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A North Adriatic centenarian: the marine research station at Rovinj

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ABSTRACT: The institute in Rovinj was founded in 1891 as the field station of the Berlin Aquarium. It soon gained in scientific importance. From 1911, it was governed by various scientific bodies, such as the 'Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften', the 'Reale Comitato Talassografico Italiano', and the 'Jugoslavenska Akademija znanosti i umjetnosti'. At present, it is a department of the 'Ruđer Bošković' Institute, called the 'Center for Marine Research Rovinj'. In the past hundred years, the Rovinj station experienced several ascents and declines in its development: both in the First and Second World Wars the station's scientific equipment, research vessels, library and reference collections were dispersed, and from 1945–1948 the station was closed. But in "happier" periods, rich support by the state and international bodies favoured the increase in research facilities and promoted interest among visiting scientists. The station has always been involved in studies of the Adriatic Sea, especially in its northern part. It contributed much to general knowledge of oceanography, of the physics and chemistry of the sea, but its paramount contribution is to various disciplines of marine biological sciences. Applied research, however, was most oriented to fisheries biology, especially shellfish culture, to resource studies, and, recently, to toxicology, bacteriology, eutrophication and pollution monitoring. The international approach in science and applied research was always favoured. At present, the Center is well equipped for complex coastal and offshore field- and laboratory research, and maintains facilities for graduate and postgraduate teaching. Scientific dissemination is also promoted by the public aquarium and professional meetings.

INTRODUCTION

The Northern Adriatic is one of the few areas which has always been attractive to scientists. The vicinity of many continental universities was one of the main reasons that the first marine biological station in the Adriatic area was founded in Trieste in 1875 (Specchi, 1965). Increasing pollution in the Gulf of Trieste, a growing lack of live resources for aquaria requirements, and poor transport possibilities were the main reasons that a new permanent biological station was founded in 1891 in Rovinj (Stossich, 1876; Hermes, 1895; Kortum, 1991).

The choice of location for this station was based on several considerations: the excellent clarity of the seawater, together with different sea-bottom types, creating a biotope for an extraordinary diversity of marine flora and fauna, and also of various benthic communities in a relatively small portion of the shallow sea. Additionally, Rovinj had a good railway connection with Trieste and many capitals of Europe, at that time of high importance where trading with living marine organisms was concerned (Rawitz, 1893; Schmeil, 1893). In addition, since the days of Spallanzani, who, in 1792, was the

first scientist to carry out research at Rovinj (Benaso, 1984), this area had been considered a classical location for Adriatic biological research. Thanks to the taxonomic studies of De Toni, Ardissone, Hauck, Graeffe, and von Drasche, the Rovinj marine flora and fauna were already well-known by 1891 (Vatova, 1928). All these facts had been decisive for Dr. Otto Hermes, the Director of the Berlin Aquarium, when he established a field station of his enterprise in Rovinj, named the Zoologische Station des Berliner Aquariums (Zoological Station of the Berlin Aquarium) (Hermes, 1891; Rawitz, 1893; Schmeil, 1893). The prime task of the station was to collect and transport live marine plants and animals to Berlin, but also to advertise, by means of the Rovinj aquarium, the sale of live and preserved biological material all over Europe, and to promote training and scientific research in the area (Hermes, 1891; Tamaro, 1893; Müller, 1976; Strehlow, 1987). Curiously enough, it was a perfect German establishment, functioning within the territory of the Austrian-Hungarian monarchy (Hämmerling, 1941).

AFFIRMATION PERIOD

The station was opened on 10th May 1891 (Fig. 1). Its microlocation was well-chosen. Located in the quiet and sheltered Valdibora Bay, very close to the railway station, just on the border of the little town of Rovinj, the station had its own fresh karstic spring water, and a specially built quay with an incorporated inlet for a seawater pumping station

