Assessment highlights 2021

Geography

Internal assessment 2

Technique: Investigation — field report

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Assessment overview

Context

This assessment requires students to investigate a land-management or water-management challenge, arising through land cover transformations at a local scale through a field investigation. Students are required to consider the natural and anthropogenic geographical processes that result in a geographic challenge at a given site.

The syllabus conditions require the student response in the genre of a written field report between 1500–2000 words. Spatial technologies and/or ICT must be used to visually represent data, which must be integrated into the field report.

Task

Students were asked to investigate a challenge of managing environmental weeds as a result of land cover transformation at a specified location and conduct a field investigation.

In the field report, students were required to:

- use a specified model to identify the data required for the investigation
- describe the features, elements and interactions that explain the risk of environmental weeds at the specified fieldwork location
- collect, record and transform data and information from the fieldwork investigation to create appropriate graphical and cartographic representations in the form of maps and graphs
- analyse and interpret the graphical and cartographic representations to infer how patterns, trends and relationships represent the nature, extent and impact of the environmental weeds at the specified fieldwork location
- extrapolate from their analysis to generalise about the impact of the identified environmental weed invasion on the environment and people
- synthesise information from their analysis to propose action/s for managing the environmental weeds to create or improve sustainability at the specified fieldwork location.

Student response

Note: The following sample is an unedited authentic student response produced with permission. Any images or sources that do not have copyright approval have been redacted from the response. The response may contain errors and/or omissions that do not affect its overall match to the characteristics indicated in the top performance levels of the instrument-specific marking guide (ISMG).

Responding to Local Land Cover Transformations

- AN INVESTIGATION INTO LAND COVER CHANGES ON STRADBROKE ISLAND

The author of this report acknowledges the Quandamooka people, the traditional custodians of Minjerribah / North Stradbroke Island, and their continuing care for the natural area.

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1.0 Introduction

Anthropogenic land cover change has accelerated following the Industrial Revolution, driven by exponential population growth, increasing the population's capacity to impact the environment. Urbanisation and resource exploitation are two main anthropogenic processes that cause land cover change (Dodd, Law, Meyer, & O'Brien, 2019). Both have occurred on Stradbroke Island.

Stradbroke Island (Minjerribah), located 30km southeast of Brisbane, is the second largest sand island in the world (Stradbroke Island Visitor Information Group, 2021). However, The North Stradbroke Island Protection and Sustainability Act forced all sand mines to close, causing a shift to tourism as its primary industry. The increase in visitors creates risk for drastic anthropogenically driven land cover changes, posing a significant threat to Stradbroke's relatively preserved coastal ecosystems. Specifically, weeds are significantly impacting the Home Beach site (Figure 1) and native species may be pushed out, affecting the area's sustainability and aesthetics. In order to prevent further degradation, site data will be used to identify a main issue. Data analysis and synthesis will help to provide a justified management strategy.

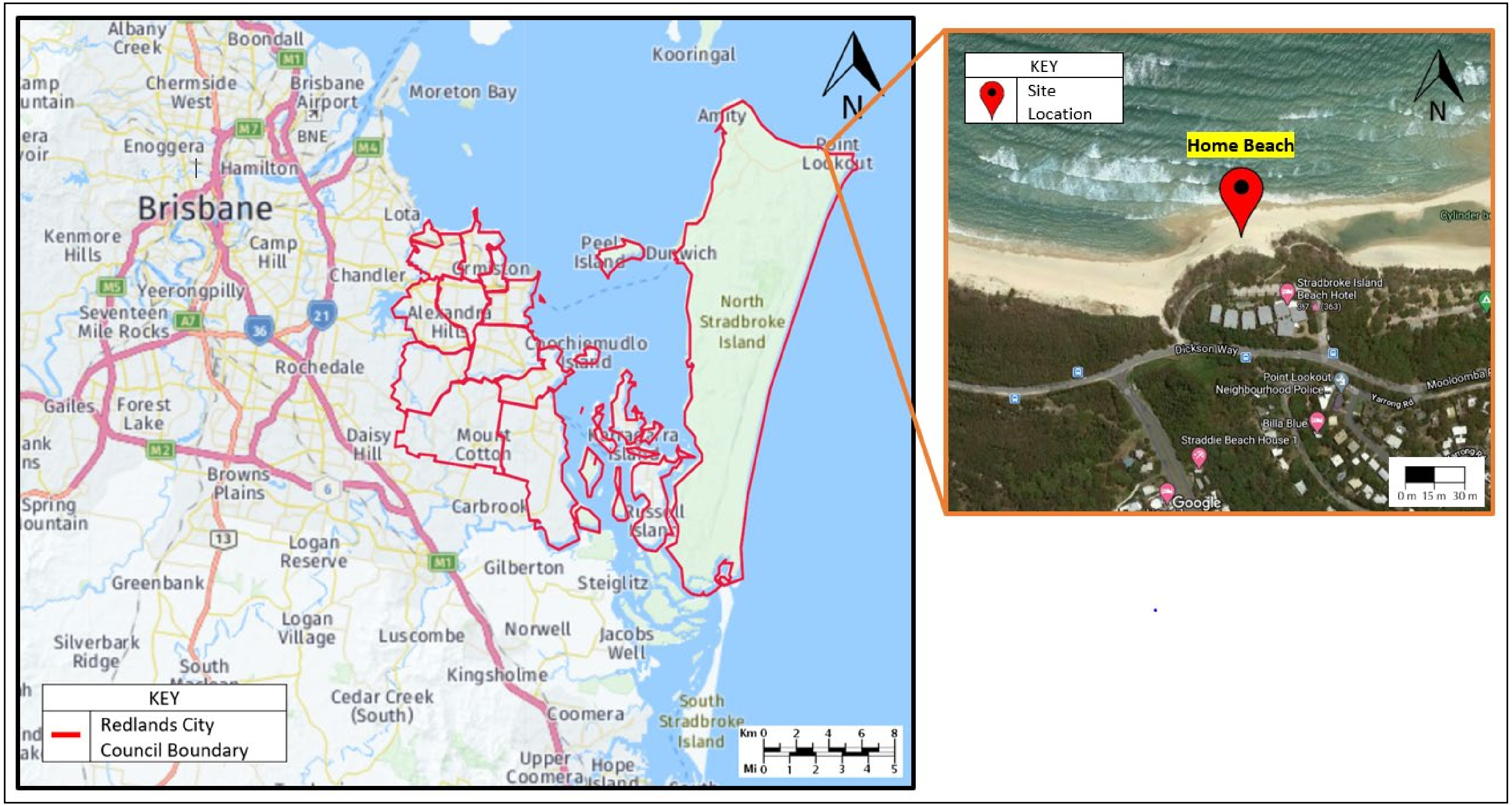

Figure 1: Home Beach, Stradbroke Island, 2021
Source: (Google Maps, 2021)

1.1 METHODOLOGY

Fieldwork was conducted at Home Beach, Stradbroke Island, on 8/2/2021 from 12pm-2pm (at low tide and during a La Nina summer). A transect line (Figure 2) was used for both elevation profiling and vegetation data in order to ascertain correlations between the two variables.

