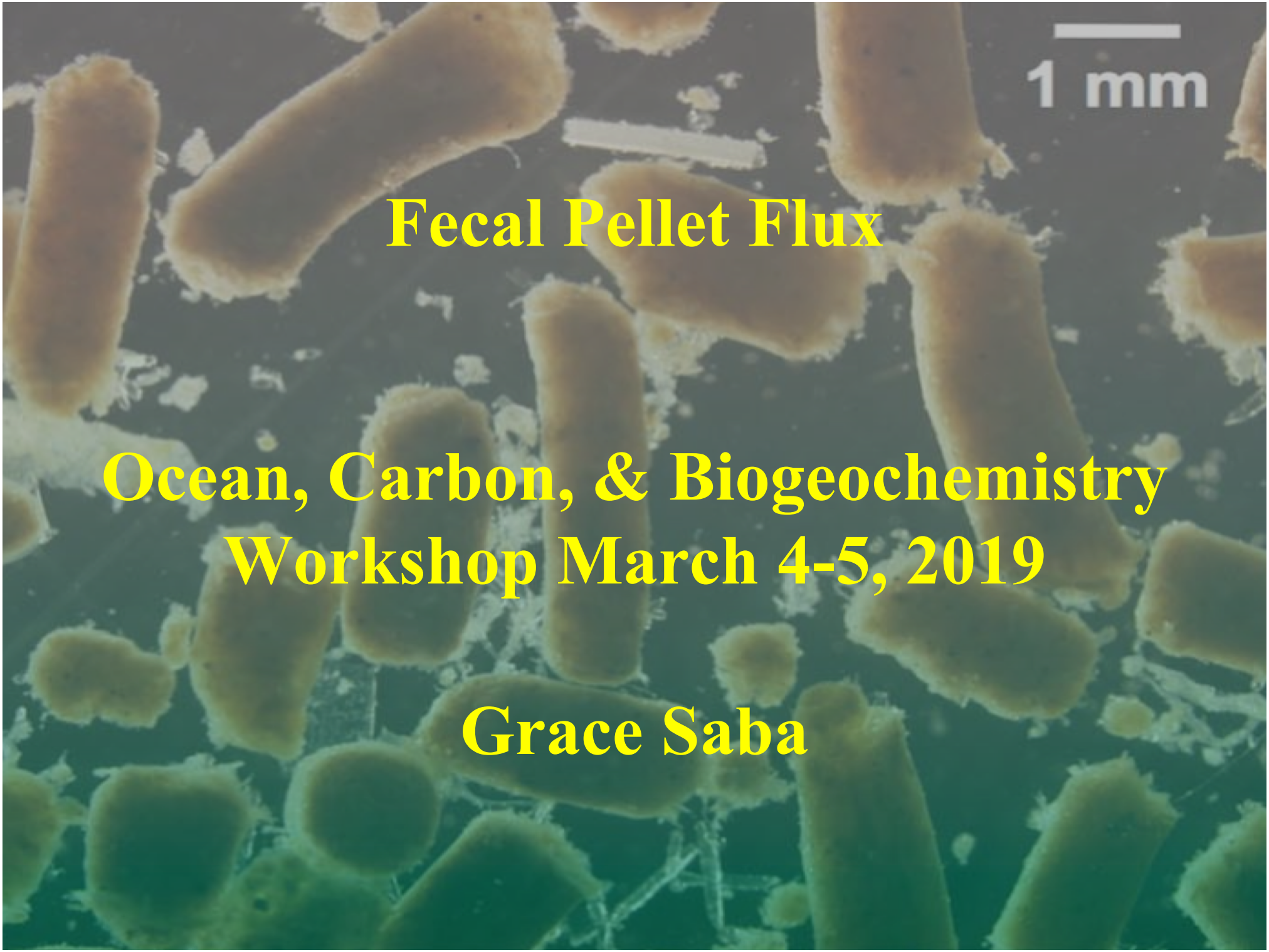
