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MEDITERRANEAN ACTION PLAN

Review Meeting on the MED POL  
Jellyfish Programme

Trieste, 27-29 January 1986

REPORT OF THE REVIEW MEETING ON THE MED POL  
JELLYFISH PROGRAMME

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UNEP

Athens, 1986

## BACKGROUND

1. At the Third Meeting of the Contracting Parties held in Dubrovnik (28 February - 4 March 1983), the problem of the occurrence of Jellyfish blooms in some areas of the Mediterranean was raised, and a request was formulated to UNEP for action in the framework of MED POL - PHASE II.
2. As a result, a Workshop on Jellyfish blooms in the Mediterranean was organized by the MED UNIT in Athens from 31 October to 4 November 1983, as part of the MED POL - PHASE II activities. Biological and environmental conditions related to the occurrence of jellyfish swarms were analysed and their impact on human activities were reviewed and discussed.
3. As a result of the Workshop, and after the matter was reviewed by the Second Meeting of the Working Group on Scientific and Technical Co-operation (UNEP/WG. 91/12), National Co-ordinators for MED POL were asked to initiate immediate action in the framework of national monitoring programmes, extending the monitoring activities to cover qualitative and quantitative observations of jellyfish and, at the same time, the submission of research proposals in the framework of MED POL research activities was encouraged through the agreed channels.
4. Finally, an operational document for the implementation of a project on jellyfish at Mediterranean scale was prepared by a small expert Group convened in Athens from 6 to 7 February 1984 and the proposed programme was subsequently adopted by the Extraordinary Meeting of the Contracting Parties to the Barcelona Convention (UNEP/IG.49/Inf.5).
5. The present meeting, which had been foreseen in the workplan and timetable of the adopted jellyfish programme, had the task to review the national activities implemented by the participating countries, identify possible problems occurred, and propose recommendations for the future of the programme.
6. MED POL National Co-ordinators of the countries participating in the jellyfish programme (France, Greece, Italy, Malta, Spain, Turkey and Yugoslavia) were invited to nominate national experts to attend the meeting. As a result, all participating countries were represented, with the exception of Spain. FAO, WHO and UNESCO had also been informed of the meeting but did not attend. In this connexion, Mr D. Krause (UNESCO) had sent a message to the Co-ordinating Unit assuring the full interest of the Organization in the project as well as in the deliberations of the meeting. The full list of participants appears in Annex I.

### Agenda item 1 - Opening of the meeting

7. On behalf of the CIMAM, Ms L. Rottini Sandrini opened the meeting and welcomed the participants. Mr F.S. Civili, on behalf of UNEP's Co-ordinating Unit for the Mediterranean Action Plan, thanked the Trieste scientific community for the continued support towards the implementation of the jellyfish programme and reminded the experts of the tasks that the meeting had to achieve. Mr G. Bressan, Director of CIMAM, briefly addressed to the meeting, thanked UNEP for the collaboration and assured the continued support of CIMAM in the framework of the MED POL programme. Brief welcoming statements were also addressed by Mr A. Pastorini from the Region Friuli Venezia Giulia and Mr A. Dini, President Consorzio Laboratorio Biologia Marina, Trieste.

Agenda item 2 - Election of officers

8. The meeting unanimously elected the following officers:

Chairman	: Mr A. Benovic	(Yugoslavia)
Vice-Chairman	: Mr I. Salihoglu	(Turkey)
Rapporteur	: Mr V. Axiak	(Malta)

Agenda item 3 - Adoption of the agenda

9. The meeting adopted the agenda which appears in Annex II to this report. The documents available at the meeting are listed in Annex III.

Agenda item 4 - Report on the implementation of the MED POL Jellyfish Programme

10. With regards to monitoring, the various suggested methodologies (including the bibliographic research, the gathering of sighting reports by volunteers, the systematic plankton sampling and the associated environmental parameters) were in fact applied in the several monitoring projects carried out over a large geographical coastal area including the French, Ligurian, Central Mediterranean, Greek waters and the Adriatic. Various species of medusae which may give rise to aggregations were in fact investigated, especially Pelagia noctiluca and Aurelia aurita. In many cases, problems were encountered in the systematic plankton sampling of adults - due to their patchy distribution. Methodological problems were also encountered in the sampling of ephyrae in certain areas. It was agreed however that such a monitoring programme had succeeded in indentifying some of the characteristic features of the occurrence of this phenomenon and that it should continue over a long term period.

