Developing bycatch reduction technologies

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Young Lives Transformed Through Science

WWF

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PERU

Comisión Nacional de Áreas Naturales Protegidas

GRUPO TORTUGUERO
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Developing bycatch reduction technologies (BRTs) for sea turtles

Coastal pound net fisheries:
Pound net escape devices

Longline Fisheries:
Circle hooks, offset hooks, appendage hooks

Coastal Gillnet Fisheries:
Visual cues (net illumination)
Developing bycatch reduction technologies (BRTs) for sea turtles

I. Japanese pound net systems
   A. Bycatch and mortality rates
   B. Developing escape devices

II. Net Illumination as a BRT for coastal gillnets
   A. Initial experimental system
   B. Expansion of net illumination studies
      1. Peru
         a. Potential for a multi-taxa BRT
      2. Indonesia

III. New technologies/New directions

IV. Lessons learned
I. Japanese pound nets (teichiami)

HUGE STRUCTURES
- Length: 200 - 325m
- Width: 50 - 90m
- Depth: 20 - 50m
- Costs: $2.5 - $6 million USD

Open type:
Access to sea surface

Roofed type:
Nets are submerged
Sea turtle bycatch monitored by STAJ in 3 pound nets systems

Japan Ministry of Fisheries listed 7,647 Pound net systems in their database
Sea turtle bycatch monitored in 3 pound net systems from 2007 to 2013

**Annual turtle bycatch**

<table>
<thead>
<tr>
<th>Location</th>
<th>Number (Cc)</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kagoshima - Open</td>
<td>65 (54 Cc)</td>
<td>2.5% mortality</td>
</tr>
<tr>
<td>Mie - Closed</td>
<td>142 (57 Cc)</td>
<td>96% mortality</td>
</tr>
<tr>
<td>Kochi - Complex</td>
<td>110 (82 Cc)</td>
<td>2.4% mortality</td>
</tr>
</tbody>
</table>

**Sea turtle bycatch rate**

<table>
<thead>
<tr>
<th>Location</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kagoshima - Open</td>
<td>0.29</td>
</tr>
<tr>
<td>Mie - Closed</td>
<td>0.46</td>
</tr>
<tr>
<td>Kochi - Complex</td>
<td>0.38</td>
</tr>
</tbody>
</table>
Bycatch workshops held at the Suma aquarium

- STAJ initiated series of design workshops to develop escape devices for sea turtles
- Created venue for collaboration
  - fishermen, net manufacturers, researchers, fisheries officials
- Construct a model of the trap end
- Capable of quickly testing different turtle release devices.
- Instant feedback in the design process
- Allowed fishers to see how turtle struggled - very moving experience
Tested 25 prototype designs, Developed 4 pound net escape devices
Workshops helped transform the narrative

Venue to engage key stakeholders

Pacific Loggerhead Workshop
Fisheries officials - Spectators

PED Workshop
Fisheries officials - Central collaborators

Media coverage:
• NHK(national TV)
• Newspapers
• Aquarium visitors

Shift in discourse
II. Coastal gillnet fisheries

- Globally ubiquitous
- Often SSF (*artisanal*)
- Poorly regulated
- Poorly monitored
- Low selectivity
- High interaction rates with sea turtles, sea birds, sharks, marine mammals
- *Few bycatch reduction solutions*
Developing sea turtle BRT for gillnets:
Develop an experimental system in Baja California, MX.
Proving grounds for bycatch reduction ideas

A. Turtle Catch Rates
B. Target Catch
C. Catch Values

Experimental system (i.e. Proving grounds)
Net illumination as a visual based BRT:
Reduces sea turtle interactions with gillnets while maintaining target catch rates and catch value

<table>
<thead>
<tr>
<th>Location</th>
<th>Visual Cue/ Illumination</th>
<th>Turtle Catch Rates</th>
<th>Target Catch Rate</th>
<th>Target Catch Value</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>Green Chemi-lights Every 5 m (night)</td>
<td>59% decrease</td>
<td>NO EFFECT</td>
<td>NO EFFECT</td>
<td>Wang et al, 2010</td>
</tr>
<tr>
<td>Mexico</td>
<td>Green LED Every 10 m (night)</td>
<td>40% decrease</td>
<td>NO EFFECT</td>
<td>NO EFFECT</td>
<td>Wang et al, 2010</td>
</tr>
<tr>
<td>Mexico</td>
<td>UV LED Every 5 m (night)</td>
<td>40% decrease</td>
<td>NO EFFECT</td>
<td>NO EFFECT</td>
<td>Wang et al, 2013</td>
</tr>
<tr>
<td>Mexico</td>
<td>Orange LED Every 5 m (night)</td>
<td>50% decrease</td>
<td>NO EFFECT</td>
<td>NO EFFECT</td>
<td>Wang et al, (In Manuscript)</td>
</tr>
</tbody>
</table>
Expansion of net illumination trials:
Testing in several small-scale fisheries

