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Observations On Board the Korean  
Squid Driftnet Vessel, *Oyang 53*  
June 9-August 8, 1988

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OBSERVATIONS ON BOARD THE KOREAN

SQUID DRIFTNET VESSEL, OYANG 53

9 JUNE - 8 AUGUST, 1988

By

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## Introduction

Korean squid gillnetting operations began on the high seas in the North Pacific Ocean in the late 1970's. By 1987, the fishery involved 117 licensed vessels in a season that extended from April - January. An estimated 141 vessels are involved in the 1988 season.

The Korean high seas squid fishery operates in the central North Pacific Ocean, outside the 200 mile zones of any nation. An agreement was reached in 1988 by the U.S. National Marine Fisheries Service and the Korea Deep Sea Fisheries Association that a U.S. scientist would observe Korean high seas squid driftnet operations in the North Pacific. These observations were the first such effort by a U.S. observer.

The objectives of observations on the Korean commercial squid driftnet vessel were:

1. obtain information on commercial squid fishing operations;
2. monitor the incidental catch of salmonids, marine mammals, seabirds, albacore and other species;
3. collect marine mammal sighting data;
4. collect biological information and specimens when possible.

Observations were made on the Korean commercial squid gillnet vessel, "Oyang 53". I departed on a Korean cargo vessel from Pusan, Korea, on 25 June, transited across 180° longitude to

the eastern Pacific fishing grounds, and transferred to the "Oyang 53" on 9 July at 41°25'N 168°20'W. During the ensuing 30 days, twenty-two gillnet operations were observed before disembarking to a cargo vessel for transit back to Pusan. The following summarizes the observations and information obtained.

#### Transit To and From the Fishing Grounds

The "Boyang" company provided the transit vessels to and from the squid fishing grounds. "Boyang" serviced the fishing grounds with cargo vessels that carried supplies to the grounds and squid catch from the grounds.

The transit vessel to the grounds was the "Suah", a freezer vessel registered in Panama, with a Korean crew. Embarkation on the "Suah" occurred on 25 June from Pusan, reaching the fishing grounds on 3 July at position 40°59'N 178°05'W. The next six days were spent offloading Korean squid driftnet vessels as the "Suah" continued to transit in a eastern direction to the "Oyang 53".

I embarked on the "Oyang 53" at 2300 on 9 July at 41°25'N 168°20'W. Towards the end of the observation period on the "Oyang 53" the vessel had transited in a western direction towards the "eastern" fishing grounds. Disembarkation to the vessel "Tsurusaki maru", a Japanese freezer vessel contracted by "Boyang", occurred on 8 August at position 40°58'N 161°33'E. The transit time to Korea was five days.

### Description of Vessel

The Korean squid gillnet vessel, Oyang 53 (call sign 6NBL), is 49m in length and displaces 430 gross tons. Launched on 30 October, 1974, the vessel was originally designed as a tuna longliner with the line retrieval gear on the starboard side (the tuna fishing was concentrated in the equatorial waters of the South Pacific). In 1986, the retrieval gear was relocated to the port side and the vessel began squid driftnetting operations in the North Pacific in April of that year. The vessel is scheduled to gillnet for tuna in the Indian Ocean between January and April of 1989.

The Oyang 53 is somewhat larger than the typical Korean squid gillnet vessel. Most of the 141 vessels are approximately 350 gross tons. Only 11 vessels are the same size as the Oyang 53. While on the cargo ship, Suah, in route to the fishing grounds, 22 Korean squid driftnet vessels were observed, 3 of which had starboard side net retrieval gear.

The single diesel engine powers the Oyang 53 to a cruising speed of 9.5 knots and a top speed of 10.5 knots. The four flash freezers, located directly aft of the retrieval deck, have a combined capacity of 15 metric tons (MT) and maintain a temperature of  $-45^{\circ}\text{C}$ . The vessel contains three freezer holds. Hold #1 is located directly under the bow and is normally utilized for storage of nets and fuel oil. Hold #2, with a capacity of 200 MT maintained at a temperature of  $-25^{\circ}\text{C}$ , is directly under the retrieval deck. This is the only hold used

specifically for storage of squid and fish. Access to hold #2 is either from a chute located between the flash freezers or from the retrieval deck by removal of a large deck plate. Hold #3 is located in the stern, directly under the galley and is used for storage of the ship's provisions.

The vessel is designed for a crew complement of 27. This includes the captain who makes all of the decisions for fishing operations and ship's logistics, the chief officer who directs the entire retrieval operation, the second officer who is responsible for navigation and directs the set operation, and the third officer who works on deck during the retrieval operation and shares in navigational duties. The radio officer, chief engineer, 1st engineer, 2nd engineer, refrigerator engineer, cook, bosun, and 16 crewmen complete the crew complement.

Electronic navigational equipment on the Oyang 53 include both a LORAN-C unit and a NNSS satellite navigation unit with printer. Since the LORAN-C was a more accurate unit for these waters, it was used instead of the NNSS. The NNSS satellite navigation unit was utilized only when the vessel was out of range for LORAN-C. Two radar units as well as a combined gyrocompass and autopilot were on the bridge. One of the radar units was down during this segment of the cruise. A remote speed/direction control was on located on the port side of the bridge where the duty officer could direct the vessel during gillnet retrieval.

