PNNL-27113

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Unmanned Systems and Platform Options for Environmental Studies

4 December, 2017

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U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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04 December, 2017

This work provides examples of Air, Ground, and Waterborne Unmanned Systems that could be utilized in a wide variety of missions associated with the goals of the environmental studies community. Specific uses or instrument deployments will not be speculated or described in this paper; however a wide range of Unmanned Systems with different form, function, endurance, and payload capacity will be presented to provide the reader with a broad spectrum of available Unmanned Systems available today. This information is intended to serve as a "quick reference guide," and it may also serve to spur thoughts for creative implementations to achieve various missions.

Unmanned Systems have been categorized in a wide variety of sets and subsets over the past 20 years. Each branch of the U.S. armed forces has, at one time or another, tried to set the standard designations for vehicles of different size, type, operational characteristic, purpose, weight class, mobility, or tactical use. Charts abound with prefix terms like "mini," "micro," "medium," "heavy," "tactical," "portable," "combat," "high altitude," "low altitude," "battalion level," "squad level," "littoral," "group 1,2,3,4,or 5" "persistent," "penetrating," etc. The spectrum of vehicles that have been developed (or converted) to unmanned systems covers an impressive variety of sizes, functions, and forms. Classifications can be helpful when managing overarching programs but ultimately it is left to the user to look at the specific mission needs and match those with the specific capabilities offered by a given vehicle – or set of vehicles. This report will categorize Unmanned Systems by the media in which they operate – Air, Ground, or Water. Subcategories of Unmanned Airborne Systems (UAS) will include: Fixed Wing, Rotorcraft (Helicopters), Multi-Rotors, Lighter-Than-Air (LTA) and Unconventional. The ground based and waterborne categories will each be presented by vehicle name in alphabetical order.

The vehicles and systems featured in this report are displayed in tables with a common format used in all classes. Access to an electronic copy of this report might allow the user to export the tables into Microsoft Excel to allow sorting and comparison between vehicle options. The electronic version of this report also features links to websites and video pages that provide further detail of each system. Most of the tables are complete, however some specifications for some vehicles were either not available, or required more time to acquire than this effort allotted. If a reader finds a specific vehicle – or just a class of vehicles of interest, the author welcomes the opportunity to provide further information about that system (or class of systems) in a follow-on effort to support program goals (please contact: je.smart@pnnl.gov).

The list of vehicles in this report is not “all inclusive.” There are many vehicles that are not featured. Some of the vehicles featured are built under U.S. Government programs of record and are available only through coordination with the U.S. DOD. Acquisition of systems that are programs of record tends to be expensive, but similar vehicle systems that are commercial competitors are often available for less cost. Sometimes researchers find that they do not need all of the robust attributes associated with militarized hardware. Other times cooperative arrangements can be formulated to co-support missions and vehicle use.

This document also includes vehicles that will not be found in most official assessments of Unmanned Systems. Unique vehicles that were built for research, or have been built for commercial or hobby use are included; especially when they present an interesting niche capability. Other vehicles where builders have incorporated complementary capability sets have also been included to help potentially spur creative applications. Examples include vehicles that can fly and “swim;” or can fly and drive. This diversity should provide the reader with enough information to conclude that almost any form of transport or combination of transport can be accomplished with Unmanned Systems. Affordable commercially sold technology is now available that allows engineers to convert almost any working vehicle into an unmanned system. Ground based driving systems, surface marine and small airborne vehicles are regularly converted into unmanned and autonomous systems.

Acronyms

AGL	Above Ground Level
AMSL	Above Mean Sea Level
BLOS	Beyond Line Of Sight
EO	Electro Optical
Ft.	Feet
GHz	Giga Hertz
HP	Horse Power
ICE	Internal Combustion Engine
IR	Infrared
Kg	Kilograms
KPH	Kilometers Per Hour
KTAS	Knots True Air Speed
KW	Kilowatts
kWh	Kilo-Watt hour
Lbs	Pounds U.S.
LOS	Line Of Sight
M	Meter
MPH	Miles Per Hour

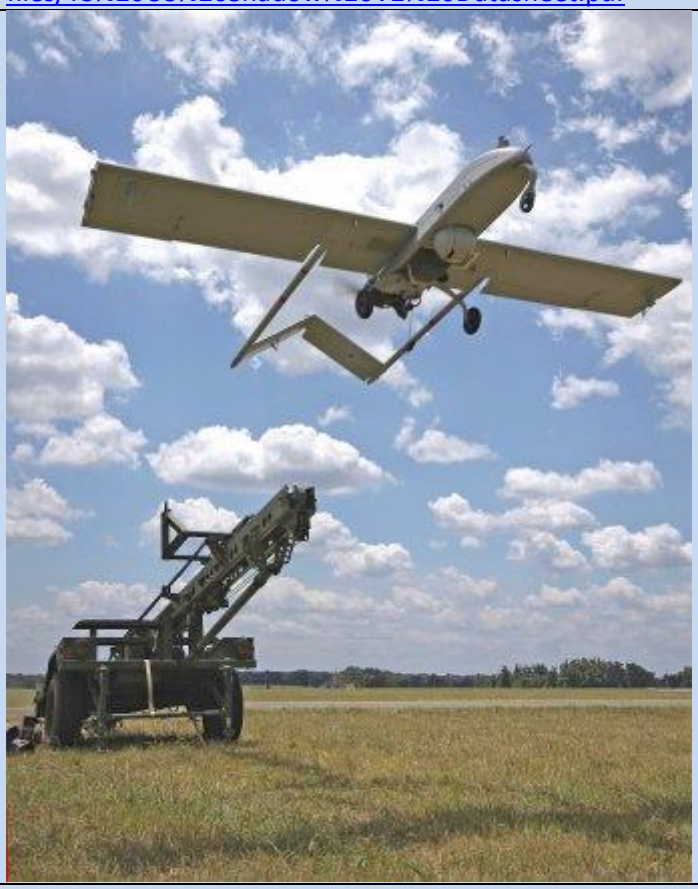
Unmanned Airborne Systems

Fixed Wing

Vehicle Name	Avenger - Predator C- RPA (Remotely Piloted Aircraft)
Manufacturer / Country	General Atomics / USA
Produced	2009
Cost	$12M - $15M
Width / Wingspan	66ft (20m)
Length	44ft (13m)
Height	
Max. Gross Take Off Weight	18,200 lbs (8,255 kg)
Maximum Payload Weight	1,400kg (3000 lbs)
Fuel / Battery / Propulsion	JP-8 ; turbine
Endurance	18 hours
Speed	400 KTAS (Knots True Air Speed)
Radio Range	global
Launch Method	runway
Max Surface Wind	-
Operating Altitude (typ.)	50,000 ft. (15,240 m) AMSL Max. (maximum altitude above Mean Sea Level)
Maximum Launch Altitude	-
Full Specifications Link	http://www.ga-asi.com/predator-c-avenger http://www.ga-asi.com/Websites/gaasi/images/products/aircraft_systems/pdf/Predator_C021915.pdf
Image	
Video Link	http://www.ga-asi.com/predator-c-avenger https://www.youtube.com/watch?v=9-Km2pe0B3o https://www.youtube.com/watch?v=xCKG5DMGV10

Vehicle Name	Firebird – optionally piloted UAV
Manufacturer / Country	Northrop Grumman / USA
Produced	
Cost	
Width / Wingspan	79.2 ft (24.1 m)
Length	34.4 ft (10.5 m)
Height	10.6 ft (3.2 m)
Max. Gross Take Off Weight	7,312 lbs (3,316 kg)
Maximum Payload Weight	600 lbs (272 kg)
Fuel / Battery / Propulsion	TEO-540 Flat-Six piston engine – 360 HP
Endurance	15.5 hours manned / 26 hours unmanned
Speed	160 KTAS (184 MPH or 296 KPH)at 20,000 ft. (6,096 km) max
Radio Range	
Launch Method	runway
Max Surface Wind	
Operating Altitude (typ.)	25,000 ft AMSL (7.62km)
Maximum Launch Altitude	
Full Specifications Link	http://www.northropgrumman.com/Capabilities/Firebird/Documents/data_sheet_Firebird.pdf
Image	
Video Link	http://www.northropgrumman.com/MediaResources/Pages/ytVideo.aspx?ytid=9hTwSmb4vMg

Vehicle Name	**Arcturus T-20**
Manufacturer / Country	Arcturus – UAV, LLC / USA
Produced	2009 - present
Cost	(3 aircraft, GCS, Catapult launcher, support trailer)
Width / Wingspan	17.5 ft. (5.33 m)
Length	9.5 ft. (2.9 m)
Height	
Max. Gross Take Off Weight	185 lbs. (84 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	ICE (Internal Combustion Engine)
Endurance	10-20 hours
Speed	86 MPH (138.4 KPH)
Radio Range	55 miles (88.5 km) LOS (Line Of Sight)
Launch Method	Catapult
Max Surface Wind	
Operating Altitude (typ.)	7,620 ft. (2322 m) rated; 25,000 (7,620 m) proven
Maximum Launch Altitude	
Full Specifications Link	http://arcturus-uav.com/product/t-20
Image	
Video Link	https://www.youtube.com/watch?v=U7p63crA4AE

Vehicle Name	RQ-7 Shadow V2
Manufacturer / Country	Textron Systems / USA
Produced	2002 – present (with variants)
Cost	
Width / Wingspan	20.4 ft. (6.21 m)
Length	11.2 ft. (3.41 m)
Height	3.3 ft. (1 m)
Max Gross Take Off Weight	
Maximum Payload Weight	95 lbs. (43 kg)
Fuel / Battery / Propulsion	Single ICE, pusher prop (Internal Combustion Engine)
Endurance	9 hrs.
Speed	81 MPH (130.2 KPH)
Radio Range	77 miles (124 km) LOS (Line Of Sight)
Launch Method	catapult
Max Surface Wind	
Operating Altitude (typ.)	18,000 ft. (28,968 km) AMSL Maximum
Maximum Launch Altitude	
Full Specifications Link	http://www.textronsystems.com/sites/default/files/resource-files/TS%20US%20Shadow%20V2%20Datasheet.pdf
Image	
Video Link	http://www.textronsystems.com/what-we-do/unmanned-

