Pilot Tests of Techniques to Mitigate Seabird Interactions with Catcher Processor Vessels in the Bering Sea Pollock Trawl Fishery: Final Report

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INTRODUCTION
Under the Endangered Species Act Biological Opinion (USFWS, 2003) the Alaska trawl industry is allowed a take of two short-tailed albatrosses over a five-year period beginning in 2003. This take limit motivated strong interest by the Pollock Conservation Cooperative (PCC) to begin a process to identify possible strategies to mitigate seabird interactions for the fleet of catcher processor vessels (CPs) owned and operated by its members in the Bering Sea pollock trawl fishery. At the invitation of American Seafoods Company and the PCC, we initiated a pilot research program to identify seabird interaction mitigation gear (deterrents) for future testing. The pilot study was conducted aboard one of the PCC member vessels, the F/V Northern Jaeger, from August 1 to 10, 2004 in the Bering Sea. Ancillary objectives included the following:

- Establishing a working relationship with the captain and crew of the F/V Northern Jaeger and the PCC board.
- Understanding trawl operations to identify opportunities and constraints as they apply to seabird interaction mitigation.
- Collecting preliminary data on seabird-trawl gear interaction rates by species.
- Ground-truthing and revising as necessary protocols for quantifying seabird contacts with the warps, cables and the net.
- Mapping the distribution of offal discharge around the vessel and quantifying the rate of offal discharge.

METHODS
The F/V Northern Jaeger is one of 6 catcher processors operated by the American Seafoods Company and one of 17 CPs targeting walleye pollock in the Bering Sea. All pollock CPs are members of the PCC. The F/V Northern Jaeger caught 42,087 tons of walleye pollock in 2003 with a non-prohibited species bycatch rate by weight of 0.6% (PCC/HSCC, 2003), representing production and performance typical of the fleet.

The vessel is 336 ft LOA with a breadth of 51.5 ft and gross tonnage of 3800. The F/V Northern Jaeger has two main engines and a single, right-handed variable pitch propeller. Fuel capacity is 300,000 gallons. As much as 1,200 to 1,600 gallons of fish oil, produced in the course of pollock processing, is mixed with diesel fuel per day to conserve diesel, reduce costs and take advantage of the oil produced. Crew includes 110 to 130 persons depending on season.

Fishing trips average 10 to 15 days with 4 to 6 tows per day. Per trip production is 1,450 metric tons (mt) of surimi and fillets in equal amounts, 200 mt of fishmeal, and 10,000 to 15,000 gallons of fish oil. Pollock carcasses and non-prohibited bycatch species are utilized in fishmeal and for fish oil.

On this trip, the F/V Northern Jaeger was operating with one engine thereby reducing towing speed from a typical 4.5 knots (range 4.0 to 4.9 knots) to an average of 3 knots (2.7 to 3.5 knots). The slower towing speed made fishing less efficient and probably reduced the distance that the third wire and warps extend from the stern. Trawl warps entered the water 17 m astern on average and ranging from 5 to 38 m. The third wire (the wire) entered the water 45 m astern on average and ranged from 5 to 80 m. The reduced warp and wire distance, compared to normal hauling speed, may have reduced seabird interaction rates with the warps and third wire. As a consequence, our observations of seabird interaction rates with the trawl gear on this trip may not be fully representative of typical conditions in this fishery; however, the nature of the interactions should be representative, and therefore, informative.

Discharge
Seawater intake for processing is 170 cubic meters (cu m) per hour. In addition, 16 cu m of freshwater is produced hourly, yielding a combined discharge rate from both sources of approximately 186 cu m per hour. Seawater from processing flows beneath the processing deck, accumulating in sumps on either side of the vessel. Finely macerated fish waste is pumped via two 6-inch diameter pipes from each sump and discharged to the sea slightly aft of mid-ships, port and starboard. Stick water from the fishmeal plant and the surimi factory is discharged forward of mid-ships, port and starboard. The surimi plant includes two highly efficient processing centrifuges (separators) that reduce the discharge of particulate fish material to near zero. Prohibited species are the only non-macerated fish discarded. Some bycaught salmon are provided to food banks. This level of processing and utilization yields minimal discharge and exceeds the requirement for full utilization in the pollock fishery.