Electronic fishing equipment included an FFC-2000 colour



fish finder and a sea surface temperature unit with a strip chart that provided a continuous record of sea temperature ( $^{\circ}\text{C}$ ). The vessel was not equipped with an anemometer; therefore, the wind direction was determined by a wind sock located on the bow and wind speed was estimated. A radio direction finder was used to locate the radio buoys deployed during fishing operations.

Two SSB radio units were located in the captain's cabin directly aft of the bridge, adjacent to the chartroom. The main unit was a 10 channel 2 MHz radio which, especially at night, had long range capabilities. For close range communication within the immediate fishing group, a small 27 MHz unit was used. The main radio gear and facsimile receiver were located in the radio room on the main deck. The facsimile unit provided meteorological updates from Japan five times daily and a five-day summary water temperature map every five days. No VHF radio gear was on board.

### **Fishing Grounds**

The annual Korean squid driftnet operation can be described as two distinctive seasons and grounds. The grounds described to me as the "western grounds" are typically located between  $36^{\circ}\text{N}$ - $43^{\circ}\text{N}$  and  $160^{\circ}\text{W}$ - $170^{\circ}\text{W}$ , (mainly located in west longitudes) and are fished from early April to late July or early August. The western grounds are characterized by a smaller number of squid with a much larger mantle size for each individual. An average mantle length for neon flying squid in the western grounds is between 70-110cm and can reach over 2m.

The "eastern grounds" (in east longitudes between 143°E and 169°E), typically located between 36°N-43°N, are fished from early August to mid-December. These grounds are characterized by much smaller squid (1/3 the size of the squid in the "western" grounds) but a larger total catch (in tonnage). The "eastern" grounds are also characterized by the crew as being a much more difficult grounds to work since the squid are smaller and thus more work is required to process an equivalent tonnage. Also, because of the lateness in the season, the sea conditions are much worse in the "eastern" fishing grounds.

The "ship's time" used on the vessel in the "western" grounds was +13 GMT. This is due to the fact that clocks were advanced as the vessels moved east. When the vessel crossed 180° longitude headed east, the clock was again advanced but the vessel kept the same day as Korea.

### Fishing Strategy

The Korean squid driftnet vessel groups targeted on areas that have been "traditionally" known to be good squid fishing. Catch statistics from the previous year are referenced when deciding where to begin fishing.

The Oyang 53 began gillnet operations in 1988 on April 7 at position 35°07'N 157°37'E. This location was not yet "on the grounds". The vessel continued to fish farther east until they reached the area between 40°N-42°N and 167°W-172°W where fishing was concentrated for the rest of the "western" season.

The vessel fished in an array with ten other vessels. A more typical array size for other driftnet groups was seven to eight vessels. The fishing groups were determined by where the vessel captain had graduated from fishing college. For example, the captain of the Oyang 53 was a graduate of Pohang Fishing College and fished with other captains from that college. Other groups were from Mokpo, Pusan, Inchon, Namhae, etc. As a result of these alliances, vessels from different companies fished together in the same group.

The fishing strategy is basically by trial and error. Each morning during the retrieval, by means of SSB, the captains within a given group compare fishing success. If high success is concentrated in one specific area of the array, the entire array would move in that direction for the next day's set in hopes of capitalizing on the high density of squid. Although captains were not inclined to share information with other captains out of their fishing group, it did not seem to be a major concern to "hide" information.

The nets were set in an east - west orientation. For example, most sets were generally in either a 270° or 90° direction. The arrays were oriented along a north to south axis with vessels spaced by two minutes of latitude. If high fishing success was concentrated at a particular section or sections of the retrieval, the captain at times would deploy three sections along one degree of latitude and three adjacent sections along the adjacent degree of latitude to capitalize on high squid

density. Squid are believed to travel in N-S direction.

Nets were always retrieved with the vessel headed into the wind. A retrieval with the wind was said to be very dangerous and difficult for the crew. On nine occasions, the vessel transited back to section one (section set first) in order to retrieve into the wind.

The electronic fishing aids available to the captain were used only minimally. The five day summary isotherm maps were used only to reference movement of temperature gradients. The captain believed that abrupt water temperature variations, creating a "thermal trough", were areas of high plankton density thus high squid density. But since isotherm maps were from five days prior they were of little help to the captain. Just prior to the initiation of the set operation, plankton density were monitored on the fish finder in order to cue on the best location to initiate deployment of the nets. Water temperatures were also closely monitored. Temperatures ranging from 13°C to 15°C were thought to be optimum temperatures for high squid fishing success. High seabird density was also thought to be a cue to high squid densities.

Korean squid gillnetting success in 1988 was said to be average to slightly below average for the "western" grounds.

The "Oyang 53" offloaded squid on 9 July to the cargo vessel "Suah" (concurrently with my embarkation) and again on 3 August to the "Oyang" company cargo vessel "Oyang 222". The captain reported that 7800 pans had been discharged for a total of 120.9

metric tons. Offloading took place at 39°52'N latitude 173°14'E longitude.

A "typical" offload schedule for a 350 gross ton Korean squid vessel (with a hold capacity of 100 metric tons) was said to be once to twice per month depending on fishing success.

### Fishing Gear and Deployment

The basic unit of driftnet gear for the Korean squid operation was the "pok" which was said to be approximately 50m in length and 9m in depth. Since the nets on board were all reworked gear (old gear that had been spliced, patched, etc.), I could not actually measure a pok. There were approximately 2000 pok of gear on board for the western grounds. Approximately 5% of the net was torn with large holes, tears, and rips. On August 3, after completion of fishing on the "western" grounds, the Oyang 53 unloaded all "western" nets to a cargo vessel and took on 1000 pok (1000 pok was already on board in storage). In the "western" grounds, the majority of the nets were of mesh size 105mm (stretch) with a small amount, 200 pok, of 115mm mesh gear. In the "eastern" fishing grounds, the majority of the gear was of 86mm mesh with 200 pok of 96mm. Most of the nets used early in "eastern" fishing grounds were new, with approximately 300 pok of old, reworked gear.

