# NIWA

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Climate, Freshwater & Ocean Science

# Casal2

Start 09:30 and finish at 11:00 NZ time (UTC + 13)

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# Agenda

1. **Brief Introduction to Casal2 (NIWA)**
   a. Current capabilities of Casal2 with example assessments
   b. Validation methods: Methods for internal testing and validation, e.g., unit tests, system tests
2. **Where we are in the Casal2 development process**
   a. Recent progress (Ocean Environmental & Zaita)
   b. Key items for development over the next 6 months (NIWA)
3. **Engaging with Casal2 (NIWA)**
   a. How to make contact
   b. How to get examples, make feature requests, document bugs, and solve problems
   c. How to develop new extensions/processes/observation classes
   d. Process for generating releases with new functionality
4. **Future features (Open discussion)**
   a. Desired features
   b. Funding

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# Introduction and examples

- CASAL has been a good stock assessment tool for New Zealand
  - But fixed to the 2000's view of assessment models, and new concepts impossible to implement
- Casal2 is the replacement for CASAL
- The aim was to keep CASAL's core features:
  - Have a common package that working groups and stakeholders know and trust
  - Easy to use with focus on assessment structure, not coding & testing
  - Manual to document how features work
  - Input files self-document assessments
  - Confidence in results by thorough testing of code
- Casal2 would also:
  - Be easily maintainable & expandable to new concepts, including coding techniques not available in 2000
  - Future-proof how stocks can be structured
  - Have a formal testing regime
- Casal2 was one of the 'next-generation' systems discussed at CAPAM[1,2]

CAPAM = Center for the Advancement of Population Assessment Methodology
1. Hoyle, S.D.; Maunder, M.N.; A'mar, Z.T. (2020). Frameworks for the next generation of general stock assessment models: Report of the 2019 CAPAM workshop. New Zealand Fisheries Assessment Report 2020/39. 80 p.
2. André E. Punt, Alistair Dunn, Bjarki Þór Elvarsson, John Hampton, Simon D. Hoyle, Mark N. Maunder, Richard D. Methot, Anders Nielsen (2020). Essential features of the next-generation integrated fisheries stock assessment package: A perspective. Fisheries Research 229. https://doi.org/10.1016/j.fishres.2020.105617.

**Who and how:**

- NIWA funding, also Fisheries New Zealand funding at start, and 2021
- Current project manager(s) at NIWA – Matt Dunn & Steven Holmes

- Software architect/developer – Scott Rasmussen (Zaita Ltd)
- Technical development – Alistair Dunn (Ocean Environmental Ltd), Teresa A'mar (NIWA), Ian Doonan (NIWA), Craig Marsh (NIWA)
- A lot of the initial Casal2 code was transferred from SPM and CASAL

# Partition: numbers-at-age by population strata

- Partition = "matrix" of population splits (rows) and ages (columns)
- Categories divide up the population
  - e.g., sex and/or area
- Each category can have one or more levels/factors
  - sex could have three factors: male, female, & unsexed
- Each row takes one factor from each category
  - Two categories: sex (male & female) and area (spawning & feeding)
    → 4 rows: male.spawning  female.spawning  male.feeding  female.feeding

```
Input file specifications:
@categories                                               # Start of  command block
format     sex ## Single area population, 2 sexes   # One category
names      male female                                    # Factors for sex = partition has 2 rows
```

- Population splits are generic
  - Casal2 has no "hard-wired" knowledge of what population categories and factors represent: meaning is user defined by the processes that are specified to operate on them
- Any population split can be conceptualised in the Casal2 partition
  - e.g., species
- To have meaning, there must be a process to operate on them
  - Otherwise a function must be coded for it, documented, and tested
  - Species can use currently available Casal2 processes
    - e.g., recruitment from within the species, fishing
  - To simultaneously catch two species in the same fishery, new code would have to be written

# Input file specification

Input file consists of a series of command blocks
Each block specifies some aspect of the model structure or processes to act on the partition
"@" marks start of a command block

```
@model                              # Mandatory model setup block, e.g., year and age range to use
time_steps  1                       # Sub-command: have one time step called "1"
⋮                                   # Sub-commands


@time_step 1                        # Defines what happens in  time step "1"
processes    Ageing  Recruitment Fishing  # Order of processes; specify block labels
                                    # Labels have no fishery meaning to Casal2
                                    # Each label has a corresponding @process block


## Ageing
@process  Ageing                    # Define what the label "Ageing" does
type        ageing                  # Calls a function that shifts numbers along a row (age axis)
categories *                        # Acts on these rows in the partition; "*" short hand for all rows
```