The vessel is maintained with a slight starboard list to optimize processing performance in the factory. The list creates almost continuous discharge from the starboard side with intermittent discharge from the port side under observed weather conditions (mean wind speed 12 knots; range 3 to 27 knots). The starboard discharge plume typically streams aft under the starboard warp and continues...
Maintaining a position starboard of the wake out to 80 to 100 m. The port discharge generally sweeps under the port warp and tends to flow into the wake. Under some conditions it sweeps into the center of the vessel’s wake and under the third wire. Both plumes are a cloudy white with fish skin the only obvious fish part. Small particles of fish were exploited by shearwaters, northern fulmars, and black-legged and red-legged kittiwakes.

Mitigation
We deployed several mitigation devices in various configurations in an attempt to eliminate or reduce seabird contacts with the net sonar third wire and with both trawl warps.

- Third wire mitigation gear included 1) running the third wire through a snatch block directly below the third wire block so as to have the third wire enter the water as close to the stern as possible (Figure 1); 2) one or two streamer lines deployed from a high point on either side of the vessel at the stern (Figures 2); and 3) attaching scaring devices directly to the third wire (wire scarers; Figures 3 and 4).

- Trawl warp mitigation gear included 1) a boom with lines attached that extended to the water (Figure 5) and 2) a buoy on a line attached to the rail. In both cases the warp mitigation devices were deployed in the offal stream aft of the discharge and forward of the warps.

- Having fish oil available, we also discharged cod oil from the meal plant into the discharge plume to determine the response of seabirds to fish oil and if fish oil has potential as a seabird deterrent.

Given the few days available, the number of mitigation measures deployed and the variety of configurations used, our intent was to gather anecdotal evidence on the relative merit of these methods as seabird deterrents for future testing. Because comparisons were opportunistic, non-random and unbalanced, and data were few, robust quantitative comparisons of seabird interactions by deterrent type were not possible or intended.

Interactions
We developed and applied a protocol\textsuperscript{1} to estimate the number of seabirds attending trawl operations, as well as the number of seabird contacts with the trawl warps, the third wire and the net. Observations were made most frequently from the deck (helo-deck) immediately above the trawl deck. As we became increasingly familiar with fishing operations, we made observations during the tow from the stern of the trawl deck, port or starboard of the trawl ramp. The trawl deck location proved superior for monitoring cable contacts, but was unsafe, and therefore inaccessible, during gear setting and the haulback.

Trawl cable contacts were categorized as occurring with birds on the water (water contacts) or with birds in flight (air contacts) and, within these categories, as heavy or light. A heavy water contact occurred when a bird was pulled below the surface by a cable for any duration. A light water contact was any contact that did not draw a bird below the surface. A heavy air contact occurred when a bird hit a cable while in flight and fell to the water. A light air contact was any contact for which the bird continued flight without touching the water. Birds were assumed uninjured if their behavior post-contact was similar to birds in the area that did not contact the gear.

Most observation sessions included a sequence of cable observations preceded and followed by an estimate of the number of seabirds at the stern of the vessel. Cable contact observations consisted of sequentially monitoring each individual trawl cable - the port and starboard warps and the third wire - for seabird contacts by species for ten to 15 minutes each. In some cases, we monitored one or more cables more than once per session. Seabird abundance consisted of estimating the number of seabirds by species in the air and on the water within a 100-meter hemisphere radiating from the center of the stern. Counts typically took fewer than five minutes.

Each session of observations was of specific steps in a trawl operation: the set, the tow, the haulback or when shortwiring. The set is the time from when the codend is deployed until the net is at fishing depth. The tow is the time the net is at fishing depth. The haulback is the time from when the net is retrieved from fishing depth until the codend is on the deck. Shortwiring occurs when the net is retrieved and held closed near the surface, with the doors at or above the surface, awaiting storage space for the catch in the factory. At the transition from one trawl operation to the next, a full session of observations was not possible due to our inability to predict when the operation would transition. When these transitions occurred, the session in progress was terminated and a new session was begun.