The captain stated that a "section" was formed by connecting approximately 230 pok. This was done by tying pok together at the corklines and leadlines. The vertical borders of adjacent pok were woven together with nylon twine. Each section was said to be approximately 11.5 kms in length and was deployed separately from other sections. Since the set and retrieval were monitored on a time elapse basis, there was no means to verify the actual section length. A typical set would consist of the deployment of 6 sections. The vessel logged 1400 pok for a typical six section set which would translate to an overall gillnet length of nearly 70 kms.

There is a major discrepancy in terms of number of deployed pok logged by the vessel versus the distance between the logged begin and end set positions calculated by dead reckoning. Possible sources for this error could be a miscalculation (by the captain) of the actual size of the pok and/or section, human error in transcribing data, or navigational equipment error. Refer to table 7 for summary of elapse time for sets.

Three types of buoys were deployed; radio, light, and spherical. No radar buoys were observed on board. Seventeen radio buoys, nine light buoys, and fifteen spherical buoys were on board. Light buoys were normally deployed on the ends of the sections that were anticipated to be retrieved in the dark. Two light buoys were deployed on the end that was to be picked up first and one at the far end of the section. One light buoy was

occasionally deployed on the far end of the entire set in case of a shift in wind direction necessitated retrieval in the reverse direction.

One radio buoy was deployed at each end of each section. Two spherical buoys were deployed with each radio buoy. With minor variations a typical configuration of the buoys went as follows: A radio buoy on a 2m line and light buoys on separate 3m lines would be connected at a common junction point to a 15m rope tethered to the corkline of the gillnet. The two spherical buoys were on a common 0.5m rope that was clipped to the line 1m from the radio buoy.

#### Set Operations

Of the 22 set operations observed aboard the Oyang 53, 20 were considered to be in the "western fishing grounds" and 2 in the "eastern fishing grounds". The 20 western ground sets (01PDG88-20PDG88) occurred between 10 July - 1 August between 40°23'N to 42°07'N and 167°19'W to 176°19'E. Sea surface temperatures for these sets varied between 15.0° - 19.2°C. Twelve operations were conducted in waters ranging between 16.0° and 17.9°C. The two sets on the "eastern" grounds (21PDG88 and 22PDG88) were at 40°45'N 161°07'E and 40°53'N 162°29'E, respectively. Temperatures for these two sets were 20.7°C and 17.3°C, respectively.

A typical set involved the deployment of six net sections. Of the twenty-two sets observed, seven sets (01PDG88,02PDG88, 16PDG88-19PDG88) consisted of five sections and for one set (20PDG88) only three sections were deployed. The deployment of fewer nets was either due to an anticipation of poor fishing or a lack of time to deploy more nets. When the captain only wanted to "sample" an area for squid density, three nets were deployed. Even though on one occasion the rough sea conditions rolled 6 km of net into a tight coil, sea conditions were not a consideration for whether or not to fish. The captain believed that only weather conditions reaching hurricane force would affect the fishing conditions adversely.

Marine mammal distribution was not a consideration in the selection of the location of sets. On one occasion a large pod of killer whales was observed adjacent to the vessel during set operations.

Set operations were normally initiated between 1500-1800 (ships time, +13 GMT) and required approximately 30-40 mins. to complete each section for a total elapsed time of 3.0-3.5 hrs. for the deployment of six sections. Average speed for set operations was said to be 7.0 - 8.0 knots. Vessel speed was estimated from a tachometer on the bridge. The average time between the end of one section and the beginning of another was 2-3 minutes.



Buoys were deployed from the port side of the stern. Nets were fed from the net house over a stern roller. The roller was designed with two small wheels on either side and a larger wheel in the center to help separate the net. Two men stood on either side of the roller keeping the nets positioned correctly on the roller and untangling any knots in the nets. A crewman also stood on the port side of the net house above the nets with a long bamboo pole to help ensure smooth deployment of the nets. If the direction of the next set was known during that morning's retrieval (e.g. if fishing was good and it was anticipated to fish the same area again) then the corkline was stored in the net house so that during the next set the corks would be on the leeward side of the vessel. The corkline on the leeward side would help to separate the net edges. In addition, a strong mist of sea water was sprayed across the stern behind the roller to help separate the nets during deployment. Small pieces of fish and squid in the nets from prior fishing attracted many albatross and shearwaters to the nets during the set operation.

Set operations were observed from the port side and aft portion of the net house 10m above the main deck. This gave an unobstructed view of the nets as they were being deployed and also a direct view below at the crewman that was deploying the buoys.

### Retrieval Operations

Retrieval operations typically commenced between 0100-0300 (ship's time) which allowed for a minimum 7.5 hour soak period. Vessel speed during retrieval operations ranged from 2.0-2.5 knots under optimum conditions. Average time required to retrieve a section of 233 pok was 1.5-2.5 hours. A set of six sections required between 10-11 hrs. to complete with one retrieval operation requiring 12 hrs. due to complications with the nets and a large catch. Transits between ends of sections averaged 12 to 20 minutes.

