IDEALISM
(Throw Away Living, Life Magazine, 1955)
REALITY
IN 20 hrs of timed observations we saw 151 pieces

Courtesy of Hank Carson, UH Hilo, Hawaii
DISTRIBUTION OF DEBRIS BY CATEGORY

- **Styrofoam**: 21%
- **Buoys**: 10%
- **Other Plastic**: 8%
- **Bottles**: 14%
- **Fragments**: 28%
- **Cups / Jars**: 3%
- **Buckets / Crates**: 5%
- **Ropes / Lines**: 2%
- **Nets**: 2%
- **Other Fishing**: 2%
- **Fragments**: 3%
- **Tarp / Sheet / Bag**: 2%

Courtesy of Hank Carson, UH Hilo, Hawaii
GLOBAL DISTRIBUTION OF PLASTIC POLLUTION
North Atlantic Gyre
North Atlantic Gyre - Mats of sargassum trap plastic
North Atlantic Gyre
North Pacific Gyre
Indian Ocean Gyre

14,817,185 km²
Indian Ocean Gyre
South Atlantic Gyre
South Pacific Gyre
SOUTH PACIFIC GARBAGE PATCH
GARBAGE PATCHES AND HOTSPOTS
FATE OF PLASTIC POLLUTION IN THE MARINE ENVIRONMENT
<table>
<thead>
<tr>
<th>Size Range</th>
<th>Fragment</th>
<th>Pellet</th>
<th>Line</th>
<th>Film</th>
<th>Foam</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;4.75mm</td>
<td>351.93</td>
<td>6.38</td>
<td>1879.73</td>
<td>161.71</td>
<td>0</td>
<td>2399.76</td>
</tr>
<tr>
<td>2.80-4.749mm</td>
<td>2407.49</td>
<td>347.01</td>
<td>687.10</td>
<td>333.04</td>
<td>0</td>
<td>3774.65</td>
</tr>
<tr>
<td>1.00-2.79mm</td>
<td>9612.69</td>
<td>180.58</td>
<td>804.19</td>
<td>591.79</td>
<td>0</td>
<td>11189.27</td>
</tr>
<tr>
<td>0.710-0.999mm</td>
<td>3374.94</td>
<td>41.55</td>
<td>188.62</td>
<td>250.02</td>
<td>0</td>
<td>3855.14</td>
</tr>
<tr>
<td>0.500-0.709mm</td>
<td>2910.44</td>
<td>17.93</td>
<td>55.17</td>
<td>0</td>
<td>0</td>
<td>2983.54</td>
</tr>
<tr>
<td>0.355-0.499mm</td>
<td>2689.33</td>
<td>0</td>
<td>6.83</td>
<td>0</td>
<td>0</td>
<td>2696.16</td>
</tr>
<tr>
<td>TOTAL</td>
<td>21346.84</td>
<td>593.47</td>
<td>3621.66</td>
<td>1336.57</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

2.79 mm particles greater than all smaller sizes?
Ratio of particle count >1 vs <1 compared to sea states <\= 2 (Blue) and > 2 (Red)
UV DEGRADATION & EMBRITTLEMENT
6000 surface tows in the North Atlantic spanning 22 years

Courtesy of SEA Education Association – Woods Hole, MA
Average plastic concentration (pieces km⁻²)

Trend: 117 ± 196 pieces km⁻² year⁻¹

\[ r^2 = 0.016, \ P > 0.1 \]

No significant increase in 22 years

Courtesy of SEA Education Association – Woods Hole, MA
WASHED ASHORE - Azores, North Atlantic
WASHED ASHORE - Easter Island, South Pacific
DOES INGESTION, ENTANGLEMENT, BIOMASS = NEGATIVE BUOYANCY
SUMMARY OF THE PROBLEM OF PLASTIC POLLUTION
GLOBAL DISTRIBUTION, INGESTION, VECTOR FOR POPs
LITTER AND DESIGN PROBLEM
WASTE MANAGEMENT PROBLEM
YAMUNA RIVER – New Delhi, India
Plastic Pollution is a Petroleum Spill

But unlike most oil spills, Plastic Pollution is:

- Non-biodegradable
- Occurs in international waters
- No corporate responsibility
FOCUS ON SOLUTIONS TO PLASTIC POLLUTION
<table>
<thead>
<tr>
<th></th>
<th>Community</th>
<th>Business</th>
<th>Government/Waste Mgmt.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>home</td>
<td>office</td>
<td>school</td>
</tr>
<tr>
<td>Low-tech</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hi-tech</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No-tech (regulation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Home</td>
<td>Office</td>
<td>School</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------</td>
<td>-------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td><strong>Low-tech</strong></td>
<td><strong>BRING YOUR OWN</strong></td>
<td><strong>Water fountains</strong></td>
<td><strong>Waste-free lunch</strong></td>
</tr>
<tr>
<td><strong>Hi-tech</strong></td>
<td><strong>Compost</strong></td>
<td><strong>Waste Audit</strong></td>
<td><strong>Use real silverware</strong></td>
</tr>
<tr>
<td><strong>No-tech (regulation)</strong></td>
<td><strong>Pay as you throw</strong></td>
<td><strong>Business Participation in Recycling</strong></td>
<td><strong>No vending machines</strong></td>
</tr>
</tbody>
</table>

**Bring Your Own**

**School recycling**
<table>
<thead>
<tr>
<th>Business</th>
<th>Retail</th>
<th>Product</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-tech</td>
<td>Customer incentives to recover depackaging</td>
<td>Refillable Containers</td>
<td>Handling pellets BMP</td>
</tr>
<tr>
<td>Hi-tech</td>
<td>Wal-mart sandwich bale Stock recyclables</td>
<td>Design for recyclability in product and packaging</td>
<td>R &amp; D on alternate polymers/additives</td>
</tr>
<tr>
<td>No-tech (regulation)</td>
<td>Ban bad designs</td>
<td>Voluntary EPR</td>
<td>Green Chemistry</td>
</tr>
</tbody>
</table>

Pyrolysis

Biopolymers

Voluntary EPR
<table>
<thead>
<tr>
<th></th>
<th>Waste Mgt.</th>
<th>Local/state/federal</th>
<th>Intl.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low-tech</strong></td>
<td>Recycle bins – curb/store/office</td>
<td>Bottle Bill</td>
<td>Plastic brick</td>
</tr>
<tr>
<td><strong>Hi-tech</strong></td>
<td>Plasma \textit{Gassification}</td>
<td>Waste to Energy</td>
<td>Standardize recycling</td>
</tr>
<tr>
<td></td>
<td>\textit{Pyrolysis}</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>No-tech (regulation)</strong></td>
<td>$/kilo.</td>
<td>Containment</td>
<td>MARPOL</td>
</tr>
</tbody>
</table>

**Structural Controls**

**Bad design obsolete**

**Plasma Gasification**
MAY 24, 2012
LOS ANGELES BANS PLASTIC BAGS

Thanks to:
Clean Seas Coalition
Heal the Bay
Environment California
….and many others.
NEXT STEPS FOR 5 GYRES
LEG 2 TOKYO TO MAUI

Source: Maximenko, Hafner IPRC/SOEST U. of Hawaii

TSUNAMI DEBRIS FIELD EXPEDITION
• Type and abundance of debris

• Rafting communities of marine organisms

• Population density of Halobates

• POPs in ambient seawater/plastic

• DNA of microbes on plastic/seawater
CITIZEN SCIENTIST – TRAVEL TRAWL LOAN PROGRAM
TRAVELING EXHIBIT 2013