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Population Assessment and Monitoring of *Prostanthera densa* in NSW for the NSW Saving our Species program

Site Assessments:

1. Marley, Royal National Park
2. Bass and Flinders Point, South Cronulla
3. Nelson Bay / Port Stephens
4. Jervis Bay
5. Helensburgh

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Prostanthera densa growing at Marley, Royal National Park (Source: D. Clarke)

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Introduction

This report (treated as a work in progress) has been prepared by Dan Clarke, a botanical consultant and member of the Australian Plants Society - Sutherland Group to provide a comprehensive population assessment of the listed threatened flora species *Prostanthera densa* at all known locations in NSW as part of the NSW Saving our Species Program.

The report represents a voluntary contribution by the Australian Plant Society towards the Saving our Species Program; an initiative administered by the NSW Office of Environment and Heritage (NSW OEH) that aims to maximise the number of threatened species that can be secured in the wild in NSW for 100 years.

Prostanthera densa (Villous Mint Bush) is listed as vulnerable under the *NSW Threatened Species Conservation Act 1995* and has been categorised under the Saving our Species Program as a **site-managed species**. This means that the best management practices for the protection and conservation of the species are to be carried out on specific sites.

Four sites have been identified (known populations) for management under the program, namely:

- Tomaree (Port Stephens)
- Royal National Park (Marley and possible other sites)
- Bass and Flinders Point (South Cronulla)
- Abraham's Bosom (Jervis Bay)

From additional literature and database research, there is another population (or sub-populations) at Helensburgh and possible a sixth population at Yalwal State Forest (west of Nowra – to be confirmed) (Figure 1).

Australian Plants Society Sutherland Group (APS), coordinated by Dan Clarke, has determined that they could organise and deliver the required population assessment and monitoring for this species in the Royal National Park as part of the group's contribution to the Saving Our Species Program.

APS began a voluntary population assessment of the Marley population in the Royal National Park, in July 2015. It has now become a goal to undertake a thorough (as far as possible) assessment of all current known populations, as well as, explore possible additional populations and provide a current population assessment with descriptions of habitat types and conditions. The aim is also to delineate population extents and provide this advice to NSW OEH. The entire works comprise a mixture of paid and volunteer time.

This report has been segregated into parts based on site assessments. Data and findings will be added to this report as populations are further assessed. This information has been produced solely to inform the NSW Office of Environment and Heritage as per the Saving our Species program and other relevant stakeholders in the populations such as:

- Australian Plants Society NSW
- Sutherland Shire Council
- Port Stephens Council.

Sources of Information

References used throughout this report include:

- NSW Office of Environment and Heritage (2013). *The Native Vegetation of the Sydney Metropolitan Area. Volume 1: Technical Report (Version 2.0) and Volume 2: Vegetation Community Profiles (Version 2.0)*.
- *Prostanthera densa* Management document for the Saving Our Species Program (<http://www.environment.nsw.gov.au/savingourspeciesapp/ManagementSite.aspx?SiteID=645>)
- Review of herbarium specimen collection data on the Australasian Virtual Herbarium website (<http://avh.chah.org.au>)
- Review of recorded data on the NSW Wildlife Atlas (Bionet) website (<http://www.bionet.nsw.gov.au/>)
- Personal communication with botanist Dr Trevor Wilson from the National Herbarium of NSW (an expert in the genus *Prostanthera*) and with Patricia Nagle (Ranger at Royal National Park).
- Review of the following literature and websites:
 - Conn, B.J, Wilson, T.C., Henwood, M.J. and Proft, K. (2013). Circumscription and phylogenetic relationships of *Prostanthera densa* and *P. marifolia* (Lamiaceae). *Telopea* 15:149-164
 - Fairley, A (2004). *Seldom Seen - Rare plants of Greater Sydney*. New Holland Publishers, Australia (2004).
 - Approved Conservation Advice for *Prostanthera densa* (Villous Mintbush) – Australian Commonwealth Government – approved on 03/07/2008.
 - Profile page for Villous Mint Bush – NSW Office of Environment and Heritage (<http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10676> accessed 15 July 2015)

SITE 1. Population Assessment at Marley, Royal National Park

Introduction

It has been known for many decades that *Prostanthera densa* exists in the Royal National Park with reviewed herbarium collections dating back to 1936.

For the known site within the Royal National Park, there are listed actions defined with criteria as follows:

Action type	Threat name	Objective	Methodology type	Status
Management action	Lack of distributional information	Determine area of occupancy of the species	Targeted survey	Proposed
Species monitoring action		Track species abundance/condition over time	Flora monitoring	Proposed

Source: *Prostanthera densa* management document

(<http://www.environment.nsw.gov.au/savingourspeciesapp/ManagementSite.aspx?SiteID=645>)

1. Background and history of *Prostanthera densa* in Royal National Park

A review of the currently known locations and recordings of *Prostanthera densa* in the Royal National Park was undertaken, using the sources of information cited above:

Australasian Virtual Herbarium Data

From the AVH data, there are two comparatively recent specimens with attached information as follows:

Specimen No.	Collector	Date of collection	Location, habitat and plant number information
NSW844191	Trevor Wilson	16 April 2008	<i>Approximately 200 metres off Marley Fire Trail [in Royal National Park], on south side of road (RH side facing ocean). Habitat: Terrestrial. Supplied as "Sandstone escarpment. Moderate slope. Amongst sandstone boulders and outcrops. Heathland-Allocasuarina, Epacris, Banksia, Acacia, Gynea. Sandy loam."</i>
NSW732721	Alan Fairley	12 August 2005	<i>On plateau north of Big Marley Beach [in Royal National Park], just below upper rock shelf. Some in flower. Although collected from Marley in the past, this species has not been seen here for some years. It was thought that fire and deer predation may have led to its extinction. 10 plants found.</i>

Less recent collections of *Prostanthera densa* within the Royal National Park, including a record at Audley, as well as from Marley, are as follows:

Specimen No.	Collector	Date of collection	Location and relevant comments
MEL1543225A	Robert Miller	September 1985	<i>Marley, Royal National Park. Marley Lagoon is situated in the Royal National Park S of Sydney; between Garie Beach and Bundeena.</i>
NSW220486	R. Coveny	21 March 1972	<i>Audley, 3 miles (4.8 km) S of Sutherland. Occasional. Shrub 40 to 50 cm high. "Slope in dry sclerophyll forest, in association with Eucalyptus gummifera, Angophora costata, Acacia botrycephala, Banksia spinulosa, Persoonia levis etc. Sandstone. "Mauve flowers. Scattered distribution.</i>
NSW128299	N. Byrnes	2 June 1948	<i>Marley</i>

Whereas most of the above recordings are from Marley, it is important to note the recorded collection by R. Coveny from the National Herbarium of NSW at "Audley" in 1972. The habitat attributes recorded for this collection are very different to that of Marley and so it is concluded that it was recorded in a different location. However, it is undetermined how close to "Audley" it might have been.

It is not known if additional collections of the species, or any monitoring of the known *Prostanthera densa* populations have been undertaken since 2005/2008.

NSW Wildlife Atlas - Bionet

Eleven (11) records (some duplicated) of *Prostanthera densa* were generated on the NSW Wildlife Atlas – Bionet within a 10 x 10 km search area. The search area was centred on a point which allows coverage of Bundeena and Marley, but not Audley. However, locality data was not specified in the downloaded data text file. GPS points are provided in the data file, with an accuracy range value, indicating how accurate the GPS points are (or may be). The GPS points have been checked using the SixMaps website (<https://maps.six.nsw.gov.au>) to ascertain the locality, as tabulated:

Record ID	Date collected	Eastings MGA56	Northings MGA56	Accuracy	Resulting Locality
R1	Undated (with 2 duplicate records)	330954	6227264	to 1000 m	Jibbon Beach Area
R2	July 1918	329349	6230933	to 10000 m	Cronulla
R3	September 1923	329349	6230933	to 10000 m	Cronulla
R4	31/03/1936	327946	6223512	to 10000 m	West of Marley Beach
R5	02/06/1948	327946	6223512	to 10000 m	West of Marley Beach
R6	01/10/1985	329349	6230933	to 10000 m	Cronulla
R7	04/07/1987	327845	6229057	to 1000 m	South Cronulla

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Record ID	Date collected	Eastings MGA56	Northings MGA56	Accuracy	Resulting Locality
R8	27/03/1990 (with duplicate record)	329400	6228161	to 1667 m	South Cronulla
R9	12/02/1991	329003	6223990	to 100 m	North-east of Marley Beach
R10	12/08/2005	329167	6224027	to 50 m	North-east of Marley Beach
R11	18/08/2007	329679	6228320	to 5 m	South Cronulla

Most of the above recordings are located in the South Cronulla locality in Sutherland Shire local government area and Marley region which includes those records considered most reliable (i.e. 1991, 2005 and 2008).

