BACK TO GREENLAND
Matt Rutherford

(*Matt received the 2012 Jester Medal for his singlehanded non-stop circuit of the Americas in his 27ft Albin Vega* Saint Brendan *– see the Awards citations in* Flying Fish 2013/1 *– and prior to that completed a 15,000 mile Atlantic circuit in a Pearson 323, again singlehanded.*

His current vessel, Ault*, is a 42ft Colvin Gazelle of steel construction in which Matt and his crew carry out marine research. Matt confesses himself "not wild" about her schooner rig, and describes her windward performance as "like a well trimmed refrigerator" but, he adds, "she gets the job done".*

This article is unusual in having been written in two parts – the first in early June and the second in October. Read on, and the reason will become obvious…)

11 June 2016: It's good to be back in Greenland. In 2015 we left *Ault* in Sisimiut, which is just north of the Arctic Circle. Believe it or not, with a population of 6000 people Sisimiut is the second largest 'city' in Greenland. When we left Annapolis last year we weren't planning on leaving her in the Arctic, but it takes a while to get to northern Greenland and then you have to do the research. By the time we wrapped up our research projects it was too late in the season to sail back south to Annapolis, so we had to find a place to haul out. When we first visited the boatyard in Sisimiut they told us they didn't have any space ashore. "Come back tomorrow", they said. When we came back, they took a backhoe and used it to destroy an old 50ft fishing boat – that's how they made room for *Ault*.

I don't like being away from my boat for eight days, let alone eight months – not to mention there was no communication from the boat yard other than an e-mail telling me how much money I owed them, but once I'd paid them they went silent. I

Ault ashore in Sisimiut

Sisimiut

must have sent ten e-mails asking about my boat with no reply. When I saw *Ault* for the first time in eight months I'd have hugged the entire vessel if my arms had been long enough. Once the initial joy had passed it was time to check for damage. Water had got into the rudder, and during the extreme cold of the winter it had expanded and popped part of the metal off. The bracket that holds the alternator onto the engine block had cracked in half (I don't know how that happened). All the ship's batteries were shot (they hadn't been in the best shape to begin with). All in all, damage was minimal.

In some ways the previous winter had been very nice. Nicole and I live on *Ault*, so when we left her in Greenland we were basically homeless. But Annapolis friends Pat and Amy Teeling were heading to the Bahamas and let us stay in their house in Annapolis for free, so long as we covered the utilities. They really helped us out. In other ways our Ocean Research Project had been struggling. Every single grant proposal we wrote, we failed to get. Failing to get a grant is nothing new, it happens all the time, but normally we get at least one. This year we got nothing. But I've never let a lack of funding stop me in the past, so why let it stop me now?

Damage to the steel rudder

Part of the reason we struggled with funding is because our primary research is geophysical data collection. Small non-profit organisations don't

The crew of Ault enjoy a good meal before leaving, Nicole and Matt on the right

normally do geophysics; it's usually done on large research vessels by scientists with PhDs. Their funding usually comes from the National Science Foundation or the National Oceanic and Atmospheric Administration. The NSF and NOAA don't fund small non-profits, they fund universities and large institutes. Usually small non-profits do research related to a particular species – counting seal colonies, collecting polar bear droppings to be analysed, etc. It's not normal for a small non-profit to be doing the type of research we are. We can't understand how climate change is affecting the Arctic without geophysical data, while sea-level rise will affect a huge variety of marine species, but hydrography is still a hard sell.

On the up side, we now have a $25,000 sonar system that will allow us to map the sea floor down to 2000m. We can lower our CTD (salinity, temperature and depth) probe twice as deep as before, down to 1000m, and we have added another scientific project with Woods Hole Oceanographic Institution. Even though we've struggled with funding, we have seriously upgraded our ability to do professional climate change research. To hell with the funding, the research is what really matters!

We are doing four scientific projects in the Arctic this year:

1. Our primary scientific objective is with National Aeronautics and Space Administration scientists who are part of the Ocean Melting Greenland programme (NASA'S OMG). There is a warmer, saltier water column, some 200–300m down, which is coming up from the Atlantic and eating Greenland's glaciers from underneath (last year we found this warmer water in a variety of locations).

