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La mer

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Proceedings of the 2nd French-Japanese Symposium of Oceanography,
the 5th French-Japanese Scientific Symposium,
3-13 October 1988, Tokyo and Shimizu, Japan

1989 年 9 月

日 仏 海 洋 学 会

La Société franco-japonaise
d'océanographie
Tokyo, Japon

Note pour la présentation des manuscrits

La mer, organe de la Société franco-japonaise d'océanographie, publie des articles et notes originaux, des articles de synthèse, des analyses d'ouvrages et des informations intéressant les membres de la société. Les sujets traités doivent avoir un rapport direct avec l'océanographie générale, ainsi qu'avec les sciences halieutiques.

Les manuscrits doivent être présentés avec un double, et dactylographiés, en *double interligne*, et au recto exclusivement, sur du papier blanc de format A4 (21×29,7 cm). Les tableaux et les légendes des figures seront regroupés respectivement sur des feuilles séparées à la fin du manuscrit.

Le manuscrit devra être présenté sous la forme suivante:

1° Il sera écrit en japonais, français ou anglais. Dans le cadre des articles originaux, il comprendra toujours le résumé en anglais ou français de *200 mots* environs. Pour les textes en langues européennes, il faudra joindre en plus le résumé en japonais de *500 lettres* environs. Si le manuscrit est envoyé par un non-japonophone, le comité sera responsable de la rédaction de ce résumé.

2° La présentation des articles devra être la même que dans les numéros récents; le nom de l'auteur précédé du prénom *en entier*, en minuscules; les symboles et abréviations standards autorisés par le comité; les citations bibliographiques seront faites selon le mode de publication: article dans une revue, partie d'un livre, livre entier, etc.

3° Les figures ou dessins originaux devront être parfaitement nettes en vue de la réduction nécessaire. La réduction sera faite dans le format 14,5×20,0 cm.

La première épreuve seule sera envoyée à l'auteur pour la correction.

Les membres de la Société peuvent publier 7 pages imprimées sans frais d'impression dans la mesure à leur manuscrit qui ne demande pas de frais d'impression excessifs (pour des photos couleurs, par exemple). Dans les autres cas, y compris la présentation d'un non-membre, tous les frais seront à la charge de l'auteur.

Cinquante tirés-à-part peuvent être fournis par article aux auteurs à titre gratuit. On peut en fournir aussi un plus grand nombre sur demande, par 50 exemplaires.

Les manuscrits devront être adressés directement au directeur de publication de la Société: Y. ARUGA, Université des Pêches de Tokyo, Konan 4-5-7, Minato-ku, Tokyo, 108 Japon; ou bien au rédacteur étranger le plus proche: H. J. CECCALDI, EPHE, Station marine d'Endoume, rue Batterie-des-Lions, 13007 Marseille, France; E. D. GOLDBERG, Scripps Institution of Oceanography, La Jolla, California 92093, Etats-Unis; T. ICHIYE, Department of Oceanography, Texas A & M University, College Station, Texas 77843, Etats-Unis; ou T. R. PARSONS, Department of Oceanography, University of British Columbia, Vancouver, B. C. V6T 1W5, Canada.

La mer 27: 83-85, 1989
Société franco-japonaise d'océanographie, Tokyo

第2回　日仏海洋シンポジウム

The Second French-Japanese Symposium of Oceanography

はじめに

第2回日仏海洋シンポジウムは，日仏会館と日仏海洋学会の共催で，1988年10月5日，6日，清水市マリンビルにおいて行われた。このシンポジウムを通じて，海洋学の分野における日本，フランス両国相互の学術交流・協力の促進がはかられた。

シンポジウムには，当面している問題を含む，3つのテーマが選ばれた。すなわち，すでに3回シンポジウムの行われた（1983年モンペリエ，1984年仙台，1985年マルセイユ）「水産養殖」，前回（1985年マルセイユ）に引き続いて2回目の「リモートセンシング」，そして今回初めての「温排水」である。これら3つのセッションをあわせて，フランスからの24名を含め，141名の参加登録があった。そして，1991年フランスにおいて，次回のシンポジウムを開くことに，参加者全員が同意した。

テーマ1は温排水の熱拡散とその影響であった。最初の両国からの2題は温排水の挙動とその対策に関するものであり，排水の温度上昇値が日本では7°Cに対し，フランスでは12〜15°Cと，大きな差のあることが論点となった。フランスからの3題を含む次の5題は，温排水の生物環境に及ぼす影響に関するものであった。ここでは，塩素の使用や，卵稚仔への影響，好熱ビブリオ菌の増殖等が問題となった。最後は双方2題ずつの温排水の養殖への利用，さらに原子力発電所設置による地域開発に関する問題などの情報交換が行われた。

テーマ2は，養殖と，その生物学的発展であった。まず，成熟に関してフランスからの2題を含む4題の話題提供があり，続く5題（フランス側2題）が成長と飼料，そしてフランスからの1題を含む最後の5題が育種に関してであった。

テーマ3はリモートセンシングの海洋への応用であった。主題は外洋への応用を扱った海面水温の測定，その水産業への応用，海洋生産力の推定，資源調査のための画像処理の4つであり，フランスからの8題を含む12の話題提供があった。論議の焦点は熱帯地方におけるマグロ漁業と，クロロフィル，海藻，さんご礁資源等海面下の生物資源評価への利用であった。

シンポジウムの前日には，シャルディ博士，ケレルー博士，飯山教授による公開講演が行われ，また，シンポ

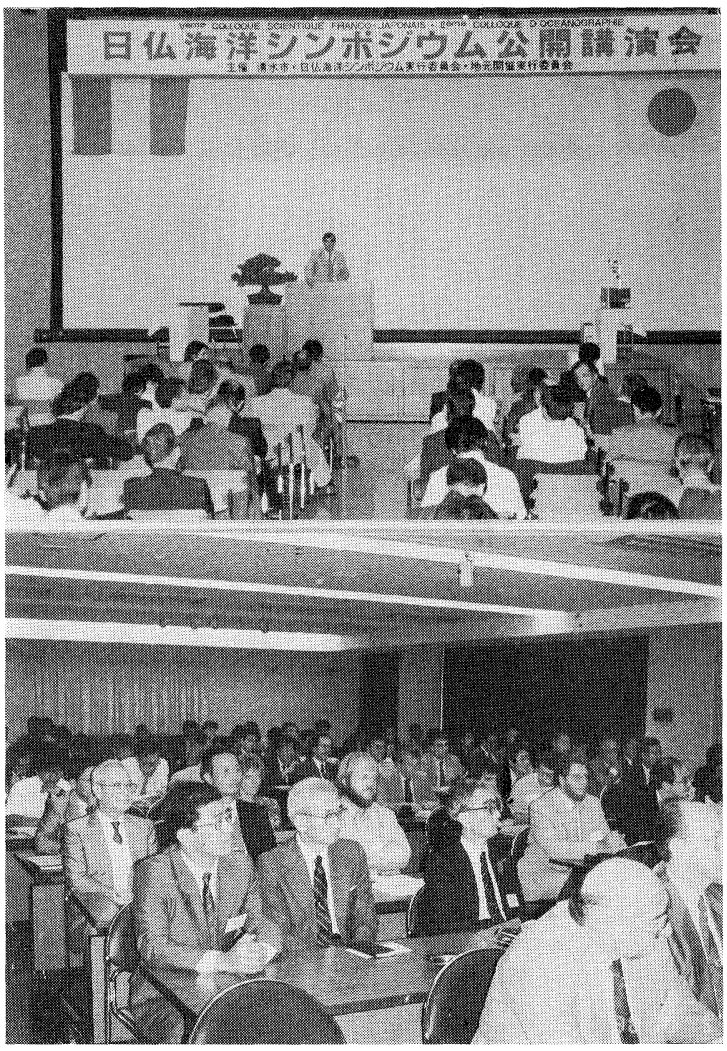
Introduction

The Second Colloque d'Océnographie Franco-Japonaise was held 5-6 October 1988 at the Shimizu Marine Building of the Municipal Government, sponsored by the Maison Franco-Japonaise and the Société Franco-Japonaise d'Océanographie. A mutual cooperation in scientific communication in the field of oceanography between Japan and France has been promoted through this symposium.

Three themes including timely topics were selected for the symposium: Aquaculture, for which previously three meetings (1983 in Montpellier, 1984 in Sendai and 1985 in Marseille) were held, and remote sensing were included in themes at the first colloque of oceanography in Marseille in 1985, while thermal effluent was the theme of the symposium that was held for the first time. The meeting had 141 registered attendees, including 24 from France. The participants were all in agreement as to that the next colloque will be held in France in 1991.

Session 1: Effects of thermal effluent on marine environment and its utilization in aquaculture. The first two talks, each one from both countries, were on the behavior of heated water and the counter plan for it. Discussion arose about a large difference in allowable temperature raise between in Japan (7°C) and in France (12-15°C). The next five talks including three from France were discussed on effects of discharged heated water on the biological environment. Main subjects were use of chlorine for removal of mussels, loss of eggs and larvae caused by entrainment and abundance of vivrio caused by thermal discharge. The last four talks including two from France were related to utilization of thermal effluent in aquaculture; besides, information concerning the grant from the government for economical promotion in the region, where a power plant was expected to be constructed, was exchanged.

Session 2: Aquaculture, its recent biological



ジウム終了後は県内のテクニカル・ツアーとして有意義な1日を過ごした。

このシンポジウム及び関連行事の諸経費は，日仏会館，清水市，IFREMER, ORSTOM，その他多くの団体，個人からの援助により賄うことができた。実行委員会および参加者一同，ここに深甚な謝意を表するものである。また，関係官庁，静岡県，清水市，フランス大使館，海洋科学技術センターの後援，および関係学会等の協賛をいただいた。これらの行事の清水市での開催をお引き受けいただいた宮城島弘正清水市長以下の市関係各位，テクニカル・ツアーの見学等にお世話いただいた静岡県および東海大学関係各位，その他地元各位の絶大なご協力に心からお礼申し上げるしだいである。

progress. Much discussion was caused by presentation of four talks including two from France on maturation, five talks from France, except for one, on growth and nutrition, and four talks including one from France on genetics.

Session 3: Application of remote sensing to oceanography. The majority of applications in this session dealt with four topics on open sea: sea surface temperature observation, its utilization for fisheries, estimation of marine productivity and image processing for resources assessment. Twelve talks including eight from France were given. A lively discussion focused on intertropical tuna fisheries and the validity of assessment of

最後に，このシンポジウムに賛同，助言いただいた顧問，組織委員各位，企画・運営に協力を惜しまれなかったセカルディ教授ほかのフランス側代表をはじめとする双方のコーディネーター，座長，参加者各位にも主催者を代表してお礼申し上げたい。

日仏海洋学会会長
第2回日仏海洋シンポジウム実行委員会委員長
宇　野　　寛

the living resources just below the sea surface such as chlorophyll, seaweeds and coral reefs.

The sessions were preceded by a public conference of Dr. Chardy, Dr. Querellou and Prof. Iiyama. On the day after the symposium 40 of participants made a post-conference tour in Shizuoka Prefecture.

The symposium was financially supported by the Maison Franco-Japonaise, the Shimizu Municipality, IFREMER, ORSTOM, various corporations concerned and two former participants of the Colloque in Marseille. The Executive Committee and all the participants wish to express their gratitude to them. The symposium was also supported by governmental ministry and agencies concerned, Shizuoka Prefectural Government, Shimizu Municipal Government, French Embassy in Japan and Japan Marine Science and Technology Center and received approval of societies of related sciences.

We owe the sincerest thanks to Mr. Hiromasa Miyagishima, Mayor of Shimizu City, and city officials conerned for kind offering to hold the symposium in the city and for extending their consistent support; to officials concerned of Shizuoka Prefectual Government and Tokai Unitersity for well arrangement and fully showing laboratories and museums we visited; and to other people in the city or in the prefecture for their help of various kinds and hearty hospitality.

Finally, I, in charge of the meeting, would like to thank the Advisory Council and the Organizing Committee for extending their approval and helpful advice; and Prof. Ceccaldi and other French delegates, coordinators, chairpersons and participants of both countries for their generous cooperation.

Yutaka UNO

President of the Société Franco-Japonaise d'Océanographie
Chairperson of the Executive Committee of the Second French-Japanese Symposium of Oceanography

La mer 27: 86-87, 1989
Société franco-japonaise d'océanographie, Tokyo

Le deuxième Colloque franco-japonais d'Océanographie — Rapport

Le Colloque fsanco-japonais d'Océanographie s'est déroulé dans de très bonnes conditions, aussi bien au point de vue matériel qu'au point de vue des échanges scientifiques.

Tous les participants français sont reconnaissants envers le Comité d'organisation japonais, qui a été un hôte parfait à tous égards, et en particulier au Professeur UNO Yutaka, dont l'énergie et les efforts ont permis la mise sur pied d'une excellente organisation. La Municipalité de Shimizu et en particulier son maire Monsieur MIYAGISHIMA Hiromasa ont également joué un rôle prépondérant dans ce succès, en soutenant matériellement ce Colloque, et en offrant l'utilisation de salles de réunion, ainsi que l'hébergement aux participants français.

Le Colloque a bénéficié de la présence de spécialistes de géodynamique marine, du programme Kaïko, comme le Dr. Pierre CHARDY le Dr. Joël QUERELLOU et le Professeur IIYAMA Toshimichi, qui ont tous trois donné une conférence publique dans un grand auditorium aimablement prêté par la Municipalité de Shimizu. Ces conférences ont été suivies par un nombreux public.

Au point de vue scientifique, les trois thèmes choisis se sont révélés extrêmement fructeux quant à la nature, quant à l'intérêt et quant au niveau des échanges établis.

Trois thèmes principaux ont été choisis, qui pourront conduire tous les trois à des coopérations ultérieures de qualité.

Effets des effluents thermiques marins, Aquaculture, et Télédétection des satellites en Océanographie sont, en effet, des thèmes très prometteurs.

Dans le thème Effets des effluents thermiques marins, le fait marquant est le début de *modélisation* des rejets, en trois dimensions, qui permet de mieux prévoir les effets à court terme et à long terme. Ces effets biologiques ont été étudiés avec plus de détail et plus de pertinence que lors des réunions habituelles du ce type.

Le second fait marquant a consisté en un début de *standardisation* dans l'observation des effets des eaux chaudes, ce qui perment effectivement de normaliser la mesure des conséquences des rejets des eaux chaudes de la même façon dans les deux pays. Les recommandations faites au cours de ces réunions pourront servir de base à une méthodologie franco-japonaise commune, et, au delà, à des techniques de mesures internationales très importantes pour l'avenir de ce secteur de la recherche.

Le troisième fait marquant est la réussite de l'*utilisation* des eaux chaudes, en particulier pour l'aquaculture, ce qui rend possible les élevages d'espèces tropicales à toutes latitudes dans des conditions contrôlées. Pour la première fois, les variations cycliques de température et les effets combinés de la température et de l'éclairement ont été abordés de façon concrète.

Dans le thème Aquaculture, les récents progrès en *nutrition* des crustacés ont été exposés de façon très constructive, pour ce qui concerne aussi bien la couverture de la ration minérale que les aliments vivants à fournir aux larves.

Le deuxième point important est le *traitement* et la *gestion des eaux* provenant de l'élevage des bassins d'aquaculture marine.

Le troisième fait important est le dèveloppement des techniques de *génétique* en aquaculture, en particulier après avoir obtenu des animaux tripoïdes, début de manipulations cellulaires de gamètes, laissant prévoir, pour plus tard, de l'emploi de techniques biotechnologiques plus évoluées.

Enfin, le *contrôle de la reproduction* des espèces élevées, clé de tout développement ultérieur de l'aquaculture, a donné lieu à de très intéressantes communications.

En ce qui concerne l'utilisation des satellites en Océanographie, les résultats exposés ont été à la fois très importants et très intéressants.

Les relations entre les données des satellites météorologiques et satellites océanographiques ont été bien exploitées, en particulier pour les *température de surface.*

Le second point est le développement de logiciels

spéciaux pour résoudre des problèmes particuliers d'imagerie satellitaire.

Le troisième point d'importance est l'utilisation des satellites pour mesurer la biomasse des algues côtières, et pour aider à la *prévision des pêches*.

En conclusion, le Colloque a permis des échanges très fructueux, qui se concrétiseront par des programmes des *recherches communes*, dans chacun des trois thèmes, à court et à moyen termes, certains programmes étant d'ailleurs en cours de développement. Il a permis aussi l'identification de *thémes interdisciplinaires*, comme l'emploi de satellites dans l'identification de zones de rejets, ou les relations entre les données des satellites et les pêcheurs.

Le fait que tous les participants soient repartis extrêmement satisfaits, aussi bien au plan des relations scientifiques établies, qu'au plan des résultats échangés constitue une preuve évidente que ce Colloque d'Océanographie a été un incontestable succès.

Hubert J. CECCALDI
Maison Franco-Japonaise, EPHE

第5回日仏学術シンポジウム
第2回日仏海洋シンポジウム

(昭和63年10月3〜13日　東京，清水市，静岡県内)

シンポジウムのテーマ:

1. 温排水の影響と水産における利用
2. 水産養殖，その生物学的進展
3. リモートセンシングの海洋への応用

主　　催:　財団法人日仏会館
日仏海洋学会第2回日仏海洋シンポジウム実行委員会

開催責任者:　宇野　寛（日仏海洋学会会長）
ユベール・J・セカルディ（フランス高等研究院，日仏会館）

後　　援:　科学技術庁
水産庁
通商産業省
工業技術院
静岡県
清水市
海洋科学技術センター
フランス大使館

協　　賛:　社団法人日本水産学会
日本海洋学会
日本リモートセンシング学会
水産海洋学会

行事の概要:

10月3日（月）

11:30-13:00 第5回日仏学術シンポジウム開会式およびレセプション（東京 日仏会館）

The Fifth French-Japanese Scientific Symposium
The Second French-Japanese Symposium of Oceanography

(October 3-13, 1988, Tokyo, Shimizu City and Shizuoka Prefecture)

Symposium Themes:

1. Effects of Thermal Effluent and its Utilization
2. Aquaculture, its Recent Biological Progress
3. Application of Remote Sensing to Ocean Studies

Sponsored by:
Maison Franco-Japonaise
Société Franco-Japonaise d'Océanographie

Symposium Organizer:
Yutaka UNO, President of the Société Franco-Japonaise d'Océanographie, Chairperson of the Executive Committee of the Second French-Japanese Symposium of Oceanography
Hubert J. CECCALDI, Maison Franco-Japonaise, EPHE

Supported by:
Science and Technology Agency
Fisheries Agency
Ministry of International Trade and Industry
Agency of Industrial Science and Technology
Shizuoka Prefectural Government
Shimizu Municipal Government
Japan Marine Science and Technology Center
Ambassade de France au Japon

Received Approval of:
Japanese Society of Fisheries, INC.
Oceanographical Society of Japan
Remote Sensing Society of Japan
Japanese Society of Fisheries Oceanography

PROGRAM

October 3, Monday
11:30-13:00 Opening Session for the Fifth French-Japanese Scientific Symposium; Reception invited by President of the Council of Administration and French Director of the Maison (Maison Francc-Japonaise, Tokyo)

16:30-17:30 日仏合同打ち合わせ会（第1回）
（ホテルサンルート東京）

18:45-20:40 実行委員会主催レセプション
（同上 参加50名）

10月4日（火）

15:00-17:00 公開講演（清水市と共催
清水市マリンビル 参加300名）

「フランスの海洋開発研究について」
ピエール・シャルディ博士
（フランス海洋開発研究所）
「海底温泉」
ジョェル・ケレルー博士 （同上）
「KAIKO」（日仏日本海溝共同調査）について
飯山敏道教授（千葉大学）

18:30-20:30 清水市主催レセプション
（三保園ホテル 参加140名）

10月5日（水）

9:00-9:30 海洋シンポジウム開会式
（参加120名）

9:30-17:30 シンポジウム（3つのテーマに分かれて研究発表・討論）
話題提供 1.1〜1.7, 2.1〜2.9, 3.1〜3.9
18:30〜20:00 東海大学海洋学部主催レセプション
（サンルートホテル清水 参加50名）

10月6日（木）

9:00-12:00 シンポジウム（3つのテーマに分かれて研究発表・討論）
話題提供 1.8〜1.11, 2.10〜2.13, 3.10〜3.12

13:30-15:00 合同セッション（テーマごとの報告，総括等）
16:10-17:10 日仏合同打ち合わせ会（第2回）
（ホテルサンルート清水）

18:30-20:20 日仏海洋学会主催懇親会
（清水マリンビル 参加150名）

16:30-17:30 Committee Meeting for Symposium of Oceanography (Hotel Sunroute Tokyo, attended by 50 persons)
18:45-20:40 Reception held by the Executive Committee (Hotel Sunroute Tokyo)

October 4, Tuesday

15:00-17:00 Public Conference co-sponsored by the Executive Committee and the Shimizu Municipal Government (Shimizu Marine Bldg., attended by 300 persons)

French Activities on Ocean Exploitation
Dr. Pierre Chardy, IFREMER, Brest
Submarine Hot Spring
Dr. Joel Querellou, IFREMER, Brest
KAIKO, the Cooperative French-Japanese Scientific Survey of Deep-sea Trenches and Troughs
Prof. Toshimichi Iiyama, Chiba Univ.

18:30-20:30 Reception invited by courtesy of the Mayor of Shimizu City (Miho-en Hotel, Shimizu, attended by 140 persons)

October 5, Wednesday

9:00-9:30 Welcome Address (Shimizu Marine Bldg., attended by 120 persons)
Prof. Yutaka UNO, President of the Société Franco-Japonaise d'Océanographie
Mr. Hiromasa MIYAGISHIMA, Mayor of Shimizu City

9:30-17:30 Simultaneous Sessions (Shimizu Marine Bldg.)
Talks 1.1-1.7, 2.1-2.9, 3.1-3.9

18:30-20:00 Reception held by Tokai University (Hotel Sunroute Shimizu, attened by 50 persons)

Octaber 6, Thursday

9:00-12:00 Simultaneous Sessions (Shimizu Mairine Bldg.)
Talks 1.8-1.11, 2.10-2.13, 3.10-3.12

13:30-15:00 General Session (Shimizu Marine Bldg.)

16:10-17:10 Committee Meeting for the Proceedings

18:30-20:20 Cocktail Reception held by the President of the Société Franco-Japonaise d'Océanographie (Shimizu Marine Bldg., attended by 150 persons)

10月7日（金）

5:30-17:40 テクニカル・ツアー

（静岡県東部　参加40名）

焼津魚市場（焼津市）

静岡県温水利用研究センター（浜岡町）

東海大学海洋博物館（清水市）

静岡県栽培漁業センター（沼津市）

10月13日（木）

10:30-12:30　評価の会（日仏会館）

14:00-15:30　公開講演（同上）

「海洋生物資源の総合管理に向けて」

ユベール・J.・セカルディ

（国立高等研究院，日仏会館フランス学長）

October 7, Friday

5:30-17:40 Post-Conference Tour in the eastern part of Shizuoka Prefecture (attended by 40 persons including 20 from France)
Yaizu Fish Market (Yaizu City)
Shizuoka Prefectural Thermal Effluent Utilization Research Center (Hamaoka)
Tokai University Marine Science Museum (Shimizu City)
Shizuoka Prefectural Mariculture Center (Numazu City)

October 13, Thursday

10:30-12:30 Meeting for Evaluation of the Fifth French-Japanese Science Symposium (Maison Franco-Japonaise)

14:00-15:30 Public Conference co-organized by the Maison Franco-Japonaise and by the Société Franco-Japonaise d'Océanographie (Maison Franco-Japonaise)
Towards Overall Global Management of Marine Biological Resources
Prof. Hubert J. Ceccaldi, French Director of the Maison Franco-Japonaise, EPHE

シンポジウムのテーマと研究発表

アンダーラインはフランス側参加者

(ORSTOM: フランス海外開発協力科学研究所
IFREMER: フランス海洋開発研究所)

テーマ1　温排水の影響と水産における利用

コーディネーター

N. LACROIX (IFREMER, ナント)

中谷　茂 (㈶海洋生物環境研究所)

千葉健治 (東京大学農学部)

話題提供

1. 温排水の熱拡散とその対策（5日午前）

1.1 温排水による熱拡散の予測と排熱の軽減対策
和田　明 (東海大学海洋学部)

1.2 フランス沿岸原子力発電所における熱拡散の影響の3次元的数値モデリング
B. MANOHA (フランス電力庁)

2. 温排水の生物環境に及ぼす影響（5日午前～午後）

1.3 沿岸水域の生物・環境に及ぼす温排水の影響に関する調査研究
深滝　弘 ㈶海洋生物環境研究所

1.4 海洋環境における温排水の生物学的影響評価
P. CHARDY (IFREMER, ブレスト)

1.5 温排水の海洋資源への影響
N. LACROIX (IFREMER, ナント)

1.6 原子力発電所に関する生態面と漁撈面からの研究の組織化
A. GREGOIRE (フランス電力庁)

1.7 発電所稼働に関する沿岸海域のモニタリング調査
浅野　一郎 ㈶海洋生物環境研究所

3. 温排水の水産における利用等（6日午前）

1.8 水産養殖における温排水の利用
千葉　健治 (東京大学農学部)

1.9 グラベリーヌ養殖センターにおける温排水の漁業への有効利用
D. LECLERCQ, H. GIGAROFF
(IFREMER, グラベリーヌ)

Symposium Themes and Talks

Theme 1 Effects of thermal effluent and its utilization

Coordinators:

N. Lacroix, IFREMER

S. Nakatani, Marine Ecology Res. Inst.

K. Chiba, Univ. of Tokyo

Session 1: Behavior of heated water and the counter plan for it

1.1 Present status of predictive and mitigation methods for thermal effluent.
A. Wada, Tokai Univ.

1.2 Three-dimensional numerical modelling of thermal impact for French coastal nuclear power plants.
B. Manoha, EDF

Session 2: Special effects of thermal effluent to the biological environment

1.3 Studies on the impact of thermal effluents on life and the environment in coastal waters.
H. Fukataki, Marine Ecology Res. Inst.

