Database Documentation: iki

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1 Introduction to the Database Document series

The National Institute of Water and Atmosphere Research (NIWA) currently carries out the role of Data Manager and Custodian for the fisheries research data owned by the Ministry of Fisheries.

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 agencies for the Ministry of Fisheries.

This document is a brief introduction to the longline sampling database **iki**, and is part of the database documentation series produced by NIWA.

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 the how all the tables are linked together and their relationship to other databases.

This document is intended as a guide for users and administrators of the **iki** database.

Access to this database is restricted to specific nominated personnel as specified in the current Schedule 6 of the 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 Longline Sampling Programme

The **iki** database was initially designed for the data collected by the longline sampling programme targeting snapper (*Pagrus auratus*) for the "iki jume" market. The measuring takes place on board vessels, and is representative of that portion of the catch that is caught. Initial data loaded into the **iki** database, were collected by technical staff engaged by NIWA Auckland, for the period from December 1997 to September 1998. This initial data loaded were collected on snapper caught by the iki longline fishery. However, the use of the **iki** database is not restricted to the iki snapper longline fishery.

Subsequent data loaded into this database have included catch sampling data from the snapper target fishery using longlines, trawls, and danish seines.

The nucleus of the **iki** database is a unit of effort and its associated catch, where a unit of effort is a longline set, one trawl, or one danish seine. Each unit of effort is allocated an effort number, commencing from one on the first unit of effort of the trip; each subsequent unit of effort follows sequentially.

From each unit of effort, the associated catch information is recorded for each fish caught as it is landed. For the initial sampling programme, these data are recorded on a page-by-page basis, with a maximum of 60 fish per page. Each page of a sets "LONGLINE FISH CHARACTERISATION

RECORD" data, acts as a sampling sub-unit, covering the time period taken to haul the section of the line on board and the sampling of the fish from that section of the line. This is to allow analysis of the fish characteristics, (a record of the status of the fish and various condition data), according to the time elapsed since set hauling commenced.

Biological data other than length were not collected for the initial data loaded. Due to the nature of the snapper iki fishery, cutting of fish is not possible; hence there is no requirement to collect sex data from that fishery. The form and database allow for sex to be recorded and is included to allow for the contingency of sexing fish should it be needed.

The highest economic value of snapper is obtained when fish are landed alive and killed by the "iki jume" method. Snapper boated dead suffer a rapid decrease in flesh quality, making them unsuitable for the export market. Reducing incidental mortality in larger size classes may therefore increase overall catch value. In longline fishing, lip-hooked snapper are generally landed alive, whereas fish ingest the hook ('gut-hook') are more likely to die as a result of damage to the gills or viscera. Trials have indicated that the incidence of gut-hooking in longline-caught snapper can be substantially reduced by using hooks modified by the addition of a wire appendage. Trials with modified hooks of varying sizes and with a variety of baits were conducted in the Hauraki Gulf in 1999, and there results of this experiment were stored into the **iki** database.

3 Data Structures

3.1 Table relationships

This database encompasses four tables. The ERD for **iki** (Figure 1) shows the logical structure[1] of the database and its entities (each entity is implemented as a database *table)* and relationships between these tables and tables in other databases. 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.

Note that Figure 1 shows the main tables only. All of the tables in the **iki** database have some attributes, called foreign keys[3], which contain standard NIWA fisheries codes, such as *species* and *gear_meth*. These attributes provide links to the **rdb** (research database) database, which contains the definitive list of standard codes. External databases such as **rdb,** are shown in the ERD (Figure 1), inside a box of dashed lines.

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

```
Indices:    UNIQUE index_name ON (attribute[, attribute])
```

[1] Also known as a database *schema.*
[2] A primary key is an attribute or a combination of attributes that contains an unique 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.

where attribute(s) make up the primary key (the key attributes) and the index name is the primary key name. Note that the typographical convention for the above format is that square brackets [] may contain more than one item or none at all. These prevent records with duplicate keys from being inserted into the tables; e.g., a trip record with an existing trip number.