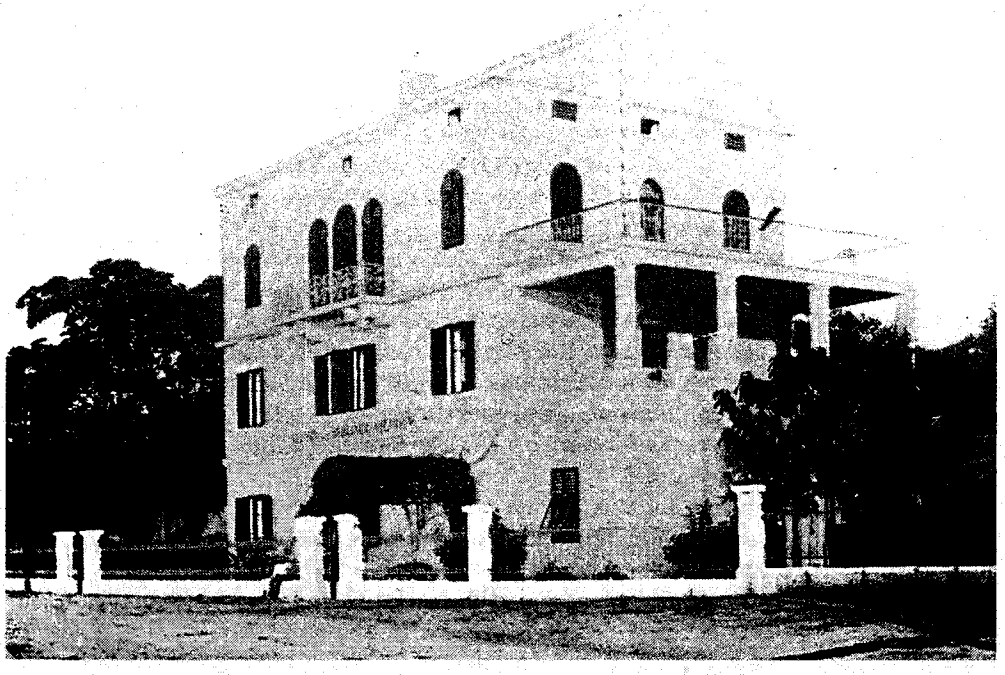

Fig. 1. Zoological Station of the Berlin Aquarium (1891)

(Hermes, 1895). The Zoological Station campus was improved by a small botanical garden of Mediterranean land flora (Ith, 1897; Zimmermann, 1903; Sendler, 1912).

Soon after its establishment, the Rovinj aquarium became famous for its attractiveness (Hermes, 1895). Although no scientific post was permanently occupied, the interest among the scientific community in a biological station constantly increased (Möbius, 1893; Virchow, 1894; Sand, 1897; Reuth, 1899). Four laboratory spaces were available for guest scientists, according to arrangements similar to those at the Naples Zoological Station (Hermes, 1894, 1895; Müller, 1976). A chronic lack of laboratory space inspired Dr. Hermes to enlarge the building. The task was finished in 1900 (Anonymous, 1900): the laboratory rooms were designed in the most modern fashion of the time, each with running fresh- and sea water, gas, electricity, compressed air, and rack for aquarium vessels. The guest scientists had at their disposal all requested equipment, library collections, the dark chamber, various chemicals, and enough aquarium space for laboratory experiments (Zimmermann, 1903; Kofoid, 1910). Good working possibilities have attracted many esteemed European scientists, such as Schaudinn, Prowazek, Reichenow, and others (Vatova, 1928; Gamulin et al., 1964). For field work, the station used, beside small surface units, a motor boat 'Hermes' and a steamer 'Rudolf Virchow' (Zavodnik, 1990), on board which very fruitful planktologic cruises in the north and central coastal Adriatic areas were undertaken from 1907 till 1911 (Steuer, 1910; Früchtl, 1923) (Fig. 2). During this period, the results of investigations performed in Rovinj were published mainly in the journals 'Zoologischer Anzeiger', 'Archiv für Protistenkunde', and 'Sitzungsberichte der k. k. Akademie der Wissenschaften'.

