beyond the visceral part of the body. The anterior corners have arc-shaped flanges. There are eleven rows of cerata. The body is translucent, finely spotted with purple. The cerata are also purple except for a gold or orange band below the translucent tips (Miller 1977). It has been recorded in tidal pools, under stones, and on hydroids in the sublittoral fringe from Whangarei Heads to the Waitemata Harbour on the east coast and the Waitakeres on the west (Miller 1977). It was possibly more common in the 1950s-1960s than it was around northern New Zealand in the 1990s-2000s, as we did not see it in our surveys. It is also known from Japan (Miller 1977).

Trinchesia reflexa (Miller, 1977)
Average animal length 7 mm. The foot is wide, extending beyond the visceral part of the body. The anterior corners are produced as semicircular processes (Miller 1977). There are nine rows of cerata. The body is transparent or pale yellow with the viscera clearly visible. The diverticula are fawn to black. It is usually found living on hydroids in mid-low tide pools on

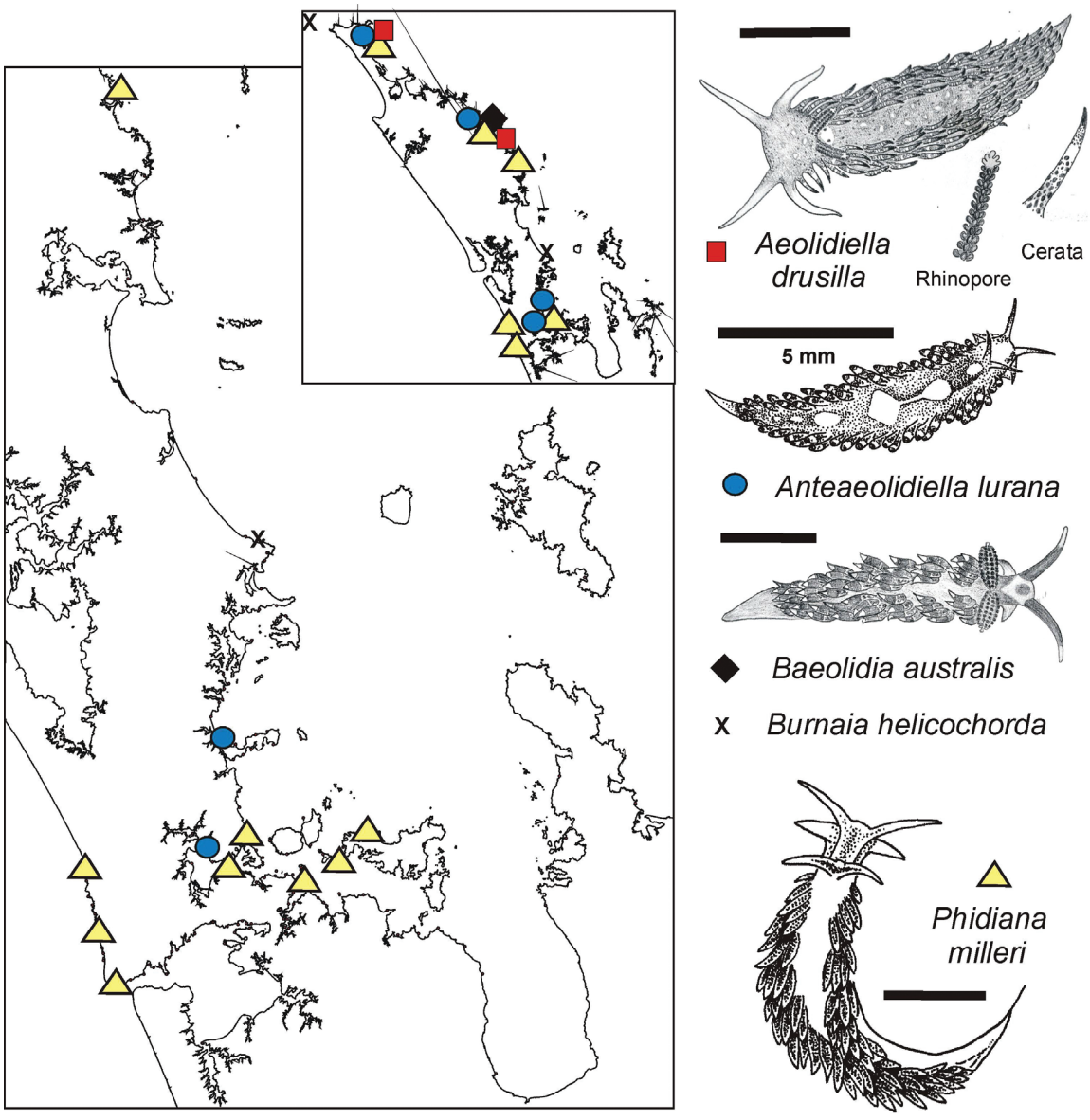


Figure 20. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Aeolidiella drusilla* (Northland, Whangamumu), *Anteaeolidiella lurana* (Parengarenga, Dog Is), *Baeolidia australis* (Bay of Islands, Tapeka Pt), *Burnaia helicochorda* and *Phidiana milleri* (Oneroa, Waiheke Island). Scale bars 10 mm long unless stated otherwise.

exposed rocky shores. This endemic species has been recorded from the Waitakere west coast and Manukau Harbour (type locality); and further south on Banks and Otago Peninsulas in the South Island (Miller 1977).

Aeolidiidae

Aeolidiella drusilla Bergh, 1900 Fig. 20
Average animal length 30 mm. The body of this nudibranch is buff with white blotches. The brown and orange cerata are tipped with orange, and the papillose grey-brown rhinophores are white-tipped (MSM pers. obs.). Although considered rare (Powell 1979, p 289 as *A. faustina)* thirty to forty specimens were seen at low tide on ascidians on Paua wharf piles, Parengarenga Harbour in 1992. We also record a pair found under a rock in 1 m depth at Whangamumu, east Northland. It has also been found around the main New Zealand islands and the Chatham Islands, and it occurs in south-eastern Australia.

Anteaeolidiella lurana (Bergh, 1888) Fig. 20
Average animal length 15 mm. Individuals vary from orange to brown with orange stripes on the head and a series of white blotches down the back. It lives from mid-tide to depths of 11 m on rocky reefs in semi-sheltered localities. We have found it curled up with bryozoa under low tidal stones at Dog Island, Parengarenga Harbour. All our records are from the east side of northern New Zealand as far south as Birkdale and West Tamaki Head, Waitemata Harbour (Miller 1977). It is widespread in tropical and subtropical seas and is possibly an introduced species to New Zealand (Willan *et al.* 2010).

Baeolidia australis (Rudman, 1982) Fig. 20
Average animal length 20 mm. This colourful nudibranch has a brown body with numerous white spots. The white tipped cerata are banded with brown, crimson and gold. It can be identified by the white hexagonal marking on the head between the oral tentacles. The cerata are large and bulbous. It is found on open coasts on seaweeds where it likes to feed on the anemone *Cricophorus nutrix* (Willan & Morton 1984). We have one record from Tapeka Point, Bay of Islands on the brown seaweed *Carpophyllum*. It is also found in Australia.

Burnaia helicochorda (Miller, 1988) Fig. 20
Average animal length 20 mm. The body is translucent brown with horseshoe-shaped clusters of cerata. A distinctive feature is the pair of large club-like rhinophores. Only two specimens have been found in New Zealand, one at the Three Kings Islands and one at the type locality Goat Island Bay, Leigh. The habitat is on exposed rocky shores at low tide to 20 m depth (Willan *et al.* 2010). It also occurs in Australia.

Facelinidae

Phidiana milleri Rudman, 1980 Fig. 20
Average animal length 30 mm. An attractive nudibranch that is frequently noticed because it moves rapidly and often crawls on exposed surfaces. The slender, translucent body has orange around the head and tentacles. The orange cerata have white tips and are darkened centrally by branches of the digestive gland. This endemic species is predominantly intertidal, frequently found in intertidal pools, but extends to depths of 21 m (Willan and Morton 1984). We have scattered records from the east coast of Northland and it is more common around the Waitemata Harbour and on the Waitakere west coast. It occurs right around the North Island and south to Banks Peninsula.

Babakinidae

Babakina caprinsulensis (Miller, 1974) Fig. 21
Average animal length 15 mm. The body is pale mauve with an iridescent white rectangle on the head. The oral tentacles are white tipped with yellow. The club shaped-rhinophores arise from a common pedicle and are orange-brown also tipped with yellow. There is a narrow white line on the tail (MSM pers. obs.). The cerata are white, tipped with yellowish green (Miller 1974, as *Babaina*). All records of this endemic species are from the east coast of northern Northland. The type locality of this rare species is Goat Island Bay, Leigh. A second specimen was found under a stone in an intertidal pool at nearby Mathesons Bay (Morley 1987). We know of records from Tapeka Point, Bay of Islands in a depth of 17 m where a specimen was spawning, and Whangaroa Harbour, Northland (Kevin Burch pers. comm.).

Glaucinidae

Glaucus atlanticus Forster, 1777 Fig. 21
Average animal length 20 mm. This pelagic nudibranch amazes with its glowing colours of blue, silver and purple. The cerata are clustered on three pairs of lateral lobes, which assist its buoyancy. It floats upside-down on the surface of the water and remains afloat by periodically gulping air into its stomach. It feeds on Portuguese man-of-war, *Physalia physalis,* by-the-wind sailor *Velella velella* and the hydrozoan *Porpita porpita* (Willan and Morton 1984). It has been recorded washed up on both coasts of northern New Zealand. It is seasonally frequent in the Kermadec Islands and occurs world-wide in tropical and warm temperate zones.

Umbraculidae

Umbraculum umbraculum (Lightfoot, 1786) Fig. 21
Average animal length 120 mm. This uncommon side-gilled sea slug has a massively thiumbraculuckened body covered in tubercles. The body colour varies from grey to brown, yellow, reddish and orange (Willan *et al.* 2010). The flattened, oval shell perches on top. Its habitat is on open rocky reefs from intertidal down to 40 m. It has been found on the east coast of northern New Zealand as far south as East Cape (Te Papa Museum database). It is also found in all tropical and subtropical seas.

