# SNAILPOT SAMPLING GUIDELINES

For each set, sample 90-120 pots for large bycatch items. Sample at least 12 pots for snails and smaller bycatch items.
Sample 3 sets per day.

Length frequency sampling:

- measure up to 70 Tanner crab and 70 King crab from bycatch samples per day.
- measure up to 40 Pacific cod (unsexed) per day.
- measure a sample of approximately 70 N. pribiloffensis once per day, plus a sample of one other frequently-occurring snail species once per day.
- try to get some measurements of 3-4 of the most common snail species sometime during your cruise. (reduce confusion)

Snail Fishery

There are ~600 pots/set; vessel sets + retrieves ~5 sets/day; each set soaks ~2 days, so a vessel deploys about 10 sets at a time (6,000 pots and retrieves 3,000 pots/day).

Bait - sardines, pollock, cod heads brought from Japan in frozen blocks

In good weather, it takes ~80 minutes to retrieve a set

Cooking times - 3 min 30 sec - 4 min for small snails
4 min - 4 min 30 sec for large snails in near-boiling sea water
↑ some other reports indicate different cooking times

Info We Want Snail Observer to Collect

vessel diagram - ~~[illegible]~~ processing deck + sorting deck
check over the gear diagrams + processing diagrams : verify
take copies of prev repts - verify those; resolve discrepancies
anything different about this vessel ?
Different fishing strategy ? area fished ? processing procedure ?
Reporting catch the same ? - Do they use the same correction factor ?
Include in your report information that would be helpful to the next observer - comments on sampling procedure, vessel work schedule, vessel accommodations, etc. - everything you would have liked to have known before you went out.

Add helpful comments to the "Snail Identification Notes"
Bring back snail shells to add to our teaching/reference collections (see request list)
Be aware there may be tagged snails - record location + bring back shell + tag
~~Hours fished - make sure that these are in 10ths of an hour (not minutes)~~
~~Continue length freq. of snails by sex ; measure all crabs + cod in sample~~

John Reynolds + Lincoln Kern > temp. snail obs.

Kirk Miller (will bring forms)

# INSTRUCTIONS FOR TEMPORARY SNAIL OBSERVERS

As you will be on board a snail vessel for only a short time, and as you have had no opportunity to be specifically trained in sampling aboard a snail vessel, you will not be expected to do the detailed sampling that most snail observers do. Your main duties will be to verify the amount of edible snail meats that the ship produces for each set, and to insure that the vessel complies with the fishery regulations. You should also be able to collect the information required to fill out the 1S forms (catch information form) and possibly some basic species composition data on the 3S forms (giving mainly the numbers and weights of snails (code 30), crabs, and fish observed in the sampled pots). As you will not be identifying the snails to species, the species composition data will be greatly simplified.

1S form: The sets should not be numbered sequentially (like hauls); ~~do not duplicate the set number.~~ (1-6 sets for each day) Record the end position of each set (the position of the ship at the time retrieval for each set is completed). Please see the "Instructions for snail fishery observers" for filling out the rest of the form. The total set catch is calculated from your species composition data--there won't be any ship's estimate of total catch because the officers normally only record the amount of snail meats that are produced. (The quota allocation is in metric tons of snail meats, not in total catch.) Sometimes the ships use a factor to extrapolate from the weight of the cooked meats back to the weight of the uncooked meats. Your job is to verify the weights of the cooked meats (by counting the trays and checking tray weights)--this will be the observer estimate of snail meats. and you must have this for every set retrieved. The ship's estimate may be exactly the same as the observer estimate, or, if they are using a factor to extrapolate to raw meats, then the ship's estimate of meats will be different by that factor.

Sampling for species composition and incidence of prohibited species: Generally observers sample 3 sets out of the 5 to 6 sets of snail pots per day. Sample each set by observing several portions of the longline set. Sample as much of the set as possible for large bycatch items: items that are sorted out from the catch soon after each pot is dumped: these will include any fish, such as Pacific cod, sculpins; Tanner crab or King crab. Keep track of the number of pots you observe for the large bycatch items, count and weigh each species or species group. Separate the Tanner and King crab species by species and sex and count each species/sex group separately as you will enter these data on the 3S forms separately, using a special species code for the crabs--use your regular species code list for everything else. Have the crewmen empty at least 12 pots (more if possible) directly into your baskets so that you can count and weigh the groups of the snails and small bycatch items. If you find any large bycatch items in this sample, add them to your large bycatch data, and always remember to include the number of pots observed for snails to the number of pots observed only for large bycatch. Small bycatch items would include hermit crabs, sea anemones, brittle stars, and other items that would be difficult to obtain 100% of in the large bycatch sample.

3S form: for each species or species group, record the number of pots you observed for that species, and the total number and weight of each. You will probably have two sample sizes--the number of pots observed for the large bycatch species and the number of pots observed for snails and small bycatch species. Follow the directions for calculating the radio messages.

Enforcement--this will mainly be verifying the log entries for the amount of edible snail meats retained (note whether raw or cooked meats are being logged). Note amounts of any whole snails that are frozen whole. All species except snails are considered to be prohibited species in this fishery. *Do not get upset if small amounts of cod are being consumed on* board, but do not allow cod to be used as bait. Tanner crab should be discarded overboard as soon as possible with a minimum of injury.

TO: MR. J. FUYIWARA
JAPAN SNAIL FISHERY ASSOCIATION
TELEX NO. 7812522636

FROM: MR. R. NELSON, OBSERVER PROGRAM
NWAFC, NMFS
SEATTLE, WA

REF.: OBSERVERS FOR SNAIL VESSELS

The observers for the Eiwa Maru No. 38 and Kaiyu Maru No. 5 will be available for boarding at Dutch Harbor on the afternoon of May 8, 1987 (local time). Mr. Itoh of the Japan Fisheries Association has advised my office that both vessels are currently scheduled to arrive at Dutch Harbor on April 29, 1987. Mr. Itoh requested that two temporary observers be placed aboard for about one week until the planned observers are be embarked on May 8. That request is acceptable under the following conditions.

1. Two temporary observers deborking longline vessels on April 29, 1987 can be picked up by the Eiwa Maru No. 38 and Kaiyu Maru No. 5 late in the afternoon of April 30, 1987 (local time).

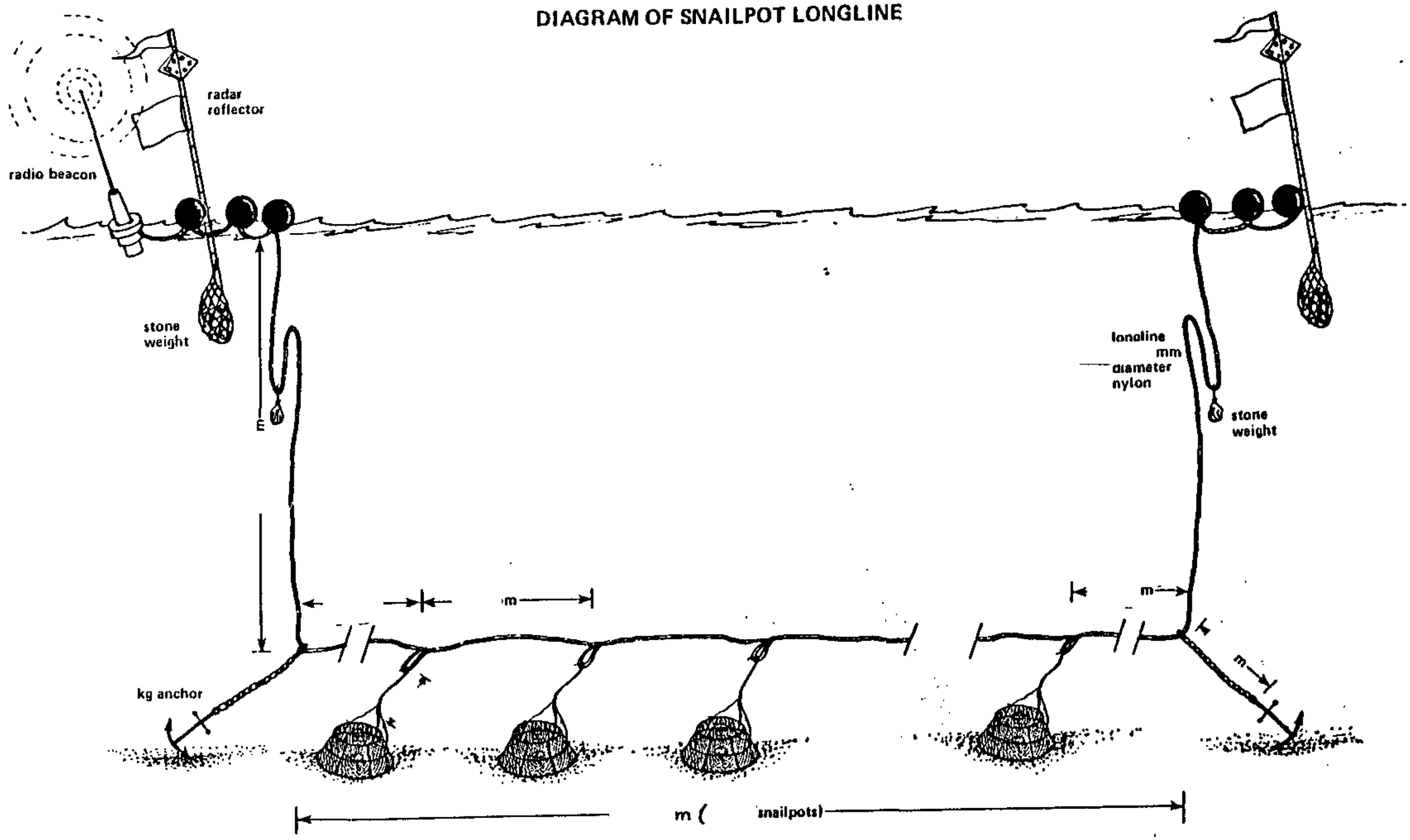
2. Both vessels must go to Dutch Harbor to embark the observers.

3. Both temporary observers must be returned to Dutch Harbor on May 8, 1987 and the new observers embarked.

4. One vessel can be used to exchange observers at Dutch Harbor on May 8, 1987 but if this method is used the other vessel must cease all fishing operations when the temporary observer is transferred off the vessel and cannot resume fishing until a new observer is placed aboard.

5. If for some reason a temporary observer is not available for a vessel because of a change in events, you will have to request a waiver from the observer requirement from the Regional Director of the NMFS Alaska Region to allow fishing until an observer is embarked. The Regional Director will then make a determination as to whether the vessel or vessels will be allowed to fish.

## DIAGRAM OF SNAILPOT LONGLINE



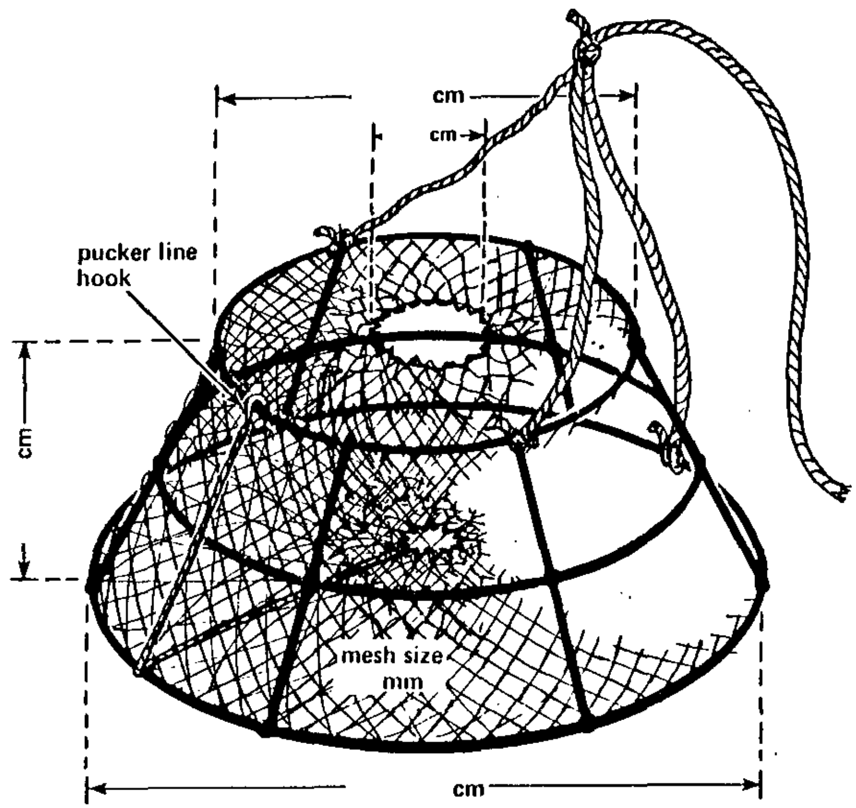



DIAGRAM OF SNAILPOT

DAILY FISHING LOG

DAILY JOINT VENTURE LOG SECTION THREE-PRODUCT

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECIES AND CODE | 673 SNAIL (? ?) | | | | | | | | | | | | | | | | | | | | | | | |
| PRODUCT CODE | | | | | | | | | | | | | | | | | | | | | | | | |
| P.R.R.(%) | | | | | | | | | | | | | | | | | | | | | | | | |
| DAILY TOTAL | | | | | | | | | | | | | | | | | | | | | | | | |
| CUMULATIVE TOTAL | | | | | | | | | | | | | | | | | | | | | | | | |
| AMOUNT TRANSFERRED | | | | | | | | | | | | | | | | | | | | | | | | |
| BALANCE | | | | | | | | | | | | | | | | | | | | | | | | |

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| SPECIES AND CODE | | | | | | | | | | | | | | | | | | | | | | | | |
| PRODUCT CODE | | | | | | | | | | | | | | | | | | | | | | | | |
| P.R.R.(%) | | | | | | | | | | | | | | | | | | | | | | | | |
| DAILY TOTAL | | | | | | | | | | | | | | | | | | | | | | | | |
| CUMULATIVE TOTAL | | | | | | | | | | | | | | | | | | | | | | | | |
| AMOUNT TRANSFERRED | | | | | | | | | | | | | | | | | | | | | | | | |
| BALANCE | | | | | | | | | | | | | | | | | | | | | | | | |

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| SPECIES AND CODE | | | | | | | | | | | | | | | | | | | | | | | | |
| PRODUCT CODE | | | | | | | | | | | | | | | | | | | | | | | | |
| P.R.R.(%) | | | | | | | | | | | | | | | | | | | | | | | | |
| DAILY TOTAL | | | | | | | | | | | | | | | | | | | | | | | | |
| CUMULATIVE TOTAL | | | | | | | | | | | | | | | | | | | | | | | | |
| AMOUNT TRANSFERRED | | | | | | | | | | | | | | | | | | | | | | | | |
| BALANCE | | | | | | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECIES AND CODE | | | | | | | | | | | | | | | (A) FROZEN PRODUCTS TOTAL | | (B) | | | ALL TOTAL |
| PRODUCT CODE | | | | | | | | | | | | | | | | | MEAL | OIL | | (A)+(B) |
| P.R.R.(%) | | | | | | | | | | | | | | | | P.R.R. | | | | |
| DAILY TOTAL | | | | | | | | | | | | | | | | DAILY TTL (CONSUMED FOIL) | | ( ) | | |
| CUMULATIVE TOTAL | | | | | | | | | | | | | | | | CUMULATIVE TTL (CONSUMED FOIL) | | ( ) | | |
| AMOUNT TRANSFERRED | | | | | | | | | | | | | | | | AMOUNT TRANSFERRED | | | | |
| BALANCE | | | | | | | | | | | | | | | | BALANCE | | | | |

Year Month Date Departure port　　Year Month Date Entered port

| No. | Item | Entry | No. | Item | Entry |
| --- | --- | --- | --- | --- | --- |
| 1 | Name of vessel | | 9 | Total length | |
| 2 | International radio call sign | | 10 | Horse power | |
| 3 | U.S. Permit number | JA | 11 | Japanese license number | |
| 4 | Name of master | | 12 | Japanese registration number | |
| 5 | Owner | | 13 | Japanese registration port | |
| 6 | Type of fishery | | 14 | Type of vessel | |
| 7 | Gross tonnage | | 15 | Number of crew | |
| 8 | Net tonnage | | | | |

VESSEL EXAMPLE

SNAIL

**Remarks**

| Inspection Particular | | | |
| --- | --- | --- | --- |
| Name of Vessel | | Position | |
| Date : Time | | Officer | |

Materials of Inspection

| Inspection Particular | | | |
| --- | --- | --- | --- |
| Name of Vessel | | Position | |
| Date : Time | | Officer | |

Materials of Inspection

| Inspection Particular | | | |
| --- | --- | --- | --- |
| Name of Vessel | | Position | |
| Date : Time | | Officer | |

Materials of Inspection

| Inspection Particular | | | |
| --- | --- | --- | --- |
| Name of Vessel | | Position | |
| Date : Time | | Officer | |

Materials of Inspection

| Inspection Particular | | | |
| --- | --- | --- | --- |
| Name of Vessel | | Position | |
| Date : Time | | Officer | |

Materials of Inspection

| Inspection Particular | | | |
| --- | --- | --- | --- |
| Name of Vessel | | Position | |
| Date : Time | | Officer | |

Materials of Inspection

# JAPAN FISHERIES ASSOCIATION

**Japan-U.S. Fisheries Trade Office**

SEATTLE OFFICE
Suite 545
1111 3rd Ave. Building
Seattle, Washington 98101

TEL (206) 624-1800
FAX (206) 467-1043

April 17 1987

Mr. Rusell E. Nelson Jr.
Observer Program
NORTH WEST AND ALASKA FISHERIES CENTER
7600 Sand Point Way NE Bin C15700
SEATTLE WA. 98115

Dear Sirs,

RE: OBSERVER FOR EIWAMARU 38/ KAIYUMARU 5

Thank you for your telex dated April 14 1987 and your kindness.
We well realized our notify of fishing snail is short for your arrangement. observers.
Kindly requested to consider following points.

1. U.S. Goverment just allocated snail quota to Japan on April therefor Snail Association could not submit fishing effort plan for snail fishery before allaocation clear.
2. As 3,000 tons snail quota were allocated, they want to start snail fishing soon for minimize their loss because they have nothing to fish in this stage.

Will you please sypathize toJapanese local fishing companies under difficalt situation and kindly arrangement of observers for the vessel to start fishing snail , EIWAMARU 38 from April 26 and KAIYUMARU 5 from May 1st 1987.

We attach quarterly fishing effort plan for snail fishing.

Yours sincerely

Kaneyasu Ito
Kaneyasu Ito

CATHLEEN SMITHWICK
KAIYU MARU #5

# FORM RM-1 WEEKLY RADIO REPORT WORK SHEET

AREA 52

CRUISE NO. 007 VESSEL CODE JP03



| DATE | A: Total Pots DAY | B: TOTAL SAMPLE POTS | C: Ed. Snails KG MT SMPL | D: Ed. Snails MT DAY | Cod KG MT SMPL | Cod MT DAY | Tanner KG SMPL | Tanner MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY | KG SMPL | MT DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/06 | 1700 | 500 | 4.85 | 16.49 | .065 | .221 | 661.8 / 28.676 | 2250. 1 | 97.498 | | | | | | | | | | | | | | | | | | | |
| 7/07 | 2500 | 1200 | 11.727 | 24.431 | .17 | .354 | 150.1 / 21.876 | 312.7 | 455.75 | | | | | | | | | | | | | | | | | | | |
| 7/08 | 2300 | 1100 | 13.605 | 28.447 | .08 | .167 | 317.8 / 30.312 | 664. 5 | 63. 38 | | | | | | | | | | | | | | | | | | | |
| 7/09 | 2900 | 1800 | 15.805 | 25.464 | .281 | .453 | 472.8 / 58.62 | 761. 7 | 94. 443 | | | | | | | | | | | | | | | | | | | |
| 7/10 | 2300 | 1800 | 16.855 | 21.537 | .256 | .327 | 423.5 / 57.765 | 541. 1 | 73. 811 | | | | | | | | | | | | | | | | | | | |
| 7/11 | 2500 | 1300 | 16.178 | 19.573 | .245 | .471 | 522.5 / 53.912 | 1004. 8 | 103. 677 | | | | | | | | | | | | | | | | | | | |
| 7/12 | 2550 | 1900 | 17.95 | 24.091 | .518 | .695 | 771.2 / 96.611 | 1035. 0 | 129. 662 | | | | | | | | | | | | | | | | | | | |
| WEEK'S TOTAL | 168. 16MT | | 76 | 160. 033 | | 2. 688 | | 6569. 9 | 1018. 221 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7/13 | 2500 | 1300 | 13.085 | 25.163 | .236 | .454 | 1890.5 | 3635.6 | .156 | .3 | | | | | | | | | | | | | | | | | | |
| 7/14 | 1950 | 1300 | 10.795 | 16.193 | .304 | .456 | 828.4 | 1242.6 | .102 | .153 | | | | | | | | | | | | | | | | | | |
| 7/15 | 1900 | 1250 | 12.153 | 18.473 | .171 | .26 | 4156.9 | 6318.5 | .303 | .461 | | | | | | | | | | | | | | | | | | |
| 7/16 | 2550 | 1900 | 18.588 | 24.946 | .284 | .381 | 1487.3 | 1996.1 | .145 | .195 | | | | | | | | | | | | | | | | | | |
| 7/17 | 2500 | 1900 | 14.701 | 19.343 | .369 | .908 | 1392.3 | 1832.0 | .182 | .239 | | | | | | | | | | | | | | | | | | |
| 7/18 | 1250 | 650 | 7.088 | 13.631 | .108 | .208 | 688.2 | 1323.5 | .06 | .115 | | | | | | | | | | | | | | | | | | |
| 7/19 No fishing | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Week's TOTAL | 131. 46MT | | | 117. 749. | | 2.667 | | 16 348.3 | | 1.463 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (OVER) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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FORM RM WEEKLY RADIO REPORT WORK SHEET AREA 52 CRUISE NO. 007 VESSEL CODE JP03

Non-Cooked Total Snow 7/6-7/12 = 44,33 MT
80% correction factor

CATHLEEN SMITHWICK
KAIYU MARU #5



| DATE & ~~HAUL~~ No. | A: # of Dots (~~HAUL WT MT~~) | B: Dots Sampled (~~TOTAL SAMPLE WT KG~~) | C (MT) Edible Snow KG SMPL | D Edible Snow MT HAUL | Cod (MT) KG SMPL | Cod MT HAUL | Tanner (Kg) KG SMPL | Tanner MT HAUL | OTH/Non (MT) KG SMPL | OTH/Non MT HAUL | Nonedsn (MT) KG SMPL | Nonedsn MT HAUL | KG SMPL | MT HAUL | KG SMPL | MT HAUL | KG SMPL | MT HAUL | KG SMPL | MT HAUL | KG SMPL | MT HAUL | KG SMPL | MT HAUL | KG SMPL | MT HAUL | KG SMPL | MT HAUL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/6 #3 | 500 | 2 | 19.4 | 4.85 | | | | | .1 | .025 | .15 | .038 | | | | | | | | | | | | | | | | |
| | 500 | 34 | | | 4.4 | .065 | 45/1.95 | 661.8/28.676 | 2.55 | .037 | | | | | | | | | | | | | | | | | | |
| 7/7 #1 | 600 | 6 | 59.17 | 5.917 | | | | | .57 | .057 | .55 | .055 | | | | | | | | | | | | | | | | |
| | 600 | 96 | | | 7.0 | .044 | 17/2.25 | 106.3/14.068 | 11.38 | .071 | | | | | | | | | | | | | | | | | | |
| #4 | 600 | 6 | 58.1 | 5.81 | | | | | .2 | .02 | .25 | .025 | | | | | | | | | | | | | | | | |
| | 600 | 96 | | | 10.0 | .063 | 7/1.25 | 43.8/7.813 | 6.05 | .038 | | | | | | | | | | | | | | | | | | |
| 7/8 #1 | 500 | 6 | 62.8 | 5.23 | | | | | .73 | .061 | .55 | .046 | | | | | | | | | | | | | | | | |
| | 500 | 96 | | | 116 | .06 | 43/3.3 | 224.0/17.187 | 11.1 | .058 | | | | | | | | | | | | | | | | | | |
| #3 | 600 | 6 | 59.0 | 5.9 | | | | | .65 | .065 | .3 | .03 | | | | | | | | | | | | | | | | |
| | 600 | 96 | | | 1.6 | .01 | 15/2.1 | 93.8/13.125 | 9.55 | .06 | | | | | | | | | | | | | | | | | | |
| 7/9 #1 | 600 | 10 | 101.75 | 6.105 | | | | | .2 | .012 | 3.0 | .18 | | | | | | | | | | | | | | | | |
| | 600 | 100 | | | 9.8 | .059 | 13/3.3 | 114/19.8 | 4.8 | .029 | | | | | | | | | | | | | | | | | | |
| #2 | 600 | 12 | 99.5 | 4.975 | | | | | .39 | .02 | 3.27 | .164 | | | | | | | | | | | | | | | | |
| | 600 | 102 | | | 15.4 | .091 | 39/4.35 | 229.4/25.582 | 6.55 | .039 | | | | | | | | | | | | | | | | | | |
| #4 | 600 | 12 | 94.5 | 4.725 | | | | | .4 | .02 | 3.26 | .163 | | | | | | | | | | | | | | | | |
| | 600 | 102 | | | 22.2 | .131 | 22/2.26 | 129.4/13.294 | 3.25 | .019 | | | | | | | | | | | | | | | | | | |
| 7/10 #2 | 600 | 12 | 116.5 | 5.825 | | | | | .35 | .018 | 3.48 | .174 | | | | | | | | | | | | | | | | |
| | 600 | 102 | | | 18.0 | .106 | 34/4.87 | 200.0/28.647 | 5.38 | .032 | | | | | | | | | | | | | | | | | | |
| #3 | 600 | 12 | 118.42 | 5.921 | | | | | .37 | .019 | 2.75 | .138 | | | | | | | | | | | | | | | | |
| | 600 | 102 | | | 14.7 | .086 | 17/1.95 | 100.0/11.471 | 5.77 | .034 | | | | | | | | | | | | | | | | | | |
| #4 | 600 | 12 | 102.18 | 5.109 | | | | | .28 | .014 | 3.64 | .182 | | | | | | | | | | | | | | | | |
| | 600 | 102 | | | 10.9 | .064 | 21/3.10 | 123.5/17.647 | 5.13 | .03 | | | | | | | | | | | | | | | | | | |

# DAILY FISHING LOG

## SECTION ONE-EFFORT

| PAGE NO | DATE YEAR/MON/DAY | VESSEL NAME | IRCS | U.S. PERMIT NUM | NOON POSITION LATITUDE LOGITUDE | NOON WEATHER | WIND DIRECTION/FORCE | | WEATHER | BAROMETER | SEA CONDITION | TEMPERATURE AIR/WATER | | TITLE / SIGNATURE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ページ 番号 | 日付 年/月/日 | 船名 | | | 正午位置 緯度/経度 | 正午 天候 | 風向 | 風力 | 天候 | 気圧 | 海況 | 気温 | 水温 | 署名 |
| | | | | JA- | N / EW | X | | | | | | | | |

| SET NO | FISHING AREA NO | GEAR TYPE | SET TIME (GMT) | | SET POSITION | COURSE OF SET | SEA DEPTH (METER) | END OF SET POSITION | DURATION OF SET (MINUTES) | HAULING TIME (GMT) START | | HAULING TIME (GMT) END | | BEGINNING HAULING POSITION | NUM OF POT/UNIT | (M/T) ESTIMATED TOTAL WEIGHT OF CATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 漁区 | 漁具 | 月/日 | 時間 | | | 水深 (m) | | (分) | 月/日 | 時間 | 月/日 | 時間 | | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |
| | | | | | N / EW | | | N / EW | | | | | | N / EW | | |

| U. S. INSPECTION | REMRKS; |
|---|---|
| OFFICER; | |
| DATE; | |

# DAILY FISHING LOG

## SECTION TWO-CATCH

| SPECIES / VESSEL | SET NO | 673 SNAIL ツブ | 702 PACIFIC COD マダラ | 118 GREENLAND TURBOT カラス | 921 ARROWTOOTH FLOUNDER アブラ | 129 OTHER FLATFISH | 120 YELLOWFIN SOLE コガネ | 701 POLLOCK スケソウ | 499 OTHERS | 703 SABLEFISH ギンダラ | 649 OTHER ROCKFISH | 780 POP POP | 201 ATKA MACKEREL ホッケ | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CATCH | | | | | | | | | | | | | | | | | |
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| | TOTAL | | | | | | | | | | | | | | | | |
| DAILY AREA 51 | C | | | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | | | |
| AREA 52 | C | | | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | | | |
| TOTAL | C | | | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | | | |
| CUMULATIVE AREA 51 | C | | | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | | | |
| AREA 52 | C | | | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | | | |
| TOTAL | C | | | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | | | |

| SPECIES / VESSEL | SET NO | PROHIBITED SPECIES 122 NUMBER | 122 KG | 210 NUMBER | 210 KG | 675 NUMBER | 675 KG | 676 NUMBER | 676 KG | | | | MARINE MAMMALS SPECIES CODE | STATUS CODE | NUMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CATCH | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | |
| DAILY AREA 51 | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | |
| AREA 52 | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | |
| TOTAL | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | |
| CUMULATIVE AREA 51 | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | |
| AREA 52 | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | |
| TOTAL | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| | TOTAL | | | | | | | | | | | | | | |

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Alaska Fisheries Center
Resource Ecology and Fisheries Management
7600 Sand Point Way NE
BIN C15700, Bldg. 4
Seattle, WA 98115-0070

May 18, 1989

Mr. Chris Hansen
Norfish
927 N. Northlake Way
Suite 210
Seattle, WA 98103

Dear Mr. Hansen:

Enclosed is the information on the Bering Sea snail fishery which you requested. The copy of the letter to Dick Reynolds gives the foreign reported catch of edible snail meats for 1983 to 1988. It also includes some observations on the species composition of the catch when targeting on Neptunea pribiloffensis or when targeting on the Buccinum species. I also included a table giving the reported catch, along with the number of pots and the calculated kg. of edible snail meat obtained per pot. For your interest, I also enclosed a copy of an article on the Bering Sea snail fishery that appeared in the "National Fisherman" in March 1987 and a copy of the one page regulations which pertain to the foreign snail fishery. I assume that a U.S. vessel won't be constrained by all of those regulations, but any foreign vessel that catches snails would be. You should probably contact Craig Hammond of NMFS Enforcement (907) 586-7225, to find out what regulations would apply to a joint venture operation, such as whether anything other than snails can be retained.

Let me know if you have any questions concerning the enclosed information. Please keep me informed regarding your plans for a joint venture snail fishery. Observers for foreign snail pot vessels have to receive special training, and it helps us to have as much lead time as possible.

Sincerely,

Janet M. Wall
NMFS Observer Program
(206) 526-4195

CODE OF FEDERAL REGULATIONS

TITLE 50

PART 611 -- FOREIGN FISHING

SUBPART G -- NORTH PACIFIC OCEAN AND BERING SEA

§611.94 SNAIL FISHERY.

(a) Purpose. This section regulates foreign fishing for snails (all species of the genera *Neptunea*, *Fusitriton*, *Buccinum*, *Beringius*, *Volutopsius*, *Clinopegma*, *Plicifusus*, and *Pyrulofusus*) in the Bering Sea.

(b) Authorized Fishery:

(1) Allocations. Foreign vessels may engage in fishing only in accordance with applicable national allocations.

(2) TALFF, DAH, DAP, JVP, Reserve. The annual total allowable level of foreign fishing (TALFF), domestic annual harvest (DAH), domestic annual processing (DAP), joint venture processing (JVP), and reserve for snails for each calendar year are published in the Federal Register. Current amounts are also available from the Regional Director.

(3) Closures The taking of snails for which nation has an allocation is permitted provided that the fishery has not been closed pursuant to §611.15.

(c) Area, gear, and other restrictions. No foreign fishing vessel may:

(1) Fish for snails east of 164° W. longitude, or within twelve miles of the baseline used to measure the territorial sea;

(2) Fish for snails using gear other than pots; or

(3) Retain in the snail fishery any species other than snails.

(d) Additional statistical report. Each nation whose vessels engage in this fishery shall report, by May 30 of the following year, annual catch and effort statistics as follows: Effort in number of pots hauled and hours pots soaked, by month, by ½° (lat.) x 1° (long.) statistical area; Catch in metric tons of edible meat, by month, by ½° (lat.) x 1° (long.) statistical area.

