

Soviet Union really wishes to maintain its principles of international cooperation in fishing research and management so advocated by the speakers at the Exhibition, it would seem a graceful gesture if she would invite them to the preliminary discussions before undertaking any more modifications of the ecology of water-masses which communicate with the open ocean.

Meanwhile, there is at least one field in which the sophisticated apparatus of Soviet oceanological research is not triumphant. To monitor the presence of radio-isotopes of caesium and strontium with long half-lives, the scientists recommend not electronic instruments but the humble sprat, which, they say, absorbs the isotope quantitatively from sea-water with an accuracy comparable to that of the most modern equipment.

VERA RICH

Fisheries/Oil Report

A report has recently been issued on the first year's work of the Fisheries and Offshore Oil Consultative Group, which was established after discussions with the UK government by representatives of the fishing industry and the offshore oil industry. The group was established to exchange information on matters of general concern and to review developments in the offshore oil and gas resources, so that both sides could carry out their operations with as little disturbance to the other as possible.

One problem discussed was the notification of hazards such as the siting of drilling rigs and the laying of buoys. The offshore oil industry has agreed to provide more detailed information in future, and in addition the BBC will broadcast short messages on emergency hazards such as large drifting buoys and lost depth charges. It has also been agreed that navigational warnings will include Decca co-ordinates, which are of much greater value to the fishermen than latitude and longitude readings.

Another major problem has been the amount of debris lying on the seabed. The fishermen complained of catching their fishing gear on discarded drums and weights, on large unmarked anchors, and of abandoned ropes fouling propellers. The oilmen accept the problem, but it is mainly a problem of enforcing their guidelines, for example among the offshore supply boats. If the company responsible can be identified then compensation can be claimed from them. In other cases compensation can now be claimed from a voluntary compensation fund established by the offshore oil industry and administered by the three fishermen's federations involved.

The fishermen have also expressed concern over the risk of damage to submarine pipelines by bottom trawl gear,

and any consequent liability of the fisherman for the damage caused. So far there do not seem to have been any problems, but the oil industry advised that it was best in such a case to sacrifice the gear, and claim compensation from the owner of the pipeline. A research project is underway to assess the effect of trawl boards striking pipes, and the results are expected soon. (Copies of the Group's report can be had from; Department of Agriculture and Fisheries for Scotland, Room H635, Argyle House, 3 Lady Lawson Street, Edinburgh EH3 9DR).

Water Filter for Pollution Control?

George Cansdale, for many years associated with zoo administration and design, became interested in the problems of providing clean seawater when he was asked to help design a coastal project, now the Skegness Natureland Marine Zoo at Skegness in Lincolnshire. Although there are some good beaches in the area, there are also mud banks in the vicinity, and the inshore water is often turbid. George and his associate John Yeadon asked the architect and engineers to design a sub-sand intake to provide pre-filtered water for an open circuit. The principle was already in use in California, but they were told that it was impossible, something they were not prepared to accept.

So they accepted the challenge, and now, after many modifications, the device is commercially available from a company established by them, Sea Water Supplies Ltd, of Skegness.

The device consists of an open box, made of fibreglass, with a false bottom which screens the water take-off pipe. It is installed open end down in a hole in the sand or gravel. When a pump is attached to the take-off pipe, water is drawn up through the sand, which acts as a filter, and after a few hours clear water is produced.

Using this method the water has all suspended matter filtered out, and in addition the subsurface organisms act as a biological filter. Other advantages include the exclusion of egg and larval stages of organisms, the damping of diurnal and longer term temperature fluctuations, the minimal maintenance needed, and the fact that no further treatment is needed.

Up till now the main applications of the device have been for the supply of water for aquaria, and as a cheap source of rural water supplies, something for which there is likely to be a big export market. But the device has obvious uses in the field of pollution control. Not only does it filter out solids and reduce bacterial pollution, but it is thought it will also retain metallic ions on the sand by colloidal action. Perhaps someone should fund some work to explore the pollution control possibilities of the device.

