2009 Grand Prize Winner ($30,000)

The Underwater Baited Hook

System That Reduces Bait Loss and Bycatch

To operate the device, fishermen place a baited hook in a capsule chamber, then mount the capsule in a docking station that is fixed to the vessel. There, it is secured to a carriageway by spectra rope attached to pulleys and operated by hydraulics. With the press of a button, the hydraulics propel the capsule down the carriageway, out of which the capsule freefalls to a preprogrammed depth.

At the end of the descent, the system reverses the hydraulics, flushing the baited hook from the capsule through a springloaded door. The capsule then returns to the docking station to be set again. The aim is to release baited hooks beneath the lower limit of propeller turbulence, so that the turbulence forms a curtain of opaque water above the sinking bait, shielding it from the eyes of scavenging seabirds.

Because it is a workable alternative to baited hooks on the water's surface, this device has the potential to eliminate the mortality of surface-seizing species such as albatrosses, and to reduce or eliminate the mortality of deep-diving species such as white-chinned petrels, shearwaters and grey petrels.

It may also enable fishing at any time of the day or night cycle, and in all seasons - including in seabird breeding seasons, when attacks are most intense. It also allows government regulators to monitor fishing vessel compliance in the absence of an onboard observer.

Proven Results
In March 2009, researchers set 300 underwater baited hooks and ran extremely successful trials. Results showed that bait quality and bait retention on hooks were not affected by the new method of deployment, so that use of the device is unlikely to affect the catch rates of target and nontarget fish species.

WWF International Smart Gear Comptetition winner will be awarded $30,000 grand prizefor a fishing gear innovation that could save thousands of seabirds from dying accidentally on longlines each year.

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"Until now, underwater hook setting has never been developed to the point where it can be considered to be a practical proposition for commercial fishing operations. By bringing together a professional engineering company and fiscal support for the basic idea to materialize, we have created a never-before-seen underwater setting technology for longline fishing that is practical, cost-effective, and supported by members of the fishing industry."

Phillip Ashworth, Amerro Engineering

The Winning Team

The underwater baited hook was the brainchild of New Zealand fisher Dave Kellian. Australian tuna fisher Tony Forster contributed to the concept and ran trials of a basic model on his fishing vessel.

However, Dave and Tony's version of the machine was extremely rudimentary because they had neither the engineering skills nor (as working fishermen) the time to perfect it.

Tony sought the assistance of Phil Ashworth, general manager at Amerro Engineering, a company with links to the Australian tuna fishing industry. Ashworth agreed to help advance the concept to the point where production fishing could be conducted without compromise.

Subsequently, Dr. Graham Robertson – principal research scientist (seabird ecology and bycatch) in the Southern Oceans Ecosystem program of the Australian Antarctic Division (AAD) – became involved when he saw a prototype of the device at Amerro Engineering. That fateful sighting led to the initial round of fundraising for the device and cemented the collaboration between Amerro and the AAD.

2009 Runner-Up ($10,000) CP2 Batwing Otter Board

© *David Sterling*

CP2 Batwing otter board

Dr. David Sterling, Australia

In the practice of prawn-trawling, the traditional otter board (the device that spreads the net) scrapes the seabed in a plowing process that occurs along its heavy steel shoe. The benthic (ocean-bottom) organisms and other material dislodged from the seabed by the edge of the otter board are transferred inward along the shoe and into the trawl net, where they accumulate as a significant part of the bycatch.

The Batwing improves on the traditional otter board by opening prawn-trawling nets in a way that causes substantially less seabed impact and towing resistance. Instead of towing a large door at a 40-degree angle across the bottom, the heavy contact shoe is aligned with the direction of tow – in a straight line. This eliminates the scraping action of the board and any serious disturbance to the seafloor. As a result, there is significantly less damage to benthic ecosystems, reduced bycatch of sedentary benthic animals, and lower fuel consumption.

Proven Results
Standardized comparison tests between the prototype CP1 Batwing boards and traditional prawn-trawling boards showed the Batwing producing half the drag and a 90 percent reduction in the accumulation of benthic material in the net. This was achieved by eliminating the impact of the trawl gear on the seabed – a more effective solution than simply filtering the disturbed seabed materials from the catch (e.g., by using longer sweeps between the otter boards and net to allow the material to pass by on the outside of the trawl wingends).

