SHALL WE REPEAT PLASTICS RESEARCH (?&!)

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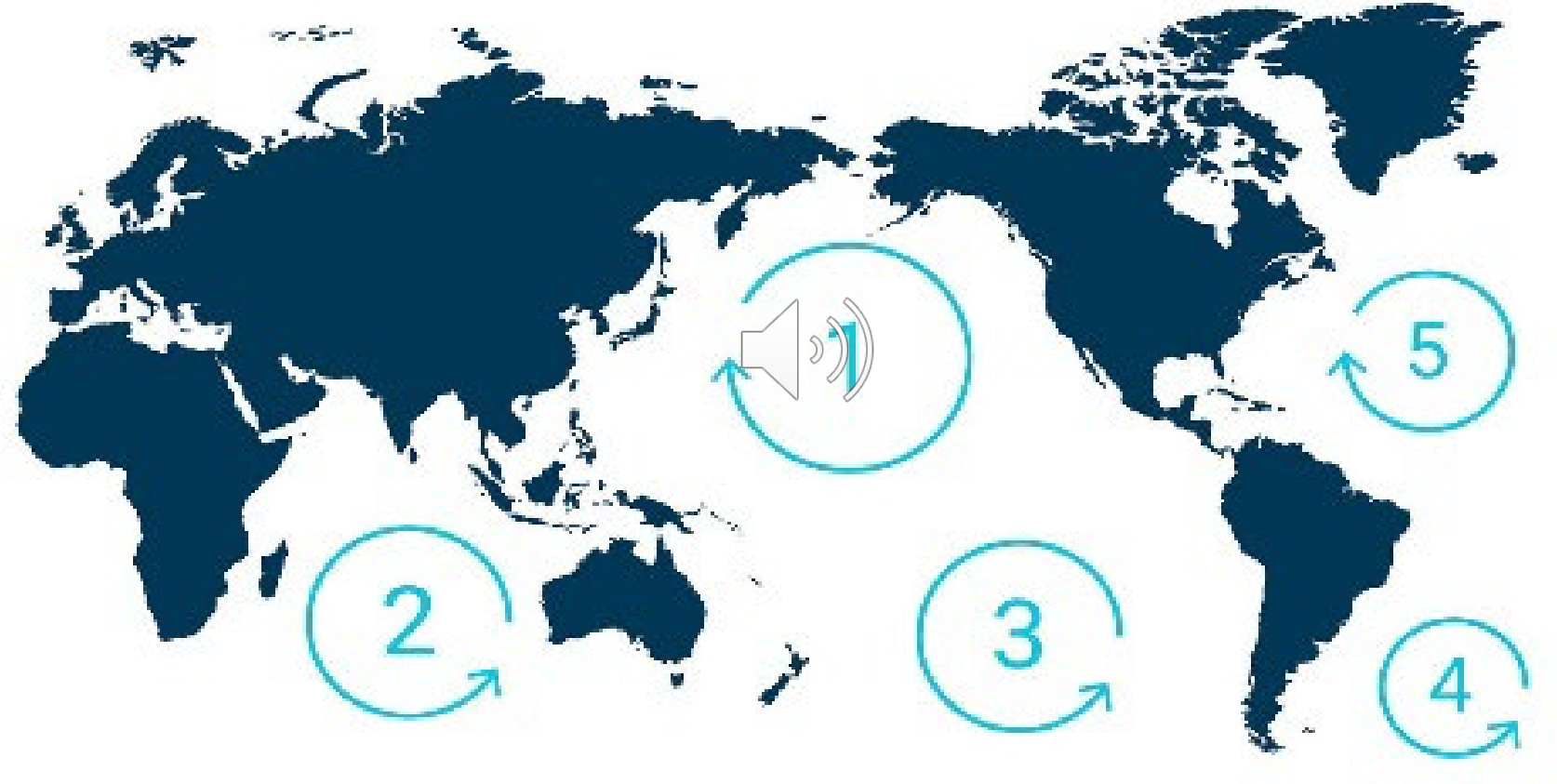
INITIAL REMARKS

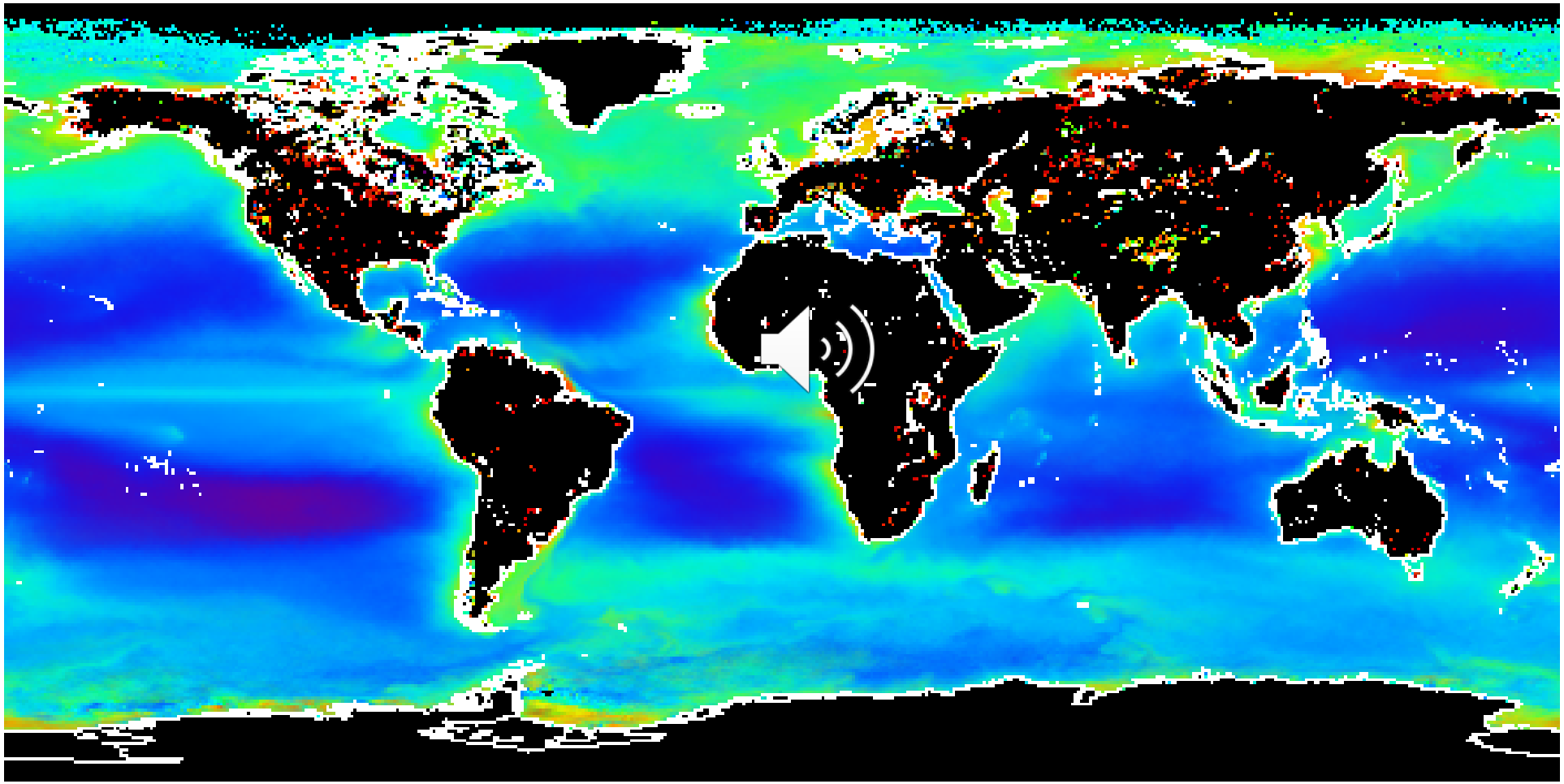
- WE WILL TALK ABOUT:
- PLASTICS IN THE WATER, OCEAN MOSTLY, NOT BIOTA AND SEDIMENTS (for NOW);
- PLASTICS INCLUDING MACRO -, MICRO- AND NANOPLASTICS;
- PRIMARY INTEREST IN TALK IS PLASTICS (**PARTICLES,** *IN SITU EFFECTS*). SORRY, WE DOESN'T PAY MUCH ATTENTION HERE TO THE NANOPLASTICS (*IN VIVO EFFECTS*) DUE TO DIFFERENT ENVIRONMENT, SCALE, SAMPLING STRATEGY & EQUIPMENT, ANALYSITICAL TOOLS;
- MY TALK IS FOLLOWING PICES RULES & ETHIC;
- WE CONCENTRATE ON THE NORTHERN PACIFIC MOSTLY;
- GOAL OF MY TALK – RISE PROBLEM WITH PLASTIC OF NORTH PACIFIC, HARD TO EXPLORE AND RESOLVE ALONE PICES MEMBER, BECAUSE OF COMPLEXITY AND OCEAN BASIN SCALE;
- AWAITING RESULT – PLASTICS PHENOMENA BECAME RECOGNASABLE AND UNDERDSTANDABLE, PLANNING A FOLLOWING STEPS FOR RESEARCH, ESTIMATIONS AND ASSESSMENT OF PLASTICS IMPACTS TO THE N.PACIFIC OCEAN ECOSYSTEMS AND VICE VERSA.

