Using the Fish Index of Biotic Integrity Calculator to meet the NPS-FM

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Introduction

Who this information for

- Regional council or unitary authority staff who are responsible for identifying attributes and their baseline states, and to monitor and report on these over time.

- Treaty partners, consultants, contractors, community groups, citizen scientists and others who are working with their regional council to monitor and report on the health of local waterways.

What is the Fish Index of Biotic Integrity?

A Fish Index of Biotic Integrity (IBI) was developed for Aotearoa New Zealand in 2004 to account for the unique attributes of New Zealand freshwater fish, such as low species diversity and a high proportion of migratory species (Joy and Death, 2004).

A Fish IBI, based off Joy and Death (2004), was incorporated as an attribute in the National Policy Statement for Freshwater Management (NPS-FM) in 2020. The NPS-FM requires regional councils to:

- monitor fish communities to calculate IBI scores

- at a minimum, develop action plans to achieve target states determined in consultation with communities.

The Fish IBI is a multi-metric indicator that takes into account natural gradients in species richness (altitude and distance from sea). It is a composite index composed of six metrics of fish community composition[1]:

1. total number of native species

2. number of native riffle-dwelling species

3. number of native benthic pool-dwelling species

4. number of native pelagic species

5. number of intolerant or sensitive native species

6. proportion of non-native species.

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[1] See Ministry for the Environment. 2019. *Fish Index of Biotic Integrity in New Zealand Rivers 1999–2018*. Wellington: Ministry for the Environment.

The Fish IBI as an attribute in the NPS-FM

The purpose of the NPS-FM

The NPS-FM establishes the regulatory framework for the long-term management and improvement of freshwater in Aotearoa. Regional councils implement the objectives and policies of the NPS-FM through regional plans, including Fish IBI action plans, that seek to improve the ecosystem health of our waterways.

The NPS-FM requires that regional councils monitor the state of freshwater. The regional council must analyse trends and take action if the current plan settings are not achieving the environmental outcome set for each value (Clause 3.9) and ultimately the long-term vision set.

Subpart 2 of the NPS-FM provides the overarching objective relevant to all compulsory attributes (including Fish IBI) required by the National Objectives Framework. Subpart 3 of the NPS-FM (Clause 3.30) relates to the assessing and reporting requirements of all monitoring data obtained by regional councils.

For further information on Subpart 3 of the NPS-FM see the Ministry for the Environment guidance on Implementing the National Objective Framework.

How the national Fish IBI scores are calculated

Fish IBI scores and the associated A–D bands in the NPS-FM attribute table were calculated in accordance with the Joy and Death (2004) methods.

Fish observations at each site visit are converted to an IBI score by summing a score for each of the six metrics above. Final scores can range from 0 to 60 for each site visit, with higher scores indicating a healthier native fish community. Site visits where no fish species were observed are given a 'No species' score. Joy and Death (2004) and the associated excel file has a table of common species codes from the New Zealand Freshwater Fish Database (NZFFD) with a classification of each species for each of the six metrics above (see appendix 1).

Each of the first five metrics were scored using two sub-metrics representing potential species richness, relative to a) elevation and b) distance from the sea. The Fish IBI Calculator uses the same maximum species richness lines (MSRL) derived by Joy and Death (2004) to indicate potential species richness (see appendix 2). A site's richness for a given metric was compared to the metric's MSRL for a given elevation and the corresponding MSRL for a given distance from the coast. A site scored 5 points when it was greater than 66 per cent of the MSRL, 3 points when between 33 per cent and 66 per cent of the MSRL inclusive, and 1 point for below 33 per cent.

Metric 6 was scored based on the proportion of native species. The maximum score of 5 was given to sites at which native species accounted for greater than 66 per cent of all species observed. A score of 3 was assigned to sites at which native species accounted for between 33 and 66 per cent of all species observed. The minimum score of 1 was assigned to sites at which native species accounted for less than 33 per cent of the total number of observed species.

The score from metric 6 was doubled to provide a score of between 2 to 10 for each site (as this metric was assumed to not be associated with elevation or distance to sea).

A final score (out of 60) for each site visit can then be converted to either a national NPS-FM attribute band (see page 55 of the National Policy Statement for Freshwater Management 2020); or a regional score using the per-region quartiles from Canning and Joy, 2021 (see appendix 3).

How the A−D band thresholds were generated in the NPS-FM

The thresholds were derived from the quartiles of the full dataset of IBIs available from the New Zealand Freshwater Fish Database (NZFFD), collating surveys conducted between 2010 and 2017. This means that grades are presented as equal quantiles, such that sites falling in the A-band fell within the top 25 per cent nationally, B-band in the highest 50 per cent nationally, C-band in the top 75 per cent nationally, and D-band in the lowest 25 per cent. With reference to these grades, the NPS-FM does not mandate a bottom line. Grades provide an approximation of state and are by no means definitive. Instead, councils have full discretion to set their own target states so long as the current state is maintained (or improved). Any new observations are compared to the thresholds that were derived from the original dataset.

Monitoring sites

Each freshwater management unit (FMU) should have one or more monitoring sites for Fish IBI. Councils are required to monitor and report on the achievement of long-term visions and target attribute states (TASs), so will need monitoring sites to do this. The sites must be representative of all or part of the FMU.

Fish IBI is one of the attributes that must be managed to meet the 'aquatic life' component of ecosystem health. Ecosystem health is a compulsory value of the NPS-FM.

The ecological values and fish communities within an FMU will vary in different catchments and as such, it will not be practical or possible to monitor every drop of water in a region. The Freshwater NPS-FM requires selective monitoring to be undertaken:

- at sites the council has identified which represent the water environment for that FMU or part thereof;
- and/or are representative of one or more primary contact sites in the FMU.

Identifying monitoring sites in an FMU

When selecting representative monitoring sites, a council, among other factors, should consider:

- the freshwater values and objectives that have been set (ie, ecosystem health, amenity or recreational values, mahinga kai), as this will help determine the appropriate location
- ease of access
- efficiency – it will be more efficient to monitor multiple attributes at each monitoring site (noting that multiple monitoring sites may be required depending on the complexity of the FMU).