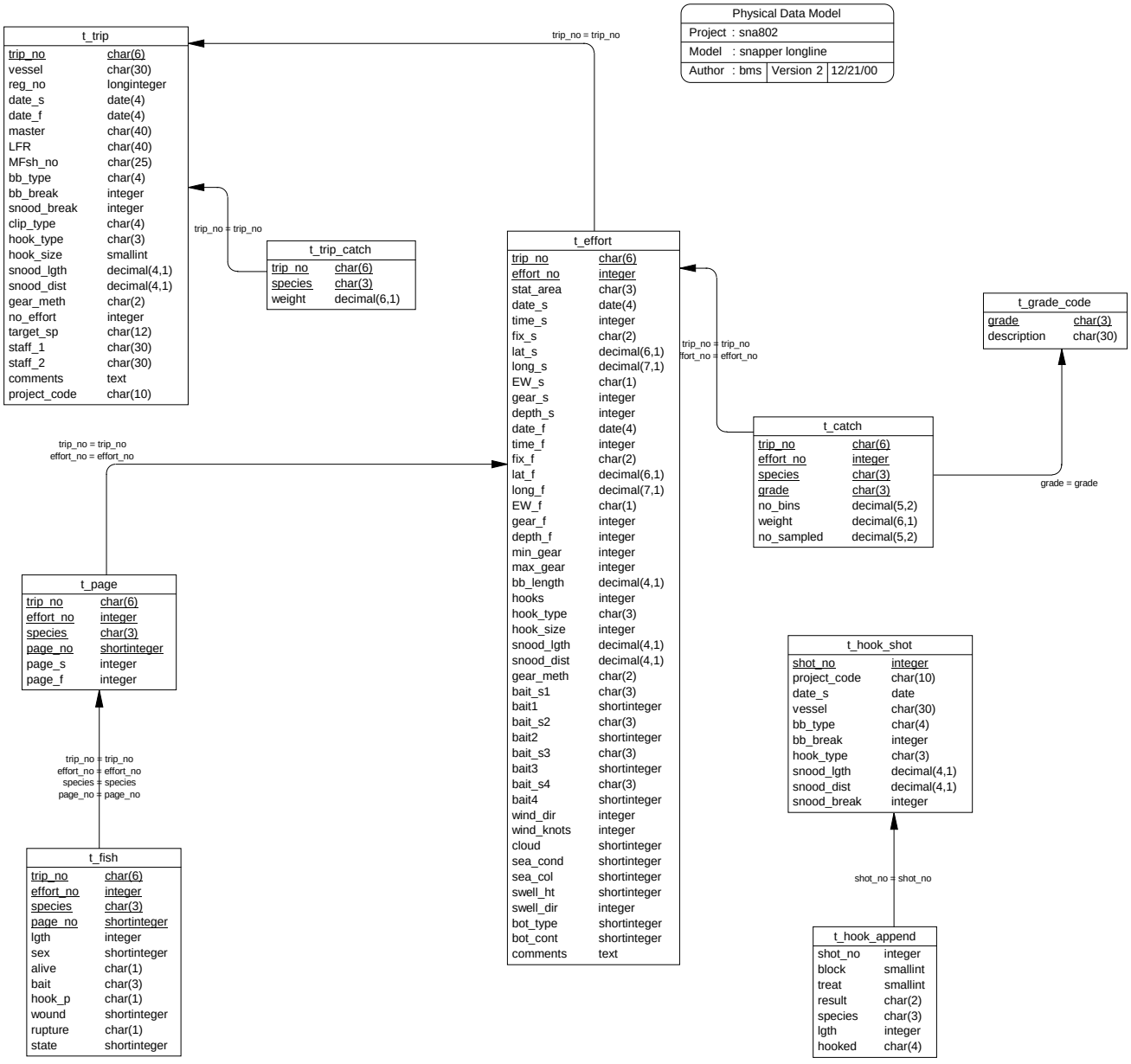

Figure 1: Entity Relationship Diagram (ERD) of the iki database.

The **iki** database is implemented as a relational database. That is, tables are linked to one another by their relationships. There is only one type of relationship between the tables in **iki**, and that is one-to-many[4]. This is shown in the ERD by connecting a single line (indicating 'many') from the child table (e.g., *t_page*) to the parent table (e.g., *t_set)* 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 at least once, while an optional relationship might not occur at all. For example, in Figure 1, consider that relationship between the table *t_page* and it's child table *t_fish.* The symbol 'o' by the child *t_fish* means that *t_fish* can have zero or many records, while the bar by the parent *t_page* means that for every fish record there must be a matching page record.

These links are enforced in the database by the use of referential constraints[5]. 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 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:      constraint name (attribute[, attribute]) |INSERT|
                                                          |DELETE|
                  parent table (attribute[, attribute])
```

Note that the typographical convention for the above format is that square brackets "[ ]" may contain more than one item or none at all. Items stacked between vertical lines | | are options of which one must be chosen.

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

```
Referential:      t_fish (species) INSERT rdb : curr_spp (code)
```

This means that the value of the attribute *species* in the current record must already exist in the parent table *curr_spp* of the **rdb** database or the record will be rejected and the following message will be displayed:

