Database documentation for the Ministry for Primary Industries

ageing database

age

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NIWA Fisheries Data Management
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Revision History

Version	Change	Date	Responsible
1.0	Initial release as MAF Fisheries Greta Point Internal Report No. 214	1993	K Mackay & K George
1.1	Update as NIWA Internal Report No. 68	2000	Kevin Mackay
1.2	?	21 Jun 2002	K Mackay & K George
1.3	Added gonad_stage in t_fish table and fixed ERD errors	7 Oct 2004	Fred Wei
1.4	Added comments to t_trip, proj_code to t_fish, t_reading and t_age	May 2006	Fred Wei
1.5	Updated business rules relating to material & t_material table, & t_fish.length.	April 2009	David Fisher
1.6	Updated ERDs Fig2, Fig3	Nov 2010	Fred Wei
1.7	Updated Appendix 1 origin and reader codes. Added block_no to t_reading & t_age. t_trip_comments lengthened Updated t_reading.reading1 comment. Added collection_date to t_fish	Feb 2011 1 Apr 2011 June 2011 19Aug2011	David Fisher David Fisher David Fisher Fred Wei
1.8	Updated attribute comments for yr, t_reading.result2 & error1. Increased size prep_no and block_no to char16.	11May2012	David Fisher
1.9	Added tables t_reference and t_ref_reading	May 2014	David Fisher
2.1	Postgres version	Jan 2015	D Fisher, F Wei
2.2	Appendix 1 Reference codes updated	Sep 2016	D Fisher
2.3	Added proj_code to t_ref_reading	2Oct2017	F Wei

1 Database documentation series

The National Institute of Water and Atmospheric Research (NIWA) currently carries out the role of Data Manager and Custodian for the fisheries research data owned by the Ministry for Primary Industries (MPI), formerly the Ministry of Fisheries.

This MPI data set, incorporates historic research data, data collected by MAF Fisheries prior to the split in 1995 of Policy to the Ministry of Fisheries and research to NIWA, and data collected by NIWA and other agencies for the Ministry of Fisheries and subsequently for MPI.

This document provides an introduction to the fish ageing database **age**, and is a part of the database documentation series produced by NIWA. It supersedes the original documentation by Mackay[1] (1993) on this database, and previous revisions.

All documents in this series include an introduction to the database design, a description of the main data structures accompanied by an Entity Relationship Diagram (ERD), and a listing of all the main tables. The ERD graphically shows how all the tables fit in together, and their relationships to other databases.

This document is intended as a guide for users and administrators of the **age** database. This database has been implemented as a schema within the Postgres database called **fish**.

2 Ageing programmes

Currently, otoliths represent the primary source of ageing material in Marine Research. Other ageing materials; e.g., scales, vertebrae, teeth, spines and statolith are rarely taken. Ageing data are derived from four main sources:

1. The Scientific Observer Programme (SOP) provides otoliths from catch sampling. The main species otoliths are collected from include hoki, ling, southern blue whiting and hake. Additional species include silver warehou, toothfish, oreos, red cod, orange roughy, jack mackerels and gemfish. Many other middle depth species are also sampled to a lesser extent.
2. The Stock Monitoring Programme (SMP) provides ageing material by market sampling. Initially hoki, red cod, and orange roughy otoliths were collected, with some black cardinalfish also sampled. Additionally kahawai and jack mackerels are also sampled. Orange roughy and black cardinalfish market samples ceased in the 1991-92 sample year, and red cod in the 1992-93 sample year. Snapper otoliths are also obtained through market sampling as well as trevally and other inshore species.
3. Research voyages provide an ongoing source of otoliths. These voyages cover a wide range of species including hoki, orange roughy, black and smooth oreos,

[1] Mackay, K. A. 1993. Marine Research database documentation. 6. age. *MAF Fisheries Greta Point Internal Report No 216.* 13p.

hake, ling, red cod, and southern blue whiting. A large number of inshore species are also sampled.

4 Historic catch and market sampling data and ageing programmes are now established on the age database. Age data for bluenose and alfonsino caught through the 1980's and data for snapper caught in the 1970's are on the age database.

To date over 70 species have been read, including, hoki, ling, hake, southern blue whiting, red cod, kahawai, gemfish, silver warehou, elephantfish, freshwater eels and snapper. All otoliths gathered, irrespective of their priority, are inventoried and then catalogued, with a brief description of their location and status.

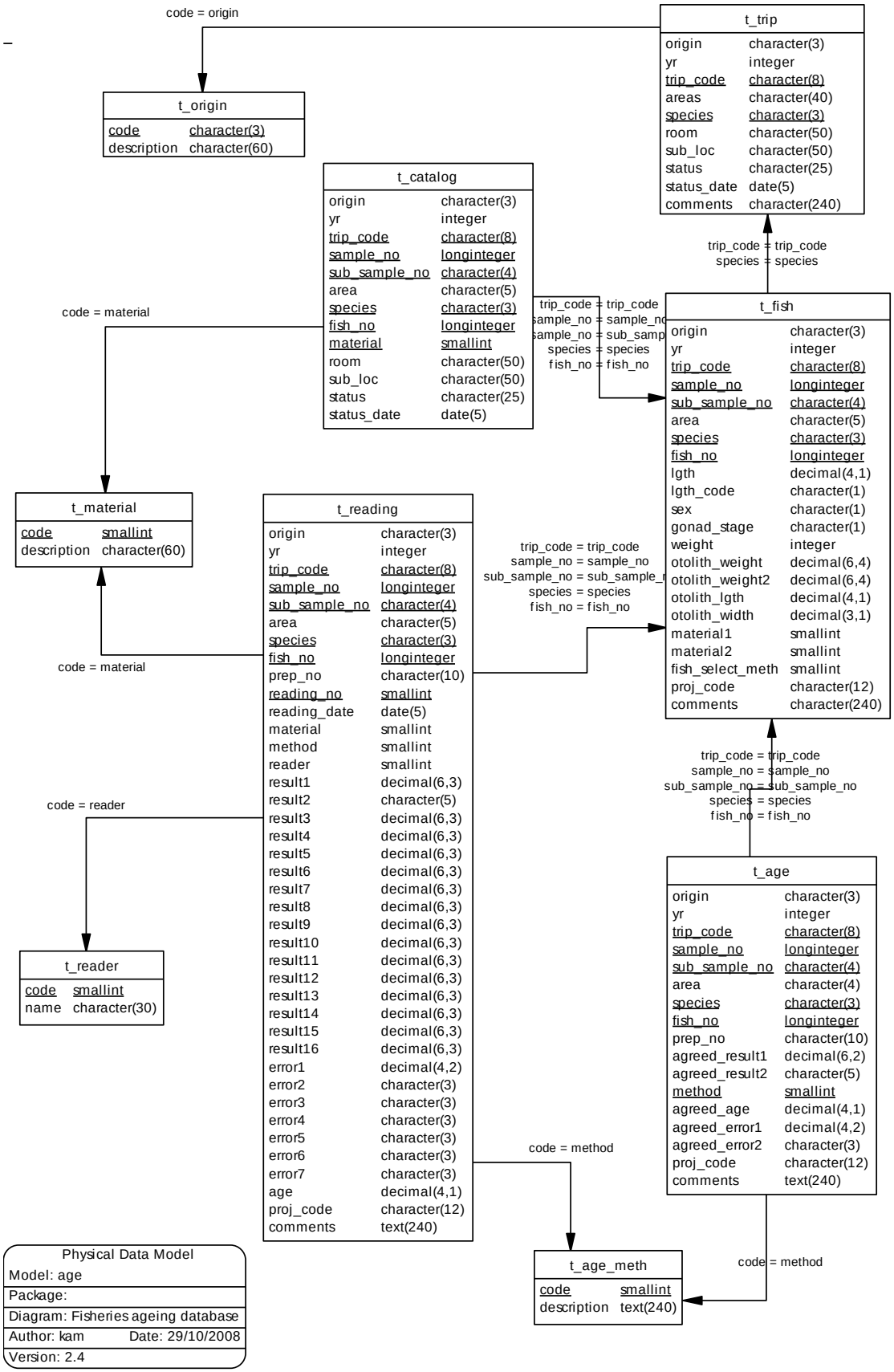

Figure 1: Entity Relationship Diagram (ERD) of the age database.

3 Data structures

3.1 Table relationships

This database contains several tables. The ERD for **age** (Figure 1) shows the physical data model structure[2] of the database and its entities (each entity is implemented as a database *table*) and relationships between these tables. Each table represents an object, event, or concept in the real world that has been represented in the database. Each *attribute* of a table is a defining property or quality of the table.

All of the table's attributes are shown in the ERD. The underlined attributes represent the table's primary key[3]. This schema is valid regardless of the database system chosen, and it can remain correct even if the Database Management System (DBMS) is changed. The ERDs in this document show attributes within tables with generic data-types.