Velutinidae

Lamellaria ophione Gray, 1850 Fig. 22
Average animal length 18 mm. Although the soft body of this species is similar externally to a nudibranch it is not related (Powell 1979, p.150). The smooth body varies in colour from yellowish, orange, grey to white, to blend with its prey of ascidians and sponges. It has a fragile internal shell which is occasionally found in shell sand. This endemic species lives under rocks at low tide on exposed to sheltered coasts and is frequently seen on both sides of northern New Zealand. It appears to be most common in the Manukau Harbour, especially at Jenkins Bay, where it was found on the compound ascidian *Alyconium aurantium.* We know of one South Island record from Haast (Te Papa Museum database).

Onchidiidae

Onchidella nigricans (Quoy & Gaimard, 1835) Fig. 23
Average animal length 20 mm. The leathery sea slug is a pulmonate, it has no shell and as the common name suggests, has a tough granulated outer skin, often with papilli. It varies in colour from black to grey and maybe mottled with white, black, orange, green or yellowish-green (Willan *et al.* 2010). There are white marginal glands. It secretes a noxious fluid to deter predators. We have found it widespread in our studies on both coasts of Northland where it is most common on shaded muddy surfaces from mid to low tide. Occasionally on semi-exposed beaches it seeks shelter in disused isopod burrows (pers. obs.). It grazes on diatoms and other organic debris (Morton & Miller 1968, p 830). It is

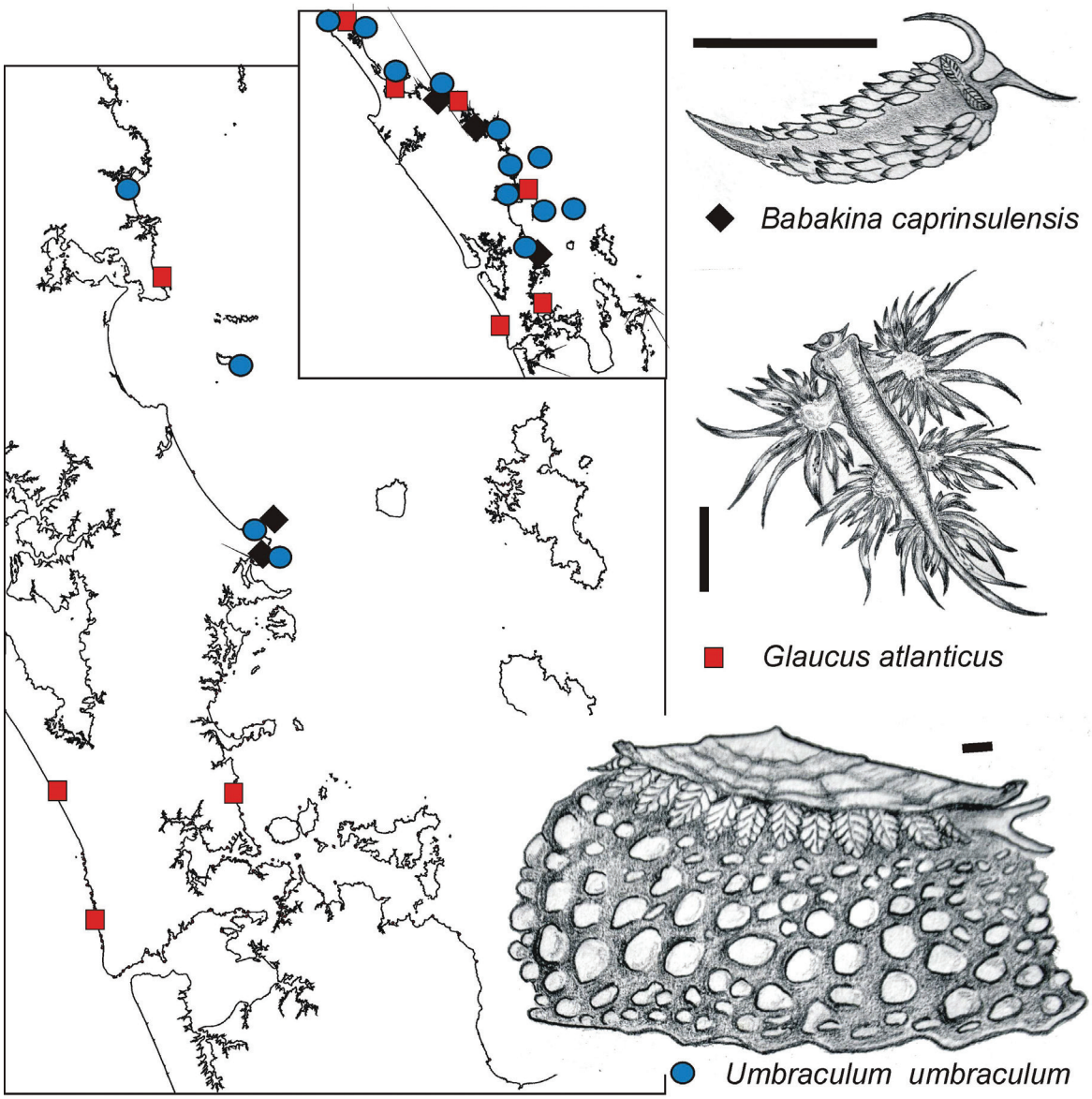


Figure 21. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Babakina caprinsulensis* (Leigh, Mathesons Bay), *Glaucus atlanticus* (Northland, Spirits Bay) and *Umbraculum umbraculum* (Bay of Islands, Long Beach). Scale bars 10 mm long.

found throughout New Zealand and also occurs on the southeast coast of Australia and Tasmania (Willan *et al.* 2010).

Fissurellidae

Scutus breviculus (Blainville, 1817) Fig. 24
A mollusc specialist would not class this as a 'sea-slug', but to the layperson it has a slug-like appearance and so we have included it here for completeness.

Average animal length 120 mm. The velvety black slug-like animal has a flattened, thickened shell which is almost entirely concealed by the mantle (Powell 1979). This shell is shield shaped and protects the heart and other vital organs. The eyes are at the outer bases of long tentacles. It can be found ocasionally under boulders, in deep crevices or overhangs at low tide on open to semi-exposed beaches. It is widespread throughout our study area on the east and west coasts. It is endemic, recorded from North, South and Chatham Islands.

DISCUSSION

Several small species of sea slug (less than 10 mm across) that have been recorded by others from the intertidal or shallow subtidal of northern New Zealand (e.g. *Okenia plana, Caldukia rubiginosa*) were not found in our surveys as their specific habitats were not targeted. Had they been present they may have gone unnoticed on account of their small size.

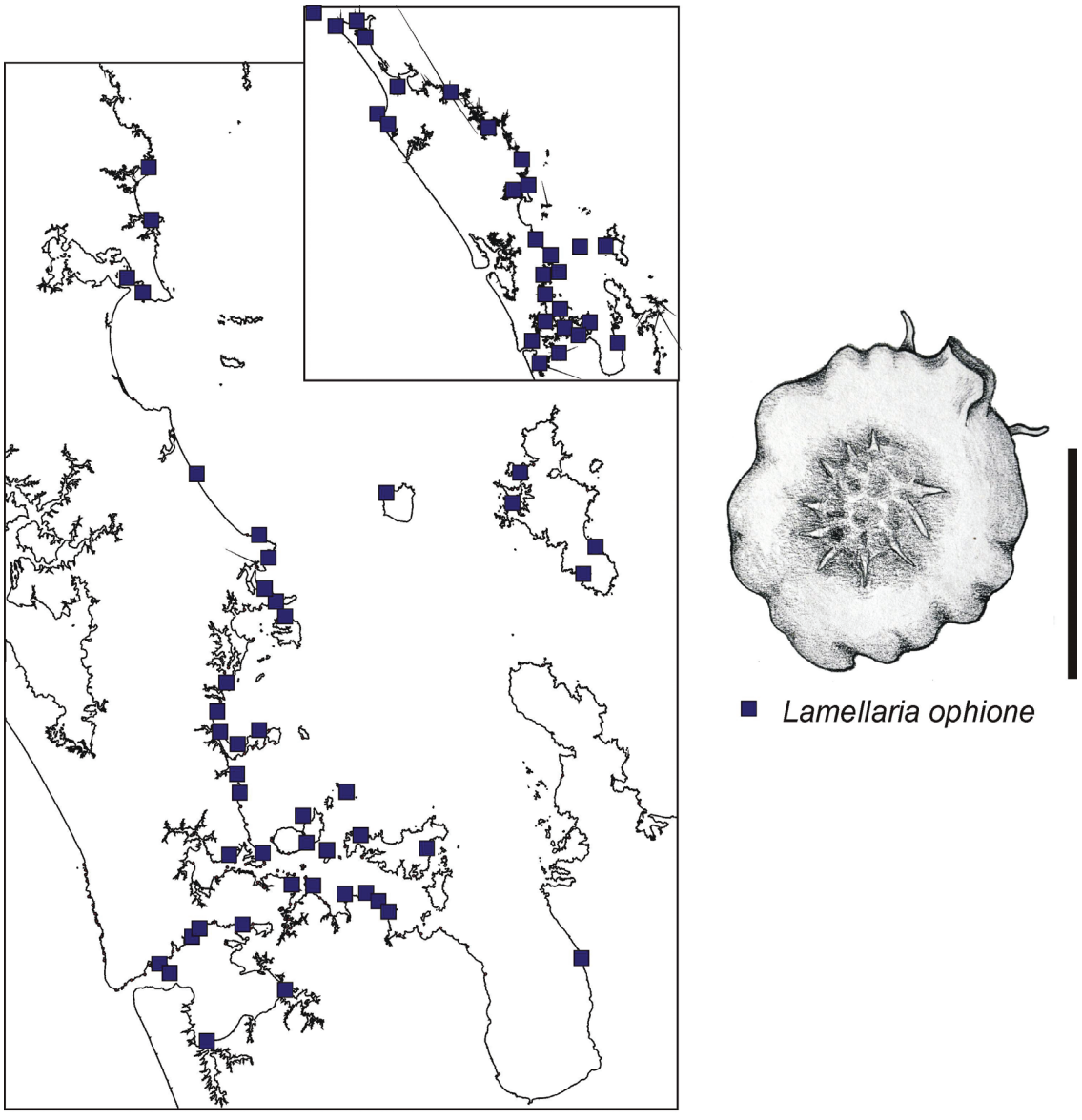


Figure 22. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Lamellaria ophione* (Whangaparaoa Peninsula, Red Beach). Scale bars 10 mm long.