```
*** User Error: insert constraint "invalid species" violation
```

The database listing (Tables 1-4) show that the tables also have indices on many of their attributes. That is, attributes that are most likely to be used as a searching key have like values linked together so as to speed up searches. These indices as listed using the following format:

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

[4] A one-to-many relationship is where one record (the *parent*) in a table relates to one or many records (the *child*) in another table; e.g., one page in *t_page* can have many fish in *t_fish* but one fish can only come from one page.
[5] Also known as integrity checks.

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 to index storage.

3.2 Database design

The main table is *t_trip* (Table 1). This holds information for each trip made by a vessel. Each record is identified by a trip code, represented by the attribute *trip_no*, which is the primary key for this table. The *trip_no* was initially defined as a unique integer that was incremented for each subsequent trip. However, the advent of simultaneous catch sampling programmes in different areas led to the prefixing of a 4-character area code to some trip numbers in order to maintain the uniqueness of the attribute. Another attribute in this table, *gear_meth* uses the NIWA fisheries standard code, and therefore has a referential to the **rdb** database. This code can be inserted into this table if and only if it exists in the **rdb** table *meth_codes*.

There are five attributes in the *t_trip* table that are default values for the station record, including the gear method, hook type and size code, and snood length and distance code fields. With the exception of gear method, these codes are specific to the longline fishery, the **iki database**'s initial requirement. The inclusion of other fishing method types associated with the snapper fishery into **longline** has made these defaults irrelevant for many records.

One of the changes brought about by the inclusion of other snapper fishing methods is the requirement to recorded the landed catch weight of not just snapper, but any other bycatch species as well. The recording of bycatch landed weights was not a requirement for these initial catch sampling programmes, never the less, they were recorded in many cases and have been stored in the *t_trip_catch* table (Table 2).

In order to catch snapper, each fishing effort has the expended some effort, specifically: set some longlines, shoot some trawls, or deploy some seines. The information for each unit of effort (one longline, one trawl, or one danish seine) is held in *t_effort* (Table 3) with primary key of *trip_no* and *effort_no*, where *effort_no* is a sequential number assigned to each subsequent unit of effort.

The time frame of hauling the longline and recording the catch is recorded by page, (maximum of 60 fish per page). A start time and end time, are entered at the top of each page, these two times are stored in the table, *t_page* (Table 4). The primary key to this table is *trip_no*, *set_no*, species, and *page_no*. For those catch sampling programmes where page numbers are irrelevant, a default page number of 1 is used.

From each unit of effort, the fish caught are measured and details of the fish status, which may include alive state, hook position, wounding, external rupture and baratrauma state. The bait species is recorded in the *bait* attribute, where attainable, however with mixed baits used for the same set, it is often not possible to ascertain the bait by fish caught. These measurements generate records, which are stored in the table *t_fish* (Table 5). All individual fish are recorded, so each fish has one record in *t_fish*. Length may be null, for instance where there is a wounding from a predator, the fish may be incomplete.

Note, the table *t_fish* may have more than one fish of the same length, with the entire same fish characteristics recorded, within the same data set. Therefore the table *t_fish* is an exception to the standard NIWA table, as it does not have any primary key; i.e., duplicate records are valid within the *t_fish* table.

A feature that is unique within the snapper fishery is the quality grading of whole fish for the "iki jime" market. The snapper catch is therefore separated based on this grading. The total number of bins and the number of bins sampled of each grade of species for each unit of effort is recorded in the *t_catch* table (Table 6). Actual weights are not recorded due to the lack of suitable scales onboard the vessels. Weights can be estimated by multiplying the number of bins (*no_bins*) by the average bin weight (*bin_wgt*). The codes used for the quality grading are recorded in the table *t_grade_code* (Table 7).

Experiments have been carried out on he effects of longline hook appendages on incidental mortality and catch rates of snapper. These experiments consisted of a variety of shots of longlines with blocks of 50 hooks, with each block having a different treatment such as hook size and bait type. Details of each of the shots are recorded in the table *t_hook_shot* (Table 8), including the date of the shot and the parameters of the longline used such as backbone type and breaking strain, hook type, and snood length and distance.

The results of each hook set in the longline shot are recorded in the table *t_hook_append* (Table 9). Each hook is recorded as being part of a block of fifty that received the same treatment. Hooks are recorded as being empty, still baited, or successful in catching a fish. If a fish is caught, the species, fish length, fish condition and position of the hook is recorded.

4 Table Summaries

This database is broken down into a set of nine tables. The following is a listing of these tables contained in the **iki** database:

1. **t_trip** : contains relevant information for a fishing trip from which fish where sampled.
