

Modeling the impact of oyster culture on a mudflat food web in Marennes-Oléron Bay (France)

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Appendix 1. Details on macrofauna groups outside the oyster tables. Ninety-eight % of the total macrofauna was taken into account and divided into 4 categories according to their class (data from P.G. Sauriau, used in Leguerrier et al. 2003). Diets are given according to the following abbreviations: ssd = facultative suspension feeders, dep = deposit-feeders, sus = suspension feeders (filter feeders), car = carnivores, omn = omnivores

Compartment and species			Biomass mgC m ⁻²	% of total macrofauna	Diet
Bivalves: bbiv			1111.81	57.6%	
<i>Macoma balthica</i>	Mollusca	Bivalvia	450.68	23 %	ssd
<i>Scrobicularia plana</i> (= <i>S. piperata</i>)	Mollusca	Bivalvia	397.36	21 %	ssd
<i>Abra nitida</i>	Mollusca	Bivalvia	133.18	7 %	dep
<i>Abra tenuis</i>	Mollusca	Bivalvia	48.95	2.5 %	dep
<i>Cerastoderma</i> (= <i>Cardium</i>) <i>edule</i>	Mollusca	Bivalvia	36.10	1.9 %	sus
<i>Tapes philippinarum</i>	Mollusca	Bivalvia	23.13	1.2 %	sus
<i>Mytilus edulis</i>	Mollusca	Bivalvia	17.16	0.9 %	sus
<i>Parvicardium ovale</i>	Mollusca	Bivalvia	5.25	0.3 %	sus
Annelids and nemerteans: bann			385.54	20 %	
<i>Sternaspis scutata</i>	Annelida	Polychaeta	95.85	5 %	dep
<i>Nephtys hombergii</i>	Annelida	Polychaeta	61.47	3.2 %	car
<i>Nemertes</i>	nemertes		53.13	2.8 %	car
<i>Hediste</i> (= <i>Nereis</i>) <i>diversicolor</i>	Annelida	Polychaeta	45.32	2.4 %	omn
<i>Glycera</i> sp.	Annelida	Polychaeta	39.07	2 %	car
<i>Euclymene</i> (= <i>Clymene</i>) <i>oerstedii</i>	Annelida	Polychaeta	25.60	1.3 %	dep
<i>Pseudopolydora antennata</i>	Annelida	Polychaeta	24.51	1.3 %	dep
<i>Clymenura tricirrata</i>	Annelida	Polychaeta	15.20	0.8 %	dep
<i>Ampharete acutifrons</i> (= <i>A. grubei</i>)	Annelida	Polychaeta	5.72	0.30 %	car
<i>Diopatra neapolitana</i>	Annelida	Polychaeta	5.47	0.28 %	car
<i>Heteromastus filiformis</i>	Annelida	Polychaeta	5.10	0.26 %	dep
<i>Neanthes</i> (= <i>Nereis</i>) <i>succinea</i>	Annelida	Polychaeta	4.90	0.25 %	dep
<i>Terebellides stroemi</i>	Annelida	Polychaeta	4.21	0.22 %	car
Gastropods: bgas			321.82	16.7%	
<i>Hydrobia ulvae</i> (<i>Peringia ulvae</i>)	Mollusca	Gastropoda	308.90	16 %	dep
<i>Ocenebra erinacea</i>	Mollusca	Gastropoda	12.92	0.67 %	car
Arthropods: bart			67.52	3.5%	
<i>Carcinus maenas</i>	Arthropoda	Eumalacostraca	44.77	2.3 %	omn
<i>Corophium volutator</i>	Arthropoda	Eumalacostraca	22.74	1.2 %	dep
Total macrofauna			1886.68	98 %	

Appendix 2. Data used for the inverse analysis as equations (=) or constraints (min/max values). Compartments are referred to by their abbreviations given in Table 1, mic = microfauna, bac = bacteria, n c mac = non cultivated macrofauna. Other abbreviations: B = biomass, C = consumption, F = feces, I = ingestion, M = mortality, P = production, R = respiration, Excr = excretion, NPP = net primary production, GPP = gross primary production, AE = assimilation efficiency ((P+R)/C), GE = growth efficiency (P/C), and \propto = is proportional to