WHERE PLASTIC IS ACCUMULATING?



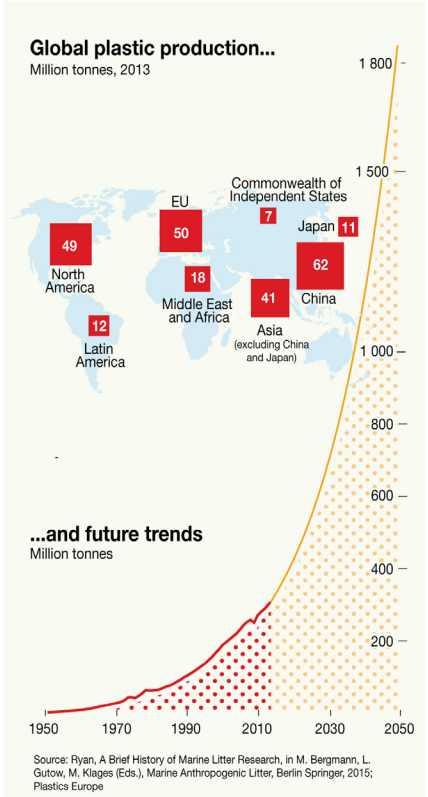
Source: www.theoceancleanup.com

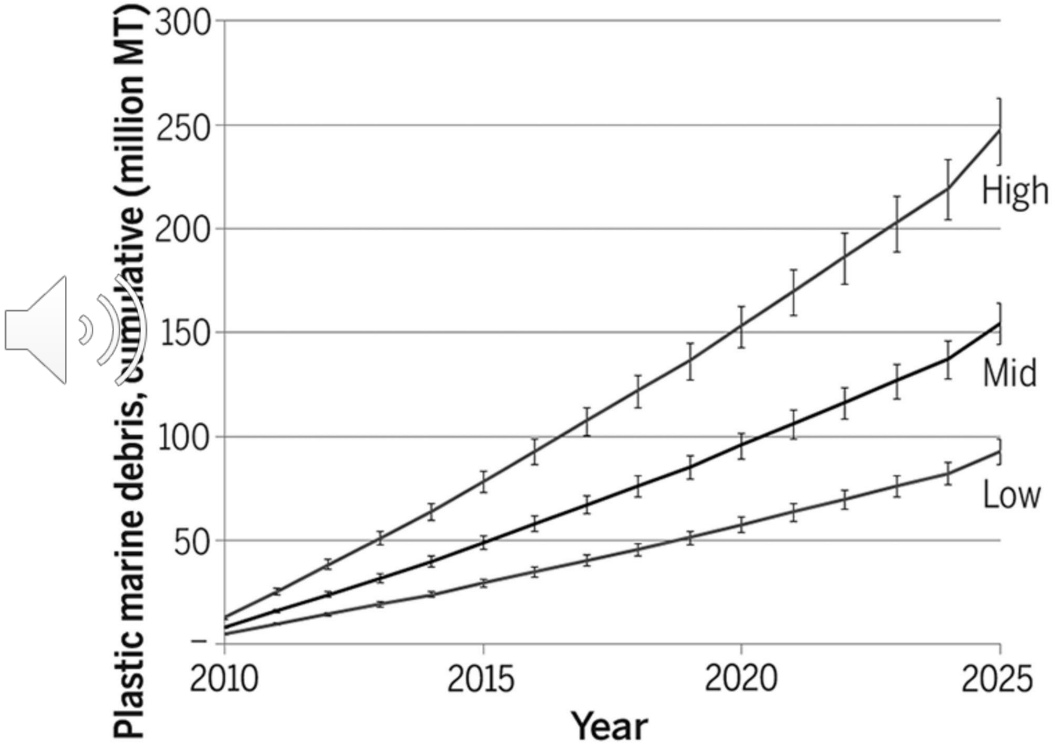
EDGE OR IN THE OLIGOTROPHIC PARTS



Total Chlorophyll,
Source: oceancolor.gsfc.nasa.gov 31 October 1996 - 15 September 2022

WHAT WE'RE KNOWN EXACTLY AND APPROXIMATELY?