During a normal retrieval, there are ten men on deck; one man on the "net hauler" which retrieved the lead line end, one man on the "ball roller" which hauled up the corkline end, two men guiding nets into the net tube, and six men moving the nets across the deck, pulling squid from the net, and/or processing the catch.

Billfish, large sharks, and porpoise were frequently gaffed and pulled up on deck manually. The electric winch was never used during the retrieval.

The net was pulled through a 32cm diameter net tube on the starboard side of the vessel into the net house by two ball rollers mounted above the net house on a movable gantry. This allowed for a careful folding of the net gear into the net house. A tarp was put in between each section of gear. A crewman usually stood in the net house and repaired large tears in the net that had been flagged by crewman on the retrieval deck.

The retrieval operation was observed from the port side bridge wing that was approximately 10m above the water surface. This location gave an unobstructed view of the net retrieval and provided an ideal location to monitor dropouts. The entire retrieval deck could also be viewed from this location.

#### Catch Composition and Processing

Neon flying squid (Ommastrephes bartrami) was the primary target species with a small amount of boreal clubhook squid (Onychoteuthis borealijaponicus) also in the catch. The boreal clubhook squid was a less desirable squid due to the hook-like appendages on the arms; clubhook head and arms were panned separately for this reason. Between 1,173 - 10,531 neon flying squid were caught per six sections of net.

The drop out rate for squid for the "western" fishing grounds was between 3-5% with 7-9% dropout rate for the two "eastern" ground retrievals. Dropout rates at the onset of the season are said to be higher due to smaller squid in the catch. Dropout rates for non-commercial species (e.g. Pacific pomfret and small sharks) that were shaken out of the net before arriving on deck was much higher than that of squid.

Aside from neon flying squid, the following species were also identified in the catch: Pacific pomfret (Brama japonica), ocean sunfish (Mola mola), albacore (Thunnus alalunga), yellowtail (Seriola aureovittata), Pacific saury (Cololabis saira), skipjack tuna (Euthynnus pelamis), Pacific mackerel

(Scomber japonicus), longnose lancetfish (Alepisaurus ferox), daggertooth (Anotopterus pharao), striped marlin (Tetrapturus audax), and swordfish (Xiphias gladius).

Of the sharks in the catch, the blue shark (Prionace glauca) was, by far, most abundant. Salmon shark (Lamna ditropis), mako shark (Isurus oxyrinchus), and one smooth hammerhead shark (Sphyrna zygaena) were also identified in the catch. Table 3 summarizes the total number of each species in the catch.

Squid were processed by separating the mantle from the head, arms and viscera. The viscera was then striped from the head arms and discarded. Mantles and head arms were then put into separate 82 x 60 x 13cm pans. Each pan weighed approximately 15.5 kilograms. Numbers of pans of mantles and pans of head arms were logged separately by the vessel. In the "western" fishing grounds, each pan of mantles contained an average of 23 mantles, while in the "eastern" grounds each pan contained approximately 60 mantles.

Albacore, yellowtail, other tunas, billfish, and large sharks were also retained either for crew consumption or for processing. Albacore, yellowtail, and other tunas were frozen whole, whereas, billfish and sharks were cut open and cleaned and cut in half longitudinally. The remainder of the catch was discarded.

### Marine Mammal and Seabird Incidental Take

A total of 18 marine mammals were incidentally taken, including 15 northern right whale dolphin (Lissodelphis borealis), 1 Dall's porpoise (Phocoenoides dalli), and 2 northern fur seals (Callorhinus ursinus). None of the cetaceans were alive. Of the two northern fur seals, one was lightly entangled and fell from the net and swam away strongly, the other was hauled up on deck, disentangled, released, and swam away strongly. Incidental take of marine mammals is summarized in Table 4.

A total of 48 seabirds were observed entangled in the nets, including 43 dark shearwaters, 3 black-footed albatross (Diomedea nigripes), 1 Laysan albatross (D. immutabilis), and 1 horned puffin (Fratercula corniculata). Table 5 summarizes the incidental take of seabirds.

### Conditions on Board the Transit

#### Vessels and the Oyang 53

Conditions on board the cargo ship, Suah, the transit vessel to the fishing grounds, were very good. I was given my own stateroom for the 14 days and was treated as an officer. The captain and officer staff on the Suah were very willing to answer questions concerning the squid fishing operation.

On July 9, I transferred to the Oyang 53. The means of transfer was a cargo net lifted and lowered on a boom on the cargo vessel.

Initially my quarters were in the radioman's room. Due to the constant interruptions by the radioman carrying out his duties, after a week I shared a room approximately 5'x 6' with two junior officers.

Food was good and was served Korean style. Any dish requested was provided. Typical dishes were rice, kimchee, mondu, bulgogee, and rameon.

A typical day went as follows (times are +13 GMT):

0200-0230 Wake up to monitor the retrieval.

0800-0900 The cook would bring breakfast up to my watch station.

1130-1330 Finish monitoring retrieval and go below to do paperwork.

1330-1430 Have lunch and soon after go to bed.

1500-1800 Monitor the set if time permitted.

1900-1930 Have dinner if I was awake.

The captain spoke English fairly well but the rest of the crew and officer staff spoke only limited English. The captain and staff were always very helpful and very willing to answer questions.

On the third week of the cruise, a crewman on one of the vessels in the fishing group suffered serious head injuries in an accident. I spent three nights on the radio with the Coast Guard arranging an evacuation by helicopter. The evacuation took place approximately 500 miles north east of Midway Island.