Other sources of information

It is acknowledged that the Commonwealth listing Advice and the NSW OEH Profile page mentions "Garie Beach" as a recorded site. Suitable habitat at Garie will also be reviewed in the future and explored.

2. Location and vegetation characteristics

The objectives of the APS field surveys (2015-2017, outlined below) were to target the known location at Marley, focusing on a target area approximately 400 m north-east of Marley Beach (Figure 1).

Marley is located approximately 3 km south of Bundeena and includes two beaches: Marley and Little Marley (Figure 1). The population location has an elevation of about 60 to 70 m AHD, sloping to the west, south-west and south (Figure 2). The location consists of dense stands of heath and taller shrub vegetation, interspersed with bare sandstone outcrops. The vegetation of the area has been mapped and described most recently in the *Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (NSW OEH 2013), with the mapped vegetation types within and, close to, the target area as follows (Figure 3):

Vegetation Type	Dominate species and substrate	Vegetation structure
S_HL06: Coastal Headland Banksia Heath	<i>Banksia ericifolia</i> / <i>Allocasuarina distyla</i> / <i>Darwinia fascicularis</i> / <i>Melaleuca nodosa</i> Hawkesbury Sandstone	Heath
S_HL08: Coastal Sandstone Heath/ Mallee	<i>Allocasuarina distyla</i> / <i>Banksia ericifolia</i> / <i>Leptospermum spp.</i> / <i>Angophora hispida</i> Hawkesbury Sandstone	Heath / Tall scrub
S_HL04: Coastal Sand Plain Heath	<i>Leptospermum laevigatum</i> / <i>Banksia serrata</i> / <i>Banksia ericifolia</i> / <i>Hakea teretifolia</i> Pleistocene Sand over Rock Plate	Heath
S_HL07: Coastal Headland Cliffline Scrub	<i>Melaleuca armillaris</i> / <i>Banksia imbricata</i> / <i>Banksia ericifolia</i>	Low heath

3a. Preliminary inspection

The Marley location was inspected by APS members Dan Clarke and Phil Keane on 18 June 2015. Approximately 15 plants of *Prostanthera densa* were observed within a radius of approximately 100 m close to the target area. GPS points of three plants were recorded, with additional GPS points sequentially recorded for where plants were not sighted. Most of the plants of *P. densa* were observed to be in flower at this time.

3b. Site surveys, methodology and results

Between June 2015 and October 2017, five (5) surveys were completed. Initially, a series of progress reports were made summarising each survey but these have now been condensed and summarised herein with surveys undertaken as follows:

Survey	Date	Personnel	Results
1	27 June 2015	Dan Clarke John Arney Rhonda Daniels Ian Hill Paul Rendell Peter Shelton Patsy Nagle	27 plants recorded
2	16 April 2016	Dan Clarke John Arney Ralph Cartwright	35 plants recorded (cumulative total = 62).
3	12 January 2017	Dan Clarke Ralph Cartwright	17 plants recorded (cumulative total = 79).
4	30 June 2017	Dan Clarke John Arney Ian Hill Ralph Cartwright	37 plants recorded (cumulative total = 116). Likely habitat polygon drawn on map at Marley.
5	24 October 2017	Dan Clarke Gemma White	1 new plant recorded (cumulative total = 117). Additional habitat searched. Twenty (20) plants (recorded in first survey) re-monitored. Likely habitat polygon adjusted (reduced)



Figure 1. General location of search area on Six Maps aerial photograph (supplied by SixMaps <https://maps.six.nsw.gov.au>)

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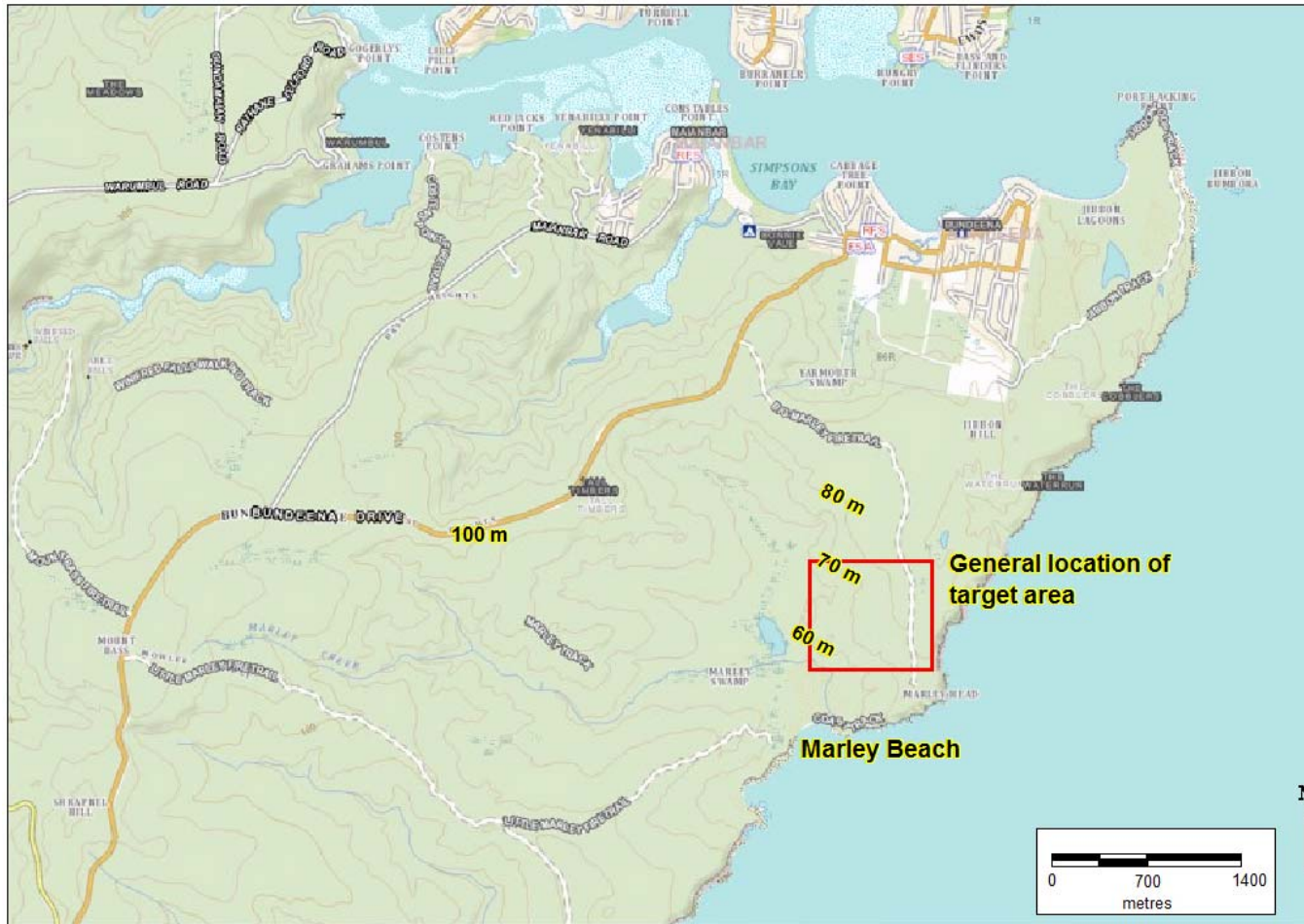


