Database documentation for the Ministry of Fisheries tagging database:
tag

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NIWA Fisheries Data Management
Database Document Series

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Revision History

Version	Change	Date	Responsible
1.0	First release	1993	Brent Wood
1.1	Revision	5 March 2002	Kevin Mackay
1.2	Added Revision History table, changed comment on t_release.weight to kg from g, D Fisher's instruction.	28 August 2003	Fred Wei
1.3	Updated the document to reflect the length of some previously increased character data types, and existing but unlisted additional attributes.	3 March 2004	David Fisher
1.4	Altered proj_code to char(16), dist to decimal(8,3).	5 August 2004	Fred Wei
1.5	Altered t_lfreq.station_code to char(12).	8 November 2004	Fred Wei
2.0	Huge change, redesigned, 9 new tables added	28 Jun 2007	Fred Wei
2.1	Added colour char(16,1) in t_tag_batch	27 August 2008	Fred Wei
2.2	replaced type_code with tag_type	18 November 2008	Fred Wei
2.3	Minor editorial corrections, including to section 4.	17 July 2009	David Fisher
2.4	Added rel6, rec6. extended rel2, rec2, fisher_name	8 Jun 2010	Fred Wei

1. Database documentation series

The National Institute of Water and Atmospheric Research (NIWA) is Data Manager and Custodian for the research data owned by the Ministry of Fisheries (MFish).

The Ministry of Fisheries data set incorporates historic research data, data collected more recently by MAF Fisheries prior to the split in 1995 of Policy to the Ministry of Fisheries and research to NIWA, and currently data collected by NIWA and other research providers for the Ministry of Fisheries.

This document provides an introduction to the tag survey database **tag**, and is a part of the database documentation series produced by NIWA. It supersedes the previous documentation by Wood (1993) on this database.

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 **tag** database.

Access to this database is restricted to nominated personnel as specified in the current Data Management contract between the Ministry of Fisheries and NIWA. Any requests for data should in the first instance be directed to the Ministry of Fisheries.

2. Tagging Programmes

2.1 Sources of tagging data

Tagging programmes have been used to provide information on fish and fisheries in New Zealand for many years. Many of these programmes are described in a variety of publications, with summaries of tagging programmes carried out in New Zealand included in Crossland (1982) and Murray (1990). A wide variety of species have been the subject of such studies, including finfish, squid, shellfish and rock lobsters.

To facilitate the storage and access of data collected by a wide range of tagging programmes requires a flexible database structure. This is likely to be more complex than that required for any single programme. A brief overview of some different programmes follows to help illustrate this:

The 1980/1981 kahawai programme involved a single target species. The animals were marked and released throughout New Zealand during the two year period. Many were measured when tagged, and samples of animals were also taken to provide additional age/growth information. Only one tag was applied to each animal. Animals were not injected with any biochemical markers. This is an example of a very straightforward tagging programme, intended to provide information on movement, age/growth and relative levels of effort by method and fisher type (recreational/commercial).

The co-operative gamefish tagging program is an ongoing tagging programme initially run by MAF Fisheries in co-operation with the International Game Fishing Association. This programme has several target species, and it is generally not possible to get an accurate length or weight of the animals tagged. This programme is particularly unusual in that there is no single target species.

The bluenose tagging programme run off the Wairarapa coast in 1987 does have a single target species. To tag bluenose without damaging them it is necessary to apply the tag to the animals at the depths they are normally found, generally over 200m deep. To do this, baited hook tags attached to lines set in appropriate areas were used. Of the baits/tags which were taken from the lines, it is not possible to say what species (or if the sea bed) "took" the tags. The actual species tagged cannot be known, except for those tags which were recaptured.

A 1987 snapper tagging programme in Tasman Bay had every tenth fish double tagged to help determine the level of tag shedding which occurred. The fish were also injected with tetracycline to assist with age determination upon recapture.

Another snapper tagging programme, this time in the Hauraki Gulf during 1994, had snapper tagged with coded wire tags. All landed snapper within a factory were passed through an electronic scanner to detect the tagged fish. Tag numbers were only known at the time of detection, but not release. A known number of snapper were seeded with tags at the factory to calculate the detection rate of the electronic scanner.

2.2 Data loading and validation

As the data from different tagging programmes has been stored in a variety of formats prior to the establishment of the **tag** database, no standard system has been developed for loading data into the database. Many of the validation rules also vary between tagging programmes so these also are not implemented on the database as a whole. Prior to data being loading to the database, for each tagging programme, appropriate validation rules should be developed and the data checked against these rules.

The referential and range checks listed in the table structures and shown in the Entity Relationship Diagram are the only validation checks enforced.

3. Data structures

3.1 Table relationships

This database contains several tables. The ERD for **tag** (Figure 1) shows the physical data model structure [1] 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[2]. This schema is valid regardless of the database system chosen, and it can remain correct even if the Database Management System (DBMS) is changed.

Some of the tables in the **tag** database have some attributes, called foreign keys[3], which contain standard NIWA fisheries codes, such as *species* and *stage_meth*. These attributes provide links to tables in the **rdb** (research database) database, which contains the definitive list of standard codes. Therefore, an expanded ERD for these tables will follow (Figure 2).

Section 5 shows a listing of all the **tag** tables as implemented by the Empress DBMS. As can be seen in the listing of the tables, a table's primary key has a unique index on it. Primary keys are generally listed using the format:

Indices: PRIMARY KEY BTREE index_name ON (*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.

This unique index prevents records with duplicate key values from being inserted into the table, e.g., a new proj_id with an existing proj_id, and hence ensures that every record can be uniquely identified.

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1 Also known as a database *schema*.

2 A primary key is an attribute or a combination of attributes that contains an unqiue value to identify that record.

3 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.