Sporadic abundances

Our surveys confirm the observations of others about the unpredictability of the presence and size of populations of sea slugs at any one time or place (e.g., Enderby and Enderby 2005). The most frequently encountered intertidal nudibranch around northern New Zealand is *Dendrodoris citrina*, often as closely associated pairs or in numbers fewer than 20 on any one shore (pers. obs.).

Occasionally there have been short periods when large numbers of one sea slug species has been present along a short section of coastline. This has been the case for the green sea hare *Bursatella leachii* which has been seen in large numbers at intertidal and shallow subtidal depths on a number of occasions, often with wash ups of dying seaweed and cyanobacteria – e.g., Orakei Basin, autumn 1996 (Hayward and Hayward 1999); Blackpool and Whakanewha, Waiheke Island, March 1999 (MSM pers. obs.); Beachlands to the North Shore, Auckland, March-July 2000 (Morley *et al.* 2001); Tindalls Beach, Whangaparaoa, Feb 2015 (this study). The well-camouflaged *B. leachii* are first noticed by their bright green spawn, like tangled balls of knitting wool, which may lead to the discovery of the recently dead bodies of this sea hare, as they die after spawning (Morton and Miller 1968). Sea hares of the genus *Aplysia* are also known to occur sometimes in large numbers intertidally – e.g., *A. argus* and *A. keraudreni*, Mathesons Bay and Echinoderm Reef, Goat Island, Feb-March 1992 (A. Enderby, pers. comm. 2015); *A. parvula* grazing on brown algae at Leigh Marine Reserve in 1991, 1997, 1998, and 2004 (A. Enderby, pers. comm. 2015). Another sea slug to occur periodically in large numbers and that may result in dog poisonings when eaten by them, is *Pleurobranchaea*

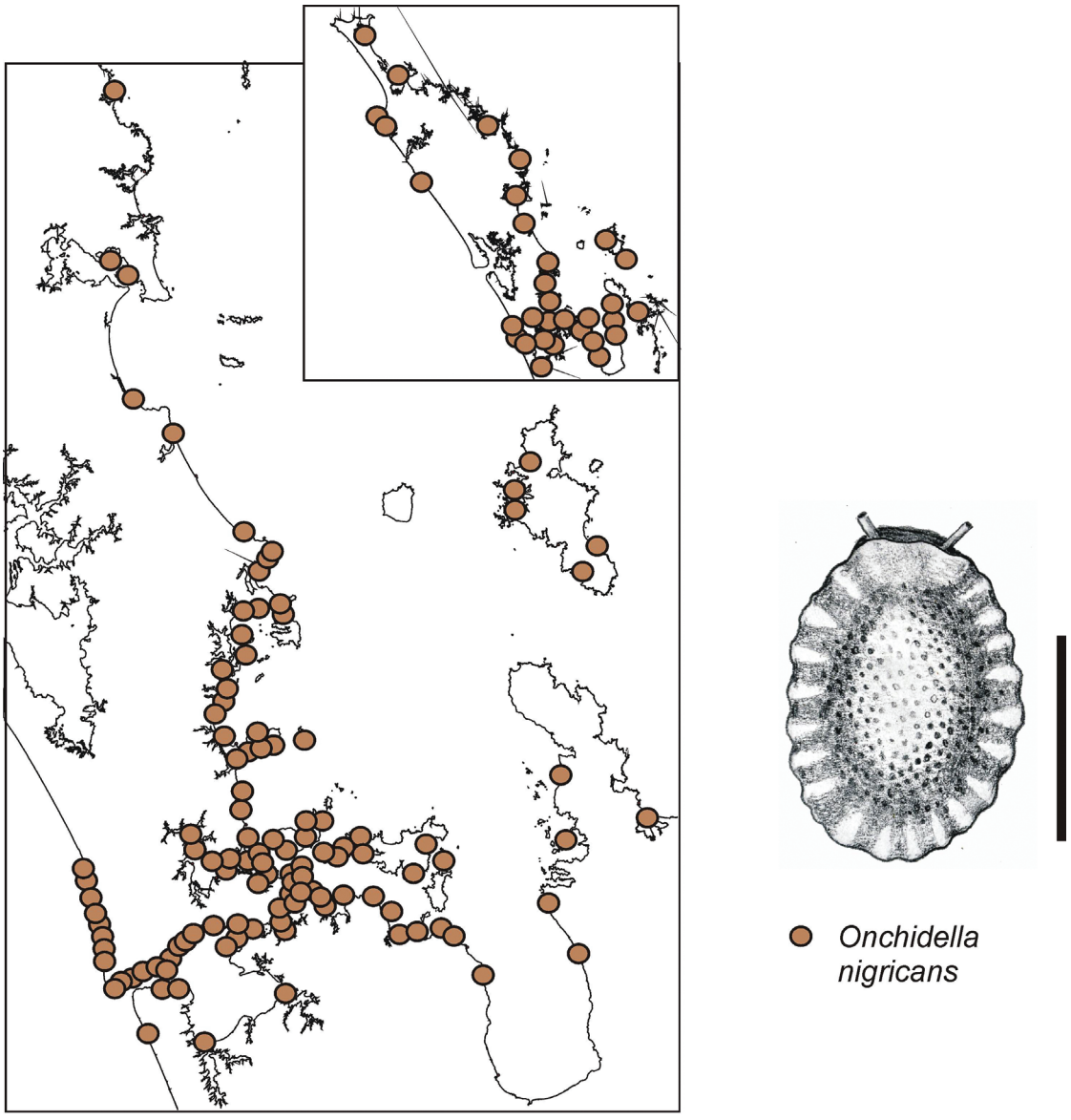


Figure 23. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Onchidella nigricans* (Waitemata Harbour, Eastern Beach). Scale bars 10 mm long.

maculata (Khor *et al.* 2014), which had a major increase in numbers along Auckland's North Shore beaches (pers. obs.) in the summer of 2009-2010 possibly as a result of an abundance of Asian date mussels just offshore (W. Blom pers. comm.). One other sea slug to be reported in large numbers is *Tritonia incerta* feeding on dead-man's fingers, *Alcyonium auranticum,* at Mathesons Bay and along the Leigh Marine Reserve coast in Feb 1992-1993 and again in Feb 2004 (A. Enderby, pers. comm. 2015).

Biodiversity

A total of 78 intertidal and shallow marine 'sea slug' species are recorded here from northern New Zealand. The majority are named but three rare taxa (e.g. *Aphelodoris* sp., *Elysia* n.sp., *Goniodoris* n.sp.) are probably undescribed new species. All species, except for *Goniodoris* n.sp., have been recorded from New Zealand previously.

Many other unnamed species of opisthobranch gastropods from New Zealand are recorded in Spencer *et al.* (2009). Of the 78 sea slug species, only three (*Aphelodoris* sp., *Flabellina albomarginata, Trinchesia reflexa*) have no intertidal record from the east coast of northern New Zealand and just 34 (44%) of the species are recorded from the west coast. The highest diversities from smaller geographic areas are 47 from around Leigh; 42 from the Bay of Islands; 38 from Great Barrier Island; 31 from Waitemata Harbour; 27 from Parengarenga Harbour; 24 from the Manukau Harbour; 19 from the Waitakere coast and 20 from Waiheke Island. The greater diversity in some areas reflects the intensity of survey (Leigh, Waitemata and Manukau Harbours, Waitakere coast) or diversity of habitats on the warmer east coast (Leigh area, Bay of Islands, Great Barrier and Parengarenga). Not surprisingly the

