# 流れ網の海産動物に与える影響に関する 1989 年調査の概要

# Outline of 1989 survey on behavior of the drifting nets and entanglement of marine organisms

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## 要　約

小笠原群島北東海域で投入した漂流網の流路は、概して反時計廻りのパターンを呈し、その流動方向は東の成分を有していた。投入後42日間の平均漂流速度は約10浬／日であった。漂流網は1988年の調査の結果をも考慮すると、投入後3日後に団塊状を形成し始めるのではないかと考えられる。但し、団塊網の形成要因として、風浪条件が第一に指摘されるため、今後はこれらの海気象条件からの検討が必要である。漂流網の長さは概して時間とともに短くなる傾向が観察された。しかし、団塊の大きさは時間とともに変化するようである。

Key網による生物採集で、1日1反当たりら網尾数の最大値は、カラフトマス1.15、最小値はサメ及びミズサワラの0.01であった。

表層流シミュレーションの結果、ハワイ北東海域及び小笠原海域に判明した環流域実証のため、同海域にアルゴスブイを放流した。

## はじめに

流失または投棄された漁網（以降流れ網）は海中に浮遊し、その間、魚類、海産哺乳動物および海鳥類等が絡まり、それら海産動物に悪影響を及ぼしているという指摘がある。しかし、その流れ網の挙動についての情報は、断片的な記録が若干あるに過ぎない。そこで、流れ網の移動状況とその形状の変化及び海産動物の捕獲状況について調査を実施したので、その概要と経過を報告する。

### 1．調査海域・期間

| | | |
|---|---|---|
| 第1次 | 小笠原群島北東沖合 | 5月8日～5月22日 |
| 第2次 | 45°N, 175°E を中心とする海域 | 6月12日～6月23日 |
| 第3次 | 45°N, 176°E を中心とする海域 | 7月14日～8月1日 |

## 2．調査内容

1）網の漂流経路および形状変化の調査

I）第1次調査

漂流物の分布状況、海況及び海洋観測を実施した。漂流物は目視観察により調査した。流況は3基のアルゴスブイを用いたが、うち1基はナイロンモノフィラメント流し網40反を設置し、その一端に付設した。なお、流し網の他端にはセルコールブイを付設した。漂流網の位置はアルゴスブイからの通報（1日平均6回）によって記録されている。海洋観測を1日1回以上適時実施した。

II）第2次調査

漂流物の分布、漂流網の形状変化およびら網状況の変化、海洋観測さらに流況調査を実施した。

用いた網は、生物調査を目的とした海産動物採集用のKey網と漂流網の2基で、使用反数は40反、水中における長さは約1,800 mであった。各網は目合115 mmのナイロンモノフィラメントである。Key網は毎日漂流網の近くで投揚した。漂流網には、片方にセルコールブイ他方にアルゴスブイを付設した。漂流網の形状変化に関する調査は、網なりの形状をバルーンを用いて観察し、ら網状況をら網生物調査用音響機器および水中テレビ（ビークル）を用い観察した。

III）第3次調査

漂流網の形状変化およびら網状況の変化に関する調査、海洋観測、漂流物の分布状況調査並びに流況調査を実施した。調査には漂流網のみ40反を4基使用した。うち2基はナイロンモノフィラメント（目合115mm、1反の水中における長さ45m）、残りの2基はナイロンマルチフィラメント（目合180 mm、1反の水中における長さ45 m）とした。各網にセルコールブイおよびアルゴスブイを付設した。なお、漂流網の形状変化等に関する調査方法は、第2次調査に同じ。

## 3．調査結果の概要

1）網の漂流経路（図1参照）

小笠原群島北東海域の27°03'N、145°06'Eで5月7日に投入した漂流網は、当初NNEに約100浬漂流して後、漂流路を北西から西へ変え、投入後10日目の5月27日には、投入点からNNEに約140浬の距離にあった。その後南西に漂流し、投入後42日目の6月17日には投入点からほとんど西方120浬のほぼ27°00'N、143°00'E付近に認められた（その漂流路は、概して反時計廻りの環流を示唆するようなパターンを呈している）。

なお、42日間の漂流距離は430浬で、一日平均漂流速度は約10浬となる。

6月17日以降は北上して7月7日少し前から北東方向へ漂流している。したがって、ほぼ同海域で5月27日～6月17日と6月17日～7月15日の期間において、漂流路が全く逆方向になっている点が特徴として指摘される。その要因については流況調査結果と対照し、追って詳細なる検討をしたい。第2次および第3次調査については、アルゴスブイの結果が整理されていない。