[43 FR 59293, Dec. 19, 1978, as amended at 46 FR 1739, Jan. 7, 1981; 47 FR 44266, oct. 7, 1982; 48 FR 34762, Aug. 1, 1983]

AJVS

Alaska Joint Venture Seafoods, Inc.

April 13, 1989

Ms. Janet M. Wall
Foreign Fishery Observer Program
Northwest and Alaska Fisheries Center
Resource Ecology and Fisheries Management
7600 Sand Point Way NE
BIN C15700, Bldg. 4
Seattle, WA 98115-0070

Dear Ms. Wall,

Thank you so much for the packet of Bering Sea Snail data which you mailed up to me. I know that your office must be getting very busy with all of the spring seasons gearing up and I appreciate the time and effort you spent in preparing the data.

As I have mentioned to you before, we are planning to begin fishing with the Soviets in June of this year. I have discussed with the President of AJVS, Mr. William Phillips, our conversations regarding permits and allocations and have thus left the proverbial ball in his court in getting those processed. He is going to Vladivostok early next week for a series of meetings with our Soviet partners, so I should have some concrete information on the standing of the venture soon. Please know that I will keep you posted as I learn more.

Again, thank you for all of your help and information.

Best regards,

AJVS, Inc.

Anne M. Gore
Assistant to the Chairman

AG/ss

2550 Denali, Suite 1406 • Anchorage, Alaska 99503 • (907) 279-0808 • Fax: (907) 279-0811 • Telex: 332471 (APANC)

Conversion factor (ships) 80% $\left(\frac{\text{cooked}}{\text{uncooked}}\right)$

Conversion factor (obs calc) 81% $\left(\frac{\text{cooked}}{\text{uncooked}}\right)$

| PRR | ~~cooked~~ whole → RAW (4.01) | whole → cooked (4.97) |
|---|---|---|
| Large Nep. prib. | .28 | .24 |
| Small Nep. prib. | .30 | .23 |
| Buccinum sp | .33 | .28 |

Foreign Reported Catch of Snails (except for 1987)
(MT Edible Meats) 3,000 mt. edible meat quota

| 1988 (no fishery) | DAYS FISHED | foreign rept. MT. EDIBLE MEATS | blend | |
|---|---|---|---|---|
| 1987 – | | 1064.4 | 881.6 | blend rept (cooked meats) |
| 1986 | | 591.3 | 493.0 | |
| 1985 | | 103.4 | 104.0 | |
| 1984 | 126 | 243.9 | 366.6 | from indiv. vessel repts |
| 1983 | 65 | 366.6 | 230.1 | from Reg. office |

| Species | Percentage | Mean kg/day | avg. kg/indiv |
|---|---|---|---|
| | 4 | .5 | 6 1/2 |

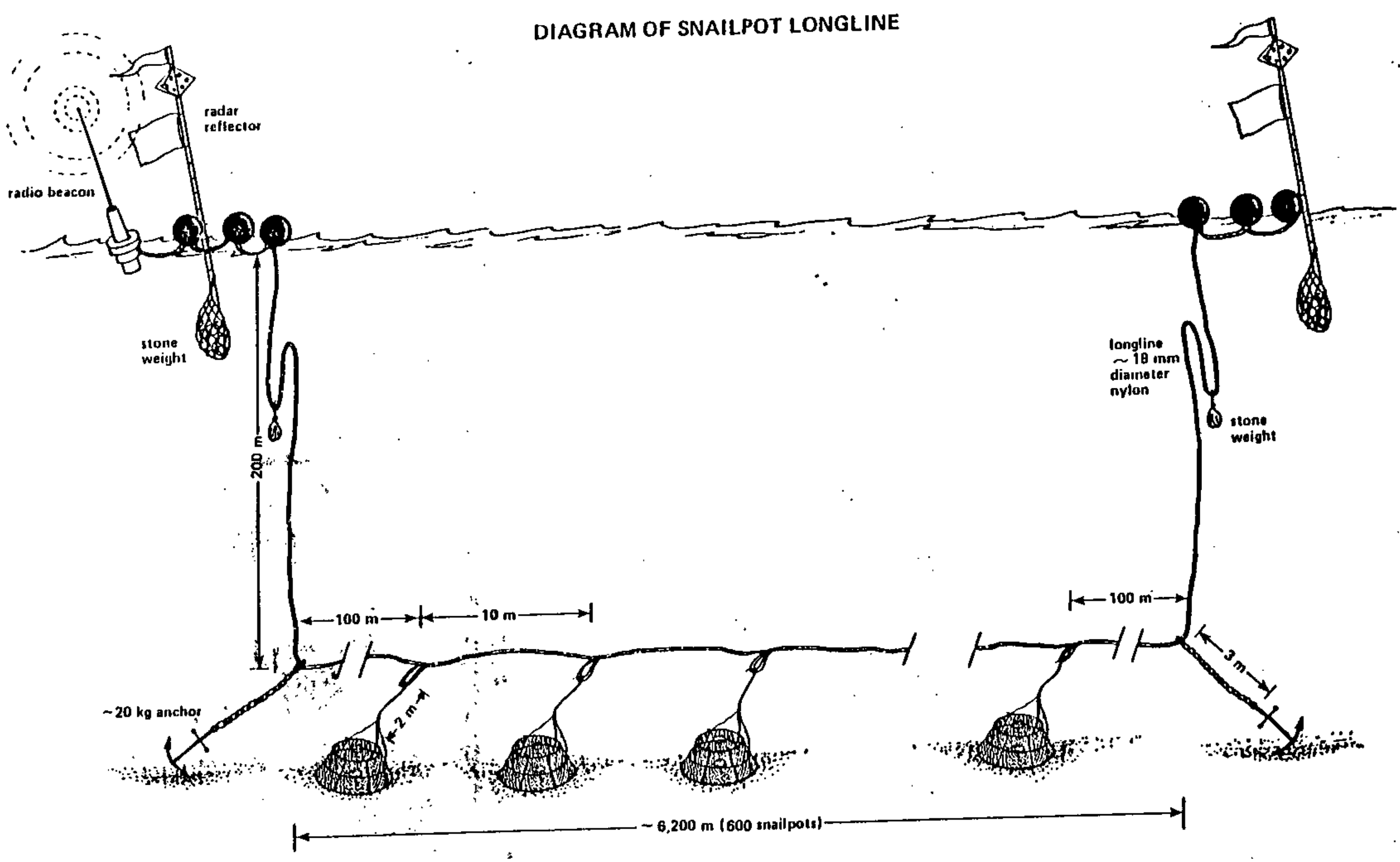
Past Snail Catch (probably edible meats)

| | | Days fished | Mt. edible meats | catch/day (calc) |
|---|---|---|---|---|
| 1981 | Chosei-78 838 | 43 | 112.0 mt | 2.60 |
| | Hoyo-63 862 | 76 | 127.4 | 1.68 |
| 1982 | 838 | 45 | 162.0 | 3.60 |
| | 840 | 36 | 69.3 | 1.925 |
| 1983 | 838 | 55 | 140.6 | 2.556 |
| | 862 | 71 | 226.0 | 3.183 |
| | | 126 | 366.6 | |

? ← (Doesn't match foreign reported) Foreign Reptd has this fig for 1983

1984 allocation is 3,000 mt in edible meats

| | | | | |
|---|---|---|---|---|
| | 838 | 65 | 230.1 | 3.540 |




Snailpot setline dimensions in 1984 Bering Sea snail fishery

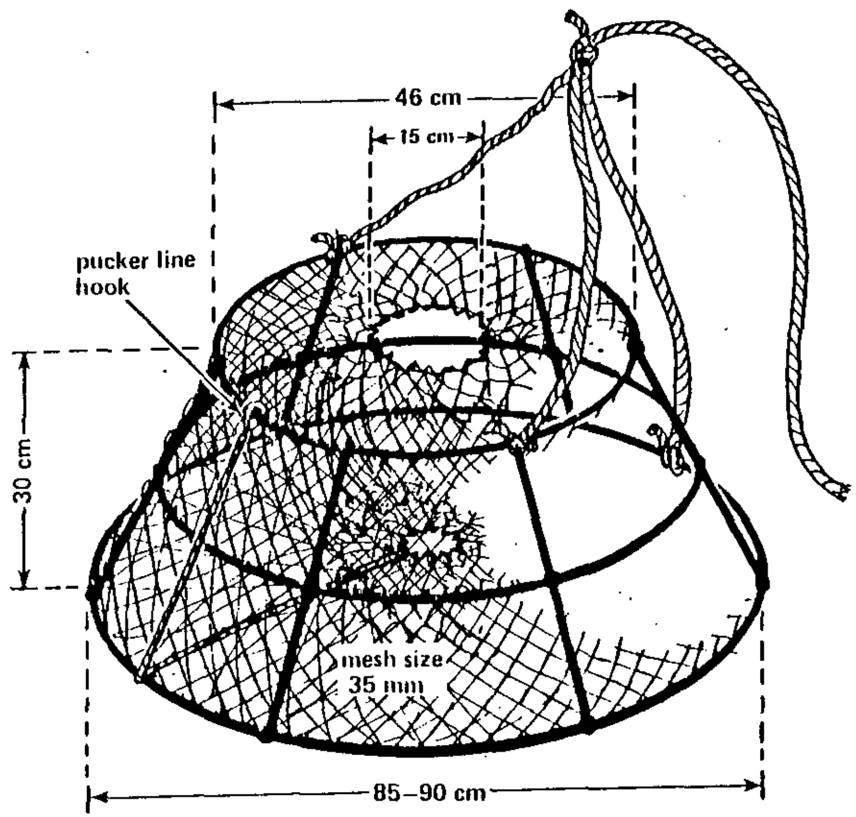



DIAGRAM OF SNAILPOT

Snailpot dimensions in 1984 Bering Sea snail fishery

# Past Snail Catch (probably edible meats)

| | | Days fished | Mt. edible meats | catch/day (calc.) |
|---|---|---|---|---|
| 1981 | Chosei-78 838 | 43 | 112.0 mt | 2.60 |
| | Hoyo-63 862 | 76 | 127.4 | 1.68 |
| | | | 239.4 | |
| 1982 | 838 | 45 | 162.0 | 3.60 |
| | 840 | 36 | 69.3 | 1.925 |
| | | | 231.3 | |
| 1983 | 838 | 55 | 140.6 | 2.556 |
| | 862 | 71 | 226.0 | 3.183 |
| | | | 366.6 | |

1984 allocation is 3,000 mt in edible meats

| | | | | |
|---|---|---|---|---|
| | 838 | 65 | 230.1 | 3.540 |

The sets should be numbered 1 to 6 (or whatever the number of sets retrieved that day) for each GMT day. Start the numbering at 1 for each GMT day.

# INSTRUCTIONS FOR SNAIL FISHERY OBSERVERS

## Filling out Data Forms 1S and 3S

### FORM 1S - Daily Catch Summary for Snail Pot Vessels

(This form is most similar to Form 1L p. 131-132 in the manual)

This sample form is designed to be filled out for each groundline set (hereafter referred to as simply "set"). If you can not obtain all of the information asked for on this form, record what you can obtain. ~~At a minimum,~~ You should be able to ~~we need at least one position for the day - so that the daily catch and biological data can be attributed to at least an appropriate location such as a GMT noon position, or a position of one of the sets. If possible, of course~~ enter the position of the ship at the time retrieval for each set is completed. If no sets are retrieved for a given GMT day, enter the GMT noon position and the reason why. Fishing time (or soak time) is the amount of time between the time the last pot of a groundline is set to the time the last pot of the same groundline is retreived. Do not enter more than 99 hours of soak time even if the actual soak time is longer. Make sure that the soak time is in tenths of hours, not minutes. It might be better to ask for the time and date each set was made and retreived so that you can calculate the soak time. The time may be approximate if no exact time is obtainable. The number of pots should be the number of pots retreived. (Do not include pots that were set but lost).

There won't be any ship's estimate of total catch because the officers

The total set catch is calculated from your species composition data - see the calculation directions on another page. If you did not sample any of the catch for a particular day - fill in at the end of the cruise by multiplying the no. of pots for each set times the average catch per pot for either that area or for the entire cruise (use your judgement). [In calculating your radiomessage, such a nonsampled day should not be included as a day on the grounds and the calculated catch for the day should likewise not be included]. Try to obtain either the ship's estimates of whole snails or snail meats by set, and correspondingly, make your own estimates of either whole snails, snail meats, or both. Previous observers have made their own estimates of both whole snails and snail meats (see calculation instructions on another page). If either of these estimates are only <u>edible</u> whole snails or edible snail meats, indicate so on the form, and in your report list the snail species that are considered "edible".

### FORM 3S - Species Composition for a Snail Pot Vessel

(See also the general instructions for Form 3 p. 67-72 in the manual).

This form enables the observer to decide the sample size for each species depending on the incidence of the species, the size of the species, or other considerations. I would assume that snails would have the smallest sample size, and I would recommend that such "prohibited" bycatch species such as king crab and Tanner crab have as large a sample size as possible.

Set no. - be sure to note the no. of the sampled set, which corresponds to the set no. for that day on Form 1S.

Species name & species code - use the code list for snails, the species code list in the manual p. 73-79, and the codes for male and female king and Tanner crab. You may either use the common name (if there is one) or the scientific name for snails. For other species, please use the common name - it is easier for the debriefers to check.

Please note - For king and Tanner crab you should collect and record the data for male and female crab separately. Use the "codes for male and female king and Tanner crabs" - not the species codes for those species found in the manual. Other crabs, such as lyre, Korean horsehair crab should have the data collected and recorded for the combined sexes (See the example Form 3S).

No. of pots sampled - record the no. of pots sampled for each particular species.

Line 999 - "no. of specimens and total weight" This line is used to check the accuracy of the keypunching. Total the numbers in the rows below, as shown on the example form. Do not fill in a total under "no. of pots sampled", however.

If there is room on the form, skip a line between species with different sample sizes. If there are more species than can be accommodated on this form for a given set, go to a new page, being sure to record the data for that set in the same numbered columns as on the first page. On the continuation sheet, record the heading, but not 999. The first sheet, line 999 should include the numbers for those same columns on the continuation sheet.

## Length Frequencies and Form 7

Take length frequencies of the predominant snail species, plus the Pacific cod, king and Tanner crab in the sample (see McIntosh's report). Make sure that the measured snails are randomly selected - i.e.: all *Neptunea pribiloffensis,* main *Buccinum* species from a 2-pot sample, for instance.

Measure snails from the apex to the middle of the anterior canal. In some cases, the margins of the anterior canal extended beyond the middle of the canal, making this less than a total length measurement. Broken shells (sometimes up to 50% of sample) are best handled by estimating the lengths - excluding them might bias the length frequency if the tendency to break is size dependent. Snails (like crabs) should be measured to the nearest 5 mm.

On form 7 use the regular species codes for crab (not the special ones with a separate code depending on sex). On form 7 you will be designating the sex of the crabs with an "M" or an "F".

## Calculations for Estimates to be Recorded on Form 1S

A  Observer's estimate of whole snails
B  Observer's estimate of edible snail meats
C  Total set catch (observer's estimate) = bycatch and all snails with shells

To calculate A:

wt. of ~~edible~~ snails in sample X $\frac{\text{no. of pots in set}}{\text{no. of pots sampled for snails}}$ = estimated wt. of edible snails in set (A)

To calculate B: *if can verify product wts.*

*Don't do this way* X

estimated wt. of edible snails in set X avg. product[1] (see footnote-bottom of page) recovery of mixed species of edible snails = estimated weight of snail meats from set

To calculate C:

wt. of bycatch species A in set X $\frac{\text{no. of pots in set}}{\text{no. of pots sampled for bycatch species A}}$ = estimated weight of of bycatch species A in set

Do this for each bycatch species or group of species that you want a separate weight estimate for. You will have to account for the weight of each species in your samples, but if you don't need a separate weight estimate for a given species, you can calculate its weight grouped with the weight of other species with the same number of sampled pots. (See "Calculation of C, continued" on next page.)

Note - Let me know if you don't understand the above - I didn't have time to work out the correct figures for the example.

[1](Concerning the average product recovery)

You will have to use your judgement as to what to use here. I don't know whether there is apt to be a great difference in the product recovery by individual snail species. If so, the product recovery of a random sample of mixed species of edible snails might vary considerably from set to set if the species composition also varies drastically from one set to another.

If the above is the case, you might have to conduct product recovery tests by species and apply it to the sample data by species (which involves a greater number of calculations).

✓ The procedure for conducting product recovery will also depend on circumstances. Depending on the factory processing procedures it might not be possible to monitor a known weight of snails with shells to a known weight of snail meats from those same snails. If that is so, you could possibly boil up a pot of snails yourself, and very carefully extract the meats (or use a hammer to break the shells).

Calculation of C, continued:

After calculating separately those species groups that have a different no. of sampled pots, or any species you want to calculate separately for other reasons, sum them all together as follows:

| | | | | |
|---|---|---|---|---|
| $\sum$ estimated weight of bycatch species A-->Z in set | + | A estimated weight of edible snails in set | = | total set catch (C) |

enter A, B, and C on the 1S data forms. It may not be necessary to calculate both A and B. Find out whether the ship is reporting catch data in whole snails or snail meats. (I suspect that they are reporting the data in snail meats). We would like you to calculate and report an estimate which correlates with their estimates of the catch. ~~Thus if they produce estimates of snail meat only, it would be unecessary for you to record the estimates of whole snails, but as this figure is used in other calculations you may decide to enter this on Form 1S anyway if you have the time.~~ We would like both estimates on the 1S forms.

To calculate C for sets that you did not sample:

| | | | | |
|---|---|---|---|---|
| sum the total set catch for the three or more sets you sampled that day | ÷ | total number of pots from the sampled sets | = | average catch per pot for the day |
| average catch per pot for the day | X | no. of pots in a nonsampled set | = | estimate of total catch in a non-sampled set |

Do the same procedure for each nonsampled set for the day and a similar procedure to calculate A or B.

If they always set the same number of pots in each set, you can shortcut the calculations as follows:

| | | | | |
|---|---|---|---|---|
| sum the total set catch for the three or more sets you sampled that day | ÷ | the no. of sampled sets for the day | = | average set catch for the day ↓ which in this instance could be used for the total catch for each nonsampled set for the day |

Preparing Your Radiomessage:

Read the sampling manual p. 148-171 concerning radiomessages, esp. days on grounds (DG), initial day of sampling (IDS), etc. Most of the catch data will not apply, however.

Sum the catch data for each week from the 1S forms. The report week is Sunday through Saturday, GMT time. As soon after Saturday as possible, get your figures together and report them in a radiomessage.

Some abbreviations, codes
SNAMTS = snail meats
SNAILS = whole snails
Otherwise, use whole words
D = decimal point
P = appears just before numerical check
The sum of the digits in the weight is the "P" value
IDS = initial day of sampling
Always use Metric tons in radiomessages unless designated otherwise

Example radiomessage:

NOJ DE(vessel call sign) MSG CATCHREP K
TO: RUSS NELSON, NWAFC, SEATTLE, WA
INFO: NMFS, AK REGION, JUNEAU, AK
FROM: RICH MACINTOSH, Vessel Name, Vessel Permit No.,
59-57N 168-32W JUNE 23 (most recent GMT noon position and date)
(ORC 717P15 3 digit
PARA 1 / ~~vessel permit number~~/ June 17-23/ A51/
DG6D0P6/ SNAMTS 18D52P16/ SNAILS 32D64P15/
TOTAL CATCH 80D56P19/ SEASICK - DID NOT SAMPLE
JUNE 19/ PARA 2/ MAIN BYCATCH SPECIES IS PACIFIC
COD 5D13P9/ KING CRAB AND TANNER CRAB WERE
OD52P7 AND OD26P8/ IDS JUNE 17
should be numbers, not wts (total extrapolated numbers all sets in sampled days)

Let us know in your first message whether the ship is reporting snail meats or whole snails. Do not be afraid to include short comments or questions you have about the catch, sampling, data forms, or advice to the next observer.

Let us know if you feel that health or safety conditions aboard the vessel make it inadvisable to place another observer aboard.

Info We Want Snail Observer to Collect

vessel diagram - ~~[illegible]~~ processing deck + sorting deck
check over the gear diagrams + processing diagrams: verify
take copies of prev repts - verify those; resolve discrepancies
anything different about this vessel?
Different fishing strategy? area fished? processing procedure?
Reporting catch the same? Do they use the same conversion factor?

has been expanded

Be aware there may be tagged snails — record location + bring back shell + tag
Hours fished - make sure that these are in 10ths. of an hour (not minutes)
Continue length freq. of snails by sex; measure all crabs + cod in sample

Karl Scc'l
Chosei Maru 78



# FORM 1S DAILY CATCH SUMMARY FOR SNAIL POT VESSELS

| CRUISE NO. (1-3) | VESSEL CODE (4-7) | GEAR CODE (11) | YEAR (12-13) |
|---|---|---|---|
| 002 | JP01 | 6 | 84 |

NOTE - 1. IF REMARKS ARE NECESSARY, RECORD ON SEPARATE PAGE; USE VESSEL NAME AND DATE AS REFERENCE.
2. LEADING ZEROS IN COLUMNS 1, 2, 14, AND 16 ONLY.
3. COLUMNS 9-10 (NOT SHOWN) ARE BLANK.
4. SKIP LINE AFTER EACH DAY.

diff between 2 est should be the conversion factor

looks like incorrect calc. of nonsampled hauls

cooked meats / raw sampled meats

| SET NO. | DATE MO. | DATE DAY | END POSITION OF SET (N) LATITUDE | E/W | (I) LONGITUDE | SET DATA AVERAGE DEPTH (M) | FISHING TIME (HOURS) | NO. OF POTS | TOTAL SET CATCH (MT) | WEATHER CODE | SEA CODE | WATER TEMP. °C SURFACE | BOTTOM | ESTIMATE OF WHOLE SNAILS OBSERVER | SHIP | ESTIMATE OF SNAIL MEATS OBSERVER | SHIP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 14 15 | 16 17 | 18 19 20 21 | 22 | 23 24 25 26 | 27 28 29 30 | 31 32 33 | 34 35 36 | 37 38 39 40 | 41 | 42 | 43 44 45 | 46 47 48 | 49 50 51 52 | 53 54 55 56 | 57 58 59 | 60 61 62 |
| 1 | 08 | 04 | 58 20 | W | 72 53 | 114 | 93.1 | 580 | 5.69 | 2 | 2 | 8.6 | . | 5.49 | . | .72 | 0.90 |
| 2 | 08 | 04 | 58 23 | ↑ | 72 36 | 110 | 88.1 | 580 | 5.16 | 2 | 2 | 8.8 | . | 4.98 | . | .83 | 1.04 |
| 3 | 08 | 04 | 58 19 | | 72 32 | 111 | 74.3 | 580 | 6.01 | 2 | 2 | 8.8 | . | 5.86 | . | .93 | 1.16 |
| 4 | 08 | 04 | 58 18 | | 72 32 | 111 | 74.5 | 580 | 5.04 | 2 | 2 | 9.0 | . | 4.86 | . | .81 | 1.01 |
| 5 | 08 | 04 | 58 20 | ↓ | 72 44 | 112 | 72.0 | 580 | 5.97 | 2 | 1 | 9.0 | . | 5.76 | . | .96 | 1.20 |
| 6 | 08 | 04 | 58 20 | W | 72 50 | 112 | 76.1 | 580 | 5.53 | 2 | 1 | 9.0 | . | 5.34 | . | .89 | 1.11 |
| | | | | | | | | | . | | | | . | . | . | . | . |
| 1 | 08 | 05 | 58 24 | W | 72 38 | 112 | 84.0 | 580 | 4.49 | 2 | 1 | 9.0 | . | 4.20 | . | .70 | 0.88 |
| 2 | 08 | 05 | 58 19 | ↑ | 72 45 | 113 | 85.2 | 580 | 5.71 | 2 | 1 | 8.7 | . | 5.45 | . | .89 | 1.11 |
| 3 | 08 | 05 | 58 23 | | 72 52 | 115 | 73.6 | 580 | 4.55 | 2 | 0 | 9.2 | . | 4.26 | . | .57 | 0.71 |
| 4 | 08 | 05 | 58 24 | ↓ | 72 53 | 116 | 74.1 | 580 | 4.60 | 2 | 0 | 8.8 | . | 4.21 | . | .70 | 0.88 |
| 5 | 08 | 05 | 58 20' | W | 72 47' | 116 | 33.9 | 580 | 2.69 | 2 | 0 | 9.2 | . | 2.52 | . | .42 | .53 |
| | | | | | | | . | | | | | | . | . | . | . | . |
| 1 | 08 | 06 | 58 20' | W | 72 35' | 110 | 44.9 | 580 | 3.56 | 4 | 1 | 9.2 | . | 3.33 | . | .64 | 0.80 |
| 2 | 08 | 06 | 58 18 | ↑ | 72 37 | 110 | 44.6 | 580 | 4.44 | 4 | 1 | 9.2 | . | 4.08 | . | .68 | 0.85 |
| 3 | 08 | 06 | 58 18 | | 72 31 | 110 | 44.4 | 580 | 4.05 | 4 | 1 | 9.0 | . | 3.59 | . | .65 | 0.81 |
| 4 | 08 | 06 | 58 18 | | 72 39 | 111 | 44.0 | 580 | 4.31 | 4 | 1 | 9.2 | . | 3.96 | . | .66 | 0.83 |
| 5 | 08 | 06 | 58 19 | ↓ | 72 46 | 112 | 44.3 | 580 | 2.88 | 5 | 1 | 9.0 | . | 2.70 | . | .46 | 0.58 |
| 6 | 08 | 06 | 58 18 | W | 72 43 | 110 | 33.0 | 580 | 4.05 | 5 | 1 | 9.2 | . | 3.72 | . | .62 | . |
| | | | | | | | . | | . | | | | . | . | . | . | . |
| 1 | 08 | 07 | 58 18 | W | 72 48 | 110 | 43.5 | 580 | 4.64 | 4 | 1 | 9.0 | . | 4.20 | . | .70 | 0.88 |
| 2 | 08 | 07 | 58 23 | ↑ | 72 55 | 115 | 44.9 | 580 | 3.66 | 2 | 0 | 9.2 | . | 3.35 | . | .54 | 0.68 |
| 3 | 08 | 07 | 58 24 | | 72 54 | 116 | 44.6 | 580 | 3.65 | 2 | 0 | 9.5 | . | 3.30 | . | .55 | 0.69 |
| 4 | 08 | 07 | 58 21 | ↓ | 72 55 | 115 | 45.6 | 580 | 4.11 | 2 | 0 | 9.5 | . | 3.65 | . | .57 | 0.71 |
| 5 | 08 | 07 | 58 18 | W | 72 43 | 110 | 35.0 | 580 | 3.78 | 2 | 0 | 10.2 | . | 3.42 | . | .57 | 0.71 |
| | | | | | | | . | | . | | | | . | . | . | . | . |

snails should be sexed
incorrect length freq. - should follow guidelines for species to select 1day

# FORM 7—LENGTH FREQUENCY OF MEASURED SPECIES
(Includes halibut, salmon, and crab measurements)



M = male
F = female
U = unknown sex
Size groups: Fish by 1 cm. Crabs by 5 mm (1–5 = 3; 6–0 = 8)

NOTE:
1. Leading zeros in columns 1, 2, 10, and 12 only—as needed.
2. For motherships—leave columns 17-19 blank. For longliners—enter set no. in column 17.
3. Start a new row each time when entering data from a different sex, species, or haul.
4. Skip lines between species when space permits.
5. Start each day's measurements on a new side.

| Cruise No. (1 2 3) | Vessel Code (4 5 6 7) | Date Year (8 9) | Date Mo. (10 11) | Date Day (12 13) |
|---|---|---|---|---|
| 001 | JP01 | 84 | 07 | 02 |

| Species Name | Species Code (14-16) | Set/haul No. (17 18 19) | Sex (20) | No. of individ. in row (21-23) | Sum of lengths in row (24-29) | Size Groups (30-32) | Freq. (33-35) | Size Groups (36-38) | Freq. (39-41) | Size Groups (42-44) | Freq. (45-47) | Size Groups (48-50) | Freq. (51-53) | Size Groups (54-56) | Freq. (57-59) | Size Groups (60-62) | Freq. (63-65) | Size Groups (66-68) | Freq. (69-71) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P. Cod | 202 | 1 | u | 3 | 202 | 65 | 1 | 68 | 1 | 67 | 1 | | | | | | | | |
| Neptunea prib | 946 | 1 | u | 36 | 436 | 43 | 2 | 53 | 3 | 58 | 2 | 63 | 4 | 68 | 8 | 73 | 9 | 78 | 8 |
| Neptunea prib | 946 | 1 | u | 96 | 686 | 83 | 10 | 88 | 8 | 93 | 17 | 98 | 23 | 103 | 25 | 108 | 9 | 113 | 4 |
| Buccinum scal | 940 | 1 | u | 88 | 406 | 43 | 3 | 48 | 29 | 53 | 26 | 58 | 24 | 63 | 4 | 68 | 1 | 73 | 1 |
| Buccinum plec | 941 | 1 | u | 111 | 441 | 48 | 8 | 53 | 19 | 58 | 22 | 63 | 21 | 68 | 27 | 73 | 9 | 78 | 5 |
| Buccinum plec | 941 | 1 | u | 6 | 274 | 83 | 4 | 93 | 1 | 98 | 1 | | | | | | | | |
| Buccinum angul | 942 | 1 | u | 50 | 336 | 33 | 1 | 38 | 1 | 43 | 4 | 48 | 5 | 53 | 13 | 58 | 10 | 63 | 16 |
| Buccinum angul | 942 | 1 | u | 40 | 219 | 68 | 27 | 73 | 12 | 78 | 1 | | | | | | | | |
| Clinopegma mag | 955 | 1 | u | 17 | 257 | 53 | 1 | 63 | 5 | 68 | 7 | 73 | 4 | | | | | | |
| Neptunea lyrata | 945 | 1 | u | 3 | 314 | 73 | 1 | 118 | 1 | 123 | 1 | | | | | | | | |
| C. opilio ♂ | 5 | 1 | M | 10 | 566 | 58 | 1 | 63 | 2 | 73 | 1 | 83 | 1 | 88 | 3 | 98 | 1 | 103 | 1 |
| C. opilio ♂ | 5 | 1 | M | 1 | 108 | 108 | 1 | | | | | | | | | | | | |
| C. opilio ♀ | 5 | 1 | F | 1 | 58 | 58 | 1 | | | | | | | | | | | | |
| C. opilio ♂ | 5 | 3 | M | 7 | 453 | 63 | 1 | 68 | 1 | 73 | 2 | 78 | 1 | 83 | 1 | 88 | 1 | | |
| C. bairdi ♀ | 4 | 3 | F | 4 | 144 | 33 | 2 | 48 | 1 | 63 | 1 | | | | | | | | |
| C. bairdi ♂ | 4 | 3 | M | 1 | 33 | 33 | 1 | | | | | | | | | | | | |
| Neptunea lyra | 945 | 3 | u | 5 | 309 | 88 | 1 | 98 | 2 | 123 | 2 | | | | | | | | |
| Neptunea prib | 946 | 3 | u | 47 | 476 | 53 | 1 | 58 | 6 | 63 | 4 | 68 | 12 | 73 | 11 | 78 | 6 | 83 | 7 |
| Neptunea prib | 946 | 3 | u | 74 | 721 | 88 | 20 | 93 | 19 | 98 | 20 | 103 | 9 | 108 | 3 | 113 | 2 | 118 | 1 |

| Cruise No. | Vessel Code | Date Year | Mo. | Day |
|---|---|---|---|---|
| 1 2 3 | 4 5 6 7 | 8 9 | 10 11 | 12 13 |
| 001 | JP01 | 84 | 07 | 02 |

# FORM 7–LENGTH FREQUENCY OF MEASURED SPECIES

(Includes halibut, salmon, and crab measurements)

NOTE:
1. Leading zeros in columns 1, 2, 10, and 12 only—as needed.
2. For motherships—leave columns 17-19 blank. For longliners—enter *set no. in column 17.*
3. Start a new row each time when entering data from a different sex, species, or haul.
4. Skip lines between species when space permits.
5. Start each day's measurements on a new side.