2. **t_trip_catch** : contains details of the total catch for a species for the entire catch.
3. **t_effort** : contains the effort details from the unit of effort sampled; i.e., details for each longline set, trawl, or danish seine.
4. **t_page** : stores the time frame that covers the sampling, of fish for that page number of the "LONGLINE FISH CHARACTERISATION RECORD" form.
5. **t_fish** : contains details of each fish caught; includes the length and information on the status of the fish such as alive, hook position, other wounding.
6. **t_catch** : contains details of catches of species for an unit of effort, including quality grade and greenweight.
7. **t_grade_code** : lists the codes and their descriptions for quality grades of fish. Used primarily for the snapper iki fishery where fish are grade on quality upon catching
8. **t_hook_shot** : contains details about the shots of longline sets used during the SNA9802 hook appendage experiment.
9. **t_hook_append** : contains details about experiments to determine the effects of longline hook appendages on incidental mortality and catch rates of snapper. Details recorded include the results for every hook used and every fish caught.

5 iki Tables

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

5.1 Table 1: t_trip

Comment: Details about a longline fishing trip.

Attribute	Data Type	Null?	Comment
trip_no	character(6,1)	No	Trip number. A unique sequential integer, which maybe prefixed by a 4-character area code for regional-specific sampling programmes.
vessel	character(30,1)		Vessel name.
reg_no	longinteger		Registration number.
date_s	date(4)		Trip start date.
date_f	date(4)		Trip end date.
master	character(40,1)		Master’s name.
LFR	character(40,1)		Licensed Fish Receiver; i.e., company name of for whom the vessel fished for.
MFish_no	character(25,1)		Number of matching MFish TCEPR/CELR form.
bb_type	character(4,1)		Longline backbone type.
bb_break	integer		Longline backbone breaking strain.
snood_break	integer		Snood line breaking strain.
clip_type	character(4,1)		Clip type.
hook_type	character(3,1)		Hook type default.
hook_size	smallint		Hook size default.
snood_lgth	decimal(4,1)		Snood length default (m).
snood_dist	decimal(4,1)		Snood distance default (m).
gear_meth	character(2,1)		Default gear method code. Refer rdb:meth_codes.
no_effort	integer		Total number of effort during the trip (e.g., sets, trawls, seines).

t_trip (cont…)

Attribute	Data Type	Null?	Comment
target_sp	character(12,1) smatch “[A-Z,]”		Comma-separated list of target species codes. For individual species codes, refer rdb:curr_spp.
staff_1	character(30,1)		Staff names.
staff_2	character(30,1)		Staff names 2.
comments	text(20,20,20,1)		Comments.
project_code	character(6,1)		Project code.

Creator: sma
Referential: Invalid gear method code (gear_meth) INSERT rdb : meth_codes (code)
Indices: UNIQUE t_trip_PK ON (trip_no)

5.2 Table 2: t_trip_catch

Comment: Details of the total catch by species for the trip.

Attribute	Data Type	Null?	Comment
trip_no	character(6,1)	No	Unique code identifying each trip. Refer t_trip.
species	character(3,1)	No	3-character species code. Refer rdb:curr_spp.
weight	decimal(6,1)		Landed weight (kg) of species for the entire trip.

Creator: dba
Referential: No such trip number (trip_no) INSERT t_trip (trip_no)
Invalid species code (species) INSERT rdb : curr_spp (code)
Indices: UNIQUE BTREE t_trip_catch_pk ON (trip_no, species)

5.3 Table 3: t_effort

Comment: Details about an individual unit of effort; e.g., one longline set, trawl, or danish seine.

Attribute	Data Type	Null?	Comment
trip_no	character(6,1)	No	Unique code identifying each trip. Refer t_trip.
effort_no	integer	No	Sequential number for each unit of effort deployed (e.g., set, trawl, seine) deployed during a trip.
stat_area	character(3,1)		3-character Statistical area code. Refer rdb:area_codes.
date_s	date(4)		Start date of the unit of effort.
time_s	integer		Start time (24 hour, NZDT) of the unit of effort.
fix_s	character(2,1)		2-character code for the method of fixing the position at start of the unit of effort. Refer rdb:t_fix_meth_codes.
lat_s	decimal(6,1)		Latitude at start of the unit of effort in DDMM.m format. For example, 43 degrees 34.5 minutes is stored as 3434.5
long_s	decimal(7,1)		Longitude at start of the unit of effort in DDDMM.m format. For example, 174 degrees 58.6 minutes is stored as 17458.6
EW_s	character(1,1) smatch “[EW]”		East or West meridian at the start of the unit of effort.
gear_s	integer		Gear depth (m) at the start of the unit of effort.
depth_s	integer		Seabed depth (m) at the start of the unit of effort.
date_f	date(4)		End date of the unit of effort.
time_f	integer		End time (24 hour, NZDT) of the unit of effort.
fix_f	character(2,1)		2-character code for the method of fixing the position at finish of the unit of effort. Refer rdb:t_fix_meth_codes.
lat_f	decimal(6,1)		Latitude at end of the unit of effort in DDMM.m format. For example, 43 degrees 34.5 minutes is stored as 3434.5

t_effort (cont…)

Attribute	Data Type	Null?	Comment
long_f	decimal(7,1)		Longitude at end of the unit of effort in DDDMM.m format. For example, 174 degrees 58.6 minutes is stored as 17458.6
EW_f	character(1,1) smatch “[EW]”		East or West meridian at the finish of the unit of effort.
gear_f	integer		Gear depth (m) at the finish of the unit of effort.
depth_f	integer		Seabed depth (m) at finish of the unit of effort.
min_gear	integer		Minimum depth of fishing gear (m).
max_gear	integer		Maximum depth of fishing gear (m).
bb_length	decimal(4,1)		Total length of the longline backbone (nautical miles)
hooks	integer		Total number of hooks on the longline.
hook_type	character(3,1)		Hook type code.
hook_size	integer		Hook size.
snood_lgth	decimal(4,1)		Snood length (m).
snood_dist	decimal(4,1)		Snood distance (m).
gear_meth	character(2,1)		Gear method code. Refer to rdb:meth_codes.
bait_s1	character(3,1)		Bait species code 1. Refer rdb:curr_spp.