There were 141 Korean squid gillnet vessels fishing the "western grounds" and each vessel had approximately 25 men on board, yet there were no medical facilities on the grounds. There was no one on board trained in first aid and the vessels did not carry equipment to take such vitals as temperature and blood pressure.

The return to Korea was on the Japanese cargo vessel, Tsurusaki Maru, which had been contracted by Boyang company. The officer staff on the Tsurusaki Maru was Japanese but the crew was Korean.

#### Marine Mammal and Net Debris Sighting Surveys

Sighting surveys were conducted on both of the transit vessels and the Oyang 53, as time permitted. Weather conditions and visibility were very poor for a majority of the cruise making sighting effort difficult to impossible much of the time.

Surveys were carried out from atop the bridge superstructure on all three vessels. This vantage point gave a virtually unobstructed 180° view of the horizon forward of the vessel. Sighting effort was classified into two categories: "on-effort" was an intensive scanning of the sea from atop the bridge superstructure. On-effort surveys were attempted only when visibility was greater than 500m. "Off effort" surveys were a less rigorous scanning conducted from the vessel under other conditions, e.g. from the bridge, during set operations, retrieval operations, etc.

Forty-five hours of "on effort" marine mammal survey was

conducted. Species sighted during these surveys included Pacific white-sided dolphin (Lagenorhynchus obliquidens), Dall's porpoise (Phocoenoides dalli), pilot whales (Globicephala macrorhynchus), killer whales (Orcinus orca), and northern fur seal (Callorhinus ursinus).

Net debris surveys were conducted concurrently with marine mammal surveys. Net debris sightings were categorized into four groups: "on effort", "off effort", "in net" (actually taken in gillnet retrieval), and "net discard" (net actually seen discarded from vessel). Net debris sightings are summarized in Table 6.







Table 1. Set data for observations on board the Korean squid gillnet vessel, Oyang 53, July 9 - August 8, 1988

Set No.	Date	Time Began	Time End	No. of Sections	Begin set Lat N.	Position Long	Lat N.	Long	Set Direction	Water Temp(°C)	Wind (°-B)	Swell Dir-m	Weather <sup>1</sup>	VIS (km)
01	7/10	1536	1853	5	41-22.0	168-35.1W	41-22.3	167-55.0W	90°	15.6	270-2	80-1.5	0	0.5
02	7/11	1507	1854	5	41-22.0	168-35.1W	41-27.3	168-56.0W	90°	16.0	200-3	180-.5	0	2.0
03	7/12	1804	2204	6	41-23.5	169-25.6W	41-24.2	168-56.2W	92°	15.0	230-3	240-.5	0	0.7
04	7/13	1625	2015	6	41-38.6	169-52.7W	41-37.9	170-24.3W	270°	15.2	260-3	240-.5	0	0.5
05	7/14	1800	2152	6	41-02.5	169-00.4W	41-02.6	168-22.9W	89°	16.8	280-3	200-.5	0	1.0
06	7/15	1816	2240	6	41-02.6	168-21.6W	41-02.6	168-57.5W	290°	16.8	300-3	300-1	0	1.0
07	7/16	1648	2058	6	41-03.8	168-40.2W	41-03.7	168-25.1W	90°	16.6	250-3	90-.5	0	1.0
08	7/17	1541	1909	6	41-03.8	169-01.8W	41-03.9	168-24.6W	91°	16.6	10-3	30-.5	0	2.0
09	7/18	1647	2015	6	41-03.1	168-30.3W	41-03.7	167-50.9W	90°	16.6	200-3	190-.5	0	2.0
10	7/19	1538	2018	6	41-03.4	168-47.5W	41-03.9	168-08.3W	91°	17.6	200-3	280-2	0	2.0
11	7/20	1508	2156	6	41-00.9	169-03.6W	41-00.6	168-23.1W	92°	17.0	200-3	200-.5	0	2.0
12	7/21	1913	2249	6	40-31.3	167-59.6W	40-31.6	167-21.8W	95°	19.2	210-3	200-.5	0	2.0
13	7/22	1513	2006	6	40-34.4	168-04.9W	40-30.4	168-04.4W	290°	18.1	92-4	100-1	0	1.0
14	7/23	1528	2007	6	40-26.8	167-59.2W	40-26.6	168-21.4W	291°	18.1	190-3	100-.5	0	2.0
15	7/24	1518	2007	6	40-23.2	168-03.9W	40-23.1	168-39.4W	270°	16.0	300-3	280-.5	0	1.0
16	7/25	1919	2222	5	41-20.1	168-16.3W	41-21.6	167-39.5W	90°	16.0	90-2	100-1	0	1.0
17	7/26	1554	2005	5	41-48.3	167-59.7W	41-45.7	168-21.4W	270°	16.0	120-4	135-1	0, R	0.5
18	7/27	1715	2136	5	41-49.1	167-48.7W	41-49.5	168-19.8W	200°	15.5	110-3	220-.5	0	1.0
19	7/31	1812	2114	5	42-08.2	167-48.3E	42-06.7	176-14.6W	210°	15.2	300-3	210-.5	0	5.0
20	8/01	1815	1958	3	41-05.6	176-01.0E	41-04.8	176-18.5E	93°	15.4	210-3	200-.5	0	2.0
21	8/06	1720	2050	6	40-45.3	161-07.8E	40-45.9	162-42.4E	90°	20.7	265-3	230-.5	0, F	1.0
22	8/07	1627	2003	6	40-53.9	162-29.2E	40-53.4	163-14.7E	92°	17.3	200-3	180-.5	0	1.5