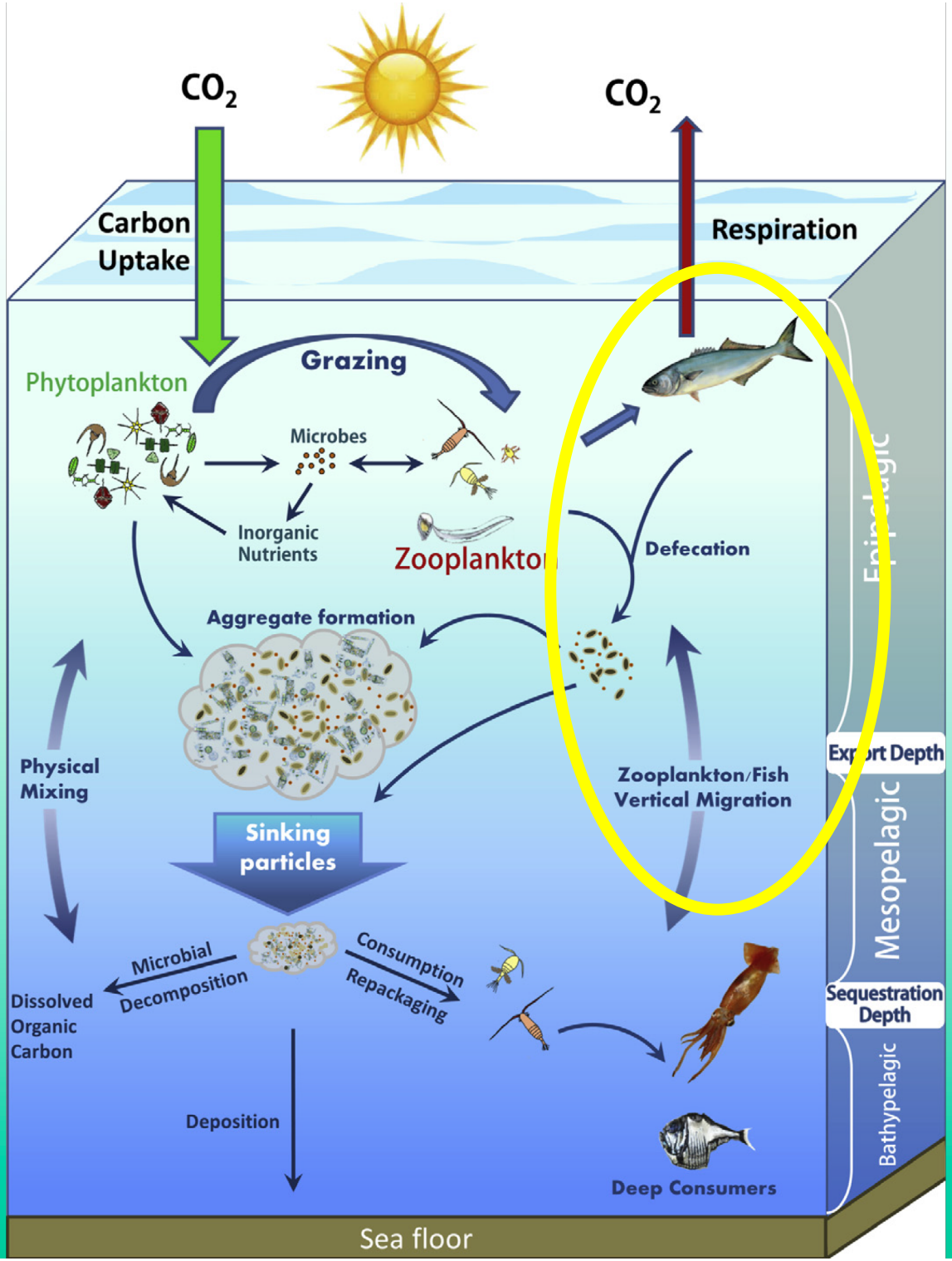