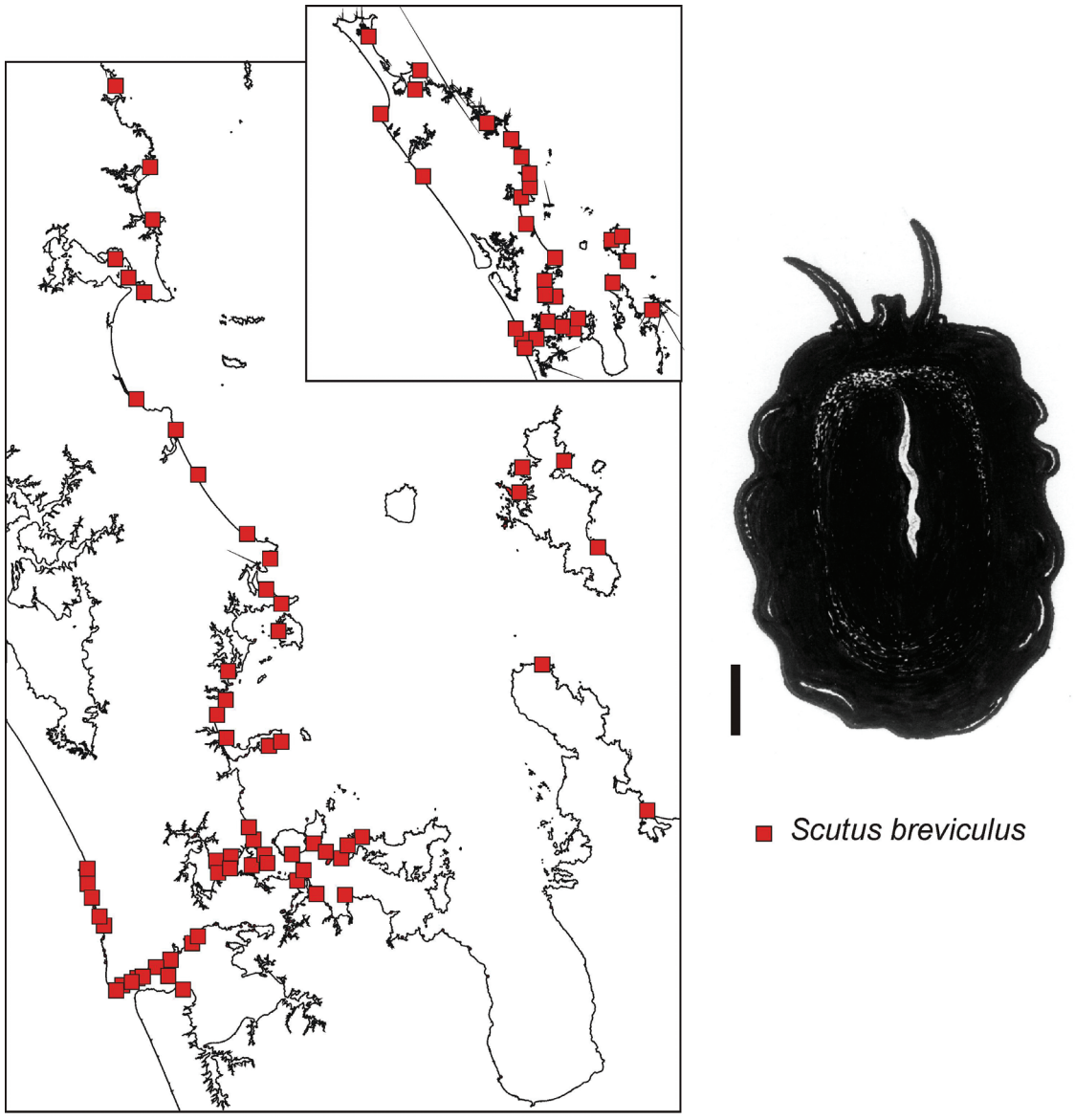


Figure 24. Intertidal and shallow subtidal (down to 2 m) distribution records around northern New Zealand of *Scutus breviculus* (Waitemata Harbour, Stanley Bay). Scale bars 10 mm long.

lowest diversities of sea slugs are around the sediment-dominated inner reaches of the major harbours and Firth of Thames where there is reduced habitat diversity (fewer hard rock substrates, seaweeds and sponges) and often a smothering with fine sediment.

Biogeography

Thirty-five species (45%) of the sea slugs recorded here from northern New Zealand are apparently endemic to New Zealand. Seven of these endemic species are restricted in their known occurrence to the north-east coast of northern New Zealand (Aupourian Province; Powell 1955). The next largest biogeographic groups are those whose distribution is Australasian (24%), cosmopolitan (18%) and IndoPacific (8%). A total of 39 species (50%) are restricted in their New Zealand occurrence to northern New Zealand (this study area), possibly including the Kermadec and Three Kings islands. Twenty-seven species (35%) of the sea slugs recored here are restricted in their New Zealand occurrence to the warmer Aupourian or Aupourian and Kermadecian provinces. A similar number (25 species) of sea slugs recorded here occur all around the main islands of New Zealand (Aupourian, Cookian and Forsterian provinces).

Many sea slugs appear to be well adapted to hitching lifts on boats and in the last few centuries many have extended their natural range by successfully establishing new populations in far off waters. In a number of instances it is difficult to be sure which sea slugs are native to New Zealand and which may be recent invasives. An example of definite human-assisted introduced sea slugs to northern New Zealand is *Dolabrifera brazieri* and possible human-assisted introduced are *Anteaeolidiella lurana* and *Polycera melanosticta*. At least one of our endemic species (*Philine auriformis*) has been introduced overseas (California, USA; Krug *et al.* 2012).

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APPENDIX 1: *(starts over the page)* **List of intertidal sites surveyed in northern New Zealand and their sea slug records.** * = Date of observations by MSM other than surveys; ** = observers other than the authors. Numbers prefixed with MA are specimens lodged in the Marine Department, Auckland War Memorial Museum. TP ** = records from the on-line Te Papa Museum database.

West Coast (north to south)

Cape Maria van Diemen, Jan 1969**. *L. ophione*

Twilight Beach, Dec 1983*. *R. oruaensis*

90 Mile Beach, Jan 1965**. *P. auriformis* (MA32954)

Ahipara, Nov 1994*, May 1999*, TP**. *A. luctuosa, A. argus* (MA140688), *C. thetidis, D. granulosa* (MA91075), *L. ophione, M. cylindrica* (MA29498), *O. nigricans, P. affinis, P. maculata, R. oruaensis* (MA140618), *S. breviculus*

Herekino, May 1999*. *B. quoyi, H. zelandiae, L. ophione, P. maculata* (MA140737), *O. nigricans* (MA140533), *R. oruaensis*

Hokianga, TP**. *R. oruaensis*

Kawerua, Jun 1993. *A. lanuginata* (MA79338), *Aphelodoris* sp. (MA131144), *B. quoyi, H. zelandiae, O. nigricans, P. maculata, S. breviculus, V. cinnabarea*

Muriwai-Collins Bay, Aug 1999, Sep 2000*, Jan 2002, Dec 2007*. *A. lanuginata* (MA118232), *Aphelodoris* sp., *D. granulosa* (MA103379), *D. wellingtonensis* (MA11824), *E. felina, F. albomarginata, G. atlanticus, O. nigricans, P. milleri, P. angasi, P. auriformis, R. muscula* (MA118233), *S. breviculus, T. incerta*

Powell Bay-Tirikohua Pt, Mar 1998, Aug 2003, May 2008. *Aphelodoris* sp., *D. wellingtonensis, E. felina* (MA115243, MA119044), *O. nigricans, S. breviculus*

Te Waharoa Bay, Jan 2001. *O. nigricans, S. breviculus*

Te Henga-O'Neills Bay, Jun 1999, Jun 2001. *O. nigricans* (MA140833), *S. breviculus*

Anawhata-Fishermens Rock Pt, Sep 1960**, Sep 1999. *E. agrius, O. nigricans, S. breviculus, T. beta, T. reflexa*

Whites Beach, Mar 2000. *E. felina, O. nigricans, S. breviculus*

North Piha, Nov 1962**, May 2001. *F. albomarginata, O. nigricans, T. reflexa*

South Piha-Lion Rock, Mar 1998, May 2001, TP**. *D. wellingtonensis, E. felina, E. agrius, F. albomarginata, F. pinnata, G. atlanticus, O. nigricans, P. milleri, T. reflexa*

Mercer Bay, Feb 1998. *O. nigricans*

Karekare Beach, Oct 1999. *O. nigricans*

Whatipu-Paratutae, Jan 2000, Sep 2001, Mar 2006, Sep 2006, Dec 2008. *Aphelodoris* sp. (MA81258, MA119060)), *E. felina* (MA108533), *F. albomarginata, H. zelandiae, O. nigricans, P. milleri* (MA108532), *R. muscula* (MA10851), *S. breviculus* (MA141950), *T. incerta*

Boulder Bay, Mar 2002, *D. granulosa, O. nigricans, R. muscula, S. breviculus*

Destruction Gully-Kaiteke Pt, May 1998, Jul 2000, Apr 2001. *A. lanuginata, Aphelodoris* sp. (MA103518), *D. wellingtonensis*, *E. felina* (MA117874), *O. nigricans, R. muscula, S. breviculus*

Huia Bay, Mar 1999*, May 2001, Dec 2001*, TP**. *A. lanuginata* (MA139473), *D. granulosa* (MA103381), *H. zelandiae, O. nigricans, P. angasi, R. muscula*, *S. breviculus*

Huia Pt-Kaitarakihi, Feb 1999, Sep 2001. *A. mollicella* (MA140815), *B. quoyi, H. zelandiae, L. ophione* (MA108534), *O. nigricans, S. breviculus*

Puponga Pt and Te Tau Bank, Nov 1994, May 2000, Aug 2001, TP**. *A. luctuosa, D. citrina, L. ophione, M. lorrainae, O. nigricans, P. angasi* (MA90365), *R. muscula, S. breviculus*

Cornwallis-Mill Bay, Feb 1996, May 1997**, Jul 2000, May 2008. *B. ornata, B. quoyii* (MA28094), *D. citrina* (MA102568, MA136851, MA142813), *H. zelandiae, O. nigricans, P. angasi* (MA142809) *R. muscula* (MA102575), *S. breviculus*

Mill Bay-Lawry Pt, Jul 2000. *Aphelodoris* sp., *D. citrina, M. cylindrica, H. zelandiae, O. nigricans, R. muscula*

Big Muddy Creek, Dec 2001. *B. quoyi, H. zelandiae, O. nigricans*

Laingholm, Kauri Pt, Botel Bay, Sep 2006, Nov 2008, Aug 2013. *E. maoria* (MA117913), *H. zelandiae, O. nigricans*

Jenkins Bay, Nov 2008. *B. quoyi, D. citrina, H. nodulosa* (MA118680), *L. ophione, O. nigricans, S. breviculus*

French Bay, June 2013. *H. nodulosa, H. zelandiae, O. nigricans, S. breviculus*

Oatoru Bay, Nov 2014. *L. ophione, O. nigricans*

Waikowhai, TP**. *H. zelandiae, O. nigricans*

White Bluff, Nov 2010. *O. nigricans*

Onehunga, Nov 2010, TP**. *L. ophione, O. nigricans*

Mangere Bridge, Mar 2013. *O. nigricans*

Ambury Park, Mar 2013, Nov 1994. *D. citrina* (MA90367), *H. zelandiae, O. nigricans*