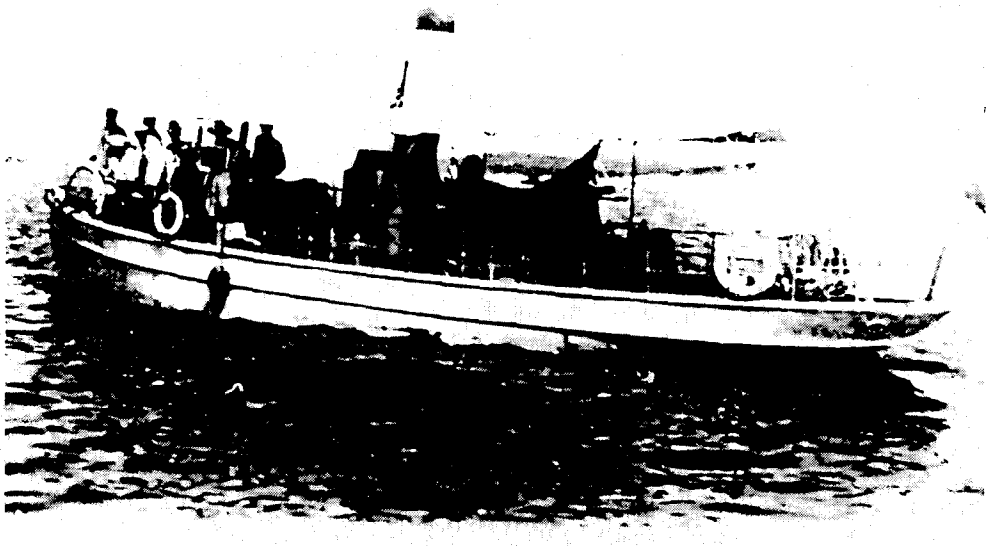

Fig. 2. Research vessel 'Rudolf Virchow'

After the failure of the Berlin Aquarium, Unter den Linden, the Rovinj station became the private property of its director Dr. O. Hermes (Strehlow, 1987). On his death in 1909, the Station was managed briefly by Hermes' heirs, until it was sold at a price of 100 000 Marks to the Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften in Berlin (Anonymous, 1912), which governed the institution until the end of the First World War. But already in 1914, the outbreak of the war rendered the acquisition of a new RV 'Albatross' and submarine 'Loligo' impossible (Zavodnik, 1990); also, the aquarium business was restricted to a major extent, and working spaces for visiting scientists and courses in marine chemistry and biology were cancelled (Krumbach, 1915). Moreover, by the end of the war, much of the scientific equipment and nearly the complete library collection had been removed (Foà, 1927; Gamulin et al., 1964).

CONSOLIDATION PERIOD

After the war, the Istrian peninsula was annexed by Italy. Thus, in 1918, the jurisdiction over the Rovinj station, now named 'Stazione Zoologica di Rovigno d'Istria', was held first by the 'Governatorato della Venezia Giullia', and some time later by the 'Reale Comitato Talassografico Italiano' in Rome. The Italians made great efforts to reinstate the station for effective scientific work. In 1920, however, the Zoological Station in Trieste was closed, and shortly afterwards its scientific personnel, equipment, about 3000 books and journal volumes, and part of the reference collection were moved to Rovinj (Specchi, 1965). Also, the aquarium capacities were enlarged. Thus, the establishment (then named 'Istituto di Biologia marina per l'Adriatico' – Institute of Marine Biology for the Adriatic Sea) regained all the attributes of a well-maintained local marine biological station: four appointed biologists, enough laboratory and aquarium space, necessary standard laboratory equipment, a library specializing in marine literature, and fair possibilities for work in the sea: in addition to the motor boat 'Auro' and a vessel called 'Adria' (which was previously owned by the Trieste Zoological Station), the steamer 'Clupea' was used (Issel, 1923; Gauss Garády, 1931; Gamulin et al., 1964). The staff and visiting scientists were mostly involved with plankton investigations, studies of benthic organisms and their populations, and, in part, with studies of pelagic fish. The Institute had a successful bout, marred by an endemic outbreak of malaria in the Rovinj area (Foà, 1927; Sella 1929a; Gauss Garády, 1931). By 1920, temporary measurements of some of the physical and chemical parameters of seawater were initiated at a permanent station (Vatova, 1928) – an activity which, with some interruptions, has remained traditional until today. By 1924, large-scale, bottom dredge studies were initiated by Vatova, and a few years later, on the initiative of Professor Steuer (Steuer, 1924), the most important paper to come out of the Rovinj station appeared: it was Vatova's voluminous 'Compendio della flora e fauna del Mare Adriatico presso Rovigno' (Vatova, 1928). In this paper, all the existing taxonomic and ecological data on the marine flora and fauna of the area are compiled. With regard to its complexity and conception, this work has remained unique up to the present day. Much attention was also paid to the studies of tuna and eel migrations in the area (Sella, 1926, 1929b). It should be noted that the results of the investigations performed at the Rovinj station in this period were mostly published in 'Memorie del R. Comitato Talassografico Italiano'.