Fecal Pellet Flux

Ocean, Carbon, & Biogeochemistry Workshop March 4-5, 2019

Grace Saba


CO_2
CO_2
Carbon Uptake
Respiration
Grazing
Phytoplankton
Microbes
Inorganic Nutrients
Zooplankton
Defecation
Aggregate formation
Physical Mixing
Zooplankton/Fish Vertical Migration
Sinking particles
Microbial Decomposition
Consumption Repackaging
Dissolved Organic Carbon
Deposition
Deep Consumers
Epipelagic
Export Depth
Mesopelagic
Sequestration Depth
Bathypelagic
Sea floor

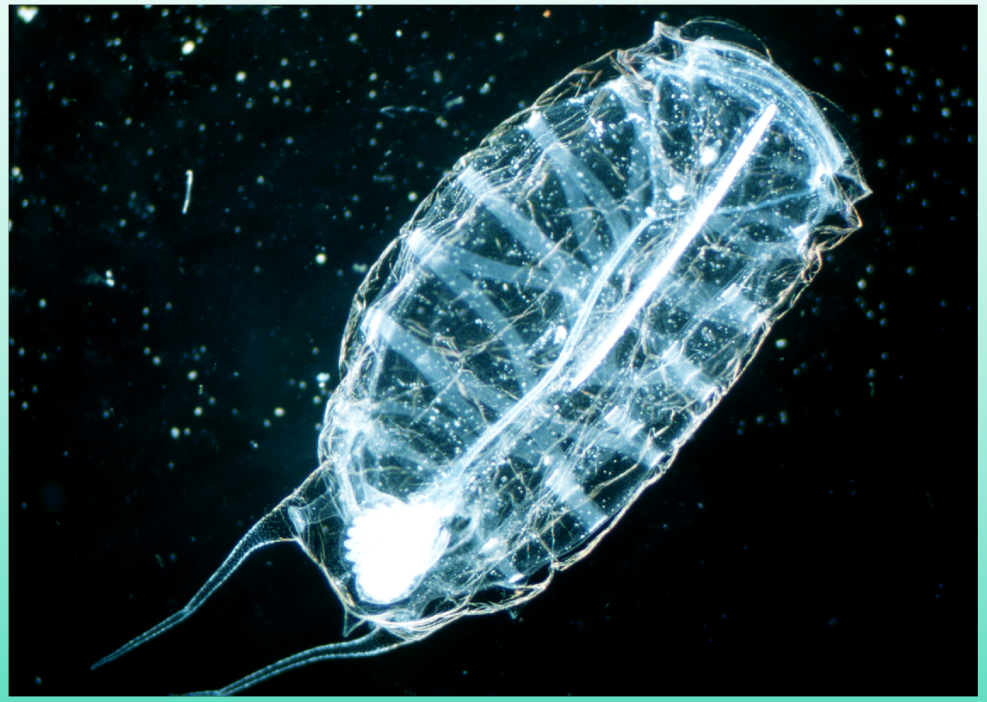
Zooplankton Fecal Flux Contribution

Turner 2015

Zooplankton fecal pellet contribution to total particulate organic carbon flux.