Puketutu Is, Mar 2010. *H. zelandiae, O. nigricans*

Weymouth, Jun 2014. *H. zelandiae, L. ophione, O. nigricans*

Clarks Beach, Jan 2014. *H. zelandiae, L. ophione, O. nigricans*

Wattle Bay, 1995**, Oct 2005*. *H. zelandiae, M. lorrainae* (holotype MA 71314, paratypes MA73138; MA116833), *O. nigricans, P. angasi*

Orua Bay, 1956, Jan 1994**, TP**. *F pinnata* (MA118314), *R. oruaensis* (paratype, MA71977), *S. breviculus*

Big Bay, Feb 2015. *O. nigricans, S. breviculus*

Hamiltons Gap, Awhitu Peninsula, Mar 2004. *O. nigricans*

Kariotahi, TP**. *P. affinis*

East Coast (north to south)

Te Werahi, Dec 1983*. *U. umbraculum*

Spirits Bay, Dec 1950**, Mar 1996*, TP**. *A. argus, A. parvula, B. vernicosa, G. atlanticus* (MA130217), *L. ophione, R. oruaensis* (MA31522)

North Cape, TP**, *P. affinis*

Waikuku Beach, **. *U. umbraculum*

Parengarenga Harbour, Mar 1986*, Mar, Oct 1992*, Mar 1995**, Mar 1996, Sep 2005. *A. drusilla, A. lurana* (MA130006), *A. parvula, B. vernicosa, B. lineata* (MA16926), *B. leachii* (MA104386), *B. ornata, B. quoyi, C. amoenum, C. thetidus* (MA104435), *D. citrina* (MA77192), *G. aureomarginatus, H. physis, H. zelandiae, H. zonata, L. ophione, M. cylindrica, M. lorrainae* (MA116817), *O. nigricans, P. milleri* (MA77191), *P. angasi* (MA73137), *P. imperialis* (MA104471, MA104385), *P. taronga, R. muscula* (MA77193), *R. oruaensis* (MA130147), *S. breviculus,* (MA104449), *T. rudmani* (MA77194)

Rangaunu Bay, Nov 1999*, Feb 2001**, TP**. *C. thetidis, G. atlanticus* (MA105456), *H. physis* (MA30942), *H. zonata, L. ophione, O. nigricans, P. auriformis, R. oruaensis*

Rangiputa, Jul 1994**, Dec 1996**, Oct 2003. *A. luctuosa, H. physis* (MA139472), *H. zonata, M. cylindrica, U. umbraculum*

Cape Karikari, Feb 1978**, Apr 1987**, TP**. *A. parvula, B. lineata, B. quoyi, Elysia* n.sp., *G. atlanticus, S. breviculus*

Doubtless Bay, 1994**, TP**. *B. ornata, H. physis* (MA139472), *S. breviculus*

Taemaro Bay, **. *C. amoenum*

Taupo Bay, Apr 1988*. *D. brazieri, U. umbraculum*

Stephensons Island, TP**. *P. angasi*

Whangaroa, Aug 1961**, TP**. *B. caprinsulensis, C, thetidis, H. physis* (MA79668), *P. affinis, P. auriformis, R. oruaensis*

Tauranga Bay, TP**. *L. ophione, S. breviculus*

Mahinepua, **. *B. lineata*

Cavalli Islands, Nov 1974**, Jan 1979*, Feb 2004**, TP**. *B. lineata*, *C. thetidis, Elysia* n.sp., *F. pinnata, P. affinis, T. incerta*

Matauri Bay, May 1995. *G. atlanticus* (MA133953)

Bay of Islands, 1971**, Oct 1975**, 1992, Aug 1993, Oct 1994, Nov 1995, Aug 1996, Nov 1997, Dec 1998, TP**. *A. argus* (MA88892), *A. lanuginata* (MA77697), *A. luctuosa, A. lurana* (MA130006), *A. juliana, B. vernicosa, B. australis* (MA77695), *B. caprinsulensis, B. citrina, B. leachii, B. lineata, B. medietas* (MA140814), *B. ornata (*MA94796), *B. quoyii* (MA140242), *C. amoenum, C. thetidis, D. nigra* (MA90186), *D. brazieri, D. krusensternii, D. granulosa* (MA89607), *D. rubidus* (MA90186), *D. wellingtonensis, G. aureomarginatus, Goniodoris* n.sp., *H. physis, H. zelandiae* (MA133273), *J. novozealandicus; L. ophione* (MA133193), *O. nigricans, P. affinis, P. angasi, P. auriformis, P. milleri, P. powelli, P. taronga, P. maculata, R. muscula* (MA888831), *R. katipoides, R. oruaensis, R. zelandica, S. breviculus, T. incerta*

Whangamumu Harbour, Dec 1991*. *A. drusilla, A. juliana, D. citrina*

Taupiri, Apr 1979. *U. umbraculum* (MA32634)

Bland Bay, Jul 2003*. *A. argus, B. lineata, M. cylindrica, P. affinis, R. oruaensis*

Whangaruru, TP**. *M. cylindrica, P. auriformis, S. breviculus*

Whananaki, Dec 2000. *A. keraudreni* (MA104949), *B. citrina* (MA105891), *C. amoenum, C. thetidus* (MA165995), *D. brazieri, D. wellingtonensis, G. aureomarginatus* (MA105888), *H. zelandiae, L. ophione, O. nigricans, P. powelli, P. maculata* (MA105883), *S. breviculus*

Matapouri Bay, Feb 2003*, TP**. *B. lineata, A. parvula* (MA113509), *A. lanuginata* (MA113511)

Tutukaka, Feb 2003**, TP**. *A. luctuosa* (MA113513), *A. parvula* (MA113509), *B. lineata, H. physis, S. breviculus, U. umbraculum*

Poor Knights Islands, Dec 1977**, 1980*, Mar 1984**, TP**. *B. citrina, C. rubiginosa, C. thetidis, C. willani, D. citrina, Elysia* n.sp., *J. novozealandicus, P. dendritica, R. katipoides, R. oruaensis, R. zelandica, T. rudmani*

Whangaumu Bay, Dec 1991*, May 2013. *Aeolidiella* sp., *B. quoyi, C. thetidis, D. citrina, R. katipoides*

Pataua, Sep 2013 *B. citrina, B. quoyi, D. citrina, L. ophione, R. katipoides, S. breviculus,*

Taiharuru, TP**. *D. brazieri, M. lorrainae*

Ocean Beach, TP**. *G. atlanticus, T. beta*

Whangarei Harbour, 1931**, May 1962**, May 1967**, Apr 2012, TP**. *A. lanuginata, A. mollicella* (MA114018), *B. citrina, B. leachii, B. lineata, B. quoyi, C. amoenum, D. citrina, D. rubidus, H. zelandiae, J. novozealandicus, J. pantherina, L. ophione, O. nigricans, P. imperialis* (MA79667), *P. maculata, R. katipoides, R. muscula* (MA114017), *R. oruaensis, S. breviculus, , U. umbraculum*

Whangarei Heads, TP**. *P. affinis*

Hen Island, TP**. *M. cylindrica, U. umbraculum*

Chicken Islands, Jan 1982*. *C. thetidis, P. affinis*

Mokohinau Islands, Dec 1977**, TP**. *Elysia* n.sp., *U. umbraculum*

Waipu Cove, May 2013. *O. nigricans, S. breviculus*

Mangawhai Heads, Mar 2014. *C. thetidis, A. juliana* (MA120614), *O. nigricans, P. maculata, S. breviculus,*

Te Arai Pt, Sep 2012, TP**. *A. keraudreni, A. luctuosa* (MA120094), *C. thetidis, D. wellingtonensis*, *L. ophione, P. affinis, S. breviculus*

Little Barrier Island, 1992**, TP**. *C. thetidis, L. ophione, T. incerta*

South Pakiri Beach, Mar 2011. *O. nigricans, S. breviculus*

Goat Island Bay, Leigh, Oct 1961**, Sep 1972, Sep 1991**, May 1999, TP**. *A. argus, A. keraudreni, A. luctuosa, A. lanuginata, A. molesta, A. parvula, B. caprinsulensis, B. citrina, B. helicochorda, B. leachii, B. ornata, C. amoenum, C. rubiginosa, C. thetidis, C. willani*, *D. brazieri, D. granulosa, D. nigra, D. wellingtonensis, E. agrius* (MA83724*), E. felina, E. maoria, G. aureomarginatus, J. novozealandicus, J. pantherina, M. cylindrica, O. plana, P. affinis, P. maculata, R. katipoides, R. muscula, S. longicauda, S. smaragdinus, T. incerta, U. umbraculum, V. cinnabarea*

Mathesons Bay, 1980s*, Feb 1992**, May 1999**, Jul 2000. *A. argus, A. juliana, A. keraudreni, A. molesta, B. vernicosa, B. caprinsulensis*, *B. leachii, B. medietas* (MA118906)*, B. ornata, B. quoyi, D. brazieri, D. citrina, D. wellingtonensis, G. aureomarginatus, L. ophione, M. cylindrica, O. nigricans, P. maculata, S. breviculus, T. incerta, U. umbraculum*

Ti Pt-Whangateau Harbour, May 1999**, Mar 2010**, May 2012, Sep 2012, Jan 2013. *B. leachii, F. pinnata* (MA120397), *H. zelandiae, M. lorrainae, O. nigricans, P. affinis, P. maculata* (MA30818)

Sth end Omaha Beach, Nov 2010. *B. quoyi, C. thetidis, L. ophione, P. maculata, S. breviculus,*

Takatu Peninsula, Nov 1977**. *J. novozealandicus*

Jones Bay to Scow Pt, Tawharanui, Aug 2011. *A. lanuginata* (MA119611)*, B. ornata* (MA119612)*, B. quoyi, C. thetidis, L. ophione, O. nigricans, P. maculata, S. breviculus*

Christian Bay, Feb 2014. *A. argus, B. citrina, B. quoyi, C. amoenum, D. nigra, H. zelandiae, O. nigricans, P. maculata*

West Baddeleys Beach, Oct 2012. *B. ornata, B. quoyi, C. amoenum, D. nigra, M. cylindrica, O. nigricans*