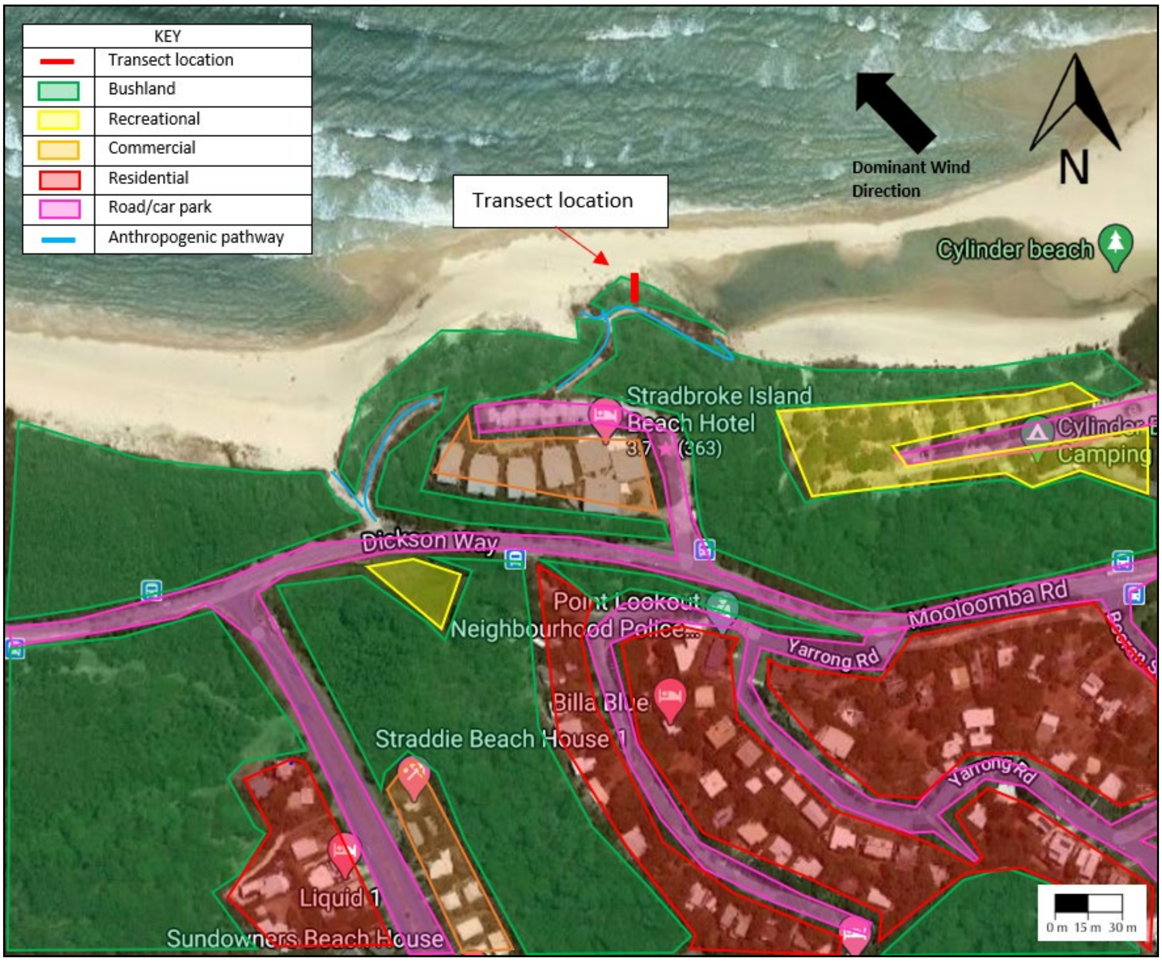

Figure 2: Home Beach land use, 2021
Source: (Google Maps, 2021) (World Meteorological Organization, 2021)

Soil temperature, pH and moisture were measured to determine if there was a relationship between soil quality and vegetation data. Wind speed, air temperature, and humidity were also measured. Simpson's Diversity Index (SDI) was calculated as a biodiversity measure that accounts for species richness and abundance.

Measures were taken to reduce error, described in the fieldwork plan (Table 1) supporting the validity of findings.

Table 1: Fieldwork plan

1. Information	2. Equipment	3. Accuracy/validity methods
4. Elevation data	5. 2 clinometers 6. 2 ranging poles 7. A tape measure	8. Readings at both poles, consensus of reading increases accuracy 9. Same transect as vegetation allows for investigation of possible relationships
10. Vegetation data	11. 1x1m transect 12. Tape measure 13. Camera 14. Vegetation classification material	15. Plant photos taken for accurate identification 16. Used plant ID app to find accurate species names 17. Species identified as invasive or native, increases accuracy of biodiversity calculations
18. Anthropogenic influences	19. Camera 20. Pencil + paper	21. Photos collected to demonstrate transect area
22. Abiotic factors • Humidity • Wind speed • Soil moisture • Soil temp • Air temp • Light intensity • Infiltration rate	23. Anemometer 24. Temperature gauge 25. Infiltration cylinder 26. 27. 28.	29. Multiple readings (3) – average reading recorded 30. Consistency of data collectors for each instrument 31.

Limitations to the data included incomplete measurement of soil qualities (some quadrats contained rock, hence the probes could not be inserted). Plant identification proved difficult as the area had been cleared and line trimmed before arrival.

Population data from the ABS and further species research was collected after the field trip to enhance the relevance of findings.

The Invasion Triangle model (Figure 3) assessed the contribution of Site Biotic Characteristics, Invader Attributes and Site Environmental Conditions to the invasive species issue.