M = male
F = female
U = unknown sex
Size groups: Fish by 1 cm. Crabs by 5 mm (1–5 = 3; 6–0 = 8)

| Species Name | Species Code | Set/haul No. | Sex | No. of individ. in row | Sum of lengths in row | Size Groups | Freq. | Size Groups | Freq. | Size Groups | Freq. | Size Groups | Freq. | Size Groups | Freq. | Size Groups | Freq. | Size Groups | Freq. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14-16 | 17 18 19 | 20 | 21-23 | 24-29 | 30-32 | 33-35 | 36-38 | 39-41 | 42-44 | 45-47 | 48-50 | 51-53 | 54-56 | 57-59 | 60-62 | 63-65 | 66-68 | 69-71 |
| Buccinum solen | 970 | 3 | u | 4 | 119 | 28 | 1 | 43 | 1 | 48 | 2 | | | | | | | | |
| Beringius berin | 950 | 3 | u | 3 | 121 | 48 | 1 | 73 | 2 | | | | | | | | | | |
| Clinopegma mag | 955 | 3 | u | 15 | 315 | 53 | 2 | 58 | 4 | 63 | 5 | 68 | 2 | 73 | 2 | | | | |
| Neptunea boreal | 949 | 3 | u | 1 | 58 | 58 | 1 | | | | | | | | | | | | |
| Buccinum pol | 943 | 3 | u | 1 | 63 | 63 | 1 | | | | | | | | | | | | |
| Volutopsius fmg | 952 | 3 | u | 1 | 93 | 93 | 1 | | | | | | | | | | | | |
| C opilio ♂ | 5 | 5 | M | 12 | 385 | 63 | 1 | 68 | 3 | 78 | 3 | 83 | 4 | 93 | 1 | | | | |
| Neptunea prib | 946 | 5 | U | 34 | 436 | 43 | 2 | 53 | 2 | 58 | 2 | 63 | 3 | 68 | 3 | 73 | 11 | 78 | 11 |
| Neptunea prib | 946 | 5 | u | 92 | 686 | 83 | 15 | 88 | 16 | 93 | 16 | 98 | 17 | 103 | 16 | 108 | 10 | 113 | 2 |
| Volutopsius midd | 951 | 5 | u | 2 | 161 | 63 | 1 | 98 | 1 | | | | | | | | | | |
| Neptunea boreal | 949 | 5 | u | 11 | 336 | 33 | 1 | 38 | 1 | 43 | 2 | 48 | 1 | 53 | 2 | 58 | 3 | 63 | 1 |
| Clinopegma m | 955 | 5 | u | 37 | 315 | 53 | 2 | 58 | 6 | 63 | 10 | 68 | 10 | 73 | 9 | | | | |
| Neptunea lyrata | 945 | 5 | u | 13 | 711 | 73 | 1 | 88 | 2 | 98 | 1 | 103 | 2 | 108 | 1 | 118 | 2 | 123 | 4 |
| Buccinum solenum | 970 | 5 | u | 7 | 157 | 28 | 1 | 38 | 1 | 43 | 3 | 48 | 2 | | | | | | |
| Beringius ber | 950 | 5 | u | 13 | 446 | 48 | 4 | 53 | 3 | 58 | 1 | 63 | 1 | 68 | 1 | 73 | 2 | 83 | 1 |
| Plicifusus incisus | 967 | 5 | u | 13 | 61 | 28 | 3 | 33 | 10 | | | | | | | | | | |
| Buccinum polare | 943 | 5 | u | 3 | 63 | 63 | 3 | | | | | | | | | | | | |

# FORM 3S

## SPECIES COMPOSITION
FOR SNAIL POT VESSELS

Leading zeros in columns 1, 2, 10, 12 only.

* Indicates weight obtained by subtraction from total sample weight. ✓

| CRUISE NO. (1–3) | VESSEL CODE (4–7) | YEAR (8–9) | MO. (10–11) | DAY (12–13) |
|---|---|---|---|---|
| 002 | JP01 | 84 | 07 | 27 |

REMARKS: Tanner crab data for set #2 were screwed up by an overzealous friend.

| | Set No. | Time | No. of baskets |
|---|---|---|---|
| FIRST SAMPLE | 15 | 0600 | 2 |
| SECOND SAMPLE | 16 | 1215 | 4 |
| THIRD SAMPLE | 17 | 1420 | 5 |

| SPECIES | SPECIES CODE (18–20) | 1st: NO. POTS SAMPLED (21–23) | 1st: NUMBER (24–29) | 1st: WEIGHT (in kg with decimal pt.) (30–38) | 2nd: NO. POTS SAMPLED (39–41) | 2nd: NUMBER (42–47) | 2nd: WEIGHT (48–56) | 3rd: NO. POTS SAMPLED (57–59) | 3rd: NUMBER (60–65) | 3rd: WEIGHT (66–74) |
|---|---|---|---|---|---|---|---|---|---|---|
| No. of specimens and total weight | 999 | ~~772~~ | 1581 | 95.86 | ~~112~~ | 1178 | 106.55 | ~~120~~ | 745 | 53.81 |
| N. pribiloffensis | 946 | 12 | 673 | 56.90 | 12 | 611 | 59.23 | 15 | 252 | 21.70 |
| B. scalariforme | 940 | | 177 | 4.00 | | 142 | 4.60 | | 179 | 5.10 |
| B. plectrum | 941 | | 245 | 9.20 | | 143 | 4.60 | | 90 | 3.30 |
| B. angulosum | 942 | | 83 | 3.00 | | 47 | 1.67 | | 36 | 1.46 |
| B. sp. | 944 | | 45 | .95 | | 32 | .70 | | 24 | .66 |
| Plicifusus kroyeri | 954 | | 81 | 2.15 | | 54 | 1.78 | | 17 | .69 |
| N. lyrata | 945 | | 18 | 1.36 | | 23 | 2.02 | | 23 | 1.85 |
| Colus halli | 961 | | 205 | 1.81 | | 44 | .41 | | 25 | .29 |
| Clinopegma magna | 955 | | 4 | .12 | | 6 | .15 | | 2 | .09 |
| N. borealis | 949 | | 4 | .02 | | 4 | .02 | | 2 | .02 |
| Fusitriton | 956 | | 1 | .02 | | 6 | .36 | | 1 | .03 |
| Beringius beringii | 950 | | 5 | .08 | | 2 | .06 | | 2 | .05 |
| Boreotrophon sp. | 968 | | 1 | .01 | | 1 | .01 | | 1 | .01 |
| hermit crab | 15 | | 28 | .68 | | 16 | .62 | | 33 | .89 |
| Brittle st + debris | 900 | 12 | 1 | .30 | | 1 | .45 | | 1 | 1.10 |
| Colus spitzenbergii | 959 | – | | | | 1 | .01 | | 1 | .02 |
| Volutopsius mid. | 951 | | | | | 1 | .06 | | 3 | .19 |
| clam (unid.) | 29 | | | | 12 | 1 | .01 | | | |
| Neptunea ventricosa | 947 | | | | | | | 15 | 1 | .04 |
| | | | | | | | | | | |
| lyre crab | 9 | 100 | 4 | .16 | 100 | 1 | .05 | 105 | 2 | .15 |
| Opilio ♂ | 990 | | | | | 21 | 4.90 | | 11 | 2.60 |
| Opilio ♀ | 991 | | | | | 2 | .25 | | 25 | 1.57 |
| Bairdi ♂ | 988 | | | | | 4 | .12 | | 6 | .41 |
| Bairdi ♀ | 989 | | | | | 5 | .12 | | 5 | .09 |
| starfish | 20 | 100 | 2 | 1.10 | | 2 | .65 | | | |
| P. cod | 202 | 100 | 4 | 14.00 | 100 | 8 | 23.7 | 105 | 3 | 11.5 |

Report #1 Cruise # 001 Vessel Code JPC1 Nationality JAPAN

Vessel Name Chosei Maru No. 78 Permit # JA-84-0838 Call Sign JNCS

Observer Richard A MacIntosh Dates Aboard 18 June - 18 July, 1984

Type of Ship : Stern Trawler Mothership (Longline Vessel-Snail Pot)

Area Fished : (Circle appropriate areas)

| | | |
|---|---|---|
| Bering Sea Area 51 | Shumagin Area 61 | Columbia Area 71 |
| (Bering Sea Area 52) | Chirikof Area 62 | Eureka Area 72 |
| Bering Sea Area 53 | Kodiak Area 63 | Monterey Area 73 |
| Aleutian Area 54 | Yakutat Area 64 | Vancouver Area 67 |
| | Southeastern Area 65 | |

Ship Personnel : Name and position of officers important in fishing operation, factory, sampling

Captain Yoshikatsu Saito Translator (if any) ____________

Estimated Date of Vessel Departure from FCZ Stayed in zone after my disembarcation

1. Comment on the handling of prohibited species by the crew under normal fishing operations when the observer is not sampling:

Prohibited species were placed on a conveyor belt and "conveyed" over the side within seconds of their coming on board. The only exception was the retention of up to about 5 cod per day for consumption aboard the vessel. To my knowledge, cod were not used for any other purpose. An occasional sculpin was also eaten. At no time did I see or suspect the retention of crab for any purpose

. How were ship's estimates of catch size made ?

See attached sheet.

3. How were observer estimates of catch size made ?

For sampled sets, catches of sampled pot were extrapolated to the total number of pots per set (usually 600). Three of the five (rarely 6) sets pulled each day were sampled. Usually sampled 12 pots for snail and 42 pots for by-catch. Average catch per pot in sampled sets was extrapolated to unsampled sets.

4. How did the two catch-size estimates compare ? (If there were large discrepancies, analyze the probable reasons. What were the percentage differences?) (percentage difference = weight difference ÷ observers estimate)

As in past years in this fishery, the vessel did not make an estimate of total catch size. Difference in ships and observers estimates of total processed snail meats caught were small: Observer est. = 97.64 mt, ship est. = 95.49 mt

Circle the appropriate answers.

5. Did ship personnel interfere with observer sampling duties or the sending of radio messages ? YES (NO)

6. Did you observe non-reporting or under-reporting of species groups in the cumulative catch log ? YES (NO) see notes

7. Did you observe the utilization of prohibited species ? (YES) NO

8. Did you observe any gear conflicts ? (YES) NO

9. Did you observe any other possible violations ? YES (NO)

10. Did you observe any difference in the fishing pattern of the vessel you were aboard as opposed to nearby non-observer vessels ? YES NO N.A.

11. Did you advise the ship's officers about any of the fishery regulations or inform them of any observed violations ? (YES) NO

IF YOU ANSWERED "YES" TO ANY OF THE ABOVE QUESTIONS, DOCUMENT YOUR OBSERVATIONS AND DIALOG WITH OFFICERS OR CREW ON A SEPARATE SHEET. SEE MANUAL INSTRUCTIONS.

Cruise # 301 Nationality JAPAN

12. Was your ship boarded by the Coast Guard while you were aboard ?

YES (NO)

13. Were you able to conduct your own product recovery determinations ?

NO SOME [EXTENSIVE PROJECT] Species: Mixed Snails

FISHERY SPECIFIC QUESTIONS: *(Answer only those questions applying to you.)*

14. Longline observers only :

a. Did ship fish east of 140° W ? (If yes, describe)
YES NO

b. Did ship fish in depths less than 500 meters in the area between 140° and 169° W. longitude ?
YES NO

c. If answer to part b was yes, did Pacific cod make up more than 50% of the catch of each set ? (If it did not, explain)
YES NO

15. Observers on trawlers fishing in the Gulf of Alaska :

a. Did ship bottom trawl between Dec. 1 and May 31 ?
YES NO If yes, describe

b. Did ship fish east of 140° W ? YES NO If yes, describe

c. Did ship bottom trawl east of 147°. W ? YES NO If yes, describe

16. Observers on trawlers fishing in the Gulf of Alaska between Dec. 1 and May 31 :

a. Did the net have chafing gear ? YES NO If yes, describe

b. Did the net have rollers or bobbins ? YES NO If yes, describe

c. Did the net have a functioning net recorder ?
YES NO If no, explain

17. Observers of the coastal hake fishery : (foreign directed fishery only)

a. Did the net have chafing gear ? YES NO If yes, describe

b. Did the net have rollers or bobbins ? YES NO If yes, describe

c. Did the net have a codend liner ? YES NO If yes, describe

d. What was the codend mesh size (stretch measure) ? ______________ mm.

2. Ships estimates of catch size

For the last several years, the only catch component value supplied by snail vessels to NMFS under FCMA has been weight of "edible meats" taken. The vessel recorded only this value but did also record the number of tanner crab caught in a JFA logbooks.

The Captain asked me to provide him with a daily estimate of the number and weight of tanner crab caught. He recorded these values (or at least numbers) in a JFA logbook. At no time did I see him make an independant estimate of crab numbers or weight. Given the nature of the deck operation, vessel generated estimates of crab numbers or weights would be crude at very best.

The ships estimate of snail meats was made by their counting the number of 10 Kg trays of processed meats produced at each set. The number of trays of large and small meats produced by each set was recorded on a blackboard in the plate freezer room and conveyed to the bridge at the end of the day. On the bridge, they took the actual catch of meats (the number of trays × 10 Kg) and multiplied it times 1.25 then entered this raw value in their own logs and on my form 15 (Daily Catch Summary for Pot Vessels). I explained to them that this last multiplication was not appropriate and went through a long dialogue (keeping in mind that none of them spoke English) regarding its use.

#2 continued

The reason they gave me for using the multiplier had something to do with accounting for weight lost during processing (see answer to #1).

Because I felt that they used this multiplier in all of their production records and because the error would be fairly easy to correct upon return of the data to Seattle, I allowed them to continue using the multiplier in calculating their catch of snail meats. I felt it would be better to address this problem after the fishing season rather than during it. For the sake of continuity, I suggested to the observer following me that he allow this practice to continue.

In summary: Snail meat values submitted in weekly radio messages were the observers values. Values submitted directly to NMFS by the vessel or JFA would presumably be the erroneous ships values. On NMFS form 15, Daily Catch Summary for Snail Pot Vessels, the observer value for snail meats is correct while the ship value is inflated and must be multiplied by 0.8 to be corrected.

Responses to Questions 6, 7, 8, and 11.

6. Given the confusion surrounding the reporting requirements in this fishery it cant be said that there was non-reporting. (See Karl Scotts excellent discussion of this topic in Cruise 002, Vessel JP02 report)

7. As previously stated, a few cod were consumed on board the vessel on most fishing days. The mortality rate on cod from rapid decompression was probably very high.

8. On almost every day on the fishing grounds there were at least a few and sometimes as many as 20 trawlers and support vessels within sight. Most were Japanese stern or pair trawlers but one day I saw two U.S. joint venture (Taiyo) boats. I talked to one skipper on the radio who had hung up on a groundline and ended up crossing his doors. He was more than willing to move out of the area as the pollock catches there were not very good. On several days (July 6-8 were three) the vessel had longlines cut by trawlers. I also got the impression that there were areas the vessel would like to have fished but didnt because of gear conflicts with trawlers. The vessel often made radio contact with trawlers and they presumably talked about the location of longline sets.

Once a twice I saw American vessels fishing for opilio tanner crab. I talked with one and his catch rates were apparently poor.

11. I advised the Captain (as best I could, given the difficult communication problem) that their practice of multiplying their estimate of snail meat catch x 1.25 was not proper and that it could cause problems if a coast guard boarding were to occur. For reasons previously stated, I allowed this practice to go on and told the Captain that if we were boarded I would explain to the Coast Guard what was going on in that regard.

The permit under which Japan harvests snails allows a quota of "edible meats". If all Japanese snail vessels fishing in the FCZ crush and cook snails, ending up with a product of cooked muscle or "meat", then it might be appropriate to express the quota in terms of cooked meats. Perhaps the problem of the vessels multiplying their catches of cooked meats has something to do with the terminology used in the permit, ie: "edible meats". Raw snail meat is apparently edible!! At any rate, this problem does need to be resolved.

Report #1 Cruise # 002 Vessel Code JP01 Nationality JAPANESE

Vessel Name Choei Maru No. 78 Permit # JP-84-0858 Call Sign JNCS

Observer Karl Scott Dates Aboard JUL 19 - AUG 30

Type of Ship : Stern Trawler Mothership (Longline Vessel) Snail-pot

Area Fished : (Circle appropriate areas)

| | | |
|---|---|---|
| Bering Sea Area 51 | Shumagin Area 61 | Columbia Area 71 |
| (Bering Sea Area 52) | Chirikof Area 62 | Eureka Area 72 |
| Bering Sea Area 53 | Kodiak Area 63 | Monterey Area 73 |
| Aleutian Area 54 | Yakutat Area 64 | Vancouver Area 67 |
| | Southeastern Area 65 | |

Ship Personnel : Name and position of officers important in fishing operation, factory, sampling

Captain - Yoshikatsu Saito Translator (if any) - Tosio Nagoshima (radio off.

Fishing Master - Yukimasa Narita

Factory Manager - Taiichi Matsuda

Estimated Date of Vessel Departure from FCZ Aug 31

1. Comment on the handling of prohibited species by the crew under normal fishing operations when the observer is not sampling:

Under ordinary circumstances all prohibiteds were returned to the water within one minute via the discard belt. However there was a common practice of retaining a few cod for consumption (probably less than 5% of the cod caught). Also I noticed cod being retained for bait on two occasions and was able to get my ideas across to the fishing master finally. There were no further problems with using cod for bait (See addendum).

2. How were ship's estimates of catch size made ?

The vessel was somewhat confused about logging requirements - please see additional information concerning non-reporting, product recovery etc. The vessel logged snail meat weights from factory figures on both Japanese logs + DCCL, but misunderstood "whole snails" to mean what a whole snail meat should weigh if entire, ie with digestive tract, etc intact. They multiplied the factory weights times 1.25 to estimate this figure which was entered under "Ships Estimate of Snail meats" on form 1-5.

CHOSEI MARU NO. 78
CRUISE #002
JAPANESE. SNAIL-POT

3. How were observer estimates of catch size made ?

My estimates of catch size were direct arithmetic extrapolations from the number of pots in each set that I sampled to the estimated number of pots in each set (usually 580). Since it would be impractical to count the number of pots in each set, I relied upon the figure given by the captain on form I-S, comparing it against the time of retrieval for large discrepancies. It usually took 74-78 minutes between the first & last pot

4. How did the two catch-size estimates compare ? (If there were large discrepancies, analyze the probable reasons. What were the percentage differences?)

The vessel did not record total catch and seemed to be misinformed about logging requirements (see my comments about non-reporting below).

Circle the appropriate answers.

5. Did ship personnel interfere with observer sampling duties or the sending of radio messages ? YES (NO)

6. Did you observe non-reporting or under-reporting of species groups in the cumulative catch log ? (YES) NO

7. Did you observe the utilization of prohibited species ? (YES) NO

8. Did you observe any gear conflicts ? YES (NO)

9. Did you observe any other possible violations ? YES (NO)

10. Did you observe any difference in the fishing pattern of the vessel you were aboard as opposed to nearby non-observer vessels ? YES (NO)

11. Did you advise the ship's officers about any of the fishery regulations or inform them of any observed violations ? (YES) NO

IF YOU ANSWERED "YES" TO ANY OF THE ABOVE QUESTIONS, DOCUMENT YOUR OBSERVATIONS AND DIALOG WITH OFFICERS OR CREW ON A SEPARATE SHEET. SEE MANUAL INSTRUCTIONS.

Cruise #002 Nationality JA

12. Was your ship boarded by the Coast Guard while you were aboard ?

YES (circled) NO

13. Were you able to conduct your own product recovery determinations ?

NO SOME EXTENSIVE PROJECT (circled) Species: MIXED SMALL SPECIES

FISHERY SPECIFIC QUESTIONS: (Answer only those questions applying to you.)

14. Longline observers only :

a. Did ship fish east of 140° W ? (If yes, describe)
YES NO

b. Did ship fish in depths less than 500 meters in the area between 140° and 169° W. longitude ?
YES NO

c. If answer to part b was yes, did Pacific cod make up more than 50% of the catch of each set ? (If it did not, explain)
YES NO

15. Observers on trawlers fishing in the Gulf of Alaska :

a. Did ship bottom trawl between Dec. 1 and May 31 ?
YES NO If yes, describe

b. Did ship fish east of 140° W ? YES NO If yes, describe

c. Did ship bottom trawl east of 147° W ? YES NO If yes, describe

16. Observers on trawlers fishing in the Gulf of Alaska between Dec. 1 and May 31 :

a. Did the net have chafing gear ? YES NO If yes, describe

b. Did the net have rollers or bobbins ? YES NO If yes, describe

c. Did the net have a functioning net recorder ?
YES NO If no, explain

17. Observers of the coastal hake fishery : (foreign directed fishery only)

a. Did the net have chafing gear ? YES NO If yes, describe

b. Did the net have rollers or bobbins ? YES NO If yes, describe

c. Did the net have a codend liner ? YES NO If yes, describe

d. What was the codend mesh size (stretch measure) ? ______________ mm.

Karl Scott
Chosei Maru No. 7
Cruise # 002
Vessel Code JP01

Report #1

I observed extensive non-reporting aboard the Chosei Maru No. 78, but this was due to the general confusion regarding logging requirements rather than intentional deception. Even the Coast Guard and NMFS enforcement agents seemed unclear about the exact regulations concerning snail-pot vessels. The problem is basically one of communication, arising from years of neglect, the language barrier, and the relative insignificance of the snail fishery. Perhaps now that the snail fishery is receiving some attention we can work together to achieve compliance while gathering the data base necessary for establishing long range objectives.

First let me describe the logging procedures that I observed. All species other than "snails" are considered "prohibited" under current regulations, but the only logging I observed was of snail meats and Tanner crabs. There was no method for estimating "total catch" or "whole snail weight". Two female Blue King crabs (which I sampled) did not appear in the logs. Further, the efforts of the captain to log crabs were rather mysterious - sometimes his figures agreed tolerably with my estimates from incidence sampling and other times were vastly different. I suspect that when the fishing master was in relief, crab monitoring was neglected. Attached to this report is a comparison of the independent estimates of Tanner crab incidence which I compiled before disembarking. During a Coast Guard boarding there was some discussion of this problem. I told them I had heard that the snail-pot vessels were not required to log crabs, and they wondered who would say such a thing. It seems as though there is a hole in the regulations whereby crabs are not specifically addressed, but my vessel was unaware of this and logged Tanner crabs for IFA anyway.

The vessel did not understand the requirements of reporting "Total Catch" or "Whole Snail Wt.", and would have had to have someone act as "observer" for these figures to have any factual basis. There are even problems with the "Snailmeat" category. The former observer let them multiply the factory figures by 1.25 for the "Ship's Estimate of Snailmeats" while he recorded the real figure as "Observer Estimate of Snailmeats". He suggested that I continue this, as correction would be simple, and explained that this adjustment was to correct for weight loss during cooking. It appears to me instead to be a faulty grasp of product recovery, but seems too low even to represent what an entire, uncooked snailmeat should weigh. Towards the end of my cruise I condensed my product recovery data and twice explained that next year they should use a factor of 6 for converting snailmeat weight to whole snail weight estimates for Form 1-S (this would include all snails brought aboard, regardless of small size or wastage in processing). They were skeptical, fearing that their quota would be exceeded in no time if the basis for reporting was suddenly quadrupled. They showed me their JFY permit which seems to allow them 316 MT apparently of whole snails (as they calculate, by a factor of 1.25). This represents 2 of 19 shares in Japan's 3000 MT quota, and would make fishing the Eastern Bering Sea unfeasible if it actually represents whole snails. I tried to get some confirmation from NWAFC on ~~Aut~~ Aug 23, but received no reply prior to disembarking.

Aside from non-reporting of prohibited species, also many times they were eaten. I allowed a few cod daily to be retained for the galley, but drew the line when I noticed quite a few cod being retained for bait (8/4 + 8/6). As with one instance of Tanner crab retention*, once my intentions were made clear, the problem ceased. Concerning the cod, it seems unfair to classify them as "prohibited" and I recommend a small quota. I would rather see them returned to the sea floor foodchain as bait than to see the seagulls peck their eyes out. Mortality from decompression seems to be about 90% anyway. There may be a similar problem with octopus - I am not practiced enough to distinguish fresh octopus from that which was brought over frozen in the ships stores. Also a few sculpins were occasionally retained for "sashimi" when they were abundant.

For a further explanation of my suggestions see the end of Report #2.

* Tanner crab retention involved only about a half dozen crabs incorporated in a soup

# A Comparison of Observer Estimates vs. Ship's Estimates for Tanner Crabs (nos. - wts.)

| Date & Set | Observer: Sample → | est. for set | Ships Est. | Obs. est. day | Ship's est. for day |
|---|---|---|---|---|---|
| 7/23 #3 | 11 - 1.04 | 188 - 18 kg | 143 - 13 | 1103 - 93 | 566 - 58 kg |
| #5 | 48 - 3.65 | 253 - 19 | 133 - 17 | | |
| 7/24 - 2 | 162 - 7.80 | 972 - 47 | 126 - 17 | 2663 - 170 | 541 - 83 |
| - 4 | 16 - 3.60 | 93 - 21 | 161 - 22 | | |
| 7/25 - 5 | 30 - 4.20 | 174 - 24 | 101 - 19 | 870 - 120 | 697 - 119 |
| 7/26 - 1 | 19 - 2.07 | 110 - 12 | 200 - 26 | 763 - 93 | 688 - 88 |
| - 3 | 25 3.69 | 145 - 21 | 129 - 18 | | |
| - 5 | 35 - 3.90 | 203 - 23 | 112 - 10 | | |
| 7/27 - 4 | 32 - 5.39 | 186 - 31 | 112 - 12 | 1145 - 138 | 706 - 83 |
| - 5 | 52 - 4.67 | 272 - 24 | 136 - 15 | | |
| 7/28 - 2 | 26 - 4.17 | 101 - 16 | 256 - 30 | 969 - 190 | 1599 - 206 |
| 4 | 29 - 5.58 | 168 - 36 | 257 - 33 | | |
| 5 | 38 - 8.35 | 220 - 48 | 315 - 41 | | |
| 7/30 - 1 | 29 - 6.19 | 168 - 36 | 64 - 13 | 1435 - 186 | 514 - 76 |
| - 3 | 34 - 5.52 | 197 - 32 | 143 - 14 | | |
| - 5 | 89 - 7.94 | 499 - 44 | 128 - 17 | | |
| 7/31 - 2 | 18 - 2.34 | 104 - 14 | 129 - 14 | 208 - 28 | 356 - 64 |
| 8/1 - 1 | 22 - 3.77 | 122 - 21 | 68 - 5 | 674 - 165 | 758 - 147 |
| - 4 | 39 - 6.08 | 215 - 34 | 122 - 72 | | |
| 8/4 - 1 | 24 - 3.50 | 139 - 20 | 115 - 25 | 939 - 174 | 1040 - 149 |
| - 3 | 30 - 6.53 | 174 - 38 | 234 - 38 | | |
| 8/5 - 2 | 17 - 3.81 | 99 - 22 | 18 - 5 | - 88 | 453 - 87 |
| - 4 | 20 - 2.19 | 116 - 13 | 114 - 20 | | |
| 8/6 - 1 | 30 - 7.01 | 174 - 41 | 150 - 29 | | |
| - 3 | 76 - 20.98 | 441 - 122 | 121 - 23 | 394 | 590 - 120 |
| - 5 | 29 - 6.53 | 153 - 34 | 93 - 20 | | |
| 8/7 - 2 | 32 - 6.36 | 186 - 37 | 92 - 20 | 238 | 525 - 108 |
| - 4 | 45 - 10.02 | 261 - 58 | 98 - 20 | | |
| 8/8 - 2 | 54 - 11.32 | 331 - 66 | 100 - 20 | 230 | 875 - 96 |
| - 5 | 22 - 4.40 | 128 - 26 | 95 - 18 | | |
| 8/9 - 1 | 21 - 3.82 | 122 - 22 | 120 - 18 | 75 | 439 - 78 |
| - 3 | 7 - 1.44 | 37 - 8 | 55 - 10 | | |
| 8/10 - 1 | 140 - 9.46 | 8120 - 549 | 88 - 16 | 1695 | 419 - 79 |
| - 3 | 471 - 22.21 | 2732 - 129 | 55 - 10 | | 1 ♀ BLUE KING - .8 |
| 8/11 - 2 | 8 - 1.88 | 46 - 11 | 115 - 20 | 917 | 651 - 91 |
| 4 | 19 - 3.75 | 110 - 22 | 113 - 11 | | |
| 5 | 32 - 3.73 | 186 - 22 | 133 - 18 | | |

8/2 144 10 gale

| Date | Set | Sample | Est. for Set | | | |
|---|---|---|---|---|---|---|
| 8/12 | -1 | 297-27.90 kg | 1723-162 kg | 95-18 kg | -753 kg | 748-148 kg |
| | -3 | 92-5.00 | 4447-242 | 272-50 | | |
| | -5 | 33-4.50 | 191-26 | 155-32 | | |
| 8/13 | -2 | 9-5.70 | 75-47 | 145-25 | -166 | 831-153 |
| | -3 | 15-10.30 | 87-60 | 115-20 | | |
| | -5 | 33-3.00 | 191-17 | 160-30 | | |
| 8/14 | -1 | 25-6.10 | 145-35 | 150-27 | -82 | 269-64 |
| 8/19 | -2 | 7-1.98 | 41-11 | 113-19 | -62 | 844-148 |
| | -4 | 4-.84 | 23-5 | 150-28 | | |
| | -6 | 7-2.13 | 51-15 | 115-20 | | |
| 8/20 | -2 | 4-1.08 | 23-6 | 115-21 | 128 | 636-121 |
| | -4 | 9-1.79 | 52-10 | 160-31 | | |
| | -5 | 24-6.63 | 174-48 | 118-22 | | |
| 8/23 | -2 | 10-2.70 | 60-16 | 232-21 | | 839-145 |
| | -4 | 8-2.30 | 66-19 | 182-28 | | |
| 8/24 | -2 | 17-1.43 | 99-8 | 125-20 | | 696-125 |
| | -5 | 68-13.41 | 394-78 | 102-19 | | 1 ♀ BLUE KNG = .77 kg |
| 8/26 | -2 | 13-2.11 | 75-12 | 201-35 | | 834-178 |
| | -4 | 6-1.13 | 35-7 | 115-20 | | |
| 8/27 | -2 | 4-1.35 | 23-8 | 143-25 | | 739-135 |

# Large Marine Gastropods of the Eastern Bering Sea

68

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ABSTRACT

Gastropods make up 6-9 percent by weight of the invertebrates caught on the continental shelf and upper slope of the eastern Bering Sea by research trawl surveys. Five species of the genus *Neptunea*—*N. lyrata*, *N. pribiloffensis*, *N. heros*, *N. ventricosa*, and *N. borealis*—make up 87 percent of the snail biomass and 68 percent of the snail numbers.

Fifteen of the most common large gastropods were grouped according to the similarity of environmental variables measured at the sampling sites at which each species was found. The variables used were annual maximum bottom temperature and maximum rate of warming. The analysis identified three thermal regions in the eastern Bering Sea in late summer, each region having a distinct assemblage of large gastropod mollusks.

*Neptunea* spawn over a protracted period and capsular life of embryos is probably more than six months. Female *N. heros*, *N. lyrata*, *N. pribiloffensis*, and *N. ventricosa* mature at shell lengths of 110, 110, 105, and 102 mm, respectively; males mature at shell lengths of 95, 100, 90, and 87 mm, respectively. Recent studies of *Neptunea* food habits show that a variety of organisms are consumed, including polychaetes, bivalves, barnacles, fishes, and crustaceans.

Japan has harvested gastropods in the eastern Bering Sea since at least 1971. Reported catch rates range from 0.9 to 4.0 kg/pot, and total Japanese catch has varied from 404 to 3,574 mt of edible meat per year. The United States has the capacity to enter the fishery but will probably not do so until snail products increase greatly in value.

## INTRODUCTION

Large marine gastropods are a conspicuous element of the eastern Bering Sea macrobenthos. Especially abundant are members of the genus *Neptunea*, of which one species or another occurs commonly over the entire upper continental slope and shelf.

Eastern Bering Sea snails were rarely studied before Japan started a commercial fishery in the early 1970's. McLaughlin (1963) outlined the distribution of invertebrates, including snails, taken north of the Alaska Peninsula, but subsequent United States research surveys generally ignored snails. In 1975, National Marine Fisheries Service (NMFS) trawl surveys began including an analysis of the distribution and relative abundance of various snail species in the eastern Bering Sea.

The Japanese Fishery Agency began research on the eastern Bering Sea snail resource in 1973. Nagai (1974) conducted research aboard a commercial snail pot vessel, and subsequent work has been based on pot and trawl surveys (Nagai, 1975a, 1975b; Nagai and Suda 1976; Nagai and Arakawa 1978). Neiman (1963) described eastern Bering Sea benthic assemblages but based her studies on bottom grab samples that probably do not adequately represent larger epifaunal animals such as snails.

