

Database documentation: oyster

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Version	Person responsible	Reason	Date
1.0	Kevin Mackay	Initial release as NIWA Internal Report No. 21	1998
1.1	Kevin Mackay	?	6 Oct 2003
1.2	Kevin Mackay	Corrected comments in t_station	1 Nov 2004
1.3	Fred Wei	Added photo_num_s and photo_num_f to t_station and changed lat_s and long_s to 6 decimal places	9 Apr 2013
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2.1	D Fisher	Added 4 columns to t_biological for more bonamia results, extended t_survey.dredge_type to 100 chars.	Aug 2019

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1 Database documentation series

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

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

This document is a brief introduction to the Foveaux Strait oyster database **oyster**, and is a 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 relationships between the tables in **oyster**.

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

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

2 Foveaux Strait oyster sampling programme

In 1985, the population of takeable (legal size $\geq 58\text{mm}$) Foveaux Strait oysters (*Tiostrea chilensis*) was estimated to have been 1140 million. An epidemic of the protistan parasite *Bonamia* sp. probably began in 1985 and was diagnosed from samples taken after high oyster mortalities in 1986. In response to this outbreak, a series of surveys was undertaken, starting in 1990, to monitor the distribution and intensity of the outbreak. These surveys showed that the infection and subsequent mortality spread through the population in the following years reducing the population to 771 million by July 1990, and 319 million by February 1992, by which time infection had reached the periphery of oyster distribution. In 1992, the population in the area surveyed in 1975 was less than 10% of that present in 1975 and recruitment was considered to be at risk. The fishery was partially closed to fishing in 1992 and fully closed in 1993 to allow the population to rebuild.

Changes in the distribution of *Bonamia* sp. in Foveaux Strait between 1990 and 1995 had indicated that the prevalence and intensity of infection had waned and that mortality of oysters in the future is unlikely to be as great as it has been in the immediate past. The size of the oyster population estimated in 1992 and 1993 suggested that the population was increasing though the increase was not statistically significant. The population has been surveyed several times since 1995 to monitor further changes.

In 1997, the survey also allowed for the opportunity to examine the effect of different dredge methods on the damage sustained by oysters at harvesting.

3 Data structures

3.1 Table relationships

This database contains several tables. The ERD for **oyster** (Figure 1) shows the logical structure¹ 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 key². This schema is valid regardless of the database system chosen, and it can remain correct even if the Database Management System (DBMS) is changed. The ERD's in this document show attributes within the tables with generic data-types. Most of the tables in the **oyster** database also contain special attributes, called foreign keys³.

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

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

where the attribute(s) make up the primary key (the key attributes) and the index name is the primary key name. This prevents records with duplicate key values from being inserted into the table, e.g., a new survey being inserted with an existing survey number.