Subsequently, a second commercial prototype (CP2) was devised. It revised implementation of the Batwing technology, using different construction materials and an alternative strategy for dealing with the harsh operating environment of commercial

trawling. The potential reduction of towing resistance for the CP2 Batwing board is 70 percent compared to current prawn-trawling otter boards -- a big incentive for fishermen to use the new technology, and a win for both fishermen and the environment.

"The development of the Batwing board for prawn-trawling occurred due to my ambition to apply an engineering approach to the design of Australian prawn trawling gear. This ambition evolved from being raised in a fishing family that operated a prawn trawler along the southern Queensland coast of Australia since 1973. The potential benefits of the Batwing board for the industry are substantial and target crucial issues. I hope that the success of the Batwing board will provide relief to the industry by reducing the energy intensity of trawling and changing negative perceptions in relation to impact on the benthic zone."

Dr. David Sterling

Dr. David Sterling: 2009 Runner-up

The development of the Batwing otter board did not involve a formal team and project outline. Instead, it evolved in Dr. Sterling's spare time over 25 years. The invention went through many developmental stages, with input from a range of institutional collaborations and experts. During the many years of development,

Dr. Sterling studied numerous subjects, was involved in research projects, and held several different jobs – all of which fed into his changing perspective as he modified the Batwing otter board technology.

2009 Runner-Up ($10,000) HOVERCRAN

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The HOVERCRAN

Institute for Agricultural and Fisheries Research, Belgium

The brown shrimp (*Crangon crangon*) fishery is widespread in the coastal zones of the North Sea. Inherent in the equipment used are two major problems: (1) the small meshed nets have poor selectivity, resulting in large amounts of bycatch, and (2) the heavy bobbin rope used to startle the shrimp into the net wreaks havoc on the seabed.

The winning team built the HOVERCRAN (HOVERing pulse trawl for selective CRANgon fishery) with these basic principles in mind: simplicity, robustness, durability and cheap design. The device is a modified 8-meter shrimp beam trawl, in which the heavy bobbin rope has been replaced with 12 lightweight electrodes. A harmless, lowintensity electric field close to the seafloor selectively provokes a startle response in brown shrimp.

The elevated footrope lets nontarget species escape underneath the hovering trawl and collects the shrimp that jump up into the water column. This technique reduces bycatch volume by 35 percent and decreases seafloor contact by 75 percent. It has implications for a large number of shrimp fisheries around the world where bycatch is the biggest issue the industry faces.

The challenge of this research was to design and integrate specific equipment capable of creating an electro-pulse that induces a maximum response in the shrimp only. Equipment needed included a pulse generator, a winch for hauling and lowering the supply cable, and a control unit to check operation.

That the existing shrimp fishing gear can serve as the basis for the construction of the HOVERCRAN is an important advantage. The additional system components can be placed on the available gear without making radical changes to the existing infrastructure. This means that HOVERCRAN does not negatively influence the current way of fishing. The towing speed, tow duration and choice of location remain the same.

But with HOVERCRAN's automatic controls in place to prevent human errors, the crews are safer and work time between hauls is shorter due to less bycatch.

Current technical modifications for bycatch reduction in the Crangon fishery focus on catch separation or filtering after species have entered the trawl. Damage incurred by contact, or stress caused during the capture and escape process, may lead to higher mortality of bycatch. HOVERCRAN can play an essential role in reducing these discards through an alternative startling method that succeeds in catching bottom-dwelling shrimp without touching the seafloor.

Hans Polet, HOVERCRAN lead researcher, ILVO Fishing Gear Technology Section

The ILVO - Fishing Gear Technology Section: 2009 Runner-up

The Institute for Agricultural and Fisheries Research (ILVO) - Fishing Gear Technology Section is a dynamic group of 13 motivated people with different backgrounds and skills. The primary objective of the group is the development of sustainable fisheries from a technical perspective, and particularly via applied fishing methods.