Note that Figure 1 shows the main tables only. Most of the tables in the **age** database have some attributes, called foreign keys[4], which contain standard NIWA fisheries codes, such as *species* and *age_meth*. These attributes provide links to tables in **age** and the **rdb** (research database) database, which contains the definitive list of standard codes. Therefore, an expanded ERD for these tables will follow (Figures 2 & 3).

Section 5 shows a listing of all the **age** tables as implemented by the Postgres DBMS. As can be seen in the listing of the tables, each table has a primary key on it. Primary keys are generally listed using the format:

Indices: index_name PRIMARY KEY, btree (*attribute* [, *attributes*])

where the attribute(s) make up the primary key and the index name is the primary key name. Note that the typographical convention for the above (and subsequent) format is the square brackets [ ] may contain an item that is repeated zero or more times.

The primary key prevents records with duplicate key values from being inserted into the table, e.g., a new trip with an existing trip code, and hence ensures that every record can be uniquely identified.

The **age** database is implemented as a relational database. That is, each table is a special case of a mathematical construct known as a *relation* and hence elementary relation theory is used to deal with the data within tables and their relationships between them. All relationships in **age** are of the type *one-to-many*[5]. This is shown in the ERD by connecting a single line (indicating 'many') from the child table (e.g.,

[2] Also known as a database *schema*.
[3] A primary key is an attribute or a combination of attributes that contains a unique value to identify that record.
[4] A foreign key is any attribute, or a combination of attributes, in a table that is a primary key of another table. Tables are linked together through foreign keys.
[5] A one-to-many relationship is where one record in a table (the *parent*) relates to one or many records in another table (the *child*).

t_reading) to the parent table (e.g., *t_fish*) with an arrow-head (indicating ‘one’) pointing to the parent.

Every relationship has a mandatory or optional aspect to it. That is, if a relationship is mandatory, then it has to occur and least once, while an optional relationship might not occur at all. For example, in Figure 1, consider that relationship between the table *t_fish* and its child table *t_reading*. The symbol “O” by the child *t_reading* means that a fish can have zero or many age readings, while the bar by the parent *t_fish* means that for every age reading there must be a matching fish.

Most of these tables contain foreign keys, which link these tables to each other and to tables in the **rdb** database (Figure 3). Foreign key constraints do not allow *orphans* to exist in any table, i.e., where a child record exists without a related parent record. This may happen when: a parent record is deleted; the parent record is altered so that the relationship is lost; or a child record is entered without a parent record. Constraints are shown in the table listings by the following format:

Foreign-key constraints:
"foreign key name" FOREIGN KEY (attribute[,attribute]) REFERENCES
parent table (attribute[, attribute])

For example, consider the following constraint found in the table *t_catalog*:

Foreign-key constraints:
"fk_t_catalog_material" FOREIGN KEY (material) REFERENCES t_material(code)

This means that the value of the attribute *material* of a record upon insert into *t_catalog* must already exist in the parent table *t_material* or the record will be rejected and an error message will be displayed.

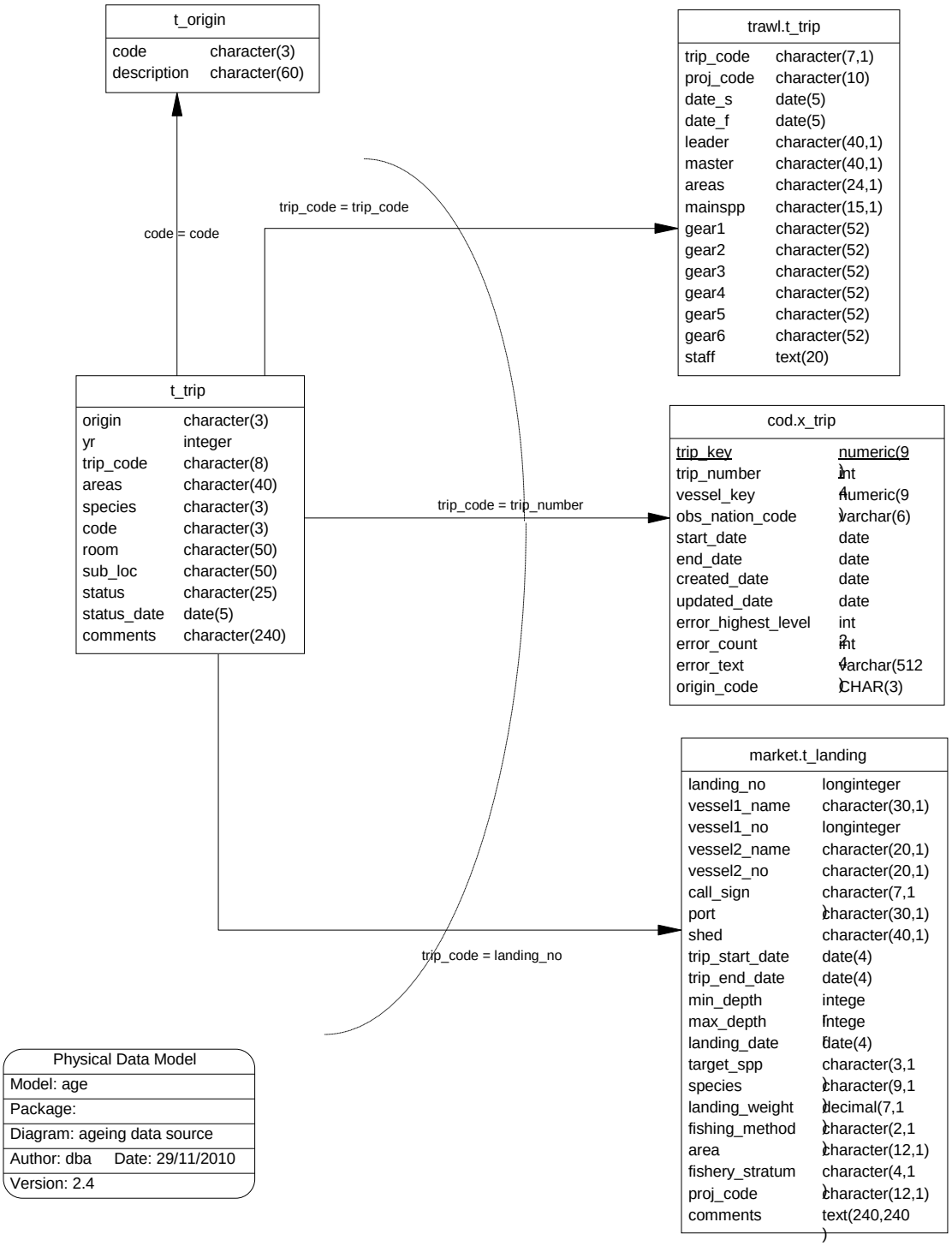

Figure 2: Expanded ERD for *t_trip* showing relationships to top-level tables in other databases.

Similarly for a record to be deleted from a table, the values of the constrained attributes must not be equal to the values of the corresponding attributes in any record of the constraining table. This is used to prevent a parent record from being deleted while child records still exist.

All tables in this database are indexed. That is, attributes that are most likely to be used as a searching key have like values linked together to speed up searches. These indices are listed using the following format:

Indices: index_name btree (*attribute*[, *attribute*])

Note that indices may be simple, pointing to one attribute or composite pointing to more than one attribute.

3.2 Database design

This ageing database can be split into several main areas, each with properties that are important to record:

1. Details about the fish. These details include biological measurements of the fish, e.g., sex, length, etc.
2. Details about the ageing material extracted from the fish.
3. The readings made on the ageing material to determine the age of the fish. One fish may have many items of ageing material.
4. The current location of the ageing material and its status.
5. The agreed age of the fish, based on different materials and reading methods.

These properties represent the main tables in this database.

At the top level we have the trip from which ageing material was collected. Ideally, ageing material should be catalogued down to an individual fish (ref. Table 4 - *t_catalog*). However, more often than not, ageing material from trip is stored in a location until such time that it may be required for research (this can sometimes never happen). Therefore, the location details and status of a collection of ageing material for each species collected from trips are held in the table *t_trip* (Table 1).

For those collections that are used, the details and biological measurements of the fish are held in the table *t_fish* (Table 2). This table has a composite primary key of *trip_code*, *sample_no*, *sub_sample_no*, species and *fish_no* to identify uniquely each fish. Apart from the key, the sex and length of the fish are the most common data held in this table, although other information such as the weight of the fish and measurements of the otolith can be held also. Up to two types of ageing material can be taken from any one fish, these being recorded by the attributes *material1* and *material2*. The ERD (Figure 1) shows that this table contains three attributes that are linked through foreign keys to master code tables. To aid in locating trips the attribute *origin* is included. This stores a 3-character code, which describes the origin of the fish.

The attributes *material1* and *material2* contain codes which identify which material was taken from the fish for ageing purposes, e.g., otoliths, scales, spines, etc. It is assumed that no more than 2 types of ageing material is taken from any one fish.