1.4 Assessing biological effects of thermal discharge in the marine environment.
P. Chardy, IFREMER

1.5 Effects of thermal discharges on marine resources.
N. Lacroix, IEREMER

1.6 Organizing about ecological and halieutic studies for French nuclear power plants.
A. Gregoire, EDF

1.7 Monitoring survey of coastal waters concerning power plant operations.
I. Asano, Marine Ecology Res. Inst.

Session 3: Utilization of thermal effluent in fisheries

1.8 Heated effluent utilization in aquatic animal culture in Japan.
K. Chiba, Univ. of Tokyo

1.9 Valorization of industrial heated effluents through intensive aquaculture water management and fish growth. Experience on the Gravelines site.
D. Leclercq and H. Gigaroff, IFREMER

1.10 グラベリーヌ養殖センターの発展
—原子力発電所排熱利用のプロジェクト—
H. SYLVESTRE (Lyonnaise des Eaux)

1.11 泊原子力発電所と地域漁業振興について
八木宏樹(北海道原子力環境センター)

テーマ2 水産養殖，その生物学的進展

コーディネーター
H.J. CECCALDI（フランス国立高等研究院）
隆島 史夫 （東京水産大学）

話題提供

1. 成熟（5日午前）

2.1 アワビ類の成熟とその制御
浮 永久（養殖研究所）

2.2 エビ類卵形成過程における卵巣，血リンパ，ビテロゲニンの生化学的特性
H. J. CECCALDI, C. BOUCARD, C. MARANGOS, M. VINCENT（フランス国立高等研究院）他

2.3 養殖クルマエビの成熟
矢野 勲 （養殖研究所）

2.4 フランスにおける養殖適性種
J. QUERELLOU (IFREMER, ブレスト)

2. 成長・飼料（5日午後）

2.5 クルマエビのリンとカルシウム要求，特にフィチン態リンの役割について
J. GUILLAUME, W. W. CHENG, R. CIVERA (IFREMER)

2.6 クルマエビ幼生の栄養要求
金沢 昭夫 （鹿児島大学）

2.7 スズキ稚魚の集約的飼育
—養殖における動物学的研究のモデル—
B. CHATAIN (IFREMER)

2.8 海水養殖池排水によるプランクトン培養及びスズキ，クロダイ稚魚飼育への利用
Y. MARTIN, N. VILLON, C. PHELEPP（リカルド海洋財団）

2.9 稚魚飼育の生物餌料としてのワムシ
萩原 篤志 （長崎大学）

1.10 Development of the aquaculture center of Gravelines. Utilization of heated effluent from the nuclear power plant.
H. Sylvestre, Lyonnaise des Eaux

1.11 Promotion planning of regional fisheries with the Tomari nuclear power plant.
H. Yagi, Hokkaido Nuclear Energy Environmental Research Center

Theme 2: Aquaculture, its recent biological progress

Coodinators: H. J. Ceccaldi, EPHE
F. Takashima, Tokyo Univ. Fish.

Session 1: Maturation

2.1 Maturation and its control in the abalone.
N. Uki, Natl. Res. Inst. Aquaculture

2.2 Biochemical charaterization of ovary, hemolymph and vitellogenin during oogenesis in the peneid shrimp.
H.J. Ceccaldi, C. Boucard, C. Marangos, M. Vincent *et al.*, EPHE

2.3 Maturation in the peneid shrimp in captivity.
I. Yano, Natl. Res. Inst. Aquaculture

2.4 Species chosen in France for aquaculture.
J. Querellou, IFREMER

Seisson 2: Growth and Nutrition

2.5 Calcium and phosphorus requirements of the Japanese shrimp *Penaeus japonicus* with special emphasis on the role of phytic phosphorus.
J. Guillaume, W. W. Cheng and R. Clivera, IFREMER

2.6 Nutritional requirements of prawn larvae.
A. Kanazawa, Kagoshima Univ.

2.7 Intensive larval rearing of sea bass, *Dicentrarchus labrax*: A model of zootechnical research in aquaculture.
B. Chatain, IFREMER

2.8 Valorization of recycled waste waters from marine fishes rearing tanks: plankton production and use for sea bass and gilthead breems larvae.
Y. Martin, N. Villon and C. Phelepp, Fondation oceanographique Ricard

2.9 Recent studies on the rotifer *Brachionus plicatilis* as a live food for the larval rearing of marine fish.
A. Hagiwara, Nagasaki Univ.

3. 育種（6日午前）

2.10 アワビ類の交雑
小池 康之（東京水産大学）

2.11 アコヤガイの量的形質と三倍体作出
和田 克彦（養殖研究所）

2.12 クロチョウガイを例とした自然集団内の遺伝変異
F. BLANC, P. DURAND
（ポールヴァレリ大学）

2.13 最近の魚類育種
尾城 隆（東京水産大学）

テーマ3 リモートセンシングの海洋への応用

コーディネーター
F. DOUMENGE（ORSTOM, パリ）
松生 洽（東京水産大学）
杉原 滋彦（理化学研究所）

話題提供

1. 海面水温測定とその大気補正（5日午前）

3.1 METEOSAT による海面水温の大気補正
J. CITEAU, H. DEMARCQ,
G. MAHE（ORSTOM, ダカール, セネガル）

3.2 衛星による海面水温の測定
高島 勉（気象研究所）

3.3 海面水温測定のための地球同期気象衛星用リモートセンシング・ソフトウェア
D. DAGORNE, L. MAREC,
（ORSTOM, ラニオン, フランス）

2. 水温測定の海洋研究への応用（5日午後）

3.4 リモートセンシングの海洋，特に水温観測への応用
友定彰，稲掛伝三（東海区水産研究所）

3.5 リモートセンシングによるマグロ漁場の予測
J.-M. STRETTA（ORSTOM, モンペリエ, フランス）

3.6 NOAA AVHRR データの漁業情報サービスへの応用
岡田喜裕（漁業情報サービスセンター）

Session 3: Genetics

2.10 Cross-breeding among the abalones.
Y. Koike, Tokyo Univ. Fish.

2.11 Quantitative genetics and triploid production in the Japanese pearl oyster, *Pinctada fucata martensii*.
K. Wada, Natl. Res. Inst. Aquaculture

2.12 Genetic variability in natural bivalve populations: the case of the black-lipped pearl oyster *Pinctada margaritifera*.
F. Blanc and P. Durand, Univ. Paul Valery

2.13 Fish genetics, its new approach.
T. Oshiro, Tokyo Univ. Fish.

Theme 3: Application of remote sensing to ocean studies

Coordinator:
F. Doumenge, ORSTOM, Paris
K. Matsuike, Tokyo Univ. Fish.
S. Sugihara, Inst. Phys. Chem. Res.

Session 1: Atmospheric correction and water temperature retrieval

3.1 A simple and reliable method for atmospheric effect removal from Meteosat IR data in SST extraction.
J. Citeau, H. Demarcq and G. Mahe, ORSTOM

3.2 Sea surface temperature measurements from space.
T. Takashima, Meteorological Res. Inst.

3.3 Remote sensing software for meteorological satellite application for operational sea surface temperature using geosynchronous satellites.
D. Dagorne and L. Marec, ORSTOM

Session 2: Application of water temperature measurement to ocean studies

3.4 Application of remote sensing to oceanography, particularly to water tempeaature.
A. Tomosada and D. Inagake, Tokai Reg. Fish. Res. Lab.

3.5 Forecasting tuna fisheries areas: what parameters, what models? The praxeological response. J.-M. Stretta, ORSTOM

3.6. Application of NOAA AVHRR data for fisheries service in Japan.
Y. Okada, Japan Fisheries Information Service Center

3.7 西太平洋熱帯マグロ漁場に関する主要な海洋パラメータは何か

R. PIANET (ORSTOM, ヌメア, ニューカレドニア)

3. クロロフィル濃度の測定（5日午後）

3.8 表層水のクロロフィル濃度のリモートセンシング

杉原滋彦, 岸野元彰 (理化学研究所)

3.9 NIMBUS-7 CZCS による 1978-1984 年の南西熱帯太平洋の海面クロロフィル濃度

C. DUPOUY (ORSTOM, ブレスト, ヌメア)

4. 水色画像の海洋研究への応用（6日午前）

3.10 リモートセンシングは漁業に関する道具として役に立つか？

M. PETIT (ORSTOM, モンペリエ, フランス), A. WADSWORTH (GDTA, フランス)

3.11 SPOT 衛星の高分解能のニューカレドニアのさんご礁資源評価への適用

W. BOUR (ORSTOM, ヌメア, ニューカレドニア)

3.12 SPOT 衛星による海藻の定性的および定量的マッピング

T. BELSHER (IFREMER, ブレスト, フランス)

3.7 Oceanography and intertropical tuna fisheries in the western Pacific. Which significant large scale parameters can be used?

R. Pianet, ORSTOM

Session 3: Chlorophyll concentration retrieval

3.8 Remote sensing of chlorophyll concentration in the surface water.

S. Sugihara and M. Kishino, Inst. Phys. Chem. Res.

3.9 Sea surface chlorophyll concentration in the southwestern tropical Pacific as seen by NIMBUS-7 CZCS from 1978 to 1984.

C. Dupouy, ORSTOM

Session 4: Application of water color image to ocean studies

3.10 Will an operational marine fishery science (halieutic) make a way through aerospatial remote sensing tool?

M. Petit, ORSTOM and A. Wadsworth, GDTA

3.11 SPOT satellite high resolution applied to coral reef resources assessment in New Caledonia.

W. Bour, ORSTOM

3.12 Qualitative and quantitative mapping of seaweeds by SPOT satellite.

T. Belsher, IFREMER

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Société franco-japonaise d'océangraphie, Tokyo

1-1: Behavior of Heated Water and the Counter Plan for It

Present status of predictive and mitigation methods for thermal effluent

Akira WADA

School of Marine Science and Technology, Tokai University,
Orido 3-20-1, Shimizu, Shizuoka, 424 Japan

1. Background of problems

In Japan, where power plants are generally constructed along the coastal lines, it has become increasingly important to accurately and scientifically evaluate the effect of cooling-water intake and discharge activities from the viewpoint of environmental impact assessment.

In this paper, present status of research and problems in predicting the diffusion of the thermal effluent, as well as measures for mitigating the effect of thermal effluent and methods for predicting the biological effect and change owing to the intake and discharge of cooling water are to be discussed.

2. Development of predictive method for diffusion extent

1) Far Field

At present, as a technique for predicting the diffusion of discharged warm water in the far field, the simulation analytical model based on the mathematical model is widely used. From a comparative study with the results of survey at many points, the appropriateness of this prediction technique has been proved and it is considered to have reached an almost practical stage. This technique aims to obtain the horizontal spread of discharged warm water.

2) Near Field

With an increase in the discharge rate of warm water due to an increase in the capacity of power plants in recent years, the high water-temperature rise region near the outlet is expanding more than ever, making it necessary to carry out more highly accurate diffusion prediction with a high temperature-rise region as a subject area.

The mixed dilution process as well as the modeling of the thermal effluent in the neighborhood of the outlet, through comparative study between the 3-D model and the results of hydraulic model experiment were examined.

3-D mathematical model devloped adequately expresses a phenomenon in which seawater is entrained into discharged water in the neighborhood of the outlet, which the conventional 2-D mathematical model (far field model) could not express. By applying this 3-D mathematical model, more highly accurate prediction of the high temperature-rise zone (3−5°) can be achieved.

3. Measures for mitigating effect of thermal effluent

Investigations have been conducted into measures for mitigating the thermal effect from both technological and economical standpoints.

1) Hydraulic Countermeasures: This method utilizes a relative decrease in the temperature of discharged water by selectively intaking the water in the bottom layer.

2) Methods for Cooling the Discharged Warm Water by Forced Mixing: A submerged discharge systems is one of these methods.

Theoretical studies as well as basic hydraulic model experiments have been conducted on the mixing dilution effect of discharged water by submerged discharge pipes.

A 3-D mathematical model is developed to predict the gravity diffusion and oceanic diffusion phenomena in the surface layer after the plume has reached the surface, through comparison between results of analyses and the results of hydraulic model experiments and field measure-

ments.

4. Predicting change of biological environment owing to intake and discharge of cooling water

As a means of quantitatively determining the ratio of floating organisms entrained owing to intake of cooling water, a stochastic mathematical model considering flow and turbulence in the sea is developed.

The results of actual investigations concerning entrainment at power plants in operation, conducted in the inland sea and open sea, were compared with the results obtained by the numerical model. Consequently, close agreement between predicted and measured results was obtained. These results reveal that the entrainment range of high probability is confined to the neighborhood of the inlet, though it has so far been considered that such entrainment takes place from a considerably wide range.

5. Remarks

The present situation of research on various problems concerning the thermal effluent from power plants has been discussed. Some progress has been achieved in establishing a simulation method for predicting diffusion extent of discharged warm water. Regarding the effect of the thermal effluent on marine organisms, however, many problems still remain to be solved in the future because the biological environment in the neighborhood of seashore considerably varies with the change of natural conditions, and the behavior of organisms consists of exquisite systems.

There are presently no practical measures to reduce the thermal energy which is released as discharged warm water. Paying attention to the heat dilution capability of discharged warm water in the front sea of the outlet, therefore, it will be necessary to select an adequate location in such a way as to mitigate the effect of the thermal effluent.

Three-dimensional numerical modelling of thermal impact for French coastal nuclear power plants

B. MANOHA

Laboratoire National d'Hydraulique, EDF Chatou, France

A lot of nuclear power plants using once-through cooling systems have been erected by Electricité de France along the French coast since many years. Because of the importance of the maritime works involved, very special care had to be taken concerning environmental problems, especially in terms of currentological and sedimentological impact of the intake and discharge works, and in terms of recirculation and thermal impact on the marine environment. These studies, performed by the Laboratoire National d'Hydraulique of E.D.F., have enabled to develop a large number of mathematical and physical models, from simple to very sophisticated ones, each model being adapted to the specific problems to be faced, and to the available necessary data. The paper is particularly focused on the problem of thermal impact, and describes the recent studies performed for the GRAVELINES nuclear power plant, where a 3D numerical model of currents and temperature evolution has been used and validated versus extensive in-situ measurements.

In the case of Gravelines (6×900 MWe, discharge flow 240 m^3/s with a temperature elevation of 12°C), the use of a 3D modelization is particularly necessary as the discharge is made through a free surface channel, leading to a rather strong buoyancy of the warm waters and an important vertical stratification of temperature in the near field.

The 3D numerical model ODYSSEE calculates simultaneously the marine currents and temperature evolution; the Navier-Stokes equations are

solved using a finite differences scheme, the main assumptions of the model being: hydrostatic pressure, Boussinesq approximation, incompressible flow. The calculation is made on a rectilinear computational grid with a splitting of operators, the Z direction being discrete through a curvilinear transformation.

The calculation area for Gravelines is 14.3 km $\times$3.9 km, with a mesh size of 100 m horizontally and 13 points on the vertical, leading to 74,880 calculation points. The evolution in time and space of the currents and thermal impact was computed during spring tide, the boundary conditions of flow being provided by the results of a 2D numerical model of larger area.

The results of the calculations could be compared with in situ measurements performed around the site, the nuclear plant being operating since a few years: infrared aerial thermographies giving surface temperature fields at various phases of the tide, punctual temperature profiles measured continuously at 11 fixed points, and transverse vertical sections measured from a boat in the thermal plume.

The comparison showed a very satisfactory agreement with the measurements, especially during full flood and ebb; the vertical stratification of temperature was also very correctly reproduced. The introduction of a more sophisticated turbulence model ($k-\varepsilon$ type for example), as well as a refined gridmesh near the outlet and along the coast, could nevertheless improve the results, especially in the very near field and during slack waters where the vertical mixing is slightly underestimated by the computation.

This kind of 3D model, which could then be validated very correctly because of the big amount of data collected on the Gravelines case, has in fact applications in all fields related to waste water management or pollution control, but also in fields related to sedimentation problems, such as transport of bed-load or suspended sediments for example.

Some other general LNH-EDF references in this particular field:

BENQUE, J.P., A. HAUGUEL and P.L. VIOLLET 1982. Engineering Application of Computational Hydraulics. Volume 2. Pitman.

COEFFE, Y., A. WARLUZEL and M.C. BURG 1982. Three-dimensional numerical model for tidal and wind generated flow. Coastal Engineering, Cape Town.

DARRAS, M., H. ALLEN, D. CAVELIER and L. CAUDRON 1984. Synthèse de mesures de température dans le rejet chaud d'une centrale en bord de mer. Rapport I. 5. 18e journées de l' hydraulique, Marseille, Société Hydraulique de France.

DEWAGENAERE, P. 1979. Thesis, University Pierre et Marie Curie, Paris VI.

Discussion on papers by A. WADA and B. MANOHA

H. ARAKI (CRIEPI): How do you manage to make a connection of far field numerical models with near field physical models ?

B. MANOHA (EDF): The far field numerical model provides the boundary conditions of flows to the near field physical model; then the dilution of the warm waters in the near field is simulated in the physical model during a limited period of time (2, 3, ····· consecutive tidal periods), and the experiment must be stopped when the warm waters begin to go out of the limits of the model; then we have to make a synthesis of both far field and near fiield results, especially in the near field where the measured results in the physical model must be "added" to the "basic temperature elevation" provided by the numerical model of the far field.

A. WADA (Tokai Univ): The rule in Japan for the discharged temperature elevation is 7°C, whereas in France this value can be 12°C (900 MW) or 15°C (1300 MW). Does this high value in France induce any problem ?

B. MANOHA (EDF): The biggest differences in the natural environment between France and Japan seem to be mostly that the marine currents in front of the French nuclear plants are some higher in velocity and generated by strong tides (which provides very good dilution of the warm waters), and also that the maximum natural temperatures in summer are not very high (18°C max. in Gravelines), which

enable in France to use temperature elevations of 12°C to 15°C without major problems.

K. CHIBA (Univ. of Tokyo): Who decides these values of the discharged temperature elevation ?

B. MANOHA (EDF): There is no governmental regulation on this topic. It depends on the site itself (maximum natural water temperature to be taken into account), and is decided by EDF after an optimization study resulting from a compromise between high discharge flow Q (which, if too high, case create problems of too high velocities in the pumping stations and strong entrainment of fishes for example), and high temperature elevations between intake and discharge. Let us recall that the thermal power discharged in the sea is the produce of $Q \times \Delta T$, which means that decreasing ΔT means increasing Q, and vice versa.

B. MANOHA (EDF): Which are the currents along the Japanese coast: are they mostly governed by the tide or by general currents, and what are the orders of magnitude of the current velocities ?

A. WADA (Tokal Univ): The tide is rather small in Japan compared to France, especially in the northern area. There exist general currents around the coasts of Japan: warm circulation currents flowing from south to northeart (to Pacific Ocean), and some cold circulation currents flowing from north to south in the Japan Sea; the paths of these general currents are more or less dependent on the season. Generally speaking, tidal current velocities are 20 cm/s in minimum, while 1～2 m/s in the highest.

Mrs. N. LACROIX (IFREMER): How many nuclear units are there presently operating in Japan ?

A. WADA (Tokai Univ): Nearly all the nuclear power stations operating in Japan are built along the coast, and use once-through cooling systems (very small and very few units inland); the total number of units is over 30.

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1-2: Special Effects of Thermal Effluent to the Biological Environment

Studies on the impact of thermal effluents on life and the environment in coastal waters

Hiroshi FUKATAKI

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The Marine Ecology Research Institute was established in December 1975 as a non-profit foundation under the joint supervision of the Ministry of Agriculture, Forestry and Fisheries, the Ministry of International Trade and Industry, and Environmental Agency, based on an agreement between the fisheries industry and electric power industry. Its purpose is to scientifically clarify the effects of the intake and discharge of cooling water by power plants on marine life and the environment.

This report gives an outline of our research from the time of establishment to the present.

Field survey and field experiments

From 1976 to present, we have been conducting a wide variety of field surveys and experiments on the effects of thermal effluents on marine life and the environments, covering the pre- and post-operational periods of power plants built on the sea coast.

The following have been the principal projects;

1) Comprehensive field survey in waters around model power plants;
2) Field survey and research on copepods passing through the cooling water system of power plants;
3) Studies on behavior of adult chum salmon in the area influenced by thermal effluents;
4) Studies of the distribution of fishes around the outfall of discharge;
5) Studies on the effects of water intake by cooling system of the plant on the selected important fish populations.

Laboratory and outdoor experiments

Since the complement of our Central Laboratory at Onjuku, Pacific coast of central Japan, in 1979, we expanded our range of activities to conduct indoor experiments to accumulate basic knowledges necessary in assessing the effects. Also, since the opening of our Demonstration Laboratory at Kashiwazaki, Japan Sea coast of central Japan, in 1984, we have started both outdoor and laboratory experiments by using actual thermal effluents from a neighboring power plant and natural seawater at normal temperature to learn the effects of the thermal effluent on the growth and maturation of marine organisms.

The principal works of these experiments are as follows;

1) Laboratory experiments on thermal tolerance of marine fishes and invertebrates in their early life stages;
2) Laboratory experiments on the effect of temperature on the growth of young seaweeds;
3) Laboratory experiments on preference, avoidance and critical temperatures for marine fishes and shellfishes;
4) Laboratory experiments on the ability of marine fishes to resist the force of water flow;
5) Outdoor experiments on the effects of temperature and current on the growth of commercially cultured seaweeds;
6) Laboratory experiments on the combined effects of water temperature and other water quality conditions;
7) Laboratory experiments on the effects of the short-term fluctuation of water temperature on marine organisms.

Our research results obtained through the above-mentioned two approaches, during the past 12 years, seem to indicate that the range and degree

of the impacts of the intake and discharge of cooling water on marine organisms and the environment are confined within a small area near the inlet and the outfall of cooling water system.

Assessing biological effects of thermal discharge in the marine environment

Pierre CHARDY

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Environmental assessment methodologies can be catalogued into three major groups: monitoring practices, experimental designs and simulation models. The aim of monitoring is the detection of effects, while experimental studies and modelling have explicative and predictive purpose. Illustration and discussion about these three procedures are attempted with reference to the environmental studies developed at Gravelines power station, on the North Sea.

Monitoring

Two possible basic strategies are used in any monitoring program (CHARDY and MENESGUEN, 1984):

—comparison of pre-operational and operational periods, the so-called "before and after" approach;

—comparison of control and affected stations at the same moment, the so-called "in and out" appoach.

The basic inferencial problem concerns the difference of means "Δ" between impacted state and reference state. In such a test the second kind of error defining the probability of accepting null hypothesis when alternative hypothesis ($\Delta>0$) is true is of major interest. Then optimal strategy should have to minimize the risk of making an error of the second kind, which is equivalent to maximize the power function: $1-\beta$.

The case study Gravelines leads to conclude that. "In and out" monitoring design may be preferable to a long-term surveys, which are, most of the time, counterproductive and may result in an inconclusive data base. Nevertheless, base line study is needed for providing spatial pattern and natural fluctuations during preoperational period. The order of magnitude of the detectable change even in the "in and out" approach is quite high; detecting a chlorophyll *a* deficit smaller than 30% in Gravelines would require a near impracticable sampling effort.

Experimental studies

Tests on a wide veriety of planktonic species indicate a mean upper lethal temperature of about 30°C for zooplankton and 40°C for phytoplankton. With a maximum ambient temperature of 20°C and a Δt of 12°C at Gravelines, thermal effect appears limited in term of mortality. Conversely, photosynthesis is stimulated below 24°C but inhibited above. When temperature exceeds 35°C no photosynthesis occurs.

Chlorination causes serious alterations in the plasmic content of almost all the planktonic cells and inhibits the photosynthesis process. These alterations occur with concentrations of free chlorine of the order of 0.1-0.2 ppm. But free chlorine disappears very quickly in the seawater, thus these effects concern mostly the passage of phytoplankton through the cooling water system. Chlorination causes severe damage on zooplankton, the rate of mortality being highly variable with the species.

Mechanical effects are limited, except for zooplankton.

Modelling

Assumption on pump entrainment impact is quite well approximated by the way of experimental designs, but additional effect due to the

heated discharge in the field is more difficult to attempt. Ideally, the most appropriate way is simulation model which provides a synthesis of the biological, chemical and physical effects. However, appropriate temporal scale for ecosystem models is usually the year, although simulation of the thermal discharge involves short time scale. MENESGUEN (in preparation) suggests an interesting strategy adequately adapted to the present purpose. A biological model of the coastal pelagic system is linked with a spatially schematized approach of the physical processes in the near field of the plant.

Results of the simulation suggest that impact on the receptive field is minor (<1 %) even in the most unfavorable conditions. It is always negative for zooplankton while it may be positive for phytoplankton during periods out of chlorination.

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Effects of thermal discharges on marine resources

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Construction of nuclear power plant on French coast induced a lot of studies in coastal areas. These areas are often involved in the reproductive cycle of living resources since many exploited species have their spawning and/or nursery grounds inshore.

In order to assess the two types of effects on halieutic populations (plume effect due to releasing of heated and chlorine effluents and entrainment effect on ichthyoplankton in cooling water system) we have developed three main ways of approach:

—field observations before and after the beginning of electric production (monitoring program);

—"In situ" experimental studies in order to assess entrainment effects;

—laboratory experiments on a few animal species in order to simulate plume effects.

Monitoring program

In this paper the monitoring program is particularly focused on the result obtained on Gravelines nuclear power plant about eggs and larvae of sole (*Solea vulgaris* QUENSEL).

The inter annual fluctuation of abundace observed during 12 years of surveys on early life stages of sole before and after the beginning of electric production ("before and after approach") are not able to assess the effects of thermal effluent on these young stages.

Natural annual fluctuation in abundance being very important, the detection of any anomaly due to the thermal effluent would require a very long term monitoring design which is most unrealistic. On the other hand, the comparison of areas in and out the plume is not adapted to young stage of fishes because the delay of answer to temperature modifications is longer than the time of residence in plume.