11. With regard to research, as a direct result of this MED POL Programme, much more information is now available on the physiology, reproduction, hystology, chemistry, development, behavioural responses, biochemical components, as well as temporal and spatial distribution of Pelagia noctiluca in the field, which is the species whose coastal swarming caused most concern. It was however agreed that the two-year research period was insufficient in producing enough information to be able to achieve all the objectives of the programme.

12. Work was carried out on the likely role of the capsule wall in the nematocyst discharge mechanism, as well as the subsequent dermatotoxicological response both of humans as well as of experimental animals. Epidemiological studies have been conducted to identify the medical significance of jellyfish stinging.

Agenda item 5 - Presentation of countries' reports

13. Under Agenda item 5, the countries' representatives in turn reported on the work carried out in the framework of MED POL since the beginning of the Programme. The reports are attached in Annex IV.

Agenda item 6 - Conclusions and recommendations

14. The monitoring programme gave results on the occurrence of different jellyfish species (Aurelia aurita, Rhyzostoma pulmo, Cothyloriza tuberculata, Chrysaora quinquecirrha, and on the following characteristics of Pelagia aggregations:

- a) the big amplitude of the fluctuations in the number of individuals,
- b) such fluctuations in populations of jellyfish have been shown to occur since at least 200 years ago,
- c) the pattern is essentially that of abundance for several successive years, with little inter-year variations, followed by a period of absence or very low population densities,
- d) the occurrence of aggregations usually extend over a wide geographical extent in the Mediterranean.

15. Regarding the recent occurrences of coastal aggregations of Pelagia noctiluca, while they were first recorded in 1977, they reached maximum intensity and the largest geographical extent in the 1980-1983 period. Since then, a significant decrease in numbers was recorded in the Greek and Central Mediterranean coastal waters, while large numbers for 1985 were only being reported in the Adriatic region. Pelagia noctiluca is essentially an offshore species and coastal swarms have been in some cases interpreted as passive aggregations of moribund individuals at the end of their biological cycle, driven into coastal waters under the action of water movements, while active aggregations may be more frequently found in offshore areas. The vertical distribution/migration of such species is at present not fully understood and the possibility that the occurrence of such species is being determined by movements of intermediate waters has been suggested. The present data and information is as yet insufficient to explain the apparent disappearance of Pelagia during the non-swarmling periods. It has been proved that in the Mediterranean, Pelagia noctiluca reproduces all the year round. Temperature has been identified as a major environmental factor affecting the population densities of the species. The time series population densities of both adults and ephyrae varies with geographical locality. Above 2.5 cm in rhopallial diameter, the size is not related either to age or to reproductive maturity.

16. It has been proved that temperature greatly affects several physiological processes. During the summer months it is expected that the increased metabolic rates and production of wastes would be high so that due to the large population densities, the impact of such swarms on the pelagic ecosystem could be significant. Considering the relatively high energy content of the species, it must represent a significant energy source for likely predators. To date, no direct relationship between coastal aggregations of Pelagia and organic pollution has been proved.

17. Impact assessment: From the data resulting from this project, there are indications that it does not really represent a serious health hazard since only few cases of stinging led to severe medical complications, although the problem of sensitization (due to repeated stinging) has not been significantly investigated. However, the mass occurrence of jellyfish may disrupt recreational activities as holidaymakers may be averse to bath in the sea for fear of being stung. The most significant impact is now thought to be on the general pelagic ecosystem. Physiological data on Pelagia noctiluca indicate that the presence of enormous numbers of this species might exert a significant impact on the nutrient regeneration mechanisms of the ecosystem and on the other members of the pelagic community. These may well lead to important implications on the marine food resources and the natural stability of such pelagic ecosystem.

18. Resulting from the present knowledge of the overall problematics of jellyfish in the Mediterranean, the following hypothesis regarding the causes leading to this phenomenon have been proposed:

- a) an increase in productivity, either due to natural fluctuations or to organic pollution, resulting in an increased food availability to the jellyfish,
- b) changes in the number of predators/competitors of Pelagia leading to a decrease in the normal factors controlling its population density,
- c) major displacement of water masses to explain the appearance of Pelagia in areas previously unrecorded,
- d) major hydroclimatic changes affecting the factors normally controlling Pelagia's population.