Figure 2. General location of search area – Topography (supplied by SixMaps <https://maps.six.nsw.gov.au>)

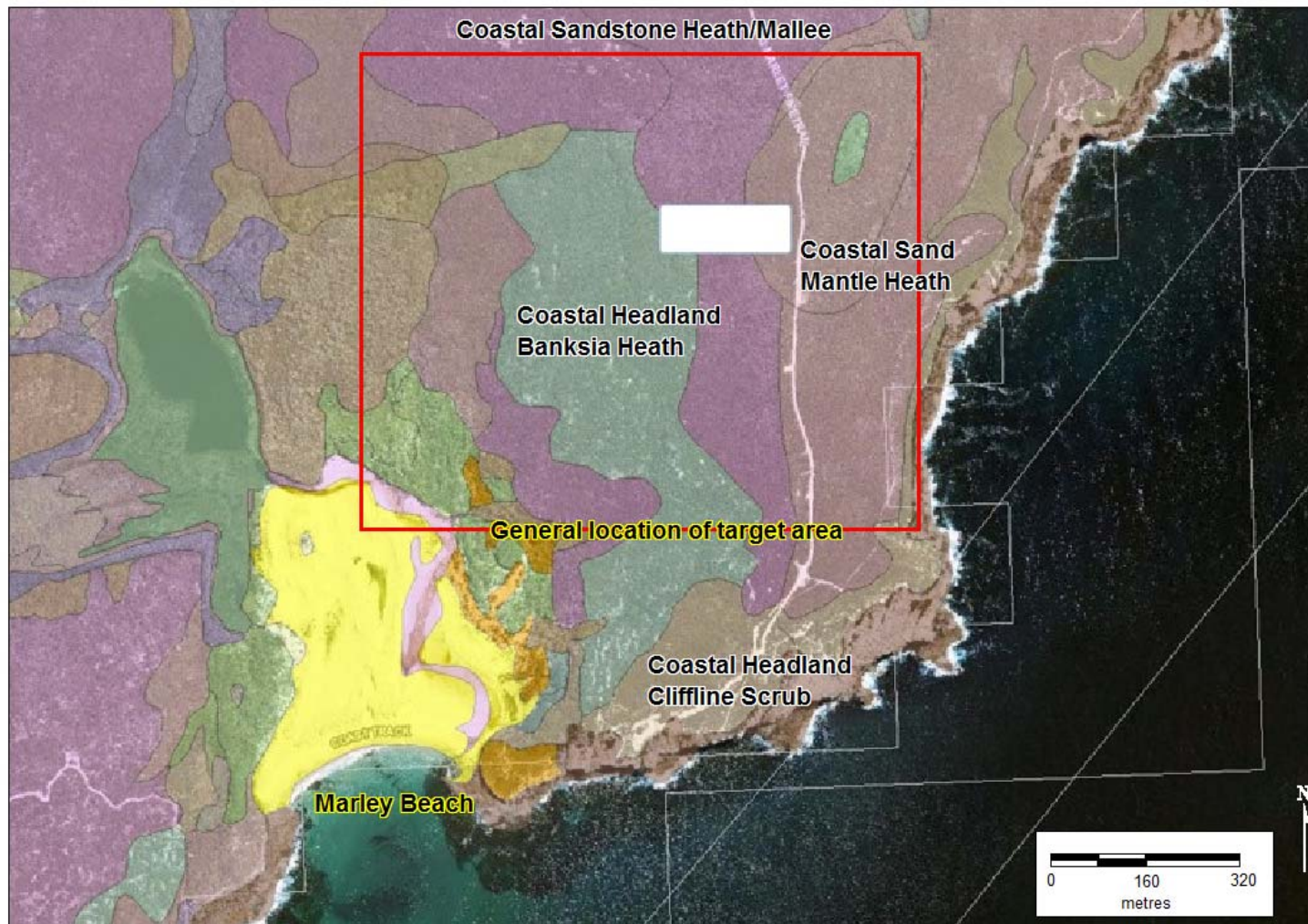


Figure 3. Vegetation mapping of population locality (Source: NSW OEH 2013, SixMaps [https://:maps.six.nsw.gov.au](https://maps.six.nsw.gov.au))

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For each plant, the following data were recorded, mostly consistent with *Appendix A4. Rare species sampling field datasheet* provided by NSW OEH:

- Plant number (as indicated on tag)
- GPS location
- Approximate maximal stem length (either to nearest 10 cm or exactly)
- Flowering status
- General health estimate; “Good” or “Poor” (based on foliage production, dead branches etc.)
- Any other relevant comments

Each plant was tagged using either a long metal pin with an attached brass numbered tag, or, a piece of pink flagging tape attached to the closest common species (usually overhanging). All plants were photographed (*Appendix 1 – currently kept separate from this document*).

Plants were recorded as they were encountered by random meander, and not in transects or quadrats.

Some limited observations were recorded on the presence of scats, to provide information as to whether Rusa Deer are present in the locality.

A total of **117 plants** of *Prostanthera densa* were recorded from 2015 to 2017.

The plants are described occurring as follows:

- Patch 1 - most south-eastern patch (Plants AB0 to AB25, then AB80 + AB81 found in later survey, then AB116 found in later survey).
- Patch 2 – to north-west, about 100 m separation from Patch 1 (Plants AB26 to AB78)
- One plant in isolation in between patches 1 and 2 (Plant AB79).
- Three comparatively isolated plants further north-west of Patch 2 (Plants AB82, AB83, and AB115).
- Patch 3 – about 180-200 m west-north-west of Patch 2. This patch consists of 2 sub-patches separated by 20 to 30 metres (Plants AB85 to AB106 and AB107 to AB114) respectively.
- One isolated plant between Patch 2 and Patch 3 (Plant AB84).

Data recorded for all plants were as follows:

Table 1. Data recorded for 117 plants of *Prostanthera densa* at Marley, Royal NP.

Plant number (brass tag)	Eastings	Northings	Height / maximal stem length (cm) (approx.)	Flowers present	General Health	Other comments
AB0	329162	6223713	50	No	Good	
AB1	329157	6223711	40	No	Good	
AB2	329157	6223712	70	No	Good	
AB3	329158	6223713	100	Yes	Poor	Much dieback evident
AB4	329156	6223712	100	Yes	Good	
AB5	329157	6223721	100	Yes	Poor	Much dieback evident
AB6	329153	6223724	100	No	Good	

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Plant number (brass tag)	Eastings	Northings	Height / maximal stem length (cm) (approx.)	Flowers present	General Health	Other comments
AB7	329153	6223724	40	No	Good	
AB8	329154	6223725	110	Yes	Good	
AB9	329151	6223727	100	Yes	Good	
AB10	329149	6223728	40	Yes	Good	
AB11	329151	6223729	110	Yes	Good	
AB12	329147	6223736	100	Yes	Good	
AB13	329134	6223729	100	Yes	Good	
AB14	329119	6223721	180	Yes	Good	
AB15	329118	6223722	70	No	Good	
AB16	329117	6223728	50	Yes	Good	
AB17	329117	6223729	50	No	Good	
AB18	329117	6223730	50	Yes	Good	
AB19	329120	6223730	50	No	Good	
AB20	329129	6223724	90	No	Good	
AB21	329143	6223724	70	No	Good	
AB22	329136	6223714	90	Yes	Good	
AB23	329136	6223713	130	Yes	Good	
AB24	329154	6223728	120	No	Good	
AB25	329072	6223821	140	Yes	Good	142 m NW from "AB0"
AB26	329064	6223825	70	No	Good	
AB27	329134	6223853	100	Yes	Good	
AB28	329136	6223854	80	Yes	Good	Some dieback of branches
AB29	329142	6223849	200	Yes	Good	
AB30	329132	6223842	80	Yes	Good	
AB31	329085	6223859	70	Yes	Good	Some dieback of branches
AB32	329089	6223846	300	Yes	Good	
AB33	329088	6223845	200	Yes	Good	
AB34	329093	6223847	130	Yes	Good	
AB35	329093	6223843	150	Yes	Good	
AB36	329088	6223852	90	Yes	Good	Some dieback of branches
AB37	329080	6223853	170	Yes	Good	Some dieback of branches
AB38	329080	6223856	120	Yes	Good	
AB39	329080	6223857	100	Yes	Good	
AB40	329079	6223861	90	Yes	Good	
AB41	329074	6223862	100	Yes	Good	
AB42	329074	6223863	80	Yes	Good	Some dieback of branches
AB43	329072	6223862	120	Yes	Good	