# An example: Blue cod

- Pot fishery + lapsed line fishery + recreational

- Data
  - CPUE series (drives results)
  - Pot surveys, but these are relatively recent (flat so relatively unimportant)
  - LF from commercial catch (retained + discards)
  - Age frequencies from the pot surveys and last few years of commercial catches
  - Catches from pot, line, & rec fisheries

- Features
  - Sensitivity with sex change (female → male)          [Casal2 only]
  - Pots: time varying L50 based on legal size limits          [Casal2 only]
    - three changes
  - To fit one length-based selectivity, needed growth morphs (3)
  - Retained & discarded catch components

Doonan, I.J. (2020). Stock assessment of blue cod (*Parapercis colias*) in BCO 5 using data to 2019. *New Zealand Fisheries Assessment Report* 2020/14. 48 p.

- No new code needed
- Input file specs

```
#sex change
#

@categories
format    sex
names     male female          #one sex, one area stock structure

@time_step 1
processes     Ageing  Recruitment sex_change Fishing

@process   sex_change              # lengths jump on transition
type            transition_category  # function that shift from one row to another
from            female
to              male
selectivities tranSex                # identify ogive label to control the transition

@selectivity tranSex                 # Use capped logistic ogive
type            logistic
a50             2                    # age 2 yrs = initial value
ato95           5                    # age at 95% is 2 + 5 = 7 yrs
alpha           0.1                  # cap at 10% transitioning
```

# Another example: Bluenose



- **Bluenose**; deep-water fish, long-lived, depleted stock.

- Age-based, Bayesian with MCMC parameter estimation.

- 112 years, 60 ages, two sexes, two areas with age-based migration.

- Base model fitted with 10 fisheries, 12 CPUE biomass indices, 6 length compositions, 12 age compositions, 49 average-weight compositions.

- Empirical length at age; logistic or domed fishery selectivity.

- Priors mostly uninformative.

- 11 parameters being estimated (constant YCS).

Dunn, M.R.; Middleton, D.A.J.; Doonan, I.; A'mar, T. (in review). The 2021 stock assessment of New Zealand bluenose. *New Zealand Fisheries Assessment Report*

# Example blocks

@derived_quantity SSB
type biomass
time_step fishery
categories male.background female.background male.features female.features
time_step_proportion 0.5
time_step_proportion_method weighted_sum
selectivities Maturation_male Maturation_female Maturation_male Maturation_female

# Example blocks

```
@selectivity sel_trawl
type logistic
a50        16.4
ato95      10.4

@selectivity sel_bns7
type logistic
a50        13.2
ato95      4.9

@selectivity One
type constant
c 1.0

@selectivity migrate
type constant
c 0.029
```

# Example blocks

- Much will be familiar to CASAL users.

- Greater flexibility.

- Maybe less "forgiving", than CASAL.

```
@observation CPUE_northland_95to02
type biomass
time_step fishery
time_step_proportion 0.5
categories male.features+female.features
catchability qnorthland_95to02
selectivities features features #sel_northland sel_northland
likelihood lognormal
process_error 0.15
years        1995 1996 1997 1998 1999 2000 2001 2002
table obs
1995        1.162        0.084
1996        1.245        0.093
1997        1.397        0.086
1998        1.253        0.076
1999        0.894        0.051
2000        0.721        0.04
2001        0.794        0.05
2002        0.771        0.053
end_table

@catchability qnorthland_95to02
type nuisance
lower_bound 1e-8
upper_bound 1e-3
```

# Average-weight compositions

- Data from fish receivers.
- They record the weight and number of bluenose they sell, e.g., a box contained 10 fish that weighted 20.5 kg.
- Temporal and spatial coverage much greater than Ministry observers can achieve; average-weight data are "free".