Compart.	Flow	Min value	Max value	Unit	Source	Remarks
bphy	NPP	188	307	$g C m^{-2} yr^{-1}$	Blanchard et al. (1996), Blanchard et al. (1997), Guarini et al. (1998) Vézina & Platt (1988) Guarini (pers. comm.) Baines & Pace (1991), Vézina et al. (1997)	Calculus: Max Productivity \times Biofilm concentration \times Exondation time
	R / GPP	5%	30%			
	Resuspension/NPP	30%	50%			
	Excr/ NPP	2%	55%			
pphy	P/B	28.6	37.4	$g C g C^{-1} yr^{-1}$	Ménesguen & Hoch (1997) Vézina & Platt (1988) Baines & Pace (1991), Vézina et al. (1997)	
	R/GPP	5%	30%			
	Excr/NPP	2%	55%			
bbac	bbac P	296	502.5	$g C m^{-2} yr^{-1}$	Garet (1996)	
	bbac R	176	300	$g C m^{-2} yr^{-1}$		
pbac	P/B	=	392	$g C g C^{-1} yr^{-1}$	Newell & Linley (1984)	
	R/B	=	873	$g C g C^{-1} yr^{-1}$		
bmic	Excr	10% of I	R		Vézina et al. (1997)	
pmic	Excr	10% of I	R		Vézina et al. (1997)	
	C/B	236	451	$g C g C^{-1} yr^{-1}$	Newell & Linley (1984)	
	P/B	59	158	$g C g C^{-1} yr^{-1}$		
	R/B	97	293	$g C g C^{-1} yr^{-1}$		
bmei	P/B	2.7	31	$g C g C^{-1} yr^{-1}$	Giere (1993)	
	Herbivore	=	44.6%		Rzeznik (pers. comm.)	
	Carnivore	=	0.20			
pmes	Grazing	3.6	16.7	$g C m^{-2} yr^{-1}$	Sautour & Castel (1993) Anderson & Ducklow (2001)	
	F / Excr	=	5			
birds	C	5.05	6	$g C m^{-2} yr^{-1}$	Turpie & Hockey (1996), Triplet et al. (1999), Pienkowski et al. (1984)	Biomasses: Boileau (pers. comm.)
	Shelduck C on bgas (<i>Hydrobia ulvae</i>), bphy, & bmic		0.35	$g C m^{-2} yr^{-1}$		
bbiv	P/B	0.1	8.9	$g C g C^{-1} yr^{-1}$	Biomass and diets: Kang (pers. comm.)	No selection
	R/B	0.64	15.7	$g C g C^{-1} yr^{-1}$		
	F/B	1.48	7.3	$g C g C^{-1} yr^{-1}$		
	Diet: benthic / pelagic C	30%	70%			
	Diet in the pelagic layer	\propto biomass				
bgas	P/B	0.33	6.58	$g C g C^{-1} yr^{-1}$	Rates: literature (reviewed in Leguerrier et al. 2003)	No specific R/B found Range of R/B bivalves taken
	R/B					
	Carnivores	=	96%			
bann	P/B	0.2	6.55	$g C g C^{-1} yr^{-1}$	Rates: literature (reviewed in Leguerrier et al. 2003)	No specific R/B found Range of R/B bivalves taken
	R/B	3.9		$g C g C^{-1} yr^{-1}$		
	Carnivores	=	50%			
bart	P/B	1.08	8.25	$g C g C^{-1} yr^{-1}$	Rates: literature (reviewed in Leguerrier et al. 2003)	No specific R/B found Range of R/B bivalves taken
	R/B					
	Carnivores	=	58%			
bcoy	Commercial P/B	0.27	0.44	$g C g C^{-1} yr^{-1}$	Details given in Table 2b	Shell of dead oysters + commercial P: exported F + flesh of dead oysters Go to bPOC
	R/B	3.1	6.6	$g C g C^{-1} yr^{-1}$		
	(F + M)/B	11.5 + 9%	51.6 + 18%	$g C g C^{-1} yr^{-1}$		
	Pred by bgas / commercial P	=	1%			
	Diet in the pelagic layer	\propto biomass (no selection)				
	Living particles sedimenting	=	70	$g C m^{-2} yr^{-1}$		In simulation B
	Proportion in PSF	\propto biomass				
General	GE	10%	60%		Vézina et al. (1997)	Bacteria, microfauna
	GE	10%	30%		Savenkoff et al. (2001)	Bmei, pmes, n c mac & nekton
	AE (all cpt except bac & mci)	50%	90%			

Appendix 3. Details on data and calculations concerning oysters. Values are given for Simulation B (16 % of mudflat area covered by oyster tables)