Incidence of Shell Disease in Shrimp in the New York Bight

Incidence of shell disease in shrimp is as high as 30% in certain localities in the New York Bight. Gross examination and histopathological preparations revealed cracking and pitting of the exoskeleton, common characteristics of

crustacean shell disease, followed by necrosis of underlying tissue. Aquarium studies, which included tests of the effects of an antibiotic, indicated a possible infectious etiology. The disease may be related to pollution of the habitat by

organic wastes including cellulose.

The caridean shrimp, *Crangon septemspinosa* Say, though little used for human consumption, is known to constitute a significant link in the food chain of the inshore and estuarine environments of the east coast of North America (Price, 1962; Squires, 1965; Williams, 1965). Deriving nourishment from the smaller benthic organisms and detritus, they in turn are fed upon by predators which include many commercially important species such as weakfish, flounder, bluefish, kingfish, basses, skates and rays. (Minor, 1950; Fitz, 1956; Daiber, 1959; Hess, 1961; Kosaka, 1970).

While carrying out ecological studies on these shrimps in the New York Bight (Fig. 1), an intensely polluted area (Gross, 1972; Pearce, 1970; National Marine Fisheries Service, 1972), it was noticed that a substantial proportion of the population was affected by a disease characterized by rotting appendages and black erosions of the exoskeleton, (Figs. 2 and 3), somewhat similar to "burn spot" or shell disease observed in other Crustacea (Rosen, 1970; Sindermann, 1970; Young & Pearce, 1975). It is suspected but not proven that the disease is related to pollution. Schlotfeldt (1972) has shown that "black spot disease" (shell disease) in *Crangon crangon* is aggravated by the presence of the detergent tetrapropylenebenzolsulfonate in water. Occurrences of fin-rot disease in several species of fishes and pathological anomalies in larger crustaceans inhabiting the domestically and industrially polluted New York Bight have been reported (Mahoney *et al.*, 1973; National Marine Fisheries Service, 1972; Anon., 1972; Young & Pearce, 1975). It is possible that information on disease in smaller organisms, like the caridean shrimp, might provide additional insight into understanding the etiology and nature of similar or related diseases occurring in a variety of larger crustaceans and fishes which inhabit the Bight and adjacent waters, and will provide information about the impact of inshore contamination on food chain organisms.

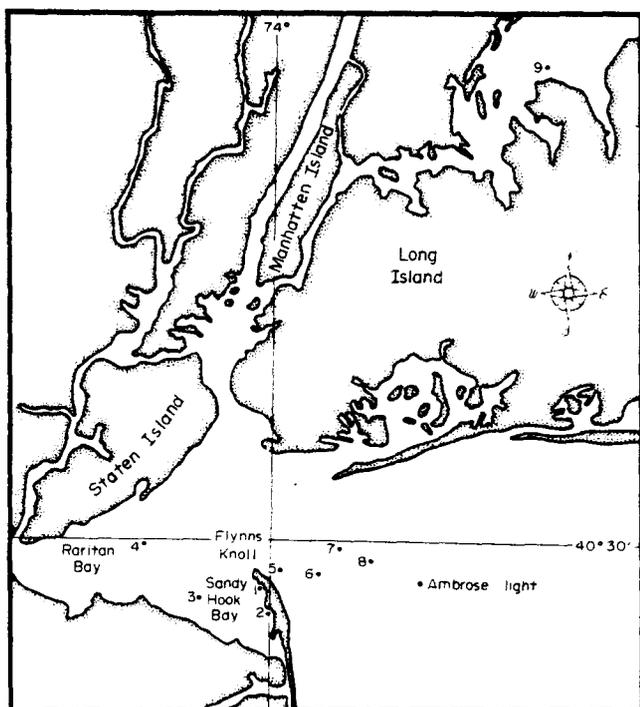


Fig. 1 Localities of stations where diseased shrimp were collected.