"In situ" experimental study

This second approach of the impact study was realized at the power plant of Gravelines with eggs and larvae sampled immediately after entrainment and reared a few days in laboratory; the results showed a total mortality of eggs by entrainment which runs between 56 and 75% for stage I and between 0 and 7% for stage II, so youngest eggs are more sensitive. Most of the

mortality is instantaneous and due to mechanical stress (75–90% of total mortality). Additional thermal or chlorine stress has less effect except when they are simultaneous; in this case, they induce 10–25% more mortality.

Low densities of larvae and their fragility toward the haul did not permit to have significant results. Nevertheless, we have noted a higher mortality rate upon larvae hatched from eggs collected in the discharges.

Previous results are used in a first attempt to quantify the impact of Gravelines power plant on the North Sea spawning gound of the sole in a year: the total mortality due to the entrainment of eggs could be evaluated approximatly at 0.004% of the total eggs spawned.

Laboratory experiments

The last way of approach of the impact study concerned the laboratory experiments. The aim of this study was to assess the impact of thermal and chlorine effects on larvae and egg-bearing females of lobster (*Homarus vulgaris*).

The females react to chlorination very sensitively and die even for low concentration: 0.1 mg/*l* (1 ppm). Thermal effects induce only some kind of apathy, the females dropping their eggs.

The impact of chlorination on larvae is less drastic, the intermolt periods are delayed, their growth decreases and only a few mortalities occur; the thermal stress stimulates the larval metobolism, intermolt peroids are accelerated but in the mean time the larvae weaken and are bound to die. The two stresses associated lead to intermediate results.

These experimental study on crustacean might lead us to suppose some kind of potential risk only for adult lobsters living close to the release area. This will have to be confirmed by further observations "in situ" over a long period of time,

According to all our results dealing with young stages of fishes, investigations are now focused on a more appropriate way consisting in modelling which simulate entrainment effect on stock, plume effect being negligible on eggs and larvae.

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Organizing about ecological and halieutic studies for French nuclear power plants

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In 1987, nulear power accounted for approximately 70% of the electricity generated in France. Pressurized water reactor (PWR) is technology choosen by French engineers.

Four nuclear power plants have been built on seaside. Gravelines, Paluel and Flamanville power plants are in operation, and Penly is still under construction.

Procedures

Nuclear power plants are subject to complex regulations and require a lot of authorizations. Most of these are governed by the regulations applying to urban planning, environmental safeguard, protection of public health and labourers. Studies and measurements carried out by specialized organizations determine the physical, chemical and biological characteristics of the marine environment into which the liquid waste is to be discharged. Then "Electricité de France" (E.D.F) utilizes these data to elaborate the obligatory environmental impact report. This document contains the following information:

—characteristics of the project,
—reference state and possible impact of the power plant on the ecosystem,
—reasons of the choice of this project,
—means in order to limit and counterbalance the consequences of this project and assessment of corresponding costs.

Many procedures involve an inquiry phase during which the project is presented to the public so as to inform it and to obtain its objections or suggestions. Water intakes from the sea are free and unrestricted. But effluents discharged from nuclear power plants into water are subject to authorization by local authority. Release licenses are granted at the end of procedures which are different for radioactive releases or non-radioactive ones.

Nature of the environmental studies

The environmental studies take several years and the choice of the site attaches the greatest importance to meteorology, hydrology, seismicity, soil characteristics, electrical network, site access, and socio-economic aspect.

Radioactive studies

Protecting the population against radioactivity implies limits and regulations to govern the discharge of radioactive effluents so as to ensure that maximum permissible doses are respected. This proceeding takes into account specific site features (transfer channels, meteorology . . .).

After the installations have been commissioned, E.D.F makes systematic checks, mainly on the atmosphere, rivers and streams, underground water, rain, grass and milk. These measures are in addition to those taken by Minister of Health all over France. This Minister is responsible for preparing the detailed environmental monitoring program and is able to verify measurements made by the power plant environmental laboratory by repeating the same tests.

Non radioactive studies

Ecological studies begin about 10 years before the startup of the plant.

The schedule of the necessary administrative authorizations and environmental studies is divided into three stages:

—Preliminary studies must show level of sensibility of all potential sites. They contribute to the choice of one of them.
It is principally a bibliographical study.
—When the site is chosen, initial ecological study is carried out for about two years. The purpose of this sort of study is treble:
- to make out a reference status,
- to predict possible disturbances,
- to choose parameters and methods for monitoring study.

—Monitoring study begins immediately by the first releases.
The environmental monitoring program takes two parameters into account:
- characteristics of the receiving environment,
- conditions of the power plant working.

Moreover, choice of parameters, location and frequency of samplings are subordinated to the previous great types of impact. Those are linked to the utilization of the water for power plant cooling. Either aquatic organisms are drawn into the cooling water systems or the heated and chlorinated effluent modifies the aquatic environment.

Monitoring survey of coastal waters concerning power plant operations

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Commissioned by the government, the Marine Ecology Research Institute (MERI) created a Scientific Committee on the Monitoring System (SCMS) comprising scientists, to examine the best possible monitoring methods for various coastal regions. We summarized the results and published "The basic formulae of coastal monitoring (1987)."

The extent of a survey we have described below includes the entire area of predicted water temperature rise of 1°C caused by thermal effluents.

This report is its abstract.

1. Survey on the diffusion of thermal effluents

We believe that a matter of basic importance in a study of changes in the marine environment and marine biota is to grasp the extent of distribution of thermal effluents. The duration and frequency of the survey, followed the start of plant operation, are three years in principle, and quarterly, by taking into account the conditions of plant operation to obtain dada on the extent of distribution of thermal effluents at typical oceanographic conditions in the area.

As for water current, this is an important item for the study on the distribution of thermal effluents. At first, one or two representative observation points should be located on the basis of the Environmental Impact Assessments (EIA) and results of current predictions. The survey should be conducted for each season to last, in principle, for one year after the commencement of plant operation to learn typical current conditions for each region.

2. Monitoring the status of the marine environment

Because water quality is closely linked to marine life, we believe it is an important item in the study of the impact of thermal effluents. Survey points are to be located on the basis of the Environmetal Impact Assessment (EIA). The duration of a study is, in principle, one year before, and three years after the start of operation. They should be conducted for each season.

Bottom sediments are also one of the important item for the study on the impact of thermal effluents, because of its close relationship with benthic animals and plants. The area, duration and time should be the same as those of the water quality survey.

3. Monitoring marine organisms

Many items may be subjects of a survey, depending on areas concerned. We took up those items common among all the coastal regions.

a. Intertidal organisms, macrobenthos and seaweeds

Since intertidal organisms and macrobenthos hardly move from their habitats, and its biota are in response to their environmental change, these are important components to the study of the impact of thermal effluents on marine life.

Observation poins should be located by taking into account the substrata of the habitats.

Monitoring should be initiated for one year before the start of plant operation to learn the pre-operation conditions. After the start of plant operation, surveys should be carried out, in principle, for three years and in all four seasons.

As for seaweeds, the range and duration for the monitoring should be the same as in the case of intertidal organisms. Observation points should be located by taking into account the substrata of their habitats and water depth. In principle the survey should be conducted twice a

year during the full-growth and decay seasons of predominant seaweeds.

b. Plankton

Any changes in plankton occurred uniformly through a region where water is replaced freqently by current. In such a region these plankton are not considered as adequate organisms for a study of the effects of thermal effluents. However, in an enclosed body of water such as a bay, in which water is not replaced frequently, the plankton data should be collected in relation to water quality.

c. Planktonic eggs, and larvae and nekton

There have been considerable amount of natural changes and irregular variations in these items. Then, these items are not appropriate subjects for monitoring the impacts of thermal effluents on marine life. However, when there are grounds for fear that these organisms in a certain region may be affected, the survey shall be conducted after a full study of when and how to conduct it.

Discussion on papers by H. FUKATAKI, A GREGOIRE, P. CHARDY, N. LACROIX and I. ASANO

B. MANOHA: Temperature effect appears negligible, while other parameters as chlorination or mechanical stresses seem to cause serious damages. What are the opinions of the Jananese and French specialists?

N. LACROIX: I agree with B. MANOHA for temparature effects.

P. CHARDY: In the French sites, upper lethal temperature for planktonic organisms is much higher than ambient temperature $+\Delta T$. But we have temperate ecosystems. In tropical ecosystems it may be different.

D. LECLERCQ: What are the seasonal variations of the sea temperature in Japan?

H. FUKATAKI: It reaches a high temperature of 28°C in summer, open sea in Japan.

Y. NAKAME: In the case of Hokkaido, it falls to 5-6°C in winter, rising to 22-23°C in summer. The ΔT is 7°C at any power plant in Japan.

I. ASANO: ΔT, 7°C is rather conventional since middle 1970's.

B. MANOHA: Do you have any regulation for thermic ambient maxima?

I. ASANO: No regulation regarding to the maximum temperature.

D. LECLERCQ: What biocide do you use in the Japanese power plant? Do you use chlorine as in France or not?

Y. NAKAME: Hokkaido power plant uses chlorine in the cooling water system for auxiliary equipment. But standard residual concentration is undetectable at the discharge point.

K. CHIBA: Why do you use chlorination in France?

B. MANOHA: To prevent the settlement of the mussel larvae in the cooling water system. Chlorination is effective when the ambient temperature stands under 10°C (April～November).

H. FUKATAKI: Elastic balls for the condenser tube cleaning are sometimes used as an alternative to the chlorination.

N. LACROIX: Have you any example of a power plant effect on stock fishes in Japan?

H. FUKATAKI: Plume effect is negligible. Less and less attention is devoted to this aspect in Japan. It is clear that mobile animals as adult fishes can escape the plume by changing their direction.

Pump entrainment may be the major effect. My opinion is that there is no worry about pump entrainment on phyto- and zooplankton because their life span is very short. Effects on eggs and larvae are depending upon the scale of the spawning area. Our results are similar to those of N. LACROIX.

For immobile life, effect can be seen in the shallow layer, in the case of 1,100 MW (2 units) extending within 200 (winter)～300m (summer) from the outfall. The general idea is that impact of the power plant is negligible in terms of stock fishes.

A. GREGOIRE: At Gravelines the most important effect was seen on the microbiota. Thermophilic vibrio was multiplied by 200. What information did you get in the Japanese studies?

S. NAKATANI: We did not survey the

microbiota component.

D. LECLERCQ: Did you find any effect on the salmon migration ?

H. FUKATAKI: (After a comment of the migration of the salmon in Japanese area) Impingement at the intake can occur in some particular period. But from our monitoring we get the information that salmon population increases during the period of increasing power plant projects.

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1-3: Utilization of Thermal Effluent in Fisheries

Heated effluent utilization in aquatic animal culture in Japan

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In Japan, several efforts have been made to utilize heated effluent from power stations and factories effectively[1]. Since the power stations are located near the coast and the flow rates of heated effluent from them are extremely large, many trials have been done for culturing marine animals with heated water. Fish farming scale by using the heated water varies to a large extent, depending on the amount of effluent available. The utilization of effluent for fish farming ranges from 0.2 to 10.2 m^3/min and the area of culturing tanks varies from 22 to 2,572 m^2. Culturing tanks are constructed on land and heated effluent is pumped up into these tanks. The culture of aquatic animals by floating cage has also been done near these sites where the warm discharged water flows[2, 3]. Sea bream, yellow tail, prawn, crab, sea abalone, etc. are cultured in tanks, floating cages, or both. Efforts have been also made to accelerate maturation of aquatic animals[4] and obtain their larvae earlier than the natural conditions. Obtaining of large sized seedlings earlier than the natural production is more desirable in order to augment the survival rate or the seedling released into the sea. Culturing of aquatic animals by using larger sized seedling can also shorten the period of culture to grow a table sized fish[5~14]. The problems of aquatic animal culture are different at each farm, but the most serious and common one is the interruption of the warm water supply either by accident or due to periodic inspections of the power station.

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Valorization of industrial heated effluents through intensive aquaculture water management and fish growth. Experience on the Gravelines site

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The use of thermal effluents from power plants for aquaculture originates in France on freshwater sites which proved unprofitable. New trials are under way on marine sites.

Land availability and cost of access to the heated effluent limit the development of aquaculture to few of the plants. The Gravelines site is being considered as a unique experience where a step by step development from the technical feasibility tests up to the industrial production stage was developed.

On land facilities including now research and development facilities, a commercial fish farm (50 tons/year) and a hatchery are fed with heated water and sea water at natural temperature to allow for year-round production of valuable fish from the egg to the market size.

Water management was investigated in, with specific studies on:

—temperature management in relation with fish growth
—dechlorination of the effluent, critical levels and means of reduction of the total residual chlorine
—gas supersaturation effects on fish health and means of degassing. Packed columns were selected and design parameters were made available to fish culturists.

Three fish species were tested successfully up to the pre-commercial stage, one of which the European sea bass (*Dicentrarchus labrax*) was selected for by the first fish farm.

Growth model, oxygen consumption and feeding tables were constructed from field observations. They are useful tool for the design and operation of the farms.

European sea bream (*Sparus auratus*) and turbot (*Scophtalmus maximus*) have good prospects for the near future as their fry availability from commercial hatcheries will improve.

A considerable understanding of water management and commercial production of market sized fish is achieved. The **Aquaculture Center of Gravelines** is on the step to further developments. Operators are looked after actively. Financing of the collective water network is under way and private investors will have to concentrate on fish farming facilities design and operation.

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Development of the Aquacultural Center of Gravelines. Utilization of heated effluent from the nuclear power plant

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1. The origins of the scheme

The nuclear power plant of GRAVELINES, located by the North Sea, produces electricity from 6 reactors of 900 MW each. The cooling system of the condensers uses 40 m^3/s of sea water per reactor. The temperature of this water rises by 10°C.

So, the plant throws out an important flow of heated water at a temperature contained between 12 and 30°C according to the season. It is also easy to take great quantities of natural seawater from the canal which supplies the plant with cool water.

All these facts were favourable to the development of aquaculture at GRAVELNES, and in order to study the possibility of intensive farming of sea bass, a structure called the SERAG, including EDF and several local partners, among which the town of GRAVELINES was created:

—a station of aquaculture testing and training (SEFA), monitored by IFREMER.

—an experimental aquacultural farm, designed to produce 50 tons of sea bass a year.

After 3 years of tests, it appeared that intensive farming of sea bass was possible. So, the SERAG decided:

—to build a hatchery near the farm in order to produce fry: it was started in November 1987.

—to start the study of the equipment of the whole site, in order to produce more than 1,000 tons of fish a year.

2. The project

The site:

The total area of the allotment will be of about 13 hectares. The sea farms and the common facilities will occupy 80,000 m^2, representing a belt of land 55 m wide and 1,200 m long.

The common facilities:

Three reactors of the nuclear power plant are equipped with 2,100 mm pipes which enable to take the heated water directly in the outlets before discharge in the sea. Another 2,100 mm pipe, used in emergency, takes lukewarm water in the discharge canal.

In the end, a 1,600 mm pipe takes cool water in the supply canal.

These pipes will work as siphons to transfer water to the common works of the aquacol site. There, a neutralization station will limit the chlorine amount to 15 ppm. The gas supersaturation due to the quick heating of the water will not be totally eliminated through the siphons and the transport of water: each farm will have to manage this problem. Water will be raised by "tube pumps" to supply canals, in which it will flow to the farms, through water meters.

The supply of water: maximum flow of water available.

For the production of 1,000 tons of fish a year the flows are:

—heated water: 13 m^3/s.

—cool water: 5 m^3/s.

The development of the site will be carried out progressively.

General equipment:

The allotment will have a common road; public networks of electricity, drinkable water and telephone will enable the farms to conduct themselves.

The security of exploitation:

—Heated water supply is based on four sources: three nuclear reactors and the discharge canal.

—The electricity supply will be made by a 20 KV underground network. In case of power cut a power plant will be able to supply 100 % of the pumpage station needs.

—The working of the siphons (vacuum pumps), of the water pumps and of the chlorine neutralization station will be automated, taking into account all the parameters: temperature, chlorine and water levels.

Promotion planning of regional fisheries with the Tomari Nuclear Plant

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1. General aspects of the fisheries activities in Tomari village and its neighboring towns and villages

The state of fisheries in Tomari Village, located on the west side of Hokkaido's Shakotan Peninsula, and its neighboring towns and villages can be said to be in a particularly difficult situation even within Hokkaido.

Fisheries, which is Tomari Village's key industry, has been suffering from poor performance these past few years, and in particular 1987 was an especially bad year as has not been seen recently. Since the establishment of the 200 miles economic sea zone, salmon fisheries have reduced the number of its fishing boats and have furthermore shortened its operations. The performance of squid and Alaska pollack fisheries has also been disappointing. Moreover, the results of a research show that the withering of seashores on the Japan Sea side has been proceeding rapidly of late years and measures to address this problem is also an urgent task. Combined with the preventive measures to preserve coastal resources, this is an issue that requires the application of the regulations of the national and the Hokkaido government.

Under such circumstances the expansion and the establishment of a managing entity for infrastructure for culturing marine organism resources and aquaculture facilities to promote resource management-type fisheries are strongly required. The necessity of carrying out studies to review the existing consolidation programs and the feasibility of establishing an aquaculture facilities firm which utilizes the thermal effluent of the Hokkaido Electric Power Company's Tomari Nuclear Power Plant has been suggested. In Japan the locations of power stations, in accordance with the Three Laws concerning Power-Resources, are entitled to receive compensation and Tomari Village is now identifying a fundamental scheme to promote fisheries using this compensation.

2. Tomari Nuclear Power-Plant and the Three Laws concerning Power-Resources

The commercial operation of Tomari Unit 1 commenced in June 1989. Tomari Unit 2 is under construction and is planned to commence operation in June 1991. Tomari Unit 1 and 2 are Pressurized Water Reactors (PWR) with electrical output of 597 MWe. The cooling and circulating water outlet is located at the north sea-wall with water flow rate about 40 m^3/sec per plant. The thermal effluent is discharged to outside of port at flow speed of about 4 m/sec to minimize the spreading area of it.

The Three Laws concerning Power-Rosources were enacted in 1974 with the promotion of power-resources as the objective. They are categorized in detail as shown in Fig. 1.

3. The future subjects and perspective plannings in Tomari Village

The water temperature in the Tomari Village's offshore varies in the range of 3.5 to 21.2°C throughout the year. Such conditions, compared to locations throughout Honshu, are without question disadvantageous for abalone and flounder to be cultured. On many days the sea is rough and thus the development of coastal aquaculture is also extremely behind. Thus it is thought that the planning for aquaculture utilizing the thermal effluents of the nuclear power plant, upon the latter's operational start-up, is hopeful since it would open up the field of on-shore aquaculture which has up till now not developed in the Iwanai-Tomari region.

Among lives habituating to Tomari Village regional coast, those that have potential for

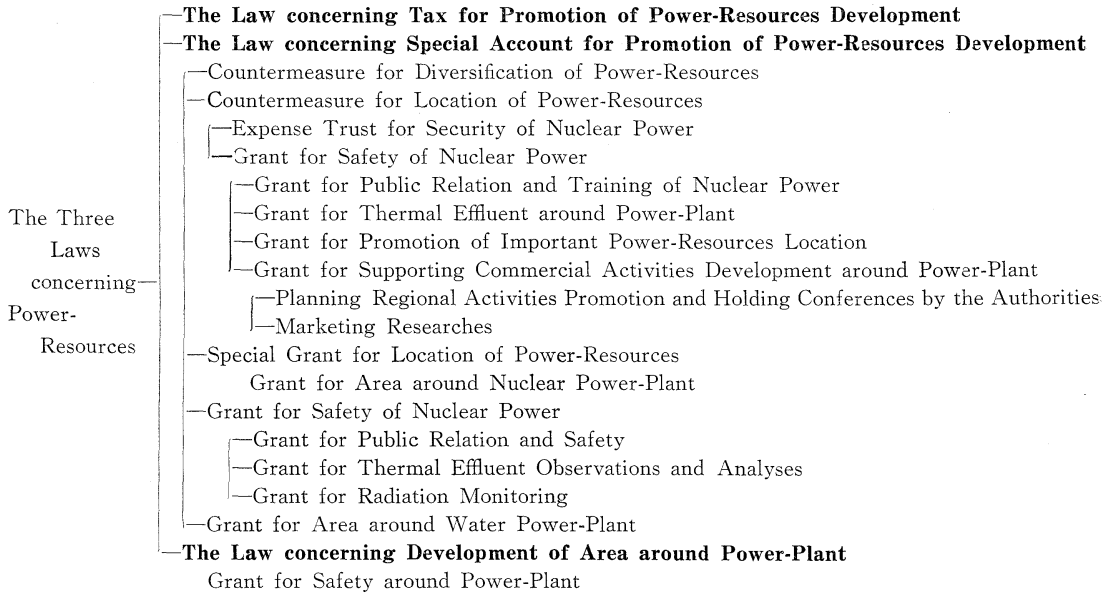

Fig. 1. System of the three laws concerning power-resources

seedling production are, in addition to those already mentioned, black rockfish, three-stripe rockfish, cresthead flounder, small-mouthed sole, stone flounder, slime flounder, willowy flounder, round-nose flounder, tiger puffer, etc. Those that have potential for seedling culture are in addition to the above striped beakperch, yellowtail, devil stinger, lobster, top shell and so on. For these fishes it is thought that there is still ample scope to review the technology level to culture them off-shore and inshore, rearing temperature, commercial size, marketing system and price, supply of seeds, seeds price, transport of seeds and so on. What is needed for Tomari Village now is to expand its possibilities and not confine itself to the traditional realm of ezo-green urchin, ezo-abalone, etc.

In any case, in order to use the advantageous economic impact, such as the compensation based on the Three Laws concerning Power-Resouces, etc., effectively, what is required is to plan for the coexistence and coprosperity of the regional society and the power plant while at the same time analyzing such issues as aquaculture of marine resources in Tomari Village coastal region in the long-run and the consolidation of fisheries infrastructure for this purpose, the expansion of aquaculture facilities, the autonomy of the managing entity of this operation, etc.

Discussion on papers by K. CHIBA, D. LECLERCQ, H. SYLVESTRE and H. YAGI

H. YAGI: Could you explain what are the grant systemes applied in France for developing aquaculture and fisheries around power plants?

H. SYLVESTRE and D. LECLERCQ: There are grants for investment in aquaculture but nothing especially directed towards warm effluents utilization. Local agreements between the electricity producer and local authorities allow to grant investment concerning water distribution from the power plant to the fish farms.

Concerning aquaculture facilities themselves, grants could reach 40 % of the investment cost by cumulating regional and European Community (EEC) grants.

In the case of Gravelines, collective pipe works should be granted by 50 % through local authorities agreements and some ministry participations.

H. YAGI: In one example in the South of France, the electricity producer owns part of

the facility where aquaculture is developed.

What is then the impact and benefit for the local communities ?

D. LECLERCQ: This is the only example where E. D. F. was directly involved and this experimental facility located by an old oilfired plant is now closed.

Elsewhere, the benefit for local communities is evaluated by employment, free access to the know-how and local development through new activities. Fishermen are often associated to the project through shares.

D. LECLERCQ: Could you precis what are the proportions of the experimental aquaculture activity using gravity flown, cage culture in the plume or water pumped based systems ?

And what are the prospects for the future?

K. CHIBA: Most of the activity is nonprofit based research.

Gravity flown systems are not developed because they were not thought of when constructing the plants. Cage culture examples are not numerous but this is used successfully at winter time to benefit of the plume effect in some sites of the South East (Japan Sea).

Penaeus japonicus production systems pump the water but only at winter time and with little impact on overall cost.

Besides these examples it seems that there is no commercial operation relying on pumping in Japan.

HORIUCHI: I confirm that there is no marketable size fish production relying on warm effluents because it is not profitable. Only sea bream seedlings production for releasing to the ocean to promote marine resources is practiced, and can afford pumping costs.

D. LECLERCQ: Do you experienced gas supersaturation problems with using heated effluents ? And how did you solve it ?

K. CHIBA: To my experience, there are no problems but Mr. HORIUCHI may have something to add.

HORIUCHI: There have been a few cases some years ago with nitrogen (N_2) supersaturation due to problems in pumping systems.

Some use aeration of the water before fish tank.

It is often linked with heating the water artificially and then we use some types of "filter" to remove the supersaturation.

H. FUKATAKI: This problem may be induced by the ΔT°C that you have in France (+10°C to+15°C) when in Japan+7°C is practiced.

The phenomenon is thus reduced.

H. SYLVESTRE: What is the use of the marine and fisheries laboratory at Tomari?

H. YAGI: The researches are conducted in the following directions:

—research on radiations effects and traces in fisheries and agriculture products.

—impact of the effluent on the local environment.

—analysis of data from the power plants.

—how to promote aquaculture and mariculture in relation with local communities.

—introduction of American lobster and improvement of larvae production for the fisheries enhancement.

—seaweed decline is analyzed. New species may be introduced.

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2-1: Maturation

Maturation and its control in the abalone

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Seedling production of abalone has been developed on a mass scale for maintaining and augmenting the resource. Induction of maturation and spawning of the abalone *Haliotis discus hannai* by exogenous factors is introduced. These techniques have contributed to recent progress in year-round seedling production in northern Japan. They consist of two principal parts; the regulation of gonadal maturation by temperature and the induction of gamete release by UV-irradiation stimulus.

Maturation control

Populations of the abalone in the gonadal-recovery stage were reared under several constant temperatures and the same constant photoperiod. The gonad index (GI) was observed at regular intervals. The GI standard was defined as follows: GI is 0 when the gonad is not developed. GI is 3 when the gonad is well developed, expanding beyond the shell periphery. GIs 1 and 2 are inserted between them. GI increase rate was proportional to the rearing period until it reached 2.5. The relation between daily GI increase (Y) was expressed to the rearing temperature (T°C) by the formula; $Y=0.00597T-0.0453$.