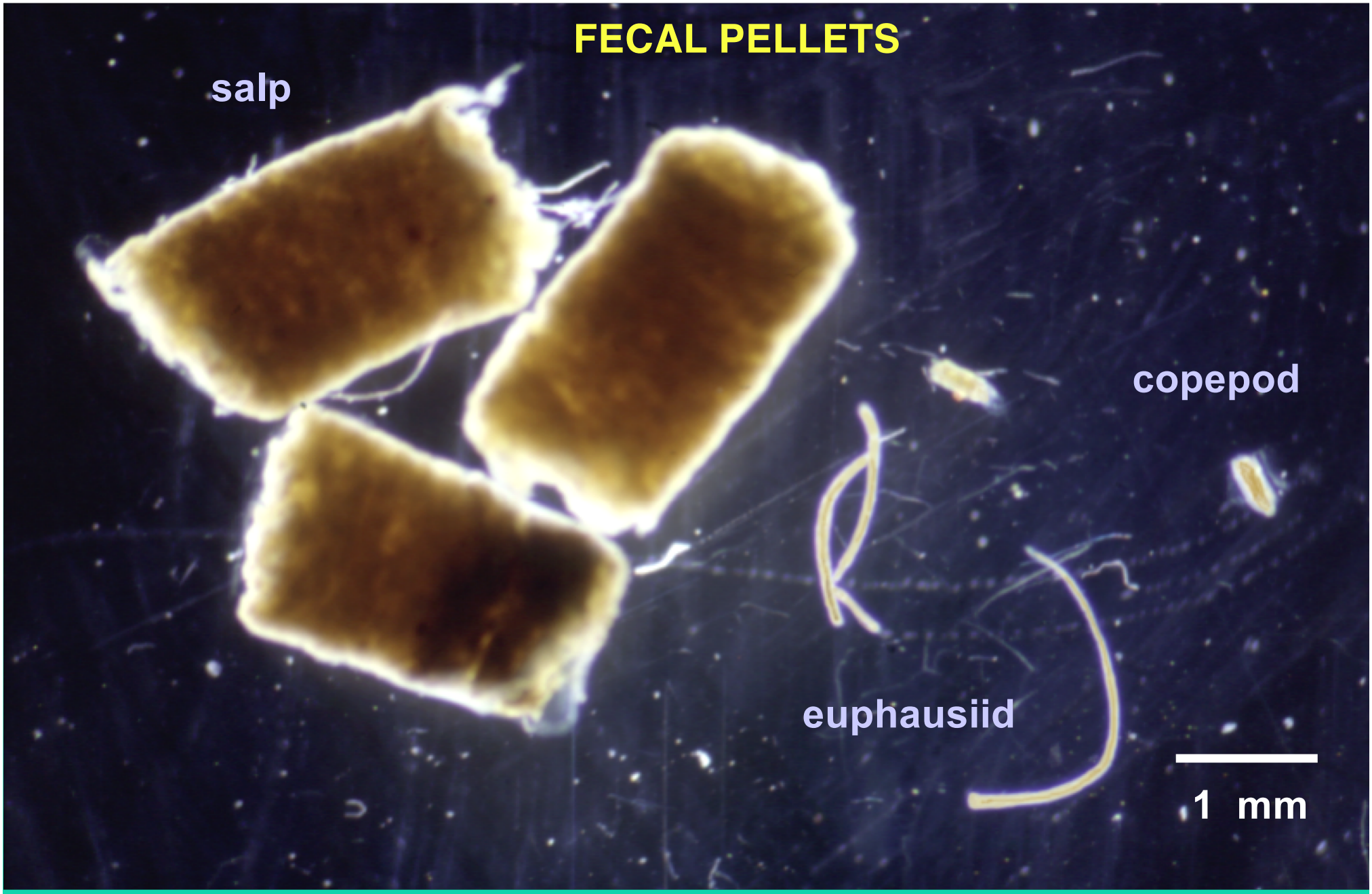
Location	Depth	Fecal pellet%	Reference
Various	Various	<1–>100	22 papers cited in Turner (2002)
Arctic Ocean	30–200 m	<2	Olli et al. (2007)
Greenland Sea, Fram Strait, and Barents Sea	470–3000 m	<24	Tamelander et al. (2012)
Barents Sea	Upper 200 m	8–40	Wexels Riser et al. (2002)
Barents Sea	Upper 200 m	1–37	Wexels Riser et al. (2007)
Barents Sea	Upper 200 m	13–27	Wexels Riser et al. (2008)
Fram Strait	340 m	10–>85	Lalande et al. (2011)
Fram Strait	179–280 m	<15–29	Lalande et al. (2013)
Balsfjord, Norway	Upper 100 m	7–75	Wexels Riser et al. (2010)
Disko Bay, Greenland	Upper 100 m	29	Juul-Pedersen et al. (2006)
Baffin Bay, Canada	Upper 200 m	1–63	Sampei et al. (2004)
Hudson Bay, Canada	50 m	52	Lapoussière et al. (2009)
Barrow Strait, Canada	Upper 90 m	<10–37	Fortier et al. (2002)
Beaufort Sea, Canada	50 m	2.4–75.7	Juul-Pedersen et al. (2010)
Newfoundland, Canada	40–240 m	20–>90	Thompson et al. (2008)
Scotian Shelf	50–150 m	4–50	Caron et al. (2004)
Iberian shelf	50–200 m	>20 (on-shelf)	Wexels Riser et al. (2001)
Iberian shelf	50–200 m	0.3–6.7 (off-shelf)	Wexels Riser et al. (2001)
Azores	200 m	2–82	Huskin et al. (2004)
Sargasso Sea	500 m	0.4–10	Shatova et al. (2012)
