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Hydrofoil: The history of a Cold War weapon-turned personal recreation gadget

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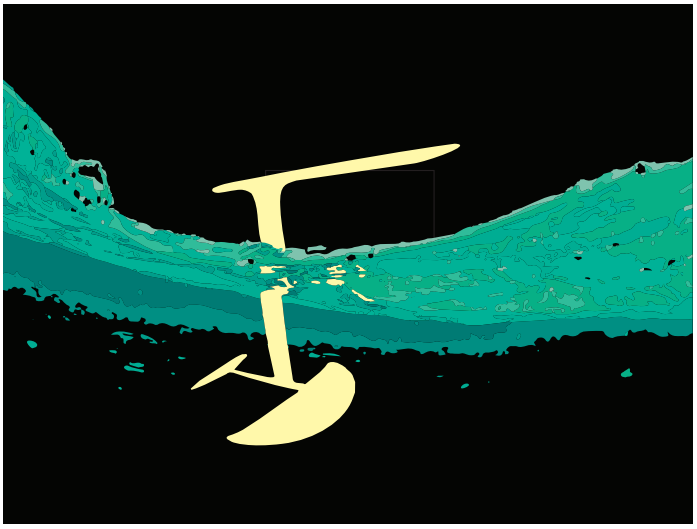
Abstract

The essay traces the history and impact of hydrofoil technology. Beginning with early pioneers like Italian inventor Enrico Forlanini, it discusses key developments like the US Navy's tests of Grumman and Boeing hydrofoils in 1969. It highlights military applications in the Cold War era and covers civilian uses like the Soviet "Raketa" ferries and Boeing's Jetfoil passenger hydrofoils. The essay then analyzes the ecological and ethical impact of hydrofoils, like the dangers posed by their high speeds to marine life and ecology. It then examines how recreational uses, like the foil surfboard, represent a shift toward more hedonistic motivations from utilitarian ones. A comparison is drawn between the hydrofoils and utopian visions of technology conquering nature and Li argues that overall, hydrofoils reflect an anthropocentric mindset of exploiting nature.

Figure I: Hydrofoil illustration by Yida "Rick" Li



Whether at the beach or on social media, hydrofoils are slowly growing in popularity. As the surfer glides across the water on their foil board, one cannot help but wonder what is happening beneath the surface. It seems as though the board is levitating above the water, defying the laws of physics. The surfer and the board seem massive compared to the minuscule proportion of the mast that supports them. It is intriguing the way the surfer effortlessly dances over waves that would typically capsize a surfboard and carves the surface of the ocean like a hot knife through butter.

How is all of this made possible? The answer is hydrofoil. Instead of the surfboard that flies above the water, hydrofoils fly underwater. A hydrofoil is a type of watercraft that uses wings, or foils, to lift the boat's hull out of the water and reduce drag, allowing it to achieve high speeds with less power. Shaped like airplane wings (airfoils), hydrofoils exploit the movement of water particles moving across their upper and lower surface to generate lift. Essentially, hydrofoils are airplanes taking flight underneath the surface of the water.

One of the earliest attempts to use hydrofoil was achieved by Italian engineer and inventor Enrico Forlanini on Lake Maggiore in 1906. Born in Milan, Forlanini was a pioneer in aeronautical engineering. The Italian inventor mounted foils vertically in the composition of a ladder, reminiscent of a multi-winged aircraft. Although just short of design expectations, Forlanini's hydrofoil craft reached an impressive 42.5 mph during his 1906 testing (Meyer and Wilkins 1992, 2).

In the spring of 1969, the U.S. Navy tested two design concepts of hydrofoil crafts built by Grumman Aircraft of Stuart, Florida, and Boeing Company of Seattle, Washington. The Grumman PGH-1 Flagstaff and the Boeing PGH-2 Tucumcari were fast-reacting, hard-hitting gunboats with high speed and rough water capabilities, and were expected to have great influences on future developments of naval vessels (International Naval

Research Organization 1968). Boeing's Tucumcari was particularly successful with its canard formation foils and waterjet propulsion system that allowed superb stability at high speeds and extremely low-maintenance power units. Both the Flagstaff and the Tucumcari took on patrol duties in Vietnam and were successful in gaining support from other nations in the North Atlantic Treaty Organization (NATO) to further the development of combat hydrofoils. The NATO Patrol Hydrofoil Missile (PHM) program ultimately produced six hydrofoil missile boats that followed closely the designs of the Tucumcari, despite the withdrawal of both Italy and Germany from the program. The PHMs proved to be particularly effective in combating drug smuggling in the Caribbean thanks to their fast reaction time and agility in coastal and open waters (Meyer and Wilkins 1992, 8).