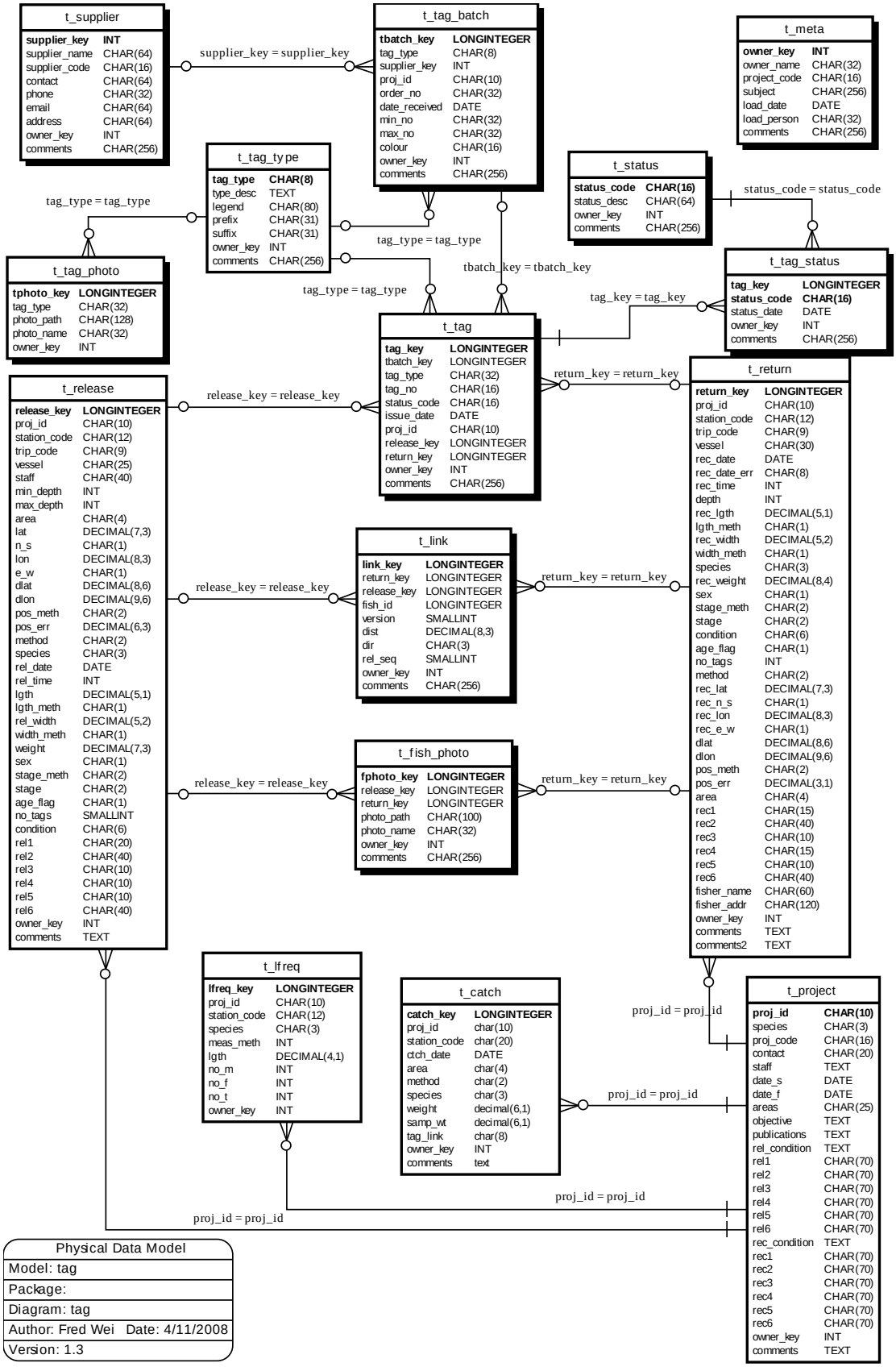

Figure 1 : Entity Relationship Diagram (ERD) of the **tag** database.

The **tag** 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 **tag** are of the type *one-to-many*[4]. This is shown in the ERD by connecting a crows foot[5] (indicating 'many') from the child table (e.g., *t_catch*) to the parent table (e.g., *t_project*) with a single line (indicating 'one') pointing to the parent.

Figure 2 : Expanded ERD of **tag** tables showing relationships to **rdb** tables.
Every relationship has a mandatory or optional aspect to it. That is, if a relationship is mandatory, then it has to occur at least once, while an optional relationship might not occur at all. For example, in Figure 1, consider that relationship between the table *t_project* and it's child table *t_catch*. The symbol "O" by the child *t_catch* means that a tag project can have zero or many catch records, while the bar by the parent *t_project* means that for every catch record there must be a matching tag project record.

Most of these tables contain foreign keys, which link these tables to each other and to tables in the **rdb** database (Figure 2). The majority of these links are enforced by referential constraints[6]. These 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:

Referential: (attribute[, *attribute*]) REFER parent table (attribute[, *attribute*])

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

Referential: (proj_id) REFER t_project (proj_id)

This means that the value of the attribute proj_id in a *t_release* record must already exist in the parent table *t_project* or the record will be rejected and an error message will be displayed.

A delete constraint implies that 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.
Foreign key constraints enforce both insert and delete constraints.

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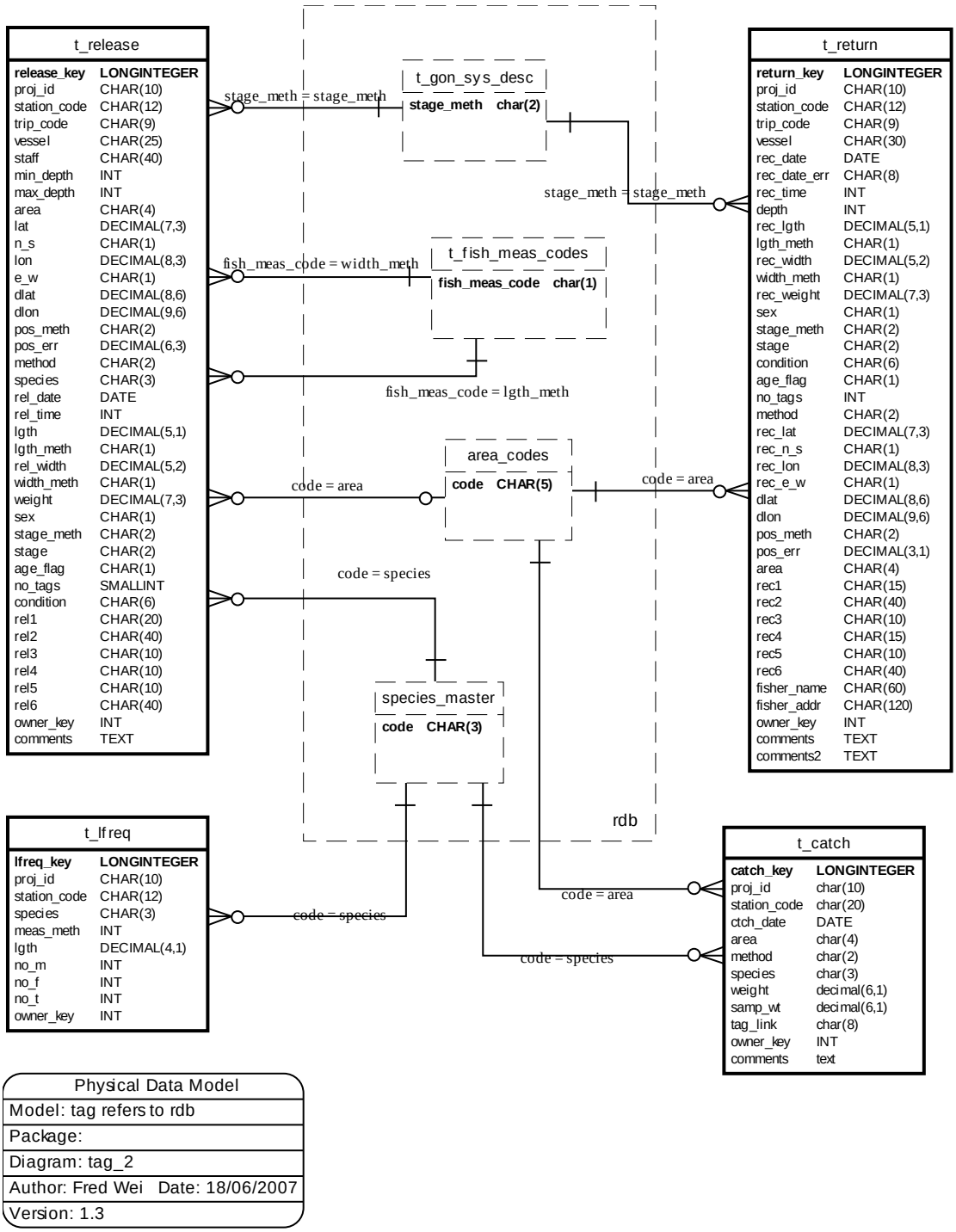
[4] A one-to-many relationship is where one record in a table (the *parent*) relates to one or many records in another table (the *child*).