Sargasso Sea	1500 m	3–16	Shatova et al. (2012)
Sargasso Sea	3200 m	1.4–8	Shatova et al. (2012)
Sargasso Sea	150 m	28–89	Steinberg et al. (2012)
Sargasso Sea	150–300 m	5–12 (inside eddies)	Goldthwait and Steinberg (2008)
Sargasso Sea	150–300 m	4–7 (outside eddies)	Goldthwait and Steinberg (2008)
Northern Gulf of Mexico	60 m	55	Rabalais et al. (2001)
Aegean Sea	16 m	10–53	Frangoulis et al. (2010)
Northwest Mediterranean	200–800 m	18–87	Abramson et al. (2010)
Bay of Calvi	36 m	<6	Frangoulis et al. (2011)
Central North Pacific	150–500 m	14–35	Wilson et al. (2008)
Northwest Pacific	150–500 m	3–39	Wilson et al. (2008)
Kagoshima Bay, Japan	50 and 150 m	<4–>40%	Kobari et al. (2010)
Northeast Pacific	3500 m	3.3–47.7	Wilson et al. (2013)
California Current	100 m	1.9–94	Stukel et al. (2013a)
Chilean upwelling	2300 m	17–44	González et al. (2004)
Chilean upwelling	50 m	79.6	González et al. (2007)
Chilean upwelling	50–100 m	61–90	González et al. (2009)
Southern Ocean	100 m	2–7 (summer)	Dagg et al. (2003)
Southern Ocean	100 m	22–63 (spring)	Dagg et al. (2003)
Ross Sea	200 m	<1–>50	Smith et al. (2011)
Terra Nova Bay (Ross Sea)(*Limacina helicina* fp only)	180 m	10–30	Manno et al. (2010)
Antarctic Peninsula shelf	170 m	34–67	Gleiber et al. (2012)