This fact indicates that the point (7.6°C) of intersection between the line and X axis is the biological zero (θ) for the gonad development and GI is proportional to the integrated value of the differences between T and θ. Y determined by the following formula is defined as the effecitve accumulative temperature for gonad development (EAT, °C-days); $Y=\sum_{i=1}^{n}(t_i-\theta)$, where t_i is the daily rearing temperature. The maturation procedure of this species was divided into the three periods on the basis of EAT; In immature stage (0-500°C-days), GI is in the range of 0-3 as gonad volume increases, however the release of gametes does not occur. In mature stage (500 to 1500°C-days), GI reaches 3. The spawning rate and the number of eggs spawned increase. After EAT exceeds 1000°C-days, a large number of eggs can be collected. In fully mature stage (after 1500°C-days), spawner reacts well to stimuli. Temperature appears to be the major external factor which regulates the breeding cycle of this mollusc, because the artificially produced spawning period (after 1500°C-days) corresponds well with the natural breeding season in terms of EAT.

Spawning control

Spawning is induced by a stimulus produced by UV irradiation of seawater. The release of gametes can be set for any desired time of day by combination of artificial photoperiod (12L-12D) conditioning of the mollusc in advance and UV stimulation. The effect of UV-irradiated seawater extends not only to *Haliotis* but also to the scallops *Chlamys* and *Patinopecten*. The effect of UV-irradiated seawater is considered to depend on oxidants generated by the energetic decomposition of the parent water molecule, similar to the mechanism in which hydrogen peroxide activates the enzymatic reaction of prostaglandin endoperoxide synthesis.

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Biochemical characterization of ovary, hemolymph and vitellogenin during oogensis in the peneid shrimp

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Two major lipoprotein types are playing a major role in the reproductive processes in penaeid shrimps: two vitellogenin forms, in haemolymph, and four lipovitellin forms, in ovary vitellus, identified by crossed immunoelectorophoresis. In *Penaeus japonicus* and *P. schmitti* vitellogenin appears when gonado-somatic index (GSI) reaches the value of about 1.8. After dissociation of lipovitellin by 10% sodium dodecylsulfate, five subunits are revealed, showing molecular weights of 150,000, 105,005, 92,000, 86,000 and 76,000.

Immunochemical identity of vitellogenin and lipovitellin has been noticed by crossed line immunoelectrophoresis. Among different groups of decapod crustaceans, six species of peneids antilipovitellin reacts against peneid vitellogenin.

An immunoenzymatic test very sensitive and specific has been used, showing that the vitellogenin concentration increases considerably when GSI reaches the value of 3.3, and decreases after that value.

Lipids content of the ovary increases linearly during the ovarian maturation, from 0.59 to 5.45 mg/g for *P. notialis*, and from 0.13 to 3.88 mg/g of animal fresh weight for *P. schmitti*.

Phospholipids represent 55% and triacylglycerols represent 20% of the total lipids of the ovary in *P. notialis*. They represent 52% and 32% in *P. schmitti*.

Essential fatty acids revealed into the ovary show the following values: 18:3ω3, 11.85%; 18:2ω3, 2.72%; 20:5ω3, 6.42%; 22:5ω3, 0.89% and 22:6ω3, 3.04%.

Total lipids and lipid classes of the hepatopancreas show significant variations during ovogensis when gonado-somatic ratio varies from 4 to 6.

During vitellogenesis, water content of the ovary and the hepatopancreas decreases by 9% for *P. notialis* and 10.7% and 3.9% for *P. schmitti*, respectively.

Quantitative and qualitative variations of free amino acids contents (FAA) of ovaries, hepatopancreas and hemolymph have been studied during the course of ovarian maturation in *Penaeus schmitti*.

In the ovary, FAA content, expressed as μM/g ovary fresh weight, decreases from 56.2 to 23.6μM, from GSI value of 0.8 to GSI value of 7.1. There is an increase of hepatopancreas FAA content of 33.4% until GSI reaches the value of 4 and hemolymph FAA content increases from 0.32 to 1.76 μM/m*l*, showing a maximal value of 3.74 μM/ml when GSI is between 3 and 4.

FAA content of ovaries, expressed as μM/g of animal, is 3.2 fold higher at the end of maturation, with a main increase in the first stages of ovogenesis.

Maturation process has a quantitative effect on all FAA, but, on a qualitative point of view, concerns mainly lysine, arginine and glycine.

The main variations of AA composition, expressed as percentage of total FAA, are observed in hemolymph.

The carotenoid esters of the shrimp, *Penaeus schmitti*, were investigated by thin layer chromatography and absorption spectrophotometry. Astaxanthin monoester and zeaxanthin monoester were identified in hepatopancreas and ovaries during the sexual development. The nature of fatty acids derived from these natural esters has been determined quantitatively by gas chroma-

tography of their methyl esters. The variations of linkage between fatty acids and carotenoids during ovogenesis are measured.

The role of zeaxanthin monoester in carotenoids transfer from hepatopancreas to ovaries during this sexual development, and relations between lipid and carotenoid metabolism are discussed.

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2-2: Growth and Nutrition

Calcium and phosphorus requirements of the Japanese shrimp *Penaeus japonicus* with special emphasis on the role of phytic phosphorus

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Eight experiments were carried out to obtain more information on the role of Ca/P ratio and of the sources of Ca and P on Japanese shrimp juveniles fed casein based diets.

In Exp. I 4 levels of Ca were combined with 2 levels of P. Growth was significantly influenced by P level, but slightly by Ca and not by Ca/P. Exp. II was devoted to the comparison of Ca sources: $CaHPO_4$, $CaCO_3$, Ca lactate and a mixture of the latter salts; a 5th diet contained 0.12% Ca. P (1.5%) derived from Na_2HPO_4 except in the $CaHPO_4$ diet. Best growth was obtained with $CaCO_3$ and Ca free diets. The low availability from $CaHPO_4$ can be explained by its unsolubility at stomach pH. The aim of Exp. III was a study on the P requirement for a given Ca supply. Best growth was obtained with 1.5% P while moulting frequency, P and Ca content of some tissues were better with 1.75% P.

In Exp.IV Na_2HPO_4 was compared to NaH_2PO_4 as well as to sodium phytate. Best results were observed with Na_2HPO_4 and sodium phytate. The low value of other phosphates could be related to their pH. The good value of phytic P was corroborated in Exp. V where sodium phytate was compared to Na_2HPO_4 at several P levels. Good growth was obtained with 0.56% P (new type of casein and low leaching of P). In Exp. VI and VII the ash content of muscle dry matter was decreased and the Ca content of ash was increased by phytate. Dietary phytate even depressed growth of *P. vannamei* ($p<0.05$) as it does in monogastric mammals. In Exp. VIII the good nutritional value of phytate was shown to be partly due to its role as inositol source.

The availability of P in phytate was rather high: 47 to 64%; however different techniques (including immunohistology used) failed to demonstrate the presence of phytase in the digestive tract.

In conclusion, criteria such as tissue Ca and P content, at intermoult state, and Ca content of exuviae are proposed as criteria for mineral requirement determination. The apparent availability of both Ca and P greatly varies from salt to salt, because of solubility and perhaps pH or anions. Dietary P plays a much more important role than Ca that can be easily extracted from seawater and than Ca/P ratio. Our data tend to indicate that P requirement had been overestimated probably because poorly available P sources and not very water stable diets had been used.

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Nutritional requirements of prawn larvae

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Microparticulate diets for the prawn, *Penaeus japonicus*, larvae for use as substitutes for live food have been prepared, and the nutritional requirements of prawn larvae have been studied by using microparticulate test diets. In this presentation, I intend to deal with three topics of prawn larvae nutrition.

(1) Protein sources of microparticulate diets

Generally, proteins having an essential amino acid profiles similar to that of whole body are likely to have a high nutritive value for prawn. Therefore, the amino acid composition of whole body protein of the prawn was analyzed, and then we prepared microparticulate diets whose essential amino acids profiles were approximated to those of body protein of larval prawn by using several protein sources. Their nutritive values were compared with a live food by a feeding trial from $zoea_1$ stage to $pastlarva_4$ stage. As a result, the larval prawn fed microparticulate diets showed good growth and high survival rates equal to or greater than those receiving the live food when the amino acid profile of the diet simulated that of the body protein of larval prawn.

Next, the attempt of replacing dietary animal protein with plant protein on growth of prawn larvae was conducted. The result of feeding trials showed good growth for larval prawn in the extent of 10–20% of soybean protein content in the diet.

(2) Phospholipid requirements

It has been demonstrated that crustaceans have a unique requirement for sterols and phospholipids.

We have found by using microparticulate diets containing carrageenan as a binder that the larval prawn essentially requires dietary sources of phosphatidylcholine or phosphatidylinositol for growth and survival. These results suggest that the requisite for [effective phospholipids is to possess the choline or inositol group besides unsaturated fatty acids as fatty acid moieties.

The requirements of cholesterol for the prawn larvae in relation to the dietary levels of soybean phospholipids were examined. The effects of cholesterol in improving growth and survival of prawn larvae seemed not to be affected by the dietary levels of soybean phospholipids. The optimum levels of cholesterol and soybean phospholipid for prawn larvae were estimated to be 1.0% and 3.0%, respectively, when pollack liver oil was used as basal lipid sources.

It was suggested by tracer experiments using ^{14}C-labelled tripalmitin and cholesterol that the dietary phospholipids may be necessary for the smooth transport of lipids such as triglycerides and cholesterol in the diets by the prawn.

(3) Growth promoting substances

A growth promoting effect of free arginine, proline, betaine, glutathoine on prawn larvae was suggested when they were fed casein diets containing some amino acid and peptide molecules.

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Intensive larval rearing of sea bass, *Dicentrarchus labrax*: a model of zootechnical research in aquaculture

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Dicentrarchus labrax is a fish species of high commercial value in France and more generally in southern Europe.

The historical background of sea bass farming in France shows that between 1974 and 1982 most efforts were devoted to do the spadework on larval rearing techniques but also, in the same time, to acquire basic knowledge on the physiology of that species, in particular on its nutritional needs. The tackled topics were thus numerous and research was geographically scattered over several laboratories and also over several institutions.

A very classical organization chart was observed in which fish production was operated by a few private producers and the research was conducted by public organisms like IFREMER, CNRS and different universities.

The rearing technique which was developed and proposed until 1982 to existing and potential fish producers was thus rather empirical and the results highly variable with an average production of roughly 3 to 400,000 fry per year, occasionally up to 600,000. Larval rearing of sea bass could not be considered as being entirely mastered in particular because of the lack of a standardized technique.

In 1983, research was reorganized and an adequate structure was created and entirely devoted to ensure the zootechnical research on that fish species. By zootechnical research we mean all aspects of technical research which will lead to select the optimum values for all biological and environmental parameters known to act on the fish survival and growth.

The main effort was centralized in the IFREMER Research Center for Aquaculture at Palavas, on the French Mediterranean coast. This center was designated to become the pivot—or in other words the mainspring—between all basic science aspects and the producers problems on that species.

The zootechnical research is conducted in two distinct but interacting units. The first one, the experimental team, is mainly turned towards basic and applied research—which are often designated by the terms of "upstream research"—which constitutes its main source of information. The second team, which we called the "pilot" team, is more oriented towards the production level. Its main source of information comes from the experimental team.

The proper running of both teams lies on several associated support teams which ensure—beside their own research—regular production of eggs, larvae, living preys, water quality control and pathological controls.

Finally, the interface between research teams and producers, to transmit in one direction the problems and in return the specific answers, is operated through what could be called a transfer cell, which is also located at Palavas.

The fact that all these elementary units are located in the same place provides obvious advantages, in particular:

—the rapidity of scientific information trasfer between scientists working on a same project with a minimum loss of time and information;
—the direct and efficient transfer of information towards the production level represented by the producers;
—and finally the fact that these producers have now a unique address for all their technical problems concerning sea bass.

The characteristics of the technique we are now offering to the private producers are the following:

—high initial density: 100 larvae per liter instead of less than 20 in 1983;
—a simplified feeding sequence in clear waters

with *Artemia* nauplii and metanauplii during the first 45 days of rearing with direct switch on pellets during weaning inestead of the complicated sequence of rotifers, *Artemia*, copepods, pellets and green waters;

—a low water renewal by the use of recirculating system instead of open systems.

As a result, the number of fry produced between 84 and 88 raised from 400,000 fry per year to $6 \cdot 10^6$ this year. This was also partly due to an increase in the number of private producers.

The production of sea bass of commercial size raised in a similar fashion from roughly 40 tons in 82 to 160 in 88. Significant increases are expected in the next 2 years wtih 350 tons expected in 1990. At that time sea bass production through farming will represent 15–20% of the fisheries production.

At IFREMER, we consider now the sea bass larval rearing technique as being mastered. We are applying since 2 years the same organizational model to another fish, namely *Sparus auratus*, a sea bream species.

Valorization of recycled waste waters from marine fishes rearing tanks: Plankton production and use for sea bass and gilthead breems larvae

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Processes allowing to recycle and valorize waste from intensive rearings of fishes present serveral advantages: decrease of calories lost and pollution released, use of waste water for microalgae cultures (tertiary treatment) suitable for different purpose . . . We have studied some of these aspects in an experimental device involving a biological filter (recycling of waste waters) and a plankton production system. This filter allows the rearing of fishes with high densities (20–25 $kg \cdot m^{-3}$) with reduced inputs of clean waters (until 90% of reused water) in the total dilution rate of fishes raceways (100%$\cdot h^{-1}$). The outflow of this device contains high levels of nutrients and is used for culture of natural marine plankton (2,3), with some modifications. Continuous input of recycled water outflow to the first plankton culture tank (8.5 m^3) is effected with a dilution rate favourable to the development of phytoplankton (0.4–0.3$\cdot day^{-1}$). A fraction of the outflow of this tank may enter into the second one (8.5 m^3), with a lesser dilution rate (0.2–0.3$\cdot day^{-1}$) in order to induce the growth of zooplankton. Both the tanks disposed under a green house are aerated and mixed by surpressed air and additional permanent light is provided. Monitoring of nutrients in recycled water of fishes raceways has shown good removal of ammonia between inputs and outputs of the filter (50.8±5.9%) and the importance of nitrate in total nitrogen (NO_3-N>70 μg at.$\cdot l^{-1}$) and phosphorus (average N/P ratios close to 5–7).

Six experiments on plankton production have been carried out, showing good efficiency of this tertiary treatment on nitrogen removal (75%), better than those obtained on phosphorus (35%).

Phytoplankton production in the first tank has shown many fluctuations during experiments and different seasonal production level. Best results, as reported elsewhere (4), have been obtained in winter, spring or summer (30 g dry weight$\cdot day^{-1}$ during 2 months, corresponding to a production of 4.5 g d.w.$\cdot m^{-2} \cdot day^{-1}$) but the lesser ones in autumn (7 g d.w.$\cdot day^{-1}$ during 1 month).

Lesser zooplankton production has been also obtained in autumn and winter (0.04 g N zooplankton$\cdot day^{-1}$ during 1 month) and the best ones in spring (0.36 g N$\cdot day^{-1}$ during 46 days)

or in summer (0.27 g N•day^{-1} during 3 weeks). This plankton biomass has been used to feed sea bass (*D. labrax*) or gilthead breems (*S. auratus*) larvae during 2 experiments. Fish larvae (initial density: 20–25•l^{-1}) have been bred in a tank receiving directly the outflow of zooplankton tank. The only food given up to larvae has been those coming from the pankton production device during the first 3 weeks of breeding (from day 4 to day 21). Brine shrimp nauplii have been distributed later on. Survival ratios after 2 months, close to 1.3%, have been similar to those observed in extensive rearings (5) and a good percentage of larvae have shown well shaped vesicles (sea bass: 85%; breems: 66%). Growth rates of larvae have been close to those reported in intensive rearings (2.6%•day^{-1} from day 4 to day 58 for sea bass). According to larvae feeding requirements (6, 7), these results lead to estimate that it is possible to rear 40,000 larvae from day 4 to day 20 in this experimental device, without any additional inputs of food during spring or summer conditions.

Finally, such a system seems to be interesting as tertiary treatment leading to a decrease of of pollution released by aquaculture farms, but also for semi-intensive rearings of fish larvae with reduced production costs. Moreover, with some technical improvements, this system seems to be usable for intensive production of micro-algae as food for herbivorous but also for industrial goals in marine bic-industries projects associated with aquaculture plants.

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Recent studies on the rotifer *Brachionus plicatilis* as a live food for the larval rearing of marine fish

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The use of *Brachionus plicatilis* as a live food was reviewed by HIRAYAMA (1985) in the 3ème Symposium franco-japonais sur l'Aquaculture. Current paper summarizes the further progress made in the use of this species in aquaculture practices mainly during the last three years in Japan.

Rotifer food

Rotifer culture practice requires large volumes of phytoplankton (i.e. *Nannochloropsis* and *Tetraselmis*). If the rotifer is only fed by phytoplankton, the volume ratio between rotifer and algal tanks is 1:3.5. Introduction of baker's yeast as a food source for the rotifer (HIRATA, 1965) enabled a significant reduction of the culture space required for the phytoplankton. If baker's yeast and phytoplankton are used as food, the volume ratio can be decreased to 1:1.6 (KITAJIMA, 1978). The use of microalgae for rotifer pro-

duction, however cannot be eliminated because it functions both in stabilizing the ecosystem in rotifer culture tanks and in improving the nutritional quality of the rotifer.

Alternatively, a condensed freshwater *Chlorella* fortified with vitamin B_{12} (Chlorella Industrial Co., Japan) can be used as a rotifer food. Its nutritional value (when fortified with VB_{12}) has been reported to be equivalent to rotifers raised on *Nannochloropsis* and can be used as a substitute for the baker's yeast (HIRAYAMA *et al.*, 1989).

Ecosystem in rotifer culture tank

Although banker's yeast can be used as an alternative food source, it often results in inconsistent production. The importance of bacteria flora in the rotifer culture tank has been reported to be an additional factor in optimizing rotifer production (YASUDA and TAGA, 1979). Recently studies have focused on the role microorganisms play in rotifer culture.

For example, axenic culture studies have provided new insights regarding the role microbes play in the culture of rotifers. HIRAYAMA and FUNAMOTO (1983) confirmed that vitamin B_{12} was essential for rotifer growth. Likewise, lipid soluble vitamins (i.e. vitamins A, D and E) raised the reproduction of *B. plicatilis*, whereas the feeding of baker's yeast alone did not support rotifer growth (SATUITO and HIRAYAMA, 1986).

Bacteria strains have been reported to affect rotifer population growth both positively (i.e. VB_{12} producing *Pseudomonas*) and negatively (*Vibrio signilyticus*) (YU *et al.*, 1988; YU, 1989). Studies on the interaction among bacteria, protoza and rotifers are currently in progress.

Selection and preservation of rotifers

Based on morphological features, *B. plicatilis* has been classified into L- and S-type. L- and S-type are remarkably different in both morphological and genetical traits (FU *et al.*, 1989). Differences also occur in the rate of population growth between the two types (RUMENGAN and HIRAYAMA, 1989). Since the mouth size of fish larvae varies with species and developmental stages, suitable sized rotifers could be selected for feeding to fish larvae.

Rotifer resting eggs remain dormant unless environmental conditions are conducive for hatching. The eggs can be used in a similar manner as brine shrimp cysts. After a seven day culture period in 1000 *l* tanks, 20 million and 110 million resting eggs could be obtained from the L- and S-type rotifers, respectively (HAGIWARA *et al.*, in preparation). The authors also found that resting egg formation of L- and S-type rotifers is inversely varied by temperature and salinity. It is conceivable that by manipulating culture histories rotifer clones with different reproductive characteristics may be obtained (HINO and HIRANO, 1985; HAGIWARA *et al.*, 1989).

Further studies are required to optimize the live food production that is necessary to meet demands of culturing an increasing number of fish species.

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2-3: Genetics

Cross-breeding among the abalones

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Recently, the spats or seeds breeding and restocking of juvenile abalones (Genus *Haliotis*) have been well developed and undergone on a commercial scale in Japan. Otherwise, the improvement on breeding techniques, especially in the aspects of ecological genetics, is expected and the interest has been shown in the possibilities of cross-breeding among the abalone species.

Table 1. Comparison of the rate of fertilization among hybrid and parental juveniles.

Combination ♀ × ♂		Rate of fertilization (%) Wakayama Pref. (1976)	Chiba Pref. (1972)	Tokyo Univ. Fish (1982-'86)
H. duscus	× *discus*	71 - 98	76	90.8(73.1 - 96.1)
	madaka	18 - 23	8	42.8
	gigantea	4	26	2.6
H. madaka	× *madaka*	76 - 96	98	85.6(64.8 - 95.0)
	discus	82	93	89.4(84.2 - 94.6)
	gigantea	0	0	4.7(1.2 - 8.2)
H. gigantea	× *gigantea*	73 - 98	-	22.8(0.3 - 76.8)
	discus	6	-	31.8(14.0 - 49.5)
	madaka	1	-	2.6(0.4 - 4.8)

Table 2. Results of growth and food consumption in hybrid juvenile abalones during 30 days feeding.

Combination (♀×♂) ♀	*H. madaka*	*H. gigantea*	*H. gigantea*	*H. madaka*	*H. gigantea*	*H. madaka*	*H. discus*
♂	*gigantea*	*madaka*	*discus*	*discus*	*gigantea*	*madaka*	*discus*
Mean SL* (mm) Initial (L_1)	10.28±1.23	10.01±0.83	10.09±1.09	10.05±0.70	11.11±0.95	10.73±0.80	10.51±0.69
Final (L_2)	13.85±1.82	13.04±1.41	12.45±1.52	11.72±1.38	14.49±1.59	13.33±1.31	11.61±1.20
Growth rate in SL (%) ($L_2/L_1\times100$)	134.7	130.3	123.3	116.6	130.4	124.2	110.5
Daily increment in SL (μm/day)	119	101	79	56	113	87	37
Mean BW* (mg) Initial (W_1)	109	97	108	101	138	130	122
Final (W_2)	262	213	196	168	302	250	168
Growth rate in BW (%) ($W_2/W_1\times100$)	240.4	219.6	181.5	166.3	218.8	192.3	137.7
Daily increment in BW (mg/day)	5.1	3.9	2.9	2.2	5.5	4.0	1.5
Daily food amount (mg)	24.0	18.1	15.1	13.0	23.4	21.8	10.9
Daily feeding rate (%)	12.9	11.7	9.9	9.7	10.6	11.5	7.5

* SL=shell length, BW=body weight.

The several investigations on hybrid abalones, found in natural conditions, have been done among American species.[1] In Japan, nowadays, genetical studies on natural hybrids of several species, especially on the hybrid between *H. discus* and *H. discus hannai*, have been done from the viewpoint of the loci, chromozomes and zymograms.[2~4]

The experiments of artificial cross-breeding among three important species of southwestern regions in Japan, *H. gigantea*, *H. madaka* and *H. discus*, have been promoted in several fisheries experimental stations and the Marine Laboratory of Tokyo Univ. of Fisheries, and all the possible crosses could be reared through metamorphosis to juvenile stages under the laboratory conditions. The rates of fertilization of these juvenile hybrids were compared among their parental juveniles. The results are shown in Table 1.

The rates of fertilization of parental species were generally high and stable, but those of hybrids were lower and unstable except one case of hybrid between *H. madaka* (♀) and *H. discus* (♂) which was about same as those of parental ones.

In December 1986, four combinations of hybrids were fertilized at the same time in our laboratory and reared under the same conditions with three species of their parental juveniles. Each 30 individuals of hybrids and parental juveniles of 6 months old were selected and reared during 30 days under the same conditions, and their feeding and growth rates were compared.

The growth rates ($W_2/W_1 \times 100$, $L_2/L_1 \times 100$) of all the hybrids were higher than their respective paternal side.

Daily feeding rates and monthly growth rates of the hybrid between *H. madaka* (♀) and *H. gigantea* (♂) were superior to their parents.

Beside the development of restocking techniques in Japan, the deterioration in quality of the spats has been recognized also in some regions by results of inbreeding depression. To find the suitable species and hybrids to different environment of the regions, more experimental data from the aspects of ecological genetics are needed and expected in every species of Haliotidae.

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Quantitative genetics and triploid production in the Japanese pearl oyster, *Pinctada fucata martensii*

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Selective breeding and genome manipulation may be the most important genetic program in hatchery of the Japanese pearl oyster *Pinctada fucata martensii*. The realized heritabilities were estimated from the selection experiments for three generations in shell width (0.127-0.467) and shell convexity (0.126-0.368). The effective responses were also obtained in selection expriments for the individuals that have not yellow pigments in shell nacres. Attempts were made to induce and detect triploid pearl oysters. A simple method of detecting the ploidy levels was developed in the cells from larvae and adults by DNA microfluorometry with DAPI staining. The effective

procedure for inducing triploid was the treatment of fertilized eggs with cytochalasin B from 20 to 50 min. after insemination.

1) Quantitative genetics

Most commercially important traits in organisms show quantitative variation and generally are influenced by both environmental and genetic factors. The genetic parameters such as heritability and genetic correlation are the measure of the genetic variance that is caused by genetic factors.

The heritability is the ratio of the additive genetic variance to the phenotypic variance. Estimation of the heritability has been conducted in the shell traits of the Japanese pearl oysters by the analysis of variance of full sib groups or by the selection response. The estimated values of realized heritability were 0.127 to 0.467 in shell width and 0.126 to 0.368 in shell convexity at 3 years of age on the basis of selection response for three generations. From these results, an improvement of shell growth or shell shape could be expected by the selective breeding in the pearl oyster hatchery.

Another estimation of the genetic variation conducted on the coloration of nacre in shell: individual that has or has not yellow pigments in shell nacre. The effective responses were obtained in selection experiments on this trait for three generations. These results showed the high genetic variation on the amount of yellow pigments and suggested that the pearls without yellow pigments could be produced more effectively by the selective breeding to some extent.

2) Triploid production

Triploid shellfishes have been expected to be sterile and studies on artificial triploid production were conducted in many species of mollusks. However, more data would be needed to use artificially induced triploid mollusks in aquaculture. Attempts were made to induce and to detect triploid pearl oysters.