[5] A crows foot is the term used for this 3 pronged fork.

[6] Also known as integrity checks.



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 on attributes that are not primary or foreign keys are listed using the following format:

Indices: NORMAL (2, 15) index_name ON (*attribute*[, *attribute*])

Note that indices may be simple, pointing to one attribute or composite pointing to more than one attribute. The numbers "…(2, 15)…" in the syntax are Empress DBMS default values relating to the amount of space allocated for the index.

3.2 Database design

There are four main subject areas of the tag data model which are described below, summarized by database table:

3.2.1 Meta data

t_meta: defines dataset ownership with each table having a mandatory (not null) owner_key attribute which is populated in the data loading process. This table also records the date when each dataset is loaded to the database.
t_project: stores information describing a tagging programme undertaken. This information does not necessarily relate to data held in other tables in the database, which enables this table to be used as a reference to tagging programmes which have been carried out, even if the actual tagging data is not stored in the database. This table is uniquely keyed on the *proj_id* attribute.

3.2.2 Tag data

t_tag: records individual tags used or to be used in a tagging programme.
t_supplier: contains information about tag suppliers.
t_tag_batch: contains information about batches or orders of tags.
t_tag_type: contains description of each type of tag, along with a code representing the tag type.
t_tag_photo: records the whereabouts of files of tag photos.
t_status: contains status information of tags, eg ordered, received, released.
t_tag_status: each tag may have a different status, this table links each tag with its status to the status table.

3.2.3 Fish data

t_release: relates to actual animals tagged and includes associated location, time, gear method information etc. Each record represents one animal being marked and released. It is linked to the project table by the *proj_id* attribute. To enable programme specific data to be stored in a generic database, five user defined attributes have been implemented. These can each hold up between ten and twenty characters and are used if required. The data stored in these attributes is described in the appropriate attributes in the project table.

t_return: contains information pertaining to tagged animals that have been recaptured. This is linked to the project table directly via the *proj_id* attribute. This table also has five user defined attributes similar to those in the release table, but for programme specific recapture or return data.
t_link: establishes links between a release event and return event.
t_fish_photo: records whereabouts of files of fish photos.

3.2.4 Catch data

Tagging projects are sometimes carried out in conjunction with other programmes including trawl surveys and market or catch sampling programmes. In these cases,

catch and length frequency data would be held in databases such as **trawl**, **market**, **scallop**, **rlcs**, etc. Where there is no appropriate database to store associated catch and or length frequency data these data are kept in the *t_catch* and *t_lfreq* tables respectively.

t_lfreq: holds length frequency data collected on catches from which animals were tagged, as collected by some programmes. Length frequency data is linked to the *t_project* table by the *proj_id* attribute, and may be linked to the *t_release*, *t_return*, or *t_catch* tables by the *proj_id* and *station_code* attributes.

t_catch: holds the total catch weight of catches from which animals were tagged or recaptured as recorded by some tagging programmes. These data are linked to the *t_project* table by the *proj_id* attribute, and may be linked to either the *t_release* or *t_return* tables by the *proj_id* and *station_code* attributes.

3.3 Handling orphan tag return records

In strictly logical terms, a tag return record can not exist without a matching tag release. However, the reality is that tags get damaged resulting in tag numbers becoming partially or wholly illegible and impossible to be matched against any one release record. In such instances, dummy release records may be inserted into the *t_release* table to match the damaged returned tags.

3.4 Multiple releases and returns

With certain species, such as crayfish, individual tagged animals may be released and recaptured many times. In such cases, one animal is represented by multiple records in both the *t_release* and *t_return* tables.

Care must be taken when joining *t_release* and *t_return* using the *proj_id, tag_no* key, as these cases result in a many-to-many relationship.

However, one could resolve this issue by using one of the user-defined fields for a sequential release and return number. Each time an animal is released, the release number is incremented by one (first release = 1). Similarly, each time the animal is recaptured, the return number is also incremented by one. The keys needed to match a tag return with its appropriate release are then: *proj_id*, *tag_no* and release/return number. In practice this sequential release and return number was seldom if ever implemented. Issues with duplicate tag numbers also confound a small number of datasets, and these duplicate tag numbers result in a many-to-many relationship.

This revision of the tag database (Version 2.0) incorporates a new table *t_link*, which records the link or association between the *t_return* and *t_release* tables.
This table includes a *rel_seq* attribute to record the chronological sequence of each release. This table was not back populated when it was created in June 2007 because

experienced interpretation of individual records is required in some cases to generate the correct links.

3.5 Tagging programme requirements and user-defined fields

By in large, the attributes of the main tag tables (*t_release* and *t_return*) are for the main data items that are common for the majority of tagging programmes. However, each programme has certain data fields that are relevant for that specific programme only. Rather than constantly add attributes to these table when the need arises, this database was created with the flexibility of user-defined fields (*rel1* - *rel5* and *rec1* - *rec5* in the *t_release* and *t_return* tables respectively) that will hold any kind of data. Interpretation of these fields will differ between programmes, their usage's are defined in the *t_project* table.

