EcoFish Status and Progress in 2014

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Work Package linkages

Experience based knowledge

WP3 Shareholder knowledge & acceptance

WP2 Data based scientific knowledge

Catchability
Stock structure
Growth
Trophodynamics

WP1 Model based scientific knowledge

Stock assessment I
Stock assessment II

WP4 Training

Capacity building

WP3 Decision support tools

"Fishermen"

"scientists"
Work Package linkages

Experience based knowledge

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Stock assessment I

Stock assessment II

WP3 Decision support tools

Paulus Kainge et. al.
Kai Wieland et al.
Romina Henriques et al.
Sarah Paulus
Johannes Itsembu
Victoria Erasmus

John Kathena et al.
WP1 workplan

- **Task 1.1**
  - National hake stock assessment data and compilation procedures (Deliverable 1.1)
    → Reviewed and described
  - Set up of state space assessment model (SAM) (Deliverable 1.2)
    → Namibian hake and horse mackerel
  - Comparing results from SAM to age model (SCAA)
    → Namibian hake (and horse mackerel)

![Graph of Recruitment of Namibian hake](image)

- **Web interface for SAM**

- **Presentation by John**
WP1 workplan

- **Task 1.1 cont.**
  - Data compilation for transboundary analyses, review of data, data compilation procedures, e.g. split of species
    → Establish trans-boundary assessment data in progress.
    → Trawl survey data prepared for analysis of distribution, stock structure, catchability and growth of hake.

- **Task 1.2**
  - Modify SCAA assessment model for SA hake to a spatial-box model with movement
    → In progress, model coded, results presented to the SA Demersal WG in December 2013 and update will be discussed at the WG in 2014.

  The model uses a box structure to account for the possible presence of multiple stocks of each of the two hake species off South Africa.
WP 1 Spatial-box model for SA hake

Example plot for an estimated moving/transport matrix *M. paradoxus* age 0 and 1

The size of the arrows is proportional to the percentage of fish moving.

The circles represent the percentage of fish staying in an area.

Black crosses show the regions in which this species is assumed to be absent for this age group.

Rademeyer (2013)
Workplan WP1

- **Task 1.3**
  - Compilation of stock assessment data for horse mackerel and sardinella, inclusive relevant quality measures (Deliverable 1.4)
    → Namibian horse mackerel
    → Sardinella and *T. trecae* started by Small Pelagic WG in August 2014 (e.g. review of sampling procedures, data inventory)
  - SAM model for horse mackerel and sardinella (Deliverable 1.9)
    → Namibian Horse mackerel
    → Sardinella and *T. trecae* - transboundary problem to the north

- **Task 1.4**
  - Extend spatial SCAA box model for hake to include Namibia, taking into account stock-structure within species with input from WP2.1 (Deliverable 1.3, part II)

→ Status of WP2?
WP 2 Input to stock assessment models

1. Determine hake **stock structure** through genetic analysis
2. Correct time series of hake **catch per unit effort data** according to environmentally-driven differences in catchability
3. Improve estimates of hake, horse mackerel and sardinella **growth rates** through **improved ageing**
4. Determine the **trophic position** of hake, horse mackerel and other demersal and pelagic fish in the northern Benguela

We will hear about tasks 2-4 afterwards, so will concentrate mostly on task 1
WP 2.1 Stock structure

BCC ECOFISH Workshop on hake stock structure March 2014:

Aim was to initiate coordinated discussions towards development of hypotheses on the stock structure of *M. capensis* and *M. paradoxus* using information from

- Genetic analyses → results presented by Romina Henriques et al.
- Parasites
- Distribution and migration - research surveys results analysed by
  - Geographical and temporal patterns of spawning, age and growth
  - The new Length Cohort GeoPop model (simple size spectrum model coupled into a model of space-time distributions of cohorts)
WP 2.1 Regional data

Demersal trawl surveys
• 3 vessels
  January-May 1998-2012

Challenges
• 3 different trawl types
• Catchability
• Vertical day/night-migration
• Uncertainties about growth

Opportunities
• 7,800 standardized demersal trawl hauls
• 14.4 million hakes!
• Data analysis beyond simple raising and smoothing:
  Patterns in space-time linked by growth

Intercalibration between Africana (new/old gear) vs. Fridjof Nansen (Gisund trawl)

236 pairs of trawl hauls considering nugget effect:
correlations between size groups within single haul
WP 2.1 Gear selectivity: Africana vs. Fridjof Nansen

Relative selectivity (with 95% confidence intervals)