\textsuperscript{1} Protocol is available on request: emelvin@u.washington.edu
RESULTS
In this cruise, fishing took place from just north of Saint Paul Island (57.4 degrees North) to about 60 nautical miles (nm) south of Saint Lawrence Island (59.4 degrees North), on the shelf in waters ranging in depth from 95 m to 133 m. Fishing depth or depth of the net ranged from 57 m to 112 m. The average gear deployment without shortwiring was 5 hours and 17 minutes with the set (net to depth) taking on average 18 minutes, the haul (net at depth) 4 hours and 30 minutes, and the haulback (net to deck) 29 minutes. When the net was shortwired, the average gear deployment was 7 hours and 30 minutes with the haulback taking on average 2 hours and 42 minutes.

Seabird abundance (all species combined) at trawl operations averaged 494 birds during this cruise, ranging from 5 to 1,865 birds. Short-tailed shearwaters (mean = 276; range 214 to 1,125) and northern fulmars (mean = 203; range 3 to 726) were the most abundant species. Black-legged, and to a lesser extent red-legged kittiwakes, were also in attendance, but kittiwakes of both species rarely exceeded 30 in number. A lone Laysan albatross was sighted on 9 August and on 10 August near Zemchug Canyon. In both cases, these albatrosses were over 200 m astern of the vessel and did not attempt to interact with the gear. **No short-tailed or black-footed albatrosses were sighted during the trip.** Most fishing occurred in waters less than 100 fathoms, away from the shelf break, where albatrosses are rare. It is the experience of the vessel that noticeably more seabirds attend fishing operations above 59 degrees N, suggesting that interactions vary by area and perhaps season.

The few whole fish dislodged during the haulback were minimally exploited by attending seabirds, as this seabird species complex is less able to exploit whole fish of this size. **No birds were observed injured or killed as a result of contacts with the cables or the net.**

The strong tendency of seabirds to fly into the wind, especially to land and to take off, appears to dictate the nature and frequency of seabird contacts in the air with the third wire. Attending seabirds maintain their position relative to the vessel by landing on the water to exploit offal plumes. After a point, they leave the dispersing plume, fly back toward the vessel and return to a point near the discharge. This dynamic creates a constant stream of birds flying into the wind across the stern of the vessel. The angle of the bird stream relative to the vessel is a function of wind direction. In a crosswind, this stream of birds flies perpendicular to the long axis of the vessel maximizing aerial exposure to the third wire, and to a lesser degree, warp cables. As the angle of the wind approaches the axis of the vessel, birds fly parallel to the vessel into the wind, minimizing aerial exposure to cables, but maximizing the precision with which they can land in the offal stream along the flanks of the vessel, thus increasing exposure to water contacts with the warps. To protect seabirds from aerial contact with cables, bird streams must be deflected aft or above trawl cables. To protect seabirds from water contacts with the warps, the area aft of the discharge source and forward of the warps must be made inaccessible.

**Based on our observations during this trip, air contacts were the primary interaction of seabirds with the trawl third wire without mitigation (Table 1).** Air contacts, primarily by fulmars and shearwaters, accounted for 61% of seabird contacts with the third wire, and these interactions were highly sensitive to wind direction relative to the direction of the vessel. Air contacts were greatest in crosswinds, and least in wind directions along the long axis of the vessel. In contrast, water contacts were most common with the warps (71% and 63% port and starboard, respectively) as seabirds, almost exclusively northern fulmars, followed the discharge plume along the vessel under the trawl warps. The rate of warp contacts on the starboard side, the side of the vessel with the most continuous discharge, was over twice that of contacts with the port warp. Net contacts were not obvious. As the net is set and hauled, the movement of the bridles and net, and the industrial noise of the related hardware tend to exclude birds from a 5 to 10 m area or greater surrounding the gear.
Table 1. Seabird contacts by cable type without mitigation. NOFU = Northern fulmar; SW = Shearwater species; KW = kittiwake species; FTSP = fork tailed storm petrel. No birds were observed killed or injured.