Reporting on Fish IBI data where there is more than one monitoring site in an FMU

Reporting on the FMU's overall (or average) attribute state will not always provide an accurate assessment of ecosystem health. This will be true in the case where councils already have more than one monitoring site established and/or have determined the need for multiple monitoring sites for the purpose of monitoring a single attribute within a given FMU. Averaging across monitoring sites may overlook a problem at one or more of the sites.

To assess progress in this scenario, councils will need to set a TAS for each monitoring site. TASs can be based on the baseline state or better, depending on objectives and long-term visions determined alongside communities and tangata whenua. The purpose of setting a TAS for each monitoring site is so you can monitor progress as to whether your policies or interventions (ie, rules/action plan) are having an effect and achieving the TAS over time.

The policies or intervention(s) should be targeted at the most stringent TAS in the FMU, noting that an action plan can be tailored towards a finer scale than rules generally provide for. Baseline states must be established as well as a timeline to achieve the target state for each site (if improvement, rather than maintaining, is required).

For example, if a council has identified four key Fish IBI monitoring sites in an FMU, and they are graded A, B, C and D, respectively, then the FMU would need to have four discrete target attribute states. The action plan and/or rules (on resource use and water takes) and consent conditions should, where appropriate (based on costs and effort), be tailored towards achieving the most limiting TAS.

For further information on FMUs, scale for target attribute states and limits see the NOF guidance 'Clause 3.8: Identifying FMUs and special sites and features'. This guide also provides more information on 'Clause 3.19: Assessing trends' and 'Clause 3.20: Responding to degradation'.

The Fish IBI Calculator

About the tool

The Fish IBI Calculator was developed to assist practitioners in calculating and reporting Fish IBI scores at a national and regional level. This document contains guidance for users of the Fish IBI calculator.

The Fish IBI Calculator was derived using the specific methods developed by Joy and Death (2004) for application to New Zealand fish communities.

When to use the Fish IBI Calculator

The national IBI provides a useful measure of national consistency across all regionals. It is not a requirement that councils use the Ministry for the Environment's calculator, so long as they are consistent with the approach specified in the NPS-FM.

- The Fish IBI Calculator may be used as the basis to report on 'baseline state/current state' (as defined in the NPS-FM) and required by 3.10 (3).

- This will allow councils to understand the starting point for monitoring against. Calculating baseline state would mean inputting at least three years of data, ideally five (for each FMU), then for each specific site, taking the median IBI score from sampling across the three to five years.

- The app may also be used to understand the state of the attribute for any given year (ie, annual sampling as per the NPS-FM). This supports the NPS-FM reporting requirements of ecosystem health (see 3.30 Assessing and Reporting).

- The app may be used to view IBI scores based on a region's bands. This provides a useful comparison, to account for regional characterises, particularly if a region may perform consistently worse or better than the national average due to natural, regional drivers.

> **The value of regionally specific Fish IBIs**
>
> It is important to consider any results from regionally derived models alongside the national IBI model.
>
> While calculating a regional IBI score is not a requirement of the NPS-FM, regional fish IBI scores may be used to inform non-regulatory actions to identify areas of fish declines (or improvements) and develop immediate and ongoing management plans. A regionally developed IBI model, or other types of ecological models, may form part of the best available information that councils rely on to assess a site's performance against the NPS-FM IBI bands.

A major benefit of a national Fish IBI is that it provides a nationally consistent indicator that can be used for the purposes of inter-regional comparisons and national environmental reporting. Regional IBIs, or other types of ecological models, on the other hand, may have particular merit where a region has natural characteristics that influence fish communities and differ from the national norm. For example, climatic drivers, catchment and river typologies or differences in coastal processes that affect recruitment. These broader environmental differences may alter the general relationship between fish communities and elevation or distance inland and so affect how a local site compares with the national IBI bands. A combination of national and regional findings may therefore benefit the interpretation of results and the development of appropriate action plans, when responding to poor grading or a decline of fish IBI scores.[2] Noting that, under the NPS-FM, regional councils must prepare an action plan for achieving the target attribute state within a specified timeframe for all NPS-FM Appendix 2B attributes, which includes fish IBI.[3]

Several councils, including Northland, Auckland, Southland, Manawatū–Whanganui, Wellington and Tasman, have developed regionally specific Fish IBI methods (Joy, 2004a, 2004b, 2010, 2014, 2015, 2019; Joy and Henderson, 2007).

For more information on comparison between national and regional scoring see (Canning and Joy, 2021).

Where to access it

The Fish IBI Calculator is free to use on the Ministry for the Environment website: Fish IBI Calculator.

How to access the data

The code for the calculator is open sourced and can be viewed on the Ministry for the Environment GitHub.

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[2] See Ministry for the Environment 2020. *Limit setting and action plans factsheet*. Wellington: Ministry for the Environment.

[3] See Ministry for the Environment 2020. *Limit setting and action plans factsheet*. Wellington: Ministry for the Environment.

How to use the Fish IBI Calculator

Regional vs national calculation

Users can select a region if they wish to be able to view their results using their region's 'bands' as well as the NPS-FM bands. If coordinate information is provided, and there are points that fall outside of a selected region's boundary, then these points are excluded from the results.

Figure 1: How to select a region for regional IBI analysis
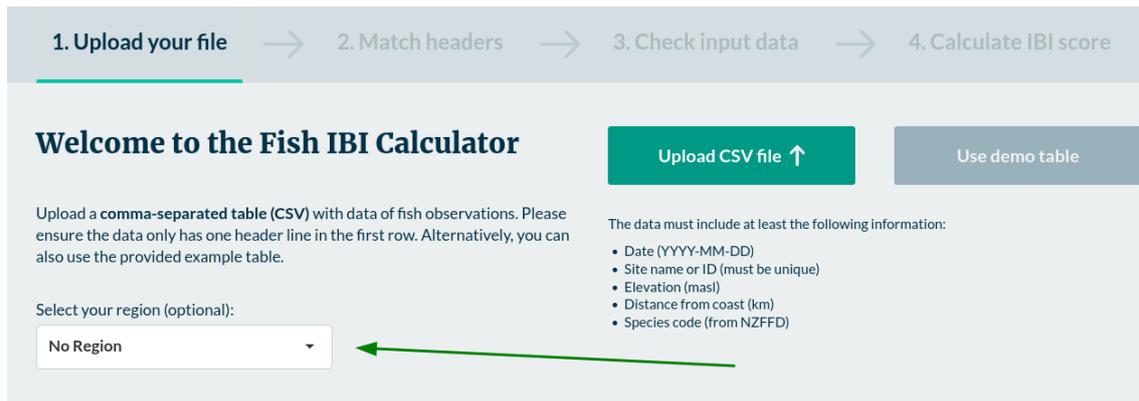
Input data format

The calculator is designed to make it easy for users to upload existing fish monitoring datasets. The calculator requires a comma-separated values (CSV) data file where each row equates to a single fish observation. To reduce the need for users to change their existing data files, the Fish IBI Calculator accepts input datasets with many extra columns and the columns are not required to have specific headers.