M. capensis

Africana old / Gisund

M. paradoxus

Africana new / Gisund

Approach feasible & promising

Results indicate:
- higher catchability of smaller fish by Gisund
- larger fish by Gisund compared to new Africana gear (border-line of significance)
- indirect estimation of old vs. new Africana possible, but more uncertain
WP 2.1 GEOstatistical POPulation model (GeoPop)

Estimated parameters for:

- Gear effects was unexpected given info on mesh-size, sweep length etc. ⇒ results from gear selectivity analysis needs to be included (hardcoded)
- Growth was in fair proximity to published growth rates ⇒ but depends on ageing
- Due to “ridge-problem” (more than one minimization solution) when fitting the model, results preliminary ⇒ estimation problem will be solved
- Spatial patterns seem robust, so we expect the final outcome to be close to the patterns presented here
WP 2.1 GeoPop results

Merlucius capensis: Along-shore and depths distribution by age and mean length (similar analysis for M. paradoxus)

Dashed line: center of gravity got hakes north of 2150 km and south of 1550 km

Dashed line: mean depths
WP 2.1 Stock structure

Workshop on hake stock structure March 2014:

Three alternative hypothesis recommended for *M. capensis* (one, two and three stocks) and two for *M. paradoxus* (one and two stocks)

Schematic illustration of hypotheses:
*Merluccius capensis*: Scenarios 1A – 1D. *Merluccius paradoxus*: Scenarios 2A and 2B.

Results from the genetic analyses to corroborate these hypotheses to be reviewed at workshop on hake stock structure in mid November 2014.
WP 2.2 Catchability

SA west coast

Analysis documents that:
1) Time of day effect not relevant for survey
2) Wind effect in a part of the area important (list of stations which should be discarded has been provided)
3) No indication that ‘green water’ effects seriously the quality of the survey indices, but process needs to be studied in 2014/2015 (commercial & scientific vessels)
4) High portion of *M. paradoxus* at depths larger than covered by the survey in 2002-2010 depending on bottom temperature on shelf, method for ‘adding’ biomass by length group requires validation (contribution to SA demersal workshop in December 2014)

SA south coast

No analysis done but 1) and 3) likely also true, 2) and 4) are not relevant

→ unlikely that correction of survey indices is necessary

Wieland et al. (2014)
WP 2.2 Catchability

Situation in Namibia

→ Presentation by Paul

Instrumentation package deployed for studying environmental effects on hake catchability
→ Presentation by Kai
WP 2.3 Ageing and growth

A workshop on age validation of *M. capensis* and *M. paradoxus* was conducted in April 2014.

A new method of age reading developed, indicates bi-annual ring formation and considerably faster growth rates than previously assumed.

Several manuscripts on hake age validation by Wilhelm et al.

Conceptual life cycle model explaining when and where translucent ring (T) form.
WP 2.3 Ageing and growth

A further workshop to identify gaps in present knowledge and constraints in present methodologies was conducted in August 2014.

Further work:

• Validation of the new method, e.g. bi-annuality of transluscent ring formation, marginal increment analyses (MIA) – work is in progress.
• Consider species specific and cohort specific differences in growth rates.
• Improve port sampling and age data collection across the region – also for pelagics e.g. horse mackerel.

→ Presentation by Sarah
→ Contributions to ICES 5th International Otolith Symposium 2014, 20–24 October 2014, Mallorca, Spain
WP 2.4 Trophodynamics

Presentations:

➔ Some aspects of the trophic relationships of hake, horse mackerel and Sardinella: Stable isotopes results by Johannes

➔ Trophic relationships of some prey species off Namibia: Stables isotopes approach by Victoria
WP1 workplan (phase 2)

• Task 1.3 cont.
  – Hake stock assessment with results from WP2.2 to be integrated
    → One of the consequences from work in WP2.3: extending SAM to use catch-at-length instead of catch-at-age and incorporate age-length key data
    → Required to re-implement the model on C++ based Template Model Builder (TMB) to replace AD Model Builder to increase necessary speed handling more model complexity (resulted a 60 times faster performance)
    More information on: http://tmb-project.org

• Task 1.5
  – Modify SCAA to take account of hake cannibalism and inter-species predation with information from WP2.4
    → In progress for reporting at SA Demersal WG December 2014

• Task 1.6
  – Extend SAM to cover two species, SA west and south coast and possibly also the Namibian regions with input from WP2.1 (Deliverables 1.6)
    → Model to be set-up based on results from WP2.1 taking into account also improved growth and catchability estimates (input from WP2.2 & 2.3)
WP 3 Incorporation of stakeholder knowledge

Objectives

1. Develop social and economic indicators for fisheries
2. Develop expert systems to integrate multitude of indicators into a single assessment
3. Develop methods for including stakeholder knowledge in assessment and management

Task 1.