4. Table summaries

The **tag** database has fifteen tables containing tag data. The following is a listing and brief outline of the tables contained in **tag**:

1. **t_meta :** contains dataset meta-data information.
2. **t_project :** contains details and descriptions of individual tagging projects, including definitions of user-defined fields used in the *t_release* and *t_return* tables.
3. **t_release :** contains details of tagged animal releases.
4. **t_return :** contains details of tagged animal returns or recaptures.
5. **t_tag :** contains information of individual tags used or to be used in a tagging program. If a tag is released or returned more than once, then t_tag_status where populated will contain status information for each release and return event.
6. **t_link :** contains interpretations of release and return data.
7. **t_tag_batch :** contains tag batch information, each order is typically treated as a batch.
8. **t_tag_type :** contains descriptions of the different types of tags.
9. **t_status :** contains detailed tag status information.
10. **t_tag_status :** contains detailed tag status information for each release or return for each tag.
11. **t_supplier :** contains information about tag suppliers.
12. **t_tag_photo :** contains locations of tag photos.
13. **t_fish_photo :** contains locations of tagged animal photos.
14. **t_lfreq :** contains length frequency data for some tagging projects.
15. **t_catch :** contains catch data for some tagging projects.

5. tag tables

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

5.1 Table t_meta

Comment: Table to contain data set ownership information, the relationships between t_meta and other tables are not enforced by foreign key, the owner_key values are assigned in data loading process

Attributes	**Data Type**	**Null?**	**Comment**
owner_key	integer	No	Primary key t
owner_name	character(32,1)		Name of the d
project_code	character(16,1)		Project code a
subject	character(32,1)		Any short des
load_date	date(5)		Date when the
load_person	character(32,1)		Person who lo
comments	character(256,1)		Text commen

Creator: dba
Indices PRIMARY KEY BTREE pk_meta ON (owner_key)

5.2 Table t_project

Comment: Table to hold information relating to individual tagging programmes.

Attributes	Data Type	Null?	Comment
proj_id	character(10,1)	No	Primary key to distinguish different tagging programmes
species	character(3,1)	No	The species code for mono-specific tagging programmes, otherwise 'MIX'.
proj_code	character(16,1)		Project code for the initial tagging programme (if available).
contact	character(20,1)	No	The staff member who is the main contact regarding the data.
staff	character(70,1)		Staff members involved with the tagging programme.
date_s	date(5)		Start date of the tagging programme.
date_f	date(5)		Finish date of the tagging programme.
areas	character(25,1)	No	Area codes as found in 'rdb:area_codes'.
objective	text(70,70,200,1)		The goals/objectives of the programme.
publications	text(70,70,200,1)		Lists publications used to plan or describing data from the programme.
rel_condition	text(70,70,200,1)		Description of the usage of the t_release condition field.
rel1	character(70,1)	No	Description of the usage of the t_release.rel1 field. ('not used' if it isn't.)
rel2	character(70,1)	No	As for rel1
rel3	character(70,1)	No	As for rel1.
rel4	character(70,1)	No	As for rel1...
rel5	character(70,1)	No	As for rel1...

rel5	character(70,1)	No	As for rec1...
rec_condition	text(70,70,200,1)	No	Description of the usage of the t_returns condition field.
rec1	character(70,1)	No	Description of the usage of the t_return.rec1 field. ('not used' if it isn't.)
rec2	character(70,1)	No	As for rec1...
rec3	character(70,1)	No	As for rec1...
rec4	character(70,1)	No	As for rec1...
rec5	character(70,1)	No	As for rec1...
rec6	character(70,1)	No	As for rec1...
owner_key	integer	No	Refer to meta record of the dataset
comments	text(70,70,200,1)		Any text comments to be made on the tagging programme.

Creator: dba
Referential: (proj_id) REFERRED t_release (proj_id)
(proj_id) REFERRED t_return (proj_id)
(proj_id) REFERRED t_catch (proj_id)
(proj_id) REFERRED t_lfreq (proj_id)
Indices: PRIMARY KEY BTREE pk_project ON (proj_id)

5.3 Table t_release

Comment: Table to contain information on individual animals released.

Attributes	**Data Type**	**Null?**	**Comment**
release_key	longinteger	No	Primary key to identify a release.
proj_id	character(10,1)	No	Foreign key to refer to a tagging programme.
station_code	character(12,1)		Station (or "release site") identifier, incorporating the trip identifier.
trip_code	character(9,1)		Optional trip code identifier.

vessel	character(25,1)	Name of vessel used to capture the animals for tagging.
staff	character(40,1)	Staff involved in this release.
min_depth	integer	Generally either bottom or gear depth as appropriate.
max_depth	integer	Generally either bottom or gear depth as appropriate.
area	character(4,1)	Area code from rdb:area_codes where release occurred.
lat	decimal(7,3)	Latitude (as DDMM.mmm) where release occurred.
n_s	character(1,1)	Release latitude North or South of equator.
lon	decimal(8,3)	Longitude (as DDDMM.mmm) where release occurred.
e_w	character(1,1)	Release longitude East or West
dlat	decimal(8,6)	Latitude (as decimal degree) where release occurred.
dlon	decimal(9,6)	Longitude east of Greenwich (as decimal degree) where release occurred.
pos_meth	character(2,1)	2 character code for the method of fixing the position. Refer rdb:t_fix_meth_codes.
pos_err	decimal(6,3)	Radius of margin of error of the position (nautical miles)
method	character(2,1)	Method used to capture the animals to be tagged.
species	character(3,1)	3 char species code.
rel_date	date(5)	Date when release occurred.
rel_time	integer	Time of day (24hr) when release occurred.
lgth	decimal(5,1)	Length of animal tagged (cm to 1 decimal)
lgth_meth	character(1,1)	1 character fish length measurement type code. Refer rdb:t_fish_meas_codes
rel_width	decimal(5,2)	Width of animal tagged (cm to 1 decimal)
width_meth	character(1,1)	1 character fish width measurement type code. Refer rdb:t_fish_meas_codes

weight	decimal(7,3)	Weight of animal tagged (may be an estimate) (kg)

Attributes	Data Type	Null?	Comment
sex	character(1,1)		null = not known, 1 = male, 2 = female, 3 = indeterminate or immature, 4 = did not sex.
stage_meth	character(2,1)		2 character code to describe gonad staging method. Refer rdb:t_gon_sys_desc
stage	character(2,1)		Stage of sexual maturity (codes vary by species).
age_flag	character(1,1)		Flag whether aging material was taken.
no_tags	smallint		Number of tags attached to the animal.
condition	character(6,1)		Physical condition of released animal.
rel1	character(20,1)		User defined field, as defined in project table.
rel2	character(40,1)		User defined field, as defined in project table.
rel3	character(10,1)		User defined field, as defined in project table.
rel4	character(10,1)		User defined field, as defined in project table.
rel5	character(10,1)		User defined field, as defined in project table.
rel6	character(40,1)		User defined field, as defined in project table.
owner_key	integer	No	Refer to meta record of the dataset.
comments	text(70,70,200,1)		Any text comments on the release site.