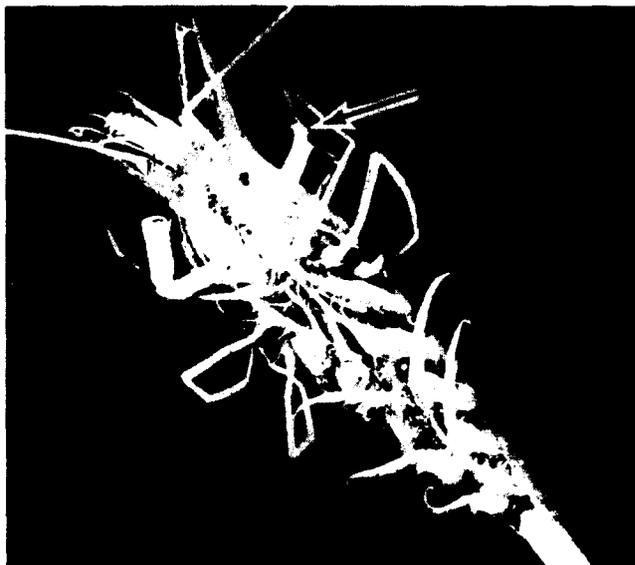


Fig. 2 Diseased shrimp; arrow indicates a rotted subchelate leg.

Materials and Methods

Samples were collected by the 36 ft. R/V *Xiphias* at a number of stations in the New York Bight during May–October, 1972 and 1973, including a sample from western Long Island Sound (Fig. 1). Usually, hauls of 10-min duration were taken at a speed of one knot using a 1 m epibenthic sledge rigged with a net of 0.5 mm mesh size. Samples were sorted on board and shrimp were brought alive to the laboratory, examined under a dissection microscope, and measured using a small measuring board. The total length referred to in this paper is the distance between the anterior end of the rostral spine and the most distal end of the telson. Part of the live sample was acclimated in large well aerated tanks and later transferred to 10 l. polyethylene containers for experimental purposes. Commercially available synthetic sea salt dissolved in distilled water to desired salinity, together with tetracycline hydrochloride (6.6 mg/l; 6600 ppm), was used in some tanks to determine the effect of an antibiotic on the disease.

Diseased appendages which had been fixed in Bouin's fluid for microscopic examination, were dehydrated in



Fig. 3 Eroded dactyl of nonchelate leg (150 X).

TABLE 1
Examples of numbers of diseased shrimp in epibenthic samples.

Location of sample	Numbers of shrimp sampled	Numbers of diseased shrimp	Date sampled
Station 1	56	6	15 June 1973
Station 2	294	25	15 June 1973
Station 3	42	6	15 June 1973
Station 4	94	29	27 Oct. 1972
Station 5, 6, 7, 8 (combined)	372	93	1 June 1972
Station 9	433	32	6 June 1972

isopropyl alcohol, embedded in paraffin, sectioned at 8–10 μm and stained with hematoxylin and eosin.

The Nature of the Disease

While recording length-frequencies in a sample of *Crangon* collected from Flynn's Knoll in May 1972, it was noticed that a considerable number of shrimp could not be measured accurately because their telsons had a truncated and burnt appearance. This prompted closer examination of the specimens, and it was observed that up to 30% (Table 1) had the burn or erosion at the distal ends of various appendages (Figs. 2, 3). Occasionally, dark brown to black areas or scars were also seen on the body surface. Numbers of diseased shrimp of various length groups have been represented in a length-frequency histogram of 373 specimens collected from four stations between Flynn's Knoll and Ambrose Light (Fig. 4) in order to show their distribution through a range of lengths. The percentage of diseased shrimp in different hauls taken in Sandy Hook Bay varied between 9 and 15. Seven % of the shrimp in a sample from western Long Island Sound was infected. Recent studies (Middle Atlantic Coastal Fisheries Center, 1974) suggest that this area is marginally to severely polluted. Diseased specimens were rarely encountered in 48 shrimp collected at Beaufort, North Carolina and 200 at Woods Hole, Massachusetts, areas without substantive pollution.