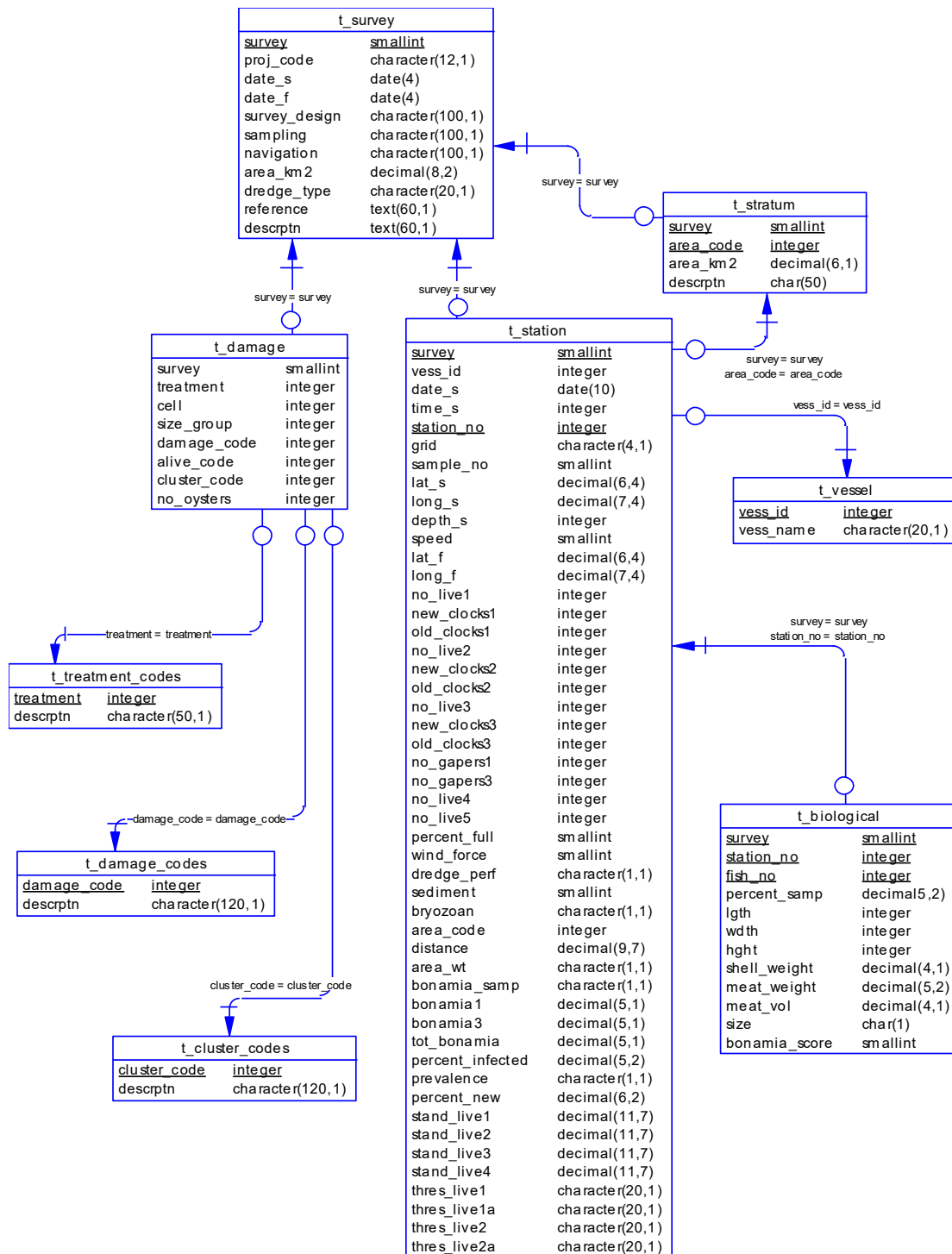
The **oyster** database is implemented as a relational database. That is, tables are linked to one another by their relationships. All relationships in **oyster** are of the type *one-to-many*⁴. This is shown in the ERD by connecting a single line (indicating 'many') from the child table (e.g., *t_station*) to the parent table (e.g., *t_survey*) with an arrow-head (indicating 'one') pointing to the parent. For example, consider the relationship between the tables *t_survey* (the parent table) and *t_station* (the child table). Any one survey in *t_survey* can have one or more stations in *t_station*, but any one station can only be a part of one survey.

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.

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 survey in *t_survey* can have many stations in *t_station* but any one station can only come from one survey.



Physical Data Model		
Project : oyster		
Model : foveaux strait oyster dredge survey databases		
Author : dba	Version 1.2	20/07/2004

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

Every relationship has a mandatory or optional aspect to it. That is, if a relationship is mandatory, then it has to occur and least once, while an optional relationship might not occur at all. For example, in Figure 1, consider that relationship between the table *t_survey* and its child table *t_damage*. The symbol ‘O’ by the child *t_damage* means that a survey record can have zero or many damage records, while the bar by the parent *t_survey* means that for every damage record there must be a matching survey record.

These relationships are enforced in the database by the use of foreign key constraints⁵. 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:

Foreign-key constraints:

```
"foreign key name" FOREIGN KEY (attribute[,attribute]) REFERENCES
    parent table (attribute[, attribute])
```

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

Foreign-key constraints:

```
"fk_t_station_t_survey" FOREIGN KEY (survey) REFERENCES t_survey(survey)
```

This means that the value of the attribute *survey* in the current record must already exist in the parent table *t_survey* or the record will be rejected and an error message will be displayed.