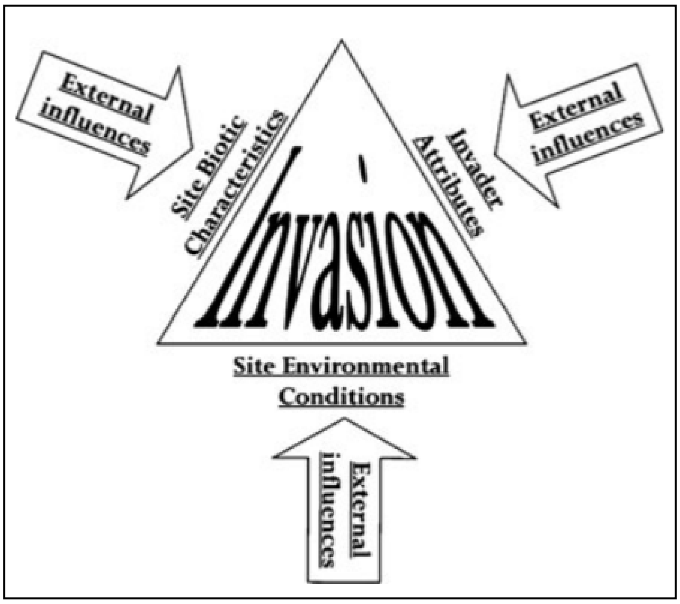

Figure 3: Invasion Triangle Model
Source: (Perkins, Leger, & Nowak, 2011)

Each factor (Table 2) was given a risk score of 1-3 (1 – low, 2 – moderate, 3 – high), giving a total score for the invasion triangle.

Table 2: Invasion factors

32. Invasive attributes	33. Site Biotic Characteristics	34. Site Environmental Conditions
- Competitive ability - Propagation - Novel weapons/engineering	- Diversity - Enemies - Mutualists	- Resources - Habitat Suitability

2.0 Findings

2.1 SITE LOCATION AND CHARACTERISTICS

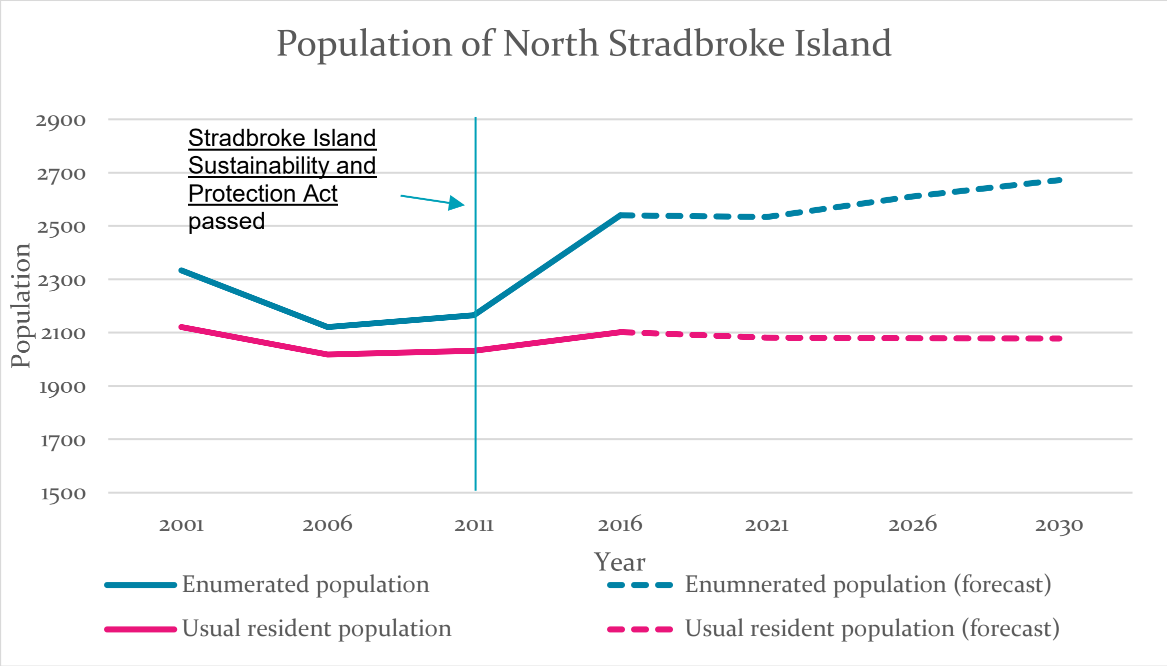

Figure 4: North Stradbroke Island Population, 2017
Source: (ABS, 2017)

From 2011-2016, the enumerated population increased by 17.3% and is expected to increase by another 5.2% by 2030 (Figure 4). The Island's usual population only grew by 3.4% (ABS, 2017). This may indicate the shift to tourism has increased visitor numbers, and preserving the land has become more crucial to support this.

First Nations people make up 41.1% of the population (compared to 2.8% of Australia's population) (ABS, 2017). The native title acknowledging the Quandamooka people allows them to actively care for the natural environment, therefore they must be recognized for their important role in the community and included in decisions regarding the land.

Redland City Council does not consider Home Beach viable for formal protection as it is in a township precinct (Figure 5). As tourists can access the area, a management strategy should be implemented to mitigate anthropogenic impacts.