<table>
<thead>
<tr>
<th>3rd Wire</th>
<th>Interaction</th>
<th>NOFU</th>
<th>SH</th>
<th>KW</th>
<th>FTSP</th>
<th>Total</th>
<th>Rate (contacts/hour)</th>
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<td>16 hauls</td>
<td>Air Light</td>
<td>19</td>
<td>27</td>
<td>1</td>
<td>1</td>
<td>48</td>
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<td>43 obs</td>
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<tr>
<td>565 min</td>
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<td>30</td>
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Port Warp

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<th>FTSP</th>
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<th>Rate (contacts/hour)</th>
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<td>17 hauls</td>
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Starboard Warp

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<th>FTSP</th>
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<th>Rate (contacts/hour)</th>
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Table 2. Seabird contacts with the trawl third wire with and without third wire deterrents. Data are too few for robust comparisons among deterrents. NOFU = Northern fulmar; SW = shearwater species; KW = kittiwake species; FTSP = fork tailed storm petrel. Includes data for mitigation devices with five or more observations. Single streamer was deployed in several configurations. No birds were observed killed or injured.

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<th>FTSP</th>
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<th>Contacts/hour</th>
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<td>19</td>
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<td>1</td>
<td>1</td>
<td>48</td>
<td>5.10</td>
</tr>
<tr>
<td></td>
<td>43 obs</td>
<td>Air Heavy</td>
<td>17</td>
<td>26</td>
<td>0</td>
<td>1</td>
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<tr>
<td></td>
<td>565 min</td>
<td>Water Light</td>
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<td>25</td>
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<tr>
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<td>Total</td>
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<td>80</td>
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Third Wire Mitigation

Snatch Block

In a typical gear deployment, the third wire runs from a reel on the helo deck (just above the trawl ramp) through a block on an overhang 8.8 m above the water at the stern to the transducer (suitcase) on the headrope of the trawl. From this configuration, the wire enters the water typically 40 to 50 m astern. The snatch block mitigation consisted of running the wire through a second block (the snatch block) that was pulled closer to the water by running a pennant (lazy line) from a hydraulic net reel above the stern through the safety bar above the trawl ramp (Figure 1). As the pennant was reeled in on the drum, the second block and the third wire were lowered close to the safety bar (5.7 meters from the water), forcing the third wire to enter the water closer to the stern. On August 6 and 7, three sets were made using the snatch block. In general, the third wire entered the water approximately 32 m from the stern when the snatch block was used. For reference, warp cables enter the water 16 to 23 m from the stern. With less of the third wire exposed, bird strikes approached zero (Table 2).

Ideally, the snatch block would work best if it were drawn as close as possible to the surface of the water in such a way that the angle of the wire off the blocks is 90 degrees or more. Angles less than 90 degrees are likely to add wear to the third wire cable, which is valued at about $30,000 per spool. Snatch block deployment was limited on the Northern Jaeger by the height of the safety bar, the overhang of the helo deck, and the acute angles of the wire off each block. The safety bar was the best available option to lower the second (snatch) block toward the water. We found that the third wire chaffed on the overhang when the snatch block was drawn as little as 3 m below the third-wire block. Reduced vessel speed may have contributed to the chaffing observed during this trip. Chaffing was reduced somewhat by restricting the pennant to the far end of the safety bar. In addition, a problem with the tension control on the net reel led to the snatch block returning to the helo deck if not continuously adjusted.

Despite these limitations, we concluded that the snatch block concept has strong merit as a method to reduce seabird contacts with the third wire. Retrofitting the vessel would be required to make the snatch block a practical and safe mitigation alternative on the F/V Northern Jaeger.