Vehicle Name	Scan Eagle
Manufacturer / Country	Boeing / USA
Produced	April 2002
Cost	
Width / Wingspan	122 in. (309.8 cm)
Length	60 in. (152.4 cm)
Height	
Max. Gross Take Off Weight	44 lbs. (20 kg)
Maximum Payload weight	22 lbs. (10 kg)
Fuel / Battery / Propulsion	Pusher prop piston engine converted to operate on JP-5 aircraft fuel.
Endurance	Over 24 hours
Speed	55 MPH (88 KPH)
Radio Range	
Launch Method	Catapult
Max Surface Wind	
Operating Altitude (typ.)	19,500 ft. (5,943 m) AMSL
Maximum Launch Altitude	
Full Specifications Link	http://www.boeing.com/history/products/scaneagle-unmanned-aerial-vehicle.page
Image	
Video Link	https://www.youtube.com/watch?v=6wSQSDi__-Q

Vehicle Name	Stalker eXtended Endurance (XE) (propane fuel cell)
Manufacturer / Country	Lockheed Martin / USA
Produced	2006
Cost	
Width / Wingspan	12 ft. (3.65 m)
Length	
Height	
Max Gross Take Off Weight	22 lbs. (10 kg)
Maximum Payload Weight	5.5 lbs. (2.5 kg)
Fuel / Battery / Propulsion	Propane / Fuel Cell - Electric
Endurance	8 hrs
Speed	45 MPH (72.4 KPH) dash
Radio Range	
Launch Method	Bungee cord
Max Surface Wind	
Operating Altitude (typ.)	15,000 ft. (4,572 m) AMSL maximum
Maximum Launch Altitude	
Full Specifications Link	http://www.lockheedmartin.com/us/products/stalker-uas.html
Image	
Video Link	https://www.youtube.com/watch?v=ARJiBcuVWGE

Vehicle Name	Maveric UAS – rolls up – deploys from a tube
Manufacturer / Country	Prioria / USA
Produced	
Cost	$25,000 turn-key
Width / Wingspan	36in (74.93cm)
Length	26.5in (91.44 cm)
Height	
Max. Gross Take Off Weight	2.6 lb (1.16kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	Battery
Endurance	45-90 minutes
Speed	30- 40 MPH (48 – 64 KPH)
Radio Range	6-9 miles (10-15 km) wireless range
Launch Method	Hand Launch
Max Surface Wind	
Operating Altitude (typ.)	10,000 ft. (3048m) max. proven; 25,000 ft. (7620m) AMSL theoretical
Maximum Launch Altitude	
Full Specifications Link	http://www.prioria.com/maveric/
Image	
Video Link	https://www.youtube.com/watch?v=ZPti9gNEClY https://www.youtube.com/watch?v=XOccS2FJz7U

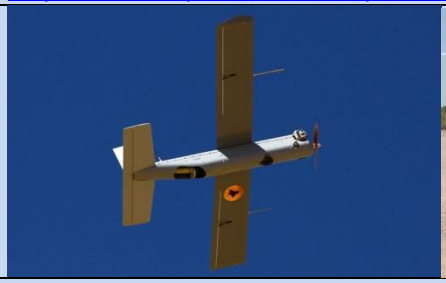
Vehicle Name	RQ-11 Raven
Manufacturer / Country	AeroVironment / USA
Produced	2004 - present
Cost	
Width / Wingspan	54 in (137.16 cm)
Length	36 in (91.44 cm)
Height	
Max Gross Take Off Weight	4.2 lbs. (1.9 kg)
Maximum Payload Weight	.4 lbs. (.18 kg)
Fuel / Battery / propulsion	Electric single motor pusher propeller
Endurance	60-90 minutes
Cruise Speed	18 MPH
Radio Range	6.2 miles (10 km)
Launch Method	Hand Launched
Max Surface Wind	
Operating Altitude	500 ft. (152.4 m) AGL (Above Ground Level) nominal
Maximum Launch Altitude	14,000 ft. (4,267.2 m)
Full Specifications Link	https://www.avinc.com/uas/view/raven https://www.avinc.com/images/uploads/product_docs/Raven_Datasheet_2017_Web_v1.pdf
Image	
Video Link	https://www.youtube.com/watch?v=JvyVdlFNO2Q https://www.youtube.com/watch?v=8RMB9WMdG6g https://www.avinc.com/uas/view/raven

Vehicle Name	RQ-14 Dragon Eye
Manufacturer / Country	AeroVironment / USA
Produced	2002 - 2004
Cost	$173,000 per system (4 airframes, 2 GCS and spare parts)
Width / Wingspan	45 in. (114.3 cm)
Length	36 in (91.44 cm)
Height	
Max Gross Take Off Weight	7 lbs. (3.17 kg)
Maximum Payload Weight	(Built in cameras only)
Fuel / Battery / propulsion	Electric – twin motor
Endurance	46-60 minutes
Cruise Speed	40 MPH (64.37 KPH)
Radio Range	3.1 miles (5 km)
Launch Method	Hand Launched
Max Surface Wind	
Operating Altitude	500 ft. (152.4 m) AGL nominal
Maximum Launch Altitude	14,000 ft. (4267.2 m)
Full Specifications Link	https://www.militaryfactory.com/aircraft/detail.asp?aircraft_id=912
Image	
Video Link	https://www.youtube.com/watch?v=USAPWm6vUqA https://www.youtube.com/watch?v=eesZe0-aTK4

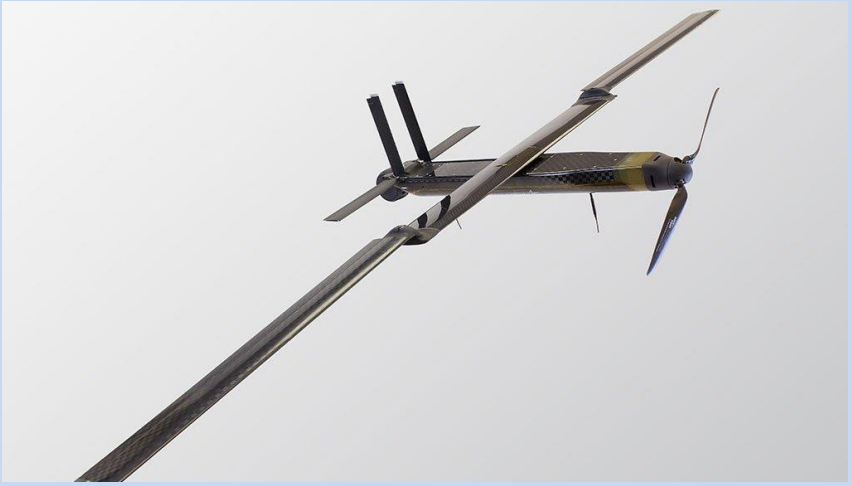
Vehicle Name	RQ-20 Puma
Manufacturer / Country	AeroVironment / USA
Produced	2007 – Present
Cost	$250,000 / system
Width / Wingspan	110 in (279.4 cm)
Length	55 in (139.7 cm)
Height	
Max. Gross Take Off Weight	14 lbs. (6.35 kg)
Maximum Payload Weight	(Built in cameras only)
Fuel / Battery / Propulsion	Electric – single motor
Endurance	120 minutes (210 minutes enhanced version)
Cruise Speed	23 MPH (37 KPH) -52 MPH (83.7 KPH)
Radio Range	9 miles (14.5 km)
Launch Method	Hand Launched
Max Surface Wind	29 MPH (46.6 KPH)
Operating Altitude	500 ft. (152.4 m) AGL (Above Ground Level) nominal
Maximum Launch Altitude	14,000 ft. (4267.2 m)
Full Specifications Link	https://www.avinc.com/uas/view/puma https://www.avinc.com/images/uploads/product_docs/PumaAE_Datasheet_2017_Web_v1.1.pdf
Image	
Video Link	https://www.avinc.com/uas/view/puma

Vehicle Name	Wasp III and Wasp AE
Manufacturer / Country	AeroVironment / USA
Produced	2007- present
Cost	$49,000
Width / Wingspan	28.5 in. (72.4 cm)
Length	16 in. (40.64 cm)
Height	
Max. Gross Take Off Weight	.95 lbs. (.43 kg)
Maximum Payload Weight	(Built in cameras only)
Fuel / Battery / Propulsion	Single electric motor
Endurance	40 minutes
Speed	25 MPH (40.2 KPH) cruise, 45 MPH (72.4 KPH) dash
Radio Range	3.1 miles (5 km)
Launch Method	Hand
Max Surface Wind	
Operating Altitude (typ.)	500 ft (152.4 m) AGL
Maximum Launch Altitude	
Full Specifications Link	https://www.avinc.com/images/uploads/product_docs/Wasp_Datasheet_2017_Web_v1.pdf
Image	
Video Link	https://www.youtube.com/watch?v=2U5hrQy8ASk https://www.youtube.com/watch?v=8iEIpJQ4Hhk

Vehicle Name	Coyote – tube launched UAV
Manufacturer / Country	Raytheon / USA - BAE / UK
Produced	2004
Cost	
Width / Wingspan	~ 72 in. (183 cm)
Length	36 in. (91.4 cm)
Height	
Max Gross Take Off Weight	13 lbs. (5.9 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	Electric, Turbine, or ICE options available
Endurance	1 hour
Speed	63 MPH (101 KPH) – 80 MPH (129 KPH)
Radio Range	57 mi. (91.7 km)
Launch Method	Tube launch from ground or parachute drop from aircraft
Max Surface Wind	60 MPH (96 KPH) [115 MPH (185 KPH) controlled flight in Hurricane]
Operating Altitude (typ.)	
Maximum Launch Altitude	30,000 ft. (9,144 m)
Full Specifications Links	http://www.raytheon.com/capabilities/products/coyote/ https://swfsc.noaa.gov/uploadedFiles/Events/Meetings/UAS_2016/Presentation/Cione_UAS_SD2.pdf https://www.ainonline.com/aviation-news/defense/2017-06-17/raytheon-further-develops-multi-mission-coyote-uas
Image	
Video Link	https://www.youtube.com/watch?v=E83YPdRa6AQ&app=desktop

Vehicle Name	Silver Fox
Manufacturer / Country	Raytheon / USA
Produced	2013 to present
Cost	
Width / Wingspan	7.8 ft. (2.4 m)
Length	4.8 ft. (1.5 m)
Height	.9 ft. (.274 m)
Max. Gross Take Off Weight	25 lbs. (11.34 kg) + 9.7 lbs. (4.4 kg) of fuel.
Maximum Payload weight	~ 5 lbs. (2.27 kg)
Fuel / Battery / Propulsion	ICE (Internal Combustion Engine)
Endurance	10 hours
Speed	52 MPH (83.7 KPH) – 58 MPH (93.3 KPH)
Radio Range	23 miles (37 km)
Launch Method	Catapult
Max Surface Wind	
Operating Altitude (typ.)	~10,000 ft. (3,048 km) max.
Maximum Launch Altitude	
Full Specifications Link	http://www.raytheon.com/capabilities/products/silverfox/
Image	 
Video Link	https://www.youtube.com/watch?v=E83YPdRa6AQ&app=desktop https://www.youtube.com/watch?v=XXdNB7gUUcE&app=desktop