A simple method of detecting the ploidy levels was developed in larval stages by DNA microfluorometry with DAPI staining. The eggs of the Japanese pearl oyster were treated with cold, heat or chemical (cytochalasin B:CB) shocks at various time intervals after insemination to induce triploidy. All these treatments were effective to induce triploidy. Much variations were observed among experiments of different batches in the effectiveness of triploid induction or the damages to hatchability and metamorphosis of embryos and larval growth rate.

The percent of triploid larvae was deduced to decrease with larval ages particularly in cold shocks. The most effective procedure for inducing triploidy was the treatment with CB from 20 to 50 minutes after insemination (100% from 0.5 mg/l and 80% from 0.1 mg/l at three months of age). Although the sterility and large shell width in the triploid groups were observed in a preliminary observation, studies should be done to examine other physiological characters such as oxygen consumption of triploid animals.

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Genetic variability in natural bivalves populations: The case of the black-lipped pearl oyster *Pinctada margaritifera*

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Genetic studies by means of electrophoretic analysis of enzymes have been widely applied to bivalves. The goals of these investigations have been (1) to identify taxonomic units such as sibling species (BLANC *et al.*, 1986), (2) to estimate the level of migration or gene flow among discrete breeding units more or less isolated within the whole specific range (KOEHN *et al.*, 1976; KOEHN and GAFFNEY, 1984; BUROKER, 1984; BLANC *et al.*, 1985; KOEHN *et al.*, 1988), and (3) to underline the relationship between genetic veriability estimated through heterozygosity and phenotypic traits such as growth rate or viability (SINGH and ZOUROS, 1978; MALLET and HALEY, 1984; ZOUROS and FOLTZ, 1984; ZOUROS *et al.*, 1988).

In this study, we present and compare data on genetic variation in natural populations of three pearl oysters of the genus *Pinctada*.

Allozymic variation at 18 presumptive loci was carried out in samples of the black-lipped pearl oyster *Pinctada margaritifera* from Polynesia and Mauritius Island, *P. mazatlanica* from Baja California and *P. maculata*, a small species sympatric with *P. margritifera*.

The data provided information about (1) the genetic divergence between the three species and among 17 samples of *P. margaritifera*, and (2) the amount of genetic diversity within populations.

(1.1.) Genetic divergence at the species level

Pinctada margaritifera and *P. mazatlanica* that are separated by a 5000–6000 km land free ocean, which can act as a good barrier to gene flow, have been considered as conspecific (JAMESON, 1901). RANSON (1961), on the basis of new diagnostic criteria, assigned to *P. mazatlanica* a specific status. Our data support RANSON's view even though any diagnostic locus between both species has been found; *P. maculata* was found clearly apart from both large species.

(1.2.) Genetic divergence at the infraspecific level

Genetic differentation among *P. margaritifera* populations is discussed on a geographic basis. Genetic distances and multivariate analysis applied on allelic frequencies allowed to segregate the Mauritian and Marquisian samples from the other. Furthermore, a biogeographic hypothesis related to stochastic aud historical events is proposed to account for genetic differentiation found between the Polynesian Tuamoto samples (BLANC *et al.*, 1985; DURAND and BLANC, 1986).

(2) Genetic diversity within populations

Population samples of pearl oyster *Pinctada margaritifera* are genetically quite variable (BLANC, 1983). The amount of genetic diversity attests a high degree of polymorphism: P=51%; A=2.8, Ho=0.226, He=0.261.

The genotypic frequencies at some loci significantly differed from those expected for populations under Hardy-Weinberg equilibrium. Usual hypotheses explaining heterozygote deficiency such as null alleles, inbreeding and Walhund effect were checked and were found inadequate. The model of balanced selection between the pelagic and settled phases, proposed by ZOUROS and FOLTZ (1984) and completed by the hypothesis of BLANC and BONHOMME (1987), which involves different set of genes acting sequentially, could explain the heterozygote deficiency in the bivalves species.

Thus, genetic variability in *Pinctada* populations can be compared to that of molluscan species with high fecundity and extensive larval dispersal, exhibiting high level of genetic polymorphism which can afford large mortalities and

some genetic load.

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Control of sex and maturation in fish by means of chromosome set manipulation

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Manipulation of chromosome sets is the simple and useful method to control sex and maturation in fish, because their gametes and zygotes can be handled in vitro. In this paper two basic fields of practical importance, involving gynogenesis and induced polyploidy, are particularly assessed according to our recent investigations.

Gynogenesis

After gynogenesis, all the offspring should be female in female homogametic (XX) species, but in female heterogametic (ZW) species, males might be produced in various ratios according to the recombination frequency of sex-determining loci or the genetic viability of both sexes.

In order to know more about the sex-determining system of fish, an investigation was carried out regarding the sex ratios of gynogenetic progeny derived from several different females in each of six species. Gynogenetic diploids were induced by temperature shock to the eggs to suppress the second polar body extrusion after fertilization with spermatozoa genetically inactivated by ultraviolet-ray irradiation. Our results were summarized as follows.

1) In two salmonids, rainbow trout (*Salmo gairdneri*) and masu salmon (*Oncorhynchus*

Type	Gametogenesis		Examples
	female	male	
I	+	+	many interspecific diploid hybrids (ex. brook × charr, masu × amago)
III	+	−	some of intergeneric diploid hybrids (ex. carp×goldfish, charr×masu)
II	−	+	auto- and allotriploids of salmonids
IV	−	−	auto- and allotriploids of cyprinids, and many intergenric diploid hybrids

masou), and in two cyprinids, carp (*Cyprinus carpio*) and loach (*Misgurnus anguillicaudatus*), gynogenesis succeeded in producing 100% females, a result consistent with female homogamety (XX).

2) In one pleuronectid, olive flounder (*Paralichthys olivaceus*), gynogenetic males appeared at the rate of nearly 50% or sometimes 100%, suggesting female heterogamety in this species.

3) In one cyprinid, goldfish (*Carassius auratus*), considerable variation was observed among gynogenetic progeny. Some were all females but others contained males in significant ratios, which ratios increased under high temperature rearing during early stage of life. This species is presumed to be originally female homogametic, but varieties with female heterogamety may have been produced by the successive selection for sex-determining genes, partially because of their multilocus and/or multiallelic nature.

Induced polyploidy

In order to create 'new' commercial fish with sterility and/or hybrid vigor, all possible allopolyploids (diploid and triploid hybrids) and autotriploids were made among six salmonids, Japanese charr (*Salvelinus leucomaenis*), brook (*Salvelinus fontinalis*), brown (*Salmo trutta*) and rainbow trout, and masu and amago (*Oncorhynchus rhodurus*) salmon, and among three cyprinids, goldfish, carp and loach. Triploidy was induced by temperature shock as mentioned above. They were reared to the maturity at two or three years old. Then their gonads were examined anatomically and histologically. Gonadotropin and sex steroids levels in plasma were measured by radioimmunoassay. Chromosome preparation was made from the cultured leukocytes. Four types of maturation were distinguished according to which sex can produce (+) or not (−) gametes.

In short, gametogeneic failure of some polyploids seems to closely relate with their karyotypes, the impairment of homologous chromosomes at pachytene stage of meiosis. It is not clear why only one sex is sterile in types II and III despite the same karyotype of both sexes. Auto- and allopolyploid males, whether fertile or sterile, developed gonadal somatic elements, including steroid-producing (interstitial) tissues, and their plasma testosterone levels were high to show secondary sexual characters and other undesirable side effects. In salmonid with relatively recent tetraploid ancestry, triploid males often produced sperm, but in cyprinid, triploid males did not. On the other hand, sterile polyploid females could not develop steroid producing (follicle) tissues in gonad, with most oocytes arrested at the pachytene stage of meiosis, and their plasma sex steroids levels were very low. They often preserved good meat quality and continued to survive and grow after maturation age.

Using much more species, further studies are needed to obtain full information about the sex-determining system prevalent among fish through gynogenesis experiments, and about the relationship between gametogeneic failure and karyotype through various polyploids production.

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3-1: Atmospheric Correction and Water Temperature Retrieval

A simple and reliable method for atmospheric effect removal from Meteosat IR data in SST extraction

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Numerous works have been done about SST retrieval using the various sensors on board of past and existing satellites.

A short review of the proposed techniques shows that, for similar atmospheric and oceanic conditions, the higher accuracies need often a more or less complex data assimilation (multispectral methods, variation of viewing angle, multitemporal analysis and geostatistic) in order to remove atmospheric absorption. Moreover, as far as the software or the data ingest is concerned, the delivery of SST maps may be delayed and limit real-time applications.

The present paper using the unique thermal infrared channel of Meteosat combined to the (numerous) ships of opportunity data proposes a simple and reliable technique of parameterization of the atmospheric absorption observed in the intertropical area.

The estimated precision fits the needs either of large climatic studies or these of regional ones: After a check of the calibration in radiance, then an inversion of Planck's function, a discrimination of cloud free area is performed using equally a guess field or a climatological chart (Reynolds). Composite images are produced in retaining the warmest value over five days (with eight images per day).

On these ones, an empirical model for atmospheric absorption will be applied on the following scheme: As the distribution of water vapor in tropical area appears mainly as a zonal phenomenon (clearly linked to the ITCZ), it can be suggested to take it in account along (several) north-south transects by polynomial functions determined in order to have the best fit between (refined) sea truth data and Meteosat data.

In our area of work (50°W to 10°E), four meridional sections have been made, inside of which atmospheric correction is assumed to be only latitude dependent.

Along each line, another polynomial adjustment is performed in order to fit continuity needs.

Finally the resulting matrix is applied to the cloud free area of Meteosat data, and the other ones being covered with ships data and objective analysis. This adjustment process appears also to remove ship's data of poor quality, and the mean difference between Meteosat corrected data and sea truth is round 0.6°C.

The aim of this work is to improve the relevant data set daily produced with Meteosat (by ESOC, Darmstadt). Compared now with NOAA products (CAC), a general good agreement is evident on a large scale; but local discrepancies remain on regional scale for which our space and time resolutions are better (i.e. senegalo-mauritanian upwelling).

By the way, the above parameterization takes into account both atmospheric effect and zenithal angle.

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Sea surface temperature measurements from space

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A method of deriving the sea surface temperature (SST) from space is described using the infrared channels of NOAA-AVHRR radiometer with reference to a model atmosphere-ocean system. Ground truth of SST was also undertaken at the water pool installed outside the Institute using our simple radiometer. It was found that when free of stratospheric aerosols the combined use of channels 3(3.7 μm), 4(11 μm) and 5(12 μm) is effective for the SST derivation for a moderate amount of precipitable water. However, in the case of a large amount of water vapor, its vertical profile has to be simultaneously determined to correct the water vapor effect. Furthermore, to evaluate the effect of the stratospheric aerosols on SST, the visible channels are also utilized for the atmospheric correction, where the radiation from the atmosphere is affected more by the presence of stratospheric aerosols. A method of simultaneous measurements using two geostationary satellite was also evaluated. Finally emissivity of pure and sea waters for the model surface in the infrared window regions was computed.

Ground truth

Measurements of temperature at points ranging from 10 cm above the water surface to 6 cm below were undertaken by the use of thermocouples at the water pool installed outside the MRI. It was found that radiometrically measured surface temperature depends on the surrounding conditions, particularly the existence of cloud. This should be taken into account for the SST measurements from space.

Algorithm deriving SST

SST measurement from space allowing for the effect of the stratospheric aerosols was undertaken. This study suggested that the effect of stratospheric aerosols is not negligible, but a knowledge of the vertical profiles of water vapor and temperature is also essential. A precise investigation of SST requires a knowledge of emissivity of sea waters. The above numerals were computed for the model sea surface in the infrared window regions.

Effective channels for future satellite

To improve the SST derivations, the vertical profile, especially the lower troposheric profile, of precipitable water has to simultaneously be in-

vestigated. In this purpose, in 4 μm and 8 μm regions of spectrum other than currently utilized channels, whether or not these regions are used for future candidate channels is presently investigated at our laboratory and field. Finally our contributions with respect to the SST work are shown as references.

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Remote sensing software for meteorological satellite application for operational sea surface temperature using geosynchronous satellites

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Introduction

L'Institut Francais de Recherche Scientifique pour le Développement en Coopération (ORSTOM) has been developing a research team in remote sensing applications, located in the "Centre de Météorologie Spatiale" in Lannion (French "Météorologie Nationale" board).

This paper describes two fields of our activities;

—the development of general tools for the processing of "meteorological" remote-sensed data (geostationary, NOAA series), which allows scientific developments as well as dedicated application in the fields of climatology and oceanography;

—an example of application devoted to sea surface temperature operational retrievals from Météosat infrared channel for the tropical Atlantic Ocean.

Satellite data processing software

This software has been developed with specifications for aims:

—availibility of general "open" tools for remote sensing research programs;

—applications in fields of environmental remote sensing with particular interest to geometric and radiometric processing;

—computing constraint based on a "software quality" approach.

The main features of the software are:

—the management of data and their representation;

—the image processing facilities;

—the decoding of main data sources, with models for radiometric and geometric pre-processing, to retrieve physical values;

—the geometrical processing with mapping in any geographical projection for multisources data;

—the access to many available data bases (climatic, cartographic, . . .) and other software facilities.

This software helps to solve the basic demands of our research team. In particular it performs very well for data management and processing of different sources as well as for their representation in image and graphic.

Operational sea surface temperature retrievals using geosynchronous satellites

Since the launch of the first European geosynchronous satellite Meteosat in 1978, ORSTOM has been developing research dealing with sea surface temperature retrievals for fisheries needs in the tropical Atlantic Ocean. As back as 1981, a permanent monitoring of SST was set up at the "Centre de Météorologie Spatiale" of Lannion (1).

Since that date, this activity has been improved with development of SST retrieval methodology in Dakar (CRODT/UTIS), while ORSTOM/Lannion developed the processing on an operational mode including mapping of SST in real time, and distribution to users.

The accuracy of sea surface temperature retrieval from satellite infrared data comes up against two major constraints: cloud coverage and atmospheric absoption. To get rid of these problems, the basic idea is to use the great repetitiveness of geosynchronous data, to build a synthetic image in "clear radiance", and to correct it by "sea truth" data.

The algorithm consists of overlaying successive images, calibrated in radiative temperature, and to create a "thermal synthesis" by retaining the warmest pixel of the series of data. This initial thermal field is corrected from atmospheric absorption effects estimated from "SST SHIP" values available on the GTS, and the data of a climatic atlas.

The final product is a five-day SST map implemented on an automatic way with data processing tools described previously. A map is sent to ORSTOM research team in Africa, and recently for an experimentation to French tuna fishing companies in Atlantic.

These maps are part of a file which can be considered as a usable tool for climatic or oceanic phenomenons monitoring (2).

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3-2: Application of Water Temperature Measurement to Ocean Studies

Application of remote sensing to oceanography, particularly to water temperature

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In the east of Japan Islands, the Kuroshio, a part of the subtropical gyre, flows east and the Oyashio, a part of the subarctic gyre, flows southwest from the northern region. The first branch of the Oyashio flows south near the coast and the second branch flows offshore to the south. And warm-core rings pinched off from the Kuroshio or cold-core rings from the Oyashio are distributed in the transition area.

The current pattern in the Oyashio is not so clear as in the Kuroshio or in the warm-core rings because the current in the Oyashio has not been observed so frequently as in the Kuroshio or in the warm-core rings. The velocity in the Kuroshio and in the warm-core rings exceeds 100 cm/sec at the maximum and the current patterns are easily estimated from the geostrophic balance in these water masses.

Current in the Oyashio

The geostrophic speed crossing the Oyashio has the maximum in 100 to 200 meters depth with less than 10 cm/sec, and the current speed at the sea surface is less than that in the subsurface water (AOTA and MOCHIZUKI, 1988). The sign of the vertical shear in the Oyashio region changes at the depth of the maximum speed and it is suggested that the water at the sea surface of the Oyashio is drawn by the subsurface water. Therefore, it is said that the sea surface water in the Oyashio moves passively drawn by the subsurface water. From this point, the current structure of the Oyashio is remarkably different from the Kuroshio current.

It was observed from the research vessel, Argos buoy tracking and NOAA AVHRR images that the minimum temperature zone at the sea surface corresponded to the maximum shear zone at 50 meters and the water with the minimum temperature flowed along the maximum shear zone of 50 meters depth in the Oyashio. This suggests that the flow at the sea surface should be advective and direct to the temperature gradient.

Current in the warm-core ring

The current speed in a warm-core ring was evaluated from the consecutive thermal images of NOAA satellite in the period of 8 to 13 June 1986. It was evaluated from the movement of the tip in a cold streamer along the edge of the warm-core ring that the shifting speed of the tip was 30 to 60 cm/sec. On the other hand, when the speed in the warm-core ring was measured from the research vessel during 21 to 28 of June, it was about 100 cm/sec and two times larger than the speed estimated from the satellite images (INAGAKE, 1988).

We must make clear the reason why such a difference has occurred.

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Forecasting tuna fisheries areas: what parameters, what models ? The praxeological response

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Sea surface temperature (SST) is the target of numerous investigations in order to describe the oceanic environment and tuna distribution (BLACKBURN 1965; SUND *et al.*, 1981; STRETTA, 1988), These studies point out that tuna forage will induce tuna distribution between the limits of environmental and physiological parameters.

Tuna movements cannot be observed in the open ocean from space. We must deduce movements by models based on tuna behavior. We know that (1) the tropical epipelagic water masses are nutritionally poor under steady conditions (HERBLAND and VOITURIEZ, 1977), (2) the migrating fauna is not a major source of food for tunas (ROGER and GRANPERRIN, 1976), (3) the bioenergetics of tuna are important and well described (KITCHELL *et al.*, 1978). As tuna movements cannot be observed directly in open ocean from space, we have to deduce them by models based on tuna behavior.

Principle of the praxeological analysis

In order to find high concentrations of tunas, first we must find areas with high density of tuna forage. Typically, these patches of prey within an epipelagic ecosystem occur in fronts, upwellings or domes (DUFOUR and STRETTA, 1973; VOITURIEZ and HERBLAND, 1982). In the tpopical ocean, the popping up of the thermocline into the euphotic layer (or only in the euphotic layer) has important consequences for nutrient enrichment and forage production. These lead us to consider a new concept in tuna ecology: the concept of the hydrological history of water masses. This is now possible throughout satellite detection by measuring throughout time and space the surface thermal signature of fertilizing processes of water masses. We can estimate forage production, and thereby predict tuna distribution: the most simplest model will be to follow the SST along time/space scale and to point out the area where the probability to find forage organisms for tunas is supposed to be high.

A possible way to find high concentration of tunas is the praxeological* analysis. This analysis, based on the study (with satellite data) of the hydrological history of water masses during the time, is the first version of a new paradigm. This version is rough and the solutions obtained are not ideal and the avantage is to be close to the reality but without mathematical elegance (BERTALANFFY, 1968).

The forecasting model: "PREVI-PECHE"

To determine the events and their duration which are necessary to get favorable hydrological conditions for tuna fishery, we have developed an "ideal" evolution for the SST (or the theoretical thermal scenario). This Ideal Thermal Scenario (ITS) is built over an empirical analysis of the surface hydrological conditions associated with tuna concentrations. This ITS is; (1) arising of cold water in surface, (2) maturation of this water during 4 weeks and (3) thermic stabilisation during two weeks, then the area may be enabled to support tuna fisheries.

We traduce the maturation of the water by an increasing of 1°C each week for the SST. The most simple model will be to follow along time/space scale the SST and to point out the area where the probability to find forage organisms for tunas is supposed to be high (STRETTA et SLEPOUKHA, 1983; STRETTA et PETIT, 1989), From February 1982 to June 1985, we have given to the tuna fleet 82 forecasting bulletins. The

* praxeology: neologism from greek word praxis ($\pi\rho\alpha\xi\iota\sigma$): action. Analysis of the evolution of events during the time.

comparisons between the fisheries and the forecasting bulletin for the validation of the model are not yet completed.

The future

If PREVI-PECHE is the result of a praxeological analysis of a tuna fishery, now exists a new way for modeling the knowledge: the expert diagnostic systems (EDS). The EDS have particularity to use symbolical knowledge while the classical models use numerical data (STRETTA et PETIT, 1989). These kinds of forecasting models could be the solution for the development of tuna fisheries for the next years.

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Collection and processing of fisheries and oceanographic data in Japan Fisheries Information Service Center (JAFIC)

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The Japan Fisheries Information Service Center (JAFIC) produces a periodical for fishermen. Four different types of charts are being produced: SST, oceanographic conditions, fisheries conditions, and market prices.

In addition to the above-mentioned products, JAFIC produces a special bulletin that includes short-term fishing forecasts, the oceanographic and fisheries conditions for special areas, and an information of the temperature map obtained from satellite data.

1. Introduction

Fish and its products play a very important role in the Japanese diet. Therefore effective utilization of fisheries resources in the sea areas adjacent to Japan is a matter of economic importance.

In consideration of the importance of Japanese fisheries resources extensive research in this region has been carried out in Japan by the Regional Fisheries Research Laboratories and Prefectural Fisheries Experimental Stations. The first experiments started to provide fishermen with "real-time" information on oceanographic and fisheries conditions in the various fishing grounds in 1964. These experiments were aimed at providing information on the sea-surface temperature distribution in the area and at monitoring surface currents and their displacement in order to facilitate scouting for commercially important fish. Although there is still no clear understanding of both oceanographic, biological and physiological processes concerning the species for which predictions are made, experience has shown that valuable assistance can be given to fishing fleets by such forecasting services. Therefore in April 1972 the Japan Fisheries Information Service Center (JAFIC) was established.

2. Information provided by the service

JAFIC provides information on oceanographic and fisheries conditions all the year round. For several areas, however, distribution of sea-surface temperature analyses and description of the oceanographic and fisheries conditions is restricted to the fishing season in the area. The service has therefore set up a system for temperature observations and their transmission to the center, based on which SST analyses are prepared during the fishing period in six different sea areas around Japan for use by the various fisheries (sardine, anchovy, mackerel, saury, squid, skipjack, tuna, albacore, swordfish, salmon and others).

The product of detailed description of the oceanographic condition is given together with special comments for different areas. The fisheries ground described in the map, of course detailed description of the fisheries condition, is given together with special comments for different fishes, for example skipjack and sardine and other fisheries.

The Fisheries Oceanography Chart has been giving to fishermen as a map of a sea surface temperature that is an important index for fishing, and the number of vessels using the map is increasing year by year. In the first investigation (in 1981), 3,035 (67%) out of 4,512 vessels with the FAX were using the map by receiving it directly.

3. Satellite information service for fisheries

SST data products obtained from satellite infrared are distributed for fisheries by JAFIC.

The satellite signals were received at the Satellite Center of the JMA. The CCTs were borrowed from the Center and were processed by the Hitachi system in JAFIC. The JAFIC analyzed and transmitted the data by means of a FAX transmitter of the Central Fisheries Radio Station.

There are two different types of charts in "Satellite Information Service";

1) The image was scaled by one degree in temperature, the boundary of each one degree scale was enhanced (edge enhancement), and the isotherm was traced along the edge of the gray scale with a grid showing latitude, longitude, and the coast line. Then a calibration was made by means of data from vessels so as to determine the temperature of the isotherm, as the "Sea Surface Temperature Chart by Satellite".

2) The important charateristics of the oceanographic conditions such as fronts, warm and cold eddies, intrusion of Kuroshio, etc. were depicted on a chart termed "Fisheries Oceanography Chart by Satellite".

4. Evaluation of information by users

The major comments of the users are summarized below;

1) It is convenient to know the direction of currents, cold and warm masses, and fronts.

2) The information of sea surface temperature using the satellite data is better than the previous chart for interpretation of the present ocenographic conditions, their changes, and their future forecasting.

3) The frequency of broadcasts should be increased to once in three to five days.

4) The information of sea surface temperature using the satellite data is helpful to fishing vessels. Several vessels were able to find fish schools by means of the chart.

5) The information of sea surface temperature using the satellite data is very useful and easy to interpret. The position of the front can be ascertained by this.

Oceanography and intertropical tuna fisheries in the western Pacific. Which significant large scale parameters can be used?

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Satellite oceanic remote sensing is playing an increasing role in fishery research and management, because of its ability to provide a synoptic picture of the relevant oceanic parameters; until now, these studies mainly used infrared thermal or colour imagery (4). However, if these methods are quite successful in temperate or semi-tropical zones, they are much less efficient in equatorial and tropical areas due to relative weakness of seasonal variability and faintness of gradients.

A brief description of the work done on open-ocean programmes by ORSTOM's scientists in Nouméa is presented: within the TOGA programme, SURTROPAC collects and analyses surface and XBT data from several shipping lines since 1969, and conducts a series of biannual cruises along the 165°E meridian since 1984; through the hydrological structure, PROPPAC attempts to estimate the influence of climatic variations on the open ocean pelagic production; lastly, the tuna fisheries propamme evaluates the impact of the seasonal and interannual variability on the distribution and availability of tunas to the different fishing gears.

The general climatology and circulation in the intertropical western Pacific (with emphasis on the ENSO phenomenon) and its impact on the distribution and availability of tunas is emphasized (3, 8, 9). Preliminary results of the programme carried out at Nouméa in collaboration between ORSTOM and the Tuna and Billfish Assessment Programme of the South Pacific Commission to study the impact of both seasonal and interannual variability on the distribution and availability of tunas are presented.

A new promising approach will be soon available: this last decade, important progress in modeling intertropical oceans was achieved, which suggests that models can be used to understand (and possibly forecast) the seasonal and interannual changes in the upper layer ocean (1, 2, 6, 7). These wind-driven models generate simulated dynamic heights series from which upper layer thickness, heat content and surface currents can be inferred. At present, the main uncertainties come from the scarcity and lack of homogeneity of the data sets used (5).

The future generation of satellites (TOPEX/POSEIDON, ERS1, NROSS) equipped with active sensors will provide information on winds, waves and sea level over wide areas. This can dramatically improve modeling by two ways: using the satellite wind information (alone or in combination with traditional field data) as input of the model, or forcing the model with the sea level data obtained from altimetry instead of wind. A major French-US cooperative program, based on the future TOPEX/POSEIDON altimetry to model the upper layers ocean circulation will start in 1989. The use of such three dimensional simulation models on an operational basis, combined with a regular reinitialization from field observations, will give a good semi-real time observation of the ocean as well as some prevision on a short-term basis (a month to a quarter).

