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French nuclear tests in Polynesia

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Nuclear test explosions

After four atmospheric tests at Reggane, Algeria, in 1960–61, France continued its nuclear testing programme there even after independence in 1962, with 13 underground tests at In Ekker between 1961 and 1966 while its Pacific Testing Centre was being built. France then undertook 46 atmospheric nuclear tests in Polynesia from 2 July 1966. France refused US urging to sign the Partial Test Ban Treaty of 1963, which banned nuclear test explosions anywhere but underground; it continued atmospheric tests until 24 August 1974 (only China conducted atmospheric tests later, until 1980). Five of the atmospheric tests were safety tests of fission weapons; two of these produced small nuclear explosive yield (0.001 kt) (SCOPE 1999, Chapter 8, p. 241-2). The explosive yield of the 41 at or above ground nuclear explosions was 10.13 Mt (SCOPE 1999, Chapter 3, p. 27), with 6.5 Mt of this estimated to be from fission (SCOPE 1999, Chapter 4, p.60).

After a moratorium on nuclear tests from 1992-95, France conducted a final six underground nuclear tests - making a total of 147 - in 1995–96 in order to be able to continue developing new nuclear weapons without explosive testing, prior to signing the CTBT when it opened for signature on 24 September 1996 (Nic Maclellan, Jean Chesneaux. *After Moruroa: France in the South Pacific.* Melbourne: Ocean Press, 1998, p.102).

France's nuclear test programme was associated with an extreme level of secrecy about all its aspects and initially categorical denial of any health or environmental impacts. Intelligence agencies undertook sabotage of protest boats and infiltrated organizations opposed to nuclear tests. The French State went to the violent lengths of destroying with two mines the Greenpeace flagship *Rainbow Warrior*, on 7 July 1985, while it was moored in Auckland Harbour *en route* to Moruroa; the operation, which killed photographer Fernando Pereira, was reportedly sanctioned by President Mitterrand (Simons 2005). Two captured perpetrators returned to France after cursory detention, received military promotions, and one a military medal (Nic Maclellan et al. 1998, cited above, p. 215). Despite greater transparency since the end of the testing, piecemeal release of information, such as radioactive fallout measurements, has been drawn-out over decades.

Physical damage, leakage and tsunami risk

Tests were conducted at Moruroa (42 atmospheric and 137 underground) and Fangataufa (4 atmospheric and 10 underground) (Ruff 2016), two coral atolls atop extinct underwater volcanos in the Tuamotu Archipelago. Fangataufa was a closed atoll, so a 400m wide channel was made through the atoll. Most of the early atmospheric tests were performed on the surface or on barges in the lagoon, resulting in high levels of radioactive fallout (e.g., up to 1 Gy/hr up to 70 km from the 125 kt

Rigel explosion on 24 September 1966, SCOPE 1999, Chapter 4, p. 60-1), so most later tests involved warheads hanging under balloons several hundred meters in the air. The first two-stage fission-fusion explosion on 24 August 1968 at Fangataufa, was the largest explosion at 2.6 Mt (IPPNW and IEER 1991, p. 135).

Extensive physical damage to the testing atolls occurred, with subsidence and ongoing risks of collapse and leakage. The underground tests were detonated down 500-1200 m shafts drilled into the basalt underlying the coral and limestone of the atolls. Early tests were conducted under the atoll rim, until extensive fracturing and fissures in the coral and underlying basalt, subsidence and subterranean landslides necessitated use of the central lagoon. In the Tydee test, a 150 kt explosion beneath the reef at Moruroa was detonated on 25 July 1979, despite the device becoming stuck 800 metres down a 1,000-metre shaft. This caused a submarine landslide dislocating an estimated 110 million m^3 of coral and rock, resulting in a 3-metre wave which swept over the southern part of Moruroa and through the Tuamotu Archipelago (IPPNW and IEER 1991, p.145). In 1981 larger tests were moved to under the lagoon, and all tests were performed there from 1986 (IPPNW and IEER 1999, p.135-7).