Histopathology

Microscopic preparations of the diseased parts revealed

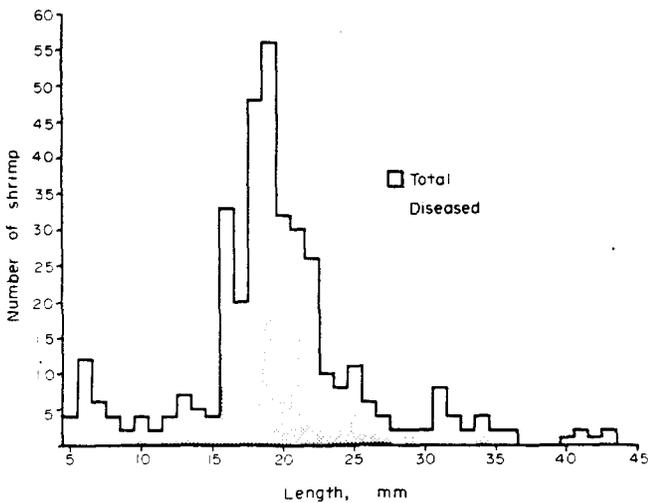


Fig. 4 Length-frequency distribution of total and diseased numbers of 372 shrimp combined from stations 5, 6, 7 and 8.

that all layers of the exoskeleton were eroded (Figs. 5A, B). Affected portions were brittle and fragmented readily when compressed under a coverslip on a microscope slide. Histological sections showed cracking and pitting of the calcified layers, similar to the type of erosion described by Rosen (1967) for shell disease in blue crabs. Epidermis was found to be necrotic beneath the eroded exoskeleton (Fig. 5C), and wherever the exoskeleton and epidermis were destroyed the inner tissues were also necrotic. Blood cells



Fig. 5 A. Section through the carpus of a rotted subchelate leg. B. Eroded exoskeleton in the area of articulation between the carpus and merus of a chelate leg, E = erosion. C. Necrosis of the epidermis underlying an eroded exoskeleton, N = necrosis.

were observed forming a covering clot or scab at the stump of a diseased appendage (Fig. 5A).

Observations in Aquaria

Diseased as well as normal-appearing individuals collected from Sandy Hook Bay were kept in equal numbers (20 each) in each of two sets of two aquaria, one set with natural sea water from Sandy Hook Bay, the second set with the artificial sea water containing tetracycline hydrochloride. Shrimp maintained in natural sea water were fed mysids, an item of their natural food (Price, 1962) that were collected from Sandy Hook Bay; shrimp held in the antibiotic medium were fed minced beef. Thus one set represented the natural marine environment and the other an entirely artificial medium. After six weeks it was observed that 50% of the initially healthy shrimp reared in natural sea water had become infected; in contrast none of the healthy individuals reared in artificial water fortified with antibiotic was infected. The erosion was also comparatively more advanced in diseased shrimp kept in the natural water. Crippled individuals were attacked and eaten by the healthy cannibalistic survivors. Eroded segments of appendages did not regenerate, even though the superficial burn spots on the body disappeared after ecdysis.

Discussion

This chitinoclasia of *Crangon* appears to fall under the general category of "shell diseases" which are manifested by the chitinolysis and erosion of the exoskeleton. The etiology of shell disease is yet to be rigorously established, although chitinivorous bacteria and fungi have been implicated as causative organisms (Rosen, 1970). Shell disease is generally found to be restricted to the exoskeleton (Sawyer & Taylor, 1949; Bright *et al.*, 1960; Rosen, 1967) although Young & Pearce (1975) have found the epidermis to be affected in crabs and lobsters. In the case presented here, the necrosis of underlying tissue was probably caused by the invasion of other pathogenic bacteria. There is considerable agreement among various investigators that the primary cause of shell disease is chitinoclastic bacteria that occur abundantly in environments where organic matter undergoes decomposition (Hess, 1937; Sawyer & Taylor, 1949; Rosen, 1967; Cook & Lofton, 1973). Exoskeletal lesions might harbour several groups of bacteria as well as fungi (Rosen, 1970) as the disease progresses. The inhibition of the rate of infection in the antibiotic medium suggests that the present disease may also be initially of bacterial origin, and the rapid infection in natural water shows the contagious nature of the disease.

In many of the eroded areas, especially where portions of appendages were missing, it is likely that the disease was induced by injury, whereby a scratch or irregularity on the exoskeletal surface would provide a place of anchor for chitinivorous bacteria, or a wound would serve as an entry route for other organisms causing necrosis of underlying tissues. However, other lesions were observed in which no trauma was evident prior to the establishment of the disease. Erosion and necrosis were frequently seen at the joints, for example.