2）網の形状変化

4基の漂流網を投入して調査した結果、網が絡まった団塊状が認められたのは、1基は4日後、他の3基は何れも3日後であった。また、1988年度の調査（三尾他, 1988）においても3日後に最初の団塊網が認められている。これらの諸例から投入後3日目付近で団塊網が形成されるのではないかと推測される。但し、団塊網の形成要因として風浪条件が第一に指摘されるため、今後はこれらの海気象条件からの検討が必要である。なお、最初に団塊が形成される部位は、1例が端の近くに認められ、他の3例は末端に認められた。これらの結果から、団塊網は流し網の末端から形成される傾向が示唆されたが、この問題もさらにデータ蓄積の上検討しなければならない。なお、これら漂流初期に形成された団塊は勿論小規模であるが、より大きい団塊は投入後、概して9日以降に観察された。特に14日後に観察された顕著な団塊は団塊の最大径が15 mであった。網の長さは概して時間とともに短くなる傾向が観察された。しかし、団塊の形成過程は、必ずしも時間とともに大きくなるとは考えられない。即ち、時間の経過とともに大きさに変化が認められる場合もあった。なお、団塊形成過程には風浪条件が大きく関与しているものと考えられるため、その点からの検討が必要である。網の形状は投入初期は網全体にわたり小規模な蛇行パターンを呈し、時間の経過とともにその形状はより顕著となる。そして、部分的に2列または3列、あるいはそれ以上の列をなした状態が観察されたが、恐らくその状態が進行して団塊が形成されるのではないかと想定される。

また、網の分布方向は、概して観察時における風向と一致する傾向が認められたが、この点は吹送時間からの検討をしなければならない。もし、船の運航上の条件が許されるならば、約2週間にわたり投入した漂流網の形状変化を連続観察することは、網の団塊形成機構を解明する上に有力な手掛りとなるであろう。

なお、網の形状について観察した結果、次のように要約される。

（1）目合、網地による変化の差異については、詳細なる検討を要するが、ら網生物（数、種類）に相違のあることが示唆された。

（2）網なりの形状パターンには特に相違は認められない。

（3）狭い範囲で海況の複雑な変化により、網なりの形状に変化が認められた。

（4）投棄網は数反単位と考えられるため、団塊を形成し易いと考えられる。

3）生物調査

生物調査用のkey網は1日に1回揚網した。合計552尾の魚が漁獲されたが、魚種別漁獲物は第1表に示したようにギンザケ（Coho salmon：*Onchoryhncus kisutch*）が最も多く全漁獲量の50.2%を占め、そのCPUEは1.15であった（CPUEは1日1反当り漁獲尾数を示す）。次いで、カラフトマス（Dog salmon：*Onchorhyncus gorbuscha*）が全漁獲量の29.0%をCPUEは0.67、以下シロザケ（Chum salmon：*Onchorhyncus keta*）、マスノスケ（Chinook salmon：*Onchorhyncus tshawytscha*）、スチールヘッド（Steel head salmon：*Salmo gairaneri*）、ミズサワラ（Pacific lancetfish：*Alepisaurus ferox*）およびサメ（Shark）などが漁獲された。

サメは3尾のうち1尾はネズミザメ（モウカザメ）（Salmon shark：*Lamma ditropis*）、他の1尾はアブラツノザメ（Spiny dog fish：*Squalus acanthias*）、さらに1尾は種不明であった。これらの魚種以外に25尾の脱落魚が確認されたが、それらの魚種はアブラツノザメ1尾が判明したのみであった。

なお、ら網生物は魚類以外にミズナギドリ2羽、ピリカ1羽が認められた。4基の漂流網は300時間以上漂流していたが、その間にら網した生物は、サケ68、シマガツオ（Pomfret：*Lepidotus brama*）203、アカイカ（Flying squid：*ommastrephes bartrami*）4、ツノザメ類（Dog fish：*Squlus* spp.）26、モウカザメ（Blue shark：*Prionace glaucus*）3、イシイルカ（Dalli's porpoise：*Phocoenoides dalli*）1、オットセイ2（うち1頭は生きた状態で網からはずれた）およびミズナギドリ6からなっていた。

以上の他、航行中に拾得した網に次のような動物がら網していた。マサバ1、マイワシ4、ギンザケ1、シロザケ1、サメ1、イシダイ2、ガザミ4、イザリウオ2、シイラ2、メダイ2、種不明魚1、海獣類と考えられる骨格1、イルカと考えられる骨肉部1、ミズナギドリ3。

これらのら網動物は何れも団塊状となった網の中で発見された。なお、海獣類はこれら魚類を捕食するために接近して、網に纏落したものと考えられる。

4）流況（第1図）

船の偏位データを用いた表層流シミュレーションにより（東海大学海洋研究所，1988）、ハワイ北東方海域、および小笠原海域に環流域が形成されていることが判明した。なお、漂流物の目視調査の結果から、ハワイ北東方海域に、漂流物の高密度分布が認められているが、上記の環流域はその高密度分布域の形状要因となっているものと考えられる。