bait1	smallint range 0.00 to 100.00		Bait type 1, percentage of bait used
bait_s2	character(3,1)		Bait species code 2. Refer rdb:curr_spp.
bait2	smallint range 0.00 to 100.00		Bait type 2, percentage of bait used
bait_s3	character(3,1)		Bait species code 3. Refer rdb:curr_spp.
bait3	smallint range 0.00 to 100.00		Bait type 3, percentage of bait used
bait_s4	character(3,1)		Bait species code 4. Refer rdb:curr_spp.

t_effort (cont…)

Attribute	Data Type	Null?	Comment
bait4	smallint range 0.00 to 100.00		Bait type 4, percentage of bait used
wind_dir	integer		Wind direction (degrees true).
wind_knots	integer		Wind speed (knots).
cloud	smallint range 0 to 8		Cloud cover code (eighths).
sea_cond	smallint		Sea condition code (Beaufort scale).
sea_col	smallint		Sea colour code.
swell_ht	smallint		Swell height code.
swell_dir	integer		Swell direction (degrees true).
bot_type	smallint		Bottom type code.
bot_cont	smallint		Bottom contour code.
comments	text(20,20,20,1)		Comments

Creator: sma

Referential:
No such trip number (trip_no) INSERT t_trip (trip_no)
Invalid bait_s1 code (bait_s1) INSERT rdb : curr_spp (code)
Invalid bait_s2 code (bait_s2) INSERT rdb : curr_spp (code)
Invalid bait_s3 code (bait_s3) INSERT rdb : curr_spp (code)
Invalid bait_s4 code (bait_s4) INSERT rdb : curr_spp (code)
Invalid fix_s code (fix_s) INSERT rdb.: t_fix_meth_codes (fix_meth_code)
Invalid fix_f code (fix_f) INSERT rdb : t_fix_meth_codes (fix_meth_code)
Invalid gear method code (gear_meth) INSERT rdb : meth_codes (code)

Indices:
NORMAL (2, 15) datesindex ON (date_s)
NORMAL (2, 15) datefindex ON (date_f)
NORMAL (2, 15) gearsindex ON (gear_s)
NORMAL (2, 15) gearfindex ON (gear_f)
NORMAL (2, 15) depthsindex ON (depth_s)
NORMAL (2, 15) depthfindex ON (depth_f)
NORMAL (2, 15) mingearindex ON (min_gear)
NORMAL (2, 15) maxgearindex ON (max_gear)
UNIQUE t_set_PK ON (trip_no, effort_no)

5.4 Table 4: t_page

Comment: Header information from a page of fish measurements. Used when fish detail data for a unit of effort is recorded on more than one page. Default page number is 1.

Attribute	Data Type	Null?	Comment
trip_no	character(6,1)	No	Unique code identifying each trip. Refer t_trip.
effort_no	integer	No	Sequential number for each unit of effort deployed (e.g., set, trawl, seine) deployed during a trip.
species	character(3,1)	No	3-character species code. Refer rdb:curr_spp.
page_no	smallint	No	Page number of the recorded fish detail data for one unit of effort in a trip. Default page number is 1.
page_s	integer		Start time of recording the page.
page_f	integer		End time of recording the page.

Creator: sma
Referential: No such trip and effort number (trip_no, effort_no) INSERT t_effort (trip_no, effort_no)
Invalid species code (species) INSERT rdb : curr_spp (code)
Indices: UNIQUE t_page_PK ON (trip_no, effort_no, page_no)

5.5 Table 5: t_fish

Comment: Individual fish measurements.

Attribute	Data Type	Null?	Comment
trip_no	character(6,1)	No	Unique code identifying each trip. Refer t_trip.
effort_no	integer	No	Sequential number for each unit of effort deployed (e.g., set, trawl, seine) deployed during a trip.
species	character(3,1)	No	3-character species code. Refer rdb:curr_spp.
page_no	smallint	No	Page number of fish characterisation for the set.
lgth	integer		Length (cm) of fish.
sex	smallint		Sex code for the fish (sex not taken for iki fishery).
alive	character(1,1) smatch “[MNY]”		Alive on landing status code: Y=yes, N=no, M=moribund.
bait	character(3,1)		3-character bait type code. Refer rdb:curr_spp.
hook_p	character(1,1) smatch “[FGL]”		Hook position code: L=lip, G=Gut, F=Foul.
wound	smallint range 1 to 4		Other wounding: 1=none, 2=gear, 3=predator, 4=bleeding or lesions, source unknown.
rupture	character(1,1) smatch “[YN]”		External rupture flag: Y=Yes, N=No.
state	smallint range 1 to 4		Baratrauma state code: 1=not distended 2=air in body, 3=gut protrusion, 4=extreme.

Creator: sma
Referential: No such trip, effort and page number (trip_no, effort_no, page_no) INSERT t_page (trip_no, effort_no, page_no)
Invalid species code (species) INSERT rdb : curr_spp (code)
Indices: NORMAL (2, 15) fishindex ON (trip_no, set_no, page_no)
NORMAL (2, 15) BTREE fishsppindex ON (species)

5.6 Table 6: t_catch

Comment: Details of catches of species for an unit of effort.

Attribute	Data Type	Null?	Comment
trip_no	character(6,1)	No	Unique code identifying each trip. Refer t_trip.
effort_no	integer	No	Sequential number for each unit of effort deployed (e.g., set, trawl, seine) deployed during a trip.
species	character(3,1)	No	3-character species code. Refer rdb:curr_spp
grade	character(3,1)	No	3-character fish quality grade code: IKI=Iki and/or slurry; GRE=Green or whole ungraded fish.
no_bins	decimal(5,2)		Number of bins of fish for the species.
bin_wgt	decimal(6,1)		Average weight (kg) of a bin of the species.
no_sampled	decimal(5,2)		Number of bins of fish for the species that were sampled

Creator: dba
Referential: No such effort number (trip_no, effort_no) INSERT t_effort (trip_no, effort_no)
No such species code (species) INSERT rdb : curr_spp (code)

5.7 Table 7: t_grade_code

Comment: Lists the codes and their descriptions for quality grades of fish. Used primarily for the snapper iki fishery where fish are grade on quality upon catching.

Attribute	Data Type	Null?	Comment
grade	character(3,1)	No	3-character fish quality grade code.
description	character(30,1)	No	Description of grade code.

Creator: dba
Indices: UNIQUE BTREE t_grade_code_pk ON (grade)

5.8 Table 8: t_hook_shot

Comment: Details about the shots of longline sets used during the SNA9802 hook appendage experiment.

Attribute	Data Type	Null?	Comment
shot_no	integer	No	Sequential number for each longline set shot during a trip.
project_code	character(10,1)		Project code.
date_s	date(5)		Date that the longline set was shot.
vessel	character(30,1)		Vessel name.
bb_type	character(4,1)		Longline backbone type code.
bb_break	integer		Longline backbone breaking strain (kg).
hook_type	character(3,1)		Hook type code.