Most tables are indexed. That is, attributes that are most likely to be used for searching, such as *survey*, have like values linked together to optimise search times. Such indices are shown in the table listings (Section 5) by the following syntax:

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

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

3.2 Database design

The genesis of **oyster** lies in the need for a central data repository for data collected by the Foveaux Strait oyster survey programme. The data were originally residing on several PCs and in a variety of formats while analyses were carried out.

Once the analyses were completed, the groomed data, usually in the form of spreadsheets, were made available for loading onto the Empress RDBMS. These spreadsheets form the basis of the database table design and on a conceptual level an attempt has been made to make these tables as robust as possible for any further surveys that may eventuate.

⁵ Also known as referential or integrity checks.

3.2.1 Oyster dredge surveys

Conceptually, a dredge survey has two main entities: a survey entity (*t_survey*, Table 1) and a station entity (*t_station*, Table 4) with one survey comprising of many stations. However, during analysis, each survey's data was stored in its own single spreadsheet, with each record in the spreadsheet broadly corresponding with a station (or dredge) site. Hence, these spreadsheets collectively represent the station entity and were loaded verbatim into the table *t_station*. The attribute *survey* was added to *t_station*, as a number to identify which survey the station was a part of. The table *t_survey* contains these codes and the survey title that they represent.

Different surveys employed a variety of sampling methodologies, from fixed grid stations to stratified random sampling. All these methodologies are accommodated in the station table resulting in a wide range of attributes, from *station_no* and *sample_no*, to *grid_no*. However, for the stratified surveys any data defining strata was seldom given for loading into the database. Any stratum data that has been presented to the Data Manager has been loaded into the table *t_stratum* (Table 3).

Spreadsheet design mentality dictates that all attributes are represented in columns, with many of the columns being used to hold results of various calculations. However, standard database design theory dictates that tables should, where possible, conform to certain normalization rules. The purpose of these normalization rules is to produce a databases design that is highly flexible, allowing the schema to be extended when needed to account for new attributes, entities, and relationships. They can also reduce redundancy in the database and make sure the database is free from certain anomalies. Usually, the aim is to conform to the first three rules. That is, the database should be in a 3rd Normal Form (3NF).

All oyster survey spreadsheets to date are in 1NF in that every attribute is single-valued for each record. However, to be 2NF, all the non-key attributes have to be fully dependent on the primary key; i.e., each attribute in a record has to be dependant on the attributes *survey* and *station_no*. Here, the spreadsheets failed because the vessel name is dependent on the vessel registration number, not the station primary key. To conform to 2NF, the vessel names are therefore stored in their own table *t_vessel* (Table 2) and are linked to *t_station* by the attribute *vess_id*.

To make *t_station* 3NF requires that every non-key attribute is not transitively dependent on the primary key. That is, there should be no attributes that are the result of calculations of other attributes in the table. The problems arise because any changes in the values of the other attributes will not automatically change the value of the transitively dependent attribute, resulting in data anomalies, unlike spreadsheets, which can do this using formula. Because the original spreadsheets were used for analyses, they have several attributes that fall into this category (such as the attribute *stand_live1* that is calculated from the attributes *no_live1* and *distance*). These transitively dependent attributes should be removed from *t_station*, but because **oyster** is used as a static data repository rather than a dynamic data analysis tool, these anomalies will not appear. Therefore, they remain in *t_station*.

The table *t_station* contains a number of attributes for absolute, percentage, and standardised abundance of oysters dredged at each station; e.g., *no_live1*, *stand_live2*, and *bonamia3*. A number to denote the shell size range they represent suffixes these attributes, with: 1 = takeable (legal size $\geq 58\text{mm}$); 2 = sublegal ($< 58\text{mm}$); 3 = pre-recruits (between 50 and 57mm); 4 = juveniles ($< 50\text{mm}$); 5 = combined pre-recruit and takeable ($\geq 50\text{mm}$).