なお、上記の環流域を実証するために、小笠原海域に5個、ハワイ北東海域に2個のアルゴスブイを放流した。小笠原海域の5個に関しては、特に一定方向の流れは認められないため、

環流域が形成されていたことも考えられる。

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Table 1 Number and CPUE by fish species caught by key net

| Species | Number | CPUE * |
|---|---|---|
| Chum salmon | 83 | 0.35 |
| Dog salmon | 160 | 0.67 |
| Coho salmon | 277 | 1.15 |
| Chinook salmon | 7 | 0.03 |
| Steal head salmon | 19 | 0.08 |
| Shark | 3 | 0.01 |
| Pacific lancetfish | 3 | 0.01 |
| Total | 552 | 2.30 |

* $tan^{-1}day^{-1}$ ( tan is the unit of length and correspond to 45m )

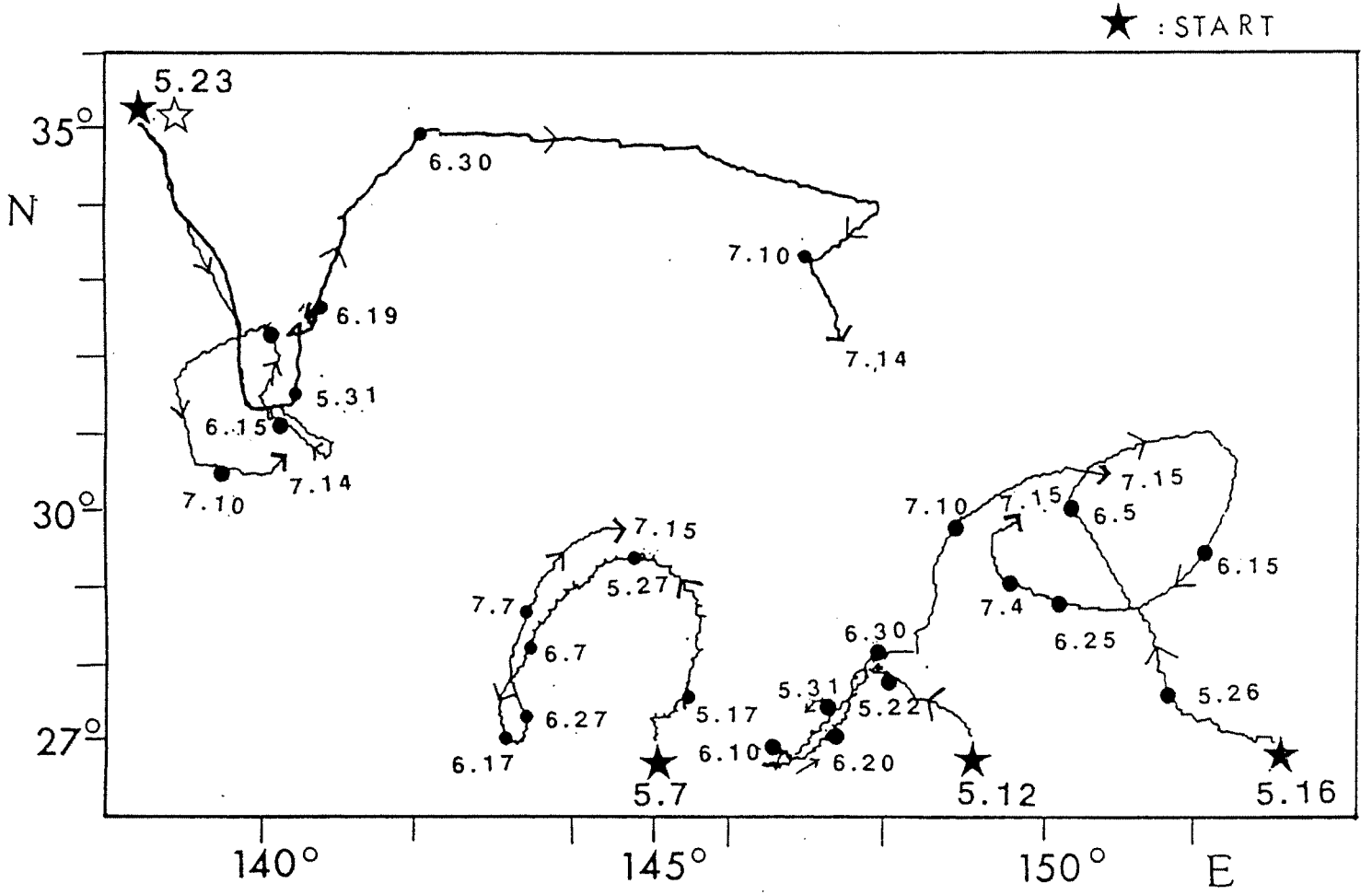


Fig.1 Drifting buoy map for the N E off Ogasawara

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# OUTLINE OF THE 1989 SURVEY ON THE BEHAVIOR OF DRIFTING NETS AND THE ENTANGLEMENT OF MARINE ORGANISMS