- Casal2 had length and age compositions, weight composition class was added. Set up so weight compositions could be single fish, or average-weight data.
- The process was to (iteratively) develop the rationale, write the maths and the technical specification, then implement the observation code, add a unit test, and add a description of the functionality to the manual.
- We found average-weight data comes with "issues".
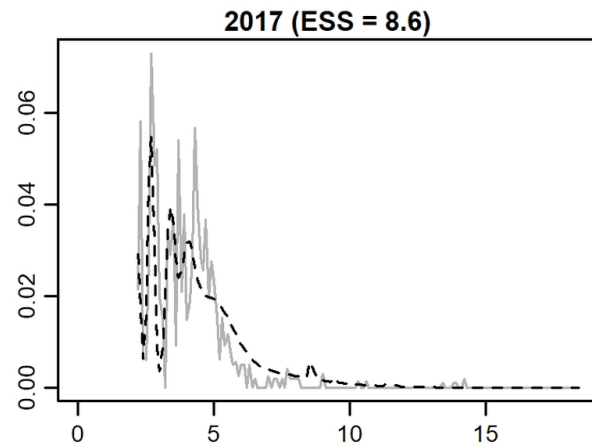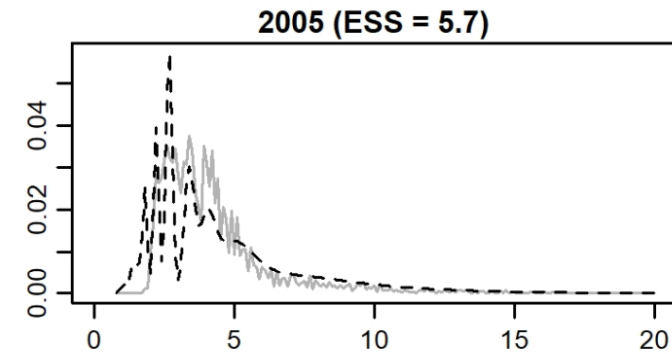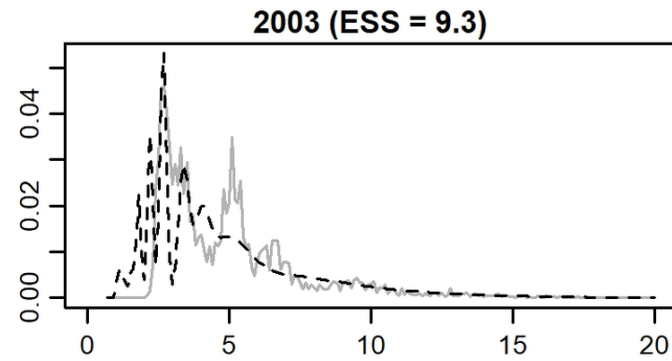
Figure 17: Bluenose observed weight frequency samples (grey lines) and base model MPD fits (black lines): Three examples from Figures 12–16 selected and magnified to show details of the fits. Top panel from Northland; middle panel from Bay of Plenty and East Cape; bottom panel from Other longline.

```
@observation Observed_weight_frequency_features_northland
type process_removals_by_weight
method_of_removal BLL_northland
time_step fishery
mortality_instantaneous_process Instantaneous_Mortality
likelihood multinomial
delta 1e-5
years 1998 1999 2001 2002 2003 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
categories male.features+female.features
units kgs
length_weight_cv 0.2
length_weight_distribution lognormal
length_bins      18 30 40 42 44 46 49 52 56 59 62 65 68 71 73 76 80 85 90
length_bins_n    20 10 5  5  5  5  5  5  4  3  2  2  1  1  1  1  1  1  1
fishbox_weight 12
weight_bins 0.7 0.9    1.1     1.4     1.5     1.6     1.7     1.8     1.9    2       2.1
table obs
1998    0       0       0.00359 0       0       0       0       0       0.00148 0       0
1999    0       0       0       0       0       0       0       0.00035 0.00339 0.00694 0.01433
#2000   0       0       0       0       0       0       0       0       0       0       0
2001    0       0       0       0       0.00046 0.00056 0       0.00084 0.00557 0.0052  0.00743
```

- Found average-weight data were naturally "spiky".

- The size range of fish being averaged in each pack was influential – but was unknown.

- We had high hopes for these data, but their statistical properties were not fully understood before being used.

- Average weight compositions in Casal v1.1.0 and newer.

# Testing and Validation

# Testing and Validation

- Unit tests
- System tests
- Test Case functionality summary document
- 6 Test Case reports

# Unit tests and system tests

- Unit tests
 - Separate code to test specific functions and classes


- System tests
 - 14 models which test specific groups of Casal2 functionality

# Test Cases

- Validation of a set of common stock assessment model functionality
  - Summary document in the Casal2 GitHub repository (in Documentation)
  - **Test_cases_and_functional_requirements_for_Casal2_v1.pdf**

- 6 models based on existing CASAL assessments
  - BCO, HAK, HOK, LIN, ORH, SBW
- Comparison of CASAL and Casal2 results
  - 2 optimisers used in Casal2, BetaDiff (from CASAL) and ADOL-C

# Functional requirements for the Test Cases for CASAL2 v1.0

6 August 2020

## 1. The Test Cases

The test cases contain the minimum required functionality for CASAL2 version 1.0, as defined by the Development Team. The test cases are based upon real stock assessments that were originally completed using CASAL. In most cases, the assumptions of those models were then modified to encompass the desired functionality; the test cases cannot therefore be compared with any published stock assessment.

