

Today Sardinia, Tomorrow the World: Malaria, the Rockefeller Foundation, and Mosquito Eradication

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"We didn't mind what they thought as long as they let us in...."
-script from the film, "Adventure in Sardinia" (1948)

For most of us, mosquito eradication may be one of our secret hopes. At least in this instance, we might ignore biocentric arguments that remind us that these creatures, too, deserve a place in the great chain of being. The little brutes, after all, serve as fish fodder or bat fodder; swarms of them coax caribou herds to migrate each summer across the arctic plains -- in fact caribou lose so much blood during the mosquito season, that they must compensate by consuming extra calories and so transform arctic grasslands in the process. Mosquitoes undoubtedly occupy vital niches in ecosystems from the poles to the equator. Yet mosquitoes are almost never protected by environmental regulations. The U.S. Endangered Species Act, for one, does not apply to insects that are pests that pose an "overwhelming and overriding risk" to humans.¹ While working in the Rockefeller Archives Center this summer, I discovered that the mosquito war is alive and well when helicopters began spraying plumes of insecticide over New York City as a measure for controlling West Nile Virus.

Eradication is an old dream. Health officials, agriculturists, even nature enthusiasts have long set out to definitively rid the land of some its most noxious creatures. Together with mosquitoes, there are flies, roaches, ticks and other creepy-crawlers that people sought to exterminate either because they carried disease, devoured crops, or inflicted some other insufferable nuisance. Wolves have long been public enemy #1, and still are in many parts -- and the methods of exterminating them have been brutal and gory. When potato farmers saw their plants devoured by beetles, they tried covering the leaves with crude oil, red lead and molasses, Paris green, London purple, DDT -- or they resorted to simple finger-squishing -- all with the dream that Colorado potato beetles would vanish from the face of the earth forever.² Taken together, these creatures appearing on the "most-wanted" lists were often termed "vermin." If plants, they were called "weeds." *Introduced* animals and plants -- the aliens, invasives, and exotics -- have been favorite targets in organized eradication programs largely because native inhabitants readily witnessed the disruptions (or changes) to ecosystems brought about by the invaders.

Some eradication programs have been successful: the South American muskrat (or coypu) was eradicated from Britain in the 1980s; the Citrus blackfly from Florida in the 1930s; the Gypsy moth from Pennsylvania in the 1920s.³ Earlier, the dodo and

¹ <http://www.open-spaces.com/article-v5n3-davison.php>

² James Whorton, *Before Silent Spring: Pesticides and Public Health in Pre-DDT America* (Princeton: Princeton University Press, 1974), 17.

³ Clay Lyle, "Achievements and Possibilities in Pest Eradication," *Journal of Economic Entomology* 40 (1947): 1-8; John Sheail, "Government and the Management of an Alien Pest Species: a British

passenger pigeon were mistakenly eradicated, but this unplanned eradication is called "extinction." Eradication is purposeful, usually local, though ideally global. Fred Soper defined eradication as "the ultimate in species reduction and implies the world-wide extermination of a species."⁴

Soper was the mastermind of the Sardinian Project, a massive effort funded by post-World War II relief monies and administered by the Rockefeller Foundation for the purpose of ridding the island of malaria-carrying mosquitoes. Some 10,000 tons of DDT-mixture were doused on Sardinia between 1946 and 1951. The goal was to kill every last specimen of *Anopheles Labranchiae* on an island two-thirds the size of Switzerland, covering more than a million and a half separate swamps, springs, wells, and creeks or wherever mosquitoes survived and bred. At the height of this campaign, 32,000 DDT sprayers combed the island. This *Lotta Anti-Anofelica*, or mosquito battle as it was called, was really the last tactic in a string of battles against Sardinia's millennial struggle with malaria. Where malariologists around the world spoke of eradicating *malaria*, in Sardinia they spoke of eradicating *mosquitoes*. Sardinia was the first large-scale testing ground for ridding mosquitoes from the face of the earth. According to official sources, the project came to within 99.936 % of achieving success: they missed a few mosquitoes. Although the Sardinia Project successfully rid the island of malaria, mosquitoes still persisted there. Some purists considered the project a failure.⁵