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Plant number (brass tag)	Eastings	Northings	Height / maximal stem length (cm) (approx.)	Flowers present	General Health	Other comments
AB44	329071	6223862	Not recorded due to extent of dieback	Yes	Very poor	Mostly dead
AB45	329069	6223862	60	Yes	Good	4 seedlings observed within a 3 m radius – less than 20 cm tall.
AB46	329068	6223862	125	Yes	Good	
AB47	329067	6223861	200	Yes	Good	Some dieback of branches
AB48	329067	6223859	70	No	Good	
AB49	329065	6223859	100	Yes	Good	
AB50	329064	6223859	200	Yes	Good	
AB51	329068	6223857	170	Yes	Good	Some dieback of branches
AB52	329065	6223861	170	Yes	Good	
AB53	329065	6223857	120	Yes	Good	
AB54	329066	6223855	150	Yes	Good	
AB55	329064	6223853	100	Yes	Good	
AB56	329066	6223853	110	Yes	Fair	Pest affected – caterpillar/borer patch/ring on stem
AB57	329065	6223855	100	Yes	Good	
AB58	329074	6223866	80	Yes	Good	Width/spread of 3 metres
AB59	329074	6223870	10	No	Good	seedling
AB60	329072	6223874	40	Yes	Good	Some dieback of branches
AB61	329068	6223875	80	Yes	Good	
AB62	329056	6223870	80	Yes	Good	Multi-stemmed
AB63	329059	6223861	100	Yes	Good	
AB64	329059	6223873	120	Yes	Poor	Some dieback with some new shoots
AB65	329060	6223871	200	Yes	Good	
AB66	329052	6223875	120	Yes	Good	Stem basal diametre of about 3 cm.
AB67	329055	6223877	80	Yes	Good	
AB68	329053	6223870	70	Yes	Good	

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Plant number (brass tag)	Eastings	Northings	Height / maximal stem length (cm) (approx.)	Flowers present	General Health	Other comments
AB69	329056	6223880	150	Yes	Good	Many flowers, Stem basal diameter of about 3 cm.
AB70	329062	6223873	120	Yes	Good	
AB71	329060	6223880	140	Yes	Good	
AB72	329050	6223883	50	Yes	Good	Some yellowing of leaves
AB73	329054	6223883	110	Yes	Good	
AB74	329052	6223884	130	Yes	Good	
AB75	329052	6223886	120	Yes	Good	Multi-stemmed
AB76	329057	6223891	90	Yes	Good	
AB77	329053	6223886	120	Yes	Good	
AB78	329053	6223887	110	Yes	Good	
AB79	329128	6223783	75	No	Good	
AB80	329122	6223834	100	No	Good	
AB81	329122	6223835	160	No	Good	
AB82	329014	6223890	140	No	Good	
AB83	328949	6223863	120	No	Good	
AB84	328884	6223955	50	Yes	Good	
AB85	328811	6223972	70	Yes	Good	
AB86	328811	6223974	100	Yes	Good	
AB87	328811	6223975	40	No	Good	
AB88	328811	6223976	70	No	Good	
AB89	328811	6223977	60	No	Good	
AB90	328810	6223977	70	No	Poor	Appears diseased
AB91	328809	6223977	110	No	Good	
AB92	328809	6223978	100	Yes	Good	
AB93	328810	6223978	70	No	Good	
AB94	328808	6223978	90	No	Good	
AB95	328809	6223980	120	No	Good	
AB96	328809	6223981	100	No	Good	
AB97	328811	6223974	50	No	Good	
AB98	328815	6223973	60	No	Good	
AB99	328815	6223970	30	No	Good	
AB100	328815	6223969	30	No	Good	
AB101	328816	6223972	100	No	Poor	stem appears to be rotted
AB102	328816	6223973	80	No	Good	
AB103	328818	6223975	300	No	Good	long elongated braches moving through <i>Banksia</i>

Plant number (brass tag)	Eastings	Northings	Height / maximal stem length (cm) (approx.)	Flowers present	General Health	Other comments
						<i>ericifolia</i> – some dieback. Plant has winding stems at least 3 metres long.
AB104	328823	6223975	150	No	Good	
AB105	328823	6223976	100	No	Good	some dieback evident
AB106	328823	6223977	100	No	Good	
AB107	328798	6223991	300	Yes	Good	
AB108	323797	6223994	100	Yes	Good	some dieback on one branch
AB109	323797	6223990	250	Yes	Good	
AB110	323797	6223992	70	No	Good	
AB111	323798	6223993	90	No	Good	
AB112	323799	6223994	130	Yes	Good	
AB113	323804	6223993	90	No	Poor	leaves and stems reddish
AB114	329807	6223993	180	Yes	Good	
AB115	329037	6223919	180	Yes	Good	
AB116	329113	6223726	70	Yes	Good	Some minor dieback

From Table 1, results are summarised as follows (Table 2):

Table 2. Summarised survey results showing flowering status at time of survey, maximum stem lengths and general plant health.

Survey	Flowering	Heights / stem lengths	General Health
27 June 2015	15 out of 27	13 plants with stem lengths at least 100 cm	25 out of 27 plants in good health.
16 April 2016	33 out of 35	23 plants with stem lengths at least 100 cm 5 plants with stem lengths at least 200 cm	34 out of 35 plants in good health
12 January 2017	17 out of 17	12 plants with stem lengths at least 100 cm	16 out of 17 in good health

Survey	Flowering	Heights / stem lengths	General Health
		1 plants with stem lengths at least 200 cm.	
30 June 2017	10 out of 37	20 plants with stem lengths at least 100 cm. 2 plants with stem lengths at least 300 cm.	34 out of 37 plants in good health
24 October 2017	1 out of 1	Only 70 cm.	Good health

For the fifth survey on 24 October 2017, additional habitat was searched for *P. densa*, mainly to the south of the recorded plants. Only one new plant was found (Plant AB117). A subset of previously recorded plants were monitored and re-measured, as well as re-photographed. Recorded data comparing plants recorded in 2015 against 2017 were as follows (Table 3):

Table 3. Comparison table of plants recorded in June 2015 compared with October 2017:

Plant	June 2015			October 2017		
	Flowering	Maximal stem length (cm)	Health	Flowering	Maximal stem length (cm)	Health
AB0	No	50	Good	No	98	Good
AB1	No	40	Good	Yes	126	Moderate. Minor dieback
AB2	No	70	Good	Yes	198	Good
AB3	Yes	100	Poor – dieback evident	Yes	103	Moderate. Some dieback
AB4	Yes	100	Good	Yes	126	Good
AB5	Yes	100	Poor – dieback evident	No	134	Good
AB6	No	100	Good	Yes	200	Moderate – smothered by a native King Fern <i>Todea barbara</i>
AB8	Yes	110	Good	Yes	166	Good.
AB11	Yes	110	Good	Yes	133	Good
AB13	Yes	100	Good	Yes	129	Good. Some minor dieback
AB14	Yes	180	Good	Yes	210	Good
AB15	No	70	Good	Yes	120	Good
AB16	Yes	50	Good	Yes	63	Good
AB17	No	50	Good	Yes	81	Good
AB18	Yes	50	Good	Yes	40	Good
AB19	No	50	Good	Yes	90	Good. Some minor dieback
AB20	No	90	Good	Yes	122	Good

AB21	No	70	Good		No	110	Good- Sparse growth
AB22	Yes	90	Good		Yes	143	Good
AB24	No	120	Good		Yes	147	Good

From Table 3, there are some differences to be noted in maximal stem length. Comparisons of photos also show that some plants have increased substantially in size over the 2+ year period since they were first observed in this study. No dead plants were observed. Plant AB18 is the only plant that has decreased in size, although not substantially. Additional monitoring will be done in 2018 to determine if additional plants recorded in 2015 are still present.