This new approach will have two considerable interests for tuna-environment studies: the first is to provide a consistent spatial interpolation of oceanographic parameters, often heterogeneous relatively to fisheries data; the second is its ability to reconstitute coherent series of ocean parameters from historical wind and surface observations. Use of this new improved oceanographic climatology will strongly benefit to open-ocean programmes, and to tunas fisheries related oceanography in particular.

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3-3: Chlorophyll Concentration Retrieval

Remote sensing of chlorophyll concentration in the surface water

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Prior to developing an algorithm for estimating the chlorophyll concentration (A_c) in the surface water from the radiance detected by the satellite, an algorithm for estimating A_c from radiance just below the sea surface where the radiance is affected by neither the reflected sky light nor the path radiance must be developed.

SUGIHARA *et al.* (1985a, 1985b, 1986) examined the correlation of observed A_c with that computed from the observed spectral irradiance through three algorithms: regression analysis technique, optical model technique and fluorescence technique.

Regression analysis technique

In the regression analysis technique, regression fits between radiance or irradiance ratio and A_c are produced and the determined regression curves or lines are used to map A_c which was not directly measured.

SUGIHARA *et al.* (1985a) reported that the ratio of irradiance at 443 nm to that at 550 nm shows a good fit to the observed A_c with the correlation coefficient of 0.81; these wavelengths correspond to those of maximum transmittance of channels 1 and 3 in CZCS (Coastal zone color scanner).

Optical model technique

The optical model used by SUGIHARA *et al.* (1985b) begins from relating the radiance emerging from below the sea surface to A_c, absorption coefficient of yellow substance (A_y) and back-scattering coefficient of particles (b_p) through a mathematical model that describes the optical process taking place in the sea. Then, A_c as well as b_p and A_y are determined to derive an optimized fit of computed irradiance spectrum to the observed one. In this approach, irradiance reflectances at 400, 440, 510 and 600 nm were used as input data. The correlation between observed and computed A_c is good; the correlation coefficient is 0.94. They stressed a significant role of the reflectance at 400 nm for obtaining the accurate computational results.

Fluorescence technique

In the fluorescence technique SUGIHARA *et al.* 1986), the ratio of upward irradiance at 685 nm, which is generated by both chlorophyll fluorescence and elastic scattering, to upward irradiance at 480 nm was the best fit to the observed A_c. In this case, correlation coefficient was 0.90.

Thus, we can estimate A_c from the irradiance observed just below the sea surface. This suggests that remote sensing of A_c from the space is possible if the path radiance and the reflected sky light can be removed from the satellite data. Accordingly, the removal of both path radiance and reflected sky light is a next important and necessary step for estimating A_c from the space.

Application to estimation of yellow substance concentration and the suspended solids (SS)

The optical model technique seems more useful for the practical application to the ocean studies since A_y and b_p in addition to A_c can be estimated at the same time. For practical application, however, the algorithm suffers from a disadvan-

tage; the atmospheric path radiance is considerably large at 400 nm.

In order to overcome this disadvantage, an algorithm combining the optical model technique and the fluorescence or regression analysis techniques were developed by SUGIHARA and KISHINO (1988). The optical model technique is used after A_c is determined by the fluorescence technique or the regression analysis technique. The computed A_y compares well with oserved one, and also the computed b_p, which might be related to SS, was linearly related to the observed SS.

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Sea surface chlorophyll concentration in the southwestern tropical Pacific as seen by NIMBUS-7 CZCS from 1978 to 1984

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Surface oligotrophy is the rule in the southwestern tropical Pacific due to the generalization of the deep chlorophyll maximum at the nutricline depth. Then, the phytoplankton content of the upper layer is an indicator of nutrient inputs in the euphotic zone due to diverse physical processes.

The Coastal Zone Color Scanner (CZCS) on board the NIMBUS-7 NASA satellite measured the ocean color variation of the sea during the 1978–1984 period. By this mean, the sea surface chlorophyll variations were followed during 6 years in the Coral Sea around New Caledonia and Vanuatu by analyzing 40 images of this archive.

The removal of atmospheric effect was successfully performed by using same methods as in previous works (HOLLIGAN *et al.*, 1983, DUPOUY and DEMARCQ, 1987).

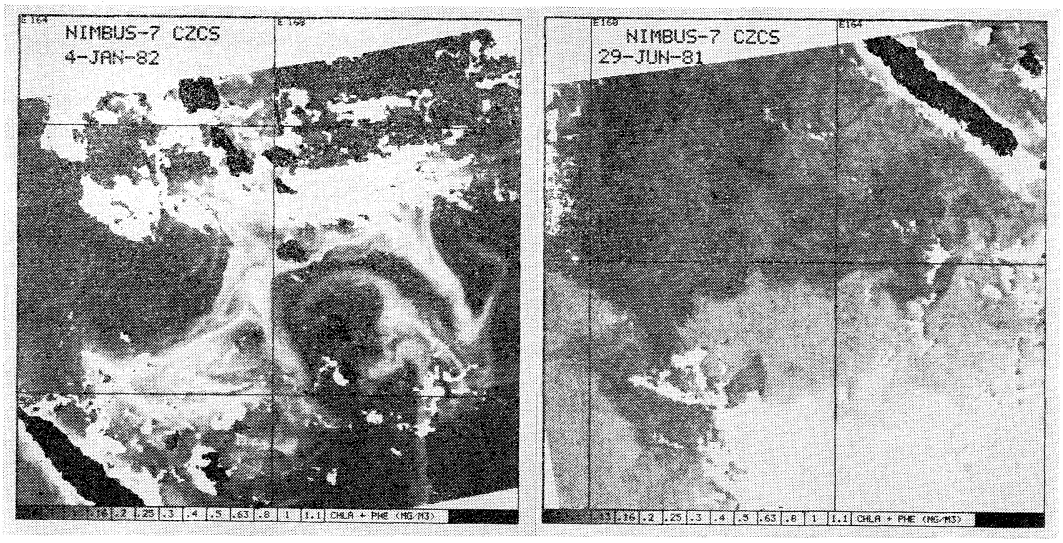
Major phytoplankton enrichment effects were then detected from the CZCS chlorophyll increases, linked to the main circulation patterns related to the position of the Tropical Convergence of the winds, and in accordance with the merchant ships survey and cruises obervations made at the ORSTOM center of Noumea. They are:

—during winter months (April to August), a strong enrichment south of New Caledonia, due to the trade-wind mixing bringing nutrients in the photic layer;

—during summer months (December to March), discolored cyanobacteria blooms extending eastward of New Caledonia along 800 miles, linked to calm weather and warm waters (DUPOUY *et al.*, 1988);

—bathymetric and island mass effect around New Caledonia and Vanuatu appearing as mesoscale gyres trapped along the northwestern coast of N.C., regular enrichments above reefs, meanders around small islands.

In conclusion, the CZCS experience was a performant tool to describe the phytoplankton enrichments in the near surface layer in the southwest tropical Pacific, around islands. From this short series of images, the major known features were retrieved. Moreover, the



NIMBUS-7 Coastal Zone Color Scanner over New Caledonia and Vanuatu (165-180°E, 23-15°S). Clouds are masked white and land in black.

1. Orbit 16390: January 4, 1982. In white, highly reflectant large bloom caused by *Trichodesmium* proliferation (atmospheric nitrogen fixing algae).
2. Orbit 13527; June 29, 1981. In white, large phytoplankton enrichment due to enhanced vertical mixing by cooling of the sea, south of New Caledonia.

complexity of the superficial circulation around islands was described in more details than before. A new satellite ocean color sensor (possibly the ADEOS one in the 1990's) would allow us to estimate the global chlorophyll content of this ocean.

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3-4: Application of Water Color Image to Ocean Studies

Will an operational marine fishery science (halieutic) make a way through aerospatial remote sensing tool?

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A brief balance of the attainments and limits in modern "halieutic" (fishery biology and economy) field is stricken and shows off the gap between the present management structure and the present problems. The surface tuna fishery case is thoroughly studied, considering its specificity and its economical importance. From there, it appears that, today, conclusive strides will be made by halieutic through the knowledge of the relationship between tuna and its environment. Some tuna environment studies are presented through typical remote sensing examples and introduce the basis of a coherent theory of tuna behaviour which can be schematically smmarized by this basic general hypothesis: if, in a zone, tunas are present, they will be inclined to aggregate close to any anomalies (gradients) of parameters in their environmental sensing field. From there, several models in order to assess or forecast surface tuna stocks are presented.

A second part analyses the potential and the contribution of the aerospatial remote sensing in the halieutic field through three original examples:

1. The contribution of aerial radar VARANS (SAR) within the framework of HAREM (HAlieutic Radar Experiment Mediterranean sea) for the small scale fisheries and tuna fishery.

2. The contribution of SPOT satellite to halieutic and oceanology (swell, sea mounts, boats . . .).

3. The contribution of colour sea sensor (CZCS) for primary production (*Cyanobacteria* bloom in New Caledonia).

These examples point out clearly that the remote sensing is one of the only tools able to "visualize" some essential concepts in oceanography and halieutic.

Last but not least, we propose a study within the framework of several countries and several activities (a) to integrate remote sensing tool in the fishery management structure and (b) to form again the data acquisition system in satellites remote sensing. From this study, a real operational halieutic would issue forth.

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SPOT satellite high resolution applied to coral reef resources assessment in New Caledonia

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Introduction

The coral reefs of the southwest Pacific, including the Australian Great Barrier Reef and the ring of reefs surrounding New Caledonia, have been studied by remote sensing methods for some years now. The generally clear waters which cover the reef formations make it possible to explore them by satellite techniques that were originally developed for mapping of emerged land areas. Since 1986, the images supplied by the French SPOT satellite have been proving extremely useful for continuation of these studies, because SPOT's high resolution—the best available at present—makes it easier to interpret the thematic maps obtained by processing of the digital satellite images.

1. Data used

A study carried out in 1985 (BOUR *et al.*, 1986) showed that it was possible, by processing of image data, to produce thematic maps of a portion of barrier reef and to identify the type of environment likely to contain an economically valuable gastropod, trochus (*Trochus niloticus*). This study used data from a SPOT simulation campaign conducted in New Caledonia in 1983.

Like many New Caledonian reefs, Tetembia has an outer reef flat that is very suitable for trochus, a gastropod (*Trochus niloticus*) which is exploited for its nacreous shell. Hundreds of tonnes of trouchus shells are exported from New Caledonia each year to Europe and Asia.

2. Method

Processing consists of supervised classification on the XS1 and XS2 SPOT channels. A bidimensional histogram of all the pixels of the reef displays a "boomerang" structure, which was already observed in the study using the simulated data (BOUR *et al.*, 1986).

The supervised classification used requires that it is possible to define thresholds of radiometric classes on both the channels. Thresholding relies on the spectral signatures of the themes being sought.

3. Results

Figure 1 shows the thematic map obtained; each theme is identified by an arbitrarily chosen colour. Six themes are represented; three are hard coral bottoms, the other three are soft sandy bottoms. Their depth range and their surface area are also shown.

Total biomass of trochus on the reef (theme 2-3)

The sum of the two themes is an area of 1038 ha; the mean density of trochus on Tetembia is 45 shells per hectare; the mean weight per trochus on this reefs, obtained through sampling, is 418 g. The weight of trochus per hectare is therefore 18.8 kg, and the total trochus biomass present on Tetembia reef is 19.5 tonnes.

Exploitable Faviidae biomass (Theme 1-2-4-5)

The ball-shaped corals of the family Faviidae are exploited by local companies. The total exploitable biomass on Tetembia reef is 2298 tonnes (hard bottoms) plus 662 tonnes (soft bottoms), which is just on 3,000 tonnes. Good management would permit about one tenth of this biomass to be removed per year, i.e. 30 tonnes per year. With 180 tonnes harvested in 1987, the current rate of exploitation is obviously far too high.

Conclusion

The examples given show how easy it is to estimate the biomass of living reef resources using satellite images, provided one also has some ground sampling data. Processing of digital high-

resolution SPOT images can provide biologists, resource managers and economic planners with an invaluable information base for understanding of coral reef environments.

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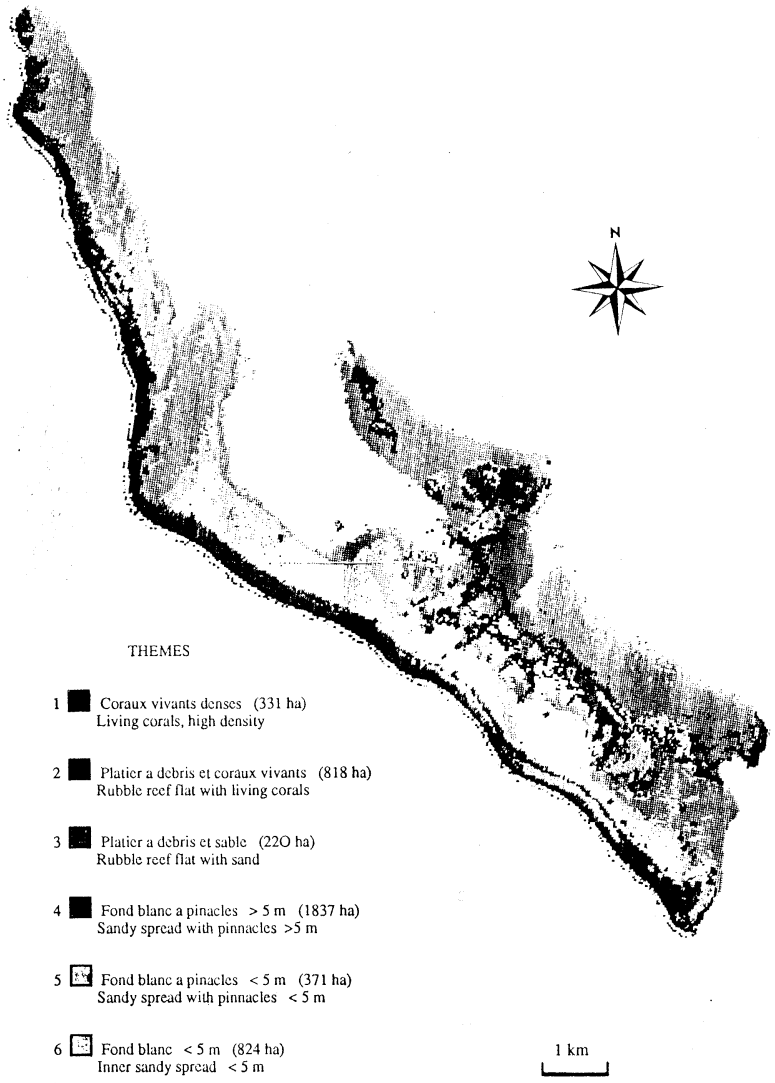

Fig. 1. Carte thematique du recif TETEMBIA (Nouvelle-Caledonie). Thematic map of TETEMBIA reef (New Caledonia).

Apport du satellite SPOT à la cartographie des végétaux marins

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Le projet "Végétaux marins" (PEPS "VEG MA") visait à démontrer que la majorité des problèmes d'inventaire, de surveillance et d'évaluation de stock posés par les macrophytes marins pouvait être résolue par la télédétection satellitaire répétitive à haute résolution de type SPOT.

1. SCENE BRETNOR (Bretagne Nord, France)

Acquisition: 25/05/1986 à 11h28mn28s T.U.

Sur ce secteur, lieu principal de récolte des algues françaises, les résultats obtenus sont les suivants:

—*En zone intertidale exondée*, la couverture végétale est mise en évidence à partir de l'indice de végétation (XS3−XS2)/(XS3+XS2) et sa superficie calculée. Les études radiométriques de terrain montrent que la différenciation des espèces semble surtout due à leur équipement pigmentaire VIOLLIER *et al.*, 1985; BEN MOUSSA *et al.*, 1987).

Aussi, un indice pigmentaire, défini par le rapport XS1/XS2 et des classifications, par traitement statistique de l'image, permettent de discriminer, au sein de cette couverture plusieurs peuplements, en particulier ceux à dominantes de Chlorophycées et de Fucales.

Pour le secteur allant des abers à Brest, la couverture végétale à dominante de Fucales s'élève à 10,7 km², soit 74% de la zone découverte traitée. A lui seul, le secteur s'étendant de Plouguerneau à Porspoder en comprend 9,06 km², soit 85% de la végétation télédétectée.

—*En zone sublittorale*, la végétation immergée est perceptible, à l'aide de l'expression $(XS1)^2/XS2$, qui constitute un véritable indice de transparence, jusqu'à la profondeur de—12 m (BEN MOUSSA, 1987).

Pour le secteur des abers, les peuplements à dominante de Laminaires sent évalués à au moins 24 km². Une houle bien formée déferlant sur le secteur côtier pénalise le traitement.

Un suivi rationnel de l'exploitation de la végétation marine peut donc, enfin, grâce à la télédétection satellitaire à haute résolution, être envisagé.

2. SCENE TAMORA (Tahiti-Moorea, Polynésie française)

Acquisition: 11/08/1986 à 20h14mn44s T.U.

Une décorrélation des deux premiers canaux de SPOT et le remplacement du canal XS2 par l'expression $(XS1)^2/XS2$ permet une classification des principaux composants de l'écosystème corallien. Seize thèmes sont discriminés, dont dix bionomiques. La couverture végétale immergée, implantée sur le platier corallien et ses micro-atolls, ainsi que celle du récif barriére (pente externe non comprise), découverte irrégulièrement et sporadiquement, sont discriminées par rapport aux autres constituants du lagon.

Dans les eaux généralement calmes et tres claires du lagon, la superposition des données bathymétriques issues de la carte SHOM (n° 6658-île de Moorea) au traitement réalisé sur l'image SPOT, s'avère spectaculaire. Celui ci traduit, de manière colorée, la bathymétrie des fonds en fonction, non seulement de la profondeur, mais de leur nature. Ainsi, les éléments détritiques sont identifiés devant la passe Taotoï jusqu'à-16 m.

SPOT s'avère donc, dans ce type d'écosystème, pour lequel l'acquisition de données répetitives par d'autres moyens s'avère, plus que partout ailleurs, difficile et onéreuse, comme un excellent outil pour la classification, la quantification, la bathymétrie et le positionnement géographique exact de vastes secteurs littoraux.

3. SCENE RADHY (rade d'Hyères, France)

Acquisition: 2/06/1986 et 28/06/1986

La rade d'Hyères comprend la majorité des fonds situés entre 0 et −10 m du littoral de la région Provence—Côte d'Azur. Ces fonds sont colonisés par un herbier constitué par la grande phanérogame *Posidonia oceanica*, dont le fonctionnement est perturbé notamment par les rejets urbains et les aménagements côtiers.

La superposition des données bathymétriques de la carte THOM (5151-rade d'Hyères) aux traitements réalisés sur les deux images SPOT et la confrontation de cet ensemble de données aux cartes bio-sédimentaires existantes permet d'ébaucher une nouvelle carte bio-sédimentaire. Elle témoigne de la régression de l'herbier de Posidonie de la partie Nord de la rade d'Hyères et de l'extension des fronds de vase et de sables grossiers.

La couverture algale apparaît discriminée en l'état actuel des connaissances de terrain, jusqu'à une profondeur d'au moins quinze mètres.

SPOT constitue donc en regard des techniques précédemment utilisées en Méditerranée pour la cartographie de l'herbier de Posidonie (transects sous-marins, quadrillages, sonar latéral, sous-marin, dragages, télédétection aéroportée) un outil révolutionnaire.

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ユベール・J・セカルディ

日仏学術シンポジウムは，文部省並びにフランス外務省の協力を仰ぎ，日本とフランスで交互に3年ごとに開かれている。シンポジウムには研究，高等教育機関並びに公共・民間の諸機関から様々の分野の専門家が集まっている。

このシンポジウムは日仏会館の活動の一環として行われている。日仏会館は23の日仏関連諸学会を擁しているが，日本における，これら諸学会の会員は，実質的にはほとんど日本人の専門家である。これら専門学会は以下の通りである：日仏生物学会，日仏理工化会，日仏医学会，日仏農学会，日仏東洋学会，日仏工業技術会，日仏社会学会，日仏法学会，日仏歴史学会，日仏経済学会，日仏音楽協会，日仏海洋学会，日仏演劇協会，日本フランス語フランス文学会，日仏政治学会，日仏図書館学会，日仏美術学会，日仏薬学会，日仏哲学会，日仏ギリシャ・ローマ学会，日仏地理学会，日仏教育学会，日仏経営学会。更に，このうち幾つかの分野では，日仏双方で対応する学会が組織され，同じテーマと問題について関心を寄せ，協力関係を結び，有益な交流を活発に行っている。

1988年日仏学術シンポジウム

第5回日仏学術シンポジウムは本年，日本で開催された。10月3日に始まり，その会議は漸く終了したところである。これまでと同様，本シンポジウムも日仏会館により組織された。その実現にあたっては，日仏の文部省，フランス学術研究省，環境省，フランス国立科学研究センター，日本学術振興会をはじめとして多くの公共機関並びに民間の財団から援助があった。

会議は東京，つくば市，伊東市，清水市，京都市等で

Rapport Général du 5e Colloque Scientifique Franco-Japonais

par Hubert J. CECCALDI
Directeur français
à la Maison franco-japonaise

Sous l'égide du Ministère français des Affaires étrangères et du Ministère japonais de l'Education nationale, des Colloques scientifiques interdisciplinaires franco-japonais sont organisés tous les trois ans, alternativement au Japon et en France. Ils réunissent des spécialistes de diverses disciplines de la recherche scientifique, de l'enseignement supérieur et des secteurs nationalisé et privé.

Ces réunions se déroulent dans le cadre des activités de la Maison franco-japonaise de Tokyo, qui abrite les activités de 23 sociétés scientiques et culturelles franco-japonaises. Au Japon, leurs membres sont pratiquement tous des spécialistes de nationalité japonaise. Ce sont les Sociétés de biologie, sciences pures et apliquées, médecine, agronomie, études orientales, techniques industrielles, sociologie, sciences juridiques, sciences historiques, sciences économiques, musique, océanographie, théâtre, langue et littérature françaises, sciences politiques bibliothécaires, art et archéologie, pharmacie, philosophie, études grecquest et romaines, géographie, sciences de l'éducation, sciences de gestion.

De plus, dans plusieurs disciplines, il existe en France et au Japon des Sociétés jumelles et homologues, s'intéressant aux mêmes sujets et aux mêmes problèmes dans les deux pays et ayant entre elles des échanges actifs et efficaces.

Le Colloque de 1988

Le 5eme Colloque pluridisciplinaire franco-japonais s'est tenu cette année au Japon. Il vient de terminer ses travaux, commencés le 3 octobre. Comme les précédents, il a été organisé par la Maison franco-japonaise. Il a été réalisé avec l'aide des Ministères français et japonais de l'Education nationale, de la Recherche scientifique, de l'Environnement, les grands organismes de recherches français et japonais, et de plusieurs fondations publiques et privées japonaises et françaises.

Les réunions se sont tenues à Tokyo, à Tsukuba,

開催されたが，このように広範な形で行われたことは極めて重要なことであろう。事実，会議のために来日したフランス人学者は100名を越え，様々な分野で約 1,000 人に達する日本人研究者・専門家との交流が行われた。

シンポジウムは，日仏会館での二つの公開講演会と閉会のレセプションをもって無事終了した。

部門別開催概要

[数　学] テーマ：解析的整数論
日　程：10月10～13日　於日仏会館
責任者：E. フーヴリ（パリ南大学），
長坂建二（放送大学）

[化　学] テーマ：光化学の最近の進歩と技術的応用
日　程：10月4～7日　於筑波大学，8日～見学
責任者：J. フォール（パリ南大学），
本多健一（京都大学）

[地理学] テーマ：農村の非農業化に関する日仏の比較地理学的研究
日　程：10月3～7日　於筑波大学，8日～巡検
責任者：Ph. パンシュメル(パリ第一大学)，
山本正三(筑波大学)

[海洋学] テーマ：1. 温排水　2. 養殖　3. リモートセンシング
日　程：10月 4～7 日，於清水市
責任者：H.J. セカルディ（国立高等研究院），
宇野　寛（日仏海洋学会）

[医　学] テーマ：「癌」の画像医学
日　程 10月 3～8日　於ホテル・エドモント，6日見学
責任者：M. テュビアーナ(ギュスターヴ・ルーシイ研究所)
加藤富三（日本医科大学）

[法　学] テーマ：紛争解決の機構と問題点
日　程：10月 4～6日 於東京大学，
11～12日 於立命館大学，京都大学
責任者：X. ブラン・ジュウヴァン(パリ第一大学)，山口俊夫（千葉大学）

[経済学] テーマ海外民間投資の比較検討
日　程：10月 8～10日　於早稲田大学，
11～12日　於御殿場市
責任者：A.アンドゥルーエ（国立科学研究センター），西川　潤（早稲田大学）

à Ito, à Shimizu et à Kyoto et c'est le plus important qui ait été tenu jusque là. En effet, plus de 100 spécialistes français sont venus au Japon, et ils ont rencontré, dans diverses disciplines, près de 1000 spécialistes japonais.

Le Colloque s'est achevé par deux conférences en assemblée plénière, et une réception de clôture à la Maison franco-japonaise.