A problem arises in the **age** database because the concept of the sub-sample (listed as *sub_sample_no* in **age**), is not used at all for the SOP, and only sometimes for the SMP. Because the possibility exists that it may be used, it must remain a part of the primary key for the four main tables (see Section 3.3 "**Handling different sampling programmes**" below). This can result in the presence of null values as part of some primary keys, and by definition a primary key cannot contain null values. Without primary keys, this database implementation can suffer due to the possibility of allowing duplicate records to enter. To overcome this, all null values are replaced with the value of -1 for the attribute *sub_sample_no*. This allows primary keys to be constructed on all the tables.

The next table *t_reading* (Table 3) records the information for one reading of the material that was used to determine the age, such as the reading method used, who the reader was, and the results generated. Figure 1 shows the ERD for *t_reading*. This table inherits the same primary key as *t_fish* to identify the fish, as well as the additional attribute *reading_no* to further identify individual age readings on the fish. There are four attributes of this table that are linked to master code tables (Figure 1). We have discussed the attributes *origin* and *material* in *t_fish* above. Two other codes are the attribute *method*, which identifies the preparation and reading methods employed, and the attribute *reader*, which identifies just who made the reading. The most common reading method is counting rings although one reading may also be a measurement such as length or otolith weight. Note that measurements such as otolith weight are also an attribute of *t_fish*. Although this data may be duplicated, the distinction is that if it has been used to determine an age, then it is a reading. If not, then it is just an attribute of the fish.

Usually, one reading generates one result with an error flag to denote the results accuracy. However, in some extreme cases, one reading may generate multiple results and error flags; e.g., a reading of an otoliths' radius can give the measurement to the year 1 annulus, year 2 annulus, and to the otolith edge. Ideally, in a 3NF data model this brings in another entity "*result*" which can be represented by a table *t_result*. The entity "*result*" will have a one-to-many relationship to the *t_reading* table. This table will store the *t_reading* primary key, a code to say what the result represents, and the value of the result. There will also be a table *t_result_code* to store the descriptions of the result codes. The table structures for these two new tables would look something like:

T_RESULT	**T_RESULT_CODES**
T_READING PKEY	RESULT_CODE
RESULT_CODE	RESULT_DESCRIPTION
RESULT_VALUE	

A decision was made not to implement this new entity, but rather to take the simpler approach to have multiple result and error attributes in *t_reading.* This is because each result and error is relevant only when compared to others to the same reading.

Therefore, queries for these data sets need return all the results and error flags for a reading in the same tuple. In addition, the performance hit of performing multi-table joins in a 3NF scenario would not be supported by the users.

This implementation of *t_reading* does mean that there is a problem of users knowing which result value got into which result field. This is addressed two ways:

1. The results returned are functionally dependent on the aging method as denoted by the method attribute in *t_reading*. Hence, a full description of the results return and which attributes they are stored in is given in the *t_age_meth* table and are listed in Appendix 1.
2. Result types are consistently stored in the same attribute for each given aging method.

Current location and status of the ageing material is held in the table *t_catalog* (Table 4). Again, this table inherits most of its primary key from *t_fish*, as well as the additional attribute *material* to further identify which piece of ageing material from the fish is being cataloged. Only two attributes of *t_catalog* are linked to master code tables (Figure 1), being *origin* and *material*. Details such as room number, and if necessary, filing cabinet number can be recorded, as well as the current status, e.g., "read" or "missing", and the date the status was last updated. This table also has a one-to-many relationship with *t_fish*. Any one fish can produce several (although usually one) type of ageing material and each type can be stored in different locations or have a different status.

The agreed age of the fish is held in *t_age* (Table 5). An agreed age is the age in years that has been agreed upon as the age of the fish, based on the various readings made on the ageing material(s). The ERD (Figure 1) shows that only two attributes of *t_age* are linked to master code tables. These attributes, *origin* and *method*, occur through most of the main tables and have been explained earlier. It is important to note that this table carries not only the age, but also the agreed result from which the age was based. A fish age is usually calculated from an algorithm applied to the agreed result. This algorithm can be recorded in the attribute *comments*.

The attribute *method* denotes the reading method used from which the age was agreed on. The agreed age can be based on: all methods, i.e., one age for the fish; or a single method, i.e., one fish has many ages based different ageing methods.

An important relationship to note is that between *t_trip* to other sampling databases (Figure 2) so that ageing data can be matched against spatial, temporal, environmental, and biological data. Currently, from *t_trip*, we can link to the tables either *t_trip* from the **trawl** database, *t_landing* from the **market** database or x_*trip* from the **cod** database. This relationship means that any one fish in the database can be linked through the attribute *trip_code* to the catch and landing records held in these other databases. In practice for otliths caught from trawl surveys a link is typically made to t_station in the **trawl** database joining on trip_code and station_no = sample_no, to obtain collection date and or latitude and longitude.

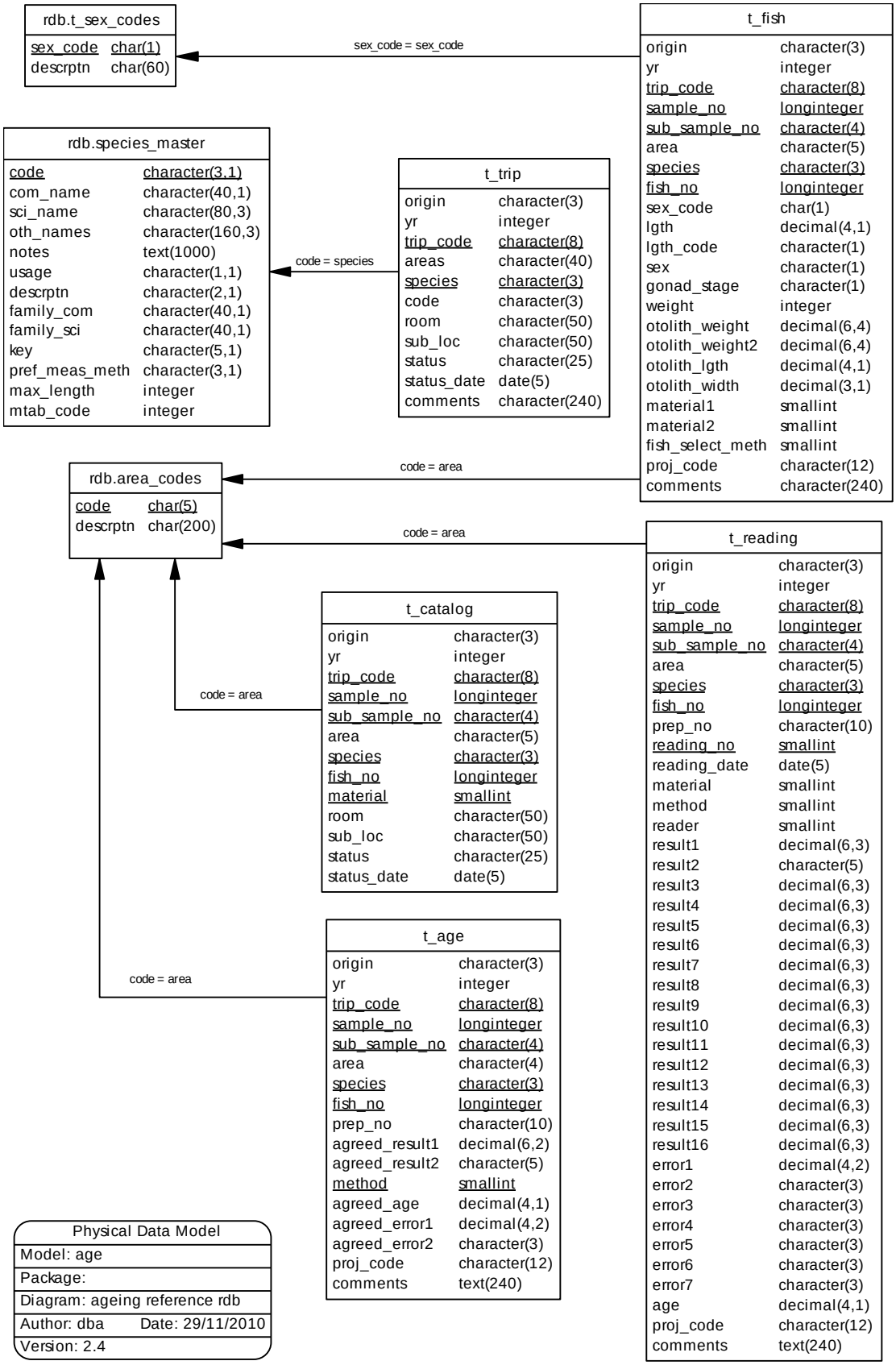

Figure 3: Expanded ERD for the tables' *t_trip*, *t_fish*, *t_catalog*, *t_reading*, and *t_age* showing foreign key relationships to rdb code tables.

There are four other tables in this database that describe the various codes used: the codes used in describing the origin of the ageing material are listed in the table *t_origin* (Table 6); the various material used for ageing are listed in the table *t_material* (Table 7); the names of the readers are listed in the table *t_reader* (Table 8); and the different method used to prepare and read the ageing material are listed in the table *t_age_meth* (Table 9). They all have only two attributes - one for the code and another for a brief description of the codes.

