MICRONUCLEI, EVIDENCE OF CHROMOSOME ABERRATIONS, SEEN IN BLOOD CELLS OF FISH FROM CONTAMINATED WATERS

Compounds that are known or suspected mutagens or carcinogens have been found in marine waters. For example, several high molecular weight polynuclear aromatic hydrocarbons have been found in coastal sediments off southern California (see report on PAHs in marine sediments, this volume, p. 13). Marine animals can accumulate these foreign compounds in their tissues and may transform them into mutagens. Once in the tissues, the compounds can directly damage the hereditary material of organisms, the DNA found within individual cell nuclei.

However, few methods have been developed to detect the effects of mutagens in organisms living in contaminated environments. In this study, J. N. Cross and D. W. Diehl of SCCWRP, and J. E. Hose of Occidental College report on a test for micronuclei in the blood cells of fishes. They found that both white croaker and kelp bass taken from contaminated waters have higher levels of micronuclei, which are indicators of chromosome damage, than fish of these species taken from cleaner waters. And both species from the contaminated waters also showed reduced fertilizations success.

The micronucleus test offers promise as an indicator of exposure to mutagens. At this early stage of evaluation, it requires additional research on occurrence of micronuclei in marine organisms. Its advantages are that the test is rapid, sensitive and inexpensive, and requires minimal technical training.

Micronuclei are cytoplasmic chromatin masses that resemble small nuclei (Figure 1). These chromosome aberrations arise from lagging chromosomes during one phase of cell division or from acentric chromosomal fragments. They can occur in almost any dividing cell. Chromosome mutations or aberrations may involve whole chromosomes or segments of chromosomes bearing many genes. There may be abnormal numbers of chromosomes, structural alterations (breaks, gaps, inversions, deletions, translocations or duplications), or aberrations involving the mitotic spindle (abnormal segregation of chromosomes). The background chromosome aberration rate in marine organisms is estimated to be about 1 in 100, in contrast to the gene mutation rate, which is far rarer at 1 in 10 million to 1 in 100,000.

Micronuclei have been detected in marine organisms exposed to mutagens. In earlier work, J. E. Hose et al (1984) found that the incidence of micronuclei in embryonic cells of rainbow trout *(Salmo gairdneri)* exposed in the laboratory to benzo(a)pyrene was directly correlated with abnormalities in development. They also found that the number of micronuclei in the cells was dose dependent.

In this study, J. N. Cross and J. E. Hose investigated whether the occurrence of micronuclei in marine organisms

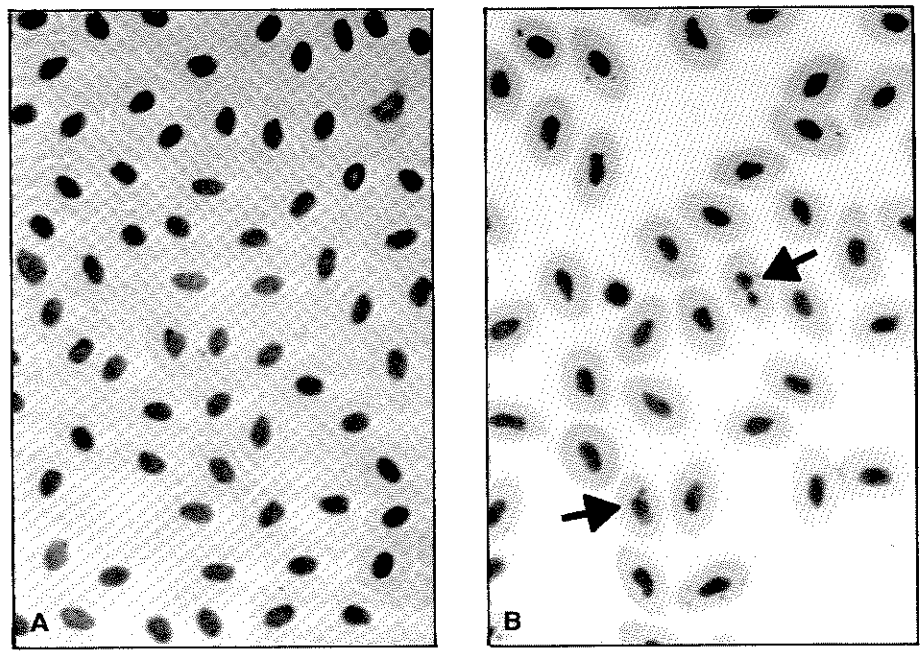

Figure 1. (A) Normal white croaker erythrocytes; (B) White croaker erythrocytes showing micronucleated cells.

in the field correlates with contamination of their environment. As part of a NOAA-funded study of the reproductive success of white croakers *(Genyonemus lineatus)* and kelp bass *(Paralabrax clathratus)* from highly contaminated and relatively uncontaminated sites near Los Angeles, they examined the frequency of micronuclei in peripheral erythrocytes and also measured fertilization success in gametes taken from these adult fishes.

As is evident in Table 1, both kelp bass and croakers from contaminated environments (White Point and outer Los Angeles Harbor, respectively) had significantly higher counts of micronuclei in their erythrocytes than did kelp bass and croakers taken from relatively uncontaminated sites (Catalina Island and Dana Point, respectively).

To test fertilization success, Cross and Hose collected fish from the sites and spawned them in the lab. Eggs judged successfully fertilized were those in which the researchers detected the swelling of the perivitelline space and raising of the chorion.

The researchers are now looking for growth effects in the adult fish. Also the micronucleus test was used to assess the toxicity of sea surface microlayer samples (this volume, p. 6).

Several questions need to be answered before the micronucleus test can be widely applied. For example, are there seasonal changes in the frequency of micronucleated erythrocytes in individual fish? Are there differences between sexes? Which contaminants induce formation of micronuclei?

Once these and other questions have been answered, Cross and Hose will evaluate the test and make recommendations for its use for routine monitoring of coastal waters.

		White Croaker		Kelp Bass	
		San Pedro Bay	Dana Point	White Point	Catalina Island
(A)	X	3.5	0.8	6.0	1.0
	SD	2.7	1.1	4.1	1.5
	N	28	28	5	5
(B)	X	79.4	86.7	32.5	68.2
	SD	16.3	13.4	15.8	10.5
	N	25	8	5	3

Table 1. **Number of micronucleated erythrocytes per 1000 cells (A) and percent fertilization (B) among white croaker and kelp bass from the coastal waters off Southern California in 1985-86. X = mean, SD = one standard deviation, and N = number of fish.**

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