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## ABSTRACT

The course of drifting nets cast in northeastern waters off the Ogasawara Islands generally showed a pattern of anti-clockwise direction and its drifting direction contained eastward component. The average drifting speed for 42 days after the cast was about 10 miles/day. Taking 1988 survey results into consideration, the drifting nets may start forming a mass after 3 days of the cast. However, because wind and wave conditions are the primary cause for forming a mass, these oceanic and meteorological conditions should be considered. The length of the drifting nets tended to be shorter with time. However the size of a mass varies with time.

The Key net was used for biological sampling and the maximum number of fish caught per tan per day was 1.15 for pink salmon and minimum was 0.01 for sharks and Pacific lancetfish.

The result of the simulation of surface layer current showed the existence of an area of circular currents in waters northeast of Hawaiian Islands and off Ogasawara Islands. Argos buoys were released in these areas for corroboration of this circular current area.

Introduction

Some people report that lost or discarded fishing nets ( hereinafter referred to as "drifting nets") drift in the sea, they continue catching fish, marine mammals and seabirds etc. and adversely affect these marine organisms. However, there is only fragmentary information on the movement and configuration of drifting nets. Therefore we conducted a survey on the movements and changing configuration of drifting nets and the entanglement of marine organisms. This is a report of outline and progress of the survey.

1. Survey area and period

| | |
|---|---|
| First survey: | northeastern waters off Ogasawara Islands<br>May 8 - May 22 |
| Second survey: | waters around 45°N and 175°E<br>June 12 - June 23 |
| Third survey: | waters around 45°N and 176°E<br>July 14 - August 1 |

2. Content of survey

1) Survey on drifting course and changing configuration of the nets

i) First survey

A survey on the distribution of floating objects, oceanographic conditions and oceanographic observations was conducted. Floating objects were observed by sighting survey. Three Argos buoys were used for the observation of current conditions, one of them was attached to an end of nylon monofilament gillnet of 40 tans in length. A Self-call buoy was attached to the other end of the net. Location of drifting nets was recorded by information transmitted from Argos buoys ( 6 times a day in average). Oceanographic observations were conducted more than once a day when possible.

ii) Second survey

A survey on the distribution of floating objects, oceanographic conditions and change of entanglement conditions and oceanographic observations was conducted. A survey on ocean currents was also conducted.

A total of 2 sets was used, one was the Key net for collecting marine organisms for biological study and the other was a drifting net. The number of tans used was 40 and the length under the water was about 1,800 m. Each net was made of nylon monofilament with 115 mm in mesh size. The Key net was set near the drifting net everyday. A Self-call buoy was attached to one end of the drifting net and an Argos buoy was attached to the other end. A balloon was used for the observation on the changing configuration of drifting net, and acoustic devices for survey on entangled organisms and underwater TV (vehicle) were used for observing the entanglement conditions.

iii) Third survey

A survey on the changing configuration of drifting nets and the changing of entanglement conditions, oceanographic observations, and a survey on the distribution of floating objects and on current conditions was conducted. The survey was conducted only by drifting nets and a total of 4 sets, each had 40 tans of nets. Two of them were nylon monofilament nets (115 mm in mesh size, 45 m in length of one tan in the water) and the remaining two were made of nylon multi-filament (180 mm in mesh size, 45 m in length of one tan in the water). A Self-call buoy and an Argos buoy were attached to each end of the net. The methods used for the survey on the change of configuration of drifting nets, etc. was the same as ones used in the second survey.

## 3. Outline of survey results

### 1) Drifting course of the nets (see Fig. 1)

The net, which was cast at 27°03'N and 145°06'E of northeastern waters off Ogasawara Islands on May 7, drifted initially about 100 miles toward NNE, then changed its course to northwest to west, and on May 27, after 10 days of the cast, the net was about 140 miles away on NNE from the casting point. Then, it drifted southwest and on June 17, 42 days after the cast, the net was found at 27°00'N and 143°00'E, 120 miles almost exactly west of the casting point (its drifting course showed a pattern which indicated anti-clockwise drifting course).

In addition, a total distance of drifting in 42 days was 430 miles and the average drifting speed per day was about 10 miles.

