Pelagic processes Case study: The Southern Ocean





1. Physico-chemical environment 1.1. Water masses and circulation









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Primary production Controlling factors: *Nutrients*



Marginal ice zone

- Sea ice concentrates airborne Fe during winter
- Psychrophilic algae seed the water column when ice melts







2. P 2.3. (rim Cont nated protozo daily primary	ary p rolling	orodu g facto e Southern Ocea duction.	ors: <i>Bi</i>	ר otic interactions
Area	Period	% of primary production grazed per day	% of bacterial production grazed per day	References	Protozoa control
Atlantic sector	October-	40	32	Becquevort,	autotrophic
ACC	October/ November	34		Klass, in press	nanoflagellates (ca. 50%
Polar front area	October/ November	44		Klass, in press	production) \rightarrow no
Weddell/ Scotia Sea	November	10	11	Garrison and Buck, 1989	nanophytoplankton
Weddell/ Scotia Sea	November	68	53	Garrison and Buck, 1989	bioom
Weddell/ Scotia Sea	March	58	22	Garrison and Buck, 1989	
Weddell/ Scotia Sea	June/July	53	68	Garrison <u>et al.</u> 1990c,d; 1992, 1993,	
McMurdo Sound	December		9	Putt <u>et al.</u> , 1991	
McMurdo Sound	January		13	Putt <u>et al.</u> , 1991	
Indian sector	March	50	90	Menon <u>et al.,</u> 1995	
Indian sector		(47->100)		Taylor and Haberstroh, 1988	
Prydz Bay	January	9		Archer <u>et al.</u> submitted	
Prydz Bay	February	22		Archer <u>et al.</u> , submitted	Lancelot et al. 1996





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ACC	October/ November	34		Klass, in press	Protozoa control
Polar front area	October/ November	44		Klass, in press	bacterial production
Weddell/ Scotia Sea	November	10	11	Garrison and Buck, 1989	(10- 90% production)
Weddell/ Scotia Sea	November	68	53	Garrison and Buck, 1989	
Weddell/ Scotia Sea	March	58		Garrison and Buck, 1989	
Weddell/ Scotia Sea	June/July	53	68	Garrison <u>et al.</u> 1990c,d; 1992, 1993.	
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3. Consumers3.2. Linear food chain: *Higher ranks*

	Lower estimate	Higher estimate	
	Krill production (10 ⁶ T/year)		
	400	1385	
Present			
Таха	Krill consumption	on (10 ⁶ T/year)	
Cetaceans (baleen whales)	34	43	
Seals (crabeater seal Lobodon carcinophagus)	64	129	
Cephalopods (principally squids of the order Oegopsidea)	30	50	
Birds (penguins accounting for 90% of the biomass of and 86% of the	25	50	
food consumed by Antarctic birds)			
Fishes (Champsocephalus gunnari Notothenia rossii)	10 ?	20 ?	
Total	163	292	
% of krill production	163/1385= 12%	292/400= 73%	
Before whale hunting			
Baleen whales		190	

•	Krill eaters consume a
	significant part of krill
	production

 Before whale hunting, most of krill production was probably consumed
Bottom-up control