All of the test case stock assessment models are age-structured, although some of the observation data may be length-based. MPD results as well as MCMC results are compared.

We intend to add further test cases as they become available and as appropriate. All current test cases are New Zealand stocks.

- HOK is hoki.
- ORH is orange roughy on the Chatham Rise (subarea Andes seamount complex).
- LIN is ling in the sub-Antarctic region.
- BCO is blue cod around the south of the South Island.
- HAK is hake in the sub-Antarctic region.
- SBW is southern blue whiting in the sub-Antarctic region.

## 2. The models

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amart UPD: update Test Case MPD report for HOK          ✓ 37e615f 2 days ago     🕓 History

..

| 📁 | BCO | UPD: update 5 of 6 Test Case MPD reports | 3 days ago |
| 📁 | HAK | UPD: update 5 of 6 Test Case MPD reports | 3 days ago |
| 📁 | HOK | UPD: update Test Case MPD report for HOK | 2 days ago |
| 📁 | LIN | UPD: update 5 of 6 Test Case MPD reports | 3 days ago |
| 📁 | ORH | UPD: update 5 of 6 Test Case MPD reports | 3 days ago |
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amart UPD: update Test Case MPD report for HOK    ✓ 37e615f · 2 days ago    🕘 History

..

| 📁 CASAL | UPD: update Test Case HOK CASAL MCMC run with Windows covar matrix | 15 months ago |
| 📁 CASAL_sens1 | UPD: update Test Case HOK CASAL MCMC run with Windows covar matrix | 15 months ago |
| 📁 Casal2 | UPD: update Test Case MPD report for HOK | 2 days ago |
| 📄 compare_HOK.MCMC.Rmd | UPD: update Test Case MCMC reports for HAK, HOK, SBW | 14 months ago |
| 📄 compare_HOK.MCMC.html | UPD: update Test Case MCMC reports for HAK, HOK, SBW | 14 months ago |
| 📄 compare_HOK.MPD.Rmd | UPD: update Test Case MPD report for HOK | 2 days ago |
| 📄 compare_HOK.MPD.html | UPD: update Test Case MPD report for HOK | 2 days ago |
| 📄 compare_HOK.r | UPD: added huxtable tables to Test Case report output | 2 years ago |
| 📄 run_mcmc.sh | UPD: update TestCase primary Linux MPD and MCMC bash scripts, update ... | last month |
| 📄 run_models.bat | UPD: update 5 of 6 Test Case MPD reports | 2 days ago |

# Casal2 Test Case MPD comparisons for HOK

# 1 HOK comparison of CASAL and Casal2 model configurations

This document compares the results of at least 2 CASAL model configurations (base and at least one sensitivity) and up to 6 Casal2 model configurations (3 BetaDiff and 3 ADOL-C).

The CASAL model sensitivity 1 has a smaller minimisation tolerance value than the CASAL base model (1e-9 vs. 1e-6).

The Casal2 ADOL-C and BetaDiff low tolerance models have a smaller tolerance value than the CASAL base model (1e-9 vs. 1e-6).

## 1.1 HOK model characteristics

The main characteristics of the Test Case HOK (hoki) CASAL model are:

- one stock, ages 1 - 17
- one area, although many characteristics are separated into "east" and "west"
- years 1972 - 2018, projection years 2019 - 2023
- five time steps: Oct_Nov, Dec_Mar, Apr_Jun, End_Jun, and Jul_Sep
- five stock categories: west.sa, east.cr, west.cr, west.wc, and east.cs (labeled "stock.area")

# 1.4 Tables

Tables of parameter estimates and objective function components for the CASAL and Casal2 model MPD results

