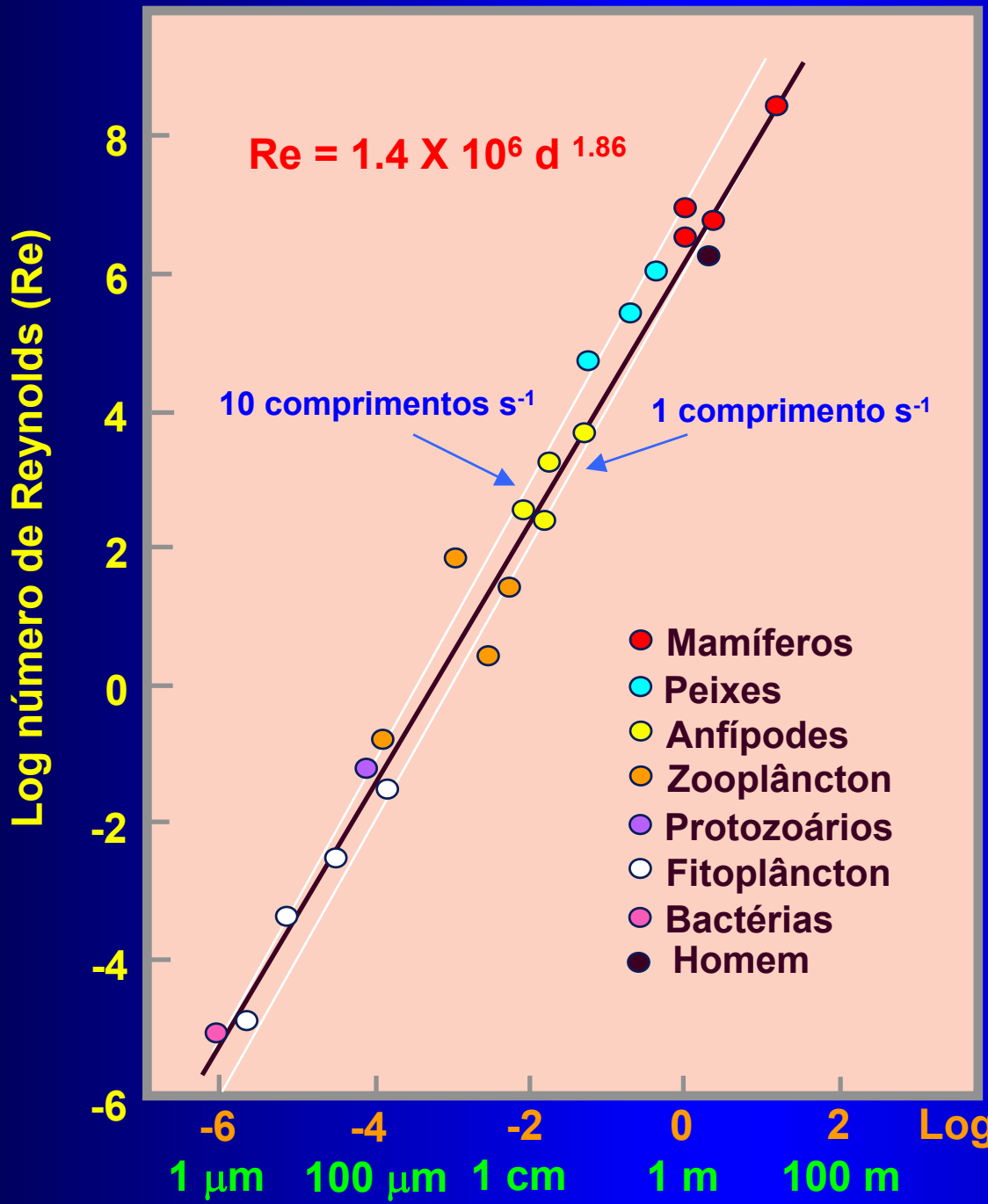
Cadeias tróficas e pescas - Tópicos

- Dimensões e requisitos alimentares
- Transferência de energia
- Métodos de pesca
- Capturas
- Avaliação de stocks