After June 17, the net moved northward and it changed course to northeast after a few days before July 7. Therefore it is noted that the net changed its drifting course to completely reverse direction in the similar area between May 27 to June 17 and June 17 to July 15. The reason for this change will be examined in detail by comparing with the results of the survey on current movement. Data obtained by Argos buoys in the second and third surveys have not yet been processed.

### 2) Changing configuration of the nets

Four sets of net were cast for the survey. A mass of net which was caused by entanglement of nets was observed after 4 days in one set and after 3 days in 3 sets. The first mass was also observed in the survey in 1988 (Mio et al. 1988). Based on these observations, it is considered that a mass of net is formed on about the third day after a cast. However, because wind and wave conditions are the primary cause for forming a mass, these oceanic and meteorological conditions should be considered. The portion of a net where the first mass was formed was near the end of a net in one case and at the end of a net in three cases. This finding suggested that a mass tended to be formed from the ends of a net, however this subject should also be considered

after accumulating further data. The mass which was formed during the early stage of drifting was, of course, small and a larger mass was generally observed after 9 days of the cast. In particular, a remarkable mass which was observed after 14 days had a maximum diameter of 15 m. The length of nets observed tended to be shorter in accordance with time. However, the size of a mass may not be always increase with time. That is, it varied with time in some cases. In addition, because wind and wave conditions may affect greatly the process of forming a mass, it is necessary to examine these aspects. For the configuration of a net, the entire net showed a meandering pattern in a small scale soon after a cast, and its configuration became remarkable in accordance with time passed. Then two/three or more folds of the net were observed in some part of the net, and these folds probably proceeded to form a mass.

In addition, the distributional direction of the nets observed was likely to be consistent with the wind direction at the time of observation, but wind drifting hour should be taken into consideration when we discuss this matter. If the operational conditions of research vessels will allow, two weeks continuous observations of changing configuration of the cast drifting nets will provide the information needed to understand the mechanism of forming a mass.

The results of observations on changing configuration of nets are summarized as follows:

(1) A difference in entangled organisms (numbers and species) was suggested between nets, although detailed examination is necessary for the difference by mesh size and net material.
(2) No particular difference was observed in patterns of changing configuration of the nets.
(3) Variation of changing configuration of nets was observed, which was caused by the complicated change of ocean currents in a limited area.
(4) Discarded nets are considered to easily form a mass because they may be discarded in a scale of several tans.

3) Biological survey

The Key net, which was used for the biological survey, was hauled once a day. A total of 552 fish was caught. For catch by species, as is shown in Table 1, coho salmon (*Onchoryhncus kisutch*) was dominant and accounted for 50.2% of the total catch. CPUE (numbers caught per tan per day) of coho salmon was 1.15. The next dominant species was pink salmon (*Onchoryhncus gorbuscha*), which was accounted for 29.0 % of the total catch and its CPUE was 0.67, followed by chum salmon (*Onchoryhncus keta*), chinook salmon (*Onchoryhncus tshawytscha*), steelhead trout (*Salmo gairdneri*), Pacific lancetfish (*Alepisaurus ferox*) and sharks.

Out of three sharks, one was Salmon shark (*Lamna dotropis*) and the other was Spiny dog fish (*Squalus acanthias*). Other than these fish, 25 dropout sharks were observed but only one shark was identified as Spiny dog fish.

In addition, the entangled organisms observed other than fish were two shearwaters and one puffin. The four sets of drifting nets drifted more than 300 hours and the entangled organisms during this period were 68 salmon, 203 pomfret (*Lepidotus brama*), 4 flying squid (*Ommastrephes bartrami*), 26 Dog fish (*Squalus* spp.), 3 Blue sharks (*Prionace glauces*), 1 Dall's porpoise (*Phocoenoides dalli*), 2 Northern fur seals (one dropped off alive from the net) and 6 shearwaters.

Other than the above, the following species were entangled in nets and retrieved during the cruise: 1 chub mackerel, 4 true sardines, 1 coho salmon, 1 chum salmon, 1 shark, 1 Japanese parrotfish, 4 swimming crab, 2 Anglerfishes, 2 common dolphinfishes, 2 Japanese butterfishes, 1 fish of unknown species, 4 swimming crabs, 1 skeletal structure which was thought to be from a marine mammal, 1 bone with muscle which was thought to be from Dall's porpoise and 3 shearwaters.

All of these entangled organisms were found in the mass of a net. In addition, marine mammals are thought to have approached the net to feed on the entangled fishes and became entangled in the net.