Kawau Island, 1994*, Sep 2011, TP**. *A. argus, A. lanuginata, A. parvula, B. leachii* (MA79648), *B. quoyi, C. amoenum*, *H. nodulosa, L. ophione, O. nigricans, P. affinis, P. angasi, P. maculata, S. breviculus*

Snells-Algies Bays, Sep 2014. *B. vernicosa, O. nigricans, R. muscula*

Martins Bay, Sep 2014. *B. quoyi, M. cylindrica* (MA120699), *O. nigricans, P. affinis*

Scott Pt, Mahurangi Harbour, Jun 2001*, Jun 2011. *B. quoyii* (MA107140), *C. amoenum, D. krusensternii, H. zelandiae, M. cylindrica, O. nigricans*

Opahi, Mahurangi Harbour, Aug 2013. *A. argus* (MA140688), *B. leachii, B. quoyi, D. citrina, L. ophione, O. nigricans, R. muscula, S. breviculus*

Cudlip Pt, Mahurangi Heads, Aug 2005, Jan 2010. *B. ornata* (MA116813), *B. leachii, B. quoyi, D. citrina, D. nigra, D. granulosa* (MA116814)

Te Muri Beach, Jan 2012. *A. argus, B. quoyi, H. zelandiae, O. nigricans, P. affinis*

Wenderholm-Waiwera, Jun 1963**, Sep 1974**, Jun 2001, Aug 2006, Jun 2012. *B. ornata* (MA107049) *B. leachii, B. quoyi, D. citrina* (MA119986)*, D. krusensternii, D. nigra* (MA107050), *D. pita*, E. *felina* (MA117912), *H. zelandiae, L. ophione, O. nigricans, R. katipoides* (MA117915), *S. breviculus, T. bractea*

Nth Orewa Beach, Jun 2000. *B. quoyi, L. ophione, M. cylindrica, O. nigricans, P. auriformis, S. breviculus,*

Red Beach, Jun 2008, Jul 2014. *A. lurana* (MA118987), *D. krusensternii, E. maoria, L. ophione, O. nigricans, P. affinis, R. muscula* (MA119020), *S. breviculus*

Manly-Stanmore Bay Pt, Jun 2005. *A. lanuginata, B. quoyi, C. amoenum, D. nigra, D. granulosa*

Tindalls Beach, 2002*, Feb 2015. *B. leachii* (MA110910)

Fishermans Rock-Coalmine Bay, Jul 2006, Jun 2007. *B. ornata, B. quoyi, D. citrina, L. ophione, O. nigricans*

Army Bay, Whangaparaoa Peninsula, May 1999. *A. argus, A. juliana, B. leachii, B. quoyi, D. citrina, D. nigra, M. cylindrica*

Tiritiri Island, Apr 1931**, Mar 2011, TP**. *A. argus, A. parvula, C. thetidus, D. citrina, E. maoria* (MA78488), *G. aureomarginatus, O. nigricans, P. maculata, T. incerta,* (MA78598)

East Shakespeare Bay, Feb 2010. *B. quoyi, D. krusensternii, D. nigra, O. nigricans, S. breviculus*

West Okoromai Bay, Dec 2011. *B. quoyi, C. amoenum, D. citrina, D. granulosa* (MA119768), *H. zelandiae, O. nigricans, S. breviculus*

Matakatia Bay and islet, Aug 2010. *B. quoyi, C. amoenum, D. citrina, D. nigra, H. zelandiae, M. cylindrica, O. nigricans, P. maculata*

Little Manly, May 2006. *B. quoyi, D. citrina, D. nigra, O. nigricans*

Arkles Bay, Oct 2010. *B. ornata, B. quoyi, C. amoenum, D. citrina, D. nigra, M. cylindrica, O. nigricans*

Long Bay, TP**. *L. ophione*

Nth end Torbay, Oct 2003, Apr 2001, TP**. *B. ornata, B. leachii, D. citrina, D. krusensternii, D. nigra, D. granulosa, L. ophione, O. nigricans*

Murrays Bay-Tarata Pt, Jun 2007. *B. quoyi, D. citrina, D. krusensternii, M. cylindrica* (MA117883)*, O. nigricans, R. muscula*

Mairangi Bay, *. *G. atlanticus*

Castor Bay, Feb 1998. *B. quoyi, M. cylindrica, S. breviculus*

Takapuna Reef, 1931**, Oct 1937**, Oct 1960**, Apr 1997, 1999, Jul 2010, TP**. *A. mollicella* (MA118714), *B. ornata, D. citrina, D. krusensternii, D. nigra* (MA135666)*, E. maoria* (MA70259)*, M. cylindrica* (MA70455), *O. nigricans, P. milleri, S. breviculus, T. beta*

Nth Narrow Neck Beach, Dec 1958**, Feb 2009. *B. quoyi, D. citrina, D. nigra, L. ophione, O. nigricans, P. maculata, S. breviculus, T. beta*

Takapuna Head, Aug 2006, Feb 2009. *A. mollicella, B. quoyi, O. nigricans, S. breviculus*

Cheltenham Beach-North Head, 1938**, May 2011, TP**. *B. quoyi, D. citrina, D. nigra, H. zelandiae, O. nigricans, P. angasi, P. auriformis* (MA31507), *S. breviculus*

Torpedo Bay, 2001*, Sep 2005. *B. ornata, D. citrina, O. nigricans, P. maculata, S. breviculus*

Devonport Naval Base, Jul 1961**, May 1969**. *J. novozealandicus, P. melanosticta, T. beta, T. reflexa*

Stanley Pt, Jun 1998, Nov 2004. *B. ornata* (MA114106, MA136696), *B. quoyi, D. granulosa, O. nigricans, P. maculata, S. breviculus*

Northcote-Birkenhead, Jul 1996, Mar 2010, Jun 2010. *A. luctuosa, B. quoyi, D. citrina, H. zelandiae, L. ophione, M. cylindrica, O. nigricans, S. breviculus*

Chelsea-Kauri Pt, Aug 2006. *B. quoyi, D. citrina* (MA117879)*, D. nigra, D. granulosa, E. maoria* (MA117880), *O. nigricans, P. maculata, S. breviculus*

Rangitoto Lighthouse, Mar 2002. *O. nigricans*

Rangitoto wharf, Jan 2014. *D. nigra, O. nigricans, S. breviculus*

Islington Bay, Rangitoto, May 1930**. *B. quoyi, D. citrina* (MA76185), *E. maoria* (MA78320), *H. zelandiae, O. nigricans*

Bird Islands, Motutapu Island, Mar 2014. *B. ornata, B. quoyi, D. citrina, D. nigra, H. zelandiae, L. ophione, O. nigricans*

Emu Bay, Motutapu Island, Apr 2013. *D. citrina, D. nigra, O. nigricans, S. breviculus*

Station Bay, Motutapu Island, Feb 2012. *B. quoyi, D. citrina, O. nigricans, P. maculata*

Otata Is, Noises Group, Jun 2007**. *A. luctuosa* (MA36464), *T. rudmani*

Nth end Motuihe Island, Jan 2000, Mar 2010. *A. luctuosa, B. quoyi, D. citrina, L. ophione, O. nigricans, P. auriformis* (MA119218), *P. maculata, S. breviculus*

Ocean and West beaches, Motuihe Island, Jun 2010. *M. cylindrica, P. maculata*

Browns Island, Jan 2000. *B. quoyi, D. citrina* (MA105071), *O. nigricans, S. breviculus*

Crusoe Island, Sep 2009. *A. luctuosa* (MA118956)*, D. citrina, O. nigricans, P. milleri* (MA118955)*, P. maculata, S. breviculus*

Motukaha Island, Waiheke Is, Aug 2009. *Aphleodoris* sp. (MA118998), *D. citrina, O. nigricans, P. maculata* (MA118947), *S. breviculus*

Enclosure and W Bays, Waiheke Is, Apr 1995*, Mar 1997*. *A. argus, B. leachii, B. quoyi, L. ophione, S. breviculus*

Church Bay, Waiheke Is, Apr 1995*. *P. maculata*

Oneroa, Waiheke Is, Jan 1987*, Feb 1988*, Jul 1988*, Dec 1989*, Apr 1995*, Sep 1999*, Aug 2009*, Jan 2014*. *A. luctuosa, B. ornata, B. quoyi, D. citrina, D. granulosa, E. maoria, H. zelandiae, L. ophione, M. cylindrica* (MA29498), *O. nigricans, P. affinis, P. milleri, P. maculata, R. muscula, R. oruaensis, S. breviculus*

Kennedy Pt, Waiheke Is, Mar 2009. *B. leachii, B. quoyi, D. citrina, O. nigricans*

Te Matuku Bay, Waiheke Is, Sep 1996. *B. quoyi, H. zelandiae, O. nigricans* (MA133334)*, P. maculata*

Man o'War Bay, Waiheke Is, Aug 2009. *B. quoyi, L. ophione, O. nigricans, P. maculata*

Rotoroa Island, Oct 2007. *P. angasi* (MA119011), *B. quoyi, O. nigricans*

Herald Is, Waitemata Harbour, Mar 2013. *O. nigricans*

Te Atatu Peninsula, Waitemata Harbour, Mar 2013. *O. nigricans*

Pt Chevalier, TP**. *H. zelandiae*

Meola Reef, Waitemata Harbour, May 1930**, Sep 1994, Jun 1996, Oct 2005. *A. luctuosa* (MA78278), *B. ornata, B. quoyi, D. citrina, D. krusensternii, D. nigra* (MA130899), *D. granulosa, J. pantherina* (MA131859), *O. nigricans, P. milleri, P. maculata* (MA87095)*, S. breviculus*

Herne Bay, Nov 1994**, Feb 1996**, TP**. *B. leachii* (MA130530), *B. quoyi, H. zelandiae* (MA92033), *M. cylindrica*

Watchman Island, Waitemata Harbour, May 1997. *B. ornata, D. citrina, O. nigricans, S. breviculus,*