Abbrev.	Name	Value	Source
Biomass on oyster tables			
TW	Total weight	4.39 kg m ⁻²	} Le Moine (pers. comm.)
WW	Wet weight (tissues)	WW/TW = 0.12	
DW	Dry weight (tissues)	DW / WW = 0.15	Bernard (1974)
AFDW	Ash free dry weight (tissues)	AFDW / DW = 0.9	} Jean & Thouzeau (1995)
CW	Carbon weight (tissues)	CW / AFDW = 0.4	
SW	Shell total weight	SW = TW - WW	
OMSW	Shell organic matter weight	OMSW = 33 % (SW)	Razet et al. (1990)
CSW	Shell carbon weight	CSW = 3 % (OMSW) = 1 % (SW)	Pouvreau (pers. comm.)
Average Brouage square meter			
	Surface of oyster beds	2731 ha	} Le Moine (pers. comm.)
	Surface of MOB	17 000 ha	
SB	Shell average biomass	6.2 g C m ⁻²	
TB	Tissue average biomass	4.6 g C m ⁻²	
Feces production			
Fmin	Feces production minimum	0.01 g h ⁻¹ g DW ⁻¹	} Razet et al. (1990)
Fmax	Feces production maximum	0.045 g h ⁻¹ g DW ⁻¹	
FC%	Fraction of carbon in feces	4.72 %	
C Fmin	Feces production minimum , in C	11.5 g C yr ⁻¹ g C ⁻¹	
C Fmax	Feces production maximum , in C	51.7 g C yr ⁻¹ g C ⁻¹	
Commercial production			
P min	110 000 tons produces 30 000 tons	0.27 yr ⁻¹	} Bacher (1989)
P max	90 000 tons produces 40 000 tons	0.4 yr ⁻¹	
P/B	Average production rate	0.36 yr ⁻¹	
Pseudofeces production			
Fil	Filtration rate	4-7 l h ⁻¹ g DW ⁻¹	Smaal & Zurburg (1997)
[SES]	Seston concentration	0.025-0.17 g l ⁻¹	} Razet et al. (1990)
[SES] C%	Fraction of carbon in seston	4.03 %	
SRi	Specific rejection rate for seston concentration i	SR25 = 50 %; SR170 = 83 %	} Barillé et al. (1997)
<PSF>	Mean pseudofeces production	254.4 g C yr ⁻¹ g C ⁻¹	
Respiration			
R O ₂	Respiration rate (T: temperature)	R O ₂ = (-0.432 + 0.613 T ^{1.042}) DW ^{0.8}	Bougrier et al. (1995)
NRJ/O ₂	Conversion rate : energetic equivalent of O ₂	1 mg O ₂ = 1/0.7/20.08 J	Barillé et al. (1995)
Tmin	Temperature minimums per season (Winter-Spring-Summer-Autumn)	1 - 6 - 15 - 16 °C	} Blanchard et al. (1996)
Tmax	Temperature maximums per season (Winter-Spring-Summer-Autumn)	11 - 19 - 29 - 25 °C	
R J	Respiration rate (energetic value)	62 - 133 J yr ⁻¹ g DW ⁻¹	
C/NRJ	Conversion rate: energetic value of carbon	1 mg C = 55.67 J	
C Rmin	Respiration rate minimum	3.1 g C yr ⁻¹ g C ⁻¹	
C Rmax	Respiration rate maximum	6.6 g C yr ⁻¹ g C ⁻¹	
Mortality			
M min	Natural mortality rate minimum	9 % of the production	} Soletchnik et al. (1999)
M max	Natural mortality rate maximum	18 % of the production	

Appendix 4. Biomass variations due to oyster tables in the Eastern MOB mudflat. The macrofaunal biomass is reduced under oyster tables. The contributions of bivalves, gastropods, annelids and arthropods (given in parentheses) vary under the tables to the benefit of annelids and arthropods at the expense of the bivalves (Sauriau et al. 1989). The meiofaunal biomass is enhanced under oyster tables (Castel et al. 1989). The third column gives the weighted average: (1 - % area in culture) × biomass outside oyster tables + % area in culture × biomass under oyster tables. These data were used to calculate the biomasses under oyster tables from the knowledge of the biomasses outside them

Biomass (g C m ⁻²)	Outside oyster tables	Under oyster tables	Mean m ² with 16 % oyster tables (Simulation B)
Meiofauna:	0.44	1.61	0.62
Total macrofauna:	1.9	0.424	1.66
Bivalves	1.11 (58 %)	0.111 (26 %)	0.95 (57 %)
Annelids	0.39 (20 %)	0.199 (47 %)	0.36 (21.5 %)
Gastropods	0.32 (17 %)	0.067 (16 %)	0.28 (17 %)
Arthropods	0.08 (4 %)	0.047 (11 %)	0.07 (4.5 %)

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