Creator: dba

Referential:
(proj_id) REFER t_project (proj_id)
(species) REFER rdb: species_master (code)
(area) REFER rdb: area_codes (code)
(lgth_meth) REFER rdb: t_fish_meas_codes (fish_meas_code)
(width_meth) REFER rdb: t_fish_meas_codes (fish_meas_code)

	(stage_meth) REFER rdb: t_gon_sys_desc (stage_meth) (release_key) REFERRED t_link (release_key) (release_key) REFERRED t_fish_photo (release_key) (release_key) REFERRED t_tag (release_key)
Indices:	PRIMARY KEY BTREE pk_release ON (release_key) FOREIGN KEY BTREE fk_release_project ON (proj_id) FOREIGN KEY BTREE fk_release_species ON (species) FOREIGN KEY BTREE fk_release_area ON (area) FOREIGN KEY BTREE fk_release_meascodel ON (lgth_meth) FOREIGN KEY BTREE fk_release_meascodew ON (width_meth) FOREIGN KEY BTREE fk_release_gonstage ON (stage_meth)

5.4 Table t_return

Comment: Table to hold information describing recaptured animals or returned tags.

Attributes	Data Type	Null?	Comment
return_key	longinteger	No	Primary key to identify a recapture event.
proj_id	character(10,1)	No	Foreign key to refer to a tagging programme.
station_code	character(12,1)		Station or recapture site identifier, incorporating the trip identifier.
trip_code	character(9,1)		Optional trip code identifier.
vessel	character(30,1)		Name of vessel where the recapture occurred.
rec_date	date(5)		Date the animal was recaptured.
rec_date_err	character(8,1)		Describes the "error" in the assigned rec_date.
rec_time	integer		Time of day (24hr) recapture took place (if known).
depth	integer		Depth of water OR gear where recapture occurred
rec_lgth	decimal(5,1)		Length of animal tagged (cm to 1 decimal).
lgth_meth	character(1,1)		1 character fish length measurement type code. Refer rdb:t_fish_meas_codes.
rec_width	decimal(5,2)		Width of animal tagged (cm to 1 decimal).
width_meth	character(1,1)		1 character fish width measurement type code. Refer rdb:t_fish_meas_codes.
rec_weight	decimal(7,3)		Weight of animal tagged (may be an estimate) (kg).
sex	character(1,1)		null = not known, 1 = male, 2 = female, 3 = indeterminate or immature, 4 = did not sex.
stage_meth	character(2,1)		2 character code to describe gonad staging method. Refer rdb:t_gon_sys_desc.
stage	character(2,1)		Stage of sexual maturity (codes vary by species).

condition	character(6,1)	Physical condition of returned animal.
age_flag	character(1,1)	Flag whether aging material was taken.
no_tags	integer	Number of tags attached to the animal.
method	character(2,1)	Method used to capture the animals to be tagged.
rec_lat	decimal(7,3)	Latitude (as DDMM.mmm) where animal was recaptured.
rec_n_s	character(1,1)	Recapture latitude North or South of Equator.
rec_lon	decimal(8,3)	Longitude (as DDDMM.mmm) where animal was recaptured.
rec_e_w	character(1,1)	Recapture longitude East or West.
dlat	decimal(8,6)	Latitude (as decimal degree) where animal was recaptured.
dlon	decimal(9,6)	Longitude east of Greenwich (as decimal degree) where animal was recaptured.

Attributes	**Data Type**	**Null?**	**Comment**
pos_meth	character(2,1)		2 character code for the method of fixing the position. Refer rdb:t_fix_meth_codes.
pos_err	decimal(3,1)		Radius of margin of error of the position (nautical miles)
area	character(5,1)		Area code from rdb:rdb:area_codes where recapture occurred
rec1	character(15,1)		User defined field as defined in the project table.
rec2	character(15,1)		as for rec1
rec3	character(40,1)		as for rec1
rec4	character(15,1)		as for rec1
rec5	character(10,1)		as for rec1
rec6	character(40,1)		as for rec1
fisher_name	character(60,1)		Name of person who caught/returned the tag

fisher_addr	character(120,1)		Address of person who caught/returned the tag
owner_key	integer	No	Refer to meta record of the dataset
comments	text(70,70,200,1)		Text comment(s) on this return.
comments2	text(70,70,200,1)		Text comment(s) on this return.

Creator: dba

Referential:
(proj_id) REFER t_project (proj_id)
(area) REFER rdb: area_codes (code)
(stage_meth) REFER rdb: t_gon_sys_desc(stage_meth)
(return_key) REFERRED t_link (return_key)
(return_key) REFERRED t_fish_photo (return_key)
(return_key) REFERRED t_tag (return_key)

Indices:
PRIMARY KEY BTREE pk_return ON (return_key)
FOREIGN KEY BTREE fk_return_project ON (proj_id)
FOREIGN KEY BTREE fk_return_area ON (area)
FOREIGN KEY BTREE fk_return_gonstage ON (stage_meth)

5.5 Table t_tag

Comment: Table of information on individual tags used or to be used in tagging program.

Attributes	Data Type	Null?	Comment
tag_key	longinteger	No	Primary key to identify a tag.
tbatch_key	longinteger		Foreign key to refer to a tag batch
tag_type	character(8,1)		Foreign key to refer to a tag type.
tag_no	character(16,1)		Number or code of the tag.
status_code	character(16,1)		Foreign key to refer to tag status.
issue_date	date(5)		Date when the tag is issued.
proj_id	character(10,1)		Code to refer to project record.
release_key	longinteger		Foreign key to refer to the release event in which the tag and fish is released.
return_key	longinteger		Foreign key to refer to the return event in which the tag and fish is collected.
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Text comment(s) on this record.