snood_lgth	decimal(4,1)		Snood length (cm).
snood_dist	decimal(4,1)		Distance (m) between the snoods.
snood_break	integer		Breaking strain (kg) of the snoods.

Creator: dba
Indices: UNIQUE BTREE t_hook_shot_pk ON (shot_no)

5.8 Table 8: t_hook_append

Comment: Details about experiments to determine the effects of longline hook appendages on incidental mortality and catch rates of snapper.

Attribute	Data Type	Null?	Comment
shot_no	integer	No	Sequential number for each longline set shot during a trip. Refer t_hook_shot.
block	smallint	No	Sequential number for each replicate block of 50 hooks.
treat	smallint	No	Sequential number for each hook treatment.
result	character(2,1)		Up to 2-character code for the result of the hook.
species	character(3,1)		3-character species code. Refer rdb:curr_spp.
lgth	integer		Length (cm) of the species caught.
hooked	character(4,1)		Up to 4-character code for where the animal caught was hooked and what condition it was in when boated.
season	character(1,1)		1-character code for the season: S=summer, W=winter.

Creator: dba
Referential: No such shot (shot_no) INSERT t_hook_shot (shot_no)
No such species code (species) INSERT rdb : curr_spp (code)
Indices: NORMAL (2, 15) BTREE shotindex ON (shot_no)

6. iki Database Business Rules

6.1 Introduction to business rules

The following are a list of business rules pertaining to the **iki** database. A business rule is a written statement specifying what the information system (i.e., any system that is designed to handle longline 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.

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 record (t_trip)

trip_no Must contain a value that is unique. Should be either an integer greater than zero, or a 4-character alphabetic code followed by an integer greater than zero.

date_s The start date of the trip must be a legitimate date within the specified period the data set covers and should be after 1st October 1998.

date_f The finish date of the trip must be a legitimate date within the specified period the data set covers and should be after 1st October 1998.

Multiple column checks on date:
The start date must not be later than the finish date and within a reasonable time period.

bb_type The backbone type, must be a valid code as listed in Appendix 1.

bb_break The backbone breaking strain should fall within the reasonable range 50 to 500 (kg).

snood_break The snood line breaking strain should fall within the reasonable range 10 to 100 (kg).

clip_type The clip type, must be a valid code as listed in Appendix 1.

hook_type The hook type, must be a valid code as listed in Appendix 1.

hook_size The hook size should fall within the reasonable range of 12 to 18.

snood_lgth The snood length should be within the reasonable range of up to 2.5 (m).

snood_dist The snood distance should be within the reasonable range of up to 4.0 (m).

gear_meth The gear method code, must be a valid code as listed in Appendix 1.

no_effort The total number of units of effort for the trip must be an integer greater than one, should fall within the reasonable range of 1 to 200.

target_sp The target species code must be a valid species code as listed in the *curr_spp* table in the **rdb** database.

project_code Project code must be a valid code within the NIWA project system.

Trip catch weight table (t_trip_catch)

trip_no Must be equal to a trip code held in the *t_trip* table.

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

weight Must be a number greater than zero and should be within the reasonable range of 5 to 50,000.

Effort record table (t_effort)

trip_no Must be equal to a trip code held in the *t_trip* table.

effort_no Must be a unique integer greater than zero, within all the effort records with the same trip number.

stat_area Must be one of the valid statistic area codes for the New Zealand Exclusive Economic Zone (EEZ) as listed in the *area_codes* table of the **rdb** database and shown in Appendix 3.

date_s The start date of the set must be a legitimate date and should be after 1st October 1998.

Multiple column checks on trip start and finish date, and the effort start date: The date must fall within the range of the trip start and finish dates.

time_s Time set must be a valid time, within the range of 0 to 2359, and be New Zealand Daylight Time.

fix_s Start fix method, must be a valid fix method code as listed in Appendix 1.

lat_s Must be a valid latitude and degrees should fall within the reasonable range of 33 to 38 South.

long_s Must be a valid longitude and degrees should fall within the reasonable range of 164 East to 170 West.

EW_s Longitude East or West at start, must be equal to either "E" or "W".

gear_s Gear depth at start should fall within the reasonable range of 5 to 120.

depth_s Bottom depth at start, should fall within the reasonable range of 5 to 120.

Effort record table (t_effort) cont….

date_f The finish date of the set must be a legitimate date and should be after 1st October 1998.

Multiple column checks on trip start and finish date, and the effort finish date:
The date must fall within the range of the trip start and finish dates.

time_f Time finish of set must be a valid time, within the range of 0 to 2359, and be New Zealand Daylight Time.

Multiple column checks on start and finish date and time:
The finish time, finish date must not be before set start time, start date and within a reasonable time period of 5 to 600 minutes.

fix_f Finish fix method, must be a valid fix method code as listed in Appendix 1.

lat_f Latitude degree at finish, must be a valid latitude and degrees should fall within the reasonable range of 33 - 38 South.

long_f Longitude degree finish, must be a valid longitude and degrees should fall within the reasonable range of 164 East to 170 West.

EW_f Longitude East or West at finish, must be equal to either "E" or "W".

Multiple column checks on position:
The finish position must be within a reasonable distance from the start position. The finish position must fall within the given statistical area for the set (where position given).

gear_f Gear depth at end of set, should fall within the reasonable range of 5 to 120.

depth_f Bottom depth at end of set, should fall within the reasonable range of 5 to 120.

min_gear Minimum depth of gear (at any point), should fall within the reasonable range of 5 to 120.

max_gear Maximum depth of gear (at any point), should fall within the reasonable range of 5 to 120.

Multiple column checks on start & finish gear depths and minimum & maximum gear depths:
Start gear depth must be within the range of *min_gear* and *max_gear*. Finish gear depth must be within the range of *min_gear* and *max_gear*.

Effort record table (t_effort) cont….

bb_length Backbone length must be a number greater than zero and should fall within the reasonable range of 1.0 to 10.0 (nm)

hooks Number of hooks must be an integer greater than zero and should fall within the reasonable range of 100 to 2500.

hook_type The hook type, must be a valid code as listed in Appendix 1

hook_size Hook size must be a number greater than zero and should fall within the reasonable range of 12 to 18.

snood_lgth Snood length must be a number greater than zero and should be within the range of 0.3 to 2.5.

snood_dist Snood distance must be a number greater than zero and should be within the range of 0.5 to 4.0.

gear_meth The gear method code, must be a valid code as listed in Appendix 1.

bait_s1}
bait_s2}
bait_s3}
bait_s4} Bait species must be a valid code as listed in Appendix 1.

bait1}
bait2}
bait3}
bait4} The percentage of hooks using the corresponding bait species must be an integer within the range of 0 – 100.

Multiple column checks on bait:
The sum of the bait1 .. bait4 must equal 100.

wind_dir Wind direction must fall within the range of 0 to 359 or equal 999.

wind_knots Wind speed in knots must be an integer greater than zero and should fall within the reasonable range of 0 to 40.

cloud Cloud cover in eighths, must fall within the range of 0 to 8.

sea_cond Sea condition using the beaufort scale, must be a valid code as listed in Appendix 1. Sea condition should fall within the reasonable range of 0 - 6.

sea_col Sea colour, must be a valid code as listed in Appendix 1.

Effort record table (t_effort) cont….

swell_ht Swell height, must be a valid code as listed in Appendix 1.

swell_dir Swell direction must fall within the range of 0 to359 or equal 999.

bot_type Bottom type, must be a valid code as listed in Appendix 1.

bot_cont Bottom contour, must be a valid code as listed in Appendix 1.

Fish Characterisation page table (t_page)

Multiple column check on trip number and effort number:
The combination of *trip_no* and *effort_no* must exist in the *t_effort* table.

page_no Page must be an integer greater than zero and should fall within the reasonable range of 1 to 30.

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

page_s Start time of this page must be a valid time, within the range of 0 to 2359, and be New Zealand Daylight Time.

page_f Finish time of this page must be a valid time, within the range of 0 to 2359, and be New Zealand Daylight Time.

Multiple column checks on page start and finish times:
The finish time must not be before set start time and should be within a reasonable time period of 10 to 300 minutes.

Individual fish table (t_fish)

Multiple column check on trip number, effort number and page number:
The combination of *trip_no*, *effort_no*, and *page_no* must exist in the *t_page* table.

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

lgth Fish length must be an integer greater than zero and should fall within the reasonable range of 10 to 120 (cm).

Multiple column check on species and length:
The fish length should be within the reasonable range for the species as listed in Appendix 1.

sex Sex , must be a valid code as listed in Appendix 1

alive Alive, must be a valid code as listed in Appendix 1

bait Bait, must be a valid bait code as listed in Appendix 1

hook_p Hook position, must be a valid code as listed in Appendix 1

wound Wounding, must be a valid code as listed in Appendix 1

rupture Rupture, must be a valid code as listed in Appendix 1

state State must be a valid code as listed in Appendix 1

Effort catch table (t_catch)

Multiple column check on trip number and effort number:
The combination of *trip_no* and *effort_no* must exist in the *t_effort* table.

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

grade Must be a valid quality grade code as listed in the t_grade_code table.

no_bins Must be a number greater than zero and should be within the reasonable range of 1 to 200.

bin_wgt Must be a number greater than zero and should be within the reasonable range of 12 to 30.

no_sampled Must be a number greater or equal to zero and should be within the reasonable range of 0 to 25.

Fish quality grade code table (t_grade_code)

grade Must have a value entered and be a 3-character alphabetic code..

description Must have a value entered and can any combination of up to 30 ASCII characters.

Hook appendage experiment table (t_hook_shot)

shot_no	Must have a value entered and be an unique integer greater than zero.
project_code	Project code must be a valid code within the NIWA project system.
date_s	The start date of the shot must be a legitimate date and should be after 1st October 1998.
vessel	Can be any combination of up to 30 ASCII characters.
bb_type	The backbone type, must be a valid code as listed in Appendix 1.
bb_break	The backbone breaking strain should fall within the reasonable range 50 to 500 (kg).
hook_type	The hook type, must be a valid code as listed in Appendix 1.
snood_lgth	The snood length should be within the reasonable range of up to 2.5 (m).
snood_dist	The snood distance should be within the reasonable range of up to 4.0 (m).
snood_break	The snood line breaking strain should fall within the reasonable range 10 to 100 (kg).