Vehicle Name	Dominator
Manufacturer / Country	Boeing / USA
Produced	
Cost	
Width / Wingspan	~ 10 ft. (3 m)
Length	
Height	
Max. Gross Take Off Weight	105 lbs. (47.6 kg)
Maximum Payload Weight	38 lbs. (12.7 kg)
Fuel / Battery / Propulsion	ICE, refueling option available
Endurance	14 – 24 hrs. (optional refueling allows 1 week or more endurance)
Speed	
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.ainonline.com/aviation-news/defense/2012-11-02/boeing-phantom-works-develops-dominator-uav
Image	
Video Link	https://www.youtube.com/watch?v=2d1ORgVjZto

Vehicle Name	Outrider
Manufacturer / Country	Lockheed Martin / UK
Produced	2017
Cost	
Width / Wingspan	
Length	
Height	Launched from 4 in. (10.16 cm) launch tube
Max. Gross Take Off Weight	3.75 lbs. (1.7kg)
Maximum Payload Weight	Small EO / IR camera
Fuel / Battery / Propulsion	
Endurance	2.5 hours
Speed	40 MPH (64 KPH) loiter / 57 MPH (91 KPH) dash
Radio Range	9.3 mi (15 km), 18.6 mi (30km) with relay
Launch Method	Tube Launch (water, air drop, or ground based)
Max Surface Wind	17 MPH (27 KPH)
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.suasnews.com/2017/09/lockheed-martin-outrider/
Image	
Video Link	https://www.youtube.com/watch?time_continue=2&v=QaHDOETFOvw

Vehicle Name	Bat
Manufacturer / Country	Northrop Grumman / USA
Produced	
Cost	
Width / Wingspan	14 ft (4.26 m)
Length	6.7 ft (2.0 m)
Height	3 ft (.91 m)
Max. Gross Take Off Weight	350 lbs (159 kg)
Maximum Payload Weight	125 lb (56.6 kg) (6 cubic feet of payload space)
Fuel / Battery / Propulsion	JP-8 ICE (Internal Combustion Engine)
Endurance	18 hrs
Speed	74 MPH (119 KPH) loiter / 105 MPH (169 KPH) max
Radio Range	
Launch Method	Mobile launch rail
Max Surface Wind	
Operating Altitude (typ.)	17,000 ft. (5,181 m) AMSL
Maximum Launch Altitude	
Full Specifications Link	http://www.northropgrumman.com/Capabilities/BATUAS/Documents/pageDocuments/BAT_Datasheet.pdf
Image	
Video Link	https://www.youtube.com/watch?v=Er8Uy38G7A4

Vehicle Name	XFC (eXperimental Fuel Cell) UAV and Sea Robin
Manufacturer / Country	Naval Research Lab and Oceaneering International Inc.
Produced	2013 – special acquisition
Cost	
Width / Wingspan	
Length	
Height	
Max. Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	
Endurance	~ 5 hours
Speed	
Radio Range	
Launch Method	Buoy launch from underwater
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	AMSL
Full Specifications Link	https://www.nrl.navy.mil/media/news-releases/2013/navy-launches-uav-from-submerged-submarine http://phasezero.gawker.com/drone-of-the-day-xfc-1714377740
Image	 
Video Link	

Vehicle Name	ALTi – Transition
Manufacturer / Country	ALTIUAS / South Africa
Produced	
Cost	
Width / Wingspan	9.8 ft. (2.98 m)
Length	
Height	
Max. Gross Take Off Weight	
Maximum Payload Weight	3.3 lbs. (1.5 kg)
Fuel / Battery / Propulsion	
Endurance	7 hour
Speed	
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://www.altiuas.com/
Image	
Video Link	http://www.altiuas.com/

Vehicle Name	X2 Geo
Manufacturer / Country	X-Craft LLC / Assembled in Idaho, USA
1st Produced	2017 -
Cost	$8,000
Width / Wingspan	33 in (83.8 cm)
Length	16 in (40.6 cm)
Height	12 in (30.5 cm)
Max Gross Take Off Weight	~3.75 lbs (1.7 kg)
Maximum Payload Weight	1 lb (.45 kg) nominal; ~2 lbs (.9 kg) max (untested)
Fuel / Battery / Propulsion	14.8 V, 5,400 mAh; 1100 kv – 160W motors x 3
Endurance	37 min (tested at 47 MPH)
Speed	47 MPH
Radio Range	29 miles (tested)
Launch Method	VTOL
Max Surface Wind	28 MPH
Operating Altitude (typ.)	Nominal: 100 – 1000 ft AGL; MAX: Not tested
Maximum Launch Altitude	Not tested
Full Specifications Link	http://xcraft.io/x2-geo/
Image	
Video Link	https://www.youtube.com/watch?v=7HdWaD9P99o

Vehicle Name	Quantix
Manufacturer / Country	AeroVironment / USA
Produced	2017
Cost	TBD – (early rumors around $35k)
Width / Wingspan	3.2 ft (1 m)
Length	
Height	
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Battery powered electric motors – 4 each.
Endurance	45 minutes
Speed	31 MPH (50 kph)
Radio Range	25 miles (40 km)
Launch Method	VTOL
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.avinc.com/images/uploads/product_docs/Quantix_double_sided_Web.pdf
Image	 
Video Link	https://www.avinc.com/uas/view/quantix

Vehicle Name	FireFLY6 PRO
Manufacturer / Country	BIRDSEYEVIEW Robotics / USA
Produced	
Cost	$6,000
Width / Wingspan	60 in. (1524 mm)
Length	32.6 in. (828 mm)
Height	
Max. Gross Take Off Weight	9.9 lbs. (4.5 kg)
Maximum Payload Weight	1.5 lbs. (.7 kg)
Fuel / Battery / Propulsion	Electric
Endurance	40 – 50 minutes
Speed	35 MPH (56.3 KPH)
Radio Range	3 miles (5 km)
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.birdseyeview.aero/pages/firefly6-pro
Image	
Video Link	https://www.youtube.com/watch?v=Tcwd2By4Q60

Vehicle Name	Phantom Sentinel
Manufacturer / Country	VeraTech Aero Corp.
Produced	USA
Cost	
Width / Wingspan	2 - 10ft. (.6 – 3 m) scalable
Length	
Height	2 – 6 in. (5 – 15 cm)
Max. Gross Take Off Weight	~ 4 lb. (1.8 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	Electric
Endurance	
Speed	
Radio Range	
Launch Method	Throw, canister launch, air drop, remote launch
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://veratech.aero/phantom.html http://veratech.aero/pdf/Phantom%20Product%20Sheet.pdf
Image	
Video Link	https://www.youtube.com/watch?v=WSslxXutL14

Vehicle Name	FLIMMER – NRL Research - experimental
Manufacturer / Country	Navy Research Laboratory – USA
Produced	Experimental circa 2015
Cost	
Width / Wingspan	
Length	
Height	
Max. Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Battery – electric motor
Endurance	
Speed	
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.nrl.navy.mil/lasr/content/flying-swimmer-flimmer-uavuuv
Image	
Video Link	https://www.youtube.com/watch?v=0Og6-oFKoV0

Vehicle Name	CICADA Microdrone - experimental
Manufacturer / Country	Naval Research Lab
Produced	2006
Cost	
Width / Wingspan	5 in. (12.7 cm) depending on model
Length	
Height	
Max. Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Gliders
Endurance	
Speed	
Radio Range	
Launch Method	Airdrop
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.dsiac.org/resources/news/naval-research-lab-tests-swarm-stackable-cicada-microdrones
Image	   
Video Link	https://www.youtube.com/watch?v=JKXWQwtJFAQ https://www.youtube.com/watch?v=t1Soa5bWrmE https://www.youtube.com/watch?v=1ZYOfDNl77M

Unmanned Airborne Systems Multirotor

Vehicle Name	Aerius - toy - radio controlled vehicle
Manufacturer / Country	Aerix / USA
Produced	2015
Cost	$35
Width / Wingspan	1.2 in. (3cm)
Length	1.2 in. (3cm)
Height	.8 in. (2cm)
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Battery
Endurance	5 – 7 min
Speed	
Radio Range	
Launch Method	VTOL
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://aerixdrones.com/products/aerius-the-new-worlds-smallest-quadcopter
Image	
Video Link	https://www.youtube.com/watch?v=WgAWcUql7Tc https://www.youtube.com/watch?v=Vt_VuBl2V-o

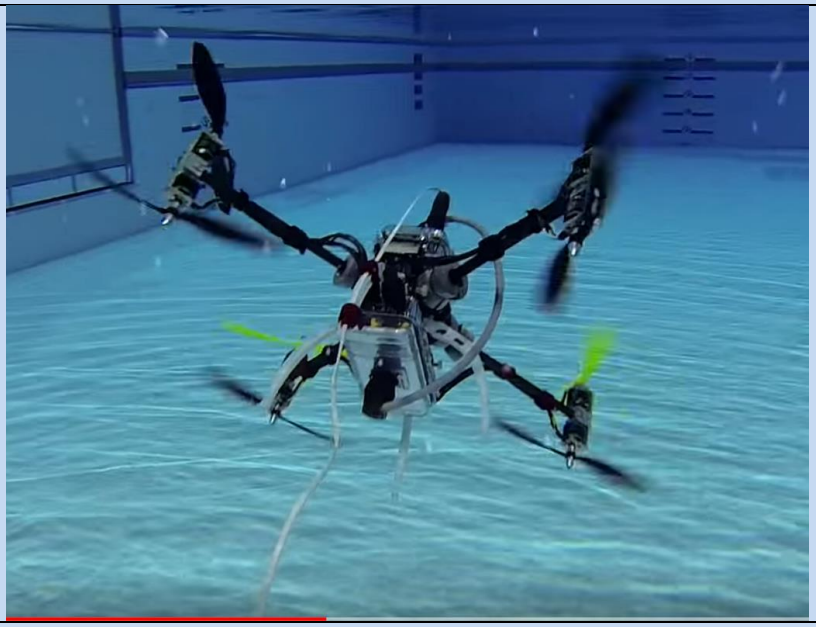
Vehicle Name	**BBCopter - Mercury**
Manufacturer / Country	BoxBotix / USA
Year Produced	
Cost	
Width / Wingspan	22 in (55.88 cm)(motor CTC)
Length	22 in (55.88 cm)
Height	12 inches (30.48 cm)
Max Gross Take Off Weight	20 lbs. (9.07 kg)
Maximum Payload Weight	10 lbs. (4.53 kg)
Fuel / Battery / Propulsion	3.41 lbs. (1.547 kg); 22.2V; 12,000 mAh Lithium Polymer Battery
Endurance	15 – 45 minutes depending on payload
Speed	35 MPH estimated
Radio Range	
Launch Method	VTOL
Max Surface Wind	18 MPH estimated
Operating Altitude (typ.)	Up to 1500 ft nominal
Maximum Launch Altitude	Unknown
Full Specifications Link	https://boxbotix.com/bbots/bbcopter/
Image	 
Video Link	https://www.youtube.com/watch?v=9auQicloM7Q