Creator: dba

Referential:
(tbatch_key) REFER t_tag_batch (tbatch_key)
(tag_type) REFER t_tag_type (tag_type)
(release_key) REFER t_release (release_key)
(return_key) REFER t_return (return_key)
(tag_key) REFERRED t_tag_status (tag_key)

Indices:
PRIMARY KEY BTREE pk_tag ON (tag_key)
FOREIGN KEY BTREE fk_tag_batch ON (tbatch_key)
FOREIGN KEY BTREE fk_tag_type ON (tag_type)
FOREIGN KEY BTREE fk_tag_releas ON (release_key)

FOREIGN KEY BTREE fk_tag_return ON (return_key)
NORMAL (2, 15) BTREE ix_tag_tag_no ON (tag_no)

5.6 Table t_link

Comment: Table to contain interpretations of associated release and return data.

Attributes	Data Type	Null?	Comment
link_key	longinteger	No	Primary key to identify an interpretation record
return_key	longinteger		Foreign key to refer to a recapture event.
release_key	longinteger		Foreign key to refer to a release event.
fish_id	longinteger		An assigned key to identify a fish in a tag programme, combined with version it should be unique through out whole table.
version	smallint		Version control over the interpreted data.
dist	integer		Estimated distance traversed between release and recapture positions. t_project record should record units used, typically kilometers or nautical miles.
dir	character(3,1)		The direction the recaptured animal traveled.
rel_seq	smallint		Number to distinguish sequential release number in multiple release-return situations.
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Text comment(s) on this record

Creator: dba
Referential: (release_key) REFER t_release (release_key)
(return_key) REFER t_return (return_key)
Indices: PRIMARY KEY BTREE pk_link ON (link_key)
FOREIGN KEY BTREE fk_link_release ON (release_key)
FOREIGN KEY BTREE fk_link_return ON (return_key)

5.7 Table t_tag_batch

Comment: Table to contain tag batch information, each order is treated as a batch.

Attributes	Data Type	Null?	Comment
tbatch_key	longinteger	No	Primary key to identify a tag batch.
tag_type	character(8,1)		Foreign key to refer to a tag type.
supplier_key	integer		Foreign key to refer to a tag supplier.
proj_id	character(10,1)		Identifier to link to project table.
order_no	character(32,1)		Order no for purchasing the tag batch.
date_received	date(5)		Date when tag batch is received.
min_no	longinteger		Minimum tag number within the tag batch.
max_no	longinteger		Maximum tag number within the tag batch.
colour	character(16,1)		Tag colour
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Text comment(s) on this record.

Creator: dba

Referential:
(supplier_key) REFER t_supplier (supplier_key)
(tag_type) REFER t_tag_type (tag_type)
(tbatch_key) REFERRED t_tag (tbatch_key)

Indices:
PRIMARY KEY BTREE pk_tag_batch ON (tbatch_key)
FOREIGN KEY BTREE fk_batch_supplier ON (supplier_key)
FOREIGN KEY BTREE fk_batch_type ON (tag_type)

5.8 Table t_tag_type

Comment: Table to identify different types of tags used.

Attributes	Data Type	Null?	Comment

tag_type	character(8,1)	No	Primary key to identify the tag type.
type_desc	text(70,70,200,1)		Descriptive text for the tag type.
legend	character(80,1)		Tag legend.
prefix	character(5,1)		Tag number prefix.
suffix	character(5,1)		Tag number suffix.
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Text comment(s) on this record.

Creator: dba
Referential: (tag_type) REFERRED t_tag_batch (tag_type)
(tag_type) REFERRED t_tag_photo (tag_type)
(tag_type) REFERRED t_tag (tag_type)
Indices: PRIMARY KEY BTREE pk_tag_type ON (tag_type)

5.9 Table t_status

Comment: Table to contain detailed tag status information.

Attributes	Data Type	Null?	Comment
status_code	character(16,1)	No	Primary key to identify status of tags.
status_desc	character(64,1)		Descriptive text about a tag's status.
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Text comment(s) on this record.

Creator: dba
Referential: (status_code) REFERRED t_tag_status (status_code)
Indices: PRIMARY KEY BTREE pk_status ON (status_code)

5.10 Table t_tag_status

Comment: Table to contain detailed tag status information for each release or return.

Attributes	Data Type	Null?	Comment
tag_key	longinteger	No	Part of primary key to identify a tag.
status_code	character(16,1)		No Part of primary key to identify status of tags.
status_date	date(5)		Start date when this status begins.
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Any comments regarding to the status of the tag.

Creator: dba
Referential: (tag_key) REFER t_tag (tag_key)

	(status_code) REFER t_status (status_code)
Indices:	FOREIGN KEY BTREE fk_status_tag ON (tag_key) FOREIGN KEY BTREE fk_tag_status ON (status_code) PRIMARY KEY BTREE pk_tag_status ON (tag_key, status_code)

5.11 Table t_supplier

Comment: Table to contain information about tag suppliers.

Attributes	Data Type	Null?	Comment
supplier_key	integer	No	Primary key to identify a tag supplier.
supplier_name	character(64,1)		Name of the supplier.
supplier_code	character(16,1)		Short name for the supplier.
contact	character(64,1)		Persons to contact.
phone	character(32,1)		Phone number(s).
email	character(64,1)		email address if any.
address	character(64,1)		Postal address.
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Text comment(s)

Creator: dba
Referential: (supplier_key) REFERRED t_tag_batch (supplier_key)
Indices: PRIMARY KEY BTREE pk_supplier ON (supplier_key)

5.12 Table t_tag_photo

Comment: Table to contain locations of tag photos.

Attributes	Data Type	Null?	Comment
tphoto_key	longinteger	No	Primary key to identify a tag photo.
tag_type	character(8,1)		Primary key to identify the tag type.

photo_path	character(128,1)		Directory path where the photo file is located.
photo_name	character(32,1)		The photo file name.
owner_key	integer	No	Refer to meta record of the dataset

Creator: dba
Referential: (tag_type) REFER t_tag_type (tag_type)
Indices: PRIMARY KEY BTREE pk_tag_photo ON (tphoto_key)
FOREIGN KEY BTREE fk_photo_tag ON (tag_type)

5.13 Table t_fish_photo

Comment: Table to contain locations of tagged animal photos.

Attributes	**Data Type**	**Null?**	**Comment**
fphoto_key	longinteger	No	Primary key to identify a fish photo.
release_key	longinteger		Foreign key to refer to a release event.
return_key	longinteger		Foreign key to refer to a recapture event.
photo_path	character(100,1)		Directory path w
photo_name	character(32,1)		Photo file name.
owner_key	integer	No	Refer to meta record of the dataset.
comments	character(256,1)		Comments on th

Creator: dba
Referential: (release_key) REFER t_release (release_key)
(return_key) REFER t_return (return_key)
Indices: PRIMARY KEY BTREE pk_fish_photo ON (fphoto_key)
FOREIGN KEY BTREE fk_photo_release ON (release_key)
FOREIGN KEY BTREE fk_photo_return ON (return_key)

5.14 Table t_lfreq

Comment: Table to store length frequency data collected during a tagging programme.