Reports from 2011 and 2013 by the French Delegate for Nuclear Safety and Radiation Protection for Defense Activities (Délégué à la Sûreté Nucléaire et à la Radioprotection pour les Activités Intéressant la Défense, DSND) and France's Atomic Energy Commission (Commissariat à l'Énergie Atomique et aux Énergies Alternatives) (Departement de Suivi des Centres D'Experimentations Nucleaires, Ministere de la Defense et des Anciens Combattants. *Surveillance des atolls de Mururoa et de Fangataufa*, Vol. 2: *Bilan de l'evolution geomecanique des atolls de Mururoa et Rangiroa.* DO 312 CEA/DIF/DASE/LDG*,* 13 September 2013, p. 19) respectively acknowledge previous collapses of the outer wall of the atoll – carbonates, mostly limestone and dolomite, atop a basalt base. The reports note that even though the tests have ended, this type of event could happen again, particularly in three areas on the northeast flank of Moruroa, where six of 28 underground tests released radioactivity into the ocean through fissures in the basalt. The CEA envisaged a possible scenario of a landslide of some 670 million m^3 of rock, creating a 15-to-20 meter tsunami wave, swamping the east of the atoll and threatening neighbouring inhabited islands, estimates which continue to be stated in reports of ongoing monitoring of the physical integrity of Moruroa and Fangataufa (CEA 2021, p. 10).

Extensive abandoned equipment and materiel, radioactive, chemical and other waste on land, in lagoons and in the ocean remains both at the former testing sites and at a network of facilities and infrastructure supporting the massive nuclear weapons enterprise, including the military harbours in Papeete and Mangareva, and the huge staging base for the nuclear test programme at Hao Atoll, which became the largest military base in the South Pacific. This legacy was examined comprehensively for the first time under local control by a commission established by the Assembly of French Polynesia in 2005-6 (CESCEN 2006).

In 2006, the DSND revealed that between 1967 and 1982 large amounts of radioactive material were dumped in the ocean – 2,656 tons in two sites at Moruroa, and 532 tons at Hao (DSND 2006, cited above, pp. 20-1). The stated amounts, which are extremely difficult to verify, were 7×10^9 Bq of beta and gamma emitters and 6.7×10^{10} Bq of alpha emitters (predominantly plutonium) in Moruroa and 1.5×10^{10} Bq of beta and gamma emitters and 3×10^7 Bq of alpha emitters in Hao. Over time, all the waste on atolls and in lagoons becomes more difficult to monitor, recover or otherwise remediate, and will increasingly be released into the marine environment as a result of accelerating sea-level rise related to global heating and extensive test-related subsidence of Moruroa; whilst declining physical integrity, and storms and hurricanes of increasing intensity, accelerate its disruption and dispersal.

Despite extremely limited access and sampling opportunities, previous independent investigations have documented the presence of short-lived isotopes including iodine-131, tritium and caesium-134 in coral interstices and in lagoon sediment and plankton, indicating rapid leakage of fission products over a timeframe as short as days, not centuries or millennia as previously claimed by French authorities. In addition, more than 20 kg of plutonium is estimated to be scattered across the Moruroa and Fangataufa lagoons (IPPNW and IEER 1991, p. 143-9).

The efforts of governments to establish and license disposal sites for radioactive waste from other sources have been difficult and protracted, and worldwide no high-level radioactive waste repository is yet operational. In stark contrast, underground nuclear explosion sites effectively become unregulated high level radioactive waste repositories, in which the explosion which creates and injects radioactive materials also compromises the ability of the fractured and fissured underground environment to contain the materials (IPPNW and IEER 1991, p. 165). Nowhere is this more apparent than in coral atolls in a marine environment. Indefinite monitoring of such sites is required.

Fallout

Although tests were generally conducted when fallout would mostly be carried eastwards towards South America, Africa and Australia before reaching the western parts of the South Pacific, circling the earth in lower and middle latitudes, sometimes varying winds and high-pressure systems carried fallout westwards and northwards towards populated areas, neighbouring Pacific-island countries, New Zealand and Australia.