During the summers of 1975 and 1976, the Northwest and Alaska Fisheries Center of NMFS conducted comprehensive trawl surveys covering approximately 566,000 km$^2$ of the eastern Bering Sea shelf and upper slope (Fig. 68-1). These surveys were designed to determine what demersal fish and shellfish communities of the eastern Bering Sea could be affected by development of continental shelf energy resources. Data on fish and epibenthic invertebrates were gathered from several hundred locations with a modified 400-mesh Eastern otter trawl. The data resulting from these surveys offer significant insight into the population and biological characteristics of numerous species of snails. This chapter brings together information on distribution, species association, biology, and the fishery for eastern Bering Sea snails based primarily on data collected on NMFS trawl surveys.

## SNAIL RESOURCE

Seventy-two species of gastropods in 19 families were identified in U.S. trawl surveys conducted in 1975 and 1976 (Feder et al. 1978; Pereyra et al. 1976; unpublished data, Table 68-1). While most small species were usually found inside shells or other objects, snails larger than about 60 mm in total length were regularly retained by the trawl mesh. The small codend mesh size (32 mm) and the bottom-tending properties of the net allowed a reasonable assessment of epibenthic snails larger than about 60 mm. How many of these larger snails avoid capture

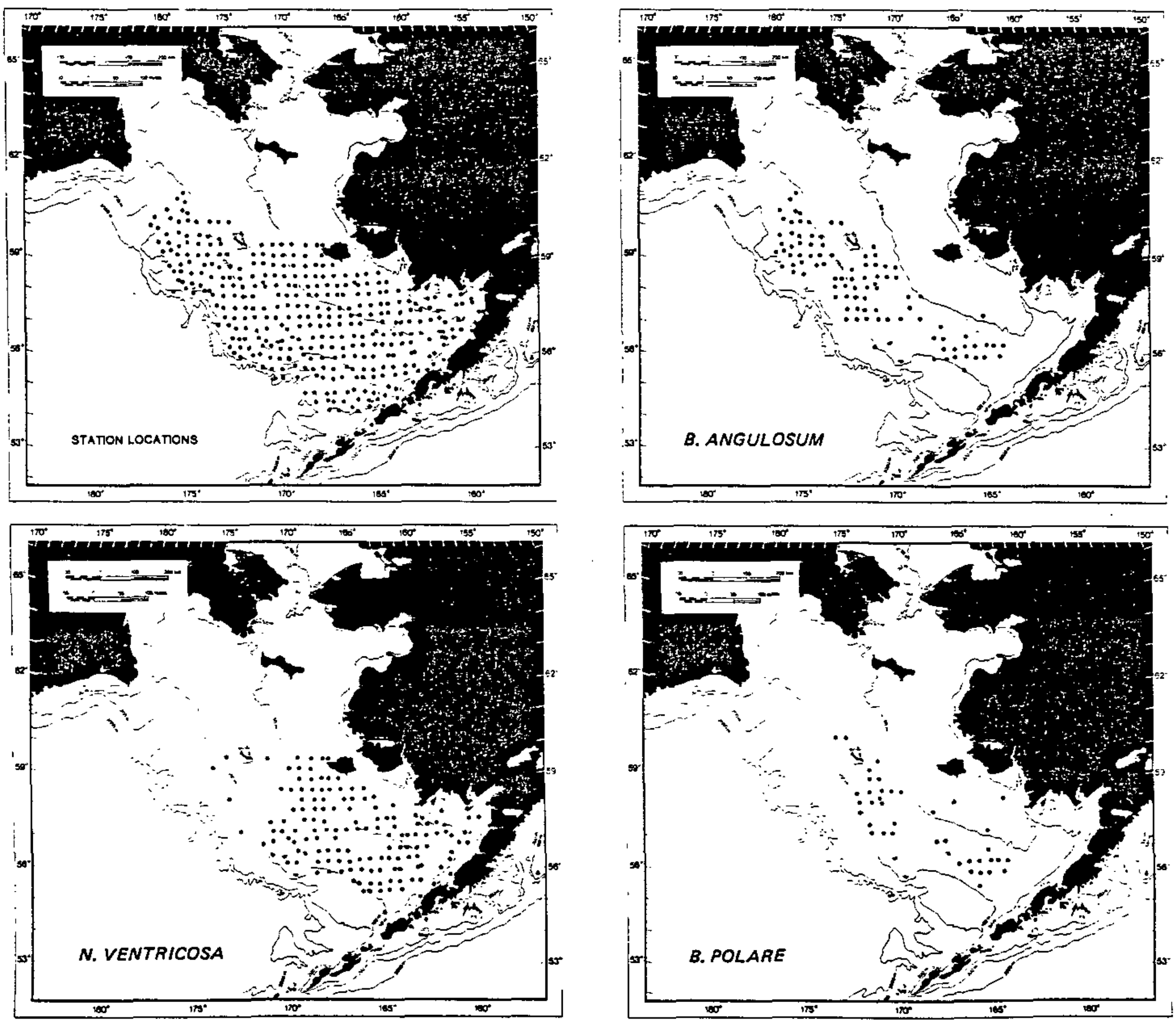
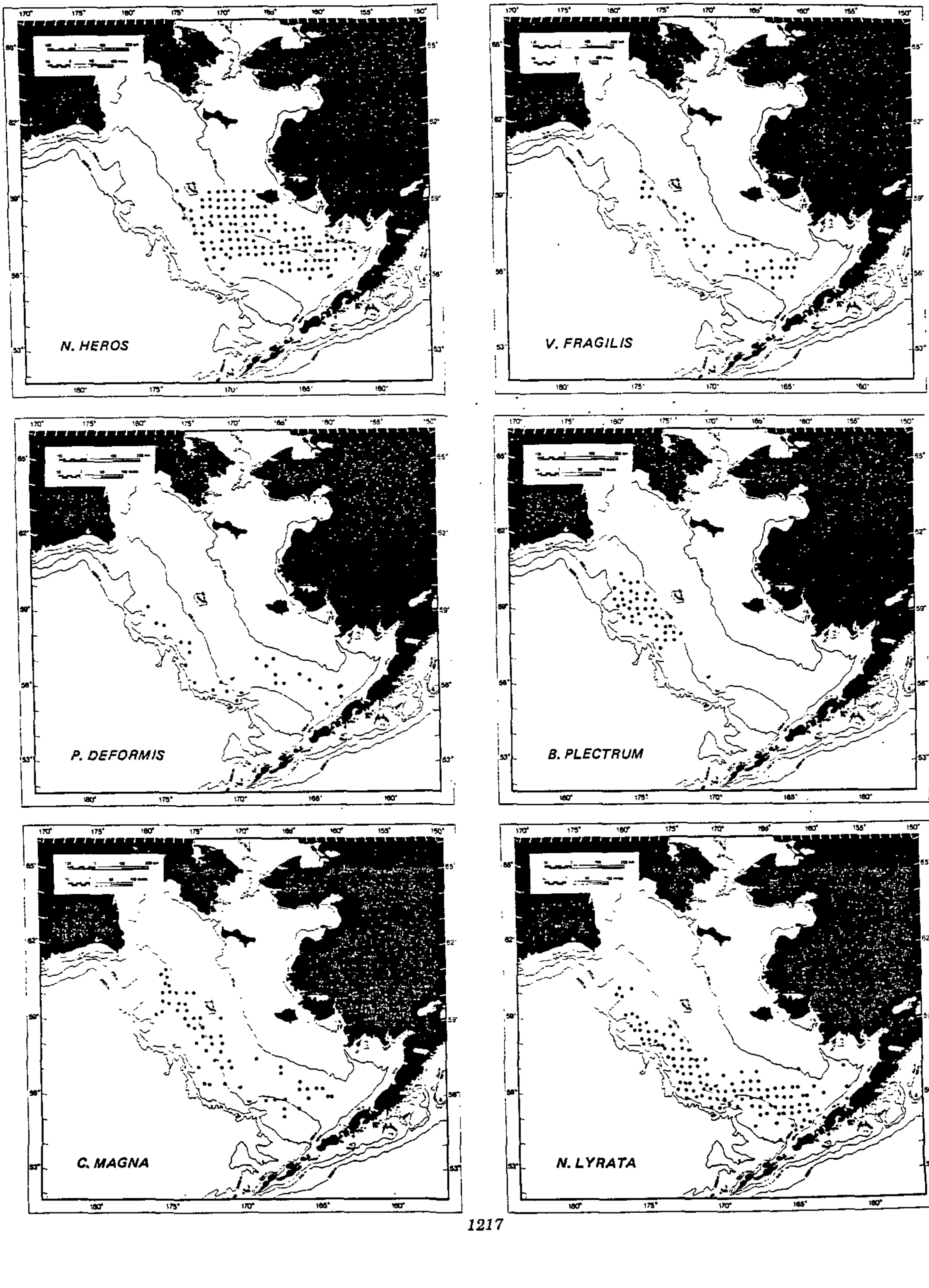
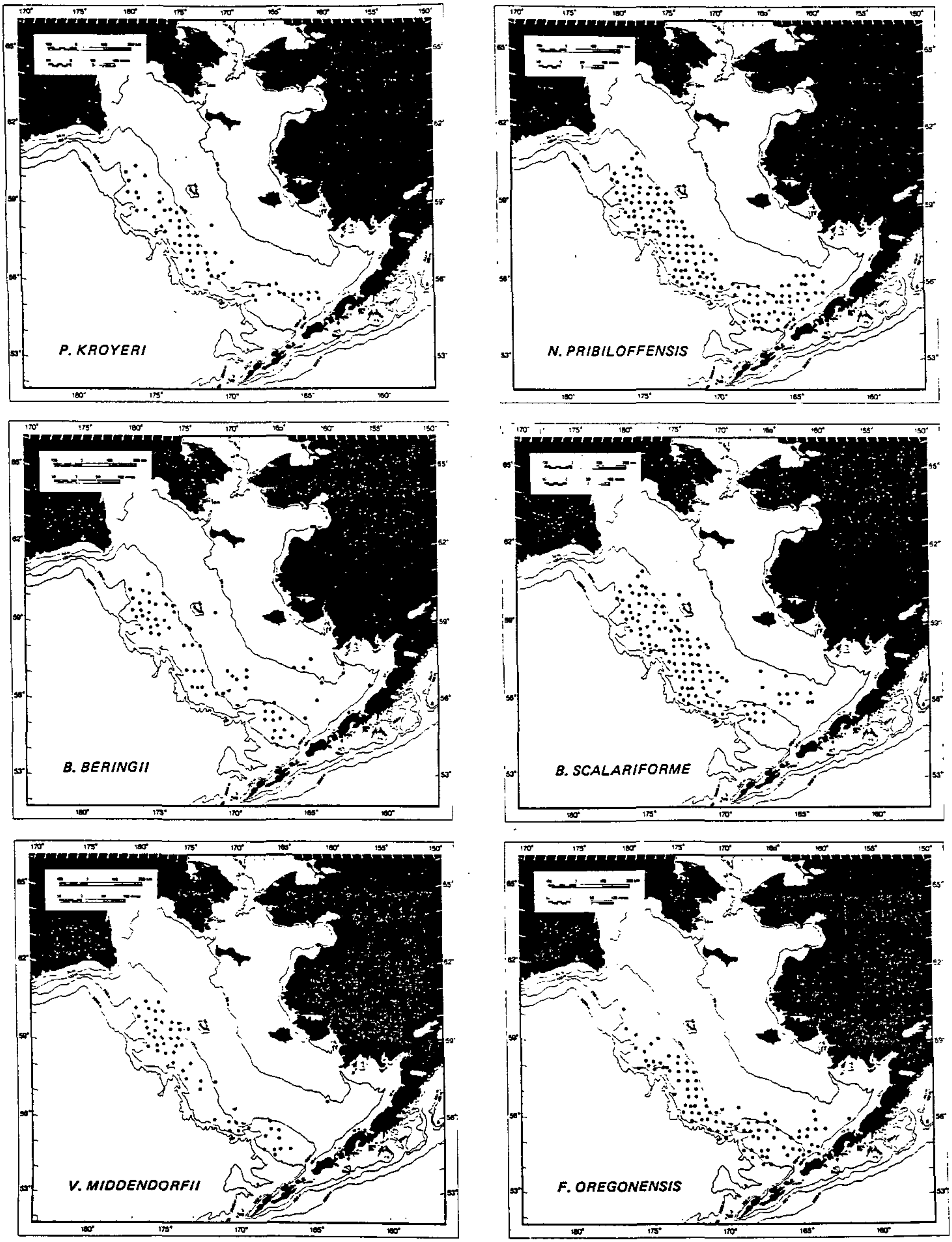



Figure 68-1. Station locations and distribution of fifteen large eastern Bering Sea snails.


N. HEROS
V. FRAGILIS
P. DEFORMIS
B. PLECTRUM
C. MAGNA
N. LYRATA


P. KROYERI
N. PRIBILOFFENSIS
B. BERINGII
B. SCALARIFORME
V. MIDDENDORFII
F. OREGONENSIS

by burrowing into the substrate is not known; estimates of abundance based on trawl surveys will always be conservative.

Gastropods comprised 1.7 percent of the total estimated biomass and 6.6 percent of the invertebrate biomass in the eastern Bering Sea during the 1975 survey (Pereyra et al. 1976). These figures are similar to the results of the 1978 NMFS trawl survey conducted in roughly the same area, in which snails made up 2.2 percent of the total biomass and 8.7 percent of the invertebrate biomass (unpublished data).

Many of the species and most of the snail biomass in the eastern Bering Sea are attributed to the family Neptuneidae. Of 67 snail species caught during the 1975 and 1976 surveys, 33 were neptunids. Five members of the genus *Neptunea, N. lyrata, N. pribiloffensis, N. heros, N. ventricosa*, and *N. borealis*, comprised 87 percent by weight and 68 percent by number of the 1978 catch.

TABLE 68-1

Gastropods identified from 1975 and 1976 NMFS trawl surveys in the eastern Bering Sea. Species followed by an asterisk (*) are the most commonly encountered large (>60mm) snails.

Class Gastropoda

Family Trochidae
- *Margarites giganteus* (Leche)
- *M. costalis* (Gould)
- *Solariella obscura* (Couthouy)
- *S. micraulax*
- *S. varicosa* (Mighels and Adams)

Family Turritellidae
- *Tachyrhynchus erosus* (Couthouy)

Family Epitoniidae
- *Epitonium groenlandicum* (Perry)

Family Calyptraeidae
- *Crepidula grandis* Middendorff

Family Trichotropidae
- *Trichotropis insignis* Middendorff
- *T. kroyeri* Philippi

Family Naticidae
- *Natica clausa* (Broderip and Sowerby)
- *Polinices pallida* (Broderip and Sowerby)

Family Velutinidae
- *Velutina velutina* (Muller)
- *V. lanigera* Moller
- *V. plicatilis* (Muller)

Family Cymatiidae
- *Fusitriton oregonensis* Redfield*

Family Muricidae
- *Boreotrophon clathratus* (Linnaeus)
- *B. pacificus* (Dall)
- *B. dalli* (Kobelt)

Family Buccinidae
- *Buccinum angulosum* Gray*
- *B. scalariforme* (Moller)
- *B. glaciale* Linnaeus
- *B. solenum* (Dall)
- *B. polare* Gray*
- *B. plectrum* Stimpson*
- *B. rondium* Dall

Family Neptuneidae
- *Clinopegma eucosmia* (Dall)
- *C. magna* Dall*
- *C. ochotensis*
- *Beringius kennicotti* (Dall)
- *B. beringii* (Middendorff)*
- *B. stimpsoni* (Gould)
- *B. frielei* (Middendorff)
- *B. crebricostatus undatus* (Dall)
- *Colus spitzbergensis* (Reeve)
- *C. herendeenii* (Dall)
- *C. roseus* (Dall)
- *C. hypolispus* (Dall)
- *C. aphelus* (Dall)
- *C. halli* (Dall)
- *C. dautzenbergi* (Dall)
- *Liomesus nassula* (Dall)
- *L. ooides* (Middendorff)
- *Neptunea lyrata* (Gmelin)*
- *N. ventricosa* (Gmelin)*
- *N. pribiloffensis* (Dall)*
- *N. borealis* (Philippi)
- *N. heros* (Gray)*
- *Plicifusus kroyeri* (Moller)*
- *P. incisus* (Dall)
- *P. brunneus* (Dall)
- *Pyrulofusus harpa* (Morch)
- *P. deformis* (Reeve)*
- *P. melonis* (Dall)
- *Volutopsius fragilis* (Dall)*
- *V. middendorfii* (Dall)*
- *V. trophonius* (Dall)
- *V. castaneus* (Dall)
- *V. filosus* (Dall)

Family Volutidae
- *Arctomelon stearnsii* (Dall)

Family Volumitridae
- *Volumitria alaskana* (Dall)

Family Cancellariidae
- *Admete couthouyi* (Jay)

Family Turridae
- *Aforia circinata* (Dall)
- *Antiplanes thalaea* (Dall)
- *Oenopota harpa* (Dall)
- *Obesitoma simplex* (Middendorff)

Family Pyramidellidae
- *Odostomia* spp.

## SPECIES ASSOCIATIONS

It has long been recognized that species of marine benthic invertebrates often occur together as groups over broad geographical areas. Such groups, variously referred to as communities, assemblages, biocenoses, or faunistic complexes, primarily result from similar tolerances of their component species to environmental variables, although within limited areas, competition and predation may also play a significant role. To the extent that group cohesiveness is environmentally determined, the area occupied by a group can be considered as a specific habitat type or faunistic region. Previous research on the distribution of benthic fauna in the eastern Bering Sea suggests that there are at least three (Nagai and Suda 1976) or possibly four (Neiman 1963) distinct faunistic regions which appear to be associated with the distribution of temperature near the sea bottom.

Early attempts at recognizing species groups undoubtedly involved comparing species distribution maps. Recently, marine ecologists have accomplished this by using computer techniques, especially hierarchical cluster analysis (Clifford and Stephenson 1975), which groups species with similar patterns of abundance over a number of sampling sites (Field 1971, Day et al. 1971, Hughes and Thomas 1971). Grouping species in this manner appears biologically sound, since similarities in distribution patterns strongly suggest a common response to some (usually unknown) suite of environmental variables. An alternative approach used in this study consists of grouping species according to the similarity of environmental variables measured at sampling sites where each species occurred (Somerton and MacIntosh, in preparation). Rather than grouping species by their abundances, which may not be associated with environmental variables, this new method allows grouping by an explicit set of niche or habitat variables.

The environmental variables used to group snails are two aspects of temperature: the annual maximum bottom temperature and the maximum rate of warming. These variables were chosen because they are considered to be important determinants of benthic invertebrate distribution (Nagai and Suda 1976, Neiman 1963) and because bottom-temperature measurements for the eastern Bering Sea were readily available (Ingraham 1973). Although other environmental variables may affect snail distribution, we have restricted our investigation to examining how various snail species distribute themselves within a heterogeneous thermal regime.

Large Bering Sea snails are probably long-lived and certainly have a limited ability to move in response to temperature changes. Therefore, long-term average temperatures were considered more appropriate for grouping species than temperature measurements made at the time samples were collected. Maps of monthly average bottom temperatures by quadrangles of 1° were available from Ingraham (1973); however, only data for May through August were sufficient to construct a reliable picture of the temperature distribution. Although the maximum bottom temperatures are probably not reached by August, the distribution pattern of temperature is established well enough by that time to use as an index of the yearly maximum. The maximum rate of warming was chosen to be the difference between August and July temperatures. To further smooth the data and allow interpolation of temperatures at the sampling sites, a fifth-order polynomial in latitude and longitude, sometimes known as a trend surface,[1] was fitted to both August temperatures and July-August temperature differences. The observed spatial distributions of the 15 most abundant snail species (Fig. 68-1) were then translated into a collection of maximum temperature and maximum warming values by evaluating each polynomial at all sites at which a given species was observed. For example, *Neptunea heros*, observed at 134 of 344 sampling sites, was represented by a set of 134 maximum temperature/maximum warming data pairs.

Arranging species into groups was accomplished in two stages. First, a measure of dissimilarity, the Mahalanobis distance, "D" (Morrison 1976), was calculated for all pairs of data sets. This distance measure was chosen in preference to the more familiar Euclidean distance (Clifford and Stephenson 1975) because it scales the Euclidean distance between data sets by their covariance (Morrison 1976). Group average sorting, one method of hierarchical cluster analysis (Clifford and Stephenson 1975), was used to join species into progressively larger groups. The sequence from many small homogeneous groups to one heterogeneous group is shown as a dendrogram in Fig. 68-2.

Choosing the level of dissimilarity at which to interpret the group structure of such a dendrogram involves some judgment. Groups of two or three closely associated species are formed at low levels of dissimilarity. In Fig. 68-2, five pair-groups of species are evident: *N. heros* and *N. ventricosa*, *P. kroyeri* and *B. scalariforme*, *C. magna* and *B. angulosum*, *V.*

[1] Trend surface analysis is discussed in *SYMAP User Reference Manual*, available through the Laboratory for Computer Graphics and Spatial Analysis, Harvard University.

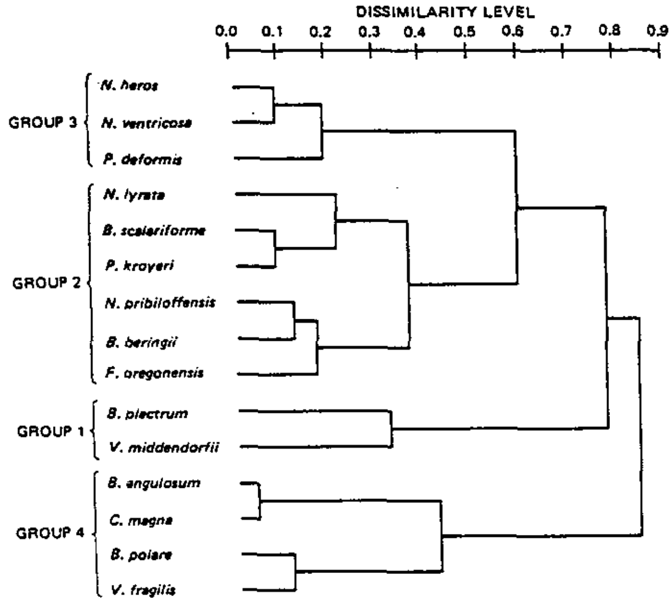



Figure 68-2. Dendrogram showing the similarity of fifteen species of snails. Groups labeled 1 through 4 occur at a dissimilarity level of 0.5.

*fragilis* and *B. polare*, and *N. pribiloffensis* and *B. beringii*. The species in these groups are quite similar in the environmental variables which join them and, as can be seen in Fig. 68-1, are also distributed similarly. At higher levels of dissimilarity, species are joined that do not have identical distributions. Thus, the groups formed at these higher levels of dissimilarity may have similar temperature tolerances but differ in other ecological requirements. If a dissimilarity level of 0.500 is chosen, then all fifteen species are included in four distinct groups (Fig. 68-2). The combined distribution of all members of each group is shown in Fig. 68-3.

Although the four groups appear quite distinct, they may not be statistically different. Two slightly different techniques were used to test for statistical differences. First, Hotelling's "T" (Morrison 1976), a multivariate extension of Student's "t" distribution, was used to test whether each group was statistically different from the others when maximum temperature and maximum warming were considered simultaneously. The results of these tests indicated that each group was different from the other three at a probability level of 0.01. A second method for testing for differences between groups consisted of making univariate "t" tests (Sokal and Rohlf 1969) on each variable. This was done because groups which differ when the variables are considered simultaneously may not differ when each variable is tested separately. The results of the univariate "t" tests are summarized in Table 68-2. If a significance level of 0.05 is chosen, Groups 1 and 4 do not differ with respect to either variable, Group 3 differs from all other groups with respect to both variables, and Group 2 differs from all other groups in maximum temperature but differs only from Group 3 in maximum warming.

Another way of stating these observations is that the four species groups can be divided into three distinct levels of maximum temperature and two distinct levels of maximum warming (Table 68-3). Although Groups 1 and 4 are statistically distinct when both variables are considered simultaneously, they are not different when each variable is considered alone. If Groups 1 and 4 are combined, then three distinct faunistic groups exist: one associated with cold water having a low maximum rate of warming, a second associated with warmer water also having a low maximum rate of warming, and a third associated with the warmest water which has a high maximum rate of warming.

The thermal characteristics of the three identifiable faunistic regions result from the manner in which warming occurs during the summer. In spring, the temperature above the bottom is uniformly cold from the shore out nearly to the edge of the continental shelf, where a northward advection of Pacific Ocean water causes it to increase slightly. As summer progresses, shallow nearshore areas are warmed by insolation. Three types of thermal regions are produced: the coastal area (inhabited by Group 3),

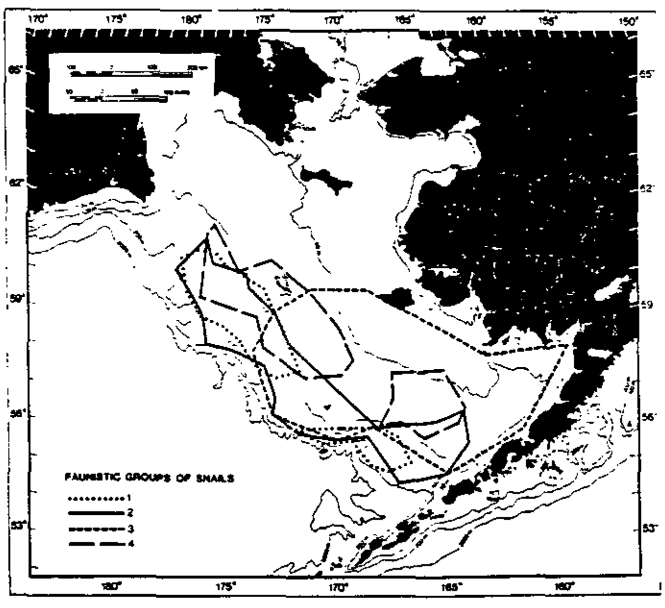



Figure 68-3. Distribution of the four faunistic groups of snails in the eastern Bering Sea.

TABLE 68-2

Summary of univariate "t" tests between all groups taken in pairs.
Shown for each pair of groups are symbols representing the probability levels of tests on maximum temperature (upper) and maximum rate of warming (lower).
Probability levels associated with each symbol are NS = $P > 0.05$, * = $0.01 < P \leqslant 0.05$, ** = $P \leqslant 0.01$.

| Group number | Number of observations | Mean maximum temperature | Mean maximum rate of warming |
|---|---|---|---|
| 1 | 94 | 1.66 | 0.31 |
| 2 | 624 | 2.49 | 0.63 |
| 3 | 302 | 3.94 | 1.16 |
| 4 | 241 | 1.72 | 0.64 |

| | GROUP 1 | GROUP 2 | GROUP 3 |
|---|---|---|---|
| 2 | * | | |
| | NS | | |
| 3 | ** | ** | |
| | ** | ** | |
| 4 | NS | ** | ** |
| | NS | NS | * |

which rapidly warms and reaches the highest temperatures; the central region (Groups 1 and 4), deep enough to escape much of the summer warming and relatively unaffected by advected water from the south; and the outer continental shelf region (Group 2), maintained at a relatively warm temperature by advection.

The thermal preferences of the fifteen species of snails, as indicated by their latitudinal ranges in the eastern Pacific, eastern Bering Sea, and Alaskan Arctic, appear to agree with the temperatures at which they were observed within the study area (Fig. 68-4). The ranges of all Group-3 snails extend from the Alaska Peninsula northward into the Arctic Ocean. None have been found in the Gulf of Alaska. Members of this group are associated with shallow coastal waters characterized by large seasonal temperature fluctuations. Such temperature changes may be intolerable for most species and are probably responsible for the fact that relatively few snail species inhabit the coastal areas. Group-2 snails have wider and more southern ranges than any other group. Although three of the six species in this group are found in the Arctic Ocean, five occur in the Gulf of Alaska, and one, *Fusitriton oregonensis*, occurs as far south as California. Since at least two species in this group, *F. oregonensis* and *Neptunea lyrata*, occur

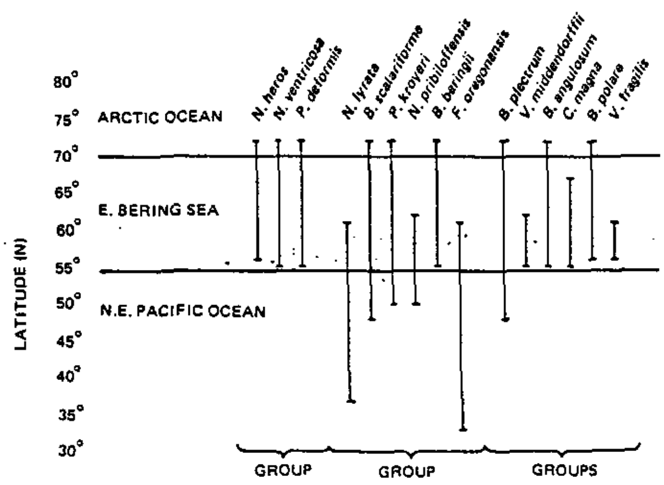



Figure 68-4. Latitudinal ranges of fifteen species of snails in the northeast Pacific Ocean, eastern Bering Sea, and Arctic Ocean off Alaska. Data on ranges are from Abbott 1974, Golikov 1961, MacGinitie 1959, Macpherson 1971, and Oldroyd 1927.

in shallow water south of the Alaska Peninsula, they may inhabit the relatively deep water along the outer continental slope because there is no strong seasonal cooling there. Groups 1 and 4 have ranges

TABLE 68-3

Summary of significant differences ($P \leq 0.05$) between groups, showing the arrangement of the four groups into three distinct categories of maximum temperature and two distinct categories of warming rate

| | | Maximum rate of warming Small | Large |
|---|---|---|---|
| | Cold | 1,4 | |
| Maximum | Warmer | 2 | |
| Temperature | Warmest | | 3 |

intermediate between the two others, and it is interesting that they contain all three of the species studied which can be regarded as endemic to the Bering Sea. Thus, the coastal areas are inhabited by species whose ranges extend into the Arctic, the deeper areas are inhabited by species whose ranges extend south of the Alaska Peninsula, and the perennially cold central region is inhabited by species which tend to be endemic.

Previous studies of the distribution of benthic invertebrates in the eastern Bering Sea have shown patterns similar to those shown in Fig. 68-3. Neiman (1963) defined four zoogeographic complexes of benthic invertebrates in the Bering Sea: Pan-Arctic complex in the cold central region, sub-Arctic-Boreal complex on the upper portion of the continental slope where there is relatively warm water of constant temperature, Arctic-Boreal complex in a region intermediate between Pan-Arctic and sub-Arctic-Boreal, and low-Arctic-Boreal complex in shallow water which heats down to the bottom in summer. Nagai and Suda (1976) discussed the distribution of snails and bivalves in the Bering Sea and defined three distributional zones: coastal, cold water, and deep. Although the geographical area assigned to each of these three zones was not as similar to that shown in Fig. 68-3 as Neiman's (1963) faunal regions were, the general pattern was still the same.

Our results, in conjunction with the findings of Neiman (1963) and Nagai and Suda (1976), support the hypothesis that three identifiable thermal regions exist in the eastern Bering Sea during the late summer and that associated with each region is a distinct assemblage of snail species. Furthermore, from the ranges of these species, the Bering Sea appears to be a transition region where both boreal and arctic species occur within their specific thermal habitats.

## LIFE HISTORIES

Relatively little is known about the life histories of the 15 common large eastern Bering Sea snails discussed here. All but *Fusitriton oregonensis*[2] are dioecious, are fertilized internally, and produce egg clusters from which crawling young are hatched. Thorson (1950) and Shuto (1974) discussed the lack of a pelagic larval stage (lecithotrophic development) among some prosobranch gastropods and its effect on their evolution and distribution. Members of the genus *Neptunea* have a fairly protracted spawning period; *Neptunea* capsules at all stages of development can be found in the eastern Bering Sea from June through August (personal observation). Golikov (1961) reported the spawning period of four *Neptunea* species in the eastern Bering Sea as ranging from 2.5 to 5 months with no spawning before the end of May or after October. *Neptunea lyrata* hatched after about three months of capsule life. In more temperate Danish waters, Pearce and Thorson (1967) found that *N. antigua* (L.) spawn from February through April and have a capsule life of about six months. *Neptunea* species in the Bering Sea may have a longer capsule phase; a *N. ventricosa* cluster containing embryos with calcified shells was collected in July and held in an aquarium at 5 C for six months before hatching (personal observation).