3.3 Handling different sampling programmes

Given the variety of sources for the ageing material, the primary key for each fish involves many attributes. Each of the three main sources (SOP, SMP, and Research Voyages) involves a fishing trip as their basic unit, but have their own format of identifying codes. To create a common code fishing trip, the following attributes are used: *origin* (the origin of the ageing material, a three character uppercase code for either the sampling programme, e.g., SOP, SMP etc., or the vessel name, e.g., TAN, KAH), *yr* (the year of the fishing trip), *trip_code* (fishing trip identifier), *sample_no* (station number for SOP (= tow number for trawls), stratum number for SMP or station number for Research Voyages), *sub_sample_no* (not used for the SOP, cluster number for SMP or sub catch number for Research Voyages). From this trip code the fish can be identified using the attributes *species* and *fish_no*.

For example, consider the following identifiers:

Fishing trip identifier	
921301	for the SMP
kah9203	for Research voyages
551	for the SOP

This would be stored as:

Origin	*yr*	*trip code*
SMP	1992	921301
KAH	1992	kah9203
SOP	1992	551

Important: the attribute *trip_code* is a character field, unlike the *trip_number* and *landing_no* fields in the **cod** and **market** databases respectively. Therefore, all trip codes must have quotes around them when using an SQL SELECT statement. For example, to select ageing data from *t_reading* for red cod market sample number 920801, we would use:

```
select * from t_reading where trip_code = '920801'...
```

A further problem arises because both the SMP and Research programmes use a two-tier strategy to get to an individual fish, but the SOP only uses one. To make matters worse, each programme has their own nomenclature to describe each tier. To handle this, the **age** database has used generic attribute names. The following table shows that relationship between the generic attributes names of **age** to the attributes specific to each programme:

Ageing Database **age**	*SMP Database* **market**	*SOP Database* **cod**	*Research Trawl* **trawl**
trip_code sample_no sub_sample_no	landing_no stratum_no cluster_no	trip_number station_number	trip_code station_no subcatch_no

Note that theoretically the *sub_catch_no* is null for certain types of records.

In 2008 the **obs_lfs** database was replaced by the Central Observer Database **cod**, which is implemented in the RDBMS Postgres. This means that users can no longer write a SQL SELECT query joining the **age** database tables and the observer database tables, such as a join on tables *t_fish* and the observer station data, that could previously be made to extract, for example, date and latitude and longitude where the fish and ageing material was taken. However the **cod** database contains tables that record the equivalent information to the **age**.*t_fish* table for observer collected otoliths so data from a join between the station and fish tables for SOP material can be extracted from the **cod** database.

From March 2009 observer data from trawl vessels including length data began to be recorded electronically by observers on a tablet computer at sea. This tablet data collection is referred to as the Observer Data Entry At Sea (ODEAS) system. These data include an electronic inventory of otoliths collected so data from the ODEAS system for the *t_fish*, *t_trip* and *t_catalog* tables where available from observers is loaded to the **age** database. This process does not require transcription from the otolith packets that was involved for non ODEAS data.

3.4 Null Values and *sub_catch_no* in the Primary Key

It is important to note that in instances where *sub_sample_no* should be null, the attribute will be assigned the value of "-1". This value can be ignored; its only purpose is to allow for a primary key to be implemented.

3.5 Ageing material reference data

Two additional tables were developed in 2014 to record data about ageing material reference sets. These reference sets of otoliths or other ageing material are established to assist fish aging staff in calibrating their readings and for training new staff in reading the respective species.

Table *t_reference* contains data including the accepted zone count and age for each fish included in a reference set of aged structures. There are several generic result and error fields to handle the numerous types of reading and measurement techniques. Explanations for what result and error is stored in what attribute is recorded in the matching reading method record in *t_age_meth*.

Table *t_ref_reading* is designed for the zone counts and estimated age of fish in an ageing structure reference set. The readings are generated when readers are calibrated before commencing the ageing of a new sample. Consequently, it is desirable to separate these readings from others used to estimate catch-at-age or growth

parameters. The result and error fields are generic to handle the numerous types of reading and measurement techniques. Explanations for what result and error is stored in what attribute is recorded in the matching reading method record in table *t_age_meth*.

4 Table Summaries

This database can be broken down into four main tables containing information on the ageing material, four other tables describing the various codes that are used, and one view.

The following is a listing and brief outline of the tables contained within **age**:

1. **t_trip :** contains location information about ageing material from species caught on a trip. This may sometimes just be a summary of records in the table *t_catalog*.
2. **t_fish :** contains biological details from all fish that ageing material has been taken; e.g., sex, length, weight (and otolith data).
3. **t_reading :** contains results generated from an individual reading of an ageing material, e.g., otolith, scale.
4. **t_catalog :** contains the current location and status of the ageing material.
5. **t_age :** contains the agreed age of the fish based on either all the readings or readings by one method.
6. **t_reference** : Table describing the accepted zone count and age for each fish included in a reference set of aged structures. The result and error fields are generic to handle the numerous types of reading and measurement techniques. Explanations for what result and error is stored in what attribute is recorded in the matching reading method record in *t_age_meth*.
7. **t_ref_reading:** Table describing the zone counts and estimated age of fish in an ageing structure reference set. The readings are generated when readers are calibrated before commencing the ageing of a new sample. The result and error fields are generic to handle the numerous types of reading and measurement techniques. Explanations for what result and error is stored in what attribute is recorded in the matching reading method record in *t_age_meth.*

Also contained in the **age** database are the numerous master tables containing all codes and their descriptions. Most of the codes used in the **age** database are checked against these master tables before being inserted. The following is a summary list of these master code tables:

8. **t_origin :** contains explanations for the codes used to describe the origin of the ageing material.
9. **t_material :** contains explanations for the codes used to describe the ageing material used.
10. **t_reader :** contains names of the readers of the ageing material.
11. **t_age_meth :** lists the meanings of the codes for the different preparation and reading methods used and describes what reading measurements go into what result and error attributes in the *t_reading* table.

5 age Tables

The following are listings of the tables in the **age** database, including attribute names, data types (and any range restrictions), and comments.

5.1 Table 1: t_trip

Comment: Table of location information about ageing material from species caught on a trip.

Column	Type	Null?	Description
origin	character varying(3)	No	3 character uppercase code for the origin of the ageing material. Refer t_origin.
yr	integer	No	Year fish was sampled. Calendar year for origin SMP and research (trawl) samples, and fishing year for origin SOP where eg Oct2011-Sep12 fishing year is recorded as 2012.
trip_code	character varying(8)	No	Up to 8 char trip identification code.
areas	character varying(40)		Codes of area(s) that ageing material was collected from, separated by commas. Refer rdb.area_codes.
species	character(3)	No	Code for the species of fish. Refer rdb.curr_spp.
room	character varying(50)		Room number or other location where the ageing material can be found.
sub_loc	character varying(50)		Location within the room, e.g., file cabinet number, draw number.
status	character varying(25)		Current status of the ageing material, e.g., CATALOGUED, READ.
status_date	date		Date when status was updated.
comments	text		

```
Indexes:
   "pk_t_trip" PRIMARY KEY, btree (trip_code, species)

Foreign-key constraints:
   "fk_t_trip_curr_spp" FOREIGN KEY (species)
    REFERENCES rdb.curr_spp(code)
   "fk_t_trip_t_origin" FOREIGN KEY (origin)
    REFERENCES age.t_origin(code)
```

5.2 Table 2: t_fish

Comment: Table of biological information for fish with ageing material collected.

Column	Type	Null?	Description
origin	character varying(3)	No	3 character code for the origin of the ageing material. Refer t_origin.
yr	integer	No	Year fish was sampled. Calendar year for origin SMP and research (trawl) samples, and fishing year for origin SOP where eg Oct2011-Sep12 fishing year is recorded as 2012.
trip_code	character varying(8)	No	Up to 8 char trip identification code.
sample_no	integer	No	Number of sample within the trip. This will be station number for Research and SOP (or tow number) and stratum number for SMP.
sub_sample_no	character varying(4)	No	Number of sub sample. This will be subcatch number for Research trawls, cluster (box) number for SMP. SOP do not use this. -1 = Not Used.
area	character varying(5)		Up to 4 character area code. Codes depend on the species sampled. Refer rdb.area_codes.
species	character(3)	No	Code for the species of fish. Refer rdb.curr_spp.
fish_no	integer	No	Sequential identifying number of the fish for any one trip, sample, sub sample, species.
lgth	numeric(4,1)	No	Length (cm) of the fish. See lgth_code for precision of measurement.
lgth_code	character varying(1)		Precision of length measurement, R = Rounded down to nearest cm, E = Exact to 1 decimal place.
sex	character varying(1)		1 digit sex code. 1=Male, 2=Female, 3=immature,