Fallout in French Polynesia/Maohi Nui

For example, following a test on 19 July 1974, the fallout from which travelled straight towards Tahiti, average total beta activity in air increased from less than 0.3 to 1,460 mBq per m^3 in the capital, Papeete (IPPNW and IEER 1991, p.143). Because of the presence, insistence and impatience of President de Gaulle, despite unfavourable winds to the west, an explosion on 11 September 1966 carried fallout directly towards populated areas (Danielsson 1990). In Apia, Samoa, 3,700 km downwind, as a result of rainout, total beta radioactivity increased from the usual level of around 200 megabecquerels (MBq) per km^2 to 370,000 MBq per km^2 after this test (IPPNW and IEER 1991, p. 143).

Fallout repeatedly contaminated the closest inhabited neighbouring islands of Tureia and Mangareva, where the population totalling 1,100 were repeatedly evacuated to shelters.

After years of intense secrecy and denial of adverse environmental and health impacts of the tests, information about fallout measurements has emerged incrementally. In 2006, the French military published estimates of radiation exposures for six locations for the six tests that it stated led to the highest fallout (DSND 2006, cited above, p. 9-12). The highest estimated effective doses after a single test were up to 10 mSv for infants in the Gambier Islands, and an average of 5.2 mSv for infants in Tahiti, 1,250 km away. External doses as low as 4.5 mGy (= 4.5 mSv in the case of external radiation) have been found to increase cancer risk in children (Matthews et al. 2013). Thyroid doses for infants of up to 80 mSv in the Gambiers and up to 49 mSv in Tahiti were estimated, again following single tests. Primary data and details of computational methods were not provided.

By way of perspective, these doses are within the range of anticipated thyroid radiation exposure for children under 18 years, along with pregnant and lactating women, warranting administration of stable iodine to protect against uptake of radioactive iodine (the threshold recommended by WHO (WHO 2017, p. 10) and by the US FDA (FDA 2001, p. 6) for those groups is 50 mGy. Independent researchers concluded that the limited data available likely miss areas of high exposure and probably underestimate the doses received (de Vathaire 2010).

French data on fallout provided to the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was summarised and incomplete (Drozdovitch 2021b). An IAEA evaluation of French retrospective radiation dose estimates in French Polynesia made clear it was unable to assess the validity of the data or calculated estimates provided (Philippe 2021, p. 4).

In 2013, 233 documents, over 2000 pages, on fallout from the tests were declassified by the French Ministry of Defence after a long legal battle between the French government and French and Polynesian test survivors' organisations (available at: https://moruroa-files.org/en/declassified-documents). To date, these have been utilised by researchers on cancer, especially thyroid cancer, in French Polynesia, and by the collaborative *Moruroa Files* project https://moruroa-files.org/en/.

A thorough independent re-evaluation of three of the tests has recently been undertaken (Philippe 2021 and discussed at https://moruroa-files.org/en/). They utilised data underpinning the 2006 official estimates in addition to data released in 2013. Five tests had previously officially been identified as most consequential for inhabited locations - the Aldebaran (2 July 1966) and Phoebe (8 August 1971) tests for the Gambier Islands; the Acturus (2 July 1967) and Encelade (12 June 1971) tests on Tureia atoll; and the Centaure (17 July 1974) test on Tahiti (no detailed official dose estimates have been presented for the other 35 atmospheric test explosions). Re-evaluations were undertaken for these and one additional test - Rigel on 24 September 1966.

