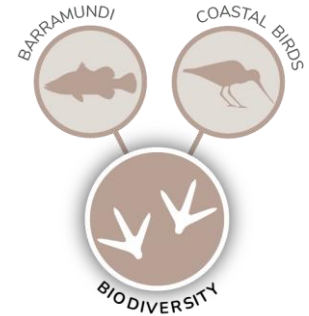


Biodiversity

1 Coastal Birds

Indicator Overview

Coastal bird diversity is a new indicator for the 2024 DHIRC within the biodiversity value. This indicator provides a measure of diversity in coastal bird populations in and around Darwin Harbour using data collected by the Larrakia Rangers.



Methodology

Coastal bird surveys of Darwin Harbour are undertaken by the Larrakia Rangers who count coastal bird numbers via transect and bird hide observations across three sites (Darwin Harbour, Gunn Point and Buffalo Creek) at multiple times per year. The coastal bird dataset includes bird numbers, location, date, and environmental factors such as weather conditions.

Coastal bird data collected throughout 2023 was assessed for the 2024 DHIRC using the Simpson's Diversity Index¹. This commonly used index of biodiversity assesses the probability that two randomly selected individuals are related (Appendix I – Coastal bird data) and provides an arithmetic means to measure the evenness of species in a community. The term “evenness” simply refers to how similar the abundances of different species are in the community.

Equation 1 Simpson Biodiversity Index of evenness of a species in a community

$$D = 1 - \left(\frac{\sum n(n - 1)}{N(N - 1)} \right)$$

D = Simpson's Diversity index

n = the total number of organisms of a particular species

N = the total number of organisms of all species

Migratory shorebirds were removed from the analysis to overcome potential future issues with the presence/absence of migratory species at times of survey. Hence, only resident species of birds were assessed for this indicator.

As with all report card indicators, coastal bird diversity requires conversion to the standardised report card score scale of 0-100% shown in Figure 1-1.

¹ Morris EK, Caruso T, Buscot F, Fischer M, Hancock C, Maier TS, Meiners T, Müller C, Obermaier E, Prati D, Socher SA, Sonnemann I, Wäschke N, Wubet T, Wurst S, Rillig MC. 2014. *Choosing and using diversity indices: insights for ecological applications from the German Biodiversity Exploratories*. *Ecol Evol*. 4(18): 3514-24.

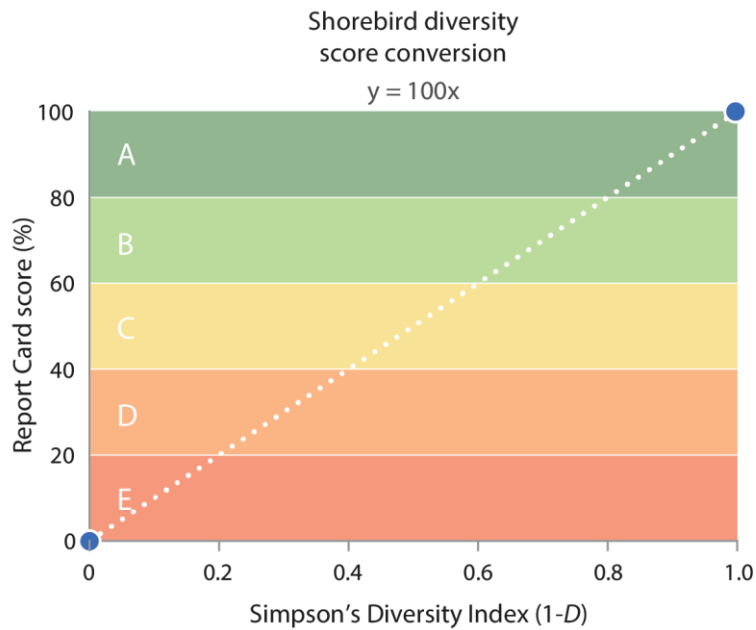


Figure 1-1. Report card indicator results are standardised to a common scale of 0-100% and categorised into five categories ranging from 'Very Poor' to 'Very Good'. A score of 100% indicates that the index returns a value of one, whilst a score of 0% indicates the index returns a score of 0. If a score is within 5% of a grade boundary, a '+' or '-' is added to the grade (e.g. a score of 58% = C+, whereas a score of 62% = B-).

Report card score and grade

The Simpson's Diversity Index for resident coastal birds in Darwin Harbour in 2023 was 0.85. This converts to a report card score of 85% (A- grade) for inclusion in the 2024 DHIRC (Table 1-1).