		4=Did not attempt to sex fish. Refer rdb.t_sex_codes.
gonad_stage	character varying(1)	Numeric code for stage of gonad maturity.
weight	integer	Weight (grams) of the fish.
otolith_weight	numeric(6,4)	Weight (grams) of an otolith.
otolith_weight2	numeric(6,4)	Weight (grams) of second otolith.
otolith_lgth	numeric(4,1)	Length (mm) of an otolith.
otolith_width	numeric(3,1)	Width (mm) of an otolith.
material1	smallint	1 digit code for the type of material taken for ageing, e.g., 1=otolith, 2=scales, 3=spine, etc. Refer t_material or Appendix 1 of the database documentation.
material2	smallint	1 digit code for the second material taken for ageing (if at all). Refer t_material.
fish_select_meth	smallint	Code for how the fish was selected for ageing: 1 = random, 2 = every i th fish, 3 = by size class, 4 = Extra otolith taken as chosen by the observer (from SOP ODEAS tablet data).
proj_code	character varying(12)	Project code for the project that funded collection of the ageing material.
collection_date	date	The date the ageing material was collected. Typically end date of the station for origin SOP and research trawl, and landing date for origin SMP.
comments	character varying(240)	Contains information on fish sampled.

```
Indexes:
    "pk_t_fish" PRIMARY KEY, btree
     (trip_code, sample_no, sub_sample_no, species, fish_no)

Foreign-key constraints:
    "fk_t_fish_curr_spp" FOREIGN KEY (species)
     REFERENCES rdb.curr_spp(code)
    "fk_t_fish_material1" FOREIGN KEY (material1)
     REFERENCES age.t_material(code)
    "fk_t_fish_material2" FOREIGN KEY (material2)
     REFERENCES age.t_material(code)
    "fk_t_fish_origin" FOREIGN KEY (origin)
     REFERENCES age.t_origin(code)
    "fk_t_fish_species" FOREIGN KEY (species)
     REFERENCES rdb.species_master(code)
    "fk_t_fish_t_sex_codes" FOREIGN KEY (sex)
     REFERENCES rdb.t_sex_codes(sex_code)
    "fk_t_fish_t_trip" FOREIGN KEY (trip_code, species)
     REFERENCES age.t_trip(trip_code, species)
```

5.3 Table 3: t_reading

Comment: Table describing the results from each reading to estimate the age of a fish.

Column	Type	Null?	Description
origin	character varying(3)	No	3 character uppercase code for the origin of the ageing material. Refer t_origin.
yr	integer	No	Year fish was sampled. As defined for t_fish.
trip_code	character varying(8)	No	Up to 8 char trip identification code.
sample_no	integer	No	Number of sample within the trip. This will be station number for Research and SOP (or tow number) and stratum number for SMP.
sub_sample_no	character varying(4)	No	Number of sub sample. This will be subcatch number for Research trawls, cluster (box) number for SMP. SOP do not use this. -1 = Not Used.
area	character varying(5)		Up to 4 character area code. Codes depend on the species sampled. Refer rdb.area_codes.
species	character(3)	No	Code for the species of fish. Refer rdb.curr_spp.
fish_no	integer	No	Sequential identifying number of an individual fish for any one trip, sample, sub sample, and species.
prep_no	character varying(16)		Number to identify ageing material within a prepared sample.
block_no	character varying(16)		Identifying number or label on the resin block, or other preparation containing multiple otoliths or other age specimens.
reading_no	smallint	No	Sequential number for each reading for each fish.

reading_date	date		Date the reading was made on.
material	smallint	No	1 digit code for the type of material used for reading, e.g., 1=otolith, 2=scales, 3=spines, etc. Refer t_material or Appendix 1 of the database documentation.
method	smallint	No	Up to 2 digit code for the method used to read ageing material. Refer t_age_meth.
reader	integer	No	Numeric code to identify the reader. Refer t_reader.
result1	numeric(6,3)		The first result of the reading, typically a count of the concentric zones or annuli on the otolith or other ageing material that are interpreted in terms of age in years. Other meanings should be documented via method and t_age_meth.
result2	character varying(5)		Up to 5 character code for the result, typically the marginal state where W = Wide, N = Narrow, L = Line. Any other values should be documented in the method description.
result3	numeric(6,3)		Additional result of the reading.
result4	numeric(6,3)		Additional result of the reading.
result5	numeric(6,3)		Additional result of the reading.
result6	numeric(6,3)		Additional result of the reading.
result7	numeric(6,3)		Additional result of the reading.
result8	numeric(6,3)		Additional result of the reading.
result9	numeric(6,3)		Additional result of the reading.
result10	numeric(6,3)		Additional result of the

		reading.
result11	numeric(6,3)	Additional result of the reading.
result12	numeric(6,3)	Additional result of the reading.
result13	numeric(6,3)	Additional result of the reading.
result14	numeric(6,3)	Additional result of the reading.
result15	numeric(6,3)	Additional result of the reading.
result16	numeric(6,3)	Additional result of the reading.
error1	numeric(4,2)	Originally defined as The error for result1, i.e. result1 + or - error1. After the early 1990s typically used for a readability score on scale of 1 - 5 where 1= Unambiguous to 5= unreadable. Alternative meanings should be documented in the method description.
error2	character varying(3)	Additional character code for the error.
error3	character varying(3)	Additional character code for the error.
error4	character varying(3)	Additional character code for the error.
error5	character varying(3)	Additional character code for the error.
error6	character varying(3)	Additional character code for the error.
error7	character varying(3)	Additional character code for the error.
age	numeric(4,1)	Agreed age (in years) for the reading.
proj_code	character varying(12)	Project code for the reading.
comments	text	

```
Indexes:
    "pk_t_reading" PRIMARY KEY, btree
     (trip_code, sample_no, sub_sample_no, species, fish_no,
      reading_no)

Foreign-key constraints:
    "fk_t_reading_material" FOREIGN KEY (material)
     REFERENCES age.t_material(code)
    "fk_t_reading_method" FOREIGN KEY (method)
     REFERENCES age.t_age_meth(code)
    "fk_t_reading_origin" FOREIGN KEY (origin)
     REFERENCES age.t_origin(code)
    "fk_t_reading_species" FOREIGN KEY (species)
     REFERENCES rdb.curr_spp(code)
    "fk_t_reading_t_reader" FOREIGN KEY (reader)
     REFERENCES age.t_reader(code)
```

5.4 Table 4: t_catalog

Comment: Catalog of all ageing material, their storage location, and current ageing status.

Column	Type	Null?	Description
origin	character varying(3)	No	3 character uppercase code for the origin of the ageing material. Refer t_origin.
yr	integer	No	Year fish was sampled. As defined for t_fish.
trip_code	character varying(8)	No	Up to 8 char trip identification code.
sample_no	integer	No	Number of sample within the trip. This will be station number for Research and SOP (or tow_number) and stratum number for SMP.
sub_sample_no	character varying(4)	No	Number of sub sample. This will be subcatch number for Research trawls, cluster (box) number for SMP. SOP do not use this. -1 = Not Used.
area	character varying(5)		Up to 4 character area code. Codes depend on the species sampled. Refer rdb.area_codes.
species	character(3)	No	Code for the species of fish. Refer rdb.curr_spp.
fish_no	integer	No	Sequential identifying number of an individual fish for any one trip, sample, sub sample, and species.
material	smallint	No	1 digit code for the type of material collected for ageing, e.g., 1=otolith, 2=scales, 3=spines, etc. Refer t_material or Appendix 1 of the database documentation.
room	character varying(50)		Room number or other location where the ageing material can be found.
sub_loc	character varying(50)		Location within the room, e.g., file cabinet number,

		draw number.
status	character varying(25)	Current status of the ageing material, e.g., CATALOGUED, READ.
status_date	date	Date when status was last updated.

Indexes:
"pk_t_catalog" PRIMARY KEY, btree
(trip_code, sample_no, sub_sample_no, species, fish_no, material)

Foreign-key constraints:
"fk_t_catalog_material" FOREIGN KEY (material)
REFERENCES age.t_material(code)
"fk_t_catalog_origin" FOREIGN KEY (origin)
REFERENCES age.t_origin(code)
"fk_t_catalog_species" FOREIGN KEY (species)
REFERENCES rdb.species_master(code)

5.5 Table 5: t_age

Comment: Table listing the agreed age assessment for each fish aged.