The researchers used official data to reconstruct fallout clouds and their movement using the US National Ocean and Atmospheric Administration's HYSPLIT model, calculated doses for 1 year rather than 6 months, and re-evaluated data on water contamination and consumption. For Aldebaran fallout on the Gambiers, they estimate that radiation exposure from water contamination in the 2006 CEA estimates could have been underestimated by a factor of 20, and maximum effective whole body and thyroid doses for children and adults could have been underestimated by a factor of 2.5. For Rigel fallout, the factor was between 10 and 20. The Centaure test is particularly significant because although the plutonium bomb was only 4 kt in explosive yield, its fallout travelled directly towards Tahiti and neighbouring islands where 90% of the Polynesian population lives, resulting in revised effective doses, depending on age, between 10% and 120% higher than official estimates. About 90% of the Polynesian population may thus have received a dose greater than 1mSv in the first year after this single test.

For the other three tests for which official fallout estimates have been produced, the researchers found that maximum effective whole body and thyroid doses could have been underestimated by factors of 1.5 - 4 and 1.5 - 2.5 respectively (Philippe 2021).

These findings have important implications, since in nuclear test-related compensation claims in France, the adjudication process currently applies an effective radiation dose threshold of 1 mSv/yr. The findings described could enlarge the number of eligible applicants in Polynesia from 11,000 to more than 110,000 (Philippe 2021).

These findings highlight that fallout consequences of nuclear tests are not simply proportional to their explosive yield. Three tests contributed about 94% of the total radioactive fallout deposited in Tahiti from all 41 test explosions (Drozdovitch 2020). These findings also highlight the importance of independent evaluation in the face of what the researchers described as: "dose reconstruction studies that are at best incomplete and uncertain, and at worst systematically under-representative of levels of external and internal radiation exposures" (Philippe 2021, p. 20).

The same fallout reports, belatedly released in 2013, have also been utilised by health researchers examining thyroid cancer in Polynesia, contributing to an updated ground radionuclide deposition assessment, which produced deposition estimates due to beta activity in air and iodine-131 that are respectively 60% and 20% higher than those derived from official data provided to UNSCEAR (Drozdovitch 2020). The resulting revised thyroid dose estimates are significantly higher than the researchers' 2008 estimates by a factor of 3 for median and almost 2 for mean doses (Drozdovitch 2021a). People resident in the Gambier Islands during 1966-74 had mean estimated thyroid doses of 17 mGy, with a maximum of 36 mGy. They note that a child born in 1966 living in Tureia through to 1974 could have received a thyroid dose of up to 500 mGy.

Fallout in other regions

Fallout patterns are complex and variable, and hotspots can occur at considerable distances, particularly when rain or snow increase fallout intensity. Researchers have used the reports declassified in 2013 and other published reports to evaluate the fallout exposures from atmospheric French Pacific tests in other countries (Drozdovitch 2021b). They found that iodine-131 in cow's milk produced in Australia (Malanda), Peru (Lima, Tacna and Arequipa), Chile (Santiago), Bolivia (La Paz) and Madagascar (Antsiranana) in three years during 1966- 1972 was even higher than in milk produced in Tahiti; and that in 1968 thyroid radiation exposure was higher for one-year old infants in Peru (0.35 mGy) and Madagascar (0.30 mGy) than in Tahiti (0.25 mGy). In Oceania, the highest estimated thyroid doses were in Tahiti, followed by Samoa. Total beta concentration in air was almost twice as high in 1970 in Lima, Peru and in 1972 in Santiago, Chile than in Tahiti (Drozdovitch 2021b).

Health effects

In 2020 the French National Institute for Health and Medical Research (Inserm), issued a report: "Nuclear tests and health - consequences in French Polynesia", commissioned by the Ministry of Defense (Inserm 2020). The report concluded that the links between the fallout from atmospheric tests and the occurrence of radiation-induced pathologies cannot be established. However, the authors also stated that their "results do not make it possible to exclude the existence of health consequences" and recommend "to refine the estimates of doses received" by the local population.