It is not known whether plant AB116 was missed in the first survey or has emerged since. Meticulous care was taken reviewing data and analysing photographs with conclusions made that this plant had not previously been recorded.

The plant locations have been mapped (Figures 4a and 4b). Previously recorded occurrences in 2005 and 2008 are also mapped (Figure 4b).

A total of 28 way points were recorded during surveys showing where no plants were recorded (Figure 4b). These are also mapped to show the extent of the search and relied upon to map a likely polygon of potential habitat (Figure 4c). This polygon continues to be adjusted through time as additional habitat has being explored. It has been reduced in size after the latest survey in October 2017.

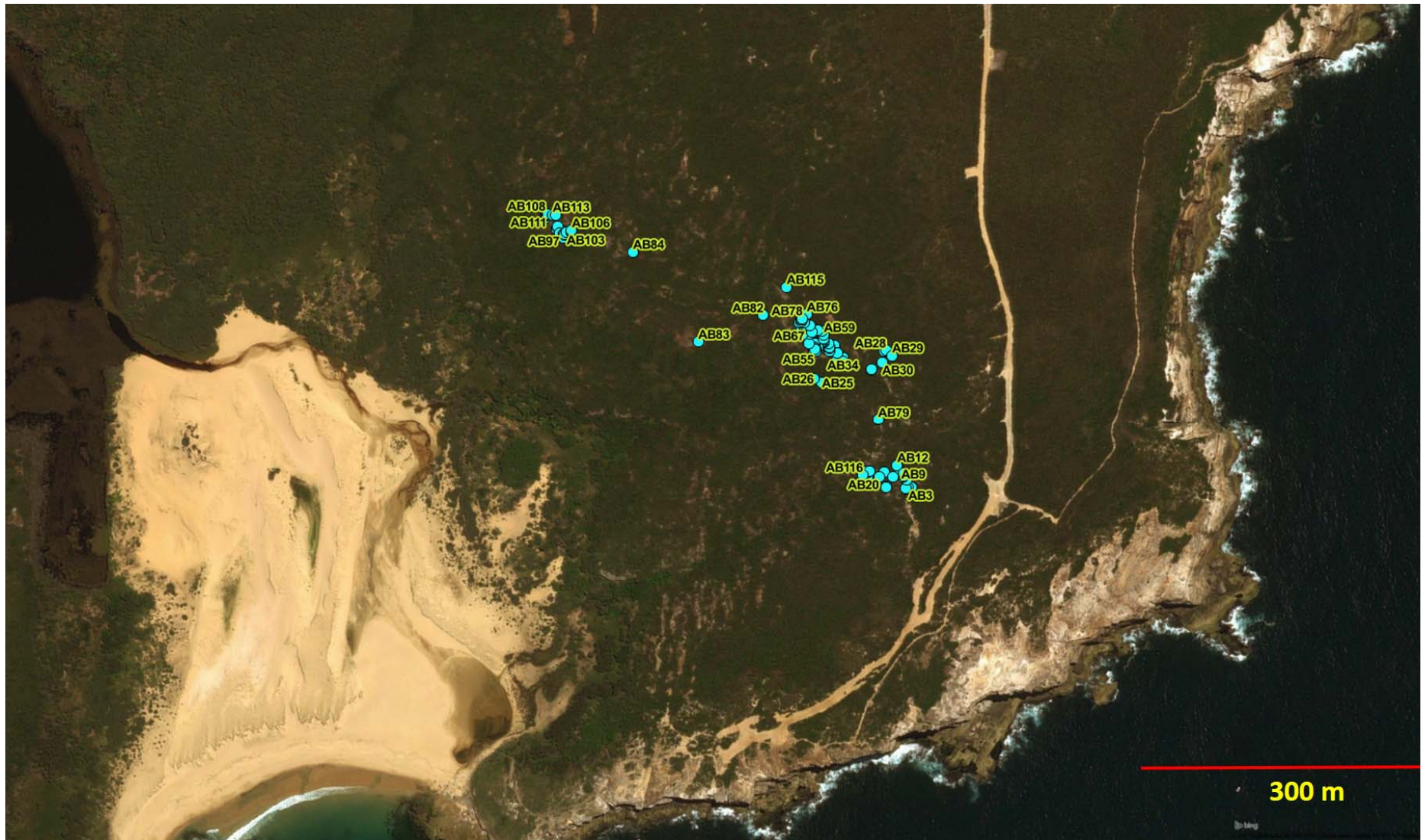


Figure 4a. Distribution map of the 117 plants of *Prostanthera densa* recorded between June 2015 and October 2017 at Marley, Royal National Park.

Population Assessment and Monitoring of *Prostanthera densa* in NSW for the NSW Saving our Species program

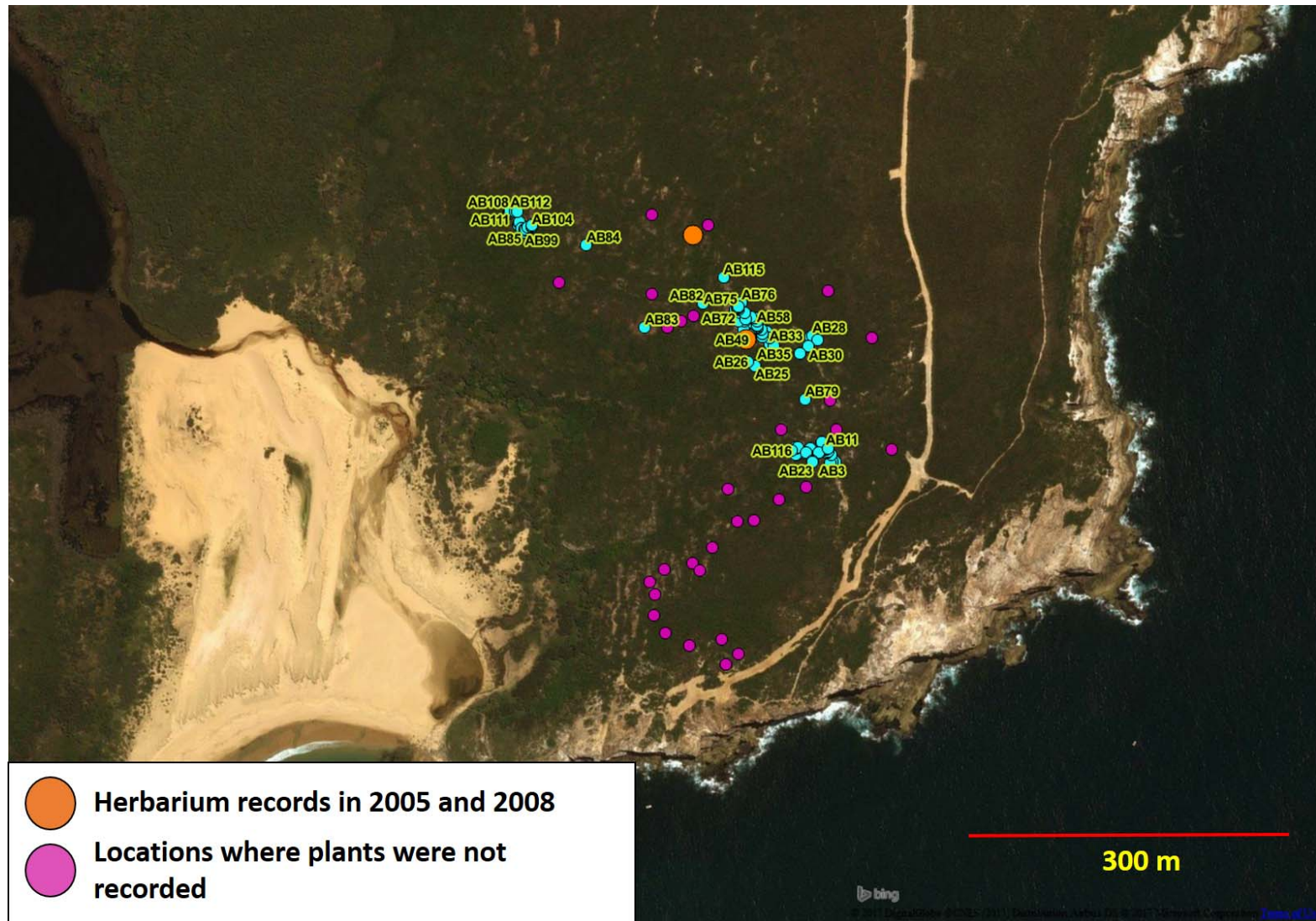


Figure 4b. Population map with recent herbarium records and explored locations between June 2015 and October 2017 shown.