CASAL parameter estimates

| rownames | Base_Model | Sensitivity_1 | Percent_Diff |
|---|---|---|---|
| q[CSacous].q | 0.43120 | 0.43120 | 0.000 |
| q[WCacous].q | 0.30030 | 0.30020 | 0.033 |
| q[CRsum].q | 0.07431 | 0.07431 | 0.000 |
| q[SAsum].q | 0.05925 | 0.05925 | 0.000 |
| q[SAaut].q | 0.06717 | 0.06717 | 0.000 |
| relative_abundance[CRsumbio].cv_process_error | 0.14050 | 0.14050 | 0.000 |
| relative_abundance[SAsumbio].cv_process_error | 0.43060 | 0.43060 | 0.000 |
| log_B0_total | 14.34000 | 14.34000 | 0.000 |
| B0_prop_stock1 | 0.32870 | 0.32870 | 0.000 |
| natural_mortality.all | 0.29600 | 0.29600 | 0.000 |
| selectivity[Wspsl].shift_a | -0.21740 | -0.21740 | 0.000 |
| recruitment[E].YCS1 | 0.44780 | 0.44780 | 0.000 |

# compare_HOK.MPD.html

Casal2 parameter estimates

| rownames | betadiff_casal_flags_on | betadiff_casal_flags_off | betadiff_casal_flags_on_low_tol | adolc_casal_flags_on | adolc_casal_flags_off | adolc_casal_flags_o |
|---|---|---|---|---|---|---|
| catchability[CSacous].q | 0.42724 | 0.42786 | 0.43116 | 0.43829 | 0.43770 | |
| catchability[WCacous].q | 0.31284 | 0.31244 | 0.30024 | 0.27303 | 0.27856 | |
| catchability[CRsum].q | 0.06832 | 0.06812 | 0.07431 | 0.08044 | 0.07817 | |
| catchability[SAsum].q | 0.06717 | 0.06706 | 0.05925 | 0.04403 | 0.04676 | |
| catchability[SAaut].q | 0.07578 | 0.07563 | 0.06717 | 0.04760 | 0.05060 | |
| observation[CRsumbio].process_error | 0.14094 | 0.14089 | 0.14048 | 0.14956 | 0.14992 | |
| observation[SAsumbio].process_error | 0.42364 | 0.42381 | 0.43061 | 0.40906 | 0.40764 | |
| process[recruit_E].b0 | 548395.00000 | 547497.00000 | 555125.00000 | 564399.00000 | 561440.00000 | |
| process[recruit_W].b0 | 1082670.00000 | 1083360.00000 | 1133680.00000 | 1246900.00000 | 1220960.00000 | |
| process[Instant_mortality].m{west.sa} | 0.31271 | 0.31293 | 0.29598 | 0.26632 | 0.27151 | |
| time_varying[shifted_mu].a | -0.22921 | -0.22959 | -0.21744 | -0.17795 | -0.17121 | |
| process[recruit_E].ycs_values{1975} | 0.44537 | 0.44590 | 0.44782 | 0.44226 | 0.44368 | |
| process[recruit_E].ycs_values{1976} | 0.72940 | 0.73052 | 0.72680 | 0.70501 | 0.70695 | |
| process[recruit_E].ycs_values{1977} | 0.79231 | 0.79333 | 0.78454 | 0.75637 | 0.75887 | |
| process[recruit_E].ycs_values{1978} | 1.38645 | 1.38827 | 1.36001 | 1.29318 | 1.30663 | |
| process[recruit_E].ycs_values{1979} | 1.00265 | 1.00372 | 0.98776 | 0.94780 | 0.95478 | |
| process[recruit_E].ycs_values{1980} | 0.33437 | 0.33462 | 0.32932 | 0.31728 | 0.31857 | |

**E SSB comparison**



Biomass (t)