Sources: (L) Bergmann, Gutow, Klages 2015; (R) Jambeck et al., 2015

IS HERE A PARADOX? YES!

- PLASTICS IN THE OCEANS SHOULD ACCUMULATE.
- IN THE SAME TIME:
- - PLASTICS MASS IN THE OCEANS IS UNKNOWN, DESPITE A SURFACE DENSITY DISTRIBUTION FOR WORLD OCEAN DECLARED AS EQUAL TO ~ 6 K PARTICLES FOR EACH 1 KM^2 (Bohdan, 2022);
- - DEVELOPING UNDERSTANDING OF LIFE CYRCLE/FATE PLASTICS IN THE WATER – PLS. LINK TO WHOI Colloquium by E.W. and H.A.Morss, Jr. 2019 © *Microplastic in the Ocean: Emergency OR Exaggeration*? (JUST AS INTRO, MANY OTHER SOURCES, FOR EXAMPLE, IRINA CHUBARENKO ET AL. (2021) PLASTICS IN MARINE WATER(C);
- - TAKING IN ACCOUNT MILLIONS OF TONNS PLASTICS LOAD ANNUALLY TO THE OCEAN ECOSYSTEMS, WE MUST HAVE AN INCREASING (AT LEAST) PLASTICS CONCENTRATIONS – BUT WE NOT OBTAIN THAT AT ALL!
- -EXAMPLE: REGION OUTSIDE GREAT PACIFIC GARBAGE PATCH (GPGP), I.E. GULF OF ALASKA AND VICINITIES
- - PROOFS NEXT 2 PAGES PLS.

PREDESSORS, N.PACIFIC 1985-1988

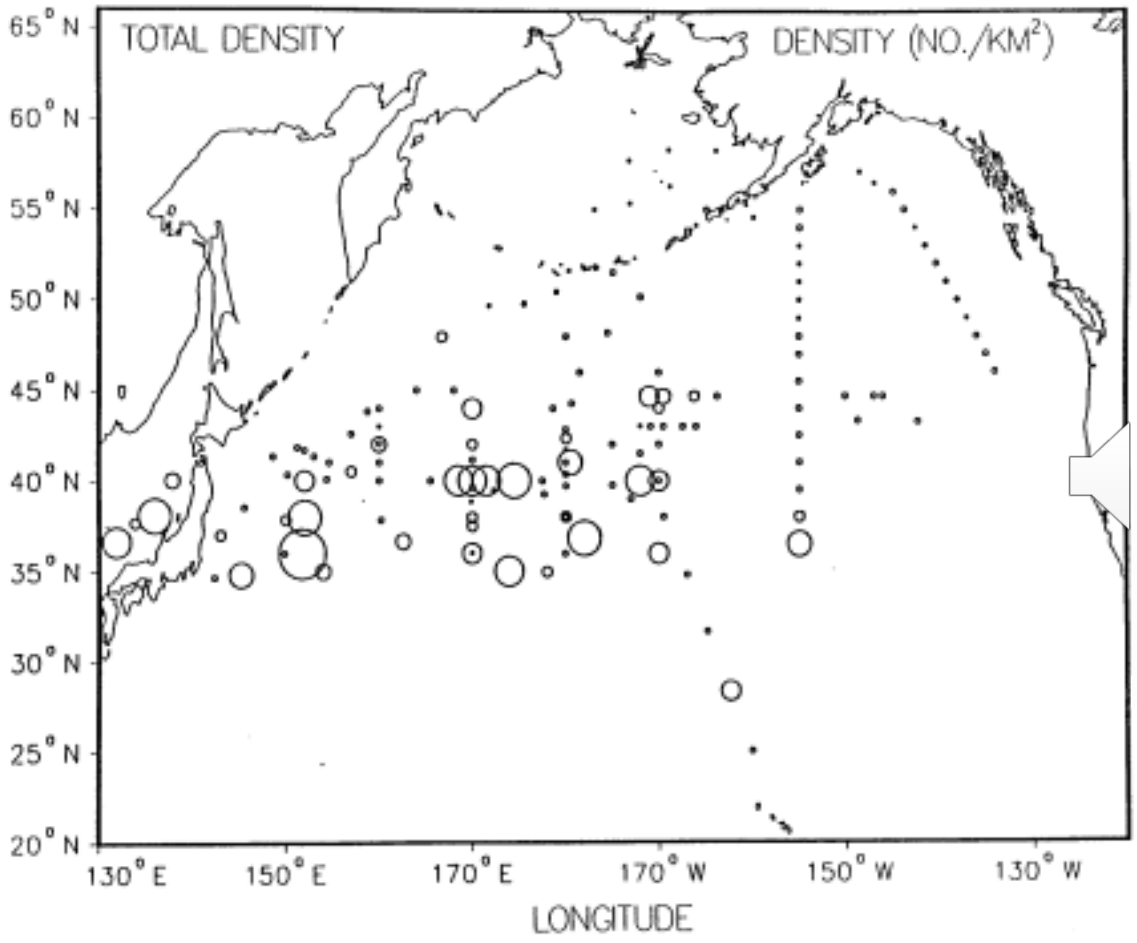


Table 1.--Densities (number per square kilometer) and concentrations (grams per square kilometer) of neuston plastic in five water masses of the North Pacific, 1985-88.

Parameter	Bering Sea Water		Subarctic Water		Transitional Water		Subtropical Water		Japan Sea and nearshore Japan Water	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number		66		64		60		2		11
Area sampled (m^2)		35,906		28,662		22,154		541		3,824
Total concentration	1.0	4.2	61.4	225.5	291.6	714.4	535.1	726.1	128.2	172.2
Total density	100	600	12,800	22,300	57,900	72,800	61,000	74,000	74,700	73,800
Pellet	0	0	<100	300	300	800	3,300	4,600	500	1,200
Fragment	0	0	9,600	20,300	52,700	69,200	57,700	69,400	46,100	40,000
Styrofoam	0	0	400	1,300	1,100	3,200	0	0	26,200	37,200
Polypropylene line	100	400	400	1,500	500	1,500	0	0	0	0
Miscellaneous line/thread	100	300	2,600	6,900	2,300	4,600	0	0	1,900	3,300
Miscellaneous/unidentified	100	500	100	500	1,000	3,100	0	0	0	0