Relação entre o comprimento e o número de Reynolds

$Re = 1.4 \times 10^6 d^{1.86}$

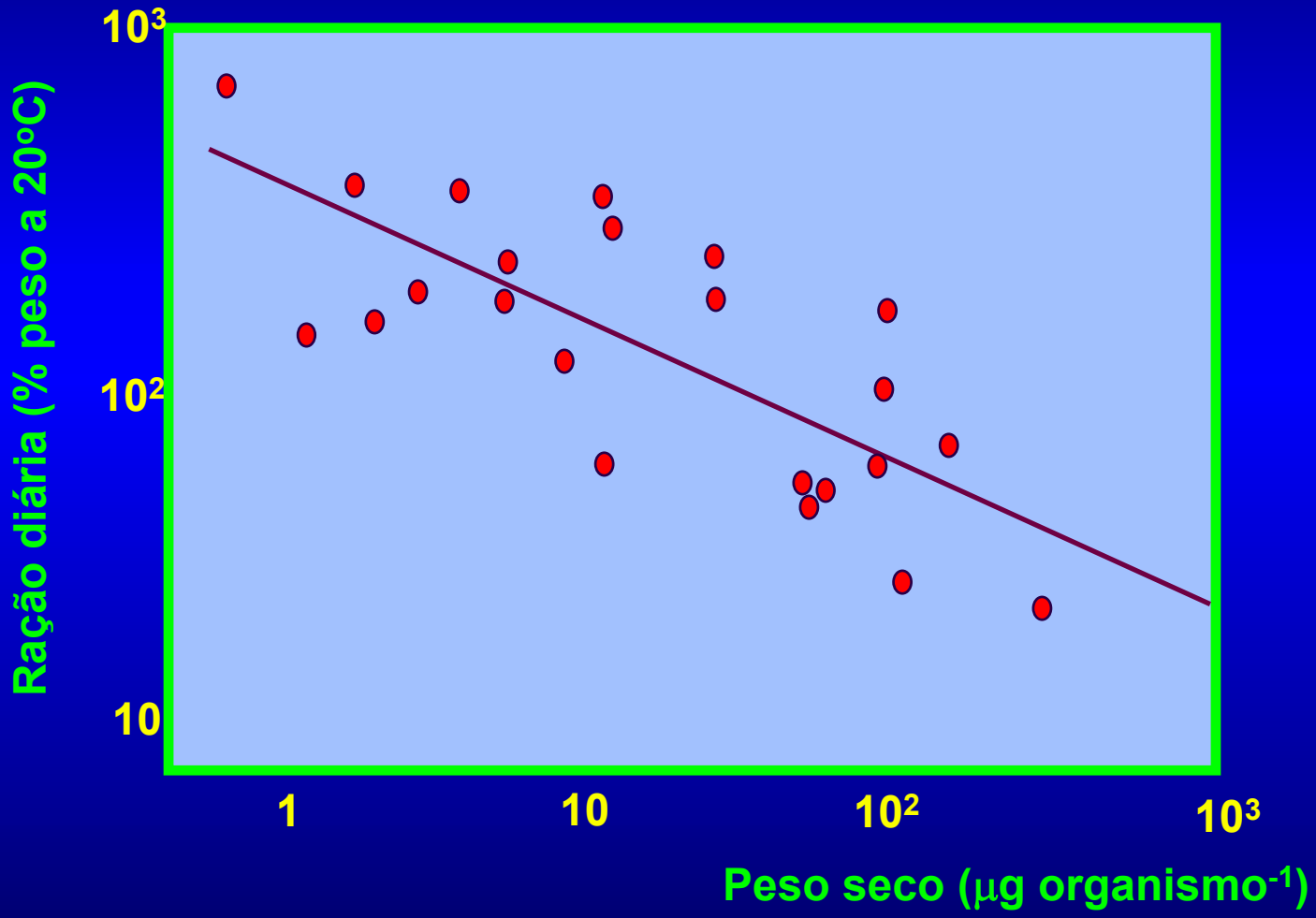
$ud/v = 1.4 \times 10^6 d^{1.86}$

$u/v = 1.4 \times 10^6 d^{0.86}$

$v = 10^{-6} m^2 s^{-1}$

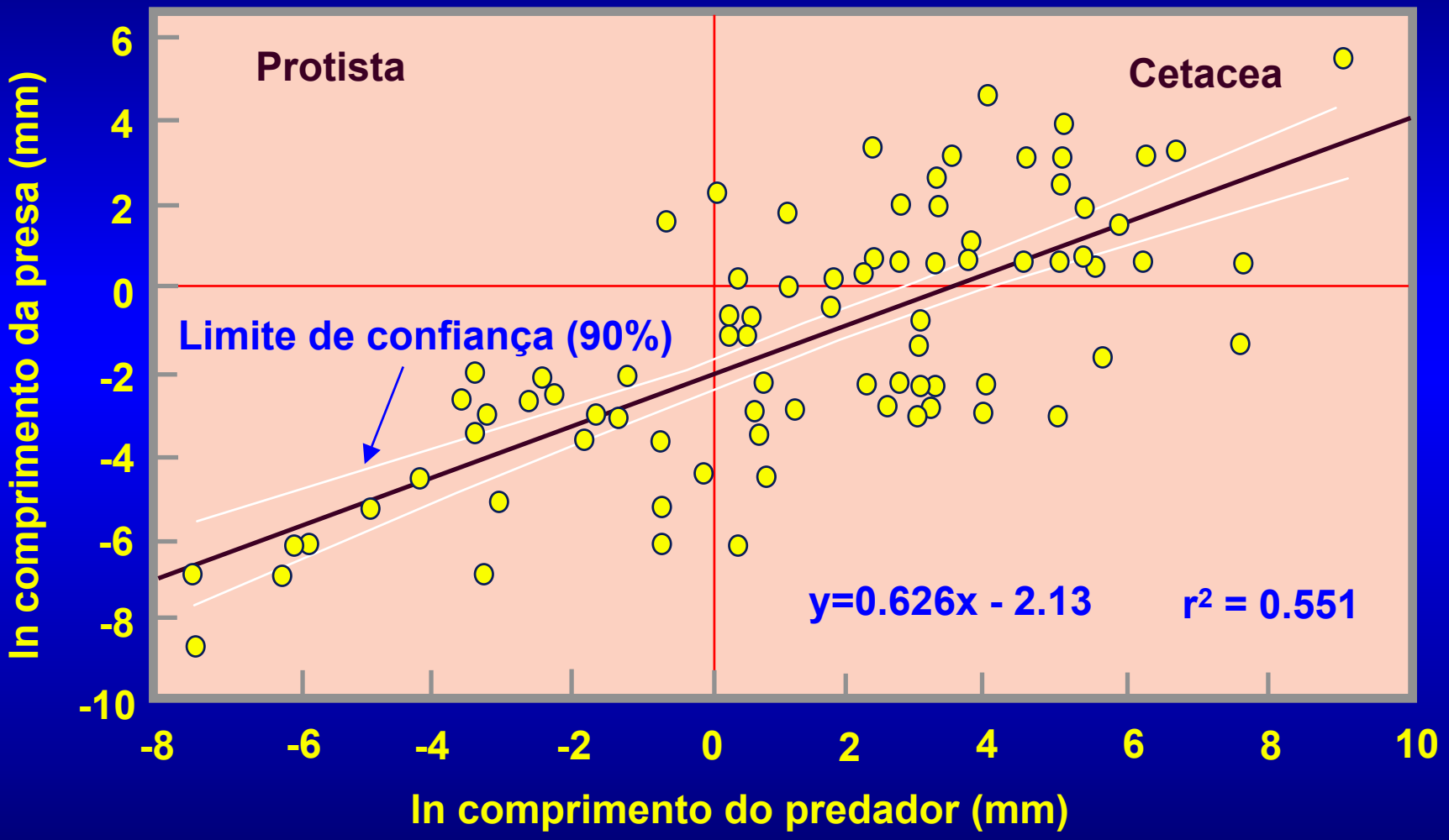
$u (ms^{-1}) = 1.4 d^{0.86}$

Relação entre a ração e o peso individual em diversas espécies de copépode



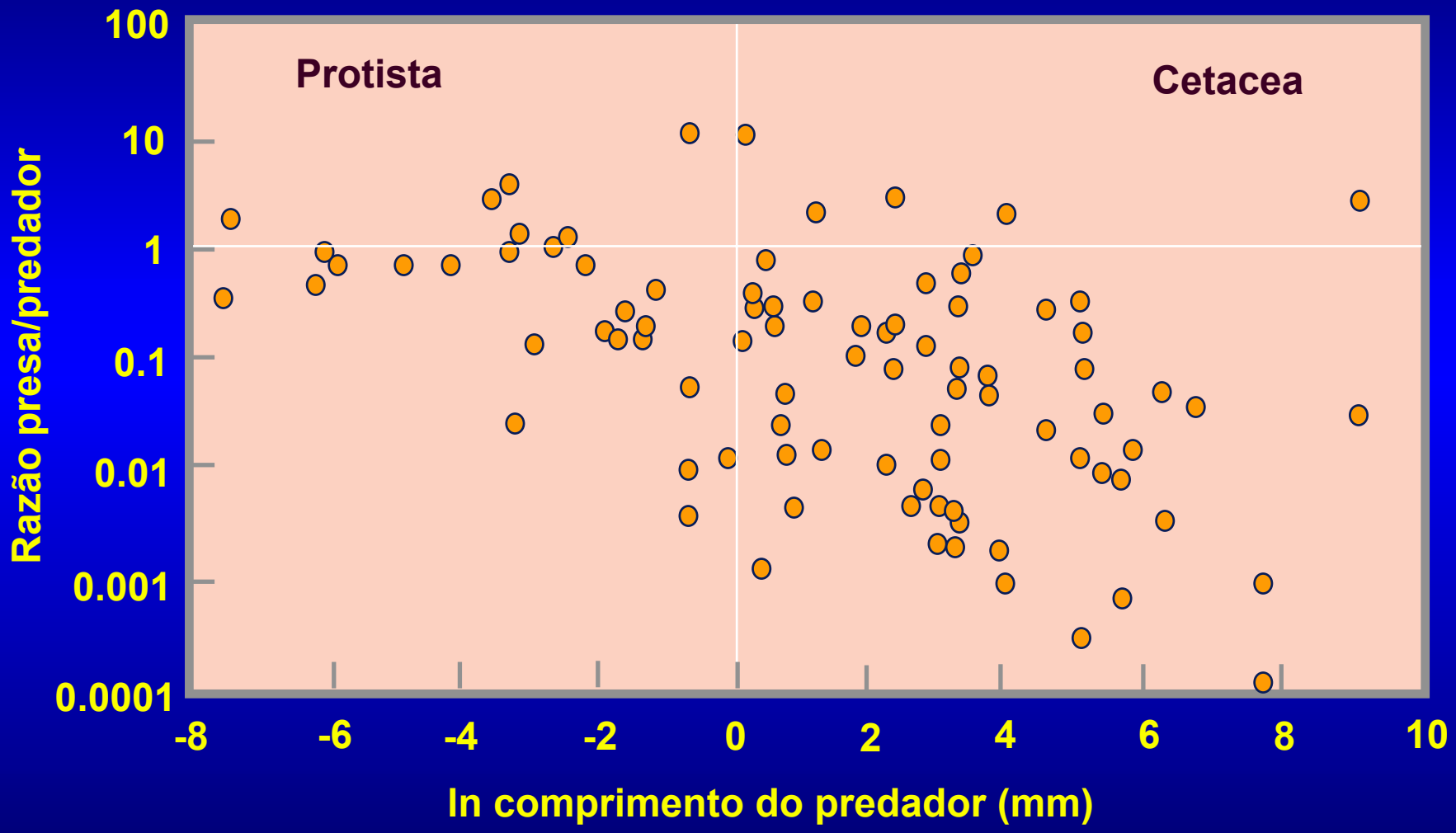
Ikeda, T., 1977. J. Exp. Mar. Biol. Ecol., 29, 263-277

Relação entre o comprimento do predador e presa (> 100 espécies marinhas)



Longhurst, 1991. Limnol. & Oceanog. 36, 8, 1507-1526

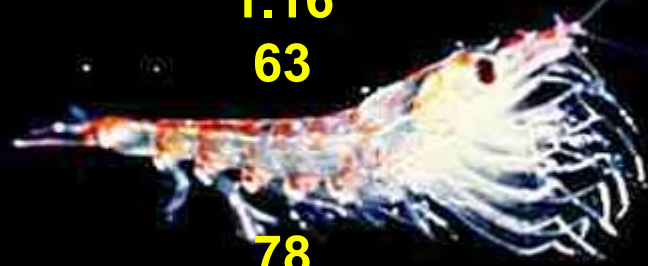
Relação entre a razão predador:presa e o comprimento do predador



Longhurst, 1991. Limnol. & Oceanog. 36, 8, 1507-1526

Distribuição de requisitos alimentares em *Euphasia pacifica*

Parâmetro	Laboratório (1)	Laboratório (2)	Campo
Peso seco (mg)	1.19	1.65	0.23
Crescimento(F_w/I_w)	3.95	1.16	39.2
Tempo (dias)	69	63	580
% Alimento			
Assimilação	86	78	-
Crescimento	30	6.2	9.4
Mudas	8.0	7.0	15.3
Ovos	0	0	8.9
Metabolismo	62	86.8	66.4



Lasker, 1966. J. Fish. Res. Bd. Canada, 23, 1291-1317

Produção de diferentes níveis tróficos no Mar Negro

Nível trófico	Alimento consumido	Taxa de mortalidade	Diferença no stock	Produção (gC m^{-2} dia^{-1})
Prod. 1arios	478.5	12593.8	5397.2	18469.5
Herbivoros	361.2	4.0	-6.3	515
Omnivoros	67.0	1.2	20.0	170.4
Carnivoros (1^{os})	53.5	1.3	27.4	82.2
Carnivoros ($2\text{-}3^{os}$)	33.0	2.8	-1.1	34.7

Petipa *et al.*, 1970. In Marine Food Chains, Ed. J.H. Steele, 142-167

Produção de peixes em ecossistemas marinhos

Ecossistema	Produtividade primária ($gC\ m^{-2}\ ano^{-1}$)	Níveis tróficos	Eficiência (%)	Produção de peixes ($mgC\ m^{-2}\ ano^{-1}$)
Oceânico	50	5	10	0.5
Plataforma	100	3	15	340
Afloramento	300	1.5	20	36000