4) Oceanographic conditions (Fig. 1)

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In addition, 5 Argos buoys were released in the Ogasawara area and 2 buoys were released in the northeast area of the Hawaiian Islands to corroborate the existence of this circular current area. For the five buoys released in Ogasawara area, circular current area may be formed because no specific direction of drifting was observed.

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# OUTLINE OF THE 1989 SURVEY ON THE BEHAVIOR OF DRIFTING NETS AND THE ENTANGLEMENT OF MARINE ORGANISMS

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# OUTLINE OF THE 1989 SURVEY ON THE BEHAVIOR OF DRIFTING NETS AND THE ENTANGLEMENT OF MARINE ORGANISMS

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## ABSTRACT

The course of experimental nets cast in northeastern waters off the Ogasawara Islands generally showed a pattern of anti-clockwise direction and its drifting direction contained eastward component. The average drifting speed for 42 days after the cast was about 10 miles/day. Taking 1988 survey results into consideration, the experimental nets may start forming a mass (the condition in which sections of the net overlap) after 3 days of the cast. Therefore, the fishing ability of the actual drifting nets, the length of which is generally shorter than the experimental nets, is considered to be lost in a short period.

The result of the simulation of surface layer current showed the existence of an area of circular currents in waters northeast of Hawaiian Islands and off Ogasawara Islands. Argos buoys were released in these areas for corroboration of this circular current area.

Introduction

Some people report that lost or discarded fishing nets ( hereinafter referred to as "drifting nets") drift in the sea, they continue catching fish, marine mammals and seabirds etc. and adversely affect these marine organisms. However, there is only fragmentary information on the movement and configuration of drifting nets. Therefore we conducted a survey on the movements and changing configuration of drifting nets and the entanglement of marine organisms. This is a report of outline and progress of the survey.

1. Survey area and period

| | |
|---|---|
| First survey: | northeastern waters off Ogasawara Islands<br>May 8 - May 22 |
| Second survey: | waters around 45°N and 175°E<br>June 12 - June 23 |
| Third survey: | waters around 45°N and 176°E<br>July 14 - August 1 |

2. Content of survey

1) Survey on drifting course and changing configuration of the nets

i) First survey

A survey on the distribution of floating objects, oceanographic conditions and oceanographic observations was conducted. Floating objects were observed by sighting survey. Three Argos buoys were used for the observation of current conditions, one of them was attached to an end of nylon monofilament gillnet of 40 tans in length. A Self-call buoy was attached to the other end of the net. Location of drifting nets was recorded by information transmitted from Argos buoys ( 6 times a day in average). Oceanographic observations were conducted more than once a day when possible.

ii) Second survey

A survey on the distribution of floating objects, changing configuration of the experimental nets and change of entanglement conditions in the nets and oceanographic observations was conducted. A survey on ocean currents was also conducted.

A total of 2 sets was used, one was the control net for collecting marine organisms for biological study and the other was an experimental net. The number of tans used was 40 and the length under the water was about 1,800 m. Each net was made of nylon monofilament with 115 mm in mesh size. The control net was set near the drifting net everyday. A Self-call buoy was attached to one end of the experimental net and an Argos buoy was attached to the other end. A balloon was used for the observation on the changing

configuration of drifting net, and acoustic devices for survey on entangled organisms and underwater TV (vehicle) were used for observing the entanglement conditions.

iii) Third survey

A survey on the changing configuration of drifting nets and the changing of entanglement conditions, oceanographic observations, and a survey on the distribution of floating objects and on current conditions was conducted. The survey was conducted only by drifting nets and a total of 4 sets, each had 40 tans of nets. Two of them were nylon monofilament nets (115 mm in mesh size, 45 m in length of one tan in the water) and the remaining two were made of nylon multi-filament (180 mm in mesh size, 45 m in length of one tan in the water). A Self-call buoy and an Argos buoy were attached to each end of the net. The methods used for the survey on the change of configuration of drifting nets, etc. was the same as ones used in the second survey.

## 3. Outline of survey results

### 1) Drifting course of the nets (see Fig. 1)

The net, which was cast at 27°03'N and 145°06'E of northeastern waters off Ogasawara Islands on May 7, drifted initially about 100 miles toward NNE, then changed its course to northwest to west, and on May 27, after 10 days of the cast, the net was about 140 miles away on NNE from the casting point. Then, it drifted southwest and on June 17, 42 days after the cast, the net was found at 27°00'N and 143°00'E, 120 miles almost exactly west of the casting point (its drifting course showed a pattern which indicated anti-clockwise drifting course).

In addition, a total distance of drifting in 42 days was 430 miles and the average drifting speed per day was about 10 miles.