The capsules and clusters of 6 of the 15 large, common eastern Bering Sea snails have been described: *Neptunea lyrata*, *N. heros*, and *N. ventricosa* by Golikov (1961); *Pyrulofusus deformis* by Gonor (1964); *Fusitriton oregonensis* by Howard (1962); and *Beringius beringii* by MacIntosh (1979). In the eastern Bering Sea, clusters are usually laid on the shells of large snails, but they are also occasionally found on rocks, waterlogged wood, and debris of human origin. The high incidence of clusters on snail shells may simply reflect the scarcity of other hard stable surfaces in the environment. Egg clusters of the various species vary considerably in size, shape, color, and number of individual capsules. Group spawning must occur among some of the *Buccinum* species, because, although females seldom exceed 70 g in weight, round clusters of egg capsules weighing over 4 kg and containing thousands of capsules have been found (personal observation). Number of capsules per cluster and number of well-developed embryos per capsule for three of the four large eastern Bering Sea *Neptunea* are shown in Table 68-4.

[2] *Fusitriton*, a member of the tropical family Cymatiidae, lays a cluster of capsules from which pelagic larvae hatch. (Personal communication, Dr. Alan Kohn, University of Washington, Seattle.)

TABLE 68-4

Number of well-developed embryos per capsule and number of capsules per cluster in three species of eastern Bering Sea *Neptunea*.

| | *N. pribiloffensis* | *N. heros* | *N. ventricosa* |
|---|---|---|---|
| No. of clusters examined | 7 | 3 | 5 |
| Capsules per cluster—range | 74-134 | 27-41 | 37-111 |
| Capsules per cluster—mean | 103 | 34 | 81 |
| Embryos per capsule—range | 0-6 | 0-7 | 1-4 |
| Embryos per capsule—mean | 3.2 | 3.4 | 2.9 |

Because some clusters may be the product of more than one female and females may lay more than one cluster per spawning season (see Pearce and Thorson 1967), it is difficult to determine the net production of young per female.

Aging of neptunid and buccinid snails is difficult and has been successfully accomplished only for *Babylonia japonica* (Reeve), a small (<70 mm) fast-growing buccinid found in shallow waters along the coast of Japan (Kubo and Kondo 1953). Pearce and Thorson (1967) speculated that large, sexually mature specimens of *Neptunea antigua* from Danish waters were about 10 years old. In that study, *N. antigua* were about 10 mm long at hatching and grew 10-20 mm in a year.

Some eastern Bering Sea *Neptunea*, *N. heros* in particular, have opercula with well-defined growth rings on the exterior surface; but it is not certain whether these rings represent annular growth. If they do, then animals approximately 110 mm in length are more than 15 years old.

Size at maturity of the four large eastern Bering Sea *Neptunea* has been documented by MacIntosh and Paul (1977). Female *N. heros*, *N. lyrata*, *N. pribiloffensis*, and *N. ventricosa* were found to mature at 110, 110, 105, and 102 mm, respectively; corresponding lengths of males were 95, 100, 90, and 87 mm. Females of all four species examined appear to mature at shell lengths 10-15 mm greater than males of the same species. Pearce and Thorson (1967) found mature female *N. antigua* in Danish waters to be larger than males. They also reported that females did not feed during the average 21 days of capsule-laying and that most females subsequently died because of the rigors of spawning. Shimek (1979) similarly found that females of *N. lyrata* and *N. ventricosa* probably do not feed during the prespawning and spawning period. He speculated that this, coupled with the need to produce many large yolky eggs, tends to select for large females with increased energy reserves.

Shimek (1979) reported that the diets of *N. pribiloffensis*, *N. lyrata*, *N. heros*, and *N. ventricosa* in the eastern Bering Sea consisted of a variety of organisms including polychaetes, bivalves, barnacles, fishes, and crustaceans (Table 68-5). Other studies of the diets of related species suggest that snails are scavengers and facultative predators (Blegvad 1914, Hunt 1925, Avery 1961, Pearce and Thorson 1967).

## JAPANESE FISHERY

Japan has commercially harvested snails in the eastern Bering Sea since at least 1971 (MacIntosh 1980). The fishery occurs east of 175°W on the continental shelf northwest of the Pribilof Islands. Nagai described several aspects of the commercial fishery, including gear, species captured, size-composition of the catch (1974), incidental catch (1975a), and catch-per-unit-effort (1975b). Statistics available since 1972 indicate that about 3,000 mt of edible snail meats (11,000 mt live weight) were harvested each year from 1972 through 1975 (Table 68-6). Total weight and recovered meat weight data from the 1974 harvest indicate an edible meat recovery of 27 percent. This value is similar to values of edible meat recoveries of from 26.8 to 30.6 percent obtained by MacIntosh and Paul (1977) for four species of eastern Bering Sea *Neptunea*.

The most common gastropod in Japanese catches made northwest of the Pribilof Islands in 1973 was *N. pribiloffensis*, about 70 percent of the catch by weight (Nagai 1974). *Buccinum angulosum* and *B. scalariforme* accounted for an additional 23 percent of the catch.

In 1977 Japan began to supply the United States with statistics on the number of vessels and amount of effort expended in the eastern Bering Sea snail fishery. Vessels licensed for this fishery range from 96 to 490 gross mt and from 25 to 50 m in length. Between June and October 1977, three vessels caught 404 mt of edible meat, approximately 15 percent of

TABLE 68-5

Diets of four eastern Bering Sea *Neptunea* expressed as the number of each species examined containing a given item (from Shimek 1979).

| Contents | *N. pribiloffensis* | *N. lyrata* | *N. heros* | *N. ventricosa* | Total |
|---|---|---|---|---|---|
| Nothing | 71 | 92 | 73 | 104 | 340 |
| Tissue | 3 | 12 | 21 | 29 | 65 |
| Tissue and Sand | 7 | 15 | 12 | 19 | 53 |
| Sand | 23 | 28 | 16 | 19 | 86 |
| Polychaetes | 21 | 16 | 12 | 14 | 63 |
| Cuticle | 1 | 8 | 3 | 4 | 16 |
| Bivalves | 1 | 4 | 2 | 1 | 8 |
| Barnacles | 0 | 4 | 3 | 10 | 17 |
| Fishes | 0 | 1 | 1 | 2 | 4 |
| Crustaceans | 1 | 1 | 3 | 3 | 8 |

Japan's 3,000 mt quota. The vessels had an average catch of 2.7 mt of meat per day. In 1978, a maximum of nine vessels caught 2,200 mt of edible meat between May and November. The average catch rate during the 1978 fishery was 2.9 mt/d. In 1979 three vessels caught only 537 mt of edible meat in a fishing season that began in July and ended in October. The average daily catch was 2.8 mt of meat per vessel day.

Fishing gear consists of baited pots fished at intervals on a groundline. The pots are truncated cones, roughly 88 cm in height, with a single opening or tunnel approximately 12-15 cm in diameter on the top. Webbing covering the pot has 6-cm meshes on the lower 23 cm of the pot and 12-cm meshes on the remainder.

We know little about Japanese fishing techniques, but in 1973, one vessel fished about 6,000 pots on 12 groundlines (500 pots/groundline) and took three days to pick and rebait the entire set of gear. An average catch rate of 4 kg/pot/3-day soak was reported by that same vessel (Nagai 1975a). In the 1977 fishery, the average catch rate was reported as 0.9 kg/pot/33-hour soak (Unpublished data, NMFS, 1979, Juneau).

All processing of the snail catch now occurs on board the catcher vessel. This consists of crushing the shells, briefly cooking the meats, and removing any soft parts and shell fragments. The meats are graded by size and quality and quick-frozen in trays. Small snails in the catch may be frozen whole.

The only available figures on the value of the snail fishery are derived from estimates of the ex-vessel price of snail meats. These figures are used by the United States as a base for calculating fee schedules for foreign vessels fishing within the extended jurisdiction zone. Estimated ex-vessel prices for the years 1976-78 are $600, $600, and $1,657 per metric ton of meat. At these ex-vessel prices, the 1976 and 1977 eastern Bering Sea catch was worth $242 thousand, the 1978 catch was worth $1.3 million, and the 1979 catch was worth $890 thousand.

Until recently, there was no U.S. regulation of the eastern Bering Sea snail fishery. Implementation of the Fishery Conservation and Management Act of 1976 provided the United States a tool to monitor and manage the snail fishery within the 200-mile conservation zone. A preliminary management plan developed by NMFS for the Secretary of Commerce is currently the basis for regulations governing the fishery. Because there is currently no domestic

TABLE 68-6

Catch and effort statistics of the Japanese snail fishery in the eastern Bering Sea, 1972-78

| Year | Catch (mt) edible meat | Total weight[a] | Fishing effort (vessel days) |
|---|---|---|---|
| 1972 | 3,218[b] | 11,900 | NA |
| 1973 | 3,319[b] | 12,300 | NA |
| 1974 | 3,574[b] | 13,237 | NA |
| 1975 | 3,447[b] | 12,767 | NA |
| 1976 | NA[c] | NA | NA |
| 1977 | 404[d] | 1,500 | 152 |
| 1978 | 2,184[d] | 8,100 | 749 |
| 1979 | 537[d] | 1,990 | 190 |

[a] Values are estimates derived from the weight of edible meat and whole snails taken by the fishery in 1974.
[b] Data provided by the Japan Fisheries Agency through the U.S. Embassy, Tokyo, Japan.
[c] NA designates that data were not available.
[d] As reported to the United States under provisions of the Fishery Conservation and Management Act of 1976.

fishery for snails in the eastern Bering Sea, the total allowable catch has been allocated to Japan, the only nation now involved in the fishery. Japan's 1977-79 quotas were set at 3,000 mt of edible meat, the same level as the average catch for the years 1972 to 1975. Changes in total allowable catch and Japan's harvest level will depend upon newly acquired biological and socioeconomic data.

## PROSPECTS FOR A DOMESTIC SNAIL FISHERY

Domestic fishermen and processors have expressed interest in the Alaskan snail resource, but their future involvement is less certain than the future involvement of Japan. The rapidly expanding and highly profitable king and snow crab fisheries are currently dominating domestic fishing activities. Although crab vessels would be well suited to snail pot fishing, most crab fishermen consider fishing for Gulf of Alaska and eastern Bering Sea bottomfish as an alternate or supplemental activity. Attempts to initiate a snail fishery in the Gulf of Alaska have not so far been productive: they have been exploratory in nature but show promise as potential off-season operations in the next few years. Innovative processing and marketing techniques as well as a continued increase in the value of the traditional frozen meat product will be necessary conditions for the initiation of a domestic snail fishery.

## REFERENCES

Abbott, R. T.
1974 American seashells. Van Nostrand Reinhold, N.Y.

Avery, J.
1961 Observations on certain aspects of the feeding habits of four species of carnivorous marine gastropods. Unpub. Rep., Zoology 533. Friday Harbor Laboratories, Univ. of Washington.

Blegvad, H.
1914 Food and condition of nourishment among the communities of invertebrate animals found on or in the sea bottom in Danish waters. Rep. Dan. Biol. Sta. 22:41-78.

Clifford, H. T., and W. Stephenson
1975 An introduction to numerical classification. Academic Press, N.Y.

Day, J. H., J. G. Field, and M. Montgomery
1971 The use of numerical methods to determine the distribution of the benthic fauna across the continental shelf of North Carolina. J. Animal Ecol. 40:93-126.

Feder, H. M., J. Hilsinger, M. Hoberg, S. Jewett, and J. Rose
1978 Survey of the epifaunal invertebrates of the southeastern Bering Sea. *In:* Environmental assessment of the Alaskan continental shelf. NOAA/OCSEAP (Final Rep.), Ann. Rep. 4:1-126.

Field, J. G.
1971 A numerical analysis of changes in the soft-bottom fauna along a transect across False Bay, South Africa. J. Exp. Mar. Biol. Ecol. 7:215-53.

Golikov, A. N.
1961 Ecology of reproduction and the nature of egg capsules in some gastropod molluscs of the genus *Neptunea* (Bolten). Zool. Zh. 40:997-1009.

Gonor, J. J.
1964 Egg capsules and young of the gastropod *Pyrulofusus deformis* (Neptuneidae) at Darrow, Alaska. Arctic 17: 48-51.

Howard, F. B.
1962 Egg-laying in *Fusitriton oregonensis* (Redfield). Veliger 4:160-5.

Hughes, R. N., and M. L. H. Thomas
1971 The classification and ordination of shallow-water benthic samples from Prince Edward Island, Canada. J. Exp. Mar. Biol. Ecol. 7:1-39.

Hunt, O. D.
1925 The food of the bottom fauna of the Plymouth fishing grounds. J. Mar. Biol. Assoc. U.K. 13:350-599.

Ingraham, W. J.

1973 Maps of mean values of water temperature (°C) and salinity (°/oo) in the eastern Bering Sea by the 1 × 1° quadrangles. MS. rep., Northwest and Alaska Fish. Cent., Nat. Mar. Fish. Serv., Seattle, Wash.

Kubo, I., and K. Kondo

1953 Age determination of the *Babylonia japonica* (Reeve), an edible marine gastropod, basing on the operculum. J. Tokyo Univ. Fish. 39:199-209.

MacGinitie, N.

1959 Marine mollusca of Point Barrow, Alaska. Proc. U.S. Nat. Mus. 109:59-208.

MacIntosh, R. A.

1979 Egg capsule and young of the Gastropod *Beringius beringii* (Middendorff) (Neptuneidae). Veliger 21:439-41.

1980 The snail resource of the eastern Bering Sea and its fishery. Mar. Fish. Rev. 42:15-20.

MacIntosh, R. A., and A. J. Paul

1977 The relation of shell length to total weight, tissue weight, edible-meat-weight, and reproductive organ weight of the gastropods *Neptunea heros*, *N. lyrata*, *N. pribiloffensis*, and *N. ventricosa* of the eastern Bering Sea. Proc. Nat. Shellfish Assoc. 67:103-122.

Macpherson, E.

1971 The marine molluscs of arctic Canada. Nat. Mus. Nat. Sci. (Ottawa) Pub. Biol. Oceanogr. 3:1-149.

McLaughlin, P. A.

1963 Survey of the benthic invertebrate fauna of the eastern Bering Sea. U.S. Fish Wildl. Serv., Spec. Sci. Rep., Fish. No. 401.

Morrison, D. F.

1976 Multivariate statistical methods. McGraw-Hill, N. Y.

Nagai, T.

1974 Studies on the marine snail resources in the eastern Bering Sea. 1. Species composition, sex ratio, and shell length composition of snails in the commercial catch by snail-basket-gear in the adjacent waters of Pribilof Islands, 1973. Bull. Far Seas Fish. Res. Lab. 10:141-56. (Transl. Language Serv. Div., Off. Int. Fish., Nat. Mar. Fish. Serv., NOAA, Dep. Comm., Washington, D.C.)

1975a An analysis of the snail fishing data in the eastern Bering Sea. 1. On the variation of catch per unit effort. Bull. Far Seas Fish. Res. Lab. 12:121-35. (Transl. Language Serv. Div., Off. Int. Fish., Nat. Mar. Fish. Serv., NOAA, Dep. Comm., Washington, D.C.)

1975b Studies on the marine snail resources in the eastern Bering Sea. 2. List of Gastropoda and Bivalvia (Mollusca) species collected with snail-baskets and some information about the incidental catch in the adjacent waters of the Pribilof Islands, 1973. Bull. Far Seas Fish. Lab. 12:137-143. (In Japanese, Eng. abs.)

Nagai, T., and O. Arakawa

1978 Survey report on the sea snail resources in the eastern Bering Sea, using the *Meiko Maru* No. 7 during the summer of 1978. Bull. Far Seas Fish. Res. Lab. 168:1-45. (In Japanese, Eng. abs.)

Nagai, T., and A. Suda

1976 Gastropods and bivalves in the eastern Bering Sea in summer with reference to their environment as seen from incidental trawl catches. Bull. Far Seas Fish. Res. Lab. 14:163-79. (Transl. Language Serv. Div., Off. Int. Fish., Nat. Mar. Fish. Serv., NOAA, Dep. Comm., Washington, D.C.)

Neiman, A. A.
1963 Quantitative distribution of benthos on the shelf and upper continental slope in the eastern part of the Bering Sea. *In:* Soviet fisheries investigations in the northeast Pacific, P. A. Moiseev, ed., 1: 143-217.

Oldroyd, I. S.
1927 The marine shells of the west coast of North America. Gastropoda and Amphineura. Stanford Univ. Pub., Univ. Series, Geol. Sci. 2.

Pearce, J. B.. and G. Thorson
1967 The feeding and reproductive biology of the red whelk, *Neptunea antigua* (L.), (Gastropoda, Prosobranchia). Ophelia 4:277-314.

Pereyra, W. T., J. E. Reeves, and R. C. Bakkala
1976 Demersal fish and shellfish resources in the eastern Bering Sea in the baseline year 1975. Nat. Mar. Fish. Serv., Northwest Fish. Cent., NOAA U.S. Dep. Comm., Seattle, Wash., Proc. Rep.

Shimek, R.
1979 Diets, morphology and competitive displacement of four species of Bering Sea whelks (Gastropoda: Buccinidea: *Neptunea*). Unpub. MS., Univ. of Alaska, Anchorage.

Shuto, T.
1974 Larval ecology of prosobranch gastropods and its bearing on biogeography and paleontogy. Lethaia 7:239-56.

Sokal, R. R., and F. J. Rohlf
1969 Biometry. W. H. Freeman, San Francisco.

Somerton, D. A., and R. A. MacIntosh
A classification of snail species based on niche and habitat variables (in prep.).

Thorson, G.
1950 Reproductive and larval ecology of marine bottom invertebrates. Biol. Rev. 25:1-45.

# The Snail Resource of the Eastern Bering Sea and Its Fishery

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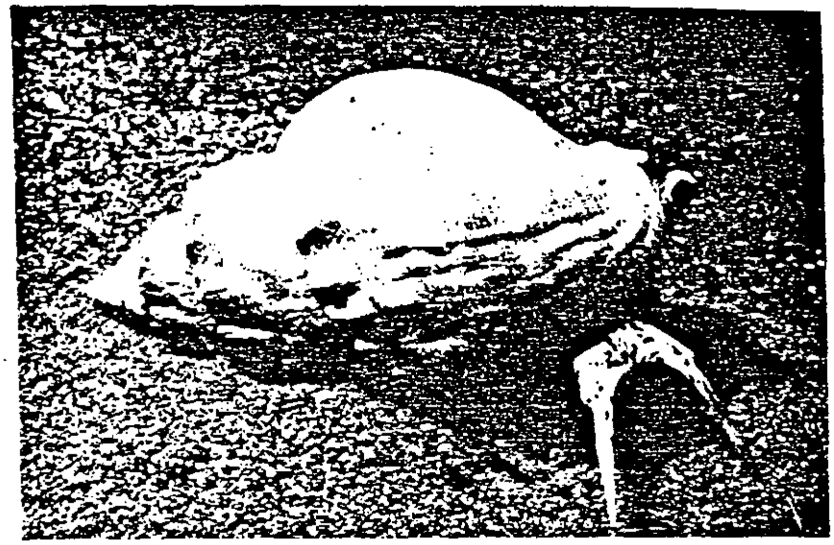

*Buccinum* sp., photographed in Alaska's Auke Bay by Lou Barr, then with the NMFS Auke Bay Fisheries Laboratory, Northwest and Alaska Fisheries Center, Auke Bay, AK 99821.

*ABSTRACT–A trawl survey in the eastern Bering Sea outlined the distribution and relative abundance of several large snails of commercial importance. Snails made up 6.6 percent of the invertebrate biomass with members of the genus* Neptunea *being most abundant. These snails lack a larval stage and are facultative predators and scavengers. Japan has harvested snails in the area since at least 1971. Reported catch rates in pots ranged from 0.9 to 4.0 kg/pot and total Japanese catch has varied from 404 to 3,574 t of edible meat per year. The United States has the vessel capacity to enter the fishery but probably will not do so until there is a large increase in the value of snail products.*

The Alaskan continental shelf is an area of vast fishery resources. Fish and crab resources are well known and have long been exploited by many fishing nations; potential resources, like eastern Bering Sea snails, are virtually unknown. Several species of large snails occur in relatively high abundance in Alaskan waters and offer considerable fisheries potential.

Japan has harvested snails in the eastern Bering Sea since the early 1970's and there is potential for the development of a U.S. domestic fishery as well. This report presents information about the Japanese fishery in the eastern Bering Sea, life history characteristics for the principal snail species, and discusses the potentiality for U.S. participation in the harvest of this unique shellfish resource.

## The Snail Resource and Its Composition

During the summer and fall of 1975, the Northwest and Alaska Fisheries Center of the National Marine Fisheries Service (NMFS) conducted a comprehensive trawl survey over 566,000 km$^2$ (218,600 miles$^2$) of the eastern Bering Sea shelf and upper slope (Fig. 1). This survey was designed to identify principal demersal fish and shellfish communities of the eastern Bering Sea which could be affected by development of continental shelf energy sources. Data on fish and epibenthic invertebrates were gathered from several hundred locations with a modified 400-mesh eastern otter trawl. The resulting data offered significant insight into the population and biological characteristics of numerous species of snails.

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Gastropods made up 1.7 percent of the total biomass and 6.6 percent of the invertebrate biomass in the survey area (Pereyra et al.[1]).

Distribution of snails throughout the area is patchy, with the areas of highest concentration also supporting a high biomass of fish and epibenthic invertebrates. Snail biomass in some areas exceeded 3,000 kg/km$^2$ (17,000 pounds/nmi$^2$); however, if the trawl is not effective at catching species of snails that sometimes burrow into the substrate, then the biomass may actually be much higher.

About 15 species of large (>5 cm) snails are common in the eastern Bering Sea (Table 1). Members of the genus *Neptunea* are by far the most abundant in terms of both numbers and biomass. The Pribilof neptune, *N. pribiloffensis*, (Fig. 2), is probably the most abundant *Neptunea; N. lyrata, N. ventricosa,* and *N. heros* (Fig. 2) are also very

[1]Pereyra, W. T., J. E. Reeves, and R. G. Bakkala. 1976. *Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975.* Northwest and Alaska Fisheries Center, NMFS, NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112. Processed rep., 619 p.

Table 1.—Scientific names of large snails taken in the eastern Bering Sea during the 1975 trawl survey of the NMFS Northwest and Alaska Fisheries Center.

| |
|---|
| *Beringius beringii* (Middendorf, 1849) |
| *Buccinum angulossum* Gray, 1839 |
| *B. plectrum* Sumpson, 1865 |
| *B. polare* Gray, 1839 |
| *B. scalariforme* Möller, 1842 |
| *Clinopegma magna* (Dall, 1875) |
| *Fusitriton oregonensis* (Redfield, 1848) |
| *Neptunea heros* (Gray, 1850) |
| *N. lyrata* (Gmelin, 1791) |
| *N. pribiloffensis* (Dall, 1919) |
| *N. ventricosa* (Gmelin, 1791) |
| *Plicifusus kroeyeri* Möller, 1842) |
| *Pyrulofusus deformis* (Reeve, 1847) |
| *Volutopsius fragilis* (Dall, 1891) |
| *V. middendorffii* (Dall, 1891) |

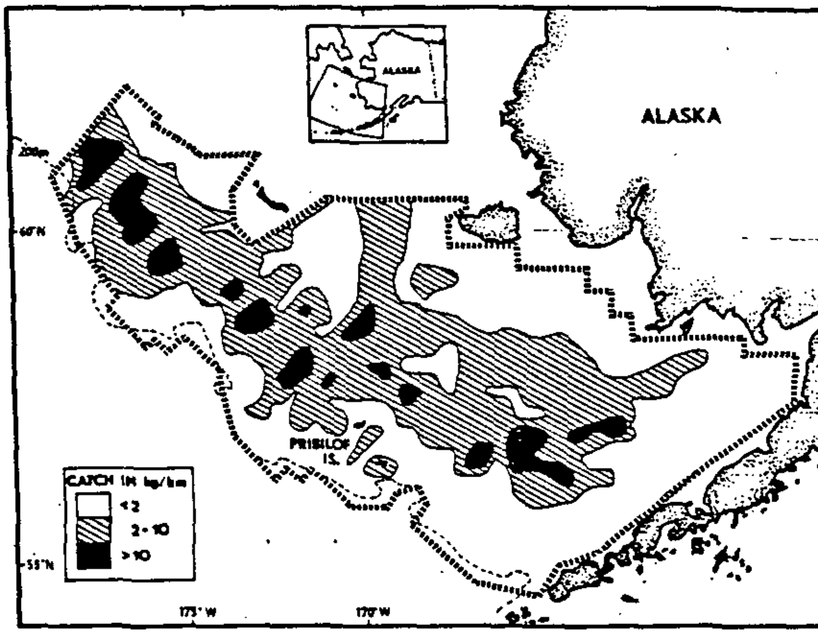


Figure 1.—Location of trawl survey area of the NMFS Northwest and Alaska Fisheries Center in 1975 (inside dashed line) and areas of high snail density (all species combined).

common. The mean shell lengths of *N. pribiloffensis*, *N. lyrata*, *N. ventricosa*, and *N. heros* were 100, 115, 102, and 121 mm, respectively (MacIntosh[2]).

The genus *Buccinum* is also well represented in the eastern Bering Sea. Six species of this genus were taken in the 1975 survey, of which four, *B. angulossum*, *B. plectrum*, *B. polare*, and *B. scalariforme*, were fairly abundant. Although quite numerous, these smaller snails (58-75 mm average shell length) contribute relatively little to total snail biomass in the eastern Bering Sea. *Buccinum angulossum* (Fig. 3) is representative of the size and general form of these snails.

Most species of eastern Bering Sea snails do not occur over the entire shelf but are retricted to specific depth and temperature regions. In general, those species that have continuous distributions into the Gulf of Alaska inhabit the warmer, deeper waters near the continental shelf edge, while those species having a more northerly distribution into Arctic waters inhabit the colder (at least seasonally), shallower, inshore waters. Basically, *N. pribiloffensis* and *N. lyrata* are temperate water snails and are characteristically found in deeper, warmer waters along the edge of the continental shelf. In contrast, *N. heros* and *N. ventricosa*, which range into the Arctic Ocean, inhabit shallower, seasonally cooler waters near the coast of western Alaska.

Numerous trawl surveys have been conducted in the Gulf of Alaska, but very little attention has been paid to the snail resources of the area. Although quantitative data are lacking, it is apparent that *N. pribiloffensis*, *N. lyrata*, and *Fusitriton oregonensis* make up the bulk of the snail biomass. *Fusitriton* reaches a length of 13 cm and ranges from the California coast to the Gulf of Alaska and the eastern Bering Sea. All three species occur at depths from at least 50 to 250 m with the latter also found inshore to the intertidal zone. Large catches of *N. pribiloffensis* and *N. lyrata* have been made by trawlers and pot fishermen of Ketchikan, Petersburg, Kodiak, and Cordova. Overall, species diversity appears to be less and distribution of snails appears to be more patchy in the Gulf of Alaska than in the eastern Bering Sea.

## Life History

Most snails listed in Table 1 have similar life histories. The sexes are separate and fertilization is internal. Among the large *Neptunea*, sexual maturity occurs at a shell length of 90-110 mm (MacIntosh and Paul, 1977) which probably corresponds to an age of about 10 years. Definitive work on aging has not been completed.

A feature of the life histories of all but one[3] of the common large snails is the production of egg capsules from which crawling young are hatched. Thorson (1950) and Shuto (1974) have discussed this lack of a pelagic larval stage (termed lecithotrophic development) among some Prosobranch gastropods and the effect it has had on their evolution and distribution.

In the eastern Bering Sea, egg clusters are usually laid on the shells of large snails. Both living and dead shells are utilized as substrates, and there appears to be little correlation between the

[2]MacIntosh, R. A. 1976. A guide to the identification of some common eastern Bering Sea snails. Northwest and Alaska Fisheries Center, NMFS, 2725 Montlake Blvd. E., Seattle, WA 98112. Processed rep., 27 p.

[3]*Fusitriton oregonensis*, a member of the tropically oriented family *Cymatiidae*, apparently has pelagic larvae although no literature on the subject exists. Pers. commun. Alan J. Kohn, Univ. Washington, Seattle, WA 98195.

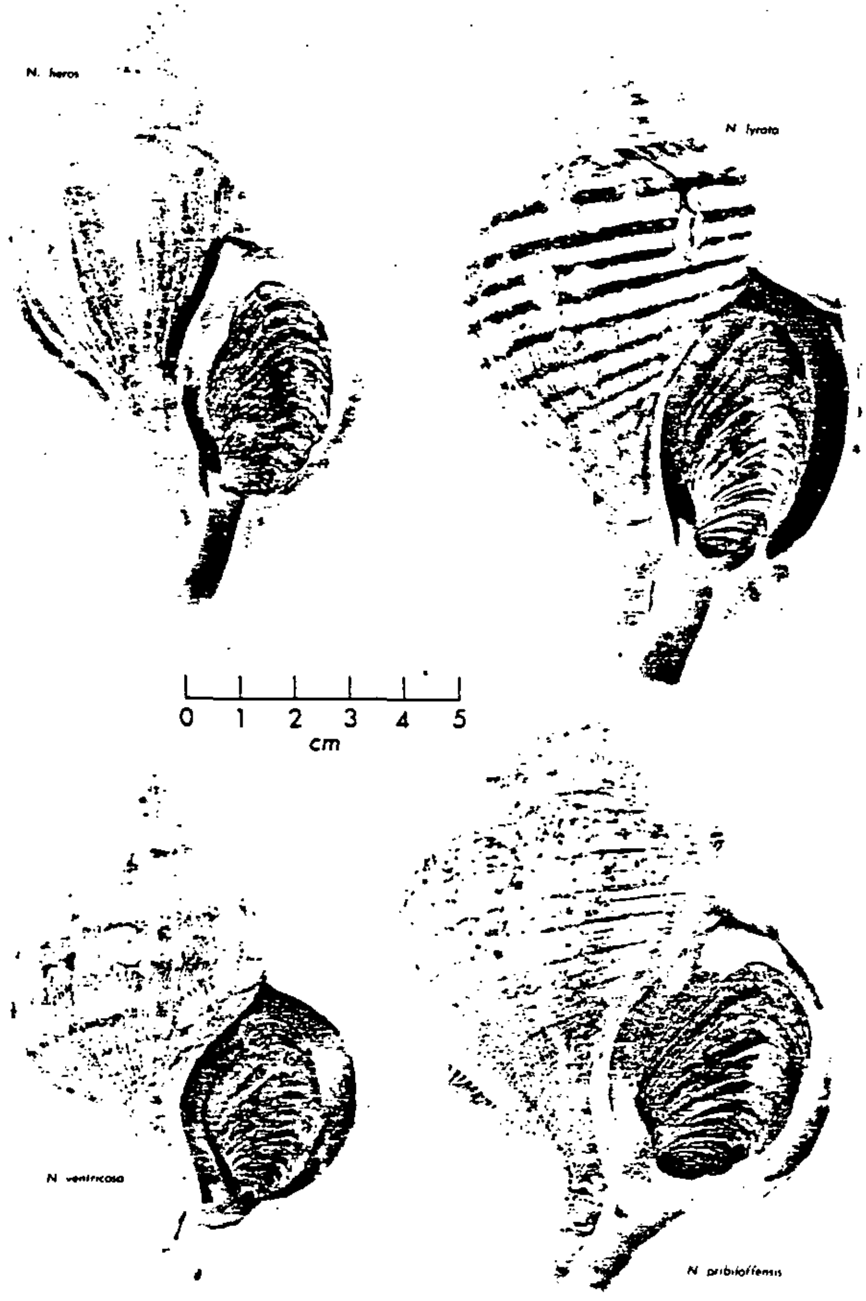



Figure 2.—The four large *Neptunea* from the eastern Bering Sea, clockwise from upper left, *N. heros*, *N. lyrata*, *N. pribiloffensis*, and *N. ventricosa*.

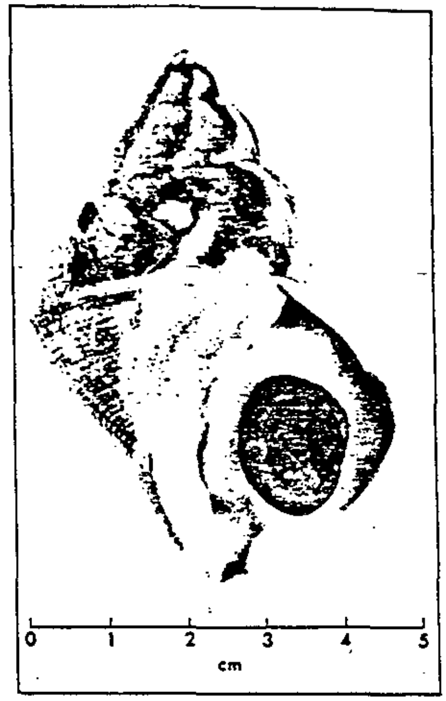



Figure 3.—*Buccinum angulossum*, one of four common *Buccinum* in the eastern Bering Sea.

species of snail depositing its eggs and the species the cases are deposited on. Egg clusters of the large eastern Bering Sea gastropods vary considerably in size, shape, color, and number of individual capsules contained. The capsules, clusters, and young of many species remain undescribed.