Cancer

During the decades of the testing programme, protection, health monitoring and care of those at greatest risk were grossly neglected. Health data were inadequate – a cancer registry was only established in 1988. No medical follow-up was undertaken of the up to 13,000 Polynesians who worked in the test programme (CESCEN 2006, p. 135). Over the period 1986-2001, the incidence of acute myeloid leukaemia in French Polynesia was the highest in the world (Rio 2012). International Agency for Research on Cancer global cancer data showed that for the period 1998–2002, French Polynesian women had the highest rates of thyroid cancer and myeloid leukaemia in the world (Bouchardy 2011); both these cancers are among those most strongly associated with radiation exposure, and tend to peak earlier than most solid tumours.

A clear gradient of thyroid cancer incidence associated with the level of radiation to the thyroid from the atmospheric nuclear tests has been demonstrated (de Vathaire 2010; Xhaard 2014). Thyroid dose estimates have been improved, including with the additional official fallout data released in 2013 (Drozdovitch 2021a).

Ciguatera fish poisoning

An important environmental and health impact of the nuclear test programme in French Polynesia is outbreaks of ciguatera fish poisoning. Ciguatera is the most common type of toxin poisoning by marine foods worldwide, and is found across many tropical regions. It is a disease of the food chain, with microscopic dinoflagellate plankton producing toxins which concentrate up the food chain, producing sometimes severe and protracted illness. Fish most likely to be toxic are larger carnivorous inshore reef fish accessible to local people and prized for eating. The toxins cannot be identified by any simple means and survive cooking.

Ciguatera plankton preferentially proliferate on dead or damaged coral surfaces. Outbreaks of ciguatera have been associated with many types of damage to coral reefs, including blasting, waste dumping, construction activities and nuclear test explosions in French Polynesia, as well in the Marshall Islands and Kiribati. There is clear evidence of a dramatic rise to high levels of ciguatera cases in French Polynesia coincident with the testing programme, extremely high levels of toxicity at Moruroa and in the military harbour at Mangareva, and extensive outbreaks associated with coral reef damage from construction, shipping and waste dumping associated with the nuclear test programme. For example, during construction of the nuclear test staging base at Hao Atoll, a large outbreak affected almost half the population in 1968 (Ruff 1989). Ciguatera has important nutritional, social and economic implications, interfering with local inshore, largely subsistence, traditional fishing and increasing dependence on imported foods, with their exacerbation of risk factors for chronic disease (Tilman Ruff. Bomb Tests Attack the Food Chain. *Bulletin of the Atomic Scientists*, 1990, Vol. 46 (2): 32-4).

References

Bouchardy 2011	Christine Bouchardy, Simone Benhamou, Florent de Vathaire, Robin Schaffar, Elisabetta Rapiti. Incidence Rates of Thyroid Cancer and Myeloid Leukaemia in French Polynesia. *International Journal of Cancer,* 2011, Vol. 128: 2241-3. https://onlinelibrary.wiley.com/doi/epdf/10.1002/ijc.25545
CEA 2013	Departement de Suivi des Centres D'Experimentations Nucleaires, Ministere de la Defense et des Anciens Combattants. *Surveillance des atolls de Mururoa et de Fangataufa*, Vol. 2: *Bilan de l'evolution geomecanique des atolls de Mururoa et Rangiroa.* DO 312 CEA/DIF/DASE/LDG*,* 13 September 2013, pp. 5–53.
CEA 2021	Departement de Suivi des Centres D'Experimentations Nucleaires. *Surveillance des atolls de Mururoa et de Fangataufa.* Tome II: Bilan geomecanique, Annee 2020. N°182 DGA/DO/UM NBC/SCEN du 06 septembre 2021 CEA/DIF/DASE/LDG/62/2021/DO du 08 juin 2021 https://www.defense.gouv.fr/sites/default/files/ministere-armees/2020%20-%20tome%202%20-%20bilan%20géomécanique%20-%20surveillance%20des%20Atolls.pdf
CESCEN 2006	Commission d'Enquete sur les Consequences de Essais Nucleaire (CESCEN). *Les polynesiens et les essais nucleaires.* Deliberation No. 2005-072, Assemblee de la Polynesie Francaise, 2006. https://www.service-public.pf/wp-content/uploads/2017/09/CESCEN-2006.pdf