Americans and Italians now generally celebrate the project as a stunning success, with village main streets across Sardinia being renamed Via Rockefeller during various commemoration events. Where in the 1930s more than 70,000 Sardinians suffered from malaria, in the 1950s, just three or four malaria cases persisted among all of the island's 1.2 million inhabitants. Killing mosquitoes had indeed killed malaria. But the question remains as to whether the Rockefeller Foundation was justified in seeking mosquito eradication. Precedent projects in the United States, in the South Pacific, Latin American and Africa, and in the Italian peninsula itself showed that malaria could be extinguished by killing many but not all mosquitoes; an 80 to 90% reduction in the mosquito population was sufficient to disrupt a malaria epidemic. Expenses and materials both could have been saved by eradicating the disease instead of the vector. Sardinian Project administrators estimated that in nearby Corsica, also plagued by malaria, just one-third to one-fourth as much DDT would be needed if the target was merely malaria instead of mosquitoes.⁶

Such issues were crucial in 1946, a year poised on the edge of the DDT age, an age when bothersome insects could be eliminated with the push of an aerosol-can button. Mere grams of the chemical could be diluted and sprayed into houses or over swamplands to continue killing mosquitoes and flies for months. Thousands of soldiers and civilians owed their life to DDT for controlling typhus and malaria epidemics, and the rest of the world was eager to share in this chemical's new benefits. But problems

perspective," in Marcus Hall and Peter Coates, eds., "The Native, Naturalized and Exotic: Plants and Animals in Human History," special issue of *Landscape Research* 28:1 (2003): 101-130.

⁴ Fred L. Soper, "Species Sanitation as Applied to the Eradication of (A) an invading or (B) an Indigenous Species," in *The Proceedings of the Fourth International Congresses on Tropical Medicine and Malaria*, Wash., D. C., 1948, 48.

⁵ John Logan, *The Sardinian Project: An Experiment in the Eradication of and Indigenous Malarious Vector* (Baltimore: The Johns Hopkins Press, 1953), 73, 104; *The Sardinian Project* (1948), Shell Film.

⁶ Logan, *The Sardinian Project* (1953), 194; John Logan to Leach, June 16, 1947, RAC 1.1 / 502 / 1 / 2.

with the miracle insecticide were already known or suspected. Most obviously, DDT was a poison, and anything that killed bugs might also kill fish and birds, sheep and people -- and there were published and private reports in Sardinia and beyond, that claimed DDT did all of these things.

The eradication question therefore centered on risk analysis: was malaria or insecticide more dangerous? In wartime, soldiers were assumed to face greater danger from malaria than from DDT. But the same might not be true in peacetime when there was less shooting and more time for planning. How did the Rockefeller Foundation justify subjecting Sardinians and their island to DDT concentrations that were 3 to 4 times higher than absolutely necessary?

Risks were certainly present. In July 1946, Fred Soper wrote to his Rockefeller Foundation colleagues that, "With regards to the Sardinian Project, there may be contraindications to the widespread use of DDT." Soper explained that at a recent meeting in California of Agriculture Entomologists, he had heard reports that animals eating forage treated with DDT, in turn produced milk with high DDT concentrations. He also relayed his private conversation at the recent meeting of the American Medical Association in which he was told of rabbits and birds dying after airplane application of DDT. Soper's correspondents, including Sardinian Project superintendent, John Kerr, showed a keen interest in these news items. A few months later, Kerr also inquired about the toxicity of the solvent used in the DDT emulsions arriving in Sardinia, noting that the label on the DDT barrels stated: "Avoid excessive inhalation and skin contact Do not use on humans." These scattered warnings, together with the wider evidence uncovered by Edmund Russell in U.S. War Department records, demonstrate that DDT risks were already on the minds of all thinking scientists and malariologists.⁷

Still, these risks were not communicated to the Sardinian public. The public notice tacked on village walls a day or two before DDT house-spraying squads arrived made it clear that there was very little to worry about. Small children, it stated, should not be allowed to stay in rooms being sprayed "because petroleum mist coming into eye contact may cause a little burning." Also, "food and water containers must be covered so that they don't take on the smell of petroleum." In bold letters it added: "One must keep in mind that in the quantities used, these sprays are absolutely harmless."