After June 17, the net moved northward and it changed course to northeast after a few days before July 7. Therefore it is noted that the net changed its drifting course to completely reverse direction in the similar area between May 27 to June 17 and June 17 to July 15. The reason for this change will be examined in detail by comparing with the results of the survey on current movement. Data obtained by Argos buoys in the second and third surveys have not yet been processed.

### 2) Changing configuration of the nets

In the third survey, four sets of experimental nets were cast for the survey. A mass of net which was caused by the overlap of nets was observed after 4 days in one set and after 3 days in 3 sets. The first mass was also observed in the survey in 1988 (Mio et al. 1988). Based on these observations, it is considered that a mass of net started forming on about the third day after a cast. However, because wind and wave conditions are the

primary cause for forming a mass, these oceanic and meteorological conditions should be considered. The portion of a net where the first mass was formed was near the end of a net in one case and at the end of a net in three cases. This finding suggested that a mass tended to be formed from the ends of a net, however this subject should also be considered after accumulating further data. The mass which was formed during the early stage of drifting was, of course, small and a larger mass was generally observed after 9 days of the cast. In particular, a remarkable mass which was observed after 14 days had a maximum diameter of 15 m. The length of nets observed tended to be shorter in accordance with time. However, the size of a mass may not be always increase with time. That is, it varied with time in some cases. In addition, because wind and wave conditions may affect greatly the process of forming a mass, it is necessary to examine these aspects. For the configuration of a net, the entire net showed a meandering pattern in a small scale soon after a cast, and its configuration became remarkable in accordance with time passed. Then two/three or more folds of the net were observed in some part of the net, and these folds probably proceeded and finally formed a complete mass.

In addition, the distributional direction of the nets observed was likely to be consistent with the wind direction at the time of observation, but wind drifting hour should be taken into consideration when we discuss this matter. If the operational conditions of research vessels will allow, two weeks continuous observations of changing configuration of the cast drifting experimental nets will provide the information needed to understand the mechanism of forming a mass.

The results of observations on changing configuration etc. of nets are summarized as follows:

(1) A difference in entangled organisms (numbers and species) was suggested between different mesh sizes and between monofilament and multifilament nets, and future study is necessary for detailed examination.
(2) No particular difference was observed in patterns of changing configuration of the nets between the different mesh sizes and between monofilament and multifilament nets.
(3) Variation of changing configuration of nets was observed, which was caused by the complicated change of ocean currents in a limited area.
(4) The actual drifting nets are considered to easily form a mass because their length may be in a scale of several tans.

3) Biological survey

The control net, which was used for the biological survey, was hauled once a day. A total of 552 fish was caught, coho salmon (*Onchoryhncus kisutch*) was dominant and accounted for 50.2% of the total catch. CPUE (numbers caught per tan per day) of coho salmon was 1.15. The next dominant species was pink salmon (*Onchoryhncus gorbuscha*), which was accounted for 29.0 % of the total catch and its CPUE was 0.67, followed by chum salmon (*Onchoryhncus keta*), chinook salmon (*Onchoryhncus tshawytscha*), steelhead trout (*Salmo gairdneri*), Pacific lancetfish (*Alepisaurus ferox*) and sharks.

Out of three sharks, one was salmon shark (*Lamna dotropis*) and the other was spiny dog fish (*Squalus acanthias*). Other than these fish, 25 dropout sharks were observed but only one shark was identified as spiny dog fish. In addition, the entangled organisms observed other than fish were two shearwaters and one puffin.

The four sets of experimental nets drifted more than 300 hours and the entangled organisms during this period were 68 salmon, 203 pomfret (*Lepidotus brama*), 4 flying squid (*Ommastrephes bartrami*), 26 dog fish (*Squalus* spp.), 3 blue sharks (*Prionace glauces*), 1 Dall's porpoise (*Phocoenoides dalli*), 2 northern fur seals (out of the two one dropped off alive from the net) and 6 shearwaters. The CPUE of salmon based on the assumption that the drifting hours were 300 was 0.03 and it indicated that the fishing ability of the net rapidly decreased compared with the control net.

Other than the above, the following species were entangled in nets and retrieved during the cruise: 1 chub mackerel, 4 true sardines, 1 coho salmon, 1 chum salmon, 1 shark, 1 Japanese parrotfish, 4 swimming crab, 2 anglerfishes, 2 common dolphinfishes, 2 Japanese butterfishes, 1 fish of unknown species, 4 swimming crabs, 1 skeletal structure which was thought to be from a marine mammal, 1 bone with muscle which was thought to be from Dall's porpoise and 3 shearwaters.

All of these entangled organisms were found in the mass of a net. In addition, marine mammals are thought to have approached the net by the attraction of the entangled fishes and became entangled in the net.