Year

| | |
|---|---|
| ▬▬▬ | CASAL |
| ▬▬▬ | CASAL sens1 |
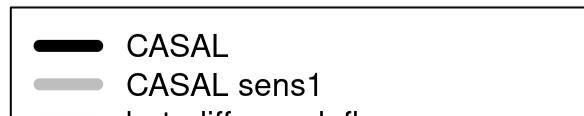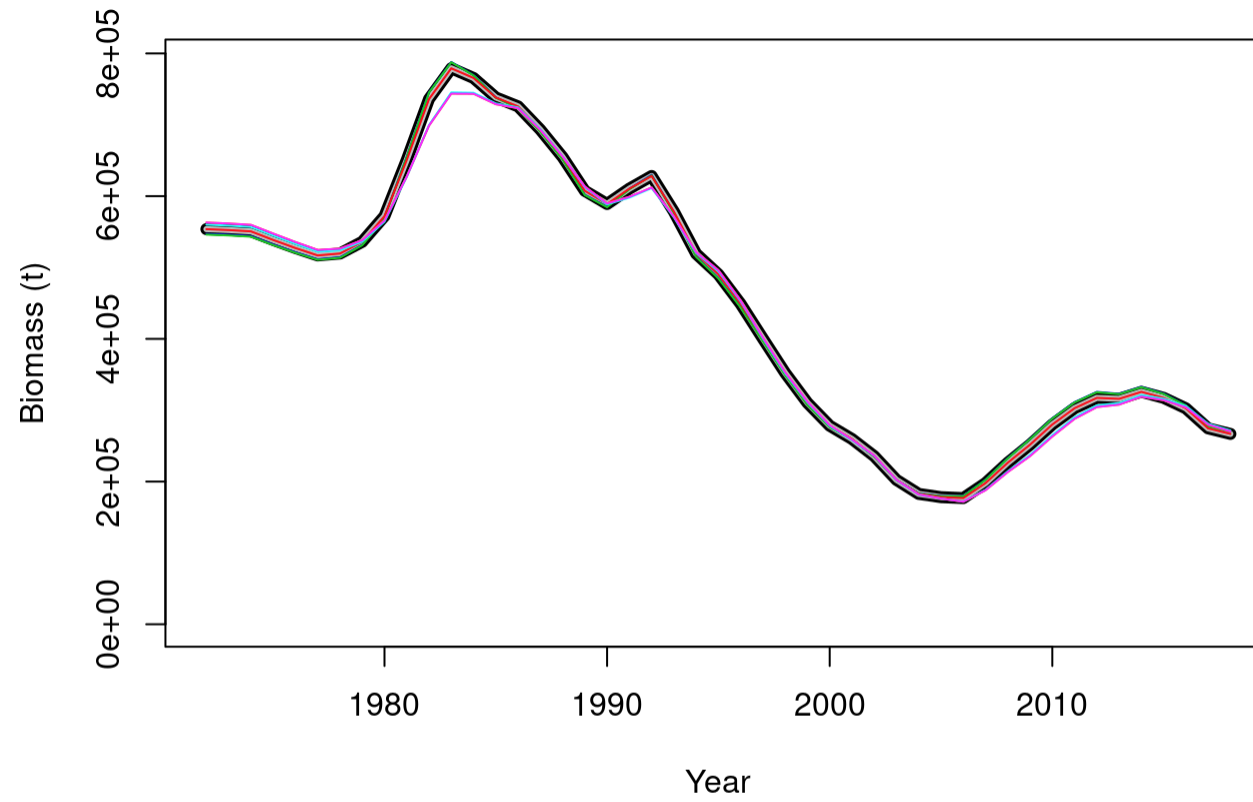
# Recent progress

# Background

- Recent Casal2 development had been delayed
  - Resource and people constraints
  - Some of the development had expanded the code base with partial development and testing of new ideas
    - Not fully implemented with partial testing and documentation
    - Some code had become obsolete with recent operating systems updates and changes (specifically on Linux)
  - User manual descriptions out of date and incomplete

# Recent developments with Casal2

- Review and develop the list of aspects to resolve
- Updates and revisions to the Casal2 code base and the documentation
  - Identified a number of software inconsistencies and bugs in the code to ensure it operates correctly
  - Initial optimisation of the software code to improve the speed of model estimation and MCMCs
  - Incomplete functionality now mostly removed (or hidden)
  - Updated the user manual
- "Streamlining" the current code base to focus on important aspects

# Resolve code inconsistencies and bugs

- Code updated to C++17
- Implemented an open-source build system
- Implemented thread-safe implementation of all code, and threading now available in some minimisers and MCMC algorithms
- Removed undocumented generation of reports etc., that caused crashes
- Cleaned the Python build scripts and supported new functionality
- Fixed functionality causing undefined behaviour and crashes
- Implemented a number of changes to improve speed and user interface
- Added and enhanced the test harness system to support creating threaded tests and to better allow running tests in different run modes

# Usability updates

- Usability modifications
  - Command line and internal syntax improvements for consistency and usability
  - Standard and default reports
  - Improved error reporting and logging
- Improve the User Manual
  - Update the user manual with methods description sections
  - Update the syntax descriptions to match the underlying code

# Upcoming developments

## Upcoming developments (this FY):

- Automatic build and test for Windows and Linux with GitHub resources.
- Speed improvements
  - Memory use.
  - Re-working age-length-weight module.
  - Model improvements.
  - Test and validate parameter transformations.
- Refine and validate existing functionality
  - Projections.
  - Simulations.

- $q$ ratio priors
  - A feature of CASAL.
  - Needed for orange roughy assessments (1st quarter 2022).
- Ongoing user documentation updates.