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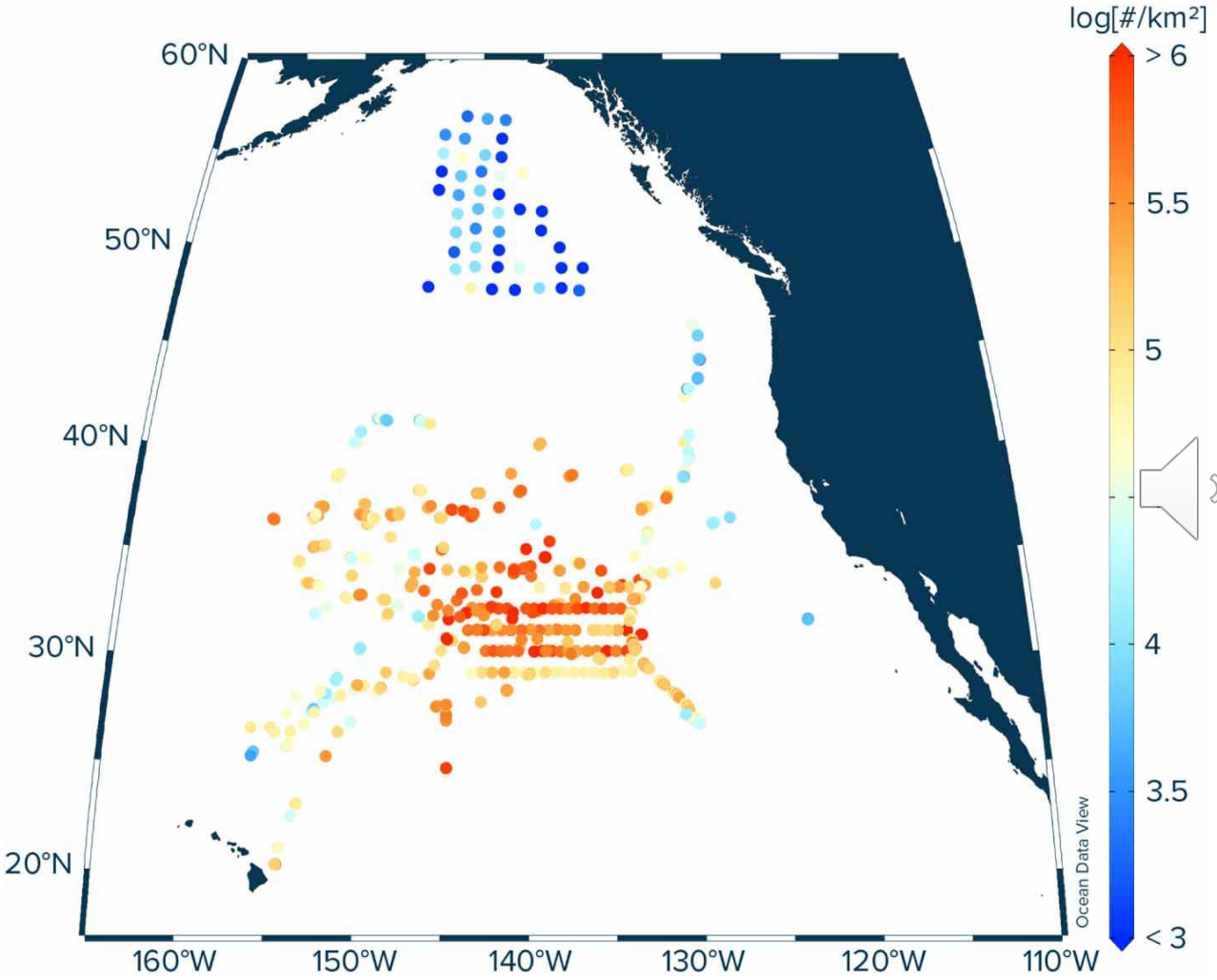
SOURCE:
THE QUANTITATIVE DISTRIBUTION AND CHARACTERISTICS OF NEUSTON PLASTIC IN THE NORTH PACIFIC OCEAN, 1985-88// Robert H. Day, David G. Shaw and Steven E. Ignell, NOAA 1990

NOWADAYS EXAMPLE, E. PACIFIC 2015-2019



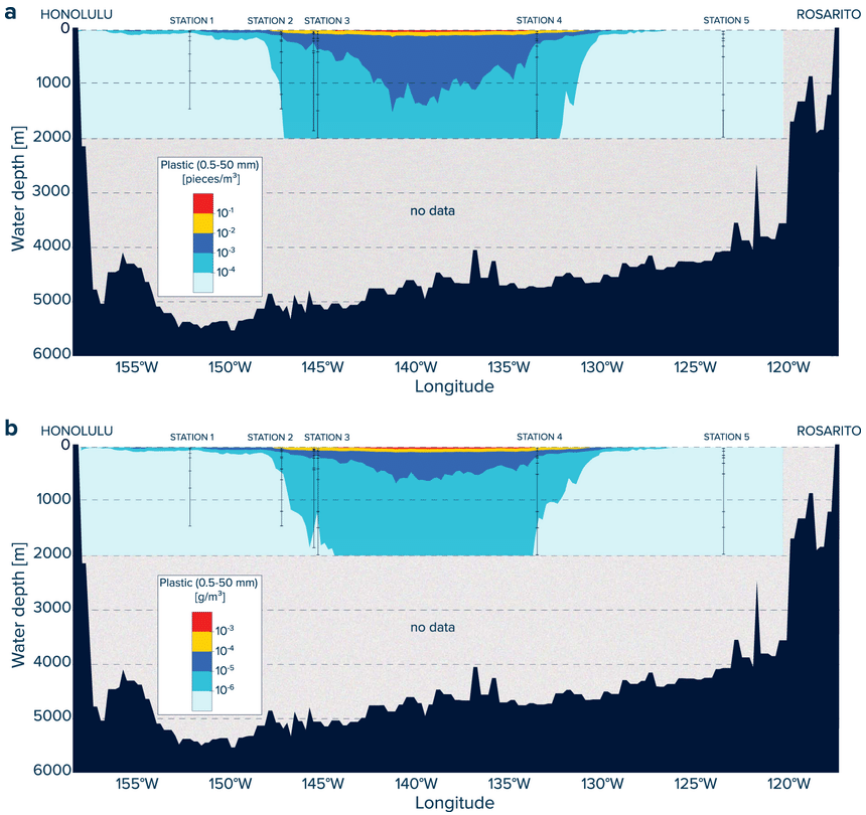
Size class (cm)		H-type	N-type	P-type	F-type	All
0.05-0.15	(grams per km²)	0.500454	0.040274206	0	0	0.540728
	(# per km²)	1693	494	0	0	2186.959
0.15-0.5	(grams per km²)	0.794227	0.263058643	0	0.0159	1.073178
	(# per km²)	1543	3258	0	84	4885.594
0.5-1.5	(grams per km²)	1.338606	0.287817804	0	0.1535	1.779884
	(# per km²)	232	851	0	37	1121.211
1.5-5	(grams per km²)	3.899726	0.405798069	0	0	4.305524
	(# per km²)	21	52	0	0	72.37816
All	(grams per km²)	6.533013	0.996948722	0	0.1694	7.699314
	(# per km²)	3488.727	4656	0	121	8266.143
Numerical %		42%	56%	0%	1%	100%
Mass %		85%	13%	0%	2%	100%

FIG. DENSITY (#/KM^2), TABLE FOR GULF OF ALASKA & VICINITIES (#/KM^2 AND G/KM^2)

CONCLUSION: SEEM TO BE AFTER 30+ YEARS ***NO INCREASING*** IN DENSITY / MASS OF PLASTICS FOR THE SUBARTIC WATERS OF NE PACIFIC BASED ON ~ SAME SAMPLING GEARS (NEUSTON NETS)

SOURCE : Egger et al. (2020) A SPATIALLY VARIABLE SCARCITY OF FLOATING MICROPLASTICS IN THE EASTERN NORTH PACIFIC OCEAN

SUPPOSE: PLASTICS PARADOX IS EXISTING IN THE OCEAN, WHAT IS EXPLANATION OR HOW&WHERE ARE DISSAPEARED MILLIONS TONNS OF PLASTICS?