Fitzpatrick Bay, Waitemata Harbour, Jun 1996. *A. lurana* (MA131290)

Hobson Bay, Jun 1998. *B. leachii, O. nigricans*

Orakei Basin, Sep 1991*. *B.leachii* (MA75226)

Okahu Bay, Jun 1998*. *B. ornata, D. citrina, O. nigricans*

Mission Bay-St Heliers, May 1997. *D. citrina, D. krusensternii*

St Heliers-W Tamaki Pt, Oct 1960**, 2004. *B. medietas* (MA115126)*, B. ornata, D. citrina, J. pantherina, O. nigricans, S. breviculus*

West Tamaki Pt, Jul 2004, Sep 2004, Mar 2006. *A. lanuginata, A. lurana, B. quoyi, D. citrina, M. cylindrica, O. nigricans, P. maculata, R. muscula*

Karaka Bay-Glendowie, Aug 2002, 2003, 2004, Jul 2010 *A. mollicella* (MA113210), *A. lanuginata* (MA114105), *B. leachii* (MA102567), *B. medietas, B. quoyi, D. citrina, H. zelandiae, M. cylindrica* (MA114102)*, O. nigricans, R. muscula*

Tahuna Torea-Point England, Tamaki Estuary, Oct 2002, Jan 2003 *B. leachii, B. quoyi, D. citrina, H. zelandiae, O. nigricans, P. auriformis* (MA112619), *P. maculata, P. taronga*

Upper Tamaki Estuary, Sep 2003. *H. zelandiae, O. nigricans*

Halfmoon Bay, Tamaki Estuary, Jun 2002. *D. citrina* (MA111352), *H. zelandiae, O. nigricans*

Panmure Bridge-Half Moon Bay, Oct 1986*, Sep 1988*, Jul 2002, Jun 2003 *D. citrina, H. zelandiae, M. cylindrica, O. nigricans, P. auriformis, P. taronga*

Little Bucklands-Bucklands Beach, Apr 2003. *B. ornata, B. leachii, B. quoyi, D. citrina, D. nigra, E. maoria, H. zelandiae, M. cylindrica, O. nigricans, P. milleri, P. maculata, R. muscula*

Bucklands Beach-Musick Pt, Feb 1995*, Jul 2000*, Apr 2003, Oct 2003, Mar 2006, Aug 2010. *P. auriformis* (MA119275). *A. lanuginata, B. leachii, B. quoyi, D. citrina, D. nigra, E. maoria* (MA92806)*, H. zelandiae, M. cylindrica, O. nigricans, P. auriformis, P. maculata* (MA102566)*, P. taronga, R. muscula*

Musick Pt-Eastern Beach, Aug 2004, Sep 2006, Sep 2007*, Dec 2007*, Aug 2010, Apr 2011 *A. mollicella, B. ornata, B. quoyi, D. citrina, D. krusensternii* (MA119595)*, D. nigra* (MA118313), *L. ophione, O. nigricans, R. muscula, T. bractea* (MA118155)

Eastern Beach Sth end, Jun 2014. *A. mollicella, B. leachi, D. krusensternii, D. nigra, M. cylindrica, O. nigricans*

Mellons Bay, Feb 2005, 2010**. *A. mollicella, B. leachii, B. quoyi, D. krusensternii, D. nigra, H. zelandiae, O. nigricans, S. breviculus*

Howick Beach, May 1954**, Nov 1999, Jan 2000, Oct 2006, Jul, Aug 2012. *B. leachii* (MA142020)*, B. quoyi, D. densioni* (MA117928)*, D. nigra, H. zelandiae, L. ophione* (MA104746), *O. nigricans, P. milleri, R. muscula*

Howick Beach-Cockle Bay, Aug 2011. *B. leachii D. krusensternii, D. nigra, H. zelandiae, M. cylindrica, O. nigricans, R. muscula*

Mangemangeroa Estuary, **. *P. dendritica* (MA120714)

Motukaraka Island, Beachlands, Sep 1997, Feb 2014, *B. quoyi, D. citrina, D. nigra, H. zelandiae, L. ophione, M. cylindrica, O. nigricans, P. maculata, R. muscula, S. breviculus*

Omana, Mar 2003, 2004*. *B. leachii* (MA115213), *B. quoyi, D. citrina* (MA115214), *H. zelandiae*

Maraetai Pt, Mar 2001. *B. leachii, L. ophione, R. muscula*

Maraetai, Magazine Pt, Aug 2014. *B. quoyi, D. citrina, D. krusensternii, L. ophione, O. nigricans, R. muscula*

Nth side Duders Regional Park, May 2003. *B. leachii, B. quoyi, D. nigra, L. ophione, O. nigricans, R. muscular*

Mataitai Bay, Mar 2015. *D. citrina*

Pouto Pt, Mar 2007. *O. nigricans*

West end Kawakawa Bay, Mar 2006. *B. quoyi, D. citrina, O. nigricans*

East end Kawakawa Bay, Jun 2004. *D. citrina, H. zelandiae, O. nigricans, P. maculata*

Nth Orere Pt, Apr 2015. *D. krusensternii*

Sth Orere Pt, May 2005. *B. quoyi, D. citrina, R. muscula, O. nigricans*

Matingarahi Pt, Firth of Thames, Jun 2007. *O. nigricans*

Great Barrier Island and Coromandel Peninsula

Whangapoua, Great Barrier Is, Jun 2000, Mar 2002, TP**. *A. lanuginata* (MA111094), *A. parvula* (MA111092)*, B. citrina* (MA111093), *B. lineata, B. quoyii* (MA111635), *C. thetidis, H. zelandiae* (MA103110), *S. breviculus* (MA110813)

Rakitu Is, Great Barrier, Jan 1981*, TP**. *P. affinis*

Katherine Bay-Kawa, Great Barrier Is, Mar 2002. *B. citrina* (MA110228), *B. leachii, B. quoyi, C. amoenum, O. nigricans, R. oruaensis, S. breviculus*

Port Abercrombie, Great Barrier Is, Jan 1991*, Dec 1992, Mar 2002. *B. vernicosa, B. citrina, B. leachii, B. quoyi, C. amoenum, L. ophione*

Fitzroy, Great Barrier Is, Dec 1993. *A. luctuosa* (MA80958), *G. aureomarginatus, P. angasi, P. auriformis*

Kaikoura Is, Great Barrier Is, 1995*, Dec 2009. *D. brazieri, D. citrina, D. krusensternii, O. nigricans, S. breviculus*

Oneura Bay, Great Barrier Is, Mar 2002. *B. ornata, B. leachii* (MA1100912)*, B. quoyi, C. amoenum, D. nigra, D. granulosa* (MA110922)*, H. zelandiae, O. nigricans, R. muscula*

Rangiahua Is, Great Barrier. Jan 1985*, 1991*. *C. thetidis, C. willani, P. affinis*

Blind Bay, Great Barrier, Dec 1986*. *A. argus*

Schooner Bay, Great Barrier Is, Nov 2005. *A. luctuosa, C. thetidis, D. nigra, R. muscula*

Tryphena, Great Barrier Is, Feb 1991*, TP**. *A. lanuginata, B. ornata, B. quoyi, C. amoenum, C. thetidis, D. brazieri, D. nigra, D. wellingtonensis, H. zelandiae, L. ophione, M. cylindrica, O. nigricans, R. oruaensis, S. breviculus*

Medlands, Great Barrier Is, Dec 1981*, Feb 2004. *A. luctuosa* (MA114993)*, A. parvula, B. lineata, B. ornata* (MA114999)*, B. quoyi, L. ophione, O. nigricans* (MA114997)*, R. oruaensis* (MA116696), *S. breviculus*

Cuvier Island, TP**. *C. thetidis*

Whangapoua-Mahurangi, east Coromandel Peninsula, Jun 2000. *A. keraudreni, O. nigricans, S. breviculus* (MA103156)

Kuaotunu, east Coromandel Peninsula, Mar 1946**. *A. parvula*

Whitianga, east Coromandel Peninsula, 2010**. *P. maculata*

Hahei, east Coromandel Peninsula, Dec 2000**. *A. luctuosa* (MA116991), *C. rubiginosa*

Hot Water Beach, TP**. *P. affinis*

Pauanui, east Coromandel Peninsula, Nov 2007*. *A. lanuginata* (MA30167)

Opoutere, east Coromandel Peninsula, 2005**. *F. pinnata* (MA118314), *M. cylindrica, R. katipoides*

Fletchers Bay, Coromandel Peninsula, Dec 2013. *B. ornata, B. citrina*

Waitete Bay, west Coromandel Peninsula, Jan 2013. *B. citrina, O. nigricans*

Wyuna Bay-Little Passage, west Coromandel Peninsula, Jan 2013. *B. leachii, B. quoyi, O. nigricans, P. angasi, P. auriformis* (MA120174)

Wilson Bay, west Coromandel Peninsula, Dec 2013. *D. citrina, O. nigricans*

Te Mata, west Coromandel Peninsula, Oct 2014. *L. ophione, O. nigricans*

APPENDIX 2: Summary of distribution and features of intertidal and shallow subtidal sea slugs of northern New Zealand. The known New Zealand-wide distribution of each species is given in terms of New Zealand biogeographic provinces of Powell (1955) and listed in Spencer *et al.* (2014). E = Endemic to New Zealand. Biogeography: Aus = Australasian; Cos = cosmopolitan in warm waters; E = NZ endemic; IP = Indo-Pacific; Pac = Pacific; SP = South Pacific; Shell: Ext = easily seen externally; Int = internal and not seen externally