A little more than a year after Soper's letter about contraindications, Kerr quit his job as superintendent, being transferred back to the U.S. to work on other Rockefeller Foundation projects. The real reason for Kerr's resignation was not made public, with the official excuse blaming Kerr's health. In fact Kerr, although concerned about DDT risks, was even more troubled by the overwhelming challenge of directing a campaign aimed at killing every single *labranchiae* mosquito, whether adult or larva, across an enormous and rugged terrain. Kerr wrote to Soper that:

In my opinion, the organization of comprehensive anti-larva work in the portion of Sardinia which has an elevation of up to 1,000 meters is an

⁷ Fred Soper to George Strode, July 8, 1946; George Strode to Fred Soper, July 12, 1946, in Rockefeller Archive Center 1.2 / 700 / 12 / 104; John Kerr to George Strode, Jan. 22, 1947, in RAC 1.2 / 700 / 12 / 106; Edmund Russell, "The Strange Career of DDT: Experts, Federal Capacity, and 'Environmentalism' in World War II," *Technology and Culture* 40 (1999): 770-796.

impossible task. Call me a pessimist if you will, but the word impossible is in my vocabulary, and I intend to keep it there.⁸

Kerr and all malariologists knew that the Sardinia Project was premised on recent mosquito victories in Brazil and Egypt. In northeast Brazil in the late 1930s, and in northern Egypt in the early 1940s, Soper directed projects that successfully eradicated *Anopholes gambiae*, another species of malaria-carrying mosquito. In these cases, the mosquito was an exotic, introduced species from central Africa that was already feeding malaria epidemics. Relying on traditional pesticides like Paris green (which contained arsenic), Soper and his armies of sprayers tenaciously and meticulously eliminated every last trace of this mosquito -- and these projects were rapidly becoming legend. To ambitious malariologists, these local successes suggested expanding up the Nile and up the Amazon to cover subcontinental, even continental areas. Sardinia was the test case, or "experiment" as it was finally admitted, for trying eradication on a very large scale that involved a native mosquito endemic to the Mediterranean. Compared to its precedents, Sardinia was bigger, but then DDT was stronger. For people like Fred Soper, DDT offered an amazing opportunity to definitively eradicate mosquitoes. Today Sardinia, tomorrow the world.

But dissenters like Kerr protested that eradication of native mosquitoes was something entirely different. In his pessimistic note to Soper, Kerr added that, "The fact that *gambiae* was eradicated in Brazil and in Egypt without much thought having been given to ecology does not obviate the need for very careful studies regarding indigenous species of *anopheles* in other areas." Soper in response growled to a colleague that, "It is indeed to be regretted that the word 'ecology' was ever invented, or having been invented came to [Kerr's] attention." Soper also hoped that Kerr would "not get involved in studying too many non-essentials and collecting masses of data from which no conclusions can be drawn." Two months later under a new superintendent, the Sardinian experiment would continue for four more years to include an extended all-out campaign, with one Rockefeller Foundation officer mentioning that Foundation "prestige as well as word is involved." Another officer rejoined that, "The eyes of the world are on the Sardinian Project." As it turned out, ecology was at the center of Sardinia's mosquito eradication failure.⁹

Public health experts now refer to "malaria landscapes," which differ from region to region. In the tropics, malaria is fostered wherever humans settle new areas, cut down forests, build dwellings, and maintain open water sources. In Tanzania malaria is traditionally termed *mbu*; in Somalia the disease is called *canda-dilmaio*, with both words being synonyms for "mosquito" itself. But in Europe, the disease was long called swamp fever; or *paludisme* in French; *mal-aria* (bad air) in Italian -- all names associated with places more than mosquitoes. In tropical Africa, *Anopholes gambiae* spreads the disease, preferring domestic, human-modified habitats, breeding in open water containers. In temperate Europe, *Anopholes labranchiae* transmits the disease, preferring to breed in stagnant ponds with abundant aquatic plants. In short, targeting the mosquito makes good sense in the tropics, but targeting the habitat is a good strategy in

⁸ John Kerr to Fred Soper, June 6, 1946, RAC 1.2 / 700 / 12 / 104.