- Posterior predictive checks for MCMC diagnostics.

# Engaging with Casal2

First Port of Call:     https://casal2.github.io/

# Information for Casal2 Users and Developers

Casal2 is NIWA's next generation open-source integrated assessment tool for modelling the population dynamics of marine species, including fishery stock assessments. Casal2 expands functionality and increases maintainability relative to its predecessor, CASAL. Casal2 can be used for

● ● ●

## Casal2 Code of Conduct

The Casal2 Code of Conduct

## Casal2 releases for Windows and Linux

The Casal2 installation packages are available in the Casal2 GitHub repository.

The Casal2 release notes

The Casal2 project status

## CASAL files for Windows and Linux

Files for CASAL, the predecessor of Casal2

# First Port of Call (cont): https://casal2.github.io/

## Casal2 User and Developer Support Forums

The Casal2 user and developer support forums are available on the Casal2 Discourse site.

## Casal2 Contributor Guidelines

The Casal2 contributor guidelines

## About Casal2

The Casal2 software implements a generalised age-structured population model that allows for a great deal of choice in specifying the population dynamics, parameter estimation, and model outputs. Casal2 is designed for flexibility. It can implement an age-structured model for a single population or multiple populations using user-defined categories such as area, sex, and maturity. These structural elements are generic and not predefined, and are easily constructed. Casal2 models can be used for a single

Discourse site: https://casal2.discourse.group/

| all categories ▶ | **Categories** | Latest | | + New Topic |

| Category | Topics | Latest |
|---|---|---|

**Casal2 Support** — 4

For all questions and comments on Casal2 functionality, use, troubleshooting, etc.

■ Test

---

**Casal2 Development** — 7

For discussing Casal2 development: bugs, features, directions, performance, testing etc.

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**Casal2 Documentation** — 0

For discussing Casal2 documentation: current e.g. user manual, contributor guidelines, and required.

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**Casal2 Announce** — 1

Casal2 Announcements and News from the development team. Others can read and reply to posts, but not create new topics.

---

**Uncategorized** — 2

Topics that don't need a category, or don't fit into any other existing category.

---

**Site Feedback** — 0

Discussion about this site, its organization, how it works, and how we can improve it.

---

Latest:

⊤ Welcome to the Casal2 Discourse forum…read me — 0 — Nov '20

Casal2 workshop in October 2021 — 0 — 22h
■ Casal2 Announce

Casal2 workshop — 3 — 6d
■ Casal2 Development

Identify how an addressable primitive object in a class is being used? for a given model run — 0 — 7d
■ Casal2 Development

Practice creating my new topic — 3 — Apr 21
■ Test

@report.type=m_p_d gives an error — 1 — Feb 22
■ Casal2 Support

Default residual options for report.type=observation — 1 — Feb 22
■ Casal2 Development

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| all categories ▶ | Categories | **Latest** | | | **+ New Topic** |
|---|---|---|---|---|---|

| Topic | | Replies | Views | Activity |
|---|---|---|---|---|
| 📌 Welcome to the Casal2 Discourse forum…read me | | | | |
| Welcome to the official forum for all news, support and discussion of Casal2. Information about Casal2 can be found here. By using this forum you agree to abide by the Casal2 Code of Conduct. Information from Discourse … read more | | 0 | 68 | Nov '20 |
| Casal2 workshop in October 2021<br>■ Casal2 Announce | T | 0 | 9 | 22h |
| Casal2 workshop<br>■ Casal2 Development | H | 3 | 43 | 6d |
| Identify how an addressable primitive object in a class is being used? for a given model run<br>■ Casal2 Development | C | 0 | 21 | 7d |
| Practice creating my new topic<br>■ Test | | 3 | 31 | Apr 21 |
| @report.type=m_p_d gives an error<br>■ Casal2 Support | H | 1 | 35 | Feb 22 |
| Default residual options for report.type=observation<br>■ Casal2 Development | H | 1 | 37 | Feb 22 |

# If you forget the URLs:

**Type "NIWA Casal2" into Google and click on the first entry**

## Population modelling software

**Casal2 is an advanced software package developed by NIWA for modelling the population dynamics of marine species.**

Casal2 is NIWA's new integrated assessment tool for modelling population dynamics of marine species, including fishery stock assessments. Casal2 expands functionality and maintainability over its predecessor, CASAL. Casal2 can be used for quantitative assessments of marine populations, including fish, invertebrates, marine mammals and seabirds.