Very little is known about the feeding habits of Bering Sea snails. Laboratory studies (Avery[4]) have shown that *Fusitriton oregonesis*, *Neptunea lyrata*, and *Buccinum plectrum* respond to a variety of scents including those of freshly killed mussel, nereid worm, crab, mud shrimp, and fish. Eastern Bering Sea snails are probably facultative predators and scavengers.

## Japanese Fishery

Japan has commercially harvested snails in the eastern Bering Sea since at least 1971. The fishery occurs east of long. 175°W on the continental shelf northwest of the Pribilof Islands. Aspects of the commercial fishery have been described, including gear, species captured, and size composition of the catch (Nagai, 1974); incidental catch

[4]Avery, J. 1961. Observation on certain aspects of the feeding habits of four species of carnivorous marine gastropods. Friday Harbor Laboratory Library, Friday Harbor, WA 98250. Unpubl. manuscr., 29 p.

(Nagai, 1975a); and catch-per-unit-effort (Nagai, 1975b). So little information is available for this fishery that only a fragmentary account of its history can be pieced together. Statistics available since 1972 indicated an annual harvest of about 3,000 metric tons (t) (11,000 t live weight) of edible snail meats through 1975 (Table 2). Data for both total weight and recovered meat weight of the 1974 harvest indicated an edible meat recovery of 27 percent. The value compares favorably with values of edible meat recoveries from 26.8 percent to 30.6 percent generated for four species of eastern Bering Sea *Neptunea* by MacIntosh and Paul (1977).

The most common gastropod in Japanese catches made northwest of the Pribilof Islands in 1973 was *N. pribiloffensis* which composed about 70 percent of the catch by weight (Nagai, 1974). *Buccinum angulossum* and *B. scalariforme* accounted for an additional 23 percent of the catch.

Until 1977, the number of vessels involved in the fishery was unknown. In some years, the Fisheries Agency of Japan licensed 21 vessels but it is unlikely that all of these vessels actually took part in the fishery. Patrols of NMFS in the eastern Bering Sea observed ony 14, 5, 0, and 6 vessels fishing snails in the years 1971 through 1974, respectively, and no vessels in 1975 and 1976[5]. Records submitted for 1977 by the Japanese in compliance with the Fishery Conservation and Management Act of 1976 indicated that three vessels fished in the eastern Bering Sea (east of long. 175°W) during the year. These vessels were given an allocation of 3,000 t of meat by the North Pacific Fishery Management Council. Fishing began in June and terminated on 16 October, at which time the combined catch of the vessels was 404 t of edible meat—about 15 percent of Japan's allocation. The average catch rate in 1977 was 2.7 t of meats per vessel day.

The 1978 season began in May and ended in November. There was a considerable increase over 1977 in both effort and catch, with about 2,200 t of snail meats taken in about 760-vessel-days (average 2.9 t/day). Fishing effort peaked in August when nine vessels fished northwest of the Pribilof Islands along the edge of the continental shelf. Vessels licensed for this fishery range from 96 to 490 gross t and 25 to 50 m in length (Fig. 4) (unpublished data, U.S. Embassy, Tokyo, Japan). Similar vessels are used in the Japanese longline and crab fisheries in Alaska and, in fact, several vessels fished for crab before switching to the snail fishery in the 1978 season.

Table 2.—Catch and effort statistics of the Japanese snail fishery in the eastern Bering Sea, 1972-78.

| Year | Catch (t) edible meat | Total weight[1] | Fishing effort (vessel days) |
|---|---|---|---|
| 1972 | [2]3,218 | 11,900 | NA[3] |
| 1973 | [2]3,319 | 12,300 | NA |
| 1974 | [2]3,574 | 13,237 | NA |
| 1975 | [2]3,447 | 12,767 | NA |
| 1976 | NA | NA | NA |
| 1977 | [4]404 | 1,500 | 152 |
| 1978 | [4]2,184 | 8,100 | 749 |

[1]Values are estimates derived from the weight of edible meat and whole snails taken by the fishery in 1974.
[2]Data provided by the Japan Fisheries Agency through the U.S. Embassy, Tokyo, Japan.
[3]Not available.
[4]As reported to the United States under provisions of the Fishery Conservation and Management Act of 1976.

Fishing gear consists of pots fished at intervals on a groundline. The snail pots are truncated cones 88 cm in height (Fig. 5). The diameter of the tunnel in the top of the pot varies from 12 to 15 cm and webbing on the side of the pot is 6-cm mesh over the lower 23 cm of the side and 12-cm mesh on the remainder. Snails, being predators and scavengers, are strongly attracted to the fish bait in the pots.

Little is known about Japanese fishing techniques, but in 1973 one vessel fished about 6,000 pots on 12 groundlines (500 pots/groundline) and took 3 days to pick and re-bait the entire set of gear. An average catch rate of 4 kg/pot per 3-day soak was reported by that same vessel (Nagai, 1975a). In the 1977 fishery, the overall average catch rate was reported as 0.9 kg/pot per 33-hour soak (unpublished data, 1979, Alaska Regional Office, National Marine Fisheries Service, NOAA, Juneau, AK 99802).

All processing of the snail catch now occurs on board the catcher vessel. This consists of crushing the shells, briefly cooking the meats, and removing any soft parts and shell fragments. The meats are graded by size and quality and quick frozen in trays. Small snails in the catch may be frozen whole.

The only available figures on the

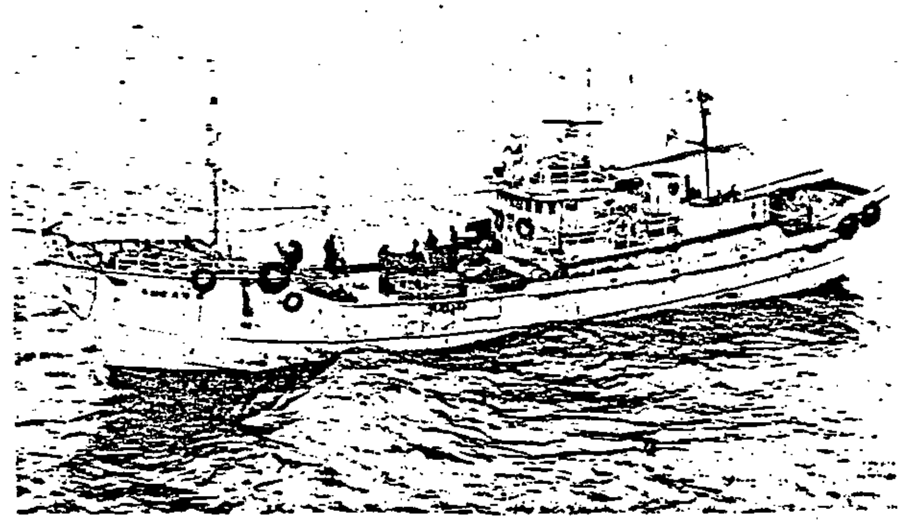


Figure 4.—A Japanese snail fishing vessel in the eastern Bering Sea.

[5]The 1974 total included one factoryship which processed snails from the five catcher vessels. This appears to be the only year in which fishing vessels did not process their own catch.

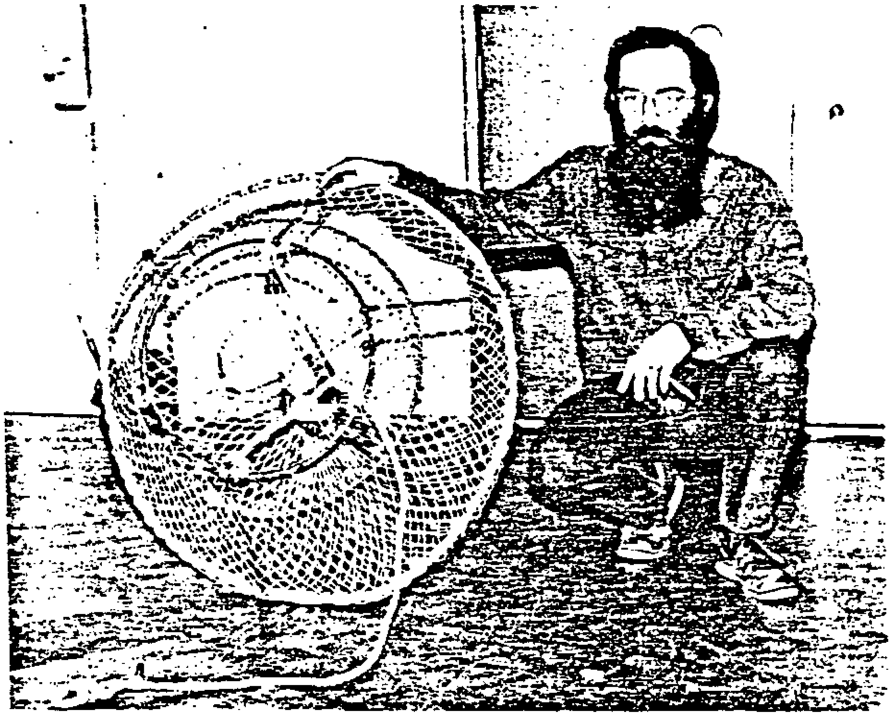


Figure 5.—Snail pot used by the Japanese fishery in the eastern Bering Sea.

value of the snail fishery are derived from estimates of the ex-vessel value of snail meats that are used by the United States as a base for calculating fee schedules for foreign vessels fishing within the extended jurisdiction zone. Fee schedules for the years 1977-79 were based on the ex-vessel snail meat value of $600, $600, and $1,657 per t for the years 1976-78, respectively. The ex-vessel value of snail meats in 1977 was probably higher than the reported $600. At these ex-vessel prices, the 1977 eastern Bering Sea catch was worth only $242,000 and the 1978 catch was worth $1.3 million. In 1979, if the total catch is similar to that made in 1978 (2,187 t of edible meats), its ex-vessel value will probably be in excess of $3.6 million.

Until recently, there was no U.S. regulation of the eastern Bering Sea snail fishery. Implementation of the Fishery Conservation and Management Act of 1976 gave the United States a tool to monitor and manage the snail fishery within the 200-mile conservation zone. At this time, a preliminary management plan developed by NMFS is being used by the North Pacific Fishery Management Council to manage the fishery.

Because there is currently no domestic fishery for snails in the eastern Bering Sea, the total allowable catch has been allocated to Japan, the only nation now involved in the fishery. So little data are available on the snail resource and fishery that Japan's 1977 and 1978 quotas were set at the same level as previous yearly catches, i.e., 3,000 t of edible meats. Changes in total allowable catch and Japan's harvest level will depend upon newly acquired biological and socioeconomic data.

## Prospects for a U.S. Snail Fishery

United States fishermen have made little effort to initiate a domestic fishery for snails in the eastern Bering Sea. With only slight modifications, domestic crab vessels currently fishing for king and snow (Tanner) crab in the eastern Bering Sea could fish for snails.

Although there has been little progress toward a domestic snail fishery in the Bering Sea, seafood processors have made several recent attempts to initiate fisheries in other parts of Alaska. In Prince William Sound, as in many other areas of the Gulf of Alaska, snails are regularly taken in crab pots despite the large mesh used. New England Fish Company[6], Petersburg Fisheries, Inc., and others have had samples of Alaskan snails analyzed and have explored marketing possibilities. North Pacific Processors of Cordova, in an effort to build a broader based Prince William Sound pot fishery, installed a snail crushing machine and purchased snails from fishermen during the 1977-78 snow crab season. Only 5,000 pounds of snails were delivered during the season. Small deliveries were attributed to relatively good snow crab fishing, the low price (US$0.06-0.10/pound) paid to fishermen, and the unexpectedly low concentrations of snails encountered.

The current attempt to develop a snail fishery in Nova Scotia, Canada, should be of interest to Alaskan processors. The Nova Scotia Department of Fisheries has developed an escargot-like product that is produced from marine snails similar to those found in Alaska. It is attempting to develop a market for the marine snails *Buccinum undatum* and *Neptunea decemcostata* that are taken in the lobster pot fishery[7].

## Discussion

Snails are an underutilized resource in Alaska. Although our knowledge of their distribution and relative abundance is increasing, a data base that provides estimates of stock size and condition is not yet available. Studies on distribution and abundance, species associations, age and growth, trophic

[6]Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

[7]Ernest Cadegan, Nova Scotia Department of Fisheries, Box 2223, Halifax, Nova Scotia, Canada. Pers. commun.

relationships, and biochemical genetic relationships of four species of eastern Bering Sea *Neptunea* are now being conducted by NMFS.

The prospects for rapid development of Alaska's snail resources are uncertain. Snail stocks in the Gulf of Alaska are essentially unexploited and eastern Bering Sea stocks may well be underexploited. Recent fluctuations in snail catch and effort in the Japanese eastern Bering Sea fishery are probably a response to political and economic factors and not to the availability of snails. The increased cost of distant water fisheries and the remarkably low dockside value of snail meats (est. $1,700/t in 1978) would seem to limit the growth of the fishery. The recent reduction of Japanese snail allocations in the 200-mile fisheries zone of the U.S.S.R. and the strength of the Japanese yen in world money markets, however, might have the opposite effect.

Domestic fishermen and processors have expressed interest in the Alaskan snail resource, but their future involvement is more uncertain than the future involvement of Japan. The rapidly expanding and highly profitable king and snow crab fisheries are currently dominating domestic fishing activities in the area. While crab vessels would be well suited to snail pot fishing, most crab fishermen are looking at Gulf of Alaska and eastern Bering Sea bottomfish stocks as an alternate or supplemental activity. Attempts to initiate a snail fishery in the Gulf of Alaska have not been productive to date. They have been exploratory in nature but show promise as potential off-season operations in the next few years. As in the eastern Bering Sea, the resource and harvesting capacity now exists. Innovative processing and marketing techniques as well as continued increase in the value of the traditional frozen meat product will be necessary conditions for the initiation of a domestic snail fishery.

## Literature Cited


MacIntosh, R. A., and A. J. Paul. 1977. The relation of shell length to total weight, tissue weight, edible-meat-weight, and reproductive organ weight of the gastropods *Neptunea heros*, *N. lyrata*, *N. pribiloffensis*, and *N. ventricosa* of the eastern Bering Sea. Proc. Natl. Shellfish. Assoc. 67:103-112.

Nagai, T. 1974. Studies on the marine snail resources in the eastern Bering Sea. I. Species composition, sex ratio and shell length composition of snails in the commercial catch by snail-basket-gear in the adjacent waters of Pribiloff Islands, 1973. [In Jpn., Engl. abstr.] Bull. Far Seas Fish. Res. Lab. 10: 141-156.

________. 1975a. An analysis of the snail fishing data in the eastern Bering Sea. I. On the variation of catch per unit effort. [In Jpn., Engl. abstr.] Bull. Far Seas Fish. Res. Lab. 12:121-135.

________. 1975b. Studies on the marine snail resources in the eastern Bering Sea. II. List of Gastropoda and Bivalvia (Mollusca) species collected with snail-basket and some informations about the incidental catch in the adjacent waters of the Pribiloff Islands, 1973. [In Jpn., Engl. abstr.] Bull. Far Seas Fish. Res. Lab. 12:137-143.

Shuto, T. 1974. Larval ecology of prosobranch gastropods and its bearing on biogeography and palenontogy. Lethaia 7:239-256.

Thorson, G. 1950. Reproductive and larval ecology of marine bottom invertebrates. Biol. Rev. (Camb.) 25:1-45.

Report #2 CRUISE # 002 VESSEL CODE JP01

Vessel Name CHOSEI MARU NO. 78

Observer KARL A. SCOTT Contracting Agency UNIV OF WA

Itinerary : (Local Dates and Times)

Depart Seattle 0700 JUL 17 PDT Return Seattle 0030 AUG 31, 1984

Depart Port for Vessel 1100 JUL 18 Return to Port from Vessel AUG 29, 1984

Port of Departure DUTCH HARBOR Port of Return DUTCH HARBOR

U.S. Transfer Co. "BALLYHOO BABY" U.S. Transfer Co. "PAPILLA"

GMT Dates and Times

Arrival Aboard Vessel 2000 JULY 18 Depart Vessel 2130 GMT AUG 29

Dates Not Sampled (if any, and reasons why) JUL 20-22, SICK ; ROUGH WEATHER

JUL 29 AUG 2, 3, 21, 22, 28 ; AUG 15-19 - TO DUTCH HARBOR FOR REPAIR PARTS

Date Sampling Began JUL 25 Date Sampling Ended AUG 27

Total # Days Sampled 25

Sampling on Other Ships : Cr.# ______ ______ ______

Vessel Name ______ ______ ______

Dates Aboard ______ ______ ______

Name and Dates Aboard Ships Used as Transport Only : ______

Customs Check : Location DUTCH HARBOR Date AUG 29 Time 1250
(Local Date and Time)

Vessel Statistics Permit # JA-84-0838 Vessel Type LONG LINE — SNAIL POT

Length 47.55 m Width 8.8 m Draft 3.58 m

Gross Tonnage 349.76 Net Tonnage 159.22

Engine Type DIESEL Horsepower 1140

Year Commissioned 1968 Radio Call Sign JNCS

Company TAKUYO SUISAN K.K.

Home Port OMUCHO, HAKAIDO, JAPAN

Name and position of officers important in fishing operation, factory, sampling :

Captain : YOSHIKATSU SAITO FISHING MASTER : YUKIMA HARITA

FACTORY MGR : TAIICHI MATSUDA RADIO OFFICER (AND SAINT) TOSIO NAGASHIMA

# Officers 5 #Crew 16 #Processing ______ Total Ship Complement 21

Report No. 2

The *Chosei Maru No. 78* was commissioned in 1968 and to some extent shows her age. The general cleanliness of the vessel belowdecks is poor, but the officers' quarters and the bridge are relatively spotless, shoes-prohibited areas. The fishing master (who is also the owner's nephew) evicted the captain from his cabin to make room for the observer. The cabin was cramped, but adequate; I couldn't stand up to full height but could almost stretch out on the bunk (74"). Storage space is minimal and a small desk proved inadequate for me. The radio officer in the next room generously allowed me to use his rather large and comfortable table for paperwork (Nagashima is a real Saint and speaks the best English aboard). The captain's cabin door could apparently be locked for assured privacy if one had the key, but I found the Japanese to be quite respectful of closed doors. Safety conditions are no problem. The vessel seems quite seaworthy and the snail fishery has none of the heavy gear which make even new trawlers hazardous. Slippery decks and low clearance belowdecks are the chief concerns. I never wore a hardhat belowdecks as this only added more to my height and limited peripheral vision. The food aboard was wonderful, but be warned that the water is not safe unless boiled - believe me! I was treated really well overall and think most observers would enjoy a cruise on this vessel. I suggested to the captain that next year the observer may be a female, to which he responded unfavorably, citing the smallness of the ship, the condition of the bathroom, and the proclivities of the cook; but I think he accepted the possibility and some refurbishing of the vessel is planned for this winter.

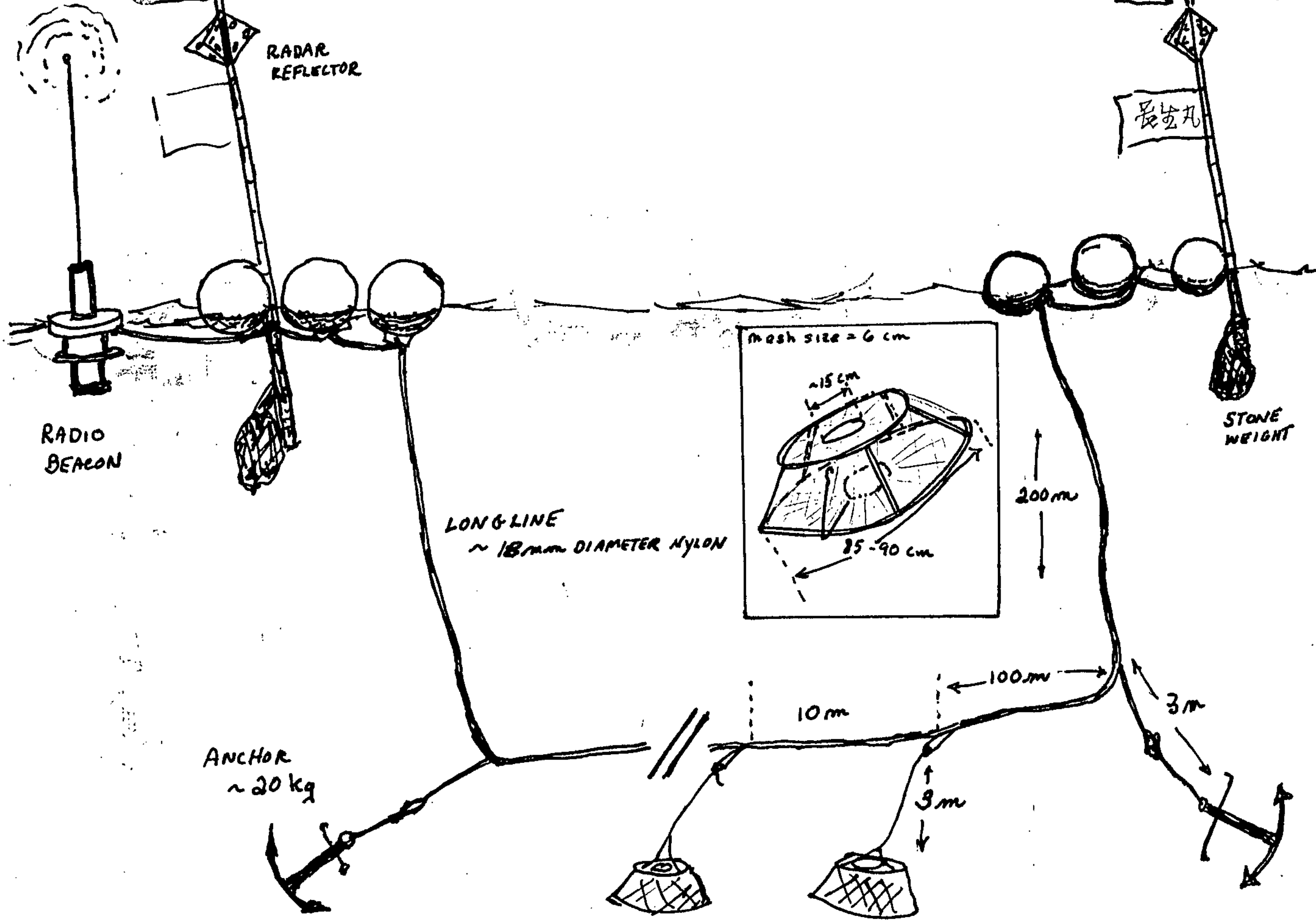
If 1984 is an accurate indication the *Chosei Maru 78* may be a relic of the snail-pot fishery. In 1982 and 1983 the *Chosei Maru* and the *Hoyo Maru* were the only snail-pot vessels to come to the eastern Bering Sea. This year the *Hoyo Maru* went squid fishing instead during the summer break between snail seasons in Soviet waters. The added economic burden of the Observer program may force the owners of *Chosei Maru* to make a similar choice.

From years past the Japanese have set up a grid of 30'x 60' areas all across the Bering Sea from which they report catch statistics. Saito, the captain, explained to me that fishing has traditionally been in Area 9 (58°00' - 58°30'N, 172° - 173°W) Area 20 (58°30' - 59°00'N, 172° - 173°W) and Area 21 (58°30 - 59°00'N, 173° - 174°W). For the last 3 years effort has been mainly in Area 9. Depths are usually from 100 - 130 meters. The presence of trawlers (looking for pollock, I assume) may cause them to relocate to avoid gear loss (Apparently Americans involved in JV are respectful of the longline gear, but the Japanese small trawlers working with motherships are not. I'd be interested to hear if observers have recovered snail pots aboard these vessels). The captain also claims that sea-lice are so prevalent inshore and in some areas that fishing success is reduced since they devour the bait. Surprisingly one factor that did not seem to affect location was snail abundance! We followed a semi-organized exploratory pattern, moving apparently according to plan rather than re-setting where snail size and abundance seemed most profitable.

The general fishing procedure is as follows. Ten (10) groundlines, each with 600 pots/set were deployed, the idea being to retrieve on average 5 per day, giving an average "soak time" of 2 days. The dimensions and basic configuration of a set may be seen in the attached gear diagram. Large quantities of sardines, pollock, and cod heads were brought out on deck from the freezer to thaw, and were used in combinations as bait. Sets were deployed rapidly at a vessel speed of 7 - 8 knots, and usually taking 20 - 25 minutes.

The sets were located by individual radio beacons for each set. Each set had "high flyers" at each end with color-coded flags for additional identification. Sets were retrieved by use of a large (~ 0.7 m diameter) hydraulic pinch-hauler located on the starboard side. The captain or the fishing master stood by at an auxilary steering station just above, in order to maneuver the vessel with respect to the line as it was brought aboard. The hauler operated

# DIAGRAM OF SNA●POT LONGLINE



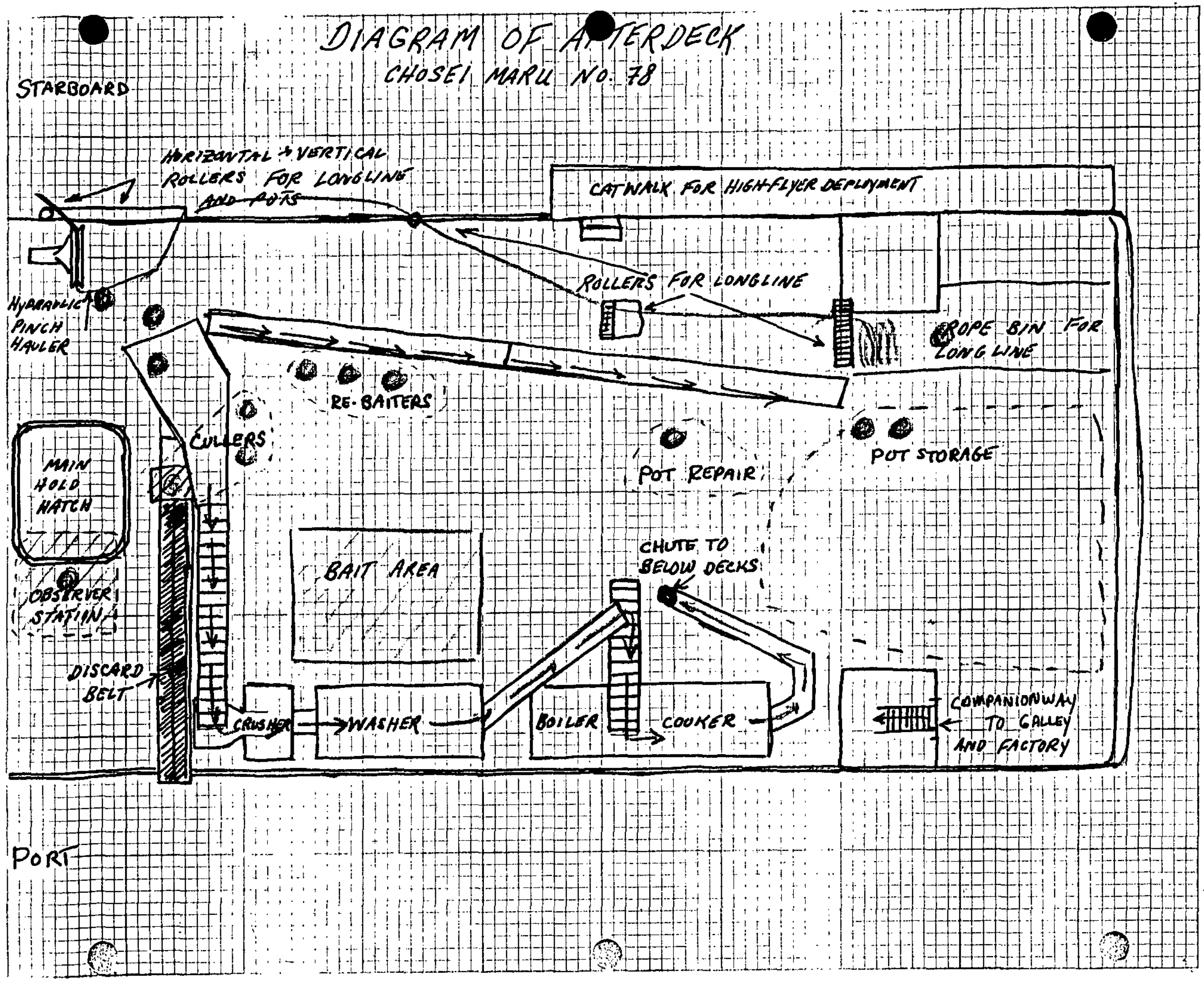


DIAGRAM OF AFTERDECK
CHOSEI MARU NO. 78
STARBOARD
HORIZONTAL + VERTICAL ROLLERS FOR LONGLINE AND POTS
CATWALK FOR HIGH-FLYER DEPLOYMENT
ROLLERS FOR LONGLINE
HYDRAULIC PINCH HAULER
ROPE BIN FOR LONG LINE
RE-BAITERS
CULLERS
POT REPAIR
POT STORAGE
MAIN HOLD HATCH
OBSERVER STATION
BAIT AREA
CHUTE TO BELOW DECKS
DISCARD BELT
CRUSHER
WASHER
BOILER
COOKER
COMPANIONWAY TO GALLEY AND FACTORY
PORT

at a continuous rate under normal conditions, and retrieval time could be used as a check against the number of pots per set given by the captain for Form 1-S. With the present hydraulic system retrieval of 500-600 pots usually takes about 78 minutes, unless the weather is rough or a foul up occurs.

Once aboard the pots are disconnected quickly (the knot is a "slipped bowline") and passed up to a man standing on a low table; he dumps the catch by releasing an elastic "pucker line" and passes the empty pot along to workers standing by a long conveyor belt. They re-bait the trap, check its state of disrepair, and send it back to crewmen on the stern who stack the set neatly so that redeployment will be easy and efficient. Two men occupy the rope bin, neatly arranging the groundline for the next deployment and placing the loops where pots are tied onto pegs where they will be easily accessible to the "knot-tier" (Bosun).

Meanwhile the catch is channeled down the sloping table to an elevator belt which leads to the crusher. On this table bycatch is removed and sent overboard on an adjacent discard belt. Also, large snails, mostly Neptunea, are removed for later processing with different crusher settings and cooking time. The crusher consists of two parallel cylinders with rounded, meshing cogs and serves to break up most of the shells and to separate some of the softer, unwanted tissues. The snails are then channeled through a long washer and up into the ~~[illegible]~~ cooker. Cooking times given by the captain are 3 min 30 sec - 4 min. for small snails and 4 - 4 min 30 sec for large ones. Temperature was given as 100°C, but may be higher as it is sea water near boiling.

Snailmeats and shell debris are then shunted belowdecks into one of three large aggitator-washers with horizontal spray arms which rotate through the slurry of snail debris to finish the breaking up of product from waste tissue. The factory manager controls this busy step in processing and also the release from these tanks of the snails, which travel down a separation canal where shell bits settle out. He controls the flow of water and snailmeats down this canal, and removes the debris that collects at each of several baffles. Whole snailmeats will float along with the current he creates; shell fragments, and small unbroken snails, and a small portion of the snailmeats are discarded as they accumulate. The snails that reach the end of this canal go through a final wash and then up on the sorting table where they are packed into 10-kilogram trays to be frozen. They are sorted on the basis of size, either large or small; fragments of meat, proboscis, etc. are discarded. Only the main fleshy part of the snail is desired but it's fine if the proboscis, penis, or operculum is still attached. Trays are stacked in an adjoining room where they accumulate for two, and sometimes three, sets. As Larges and Smalls come through processing separately (for the most part) sets can be distinguished. The factory manager counts the trays and records the numbers of trays of large and small meats on a chalk board. The trays are frozen for several hours in plate freezers before being stacked below in the hold. I noticed only small discrepancies between the number of trays I counted and the number recorded by the factory manager. These differences are due to partial trays which were held out until filled, or by small amounts left in the aggitator or elsewhere in the processing line. The small discrepancies averaged out over the course of the day so I gave up verifying pan counts after a few weeks and used the figures recorded by the factory manager (Further, a hold inventory during the Coast Guard boarding revealed no sizeable difference from the weights logged by the captain).

My sampling procedure was fairly straightforward. Sample size was simply the number of pots per set that I sampled for species composition or monitored for incidence of prohibited species. My standard sample procedure was to stand by the discard belt and elevator belt with a thumb counter. I would monitor 30 pots for incidence, tossing crab, cod, etc. into a basket for later counting and weighing. Then I would collect the contents of 4 pots for species composition. I would remove the main species, Neptunea pribiloffensis, to reduce the sample to a more manageable size and to allow some time to pass before the process was repeated. Species which I was monitoring for incidence were removed from the species composition sample and added to the incidence sample. The result was two samples of 100 and 12 pots, for incidence and species composition respectively, collected throughout the set in an order of 30-4-30-4-28-4. Occasionally I was forced to reduce sample size due to time limitations, rough weather, or particularly high incidence of snails or crabs.