⁹ John Kerr to Fred Soper, June 6, 1946; Fred Soper to George Strode, June 22, 1946; Fred Soper to George Strode, June 28, 1946, RAC 1.2 / 700 / 12 / 104; D. B. Wilson to George Strode, Feb. 23, 1947, 1.2 / 700 / 12 / 106.

temperate climates. The most dangerous mosquitoes in the tropics hang out near villages, which can be sprayed for effective control; but dangerous mosquitoes in the Mediterranean can live anywhere, from villages to mountain tops. Malaria may really be a north-south issue. Due to different mosquito species, pesticides may be very useful in the jungle, but relatively useless everywhere else.¹⁰

Mussolini probably understood a good deal of mosquito ecology when he laid out plans for the "Bonifica Integrale," the massive drainage program designed to control malaria while producing arable farmland. Draining marshes and lakes, deepening rivers, embanking streams -- and any other method for getting water off the land -- were perhaps the first effective ways for controlling temperate malaria. Such habitat modification, together with low-priced quinine (the drug acting on the transmitted parasite itself), were the main reasons why Italy's malaria epidemics were already tempered when the Rockefeller Foundation arrived. As not often noted in official Foundation reports, from 1918 to 1940, government figures show Italy's malaria deaths decreasing by 96%, with Sardinia recording similar percentages over the same period: 3800 malaria deaths dropping to 138. There were still lots of malaria *sufferers* across Italy, and malaria incidence flared during the war with disruptions to drug distribution and drainage programs, providing a real need to address the rising malaria epidemic in 1945. But the Rockefeller Foundation's insistence on carrying out a mosquito-based rather than habitat-based malaria campaign did not make good sense, even with the appearance of a wonder insecticide like DDT. It made sense only if the project was an experiment.

Italy's own malaria experts, themselves international leaders in malariology, were divided over Rockefeller Foundation strategies. Italian scientists had unraveled some of the basic principles of malaria medicine, including co-discovering with their British colleagues the plasmodium parasite carried by the mosquito. Italy actually housed two malaria institutes; the older more established institute received generous support from the Italian government, while the other was born in the 1920s, again, from Rockefeller Foundation monies and counseled by an earlier generation of American experts. Partway through the Sardinian campaign, a number of Italian malariologists became more openly critical of the reliance on heavy DDT spraying. One of Sardinia's newspapers spoke disparagingly of what it called "American" methods aimed at eradication, while calling for more "Italian" methods aimed at killing only enough mosquitoes to disrupt malaria transmission. As DDT residues continued accumulating, Sardinians were becoming less convinced that they wanted their island to be the test case for mosquito eradication. If malaria biology divided north from south, malaria politics divided Italy from the United States.¹¹

In the field, Sardinians were seeing many more problems. Some farmers complained that their well water tasted bad after DDT spraying, and a few of them fired shots at sprayers. One sprayer even ate a bit of pure DDT in order to convince a farmer to allow him to continue spraying. Yet other farmers maintained that their sheep had been poisoned; bee keepers filed complaints about dead bees; fish farmers threatened court action when their fish died after airplane spraying. In some cases, these complainers were mailed the results of scientific tests showing that DDT was harmless.

¹⁰ M. Coluzzi, "Malaria and the Afrotropical Ecosystems: Impact of Man-Made Environmental Changes," *Parassitologia* 36 (1994): 223-27.

¹¹ John Logan Diary, Nov. 19, 1948.