<sup>1</sup> Weather Codes: 0 = overcast R = rain F = fog

Table 2. Retrieval data for observations on board the Korean squid gillnet vessel, Oyang 53, July 9 - August 8, 1988

Set No.	Time Began	Time End	Begin set Position		Position		Set Direction	Wind ('-B)	Swell Dir-m	Weather <sup>1</sup>	VIS (km)
			Lat N.	Long	Lat N.	Long					
01	0154	1150	41-21.5	167-52.5W	41-20.7	168-27.8W	260°	250-3	90-1	O,F	0.5
02	0155	1155	41-21.2	167-53.5W	41-20.6	168-27.8W	270°	250-4	260-1.5	F	0.1
03	0134	1125	41-24.6	168-56.2W	41-21.1	169-26.9W	274°	240-4	260-1.5	O,F	0.5
04	0229	1137	41-38.8	169-47.1W	41-34.8	170-16.6W	271°	265-4	230-1	O,R	0.4
05	0545	1800	41-01.5	169-01.7W	41-04.1	168-21.1W	87°	45-3	200-1.5	O	1.5
06	0307	1342	41-01.2	168-21.2W	41-04.7	168-55.4W	293°	340-3	330-.5	O	2.0
07	0250	1412	41-05.8	168-37.3W	41-04.9	169-00.8W	290°	0-3	80-1	O	3.0
08	0302	1310	41-03.1	168-20.7W	41-03.5	169-03.1W	274°	320-2	350-.5	O,C	4.0
09	0300	1240	41-01.5	167-50.9W	41-03.7	168-21.7W	250°	200-3	200-.5	PC	8.0
10	0304	1310	41-00.8	168-06.7W	41-01.2	168-48.9W	270°	240-3	300-.5	F,R	3.0
11	0300	1350	41-00.9	168-21.4W	41-03.8	169-02.9W	280°	220-4	210-3	F,R	0.2
12	0300	1203	40-32.3	167-19.6W	40-32.0	167-58.2W	275°	230-3	250-.5	O,CL	3.0
13	0210	1425	40-31.8	167-41.1W	40-34.0	168-03.7W	290°	270-6	270-3	CL,G	0.5
14	0200	1124	40-26.1	167-57.1W	40-26.5	168-20.1W	289°	200-3	180-.5	O,F	0.5
15	0232	1305	40-23.4	168-07.7W	40-23.5	168-42.1W	278°	310-3	50-.5	O	3.0
16	0230	1212	41-20.8	168-12.5W	41-22.5	167-39.4W	100°	210-2	230-.5	F,R	3.0
17	0230	1238	41-45.9	167-56.1W	41-41.3	168-24.6W	265°	230-5	250-2	F,R	0.5
18	0230	1045	41-49.6	167-45.1W	41-48.1	168-15.6W	235°	180-3	250-1	O	5.0
19	0200	1014	42-07.4	176-50.2E	42-05.8	176-15.2E	215°	190-3	250-.3	O	5.0
20	0050	0446	41-02.1	176-19.7E	41-00.9	176-02.5E	270°	200-3	200-.5	O,F	0.5
21	0215	1235	40-45.1	162-46.6E	40-45.0	161-09.8E	280°	250-3	240-.5	F	0.5
22	0105	1243	40-58.3	163-18.2E	40-57.3	162-33.2E	210°	-1	-----	F	0.2

<sup>1</sup> Weather Codes:

G = Gail    CL = Cloudy    O = Overcast    F = Fog    R = Rain    C = Calm    PC = Partly Cloudy

Table 3. Fish and squid catch summary for sets observed on board the Korean Squid Gillnet Vessel Oyang 53, July 9 - Aug 8, 1988

	OB	BJ	TA	MM	AF	AP	SA	CS	EP	SJ	PG	IO	LD	SZ	TX	XG
01	4023	100	-	2	-	-	-	-	-	-	-	-	-	-	-	-
02	2530	40	-	-	-	3	-	-	-	-	-	-	-	-	-	-
03	1518	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04	1403	100	1	-	1	-	-	-	-	-	-	-	-	-	-	-
05	8556	500	21	2	-	-	-	-	-	-	19	-	-	-	-	-
06	6118	300	70	-	3	-	5	-	-	-	53	-	-	1	-	1
07	10531	200	41	3	-	-	-	-	-	-	30	-	-	-	-	-
08	4922	50	8	-	-	-	-	-	-	-	2	-	-	-	-	1
09	5014	100	18	1	2	-	3	-	-	-	46	-	-	-	-	1
10	2829	100	23	-	-	-	2	-	-	-	52	-	-	-	-	-
11	1173	300	35	-	-	-	9	25	-	-	20	-	-	-	-	1
12	3565	100	50	-	-	-	10	-	150	-	7	-	1	-	1	1
13	2323	100	45	-	-	-	30	-	-	-	9	-	-	-	1	1
14	2852	100	8	-	-	-	50	-	15	-	15	-	-	-	1	1
15	1656	50	25	-	-	-	65	-	25	-	20	-	-	-	3	1
16	2797	50	12	-	-	-	15	-	20	-	7	-	-	-	-	1
17	2829	100	23	1	-	-	-	-	-	-	10	-	1	-	-	-
18	2093	100	20	-	-	-	-	-	-	-	10	-	2	-	-	1
19	280	120	40	-	-	-	-	5	12	-	3	-	3	-	-	-
20	240	150	35	-	-	1	-	-	-	17	100	-	-	-	-	-
21	5460	50	30	-	1	-	17	-	45	-	5	2	-	-	1	-
22	8400	200	30	-	-	-	-	-	35	-	3	-	-	-	-	-