Vehicle Name	Cheerson CX-10WD (toy) Alt. Hold FPV nano-quad
Manufacturer / Country	Aerix / USA
Produced	2016
Cost	$45
Width / Wingspan	1.65 in. (4.2 cm)
Length	.98 in. (2.5 cm)
Height	1.65 in. (4.2 cm)
Max Gross Take Off Weight	
Maximum Payload Weight	Payload is a .3MP (MegaPixle) camera
Fuel / Battery / Propulsion	Battery 3.7V 150mAh, 30 minute charging time
Endurance	4 min
Speed	
Radio Range	
Launch Method	VTOL
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.gearbest.com/rc-quadcopters/pp_363430.html Bottom of page
Image	
Video Link	https://www.youtube.com/watch?v=BbkWobTty24&t=1s https://www.youtube.com/watch?time_continue=5&v=E5GbIEW66zs

Vehicle Name	Eagle XF
Manufacturer / Country	UAV America / USA
Produced	
Cost	
Width / Wingspan	43.5 in. (110.5 cm) motor CTC diameter
Length	
Height	19.5 in. (49.5 cm)
Max. Gross Take Off Weight	34.5 lbs. (15.6 kg)
Maximum Payload Weight	7.5 lbs. (3.4 kg)
Fuel / Battery / Propulsion	2 each 22000mAh = 10.5 lbs. (4.76 kg); 4 each KDE 7208 motors
Endurance	45 minutes
Speed	
Radio Range	
Launch Method	VTOL
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://uavamerica.com/eaglexf/ https://uavamerica.com/specs/
Image	
Video Link	https://www.youtube.com/watch?time_continue=22&v=sHeqCCSbUSA https://www.youtube.com/watch?time_continue=1&v=gCERT5TGRWk

Vehicle Name	Hycopter 1 (hydrogen fuel cell powered)
Manufacturer / Country	HUS / Singapore
Produced	2017
Cost	
Width / Wingspan	
Length	
Height	
Max Gross Take Off Weight	14.7 lbs. (6.7 kg)
Maximum Payload Weight	3.3 lbs. (1.5 kg)
Fuel / Battery / Propulsion	3 L tank Hydrogen gas powered fuel cell
Endurance	4 hrs
Speed	
Radio Range	
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.youtube.com/watch?v=aFZ9-4YG4B0 https://docs.wixstatic.com/ugd/047f54_dad8e43d15ac4e6592808e3c74b72c26.pdf http://www.uasvision.com/2015/05/11/hydrogen-fuel-cell-powered-quadcopter/ http://www.somedrones.com/the_hycopter/
Image	
Video Link	https://www.youtube.com/watch?v=8mBzmCFgu5Y

Vehicle Name	Indago
Manufacturer / Country	Lockheed Martin / USA
Produced	2012
Cost	
Width / Wingspan	2.66 ft. (.81 m)
Length	2.66 ft. (.81 m)
Height	.56 ft. (.17 m)
Max Gross Take Off Weight	5 lbs. (2.26 kg)
Maximum Payload Weight	1 lb. (.6 kg)
Fuel / Battery / Propulsion	Electric
Endurance	50 min. with 200 gram payload
Speed	
Radio Range	6 miles (10 km)
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	500 ft. (152 m) typical; 18,000 ft. (5,486 m) maximum AMSL
Maximum Launch Altitude	
Full Specifications Link	http://www.lockheedmartin.com/us/products/procerus/indago-uas.html
Image	
Video Link	https://www.youtube.com/watch?time_continue=2&v=Dh6g9FWY75s https://www.youtube.com/watch?v=Cdd6bfIn8aA

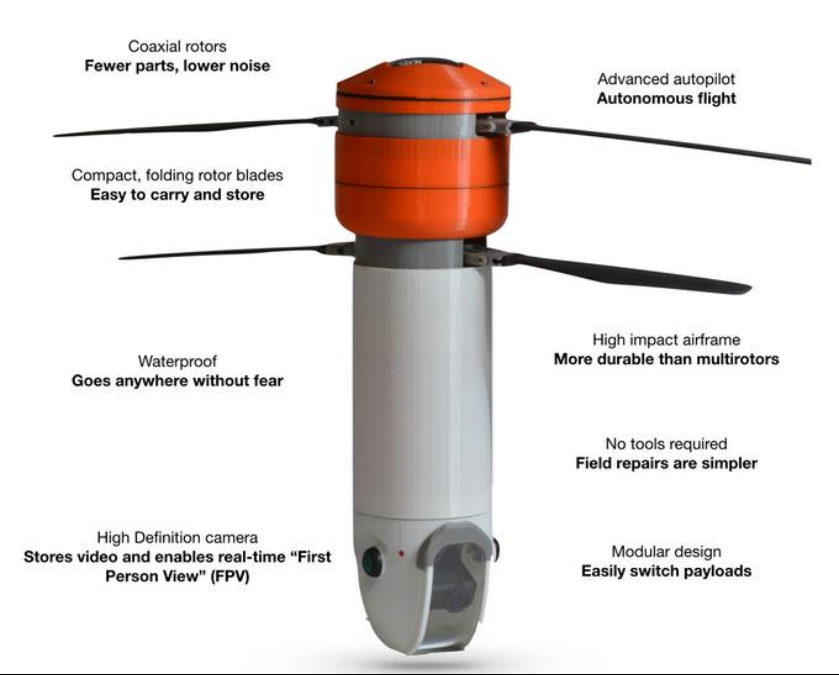
Vehicle Name	Naviator – Experimental underwater quadcopter
Manufacturer / Country	Rutgers University – USA
Produced	Circa 2015
Cost	
Width / Wingspan	
Length	
Height	
Max. Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	
Endurance	
Speed	
Radio Range	
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	
Image	
Video Link	https://www.youtube.com/watch?v=FC9EJhs0pc0

Vehicle Name	Phoenix ACE RAD – experimental ?
Manufacturer / Country	BNC Scientific – USA – claim to have mounted radiation detector
Produced	
Cost	
Width / Wingspan	31.75 in. (80.6 cm)
Length	
Height	
Max. Gross Take Off Weight	7.5 lbs. (3.4 kg)
Maximum Payload Weight	½ lb. (.22 kg)
Fuel / Battery / Propulsion	Battery powered electric motors x6
Endurance	60 minutes with custom battery solution
Speed	21 MPH (33 KPH)
Radio Range	2 miles (3.22 km) LOS
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	28 MPH (45 KPH)
Operating Altitude (typ.)	50 – 250 ft. (15 – 76 m) AGL
Maximum Launch Altitude	~5,000 ft. (1,524 m) AMSL
Full Specifications Link	http://www.qaltek.com/product/ace-rad/
Image	
Video Link	

Vehicle Name	Phoenix Ace LE Pro (Long Endurance)
Manufacturer / Country	UAV Solutions / USA
Produced	
Cost	
Width / Wingspan	18 in (45.7 cm)
Length	18 in (45.7 cm)
Height	
Max. Gross Take Off Weight	6.3 lbs. (2.86 kg) with three batteries
Maximum Payload Weight	EO (Electro-Optic) and IR (InfraRed) camera
Fuel / Battery / Propulsion	3 batteries = ~3.8 lbs. (1.7 kg)
Endurance	60 minutes with three batteries
Speed	
Radio Range	
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://uav-solutions.com/phoenix-ace-le-pro/
Image	
Video Link	https://www.youtube.com/watch?v=BvI-drQvJ0g https://www.youtube.com/watch?v=pkHtdtC45xI

Vehicle Name	Q919B Tank Quadcopter – toy - R/C vehicle
Manufacturer / Country	
Produced	
Cost	$70
Width / Wingspan	8.3 in. (210 mm)
Length	16.7 in. (425 mm)
Height	4.3 in. (110 mm)
Max Gross Take Off Weight	.7 lbs. (319 g)
Maximum Payload Weight	
Fuel / Battery / Propulsion	Battery
Endurance	8 min
Speed	
Radio Range	
Launch Method	VTOL or Roll in “tank mode”
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.rcmoment.com/p-rm7328us.html?currency=USD&Warehouse=CN&aid=rmsplaus1&gclid=Cj0KCQjw9afOBRDWARIsAJW4nvwAqNEtFWXRv3S4jtIljPsDFTf3X5gzAsGI0bus2a0lti4j3EcV9awaAr-iEALw_wcB
Image	
Video Link	https://www.youtube.com/watch?v=pAfy_zBL1xE https://www.youtube.com/watch?v=-gtmeEgW7q8

Vehicle Name	Snipe Nano UAS (quad copter)
Manufacturer / Country	AeroVironment / USA
Produced	2017-
Cost	
Width / Wingspan	8 in (20.3 cm)
Length	8 in (20.3 cm)
Height	
Max. Gross Take Off Weight	.3 lbs. (.13 kg)
Maximum Payload Weight	(Built in cameras only)
Fuel / Battery / Propulsion	Electric motor x 4
Endurance	15 minutes
Cruise Speed	22 MPH (35.4 KPH)
Radio Range	.6 miles (.965 km)
Launch Method	VTOL
Max Surface Wind	11 MPH (17.7 KPH) gusts to 23 MPH (37 KPH)
Operating Altitude	100 ft. (30.5 m) AGL
Maximum Launch Altitude	
Full Specifications Link	http://www.avinc.com/images/uploads/product_docs/Snipe_Datasheet_2017_web_rv1.3.pdf
Image	
Video Link	https://www.youtube.com/watch?v=8QRwX55riBs https://www.avinc.com/media_center/unmanned-aircraft-systems