The requirements for the input data are:

- CSV file
- single header line in the first row
- one row per fish observation.

Input data content

To calculate Fish IBI results, a minimum set of five variables are required per observation. The input dataset must include columns that contain information for each of these variables. To be included in the analysis each row must have data recorded for each of these variables:

1. date (ideally YYYY-MM-DD) to distinguish between separate site visits

2. site name or ID (must be unique between sites)

3. elevation in metres above sea level (altitude)

4. distance from coast in kilometres (penetration)

5. species code (from the New Zealand Freshwater Fish Database; download the full list from the NIWA website).

The tool calculates the Fish IBI score for each unique site visit. A unique site visit is calculated based upon concatenating together the site name, date, altitude and penetration values. This includes altitude and penetration controls for the situation where site names are not unique (for example, multiple measurements from different locations along the same river). To check how the tool has calculated unique site visits for your data, the downloadable results table includes a column called 'stratum'.

The Fish IBI Calculator results can also include maps. To include maps in your Fish IBI results, the input data requires two additional columns (NZ Map Grid EPSG:27200):

6. northing

7. easting.

An example of what the input data could look like is given below:

Figure 2: **Example input data for the Fish IBI Calculator**

	A	B	C	D	E	F	G	H	I
1	site name	date	species	distance from co	penetration	east	north	card	m
2	Otuwheti S	2006-3-15	parane	1	3	2762976	6443437	22247	3
3	Otuwheti S	2006-3-15	hyrmen	1	3	2762976	6443437	22247	3
4	Otuwheti S	2006-3-15	galmac	1	3	2762976	6443437	22247	3
5	Otuwheti S	2006-3-15	parane	1	5	2762962	6443415	22248	3
6	Otuwheti S	2006-3-15	hyrmen	1	5	2762962	6443415	22248	3
7	Otuwheti S	2006-3-15	galfas	1	5	2762962	6443415	22248	3
8	Otuwheti S	2006-3-15	gobhut	1	5	2762962	6443415	22248	3
9	Otuwheti S	2006-3-15	hyrmen	1	10	2762938	6443368	22249	3
10	Otuwheti S	2006-3-15	parane	1	10	2762938	6443368	22249	3

To help users understand the input data requirements, and explore how the Fish IBI Calculator works, there is a 'Use demo table' button (see figure 3).

Figure 3. **How to upload user data or select example demonstration data**

Match headers

On this page the user is given a preview of what their uploaded data looks like. From here they are able to specify which column relates to each of the mandatory fields required for the calculation.

Figure 4:   **How to match data headers to the mandatory fields in the Fish IBI Calculator**

In the picture above it can be seen that the mandatory field SpeciesCode has not been automatically identified as present in the data. In the example above, the column that contains this information is called 'Species'.

To specify that this column contains SpeciesCode information, right click on the header 'Species' in dark blue. From there a pop-up menu will appear as shown in the picture below:

Figure 5: How to select a mandatory field when matching data headers in the Fish IBI Calculator

Please match your data headers to ours in order to run the analysis

Right-click on your **table headers below** to identify which columns in your data correspond to the mandatory fields.

Please note that if any of the headers are missing or can't be matched, you'll need to edit your original table and re-upload.

Check input data →

Mandatory fields:

✔ SiteID
✔ Date
✔ Penetration
✔ Altitude
○ SpeciesCode

Match header with one of these:
○ Date
○ SiteID
○ Penetration
○ Species code
○ Altitude

Optional location (needed for map)
○ Easting (opt)
○ Northing (opt)

○ [Remove]

SiteID	Date	Species	Penetration	Altitude	Easting	Northing	card	m	y	c
SiteID	Date				ing	Northing				
Otuwheti S	2006-3-15	pa			62976	6443437	22247	3	2006	
Otuwheti S	2006-3-15	hy			62976	6443437	22247	3	2006	
Otuwheti S	2006-3-15	ga			62976	6443437	22247	3	2006	
Otuwheti S	2006-3-15	pa			62962	6443415	22248	3	2006	
Otuwheti S	2006-3-15	hy			62962	6443415	22248	3	2006	
Otuwheti S	2006-3-15	ga			62962	6443415	22248	3	2006	
Otuwheti S	2006-3-15	go			62962	6443415	22248	3	2006	
Otuwheti S	2006-3-15	hy			62938	6443368	22249	3	2006	
Otuwheti S	2006-3-15	pa			62938	6443368	22249	3	2006	
Otuwheti S	2006-3-15	ga			62938	6443368	22249	3	2006	

Within this menu select the relevant field which the column matches, in this case that field is SpeciesCode:

Figure 6:   A selected mandatory field in the Fish IBI Calculator.

Click outside of the pop-up menu to close it. The user will see that beneath the column name that was supplied in the CSV there is a green column name which relates to the field the user selected:

Figure 7:   An applied mandatory field in the Fish IBI Calculator

When all of the mandatory fields have been specified, all fields in the mandatory fields checklist will have a tick beside them:

Figure 8: **A missing mandatory field**

Figure 9: All mandatory fields in the data headers

Click the 'Check input data' button to proceed to the next page.

Check input data

This page informs the user of any issues that exist in the uploaded data set. The number of issues is reported and a table showing rows with issues.

The app detects two categories of issues: errors and warnings. Warnings are coloured blue/grey and errors are coloured red. Users can hover their mouse over coloured cells to find more information about the issues. Users can also filter the table of issues using a drop-down menu.

There is a button to download a full list of issues as a CSV file. This file includes a field showing the rows in the user's original data where issues can be found.

The intention is for users to correct the issues in their data and then re-upload the file to the Fish IBI Calculator app. However, there is also an option to exclude the issues, in order to proceed to the results page. Excluding issues removes individual records for warnings (such as non-fish code issues). For errors, the entire site visit is excluded from the analysis.