Method B

On many of my samples I sorted the N. pribiloffensis and N. lyrata according to size, much as the crew was doing. By comparing the numbers of baskets of large Neptunea held out by the crew, to the percentages of large Neptunea in my samples, I was able to make a second, fairly independent estimate of whole snail catch and corresponding PRR values. I called this "method B", and found comparisons to the direct extrapolations helpful. "method A", however, remained the catch of record, even when suspect (See PRR data chart for an example of this, and PRR summary sheet for further explanations of PRR). Method A was a simple extrapolation from my sample weights depending on the number of pots sampled and the estimated number of pots per set. The number of pots actually retrieved was variable, as a few pots were inevitably lost, or perhaps a trawl-damaged set was lengthened piecemeal. I usually stuck with 580 pots as a good estimate unless the captain recorded a smaller figure. As the sets are individually recognizable, the status of a known short set could be watched, and the captain's quote of pot numbers questioned. Other checks for short sets are the amount of deck space it takes up before re-deployment and the amount of time it takes to haul back. I found that they were usually quite trustworthy.

Method A

After washing down the remaining snails I would dump them on the port side of the main hatch and sit down to sort. I arranged three baskets at my feet to receive the most common Buccinum species, and distributed the less common species into small piles. This hatch served as a table and was conveniently located near to the belts, the pot hauler, and a salt-water hose. Unfortunately it was also quite exposed and weather interupted my sampling several times. As we hauled back on the starboard, it was necessary (or atleast favorable) to keep the wind on the port bow, especially when it was blowing above 35 knots. It would whip around the super structure then creating havoc with my little piles of snails and making weighing ridiculous. I can see no remedy for this which I could consider practical.

My length-frequency data was obtained from additional subsamples usually or from the last sub sample of four pots for species composition. I would measure ~~the~~ all of the *Buccinum* or *Neptunea* in a two-pot sample, for example. After getting used to other duties I began taking sexed length-frequencies of the main species, a more time-consuming task than unsexed length-frequencies. My method was to tally the snail's length, then break it open to determine sex by the presence or absence of a penis, then to change the tally mark to an "F" or "M". *Buccinum* species received more emphasis towards the end of my cruise. Sexing of very small snails was questionable at first, but definite penises on many quite small *N. pribiloffensis* was encouraging.

See MacIntosh for description of method

I thought that the product recovery work I did was one of my most important duties since it gives a basis for the conversion factor I suggested to the officers for estimating whole snail weight. As there are many factors affecting PRR, I tried to approach it from several different angles in hopes of gaining some understanding of these variables. There's still a lot to do. I thought it was impractical to follow a set quantity of snails through the factory - it would have to be a relatively small quantity and would probably not yield information pertinent to the factory's normal operation. I therefore worked mainly from estimated snail catch figures compared to reliable factory figures, and from estimated average weights of whole snails compared to estimates of snailmeat average weights. I have compiled the data for PRR using both Method A and Method B, and also the narrative which follows:

General information can be gleaned directly from my radio messages, by dividing total snail weight into snailmeat weight. Remember that the total snail weight is an extrapolation from sampled sets to all sets, and snailmeats represents an actual factory figure for all sets.

Week ending 8/4 = 16.09 %
8/11 = 16.67
8/18 = 16.61
8/25 = 16.52

The average of these four PRR values is 16.47%, yielding a reciprocal conversion factor of 6.07.

From the 58 sets that I sampled for species composition I obtained an average PRR estimate of 16.76% using Method A, the standard extrapolation procedure. Method B consisted of the following:

"B" est. of W.S. = (The number of baskets of Larges for set × 65 kg/basket) / (% of Larges in Sample)

For the 44 sets where I used both methods, A yielded 16.66% and B yielded 17.68%. Method B is obviously limited by the necessity that I must make judgements similar to those of the culling crew if our percentages are to be comparable. These estimates both are for total catch and include the portion of snails that escape processing due to small size and wastage.

I noticed early on that there was often a 1:1 ratio of baskets of larges to trays of large meats and thought this might prove helpful. If an average basket weighs 65 kg and produces 10 kg of meats the resulting PRR est would be 15.38%. From the 40 sets sampled after Aug. 1 656.8 baskets produced 662 trays according to factory figures (a 1:1.008 ratio) so the ratio is valid. A comparison of average weights, however, suggests that some of the snails are "lost" (probably reclassified as small meats or lost to wastage. From data collected on Aug. 1:

| Baskets # | wt. | # Larges | ave wt. | Trays | wt. | # | ave. wt. |
|---|---|---|---|---|---|---|---|
| 1 | 65.3 kg | 440 | 148 g | 1 | 10.00 kg | 385 | 25.97 g |
| 2 | 62.5 | 406 | 154 | 2 | " | 382 | 26.18 |
| 3 | 67.6 | 455 | 149 | 3 | " | 361 | 27.70 |

Although these figures don't represent the same exact snails, the differences in average numbers per basket vs. per tray (437 vs. 376) seem to indicate that over 10% (14.0%) are not accounted for. While a PRR estimate of the weights (assuming a 1:1 ratio of baskets to trays) gives a figure of 15.4%, a comparison of the average weights of snailmeats ÷ whole snails = 17.4%

Late in the cruise I attempted a similar comparison with Buccinum species thinking I could get some idea of PRR if I could separate the meats in snailmeat trays on the basis of Buccinum sp. vs. other species. The three times I attempted this I got values of 30.6%, 30.0%, and 21.7% (8/23, 8/24).

Admittedly these values are somewhat erratic, but I think some broad observations can be made. Buccinum species have a significantly higher PRR and will increase the overall PRR favorably when they are abundant, as they were towards the end of my cruise. The very small species like Colus halli may pass through the processing plant completely entire, and can be considered as wasted. The majority of the less common species play virtually no role as far as production is concerned — the "big four" are Neptunea pribiloffensis, Buccinum scalariforme, B. plectrum, and B. angulosum. They constitute 90+% of the catch and their relative abundance determines PRR. The size distribution of N. pribiloffensis also affects PRR (and, of course, the percentage of large meats). Larger snails may have a lower recovery rate since much biomass is tied up in gonadal tissue and digestive tract, and their shells are sometimes excessive; but this is balanced by a higher ex-vessel price for large meats (500¥ per kilo vs. 400¥ per kilo for small meats).

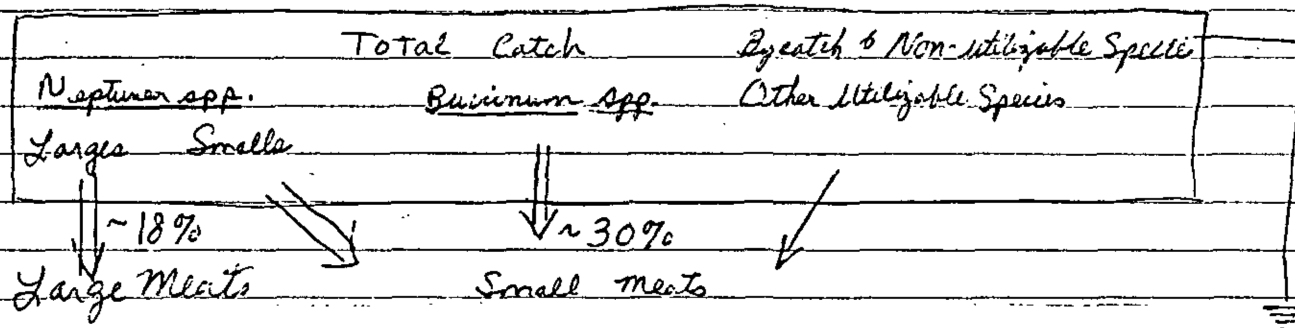
Karl Scott
Chozei Maru No. 78
JPO1
002
July 18 - Aug 28, '8

# P.R.R. DATA

| DATE & SET | METHOD A: OB. EST. W.S. | METHOD A: SNAMTS. FAC. FIGS. | METHOD A: EST. PRR | TRAYS SMALL | METHOD B: TRAYS LARGE | METHOD B: % L.ND SAMPLE | METHOD B: BASKETS L.ND | METHOD B: W.S. EST | METHOD B: EST. PRR | METHOD B - A: | % Buccinum BY WT. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/23 - #3 | 3.50 MT | .46 MT | 13.1% | | | | | | | | |
| #5 | 3.41 | .63 | 18.5 | | | | | | | | |
| 7/24 - #2 | 4.12 | .56 | 13.6 | | | | | | | | |
| #4 | 4.41 | .57 | 12.9 | | | | | | | | |
| 7/25 - #5 | 4.14 | .73 | 17.6 | | | | | | | | |
| 7/26 - #1 | 4.23 | .54 | 12.8 | | | | | | | | |
| #3 | 3.27 | .68 | 20.8 | | | | | | | | |
| #5 | 2.47 | .46 | 18.6 | | | | | | | | |
| 7/27 - #2 | 3.67 | .65 | 17.7 | 48 | 17 | 30.9% | 16 | MT 3.67 | 17.7% | 0 | |
| #4 | 4.03 | .64 | 15.9 | 37 | 27 | 44.0 | 29 | 4.28 | 15.0 | - 0.9 | |
| #5 | 1.30 | .43 | 33.1 | | | | | | | | |
| 7/28 - #2 | 5.26 | .81 | 15.4 | 52 | 29 | | 29 | | | | |
| #4 | 4.68 | .70 | 15.0 | 39 | 31 | | 29 | | | | |
| #5 | 4.08 | .68 | 16.7 | 46 | 22 | | 21 | | | | |
| 7/30 - #1 | 5.94 | .79 | 13.3 | 49 | 30 | | 28.5 | | | | |
| #3 | 4.16 | .79 | 19.0 | 46 | 33 | 32.8 | 31 | 6.14 | 12.9 | -6.1 | |
| #5 | 4.71 | .64 | 13.6 | 35 | 29 | 38.2 | 29 | 4.93 | 13.0 | -0.6 | |
| 7/31 - #2 | 5.10 | .91 | 17.8 | 57 | 34 | 37.3 | 31 | 5.40 | 16.9 | -0.9 | |
| | | | | | | | | | | | |
| 8/1 - #1 | 4.53 | .85 | 18.8 | 54 | 31 | 43.3 | 30.5 | 4.58 | 18.6 | -0.2 | |
| #4 | 4.07 | .73 | 17.9 | 37 | 36 | | 35 | | | | |
| 8/4 - #1 | 5.49 | .72 | 13.1 | 44 | 28 | 46.9 | 30.5 | 4.23 | 17.0 | +3.9 | 16.5% |
| #3 | 5.86 | .93 | 15.9 | 57 | 36 | 42.4 | 33 | 5.06 | 18.4 | +2.5 | 19.8 |
| 8/5 - #2 | 5.45 | .89 | 16.3 | 46 | 43 | 52.6 | 40 | 4.94 | 18.0 | +1.7 | 13.2 |
| #4 | 4.21 | .70 | 16.6 | 41 | 29 | 42.6 | 30 | 4.58 | 15.3 | -1.3 | 23.0 |
| 8/6 - #1 | 3.33 | .64 | 19.2 | 46 | 18 | 33.2 | 18 | 3.52 | 18.2 | -1.0 | 23.9 |
| #3 | 3.59 | .65 | 18.1 | 43 | 22 | 44.9 | 22.5 | 3.26 | 19.9 | +1.8 | 25.7 |
| #5 | 2.70 | .46 | 17.0 | 28 | 18 | 41.8 | 18 | 2.80 | 16.4 | -0.6 | 22.0 |
| 8/7 - #2 | 3.35 | .54 | 16.1 | 38 | 16 | 39.3 | 18 | 2.98 | 18.1 | +2.0 | 28.0 |
| #4 | 3.65 | .57 | 15.6 | 32 | 25 | 40.6 | 21 | 3.36 | 17.0 | +1.4 | 27.6 |
| 8/8 - #2 | 4.23 | .66 | 15.6 | 41 | 25 | 42.1 | 26 | 4.01 | 16.4 | +0.8 | 17.8 |
| #4 | 3.77 | .59 | 15.6 | 36 | 23 | 39.0 | 24 | 4.00 | 14.8 | -0.8 | 27.8 |
| 8/9 - #1 | 3.63 | .60 | 16.5 | 43 | 17 | 31.3 | 18 | 3.74 | 16.1 | -0.4 | 23.4 |
| #3 | 2.86 | .59 | 20.6 | 40 | 19 | 36.1 | 18 | 3.24 | 18.2 | -2.4 | 30.2 |
| 8/10 #1 | 2.70 | .43 | 15.9 | 35 | 8 | 29.4 | 9.5 | 2.10 | 20.5 | +4.6 | 44.9 |
| #3 | 2.60 | .52 | 20.0 | 40 | 12 | 26.8 | 12.5 | 3.03 | 17.2 | -2.8 | 42.4 |

# SUMMARY OF PRR DATA (continued)

| DATE + SET | METHOD A: OB. EST. W.S. | METHOD A: SNAMTS FAC. FIG. | METHOD A: EST. P.R.R. | METHOD B: TRAYS SMALL | METHOD B: TRAYS LARGE | METHOD B: % L. No SAMPLE | METHOD B: BASKETS L. No. | METHOD B: EST. W.S. | METHOD B: EST. P.R.R. | DIFF. (B-A) | % Buc. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/11 - #2 | 3.29MT | .51MT | 15.5% | 35 | 16 | 23.5 | 15.5 | 4.31MT | 11.8% | -3.7 | 36.6% |
| #4 | 3.02 | .51 | 16.9 | 38 | 13 | 27.8 | 12.3 | 2.88 | 17.7 | +0.8 | 32.8 |
| #5 | 3.06 | .46 | 15.0 | 33 | 13 | 27.2 | 13 | 3.11 | 14.8 | -0.2 | 30.3 |
| 8/12 - #1 | 3.12 | .57 | 18.3 | 44 | 13 | 28.1 | 13.5 | 3.12 | 18.3 | 0.0 | 42.7 |
| #3 | 4.29 | .60 | 14.0 | 46 | 14 | 30.0 | 14 | 3.03 | 19.8 | +5.8 | 45.6 |
| #5 | 3.37 | .60 | 17.8 | 44 | 16 | 26.4 | 15 | 3.69 | 16.2 | -1.6 | 36.0 |
| 8/13 - #2 | 3.62 | .62 | 17.1 | 45 | 17 | 18.8 | 16 | 5.62 | 11.0 | -6.1 | 43.3 |
| #3 | 4.05 | .58 | 14.3 | 47 | 11 | 21.8 | 10.5 | 3.13 | 18.5 | +4.2 | 44.4 |
| #5 | 2.65 | .58 | 21.9 | 50 | 8 | 17.4 | 8.5 | 3.18 | 18.2 | -3.7 | 39.4 |
| 8/14 - #1 | 3.97 | .66 | 16.6 | 51 | 15 | 30.1 | 14 | 3.02 | 21.9 | +5.3 | 40.7 |
| 8/19 - #2 | 4.58 | .72 | 15.7 | 59 | 13 | 21.9 | 12 | 3.56 | 20.2 | +6.2 | 37.3 |
| #4 | 3.86 | .57 | 14.8 | 49 | 8 | 22.0 | 9.5 | 2.81 | 20.3 | +4.5 | 42.8 |
| #6 | 4.24 | .74 | 17.5 | 65 | 9 | 15.0 | 8 | 3.47 | 21.3 | +3.8 | 36.2 |
| 8/20 - #2 | 5.11 | .67 | 13.1 | 59 | 8 | 17.2 | 8.5 | 3.21 | 20.9 | +6.8 | 39.2 |
| #4 | 4.13 | .64 | 15.5 | 56 | 8 | 16.1 | 8 | 3.23 | 19.8 | +4.3 | 34.8 |
| #6 | 3.47 | .51 | 14.7 | 45 | 6 | 16.1 | 6 | 2.02 | 25.2 | +10.5 | 42.9 |
| 8/23 - #2 | 4.07 | .70 | 17.2 | 60 | 10 | 15.4 | 12 | 5.06 | 13.8 | -3.4 | 34.3 |
| #4 | 2.46 | .63 | 25.6 | 54 | 9 | 13.0 | 9 | 4.50 | 14.0 | -11.6 | 47.2 |
| 8/24 - #2 | 3.94 | .44 | 11.2 | 38 | 6 | 18.6 | 6 | 2.10 | 21.0 | +9.8 | 41.4 |
| #5 | 2.98 | .49 | 16.4 | 38 | 11 | 24.1 | 8 | 2.16 | 22.7 | +6.3 | 37.5 |
| 8/26 - #2 | 4.27 | .62 | 14.5 | 53 | 9 | 17.5 | 9 | 3.34 | 18.6 | +4.1 | 37.8 |
| #4 | 4.33 | .63 | 14.5 | 54 | 9 | 19.7 | 11 | 3.63 | 17.4 | +2.9 | 39.7 |
| 8/27 - #2 | 3.68 | .73 | 19.8 | 59 | 14 | 21.7 | 13 | 3.89 | 18.7 | -1.1 | 30.3 |




Someone might like to play with our data on the computer as a modelling problem to better understand how species composition and size distribution affects PRR.

In summary I had an enjoyable cruise; the snail fishery is definitely different, and the problems were an interesting challenge. I think there are several things that should be changed by next year in order to make things work better. The cloudy problem of communications should be cleared up during the off-season so that the Japanese fishing company can make decisions based on facts. They may not be back next year for economic reasons. It would be unfortunate for us because this is a really valuable chance to get some good data cheaply. With that in mind, I recommend the extension of small quotas – for cod, as a concession to reality, and perhaps for other species as an incentive to encourage them to return. Octopus and sculpin, for example, could be lifted from the prohibited species list. Also the logging requirements need to be clarified and the NMFS enforcement agents notified – maybe a special logging form could be compiled without much difficulty.

Area fished by the CHOSEI MARU No. 78

Inclusive dates JULY 21 - AUG 28 1984

(Blackened squares indicate areas fished)

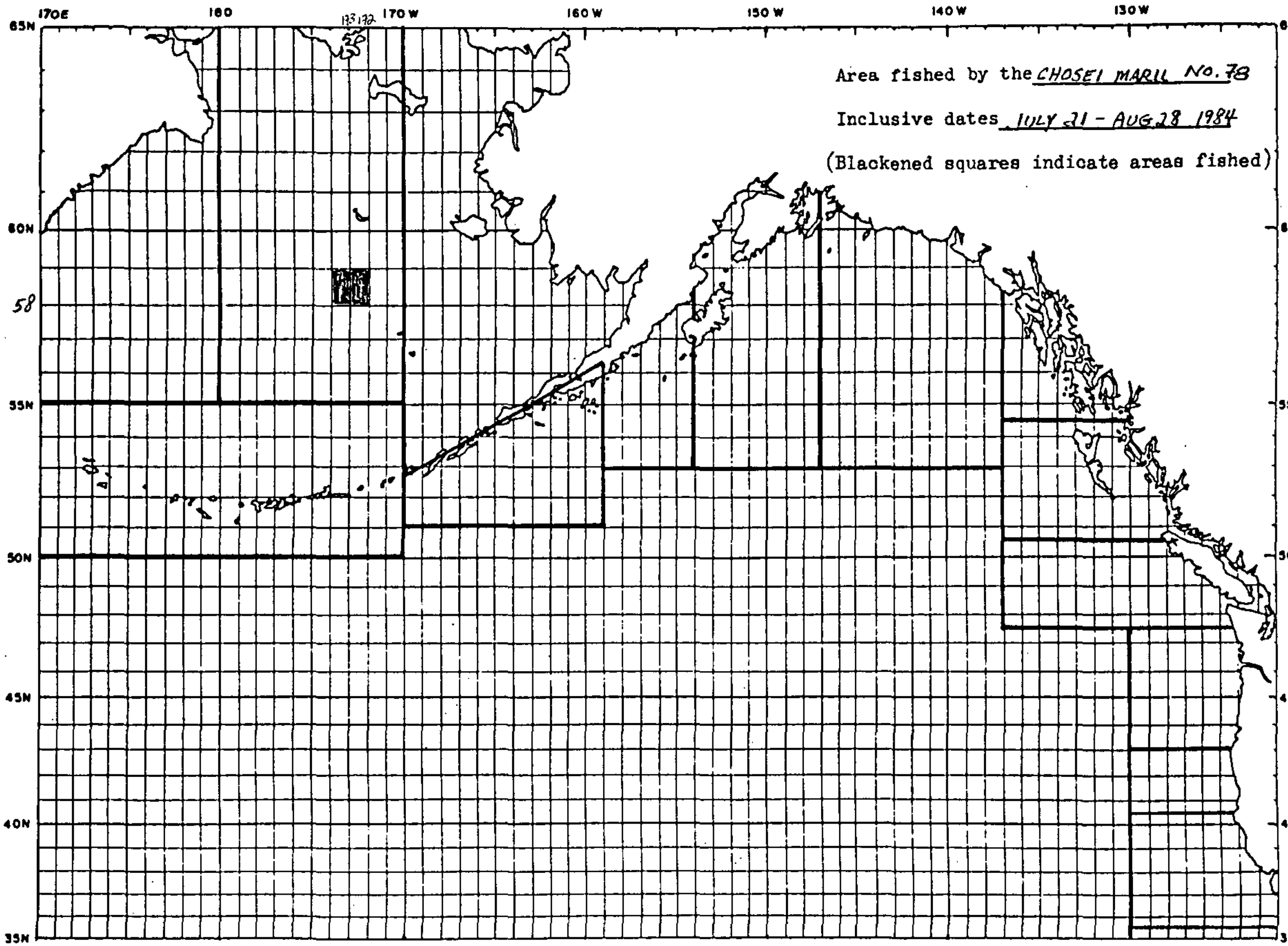


Table I. Ship's Snailmeat Reports, Observer's Snail Estimates, and PRR

| Set | Date | FM Tally | Norm. FM Tally | Total Meats | Yellow Large Meats | Yellow Small Meats | White Meats | Total Snails | Snails ------ Meats | Nep-tunea Snails | YL+YS ----- Nept. | Bucc. +Other Snails | W --------- Bucc.+Oth. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6/10 | 33 | 374 | 370 | 140 | 170 | 60 | 1635 | 0.226 | 1316 | 0.236 | 319 | 0.188 |
| 2 | 6/10 | 42 | 476 | 480 | 180 | 220 | 80 | | | | | | |
| 3 | 6/10 | 28 | 310 | 320 | 100 | 140 | 80 | 1287 | 0.249 | 1032 | 0.233 | 255 | 0.314 |
| 4 | 6/10 | 30 | 332 | 340 | 120 | 140 | 80 | 1729 | 0.197 | 1352 | 0.192 | 377 | 0.212 |
| 1 | 6/11 | 34 | 376 | 390 | 130 | 170 | 90 | | | | | | |
| 2 | 6/11 | 40 | 442 | 410 | 140 | 170 | 100 | | | | | | |
| 3 | 6/11 | 20 | 244 | 250 | 80 | 100 | 70 | 1680 | 0.149 | 1140 | 0.158 | 540 | 0.130 |
| 4 | 6/11 | 35 | 427 | 430 | 150 | 180 | 100 | | | | | | |
| 5 | 6/11 | 33 | 402 | 390 | 140 | 160 | 90 | 1999 | 0.195 | 1500 | 0.200 | 499 | 0.180 |
| 1 | 6/12 | 38 | 464 | 470 | 170 | 190 | 110 | | | | | | |
| 2 | 6/12 | 28 | 342 | 340 | 120 | 140 | 80 | 1869 | 0.182 | 1530 | 0.170 | 339 | 0.236 |
| 3 | 6/12 | 32 | 391 | 390 | 140 | 170 | 80 | | | | | | |
| 4 | 6/12 | 31 | 374 | 380 | 130 | 160 | 90 | 1774 | 0.214 | 1278 | 0.227 | 496 | 0.181 |
| [illegible] | 6/12 | 36 | 435 | 430 | 150 | 180 | 100 | | | | | | |
| 1 | 6/13 | 34 | 410 | 400 | 140 | 170 | 90 | 1670 | 0.240 | 1341 | 0.231 | 329 | 0.274 |
| 2 | 6/13 | 33 | 398 | 400 | 140 | 170 | 90 | | | | | | |
| 3 | 6/13 | 35 | 422 | 430 | 150 | 180 | 100 | 2483 | 0.173 | 1930 | 0.171 | 553 | 0.181 |
| 4 | 6/13 | 26 | 317 | 320 | 120 | 140 | 60 | 2175 | 0.147 | 1529 | 0.170 | 646 | 0.093 |
| 5 | 6/13 | 30 | 365 | 380 | 180 | 120 | 80 | | | | | | |
| 1 | 6/14 | 30 | 365 | 360 | 140 | 150 | 70 | 2014 | 0.179 | 1605 | 0.181 | 409 | 0.171 |
| 2 | 6/14 | 29 | 353 | 340 | 130 | 140 | 70 | | | | | | |
| 3 | 6/14 | 32 | 400 | 400 | 150 | 160 | 90 | | | | | | |
| 4 | 6/14 | 36 | 451 | 450 | 170 | 180 | 100 | | | | | | |
| 5 | 6/14 | 31 | 388 | 390 | 130 | 170 | 90 | 1900 | 0.205 | 1349 | 0.222 | 551 | 0.163 |
| 1 | 6/15 | 34 | 426 | 420 | 160 | 160 | 100 | 2154 | 0.195 | 1628 | 0.197 | 526 | 0.190 |
| 2 | 6/15 | 34 | 426 | 430 | 160 | 180 | 90 | | | | | | |
| 3 | 6/15 | 29 | 348 | 340 | 150 | 110 | 80 | 2263 | 0.150 | 1000 | 0.260 | 1263 | 0.063 |
| 4 | 6/15 | 30 | 360 | 360 | 150 | 120 | 90 | | | | | | |
| 1 | 6/16 | 29 | 348 | 370 | 160 | 120 | 90 | 2098 | 0.176 | 1565 | 0.179 | 533 | 0.169 |
| 2 | 6/16 | 31 | 372 | 350 | 150 | 110 | 90 | | | | | | |
| 3 | 6/16 | 33 | 396 | 400 | 170 | 130 | 100 | 2620 | 0.153 | 1760 | 0.170 | 860 | 0.116 |
| 4 | 6/16 | 32 | 384 | 390 | 170 | 120 | 100 | | | | | | |
| 5 | 6/16 | 30 | 361 | 360 | 170 | 100 | 90 | 1981 | 0.182 | 1455 | 0.186 | 526 | 0.171 |
| 6 | 6/16 | 28 | 336 | 330 | 160 | 90 | 80 | | | | | | |
| [illegible] | 6/17 | 30 | 361 | 370 | 170 | 110 | 90 | 2403 | 0.154 | 1970 | 0.142 | 433 | 0.208 |
| 2 | 6/17 | 26 | 312 | 310 | 140 | 90 | 80 | | | | | | |
| 3 | 6/17 | 36 | 472 | 360 | 170 | 110 | 80 | 2317 | 0.155 | 1922 | 0.146 | 395 | 0.203 |

Eiwa Maru No. 38 Cr#: 004 Vessel: JP02 
Nicholas Dean Pentcheff Report 2 7/19/85

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 6/17 | 32 | 419 | 440 | 210 | 120 | 110 | | | | | | |
| 5 | 6/17 | 28 | 367 | 390 | 190 | 110 | 90 | 2160 | 0.181 | 1576 | 0.190 | 584 | 0.154 |
| 1 | 6/18 | 19 | 249 | 270 | 130 | 70 | 70 | | | | | | |
| 2 | 6/18 | 26 | 341 | 360 | 170 | 100 | 90 | | | | | | |
| 3 | 6/18 | 36 | 472 | 500 | 240 | 140 | 120 | | | | | | |
| 4 | 6/18 | 23 | 300 | 300 | 130 | 90 | 80 | 1884 | 0.159 | 1353 | 0.163 | 531 | 0.151 |
| 5 | 6/18 | 25 | 326 | 330 | 140 | 100 | 90 | | | | | | |
| 1 | 6/19 | 34 | 444 | 440 | 190 | 130 | 120 | 2185 | 0.201 | 1782 | 0.180 | 403 | 0.298 |
| 2 | 6/19 | 37 | 483 | 480 | 210 | 140 | 130 | | | | | | |
| 3 | 6/19 | 38 | 496 | 500 | 210 | 160 | 130 | 2533 | 0.197 | 1890 | 0.196 | 643 | 0.202 |
| 4 | 6/19 | 39 | 499 | 500 | 240 | 140 | 120 | 2562 | 0.195 | 2050 | 0.185 | 512 | 0.234 |
| 5 | 6/19 | 37 | 473 | 470 | 230 | 130 | 110 | | | | | | |
| 6 | 6/19 | 41 | 524 | 510 | 250 | 140 | 120 | | | | | | |
| 1 | 6/20 | 20 | 256 | 260 | 130 | 70 | 60 | 1388 | 0.187 | 760 | 0.263 | 628 | 0.096 |
| 2 | 6/20 | 30 | 384 | 380 | 190 | 100 | 90 | | | | | | |
| 3 | 6/20 | 34 | 435 | 450 | 220 | 120 | 110 | | | | | | |
| 4 | 6/20 | 48 | 669 | 670 | 320 | 190 | 160 | 2550 | 0.263 | 1755 | 0.291 | 795 | 0.201 |
| 5 | 6/20 | 49 | 683 | 680 | 320 | 190 | 170 | | | | | | |
| 1 | 6/21 | 42 | 585 | 590 | 280 | 160 | 150 | 3095 | 0.191 | 2077 | 0.212 | 1018 | 0.147 |
| 2 | 6/21 | 41 | 571 | 570 | 270 | 160 | 140 | | | | | | |
| 3 | 6/21 | 36 | 502 | 500 | 240 | 140 | 120 | 2944 | 0.170 | 2370 | 0.160 | 574 | 0.209 |
| [illegible] | 6/21 | 29 | 398 | 400 | 180 | 110 | 110 | 1803 | 0.222 | 1180 | 0.246 | 623 | 0.177 |
| 5 | 6/21 | 27 | 371 | 380 | 170 | 100 | 110 | | | | | | |
| 6 | 6/21 | 36 | 494 | 490 | 220 | 130 | 140 | | | | | | |
| 1 | 6/22 | 43 | 590 | 590 | 270 | 150 | 170 | 3069 | 0.192 | 2080 | 0.202 | 989 | 0.172 |
| 2 | 6/22 | 44 | 604 | 600 | 270 | 160 | 170 | | | | | | |
| 3 | 6/22 | 30 | 412 | 410 | 180 | 110 | 120 | | | | | | |
| 4 | 6/22 | 47 | 650 | 660 | 300 | 210 | 150 | 3829 | 0.172 | 2967 | 0.172 | 862 | 0.174 |
| 5 | 6/22 | 37 | 511 | 510 | 240 | 160 | 110 | | | | | | |
| 1 | 6/23 | 44 | 608 | 600 | 280 | 190 | 130 | | | | | | |
| 2 | 6/23 | 30 | 415 | 410 | 190 | 130 | 90 | 1672 | 0.245 | 1292 | 0.248 | 380 | 0.237 |
| 3 | 6/23 | 41 | 567 | 570 | 260 | 180 | 130 | | | | | | |
| 4 | 6/23 | 43 | 628 | 630 | 260 | 200 | 170 | 2733 | 0.231 | 2150 | 0.214 | 583 | 0.292 |
| 5 | 6/23 | 32 | 468 | 470 | 200 | 140 | 130 | | | | | | |
| 1 | 6/24 | 34 | 497 | 500 | 210 | 160 | 130 | 2917 | 0.171 | 2292 | 0.161 | 625 | 0.208 |
| 2 | 6/24 | 33 | 482 | 480 | 200 | 150 | 130 | | | | | | |
| 3 | 6/24 | 40 | 585 | 580 | 240 | 180 | 160 | 3177 | 0.183 | 2260 | 0.186 | 917 | 0.174 |
| 4 | 6/24 | 37 | 474 | 470 | 220 | 150 | 100 | 2354 | 0.200 | 1922 | 0.193 | 432 | 0.231 |
| 5 | 6/24 | 38 | 486 | 490 | 230 | 160 | 100 | | | | | | |
| 1 | 6/25 | 29 | 372 | 360 | 170 | 120 | 70 | 1831 | 0.197 | 1135 | 0.256 | 696 | 0.101 |
| 2 | 6/25 | 33 | 423 | 430 | 200 | 140 | 90 | | | | | | |
| 3 | 6/25 | 30 | 384 | 390 | 180 | 130 | 80 | 2286 | 0.171 | 1805 | 0.172 | 481 | 0.166 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 6/25 | 34 | 480 | 470 | 190 | 180 | 100 | 2186 | 0.215 | 1695 | 0.218 | 491 | 0.204 |
| 5 | 6/25 | 35 | 494 | 510 | 250 | 130 | 130 | | | | | | |
| 1 | 6/26 | 30 | 424 | 420 | 190 | 150 | 80 | 2491 | 0.169 | 1965 | 0.173 | 526 | 0.152 |
| 2 | 6/26 | 38 | 537 | 500 | 240 | 170 | 90 | | | | | | |
| 3 | 6/26 | 28 | 395 | 430 | 220 | 140 | 70 | 2422 | 0.178 | 1950 | 0.185 | 472 | 0.148 |
| 4 | 6/26 | 30 | 389 | 390 | 170 | 130 | 90 | 2786 | 0.140 | 2365 | 0.127 | 421 | 0.214 |
| 5 | 6/26 | 28 | 363 | 360 | 160 | 120 | 80 | | | | | | |
| 6 | 6/26 | 34 | 441 | 440 | 190 | 150 | 100 | 2028 | 0.217 | 1625 | 0.209 | 403 | 0.248 |
| 1 | 6/27 | 29 | 376 | 380 | 180 | 130 | 70 | | | | | | |
| 2 | 6/27 | 29 | 376 | 380 | 170 | 130 | 80 | 2266 | 0.168 | 1635 | 0.183 | 631 | 0.127 |
| 3 | 6/27 | 35 | 454 | 450 | 200 | 150 | 100 | | | | | | |
| 4 | 6/27 | 29 | 404 | 390 | 200 | 140 | 50 | | | | | | |
| 5 | 6/27 | 31 | 432 | 430 | 210 | 140 | 80 | 2584 | 0.166 | 2225 | 0.157 | 359 | 0.223 |
| 6 | 6/27 | 33 | 460 | 470 | 230 | 150 | 90 | 2251 | 0.209 | 2000 | 0.190 | 251 | 0.359 |
| 1 | 6/28 | 26 | 363 | 370 | 190 | 120 | 60 | | | | | | |
| 2 | 6/28 | 27 | 376 | 380 | 170 | 140 | 70 | 1760 | 0.216 | 1388 | 0.223 | 372 | 0.188 |
| 3 | 6/28 | 29 | 404 | 400 | 190 | 100 | 110 | | | | | | |
| 4 | 6/28 | 33 | 479 | 480 | 220 | 140 | 120 | | | | | | |
| 5 | 6/28 | 30 | 436 | 430 | 230 | 110 | 90 | 2242 | 0.192 | 1705 | 0.199 | 537 | 0.168 |
| 6 | 6/28 | 28 | 407 | 390 | 200 | 120 | 70 | 2490 | 0.157 | 1933 | 0.166 | 557 | 0.126 |
| [illegible] | 6/29 | 25 | 363 | 360 | 170 | 110 | 80 | | | | | | |
| [illegible] | 6/29 | 24 | 348 | 360 | 170 | 110 | 80 | 2226 | 0.162 | 1767 | 0.158 | 459 | 0.174 |
| 3 | 6/29 | 26 | 377 | 390 | 190 | 110 | 90 | | | | | | |
| 5 | 6/29 | -- | | 490 | 240 | 170 | 80 | | | | | | |
| 6 | 6/29 | -- | | 410 | 180 | 160 | 70 | 2711 | 0.151 | 2208 | 0.154 | 503 | 0.139 |