The new superintendent spoke nervously about these accumulating law suits, but was finally relieved by court judgements, as the one in June 1949: "We have been completely exonerated from all claims by bee keepers.... [Moreover] The commission [for Damage Claims] agreed to settle no fish or land damage claims on a friendly basis as this would lead to a rush in clams." So the project certainly had its local supporters. But by then, morale was at a low point with mounting grassroots resistance, professional differences of opinion, and continued mosquito sightings even after heavy spraying that pointed to the likelihood of mosquito DDT-resistance. Even though malaria was almost completely gone from the island by 1950, the superintendent reported dejectedly that "the eradication of an indigenous vector is a far more difficult proposition than the eradication of an invader."¹²

In closing the Sardinia operations the next year, American administrators offered suggestions to Italian leaders for follow-up procedures on mosquito eradication. The Americans claimed that vector eradication, in the long run, would be cheaper than vector control, which required indefinite annual spraying and expenditures. There was also the understanding that the eradication campaign had pumped some 12 million dollars of labor and materials into a depressed Sardinian economy. But the Italians paid them almost no attention. "It was obvious from the beginning that [they were] not interested in further eradication," reported the superintendent at the last meeting with his Italian successors; "however, they gave our proposals a polite hearing and we have had the satisfaction of getting our views on record."¹³

Sardinia at the 50th anniversary of the Anopholes eradication campaign has become a favorite place for testing long-term DDT toxicity. Death rates and causes, cancer rates and types, are carefully tabulated, both for former DDT sprayers and for the Sardinian population. To date, there is no study that concludes Sardinians suffered from DDT-caused health problems. A battery of other tests beyond Sardinia that investigate links between DDT and human health suggest that DDT really isn't very dangerous to humans -- with possible, discreet exceptions for small children and lactating mothers. However, other studies demonstrate that small creatures are acutely affected by DDT, particularly fish and birds. And so DDT opponents have more grounds to focus on disruptions to ecosystems than on disruptions to human health. If DDT was or is useful for controlling malaria -- today's most widespread disease that kills a person every 14 seconds -- then we must really analyze risk: Risk from DDT, risk from substitutes like pyrethrum (while organic is measurably more toxic), risk from habitat changes like draining. Even supporters of POPs, the Persistent Organic Pollutants treaty currently being debated in the United Nations, have been considering risk, as they now generally agree that limited DDT campaigns can lower the chances that humans contract insect-born diseases.

Looking back at the Sardinia Project, one realizes that wetlands undoubtedly suffered under malaria programs that relied on drainage. The advent of DDT, and so a new reliance on spraying insecticides instead of draining marshes, in turn saved more than one wetland bird or fish or plant. Like the cartoon of whales in the nineteenth

¹² John Logan Diary, June 14, 1949; Excerpt from Trustees Confidential Report, Jan. 1, 1954, RAC 1.2/700 / 12 / 101; John Logan Diary, Oct. 18, 1948; June 14, 1949; Aug. 31, 1949.

¹³ Logan, Jan. 22, 1951; Logan, Feb.-March, 1951.

century who celebrated the first extraction of petroleum because they would no longer be butchered for their oil, many wetland creatures also had cause to celebrate the first demonstration that DDT ruthlessly killed some of humanity's most noxious insects. The invention of DDT meant that many wetlands could remain wet.

DDT did help control malaria around the world, thereby saving millions of lives. But the Rockefeller Foundation did submit Sardinians to DDT levels that were much higher than was necessary for extinguishing malaria. Padded by technological hubris and post-war hegemony, the Rockefeller Foundation knowingly took a risk -- a small risk to humans as it turned out, given the characteristics of DDT's toxicity. The Foundation had eradicated mosquitoes elsewhere, and it might have eradicated them on this island. But one must consider whether that risk was worth it, or whether Sardinians were aware of these risks or even of the real goal of the project; or why other islands lying closer to home, like Long Island, were not chosen as the experimental site for eradicating a native mosquito.

A last point: when in the 1950s the World Health Organization undertook global malaria control operations based largely on Rockefeller Foundation precedents, it made the decision not to attempt species eradication. The world was thereby saved metric tons of DDT. Living organisms everywhere were spared because of the results in Sardinia. For those of us living outside of Sardinia, we have the Rockefeller Foundation -- and Sardinians -- to thank for saving us the risk of 3 to 4 extra squirts of DDT.