Attributes	Data Type	Null?	Comment
lfreq_key	longinteger	No	Primary key to identify a length frequency record.
proj_id	character(10,1)	No	Foreign key to refer to a tagging programme.
station_code	character(12,1)	No	Identifier to link to releases table.
species	character(3,1)	No	Valid 3 letter species code.
meas_meth	integer		Code describing the method used to derive the length of the animal.
lgth	decimal(4,1)	No	Length in cm (to 1 mm as decimal if required).
no_m	integer		No of males at this length.
no_f	integer		No of females at this length.
no_t	integer	No	Total of males, females & unsexed animals at this length.
owner_key	integer	No	Refer to meta record of the dataset.

Creator: dba
Referential: (proj_id) REFER t_project (proj_id)
(species) REFER rdb: species_master (code)
Indices: PRIMARY KEY BTREE pk_lfreq ON (lfreq_key)
FOREIGN KEY BTREE fk_lfreq_project ON (proj_id)
FOREIGN KEY BTREE fk_lfreq_species ON (species)
UNIQUE BTREE lfreq_uniq_ndx ON (proj_id, station_code, species, lgth)

5.15 Table t_catch

Comment: Table to store catch data from tagging stations.

Attributes	Data Type	Null?	Comment
catch_key	longinteger	No	Primary key to identify a catch record.
proj_id	character(10,1)	No	Foreign key to refer to a tagging programme.
station_code	character(20,1)	No	Identifier to link to releases table.
ctch_date	date(5		Date of catch.
area	character(4,1)		Area code from rdb:area_codes where catch made.
method	character(2,1)		Method code from rdb:meth_codes used to for catch.
species	character(3,1)	No	Valid 3 letter species code.
weight	decimal(6,1)		Weight in kg.
samp_wt	decimal(6,1)		Weight of sample used for tagging release or return.
tag_link	character(8,1)	No	Flag to mark if catch relates to tag releases or returns.
owner_key	integer	No	Refer to meta record of the dataset.
comments	text(70,70,200,1)		Catch comments

Creator: dba
Referential: (proj_id) REFER t_project (proj_id)
(species) REFER rdb: species_master (code)
(area) REFER rdb: area_codes (code)
Indices: PRIMARY KEY BTREE pk_catch ON (catch_key)

FOREIGN KEY BTREE fk_catch_projec
ON (proj_id)
FOREIGN KEY BTREE
fk_catch_species ON (species)
FOREIGN KEY BTREE fk_catch_area
ON (area)
UNIQUE BTREE catch_uniq_ndx ON
(proj_id, station_code, species)

6. Tag Business Rules

6.1 Introduction to business rules

The following are a list of business rules pertaining to the **tag** database (see Section 2.2 “Data loading and Validation”). A business rule is a written statement specifying what the information system (i.e., any system that is designed to handle tag 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. Formula and validation rules are implemented by referential constraints, range checks, and algorithms both in the database and during data validation.

Because of the generalised nature of the tag database schema, business rules can not be defined for data in the user-defined fields. For such fields, business rules are often specified in the definition fields in the *t_project* table.

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.

A data range rule on an attribute only applies when the attribute is not null.

6.2 Summary of rules

t_meta

owner_key	Must be unique within the tag database.
owner_name	Should be a valid name of an organization or person.
project_code	refer to t_project.proj_code.
load_date	Must be a legitimate date

t_project

proj_id	Must be unique within the tag database.
proj_code	Project code should be a valid code within the NIWA and/or MFish project management system.
species	Must be a valid species code as listed in the *species_master* table in the **rdb** database.
date_s	Must be a legitimate date.
date_f	Must be a legitimate date. Multiple column checks on date: The start date should not be later than the finish date.
areas	Each of the listed area codes must be a valid code as listed in the area_codes table in the rdb database.
rel1 - rel5 **rec1 - rec5**	Must be used to describe what values are being stored in the user-defined fields in the t_release and t_return tables respectively. Default value - “not used”.
owner_key	Must be a valid integer value listed in t_meta table.

t_release

release_key	Must be unique within the tag database.
proj_id	Must be a valid proj_id listed in t_project table.
min_depth	Must be a number greater than 0.
max_depth	Must be a number greater than 0. Multiple column checks on depth: The minimum depth should be less than or equal to the maximum depth.
area	Must be a valid area code as listed in the area_code table in the rdb database.
lat	Must be a valid latitude ranging from 0 to 90.
n_s	Must be equal to either an “N” or a “S” if not null, and should not be Null if lat is not null.
lon	Must be a valid longitude ranging from 0 to 180.
e_w	Must be equal to either an “E” or a “W” if not null, and should not be Null if lon is not null.

dlat	Must be a valid latitude ranging from 90 to -90 degrees.
dlon	Must be a valid longitude ranging from 0 to 360 degrees.
	Multiple column checks on lat, n_s, lon, E_W, dlat, dlon, area:
	The latitude and longitude should be within the area recorded.
method	Must be a valid gear method code as listed in the meth_codes table in the rdb database.
species	Must be a valid species code as listed in the species_master table in the rdb database.
rel_date	Must be a valid date.
rel_time	Must be a valid 24 hour time ranging 0 to 2359.
lgth	Must be a number greater than 0, and should be less than the maximum recorded length for the species as recorded in the curr_spp table in the rdb database.
lgth_meth	Must be a valid fish measurement code as listed in the t_fish_meas_codes table in the rdb database.
rel_width	Must be a number greater than 0.
width_meth	Must be a valid fish measurement code as listed in the t_fish_meas_codes table in the rdb database.
weight	Must be a number greater than 0.
sex	Sex code. Must be a valid sex code as listed in the t_sex_codes table in the rdb database.
stage_meth	Must be a valid gonad staging system as listed in the t_gon_sys_desc table in the rdb database.
stage	Gonad (or life cycle) stage. Must be a valid code as listed in the t_gon_stg_meth table in the rdb database.
rel1 - rel5	User defined fields. Descriptions of the fields usage must be listed in the t_project table.
owner_key	Must be a valid integer value listed in t_meta table.

t_return

return_key	Must be unique within the tag database.
proj_id	Must be a valid proj_id listed in t_project table.
rec_date	Must be a valid date and should be on or after the initial release of the tagged animal.
rec_time	Must be a valid 24 hour time ranging 0 to 2359.
depth	Must be a number greater than 0.
rec_lgth	Must be a number greater than 0, and should be less than the maximum recorded length for the species as recorded in the curr_spp table in the rdb database.
lgth_meth	Must be a valid fish measurement code as listed in the t_fish_meas_codes table in the rdb database.
rec_width	Must be a number greater than 0.
width_meth	Must be a valid fish measurement code as listed in the t_fish_meas_codes table in the rdb database.