19. Recommendations.

A. Monitoring of medusae is to continue on a long term basis and to include the investigation of the whole pelagic ecosystem. Therefore the monitoring of medusae should become a mandatory parameter in the framework of the MED POL national monitoring programmes.

B. The UNEP reference method on monitoring and identification of Scyphomedusae should be finalized and made available as soon as possible.

C. More research is required on the basic biology and environmental relationships of jellyfish. This should be carried out in the framework of the existing MED POL research activities and, when this is not possible, funds from the direct assistance budget line of MED POL should be utilized.

D. Emphasis should be given to prediction models and controlling methods as well as health-related programmes (guidelines on curative treatments and prevention beach management, informative leaflets, etc.). Whenever possible such activities should be integrated with any ongoing regional monitoring and research activities.

E. Priority should be given to a wide diffusion of the data and results obtained through the jellyfish programme. Publication of reports and attendance at meetings where results could be presented, should be encouraged and facilitated to the extent possible by mobilizing national as well as MED POL funds.

6. Due to the fast and significant progress being achieved in the field of jellyfish through the MED POL programme, any effort should be made by UNEP to convene, at latest in 1988, the second Workshop on jellyfish blooms in the Mediterranean

Agenda item 7 - Adoption of the report

20. The meeting unanimously adopted the English version of the report on 29 January 1986.

Agenda item 8 - Closure of the meeting

21. The Chairman addressed to the meeting by thanking the participants for the highly constructive work and the organizers for the excellent arrangements. Mr Civili joined the Chairman in his words of thanks and reminded the group the jellyfish programme had been, among the MED POL projects, one of the most scientifically productive, also considering the short time since its beginning. He also assured the group that, in spite of the obvious limitations brought forward by the budget approved by Mediterranean Governments, UNEP will endeavour to continue the jellyfish programme within the framework of MED POL by using all the existing structures.

22. Many participants thanked the UNEP's Co-ordinating Unit for the Mediterranean Action Plan and its staff for the very efficient work carried out in the management of the programme.

23. The Chairman closed the meeting at 13.00 hours of 29 January 1986.

ANNEX I  
ANNEXE I

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LISTE DES PARTICIPANTS

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ANNEX II

AGENDA

1. Opening of the Meeting
2. Election of Officer
3. Adoption of the Agenda
4. Report on the implementation of the MED POL Jellyfish Programme
5. Presentation of countries' reports
6. Conclusions and recommendations
7. Adoption of the report
8. Closure of the meeting

ANNEX III

LIST OF DOCUMENTS

Working documents

UNEP/WG.145/1                      Provisional Agenda  
UNEP/WG.145/2                      The Med Pol Jellyfish Programme - A review

Information documents

UNEP/WG.145/Inf.1                  List of documents  
UNEP/WG.145/Inf.2                  Provisional list of participants

Reference documents

UNEP/WG.118/Inf.3                  Workshop on Jellyfish blooms in the Mediterranean  
(Athens, 31 October - 4 November 1983)

-    Workshop on Jellyfish Blooms in the  
Mediterranean (Athens, 31 October - 4 November  
1983 - Bibliography on blooms on Jellyfish and  
related organisms

UNEP/IG.49/Inf.5                      Project on Jellyfish in the Mediterranean (Report  
of a Consultation on a jellyfish project in the  
Mediterranean Sea, Athens, 6-7 February 1984)

-    Changes in the distribution and size of the  
population of Pelagia noctiluca in the  
Mediterranean

UNEP/WG.118/9                        Report of the Third Meeting of the Working Group  
for Scientific and Technical Co-operation for Med  
Pol (Athens, 27-31 May 1985)

UNEP/IG.56/5                        Report of the Fourth Ordinary Meeting of the  
Contracting Parties to the Convention for the  
Protection of the Mediterranean Sea against  
pollution and its related Protocols (Genoa, 9-13  
September 1985).

ANNEX IV

COUNTRIES' REPORTS ON THE IMPLEMENTATION  
OF THE MED POL JELLYFISH PROGRAMME

FRANCE

Research is carried out at three levels:

Long term

1. Correlation of the chronology, over two centuries, of jellyfish blooms in the Mediterranean with climatic variations: retreat of Alpine glaciers, or precipitation at Nice and Genoa (concomitance of jellyfish-bloom years and rainfall shortage).