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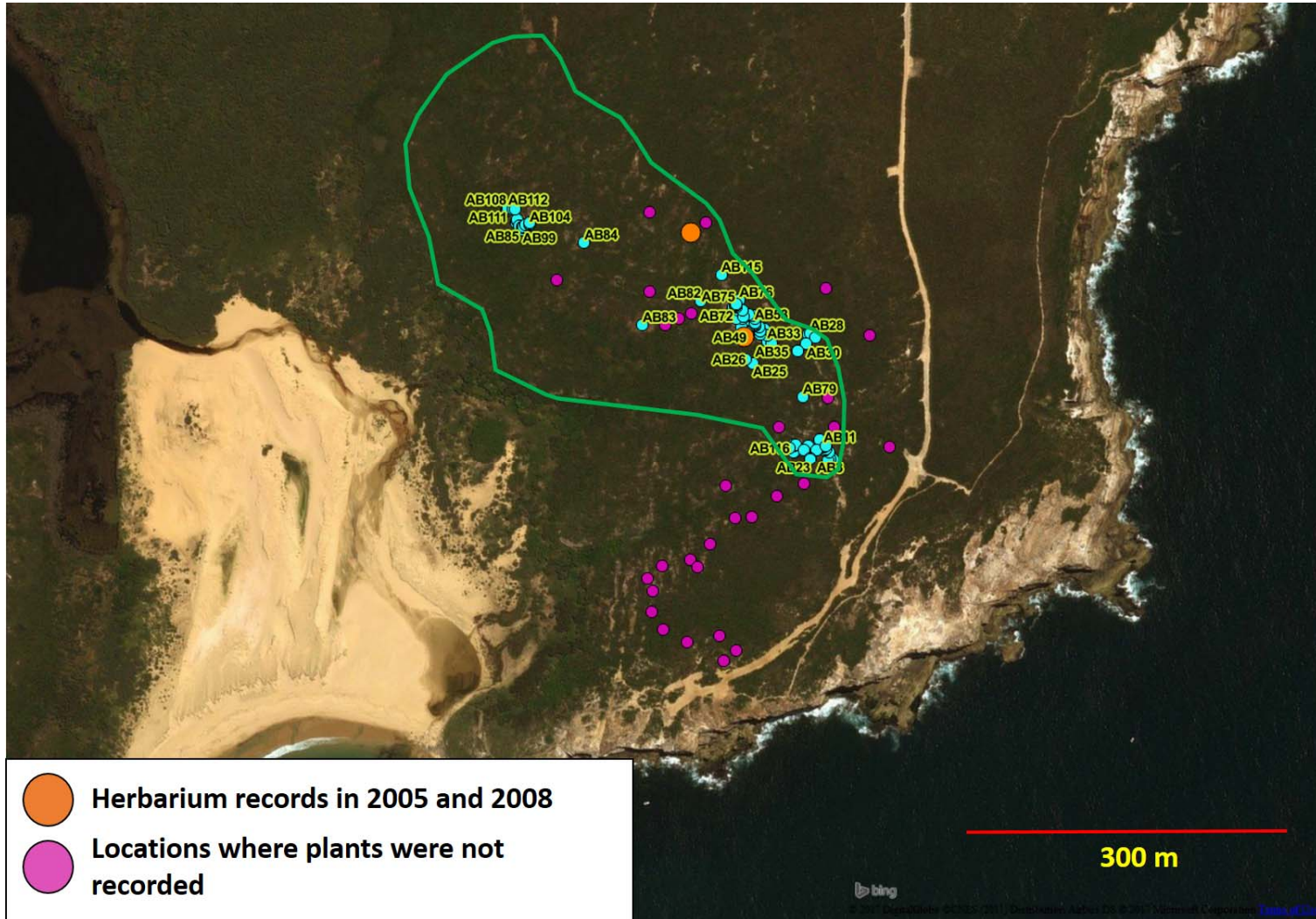


Figure 4c. Population map with mapped polygon of predicted likely habitat (green polygon) at Marley after survey in October 2017

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4. Associated vegetation structure and other variables

The population is located within heathland vegetation, consistent with the vegetation mapping of NSW OEH (2013), namely *Coastal Headland Banksia Heath* with the main shrub species observed being *Darwinia fascicularis*, *Banksia ericifolia* (Heath Banksia), *Banksia marginata* (Silver Banksia), *Allocasuarina distyla* (Scrub She-oak), *Hakea teretifolia* (Dagger Hakea) and *Epacris longiflora* (Native Fuchsia) (refer to *Volume 2: Vegetation Community Profiles* of NSW OEH 2013).

Many plants of *Prostanthera densa* were found in clusters. All plants were located either on or beneath sandstone outcrops with some found in relatively deep crevasses of 1 – 2 m between sandstone boulders or platforms. It was noted that some plants would likely receive direct sunlight for most of the day whilst others would almost always be in deep shade.

There was no observable evidence of browsing damage with only one scat of Rusa Deer observed on top of sandstone outcrops and at least 30 m away from the nearest plant. Wallaby/Macropod scats were commonly sighted throughout the location. Copious deer scats were observed to the south of the recorded plants in the area where southern-most way points were recorded (Figure 4c).

5. Conclusions and future directions

From the data collected, it is concluded that there is a strong likelihood of there being less than 150 plants at the Marley location.

Plants simply cease to be found, generally to the north and east, of recorded plants. It is not known why the species has a somewhat limited distribution at Marley but seems to be limited to rises and depressions in large continuous sandstone outcrops. There are several drainage lines which run through the habitat. Plants are seldom found in these lines.

Future surveys and monitoring will be done at Marley till at least June 2018.

It is also planned to explore additional locations in the Royal NP, namely Garie Beach as well as Wattamolla where there is suitable habitat.

SITE 2. Population Assessment at Bass and Flinders Point, South Cronulla

Introduction

The second population to be monitored by Australian Plants Society was the known population at Bass and Flinders Point at South Cronulla in the Sutherland Local Government Area.

The population at Bass and Flinders Point has been known for some time and it has been conserved as part of a bushland reserve with active Bushcare works ongoing since at least 2004 (based on personal experience of author).