   If you were to melt all of the glaciers on earth except for those in Greenland and Antarctica you would cause half a metre of sea level rise. If you melted the Greenland

glaciers you would add 7m (21ft) of sea level rise. Since the Arctic is melting faster than the Antarctic, the Greenland ice cap will be the first thing that will seriously increase our sea levels. Sea level rise isn't just about our tides rising higher – it will increase sea surge, and it's the increase in sea surge that will beat and batter our coastal cities.

This project will happen way, way north near Qaanaaq (Inglefield Fjord), one of the last parts of West Greenland that hasn't been detailed yet. It's possible that this is where the majority of the warmer, saltier water column terminates. We will find out soon.

2. Our second project is with the Smithsonian's Environmental Research Center. When researching ocean acidification most people look at the level of pH. As we burn fossil fuels it releases CO_2 into our atmosphere. Around 30% of that CO_2 gets absorbed by our oceans, and once in the water becomes pCO_2 (sometimes called xCO_2). The increasing amount of CO_2 in the water is lowering the pH, making the water more acidic. Most scientists look at the pH, instead of the amount of CO_2 in the water, because CO_2 sensors are ungodly expensive. However, our partner Dr Miller at the Smithsonian has invented a CO_2 sensor that is a fraction of the traditional cost. We're not just collecting Arctic ocean acidification data and helping to trouble shoot this new device, but next year we'll be installing these CO_2 sensors on citizen scientists' sailboats.

3. During our third project we'll be deploying sensors that can detect minute differences of pressure in the water. Every time a glacier calves an iceberg it makes a wave, and these sensors can detect the waves and count them. This means they'll be able to count the number of times a glacier calves during the period that they're deployed. Previously, if you wanted to know how many times a glacier calved you would have to stand there 24/7 and count as it happened. To be able to get an accurate idea of the rate of glacial calving is crucial to understanding the speed of its melt and ultimately the health of the glacier.

4. There are five major gyres in our earth's oceans*. These gyres are where the 'garbage patches' are, the accumulation zones where plastic trash gathers. Last year we did the first ever microplastics trawls in Baffin Bay (or anywhere else in the Arctic). I believe there is a small gyre in the northern central region of Baffin Bay, and we plan to trawl this accumulation zone to better understand the amount of microplastics making its way up from the Atlantic into the Arctic Ocean. It should be interesting to see what we find.

Even though we've struggled with funding, we've still put together a serious scientific research expedition. The obstacles we face only make us stronger, and there's no limit to our determination. *Fortitudine vincimus* (by endurance we shall conquer).

* See https://en.wikipedia.org/wiki/Ocean_gyre for a brief but very clear overview of these.

8 October 2016: Sydney, Nova Scotia seems like the Caribbean after sailing in the Arctic for the last four months. *Ault* is tied off to a small protruding 11m seawall in Sydney Harbor, the only place left where you can tie off for free. We've stopped here to avoid Hurricane *Matthew* on our way south to Annapolis, Maryland. Matthew has just turned south again, so instead of a hurricane we have blue skies and sunshine.

We had our fair share of hurricane force winds when we were doing research for NASA's Ocean Melting Greenland program, mapping an area 800 miles from the North Pole. It's been a long expedition, in some ways more tiring then when I spent 309 days alone circumnavigating the Americas. Sailing to the ends of the earth is hard enough – trying to collect professional-grade scientific data while doing so makes it ten times harder.

After sailing around the Americas non-stop singlehanded I realised I'd never stop sailing. I decided that if I was going to spend my life sailing I might as well do it in a way that gives back to the ocean, so I created Ocean Research Project, a 501(c)(3)* non-profit organisation. We spent 2013 and 2014 sailing 15,000 miles in the Atlantic and Pacific garbage patch regions collecting microplastics samples for various universities and institutes. Plastic trash in our ocean is a big problem, but so is climate change. In 2015 I set my sights on sailing to the Arctic and researching both issues.

In 2015/16 we worked primarily with NASA's Ocean Melting Greenland (OMG) program in the uncharted regions of Northwest Greenland, mapping the seafloor to look for deeper areas where this warmer water may be hiding. On finding one we lowered a CTD (conductivity, temperature and depth) probe to verify if there was warmer water in that area. We also collected data relating to the other three topics

* Being '501(c)(3)' means that an organisation has been approved by the US Internal Revenue Service as a tax-exempt, charitable organisation.

Mapping the seafloor in Inglefield Fjord

Working our way to the face of a glacier

described previously – if you're going to sail all the way to the Arctic you might as well do as many different projects as possible.