Detailed observations were not made on the environmental factors contributing to the rate and intensity

of infection. The highly polluted benthic habitats of the New York Bight and Raritan Bay carry 6–13.8% organic matter originating from dredge spoils and sewage sludge in the superficial sediment (Gross, 1972). Such an environment might provide ideal substrata for bacterial growth. Coliform counts with MPN's as high as 920,000 per 100 g were found in such sediments (National Marine Fisheries Service, 1972). Furthermore, the suspended matter in these waters contains large amounts of detritus including cellulose (Manheim and Meade, 1970), which can be digested by several chitinoclastic bacterial (Benton, 1935).

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U. K. GOPALAN*
J. S. YOUNG†

National Marine Fisheries Service,
Middle Atlantic Coastal Fisheries Center,
Sandy Hook Laboratory,
Highlands, NJ 07732, U.S.A.

*Present address: National Institute of Oceanography, Cochin 18, India.

†Present address: Batelle, Pacific N.W. Division, Marine Research Laboratory, Rt. 2, Box 140, Sequim, WA98302, U.S.A.

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Effectiveness and Toxicity of an Oil Dispersant in Large Outdoor Salt Water Tanks

Use of the dispersant, Oilperse 43, increased the dispersion of Venezuelan Guanipa crude oil. The resulting mixture was more homogeneous and the oil slick less viscous than in the oil tank. The dispersant appeared to retard formation of the familiar "crust" on the surface. A weathered crude oil plus dispersant mixture with an oil concentration of 250 µg/l was lethal to over 50% of the test organisms, green sea urchins, within 4 days. No mortalities occurred among urchins exposed to the crude oil treatment.

During oil spills in Canadian waters, chemical dispersants can be used under special circumstances. To control their use, the Environmental Protection Service of the Department of the Environment prepared guidelines describing preliminary laboratory procedures for determining the effectiveness, toxicity and degradability of dispersants (Anon., 1973). These laboratory tests use fresh water and fingerling rainbow trout (*Salmo gairdneri* Richardson) as the toxicity testing system.

We conducted a 31 day experiment to determine the effectiveness and toxicity of a dispersant with crude oil in marine conditions, simulated using large-volume, outdoor tanks, and sea urchins as test organisms. The overall objective was to initiate a comparison between the fate and effects of dispersants under laboratory conditions and simulated field conditions, hence expanding the evaluation of dispersants tentatively designated in Canada as acceptable for combating oil spills. The specific objectives were: (1) to determine the effectiveness of the dispersant by comparing concentrations of petroleum hydrocarbons in

the water column of an oil and sea water tank and an oil plus dispersant and sea-water tank over the 31 day test period; and (2) to determine the acute toxicity of the undiluted solution from the respective tanks by estimating the LT_{50} 's (median lethal times) of the water to the boreal green sea urchin, *Strongylocentrotus droebachiensis*, in 4-day static tests.

Sea urchins were chosen as test organisms because of availability, presence in inshore areas, suspected sensitivity to changes in water quality and ease of maintenance in the laboratory. Previous studies demonstrated the acute toxicity and uptake of naturally dispersed petroleum oils with urchins and their eggs (North, 1967; Nelson-Smith, 1970; Allen, 1971; Scarratt & Zitko, 1972) and the short-term toxicity of a first-generation dispersant (BP1002) to urchins (Perkins, 1968; Smith, 1968). However, no known studies investigated the acute toxicity of oil plus dispersant mixtures to urchins, as well as the fate and toxicity of oil plus dispersant and oil mixtures at concentrations likely to be encountered in the area of a spill.

Methods

Experimental Design The experimental tanks were PVC-lined, metal-walled swimming pools, 12 ft in diam. by 3 ft deep, situated on the eastern shore of Bedford Basin. Approximately 8000 l. of surface water from Bedford Basin was pumped into the tanks and settled for 24 h prior to the experiment. The water level was 15 cm below the top edge. The temperature of the water was occasionally measured and dissolved oxygen was determined at the end of the experiment. Both tanks were fitted with siphons to allow