Predicted concentrations of plastic debris in the upper 2000 m of ocean water column along our cruise track from Honolulu (Hawaii, USA) to Rosarito (Mexico). The (a) numerical and (b) mass concentrations in the water column are estimated as a function of the debris afloat at the ocean surface in the eastern North Pacific Ocean and corresponding water depth. The sampling stations and associated trawling depths are indicated by black solid lines.

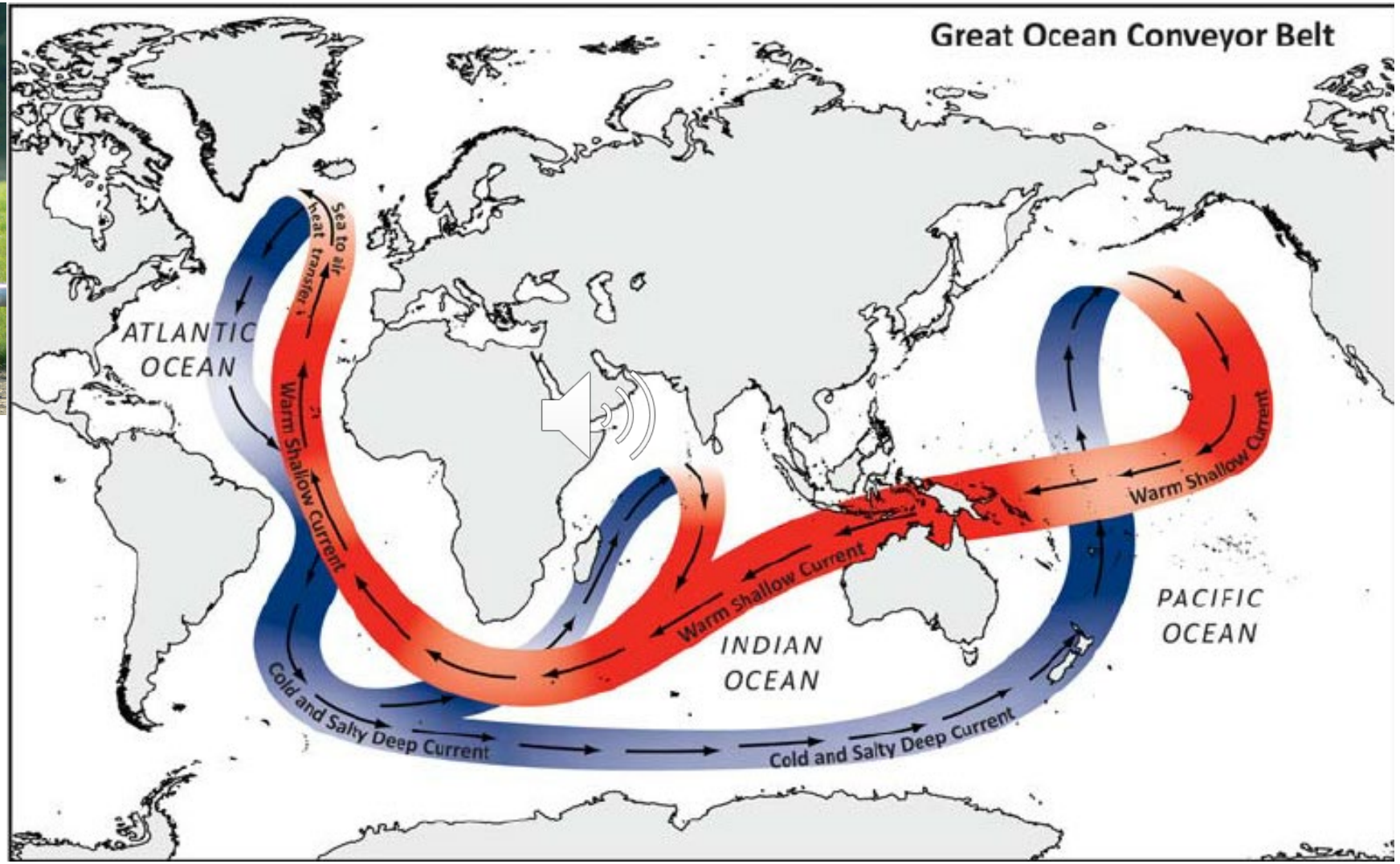
Thus, these plots should be interpreted as a first qualitative attempt to visualize the possible vertical distribution of plastic debris in the area.

Source: Egger, Sulu-Gambari & Lebreton (2020)

IS HERE GLOBAL CONVEYOR PARTICIPATE?