2. Analyses of daily counts, over a 20-year period, of 50 species of macroplankton. The statistical methods used are the following:

- charting of the frequency, relative numbers and annual variations of certain species, as well as the non-annual variations of Pelagia;
- analysis of the main components in order to show what distinguishes Pelagia from other species of macroplankton like Leucothea (Ctenophorum) and Hyppopodius (Siphonophore).

At a later stage, the typical associations which define a "Pelagia noctiluca biotope" will be established.

Medium term

1. The current bloom is studied by means of field studies (cruises) on a Nice-Calvi radial that cuts the Ligurian-Provençal front: the hydrological structures between the central waters and the coastal waters play the role of a natural eutrophication source. Adult individuals of Pelagia have been observed on both sides of the front every year since the onset of the bloom in 1982; moreover, larval ephyrae have been observed in the summer and on the coast.

Therefore, it becomes clear that there is segregation of the various life stages and that the younger stages are sensitive to ecosystem modifications; thus the studies concerning ephyrae should be continued.

2. A follow-up of the medusae stranded on the shore is carried out between Monaco and Port-Vendres as well as in Corsica by the 43 monitoring posts of the Compagnies Républicaines de Sécurité during the summer season. It is the Ligurian current that brings the medusae from the Alpes Maritimes to the Var, with some dispersion observed at the height of the Levant islands.

Since 1983, the numbers of medusae stranded on the shore have been decreasing, even though there are now more observation posts. In the Languedoc-Roussillon region, jellyfish are less abundant, a fact due perhaps to the Rhône dilution area. Furthermore, a local accumulation is observed at Eze, a site protected by Cap Ferrat from the Mistral which is the dominant Riviera wind. Data are also provided by stung swimmers and pleasure boats.

Very short term:

As we have already mentioned the most sensitive life stage of the medusa is that of the ephyra which is the object of specific studies. The cycle is hypogenetic and holoplanctonic and this can be seen in the plancton. Thus, experiments have been continued on the following:

- growth and development at temperatures ranging between 15° and 25°C; the lower the temperature, the slower the growth.
- metabolism and excretion-respiration at temperatures ranging between 15° and 25°C; the lower the temperature, the slower the metabolism.

Therefore, it becomes clear that in the sea, animals save energy by living in lower temperatures, as shown by the fact that they are found in the Mediterranean in the winter and under the thermocline in the summer. On the other hand, the growth of ephyrae within the temperature range in culture is comparable with that observed within the same temperature range in the sea, between May and September, i.e. the ephyra-fishing period.

All experiments are strictly correlated with data gathered during daily plancton observation at sea. In order to understand the special dynamics and the factor(s) promoting such mass aggregations in the pelagic ecosystem, the trophic network must especially be taken into consideration.

## GREECE

### 1. Monitoring

The Greek monitoring programme was started in May 1983 by the National Center for Marine Research (N.C.M.R.) in Saronikos Gulf, with systematic sampling and observations of the increased population of scyphomedusae in Greek waters. The areas covered by the N.C.M.R. were Saronikos Gulf, Evoikos Gulf and Cyclades while sampling of the medusae during winter 1985 was also carried out by the University of Athens, Department of Zoology, in the Amvrakikos Gulf. During this monitoring project we carried out in detail on monthly bases:

- the physical parameters (sea water temperature, salinity, sea surface currents)
- the chemical properties (nutrients)
- Systematic zooplankton, phytoplankton and chlorophyll samples
- underwater illumination measurements
- systematic sampling of medusae.

At the same time, information from all over Greece concerning the occurrence of Pelagia noctiluca were gathered from N.C.M.R. and, together with all hydroclimatic conditions, were fed into a computer in order to correlate statistically the occurrence of the medusae with these parameters. Special interest was given to the sampling of the Elefsis Bay, mainly because of its special characteristics (eutrophic area, very near to the sewage outfall, etc) and the impressive occurrence of a local population of Aurelia aurita.

From the reports gathered from Port Authorities it is evident that Pelagia noctiluca populations were declining during the period 1984-1985. For the Aurelia Aurita study, we tried, and we have now enough data to support it now, to correlate the massive occurrence of this species with biological and environmental conditions. Many more details concerning the biomass, the bell diameter, the ephyrae liberation, the ephyrae biomass, the wet weight/dry weight/displacement volume, the different size class, the reproduction cycle and the correlation with environmental conditions can be found in the year's report that has been submitted to UNEP.

### 2. Research

Several projects were carried out in Greece during 1984-1985 concerning the jellyfish.