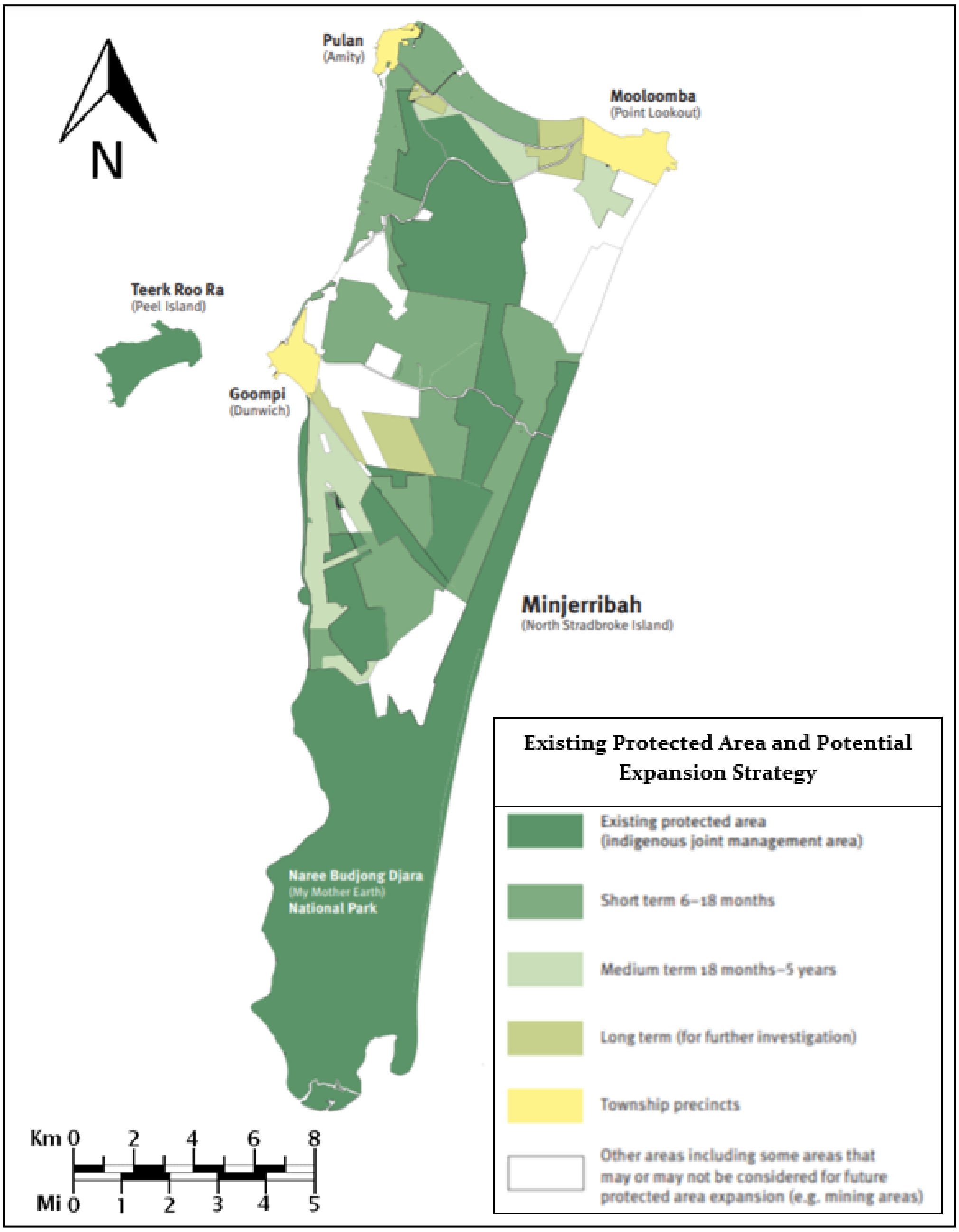

Figure 5: Protected area plan, North Stradbroke Island, 2019
Source: (Redlands City Council, 2019)

Home Beach is defined as casuarina woodlands by the Queensland Herbarium (Table 3).

Table 3: Ecosystem Characteristics
Source: (Department of the Environment and Energy, 2017)

35. Casuarina woodlands	- Features sheoaks - Sparse canopy in semi-arid areas - Shrub and grass layer - Trees are typically ~12 m tall with crown cover >20%

Photographs of Home Beach (Figure 6) deviate from this model via anthropogenic land cover changes, such as line clearing. The area lacked the specified canopy cover (>20%) and a grass and shrub layer. Reasons for clearing may be to reduce snake habitat, whilst the path enables safe beach access.

Figure 6: Home Beach site, 2021

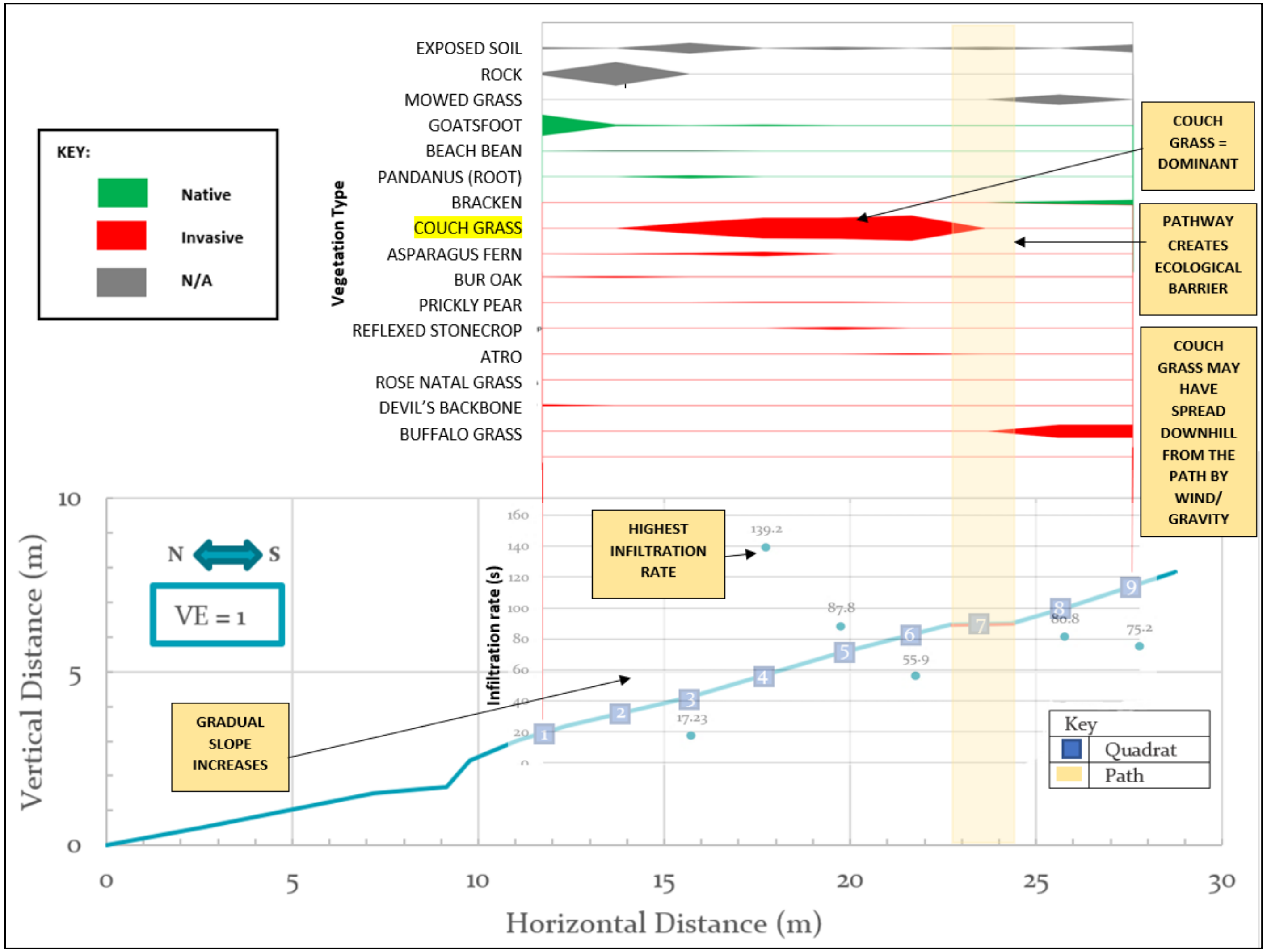

Figure 7: Home Beach profile, 2021

Couch grass coverage (Figure 7) may suggest it was introduced via the path (seeds transported on shoes, animals), travelling downhill via wind and gravity, assisted by a trampling effect. The pathway creates an edge effect as the lack of trees reduce canopy cover.