Danielsson 1990	Bengt Danielsson. Poisoned Pacific: The Legacy of French Nuclear Testing. *Bulletin of the Atomic Scientists*, 1990 Vol. 46 (2): 22-31, at https://www.tandfonline.com/doi/abs/10.1080/00963402.1990.11459794 . More detailed background can be found in: Bengt Danielsson, Marie-Therese Danielsson. *Poisoned reign: French nuclear colonialism in the Pacific.* 2nd revised ed. Ringwood: Penguin Books, 1986.
de Vathaire 2010	Florent de Vathaire, Vladimir Drozdovitch, Pauline Brindel, Frederique Rachedi, Jean-Louis Boissin, et al. Thyroid cancer following nuclear tests in French Polynesia. *Br J Cancer* 2010, 103**:** 1115-21. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2965871/pdf/6605862a.pdf
Disclose, SGS, Interprt 2020	Disclose, Princeton University's Program on Science and Global Security, Interprt. *Moruroa files*. https://moruroa-files.org/en/
Drozdovitch 2020	Vladimir Drozdovitch, Florent de Vathaire, Andr�e Bouville. Ground deposition of radionuclides in French Polynesia resulting from atmospheric nuclear weapons tests at Mururoa and Fangataufa atolls. *Journal of Environmental Radioactivity* 2020, 214-215: 106176 https://www.sciencedirect.com/science/article/abs/pii/S0265931X19306526?via%3Dihub
Drozdovitch 2021a	Vladimir Drozdovitch, André Bouville, Marc Taquet, Jacques Gardon, Tetuaura Tetuanui, Constance Xhaard, Yan Ren, Françoise Doyon, Florent de Vathaire. Thyroid doses to French Polynesians resulting from atmospheric nuclear weapons tests: estimates based on radiation measurements and population lifestyle data. *Health Physics* 2021, 120(1): 34–55. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7710602/
Drozdovitch 2021b	Vladimir Drozdovitch, Florent de Vathaire, André Bouville. Radiological Impact of Atmospheric Nuclear Weapons Tests at Mururoa [sic] and Fangataufa Atolls to Populations in Oceania, South America and Africa: Comparison with French Polynesia. *Asian Pac J Cancer Prev 2021,* 22 (3): 801-809. http://journal.waocp.org/article_89518.html
DSND 2006	Jurien de la Gravière Marcel. Les essais nucléaires français dans le Pacifique : Mission du délégué à la sûreté nucléaire et à la radioprotection pour les activités et installations intéressant la défense (DSND), Mai 2006. Paris, France: Ministère de la défense, May 2006. - 36 p.
DSND 2011	Délégué à la Sûreté Nucléaire et à la Radioprotection pour les Activités Intéressant la Défense. *Surveillance geomecanique de Mururoa.* 25 January 2011, pp. 1–6.
FDA 2001	Food and Drug Administration. *Guidance. Potassium iodide as a thyroid blocking agent in radiation emergencies*. Rockville MD: US Department of Health and Human Services, Dec 2001. https://www.fda.gov/media/72510/download
IPPNW and IEER 1991	International Physicians for the Prevention of Nuclear War and Institute for Energy and Environmental Research. *Radioactive Heaven and Earth: The Health and Environmental Effects of Nuclear Weapons Testing In, On, and Above the Earth*. New York: Apex Press 1991, at http://ieer.org/wp/wp-content/uploads/1991/06/RadioactiveHeavenEarth1991.pdf
Inserm 2020	Inserm. Essais nucléaires et santé. Conséquences en Polynésie française. Collection Expertise collective. Montrouge: EDP Sciences, 2020. https://presse.inserm.fr/essais-nucleaires-et-sante-consequences-en-polynesie-francaise-une-expertise-collective-de-linserm/42219/
Maclellan 1998	Nic Maclellan, Jean Chesneaux. *After Moruroa: France in the South Pacific.* Melbourne: Ocean Press, 1998.