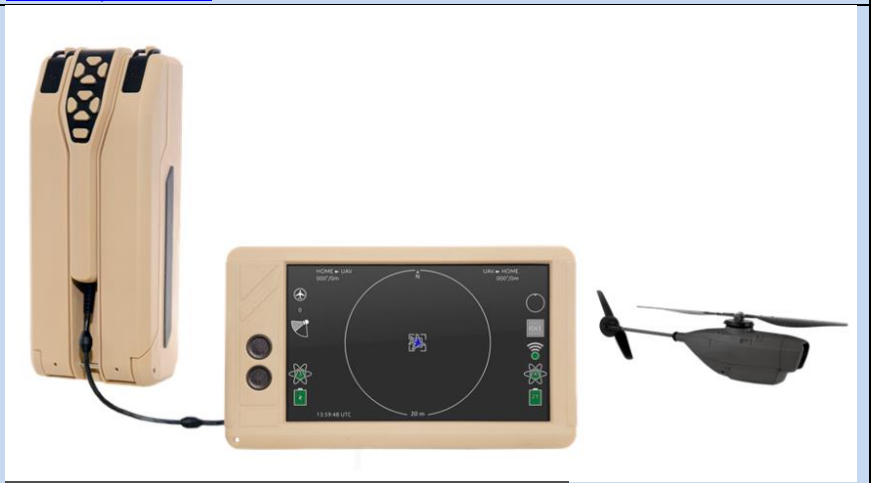
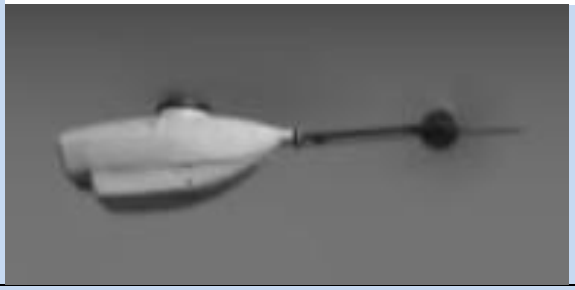
Vehicle Name	SPRITE
Manufacturer / Country	Ascent AeroSystems / USA
Produced	2014 – Present
Cost	~$1,000
Width / Wingspan	Body Width = 4.25 in (108 mm)
Length	
Height	22 in. (560 mm) with camera payload and antenna extended. 13.5 in. (350 mm) without payload and antenna folded
Max Gross Take Off Weight	4.5 lbs. (2.02 kg)
Maximum Payload Weight	1 lb. (.45 kg)
Fuel / Battery / Propulsion	14.8V 4000 mAh battery – electric motor propulsion
Endurance	25 min with no payload. 10-12 min with payload
Speed	33 MPH (53 KPH) max.
Radio Range	Easily upgradable
Launch Method	Hand launch
Max Surface Wind	15 MPH (24 KPH)
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.ascentaerosystems.com/pages/specifications
Image	
Video Link	https://www.kickstarter.com/projects/ascentaerosystems/sprite-the-portable-rugged-totally-different-small?ref=user_menu

Vehicle Name	SY X25-1 Flying Car Drone – Toy – R/C vehicle
Manufacturer / Country	China
Produced	
Cost	$80
Width / Wingspan	6.75 in. (17.1 cm)
Length	7.25 in. (18.4 cm)
Height	2.5 in. (6.35 cm)
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	This vehicle both flies and drives. Wheels and props are driven electrically by individual motors.
Endurance	7-9 min
Speed	
Radio Range	160 ft.
Launch Method	VTOL (Vertical Take Off and Landing) or roll in “car mode”
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.amazon.com/Space-Rails-Flying-Quadcopter-Drone/dp/B010TFJTCU https://www.hobbytron.com/X251SpaceExplorerFlyingCar2In124GHz45CHRCDrone.html#
Image	  
Video Link	https://www.youtube.com/watch?v=HHN2jGzbm8A

Vehicle Name	Tailwind – hybrid gasoline-electric quadrotor
Manufacturer / Country	Skyfront / USA
Produced	
Cost	
Width / Wingspan	
Length	
Height	
Max. Gross Take Off Weight	26.4 lbs. (12 kg)
Maximum Payload Weight	6.6 lbs. (3 kg)
Fuel / Battery / Propulsion	Gasoline powered ICE to charge and operate battery powered motors
Endurance	5 hours – or 3.5 hours with 1kg payload
Speed	
Radio Range	
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://skyfront.com/products/tailwind-drone/
Image	 
Video Link	https://www.youtube.com/watch?v=H8mqOl_gr4k

Unmanned Airborne Systems

Single Rotor

Vehicle Name	Black Hornet PD-100 personal reconnaissance
Manufacturer / Country	Prox Dynamics - FLIR / USA
Produced	
Cost	
Width / Wingspan	4.6 in. (120 mm)
Length	
Height	
Max Gross Take Off Weight	18 gms
Maximum Payload Weight	Camera included
Fuel / Battery / Propulsion	Electric – battery powered
Endurance	25 minutes
Speed	11.2 MPH (18 KPH)
Radio Range	5,249 ft. (1600 m) Line Of Sight (LOS)
Launch Method	Hand Launch
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://www.proxdynamics.com/products/pd-100-black-hornet-prs http://www.defensereview.com/prox-dynamics-pd-100-black-hornet-prs-personal-reconnaissance-system-palm-sized-nano-uas-micro-helicopter-drone-provides-cargo-pocket-isr-capability-for-infantry-recon-ops-video/
Image	 
Video Link	https://www.youtube.com/watch?time_continue=6&v=4o7mRg74qcY https://www.youtube.com/watch?v=R9aS7LjRrNg

Vehicle Name	MQ-8B Fire Scout
Manufacturer / Country	Northrop Grumman / USA
Produced	
Cost	$18M
Width / Wingspan	27.5 ft (8.4m)
Length	23.95 ft (7.3m)
Height	9.71 ft (2.9 m)
Max Gross Take Off Weight	3,150 lb (1,430 kg)
Maximum Payload Weight	600 lb (272 kg)
Fuel / Battery / Propulsion	JP-8 fuel, Rolls Royce 250-C20 Turbine
Endurance	5 hours fully loaded, 8 hours typical
Speed	85 KTAS (157.4 km/hr)
Radio Range	685 miles (1102 km)
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	20,000 ft (6,100 m) AMSL max
Maximum Launch Altitude	
Full Specifications Link	http://www.northropgrumman.com/Capabilities/FireScout/Documents/pageDocuments/MQ-8B_Fire_Scout_Data_Sheet.pdf
Image	
Video Link	https://www.youtube.com/watch?v=D66x3rhLCPQ https://www.youtube.com/watch?v=i0bib2SYzqY https://www.youtube.com/watch?v=h46b37E8wCo

Vehicle Name	RMAX & “R-BAT”
Manufacturer / Country	Yamaha / Japan - Northrop Grumman / USA
Produced	~1987 - present
Cost	
Width / Wingspan	Rotor Diameter 10.2 ft. (3,130 mm), landing strut width = 2.4 ft. (720 mm)
Length	11.9 ft. (3,630 mm) with tail rotor
Height	3.54 ft. (1,080 mm)
Max Gross Take Off Weight	
Maximum Payload Weight	62 lbs. (28 kg)
Fuel / Battery / Propulsion	Gasoline with oil added - 2 stroke 2 cyl. 246cc 15.4 kW with electric start
Endurance	~ 50 minutes depending on payload
Speed	Governed to (40 KPH)
Radio Range	400 m manual control (options include satellite coms)
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	20,000 ft (6,100 m) AMSL max
Maximum Launch Altitude	
Full Specifications Link	https://www.yamaha-motor.com.au/buying/digital-brochures https://www.ainonline.com/aviation-news/2014-05-08/northrop-grumman-yamaha-announce-r-bat-uav
Image	 
Video Link	https://www.youtube.com/watch?v=-X9U6lQjNi8 https://www.youtube.com/watch?v=G45u4zrgj38 https://www.youtube.com/watch?v=zhMMtN7nc7A https://www.youtube.com/watch?v=ydfPzqaNkuA The FAZER: https://www.youtube.com/watch?v=jTM7Ofki8Rw R-BAT: https://www.youtube.com/watch?v=MzvdWnFlEZk

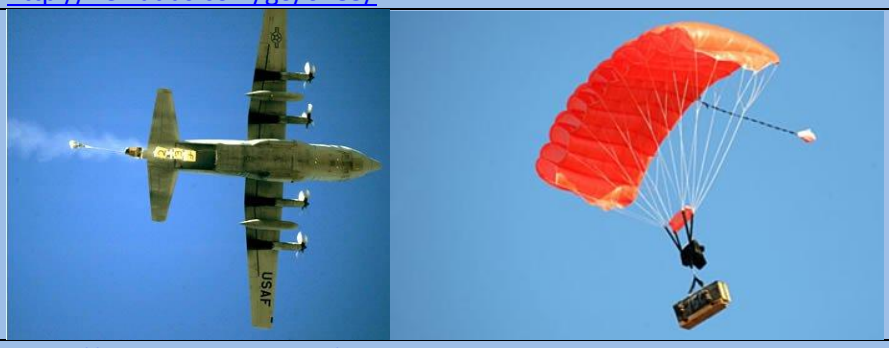
Vehicle Name	Velos
Manufacturer / Country	Velos Rotors / USA
Produced	2016 - present
Cost	
Width / Wingspan	
Length	
Height	
Max Gross Take Off Weight	45 lbs. (20 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	Electric
Endurance	70 min with 2.2 lbs. (1 kg); 60 min with 5.5 lbs. (2.5 kg); 50 min with 11 lbs. (5 kg)
Speed	
Radio Range	
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://velosuav.com/?gclid=CjwKCAjw3_HOBRBaEiwAvLBboi6XUltkFS8awLCN3xkF4R6NdNh9S1LHika7hTXY5HX_AgkYUixFwhoC_JkQAvD_BwE#1490880070686-d678f4ff-c5de
Image	  
Video Link	https://www.facebook.com/1437307453216466/videos/1973469876266885/

Vehicle Name	AXE4FT-8H Tactical Aerostat (tethered)
Manufacturer / Country	Skydocballoon / USA
Produced	1989 - present
Cost	
Width / Wingspan	4.7 -27 ft. (1.44 – 8.43 m) inflated diameter options
Length	
Height	3.1 – 17.9 ft. (.93 – 5.44 m) inflated height
Max Gross Take Off Weight	.9 – 347.6 lbs. (.4 - 157 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	99% Helium gas for lift, payload power is usually battery or ground source through conductive tether
Endurance	
Speed	
Radio Range	39 miles (63 km)
Launch Method	Deployment trailer with tether
Max Surface Wind	Tested in 110 MPH (177 KPH) wind with good results
Operating Altitude (typ.)	Standard 24V winch with 3,000 ft. (914 m) of tether
Maximum Launch Altitude	
Full Specifications Link	http://www.skydocballoon.com/AXE4FT8H.html
Image	
Video Link	