Table II. PRR Summarized by Workday

| Date | Total Meats | Yellow Large Meats | Yellow Small Meats | White Meats | Total Snails | Snails ------ Meats | Nep-tunea Snails | YL+YS ----- Nept. | Bucc. +Other Snails | W --------- Bucc.+Oth |
|---|---|---|---|---|---|---|---|---|---|---|
| 6/ 9-6/10 | 370 | 140 | 170 | 60 | 1635 | 0.226 | 1316 | 0.236 | 319 | 0.188 |
| 6/10-6/11 | 660 | 220 | 280 | 160 | 3016 | 0.219 | 2384 | 0.210 | 632 | 0.253 |
| 6/11-6/12 | 980 | 340 | 400 | 240 | 5548 | 0.177 | 4170 | 0.177 | 1378 | 0.174 |
| 6/12-6/13 | 1210 | 420 | 510 | 280 | 5927 | 0.204 | 4549 | 0.204 | 1378 | 0.203 |
| 6/13-6/14 | 680 | 260 | 290 | 130 | 4189 | 0.162 | 3134 | 0.175 | 1055 | 0.123 |
| 6/14-6/15 | 810 | 290 | 330 | 190 | 4054 | 0.200 | 2977 | 0.208 | 1077 | 0.176 |
| 6/15-6/16 | 1020 | 390 | 360 | 270 | 6981 | 0.146 | 4325 | 0.173 | 2656 | 0.102 |
| 6/16-6/17 | 730 | 340 | 210 | 180 | 4384 | 0.167 | 3425 | 0.161 | 959 | 0.188 |
| [illegible]17-6/18 | 750 | 360 | 220 | 170 | 4477 | 0.168 | 3498 | 0.166 | 979 | 0.174 |
| 6/18-6/19 | 1240 | 530 | 380 | 330 | 6602 | 0.188 | 5025 | 0.181 | 1577 | 0.209 |
| 6/19-6/20 | 760 | 370 | 210 | 180 | 3950 | 0.192 | 2810 | 0.206 | 1140 | 0.158 |
| 6/20-6/21 | 1760 | 840 | 490 | 430 | 8589 | 0.205 | 6202 | 0.214 | 2387 | 0.180 |
| 6/21-6/22 | 990 | 450 | 260 | 280 | 4872 | 0.203 | 3260 | 0.218 | 1612 | 0.174 |
| 6/22-6/23 | 1070 | 490 | 340 | 240 | 5501 | 0.195 | 4259 | 0.195 | 1242 | 0.193 |
| 6/23-6/24 | 1710 | 710 | 540 | 460 | 8827 | 0.194 | 6702 | 0.187 | 2125 | 0.216 |
| 6/24-6/25 | 1220 | 570 | 400 | 250 | 6471 | 0.189 | 4862 | 0.200 | 1609 | 0.155 |
| 6/25-6/26 | 1320 | 600 | 470 | 250 | 7099 | 0.186 | 5610 | 0.191 | 1489 | 0.168 |
| 6/26-6/27 | 1210 | 530 | 410 | 270 | 7080 | 0.171 | 5625 | 0.167 | 1455 | 0.186 |
| 6/27-6/28 | 1280 | 610 | 430 | 240 | 6595 | 0.194 | 5613 | 0.185 | 982 | 0.244 |
| 6/28-6/29 | 1180 | 600 | 340 | 240 | 6958 | 0.170 | 5405 | 0.174 | 1553 | 0.155 |
| 6/29-6/30 | 410 | 180 | 160 | 70 | 2711 | 0.151 | 2208 | 0.154 | 503 | 0.139 |

Figure I. Starboard Side of Eiwa Maru's Stern.

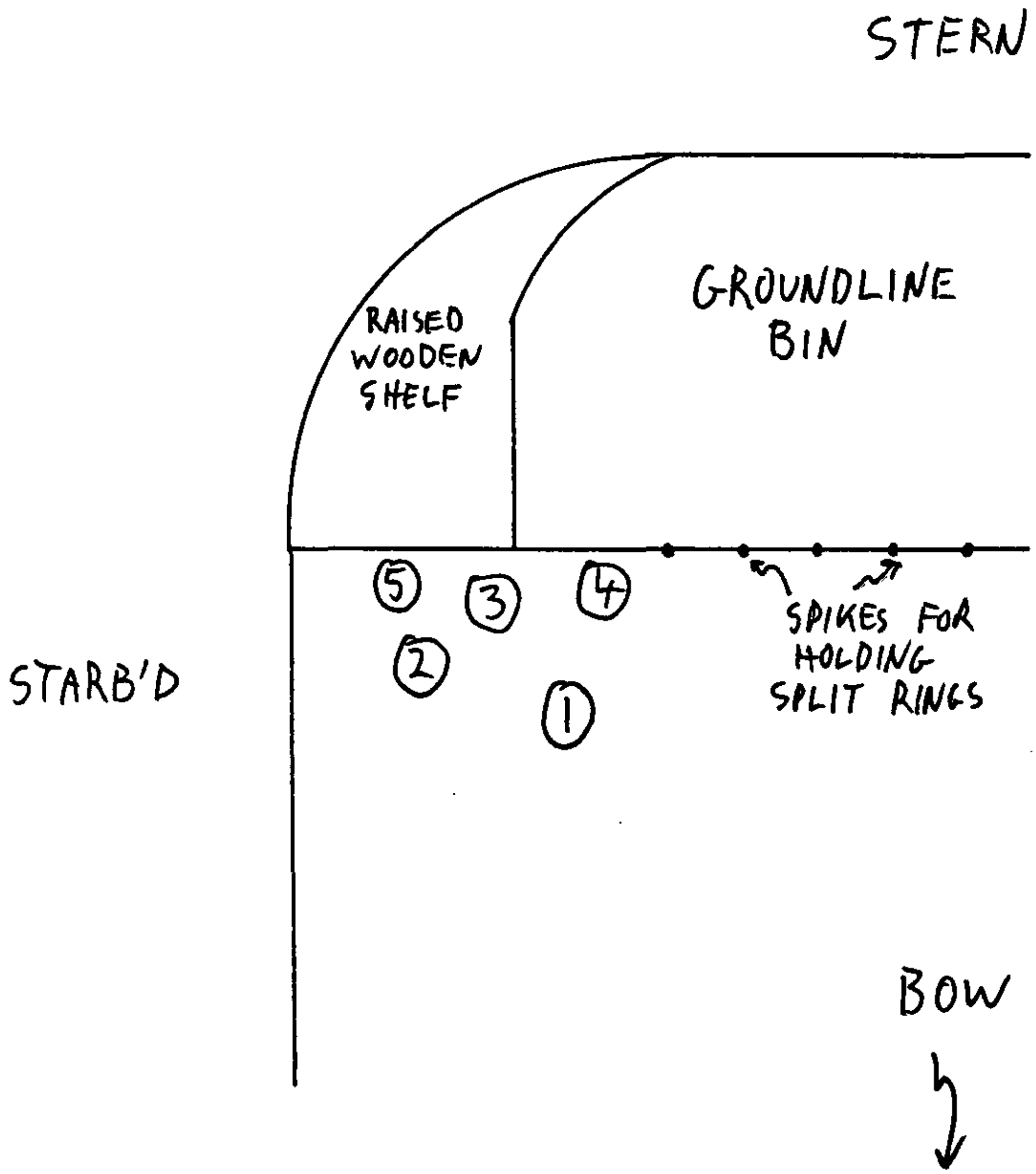


Figure II. Foredeck of Eiwa Maru.

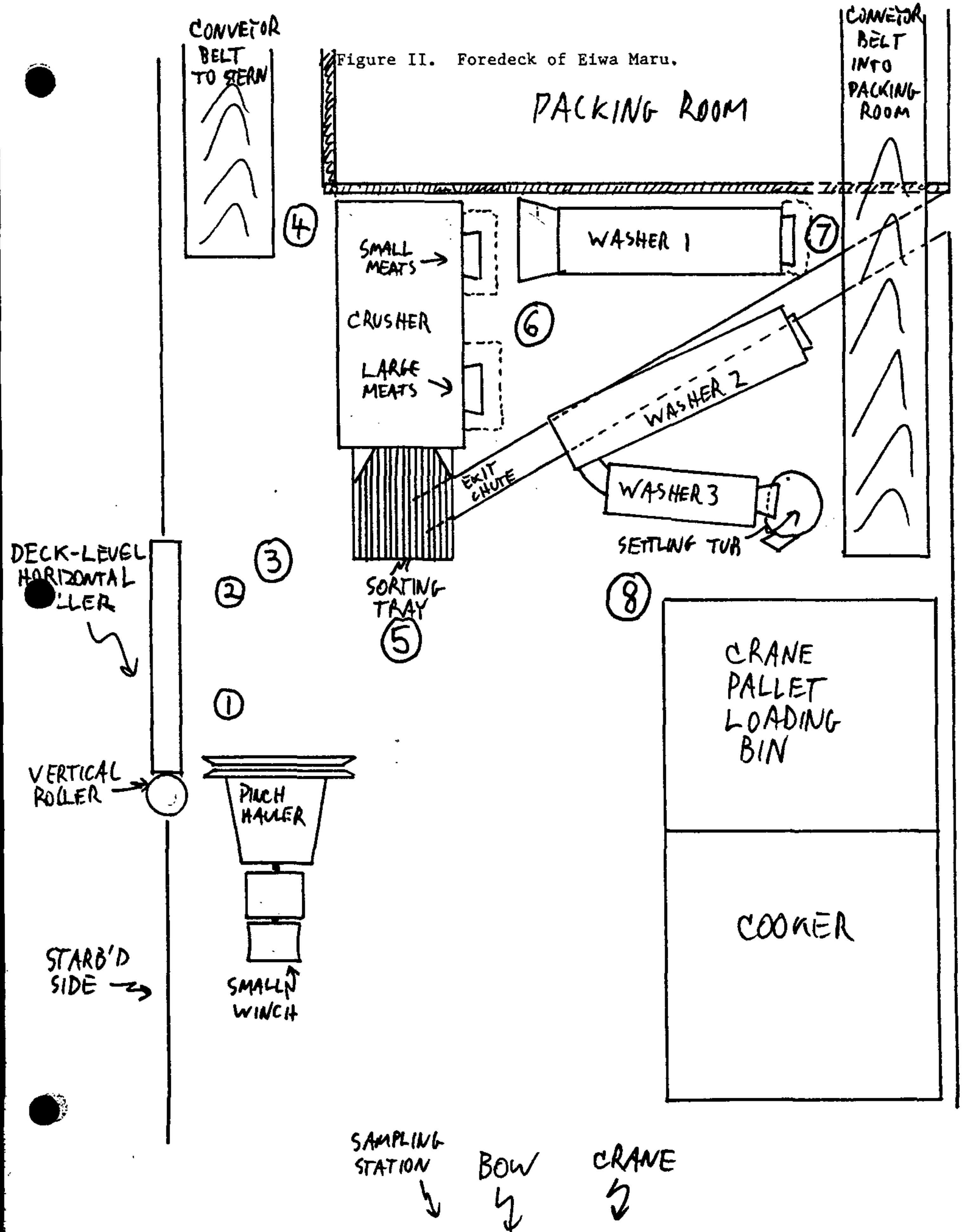
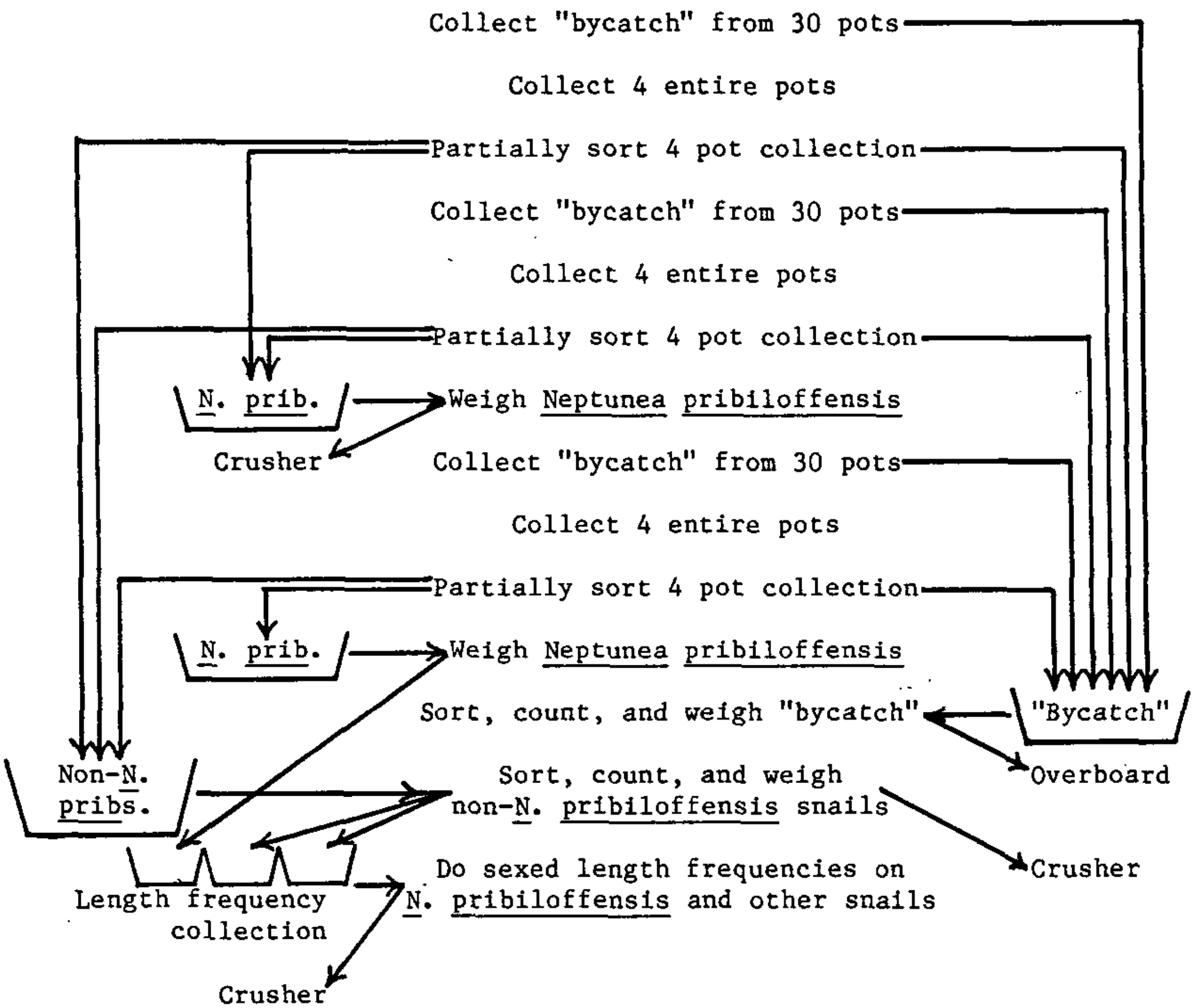


Figure III. Snailpot Sampling Flowchart.



# Appendix I. Catch Extrapolation Methods

I used two different methods to extrapolate from the sampled pots to the total catch for the set and for the day. Both use the same method to extrapolate from sampled pots to total set, but one method then uses a straight pot-by-pot extrapolation to estimate the total day's catch, while the other method uses average PRR values to estimate a total catch for each set. In all cases, to maintain precision for small weights I kept all calculations in kilograms on all extrapolations, converting to metric tons only when writing the radio messages.

The procedure for extrapolation from the sampled pots to the total set catch is straightforward:

$$\left(\text{Total Set Catch}\right) = \frac{(\text{Observed Weight}) * (\text{Total \# of Pots in Set})}{(\text{Total \# of Pots Sampled})}$$

Data for this extrapolation comes from Form 1S and goes to Form BM. Be careful to use the proper number of pots sampled for each species if you have more than one sample size on Form 1S. As long as they have the same sample size, however, species can be grouped before the extrapolation. Because of the PRR work I was doing, I did not combine all snails at this stage, but used the following column headings (groups) on Form RM: King Crab, Tanner Crab, Pacific Cod, Neptunea, Buccinum, Other Snails, Other. For convenience, I also recommend a column of All Snails and Ship's Snail Meats. Since my captain wanted reports of both crab numbers and weights, I extrapolated crab numbers as well. The method is identical. Since the RM form's "KG SAMPL" column cannot be used because of the varying sample sizes, I used that column for crab numbers.

The method I used to estimate total catch for a day while on board the Eiwa was cruder than the second method described below. The method I used on board was a straight pot-by-pot extrapolation from the sampled sets:

$$\left(\text{Total Day's Catch}\right) = \frac{\left(\text{Sum of Total Set Catch Estimates for Sampled Sets}\right) * \left(\text{Total \# of Pots Retrieved in the Day}\right)}{\left(\text{Total \# of Pots in Sampled Sets}\right)}.$$

A better method is ~~based~~ a set-by-set estimate based on PRR values for snails and an average non-snail bycatch. For each unsampled set, the sets sampled that day are used to determine an average PRR for the day. This is used to estimate the total snail catch for each unsampled set, based on the ship's report of snail meat weights. To this is added an appropriate average weight of bycatch estimated from the average bycatch per pot for that day.

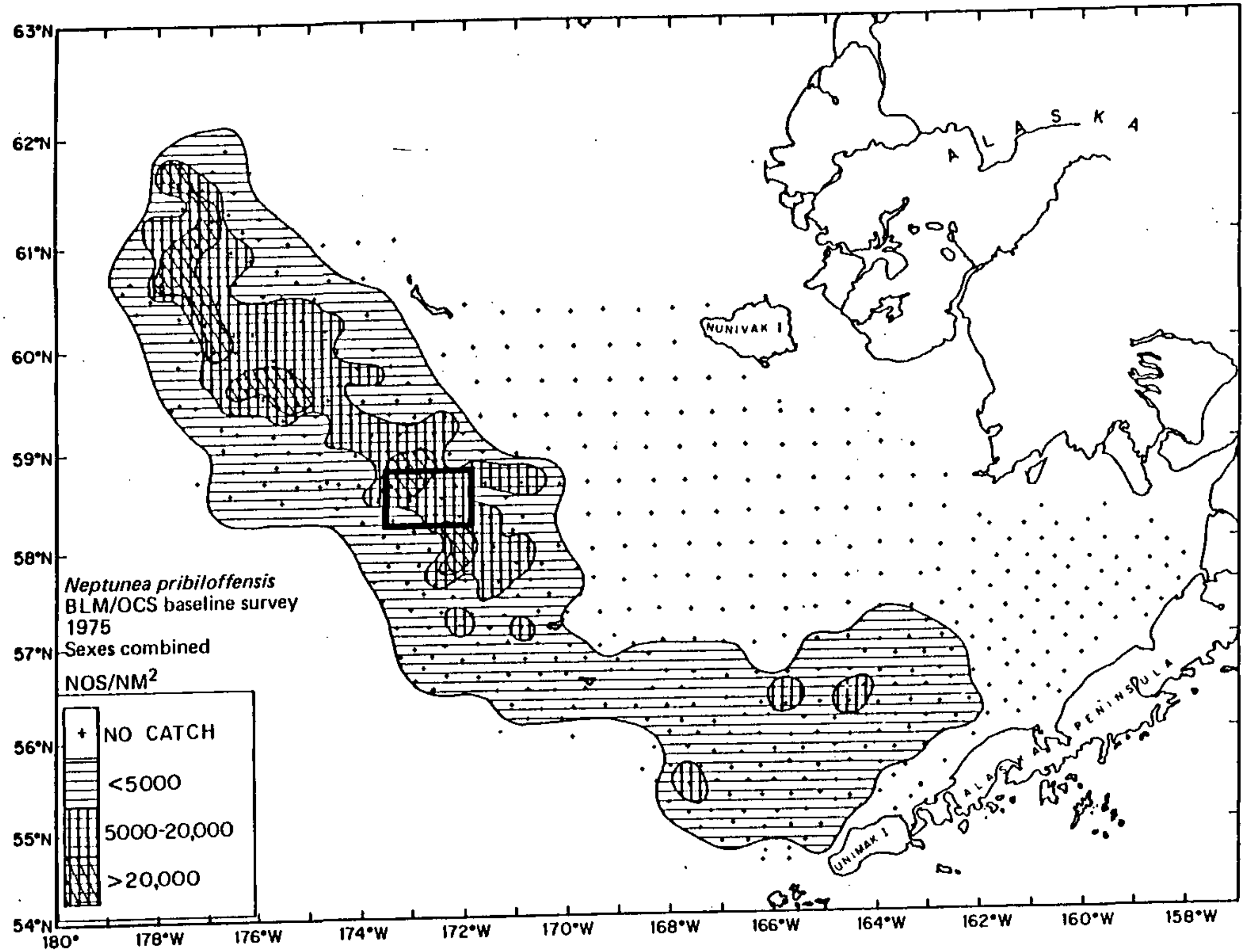
$$\left(\text{Day's Average PRR}\right) = \frac{\left(\text{Sum of Estimate of Snail Meats in Sampled Sets}\right)}{\left(\text{Sum of Estimate of Whole Snails in Sampled Sets}\right)}$$

$$\left(\begin{array}{c}\text{Day's Average} \\ \text{Bycatch per Pot}\end{array}\right) = \frac{\left(\begin{array}{c}\text{Sum of Estimated Weights of Non-Snail Bycatch} \\ \text{in Sampled Sets}\end{array}\right)}{\left(\text{Total \# of Pots Sampled}\right)}$$

For each unsampled set:

$$\left(\text{Total Set Snail Catch}\right) = \frac{\left(\text{Set's Estimate of Snail Meats}\right)}{\left(\text{Day's Average PRR}\right)}$$

$$\left(\text{Total Set Catch}\right) = \left(\text{Total Set Snail Catch}\right) + \left(\left(\begin{array}{c}\text{Day's Average} \\ \text{Bycatch per Pot}\end{array}\right) * \left(\begin{array}{c}\text{Total \# of} \\ \text{Pots in Set}\end{array}\right)\right)$$




The location of the 1984 Bering Sea snail fishery in relation to the abundance of Neptunea pribiloffensis as indicated by the 1975 BLM/OCS survey.

# SNAIL IDENTIFICATION NOTES

I. Larger shells

A. Presence of a radial rib forming a shoulder at least in the spine whorls, and usually on the body whorl as well

1. Fine radial sculpture, often with 15-20 slightly more prominent ribs. Usually 3 ribs on upper whorls. No axial sculpture.
   *Neptunea pribiloffensis*
   (Most common species.)

2. Prominent, regular radial sculpture (9 - 12 bands), sometimes with finer bands between. Two, sometimes three bands visible on topmost whorls. May have a slight lamellation on body whorl. No fine radial sculpture above the body whorl.
   *Neptunea lyrata*
   (1 to 3 of these in some samples.)

3. Prominent, but slightly irregular radial sculpture (9 bands). One to one and one-half bands visible on topmost whorls. Two equally thick ribs.
   nonlamellar form of *Neptunea ventricosa*

4. Fine radial sculpture, prominent lamellation of body whorl, knobbed axial sculpture.
   lamellar form of *Neptunea ventricosa*

5. No radial sculpture, knobbed axial sculpture. Shell is heavy in weight, sometimes lamellated at body whorl. Single shoulder on topmost whorls.
   *Neptunea heros*

B. No shoulder formed by a radial rib.

1. Strong axial, knobbed sculpture. Knobs are angled and parallel to the top angle of aperture. Yellow operculum.
   *Voluptosius fragilis*

2. Fine axial sculpture, irregular. Flaky yellow-brown periostracum. Sometimes slightly knobbed.
   *Beringius beringii*
   (Aperture interior is often purplish.)

3. Medium prominent axial sculpture, finely spaced. Multiple ridges in each sculpture band. Brownish periostracum.
   (This one tends to be pink.) *Beringius freilei*

4. Extremely fine radial and axial sculpture, almost smooth.
   (This one tends to be purple.) *Voluptosius middendorffii*

5. Fairly subtle axial sculpture, rounded whorls.
   *Voluptosius stephansonii*

II. Small shells

A. Central opercular focus (Buccinum)

1. Angle (sometimes knobbed) in center of body whorl. Shell is roughly cone-shaped.

Buccinum angulossum

(A very small percentage of these don't have a well-defined angle. Very small specimens are often found in the catch. Brownish in color, these never have a pinkish tone.)

2. Radial sculpture ridge above center of body whorl. Some axial sculpture visible above body whorl. Brown periostracum.

Buccinum polare

(The radial ridge might not be present in all specimens. This species is brownish and never has the pink hue that B. scalariform and B. plectrum often have.)

3. Thin radial sculpturing and regular axial sculpture through top (spir whorls.

Buccinum plectrum

(If shell is covered with growth/mud, look for spiral sculpture on body whorl next to the aperature.)

4. Virtually no radial sculpture, axial sculpture well defined and curve

Buccinum scalariforme

(Spiral sculpture is essentially not visible without magnification This usually has a pink or purple hue.)

5. Axial scuplture wavier and less distinct than B. scalariforme.

Buccinum solenum

(Not in Kessler's guide. Shell is light tan, has no pink or purpl Confusion here--someone else says the axial sculpture is more distinct than in B. scalariforme. Dorsal relief has been describe as having a "melted look" to it.)

B. Opercular focus not central.

1. Thin, brown periostracum, a single radial ridge above center of body wall.

Clinopegma magna

(One to fifteen of these in most samples. Very chocolate colorinc least in some places.)

2. Tall spire

a. Regular, uniform radial sculpture in 20 - 25 bands.

Colus (spitzbergii)

(Be aware that most Colus species are Colus halli. Colus spp. is fine.)

b. Prominent shoulder is almost flattened; not very uniform spiral sculpture; very long anterior canal.

*Aforia circinata*

(Not very abundant--usually occupied by hermit crabs.)

c. Distinct axial sculpture; no radial sculpture.

*Plicifusus Kroyeri*

(If the anterior canal is broken on this species, it can be very difficult to distinguish from B. scalariforme--look at the operculum. Spire is also taller and more flattened.)

d. No radial or spiral sculpture; non-curved sutures.

*Arctomelon stearnsii*

3. Chunky spire, radial sculpture, shoulder ridge with small Knobs.

*Neptunea borealis*

(One to ten of these in most samples. The Knobs at the shoulder really set this apart from Neptunea pribiloffensis, although some N. borealis and similarly sized N. pribiloffensis are hard to tell apart. N. borealis is usually no longer than 50 mm.)

Notes on other snails:

*Fusitriton oregonensis* (Hairy Triton)--shell is covered with bristle-like hairs. (Rare in catches.)

*Boreotrophon muriciformis* (Dall's Boreotrophon)--short spire, very long anterior canal. (Very few in catches.)

Basket sample form (2)
Prohibited species form (2)

The following gear will be checked out to the observer:

Calculator (1)
Extra calculator batteries (2)
Calipers (1) or clay calipers
Book- Hart (1)
Book- Keen and Coan (1)
Book- McIntosh (1)
Book- Kessler (1) (or xerox copy)
Species identification manual (esp crab key)
Marine mammal guide (1)

Number of data forms to take for a two-month cruise

| | |
|---|---|
| Form 1S | -- 30 |
| Form 3S | -- 80 |
| Form 7 | -- 50 |
| Form 11 | -- 15 |
| Radio rpt worksheets RM | -- 10 |
| Radio rpt worksheets RM-1 | -- 7 |
| Enforcement report #1 | -- 2 |
| Cruise report #2 | -- 2 |

Extra instructions and handouts

English letter of introduction
Translated letter of introduction
Personal history sheet
Notice to vessel captains (translated-Japan only)
Gear, weather and sea codes (translated)
Meal and bath schedules (translated)
Pot and groundline diagrams
Language helper and translated phrases
Other snail articles, copies of previous reports

Sampling manual
Enforcement manual (plus sheets on snail fishery)
Snail sampling instructions

# SNAIL POT OBSERVER EQUIPMENT LIST

Baskets (2 or 3)
Set of castors
Rope
Lined pads(2)
Clipboards (2)
Logbook (1)
Scouring powder (1 can)
LPS-1 rust preventor (16 oz bottle with cap)
50 Kg scale (1)-(observer should check accuracy with standard weight before leaving).
5 Kg scale (1)
2 Kg scale (1)
Filament tape (1 roll)
Sponge (3)
Plastic bags (15)
Rubber gloves (3 pair)
Glove liners (3 pair)
Hardhat (1)
Life vest
Survival suit
First aid Kit (1) -(check contents for completeness)
Measuring strips (3)
Manilla folder (1)
Carbon paper (10 sheets)
Graph paper (5 sheets)

In cardboard box in basket:

Pencils #2 (12)
Pens (5)
Pencil erasers (2)
Plastic ruler (1)
Looseleaf rings for extra forms (3)
Scotch tape (1 roll)
Thumbtacks (1 container; about 25 tacks)
Rubber bands (1 container; about 40 rubber bands)
Tape measure (1)
Thumb counters (1)
Twine (1)

To be obtained during training:

Rain pants (1)
Rain jacket (1)
Boots (1 pair)
Large ring looseleaf notebook for data forms
Index pages for notebook (10)
Data forms (check for completeness)
Permanent felt-tip marker pen (1)
Plastic sheets