Figure 10:   How to filter issues shown in the 'check input data' stage

Once there are no issues (or if the user has chosen to exclude issues), the app shows a table with the data that will be submitted to the Fish IBI calculator and a summary of the final number of valid rows and the number of rows that were excluded.

Figure 11:   Resolved issues

OriginalRow	SiteID	Date	Penetration	Altitude	SpeciesCode	Easting	Northing	Stratum
3	Otuwheti S	2006-3-15	1	3	galmac	2762976	6443437	2006-3-15_O...
6	Otuwheti S	2006-3-15	1	5	galfas	2762962	6443415	2006-3-15_O...
7	Otuwheti S	2006-3-15	1	5	gobhut	2762962	6443415	2006-3-15_O...
10	Otuwheti S	2006-3-15	1	10	galfas	2762938	6443368	2006-3-15_O...
11	Grey R	1985-3-15	61	130	saltru	2404100	5882300	1985-3-15_G...
12	Grey R	1985-3-15	61	130	angdie	2404100	5882300	1985-3-15_G...
13	Grey R	1985-3-15	61	130	gobbre	2404100	5882300	1985-3-15_G...
14	Grey R	1985-3-15	61	130	galdiv	2404100	5882300	1985-3-15_G...
15	Grey R	1985-3-15	59	120	chefos	2402600	5883100	1985-3-15_G...
16	Grey R	1985-3-15	59	120	gobbre	2402600	5883100	1985-3-15_G...

From here the user can now click the 'Calculate IBI score' button to proceed to the final page.

Calculate IBI score

The app calculates Fish IBI scores for each site visit (following the method outlined in Joy and Death, 2004), and presents the scores for each site visit according to the categories set out in the National Policy Statement for Freshwater Management 2020, with the addition of a 'No Species' category to reflect site visits where it was recorded that no species were found.

Figure 12 picture depicts an example set of results:

Figure 12:   An example set of results
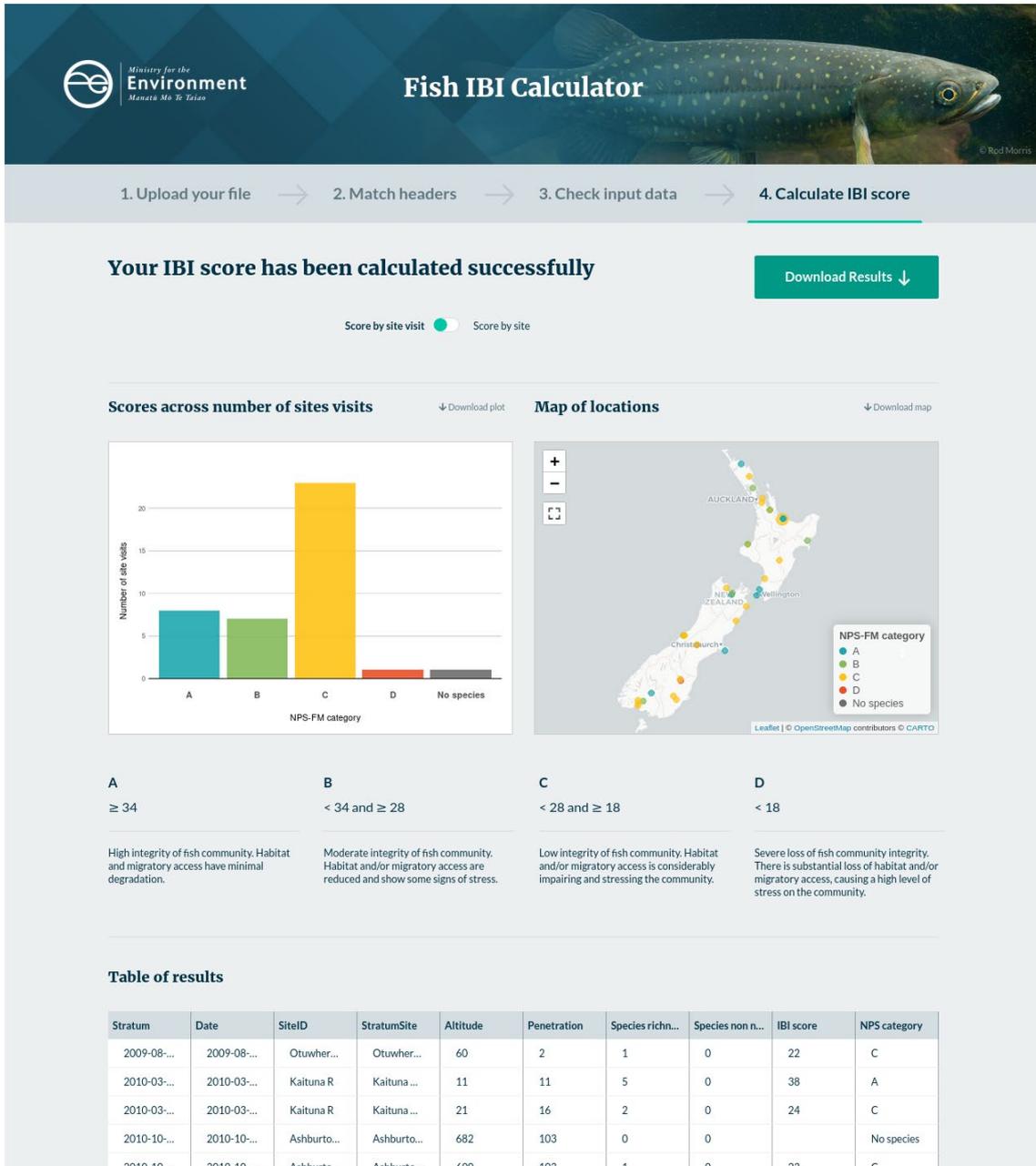
Download results and images

The full table of results, 'Scores across number of sites' bar graph and 'Map of locations' can each be individually downloaded.