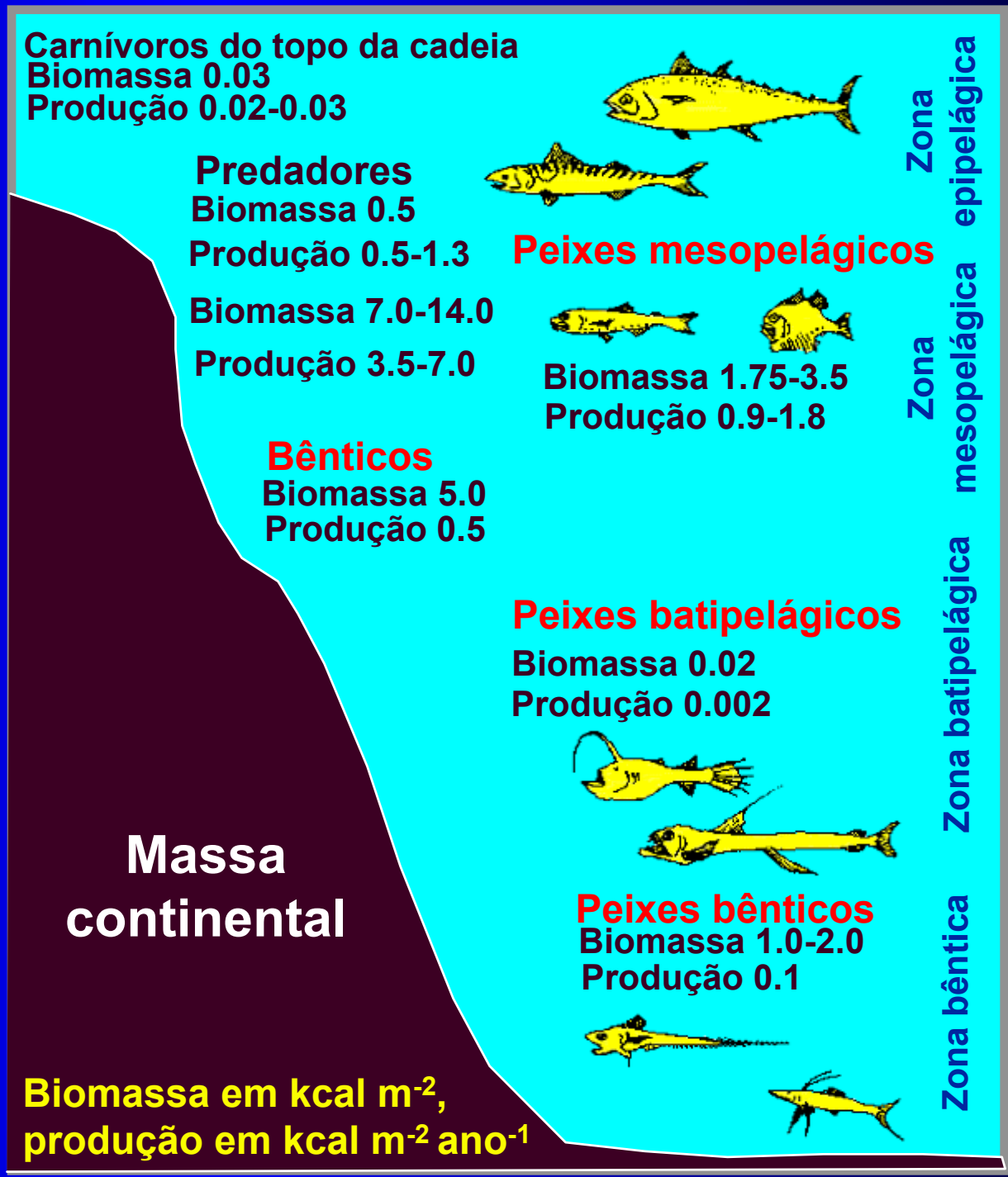
Ryther, 1969. Science, 176, 72-76

$P = BE^n$

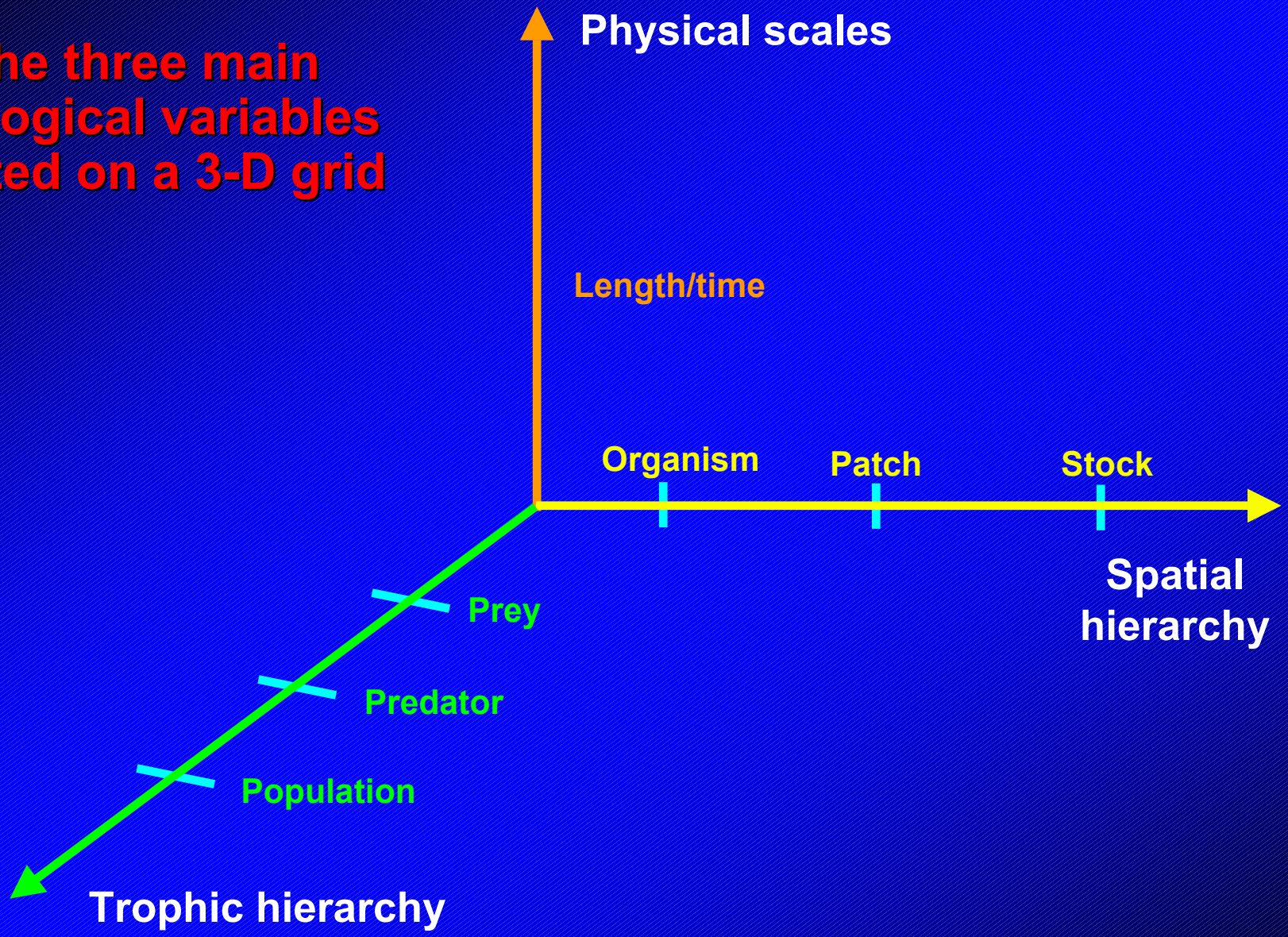
- P = Productividade do topo da cadeia
- B = Produtividade da base da cadeia
- E = Eficiência ecológica
- n = Número de elos da cadeia trófica

$$E = \frac{Energy_{out}}{Energy_{in}}$$

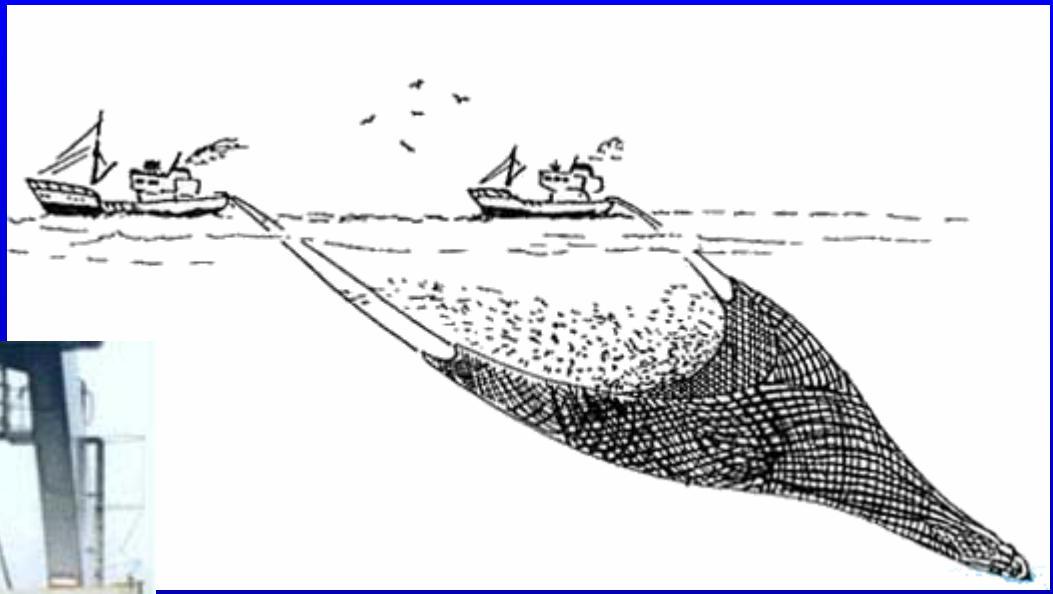
Transferência de biomassa em cadeias tróficas marinhas



The three main ecological variables plotted on a 3-D grid



Steele (1988) - Scale selection for biodynamic theories. p.513-526 In B.J. Rothschild (Ed.) Towards a theory on biological-physical interactions in the world ocean (Kluwer)