Streamer Lines

Streamer lines were deployed in pairs (Figure 2) and singly to deter contacts with the third wire. Streamer lines were 90 m lines designed by Melvin and made available by the US Fish and Wildlife Service to the Alaska longline fleet since 1999.

Several configurations were deployed:

1) Streamer lines were first attached to a line rigged to the rail atop the rear gantry in such a way that the height of attachment point to the vessel could be easily adjusted. An inflated ribbed low-drag polyform buoy (LD – 3) tightly covered with codend webbing (to ease retrieval) was attached to the swivel at the water end of the streamer line with two hammerlocks (4 lbs each) affixed between the buoy and the swivel so as to increase the drag created by the buoy. Streamer lines were deployed from the port and starboard corners of the stern at a height of ~ 12 to 13 m above the water at the stern. In this configuration and towing at about 3 knots, streamer lines were in the air to 60 m astern and individual streamers were about 5 m above the water due to the height of the vessel attachment point. The starboard drogue tracked directly behind the attachment point on the starboard side of the vessel; however, in 25-knot winds from the port side the port drogue tracked far to starboard nearly crossing the starboard streamer line buoy.

2) Weight was increased and configured in-line with the buoy using approximately 20 pounds of heavy chain (rather than the hammerlocks) in order to minimize potential hang-ups on the net during haulback, and to possibly improve the tracking of the port drogue. In this configuration the streamer lines were in the air from 70 to 80 m, but tracking remained unchanged – the port drogue continued to stray toward the starboard drogue while the starboard drogue continued to track directly astern of the attachment point. This led us to conclude that turbulence at the stern was drawing the port streamer line to starboard. This is consistent with observations of the port discharge plume, which consistently flowed to starboard into the wake.

3) Thirty meters of line with streamers at 5-m intervals were added to the vessel end of the original 90 m streamer line, creating a 120 m streamer line. This lengthening brought the individual streamers of the original section of streamer line in contact with the water and moved the terminal buoys further from the vessel where they may be less likely to hang up on the net during haulback. Drogues were the same as in configuration 2. During this trial, wind was from port at 15 to 27 knots. The port buoy again strayed to starboard crossing over the starboard drogue and tangling the streamer lines.

\[\text{wsg.washington.edu/research/living/fisheries.html}\]
4) Finally, we deployed a single, 120-m streamer line from the crane situated starboard and aft of the gantry. The attachment point was maintained at approximately 14 m above the water at the stern and 6 m outboard of the starboard rail. Later we moved the single streamer line closer to the midline of the vessel and the third wire.

On two occasions, a streamer line hung up on the gear. In the first case, the starboard streamer line buoy/weight array of the 90 m streamer line wound around the third wire as the gear was deployed. During this trial two streamer lines were deployed prior to setting the gear. It took almost an hour to free the streamer line from the third wire. Subsequently, the streamer line was extended from 90 to 120 m. In the second case, individual streamers of the starboard streamer line were fouled in the large meshes of the trawl wings as it was hauled back. In this case, the streamer line was across the stern as the vessel was turning to port. The line was cut by a deckhand from the helo deck, but was later recovered after the haul back. In this case, the rigging that allowed adjustment of the height of the streamer line was fouled. Had we been able to adjust the height of the streamer line from the water, this mishap may have been prevented.

In most configurations, streamer lines virtually eliminated seabird air and water contacts with the third wire (Table 2). Paired streamer lines functioned to divert streams of birds flying across the wake zone around and above the streamer lines at near 100 percent. Unlike streamer line applications to longline fisheries, the leeward streamer was highly effective at diverting the birds’ flight path. Seabirds characteristically flying into the wind, and approaching two streamer lines, intercepted the leeward streamer line first. Birds reacted by flying above and/or aft of it. The windward streamer line reinforced the diversion especially if it was higher than the leeward streamer line.