Table 1-1. Summary of coastal bird diversity scores and report card grade for the 2024 DHIRC.

Simpsons Biodiversity Index Score	Report Card Score	Report Card Grade
0.851	85.1%	A

2 Barramundi

Indicator Overview

Barramundi is a new indicator to be included in the 2024 DHIRC under the biodiversity value. It has been identified as a key species in the harbour’s aquatic ecosystem where fluctuations in species health indicates changes in food webs and ecosystem health. As barramundi recruitment is highly dependent on environmental conditions, trends in size are the result of environmental conditions in the years prior.

The indicator reports on data captured by the [Top-End Barra series](#), an annual Darwin Harbour fishing competition that includes strict rules regarding fishing methods, effort, and measurement. Fish lengths submitted in the competition are verified by photographic evidence.

A summary of the competition rules is included below:

1. Fishing will start at 6 am on the Saturday of the round and finish at 6 pm on Sunday night of the Round.
2. Fish can be caught by casting or trolling lures, soft plastics or by fly fishing. No bait fishing is allowed. There is no restriction on leader size or length. You can use either barbed or barbless hooks. There are no limits to the number of rods used (trolling for example).
3. Take photos of your best 5 Barra caught over the weekend over 50 cm. Once you have caught your 5 eligible fish you may then upsize your scoring fish by dropping off your smallest and adding the larger one to the five you upload via the website.
4. Fish will be sized down to the centimeter. For example, if the fish is between 58.0 to 58.9 cm it will be scored at 58 cm.

Methodology

The Top End Barra dataset reports on barramundi length caught in the competition held in Darwin Harbour since 2014. The dataset includes 575 barramundi fish caught between 2014 and 2023, reported yearly, except for 2018 and 2021, when no data was captured. The dataset includes fish length, which has been included as a proxy for ecosystem health. The DHIRC assumes that in a healthy ecosystem, fish lengths will stay constant or increase, whilst in an unhealthy ecosystem, fish length will decrease.

A scoring system was developed to assess the barramundi indicator using seven years of historical data between 2014 and 2020. This period acts as a baseline of barramundi length in the harbour, against which changes in current and future years can be assessed. Fish length for this period was ranked into 20th percentiles (Table 2-1), resulting in 5 ‘category bins’ that align with the standard report card “category bins” shown in Table 2-1 and Table 2-2.

Table 2-1. Barramundi length for 2014 to 2020 ranked by percentiles.

Percentile rank	Barramundi Length (cm)
100	92
80	66
60	61
40	56
20	53
0	50

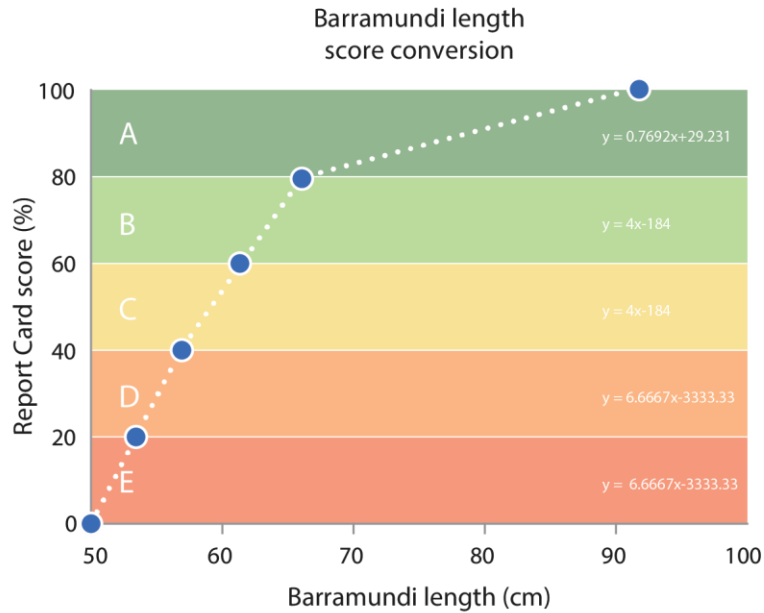


Figure 2-1 Linear relationship between barramundi length and the standardised 0-100% report card scale. Report card indicator results are standardised to a common scale of 0-100% and categorised into five categories ranging from ‘Very Poor’ to ‘Very Good’. A score of 100% for the barramundi length indicates that the two-year average length has met or exceeded the highest level recorded in the harbour between 2014-2020, whilst a score of 0% indicates the two-year average of barramundi length was at or below the lowest level recorded in the harbour between 2014-2020. If a score is within 5% of a grade boundary, a ‘+’ or ‘-’ is added to the grade (e.g. a score of 58% = C+, whereas a score of 62% = B-).