At the beginning of the 1930's, some improvements were made to the Institute

building and the aquarium installations (Foà, 1927; Gauss Garády, 1931); the adjacent old chapel was transformed into a library, and the botanical garden was enlarged by a neighbouring lot of ground donated by the municipality (Steuer, 1933). The motor vessel 'San Marco' was adapted for scientific offshore surveys (Vatova, personal communication).

In 1931, the station was completely reorganized. Its care was entrusted to the joint management of the 'R. Comitato Talassografico Italiano' and the 'German Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften', and the Institute was named 'Deutsch-Italienisches Institut zu Rovigno d'Istria – Istituto Italo-Germanico di Biologia Marina di Rovigno d'Istria' (Glum & Magrini, 1931). Thus, the research potentials of two economically and politically very strong European states were united, resulting in excellent fundamental and applied research within a short time (Anonymous, 1935). The enterprise was modern and harmonious, and very effectively ruled by two directors, one Italian (Sella) and one German (Steuer and, after his retirement, Hämmerling). A permanent scientific staff in this period did not exceed five persons, but the contribution of visiting scientists was respectable. By 1932 two special journals had begun to be issued by the Institute: 'Thalassia' and 'Note', in which many papers produced by the permanent staff and numerous visiting scientists appeared. The papers were, however, also published in other journals, especially in the Italian 'Memorie'.

In this productive period, research was focused on zooplankton, hydrography and benthos. The quantitative benthic surveys of Vatova conducted in 1927–1938 in the coastal and offshore areas of the north and central Adriatic (Vatova, 1935, 1949), are considered as classics on the Mediterranean area. In 1933, the staff was also engaged in fisheries biology and benthic research in the Alexandria area in Egypt (Steuer, 1935). Studies on interactions of phytoplankton, nutrients and selected abiotic factors (Gessner, 1936; Nümann, 1941), and research on sedimentological features in the area (Schmidt, 1935) were also very important, as were studies on the transplantation of cell nuclei in *Acetabularia* (Hämmerling, 1940), fouling (Nümann & Beth, 1955), and taxonomy and ecology of marine organisms. Up to 1940, about 125 new marine animal taxa were described in the area. Many visiting scientists and professionals repeatedly worked in Rovinj (Michailovits, 1936; Kamptner, 1940; Kolosvàry, 1947; Pax & Müller, 1962). Summer courses for Vienna and Breslau University students were organized (Anonymous, 1937a; Anonymous, 1937b).

The Second World War was crucial for the Institute. Just as it began, the vessel 'San Marco' was sold for practically nothing (Vatova, personal communication). Soon most of the laboratory equipment, the library containing 15 000 units, and reference collections, numbering about 1000 zoological taxa, were transported to Italy (Marcuzzi, 1972). The publishing of both journal series was interrupted. After the surrender of Italy and proclamation of the German Reich sovereignty in the area, the motor boat 'Beroë', acquired just before the War, was requisitioned by the Navy and shortly sunk after an aircraft attack (Vatova, personal communication). The German director, however, watched over the Institute until 1945, when it finally was closed down and abandoned (Harris, 1982). Of course, this situation was taken advantage of by local burglars, and occasionally the main building furniture and installations were damaged or removed.

RENOVATION PERIOD

After Yugoslavian sovereignty had been established in the area, the Institute was revitalized in 1948 under the auspices of the 'Federal Ministry for Science and Culture'. It was named 'Institut za ribarstvenu biologiju' (Institute for Fisheries Biology), but administratively it was a department of the 'Institute for Oceanography and Fisheries' in Split (Anonymous, 1953a). Two scientists were appointed. Many efforts were made to ensure the availability of the indispensable equipment, library and aquarium facilities for scientific work, but an overall lack of requested items made the task very difficult. A small motor boat, named 'Istraživač' (Explorer), fitted only for coastal surveys, was donated to the Institute. The staff was mostly involved with problems in fisheries biology (Gamulin et al., 1964; V. Križanec, personal communication), but also successfully organized graduate student summer trainings (Scotti, 1952; Center for Marine Research Archives), and enabled access of visitors to the aquarium (Pax, 1952a).