Column	Type	Null?	Description
origin	character varying(3)	No	3 character uppercase code for the origin of the ageing material. Refer t_origin.
yr	integer	No	Year fish was sampled. As defined for t_fish.
trip_code	character varying(8)	No	Up to 8 char trip identification code.
sample_no	integer	No	Number of sample within the trip. This will be station number for Research and SOP (or tow number) and stratum number for SMP.
sub_sample_no	character varying(4)	No	Number of sub sample. This will be subcatch number for Research trawls, cluster (box) number for SMP. SOP do not use this. -1 = Not Used.
area	character varying(5)		Up to 4 character area code. Codes depend on the species sampled. Refer rdb.area_codes.
species	character(3)	No	Code for the species of fish. Refer rdb.curr_spp.
fish_no	integer	No	Sequential identifying number of an individual fish for any one trip, sample, sub sample and species.
prep_no	character varying(16)		Number to identify ageing material within a prepared sample.
block_no	character varying(16)		Identifying number or label on the resin block, or other preparation containing multiple otoliths or other age specimens.
agreed_result1	numeric(6,2)		The agreed result of the reading, typically the agreed count of the concentric zones or annuli

			on the otolith or other ageing material that are interpreted in terms of age in years. Other meanings should be documented in this database.
agreed_result2	character varying(5)		Up to 5 character code for the second result.
method	smallint	No	Up to 2 digit code for the method used to read ageing material.
agreed_age	numeric(4,1)		Agreed age (years) of the fish.
agreed_error1	numeric(4,2)		Originally defined as The error for result1, i.e. result1 + or - error1. After the early 1990s typically used for a readability score on scale of 1 - 5 where 1 = Unambiguous to 5 = unreadable. Alternative meanings should be documented in the method description.
agreed_error2	character varying(3)		Additional character code for the agreed error.
proj_code	character varying(12)		Project code for the age.
comments	text		Contains information on materials and methods used to arrive at the agreed age of the fish.

Indexes:
"pk_t_age" PRIMARY KEY, btree
(trip_code, sample_no, sub_sample_no, species, fish_no, method)

Foreign-key constraints:
"fk_t_age_curr_spp" FOREIGN KEY (species)
REFERENCES rdb.curr_spp(code)
"fk_t_age_t_age_meth" FOREIGN KEY (method)
REFERENCES age.t_age_meth(code)

5.6 Table 6: t_reference

Comment: Table describing the accepted zone count and age for each fish included in a reference set of aged structures. The result and error fields are generic to handle the numerous types of reading and measurement techniques. Explanations for what result and error is stored in what attribute is recorded in the matching reading method record in t_age_meth.

Column	Type	Null?	Description
origin	character varying(3)	No	3 character code for the origin of the ageing material. Refer: t_origin.
yr	integer	No	Year fish was sampled. As defined for the t_fish table.
trip_code	character varying(8)	No	Up to 8 char trip identification code.
sample_no	integer	No	Number of sample within the trip. This will be station number for Research, stratum number for SMP, and tow number for SOP.
sub_sample_no	character varying(4)	No	Number of sub sample. This will be subcatch number for Research trawls, cluster (box) number for SMP. SOP do not use this. -1 = Not Used.
species	character(3)	No	Code for the species of fish. Refer rdb.curr_spp.
fish_no	integer	No	Sequential identifying number of an individual fish for any one trip, sample, sub sample, and species.
ref_set_no	character varying(8)	No	Number to identify ageing material within the reference set.
area	character varying(4)		Up to 4 character area code. Codes depend on the species sampled. Refer rdb.area_codes.
prep_no	character varying(16)		Number to identify ageing material within a prepared sample.
block_no	character varying(16)		Identifying number or

			label on the resin block, or other preparation containing multiple otoliths or other age specimens.
reading_no	smallint	No	Sequential number for each reading for each fish.
reading_date	date		Date the reading was made on.
material	smallint	No	1 digit code for the type of material used for reading, e.g., 1=otolith, 2=scales, 3=spines, etc. Refer t_material or Appendix 1 of the database documentation.
method	smallint	No	Up to 2 digit code for the method used to read ageing material. Refer t_age_meth.
reader	smallint	No	Numeric code to identify the reader. Refer t_reader.
zone_count	integer		The count of the zones or annuli on the otolith or other ageing material that are interpreted in terms of age in years.
margin	character varying(4)		Up to 5 character code for the marginal state where W = Wide, M = medium, N = Narrow, L = Line. Any other values should be documented in the method description.
result3	numeric(6,3)		Additional result of the reading, documented in the method description.
result4	numeric(6,3)		Additional result of the reading documented in the method description.
result5	numeric(6,3)		Additional result of the reading documented in the method description.
result6	numeric(6,3)		Additional result of the reading documented in the method description.
result7	numeric(6,3)		Additional result of the reading documented in the

		method description.
clarity	numeric(4,2)	A readability score on scale of 1-5 where 1 = unambiguous to 5 = unreadable.
age	numeric(4,1)	Agreed age (in years) for the reading.
comments	text	

```
Indexes:
   "pk_t_reference" PRIMARY KEY, btree (species, ref_set_no)
   "nx_t_reference_area" btree (area)
   "nx_t_reference_origin" btree (origin)
   "nx_t_reference_species" btree (species)
   "nx_t_reference_trip_code" btree (trip_code)
   "nx_t_reference_yr" btree (yr)

Foreign-key constraints:
   "fk_t_reference_rdb_curr_spp" FOREIGN KEY (species)
    REFERENCES rdb.curr_spp(code)
   "fk_t_reference_t_age_meth" FOREIGN KEY (method)
    REFERENCES age.t_age_meth(code)
   "fk_t_reference_t_fish" FOREIGN KEY
    (trip_code, sample_no, sub_sample_no, species, fish_no)
    REFERENCES age.t_fish
    (trip_code, sample_no, sub_sample_no, species, fish_no)
   "fk_t_reference_t_material" FOREIGN KEY (material)
    REFERENCES age.t_material(code)
   "fk_t_reference_t_origin" FOREIGN KEY (origin)
    REFERENCES age.t_origin(code)
   "fk_t_reference_t_reader" FOREIGN KEY (reader)
    REFERENCES age.t_reader(code)
```

5.7 Table 7: t_ref_reading

Comment: Table describing the zone counts and estimated age of fish in an ageing structure reference set. The readings are generated when readers are calibrated before commencing the ageing of a new sample. Explanations for what result and error is stored in what attribute is recorded in the matching reading method record in t_age_meth.

Column	Type	Null?	Description
origin	character varying(3)	No	3 character uppercase code for the origin of the ageing material. Refer: t_origin.
yr	integer	No	Year fish was sampled. As defined for the t_fish table.
trip_code	character varying(8)	No	Up to 8 char trip identification code.
sample_no	integer	No	Number of sample within the trip. This will be station number for Research, stratum number for SMP, and tow number for SOP.
sub_sample_no	character varying(4)	No	Number of sub sample. This will be subcatch number for Research trawls, cluster (box) number for SMP. SOP do not use this.
species	character(3)	No	Code for the species of fish. Refer rdb.curr_spp.
fish_no	integer	No	Sequential identifying number of an individual fish for any one trip, sample, sub sample, and species.
ref_set_no	character varying(8)	No	Number to identify ageing material within the reference set.
area	character varying(4)		Up to 4 character area code. Codes depend on the species sampled. Refer rdb.area_codes.
prep_no	character varying(16)		Number to identify ageing material within a prepared sample.

block_no	character varying(16)		Identifying number or label on the resin block, or other preparation containing multiple otoliths or other age specimens.
reading_no	smallint	No	Sequential number for each reading for each fish.
reading_date	date	No	Date the reading was made on.
material	smallint	No	1 digit code for the type of material used for reading, e.g., 1=otolith, 2=scales, 3=spines, etc. Refer t_material or Appendix 1 of the database documentation.
method	smallint	No	Up to 2 digit code for the method used to read ageing material. Refer t_age_meth.
reader	smallint	No	Numeric code to identify the reader. Refer t_reader.
zone_count	numeric(6,3)		The count of the zones or annuli on the otolith or other ageing material that are interpreted in terms of age in years.
margin	character varying(4)		Up to 4 character code for the marginal state where W = Wide, M = medium, N = Narrow, L = Line. Any other values should be documented in the method description.
result3	numeric(6,3)		Additional result of the reading, documented in the method description.
result4	numeric(6,3)		Additional result of the reading documented in the method description.
result5	numeric(6,3)		Additional result of the reading documented in the method description.
result6	numeric(6,3)		Additional result of the reading documented in the method description.

result7	numeric(6,3)	Additional result of the reading documented in the method description.
clarity	numeric(4,2)	A readability score on scale of 1 - 5 where 1 = unambiguous to 5 = unreadable.
proj_code	character varying(12)	Project code for the reading.
comments	text	

```
Indexes:
   "pk_t_ref_reading" PRIMARY KEY, btree
    (species, ref_set_no, reading_no)
   "nx_t_ref_reading_area" btree (area)
   "nx_t_ref_reading_origin" btree (origin)
   "nx_t_ref_reading_species" btree (species)
   "nx_t_ref_reading_trip_code" btree (trip_code)
   "nx_t_ref_reading_yr" btree (yr)

Foreign-key constraints:
   "fk_t_ref_reading_rdb_curr_spp" FOREIGN KEY (species)
    REFERENCES rdb.curr_spp(code)
   "fk_t_ref_reading_t_age_meth" FOREIGN KEY (method)
    REFERENCES age.t_age_meth(code)
   "fk_t_ref_reading_t_material" FOREIGN KEY (material)
    REFERENCES age.t_material(code)
   "fk_t_ref_reading_t_origin" FOREIGN KEY (origin)
    REFERENCES age.t_origin(code)
   "fk_t_ref_reading_t_reader" FOREIGN KEY (reader)
    REFERENCES age.t_reader(code)
   "fk_t_ref_reading_t_reference" FOREIGN KEY (species, ref_set_no)
    REFERENCES age.t_reference(species, ref_set_no)
```

5.8 Table 8: t_origin

Comment: Table describing the origin codes of the ageing material.