Measurements of individual oysters are stored in the table *t_biological* (Table5). Measurements include: shell length, width and height, shell weight, meat weight, and an index for the level of bonamia infection.

In May 2014 6 additional columns were added to table *t_biological* to identify and capture the results of qPCR (quantitative polymerase chain reaction) assays of oyster tissue for bonamia infection. Values given in attributes *heart_fam*, *heart_tr*, *gill_fam*, and *gill_tr* represent the Cq values which represent the number of cycles needed to reach a set threshold fluorescence signal level (RFU, relative fluorescence units), in this case the baseline. Values for *heart_fam* and *heart_tr* are for heart tissue and *gill_fam* and *gill_tr* for gill tissue. FAM (6-carboxyfluorescein) is the fluorophore that detects bonamia and TR (Texas-red, sulforhodamine 101 acid chloride) the fluorophore used as a cross check to ensure the qPCR reaction occurred by detecting DNA from oyster tissue in the sample.

3.2.2 Survey on the impact of dredging on oysters

The exception to the survey/station relationship is the 1997 survey on the impact of dredging on Foveaux Strait oysters, which looked at differences of levels of damage sustained by oysters at harvesting by different dredging methods. Conceptually, this survey is a one-to-many relationship between the survey entity (*t_survey*) and the damage entity (*t_damage*, Table 6). Individual records in *t_damage* don't represent a station, but a cluster of oysters, where a cluster is defined as either one adult (legal size $\geq 58\text{mm}$) oyster or a clump of juvenile spat formed around a single nucleus.

Much of the data in *t_damage* are in the form of numeric codes. Separate tables contain the definitive lists of these codes, and their descriptions. The codes are for the types of damage to oysters (*t_damage_codes*, Table 8), treatment (or method of dredging) of oysters at harvesting (*t_treatment_codes*, Table 7), and cluster types (*t_cluster_codes*, Table 9).

4 Table summaries

This database is arranged as a set of six main tables containing survey data, and three other tables describing the various codes that are used.

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

1. **t_survey** : contains descriptions of the various Foveaux Strait oyster surveys undertaken and a numeric code to identify each survey.
2. **t_vessel** : contains vessel registration codes and vessel names.
3. **t_stratum**: contains oyster survey stratum codes, descriptions and areas.
4. **t_station** : contains station details including date, position, distance dredged, and depth, as well as catches of oysters by size class and levels of infection by *Bonamia* sp.
5. **t_biological** : Table of morphological measurements, weights and bonamia indices of individual oyster specimens
6. **t_damage** : contains details of damage to clusters (a single takeable oyster or a cluster of juveniles around a single nucleus) sustained by various dredging methods.

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

7. **t_treatment_codes** : contains codes and descriptions of the different ways in which the oysters are treated (fishing methods) at harvesting.
8. **t_damage_codes** : contains codes and descriptions for the various levels of damage sustained to an oyster.
9. **t_cluster_codes** : contains codes and descriptions for the various types of clusters ranging from a single takeable oyster to a cluster of multiple generations of oysters around a single nucleus.

5 oyster Tables

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

5.1 Table 1: t_survey

Comment: Table of oyster survey codes and descriptions.

Column	Type	Null?	Description
survey	smallint	No	Unique sequential numeric code for each survey.
proj_code	character varying(12)		Project or programme code for this survey.
date_s	date		Survey start date.
date_f	date		Survey finish date.
survey_design	character varying(100)		Brief description of the overall survey design methodology.
sampling	character varying(100)		Brief description of the sampling methodology.
navigation	character varying(100)		Brief description of the navigation methodology.
area_km2	numeric(8,2)		Total area (sq. km) surveyed.
dredge_type	character varying(100)		Description of the type of dredges used.
reference	text		Bibliographic reference.
descrptn	text		Description of survey.

Indexes:

"pk_t_survey" PRIMARY KEY, btree (survey)

5.2 Table 2: t_vessel

Comment: Registration numbers and names of vessels used during Foveaux Strait oyster surveys.