In 1950, the care of the Institute was undertaken by the Academic Council of the RFPY (Republique Fédérative Populaire Yougoslave), and by the end of 1951, this was transferred to the Yugoslav Academy of Sciences and Arts (Anonymous, 1953a). The name of the Institute was changed to the 'Institut za biologiju mora' (Institute for Marine Biology), and a larger fisheries motor boat named 'Bios' was acquired (Fig. 3). The appointed scientists (four persons) concentrated on hydrographical measurements, fisheries biology (especially benthic fish and oyster cultivation), fouling, and ecology of

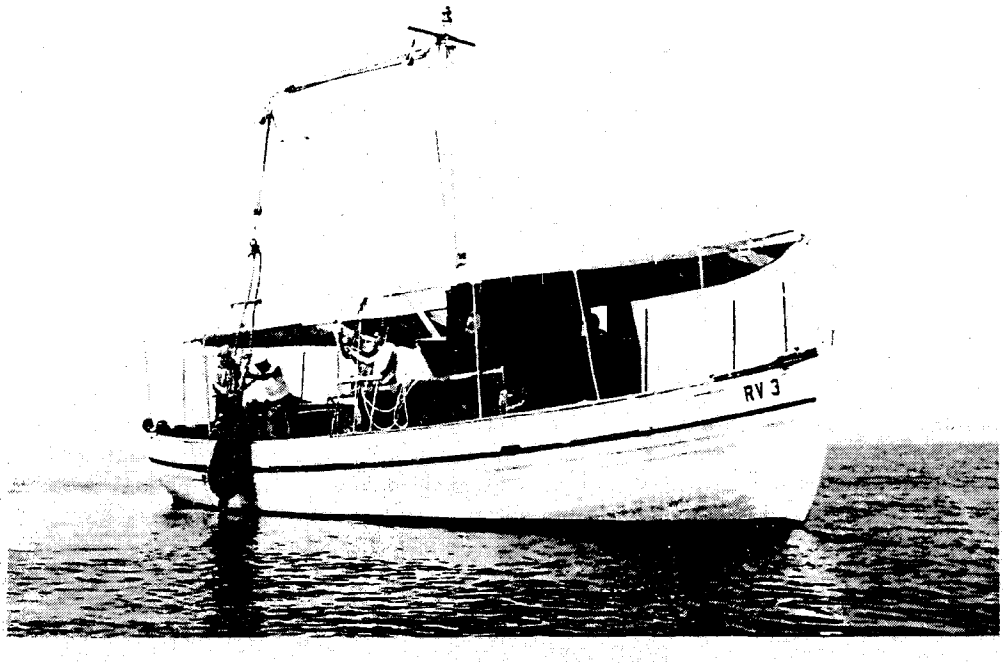

Fig. 3. Motor boat 'Bios'

benthic organisms. In 1956, the first issue of the Institute's new journal 'Thalassia Jugoslavica' appeared. By that time, many efforts were made to develop marine biology training for graduate students from Yugoslavia and abroad (Anonymous, 1953b), and to enable research for foreign scientists in this area (Pax, 1952b; Zei, 1954, 1959; Gamulin et al., 1964). Particularly fruitful were the long-term studies of submarine cave habitats and taxonomic research performed by Austrian scientists (Riedl, 1963, 1966; Riedl & Ozretić, 1969). In 1958, an underwater TV system, the first in the Adriatic Sea, was applied to benthic research (Nikolić, 1959; Czihak & Zei, 1960).

In 1958, the Institute became a department of the Yugoslav Academy Institute for Biological Studies. Two years later, the Rovinj station and the Biological Institute in Dubrovnik were united under a common name, the 'Biološki Institut JAZU Rovinj-Dubrovnik' (The Biological Institute of the Yugoslav Academy of Sciences and Arts). At Rovinj, six scientists were permanently employed. However, overriding difficulties in administering two stations separated by several hundreds of kilometers resulted in their division in 1963. The Rovinj station reassumed its previous name, 'Institut za biologiju mora JAZU', and was staffed by eight scientists. The research of visiting scientists, and teaching in marine biology were continually advancing (Hiatt, 1963; Stiller, 1967; Major, 1971), although research facilities, because of the chronic insufficient support, were only improved step-by-step. For example, in 1961, after never-ending diplomatic activities, 1300 books and journal volumes were returned from Italy. Thus the library collection reached 2100 units. The following year, some books, journals, and basic laboratory equipment were assigned from the previous Institute for Experimental Biology in Zagreb. Most of the optical equipment was donated by German and Austrian institutions which held student training at Rovinj. Many efforts were made to enlarge the library acquisitions by a permanent exchange for 'Thalassia Jugoslavica' (Gamulin et al., 1964). In addition to the 'Bios', a motor boat 'Tunolovka', owned by the fish cannery 'Mirna', was also occasionally employed. In 1966, the first international meeting was organized by the Rovinj staff.