Figures II[1] and III[2]: US Navy hydrofoil PHM3

Research on hydrofoils was progressing simultaneously in the rest of the world. The Canadian Navy conducted research centered around anti-submarine warfare since the stability of the hydrofoil proved it to be the smallest ship capable of sustained deep ocean operations. Completed in 1967, the resulting FHE-400 Bras d'Or is still the most sophisticated and advanced surface-piercing hydrofoil to this day (Meyer and Wilkins 1992, 9). Instead of conducting its own research, the Israeli Navy commissioned Grumman to build the Shimrit Class hydrofoils in 1977. The Shimrit was essentially a replica of the Flagstaff in its hull design and foil composition, though it was equipped with modern, upgraded propulsion and weapon systems (Meyer and Wilkins 1992, 9). Although the United States Navy did not halt its research and development on further hydrofoil models, the advancement of foil technology was largely restricted to theoretical studies after the PHM and the Jetfoil programs. The designs of the Corvette Escort, the Developmental Big Hydrofoil (known colloquially as the "Damn Big Hydrofoil"[3]), and the Grumman HYD Programs featured ambitious sizes, experimental foil formations, advanced and varied weapon equipment, and helicopter-carrying capabilities (Meyer and Wilkins 1992, 9).

However, hydrofoils were not limited to military purposes. Following the PHM program, the Boeing Company continued to apply its hydrofoil technology to passenger hydrofoils: the Jetfoil. Boeing built and sold around 30 Jetfoils until the cancellation of its marine division in 1987 (Timoleon 2004). Developed from the iconic gunboat Tucumcari, the Boeing 929-100 Jetfoils initially entered service as passenger ferries in Hawaii. After three years of service in Hawaii, the Jetfoils were acquired by Far East Hydrofoil of Hong Kong. Configured with 300 seats, the hydrofoils transported passengers across international waters between Hong Kong and then Portuguese Macau and remained in service to this day (Golubev 2020).

Like the Boeing Company's Jetfoil, many countries around the globe developed and employed their own commercial passenger hydrofoils. As a fast and efficient solution for mass transportation, the capabilities of hydrofoils played right into the sociopolitical landscape of the Soviet Union (USSR). Built on communist ideologies, the USSR aimed to achieve the perfect utopia where the collective overruled the individual through technological advancements. The cutting-edge hydrofoils

[1] "An aerial view of a hydrofoil patrol combatant missile ships reveals its foil moving beneath the water. Navy hydrofoils are regularly used on Joint Task Force 4 drug interdiction missions" by PH1(Ac) Scott M. Allen, 06/28/1990. Public Domain

[2] "A starboard bow view of the hydrofoil patrol combatant missile ship USS TAURUS (PHM 3), foil-borne. Navy hydrofoils are rzegularly used on Joint Task Force 4 drug interdiction missions" by PH1(Ac) Scott M. Allen, 06/28/1990. Public Domain

[3] "Damn Big Hydrofoil" was what the US Navy called their hydrofoil project because it was an application of foil technology on a larger vessel than there had been previously.

Figure IV: Boeing 929[4]

technological advancements. The cutting-edge hydrofoils were the perfect vessel to transport the collective across vast distances and serve as political propaganda to the avant-garde government determined to break off from the past and construct a society of the future. Launched in 1957 and shaped like a rocket, "Raketa" was the first passenger hydrofoil to serve the Soviet techno-utopia (Abrams 2012). After the unveiling of the Raketa, Soviet leader Nikita Khrushchev famously addressed: "Enough of stumbling around rivers in some rusty tubs. Let's travel in style!" (Abrams 2012). Later hydrofoils possessed the same space-age aesthetic, were equipped with airplane turbine engines, and could reach speeds of up to 93 MPH. The streamlined, futuristic hydrofoils were more than a method of transportation, rather, they were the manifestation of the Soviet's techno-utopia ("The Boats" 2023).

Hydrofoils also became popular in the world of sports and recreation, from sailboats to personal watercraft. Today, America's Cup is the pinnacle of foil sailing, equivalent to the status of Formula One in the motor racing world. In 2023, the AC75 monohull, which is a hydrofoil racing yacht, will compete in the 37th America's Cup in Barcelona, Spain. Manned by a crew of eight, these incredibly sleek sailing yachts ride on hydrofoils at more than 60 MPH when aloft ("Born in the USA" 2023). As technology advances, the AC75 is bound to push the boundaries of hydrofoil sailing.