In situations where a single streamer line was deployed, it was most effective just leeward of the third wire with the vessel attachment point slightly to windward. This configuration was accomplished using the aft-starboard crane, which could position the streamer line based on wind conditions. The crane added the capability to move the streamer line downwind of the gear as it was hauled back, thus minimizing the likelihood of fouling on the trawl. We concluded that streamer lines are a highly effective third wire deterrent, but that more work is needed to make them track predictably and minimize the potential for fouling on the gear during haulbacks. Ideally, streamer line configurations in trawl operations would be designed such that they are permanently deployed and do not require retrieval and redeployment each haul.

**Third Wire Scarer**

We attached several mitigation devices directly to the third wire in an attempt to deter bird strikes.

1) We ran the third wire through orange, plastic tight mesh 17-inch diameter tube netting typically used for making bait bags for crab pots. Three four-inch seine rings were sewn into the netting every 5 m for a total of 10 m. One meter of orange plastic tubing (streamer material) was fixed to each seine ring. The sleeve was attached to the vessel with a lazy line allowing the third wire to pay out as the net fished (Figure 3).

2) In another trial, we attached a 36 cm hard, spherical red-trawl float to one meter of line running through the center of the buoy. It was attached via a carabineer to a seine ring on the wire. The buoy was free to ride up and down the line in the center of the buoy as it hit or rode the water.

3) We deployed #2 with a lazy line running from the water end of the buoy line to the vessel (Figure 4).

4) We modified #2 to include a lazy line running up through two carabineers spaced at 5 m with one meter of orange plastic tubing attached to each seine ring.

In general, all of the third wire scarer options were difficult to deploy, but with one exception (trial 2), they were effective at reducing seabird strikes, but less effective than streamer lines. With the scarers deployed, third wire air contacts were reduced, but many birds on the wing came very close to making contacts. It appeared that birds responded to the wire scarer immediately prior to contact. In almost all cases, deployment of a third wire scarer required deck crew to reach outboard from the upper decks creating a possible safety issue if used routinely. Care had to be taken to keep the devices clear of fouling the third wire block as the gear was retrieved during haul back.

The sleeve (trial 1) was effective at reducing air strikes, but it was difficult to deploy to its optimal location low on the wire due to the lack of weight at the water end of the sleeve. After the second deployment, the sleeve and streamers were badly twisted around the third wire and had to be cut free. A buoy attached to the wire without a lazy line (trial 2) quickly sank below the surface to the suitcase rendering it ineffective as a deterrent. Using the buoy with a lazy line (trial 3) made the buoy effective at limiting birds from water strikes, but did little to deter air strikes. With the buoy plus streamer lines (trial 4), the buoy and lazy line wound around the wire making it difficult to manage. In general, third wire scarers were difficult to deploy and manage, created potentially
unsafe conditions for the deck crew, and were less effective than streamer lines at diverting flying birds away from the third wire.

**Trawl Warp Mitigation**

*Boom Array and Buoy Line*

Warp mitigation was applied only to the starboard side of the vessel, where discharge was most consistent. A 6 m boom was deployed with five 2-inch diameter mooring lines running from the boom to the water into the discharge plume. Lines were longer than the height of the boom off the water and streamed on the surface to slightly beyond the stern (Figure 5). We also deployed a buoy on a line tied to the rail forward of the stern such that the buoy floated in the discharge plume aft of the stern but forward of the contact point of the warp with the water. Although no contacts were recorded when either the boom array or the buoy were deployed, the buoy was less effective at keeping birds from nearing the warp, primarily because the buoy could not be maintained outboard of the warp in the discharge plume, but rather, was drawn inboard of the warp toward the center of the wake. The multiple lines of the boom array excluded birds from a broader swath of the plume, could be maintained in the area outboard of the wire, and could be permanently deployed with no negative effect on deck crew operations.

**Fish Oil**

We discharged 1,000 gallons of pollock oil produced in the fishmeal plant over the course of 15 minutes into the starboard discharge plume to determine if seabirds avoided fish oil. We enumerated birds feeding on offal from within the plume and at its periphery. Before the oil was applied, 13 birds per minute were feeding at the periphery and 1.5 from within the plume. Post-application, 1.2 birds per minute fed from the periphery and 0 birds fed in the plume. Anecdotally, fish oil appeared to eliminate seabirds from the starboard sector of the vessels out beyond 100 m for at least 30 minutes post application.