In 1962, the 'Ruđer Bošković' Institute from Zagreb had hired some rooms in the Institute's building and created its own Laboratory for Marine Radiobiology. It was modernly equipped and staffed by five scientists. In addition to fundamental studies on radioactivity in marine organisms and in the environment, the research of this unit, excellently supported by national and international agencies, especially by IAEA, was shortly expanded to fundamental studies of ecophysiology, productivity, and hydrography in the area. In part, this research was closely related and concurrent to environmental studies which were carried out by the staff of the academic Institute for Marine Biology. Tensions became inevitable and, therefore, a drastic solution was undertaken.

EXPANSION PERIOD

With the goal of an enhanced collaboration and elimination of duplication in research, the Laboratory of Marine Radiobiology and the Institute of Marine Biology in Rovinj, together with some other laboratories of the 'Ruđer Bošković' Institute in Zagreb, were united in 1969 and a new administrative research department of the 'Ruđer Bošković' Institute was created: 'Centar za istraživanje mora' (Center for Marine Research). At that time it was the largest marine research institution in Yugoslavia

(UNEP, 1977), which permanently employed about 80 scientists, 15 of them at Rovinj. Research was conducted in nine research units (laboratories) with working places both in Rovinj and Zagreb. The investigations covered almost all fields of fundamental oceanography. The Center enjoyed support from many national and international bodies, such as IAEA, FAO, WHO, UNEP, EPA, NSF etc. In 1971, the exhibition aquarium was readapted and modernized: 12 large basins made of fibreglass, and 7 concrete basins allowed the installation of an aquarium of a fairly modern concept with an open circuit of seawater. The same year, the Center hired additional laboratory space in the campus of the Rovinj Hospital for Bone Tuberculosis. The facilities for training graduate students and young scientists were enlarged to allow simultaneous teaching in two large rooms (practicums) with 25 and 40 working spaces, respectively.

In 1969, during a violent storm, the old boat 'Bios' was heavily damaged and sunk very near to the Institute's quay. Therefore, in 1971, a retired minesweeper was bought from the Navy. It was completely rebuilt and adapted for scientific research in 1972. In honour of an old folk-legend, and in memory of the first Croatian expedition cruises performed at the beginning of this century, the vessel was named 'Vila Velebita' (Fig. 4). By 1973–1974, the previous cruises were repeated, applying modern concepts in the field work (Zavodnik, 1979). Since the acquisition of this large vessel, the Center has been continuously engaged in the study of offshore waters in the north Adriatic (Gilmartin et al., 1972; Revelante & Gilmartin, 1976; Degobbis et al., 1979), in Rijeka Bay (Jeftić, 1981), and many other areas of the eastern Adriatic Sea (UNEP, 1983). In 1975, a new motor boat for coastal research named 'Burin' was acquired (Fig. 5). Several national and international meetings were organized during those years.

Fig. 4. Research vessel 'Vila Velebita'