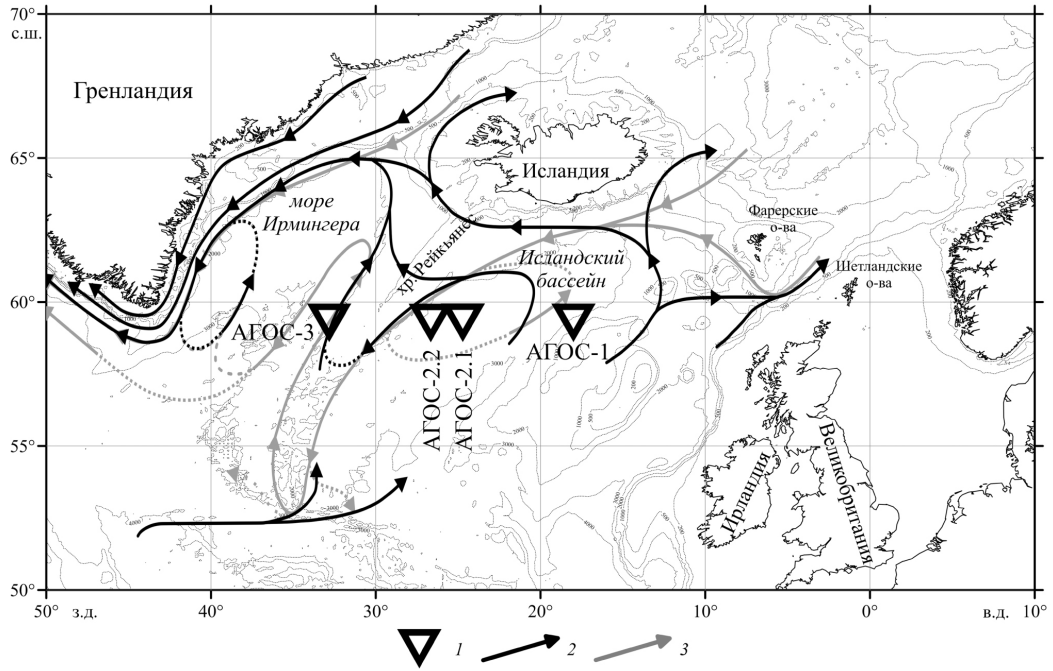
Wallace Broecker

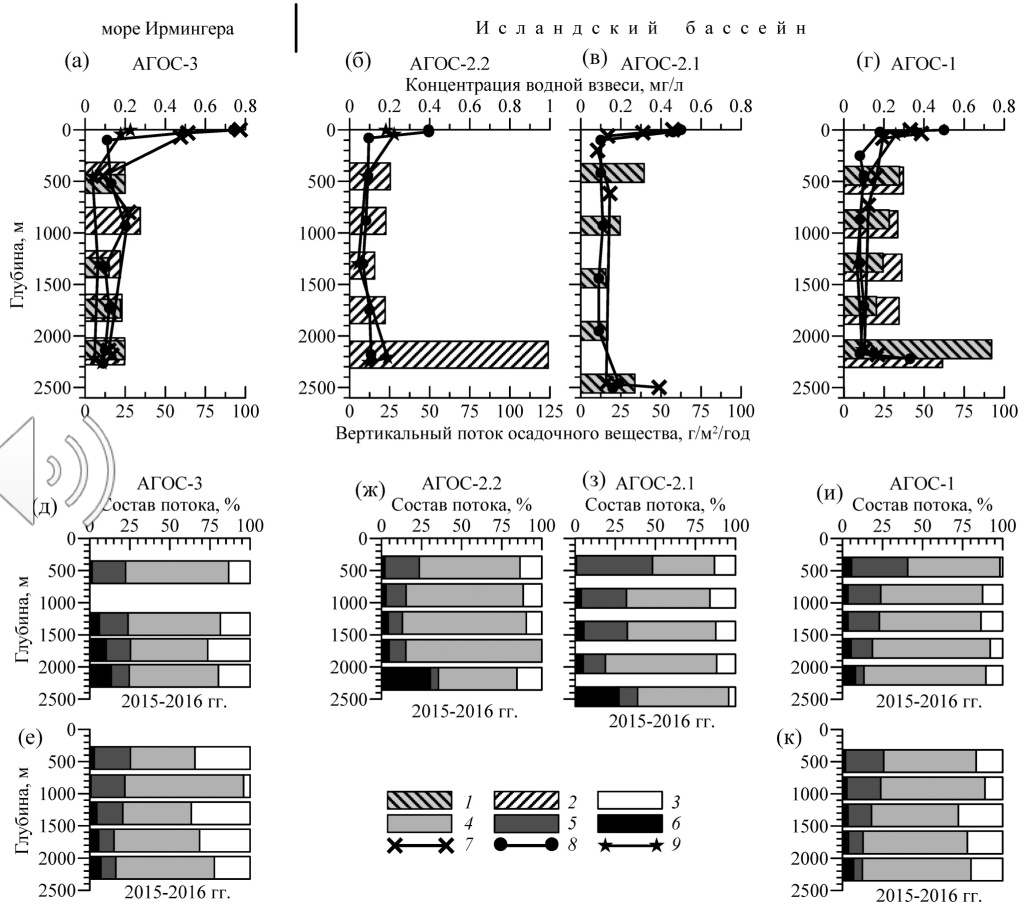
Photo credit:
Janice Castro ©



Source: Broecker, 1987

PERHAPS! (FOR A MINUTE ICES AREA!)

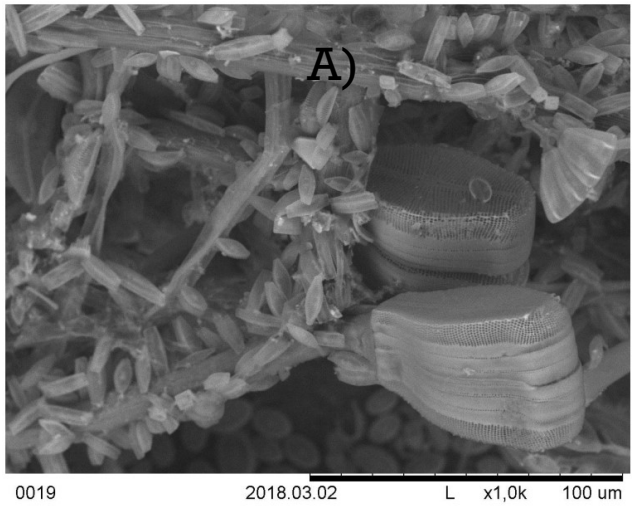


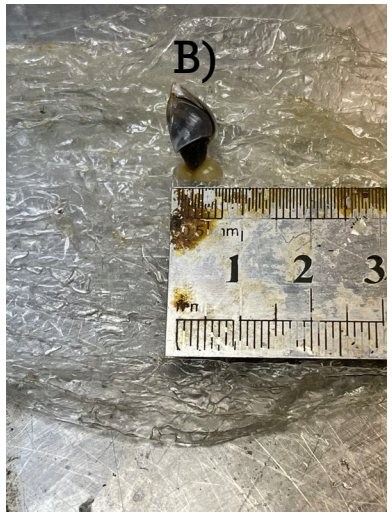


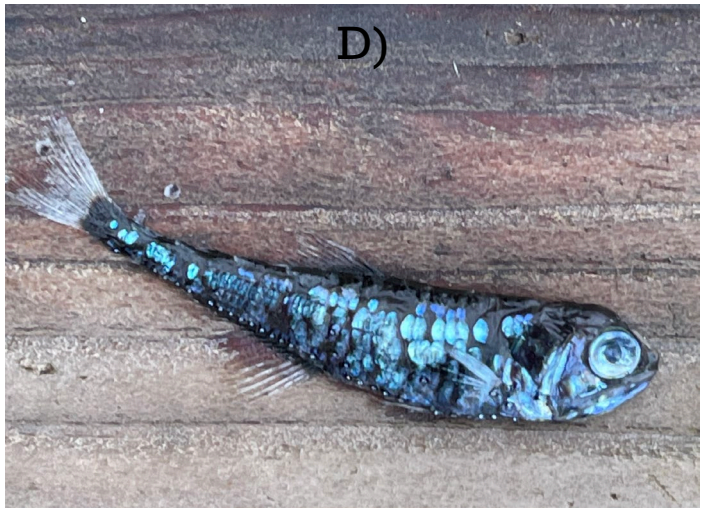
Studies of particle fluxes of sedimentary matter along multiyear transoceanic section in northern Atlantic and Arctic interaction area

Sourse: Klyuvitkin et al., 2019

HOW BIG BECAME SMALL (P. PARTICLES) AND SINKING BEYOND CONVEYOR IMPACT?





