Microplastics in the Eastern Mediterranean – environmental interactions

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East Med is hyper-oligotrophic

Powley et al. 2017
Eastern Med plastics

- So, considering Eastern Med is the marine equivalent of the Sahara, would you expect to find a lot of marine debris there?
- There are occasional pulses of macro-debris, but not exceptional...
What about Micro-debris in the Eastern Mediterranean?

2 year Manta tow study

Particles: 335µm - 5mm

17 sites along the Med Israeli coast

van der Hal et al. 2017
Coastal tows
Average Speed = 2 knts
Tow duration = 15 min
Tow Direction = N or S
Microplastic **Abundances** in E Med

Mean abundance of microplastic particles \( \text{m}^3 \)

- N Atlantic (coastal waters); Carpenter et al., 1972
- N Pacific Gyre study; Moore et al., 2001
- S California – Santa Monica Bay; Lattin et al., 2004
- N Pacific, inshore, surface; Moore et al, 2005
- Mediterranean; Cozar et al., 2015
- NW Mediterranean; Colignon et al., 2012
- This research - **Israeli coastal waters**

Cozar et al., 2015
Exceptionally high abundances of microplastics in the oligotrophic Israeli Mediterranean coastal waters

Noam van der Hal\textsuperscript{a}, Asaf Ariel\textsuperscript{b}, Dror L. Angel\textsuperscript{a,}\textsuperscript{*}
MPs in water column

• Large abundances of MPs not only at the sea surface, but also in plankton tows, in the water column

• Whereas some MPs float, others sink and there is a substantial # of MPs in the water column

• What happens at the seafloor?
This is not a lot... no relationship between water column & benthic MPs?
MPs in sediments

• Low abundances of MPs at seafloor in comparison to other studies (e.g. Van Cauwenberghe et al. 2015)

• Is it because:
  – Most polymers are less dense (do not sink)?
  – Most benthic MPs are small (we counted MPs > 300um)?
  – Sediment bioturbation dilutes surface sediment MPs?
  – Currents carry away benthic MPs?
  – Ingestion by benthos removes sediment MPs?

• Need to invest efforts in methods (Yao et al. 2019)
The case of rabbitfish & MP’s

Rabbitfish are successful invasive’s in the E Med
% of rabbitfish with MPs in digestive tracts, 1960 - 2016

Is this a reflection of the abundances of MPs in the coastal zone?
MPs in rabbitfish, 2017

- 81 out of 88 (92%) siganids examined contained MPs
- Abundances of MP’s varied among the fish:

<table>
<thead>
<tr>
<th># of MPs/fish</th>
<th>Number of fish in each category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>1-9</td>
<td>12</td>
</tr>
<tr>
<td>10-99</td>
<td>55</td>
</tr>
<tr>
<td>100-548</td>
<td>14</td>
</tr>
</tbody>
</table>
Abundance of MPs as a function of rabbitfish size

![Bar graph showing the abundance of MPs as a function of rabbitfish size. The x-axis represents the mean weight (+/- S.E.) of fish digestive tract (g), and the y-axis represents the number of MPs. The graph indicates a peak in MP abundance between the sizes of 6-8 g and 8-10 g.](image-url)
So, what is going on?

• Red macroalga, *Jania rubens* (Ashdod, June 2017) contains 0.5 – 4 MPs/g DW (this study)

• rabbitfish are herbivores & many plants trap plastics

• ... is plastic ingestion by the fish incidental, i.e. not by design?

• Gutow et al. (2015) showed that snails ingest MPs on macro-algae
MPs ingestion - consequences

- Can the MPs ingested by the rabbitfish cause damage? Health hazards?
PAH’s adsorbed to MPs collected in Israeli coastal waters
PCB’s adsorbed to MPs collected in Israeli coastal waters
Rabbitfish offered food pellets with PCB-laced MPs

In one treatment, 200 ng/g PCBs in siganid muscle tissue
Ongoing research

• **Trophic transfer** of MPs? POPs?

• Impacts of MP ingestion on *sea turtles*?

• Relationship between MPs and *JF* blooms?
Groupers feed on rabbitfish in Israeli coastal waters – is there trophic transfer of MPs? of POPs?
Plastics & MPs ingested by sea-turtles: incorporation of POPs, heavy metals?

Diana Shukis, MA research

20% of loggerheads – MPs
87% of green’s – MPs
Tissues tested: no PCBs; low Hg; Cd, As, Pb – normal range
Medusae swarm in the E Med annually, since the 1980s

Summer blooms of Rhopilema nomadica estimated at $>10^5$ individuals/km$^2$
Do the abundant MPs in East Mediterranean serve as substrates for scyphozoan polyps?

Any connection between huge *Rhopilema nomadica* blooms & the abundant MPs?
Thank you!

...a tiny reef established on a plastic bottle

(Stephen Breitstein)