One of them, a joint project between "Democritus" Nuclear Center and the University of Southern California, U.S.A., tried to establish the possible connection between jellyfish blooms and the sewage effluent, which may possibly provide the dissolved organic matter (D.O.M.) or induce eutrophication. By using <sup>14</sup>C labelled glycine and algal hydrolysate this scientific group was able to indicate the capacity of Aurelia aurita to use DOM as a nutrient source. Samples of the same species were also collected for stable isotope analysis and trace metal neutron activation analysis.

Another project that was carried out in this field was from University of Athens, Chemistry Department. The aim of this project was to investigate from a chemical point of view (lipids, phospholipids, fatty acids) the relation between Pelagia noctiluca and Boops boops, species that are known to have a prey-predator relationship. Phospholipids are very important to be studied since they can provide the final complex molecules with their unique properties like:

- contribution to the protection of cellular integrity
- decisive functioning in the cell's adaptation to environmental conditions
- contribution to the survival of aquatic organisms and participation in specific metabolic pathways.

All data concerning the lipid content, the free lipids as well as the fatty acids content are included in the year's report that has been submitted to UNEP.

A research project from University of Athens, Department of Biology was also carried out concerning the biochemical analysis of Aurelia aurita as well as the study of the ultrastructure of the nervous system, the nematocysts and the different cell types that were found in this species. The biochemical analysis included amino-acid profile free protein, crude protein organic content and NaCl content. The results indicate that Aurelia aurita, having all basic aminoacids could become a future protein source. On the other hand in the lyophilized material the chemical composition of this species remains unchanged and will, in a long term basis, give the initiative for experiments concerning the impact of the toxic effects on other organisms as well as the evaluation of the jellyfish potential in the marine food resources.

### 3. Other studies

A project on epidemiology and therapeutic methods of jellyfish poisoning in Greece was carried out by the Poison Control Center, Children's Hospital P.A. KYRIAKOU. The aim of this study was to evaluate the epidemiological aspects of jellyfish poisonings and the therapeutic methods applied. After a year's study the following points were made:

- the total number of stinging cases cannot be evaluated
- there was not great difference among patients, concerning the sex although 75% were adults
- the peak season in July and August. Symptoms were mainly local and short-lived.

Finally, the evaluation of therapeutic methods accuracy is not easy and further study together with the participation of Doctors with the Poison Control Center is needed in order to accomplish this study in the future.

ITALY

Activities related to the jellyfish project carried out in Italy, 1985

GENOVA: Prof. A. Carli - Cattedra di Planctologia - Istituto di Scienze Ambientali Marine - Università di Genova

Monitoring of jellyfish in the Ligurian sea was carried out during summer and winter seasons and is still continuing. The monitored area includes Imperia and La Spezia with particular reference to the area of Spotorno.

Simultaneously to the collection of jellyfish, samples of plancton are taken in various zones and different periods so as to discover the presence of ephirae in the various stages of development (reproduction potential). This study was also carried out on samples of plancton taken during the past in some zones of the Western Mediterranean and it may provide useful information on the tendency of the phenomenon. Regarding the environmental parameters, observations on physical and hydrological, chemical and biological factors in relation to the finding of the jellyfish will be done. To this effect we find it worthwhile to extend our knowledge towards the presence of jellyfish along the French coasts. Therefore, a scientific collaboration will be started with P. Bernard - Inst. National de la Santé et de la Recherche médicale (Unité Mer et Santé, Nice, France).

Together with the monitoring activity, an epidemiological study on man is under way on the stinging effects of the jellyfish. Forms were distributed in the bathing areas and the best available methods for treatment of the lesion in their different forms and seriousness have been taken into consideration.

MESSINA: Prof. A. Salleo et al. - Istituto di Fisiologia Generale - Università di Messina.

The research group, operating at the Physiology Institute, has continued investigations of the discharge mechanism of cnidocysts of Pelagia noctiluca. In particular they have looked into the effectiveness of producing discharges of substances which reduced s-s comparing it to that of the lyotropic anions.

Furthermore, they have studied alterations of volume associated to discharge, observing that the latter is preceded by an increase in volume, and followed by a reduction.

During 1986, the release dynamics of the CA<sup>++</sup> associated with the discharge will be investigated.

CATANIA: Prof. G. Pappalardo - Cattedra di Chimica Generale - Dipartimento di Scienze Chimiche - Università di Catania.