OB = Ommastrephes bartrami  
Neon Flying squid

BJ = Brama japonica  
pomfret

MM = Mola mola

AF = Alepisurus ferox

TA = Thunnus alalunga  
Albacore

AP = Protopteus phaeo

SA = Seriola aureovittata  
Yellowtail

CA = Coloabis saia

EP = Euthyrus pelamis

SJ = Scomber japonica

PG = Prionace glauca  
Blue shark

IO = Isurus oxyrinchus

LD = Lamna ditropis

SZ = Sphyrna zpgaeana

TX = Tetrapturus audax

XG = Xiphias gladius

Table 4. Summary of marine mammals incidentally taken in retrieval operations observed aboard the Korean squid driftnet vessel, Oyang 53, July 9 - Aug. 8, 1988 in the North Pacific. Noted as number dead (D) - number released alive (A) - number lost (L).

Haul no.	<u>Lissodelphis</u>	<u>Phocoenoides</u>	<u>Callorinus</u>
	<u>borealis</u>	<u>dalli</u>	<u>ursinus</u>
	D-A-L	D-A-L	D-A-L
01	-	0-0-1	-
02	-	-	-
03	-	-	-
04	-	-	-
05	1-0-0	-	-
06	-	-	-
07	-	-	0-1-0
08	-	-	-
09	-	-	0-1-0
10	-	-	-
11	2-0-0	-	-
12	-	-	-
13	2-0-5	-	-
14	-	-	-
15	-	-	-
16	3-0-1	-	-
17	-	-	-
18	-	-	-
19	-	-	-
20	1-0-0	-	-
21	-	-	-
22	-	-	-
Totals	9-0-6	0-0-1 .5X	0-2-0

Table 5. Summary of seabirds incidentally taken in retrieval operations observed on board the Korean squid driftnet vessel, Oyang 53, July 9 - Aug. 8, 1988 in the North Pacific. Noted as number dead (D) - number released alive (A) - number lost (L).

Haul no.	<u>Puffinus</u>	<u>Diomedea</u>	<u>Diomedea</u>	<u>Fratercula</u>
	<u>sp.</u>	<u>nigripes</u>	<u>immutables</u>	<u>corniculata</u>
	D-A-L	D-A-L	D-A-L	D-A-L
01	6-0-0	-	-	-
02	2-0-0	-	-	-
03	4-0-0	-	-	-
04	7-4-0	0-0-1	-	-
05	3-0-1	-	-	-
06	4-0-1	-	1-0-0	-
07	1-0-0	-	-	-
08	-	-	-	-
09	-	-	-	-
10	-	-	-	-
11	-	-	-	-
12	-	-	-	-
13	2-0-0	-	-	-
14	-	-	-	-
15	1-0-0	-	-	-
16	-	1-0-0	-	-
17	6-0-0	1-0-0	-	-
18	-	-	-	-
19	1-0-0	-	-	1-0-0
20	-	-	-	-
21	-	-	-	-
22	-	-	-	-
Totals	37-4-1	2-0-1	1-0-0	1-0-0

Table 6. Summary of net debris observed during the period June 6 through August 13.

Date	Position of Net Debris	Sighting Classification	Type of Net and Description
7/01	40°31'N 167°30'E	on effort	Round flourescent float with net over entire sphere.
7/08	39°21'N 169°08'W	on effort	4mx3m net section, similar to that used on cargo vessels.
7/08	39°30'N 169°24'W	on effort	White spherical bouy wrapped with net.
7/08	39°30'N 169°24'W	on effort	15m of gillnet debris in "S" shape configuration.
7/11	41°21'N 168°05'W	off effort	5m of gillnet debris.
7/15	41°03'N 168°42'W	in net	Cargo transfer type net covered with moss, 1.0mx1.5m
7/19	41°03'N 168°06'W	off effort	15m of gillnet debris in an "S" shape configuration.
7/19	41°04'N 168°14'W	off effort	10m of gillnet debris.
7/21	41°03'N 168°41'W	in net	20m of gillnet debris with female <u>Lissodelphis borealis</u> in net. Net was same type as Korean.
7/21	41°03'N 168°44'W	off effort	20m of gillnet debris. White floats.
7/21	41°02'N 168°57'W	off effort	30m of gillnet debris, same type as Korean.
7/23	40°28'N 167°46'W	in net	30m of gillnet debris with dead <u>Lissodelphis borealis</u> . Yellow and white corks.



Table 6 (cont.)

7/25	40°27'N 168°18'W	in net	3m of gillnet debris with large decayed shark entangled in net. Same net type that Koreans use.
7/26	41°20'N 167°58'W	in net	30m of gillnet debris
8/05	40°20'N 165°13'W	off effort	30m of gillnet debris

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Table 7. Summary of elapsed time for the sets on the  
Oyang 53, July 9 - August 8.