Vehicle Name	Project LOON
Manufacturer / Country	Google / USA
Produced	Private venture since 2015
Cost	~$10K
Width / Wingspan	49 ft. (15 m)
Length	
Height	39 ft. (12 m)
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Solar panels produce 100 watts
Endurance	Over 100 days
Speed	0-62 MPH (0 – 100 KPH)
Radio Range	Coverage area of 1930 square miles (5000 square km) (~25mi dia.)
Launch Method	Auto launcher 1 every 30 minutes
Max Surface Wind	
Operating Altitude (typ.)	12.4 miles (20 km)
Maximum Launch Altitude	
Full Specifications Link	https://x.company/loon/journey/ https://x.company/loon/technology/
Image	 
Video Link	https://www.theverge.com/2015/3/2/8129543/google-x-internet-balloon-project-loon-interview

Vehicle Name	Nano Hummingbird
Manufacturer / Country	AeroVironment
Produced	2011
Cost	
Width / Wingspan	6.3 inches (160 mm)
Length	
Height	
Max Gross Take Off Weight	.67 ounces (19 g)
Maximum Payload Weight	Camera included in MGTW
Fuel / Battery / Propulsion	Battery Powered, electric motor
Endurance	4-11 minutes
Speed	15 MPH (24 KPH)
Radio Range	
Launch Method	
Max Surface Wind	5 MPH (8 KPH)
Operating Altitude (typ.)	100 ft or less typical
Maximum Launch Altitude	
Full Specifications Link	https://www.maxonmotorusa.com/medias/sys_master/root/8817214390302/Hummingbird-Aerovironment.pdf
Image	
Video Link	https://www.youtube.com/watch?v=a8ZbtZqH6Io

Vehicle Name	RQ-16 T-Hawk (ducted fan – single rotor)
Manufacturer / Country	Honeywell / USA
Produced	2003
Cost	$375,000
Width / Wingspan	14 in. (35.5 cm)
Length	
Height	
Max Gross Take Off Weight	20 lb (8.4 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	3W-56; 56cc Boxer Twin Piston Gas Powered – produces 4HP
Endurance	40 min
Speed	50 KTAS (93 KPH), 70 KTAS max (130 KPH)
Radio Range	
Launch Method	VTOL (Vertical Take Off and Landing)
Max Surface Wind	17 MPH (27 KPH)
Operating Altitude (typ.)	10,500 ft (3,200 m) AMSL
Maximum Launch Altitude	
Full Specifications Link	http://www.army-technology.com/projects/honeywell-thawk-mav-us-army/
Image	
Video Link	https://www.youtube.com/watch?v=mr28m3Ay0Nw

Vehicle Name	Atair Onyx / Insect
Manufacturer / Country	Atair / USA
Produced	2005
Cost	
Width / Wingspan	14.7 ft. (4.48 m)
Length	3.9 ft. (1.19 m)
Height	16.4 ft. (5 m)
Max. Gross Take Off Weight	88 lbs. (40 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	Electrically operated control system. Optionally available with ICE
Endurance	~ 1 hour
Speed	25 MPH (40 KPH) – 43 MPH (69 KPH)
Radio Range	30+ miles (48 km)
Launch Method	Air Drop
Max Surface Wind	
Operating Altitude Max.	~35,000 ft. (10,668 m)
Maximum Launch Altitude	35,000 ft. (10,668 m) air drop or ground deploy
Full Specifications Link	http://en.avia.pro/blog/atair-insect-tehnicheskie-harakteristiki-foto http://newatlas.com/go/6285/
Image	
Video Link	https://www.youtube.com/watch?v=0njTLG7vQbE

Vehicle Name	Atair Micro LEAPP (Long Endurance Autonomous Powered Paraglider)
Manufacturer / Country	Atair
Produced	2006
Cost	$14,900
Width / Wingspan	25 in. (63.5 cm)
Length	40 in. (101.6 cm)
Height	30 in. (76.2 cm)
Max. Gross Take Off Weight	75 lbs. (34 kg)
Maximum Payload Weight	30 lbs. (13.6 kg)
Fuel / Battery / Propulsion	8 HP 2-Cycle Gas
Endurance	4 hours
Speed	
Radio Range	
Launch Method	One man deployable / backpack – 10 meter runway required
Max Surface Wind	
Operating Altitude Max.	12,000 ft. (3,657 m)
Maximum Launch Altitude	
Full Specifications Link	http://defense-update.com/20071024_leapp.html http://www.slideserve.com/flavio/the-micro-leapp-unmanned-aerial-vehicle-cybershare-report
Image	
Video Link	

Vehicle Name	Microfly II guided parachute system
Manufacturer / Country	Airborne Systems
Produced	USA
Cost	
Width / Wingspan	31.7 ft (9.7m)
Length	12 ft (3.7m)
Height	
Max. Gross Take Off Weight	49 lb (22kg)
Maximum Payload Weight	200 lb (90.7 kg) to 450 lb (204.1 kg)
Fuel / Battery / Propulsion	
Endurance	4:1 glide ratio
Speed	
Radio Range	Line of sight – 10 miles
Launch Method	Air drop
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	24,500 ft (7,467.6m) AMSL, 3500 ft (1,66.8m) AGL
Full Specifications Link	file:///H:/2017%20Project%20Files/Platform%20Study/http---airborne-sys.com-wp-content-uploads-2016-08-ASG-MicroFly-II-20170203-English.pdf
Image	
Video Link	https://www.youtube.com/watch?time_continue=4&v=UPHB_IwPBW8 https://www.youtube.com/watch?v=UPHB_IwPBW8

Vehicle Name	Hawkeye
Manufacturer / Country	Tetracam – USA
Produced	
Cost	
Width / Wingspan	Vehicle: 16 in. (40.6 cm); Wing: 120 in. (304.8 cm)
Length	Vehicle: 35 in. (88.9 cm) ; Wing: 32 in. (81.3 cm)
Height	Vehicle: 20 in. (50.8 cm)
Max. Gross Take Off Weight	8 lbs. (3.6 kg)
Maximum Payload weight	3 lbs. (1.36 kg)
Fuel / Battery / Propulsion	2 each 4400 mAh LiPo batteries; brushless motor with propeller
Endurance	30 min
Speed	10 MPH (16 KPH)
Radio Range	5 miles (8 km)
Launch Method	60 ft. (18.2 m) runway
Max Surface Wind	12 MPH (22.5 KPH)
Operating Altitude (typ.)	Up to 1500 ft. (457 m) AGL
Maximum Launch Altitude	
Full Specifications Link	http://www.tetracam.com/ProductHawkeyewindow2.htm http://www.tetracam.com/PDFs/Hawkeye-manual_2011-01-21.pdf
Image	
Video Link	https://www.youtube.com/watch?v=ERSAm7k6clI

Vehicle Name	Atair LEAPP (Long Endurance Autonomous Powered Paraglider)
Manufacturer / Country	Atair
Produced	2006
Cost	
Width / Wingspan	112 ft. (34.13 m)
Length	105 in. (266.7 cm) vehicle body
Height	95 in. (241.3 cm) vehicle body
Max. Gross Take Off Weight	3,600 lbs. (1,632 kg)
Maximum Payload Weight	250 lbs. (113 kg) of surveillance and 2,145 lbs. (973 kg) of fuel
Fuel / Battery / Propulsion	
Endurance	~ 48-55 hours
Speed	
Radio Range	
Launch Method	150 ft. runway
Max Surface Wind	
Operating Altitude Max.	35,000 feet max.
Maximum Launch Altitude	Dropped from cargo plane at altitudes up to 35,000 feet
Full Specifications Link	https://www.scribd.com/document/159334644/Atair-Ppg-Uav
Image	
Video Link	

Vehicle Name	Dronebox – optionally tethered drone system
Manufacturer / Country	HUS / Singapore
Produced	Circa 2015
Cost	
Width / Wingspan	
Length	
Height	
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Hybrid battery, solar, gasoline generator, building power, or other source.
Endurance	24/7
Speed	Drone is connected to tether – or can fly freely
Radio Range	
Launch Method	Autonomous launch, land, and recharge
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.hus.sg/
Image	
Video Link	https://www.youtube.com/watch?v=MD3cQNd-iSA

Unmanned Ground Systems

Vehicle Name	AMAS (Autonomous Mobility Applique System)
Manufacturer / Country	Lockheed Martin / USA
Produced	Turn any vehicle into an autonomous driverless vehicle.
Cost	
Width / Wingspan	
Length	
Height	
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	
Endurance	
Speed	
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://www.lockheedmartin.com/us/products/amas1.html http://www.lockheedmartin.com/us/products/amas1/mfc-amas-overview.html
Image	
Video Link	https://www.youtube.com/watch?v=qBs4fHXYgEw

Vehicle Name	AMDS (Autonomous Mine Detection System)
Manufacturer / Country	Carnegie Robotics LLC / USA
Produced	2018
Cost	
Width / Wingspan	
Length	
Height	
Max. Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	
Endurance	
Speed	
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://asc.army.mil/web/portfolio-item/autonomous-mine-detection-system-amds/ http://carnegierobotics.com/case-studies-system-development#srehd
Image	
Video Link	

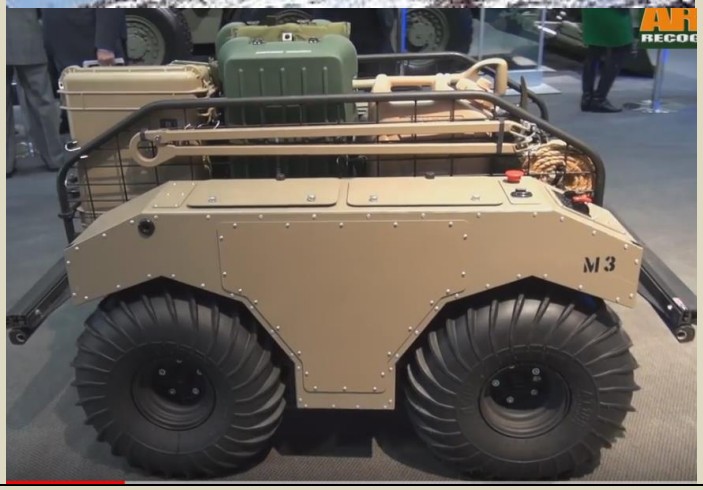
Vehicle Name	CaMEL (Carryall Mechanized Equipment Landrover)
Manufacturer / Country	Northrop Grumman / USA
Produced	~2013
Cost	
Width / Wingspan	32 in (81 cm)
Length	72 in (182.9 cm)
Height	25 in (63.5 cm) deck, 47 in (119.4 cm) cage
Max Gross Take Off Weight	
Maximum Payload Weight	750+ lbs (340 kg)
Fuel / Battery / Propulsion	JP9 / diesel fuel (3.5 gallons) - hybrid diesel electric.
Endurance	20 hrs
Speed	4-7 MPH
Radio Range	Tether, voice command, or BLOS (Beyond Line Of Sight) radio / autonomous operation
Launch Method	Ground; transport possible with trailer hitch extension on HMMWV
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://www.northropgrumman.com/Capabilities/CaMEL/Pages/default.aspx http://www.northropgrumman.com/Capabilities/CaMEL/Documents/CaMEL_datasht.pdf
Image	 
Video Link	https://www.youtube.com/watch?v=bJmV07_ss3o