Figure 13:   How to download results and images
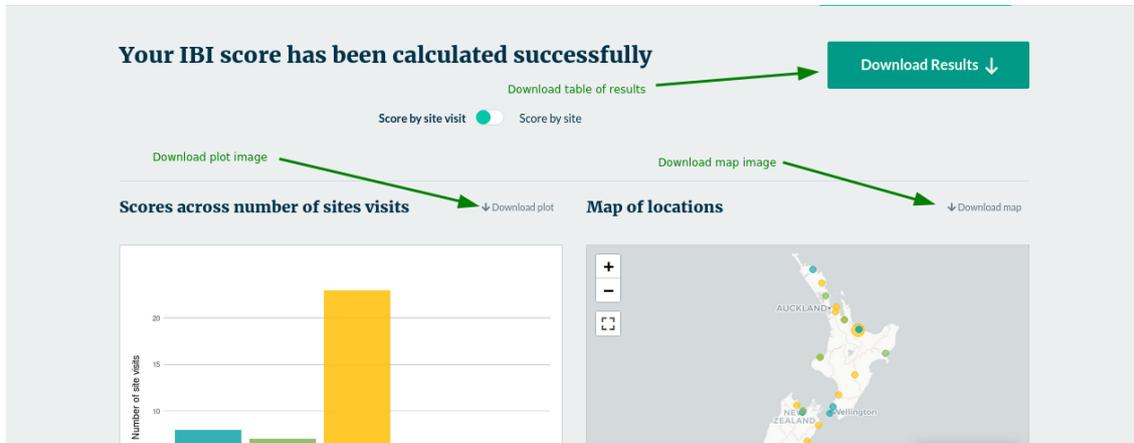
Interactive map

The map is interactive (can move and zoom) and can be expanded to full screen.

Figure 14:   How to expand the interactive map
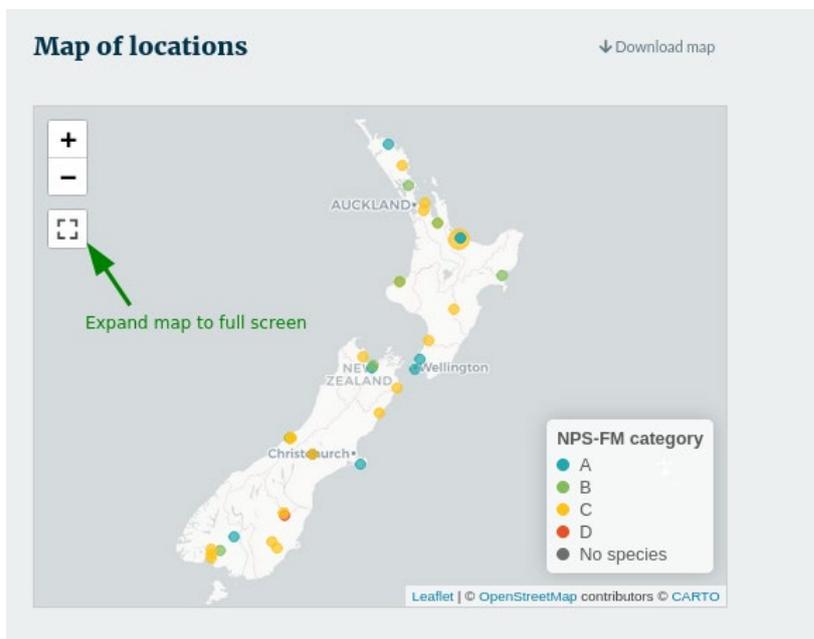
Where there are multiple visits to a site with the same coordinates, the map displays a larger point marker. Clicking on this marker displays a tooltip with scores for both site visits and the median score for that site.

Figure 15:   Tooltip with site-specific results
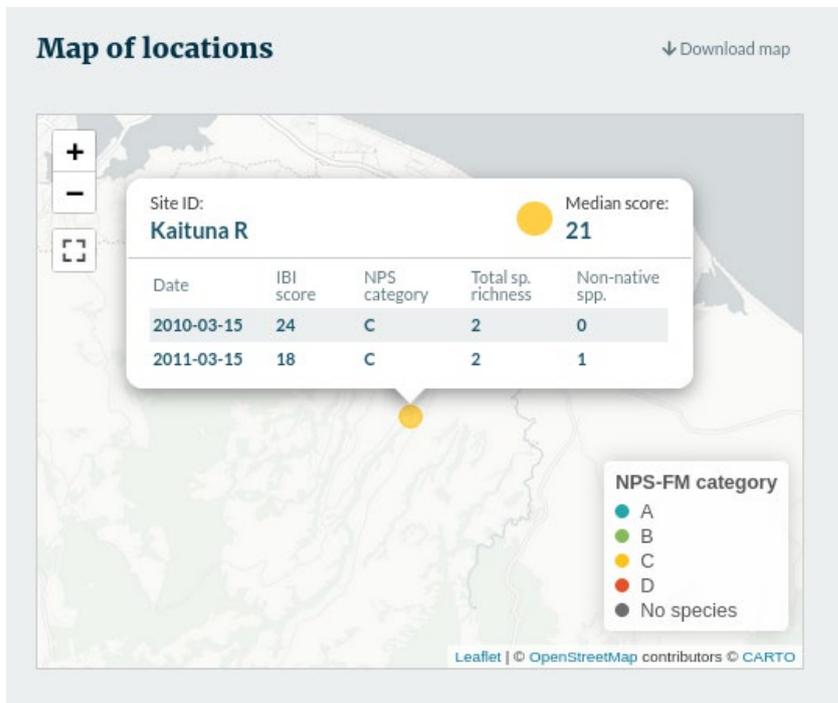
National vs regional results

If the user selected a region on the first page of the Fish IBI calculator, then the results page includes a toggle to display the results by national vs regional bands.

