EMP: Fallout over a naval EMPRESS

Since the Navy first announced its intent to build and operate an electromagnetic pulse (EMP) simulator in the Chesapeake Bay — one of the most productive estuarine systems in the world — there has been growing concern about the project's potential environmental impact. The most recent concerns appear in responses to a new environmental evaluation of the project, in strongly worded comments in a joint resolution by the Maryland legislature and in a lawsuit filed last week.

EMP is the rain of "Compton electrons" produced when gamma rays emitted by the detonation of high explosives — such as nuclear weapons — collide with air molecules. This electronic fallout will induce current or voltage surges through any electrically conducting material (SN: 5/9/81, p.300). While electrical equipment based on the old vacuum-tube technology is relatively immune to it, an EMP could literally fry sensitive electronic devices like those contained in computers, modern consumer electronics and communications systems.

The U.S. military's concern about EMP's possible incapacitating effects on weapons during a nuclear war launched a massive campaign to electronically shield all potentially vulnerable equipment (SN: 5/16/81, p.314). The Navy's proposed Electromagnetic Pulse Radiation Environment Simulator for Ships (EMPRESS-II) — an antenna system emitting simulated EMPs from atop a barge — would generate more realistic ("threat level") pulses than are now possible, to test how well shipboard electronics have been shielded.

Though in general EMP has been viewed as a problem only for electronics, a number of organizations are coming to question whether it is, in fact, biologically benign. In 1984, the Navy issued a draft "environmental impact statement" (EIS) on EMPRESS-II, as required by law for projects considered highly controversial or with the potential to "significantly affect the quality of the human environment." (There is a much smaller EMPRESS-I facility, for which an environmental assessment has not been done.) But the paucity of biological-effects data on EMP described in the EIS only generated more public concern.

So the Navy commissioned additional studies on potential short-term effects to aquatic life or waterfowl, and published these in a supplemental draft EIS, issued last December. Although the report does say there is evidence "to assure us that EMP has no effect on humans," official comments on this document, filed over the past six weeks, indicate significant public objections to EMPRESS-II still remain.

For example, the Environmental Protection Agency (EPA) reports that "we do not agree with the supplemental draft EIS that EMPRESS-II will cause no impact to organisms of the Chesapeake Bay." According to EPA's Feb. 27 letter, many questions EPA raised earlier about potential impacts of the project remain unanswered, and "statistics presented in the report do not clearly support the conclusions that were drawn."

EPA says that studies involving birds "were too limited . . . to allow definite conclusions," and that too few tests on oysters and crabs were conducted "to allow for any conclusions." Some of the reports of tests on fish not only are confusing and contain discrepancies, according to the agency, but also "lack sufficient data points for reliable statistical analysis." And it says it is possible that some boaters in the bay during EMP-simulation tests could experience a "brief painful shock."

Both Maryland and Virginia, states bordering the bay, strongly oppose siting the EMPRESS-II facility in the Chesapeake. Among Maryland's objections are complaints that: EMP effects on marine electronics have not been adequately assessed, "the Navy has prematurely discounted the effects of [EMPRESS-II's] operation on the Calvert Cliffs Nuclear Power Station" 20 miles away, and the EIS fails to project chronic or long-term impacts of zapping estuarine life with EMPs. Among Virginia's concerns are potential hazards to humans, including cardiac-pacemaker failures and electrical shocks.

Last week Jeremy Rifkin and his Washington, D.C.-based Foundation on Economic Trends joined the fray with the filing of a lawsuit asking the Defense Department to prepare a programmatic EIS on its entire EMP-simulation program. As a precedent, Rifkin cited a similar suit he won asking for an EIS on the Defense Department's biological weapons program (SN: 2/28/87, p.132). But in this suit, unlike the biological weapons suit, Rifkin is seeking to halt the EMP program until a program-wide EIS is completed.

The Navy says it is "inappropriate" to comment on the lawsuit prior to its resolution, but hopes to decide whether to proceed with EMPRESS-II by late summer. — *J. Raloff*

Tuning in to songbirds and their songs

Next to humans, songbirds have perhaps the most varied language repertoire of any animal. Recent studies of their brains and behavior are revealing singing secrets that may help scientists understand how birds — and humans — learn and use the melodies they make.

In the last decade, scientists have linked the size of certain regions of a bird's brain with its ability to sing. For example, one brain region in male canaries appears to grow during breeding season, when songs are used to attract mates and stake out territories from other males.

Recently, Sarah W. Bottjer at the University of Southern California in Los Angeles and her colleagues demonstrated that in the course of learning their species' song, baby male zebra finches show growth in one brain region while another region is diminished. Specifically, the caudal nucleus of the ventral hyperstriatum (HVc) increases its number of neurons by 50 percent during the 70-day maturing period; the magnocellular nucleus of the anterior neostriatum (MAN) loses half of its cells. According to Bottjer, this is the first demonstration in any animal species that one brain region grows at what appears to be the expense of another.

The loss of neurons in the MAN suggests to Bottjer that zebra finches are born with a wide capacity for possible notes and that later, once they've learned the species' songs, they discard the cells for notes they no longer need. This idea, which the researchers are now testing, is supported by other scientists' findings that baby zebra finches raised by different species learn the other species' songs and ignore zebra finch songs later in life. In addition, adult zebra finches appear incapable of learning new songs, according to Bottjer.

This trait is somewhat similar to the behavior of humans, in that the human capacity to learn languages diminishes considerably after puberty. Because of such similarities, Bottjer says she would like to examine human brains at postmortem to see if there is any evidence that the region involved in human vocal development gets smaller as children reach puberty.

There is evidence, however, that early in the 70-day maturing period, the MAN "is important for vocal learning," Bottjer says. She and her co-workers have found that when they damaged the MAN early in a zebra finch's development, its later vocal repertoire was diminished and the sounds it made were abnormal. But MAN lesions in older juveniles and adult birds had no effect.

"This suggests to us that there may be some [very early] function carried out in the MAN region," she says, "such as taking in auditory information or programming motor information with respect to vocal behavior." It appears, she adds, that HVc may be taking control of vocal behavior as the bird ages.

In the March JOURNAL OF NEUROBIOLOGY, Bottjer and her co-workers also report that early in a zebra finch's

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