Taxon	Biogeography	Kermadecian	Aupourian	Cookian	Forsterian	Moriorian	Antipodean	Animal colour	Shell	Figure
Acteonidae										
Pupa affinis (Hutton, 1873)	Cos		A	C				Creamy white	Ext	1
Bullinidae										
Bullina lineata (Gray, 1825)	IP	K	A					Cream with blue margin	Ext	1
Aplustridae										
Hydatina zonata (Lightfoot, 1786)	IP		A						Ext	1
Hydatina physis (Linnaeus, 1758)	Cos	K	A					Pink	Ext	1
Cephalaspidea: Cylichnidae										
Cylichna thetidis Hedley, 1903	Aus	K	A	C					Ext	2
Philinidae										
Philine angasi (Crosse and Fischer, 1865)	Aus	K	A	C				White	Int	2
Philine auriformis Suter, 1900	E		A	C	F			White	Int	2
Retusidae										
Retusa oruaensis (Webster, 1908)	E		A	C	F	M		Creamy white		2
Aglajidae										
Melanochlamys cylindrica Cheeseman, 1881	E		A	C	F		An	Black	Int	3
Melanochlamys lorrainae (Rudman, 1968)	E		A	C				White to grey	Int	3
Philinopsis taronga Allan, 1933	Aus		A					Brown with yellow spots	Int	3
Runcinidae										
Pseudoilbia zelandica Miller and Rudman, 1968	E		A					Black longitudinal bands, white front and back	Int	3
Runcina katipoides (Miller and Rudman, 1968)	E		A					Dk grey, with red central stripe	Int	3
Runcinella zelandica Odhner, 1924	E		A					Dk green with irregular pink bands and white splotches	Int	3
Bullidae										
Bulla vernicosa (Pilsbry, 1893)	SP	K	A						Ext	4
Bulla quoyii Gray, 1843	Aus		A	C					Ext	4

Taxon	Biogeography	Kermadecian	Aupourian	Cookian	Forsterian	Moriorian	Antipodean	Animal colour	Shell	Figure
Haminoeidae										
Haminoea zelandiae (Gray, 1843)	E		A	C				Dark grey	Ext	5
Aplysiomorpha: Aplysiidae										
Aplysia argus (Ruppell and Leuckart, 1830)	Cos	K	A					Olive green, with black reticulate lines	Int	6
Aplysia juliana (Quoy and Gaimard, 1832).	Cos		A	C	F			Choc brown to black, with white spots	Int	6
Aplysia keraudreni Rang, 1828	SP		A	C	F			Kelp brown with white mottles, black netted lines	Int	6
Aplysia parvula Guilding, 1863	Cos		A	C	F			Kelp brown with white dots	Int	6
Bursatella leachii Blainville, 1817	Pac		A	C				Brownish-green, black speckles, emerald green patches	No	7
Dolabrifera brazieri G.B. Sowerby, 1870	Aus	K	A					Green marbled brown, white and pink	Int	7
Stylocheilus longicauda Quoy and Gaimard, 1832	Cos		A					Green with brown lines and spots ringed with black	No	7
Sacoglossa: Limapontiidae										
Ercolania felina (Hutton, 1882)	E		A	C	F			Grey-black, central white stripe	No	8
Stiliger smaragdinus Baba, 1949	Pac		A					Bright green	No	8
Placida dendritica (Alder and Hancock, 1843)	Cos		A	C	F		An	Green	No	8
Placobranchidae										
Elysia maoria Powell, 1937	Aus		A	C				Dark green	No	8
Elysia n.sp.	Aus		A					Pale green with blue spots & bright blue-green margin	No	8
Pleurobranchomorpha: Pleurobranchidae										
Berthella medietas Burn, 1962	Aus		A	C	F	M	An	Orange to bronze	Int	9
Berthella ornata (Cheeseman, 1878)	E		A	C	F	M		Cream-white with dark red-brown blotches	Int	9
Berthellina citrina (Ruppell and Leuckart, 1828)	IP		A	C				Orange to pale yellow or red	Int	9
Pleurobranchaea maculata (Quoy and Gaimard, 1832)	IP		A	C	F			Grey to black with dark wavy lines	No	10
Nudibranchia: Cadlinidae										
Cadlina willani Miller, 1980	E		A	C				White with central yellow stripe and border	No	11

Taxon	Biogeography	Kermadecian	Aupourian	Cookian	Forsterian	Moriorian	Antipodean	Animal colour	Shell	Figure
Chromodorididae										
Ceratosoma amoenum (Cheeseman, 1886)	Aus		A	C				White with orange patches and purple gills and rhinophores	No	11
Goniobranchus aureomarginatus (Cheeseman, 1881)	E		A	C	F	M		White bordered with gold line	No	11
Discodorididae										
Alloiodoris lanuginata (Abraham, 1877)	E		A	C	F	M		Red-brown to grey with brown and white spots; green gills	No	12
Atagema molesta (Miller, 1989)	E		A					Fawn brown	No	12
Hoplodoris nodulosa (Angas, 1864)	E		A	C	F			Yellow to grey with brown blotches, gills and rhinophores	No	12
Jorunna pantherina (Angas, 1864)	Aus		A					Peachy, yellow to black with marbled ring patches	No	12
Rostanga muscula (Abraham, 1877)	E		A	C				Tomato red with dark spots	No	12
Doridiidae										
Aphelodoris luctuosa (Cheeseman, 1882)	E		A	C	F	M		Cream with brown stripes, blotches and concentric lines	No	13
Aphelodoris sp.	E			C				Cream with tan blotches	No	13
Doris granulosa (Pease, 1860)	Aus		A	C	F	M		Yellow	No	14
Doris wellingtonensis Abraham, 1877	Aus	K	A	C	F	M		Khaki brown to yellow	No	14
Dendrodoridae										
Dendrodoris citrina (Cheeseman, 1881)	E		A	C	F			Lemon yellow to orange with numerous small white dots	No	15
Dendrodoris krusensternii (Gray, 1850)	IP		A					Light brown and peacock blue with concentric brown lines	No	16
Dendrodoris nigra (Stimpson, 1855)	IP		A	C				Black with white tipped rhinophores	No	16
Polyceridae										
Plocamopherus imperialis Angas, 1864	IP		A					Scarlet with sm dk spots, 2 cream stripes; white tipped rhinophores	No	17
Polycera hedgpethi Er. Marcus, 1964	Cos		A	C				Cream peppered with black, white and gold papillae	No	17
Polycera melanosticta Miller, 1996	Aus		A					Translucent white to greyish-brown with black spots	No	17

Taxon	Biogeography	Kermadecian	Aupourian	Cookian	Forsterian	Moriorian	Antipodean	Animal colour	Shell	Figure
Thecacera pennigera (Montagu, 1815)	Cos		A					White with orange and black spots	No	17
Proctonotidae										
Caldukia rubiginosa Miller, 1970	E		A					Reddish-brown; yellow and iridescent blue cerata	No	17
Janolus novozealandicus (Eliot, 1907)	E		A	C	F			Translucent with brown & white speckles; diverticula blue & orange	No	17
Vassieridae										
Vayssierea cinnabarea Ralph, 1944	E		A	C				Dull red	No	17
Fionidae										
Fiona pinnata (Eschscholtz, 1831)	Cos		A	C	F	M	An	Cream or buff with orange patch	No	17
Onchidorididae										
Acanthodoris mollicella Abraham, 1877	E		A	C	F		An	Mottled black, brown and ochre-yellow	No	18
Goniodorididae										
Goniodoris n.sp.	E		A					Unknown	No	18
Okenia plana Baba, 1960	Pac		A					Lilac and red-brown spotted	No	18
Trapania rudmani Miller, 1981	E		A	C				White with yellow stripes	No	18
Dotidae										
Doto pita Er. Marcus, 1955	Cos		A	C				Translucent white with brown, yellow and lilac spots	No	19
Arminidae										
Dermatobranchus rubidus (Gould, 1852)	Aus		A					Dark orange and white	No	19
Tritoniidae										
Tritonia incerta Bergh, 1904	E		A	C				Rose-pink, apricot or red, with white gills and foot	No	19
Flabellinidae										
Flabellina albomarginata (Miller, 1971)	E		A	C	F			White, with red cerata	No	19
Tularia bractea (Burn, 1962)	Aus		A	C				Transparent white-yellow-brown with white flecks, red-greenish diverticula	No	19
Eubranchidae										
Eubranchus agrius Er. Marcus, 1959	Pac		A	C	F			Transparent with sm patches and stripes of yellow to red	No	19

Taxon	Biogeography	Kermadecian	Aupourian	Cookian	Forsterian	Moriorian	Antipodean	Animal colour	Shell	Figure
Tergipedidae										
Trinchesia beta (Baba and Abe, 1964)	Pac		A	C				Transparent speckled purple, gold band, pink diverticula	No	19
Trinchesia reflexa (Miller, 1977)	E			C	F			Transparent to white, fawn speckled diverticula	No	19
Aeolidiidae										
Aeolidiella drusilla Bergh, 1900	Aus		A	C	F	M		Buff with white blotches with brown and orange cerata	No	20
Anteaeolidiella lurana (Bergh, 1888)	Cos		A					Orange to brown, with orange stripes and white blotches	No	20
Baeolidia australis (Rudman, 1982)	Aus		A					Brown with white spots. Brown, crimson and gold cerata	No	20
Burnaia helicochorda (Miller, 1988)	Aus		A					Transparent orange-brown, white-tipped cerata	No	20
Facelinidae										
Phidiana milleri Rudman, 1980	E		A	C				Translucent with orange head, tentacles and cerata	No	20
Babakinidae										
Babakina caprinsulensis (Miller, 1974)	E		A					Pale mauve with white, yellow and orange features	No	21
Glaucinidae										
Glaucus atlanticus Forster, 1777	Cos	K	A	C				Glowing blue, silver and purple	No	21
Umbraculidae										
Umbraculum umbraculum (Lightfoot, 1786)	Cos	K	A	C				Grey to yellow, brown or red	Ext	21
Velutinidae										
Lamellaria ophione Gray, 1850	E	K	A	C				Yellow, orange, grey or white	Int	22
Onchiidae										
Onchidella nigricans (Quoy & Gaimard, 1835)	Aus		A	C	F	M		Black-grey	No	23
Fissurellidae										
Scutus breviculus (Blainville, 1817)	E		A	C	F			Black	Int	24

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