A kite diagram shows little native coverage (Figure 7). Couch grass is dominant, and the native species Goatsfoot is only present in areas without it (Q1 – 80%), suggesting Couch grass hinders other plants. The presence of Couch grass in a cleared area may suggest the dispersal of invasive species seeds is assisted by anthropogenic practices such as line clearing. Other invasive species such as Devils Backbone (Q1 – 50%), and Buffalo grass (Q8/9 – 50%) were sparse, but present.

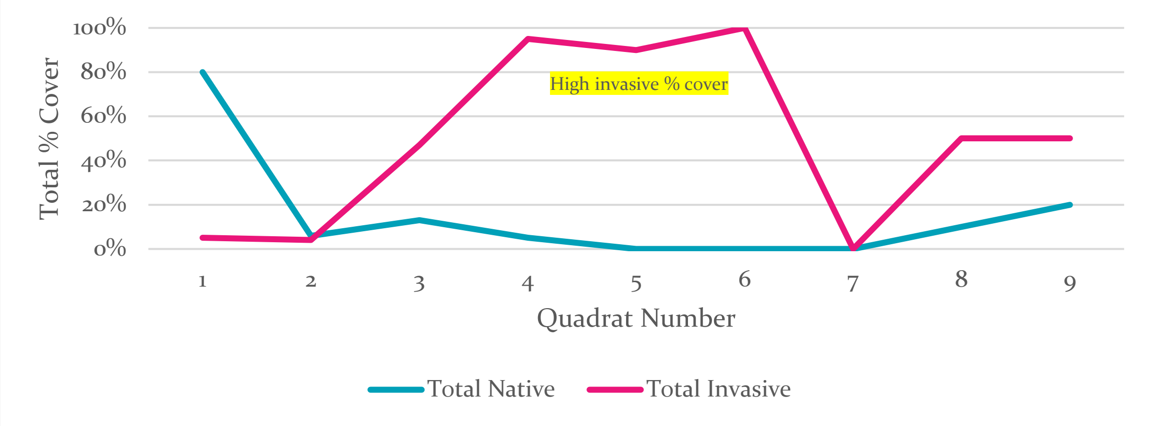

Figure 8: Native and invasive percentage cover

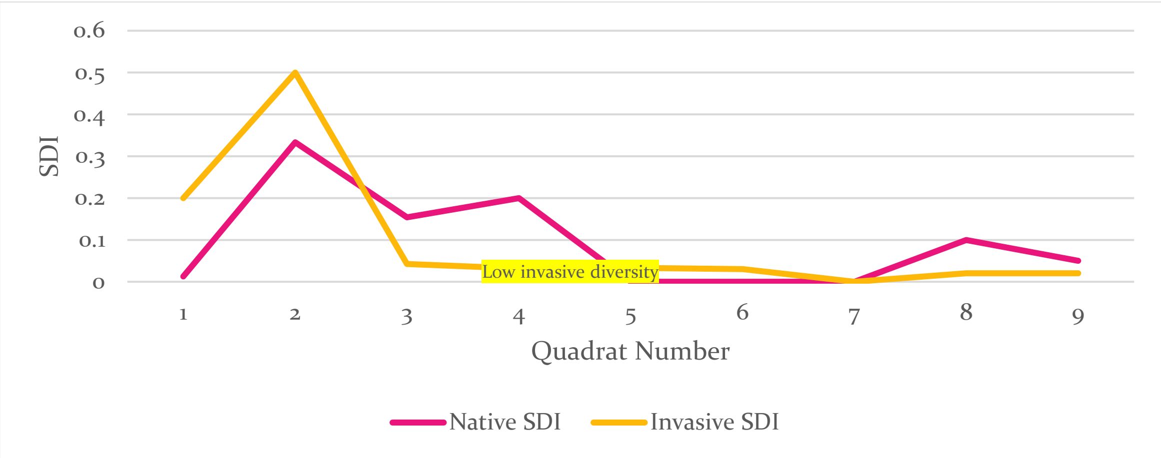

Figure 9: Native and invasive SDI

Invasive species appear to have a high coverage but low diversity in Quadrats 3-7 (Figure 8 & 9). This further supports couch grass as a dominant species. Hence, weed domination is a significant issue within the ecosystem.

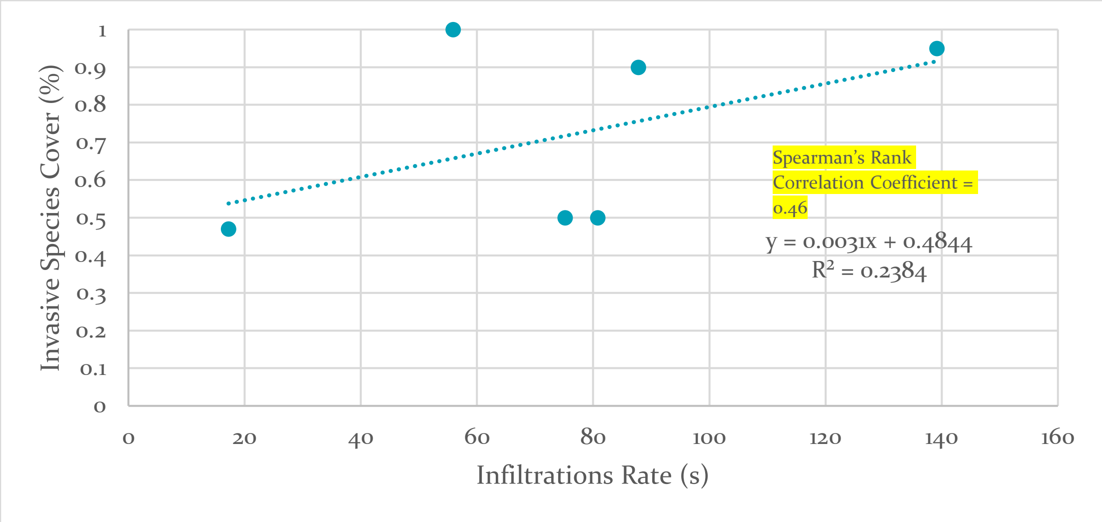

Figure 10: Invasive species cover (%) vs infiltration rate (s)

A moderate positive correlation existed between infiltration rate and invasive species coverage (Figure 10). Soils with a higher infiltration rate are drier and less dense, allowing invasive species to populate a harsh, disturbed environment (Dix & Buford, 2009).