rec_weight	Must be a number greater than 0.
sex	Must be a valid sex code as listed in the t_sex_codes table in the rdb database.
stage_meth	Must be a valid gonad staging system as listed in the t_gon_sys_desc table in the rdb database.
stage	Gonad (or life cycle) stage. Must be a valid code as listed in the t_gon_stg_meth table in the rdb database.
method	Must be a valid gear method code as listed in the meth_codes table in the rdb database.
rec_lat	Must be a valid latitude ranging from 0 to 90.
rec_n_s	Must be equal to either “N” or “S”.
rec_lon	Must be a valid longitude ranging from 0 to 180.
rec_e_w	Must be equal to either an “E” or a “W”.
dlat	Must be a valid latitude ranging from 90 to -90 degrees.
dlon	Must be a valid longitude ranging from 0 to 360 degrees.
area	Must be a valid area code as listed in the *area_codes* table in the **rdb** database. **Multiple column checks on rec_lat, N_S, rec_lon, E_W, dlat, dlon, area:** **The latitude and longitude should be within the area recorded.**
pos_meth	Must be a valid position fixing method code as listed the t_fix_meth_codes table of the rdb database.
rec1 - rec5	User defined fields. Descriptions of the fields usage must be listed in the *t_project* table.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_tag

tag_key	Must be unique within the tag database.
tbatch_key	Must be a valid integer value listed in *t_tag_batch* table.
tag_type	Must be a valid type code listed in *t_tag_type* table.
status_code	Must be a valid status code listed in *t_status* table.
issue_date	Must be a valid date.
proj_id	Must be a valid proj_id listed in *t_project* table.
release_key	Must be a valid integer value listed in *t_release* table.
return_key	Must be a valid integer value listed in *t_return* table.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_link

link_key	Must be unique within the tag database.
return_key	Must be a valid integer value listed in *t_return* table.
release_key	Must be a valid integer value listed in *t_release* table.
dist	Distance must be a number greater than 0.

dir	Should be a valid compass direction involving the characters “N”, “E”, “S”, and “W”; e.g. “ENE”, or an integer representing a valid direction in degrees from 0 to 359.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_tag_batch

tbatch_key	Must be unique within the tag database.
tag_type	Must be a valid type code listed in *t_tag_type* table.
supplier_key	Must be a valid integer value listed in *t_supplier* table.
proj_id	Must be a valid proj_id listed in *t_project* table.
date_received	Must be a legitimate date.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_tag_type

tag_type	Must be unique within the tag database.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_status

status_code	Must be unique within the tag database.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_tag_status

tag_key	Must be a valid integer value listed in *t_tag* table.
status_code	Must be a valid status code listed in *t_status* table, the combination of tag_key and status_code must be unique.
status_date	Must be a legitimate date.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_supplier

supplier_key	Must be unique within the tag database.
email	Should contain a valid email address.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_tag_photo

tphoto_key	Must be unique within the tag database.
tag_type	Must be a valid type code listed in *t_tag_type* table.

owner_key	Must be a valid integer value listed in *t_meta* table.

t_fish_photo

fphoto_key	Must be unique within the tag database.
release_key	Must be a valid integer value listed in *t_release* table.
return_key	Must be a valid integer value listed in *t_return* table.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_lfreq

lfreq_key	Must be unique within the tag database.
proj_id	Must be a valid proj_id listed in *t_project* table.
station_code	Should be a station code that has been used in either the *t_release* or the *t_return* table.
species	Must be a valid species code as listed in the *species_master* table in the **rdb** database.
meas_meth	Must be a valid fish (animal) measurement method code as listed in the *meas_meth* table in the **rdb** database.
lgth	Must be a number greater than 0.
no_m	Must be a number greater than or equal to 0.
no_f	Must be a number greater than or equal to 0.
no_t	Must be a number greater than 0. **Multiple column check on no_m, no_f and no_t.** The number in *no_t* should be equal to or greater than the sum of *no_m* and *no_f*.
owner_key	Must be a valid integer value listed in *t_meta* table.

t_catch

catch_key	Must be unique within the tag database.
proj_id	Must be a valid proj_id listed in *t_project* table.
station_code	Should be a station code that has been used in either the *t_release* or the *t_return* table.
species	Must be a valid species code as listed in the *species_master* table in the **rdb** database.
weight	Must be a number greater than 0.
samp_wt	Must be a number greater than 0, and less than or equal to *weight*.
tag_link	Must be equal to either “release” or “return”.
owner_key	Must be a valid integer value listed in *t_meta* table.

7 Acknowledgements

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8 References

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Appendix 1 – Reference code tables

Codes for attributes lgth_meth and width_meth from rdb:t_fish_meas_codes

fish_meas_code	description
1	Fork Length
2	Total Length
3	Standard Length
4	Mantle Length (squid)
5	Pelvic Length (rays)
6	Carapace Width
7	Shell Height
8	Shell Length
B	Carapace Length - Orbit to Carapace notch (scampi)
G	Tip of snout to posterior end of dorsal fin (Ghost sharks)
E	Eye to Fork Length (billfish)
J	Lower Jaw to Fork Length (billfish)
O	Orb Length - length across the eye (billfish)
C	Carapace Length - Base of antennal platform to posterior margin
W	Tail Width - as legally defined for red rock lobsters
L	Tail Length - as legally defined for red rock lobsters

stage_meth codes and associated *stage* codes from rdb: t_gon_stg_meth

stage_meth	stage	description
CF	MM	Males
CF	BF	Berried female
CF	IF	Immature female
CF	MF	Mature female, setae greater than 6mm
CF	SC	Scattered - spent female
CF	UF	Unidentified stage female
RL	0	Hermaphrodite or indeterminate
RL	1	Male
RL	2	Immature female
RL	3	Mature female, setae greater then 6mm
RL	4	Berried female, no eyes on berry
RL	5	Berried female, eyes in berry visible
RL	6	Spent female, with infertile/unhatched eggs visible
RL	7	Spent female, no eggs visible
RL	9	Female, maturity not determined

Codes for attribute *pos_meth* from rdb:t_fix_meth_codes

fix_meth_code	description
01	Radar
02	Dead reckoning
03	Astrofix
04	Transect marks
05	Radio (RDF)
06	Radar and RDF
07	SatNav
08	Global Positioning Satelite (GPS)
09	Local knowledge
10	GPX