We were poised to conduct a more structured experiment on 10 August; however, we cancelled our plans when few birds attended the vessel and wind speed dropped to zero. We recommend that fish oil be tested in the future as a possible seabird deterrent. However, because seabirds can be harmed when they become oiled, it would be essential to demonstrate that fish oil discharged as a deterrent has no detrimental effect on seabirds attending vessel operations.

**CONCLUSIONS**

Streamer lines and lowering the third wire to near the water with a snatch block are most likely to reduce seabird contacts with the third wire in the Bering Sea pollock fishery based on our observations during this trip. The effectiveness of streamer lines as a seabird deterrent and their practical and safe deployment may break down at wind speeds and swells exceeding some threshold. Ideally, future trials would identify configurations that would allow streamer lines to be constantly deployed and thus minimize handling. Continual deployment might be accomplished on the F/V Northern Jaeger by installing outrigger poles similar to that characteristic of trollers. Outriggers with streamer lines could be raised or lowered as sea conditions permit. Alternatively, a boom along the upper gantry might allow the captain to position a single streamer line in an optimal configuration as sea conditions unfold. The latter would require additional responsibilities for the captain during each tow.

Practical and safe application of the snatch block would require modifying the vessel to pull the third wire close to the stern with minimal effort by the crew in such a way as to minimize wear and damage to the wire. The snatch block is likely to be more robust in a wide variety of sea conditions and might be substituted for streamer lines in heavy weather.

The boom array-warp deterrent could be permanently deployed from port and starboard to deter water strikes and could be integrated into the outrigger poles described for streamer lines. Fish oil appeared to dramatically exclude seabirds from the discharge plume for a considerable distance behind the vessel. This approach should be further tested as a mitigation alternative for catcher processors with fishmeal plants provided potential detrimental effects to seabirds can be ruled out. Continued innovation and testing of seabird deterrent systems by the F/V Northern Jaeger will build on these results and further inform future plans for developing and testing mitigation techniques in the 2005 pollock fishery.
RECOMMENDATIONS
Based on our experience during this cruise, we propose
the following three-phase course of action for PCC, in
collaboration with the Washington Sea Grant Program,
NOAA Fisheries and the US Fish and Wildlife Service,
to address seabird interactions in the Bering Sea pollock
fishery:

1) Develop the F/V Northern Jaeger into a prototype
seabird-safe trawl catcher processor based on
available information as a model for the fleet, and
test its effectiveness in the 2005 A-Season. The
prototype would include installation and/or retrofit
of infrastructure to accommodate the practical and
safe use of a snatch block, of streamer lines and of a
boom-warp deterrent.

2) Building on the experience of Phase 1, outfit
a second vessel, preferably a catcher processor
without a meal plant (to capture the range of
processing and discharge in the fleet) as a second
seabird-safe vessel.

3) Test the effectiveness of streamer lines and the
snatch block as third wire deterrents, and the
boom-warp deterrent in controlled experiments
on both seabird-safe prototype vessels in the 2005
B-Season. As resources allow, explore the potential
of other deterrent concepts such as fish oil at the
pilot level and include in controlled experiments as
appropriate. Phase three results would be used to
establish seabird mitigation requirements for the
PCC fleet.

In 2004, the US Fish and Wildlife Service provided the
Washington Sea Grant Program with funds to develop
seabird mitigation for the trawl industry. Remaining
USFWS funds can be applied to phase three of this plan.
Additional funds may be necessary and will be sought.

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Figure 1. Snatch block applied to the trawl third wire.

Figure 2. Paired streamer lines.
Figure 3. Third wire sleeve with lazy line to the helo-deck and paired streamer lines as the net sounder is retrieved during a haulback.

Figure 4. Hollow hard buoy with lazy line attached to the third wire.
Figure 5. Trawl warp boom array.