Hook appendage experiment table (t_hook_append)

shot_no Must have a value entered and be a valid shot number as listed in the *t_hook_shot* table..

block Must have a value entered and be an integer greater than 0. Should be within the reasonable range of 1 to 3.

treat Must have a value entered and be an integer within the reasonable range of 1 to 9. Valid treatments are list in Appendix 1.

result Must be a valid result code as listed in Appendix 1.

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

lgth Fish length must be an integer greater than zero and should fall within the reasonable range of 10 to 120 (cm).

Multiple column check on species and length:
The fish length should be less than the maximum-recorded fish length for the species as recorded in the *curr_spp* table in the **rdb** database. Maximum lengths for some of the more common species are listed in Appendix 1.

hooked Must be a valid hooked code as listed in Appendix 1.

Multiple column check on species and hooked code:
Hooked must equal “WING” if species is a bird. Conversely, if a bird species is caught, the hooked code must equal “WING”.

season Must be equal to “S” or “W”..

7 Acknowledgements

The authors would like to thank David Banks for his help with technical and editorial input in the preparation of this document.

Appendix 1 - Reference Code Tables

Backbone type "MONO" (the only type allowed to date).

Clip type "ECLP", "SHVR", " JVI".

Hook type "TAI", "TCL".

Gear method		
	30	Surface Longline
	31	Bottom Longline
	32	Trolling lines
	33	Handlines

Position fix method code

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

Bait species	*Code*	*Common name*
	SQU	Arrow Squid
	BAR	Barracouta
	BCO	Blue Cod
	EMA	Blue Mackerel
	BWH	Bronze Whaler Shark
	CON	Conger Eel
	HHS	Hammerhead Shark
	JMA	Jack Mackerel
	KAH	Kahawai
	OCT	Octopus
	PIL	Pilchard
	SAU	Saury
	SKJ	Skipjack Tuna
	JMN	Trachurus Novaezelandiae
	UNI	Unidentified
	YEM	Yellow-Eyed Mullet

Sea condition using the beaufort scale;

Code	*Descriptive term*	Mean wind speed in knots
0	Calm, glassy	< 1
1	Light air	1 - 3
2	Light Breeze	4 - 6
3	Gentle Breeze	7 - 10
4	Moderate Breeze	11 - 16
5	Fresh Breeze	17 - 21
6	Strong Breeze	22 - 27
7	Near Gale	28 - 33
8	Gale	34 - 40
9	Strong Gale	41 - 47

Sea colour

01	Deep blue
02	Blue
03	Light blue
04	Greeny blue
05	Bluey green
06	Deep green
07	Green
08	Yellow green

Swell height

01	Low	0 - 2.0 m
02	Moderate	2 - 4 m
03	Heavy	over 4 m

Bottom type

0	Unknown
1	Mud or ooze
2	Mud with some sand
3	Sand
4	Sand / gravel and shells
5	Shells
6	Gravel
7	Rock
8	Coral
9	Stone

Bottom contour

0	Unknown
1	Smooth / flat
2	Undulating
3	Hillocks
4	Rugged
5	Very rugged

Minimum and maximum fish lengths by species

Species	*Minimum length*	*Maximum length*
KIN	40	120
SNA	10	85
JDO		75
SPO		150
SCH		190
TAR		60
HHS		350
JMA		70
GUR		60

Sex code	1	Male
	2	Female
	3	Unable to determine
	4	Did not attempt to sex fish
Alive code	Y	Yes, is alive
	N	No, not alive (dead).
	M	Moribund.
Hook position	L	Lip
	G	Gut
	F	Foul
Wounding	1	None
	2	Gear
	3	Predator
	4	Bleeding or lesions, source unknown
Rupture	Y	Yes
	N	No
	X	Probably not burst
	U	Probably is burst.

Codes X & U are additional codes, to give indicative value, where fish already killed and observers unable to provide an absolute yes or no.

Baratrauma state

1	Not distended
2	Air in body
3	Gut protrusion
4	Extreme

Hook treatment	1	Normal, squid
	2	Normal, pilchard
	3	Normal, mackerel
	4	20mm, squid
	5	20mm, pilchard
	6	20mm, mackerel
	7	40mm, squid
	8	40mm, pilchard
	9	40mm, mackerel

Hook result	B	Bait
	E	Empty
	S	Skin or bait fragment
	BO	Bitten off
	F	Fish
	O	Other

Hooked code	S	Side mouth
	SR	Side mouth, dead, reject
	L	Lip
	LR	Lip, reject (choked on bait)
	LL	Lower lip
	UL	Upper lip
	F	Foul
	G	Gut
	GE	Gut, export
	GR	Gut, reject
	DM	Deep mouth
	GILL	Deep, in gills
	WING	Wing of a bird

LONGLINE TRIP RECORD

(1997 edition)

NIWA

Project Code

RECORDER: _____
Please print

TRIP

Trip Code	Vessel	Reg. No	Start Date Day	Start Date Month	Start Date Year	End Date Day	End Date Month	End Date Year

MASTER

LFR

DEFAULTS

Backbone Type	Backbone Breaking Strain	Snood Line Breaking Strain	Clip Type

Hook Type	Hook Size	Snood Length (m)	Snood Distance (m)	Gear Method	Total No Of Sets

S T A F
Staff Names _____

T C O M
Trip Comments _____

_____

_____

_____

LONGLINE STATION RECORD

(1997 edition)

Trip Code | Station No | Stat Area

RECORDER: _____
Please print

	Day	Month	Year	Time (NZST)	Method of fix	Latitude Deg.	Latitude Min	S	Longitude Deg.	Longitude Min	E/W	Gear depth (m)	Seabed depth (m)
START								S					
FINISH								S					

	Minimum depth of gear (m)	Maximum depth of gear (m)	Total length of backbone (nm)	Total number of hooks	DEFAULTS Hook type	Hook size	Snood length (m)	Snood distance (m)	Gear method
GEAR: 1									

	BAIT TYPE 1	%	2	%	3	%	4	%
GEAR: 2								

	Wind direction °true	Wind speed knots	Cloud cover /8	Sea condition Beaufort	Sea colour	Swell height	Swell direction °true	Bottom type	Bottom contour
ENVIRONMENT									

S | C | O | M _____

Station comments _____
continue on separate page if necessary _____

LONGLINE FISH CHARACTERISATION RECORD (1997 EDITION)

NIWA

Page ..... of .....

Stat | Trip Code | Station No. | Species Code

Recorder: _____

Date: _____

Start Time 24 hour

End Time 24 hour

	Fish length (cm)	Sex 1=male, 2=female, 3=immature	Alive Y/N	Bait type	Hook position L=lip, G=gut, F=foul	Other wounding 1=none, 2=gear, 3=predator	External rupture Y=yes, N=no	Barotrauma state 1=not distended, 2=ext in body 3=gut protrusion, 4=extreme
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	Fish length (cm)	Sex 1=male, 2=female, 3=immature	Alive Y/N	Bait type	Hook position L=lip, G=gut, F=foul	Other wounding 1=none, 2=gear, 3=predator	External rupture Y=yes, N=no	Barotrauma state 1=not distended, 2=ext in body 3=gut protrusion, 4=extreme
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Appendix 3 – New Zealand Statistical Areas