[4] "Kansaikisen Boeing 929 jet7" © spaceaero2 (https://openverse.org/image/dc1f472a-79c6-4b26-8398-f8be-a00ff571?q=boeing%20929) CC BY 3.0.

Figure V: Russian Passenger Foil[5]

In recent years, the hydrofoil has gained popularity as a personal, recreational device, particularly in the form of foil surfboards. Foil boards, which are surfboards with hydrofoils attached to the bottom, allow riders to glide above the surface of the water. Compared to traditional surfboards, foil boards are less limited by the environment in which they are deployed. The performance of a conventional surfboard is extremely dependent on the wave conditions, which are unpredictable due to geography, climate, weather, and more. A foil board, on the other hand, requires minimal current to take off from the ocean surface. With the adequate technique, a foiler would even be able to fly above water in completely flat conditions by pumping the board in a sinusoidal motion. Foil board companies have furthered this technology by developing what is known as the e-foil – a hydrofoil board driven by electric motors – completely eliminating the the need for human labor in propelling the device (Shore 2001).

From military vessels to public transportation to personal watercrafts, hydrofoil technology represents a novel and unique way in which mankind interrogates its relationship with the natural world. The hydrofoil's design and functionality depart from conventional norms of water transportation and offer a new way to understand watercrafts. Rather than traveling through the water in the way a ship's hull would, the hydrofoil navigates on the ocean's surface.

[5] "Raketa Hydrofoil Ship. Moscow" © Andrey Korchagin (https://flic.kr/p/u3Cg8S) CC BY-SA 2.0 DEED

Figure VI: America's Cup foil[6]

Figure VII: Personal foil[7]

However, as yet another medium for humans to navigate nature, the hydrofoil's role is rather an anthropocentric one. Although successful as transportation vessels around the world, hydrofoils are not without drawbacks, especially when it comes to marine life. As sea traffic increased worldwide, whales fell victim to the ships and ferries. Between 1975 and 1996, 14 percent of whale strandings observed along the US East Coast were attributed to vessel collisions. Each year, near Chesapeake Bay, one-third of deceased humpback whales could be traced back to fatal collisions with ships. Off the shores of Southern California from 1975 to 1980, there were a total of 12 reported collisions involving Eastern Pacific gray whales and ships. Fast ferries were among the few common ship types responsible for 89% of lethal or severe injuries from ship collisions (Shore 2001). Operating close to shore at high speeds, hydrofoil ferries could pose a deadly threat to local marine mammals with their rapid-moving, underwater blades.

On the other hand, the use of foil boards as a personal recreational device represents a shift in the way mankind interacts with nature from a utilitarian motive to a hedonistic one. With the rise of hydrofoils, it has never been so easy for humans to turn nature into a playground. Departing from "old-fashioned" surfboards which relied largely on the temper of the ocean, electric-driven e-foils have become a device that eliminates human reverence for the elements. With foiling rapidly gaining popularity, surf culture—which centers around skill, patience, and reverence for the ocean—will be facing its biggest challenge yet.

Overall, hydrofoil technology represents a new way for humans to interact with nature, and the significance of hydrofoils on the world is manifold. On one hand, the hydrofoil is the fast maritime transportation solution of the future with a promise of efficient global connection; on the other hand, the advancing technology gives humans the ability to further capitalize on Earth's ecosystem. Under an anthropocentric motive, hydrofoils easily become vessels through which humans exploit the natural world for their selfish gains. Riding on foils allows mankind to traverse Earth's waters and transforms the ocean into a free-for-all playground. At the same time, whale calves are run over like squirrels under car wheels as humans show little respect for the natural environment and its inhabitants. Similar to the way Soviet idealists envisioned, hydrofoils are destined to become a medium through which mankind ultimately annexes the planet's ecosystem and creates an anthropocentric techno-reality in its wake.

[6] America's Cup Foil © Robert Couse-Baker (https://pxhere.com/en/photo/284808). CC BY 2.0 DEED

[7] "Jet Surf (Jetsurf) or Fliteboard - Electric Hydrofoil Surfboard in Haven marina of Phuket island, Thailand" © Phuket@photographer.net (https://flic.kr/p/2hxArUF) CC BY 2.0 DEED

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