We'd intended to sail back to the United States at the end of our 2015 research, but it dragged on until October. The temperature had dropped to 20°F (–6·7°C) and ice was forming on the boat. We decided it was too late in the season to sail back, so left *Ault* on the hard in Sisimiut, Greenland. On our return in late spring there were repairs to be done, including making good the damaged rudder. We were also upgrading our sonar system, a job that would have been hard enough in Annapolis, let alone Greenland. The transducer alone weighs 50lbs (22·7kg) and is larger than a cinder block. But after two weeks of working 14 hour days we'd fixed the broken bits and installed all our new equipment and were ready to begin the 2016 Greenland Climate Project.

Our first objective was to sail into a series of fjords in northern Disko Bay to deploy the pressure sensors. The strategy is to get as close to the face of a glacier as possible (keeping safety in mind) and deploy the sensors near shore in roughly 2–3m of water. This presents two problems:

- First off, as you approach the face of a glacier you enter a type of ice known as mélange. Mélange is a confused jumble of ice of all shapes and sizes, some pieces the size of an ice cube, some as large as an office building. This ice is so thickly pressed together that there isn't a single spot of open water anywhere. The only way to get through mélange is to insert your bow into it and slowly – often less than 1 knot – push your way through.

- The second issue is that when a glacier calves off a large iceberg it creates a large

wave. These waves are harmless so long as you are in deep water – they may be large, but in deep water they just roll by without breaking – but in shallow water, especially the 2–3m areas where we had to deploy the sensors, the waves come in like a tsunami. First all the water disappears, and then an 8m (25ft) wall of water comes crashing in, slamming against the rocks and throwing spray far into the air. If you were caught in this situation I don't think you'd survive.

We successfully deployed the sensors, some by boat and some by land, hiking over mountains to reach coastal areas too dangerous and icy to approach from the sea. These sensors would remain in place collecting data while we sailed north to do our primary research project for NASA's OMG program.

On our way north we collected microplastics samples in central Baffin Bay. This work was made more difficult by the abundant zooplankton and krill in the water – after an hour of dragging a trawl, instead of getting just microplastics we would also get gallons of little creatures in our net. After two years of looking for microplastics in the Arctic, I think it's safe to say that any area that is covered by ice for six months or more a year will only have a minimal quantity – in winter the microplastics floating on the surface will be blocked by the ice. The microplastics that do come up in the summer will be frozen in the winter and pushed south as the ice melts in the spring. More research still needs to be done, but as far as I can tell, this is what's happening in the Arctic.

Our primary scientific objective was hugely ambitious. We were going to sail to northern Greenland, roughly 800 miles from the North Pole, and map out 1300 miles of uncharted waters. We were also going to deploy the CTD probe 130 times, often down to 1000m. Can you imagine trying to lower a probe 1000m down off the back of your boat?

Nicole preparing the CTD (salinity, temperature and depth) probe for a cast

This project took six weeks to complete. We had five storms with winds over 50 knots, and when the winds weren't blowing the oysters off the rocks we were continuously underway. When we do research we don't wake up in the morning, eat breakfast, raise anchor, work for eight hours, drop anchor and go to bed. We work around the clock, five hours on five hours off, 24 hours a day. We only stop for fuel, water and bad weather.

The region we were mapping was one of the last uncharted regions left in West Greenland. There are rocks hiding all over the place – you have no idea where they are. There are icebergs everywhere, of all different shapes and sizes, and the weather forecasts that far north are a joke (one time it said we would get 30 knots and it blew 70 knots). This is as close to old-school exploration as you can get these days, sailing through uncharted waters doing important research in places where no one has ever done research before. NASA scientists will be using the data we collected in scientific papers during the coming months.

After six exhausting weeks of collecting scientific data while dodging ice and storms, we completed our project for NASA's OMG program and turned back south. We sailed back to Northern Disko Island, retrieved the pressure sensors, and prepared *Ault* for the 1000 mile crossing from Aasiaat, Greenland to Labrador, Canada.

It feels great to be in Nova Scotia, far enough south that we no longer have to worry about icebergs, even though we still have to sail 1500 miles back to Annapolis and two hurricanes are lurking in the Atlantic.

We made a series of short videos about our 2016 Greenland Climate Project. You can see them at www.oceanresearchproject.org.