Figure 16: **Example results displayed by national bands**
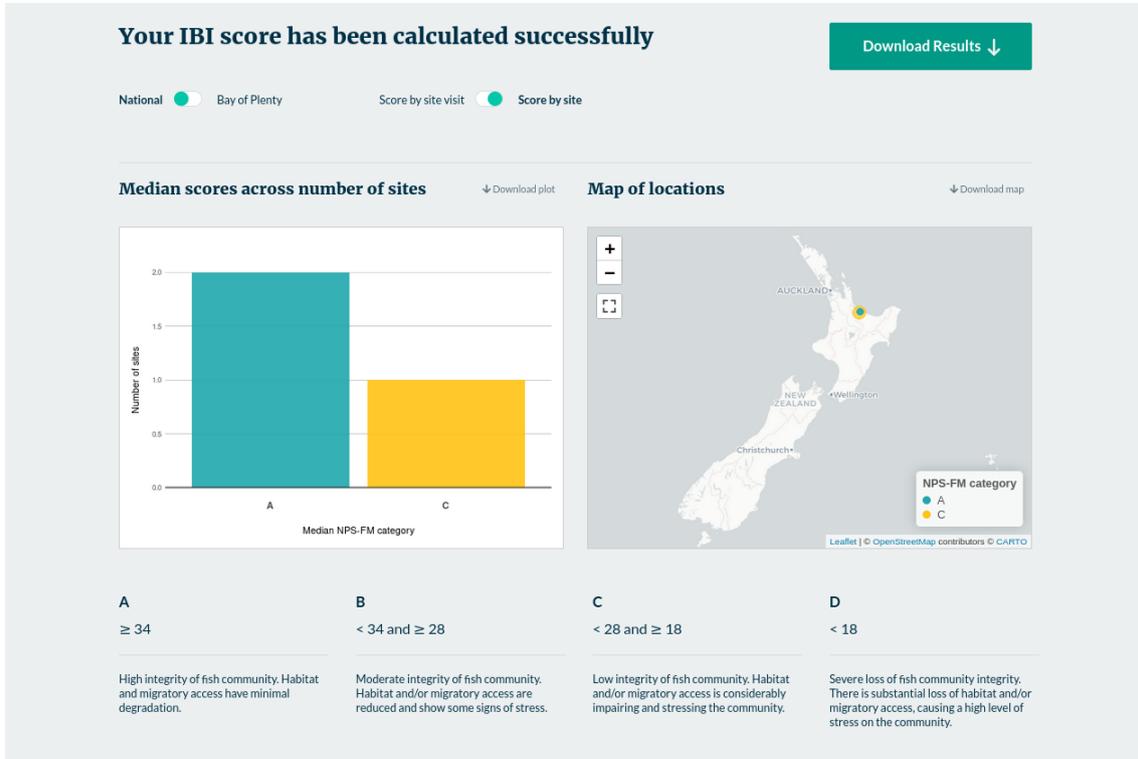
When the region is selected, the site scores are compared against the regional rather than national bands. The regional bands are displayed under the charts.

Figure 17: **Example results displayed by regional bands**
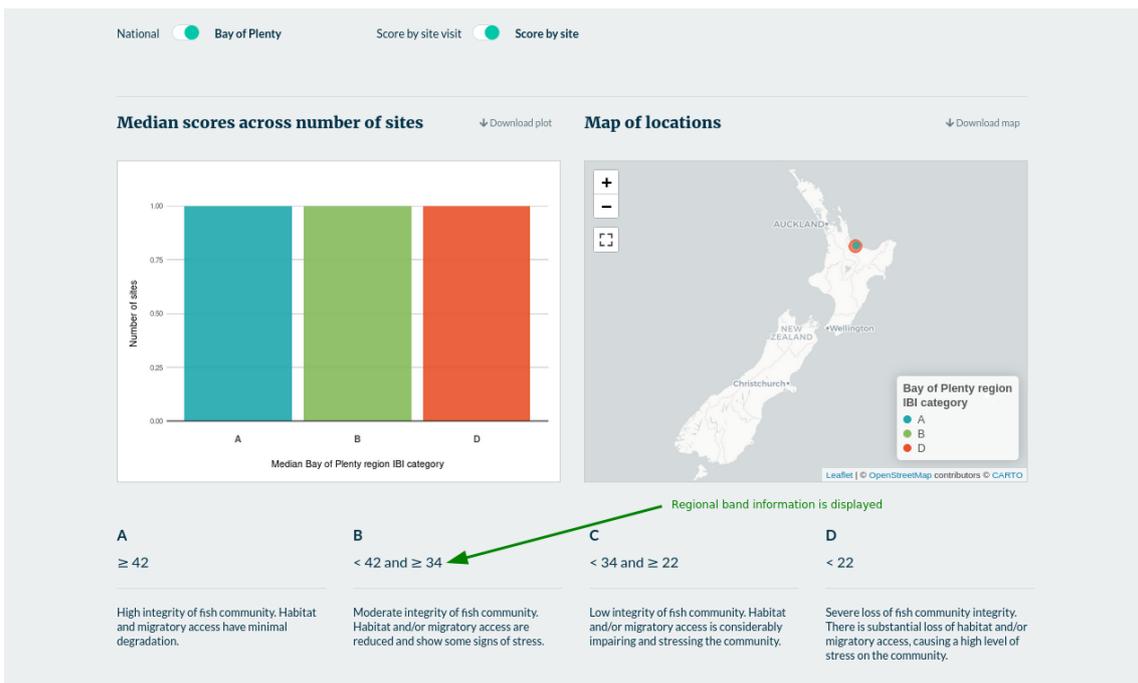
Results by site visit, or by site

The Fish IBI Calculator includes a toggle for users to change the chart to show either counts of scores by unique site visit, or counts of median score by site.