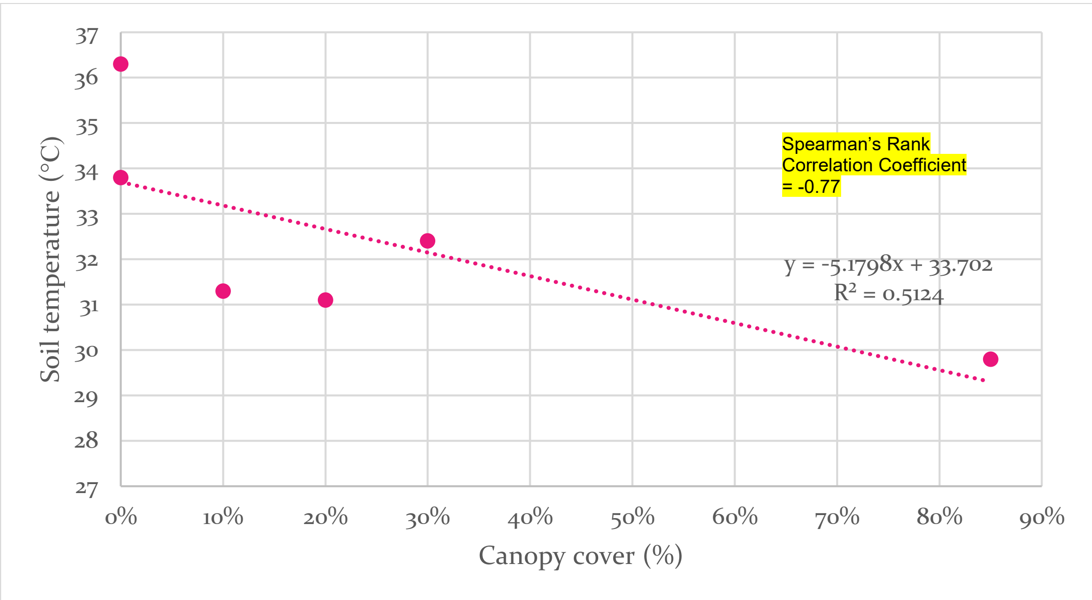

Figure 11: Canopy cover (%) vs soil temperature (°C)

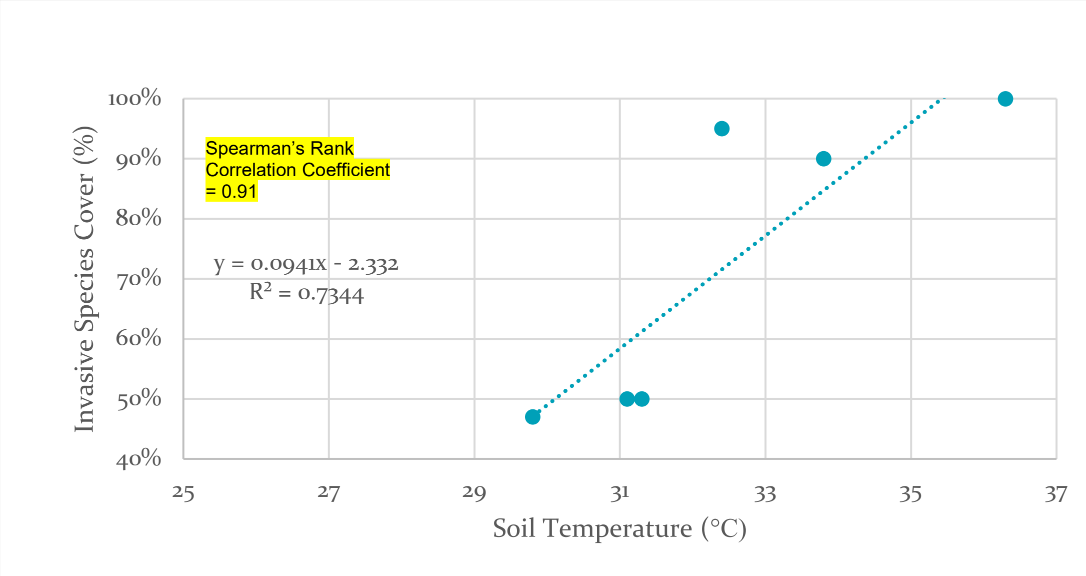

Figure 12: Soil temperature (°C) vs invasive species cover (%)

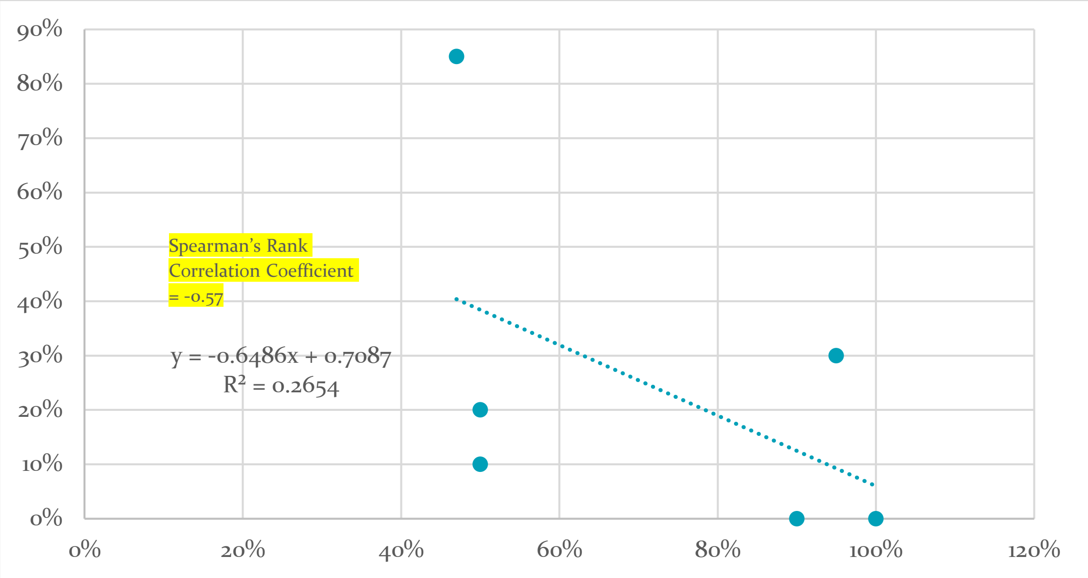

Figure 13: Canopy cover (%) vs invasive species cover (%)