Column	Type	Null?	Description
vess_id	integer	No	Vessel registration number.
vess_name	character varying(20)		Vessel name.

Indexes:

"pk_t_vessel" PRIMARY KEY, btree (vess_id)

5.3 Table 3: t_stratum

Comment: Oyster survey stratum codes, descriptions and areas.

Column	Type	Null?	Description
survey	smallint	No	Unique sequential numeric code for each survey.
area_code	character varying(4)	No	Stratum area code.
area_km2	numeric(6,1)		Stratum area (km2).
descrptn	character varying(50)		Description of the stratum.

Indexes:

"pk_t_stratum" PRIMARY KEY, btree (survey, area_code)

Foreign-key constraints:

"fk_t_stratum_t_survey" FOREIGN KEY (survey)
REFERENCES oyster.t_survey(survey)

5.4 Table 4: t_station

Comment: Station and catch details for an oyster survey station.

Column	Type	Null?	Description
survey	smallint	No	Numeric survey code (refer: t_survey).
vess_id	integer		Vessel registration number (refer: t_vessel).
date_s	date		Date on start of dredge station.
time_s	integer		Time (24hr, NZST) on start of dredge station.
station_no	character varying(8)	No	Sequential station number.
grid	character varying(4)		Station grid reference.
sample_no	smallint		Sample number.
lat_s	numeric(8,6)		Latitude at start of dredge station (decimal degrees).
long_s	numeric(9,6)		Longitude at start of dredge station (decimal degrees).
depth_s	integer		Depth (m) at start of dredge station.
speed	smallint		Towing speed (knots).
lat_f	numeric(8,6)		Latitude at finish of dredge station (decimal degrees).
long_f	numeric(9,6)		Longitude at finish of dredge station (decimal degrees).
no_live1	integer		Number of live legal size oysters (>=58mm) in dredge.
new_clocks1	integer		Number of legal size (>=58mm) new clocks in dredge.
old_clocks1	integer		Number of legal size (>=58mm) old clocks in dredge.
no_live2	integer		Number of live sublegal size (<58mm) oysters in dredge.
new_clocks2	integer		Number of sublegal size (<58mm) new clocks in dredge.

old_clocks2	integer	Number of sublegal size (<58mm) old clocks in dredge.
no_live3	integer	Number of live oysters between 50mm and 57mm in dredge.
new_clocks3	integer	Number of new clocks between 50mm and 57mm in dredge.
old_clocks3	integer	Number of old clocks between 50mm and 57mm in dredge.
no_gapers1	integer	Number of live oysters (>= 58mm) that have a gap between their two shells (i.e., alive but sick) in dredge.
no_gapers3	integer	Number of live oysters between 50mm and 57mm that have a gap between their two shells (i.e., alive but sick) in dredge.
no_live4	integer	Number of live oysters < 50mm in dredge.
no_live5	integer	Number of live oysters >50mm in dredge.
percent_full	smallint	Percent fullness of the dredge.
wind_force	smallint	Wind force (Beaufort scale) during dredge.
dredge_no	smallint	Dredge number: 1 = forward dredge; 2 = after dredge.
dredge_perf	character varying(1)	Did the dredge fish well? (Y/N).
sediment	smallint	Sediment type (0=weed;2=shell;3=shell/gravel;4=pea gravel;5=sand;6=silt;7=sponges;8=bryozoan).
bryozoan	character varying(1)	Bryozoan substrate (Y/N)?
area_code	character varying(4)	Stratum area code.
distance	numeric(9,7)	Distance dredged (km).
area_wt	character varying(1)	Area weight (0=0km grid;1=1nm grid;2=3.96km grid).