Role of surface community composition



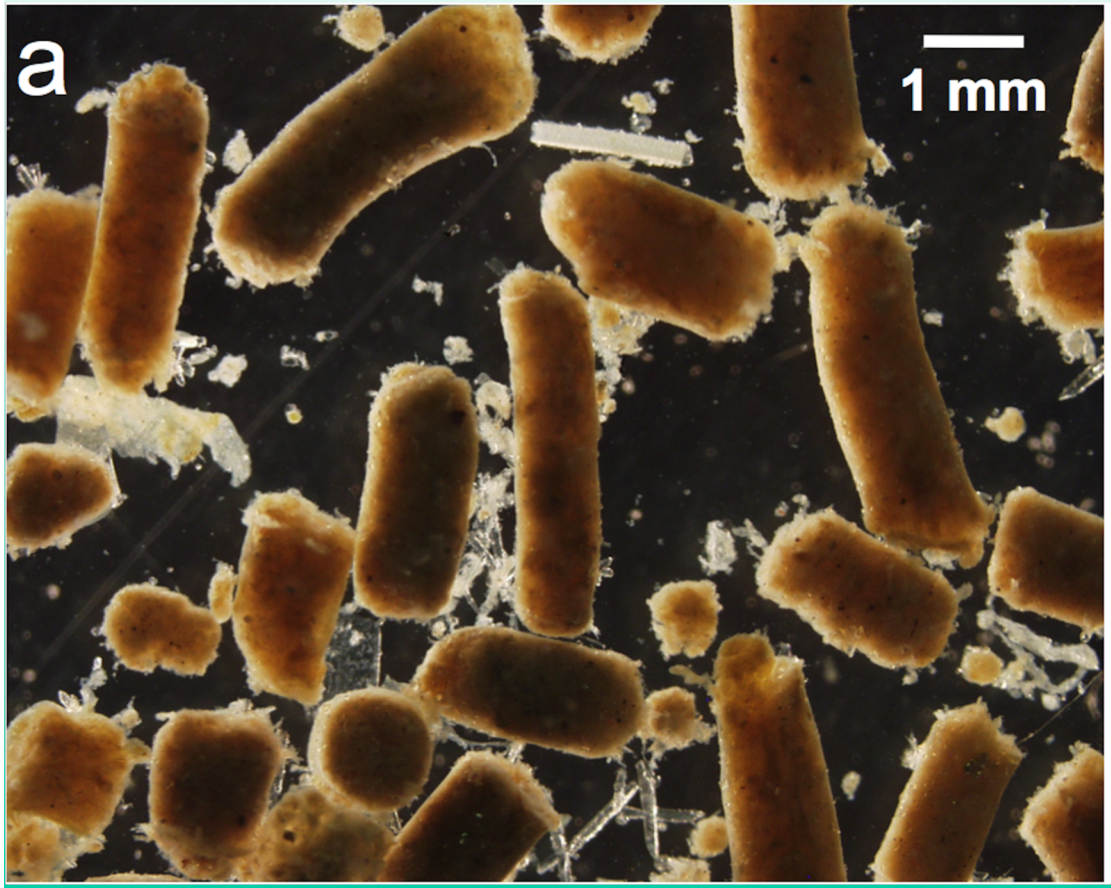
Salp

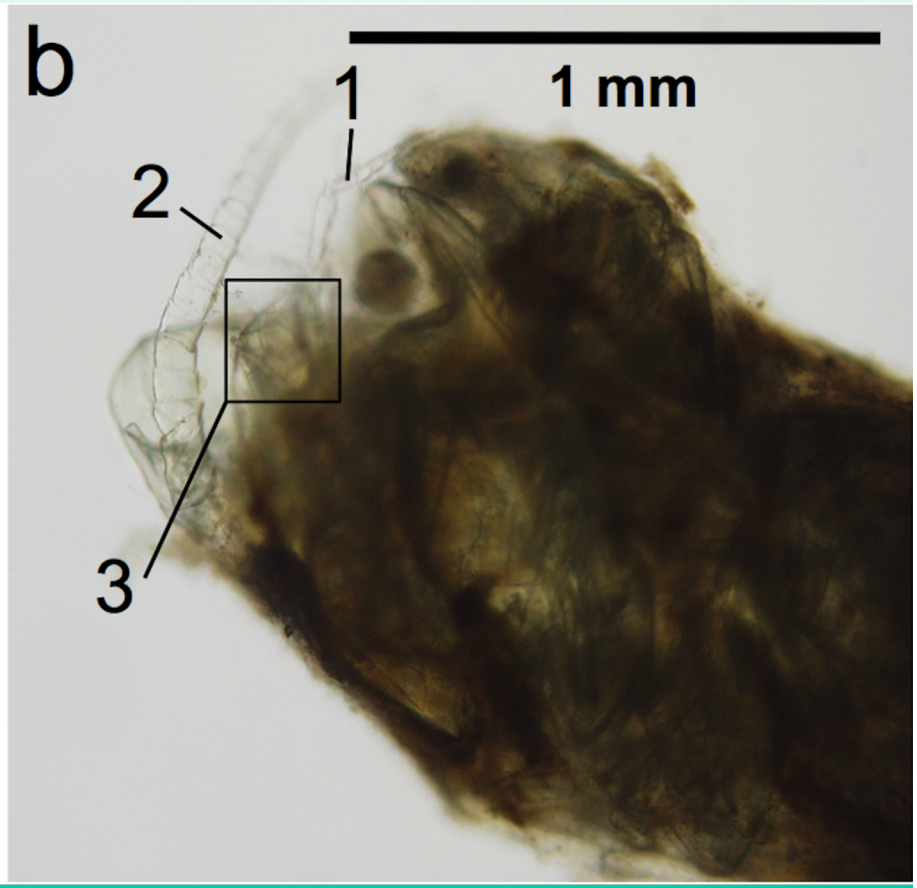
Copepod



Steinberg, Wilson

Fish are likely important exporters too…





Sinking rate = 458-1370 m d^{-1}!