1. Peruvian coastal gillnet fishery
   - Collaboration with ProDelphinus
   - 300+ green sea turtle interactions/year in N. Peru

2. Indonesian coastal gillnet fishery in West Kalimantan (Borneo)
   - Collaboration with WWF–Indo, KKP, Bogor Univ.
   - Fishery occurs off major green sea turtle nesting beach
   - Interactions with leatherback, green, olive ridley, hawksbill sea turtles

3. Pacific Baja California Sur, MX coastal gillnet fishery
   - Collaboration with INAPESCA, Grupo Tortuguero
   - 500-700 Loggerhead sea turtle interactions/year

4. El Salvador/Nicaragua Lobster gillnet fishery
   - Collaboration with ICAPO (E.Pacific Hawksbill Initiative)
   - Interactions with hawksbill sea turtles
Peru: Effects of net illumination in a small scale gillnet fishery

- Identified the SSF (gillnet) in Senchura Bay as one with the highest known sea turtle bycatch rate

- ProDelphinus has a well established relationship with this fisheries as well as with IMARPE

- Conducted paired net trials Control nets vs Illuminated nets
Peru: Effects of net illumination in a small scale gillnet fishery

- Results from 114 paired trials – control net vs green illumination
- Showed no change in total target catch rates and primary catch (Guitarfish and Rays)
- Illuminated nets had significant decreases in interaction rates with bycatch species

(Ortiz et al., *in review*) Analysis with General Additive Models (R ver 3.1.0), significance: *P<0.05.

- 63.9% decrease
- 84.5% decrease
- 79.0% decrease
### Net illumination as a multi-taxa BRT:
- Reductions in sea bird, shark, and marine mammal bycatch
- Increase selectivity of gillnets

<table>
<thead>
<tr>
<th>Bycatch</th>
<th>Visual Cue/Illumination</th>
<th>Change in bycatch rates</th>
<th>Target Catch Rate</th>
<th>Target Catch Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hammerhead</strong> <em>(Sphyrna spp)</em></td>
<td>UV LED Every 10m</td>
<td>59% decrease (experiments ongoing)</td>
<td>NO EFFECT</td>
<td>NO EFFECT</td>
</tr>
<tr>
<td><strong>Sea lions</strong> <em>(O. flavescens)</em></td>
<td>UV LED Every 10m</td>
<td>(experiments ongoing) 29 Con vs 3 Exp</td>
<td>NO EFFECT</td>
<td>NO EFFECT</td>
</tr>
<tr>
<td><strong>Porpoises &amp; Dolphins</strong></td>
<td>UV LED Every 10m</td>
<td>(experiments ongoing) 8 Con vs 0 Exp</td>
<td>NO EFFECT</td>
<td>NO EFFECT</td>
</tr>
</tbody>
</table>
Indonesia: Net illumination in West Kalimantan gillnet fishery

2013 Rapid Assessment – Coastal Indonesian fishery
2013 Bycatch Workshop – WWF, KKP, fishermen
2014/15 Fisheries Research - Bycatch Pilot Study

- Conducted observer training in Paloh, West Kalimantan
  - Reviewed observer, experimental, handling protocols
  - Established data management protocols
- Initiated gear trials testing illuminated nets

22% increase in target (Silver pomfret, black pomfret)
50% decrease in sea turtle interactions
III. New technologies/New Directions
Auditory based and multi-sensory BRTs

1. Baja California - Continue to develop novel sensory based BRT in gillnet fisheries using auditory cues (in collaboration with Wendy Dow Piniak, Ocean Discovery Institute, CONANP)

2. Combining visual (net illumination) and auditory cues (ADD) to see if there are synergistic effects
III. New technologies/New Directions
Low cost electronic monitoring systems for SSF

1. Small scale fisheries have very limited observer coverage
   Using remote video technology to increase coverage

2. Partnered with WWF-USA to develop a low cost, scalable EM system
   - Deploying EM devices in Baja MX, Peruvian, and Indonesian SSF fisheries
1. Developing novel BRTS requires large interactions rates with bycatch species

2. Working in international locations is a series of tradeoffs
   - Field sites with potentially larger interaction rates of bycatch species
   - Permitting is not necessarily easier –
     Foreign country permits, NEPA, EO12114
   - Federal contracting with non-US partners is problematic
   - Loss of experimental control
    Information IS lost in the translation
     Reliance on in country partners
     Opportunity for capacity building
   - Funding opportunities may be more complicated
     Reliance on multiple NOAA Partners (IA, S&T International, PIRO)
   - NOAA participation in research is difficult due to travel restrictions

3. It is better to be patient and find the good partners.
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Questions???