Column	Type	Null?	Description
code	character varying(3)	No	3 character uppercase code for the origin of the ageing material.
description	character varying(60)	No	Brief description of the origin of the ageing material. See Appendix 1 of the database documentation for the main origin codes used. For research surveys this is typically the same as the vessel code. Eg TAN for RV Tangaroa. Market sampling use SMP, Observer collected use SOP.

Indexes:
"pk_t_origin" PRIMARY KEY, btree (code)

5.9 Table 9: t_material

Comment: List of materials used for ageing, e.g., otoliths, vertebrae, scales.

Column	Type	Null?	Description
code	smallint	No	Numeric code for material used for reading.
description	character varying(60)	No	Brief description of the ageing material.

Indexes:
"pk_t_material" PRIMARY KEY, btree (code)

5.10 Table 10: t_reader

Comment: List of names of persons who have carried out the ageing analysis.

Column	Type	Null?	Description
code	integer	No	Numeric code identifying the reader.
name	character varying(30)	No	Name of the reader associated with the code.

Indexes:
"pk_t_reader" PRIMARY KEY, btree (code)

5.11 Table 11: t_age_meth

Comment: Table listing the methods used for estimating ages.

Column	Type	Null?	Description
code	smallint	No	Numeric code for ageing method used = method in table t_reading etc.
description	text	No	Details on method used to prepare and read ageing material and derive age.

Indexes:
"pk_t_age_meth" PRIMARY KEY, btree (code)

6 age Business Rules

6.1 Introduction to business rules

The following are a list of business rules pertaining to the **age** database. A business rule is a written statement specifying what the information system (i.e., any system that is designed to handle fish ageing data) must do or how it must be structured.

There are three recognized types of business rules:

Fact	Certainty or an existence in the information system
Formula	Calculation employed in the information system
Validation	Constraint on a value in the information system

Fact rules are shown on the ERD by the cardinality (e.g., one-to-many) of table relationships. Referential constraints, range checks, and algorithms both in the database and during data validation implement the formula and validation type rules.

Validation rules may be part of the preloading checks on the data as opposed to constraints or checks imposed by the database. These rules sometimes state that a value should be within a certain range. All such rules containing the word 'should' are conducted by preloading software. The use of the word 'should' in relation to these validation checks means that a warning message is generated when a value falls outside this range and the data are then checked further in relation to this value.

6.2 Summary of rules

Trip details (t_trip)

origin Must be a valid data origin code as listed in the *t_origin* table.

yr Must be a valid 4 digit year less than or equal to the current year.

trip_code Should be (but not necessarily) a valid alphanumeric code to uniquely identify a survey, landing or trip as listed in the header tables of such databases as **trawl**, **market**, or **cod**.

areas Should contain valid area code(s) as listed in the *area_codes* table in the **rdb** database.

species Must be a valid species code as listed in the *curr_spp* table in the **rdb** database.

Multiple columns check on trip code and species:
The combination of trip code and species must be unique.

status_date Must be a valid date.

Fish details (t_fish)

origin	Must be a valid data origin code as listed in the *t_origin* table.
yr	Must be a valid 4 digit year less than or equal to the current year.
trip_code	Should be (but not necessarily) a valid alphanumeric code to uniquely identify a survey, landing or trip as listed in the header tables of such databases as **trawl**, **market**, or **cod**.
sample_no	Must be an integer greater than zero. Should equal a corresponding station number in the trawl or cod databases where ageing material is from research surveys or observers respectively.
sub_sample_no	Must contain a value. Default = "-1". Should have the value of '-1' where origin = 'SOP'.
area	Must be a valid area code as listed in the *area_codes* table in the **rdb** database.
species	Must be a valid species code as listed in the *curr_spp* table in the **rdb** database.
fish_no	Must be an integer greater than zero.
lgth	Must be an integer greater than zero. **Multiple columns check on species and length:** The fish length should not be greater than the maximum length for the species as recorded in the *curr_spp* table in the rdb database.
lgth_code	Must be either "E" or "R".
sex	Must be a valid sex code as listed in the *t_sex_codes* table in the **rdb** database, namely a value between 1 and 4.
gonad_stage	Must be a valid gonad stage code as listed in the *t_gon_stg_meth* table in the **rdb** database for research data. For observer and market sampling data must be a value of between "1" and "5".
weight	Must be a number greater than zero.
otolith_weight	Must be a number greater than zero.
otolith_weight2	Must be a number greater than zero.

otolith_lgth	Must be a number greater than zero.
otolith_width	Must be a number greater than zero.
material1	Must be a valid ageing material code as listed in the *t_material* table, and should contain a value (i.e., should not be null).
material2	Must be a valid ageing material code as listed in the *t_material* table.
fish_select_meth	Must be a value of either “1”, “2”, “3” or “4”.

Age reading details (t_reading)

origin	Must be a valid data origin code as listed in the *t_origin* table.
yr	Must be a valid 4 digit year less than or equal to the current year.
trip_code	Should be (but not necessarily) a valid alphanumeric code to uniquely identify a trip, survey, or landing as listed in the header tables of such databases as **trawl**, **market**, or **cod**.
sample_no	Must be an integer greater than zero.
sub_sample_no	Must contain a value. Default = "-1". Should have the value of '-1' where origin = 'SOP'.
area	Must be a valid area code as listed in the *area_codes* table in the **rdb** database.
species	Must be a valid species code as listed in the *curr_spp* table in the **rdb** database.
fish_no	Must be an integer greater than zero.
reading_no	Must be an integer greater than zero.
reading_date	Must be a valid date.
material	Must be a valid ageing material code as listed in the *t_material* table.
method	Must be a valid ageing method code as listed in the *t_age_meth* table.
reader	Must be a valid reader code as listed in the t_reader table.
result1} **result3}** **result4}** **result5}** **result6}**	Must be a number greater than or equal to zero.
error1	Must be a number greater than or equal to zero.
age	Must be a number greater than or equal to zero.

Ageing material catalog details (t_catalog)

origin	Must be a valid data origin code as listed in the *t_origin* table.
yr	Must be a valid 4 digit year less than or equal to the current year.
trip_code	Should be (but not necessarily) a valid alphanumeric code to uniquely identify a survey, landing or trip as listed in the header tables of such databases as **trawl**, **market**, or **cod**.
sample_no	Must be an integer greater than zero.
sub_sample_no	Must contain a value. Default = "-1". Should have the value of '-1' where origin = 'SOP'.
area	Must be a valid area code as listed in the *area_codes* table in the **rdb** database.
species	Must be a valid species code as listed in the *curr_spp* table in the **rdb** database.
fish_no	Must be an integer greater than zero.
material	Must be a valid ageing material code as listed in the *t_material* table.
status_date	Must be a valid date.

Age details (t_age)

origin	Must be a valid data origin code as listed in the *t_origin* table.
yr	Must be a valid 4 digit year less than or equal to the current year.
trip_code	Should be (but not necessarily) a valid alphanumeric code to uniquely identify a survey, landing or trip as listed in the header tables of such databases as **trawl**, **market**, or **cod**.
sample_no	Must be an integer greater than zero.
sub_sample_no	Must contain a value. Default = "-1". Should have the value of '-1' where origin = 'SOP'.
area	Must be a valid area code as listed in the *area_codes* table in the **rdb** database.
species	Must be a valid species code as listed in the *curr_spp* table in the **rdb** database.
fish_no	Must be an integer greater than zero.
agreed_result1	Must be a number greater or equal to zero.
method	Must be a valid ageing method code as listed in the *t_age_meth* table.
agreed_age	Must be a number greater or equal to zero.
agreed_error1	Must be a number greater or equal to zero.

Age material origin codes (t_origin)

code Must contain a unique code.

description Must contain a value.

Age material type codes (t_material)

code Must contain a unique code.

description Must contain a value.

Age material reader codes (t_reader)

code Must contain a unique code.

name Must contain a value.

Ageing method codes (t_age_meth)

code Must contain a unique code.

description Must contain a value.

7 Acknowledgements

The authors would like to thank Dave Banks for his editorial contribution to this document.

Appendix 1 - Reference code tables

As new codes are added to the respective tables periodically if you do not find a code listed below then it is recommended to refer to corresponding **age** table for the complete list of codes and their meanings.