No. Observed?		Elapsed Time of Set	No. of Sections of Set	Reported Pok <sup>1</sup> of Set	No. Set
01	yes	244 mins.	5	1400	
02	no	227 mins.	5	1400	
03	no	240 mins.	6	1400	
04	yes	230 mins.	6	1400	
05	no	233 mins.	6	1400	
06	no	264 mins.	6	1400	
07	no	250 mins.	6	1400	
08	no	208 mins.	6	1400	
09	no	208 mins.	6	1400	
10	no	280 mins.	6	1400	
11	no	408 mins.	6	1400	
12	no	216 mins.	6	1400	
13	yes	293 mins.	6	1400	
14	no	277 mins.	6	1400	
15	no	289 mins.	6	1400	
16	no	183 mins.	5	1400	
17	no	251 mins.	5	1400	
18	no	261 mins.	5	1400	
19	yes	182 mins.	5	1400	
20	no	103 mins.	3	-	
21	yes	210 mins.	6	1400	
22	no	216 mins.	6	1400	

1) One Pok reportedly equals 50m

Table 8. Summary of marine mammal sightings from surveys conducted on board the Korean squid driftnet vessel, Oyang 53, and transit vessels, Suah and Tsurusaki Maru. June 25-August 13, 1988. Noted as number of sightings/number of animals.

Species	On Effort	Off Effort
<u>Phocoenoides dalli</u>	5/48	2/37
<u>Globicephela macrorhynchus</u>	1/17	-
Unidentified porpoise	3/21	2/38
Unidentified whale	1/10	-
<u>Lagenorhynchus obliquidens</u>	-	1/40
<u>Orcinus orca</u>	-	1/12
<u>Callorhinus ursinus</u>	1/2	17/39

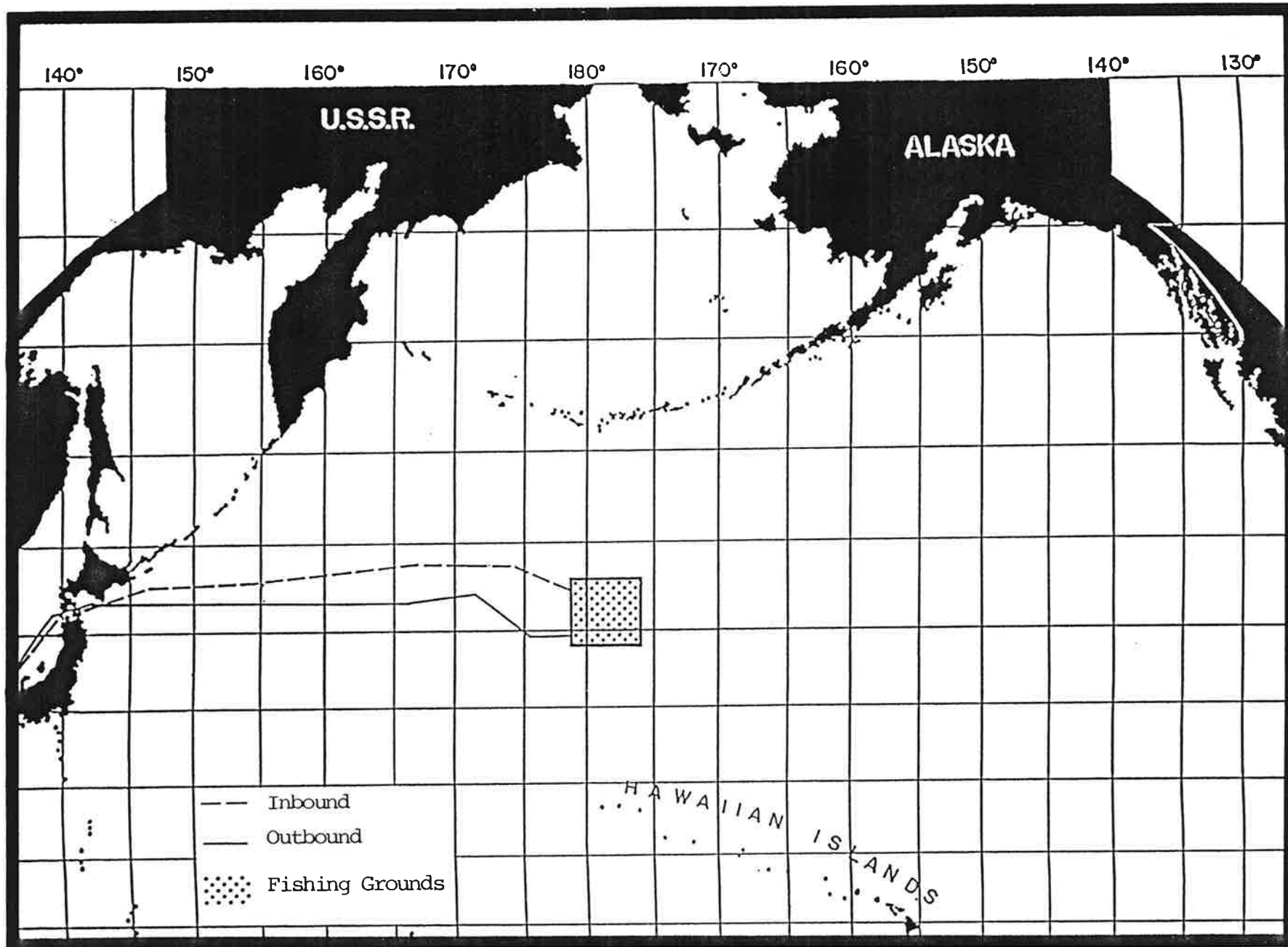


Figure 1: Trackline of the U.S. - Korean Cooperative Cruise to the Korean squid fishing grounds, June 9 - August 8, 1988