Déroulement des travaux de chaque discipline

MATHEMATIQUES: Théorie analytiques des nombres
10-13 oct. Maison franco-japonaise
E. Fouvry (Univ. Paris-Sud), K. Nagasaka (Univ. of the air)

CHIMIE: Progrès récents en photochimie et application à l'industrie
4-7 oct. Univ. de Tsukuba, 8 oct. -visites diverses
J. Faure (Univ. Paris-Sud), K. Honda (Univ. de Kyoto)

GEOGRAPHIE: Les activités non agricoles en milieu rural
3-7 oct. Univ. de Tsukuba, 8 oct.- visites diverses
Ph. Pinchemel (Univ. Paris I), S. Yamamoto (Univ. de Tsukuba)

OCEANOGRAPHIE: 1. Faux réchauffées;
2. Aquaculture;
3. Télédétection
4-7 oct. Shimizu-shi
H. J. Caccaldi (EPHE), Y. Uno (Société franco-japonaise d'Océanographie)

MEDECINE: Imagerie en cancérologie
3-8 oct. Hôtel Edmont (Tokyo)
M. Tubiana (Institut Gustave-Roussy), T. Kato (Univ. médicale de Nihon)

DROIT: Administration de la Justice
4-6 oct. Univ. de Tokyo, 11-12 oct. Univ. de Ritsumeikan, Univ. de Kyoto, et visites diverses
X. Blanc-Jouvan (Univ. Paris I), T. Yamaguchi (Univ. de Chiba)

ECONOMIE: I'investissment extérieur direct: comparaison de la France et du Japon
8-10 oct. Univ. Waseda, 11-12 cot. Gotenba-shi
A. Androuais (CNRS), J. Nishikawa (Univ. Waseda)

[社会学] テーマ: 教育と情報社会
日 程: 10月4〜6日 於日仏会館,
7〜12日 地方講演会
責任者: P. アンサール (パリ第五大学),
福鎌忠恕 (東洋大学名誉教授)

[東洋学 I] テーマ: 日中の宗教文化の交流
日 程: 10月4〜7日 於伊東市, 8日見学
責任者: K. シッペール(社会科学高等研究院),
福井文雅 (早稲田大学)

[東洋学 II] テーマ: 中央アジア由来文書
日 程: 10月 4〜7 日 於京都国際会議場,
8日 於竜谷大学
責任者: L. バザン(社会科学高等研究院, パリ第三大学), 羽田 明(京都大学名誉教授),
大地原豊 (京都大学名誉教授)

SOCIOLOGIE: Education et Société
4-6 oct. Maison franco-japonaise, 7-12 oct. Conférences en province
P. Ansart (Univ. Paris VII), T. Fukukama Prof. émérite à l'Univ. de Toyo)

ETUDES ORIENTALES I: Les échanges culturels entre les religion chinoises et japonaises
4-7 oct. Ito-shi, 8 oct.- visites diverses
K. Schipper (EPHE), F. Fukui(Univ. Waseda)

ETUDES ORIENTALES II: Documents et archives provenant de l'Asie Centrale
4-7 oct. Kyoto International Conference Hall, 8 oct. Univ. Ryûkoku et visites diverses
L. Bazin (EPHE, Univ. Paris III), A. Haneda (Prof. émérite à l'Univ. de Kyoto), Y. Ojihara (Prof. émérite à l'Univ. de Kyoto)

評価の会

本シンポジウムについての「評価の会」が, 10月13日, 日仏会館において十部門の各々から日仏の責任者が出席して行われた。会議ではシンポジウムの意義が確認され, その継続と今後の日仏両国の協力の展望について話し合いが行われた。また, この数年来両国間で出来つつある人的関係のネットワークと多様な共同研究の重要性も確認された。今回のシンポジウム終了後, その学術的成果もまた公刊される予定である。これらの会議は日仏両国間の今後の研究協力活動にとってメルティング・ポットの役割を果たすものである。従って, 評価の会では, 1991年にフランスで次回シンポジウムを開催する計画について, 全員一致しての積極的な賛成の意が示された。

フランスに於いて, 近く日本文化会館の建設が実現すれば両国間の交流を一層容易なものとするであろう。

この評価の会においても, 以下の二つの意見が確認された:

—将来にわたっても, このシンポジウムの伝統とそこで培われた活発な交流関係を継続させるために, また学術文化交流と両国間の友情を促進するためにも, フランスにおいて, あらたに仏日専門学会が設立されることが望ましい。現在, 五つの学会 (海洋学, 医学, 地理学, 生物学, 工業技術) が存在するが, その数が日本の23に

Réunion d'évaluation

Une réunion d'évaluation s'est tenue le 13 octobre à la Maison franco-japonaise, avec tous les responsables scientifiques français et japonais de chacun des dix thèmes. Elle a montré l'importance du colloque et ses prolongements, ainsi que les perspectives de coopération entre les deux pays. Elle a montré aussi l'importance des réseaux de relations personnelles et des multiples travaux scientifiques en commun qui s'étaient tissés au cours de ces dernières années entre la France et le Japon. De nombreux travaux scientifiques seront également publiés à l'issue de ces rencontres.

Ces réunions constituent le creuset des travaux ultérieurs entre les deux pays. Le projet de tenir le prochain colloque en 1991 en Frace suscite un accord unanime et très motivant.

Il est certain que la création prochaine, en France, d'une Maison du Japon, permettra de rendre encore plus facile les échanges entre les deux pays.

Deux motions ont été adoptées au cours de cette réunion d'évaluation:

—Pour assurer la continuité de la tradition de ces colloques dans l'avenir, de la vitalité des relations établies au cours de ces réunions et pour promouvoir à la fois les échanges culturels et scientifiques ainsi que l'amité entre les deux pays, il est souhaitable de créer de nouvelles sociétés franco-japonaises spécialisées, en France. Il en existe cinq actuellement (océanographie, méde-

匹敵するようなものとなることが好ましい。

—それら仏日専門学会が全体として一つの本処をパリに置き，それら学会の活動を助け，フランスでのこのシンポジウムの組織・開催を容易にすることが不可欠である。

評価の会は参加者全員の意見として，今後，日仏両国におけるパリ日本文化会館設立準備委員会に対し，この新たな施設の中に仏日専門学会の活動のために教室を供与されるよう要求して行くこととした。この部屋には各学会の事務局が置かれ，これによって会館を中心とした学会の活発な活動が期待できるであろう。

1988年のシンポジウムは，以上の点を鑑み，日仏学術協力の目覚ましい成功の証左であると言えよう。

cine, géographie, biologie, et techniques industrielles), et il serait opportun que leur nombre devienne comparable à celui des sociétés correspondantes existant au Japon, qui est de 23.

—Il est indispensable que l'association des sociétés savantes franco-japonaises ait un siège à Paris pour soutenir ses activités et faciliter l'organisation des colloques en France.

L'assemblée exprime dès maintenant une demande aux Comités japonais et français chargés de la préparation de la Maison de la Culture du Japon à Paris afin d'obtenir l'attribution de pièces qui seront réservées à l'activité des sociétés franco-japonaises dans cet établissement nouveau; elles pourront ainsi y établir matériellement et concrètement leurs sièges respectifs.

Ce Colloque de 1988 contitue à tous égards un éclatant témoignage du grand succès de la coopération scientifique entre la France et le Japon.

あ　と　が　き

第5回日仏学術シンポジウムに，日仏海洋学会が主体となって海洋学部門が参加するよう，検討と準備がはじめられたのは1987年にはいってからであった。総会にはかり，具体的なテーマ等についても，アンケートにより会員の意向をうかがった。9月に，セカルディ仏日海洋学会会長を迎えて，前回（マルセイユ）のシンポジウム参加者有志を交えての関係者による打ち合わせを行い，「温排水」「増養殖におけるバイオテクノロジー」「リモートセンシング」の3つのテーマをとりあげることが決まった。これを受けて，日仏会館にシンポジウム参加をお願いしたところ，1987年10月15日の日仏会館学術委員会において，「第5回日仏学術シンポジウム」の海洋学部門として正式に参加を認めていただくことができた。会期まで1年足らずという，国際会議の準備としてはすでに遅すぎたこの時期に，このような特段のはからいをされた学術委員会の諸先生方に厚くお礼申し上げるしだいである。

直ちに，学会内外の関係者による実行委員会が組織され，以後，会期直前の1988年9月までに9回，さらに12月と，計10回の実行委員会を開いて準備等を進めてきた。期間がせまっていたにもかかわらず，各テーマの責任者の方は，プログラムの作成のため，交渉や連絡等多大な労をとられた。話題提供者のほとんどの方から，アブストラクトあるいはさらに詳しい資料を事前にいただき，会場で配布することができた。

最も心配していたことの一つは経費の調達であったが，幸い下記の機関，団体及び各位から多大な援助を賜った。ここに厚くお礼申し上げる。

㈶日仏会館
清水市
IFREMER（フランス海洋開発研究所）
ORSTOM（フランス海外開発協力科学研究所）
㈱旭潜研
㈱アーンデラ・ジャパン・リミテッド
いすず自動車㈱機能開発センター
エヌティエス
㈶温水養魚開発協会
㈶海洋生物環境研究所
海洋バイオ研究会
鹿島建設㈱
㈱片山化学工業研究所
関西総合環境センター
関西電力㈱
九州真珠㈲
九州電力㈱
旭光産業㈱

ゴードンアンドブリーチ科学出版社
五洋建設㈱技術研究所
四国電力㈱
システム科学コンサルタンツ㈱
㈶清水漁港振興会
清水港振興会
清水市日仏海洋シンポジウム促進委員会
新日本気象海洋㈱
㈱すかいらーく
鈴与㈱
西洋環境開発㈱
㈶全国沿岸漁業振興開発協会
全国漁場環境保全対策協議会
田崎真珠㈱
中国電力㈱
中部電力㈱
㈱鶴見精機
電源開発㈱
㈱東京久栄
東京電力㈱
東北電力㈱
東洋冷蔵㈱
㈱西日本流体技研
日商岩井㈱
日本アクアラング㈱関東支社
㈶日本水路協会
羽衣フーズ㈱
㈱間組　海洋土木部
日立造船㈱桜島工場
平山和次
蓉芙海洋開発㈱
北陸電力㈱
北海道電力㈱
㈱本地郷
三井造船㈱
㈱三菱総合研究所
㈱ユニオン・エンジニアリング
吉村廣三
渡辺機開工業㈱

このシンポジウムを清水市で開催するにあたり，地元市当局では，下記委員会を設置して，受け入れをすすめられた。会場の設営，公開講演の共催，レセプションその他の歓迎行事開催等のほか，フランス側参加者の東京からの往復旅費，市内見学費用の負担等，絶大なご協力をいただいた。シンポジウムを成功裡に終了できたのは，ひとえに宮城島弘正清水市長以下の市当局をはじめとする地元関係各位のご尽力とご厚情によるものである。参加者一同深甚なる謝意を表するものである。

この煩雑な事務を引き受けられたのは，市経済部（部長　今本一明氏）で，特に海洋開発担当参事の勝山恵逸氏には，このプロシーディングズ編集に至るまで一方ならぬお世話になったことを付記し，お礼申し上げたい。

清水市日仏海洋シンポジウム地元開催実行委員会
委員長　黒田　信五　（鈴与株式会社副社長）
委　員　石原　一郎　（静岡県農業水産部水産課長）
委　員　鈴木　金苗　（静岡県商工企画室技監）
委　員　小菅　　晋　（東海大学海洋学部助教授）
委　員　兼子　善信　（清水市商工会議所専務）
副委員長　清水四麻夫　（清水漁港対策協議会会長）
委　員　酒井　貞夫　（日本交通公社清水支店長）
委　員　花井　　孝（イベント清水実行委員会委員長）
委　員　堤　　利博　（清水市観光協会事務局長）

また，「清水市日仏海洋シンポジウム促進委員会」（委員長　酒井高夫，委員　奥田好則，佐々清辰の各氏）からも終始ご援助，ご激励をいただいた。

静岡県当局には農業水産部，商工部等を通しての後援のほか，特にツアーの県関連施設等の見学に便宜をはかっていただいた。現地においては，早朝あるいは夕方等多用中にもかかわらず，長時間にわたりご案内，ご説明をいただいた。松浦勝己静岡県温水利用研究センター所長，阿井敏夫静岡県栽培漁業センター所長，浅原寛司焼津漁業共同組合長理事，高橋平吉同部長ほか，現地の関係各位にお礼申し上げる。

東海大学においては，海洋博物館の見学，歓迎レセプションの開催による日仏文化交流や親善に寄与された。松前仰東海大学社会教育センター所長以下各位にお礼申し上げる。

このシンポジウムは第５回日仏学術シンポジウムの一環として開催されたものであり，日仏学術交流に大きく貢献するものである。このような意義深い行事に参加でき，さらに，多額の運営費の補助をいただくことができたのは，日仏会館学術委員会のご尽力によるものである。また，種々の案内や連絡，報告書のとりまとめ等では，特に日仏会館フランス事務所にお世話になった。オギュスタン・ベルク前日仏会館フランス学長，ユベール・J・セカルディ現学長，同学術委員会の秋山光和委員長，坂井光夫委員，同フランス事務所の林春郎氏，川上恭子氏ほか関係各位にあらためて謝意を表するものである。な

お，日仏会館フランス学長セカルディ教授の総括報告を本誌にも掲載させていただき，第5回日仏学術シンポジウムの概要を紹介することとした。

このシンポジウムでは英語を使用することとしたが，関連行事における挨拶，見学の際の案内，その他フランス側参加者との打ち合わせや公私にわたる世話等，テーマ別セッション外では，日仏両国語間の通訳なしには考えられなかった。この気の疲れる仕事を自発的に引き受けられた小池康之，佐伯，嶋野，シマール，八木各実行委員には心から謝意を表したい。特に八木氏にはセカルディ教授の公開講演の通訳をもお願いした。

このシンポジウムのプロシーディングズは有賀祐勝編集委員長の取り計らいにより，La mer の特集号として刊行することができた。また，ケレルー博士は，シンポジウムには代理として急に参加することになったため，プロシーディングズへ研究報告を掲載するかわりに，フランスにおける水産養殖研究の近況，成果，計画等についての総合報告を La mer に寄稿されることになった。

シンポジウムの企画からプロシーディングズの刊行に至るまで，上記以外にも多くの方々のお世話になったことを付記して，お礼申し上げる。関文威幹事，高野健三前副会長には企画や準備の段階でお骨折りいただいた。文書の作成，連絡等，事務局の仕事は吉田洋子さんをわずらわせた。

最後に前回のシンポジウムに参加され，今回も組織委員あるいは実行委員として企画段階からご尽力いただいた大草重康，吉村廣三両氏が，この夏，不帰の客となられたことに深く哀悼の意を表するものである。

（1989年9月　宇野　寛，高木和徳，須藤英雄）

La mer 27: 166-167, 1989
Société franco-japonaise d'océanographie, Tokyo

日仏海洋学会賞受賞記念講演

植物プランクトンの基礎生産，特に低温水域の基礎生産に関する研究*

山　口　征　矢**

Studies on phytoplankton primary productivity with special referencc to low temperature waters*

Yukuya YAMAGUCHI**

このたびは思いがけなく，栄誉ある日仏海洋学会賞を賜ることとなり，身にあまる光栄と感謝するとともに，今後の責任の重さを痛感いたしております。

私は，東京教育大学の市村俊英先生のもとで「奥日光湯の湖」を中心に，陸水域の基礎生産の研究を始めましたが，1970年代になって，数回の研究航海に参加する機会を与えられ，海洋の基礎生産の研究の経験を積むことが出来ました。BIOMASS計画の一環として，海鷹丸の南極への航海に2度にわたって乗船させていただいたことが，低温水域における基礎生産の研究を始めるきっかけとなりました。

最初の航海では，光合成速度を直接測定する手段を持たなかったことと，調査海域が比較的過去のデータが希薄なオーストラリア南方海域であったことから，植物プランクトンの現存量の変動に集中してデータをとることにしました。全航程にわたる連続観測と各層観測から，クロロフィル*a*を指標とした植物プランクトンの現存量は，海域・測定時期によって変化するものの，表層水中の平均値としては 0.118-0.385 mg m^{-3}，水柱内の積算値として 12.48-50.96 mg m^{-2} の範囲にあり，低緯度海域と著しい差が認められない事を示しました。またサイズ別に植物プランクトンの現存量を表しますと，南極海域では他の海域に較べ，いわゆるナンノプランクトンの寄与率が低く，海域によるその現存量の差も少ないことが明らかになりました。このことは，南極海域では現存量の地理的変動が，主としてより大型の植物プランクトンの多寡によって生じていることを示しています。より大型の生産者によって基礎生産が維持されているということは，生産者から高次の消費者への栄養段階を短縮することを可能にし，エネルギー転送の効率をより効果的に高めていると考えてよいのではないでしょうか。

あわせて測定されたクロロフィル蛍光の連続記録には，夜半に極大となり，昼間に極小となる明瞭な昼夜変動が認められ，この変動は南極海域でのみ認められました。この現象は後に谷口博士らによる「しらせ」号の航海でも再確認され，蛍光だけでなくクロロフィルの絶対値にも昼夜変動が認められること，変動の周期は24時間が最も卓越していること等が明らかにされましたが，なぜこのような変動が起こるのか現在のところ不明です。ぜひとも機会を見つけてこの現象の解明をしたいと考えております。

現存量の測定だけではやはり極海の植物プランクトンの動態を知るためには限度がありますので，最初の航海からもどってからは，^{14}C 法に代わって，手軽に光合成活性を測定する手段の開発に取り掛かりました。船上で自由に利用するために安定同位元素 ^{13}C を採用することとし，得られる大量の試料を簡便にまた短時間に処理するため，日本分光社の協力を得て，赤外分光法により定量することで植物プランクトンの試料の測定が可能であることを示しました。この方法の利点は，試料中の ^{12}C, ^{13}C の存在比が，それぞれの絶対量とともに数分で測定出来ることです。

2度目の航海では，この方法を用いて温度と植物プラ

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* 1989年5月31日　日仏会館（東京）で講演
Conférence à la remise du Prix de la Société franco-japonaise d'océanographie

** 埼玉大学教養部
College of Liberal Arts, Saitama University

ンクトンの光合成の関係を中心に極海の植物プランクトンの光合成特性を明らかにすることに努めました。植物プランクトンの光合成の最適温度域は，北太平洋では水温が −0.9〜18°C の範囲にあるにも拘わらず，一般に20°C 前後であるとされていますが，南極海では極前線を境にその北と南の海域では明らかに温度特性が異なっており，前線より北のより暖かい水域では最適温度域は 15°C に，また南の南極海では 7.5〜10°C の範囲にあり，これより高温でも低温でも低下することが明らかになりました。また彼らは0°Cのもとでも，相当の活性を保っていることも明かとなりました。同じころ，アイス・アルジーについては，光合成の温度最適域が 5〜10°C であることを Neori and Holm-Hansen (1983) や Satoh and Watanabe (1986) らが報告しています。これらの結果はいずれも，南極海域の微細藻類の光合成が，低緯度海域のものに較べ，著しく低温に適応していることを示していますが，同時に南極海では，夏季でも水温が植物プランクトンの光合成を制限する主要な要因のひとつであることも明かです。つまり，南極海域の現場水温近くで得られる光合成活性は，他の海域で得られる値と比較したとき，決して高いものではありません。実際に現場法で測定された基礎生産力もまた同様です。以上から南極海域外洋域の生産力は，少なくともオーストラリア南方の海域に関する限り，これまで考えられてきたよりはるかに低いと結論出来るでしょう。

一方，このような極低温域で生活する植物プランクトンが，どのような機構で低温に適応しているのかを探ることは興味あるテーマですが，極域へたびたび出かけることは出来ませんので，これらの航海の後はサロマ湖をフィールドとして研究を進めています。サロマ湖は北半球域で海水が結氷する最も南の水域に当たりますが，結氷期の海況は昭和基地周辺の春の海況によく似ており，おなじようにアイス・アルジーの生長が見られます。それらの光合成特性は，南極海域のアイス・アルジーとよく似ており，低照度や低温に適応したものであることがわかりました。当面はこれらを材料として，低温域の植物プランクトンの動態の研究を進めていきたいと考えております。

このように，私の研究はまだまとまったものとは言えず，ようやく研究の糸口を見つけたという段階にすぎません。このたび栄誉ある賞をいただいたことを励みに，少しずつ低温域の植物プランクトンの生理・生態的特性の研究を進め，基礎生産の研究の発展にいささかでも寄与出来ればと願っております。

最後になりましたが，恩師市村先生にはこの道へ導いていただいたことを感謝致します。多くの研究航海で，実質的に私に海洋学の手ほどきをしていただいた多くの方々に深く感謝いたします。特に，いつも多くのはげましとご指導をいただいた東京水産大学の有賀祐勝，村野正昭，松生洽先生には心から感謝いたします。よき先輩であり，また友人でもある東北大学の谷口旭博士には，公私にわたり多くの助言とはげましをいただきました。これらの方々に，この場をお借りして心から御礼を申しあげさせていただきます。

La mer 27: 168-172, 1989
Société franco-japonaise d'océanographie, Tokyo

学　会　記　事

1. 1989年5月25日　平成元年度第1回幹事会が東京水産大学において開かれた。
主要な議事は下記のとおり。

1) 日仏会館から依頼のあった日仏学者交換に関しては隆島史夫氏を推薦した。
2) La mer の編集状況ならびに刊行の遅れの回復をはかるようにする旨の報告があった。
3) 第4回「海洋科学技術に関する太平洋会議」の協賛を承認した。
4) 平成元年度定例評議員会ならびに総会に提出する議案について説明があり，一部修正が行われ，承認された。
5) 第3回日仏海洋シンポジウムへの対応及び関連の日仏共同研究計画について，準備委員会を発足させることとし，とりあえず隆島，杉原両氏を世話役にすることとした。
6) 第2回日仏海洋シンポジウムプロシーディングズは，La mer 第27巻第3号を特集号としてこれにあてることとした。
7) La mer の著者負担印刷費を1ページあたり10,000円とすることとした。

2. 1989年5月25日　平成元年度評議員会が東京水産大学において開かれた。主要な議事は下記のとおり。

1) 昭和63年度事業報告（庶務，編集，その他）
2) 平成元年度学会賞受賞候補者選考経過報告
3) 昭和63年度収支決算案審議
4) 平成元年度事業計画案審議
5) 平成元年度収支予算案審議
6) 平成2年度学会賞受賞候補者推薦委員会委員選出
7) 日仏海洋シンポジウム
8) 名誉会員推薦

3. 1989年5月31日　平成元年度学術研究発表会が日仏会館会議室において開催された。発表題目と発表者は次のとおり。

1. 日本海沿岸各地の波の異名について……
…… 矢内秋生（目白短大）
2. 三陸沿岸における内部長周期波について……
…… 岡崇守良・長島秀樹（理化学研）
3. 沖合の擾乱にもとづく田辺湾内流動パターンの数値実験…… 中村重久（京大防災研）
4. 1988年ラ・ニーニャにおける中部赤道太平洋の水温鉛直構造について……
…… 行縄茂理・水野恵介（遠洋水研）
5. 表面ブイ方式の係留系による海洋混合層の観測システム……稲葉栄生・平野敏行・安田訓啓・
…… 川畑広紀・守屋　洋（東海大海洋）
6. 北フィジー海盆リフト系の化学合成細菌……
…… 長沼　毅・関　文威（筑波大生物）
7. 海水懸濁物中の微細鉱物……青木三郎（東洋大）・
…… 神山宣彦（労働省産医総研）
8. 結氷期サロマ湖の基礎生産力……
……佐藤博雄（東水大）・山口征矢（埼玉大）・
渡辺研太郎（極地研）・有賀祐勝（東水大）
9. 栽培ノリの交雑育種について……
…… 申　宗　岩・三浦昭雄（東水大）
10. 日本における廃棄物の海洋投入処分……
…… 吉村廣三（学習舎）

4. 1989年5月31日　第30回総会が日仏会館会議室において開催された。議事の概要は次のとおり。

1) 昭和63年度事業報告
a) 庶　務
会員移動状況

	1988年4月	入会	退会	1989年4月
名誉会員	2	—	—	2
正会員	326	7	14	319
賛助会員	27	0	3	24

活動状況
評議員会1回，総会1回，学術研究発表会1回，学会賞授与　青木三郎(東洋大学)，幹事会4回，第2回日仏海洋シンポジウム（公開講演会2回，シンポジウム，テクニカル・ツアー），同実行委員会5回
b) 編　集
La mer 4号刊行
2) 平成元年度学会賞受賞候補者選考経過報告（詳細は **5.** 参照）
3) 昭和63年度収支決算及び監査報告

昭和63年度収支決算

収　入	(円)
前年度繰越金	412,696
正会員会費	1,800,116
賛助会員会費	290,000
学会誌売上金	229,120
広　告　料	280,000
著者負担印刷費	312,400
雑　収　入	7,320
計	3,331,652

支　出	(円)
学会誌印刷費	1,861,500
送料・通信費	264,375
事　務　費	728,181
交　通　費	27,920
会　議　費	15,996
学会賞経費	71,040
雑　費	151,610
次年度繰越金	211,030
計	3,331,652

4)　平成元年度事業計画案審議

下記のとおり承諾された。

評議員会1回，総会1回，学術研究発表会1回，幹事会4回，シンポジウム及び講演会の開催，La merの発行(4号)，学会賞受賞候補者推薦，第3回日仏海洋シンポジウム参加準備，その他

5)　平成元年度収支予算案審議

原案どおり承認された。

平成元年度収支予算

収　入	(円)
前年度繰越金	211,030
正会員会費	1,800,000
賛助会員会費	350,000
学会誌売上金	250,000
広　告　料	320,000
著者負担印刷費	350,000
雑　収　入	360,000
計	3,641,030

支　出	(円)
学会誌印刷費	2,500,000
送料・通信費	300,000
事　務　費	650,000
交　通　費	50,000
会　議　費	30,000
学会賞経費	75,000
予　備　費	36,030
計	3,641,030

6)　平成2年度学会賞受賞候補者推薦委員会委員選出結果報告

青木三郎，阿部友三郎，有賀祐勝，石野　誠，井上　実，鎌谷明善，高野健三，竹松伸，谷口　旭，中村重久，根本敬久，松生　洽，村野正昭，柳　哲雄，山口征矢

7)　前会長等を名誉会員に推薦することが会長から提案され，了承された。

総会に引続いて，山口征矢会員への学会賞授与と受賞記念講演が行われた。また，懇親会が別席で開かれ，盛会裡に終了した。

5.　平成元年度日仏海洋学会賞

受賞者：山口征矢（埼玉大学）

受賞課題：植物プランクトンの基礎生産，特に低水温域の基礎生産に関する研究

推薦理由：山口征矢博士の植物プランクトンの基礎生産に関する研究は，1960年代末の湖沼における研究に始まり，1970年代中頃からは海洋においても行われている。それらの成果は数多くの論文として国内・国外の研究誌に公表され，近年では特に低水温域の基礎生産に関する研究にその中心がおかれている。