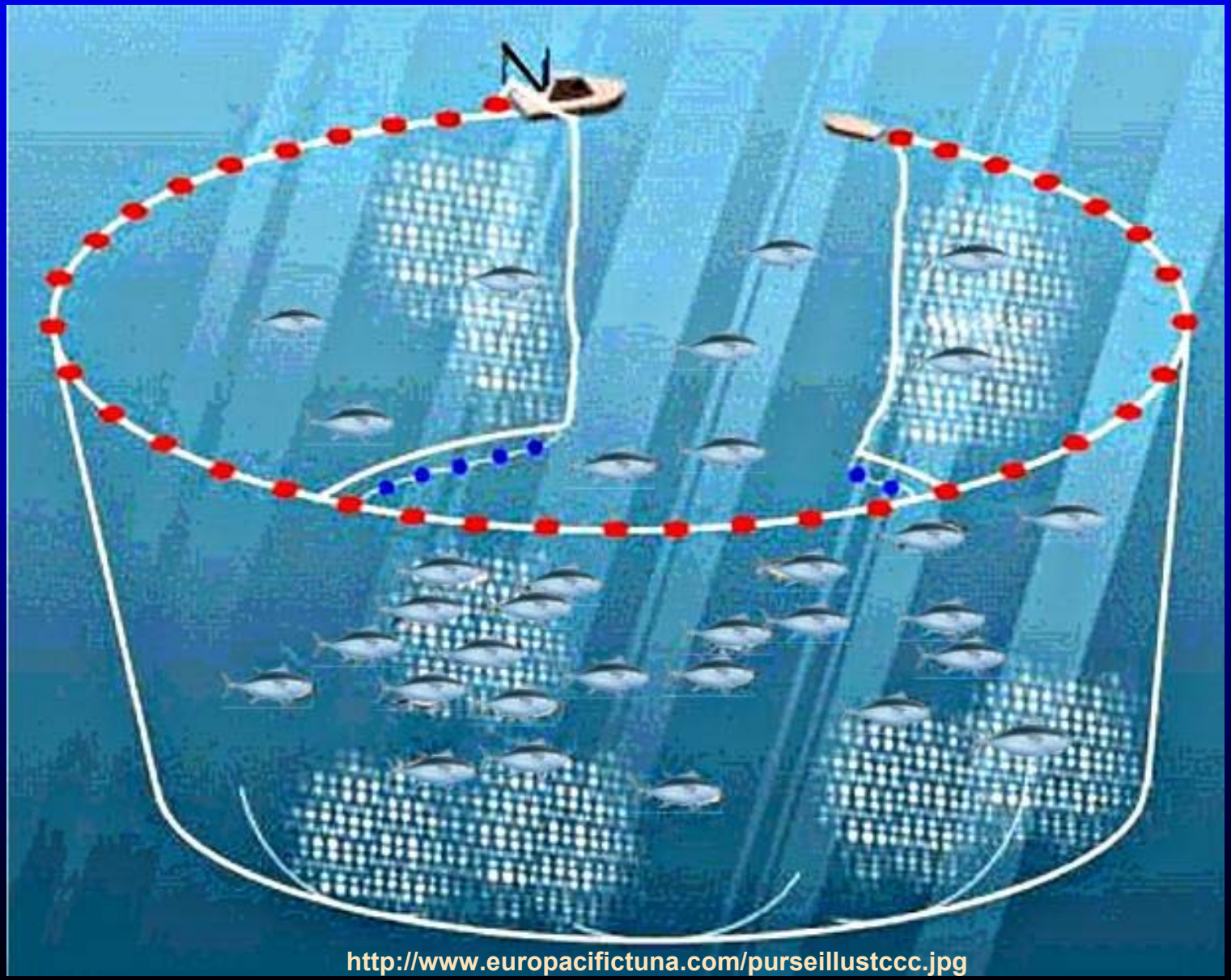
Fishing techniques
Pelagic trawl

http://www.sauvonslesdauphins.com/image/chalut.jpg

Fishing techniques
Purse seine

http://www.photolib.noaa.gov/fish/images/fish0704.jpg

Fishing techniques
Purse seine

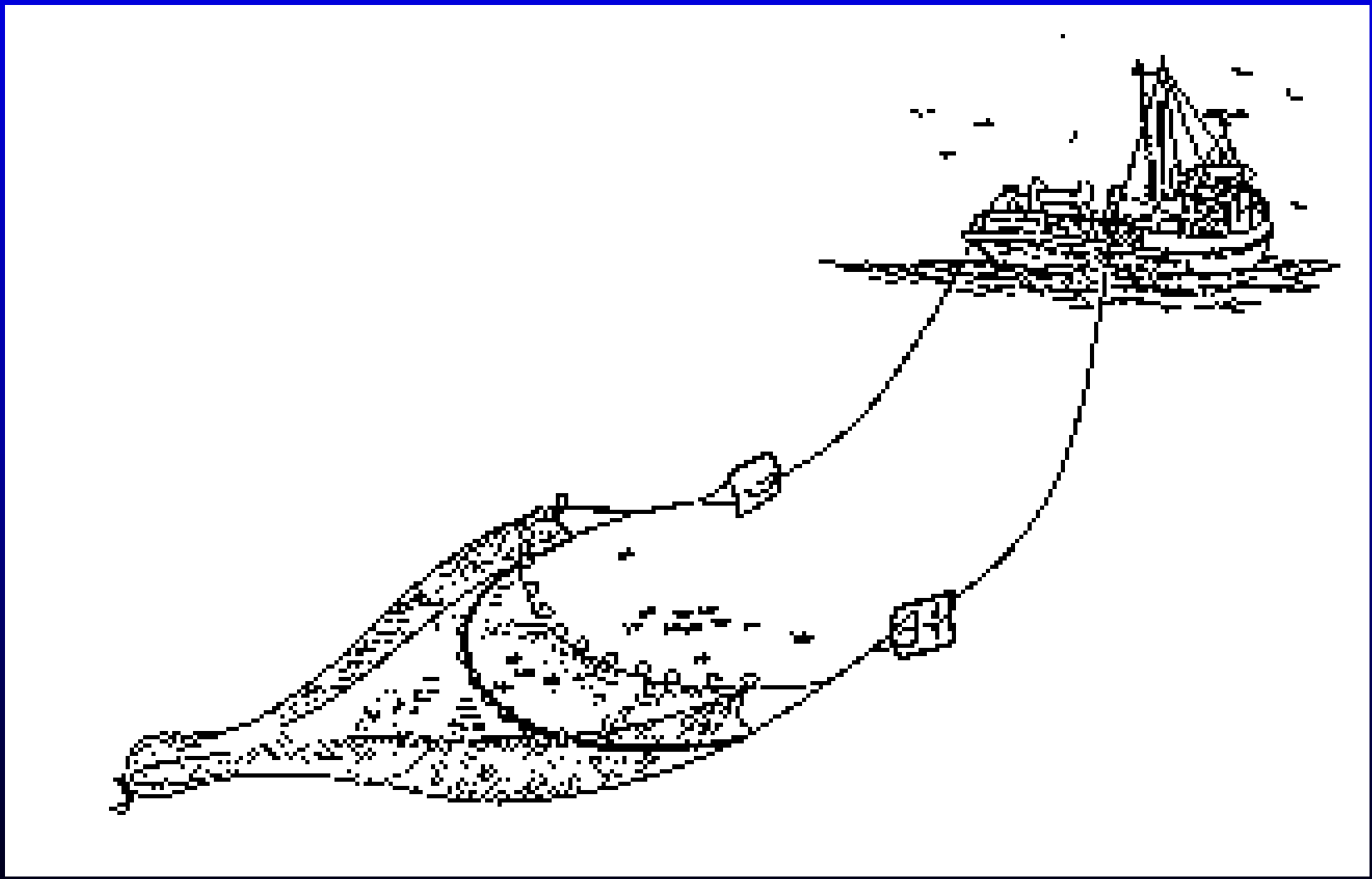


http://www.europacifictuna.com/purseillustccc.jpg

Fishing techniques
Bycatch – Dolphins in purse seine net

http://www.earthtrust.org/gif/dolphins_in_purse_seine.jpeg