The site is subject to intense public visitation and has become largely fragmented which is reflected in the management actions identified under the Saving our Species program, as follows:

Action type	Threat name	Objective	Methodology type	Status
Management action	Disturbance from recreational users	Minimise impacts of recreational activities	Land manager consultation	Proposed
Management action	Herbaceous weeds	Reduce and maintain weed densities at low levels	Site-based weed control	Proposed
Management action	Illegal dumping	Reduce incidence of illegal dumping	Community education	Proposed
Management action	Disturbance from recreational users	Minimise impacts of recreational activities	Monitoring disturbance impacts	Proposed
Management action	Herbaceous weeds	Reduce and maintain weed densities at low levels	Monitoring pest/weed threat	Proposed
Management action	Illegal dumping	Reduce incidence of illegal dumping	Monitoring disturbance impacts	Proposed
Species monitoring action		Track species / abundance condition over time.	Flora monitoring	Proposed

1. Background and history of *Prostanthera densa* at Bass and Flinders Point

A review of the established records and collections was undertaken, using the sources of information cited above:

Population Assessment and Monitoring of *Prostanthera densa* in NSW for the NSW Saving our Species program

Australasian Virtual Herbarium Data

From the AVH data, there were four collections from Cronulla with attached information as follows:

Specimen No.	Collector	Date of collection	Location, habitat and plant number information
NSW749529	Conn, B.J.	18 April 2007	Near coastal walk, about 30 m SW of Bass and Flinders Point, Port Hacking, Cronulla. Coastal Shrubland vegetation on sandy soils amongst sandstone boulders.
NSW226032	D'Aubert, G.	27 March 1990	Bass and Flinders Point, near Cronulla, Rare. Small woody shrub to 1m. Only two plants seen. Leaves ovate, soft. Flowers mauve. Roadside, south facing slope of tall shrubland incl. <i>Banksia</i> sp. Rock face back from cliff edge. Sandstone covered in thick moss.
NSW203744	Conn, B.J.	04 July 1987	Occasional. Shrub, 0.5-1.2 m high. Branches with white hairs. Leaves mid to light green. Calyx mid green to light green. Corolla mauve with orange markings in throat. Staminal filaments white. Anthers and anther appendage white. Style white. Fruit not seen. Bass & Flinders Point, Cronulla. Disturbed vegetation with <i>Banksia integrifolia</i> , <i>Epacris longiflora</i> and <i>Pittosporum undulatum</i> . Sandstone outcrop.
NSW128301	Gostelow	September 1923	Cronulla

Given the above, it would appear that the species has been known to exist at South Cronulla since at least 1923.

NSW Wildlife Atlas - Bionet

Eleven (11) records (some duplicated) of *Prostanthera densa* were generated on the NSW Wildlife Atlas – Bionet within a 10 x 10 km search area. The search area was centred on a point which allows coverage of Bundeena and Marley, but not Audley. However, locality data was not specified in the downloaded data text file. GPS points are provided in the data file, with an accuracy range value, indicating how accurate the GPS points are (or may be). The GPS points have been checked using the SixMaps website (<https://maps.six.nsw.gov.au>) to ascertain the locality, as tabulated below.

As shown in the records generated for Site 1 – Marley, Royal National Park, there were six reported records (some duplicated) of *Prostanthera densa* at South Cronulla as follows:

Record ID	Date collected	Resulting Locality
R2	July 1918	Cronulla
R3	September 1923	Cronulla
R6	01/10/1985	Cronulla
R7	04/07/1987	South Cronulla
R8	27/03/1990 (with duplicate record)	South Cronulla
R11	18/08/2007	South Cronulla

Two of these records correlate (by date) to collected herbarium specimens shown in AVH.

2. Location and vegetation characteristics

Bass and Flinders Point is located where the Hacking River meets the sea. The location is accessed at the southern end of Gowrie Street and is a popular recreational spot for walkers and bathers (Figure 1). Remnant vegetation persists on the site in two narrow bands, orientated east- west; one running along the foreshore and adjoining the walking path, and the other running more or less parallel between residential homes and the walking path (with interspersed cleared and developed open spaces). Like the population at Marley, the site has a south-facing aspect but only has an elevation of <10 m AHD (Figure 2). The general vegetation can be described as somewhat modified and consists partly of mesic vegetation with patches of *Pittosporum undulatum*, *Cissus antarctica*, *Ficus rubiginosa* and *Acmena smithii* (possibly reflecting a combination of altered drainage, absence of fire, aspect and microclimate). However, the small patch where *Prostanthera densa* is found is somewhat open, on exposed sandstone outcrop and growing with species such as *Monotoca elliptica*, *Lomandra longifolia*, *Banksia integrifolia*, *Epacris longiflora*, *Xanthosia pilosa*, *Breynia oblongifolia* and *Kunzea ambigua* (some of which may have been planted as part of Sutherland Shire Bushcare activities). The vegetation of the area has been mapped and described most recently in the *Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (NSW OEH 2016). This mapping is reflected and incorporated into Sutherland Shire Council's online maps (<http://www.sutherlandshire.nsw.gov.au/Development/Shire-Maps>) with the mapped vegetation as follows:

Vegetation Type	Dominant species and substrate	Vegetation structure	Area
S_RF08: Coastal Headland Littoral Thicket	<i>Acmena smithii</i> , <i>Eucalyptus botryoides</i> , <i>Ficus rubiginosa</i> , <i>Livistona australis</i> , <i>Elaeodendron australe</i> , <i>Allocasuarina distyla</i> , <i>Darwinia fascicularis</i> , <i>Melaleuca nodosa</i> Shale influenced soil	Forest	General area where <i>P. densa</i> is found
S_DSF06: Coastal Sandstone Foreshore Forest	<i>Angophora costata</i> , <i>Banksia integrifolia</i> , <i>Eucalyptus piperita</i> , <i>Eucalyptus botryoides</i> , <i>Eucalyptus pilularis</i>	Forest	Patches further west along foreshore
S_SW03		Seagrass Meadows	

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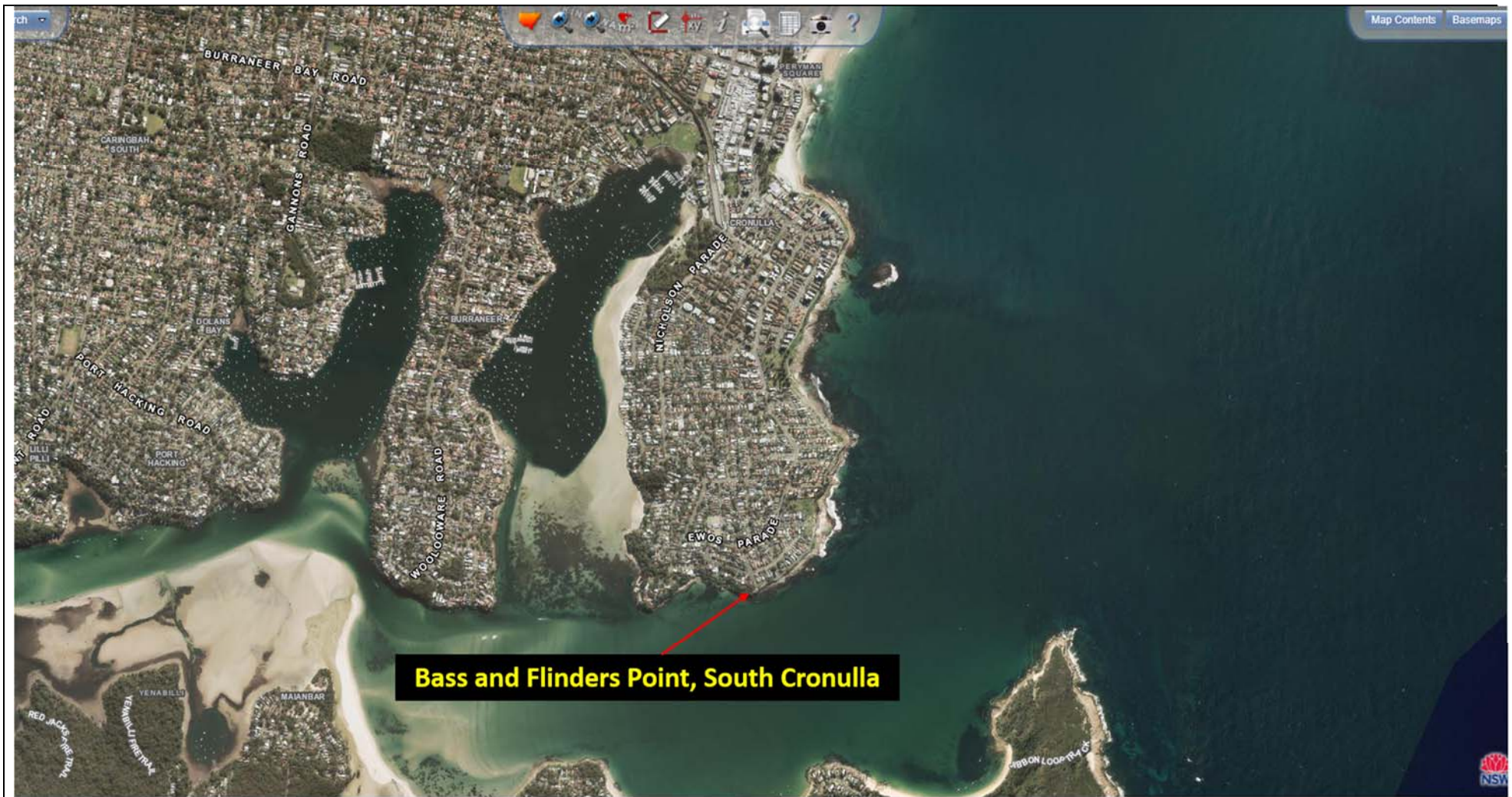