Figure 18:   Example results by site visit
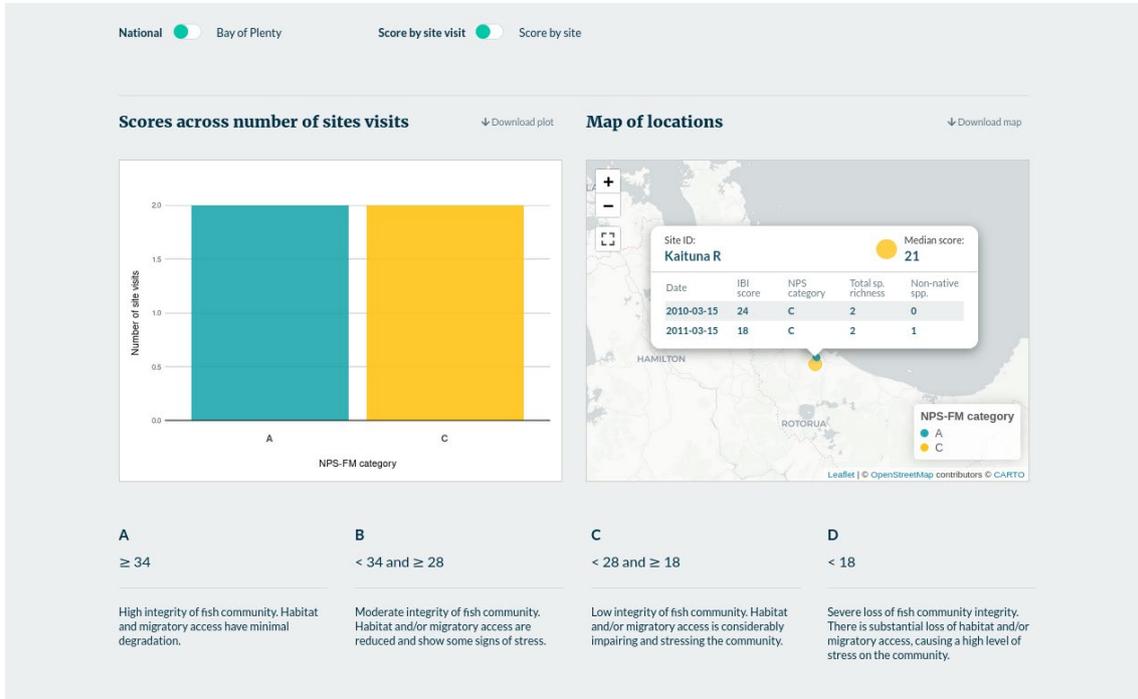
Figure 19:   Example results by site
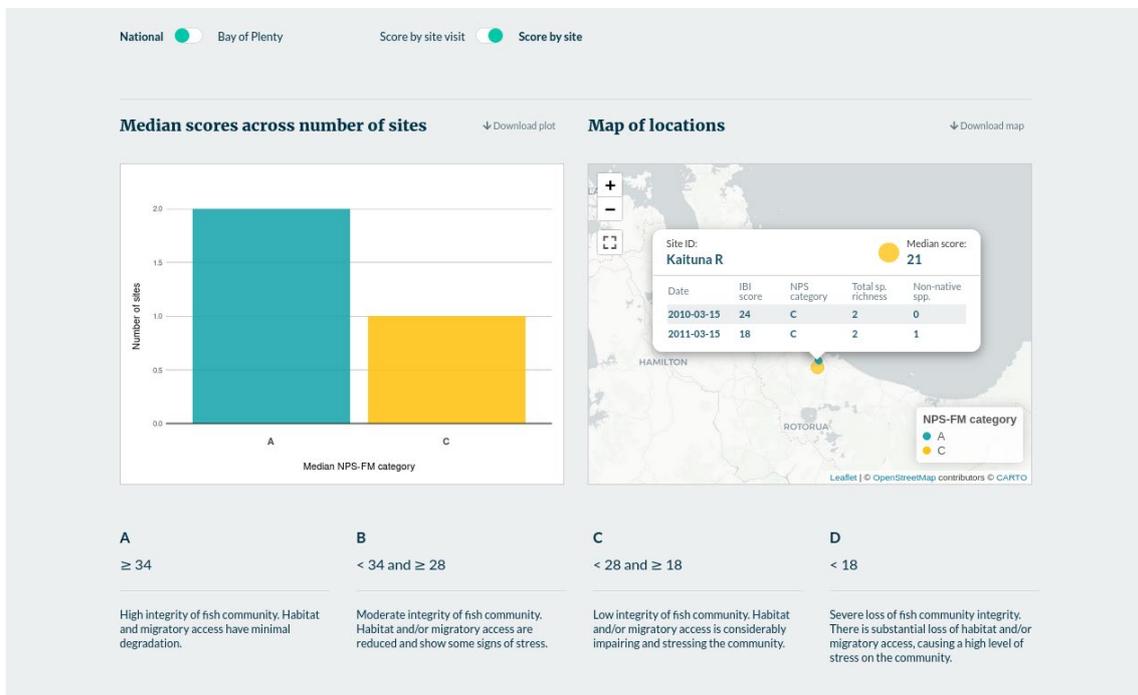
Appendix 1: Fish species from the New Zealand Freshwater Fish Database and their metric classification

Table 1:   Fish species from the New Zealand Freshwater Fish Database (NZFFD) and their metric classification

spcode	native	benthic_riffle	benthic_pool	pelagic_pool	intolerant	non_native
aldfor	1	0	0	1	0	0
angaus	1	0	1	0	0	0
angdie	1	1	1	0	0	0
chefos	1	1	0	0	0	0
galarg	1	0	0	1	1	0
galbre	1	1	1	0	1	0
galdiv	1	1	0	0	1	0
galfas	1	0	1	1	1	0
galmac	1	0	0	1	0	0
galspp	1	1	0	0	1	0
galpau	1	1	0	0	1	0
galpos	1	0	1	1	1	0
galpro	1	1	0	0	1	0
galvul	1	1	0	0	1	0
geoaus	1	0	1	0	0	0
gobbas	1	0	1	0	0	0
gobbre	1	0	1	0	0	0
gobcot	1	0	1	0	0	0
gobgob	1	0	1	0	1	0
gobhub	1	1	0	0	1	0
gobhut	1	1	0	0	1	0
mugcep	1	0	0	1	0	0
neoapo	1	0	1	0	1	0
neobur	1	0	1	0	1	0
neodiv	1	0	1	0	1	0
retret	1	0	0	1	0	0
rhoret	1	0	1	0	1	0
stoani	1	0	0	1	0	0

spcode	native	benthic_riffle	benthic_pool	pelagic_pool	intolerant	non_native
ameneb	0	0	0	0	0	1
caraur	0	0	0	0	0	1
cteide	0	0	0	0	0	1
gamaff	0	0	0	0	0	1
oncmyk	0	0	0	0	0	1
oncner	0	0	0	0	0	1
onctsh	0	0	0	0	0	1
perflu	0	0	0	0	0	1
poeret	0	0	0	0	0	1
salfon	0	0	0	0	0	1
saltru	0	0	0	0	0	1
scaery	0	0	0	0	0	1
tintin	0	0	0	0	0	1
galano	1	1	0	0	1	0
galaxi	1	1	0	0	1	0
galcob	1	1	0	0	1	0
galdep	1	1	0	0	1	0
galeld	1	1	0	0	1	0
galgol	1	1	0	0	1	0
galmar	1	1	0	0	1	0
galpul	1	1	0	0	1	0
galspd	1	1	0	0	1	0
galspn	1	1	0	0	1	0
galsps	1	1	0	0	1	0
galspt	1	1	0	0	1	0

Note: From Joy and Death (2004) and 'allnzIBI_NPS.xlsm' macro-enabled spreadsheet.