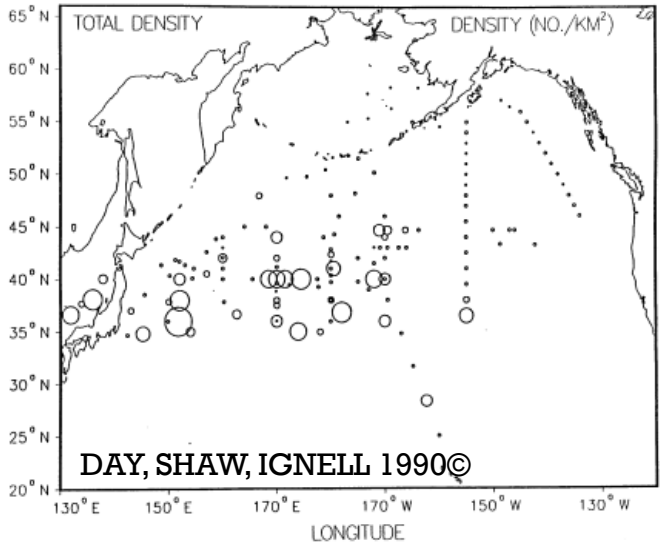


A) Colonization & breaking plastics, *Didymosphenia geminata* cells + diatoms on the polyethylene film surface;
B) Sunken by adding weight of organisms (including microbio colonization);
C) Gasterosteus sp. as candidate of the plastics eating/excretion;
D) Mictophydae (and other species!) as candidate of the plastics eating eating/excretion.

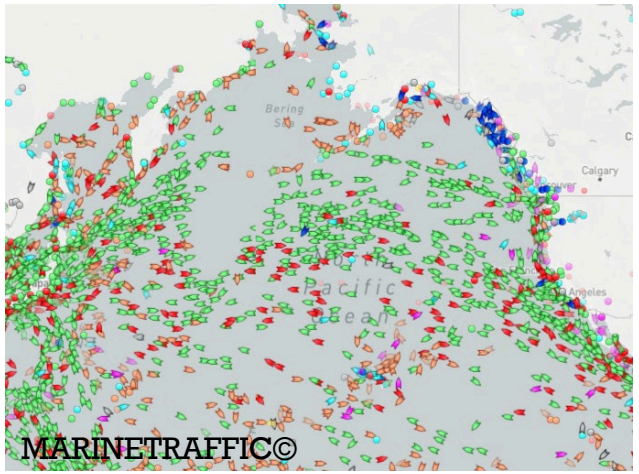
Sources:

(A) Philipp Sapozhnikov © (IO RAS *A.P. Shirshov,* photo, personal communication);
(B) Mollusk on the plastic film, sampled from 30 meter depth (R/V TINRO, North Pacific NPAFC/IYS 2022 winter expedition);
(C) Gasterosteus sp. during plastics catch filtration (R/V TINRO, North Pacific NPAFC/IYS 2022 winter expedition);
(D) Myctophidae on the deck (R/V TINRO, North Pacific NPAFC/IYS 2022 winter expedition).

IF 80-IES REPEATED WHAT'S RATIONALE?



DAY, SHAW, IGNELL 1990©



MARINETRAFFIC©

- REPEAT NOAA 80-IES RESEARCH IN N.PACIFIC FOR COMPARING AT A NEW TECHNOLOGICAL LEVEL AND QUANTITATELY;
- BECAUSE GROWING PLASTICS LOAD TO THE PACIFIC RESEACHING OPEN NORTH PACIFIC WILL PROVIDE BETTER UNDERSTANDING PLASTICS PRESENCE AND FATE FOR EACH PICES COUNTRY INNER EEZ, FISHERY AND ENVIRONMENT;
- MIGHT BE ADD PLASTICS FISH RESEARCH OVER NORTH PACIFIC FOR THE COMMERCIAL AS WELL ABUNDANT SPECIES AS ROUTINE MONITORING TOOL WITH EXCHANGING INFORMATION ABOUT AS GLOBAL PHENOMENA;
- MIGHT BE ADD ABBYSAL DEPTH SEDIMENTS SAMPLING (NEW) + SEDIMENT TRAPS COLLECTION RE-ANALYSIS WITH PROSPECTIVE OF A NEW PAGE FOR THE PACIFIC PLASTICS RESEACH;
- BECAUSE PROSPECTIVE FOR THE JOINT SCIENTIFIC EFFORTS BETWEEN PICES AND ICES DIASPORAS OF SCIENTISTS;
- PICES HAS OWN 42 WORKING GROUP WHICH MIGHT BE CONSIDERING/DEVELOPING IDEA TO EXECUTABLE DETAILS.

BY THE WAY…

- https://doi.org/10.2307/4083505

Kenyon, K.W. and Kridler, E. (1969)

Laysan Albatrosses Swallow Indigestible Matter. Auk, 86, 339-343

The first published paper regarding plastics and marine biota (birds).

Plastic pellets from ingestion system of *Aethia psittacula,*
Commander islands, North Pacific, 1988
Scale 5 mm
Yuri B. Artyukhin © photo (courtesy),
Kamchatka branch of
Geography Institution, RAS

PLASTICS AND THE BIOTA…

- Widespread contamination of microplastics may lead to internalization in fish. Literature review from March 2019 to March 2020 details that a median of 60% of fish, belonging to 198 species captured in 24 countries, contain microplastics in their organs. Carnivores species ingested more microplastics than omnivores. Only 14% of fish were from aquaculture. Most studies focused on digestive systems. 44% marine birds ingest plastics, sea turtles eat plastics as well as 26 marine mammals species, with total accounting from 267 (2008) to 4000 (recent) marine biota species, with unavoidable discussion plastics impact to the water animals and follow up to the humans.
- Here should be more rising of accent to the opposite process – how biota impact to the plastics, adding to physical and chemical factors eliminations plastics from biotops and ecosystems.