A) Sea Water Analyses:

Monitoring of three major and minor elements in sea water samples was made by ICP analysis on samples collected during two oceanographic cruises in Southern Italian seas. At each sampling station and depth a simultaneous registration of oceanographic and meteo-climatic data was made. Data from these determination together with 20 000 analytical data for the determined elements are stored in a data bank. Correlation study with Pelagia noctiluca occurrence were initiated through computerized methods. It is likely that one or more of the major or minor elements present in seawater interact with pollutants and affect the ecosystem and thus Pelagia noctiluca blooms. This monitoring must be made, as more extended possible, in space and time, to identify the environmental parameters controlling blooms, reproductive processes, etc.



B) Arseno-lipids in Pelagia:

These preliminary results gave suggestions as to the nature of organic and, in particular, of organo-arsenic compounds (after growth in arsenic-rich water) formed by Pelagia noctiluca. Future experiments, will show the exact chemical structure of some of these compounds. The other aim is to determine whether the arsenic, a priority pollutant, and its compounds, can play the role of nutrient.

BARI: Prof. L. Scalera Liaci - Istituto di Zoologia - Università di Bari.

During 1985 a weekly monitoring was done along the coasts between Bari and Termoli, and on Tremiti Islands, with five fixed stations. When coastal aggregations were detected, daily observations were carried out. The monitoring includes also hydrological and meteorological data. Data collected are still to be analysed, but show a massive occurrence of Pelagia noctiluca from July onwards.

During 1986, the monitoring activities will continue. Maturity stages of the gonads will be determined by histological and histochemical analysis on Pelagia noctiluca sampled during aggregations.

FANO: Prof. C. Piccinetti - Laboratorio di Biologia Marina e Pesca, Cattedra di Ecologia - Università di Bologna.

During 1985 the program on the monitoring of jellyfish and hydrological parameters which started in 1984, was continued by means of seasonal research cruises. These cruises are operative in the framework of the Fishery Research Project of the "Ministero Marina Mercantile" in the Adriatic Sea and Western Mediterranean Sea. Data of the 1985 cruises show a presence of Pelagia noctiluca in the Adriatic Sea in massive aggregations during spring and summer. Hydrological data have been collected as well and have to be elaborated. An analysis to determinate the reproduction potential of this species in the Adriatic is being carried out.

The continuation of this program is forecasted for 1986, also analysing the correlation between Pelagia noctiluca and the quantity of eggs and larval stages of fish.

TRIESTE: Prof. L. Rottini Sandrini - Dipartimento di Biologia - Università di Trieste; CIMAM - Laboratorio di Biologia Marina - Trieste.

Bio-ecological research: This operative group have carried out monitoring in four permanent stations in the Gulf of Trieste and have gathered meteorological and hydrological data with the collaboration of the Thalassografic Institute - CNR of Trieste. The year-to-year sea level and wind variability have been studied, in relation to the periodic marine phenomena. A series of experiments in aquarium have been carried out on the influence of temperature and salinity on the behaviour, reproduction and the development of Pelagia noctiluca. An histological control of the grade of maturity has been done on specimens collected from coastal surface aggregation in the Gulf of Trieste. Analyses on the reproduction potential, the seasonal variations and maturity gradient are under way. The interaction between fishery and jellyfish in the Adriatic Sea has been examined.

1986 program:

- 1) Prey-predator model and damage to fishery, eco-system, sanitary
- 2) Analysis of isotopic content in the mesoglea in relation with the seawater values
- 3) Creation of a climatological data bank and climatic studies of the Northern Adriatic area.

Toxicological-medical research

- R. Della Loggia et al. - Istituto di Farmacologia e Farmacognosia -  
Università di Trieste; Laboratorio di Biologia Marina - Trieste

The first problem considered was the individuation of an animal model suitable for the detection of the dermatotoxic effects of Pelagia noctiluca preparations. The second step in the research program was the separation of Pelagia nematocysts in still active form, without contamination by non-nematocyst material.

In 1986, the aims of the research will be the purification of the toxin and possible immunological studies.

- C. Scarpa et al. e Kokelj F. - Clinica Dermatologica - University Skin Clinic, Trieste

A study of the clinical evolution of patients suffering from serious jellyfish stings has been carried out and a statistical analysis was therefore done.