南極海は長い間生産性の高い海域であると信じられてきたが，近年における研究の進展に伴って，一部の海域を除き必ずしも生産性が高くないことが明らかにされつつある。山口征矢博士は，国際共同研究であるBIOMASS計画の一環として南極海への2度の研究航海に参加し，特に基礎生産に関するデータが稀薄であったオーストラリア南方海域を中心に基礎生産の動態を解析し，同海域が極めて生産性の低い海域であることを明らかにした。山口博士は，まずクロロフィル量を指標として南極海の植物プランクトン現存量を解析するとともに，同海域ではクロロフィル蛍光に明瞭な昼夜変動が認められ，その値は常に夜中に高く日中に低いことを指摘した。また，オーストラリア南

方海域では，表層のクロロフィル濃度および生産層中のクロロフィル積算量は，ともに海域により変動するが，その値は低緯度海域で得られる値と大差がないことを指摘した。さらに，サイズ別の現存量について解析を進め，南極海では他の海域に比べて全現存量に対するいわゆるナノプランクトンの寄与率が低く，かつその量は測点によらずほぼ一様であること，すなわち南極海における現存量の地理的変動は主としてより大型の植物プランクトンの多寡によってひきおこされていることを明らかにした。これらの知見は，今後同海域の基礎生産に関する研究を進める上で大きな指針を与えるものである。

また，山口博士は，海洋における基礎生産測定の手法として ^{14}C 法に代る安定同位元素 ^{13}C の利用について検討し，特に赤外分光法を導入して，より簡便で迅速な同位体比の測定法を確立するとともに，この方法を用いて南極海の基礎生産力の測定を行なった。その結果，まず，南極海外洋の植物プランクトンの光合成は，海表面受光量の 50～64% で光飽和に達するが，夏季には必ずしも光が制限要因になっていないことを指摘した。一方，光合成の最適温度域は7.5～10°C であり，これより高温でも低温でも低下するが，0°C 付近でも相当の活性を保っていることを指摘し，夏季の南極海においては少なくとも温度が植物プランクトンの光合成を制限する主要な要因であることを指摘するとともに，現場法によって同海域の基礎生産量を測定し，熱帯・亜熱帯海域に比べ必ずしも高くないことを明らかにした。さらに，近年は，結氷期のサロマ湖をモデルとして，低温水域の植物プランクトンの生理・生態的研究を進めつつある。現在までに，サロマ湖においても海氷下には珪藻類を中心とするいわゆるアイスアルジーおよびコロニー状の底生藻類が観察され，その光合成は南極海のものと同様に低照度低温適応型であることなどを明らかにしている。

以上のように山口征矢博士は極めて活発に研究活動を進めており，植物プランクトンの基礎生産に関する研究，特に低温水域の基礎生産に関する顕著な業績は，国内のみならず国際的にも極めて高く評価されている。本委員会は同博士の研究が生物海洋学の進展に寄与するところ顕著であり，本学会賞の授与に相応しいものとしてここに推薦する。

学会賞受賞候補者推薦委員会

委員長 有 賀 祐 勝

主 要 論 文

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6. 新入会員

（正会員）

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8. 逝　去

吉村広三，大草重康

9. 退　会

江口一平

10. 受贈図書

日本学術会議月報 30(5～8)
なつしま（100, 101)
航海（100)
海洋産業研究資料 20(2～4)
広島日仏協会報（105)
東海大学海洋学部紀要（28)
東海大学海洋学部業績集（18)
養殖研ニュース（17)
養殖研究所研究報告（15)
横須賀市博物館資料集（13)
横須賀市博物館研究報告（36)
神戸海洋気象台彙報（208)
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Bull. Nat. Sci. Museum 15(1, 2)
NTT R & D 38(4～7)
海洋与湖沼 19(5, 6), 20(1, 2)
青島海洋大学学報 19(1, 2)
Aquatic Living Resources 1(4)
Occ. Pap. Allan Hancock Found. (7)
Beitr. Meereskunde 59.

お知らせ

第１回　世界水産学会議（World Fisheries Congress）について

米国水産学会の呼びかけにより，各国の水産学会ないし関連学会の共催による表記の会議が計画されております。日本に対しても参加が要請されており，日本学術会議水産学研究連絡委員会が，登録各学会のご協力のもとに，その窓口を務めております。

開催期日　1991年４月14～19日

開催場所　ギリシャ国アテネ市

内　容　Main Themes

1. Condition of Major Aquatic Habitats
2. Fisheries Resource Utilization and Policy
3. Protection of Biotic Diversity
4. International Development Projects
5. Assessment Methodologies and Fisheries Management
6. Role of Aquaculture in World Fisheries

参加申込締切　1990年4月1日
講演要旨締切　1990年4月1日
事務局　World Fisheries Congress
American Fisheries Society
5410 Grosvenor Lane, Suite 110
Bethesda, MD 20814, USA

参加希望の方あるいは詳細をお知りになりたい方は下記までお問い合せください。

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Tel: 03-812-2111
(なるべく郵便または Fax をご利用ください)

日仏海洋学会役員・評議員

(1988～1989年度)

顧　問　ユベール・ブロシェ　ジャン・デルサルト　ジャック・ロベール　アレクシス・ドランデール　ベルナール・フランク　ミシェル・ルサージュ　ロベール・ゲルムール　ジャック・マゴー　レオン・ヴァンデルメルシュ　オーギュスタン・ベルク

名誉会長　ユベール・セカルディ

会　長　宇野　寛

副会長　高木和徳

幹　事　(庶務)　須藤英雄，有元貴文；(会計)　松生　洽，高橋　正；(渉外)有賀祐勝，佐伯和昭；(研究)関　文威，小池勲夫；　(編集)山口征矢，渡辺精一

監　事　久保田　穣，辻田時美

評議員　青山恒雄，阿部友三郎，有賀祐勝，石井丈夫　石野　誠，磯　舜也，井上　実，岩井　保，岩宮　浩，宇野　寛，大塚一志，岡市友利，岡部史郎，小倉通男，梶浦欣二郎，鎌谷明善　川合英夫，国司秀明，黒木敏郎，西条八束，佐伯和昭，坂本市太郎，坂本　亘，佐藤孫七　杉森康宏，須藤英雄，関　文威，平　啓介，高木和徳，隆島史夫，高橋　正，高橋正征，多紀保彦，谷口　旭，辻田時美，寺本俊彦，鳥羽良明，冨永政英，中村重久，永田　豊，奈須敬二，奈須紀幸，根本敬久，野村　正，畑　幸彦，平野敏行，松生　洽，松山優治，丸茂隆三，三浦昭雄，宮本　悟，村野正昭，森田良美，柳　哲雄
(54名，会長推薦評議員を含む)

編集委員長　有賀祐勝

日本学術会議だより　No.14

人間の科学特別委員会設置される

平成元年８月　日本学術会議広報委員会

日本学術会議は，去る4月に開催した第107回総会において，人間の科学特別委員会を追加設置しましたが，今回の日本学術会議だよりでは，この特別委員会に加えて，最近発表された「委員会報告」等について，お知らせいたします。

人間の科学特別委員会の設置

本会議は，本年4月に開催した第107回総会において，それまでにすでに設置していた７特別委員会のほかに，「人間の科学特別委員会」の追加設置を決定した。

この人間の科学特別委員会は，同総会中に，委員会の構成（各部２人ずつ計14人）を済ませるとともに，第１回目の委員会を開催する等，直ちに，その活動を開始した。委員長には，中山和久第２部会員が就任した。

今回，本会議が，この特別委員会を設置した理由は次のとおりである。

〈人間の科学特別委員会の設置理由〉

ヨーロッパの産業革命に端を発した科学技術の進歩は急速にその度を加え，かつて人類が予想もしなかった程度に物質文明を開花させたが，一方，それによって人類は，過去に見られなかった重大な危機に立たされている。科学技術の進歩は一面において物質偏重の価値観を強め，生命に対する技術介入に係る不安や，地球生態系の激しい変化を招き，社会経済環境にも様々な問題を醸し出している。

人間が創り，人間が発展させてきた科学は，本来，真理を追求し，人間の幸福に貢献すべきものであるにもかかわらず，人類の生活や自然・社会環境に混乱を招いている側面もあるのではないかとの矛盾も感ぜられ，ここに科学者の苦悩がある。我々は今や，科学の在り方を再考し，早急に人間と科学技術との不調和を克服する視点を明らかにしなければならない。

このためには，「人間とは何か」を問い直し，「人間存在の理法」ともいうべき概念を改めて考え，そこに立脚して，科学技術と自然との調和を求め，人類進歩への展望を模索するところから始めなければならない。

人間の人間たる特質はその精神であることを思えば，人間を知性，感性の面から広く把え，人間そのものについてのもっと深い知識と理解が強く望まれる。この立場から，人間を個体としてばかりでなく，生物学的並びに社会的集団として把握し，人間の総合理解に努める必要がある。

この特別委員会は，このように人間を学際的，総合的に把握し，人類の危機に対処することを目指すものである。

「委員会報告」２件を発表

このたび，本会議の「生命科学と生命工学特別委員会」と「化学研究連絡委員会」は，それぞれ，当面の重要問題に関する審議結果を取りまとめ，本会議運営審議会の承認を得て，「委員会報告」として発表した。各「報告」の要旨は次のとおりである。

ヒト・ゲノム・プロジェクトの推進について－生命科学と生命工学特別委員会報告－［要旨］

ヒト・ゲノムの全DNA配列決定を主たる目標とするヒト・ゲノム・プロジェクトは，極めて大きなインパクトを学術研究に与えると期待され，我が国として早急かつ重点的に推進すべきである。そのためには推進組織を設け，基本計画の立案，実施計画の策定，省庁間などの協議，国際協力，データ・ベースとレポジトリー整備などを総合的に行うべきである。一方この推進組織と並んでこれと密接に連携し，研究計画の実施に伴う社会的・法律的・倫理的諸問題を客観的・公正に判断することを目的とするチェック機構を設立し，調和のとれた施策を進める必要がある。

大学等における化学の研究環境の整備について－化学研究連絡委員会報告－［要旨］

化学研究連絡委員会は，昭和63年に発表された日本化学会報告書を参考資料として，大学等における化学分野の研究環境の現状について検討を行った。その結果，「全国的視野に立つ化学の新しい研究体制」の実現に向けての努力を傾注するとともに，現行の研究環境を抜本的に改善するために，関係方面に強く訴えるべきであるとの結論に達した。日本化学会報告書に盛られている数項目の重点施策のうちでも，特に，①先端研究設備の購入・維持予算の大幅増額，②研究基盤整備のための大学院関連予算の充実，③化学の特殊性を配慮した研究室面積の拡充，は緊急に実施すべきものと考えられる。

平成２年度共同主催国際会議

本会議は，昭和28年以降おおむね４件の学術関係国際会議を関係学術研究団体と共同主催してきたが，平成２年度には，２件増えて，次の６国際会議を開催することが，６月20日の閣議で了解された。（カッコ内は，各国際会議の開催期間と開催地）。

◆第14回国際土壌科学会議
（平成２年８月12日～18日，京都市）
共催団体：(社)日本土壌肥料学会

◆第22回国際応用心理学会議
（平成２年７月22日～27，京都市）
共催団体：日本心理学会

◆第15回国際微生物学会議
（平成２年９月13日～22日，大阪市）
共催団体：日本微生物学協会

◆第11回国際数学連合総会及び第21回国際数学者会議
（平成２年８月18日～29日，神戸市他）
共催団体：(社)日本数学会他６学会

◆第11回国際神経病理学会議
（平成２年９月２日～８日，京都市）
共催団体：日本神経病理学会

◆第５回国際生態学会議
（平成２年８月23日～30日，横浜市）
共催団体：日本生態学会

国際社会科学団体連盟(IFSSO)第９回大会・総会の日本開催

国際社会科学団体連盟（IFSSO）の第９回大会及び総会が，本年10月２日(月)～７日(土)，東京六本木の国際文化会館と日本学術会議で開催される。

国際社会科学団体連盟(International Federation of Social Science Organizations，略称IFSSO)は，世界の社会科学の発展に貢献することを目的とする，世界各国の学士院や学術会議で構成されている，社会科学分野を代表する国際学術団体である。現在，35か国の国家会員等で構成されており，我が国では，日本学術会議が，我が国を代表して加入している。また，現在，日本からは本会議の藤井隆第３部会員がIFSSOの事務総長を務めている。

なお，IFSSOは，社会科学分野の国際学術団体の連合体（総括機関）である国際社会科学協議会（International Social Science Council，略称ISSC）に加入しており，ISSCの中では，国及び地域を代表する機関という位置付けをもっている。

今回の会議には，IFSSOに加入している各国の学士院や学術会議の代表，並びに関係する国際機関，国際学術団体の代表など，50を超える国々から約300名（うち，外国人は約150名）の科学者等が参加する。

この会議では，メインテーマ「変容する世界の学術政策」の下に，「研究・訓練体制の改革」，「既存領域を超える新分野」，「社会と科学・技術のインターフェイス」及び「国際協力のアカデミック・インフラステラクチャー」の４つのサブテーマが設けられ，多方面から世界の学術政策の変化が論じられる。

また，この会議では，特に，３つの日本セッションが設けられ，「急激な科学技術の進歩」について，①人間に与えるインパクト，②法律や政治に与えるインパクト，③社会経済システムに与えるインパクト，という３つの視点から論じられ，日本の先端研究が広く紹介されることになっている。

■本件問い合わせ先：〒102 東京都千代田区紀尾井町7-1，上智大学心理学研究室内，国際社会科学団体連盟第９回大会日本組織委員会事務局，電話 03-238-3811

日本学術会議主催公開講演会開催のお知らせ

本会議では，毎年，学術の成果を広く国民に還元するという日本学術会議法の主旨に沿うための活動の一環として，公開講演会を開催しています。

このたび，下記の２つの公開講演会を開催することにしました。多数の方々の御来場をお願いします。

Ⅰ　公開講演会「人間は地球とともに生きられるか」

●**日　時**：平成元年10月27日(金)13時30分～17時

●**演題と講演者**（カッコ内は所属部）
①「地球の温暖化とその影響」：吉野正敏（第４部）
②「地球環境と農業のかかわり」：久馬一剛（第６部）
③「地球環境の経営と人間社会の発展」：藤井　隆（第３部）

Ⅱ　公開講演会「“人権の歩み”から何を学ぶか―フランス人権宣言100年を記念して―」

●**日　時**：平成元年11月18日(土)13時30分～17時

●**演題と講演者**（カッコ内は所属部）
①「“人権”以前の世界」：弓削　達（第１部）
②「近代日本の人権思想 ―自由民権運動の人権論を中心に―」：大石嘉一郎（第３部）
③「科学技術と人権」：杉本大一郎（第４部）
④「人権の進化と創造」：南　博方（第２部）

●**会　場**：日本学術会議講堂（両講演とも）
（東京都港区六本木７－22－34）
（地下鉄千代田線，乃木坂駅下車１分）

◈**申込方法**：往復はがき（住所，氏名，郵便番号を明記）

◈**申込締切**：各開催日の１週間前まで（先着順，無料）

◈**申 込 先**：〒106 東京都港区六本木７－22－34
日本学術会議事務局庶務課講演会係

■　なお，本会議では，本年度には，上記の他に，「日本の学術動向」に関する公開講演会の開催を計画しています。開催日，会場，講演者などの詳細については，決定次第，新聞広告等でお知らせする予定です。

日学双書の刊行案内

本会議の第102回総会と第103回総会で行われた，本会議会員による各自由討議の記録を中心に編集された次の日学双書がそれぞれ刊行されました。

・日学双書 No.4「21世紀へ向けてのエネルギー問題」
・日学双書 No.5「食糧生産と環境」
［定価］No.4 ：1,500円，No.5 ：1,000円
（両書とも，消費税込み，送料260円）

※問い合わせ先：(財)日本学術協力財団（〒106 東京都港区西麻布３－24－20，交通安全教育センター内）

御意見・お問い合わせ等がありましたら，下記までお寄せください。
〒106 東京都港区六本木７－22－34
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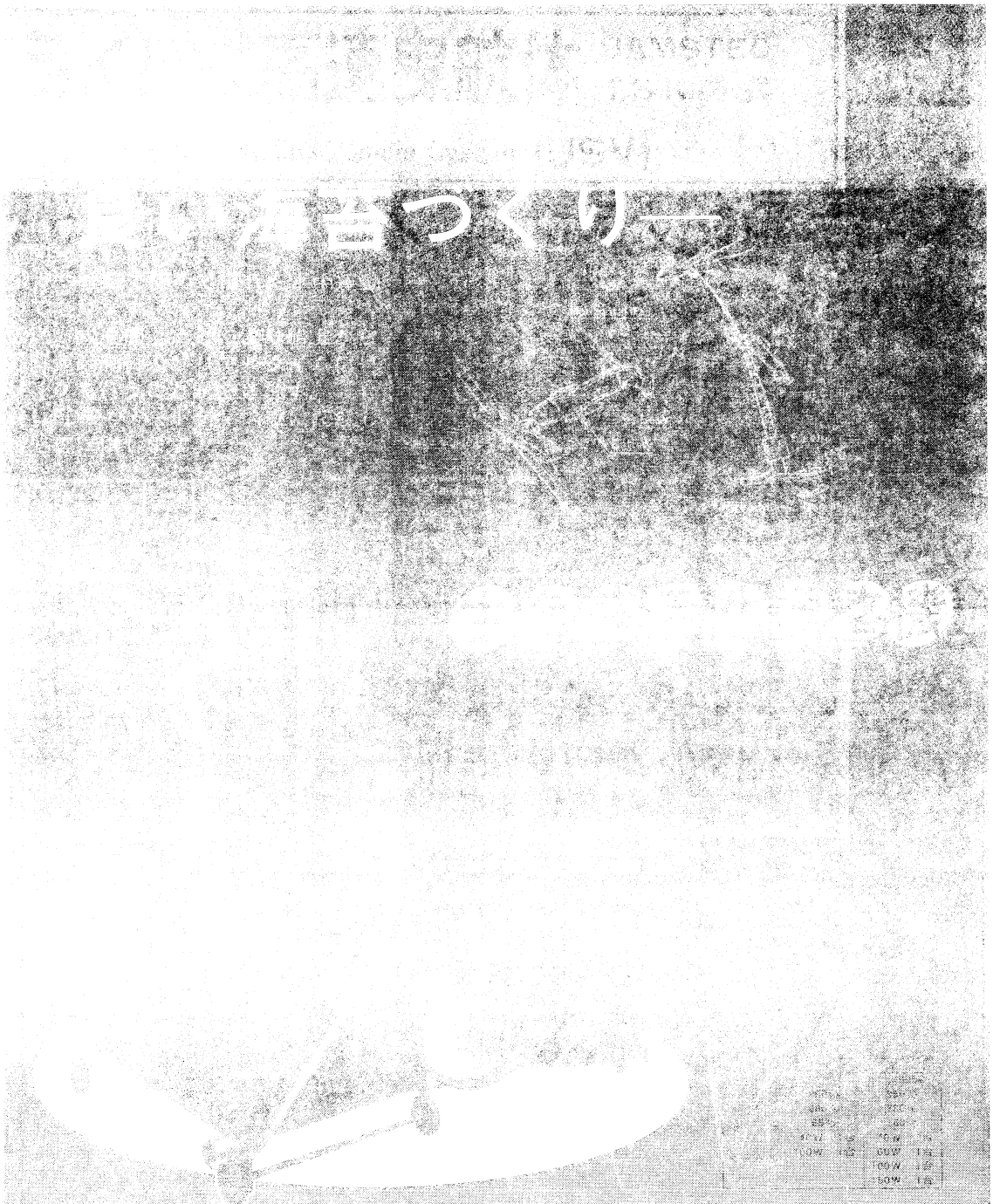

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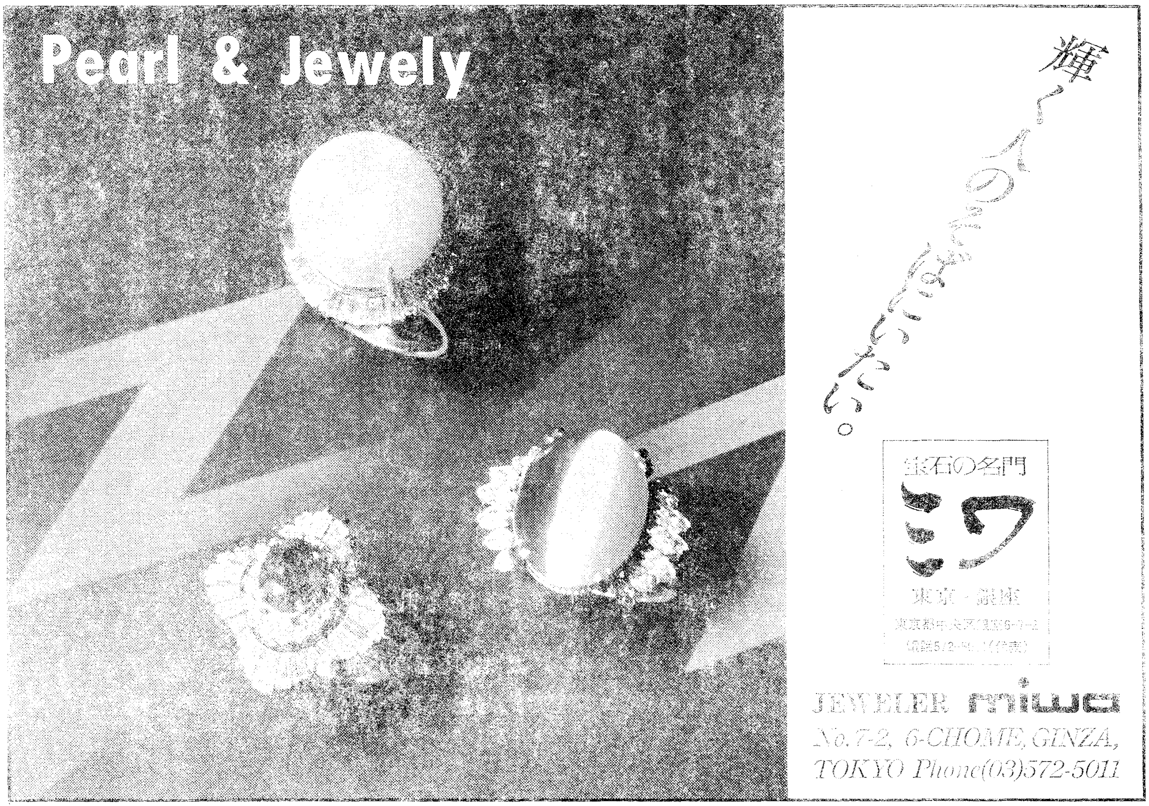

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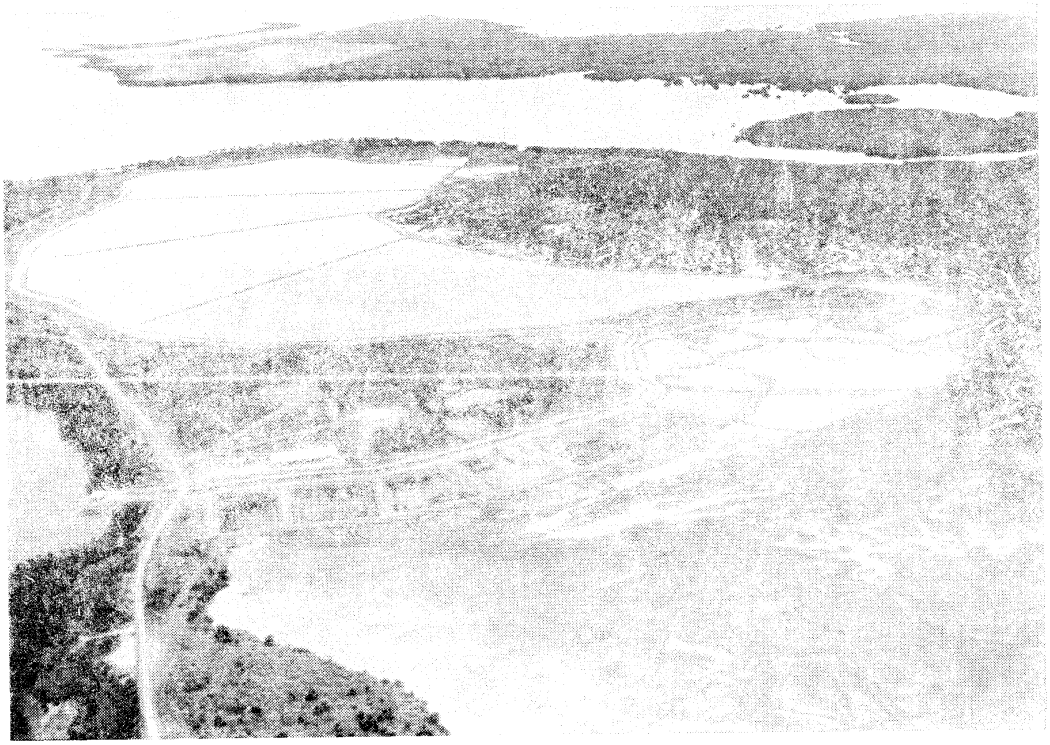

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2. 原稿は海洋学および水産学両分野の原著論文，原著短報，総説，書評，資料などとする。すべての投稿は，本文，原図とも正副2通とする。副本は複写でよい。本文原稿用紙はすべてA4判とし，400字詰原稿用紙（和文）に，または厚手白紙にダブル・スペース（和文ワープロでは相当間隔）で記入する。表原稿および図説明原稿は，それぞれ本文原稿とは別紙とする。
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