**Click on this link to go to the io page**

The NIWA Casal2 Development Team welcomes your contributions and feedback. Information about the use and development of Casal2 is available at https://casal2.github.io/ 🔗.

## CASAL

CASAL is maintained by the development team. CASAL software, documentation, example files, and R utility files are available on request. For more information, you can download the manual from: CASAL user manual (PDF 3.9 MB)

**Click on this link to go to the Discourse page**

## Contact us

For all enquiries and to find the latest news and conversations on Casal2, please visit our discourse site: https://casal2.discourse.group/latest 🔗

To contribute:       https://casal2.github.io/

## Casal2 User and Developer Support Forums

The Casal2 user and developer support forums are available on the Casal2 Discourse site.

## Casal2 Contributor Guidelines

The Casal2 contributor guidelines

## About Casal2

The Casal2 software implements a generalised age-structured population model that allows for a great deal of choice in specifying the population dynamics, parameter estimation, and model outputs. Casal2 is designed for flexibility. It can implement an age-structured model for a single population or multiple populations using user-defined categories such as area, sex, and maturity. These structural elements are generic and not predefined, and are easily constructed. Casal2 models can be used for a single

To contribute: https://casal2.github.io/contributing/

# Casal2 Contributor Guidelines

## Start a discussion topic on the Casal2 Discourse site, write the documents, create GitHub issue(s), then work in git branches

All work in the NIWA Casal2 GitHub repository will be coordinated by the Casal2 Development Team and tracked using GitHub issues. Supporting documents can be attached to these issues. The changes will be managed in branches and integrated in pull requests.

To contribute:

**Order of activities**

1.  Work with the Casal2 Development Team to create a GitHub issue with detailed task information and narrow scope

2.  Have the Casal2 Development Team create a branch to work on the issue in the format <topic area>_YYYYMM, e.g., retention_unit_tests_201911

3.  Review the issue and add the documents and additional information about the work to be performed

4.  Comment regularly in the issue as work progresses about what decisions were made and why, problems or questions that arise and proposed solutions, requests for clarification, etc.

5.  Create a pull request after completing the changes and passing the unit and system tests locally

6.  Work with the Casal2 Development Team to review the changes

7.  The Casal2 Development Team will merge the changes after the code review

# Casal2 releases: https://github.com/NIWAFisheriesModelling/CASAL2/releases



Casal2 releases page at https://github.com/NIWAFisheriesModelling/CASAL2/rele...

**NIWAFisheriesModelling / CASAL2** Public

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Latest release

v1.1.0

b02147d

Verified

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# Production version 1.1.0 (interim release)

NIWAFisheriesModelling released this on Jul 21

Release notes are available at the Casal2 GitHub webpages

Windows installation package: casal2_setup.exe
Windows files: Casal2.windows.zip
Debian/Ubuntu Linux installation package: Casal2.deb
Linux files: Casal2.tar.gz and Casal2.linux.zip

▾ Assets 7

| | |
|---|---|
| Casal2.deb | 14.4 MB |
| Casal2.Linux.zip | 29.6 MB |
| Casal2.tar.gz | 29.6 MB |
| Casal2.Windows.zip | 35.6 MB |

# Casal2 release notes: https://casal2.github.io/release_notes

## Casal2 Release Notes

### Version 1.1.0, released 2021-07-21

This release is from the proportions_at_weight_202101 branch. This is an interim release, as the new observation class was used in the 2021 bluenose (BNS) stock assessment which used Casal2 and followed from this document.

This release contains a new observation class, ProcessRemovalsByWeight. The technical specification for this new observation class is in the Documentation/Enhancements subdirectory. The unit test and the R code that produced the values in the unit test are also in the repository.

Casal2 now outputs the covariance matrix from CppAD minimisation.

This release also updates the MPD reports for the Casal2 Test Cases. The Test Cases are 6 sets of age-based stock assessment models (labeled BCO, HAK, HOK, LIN, ORH, and SBW) that were constructed to include a commonly used subset of the existing functionality.

The Windows installation package for CASAL and the executables for Windows and Linux are in the TestCases/CASAL subdirectory.

### Known issues

The executables in this release have known efficiency issues.

The documentation in this release is not complete.

The simulation functionality has not been reviewed or tested.

Casal2 releases: https://github.com/NIWAFisheriesModelling/CASAL2/releases

# Future features

# Future features:

Ideas raised during open discussion:

- True length-based model (CASAL did this)

- Preference functions (or equivalent functionality implemented in Casal2)

- MICE application

- Close Kin Mark Recapture (CKMR)

- Tagging