An Experimental testing on human skin with Pelagia noctiluca watery extract was made: an extract was obtained in distilled water with Pelagia noctiluca tentacles, then filtered through a plancton net to 100 nanometers. This extract was then tried by patch-scratch-testing on skin of 16 human volunteers. Positive results were obtained in 75% of the tested group (12/16). This fluid is now being used in our present research work in order to find the proper testing dilution. The elicited reactions seem to be of irritative, not allergic nature. We will try in the future some local and general antidote drugs in order to achieve a faster healing of pelagia noctiluca skin injuries.

## MALTA

Activities related to the jellyfish project carried out in Malta, 1983-1985

A national committee to deal with jellyfish aggregations in coastal waters was set up in 1983. The Departments of Tourism, of Health and Environment, the Maritime Section of the Task Force and the University of Malta were represented on this committee.

### Monitoring Programme

**Sighting reports by volunteers:** Coastal hotel establishments were invited to participate in this monitoring programme by reporting sightings of jellyfish in water or stranded on the shoreline using specially prepared data sheets. The Beach Cleaning Section of the Department of Tourism was likewise to report such sightings. Sighting reports of jellyfish from offshore waters were also collected by personnel of the patrolling crafts of the Maritime Section of the Task Force (i.e. the local coast guards). Such reports included information on the relevant environmental parameters at the time of sighting as indicated in UNEP's manual (Monitoring of Swarming by Scyphomedusae, 1983). The substantial amount of data collected from such sources was collected and analysed at the Department of Mathematics and Science of the University of Malta.

**Systematic coastal sight counts:** This was carried out daily by personnel from the Department of Health and Environment and the Maritime Section of the Task Force at two fixed coastal stations according to UNEP's manual.

**Systematic plankton surveys in coastal waters:** Monthly plankton sampling for medusae and ephyrae at one coastal station, together with the monitoring of the usual environmental parameters (temperature, salinity, nutrient and chlorophyll levels, etc...) are being carried out according to methodologies indicated in UNEP's manual.

Data resulting from such monitoring activities indicate that coastal aggregations of *Pelagia noctiluca* were first reported in 1980 and reached maximum densities in 1983. Afterwards, their coastal population densities decreased such that during the recent months only isolated individuals were reported in coastal waters. During the period 1980-1983, large coastal aggregations occurred throughout the whole year and not necessarily in summer. Moreover, aggregations appearing during the first three months of the year were characterised by a small size of their component individuals (10-20 mm). These small medusae were presumably representatives of recent spawning. Though ephyrae have been found in local coastal waters throughout the year, there are indications that in this region, reproduction of *Pelagia* is more pronounced during Autumn or early Winter. The major factors which determined the occurrence of such aggregations in local coastal waters were directions of surface water currents and wind. Preliminary analysis of data indicate that most of such swarms reached the Maltese Islands from the Northwest Mediterranean.

Research activities

Laboratory experiments on the effects of fluctuations in the light intensity on the motility of *Pelagia noctiluca* were carried out. These indicate that decreasing light intensities caused an increase in the rate of umbrella pulsations. Further work is planned to help assess the ecological significance of such results with respect to possible diurnal vertical migrations/distribution of this species.

Development of controlling methods:

In an effort to minimize the number of jellyfish reaching bathing waters, a device was developed by the Maritime Section of the Task Force consisting of a large net dragged by a boat employing specially designed floats to maximize the efficiency of jellyfish collection. Preliminary results indicated that such a device was quite efficient in fragmenting large numbers of medusae over a relatively short period of time. Provided that the necessary precautions are taken to ensure that the resultant fragments of jellyfish do not reach the coast (eg. carrying out such an operation under the right wind conditions and well offshore), such a device may be helpfull in minimizing the densities of jellyfish reaching specific bathing beaches from offshore dense aggregations. No further experiments on such a device could be carried out due to the fortunate absence of such coastal aggregations of jellyfish during the past months.

## TURKEY

The need to study all and/or special aspects of marine environment has largely increased in Turkish seas. The urgent need of understanding the jellyfish problem is not only based on scientific curiosity but is also based on the plague of fishermen and different interest groups. Although existence of jellyfish has been reported from the Mediterranean Coast (North Levantine Basin and Antalya Basin) and Aegean Coast, the problem is more pronounced in the Black Sea and the Sea of Marmara.