• 39 indicators were developed
  - human wellbeing (25 indicators)
  - ability to achieve (14 indicators)
  - ecological wellbeing (9 indicators, taken from management plan)

• To integrate all indicators into a single assessment, a framework was developed based on goals derived from key policy documents:
  ‣ FAO code of conduct for responsible fisheries; Marine Resources Act (2000); The white paper (2004); Hake management plan.

• The framework breaks policy goals into operational objectives; specific indicators for each objective; definition of parameters for each indicator and specifies data properties (source & type of data required).
WP 3 Incorporation of stakeholder knowledge

Integration of fishers knowledge into stock assessment: Namibian hake fisheries

1. Understanding of fish & fishing behaviour important for accuracy of assessment
   - Log-book data require interpretations
   - Knowledge on stock structure, distribution and migration
   - Knowledge on efficiency (e.g. technological creeping)

2. When stakeholder and scientific information match, uncertainty in assessment and management can be reduced

3. When information diverge, further investigations are needed to strengthen the knowledge base

→ Case study in Angola pending

Four peer reviewed publications: Paterson et al. (2013), Draper (2014), Paterson & Kainge (2014) and Peterson (in press)
WP 4 Training and capacity building

Programme since Annual Science Forum 2013

• WP1 SAM introduction to stakeholders, 4. October 2013, Walvis Bay
• WP1 Fish stock assessment course, 7.-10. October 2013, Cape Town
• WP1 session in Annual SA International Stock Assessment Review Workshop, 4.-5. December 2013, Cape Town
• WP1/Wp2 workshop on hake stock structure, 26.-28. March 2014, Cape Town
• WP2 workshop on hake age validation, 7.-12. April 2014, Swakopmund
• WP1 workshop on assessment modelling of hake, 26.-28. May 2014, Copenhagen
• WP2 workshop on ageing, 12.-15. August 2014, Copenhagen
Summary WP 1

Improve stock-assessment methodologies and establish trans-boundary assessment models that could provide a basis for regional fisheries management advice

→ Substantial progress made in:
  - compilation/quality assurance of assessment input data, requires more regional cooperation and data management structures,
  - analyses of survey results and development of geostatistical modelling tools, technical problems encountered – but will be solved,
  - implementation of easy to use/statistically sound stock assessment models,
  - incorporating and capturing important processes should not be a contradiction, but is a challenge.

→ Way forward through BCC Small Pelagic WG (set-up in 2013), Demersal WG (to be started in 2014).
**Summary WP 2**

Enhance the knowledge on stock structure, growth and mortality rates as well as catchability, information to be used in fish stock assessments:

- genetic analyses in progress, but required higher effort than expected, other information on stock structure drawn in;
- catchability analyses progresses – field part a bit delayed due to technical problems, but sea trials on-going;
- growth analyses/ageing a substantial challenge, as back-up length based assessment model under development;
- trophodynamic analysis on its way, implementation in stock assessment focusses on cannibalism, how important for assessment?
Summary WP 3 and 4

Develop methods for including stakeholder knowledge in stock assessment and fisheries management

→ Results from industry survey for Namibian hake confirms largely WP2 findings on distribution, diurnal and horizontal migration, catchability, partly also stock structure (merger of information with WP2 also in publications).

→ Social and economic indicators for fisheries reviewed and framework developed to integrate indicators into a single assessment.

Training and capacity building in methodologies throughout project.

→ Series of workshops and courses conducted, but participation often local; repetition in different locations necessary; higher effort than expected – advantage that level can be adjusted to local needs.
Conclusions

Challenging project, of high importance to build up international and transboundary stock assessment and advisory capabilities in BCC.

Progress is good, but it needs to be recognised that we deal with some problems hardly solved in other regions of the world, even with well established international stock assessment/advisory organisations; these include:

• spatially explicit stock assessment models,
• catchability changes in relation to environmental changes.

Way forward

Will be incremental and through BCC pelagic and demersal WG’s and continued international cooperation.

Planning second phase for EcoFish

It is expected that major scientific and technical project goals are reached.

However, successful and sustainable implementation as well as further development requires a follow-up project.
Thank you for listening!