bonamia_samp	character varying(1)	Bonamia sample taken?
photo_num_s	integer	First digital image number of dredge contents.
photo_num_f	integer	Last digital image number of dredge contents.
bonamia1	numeric(5,1)	Percent prevalence of Bonamia in oysters >= 58mm.
bonamia3	numeric(5,1)	Percent prevalence of Bonamia in oysters between 50mm and 57mm.
tot_bonamia	numeric(5,1)	Percent prevalence of Bonamia in all oysters.
percent_infected	numeric(5,2)	Percent of a 50 oyster sample infected with bonamia.
prevalence	character varying(1)	Levels of prevalence of bonamia in all oysters (o=0;l=1-10;m=11-25;h=26+;*=no sample).
percent_new	numeric(6,2)	Percent of new clocks over new clocks+live(>50mm).
stand_live1	numeric(11,7)	Number of live oysters >= 58mm in a standard 0.37km dredge.
stand_live2	numeric(11,7)	Number of live oysters < 58mm in a standard 0.37km dredge.
stand_live3	numeric(11,7)	Number of live oysters between 50mm and 57mm in a standard 0.37km dredge.
stand_live4	numeric(11,7)	Number of live oysters between <= 50mm in a standard 0.37km dredge.
thres_live1	character varying(20)	Undocumented column used in survey = 5, Oct 1995.
thres_live1a	character varying(20)	Undocumented column used in survey = 5, Oct 1995.
thres_live2	character varying(20)	Undocumented column used in survey = 5, Oct 1995.
thres_live2a	character varying(20)	Undocumented column used in survey = 5, Oct 1995.
startp	geometry	Position of vessel at start of station as gis point type.

endp	geometry	Position of vessel at end of station as gis point type.
track	geometry	Track line of vessel from start position to end position of station as gis line type.

Indexes:

```
"nx_t_station_endp" gist (endp)
"nx_t_station_startp" gist (startp)
"nx_t_station_track" gist (track)
"nx_t_station_vess_id" btree (vess_id)
```

Check constraints:

```
"enforce_dims_endp" CHECK (ndims(endp) = 2)
"enforce_dims_startp" CHECK (ndims(startp) = 2)
"enforce_dims_track" CHECK (ndims(track) = 2)
"enforce_geotype_endp" CHECK (geometrytype(endp) = 'POINT'::text
OR endp IS NULL)
"enforce_geotype_startp" CHECK (geometrytype(startp) = 'POINT'::text
OR startp IS NULL)
"enforce_geotype_track" CHECK (geometrytype(track) = 'LINESTRING'::text
OR track IS NULL)
"enforce_srid_endp" CHECK (srid(endp) = 4326)
"enforce_srid_startp" CHECK (srid(startp) = 4326)
"enforce_srid_track" CHECK (srid(track) = 4326)
```

Foreign-key constraints:

```
"fk_t_station_t_survey" FOREIGN KEY (survey)
REFERENCES oyster.t_survey(survey)
"fk_t_station_t_vessel" FOREIGN KEY (vess_id)
REFERENCES oyster.t_vessel(vess_id)
```

5.5 Table 5: t_biological

Comment: Table of morphological measurements, weights and bonamia indices of individual oyster specimens.

Column	Type	Null?	Description
survey	smallint	No	Unique sequential numeric code for each survey.
station_no	character varying(8)	No	Sequential station number.
fish_no	integer	No	Oyster number unique by station.
percent_samp	numeric(5,2)		Percentage of total oyster catch sampled per station.
lgth	integer		Shell length (mm).
wdth	integer		Shell width (mm).
hght	integer		Shell height (mm).
shell_weight	numeric(4,1)		Weight of shell only (grams).
meat_weight	numeric(5,2)		Weight of oyster meat only (grams).
meat_vol	numeric(4,1)		Volume of oyster meat.
size	character varying(1)		1-character code for the size of the oyster: R=recruit; P=pre-recruit; S=small recruit.
bonamia_score	smallint		Bonamia level score (0-5, where 0 = no detectable infection) for the numbers of bonamia cells in an oyster blood cell from stained heart imprint on slides.
plate	character varying(8)		qPCR plate number or plate identifier.
sample	character varying(8)		qPRC sample number or sample identifier.
heart_fam	numeric(6,3)		Cq value from qPCR assay for heart tissue using the flurophore FAM (6-carboxyfluorescein) to detect bonamia.
heart_tr	numeric(6,3)		Cq value from qPCR assay for heart tissue using the flurophore texas red to detect oyster dna.