The HOVERCRAN team consists of:

- Hans Polet, engineer. Leader of the Fishing Gear Technology Section and initiation of the HOVERCRAN research, Polet launched the innovative idea to use electric pulses as a means to develop a species-selective electro-trawl for the brown shrimp fishery.
- Bart Verschueren, biologist with technical experience. Coordinator of the HOVERCRAN research.
- Fernand Delanghe, electrical engineer. More than 35 years of experience in fisheries research.
- Norbert Van Craeynest, technician. Ex-fisherman with lifelong experience in all kinds of fisheries.
- Eddy Buyvoets, technician. Expert knowledge of net construction.
- Manfred Van Elslande, ex-shrimp fisherman. With his lifelong experience in the Belgian coast Crangon fishery, he was skipper on the HOVERCRAN testing vessel.

Special East Africa Prize Winner: The Selector

The Selector, a device that reduces the bycatch of goldfish in the Lake Victoria pellegrin fishery, earned a Special East Africa Prize in the International Smart Gear Competition.

The goldfish of Lake Victoria, aside from being a rare and highly prized aquarium species, are a main source of food for the Nile perch - one of the lake's biggest and most abundant fish. But the goldfish population here has dwindled to dangerously low levels. Actions are needed to prevent the species from going extinct in the second-largest freshwater lake in the world.

Developed by Moi University staff members in Kenya, the Selector reduces goldfish bycatch by fishermen targeting pellegrin fish. Easily attached to fishing mesh already used by the fishermen, the Selector is a rectangular-shaped plastic device that is painted a brilliant white on the outside and black on the inside. Rectangular openings in the front act as water inlets. The back of the device has wedge-shaped openings, and the lower side of the gear is hollow to create a vacuum. The water inlets create powerful water currents that prevent the minute pellegrin fish from escaping the mesh, while the wedge-shaped openings allow goldfish to escape.

This fishing gear takes advantage of the common feeding behaviors of goldfish and pellegrin fish - who swim and feed together - and their varying reaction to danger. Both fish are attracted to light, which is how they are caught by fishermen in the mesh, but pellegrin fish get confused in light and remain docile in the mesh, whereas goldfish become restless and try to escape. By instinct, goldfish look for dark places to hide when they are threatened, so they gravitate toward the dark environment inside the device that leads to their escape through the wedge-shaped openings.

Since the technology utilizes plastic to fabricate the gear, local fishermen can be trained to make their own Selectors and fasten them to their existing fishing nets. This makes the device readily available for use, greatly increasing its effectiveness.

Proven Results

In real-time trials on Lake Victoria, the Selector proved to be instrumental in reducing bycatch of goldfish. In testing aboard the pellegrin fishing vessel the MV Nyayo, goldfish bycatch was reduced by 61 percent. In testing aboard a vessel owned by the Kenya Marine & Fisheries Services, goldfish bycatch was reduced by 56 percent.

Benefits to Fishermen and Oceans

- The device is cheap and easy to fabricate
- The device is made out of plastic - a readily available material
- When fastened properly on the fishing mesh, the device helps avoid mesh entanglement, thereby increasing the lifespan of the mesh
- The device is light and easy to carry, which will encourage fishermen to adopt it
- Tests have shown that the Selector reduces goldfish bycatch by more than 50%

The Winning Team

The Selector was created by three staff members at Moi University in Kenya: Samwel Biwott Bikens, Sammy Kipkemoi and Arusei Chebet. Biwott - the principal researcher for the project - helps manage the university's fish farm, which produces tilapia and pellegrin fish originally imported from Lake Victoria. Kipkemoi and Chebet are lab technicians in the university's fisheries department.

Biwott got the inspiration for creating this device during one of his trips to Lake Victoria, where he witnessed fishermen returning from an all-night fishing expedition. As the fishermen unloaded their catch for sorting, Biwott noticed the goldfish bycatch.

Upon his return to the university, he met with Kipkemoi and Chebet to find a way of reducing the unnecessary catch of goldfish and prevent the species' extinction from the lake. The trio came up with the idea of the Selector after carefully studying the behaviors of pellegrin and goldfish at the university's Department of Fisheries and Aquatic Sciences lab.