Fishing techniques
Bottom trawl



http://www.trawl.org/trawl.gif

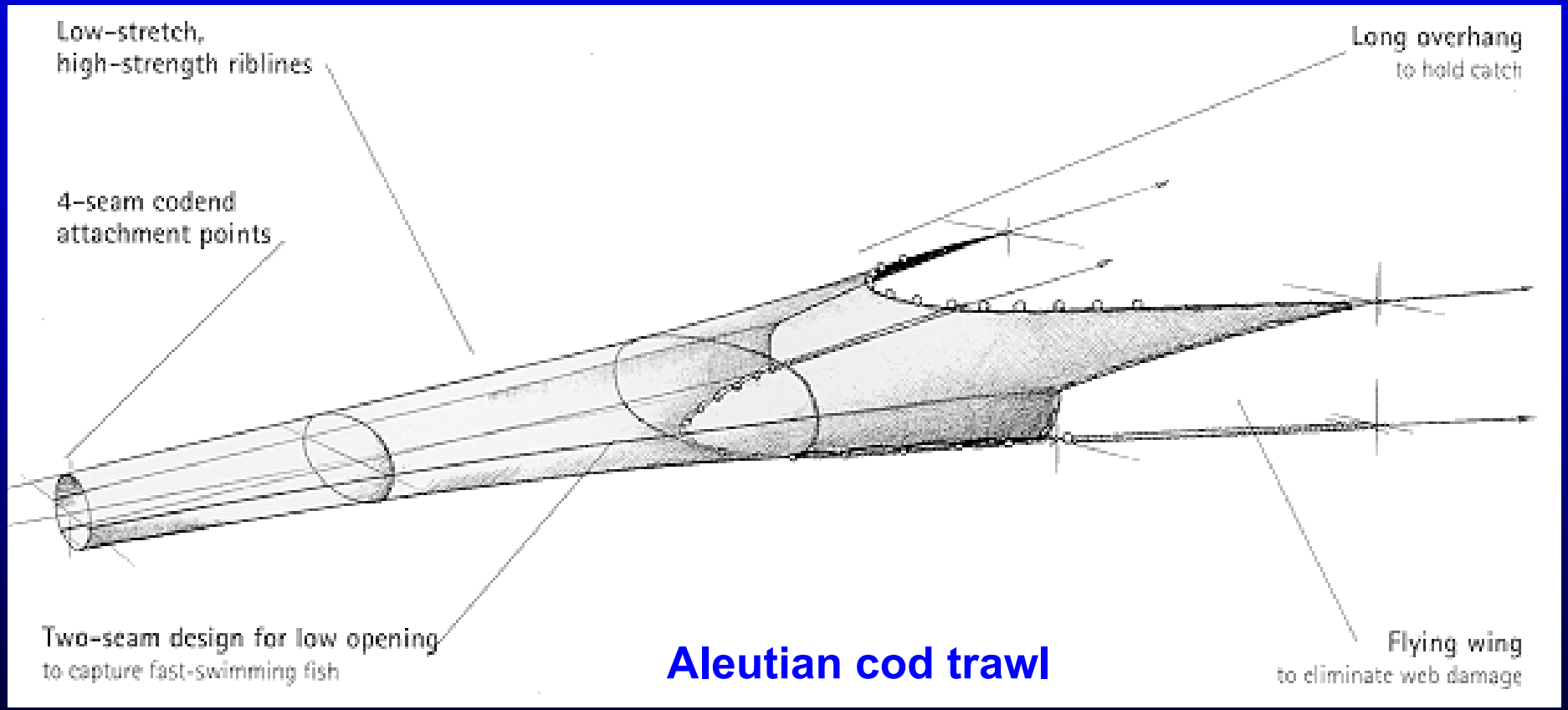
Fishing techniques Bottom trawl

http://www.pmel.noaa.gov/

Fishing techniques
Bottom trawl

http://www.dvz.be/images/Photo's/Otter-trawl.jpg

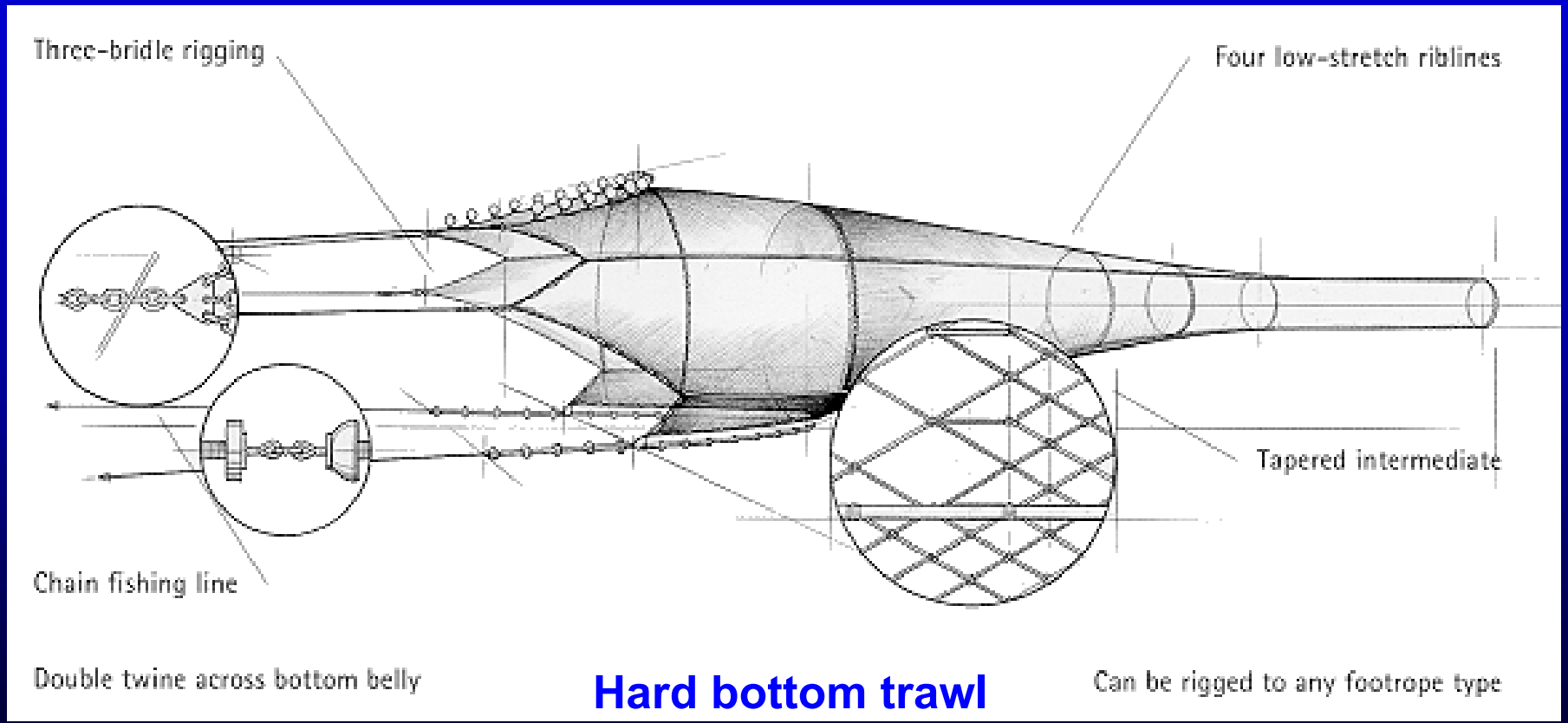
Fishing techniques
Bottom trawl for cod



Aleutian cod trawl

http://www.net-sys.com/act.htm

Fishing techniques
Hard bottom trawl
(for Pollock, Whiting etc)



