ECASA - Model description template

1	**Name of model**	*Reporter/Institute (email address) Daniele Brigolin & Roberto Pastres, DCF-Unive. (brigo@unive.it)*
1.a	***BREAMOD.***	
1.b	*31/7/2007*	

2	**Short DESCRIPTION of model**	
2.a	*Main state variables:*	Wet weight.
2.b	*Scale to which applicable:*	Local, scale A.
2.c	*General description.* *NB: if the model is complicated, or has easily distinguishable components (such as a physical and a biological sub-models) that can be, or have been, used separately, it may be easier to complete one form for each of the main components.*	Bio-energetic individual-based model, which describes the growth of the Gilthead seabream, *Sparus aurata*. The model is based on the equation proposed by Ursin (1967), which describes fish growth as the result of an energy budget, and on the results presented in (Lupatch, 200?), in which the nutritional requirements of seabream are investigated. The rate of energy assimilation, i.e. the anabolic term, depends on wet weight, water temperature, and feed composition. The rate of energy loss through respiration is explicitly taken into account. The respiration rate depends on water temperature and on wet weight.
2.d	*Key semi-universal parameters and example values (which should apply at least regionally or for at least one type of water body); summarize any restrictions or reservations about these parameters*	The parameters of the model which specify the respiration rate were estimated using the oxygen consumption data reported in Guinea & Fernandez (1997). Preliminary estimates of the parameters which specifies the dependence of the specific rate of energy assimilation on the water temperature were obtained on the basis of the data presented in Petridis & Rogdakis (1996). Parameters were finely tuned by calibrating the model against a data set collected at Porto Ercole, which was made available by ECASA participant ICRAM .
2.e	*Main forcing data needed - initial values of state variables; boundary conditions; inputs; imposed environmental conditions; generalized loss terms. State whether single values or time-series needed.*	Feed composition, monthly time series of water temperature and the average feed ration. Initial value of wet weight.
2.f	*Restrictions to use of model*	The model was calibrated and validated over the following ranges of forcings: temperature: 9.5-26 °C. Protein daily ratio: 0.85-5.5 g /kg $^{0.7}$. Model performances should be re-assessed if the forcings were to exceed the above boundaries.

3	**possibly relevant INDICATORS and example EcoQOs**	
3.a	***D**river*	
3.b	***P**ressure*	The model can be used for estimating the faeces production rate and, therefore, the monthly loads of N and P released by each cage, as a function of the biomass, water temperature, feed ration and composition.
3.c	***S**tate*	The model can be coupled with: ➢ a transport model, in order to estimate the increase in the concentration of dissolved N and P due to release of seabream excretions; ➢ a deposition model, in order to estimate the fluxes of C, N and P on the sediment, due to seabream faeces.
3.d	***I**mpact*	
3.e	***R**esponse*	

4	**STATUS of model** *NB: refers to scientific theory and equation set; distinguish from implementation*	
4.a	*Origin(ator) of model concept and initial formulation:*	DCF-Unive. Pastres, R., Libralato, S., Brigolin, D.
4.b	*Present status of model, including scientific basis of claimed robustness and key matters still needing study:*	The model was calibrated and validated using two data sets made available by ECASA Participant 11, ICRAM-Rome.
4.c	*Present use:*	This individual-based model was applied in combination with MERAMOD, for assessing the impact of a seabream farm at the Bisceglie ECASA study site.
4.d	*Potential use and development in ECASA :*	The coupling of this model with a deposition model, such as MERAMOD, could provide a useful tool for EIA, since the integrated model can simulate the deposition of food waste and faeces, as a function of fish size, water temperature and husbandry practises.

5	**IMPLEMENTATION of model**	
5.a	*State of implementation :* *(This refers to realization of model theory in numerical algorithms, spreadsheets, computer programs, etc. to provide solutions of the model equations when supplied with appropriate forcing data.*	The model was coded using MatLab. A Visual-basic user friendly interface will be available by December 2007.
5.b	*State of documentation (which describes how to use an*	The state equation and the formulations which relate the seabream anabolism and catabolism to water

	implementation as well as giving model theory)	temperature are described in detail in (Libralato, 1998). A detailed account of model calibration and validation is given in (Brigolin, 2007).
5.c	*Intellectual property concerns - if none stated here, model and implementation will be deemed to freely available on request*	Available to ECASA participant

6.	**TESTING of model**	
6.a	*Summary of conditions and measurements needed:* *Refer back to 2.e if necessary. Highlight observations needed for model testing.*	Input data: feed composition, monthly time series of: water temperature, feed ration. Output data: time series of wet weight, time series of faeces production.
6.b	*Criteria for model rejection*	

7	**OTHER models**	
7.a	*Used explicitly or implicitly with this model*	
7.b	*Similar models (which might serve roughly the same purpose in relation to mariculture)*	Cuenco et al. (1985) and Hernández et al. (2003).

8. REFERENCES cited *show in bold the most important paper describing the model*

Barbaro, A., Francescon, A., Guidasti, G., 1982. Alimentazione di *Sparus aurata* L. in ambiente vallivo, Boll. Mus. Ist. Biol. Univ. Genova, 50 suppl.: 372.

Brigolin, D. , 2007. Development of integrated numerical models for the sustainable management of marine aquaculture. Ph.D. thesis in Environmental Science, University of Venice.

Cuenco, M.L., Stickney, R.R., Grant, W.E., 1985, Fish bioenergetics and growth in aquaculture ponds: I. Individual fish model development. Ecological Modelling 27, 169-190.

Guinea, J. and Fernandez, F., 1997. Effect of feeding frquency, feeding level and temperature on the energy metabolism in *Sparus aurata*, Aquaculture 148, 125-142.

Hernández, J.M., Gasca-Leyva, E., León, C.J. and Vergara, J.M., 2003. A growth model for gilthead seabream (*Sparus aurata*), Ecological Modelling 165, 265-283.

Libralato S., 1998. Identification and possible applications in aquaculture of a growth model of *Sparus aurata*. M.Sc. thesis, Ca' Foscari University of Venice, (in Italian).

Lupatsch I., G.W. Kissil, Skaln, D. Defining energy and protein requirements of gilthead seabream (Sparus Aurata) to optimize feeds and feeding regimes. The Israeli Journal of Aquaculture, – Bamidgeh 55(4), 2003, 243-257.

Petridis, D. and Rogdakis, I., 1996. The developement of growth and feeding equations for sea bream, *Sparus aurata* L., culture. Aquaculture research 27, 413-419.

Ursin, E., 1967. A mathematical model of some aspects of fish growth, respiration and mortality. J. Fisheries Res. Board Canada 24 (11), 2335–2453.