Table 2-2 Report card threshold bins based on percentile ranks for 2014 to 2020 barramundi lengths.

Percentile	Threshold Category Bin (Barramundi Length cm)	Report Card Grade and Score
80 - 100	66-92	A (80-100%)
60 - 80	61-66	B (60-80%)
40 - 60	56-61	C (40-60%)
20 - 40	53-56	D (20-40%)
0 - 20	50-53	E (0-20%)

As the competition only provides a snapshot of fish caught over one weekend in the year it is expected to be variable dependent of environmental conditions both on the weekend and over the proceeding weeks / months. The 2024 DHIRC compares the 80th percentile length of barramundi from the most recent two years (2022 – 2023) against the percentile ranges calculated from 2014 - 2020 (Table 2-2). Applying a rolling average, means that the indicator reduces the impacts of annual variability on its results. The 80th percentile length of barramundi was adopted in the DHIRC as it remains sensitive to change and reports on larger fish. This is significant as larger fish are key to breeding populations and best reflect population health.

Report Card Score and Grade

The 80th percentile of barramundi lengths reported by the Top End Barra Series in Darwin Harbour for 2022-23 was 63 cm. This converts to a report card score of 68% (B grade) for inclusion in the 2024 DHIRC (Figure 2-2, Table 2-3).

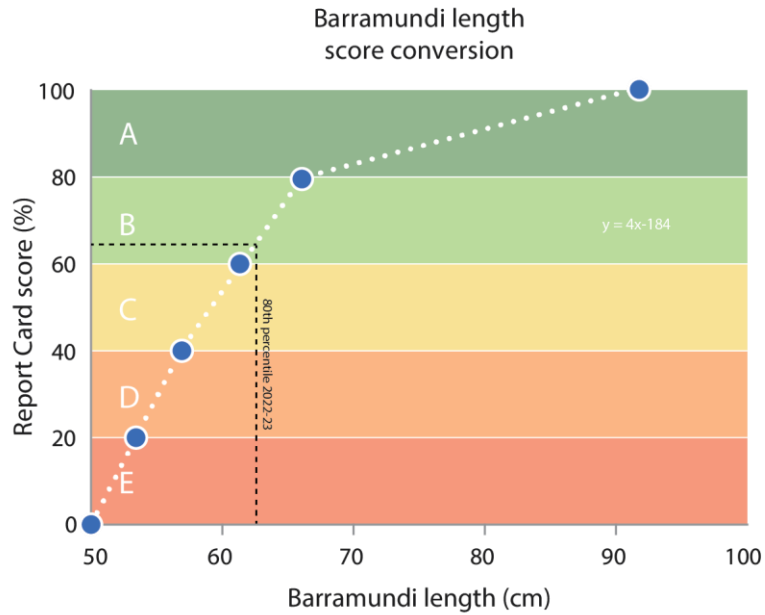


Figure 2-2 Relationship between barramundi length and threshold bins and corresponding report card grades.

Table 2-3. Barramundi length for the period 2022-23 and corresponding 2024 DHIRC report card score and grade.

	Barramundi length (cm)	Equation	Report Card Score	Report Card Grade
DHIRC 2024	63	$y = 4x - 184$	68.0%	B

Appendix I – Coastal bird data

List of non-migratory coastal birds used in calculating a Simpson's Diversity Index for the 2024 DHIRC.

Species	Number of birds (n)
Australian White Ibis	12
Beach Stone-curlew	5
Black Cormorant	1
Black Kite	2
Black-necked Stork	6
Brahminy Kite	2
Collared Kingfisher	2
Common Gull-billed Tern	32
Crested Tern	10
Eastern Reef Egret (Grey)	34
Eastern Reef Egret (White)	2
Great Egret	26
Little Egret	30
Little Tern	30
Magpie-lark	1
Masked Lapwing	2
Osprey	5
Pied Cormorant	3
Pied Heron	133
Pied Oystercatcher	2
Rainbow Bee-eater	11
Red-capped Plover	3
Silver Gull	115
Striated Heron	11
Tern	18
Whiskered Tern	205
Whistling Kite	1
White-winged Black Tern	20