Saba & Steinberg 2012

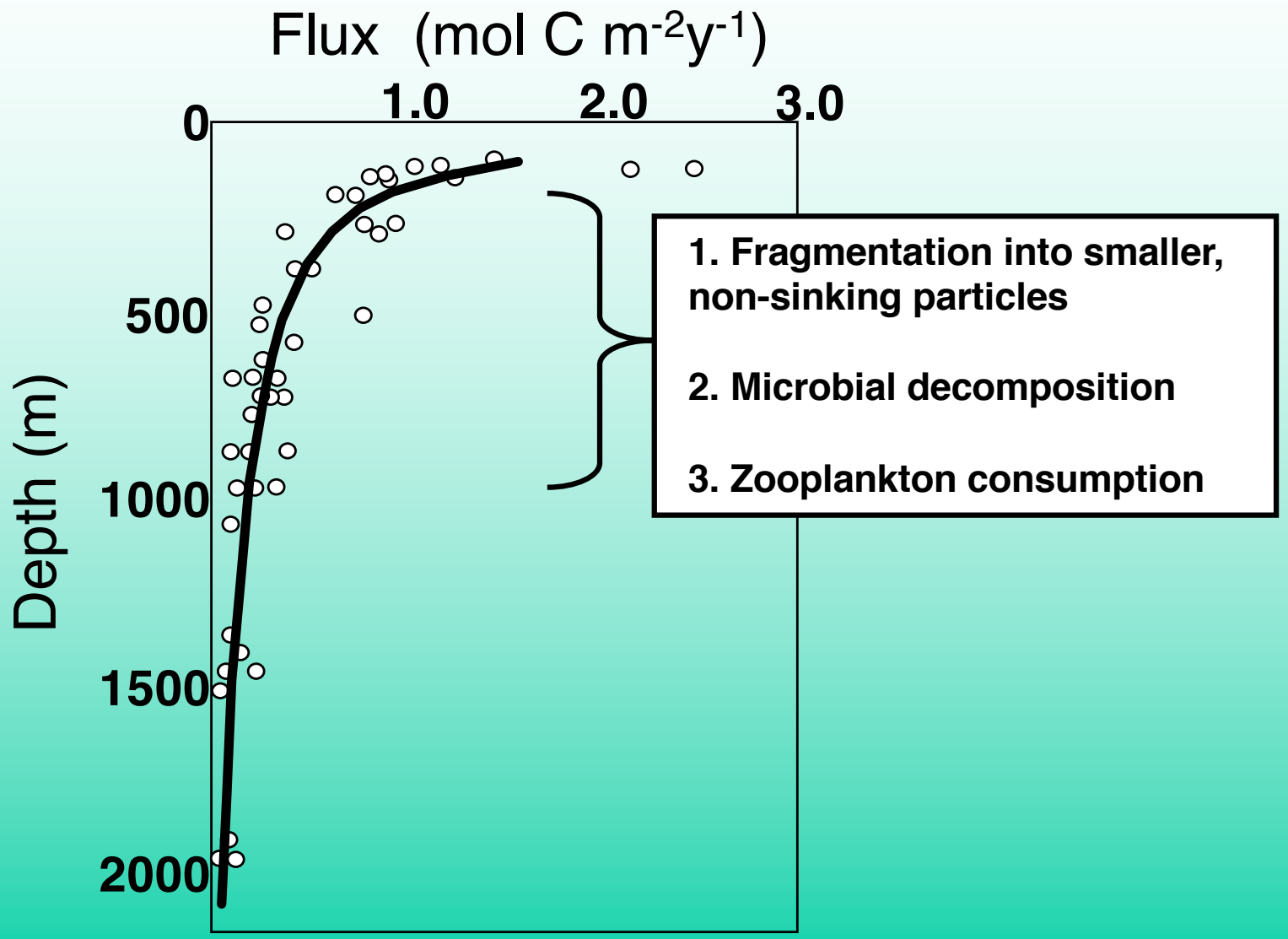
Fish are likely important exporters too…

Table 2 | Comparison of fish fecal pellet abundance, size, dry weight, particulate organic carbon (POC) and nitrogen (PON), C:N, and sinking rate from present study, northern anchovy pellets from the Monterey Bay Aquarium (MBA), and Peruvian anchovy pellets from Staresinic et al.[8]

	Abundance (# pellets m^{-3})	Length (mm)	Width (mm)	Volume (mm^3)	Dry Weight (μg $pellet^{-1}$)	POC (μg C $pellet^{-1}$)	PON (μg N $pellet^{-1}$)	C:N (molar)	Sinking Rate (m day^{-1})	Reference
Mean (SD)	1.8 (1.9)	2.1 (1.0)	1.0 (0.2)	1.8 (1.1)	314 (208)	21.7 (5.0)	2.7 (1.1)	10.1 (1.8)	787 (201)	Present study
Range	0.1–5.9	1.0–6.0	0.6–1.5	0.2–7.9	100–771	14.5–31.0	1.5–5.6	6.5–12.5	485–1370	
Mean (SD)		3.2 (1.1)	1.0 (0.2)	2.9 (1.4)						MBA anchovy pellets
Range		1.5–5.6	0.8–1.4	0.8–5.7						
Mean (SD)		1.1	1.0	0.9	286	18.4	1.9	11.3	1100	Staresinic et al.[8]
Range					223–347	14.4–21.1	1.2–2.4	10.1–15.0	691–1987	