4) Oceanographic conditions (Fig. 1)

The result of the simulation of the surface layer current, for which drifting data of vessel was used, showed the formation of an area of circular currents in waters northeast of Hawaiian Islands and off Ogasawara Islands. Based on the results obtained from the sighting surveys on floating objects, floating objects were observed to be concentrated in the area northeast of Hawaiian Islands. The said circular current area may be a factor in causing the concentration.

In addition, 5 Argos buoys were released in the Ogasawara area and 2 buoys were released in the northeast area of the Hawaiian Islands to corroborate the existence of this circular current area. For the five buoys released in Ogasawara area, circular current area may be formed because no specific direction of drifting was observed.

The data obtained by the two Argos buoys released in the northeast area of the Hawaiian Islands are under review now.

Reference

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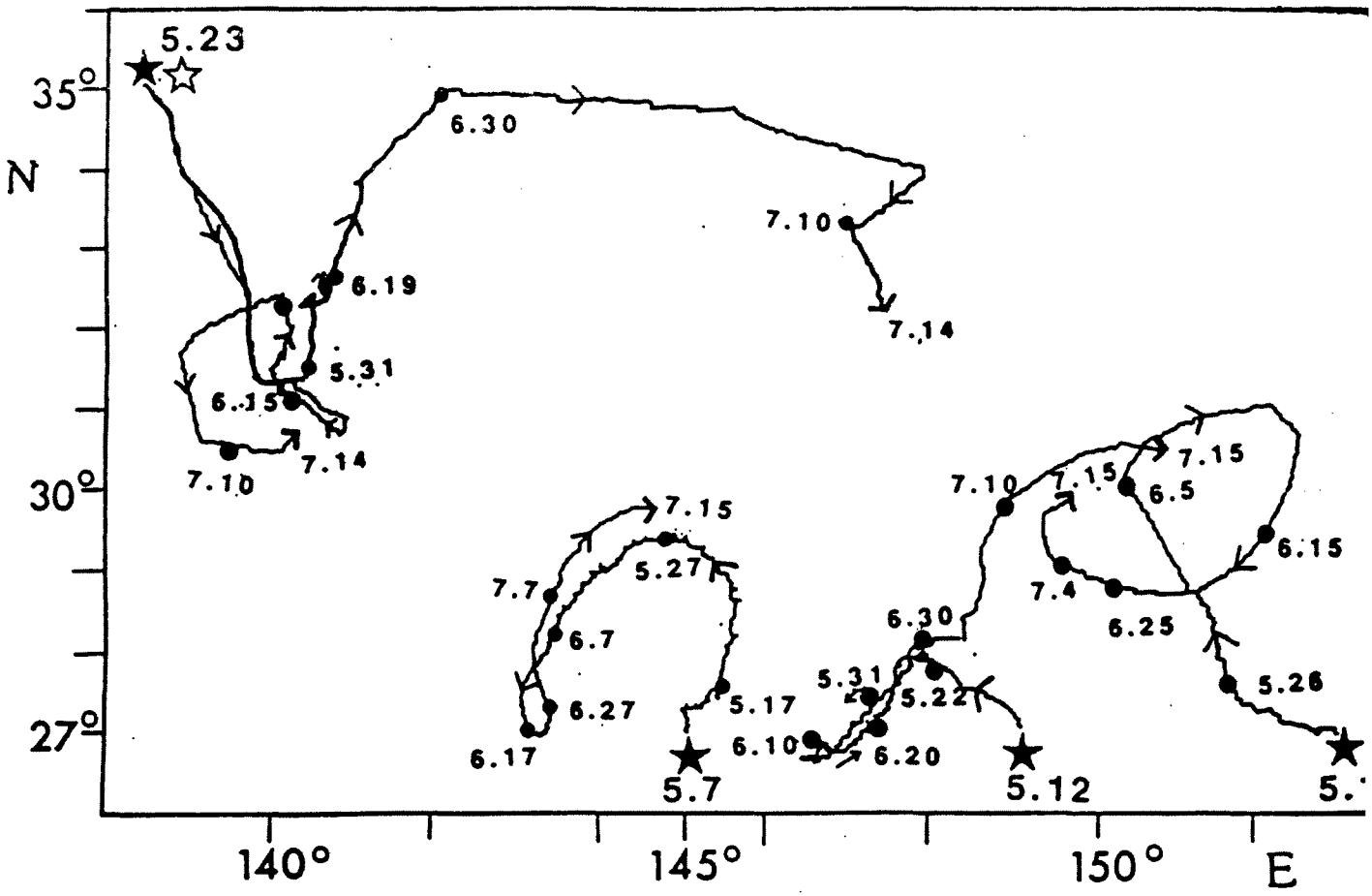


Fig.1 Drifting buoy map for the N E off Ogasawara