Sources: https://litterbase.awi.de/interaction_graph;
Moor, 2008; Sequeira et al, 2020; Lusher et al., 2017; Mercogliano et al., 2020; Kühn et al., 2020; Frank et al., 2021; Yagi et al., 2022; Solino et al., 2022; Canningham et al., 2020; Rochman, 2015).

HAVE A NICHE FOR A NEW TECHNOLOGY?

- Remote sensing from time lapse camera (1) through airborn imagery systems(2) up to satellite(3)

Sources: (1)de Vrieset al (2021) (2) Garba et al., 2021 (3) Sasaki et al., 2022 (coastal! But beginning)

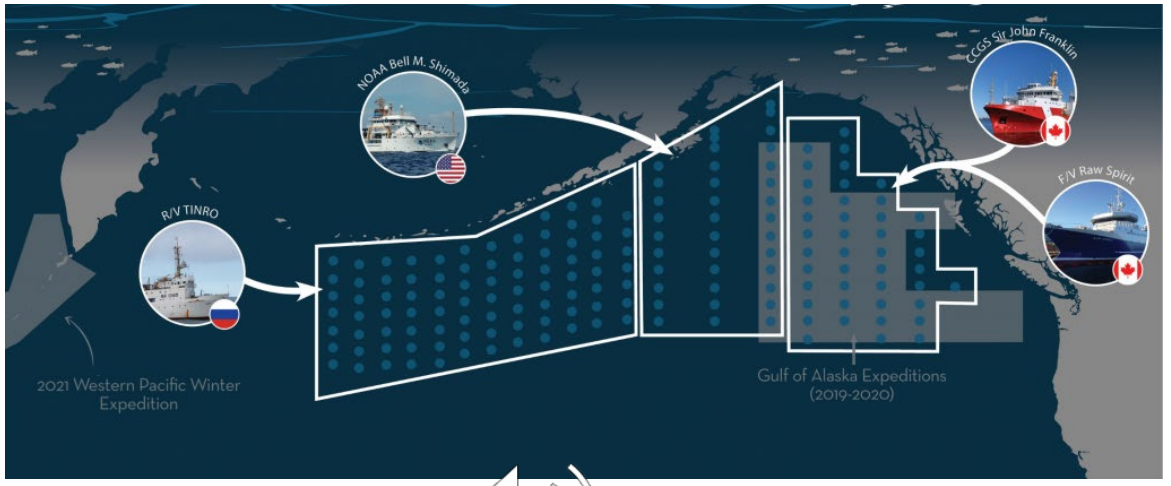
- Unfortunatelly No possibility for automatic measurements aiming plastics accounting *IN SITU* Source: https://www.sequoiasci.com/article/on-the-feasibility-of-measuring-plastic-particles-in-situ/

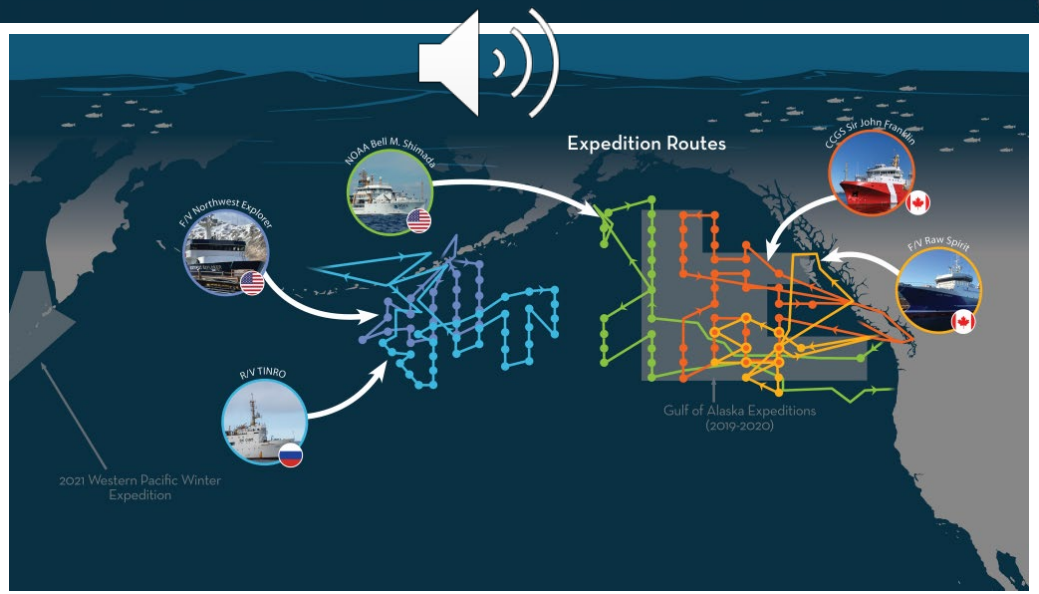
As consequence – lot of personal hand work with sampling and analysis still remain

- Autonomous platforms (saildrone©? – Welcome!) for the plastics observations;

- Here still a huge window for the standard different R/Vs with scientific crews - ***PACIFIC*** all at your boards (next page)

NPAFC EXAMPLE WITH WINTER SALMON





Source: https://yearofthesalmon.org/2022expedition/

AT LAST… EVEN…

EVEN OCEAN ECOSYSTEMS ARE EFFICIENT FOR UTILYZYING PLASTICS,

HYPOTEZIS IS THE QUANTITY OF ACCUMULATING PLASTICS BECOME ENOUGH INSIDE WHOLE OCEAN TO FEED PLASTICS THE EACH EEZS FROM OPEN OCEAN AMONG OTHER SOURCES (ATMOSPHERIC TRANSPORT, FISHERIES, RIVERINE INPUT);

BETTER TO MONITOR PLASTICS IN WATER, LOW TROPHIC LEVELS, NEKTON, SEDIMENTS, BENTHOS BECAUSE NOT ENOUGH DATA ABOUT HOW PLASTICS DENSITY&MASS ARE STATIC IN ECOSYSTEMS WITH TIME AND SPATIALLY WITHIN NORTHERN PACIFIC OCEAN AND HOW LONG THAT WOULD LASTED;

AGAIN, LOOKING WHAT'S HAPPENING WITH PLASTICS INSIDE EACH EEZ HARD TO UNDERSTAND W/O ***WHOLE NORTHEN PACIFIC SURVEY***

Same thoughts in Source: Sole et al., 2017

FRANKLY, WHY THINKING ABOUT REPEATING OF THE PLASTICS RESEARCH IN THE NORTH PACIFIC HAS A SCIENTIFIC SENSE.

PICES WG#42 AND ICES WGML, OK!

BUT PLASTICS TOO INTERDICIPLINARY! TIME FOR PRIORITIZIYNG?

SEEM TO BE (OR SHOULD BE) CONTINUED…

THANK YOU, PICES SB THINK TANK FOR LISTENING!