Origin code (from table t_origin)

SMP	Stock Monitoring Programme - Market Sampling
SOP	Scientific Observer Programme - Catch Sampling
TAN	GRV[6] Tangaroa
KAH	GRV Kaharoa
JCO	GRV James Cook
WJS	GRV W.J.Scott
BFN	Bluefin - MAF Auckland Vessel

The following **origin** codes are for various fishing vessels:

AEX	Amaltal Explorer
AKA	Akagi Maru
AKE	Akebono Maru No.73
AKS	Akebono Maru No.3
AMA	Amaltal Mariner
ARR	Arrow
BUC	Otago Buccaneer fishing vessel
CHJ	Cheryln J
COR	Cordella
GIL	Giljanes
GOL	Golden Bay (reg no.=6097)-BCO potting survey
JUG	Juggernaut (BCO potting survey)
LEG	Legacy
LHR	Lady Helen Rose
MYS	Mystique
NAV	Navigator
ORA	Ocean Ranger
SHI	Shinkai Maru
SLT	Solitare
SUZ	Suzanne
SWA	San Waitaki
WES	Wesermunde
WIL	Will Watch

Other origin codes:

ELE	Elephantfish catch sampling
HMC	Hoki Management Company
MIS	Miscellaneous e.g., mixed landing, or no length frequency
REC	Recreational

[6] GRV = Government Research Vessel

RIG	Rig catch sampling (gill-netting and trawl surveys)
SCR	Scientific Research (excludes trawl surveys)
SDF	Samples collected by Sanfords
SFC	Samples collected by SeaFIC
TAG	Collected from TAG recaptures

Reader code (from table t_reader)

0	Agreed Age
1	David A. Banks
2	David O. Fisher
3	Adam D. Langley
4	Kerri E. Lister
5	Kevin A. Mackay
6	Heidi Getrost
7	Elizabeth Halsey
8	Colin Docherty
9	Mike Coakley
10	Peter Horn
11	C. L. Newport
12	Claire L. Gabriel
13	Gerard Worsfold
14	Kevin J. Sullivan
15	Kimon George
16	Ian Rosemergy
17	Jonathan Ingerson
18	Peter Marriott
19	Darren Stevens
20	Larry Paul
21	Bruce Hartill
22	Cameron Walsh
23	Ken Kawiti
24	Helena Cadenhead
25	Bill Trusewich
26	Guido I. Kucerans
27	Dave J. Gilbert
28	A. J Taylor
29	C.Smith
30	D. J Hollaway
31	Pat. Swanson
32	N. J Millar
33	K. A Fisher
34	Brent A Wood
35	B. L Bycroft
36	Ian F West
37	CLC
38	BJW
39	Colin Sutton

Reader code [cont…]

40	Greg Meikle
41	Jim Drury
42	Victor Cauty
43	Derrick Parkinson
44	Simon Carter
45	Mark Morrison
46	Helen Johnson
47	Elwyn Green
48	Andy Hay
49	Andrea Price
50	Dominic McCarthy
51	Tracey Osborne
52	Diederik Meenken
53	Paul Creswell
54	Eunice Warren
55	Nick Davies
56	Malcolm Haddon
57	Sheryl Mutton
58	Tim Lowe
59	Jeremy McKenzie
60	Dave Allen
61	Paul Fraser
62	Eddie Sides
63	Carmen Gray
64	Stuart Hanchet
65	Evan Skipworth
66	Andrew Hamilton
67	John Taunton-Clark
68	Tessa Fagan
69	Glenn Mackay
70	Mike Beentjes
71	Don Jellyman
72	Ben Chisnall
73	Jill Parkyn
74	Glen Carbines
75	Derek Kater
76	Matthew Smith
77	Caoimhghin O Maolagain
78	Gavin James
79	ERM
80	REM
81	JF
82	T P
83	Robert Bedford
84	SJH
85	Adrian Colman
86	Malcolm Francis

Reader code [cont…]

87	Arthur Hore
88	Nathan Singleton
89	Shaun Henderson
91	Niki Alcock
92	Bruce Dudley
93	Crispin Middleton
99	Not Known
100	Di Tracey
101	Peter Horn and Di Tracey
102	Shaun Holland
103	Michael Manning
104	Jason Mills
105	Gavin Newmarch
106	Catherine Lippe
107	Kelly May
108	Corina Kemp
109	Michael Stevenson
110	Nicola Rush
111	Peter McMillan
112	Lynda Griggs
113	Dane Buckthought
114	Kyne Krusic-Golub (CAF)
115	Melanie Vaughan
116	Keren Spong
117	David Mutoro
18	Dan McClary
119	Alan Hart
120	Michael Gallagher
121	Holly Ferguson
122	Andrew Miller
123	Anna Bradley
124	Debbie Hulston
125	Warrick Lyon
126	Greg Kelly
127	Simon Robertson
128	Natalie Usmar
129	Mike Martin
130	Paul Lambert
131	Jacques Boubee
132	Josh Smith
133	Silver Bishop (MPI)
134	Ken Olivera

Ageing method code (from table t_age_meth)

1	Break, polish, bake and count rings from the centre, looking at 2 halves of the one otolith.(used by stock monitoring for the 1989 seasons otoliths)
2	Break, polish, burn and count rings from the centre, looking at one half of the otolith. A 2 mm diameter scale was used to help locate the first ring. (used by G. Worsfold, C. Gabriel and K. Sullivan for the pilot phase; i.e., 1988 otolith readings.)
3	Break, polish, burn or bake and count rings using a graticle as a guide to the 1st 3 years (1 year at 2mm, 2yrs at 4mm & 3 years at 5mm) looking at one half of the otolith. (Used for sub-samples of 1988 and 1990 seasons otoliths.)
4	Otolith read whole, immersed in water, paraffin oil or like
5	Whole, bleached vertebral centra were obliquely illuminated with a fibre optic light source. By moving the light source above and below the rim of the articulating face, it was possible to quickly view the hyperminearlised vertebral bands with both transmitted and reflected light. The theoretical birthday was defined as 1 September. The time of band deposition approximately coincides with the theoretical birthday. Therefore, the age assigned to each rig was the band count minus one for the birth band, plus the fraction of the year elapsed between 1 September and the sampling date. The mean of two age estimates (made by two readers) was taken as the final age estimate.
6	Break and Burn
7	Whole otolith baked, embedded in epoxy resin, cut transversely through nucleus with diamond tip blade. Read using binocular microscope to count rings from one or both sides of a prepared otolith.
8	Ageing material bleached, embedded in epoxy resin, sectioned, attached to a slide and polished.
10	Otolith weight in grams to 3 decimal places
11	Thin section, as in Tracey & Horn 1999; Background & review of ageing ORH.
12	Modified Ageing Methodology for Juvenile Hoki Age 1 - 2. As of December 2000.

Result and error attributes in the *t_reading* table:

Attribute	**Value Stored**
result1	Age
result2	Radius to Zone 1
result3	Radius to Zone 2
result6	Radius to otolith edge
error3	Overall clarity (1-3), where 1 = best
error5	split/multiple 2nd zone (1 = true, 0 = false)

Ageing method code [cont…]

13 Modified Ageing Methodology for Juvenile Hoki Age 3. As of December 2000.
Result and error attributes in the *t_reading* table:

Attribute	Value Stored
result1	Age
result2	Radius to Zone 1
result3	Radius to Zone 2
result4	Radius to Zone 3
result5	Radius to edge of the juvenile zone
result6	Radius to otolith edge
error1	Clarity of Zone 1 (1-4), where 1 = best, 4 = unreadable
error2	Clarity of juvenile zone 1 (1-4), where 1 = best, 4 = unreadable
error4	Split/multiple 1st zone (1=true, 0=false)
error5	split/multiple 2nd zone (1 = true, 0 = false)
error6	split/multiple 3nd zone (1 = true, 0 = false)

14 Modified Ageing Methodology for Hoki. As of December 2000.
Result and error attributes in the *t_reading* table:

Attribute	Value Stored
result1	Age
result2	Radius to Zone 1
result3	Radius to Zone 2
result4	Radius to Zone 3
result5	Radius to edge of the juvenile zone
error1	Clarity of Zone 1 (1-3), where 1 = best
error2	Clarity of juvenile zone 1 (1-4), where 1 = best, 4 = unreadable
error7	Clarity for Zones 1 to 3 combined (1-3), where 1=best

Ageing material code (from table t_material)

1 Otolith
2 Scales
3 Spines
4 Vertebrae
5 Teeth
6 Statolith (cephalopod)
7 Eye lenses
8 Caudal thorns (skates)

Gonad Stage Codes

1**. IMMATURE/RESTING** Ovary translucent or pink, small with **no** eggs visible.
Can occur in both small and large fish

2 MATURING Eggs visible, opaque/coloured, but **not hyaline** (Clear) Ovaries can get quite large and solid in this stage Colour will vary between species, but maturing ovaries are generally creamy white to orange If held up to the light or cut, a small ovary thought initially to be **Stage 1** may show some developing eggs: it is then to be classed as **Stage 2**

3. RIPENING Ovary large and firm **Clear eggs are present** (more than just one or two). The ovary can appear quite mottled with clear eggs interspersed with the opaque maturing eggs

4. RUNNING RIPE Ovary large, thin-walled and fragile. Large clear eggs flow out freely, or are obvious in large numbers when the ovary is cut

5. SPENT Ovary flaccid and bloody, size much reduced from **Stage 4.** Some residual large clear or opaque eggs may still be present