Canopy cover showed a strong negative correlation with soil temperature (SRCC = -0.77) (Figure 11), and soil temperature had a very strong positive correlation with invasive species coverage (SRCC = 0.91) (Figure 12). Hence, it was found that canopy cover had a moderate negative correlation (SRCC = -0.57) with invasive species cover (Figure 13). The canopy loss creates an edge effect surrounding the cleared area and path, disturbing the soil conditions. This has allowed couch grass to become the dominant species, posing a significant threat to the Home Beach ecosystem.

2.3 COUCH GRASS WEED ANALYSIS

Couch grass (*Elymus repens*) (Figure 14) was identified as the main issue affecting Home Beach, as the most prolific weed.

Figure 14: Elymus repens (Couch grass) at Home Beach

2.3.1 Invasive attributes

Elymus repens propagates easily through its underground rhizomes. A new plant can grow from any part of the root, creating high risk for rapid propagation. Line trimming observed at the site in Figure 6 may worsen this by breaking up the root when cutting away plant matter (CABI, 2021).

Couch grass suppresses other plants via its coverage, density, and by capitalizing root space (PFAF, 2021). This is supported by the lack of Goatsfoot in Couch-dominated areas, suggesting a high competitive ability.

It does not appear to have any biochemical effects or novel weapons (CABI, 2021).

2.3.2 Site Biotic Characteristics

Simpson's Diversity Index was used to consider native species diversity. SDI peaked at 0.33 and remained low across the transect (Figure 9). The low biodiversity and complexity creates a moderate invasion risk as the ecosystem is more vulnerable to invasive species – it is not high risk as the ecosystem is not a monoculture.

Elymus repens does not appear to have enemies as it is an introduced species (high risk) but it does share the area with other invasive species (e.g. *Kalanchoe daigremontiana* (Devil's Backbone) (Figure 15), and *Bouteloua dactyloides* (Buffalo Grass). These species are less prolific, but create a moderate risk through mutualism, as invasibility increases other invasive species exist (Grman, Robinson, & Klausmeier, 2012).

Figure 15: Devil's Backbone at Home Beach

2.3.3 Environmental Conditions

Elymus repens was originally introduced to Australian lawns because it is drought tolerant (Urban Bushland Council, 2021), which has allowed it to overtake dry and disturbed environments. A moderate positive correlation between increased infiltration rate and invasive species coverage (Figure 10), and a very strong positive correlation between soil temperature and invasive species coverage, suggests it could prosper in harsh conditions. Anthropogenic influences could worsen this though increased water use or climate change driven drought, creating a high risk for further invasion (Ramesh, Matloob, Aslam, Florentine, & Chauhan, 2017) .

2.3.4 External influences

Line trimming and trampling would greatly assist propagation by breaking up the rhizomes. Seeds may be dispersed from home gardens, assisted by the dominant south-easterly wind (World Meteorological Organization, 2021).

Canopy removal increases soil temperature and hence invasive species cover, as shown in Figures 11, 12, and 13. Therefore, anthropogenic development is a key factor creating disturbed conditions that ultimately allow *Elymus repens* to spread. This may be worsened by climate change and decreased rainfall in the future.

3.0 Invasion Triangle

Table 4: Invasive factors; Elymus repens

36. Invasive Attributes	
37. Propagation 38. Competitive ability 39. Novel weapons/engineering **40. Total**	41. 3 42. 3 43. - **44. = 6**
45. Site Biotic Characteristics	
46. Diversity 47. Enemies 48. Mutualists **49. Total**	50. 2 51. - 52. 2 **53. = 4**
54. Environmental Conditions	
55. Soil temperature 56. Dry soil (high infiltration rate) 57. pH **58. Total**	59. 3 60. 2 61. 1 **62. = 6**

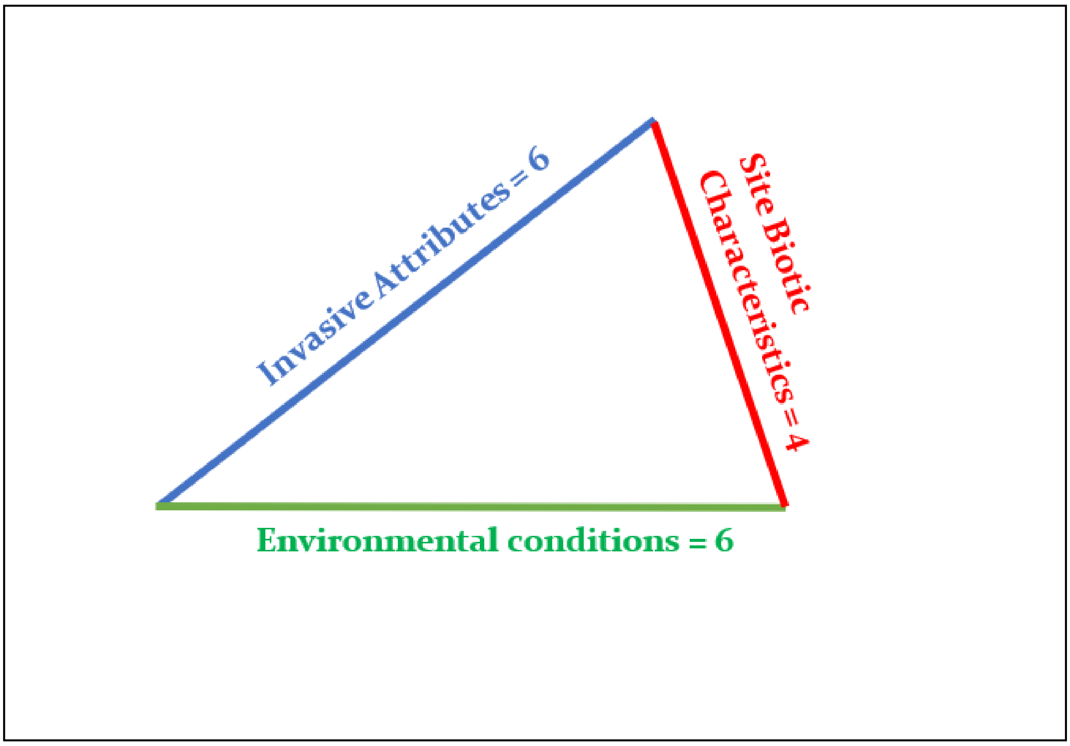

Figure 16: Invasion triangle; Elymus repens

Invasive attributes in conjunction with environmental conditions allow *Elymus repens* to spread rapidly and therefore these issues require a management strategy (Table 3 & Figure 16).