Mathews et al. 2013	John D. Mathews, Anna V Forsythe, Zoe Brady, Martin W Butler, Stacy K Goergen, Graham B Byrnes, Graham G Giles, Anthony B Wallace, Philip R Anderson, Tenniel A Guiver, Paul McGale, Timothy M Cain, James G Dowty, Adrian C Bickerstaffe, and Sarrah C Darby. Cancer risk in 680 000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. *British Medical Journal* May 21, 2013 Vol. 346: f2360, at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3660619/
Ministère de la défense 2012	Département de suivi des centres d'expérimentations nucléaires : Suveillance de l'évolution géomécanique de Mururoa : Tome II. Evolution géomécanique : Bilan 2010 de l'évolution géomécanique des atolls de Mururoa et de Rangiroa. Paris, France: Ministère de la défense, 29 mars 2012, n° n°90/DEF/DGA/D0/UM NBC/SCEN. - 59 p.
Philippe 2021	Sébastien Philippe, Sonya Schoenberger, Nabil Ahmed. Radiation Exposures and Compensation of Victims of French Atmospheric Nuclear Tests in Polynesia. https://arxiv.org/pdf/2103.06128.pdf
Rio 2012	Bernard Rio, Laurence Heuberger, Gilles Soubiran, Robert Zittoun, Jean-Pierre Marie. Incidence rates of leukemia in French Polynesia. *International Journal of Cancer* 2012, Vol. 131 (6): 1486-7. https://onlinelibrary.wiley.com/doi/epdf/10.1002/ijc.27364
Ruff 1989, 1990	Tilman Ruff. Ciguatera in the Pacific: A Link with Military Activities. *Lancet* 1989; 1: 201-5 https://www.ncf-net.org/pdf/RuffCiguateraALinkWithMilitaryActivities.pdf; summarised in: Ruff 1990
Ruff 1990	Tilman Ruff. Bomb Tests Attack the Food Chain. *Bulletin of the Atomic Scientists*, 1990, Vol. 46 (2): 32-4.
Ruff 2016	Tilman A Ruff. The humanitarian impact and implications of nuclear test explosions in the Pacific region. *International Review of the Red Cross* 2016, 97(899):775-813. https://international-review.icrc.org/articles/humanitarian-impact-and-implications-nuclear-test-explosions-pacific-region
SCOPE 1999	Frederick Warner, Rene JC Kirchmann (eds), Scientific Committee on Problems of the Environment, International Council of Science (SCOPE 59). *Nuclear test explosions: Environmental and human impacts*. Chichester, UK: John Wiley & Sons, 2000. Can be downloaded chapter by chapter at https://scope.dge.carnegiescience.edu/SCOPE_59/SCOPE_59.html Links to the referenced chapters are provided in the text.
Simons 2005	Marlise Simons. Report Says Mitterand Approved Sinking of Greenpeace Ship. *International New York Times*, 10 July 2005. www.nytimes.com/2005/07/10/world/europe/report-says-mitterrand-approved-sinking-of-greenpeace-ship.html.
WHO 2017	World Health Organization. *Iodine thyroid blocking. Guidelines for use in planning for and responding to radiological and nuclear emergencies*. Geneva: WHO, 2017. https://www.who.int/publications/i/item/9789241550185
Xhaard 2014	Constance Xhaard, Yan Ren, Enora Clero, Stephane Maillard, Pauline Brindel, Frederique Rachedi, Jean-Louis Boissin, Joseph Sebbag, Larrys Shan, Frederique Bost-Bezeaud, Patrick Petitdidier, Vladimir Drozdovitch, Francoise Doyon, Carole Rubino, Florent de Vathaire. Differentiated Thyroid Carcinoma Risk Factors in French Polynesia. *Asian Pacific Journal of Cancer Prevention* 2014, Vol. 15 (6):2675-80. http://journal.waocp.org/?sid=Entrez:PubMed&id=pmid:24761883&key=2014.15.6.2675