Figure 1. Location of Bass and Flinders Point on Six Maps aerial photograph (supplied by SixMaps <https://maps.six.nsw.gov.au>)

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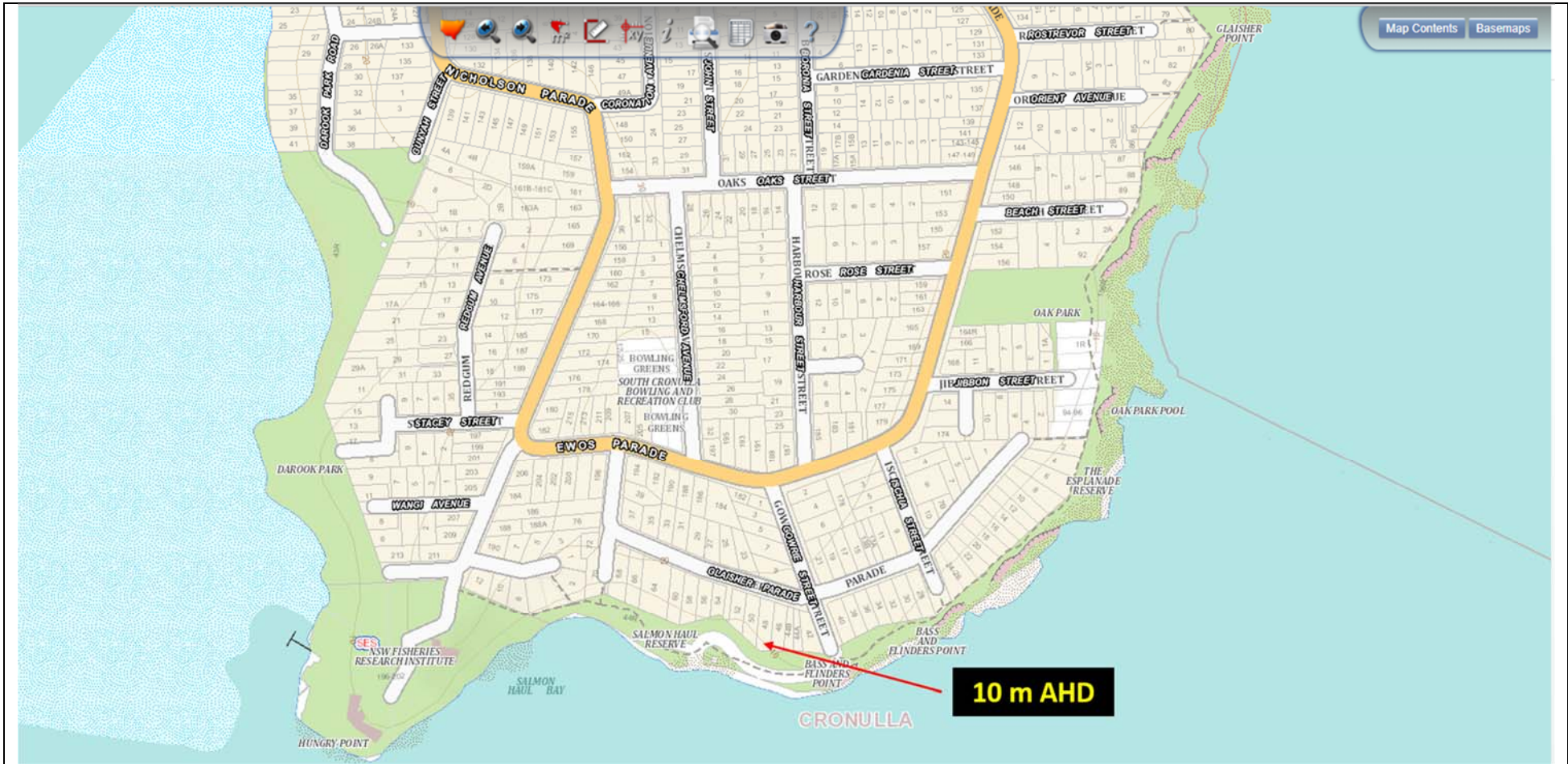


Figure 2. General location of search area – Topography (supplied by SixMaps <https://maps.six.nsw.gov.au>)

Population Assessment and Monitoring of *Prostanthera densa* in NSW for the NSW Saving our Species program



Figure 3. Vegetation mapping of Bass and Flinders Point – taken from Sutherland Shire Online Maps (based on Vegetation Mapping of Sydney Metropolitan Catchment Management Authority Area (NSW 2016))

3. Site surveys, methodology and results

Only one survey has been done on the site as plant numbers on the site are very few. Survey was done by APS members Dan Clarke and Ian Hill on 19 October 2017. Only three (3) plants were recorded growing in sandstone outcrop. Additional habitat was searched including along the foreshore areas underneath large sandstone overhangs.

Note: Due to the highly sensitive nature of the population, within an intensely used urban bushland reserve, the locations of the plants have not been disclosed and are not mapped in this report. Maps and location data will only be provided to Government (if required).

For each plant, the following data were recorded, mostly consistent with *Appendix A4. Rare species sampling field datasheet* provided by NSW OEH:

- Plant number
- GPS location
- Approximate maximal stem length (either to nearest 10 cm or exactly)
- Flowering status
- General health estimate; “Good” or “Poor” (based on foliage production, dead branches etc.)
- Any other relevant comments

Plants were not tagged.

Results of records are as follows:

Table 1. Data recorded for 3 plants of *Prostanthera densa* at Bass and Flinders Point, South Cronulla.

Plant number (brass tag)	Eastings	Northings	Maximal stem length (cm) (approx.)	Flowers present	General Health	Other comments
BF1	Recorded but withheld	Recorded but withheld	120	No	Some dieback	
BF2	Recorded but withheld	Recorded but withheld	60	No	Good	
BF3	Recorded but withheld	Recorded but withheld	80	No	Some purple-colouring on leaves	

The three plants recorded as shown in Plates 1 to 3.

Similarly to the findings at Site 1 - Marley, *Prostanthera densa* were found in clusters – in this case – one cluster. All plants were located either on or beneath sandstone outcrops with a south-facing aspect. Plants were growing in a somewhat sheltered aspect but would receive several hours of direct sunlight, at least in summer, each day.

There was no observable evidence of browsing damage.

Some weeds were evident such as *Senecio madagascariensis* (Fireweed) and *Ehrharta erecta* (Panic Veldt Grass); however, the abundances of these are kept low, presumably due to weeding efforts by Sutherland Shire Bushcare.



Plant BF1



Plant BF2



Plant BF3

4. Conclusions and future directions

From the data collected and habitat searched, it is concluded that there are currently only 3 plants occurring at Bass and Flinders Point, although discussions with others who know the population indicate that the population has been higher in the past.

Additional habitat could be explored, based on previous records, which indicate that plants have been found in different patches to the one recorded in this report.

Future surveys and monitoring will be done at Bass and Flinders Point as part of this project.

This population continues to be cared for by Sutherland Shire Council and plans are in place to trial transplanting of plants to similar locations in the general area.

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