Vehicle Name	CASSIE
Manufacturer / Country	Agility Robotics / USA
Produced	2017
Cost	$250K – quoted 13 Oct, 2017
Width / Wingspan	
Length	
Height	
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Custom Lithium Ion Battery Pack - Electric motors
Endurance	
Speed	
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://www.agilityrobotics.com/robots/
Image	
Video Link	http://www.agilityrobotics.com/ https://www.youtube.com/watch?v=Is4JZqhAy-M

Vehicle Name	Dragon Runner 10
Manufacturer / Country	QinetiQ
Produced	
Cost	
Width / Wingspan	13.8 in. (35 cm)
Length	15.5 in. (39.4 cm)
Height	6 inches (15.2 cm)
Max Gross Take Off Weight	11 lbs. (5 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	Battery – electric motors
Endurance	2-3 hours
Speed	4 MPH
Radio Range	2,100 feet LOS
Launch Method	ground
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.qinetiq-na.com/wp-content/uploads/Datasheet_DR10.pdf
Image	 
Video Link	https://www.youtube.com/watch?feature=player_embedded&v=3Nnj4ky4Z_g

Vehicle Name	Jackal UGV
Manufacturer / Country	Clearpath Robotics / Canada
Produced	
Cost	
Width / Wingspan	17 in. (430 mm)
Length	20 in. (508 mm)
Height	10 in. (250 mm)
Max Gross Take Off Weight	37 lbs. (17 kg)
Maximum Payload Weight	44 lbs. (20 kg)
Fuel / Battery / Propulsion	
Endurance	4 hrs.
Speed	4.5 MPH (7.2 KPH)
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.clearpathrobotics.com/jackal-small-unmanned-ground-vehicle/
Image	
Video Link	https://www.youtube.com/watch?v=6SrEEsE8Vb8 https://www.youtube.com/watch?v=4ae-QzQbDDk

Vehicle Name	MDRAS (Mobile Detection Rapid Assessment Response System)
Manufacturer / Country	General Dynamics Robotic Systems / USA
Produced	2007
Cost	
Width / Wingspan	
Length	
Height	
Max Gross Take Off Weight	3,500 lbs. (1,587 kg)
Maximum Payload Weight	500 lbs. (227 kg)
Fuel / Battery / Propulsion	
Endurance	16 hrs
Speed	20 MPH (32 KPH)
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://www.dtic.mil/dtic/tr/fulltext/u2/a449408.pdf http://defense-update.com/events/2007/summary/auvsi07_9ugvs.htm
Image	
Video Link	https://www.youtube.com/watch?v=iZrVAMs4ITE&list=PLRrmemXUzHDFbng1HfThOLkxAScC7dYhT

Vehicle Name	MUTT UGV 4 x 4 wheeled or tracked - tactical transport (MUM-T = Manned Un-Manned Teaming)
Manufacturer / Country	General Dynamics / USA
Produced	2014
Cost	
Width / Wingspan	54 in. (137 cm) wheeled / 60 in. (152 cm) tracked
Length	66 in. (168 cm) wheeled / 84 in. (213 cm) tracked
Height	
Max Gross Take Off Weight	1450 lbs. (658 kg) wheeled / 1700 lbs. (771 kg) tracked
Maximum Payload Weight	600 lbs. (272 kg)
Fuel / Battery / Propulsion	
Endurance	60 miles (96.5 km) wheeled / 36 miles (58 km) tracked
Speed	
Radio Range	
Launch Method	Tether control, tele-operation, semi – autonomous, or remote control.
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	http://www.gdls.com/products/tracked-combat/MUTT.html
Image	 
Video Link	https://www.youtube.com/watch?v=9BoGl6NXS7Q

Vehicle Name	Intellos Autonomous UGV
Manufacturer / Country	Sharp / Japan
Produced	
Cost	
Width / Wingspan	35 in. (89 cm)
Length	59 in. (150 cm)
Height	52 in. (132 cm)
Max Gross Take Off Weight	460 lbs (208 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	All electric
Endurance	4-12 hours depending on terrain
Speed	3 MPH (4.8 KPH)
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	file:///H:/2017%20Project%20Files/Platform%20Study/UGV%20Info/INTELLOS_AUGV_Slick_19MAY2017.pdf
Image	
Video Link	http://www.sharpintellos.com/

Vehicle Name	Talon EOD UGV
Manufacturer / Country	QinetiQ
Produced	2007
Cost	
Width / Wingspan	22.75 in. (57.7 cm)
Length	34.5 in. (87.6 cm)
Height	33 inches (83.8 cm)
Max Gross Take Off Weight	150 – 225 lbs. (68 – 102 kg)
Maximum Payload Weight	150 lbs (68 kg)
Fuel / Battery / Propulsion	Electric
Endurance	
Speed	6 MPH (9.6 KPH)
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.qinetiq-na.com/products/unmanned-systems/talon/talon-hazmat/ https://www.qinetiq-na.com/wp-content/uploads/datasheet_TalonV_web-2.pdf https://www.qinetiq-na.com/wp-content/uploads/Datasheet_THAZ_web.pdf
Image	 
Video Link	https://www.youtube.com/watch?v=iILL9q72tzo&feature=youtu.be https://www.youtube.com/watch?v=wVEjn5WcDmc https://www.youtube.com/watch?v=lOZV2mmaZLc

Vehicle Name	Warthog
Manufacturer / Country	Clearpath Robotics / Canada
Produced	
Cost	
Width / Wingspan	4.5 ft. (1.37 m)
Length	4.9 ft. (1.5 m)
Height	2.7 ft. (.83 m)
Max Gross Take Off Weight	551 lbs. (250 kg)
Maximum Payload Weight	600 lbs. (272 kg)
Fuel / Battery / Propulsion	
Endurance	8 hours
Speed	11 MPH (17.7 KPH)
Radio Range	~80 miles (128.7 km) depending on conditions
Launch Method	Ground / Amphibious
Max Surface Wind	N/A
Operating Altitude (typ.)	N/A
Maximum Launch Altitude	N/A
Full Specifications Link	https://www.clearpathrobotics.com/warthog-unmanned-ground-vehicle-robot/
Image	
Video Link	https://www.youtube.com/watch?time_continue=7&v=ilkuWxcwzV8

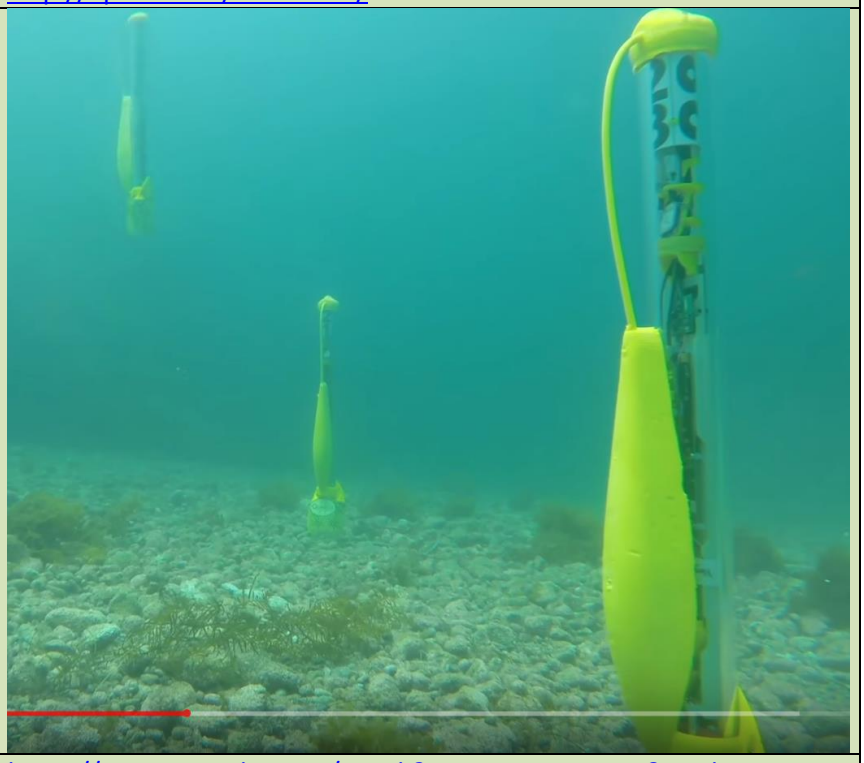
Vehicle Name	Waymo – experimental self driving car
Manufacturer / Country	Google / Chrysler Fiat Pacifica Minivan - USA
Produced	2015
Cost	
Width / Wingspan	
Length	
Height	
Max Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Electric
Endurance	
Speed	
Radio Range	
Launch Method	
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.digitaltrends.com/cars/everything-you-need-to-know-waymo/ https://waymo.com/
Image	 
Video Link	https://www.youtube.com/watch?v=uHbMt6WDhQ8 https://www.theverge.com/2017/1/8/14206084/google-waymo-self-driving-chrysler-pacifica-minivan-detroit-2017

Unmanned Marine Systems

Vehicle Name	Autonomous Mobile Buoy / Hurricane Tracker
Manufacturer / Country	Hydronalix/ Arizona, USA
Produced	
Cost	
Width / Wingspan	15 in. (38.1 cm)
Length	65 in. (165 cm)
Height	
Max. Gross Take Off Weight	75-125 lbs. (34 - 56 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	11 gallons (41 L) gasoline, ICE – with electric start + auto restart
Endurance	5-10 days at 8 MPH (12.8 KPH)
Speed	22 MPH (35.4 KPH)
Radio Range	
Launch Method	Hand launch from shore / surf / boat
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://hydronalix.com/amb/ http://emilyrobot.com/hurricane-tracker/#lightbox/1/
Image	
Video Link	https://www.youtube.com/watch?v=VzLknbVZiCg