<code>gill_fam</code>	<code>numeric(6,3)</code>	Cq value from qPCR assay for gill tissue using the flurophore FAM (6-carboxyfluorescein) to detect bonamia.
<code>gill_tr</code>	<code>numeric(6,3)</code>	Cq value from qPCR assay for gill tissue using the flurophore texas red to detect oyster dna.
<code>tissue_type</code>	<code>character varying(8)</code>	Tissue type tested.
<code>bonamia_test</code>	<code>character(3)</code>	Result from qPCR or ddPCR test for Bonamia ostreae, POSitive or NEGative.
<code>bonamia_copies</code>	<code>numeric(10,1)</code>	Bonamia copies per 20ul from qPCR or ddPCR tests.
<code>bonamia_droplets</code>	<code>integer</code>	Number of Bonamia positive droplets from ddPCR.

Check constraints:

```
"ckc_bonamia_score_t_biolog" CHECK (bonamia_score IS NULL OR
bonamia_score = 0::smallint OR bonamia_score = 1::smallint OR
bonamia_score = 2::smallint OR bonamia_score = 3::smallint OR
bonamia_score = 4::smallint OR bonamia_score = 5::smallint)
"t_biological_percent_samp_check" CHECK (percent_samp >= 0.00 AND
percent_samp <= 100.00)
"t_biological_size_check" CHECK (size::text ~ '[SPR]':text)
```

5.6 Table 6: t_damage

Comment: Impact of dredging on Foveaux Strait oysters as determined by damage to oysters.

Column	Type	Null?	Description
survey	smallint		Unique sequential numeric code for each survey.
treatment	integer		Code to describe the fishing method and the treatment of the oysters (refer: t_treatment_codes).
cell	integer		Cage cell number. 6 cells per cage.
size_group	integer		Oyster size group (1=Spat<10mm;2=Pre-recruits 10-57mm;3=Takeable oysters>=58mm).
damage_code	integer		Code to describe damage to oyster as a result of treatment (refer: t_damage_codes).
alive_code	integer		Dead or alive code (0=Alive;1=Dead).
cluster_code	integer		A hierarchical code which describes the formation of clusters by tracing successive settlements (refer: t_cluster_codes).
no_oysters	integer		Usually takeable and pre-recruits were recorded as 1 oyster per record. Spat were assessed in groups and numbers of individuals given.

Foreign-key constraints:

```
"fk_t_damage_t_cluster_codes" FOREIGN KEY (cluster_code)
REFERENCES oyster.t_cluster_codes(cluster_code)
"fk_t_damage_t_damage_codes" FOREIGN KEY (damage_code)
REFERENCES oyster.t_damage_codes(damage_code)
"fk_t_damage_t_survey" FOREIGN KEY (survey)
REFERENCES oyster.t_survey(survey)
"fk_t_damage_t_treatment_code" FOREIGN KEY (treatment)
REFERENCES oyster.t_treatment_codes(treatment)
```

5.7 Table 7: t_treatment_codes

Comment: Table of oyster treatment codes and descriptions.

Column	Type	Null?	Description
treatment	integer	No	Code to describe the fishing method and the treatment of the oysters.
descrptn	character varying(50)		Description of treatment code.

Indexes:

"pk_t_treatment_codes" PRIMARY KEY, btree (treatment)

5.8 Table 8: t_damage_codes

Comment: Table of oyster damage codes and their descriptions.

Column	Type	Null?	Description
damage_code	integer	No	Code to describe damage to oyster as a result of treatment.
descrptn	character varying(120)		Description of damage.

Indexes:

"pk_t_damage_codes" PRIMARY KEY, btree (damage_code)

5.9 Table 9: t_cluster_codes

Comment: Table of oyster cluster codes and their descriptions.

Column	Type	Null?	Description
cluster_code	integer	No	A hierarchical code which describes the formation of clusters by tracing successive settlements.
descrptn	character varying(120)		Description of the cluster settlement.

Indexes:

"pk_t_cluster_codes" PRIMARY KEY, btree (cluster_code)