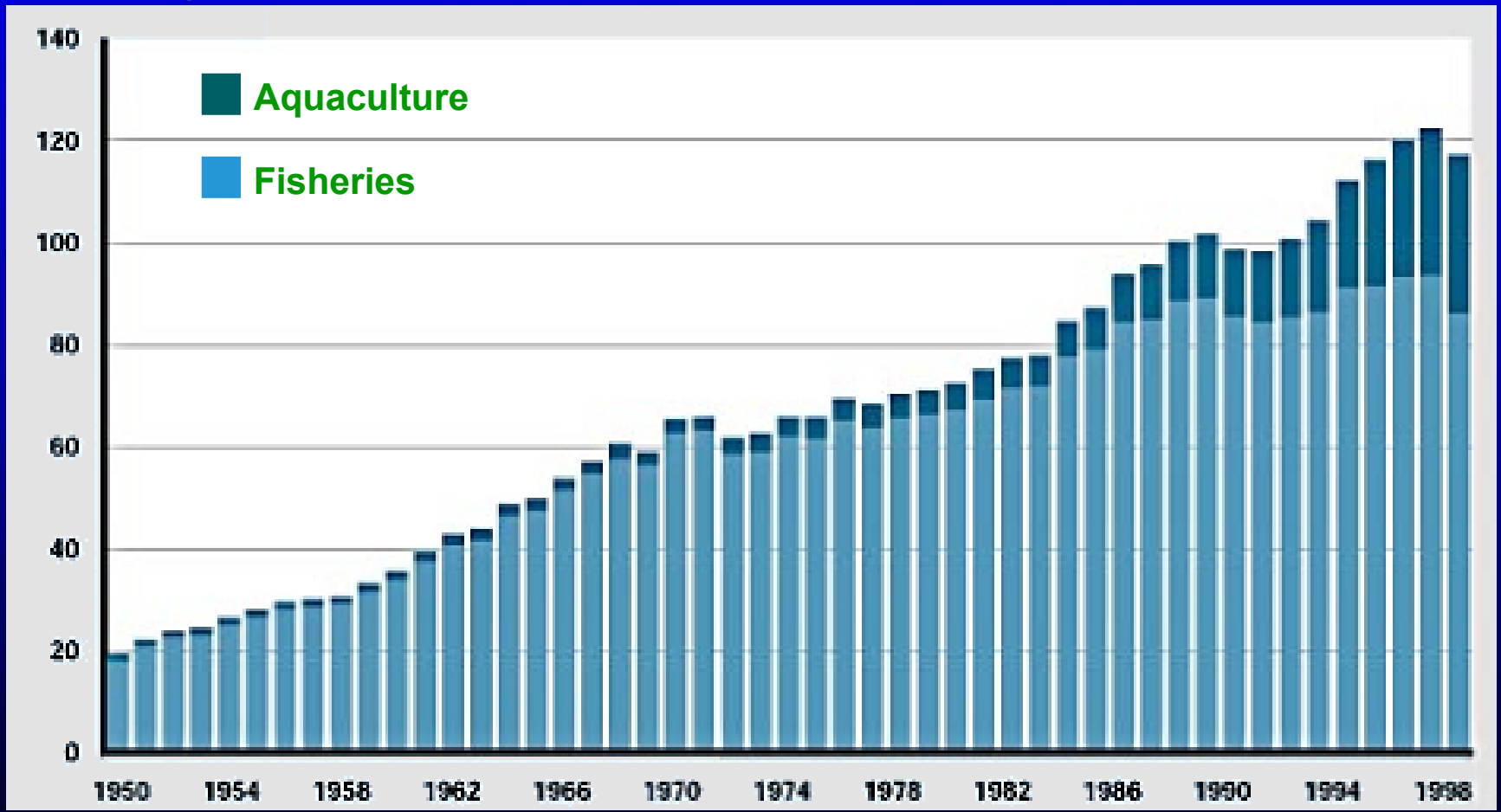
http://www.net-sys.com/act.htm

Fishing techniques Bottom trawl

http://www.oseanologi.lipi.go.id/trawl.jpg

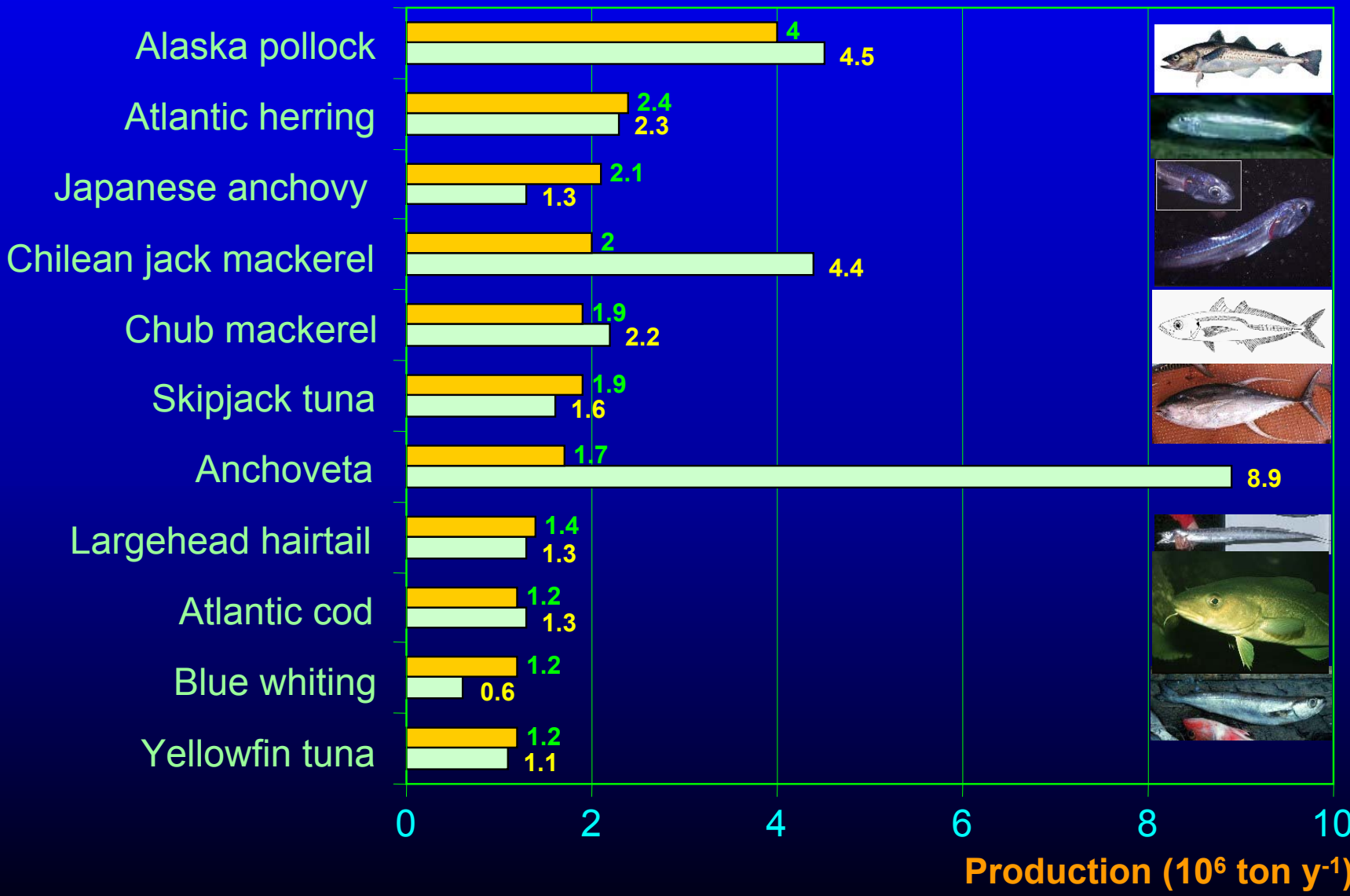
The State of world fisheries and aquaculture (SOFIA)- 2000

10^6 ton y^{-1}



FAO, 2001. The State of World Fisheries and Aquaculture (SOFIA). Food and Agriculture Organization of the United Nations. Aquaculture data prior to1984 are estimates.

Distribution of production among major fish species



FAO, 2001. The State of World Fisheries and Aquaculture (SOFIA). Food and Agriculture Organization of the United Nations.

World capture fisheries and aquaculture

WORLD PRODUCTION	1994	1995	1996	1997	1998	1999[1]
			(million tonnes)			
INLAND						
Capture	6.7	7.2	7.4	7.5	8.0	8.2
Aquaculture	12.1	14.1	16.0	17.6	18.7	19.8
Total inland	**18.8**	**21.4**	**23.4**	**25.1**	**26.7**	**28.0**
MARINE						
Capture	84.7	84.3	86.0	86.1	78.3	84.1
Aquaculture	8.7	10.5	10.9	11.2	12.1	13.1
Total marine	**93.4**	**94.8**	**96.9**	**97.3**	**90.4**	**97.2**
Total capture	91.4	91.6	93.5	93.6	86.3	92.3
Total aquaculture	20.8	24.6	26.8	28.8	30.9	32.9
Total world fisheries	***112.3***	***116.1***	***120.3***	***122.4***	***117.2***	***125.2***
UTILIZATION						
Human consumption	79.8	86.5	90.7	93.9	93.3	92.6
Reduction to fishmeal and oil	32.5	29.6	29.6	28.5	23.9	30.4
Population *(billions)*	5.6	5.7	5.7	5.8	5.9	6.0
Per capita food fish supply *(kg)*	14.3	15.3	15.8	16.1	15.8	15.4

[1]Preliminary estimate

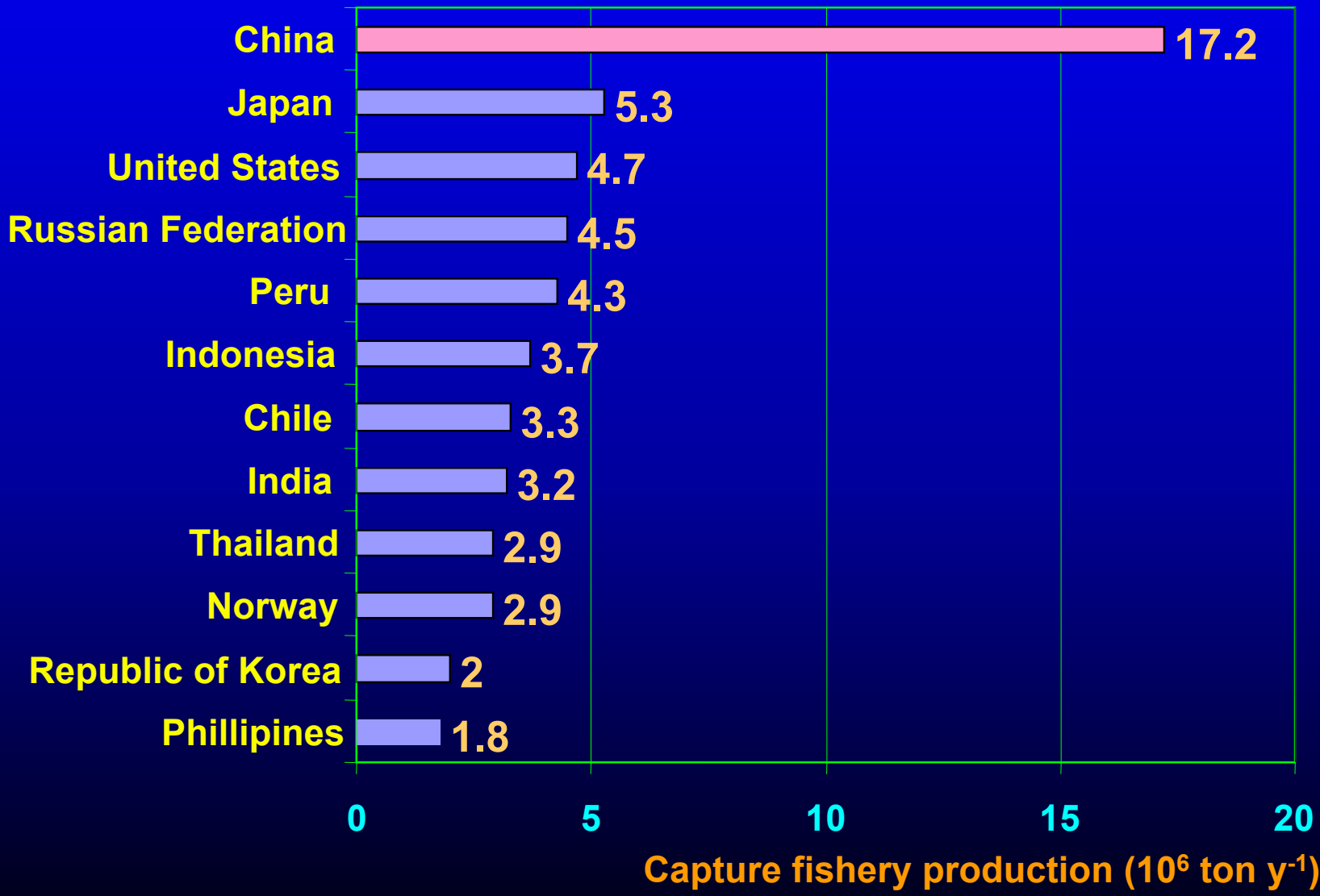
FAO, 2001. The State of World Fisheries and Aquaculture (SOFIA). Food and Agriculture Organization of the U.N.