Saba & Steinberg 2012

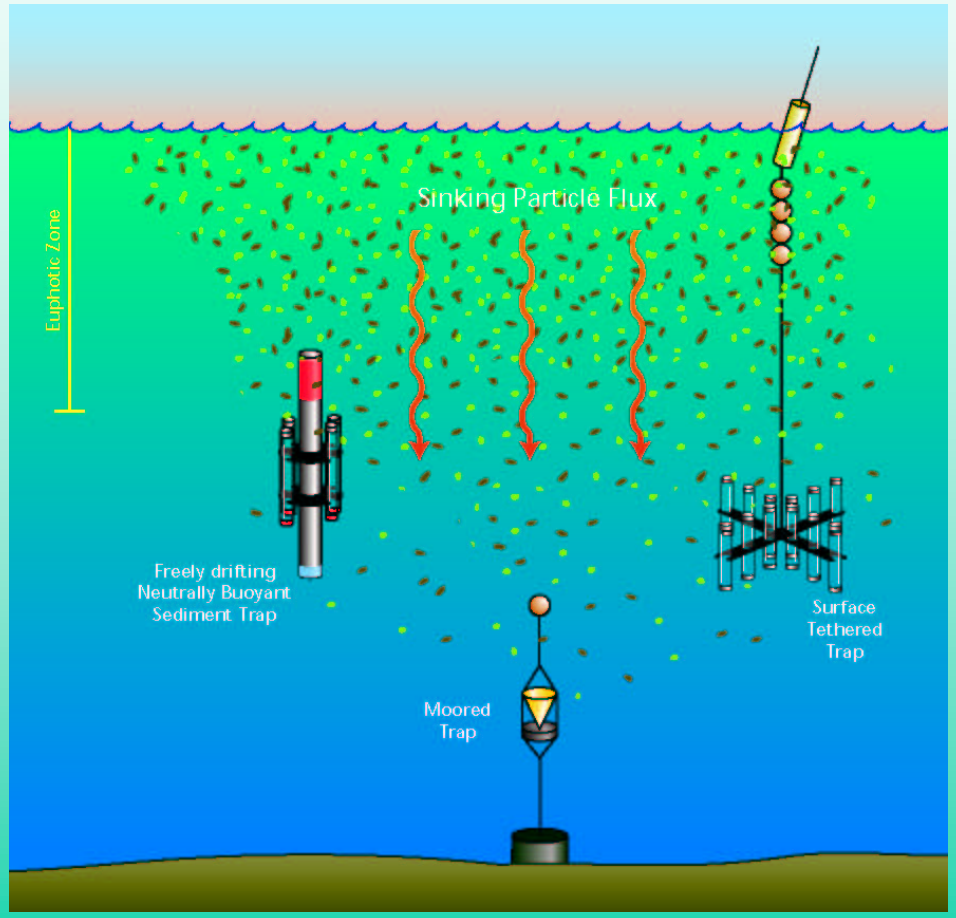
Decrease in flux with depth



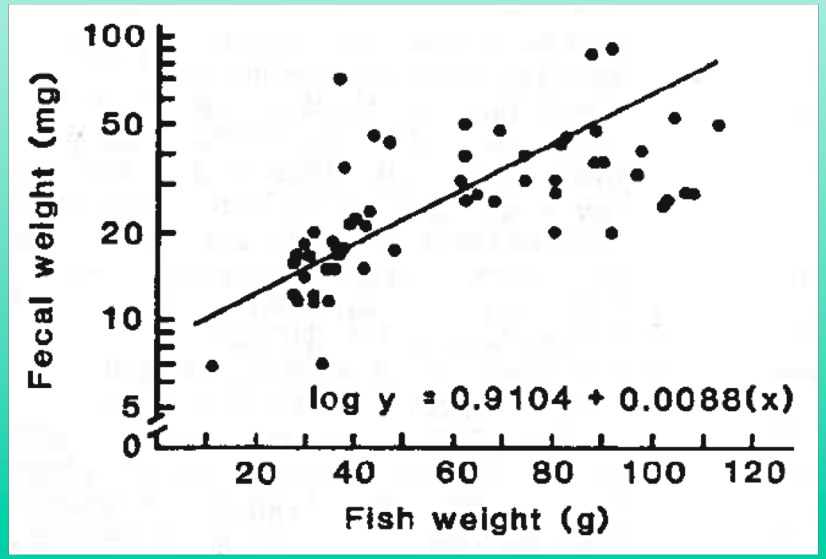
Martin et al. 1987

Approaches to measuring fish fecal pellet flux

- Sediment traps



- Lab and field studies
- Gut evacuation rates
- Modeling techniques (Bioenergetic, allometric)



Bray et al. 1983