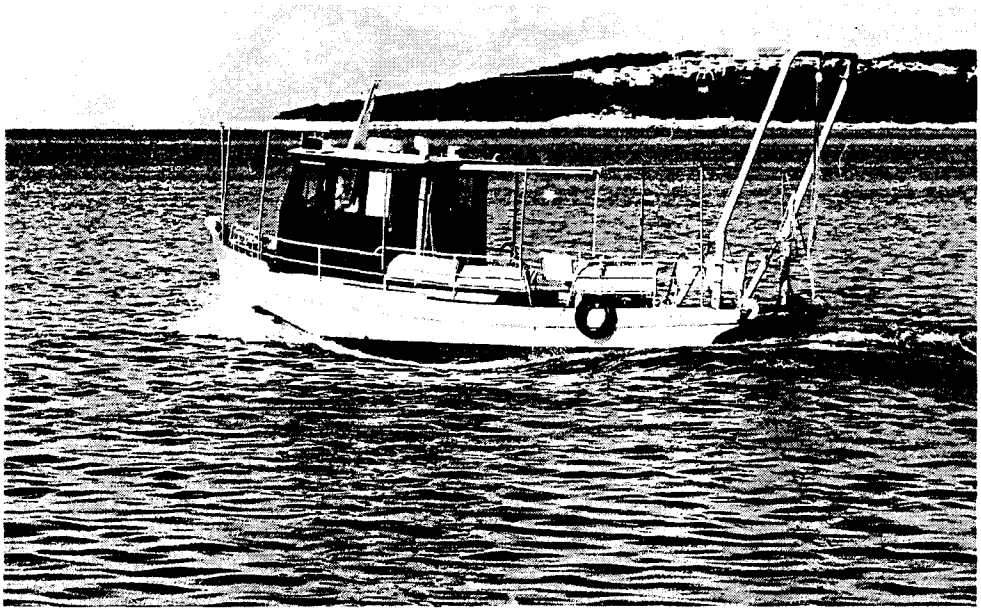

Fig. 5. Motor boat 'Burin'

Regrettably, sources of financial support began to diminish. In 1980, the Center had to move from the Hospital campus. The resulting drastic reduction in laboratory and auxiliary space caused severe difficulties for the continuation of scientific work and maintenance of other activities of the Center. Inevitably, it suffered a decline in research scope and training possibilities. Increasing difficulties regarding the management of the Center, caused by its having laboratories located far apart (in Rovinj and Zagreb), resulted in the emancipation of the Rovinj station, just as it occurred nearly twenty years ago. By the middle of 1980 it began to function as the 'Center for Marine Research Rovinj', and is up to the present day a self-governing non-profitmaking department of the 'Ruđer Bošković' Institute in Zagreb (Fig. 6).

PRESENT TIME

Initially, 30 scientists were appointed at the new Center, and the scientific work was organized in five research units: Laboratory for Ecology and Systematics, Laboratory for Hydrography and Primary Production, Laboratory for Radioecology and Ecophysiology, Laboratory for Marine Molecular Biology, and Laboratory for Mariculture. Continuous care has been paid to the acquisition of the most sophisticated equipment for laboratory and field research. Both the RV 'Vila Velebita' and MB 'Burin' were adapted to new demands; the Center ran field stations for fouling and aquaculture studies, and the aquarium pumping system was renewed. By 1991, the Center's residential house was

Fig. 6. Center for Marine Research Rovinj of the 'Ruder Bošković' Institute (1991)

built, a library building was thoroughly restored, and large installation repairs and adaptations for new laboratory space in the main building were initiated.

The Rovinj research station celebrated its 100th anniversary in what is now the fifth sovereign state it has gone through in its entire history: the Republic of Croatia. Today it is a modern and respectable marine institution in this part of the Mediterranean. It employs 35 graduated scientists, 6 technicians and 15 professional and auxilliary persons. Research is carried out in three units: Laboratory for Ecology and Systematics, Laboratory for Physics, Chemistry and Primary Production, and Laboratory for Ecophysiology and Toxicology. Basic research activities cover a wide range and include studies of hydrography of the northern Adriatic, marine flora and fauna, ecology with special references to benthic communities, primary productivity, phytoplankton variations in time and space, mechanisms of eutrophication processes, specific pollution studies, sanitary aspects of marine microbiology, ecophysiology, biochemistry, and molecular biology of marine organisms. Applied research is focussed on monitoring eutrophication and pollution in North Adriatic coastal and offshore waters. Several international projects, supported by universities, intergovernmental bodies and specialized agencies (UNEP, FAO, WHO etc.), are in procedure. The outburst of the recent war in Croatia has provoked, however, a temporary stagnancy of field research in the southern parts of the Adriatic Sea, but coastal and laboratory studies have not been affected.

The Center occupies a building at the seashore with about 750 square meters laboratory space; aquarium and auxiliary facilities occupy a 610 square-meter space. At the disposal of all project personnel and visiting scientists, are standard and sophisticated

laboratory facilities, the research vessel 'Vila Velebita', the motor boat 'Burin', and small boats with outboard motors.

The Center also maintains a library specializing in marine sciences. It has a collection of approximately 15 000 volumes and receives about 300 serial publications from all over the world. The library is especially rich in original old expedition reports. Until recently, the Center was also engaged in issuing the journal 'Thalassia Jugoslavica' which contributed articles in all fields of oceanology. Regrettably, due to the war, and political changes, the issue of the journal has been interrupted, and ended with volume No. 23 in 1991.

The Center in Rovinj is traditionally involved in the training of graduate and postgraduate fellows. About 600 students per year attend short courses, primarily in the field of marine biology. In addition, the show aquarium contributes also to the dissemination of marine sciences.

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