European Union fisheries and aquaculture production

	1986	1990	1994	1998
Aquaculture production				
Inland production *('000 tonnes)*	171	221	241	249
Percentage of world total	3.0	2.7	2.0	1.3
Marine production *('000 tonnes)*	699	717	796	1 085
Percentage of world total	20.6	14.5	9.2	8.9
Fisheries production				
Inland production *('000 tonnes)*	113	107	104	120
Percentage of world total	1.9	1.7	1.6	1.5
Marine production *('000 tonnes)*	6 774	6 067	6 737	6 419
Percentage of world total	8.6	7.7	8.0	8.2
Fisheries and aquaculture production				
Combined total *('000 tonnes)*	7 757	7 114	7 878	7 873
Percentage of world total	8.3	7.2	7.0	6.7

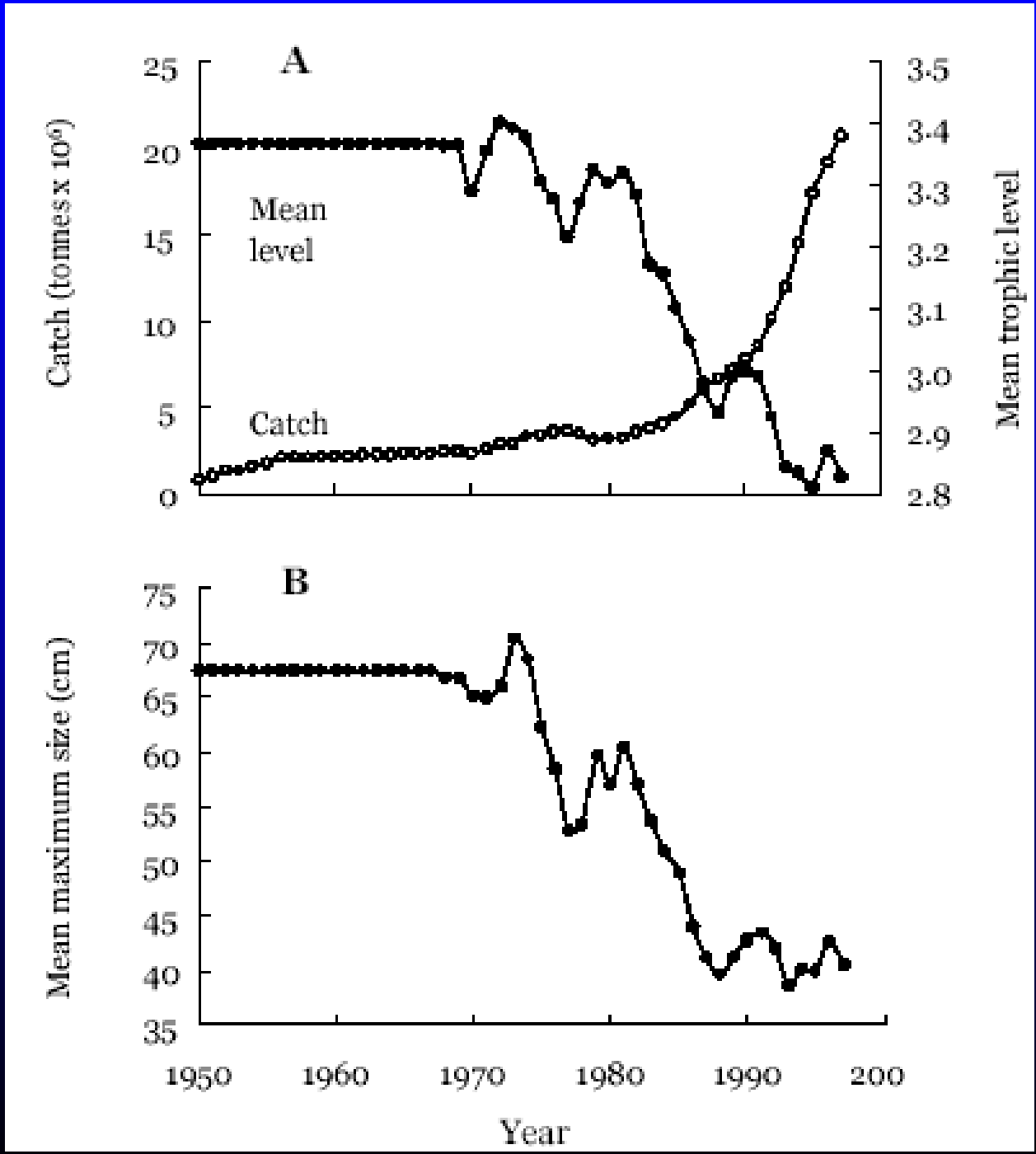
FAO, 2001. The State of World Fisheries and Aquaculture (SOFIA). Food and Agriculture Organization of the United Nations.

Capture fishery production by country



FAO, 2001. The State of World Fisheries and Aquaculture (SOFIA). Food and Agriculture Organization of the United Nations.

Chinese fishery data

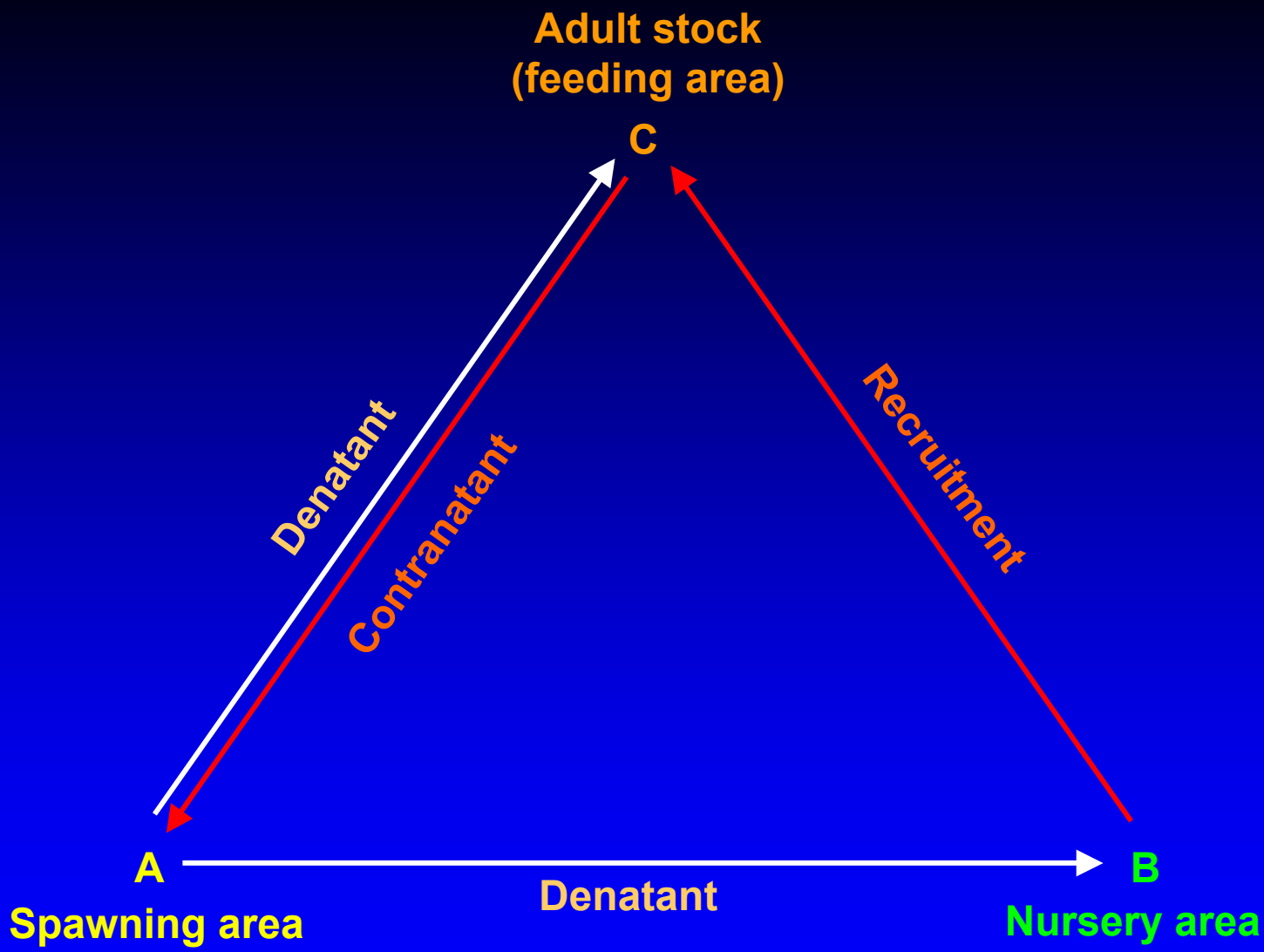


Watson, R., Pang, L., Pauly, D., 2001. The Marine Fisheries of China: Development and Reported Catches. Fisheries Centre Research Report 9(2). Univ. British Colombia, Canada.

Avaliação de stocks

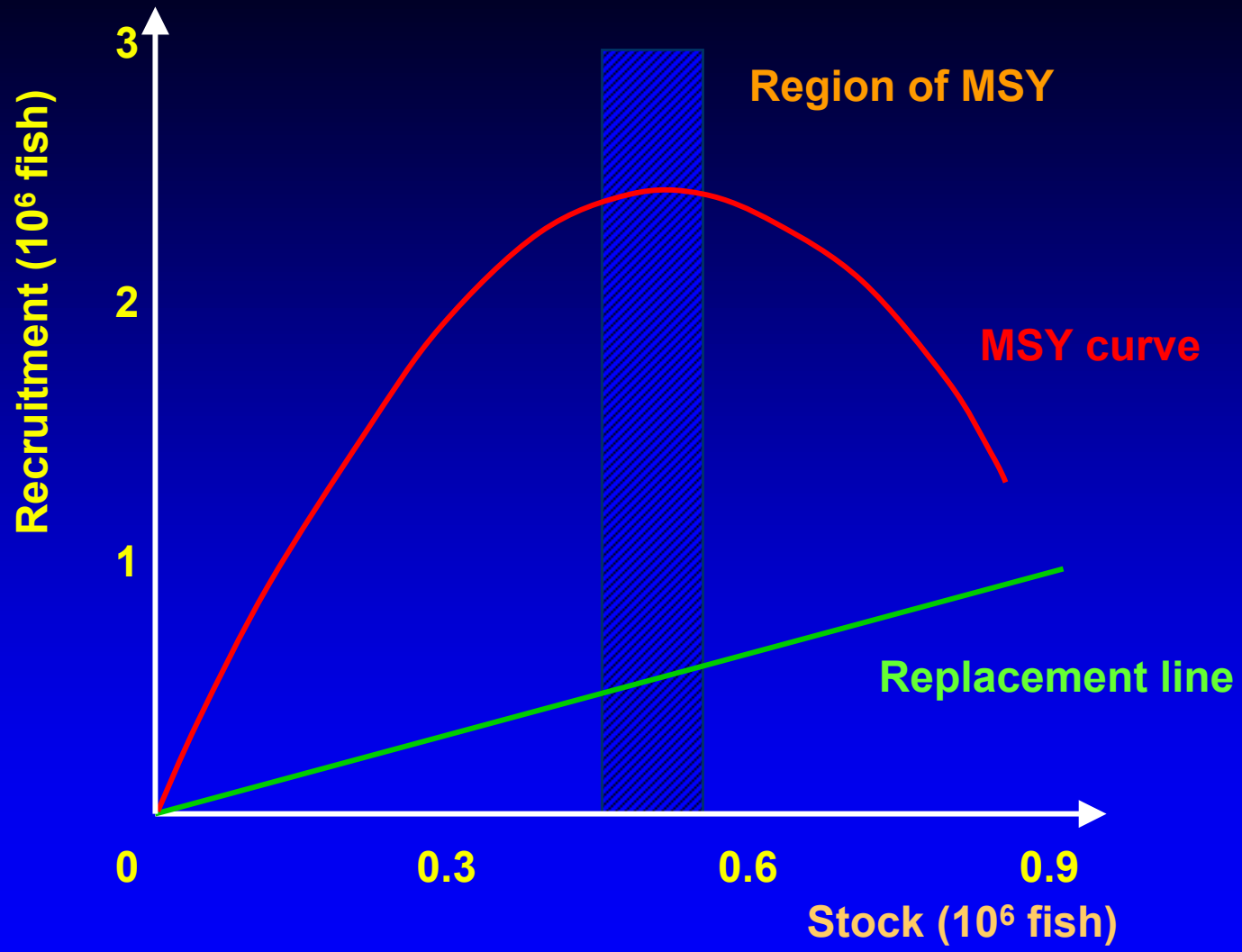
- Marcação-recaptura
- Análise de coortes
- Demografia (otolitos e/ou escamas)
- Densidade de ovos
- Curvas stock-recrutamento (MSY)