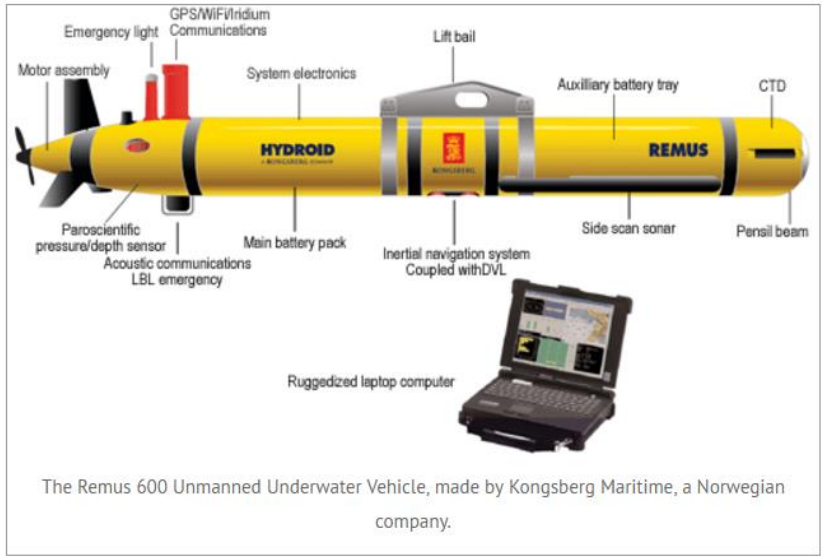
Vehicle Name	Bluefin - 21
Manufacturer / Country	General Dynamics - Bluefin Robotics / USA
Produced	
Cost	
Width / Wingspan	21 in. (53 cm)
Length	16.2 ft. (493 cm)
Height	
Max Gross Take Off Weight	1650 lbs. (750 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	13.5 kWh in nine 1.5 kWh LiPo (Lithium Polymer) battery packs – powering an electric gimbaled thruster
Endurance	25 hours @ 3.4 MPH
Speed	Up to 5.2 MPH (8.4 KPH)
Radio Range	RF, Iridium, and Acoustic communications
Launch Method	Ship launch
Max Surface Wind	
Operating Altitude (typ.)	Maximum Depth = 14,763 ft. (4,500 m)
Maximum Launch Altitude	
Full Specifications Link	https://gdmissionsystems.com/bluefinrobotics/vehicles-batteries-and-services/bluefin-21
Image	
Video Link	https://www.youtube.com/watch?v=xXlw5t1vlPc https://www.youtube.com/watch?v=O_de0dLAeuM

Vehicle Name	C-Enduro
Manufacturer / Country	Autonomous Surface Vehicles Global / UK
Produced	
Cost	
Width / Wingspan	Beam: 2.4 m
Length	4.2 m
Height	1.5 m / 2.8 m with mast
Max. Gross Take Off Weight	350 kg
Maximum Payload Weight	
Fuel / Battery / Propulsion	DC Brushless motors, batteries, 720W wind generator
Endurance	30+ days depending on power configuration
Speed	7.4 MPH (11.9 KPH)
Radio Range	Radio or Satellite
Launch Method	Surface water via towable trailer
Max Surface Wind	
Operating Altitude (typ.)	Surface only
Maximum Launch Altitude	
Full Specifications Link	https://www.asvglobal.com/product/c-enduro/
Image	
Video Link	https://www.youtube.com/watch?time_continue=1&v=TqJZUfbeIuU https://www.youtube.com/watch?v=R0eJC3YZ7Lo

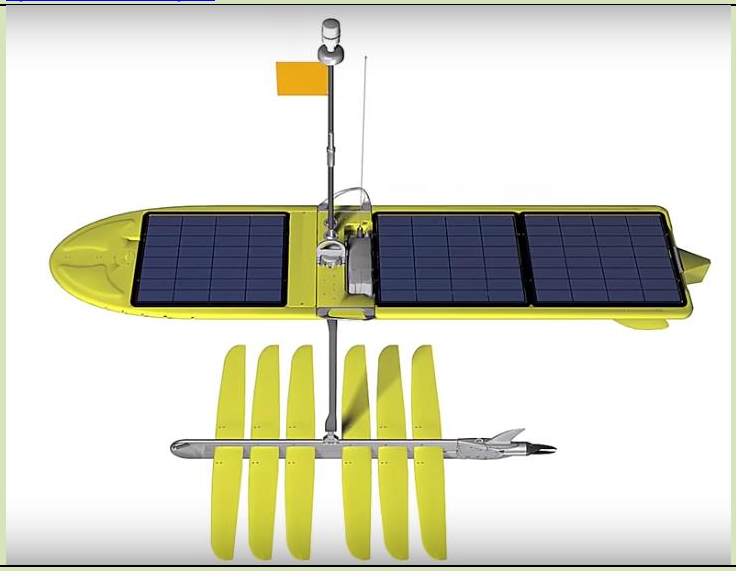
Vehicle Name	Data Diver – prototype swarm vehicle
Manufacturer / Country	Apium / USA
Produced	
Cost	
Width / Wingspan	
Length	
Height	
Max. Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	Battery
Endurance	4.3 miles (7 km)
Speed	4.6 MPH (7.4 KPH)
Radio Range	
Launch Method	Hand launch in water
Max Surface Wind	
Operating Altitude (typ.)	Dive to 328 ft. (100 m) maximum
Maximum Launch Altitude	
Full Specifications Link	http://apium.com/data-diver/
Image	
Video Link	https://www.youtube.com/watch?time_continue=34&v=JdyvtWyD79s https://www.youtube.com/watch?v=A3BZTCLSXek

Vehicle Name	Micro-UUV
Manufacturer / Country	Riptide Autonomous Solutions / USA
Produced	~2015
Cost	
Width / Wingspan	4.875 in (12.382 cm) [standard A-sized Navy Sonobuoy]
Length	25 in (63.5 cm) – 75 in (190.5 cm)
Height	
Max Gross Take Off Weight	12 to 36 lbs
Maximum Payload weight	
Fuel / Battery / Propulsion	
Endurance	30 to 400 hours depending on battery
Speed	1-8 Kts
Radio Range	
Launch Method	Surface – hand launch
Max Surface Wind	
Operating Altitude (typ.)	Depth: 650 ft (200 m)
Maximum Launch Altitude	
Full Specifications Link	https://riptideas.com/micro-uuv/
Image	
Video Link	https://www.youtube.com/watch?v=xXlw5t1vlPc https://www.youtube.com/watch?v=O_de0dLAeuM

Vehicle Name	Multi-Purpose Unmanned Surface Vehicle 4.0
Manufacturer / Country	Advanced Undersea Vehicles and Systems / Houston, TX, USA
Produced	
Cost	
Width / Wingspan	
Length	
Height	
Max. Gross Take Off Weight	
Maximum Payload Weight	
Fuel / Battery / Propulsion	DC Brushless Motors
Endurance	
Speed	8 Knots
Radio Range	
Launch Method	Surface water via towable trailer
Max Surface Wind	
Operating Altitude (typ.)	Surface only
Maximum Launch Altitude	
Full Specifications Link	https://www.marinetechnologynews.com/news/swathe-services-named-distributor-501114
Image	
Video Link	https://www.youtube.com/watch?v=szRWuguDHuo

Vehicle Name	Remus 600 UUV
Manufacturer / Country	Kongsberg / Norway
Produced	
Cost	
Width / Wingspan	12.75 in. (32.4 cm)
Length	9 – 19 ft. (2.7 – 5.5 m)
Height	
Max Gross Take Off Weight	500 - 850 lbs. (220 – 385 kg)
Maximum Payload Weight	
Fuel / Battery / Propulsion	4.5 kWh Li Ion Battery - Electric motor
Endurance	24 hrs. typical
Speed	5.5 MPH (8.8 KPH)
Radio Range	Acoustic modem, Iridium Modem, Wi-Fi 2.4 GHz
Launch Method	Ship launch
Max Surface Wind	
Operating Altitude (typ.)	Max Depth = 1,968 or 4,921 ft. (600 or 1500 m)
Maximum Launch Altitude	
Full Specifications Link	https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/F0437252E45256BDC12574AD004BDD4A?OpenDocument
Image	 The Remus 600 Unmanned Underwater Vehicle, made by Kongsberg Maritime, a Norwegian company.
Video Link	https://www.youtube.com/watch?v=NgpADOjGiH8 https://www.youtube.com/watch?v=E5aPKt6lwDI

Vehicle Name	Sandshark
Manufacturer / Country	General Dynamics – Bluefin Robotics / USA
Produced	
Cost	$30K
Width / Wingspan	4.875 in. (12.4 cm) diameter
Length	20 in. (51 cm)
Height	
Max Gross Take Off Weight	11 lbs. (5.12 kg)
Maximum Payload Weight	Customizable payload length: 23 – 60 in. (58.4 – 152.4 cm)
Fuel / Battery / Propulsion	10 Ah Lithium Ion Battery, electric propulsion
Endurance	
Speed	2.3 – 4.6 MPH (3.7 – 7.4 KPH)
Radio Range	
Launch Method	Hand launch individually or in groups from larger AUVs
Max Surface Wind	
Operating Altitude (typ.)	Depth Rating: 656 ft. (200 m)
Maximum Launch Altitude	
Full Specifications Link	https://gdmissionsystems.com/bluefinrobotics/vehicles-batteries-and-services/bluefin-sandshark
Image	
Video Link	https://www.youtube.com/watch?v=Dbfwwv47w4Y https://www.youtube.com/watch?v=U0PvLxw13do https://www.youtube.com/watch?v=LynU0Lgf3oA

Vehicle Name	Wave Glider
Manufacturer / Country	Liquid Robotics (Boeing) / USA
Produced	
Cost	
Width / Wingspan	FLOAT: 24 in. (60 cm) WINGS: 42in. (107 cm)
Length	FLOAT: 82 in. (208 cm)
Height	
Max. Gross Take Off Weight	200 lbs. (90 kg)
Maximum Payload Weight	130 lbs. (59 kg)
Fuel / Battery / Propulsion	Wave Energy and battery power for control and payload
Endurance	Self recharging – indefinite
Speed	.4 – 2.3 MPH (.6 – 3.7 KPH)
Radio Range	Satellite – Iridium 9602 or 9522B short burst/ Local: 2.4 GHz 100ft range
Launch Method	Surface water
Max Surface Wind	
Operating Altitude (typ.)	
Maximum Launch Altitude	
Full Specifications Link	https://www.liquid-robotics.com/platform/overview/ http://auvac.org/uploads/platform_pdf/lri-wave-glider-specifications.pdf
Image	
Video Link	https://www.youtube.com/watch?time_continue=29&v=77Wg1MFsLpQ

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