4.0 Conclusion

4.1 SYNTHESIS

The main threat to Home Beach's ecosystem is the dominant invasive species *Elymus repens* (Couch grass). It appears to have been introduced from residential development in the south (uphill), and travelled downhill via water (drainage) and wind.

Couch grass suppresses native flora due to its density and root structure and is advantaged by canopy reduction and an edge effect surrounding the path, which creates hot, dry soil conditions. Introduced as a drought tolerant lawn solution, it prospers in these conditions, assisted by external anthropogenic influences (line trimming) and a lack of natural enemies. Tourism could decline as the area's aesthetics and natural attraction decrease, causing Stradbroke Island's economy to suffer. Whilst Home Beach is a less popular beach, the Stradbroke Hotel's proximity makes its deterioration a moderate issue as visitors may be deterred by an unattractive beachfront.

4.2 SOLUTION

Couch grass is able to reshoot via rhizomes, therefore, a singular removal is not effective. A canopy conservation strategy could reduce the environment's invasibility in conjunction with an ongoing community initiative to remove the rhizomes from the area by hand every few months.

Canopy conservation would require input from First Nations peoples to suggest how to restore native trees and reduce edge effect. This may include increasing the Pandanus population. This would reduce overall soil temperature, improving environmental conditions for native plants.

The Pandanus Preservation Project Noosa highlighted direct seeding (Figure 17) as an economically viable preservation strategy (Frostin, 2018).

Kabi Kabi descendent Torie performing direct seeding methods.

Figure 17: Pandanus seeding
Source: (Frostin, 2018)

Invasive species have little impact on native species at a low abundance (Panetta & Gooden, 2017), hence reducing abundance through these methods would greatly reduce the issue.

5.0 References

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6.0 Appendices

APPENDIX 1 – FIELDWORK TABLE

63. What information do I need to collect?	64. What is the best field methodology to use?	65. What will I need to take to record the data?	66. Methods to ensure accuracy/validity
67. Elevation data	68. Topographic profile	69. 2 clinometers 70. 2 ranging poles 71. A tape measure	72. Consistency of data collectors ensures consistency of methodology 73. Readings at both poles, consensus of data increases accuracy 74. Same transect as vegetation profile + other data creates opportunity for investigation of possible relationships
75. Vegetation data	76. Vegetation transect	77. 1 x 1m transect 78. Tape measure 79. Camera/phone 80. Local vegetation classification material	81. Consistency of data collectors 82. Consensus required for data inclusion 83. Same transect as vegetation profile + other data creates opportunity for investigation of possible relationships 84. Photos taken on identifiable plants for later, more accurate identification by class 85. Use of plant ID app to more easily find correct species names 86. Identification of species as invasive or native, increases accuracy of biodiversity calculations and interpretation of data 87. Team plant identification assists in finding accurate species names
88. Anthropogenic influences	89. Draw field sketch 90. Take photos of erosion, tracks, rubbish	91. Camera/phone 92. Pencil and paper	93. Photos collected to demonstrate data collection area in report
94. Abiotic / physical factors - land	95. Measure all at transect site	96. Anemometer 97. Temperature gage	102. Multiple readings (3) from instruments – average reading recorded – random points within the vegetation quadrats (random selection removes bias, but is still helpful in determining correlations as it is in the quadrats)

• Humidity • Wind speed • Wind direction • Soil moisture • Soil temp • Air temp • Light intensity • Infiltration rate		98. Cylinder for infiltration, water 99. 100. 101.	103. Consistency of data collectors for each instrument 104.
105. Biotic factors (excluding transect)	106. Take photos	107. Camera/phone	108. Take photos of field sketch area for later refinement / double checking 109.
110. Land use	111. Indicate land use on map, photos, notes 112. Drone footage/photos of area if possible	113. Camera/phone 114. Map of area 115. Drone if possible	116. Use drone photos to increase accuracy of land cover map – most recent changes are visible that may not be accessible online

APPENDIX 2 – RAW DATA

Topographic Profile			
Descriptor	Horizontal Distance (m)	Gradient (deg)	
1	0	0	
2	2.7	11	
3	4.65	12	
4	1.95	6	
5	1	50	
6	1.4	24	
7	1.4	17	
8	3.39	14	
9	14.01	18	
10	3.3	15	
11	1.65	2	
12	1.65	17	
13	3	19	

Site Number	#2	Location Name	Home Beach
Weather	Slightly overcast, moderate winds	Latitude (N/S)	27.4252 S
Temperature	36	Longitude (E/W)	153.5194 E
Wind Speed	1.03m/s	Time of readings	1:28PM
Max Wind Speed	1.8m/s	Rubbish (0-10)	5
Wind Direction	SE		

Quadrat Number	Location (m from bottom of rocks)	Ground temperature (C)	Moisture scale	pH	Infiltration (Seconds)	Canopy Cove
1	11.6					60% pandan
2	13.45					
3	15.4	29.8	4	7	17.23	85%
4	17.5	32.4	6	7	139.2	30%
5	19.5	33.8	8	6.5	87.8	0%
6	21.5	36.3	4	7.5	55.9	0%
7	23.5					0%
8	25.5	31.3	2	7	80.8	10%
9	27.5	31.1	3	7	75.2	20% coastal

Land features			Native				Invasive								
Exposed soil	Rock	Mowed gras	Goatsfoot	Beach bean	Pandanus (r	Bracken	Couch grass	Asparagus fe	Bur oak	Prickly Pear	Reflexed sto	Atro	Rose natal g	Devil's Backb	Buffalo grass
5%	10%		80%											5%	
	90%		5%	1%				2%	2%						
40%			0%	3%	10%		41%	6%							
			5%				79%	15%		1%					
10%			0%				80%			2%	8%				
			0%				96%					3%	1%		
100%			0%												
		40%	0%			10%									50%
30%			0%			20%									50%

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