The triangle of fish migration



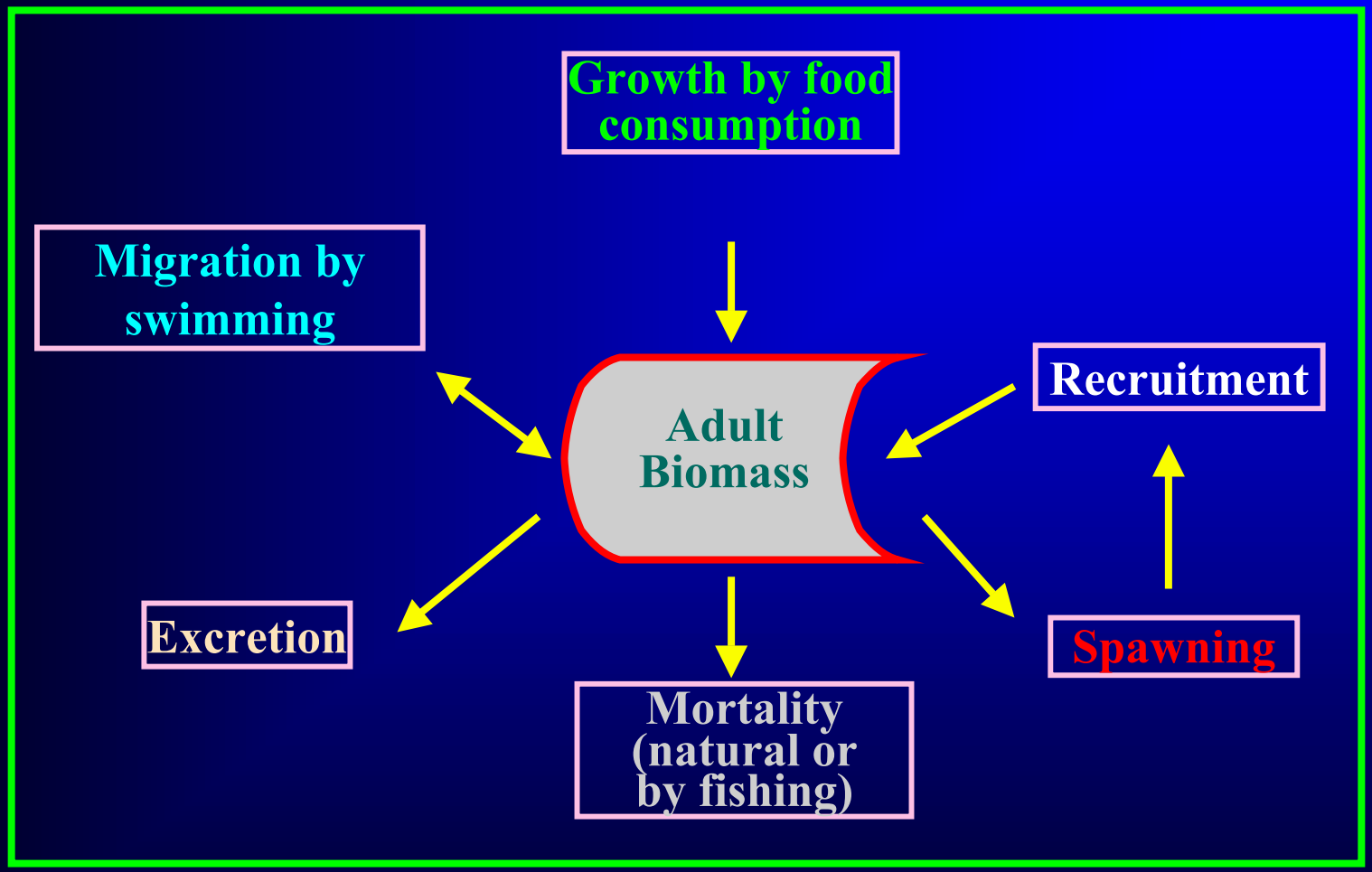
Cushing, D.H., 1975. Marine Ecology and Fisheries, Cambridge Univ. Press

Maximum sustainable yield



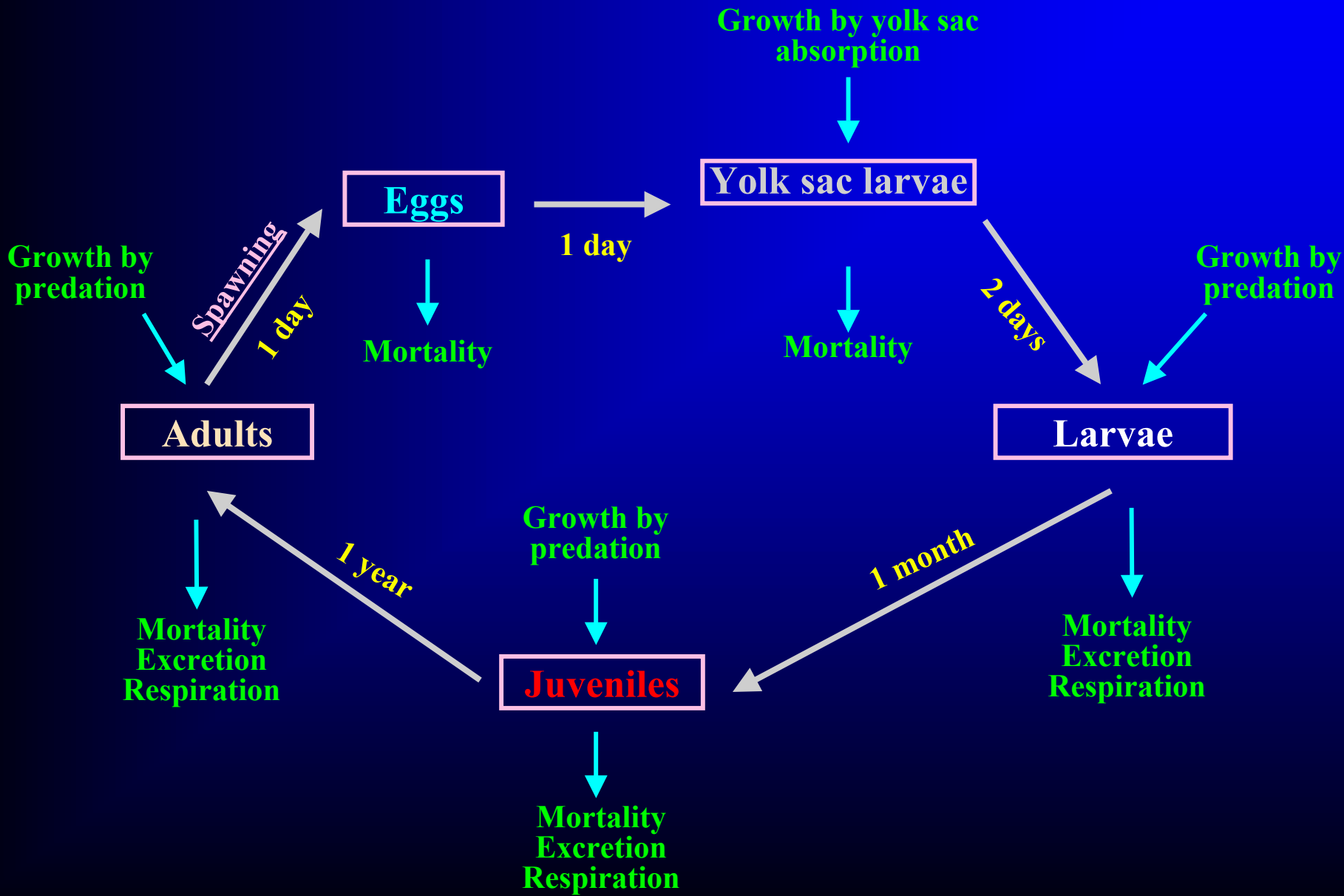
Parsons, Takahashi & Hargrave, 1984. Biological Oceanographic Processes, Pergamon

EcoWin - Conceptual scheme of fish biomass variation



$$\frac{\delta B}{\delta t} = \text{Growth} + \text{Recruitment} - \text{Excretion} - \text{Spawning} - \text{Death} \pm \text{Swimming}$$

EcoWin - Conceptual scheme of fish life cycle



Time and space scales for different groups