Appendix 2: Maximum species richness lines

Table 2:   Maximum Species Richness Lines

Fish type	scale	x intercept	y intercept
Native	Elevation	1600	5.334
Native	Distance	500	6
Benthicriffle	Elevation	1600	3.555
Benthicriffle	Distance	500	3.333
Benthicpool	Elevation	1600	3.333
Benthicpool	Distance	500	4
Pelagicpool	Elevation	1600	2
Pelagicpool	Distance	500	2.667
Intolerant	Elevation	1600	2.667
Intolerant	Distance	500	2.667

Note: From Joy and Death (2004) and Canning and Joy (2021) and 'allnzIBI_NPS.xlsm' macro-enabled spreadsheet.

Appendix 3: Distribution of Fish IBI scores

Table 3: Distribution of fish IBI scores by region for deriving regional fish IBI bands from Canning and Joy, 2021

Region	Q1	mean	Q3
Auckland	16	20	26
Bay of Plenty	22	34	42
Canterbury	18	24	34
Gisborne	18	24	28
Hawke's Bay	22	27	36
Manawatū–Whanganui	16	24	32
Marlborough	18.5	25	32
Nelson	16	23	36
Northland	16	22	31.5
Otago	12	18	24
Southland	10	16	26
Taranaki	14	22	32
Tasman	16	23	36
Waikato	20	26	34
Wellington	16	20	30
West Coast	16	23	34

Note: In the NPS-FM attribute table, the A-band corresponds to Q3 or above, B-band is mean-Q3, C-band is Q1-mean and D-band is less than Q1.

Appendix 4: Species codes

How are non-specific species dealt with in the Fish IBI Calculator?

During some surveys, fish will be observed that cannot be identified to species level. These individuals will get recorded as a genus-level entry, rather than as a species. For example, if an anguillid eel is observed but could not be confidently identified as either *Anguilla australis* (angaus) or *Anguilla dieffenbachii* (angdie), then it would be recorded as an unidentified anguillid eel (anguil).

The IBI scoring is very sensitive to the detection of each additional species. Genus-level records (ie, anguil) may pose a problem if there were also some larger eels present that could be identified, and this gave the impression of two species being present because a genus-level entry (anguil) is entered as well as a species-level record (angaus), despite only one species of eel being present at the site.

Conversely, if only one eel was observed and it could not be identified, that eel observation should contribute to the IBI score. To be able to utilise genus-level taxa records for IBI calculations, but avoid the risk of double counting, we recommend that genus-level records are only included if there are no other individuals from the genus present that may be of the same species as the genus-level entry. If genus-level entries are included as well as species-level entries that may be from the same species, then the genus-level entries should be ignored for the purposes of calculating the IBI.

In table 4 below, many of the more recently recognised native taxa, more recently arrived colonisers, and some exotic species are not represented by specific codes in the Fish IBI Calculator.

'Work-arounds' have been built into the current version of the IBI calculator to accommodate these additional taxa, and include:

- green highlighted cells are for genus-level entries have the same metric scores as the most common expected species for that genus

- yellow highlighted cells are those unlisted native species that have been mapped to a species that will have the same metric scores

- blue highlighted cells are unlisted exotic species have been mapped to a matching exotic, which is insensitive to phylogeny because all exotics get the same metric scores

- purple highlighted cells are species that are ignored for the IBI, because they are:

  - not fish species (for example, Paranephrops spp/koura)

  - not considered freshwater species for the Fish IBI (for example, Grahamina sp./triplefin)

  - otherwise extinct (for example, Prototroctes oxyrhynchus/New Zealand grayling).

All of the non-migratory species that have been derived from Galaxias *brevipinnis* will get the same metric scores as each other, and so have been coded as *Galaxias vulgaris*.

Any recently described species that is not listed in Table 4, and does not have its own IBI code, should be treated in the same manner – ie, choose a code for a species that will score the same across the six metrics, and use that as a dummy code.

Table 4: Look up table mapping species codes from Joy and Death 2004 with contemporary species codes from the NZ Freshwater Fish Database

nzffd_spp_code	spp_code_2004
aldfor	Aldfor
ameneb	Ameneb
angaus	Angaus
angdie	Angdie
angrei	Angdie
anguil	Angdie
caraur	Caraur
chefos	Chefos
cteide	Cteide
cypcar	Perflu
galano	Galano
galarg	Galarg
galaxi	Galaxi
galbre	Galbre
galcob	Galcob
galdep	Galdep
galdiv	Galdiv
galeld	Galeld
galfas	Galfas
galgol	Galgol
galgra	Galmac
galmac	Galmac
galmar	Galmar
galpau	Galpau
galpos	Galpos
galpro	Galpro
galpul	Galpul
galspd	Galspd
galspn	Galspn
galsps	Galsps
galspt	Galspt
galvul	Galvul
gamaff	Gamaff

nzffd_spp_code	spp_code_2004
geoaus	Geoaus
gobalp	Gobbre
gobbas	Gobbas
gobbre	Gobbre
gobcot	Gobcot
gobgob	Gobgob
gobhub	Gobhub
gobhut	Gobhut
gobiom	Gobbre
graham	nospec
hypmol	Perflu
hyrmen	nospec
leuidu	Perflu
marine	nospec
mugcep	Mugcep
mugil	Mugcep
neoapo	Neoapo
neobur	Neobur
neodiv	Neodiv
neohel	Neodiv
neorek	Neodiv
oncmyk	Oncmyk
oncner	Oncner
onctsh	Onctsh
parane	nospec
parcur	nospec
parmar	nospec
perflu	Perflu
poelat	Poeret
poeret	Poeret
prooxy	nospec
retret	Retret
rhombo	Rhoret
rhoret	Rhoret
salfon	Saltru
salmo	Saltru
salsal	Onctsh
saltru	Saltru

nzffd_spp_code	spp_code_2004
scaery	Scaery
stoani	Stoani
tintin	Tintin
galspp	Galspp

Note: Developed by Andy Hicks (Ministry for the Environment).

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