The existence of jellyfish in the Aegean Coast was reported by Balik (1973), who studied the species composition of Scyphozoa in Izmir Bay. Bingel (1984) reported the occurrence of jellyfish in the Eastern Mediterranean covering a coastline of 120 kilometres. Most jellyfish were observed in Tarsus and Seyhan rivers delta in the Mersin Bay and Ceyhan River delta in Iskenderun Bay.

In order to have a continuous time series of the abundance and distribution of jellyfish in the Mersin Bight a research and monitoring programme has been developed. Besides jellyfish, measurement of some basic oceanographic and meteorological parameters is included in the programme. The main aim of the programme is to find a sound basis to explain jellyfish mass occurrences in the region.

The jellyfish problem is more pronounced in Black Sea and the Sea of Marmara. There is a continuous flow of Black Sea water masses into the Mediterranean and more specially to the Aegean Sea, via Bosphorus, the Sea of Marmara and Dardanelles and thus it is believed that the quantity of jellyfish, especially Aurelia, when transported by these water masses may become considerable. On this basis, METU Marine Sciences Institute started a programme to measure the quantity of jellyfish at the two straits (Bosphorus and Dardanelles) and adjacent waters. Together with jellyfish measurements, basic oceanographic parameters such as  $S^{\circ}/\infty$ , temperature, pH, dissolved oxygen, biochemical oxygen demand, nutrients, suspended material, dissolved organic carbon, chlorophyll-a, primary production, currents, etc, are measured.

As a result of these measurements, it is expected to gather some basic information about the dynamic jellyfish processes.

On the Aegean Coast of Turkey, within the framework of national MED POL activities, the monitoring of jellyfish is carried out by the Eylül University Institute of Marine Sciences and Technology. The findings of this programme will be reported together with MED POL programme reports.

## YUGOSLAVIA

### Monitoring activities

Monitoring of Pelagia noctiluca occurrence has been carried out in the southernmost part of the Yugoslav coast as to evaluate the "input" of medusae to more northern regions of the Adriatic Sea. Jellyfish appearance has been followed along the whole eastern coast with a peak abundance (especially in form of passive aggregations) registered in the Northern Adriatic. Reports from the Southern Adriatic in early spring of 1985 describing Pelagia as real "zoocurrent" and its mass presence in Northern Adriatic during late summer, autumn and early winter indicate the transport by currents as an important factor in regulating the population dynamics in the northern region of the Adriatic Sea. It must be stressed, however, that the observations were limited to coastal regions and surface waters.

In Northern Adriatic the behavioural characteristics of Pelagia noctiluca distribution were studied and two types of aggregations were recognized: passive, formed on surface by organisms with limited mobility and active, where animals were active and spread throughout the water column. Both types could be observed along the shore but also in open waters. Some comments on existing methodology for monitoring jellyfish were also prepared in collaboration with Italian colleagues. Special attention has been given to the impact of mass presence of Pelagia noctiluca on human health. This aspect has been studied in Dubrovnik, Pula and in 1983 and 1984 also in Piran. It was concluded that this jellyfish represented more a nuisance than a real health hazard. In Pula, the experiments with the venom apparatus and antybody tests ELISA are also in course.

### Research activities

Research activities included the study of proteolytic activity of Pelagia noctiluca, investigations of plankton community and research of the biometric characteristics and nutritional ecology of Pelagia noctiluca.

It is concluded that at least two proteolytic enzymes are present in Pelagia, one of which is active in the acid pH range and the other in the alkaline pH range. A high degree of activation after dialysis is observed. Plankton was studied by standard plankton methodology in the Adriatic Sea near Dubrovnik. The prevalence of holoplanktonic species and rare findings of meroplanktonic medusae confirm influence of the Southern Adriatic open waters, which is recognizable very near to the coast. The presence of meroplanktonic species indicate their shifting by currents.

Numerous measurements of biometric characteristics of Pelagia noctiluca enabled us to describe their relationship by allometric equations which indicate isometric growth. Biochemical analyses of Pelagia revealed protein as major constituent and showed a tendency of decreasing in bigger animals. The opposite is shown for lipids. Estimation of the caloric value indicate Pelagia as nonegligible food source.  $\Delta^{13}\text{C}$  analyses in differently sized animals suggest the change of diet during growth. Metabolic rates were significantly influenced by temperature and it is suggested that migration to colder water layer and reduction of activity level (passive floating at the depth of jellyfish neutral buoyancy) would minimize energy losses. The findings were correlated to the formation of passive and active aggregations.