In [119]:
```
from mpl_toolkits.mplot3d import Axes3D
#from sklearn.preprocessing import StandardScaler
import matplotlib.mlab as mlab
import matplotlib.pyplot as plt # plotting
import numpy as np # linear algebra
import numpy as n
import os # accessing directory structure
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
#import plotly.plotly as py
#import plotly.tools as tls
import seaborn as sns
import random

from math import sqrt

import calendar
import datetime
```

In [120]:
```
!sudo pip install --upgrade pip
!sudo pip install xlrd
```

```
DEPRECATION: Python 2.7 will reach the end of its life on January 1st,
 2020. Please upgrade your Python as Python 2.7 won't be maintained aft
er that date. A future version of pip will drop support for Python 2.7.
More details about Python 2 support in pip, can be found at https://pi
p.pypa.io/en/latest/development/release-process/#python-2-support
/usr/local/lib/python2.7/dist-packages/pip/_vendor/urllib3/util/ssl_.p
y:380: SNIMissingWarning: An HTTPS request has been made, but the SNI
 (Server Name Indication) extension to TLS is not available on this pla
tform. This may cause the server to present an incorrect TLS certificat
e, which can cause validation failures. You can upgrade to a newer vers
ion of Python to solve this. For more information, see https://urllib3.
readthedocs.io/en/latest/advanced-usage.html#ssl-warnings
  SNIMissingWarning,
/usr/local/lib/python2.7/dist-packages/pip/_vendor/urllib3/util/ssl_.p
y:139: InsecurePlatformWarning: A true SSLContext object is not availab
le. This prevents urllib3 from configuring SSL appropriately and may ca
use certain SSL connections to fail. You can upgrade to a newer version
of Python to solve this. For more information, see https://urllib3.read
thedocs.io/en/latest/advanced-usage.html#ssl-warnings
  InsecurePlatformWarning,
Requirement already up-to-date: pip in /usr/local/lib/python2.7/dist-pa
ckages (19.3.1)
DEPRECATION: Python 2.7 will reach the end of its life on January 1st,
 2020. Please upgrade your Python as Python 2.7 won't be maintained aft
er that date. A future version of pip will drop support for Python 2.7.
More details about Python 2 support in pip, can be found at https://pi
p.pypa.io/en/latest/development/release-process/#python-2-support
Requirement already satisfied: xlrd in /usr/local/lib/python2.7/dist-pa
ckages (1.2.0)
```

In [ ]:

In [121]:
```
%matplotlib inline
```

In [122]:
```
Waves1 = pd.read_csv('Buoys-Waves.csv')
Control = pd.read_csv('control.csv')
```

In [123]:
```
Waves1 = Waves1.rename(columns = {'Date/Time' : 'time','Hs' : 'significa
nt_wave_height' , 'Hmax' : 'maximum_wave_height', 'Tz' : 'zero_wave_peri
od',
                          'Tp' : 'peak_wave_period' , 'SST' : 'sea_surface_
temperature' , 'Peak Direction' : 'peak_direction'})
Waves1 = Waves1[Waves1['maximum_wave_height'] != -99.9]
Waves1.head()
```

Out[123]:

	time	significant_wave_height	maximum_wave_height	zero_wave_period	peak_wa
1	1/1/2017 0:30	0.875	1.39	4.421	4.506
2	1/1/2017 1:00	0.763	1.15	4.520	5.513
3	1/1/2017 1:30	0.770	1.41	4.582	5.647
4	1/1/2017 2:00	0.747	1.16	4.515	5.083
5	1/1/2017 2:30	0.718	1.61	4.614	6.181

Background/Introduction

I am exploring the years of 2017-2019. My goal is to find interactions between data columns, if any exist (ex. Peak wave height and average wave height).Using the location and direction of the wave currents, being able to plot the patterns of the waves. Plot the patterns of ocean currents throughout a calendar year. Predict information about future wave patterns given a set of parameters such as time of year or ocean temperature. People who may be interested in this data would be surfers as well as people who may study wave patterns.

Data

I plan to compare years as well as months with my main columns such as significant wave height and sea sruface temperature ,to see any patterns that may be useful. I would like to study the waves specifically by month as I believe the colder months of the year such as november - march would have either a higher wave impact from the weather or even a lower impact from the weather.

In [124]:
```
#This code allows me to break up the time column because it was not usef
ul to me, and make
#individual columns such as month,year and time
Waves1["time"] = pd.to_datetime(Waves1["time"])
Waves1["year"] = Waves1["time"].astype(str).str[0:4]
Waves1["year"] = Waves1["year"].astype(int)

Waves1["time1"] = Waves1["time"].astype(str).str[11:16]
Waves1["month"] = Waves1["time"].astype(str).str[5:7]
Waves1.head()
```

Out[124]:

	time	significant_wave_height	maximum_wave_height	zero_wave_period	peak_wa
1	2017-01-01 00:30:00	0.875	1.39	4.421	4.506
2	2017-01-01 01:00:00	0.763	1.15	4.520	5.513
3	2017-01-01 01:30:00	0.770	1.41	4.582	5.647
4	2017-01-01 02:00:00	0.747	1.16	4.515	5.083
5	2017-01-01 02:30:00	0.718	1.61	4.614	6.181

In [ ]:

In [125]:
```
# Variable meanings in the wave datset
# Date/Time - Date
#Hs -Significant wave height, an average of the highest third of the wav
es in a record
#Hmax -The maximum wave height in the record
#Tz- The zero upcrossing wave period
#Tp- The peak energy wave period
#Peak Direction -Direction (related to true north) from which the peak p
eriod waves are coming from
#SST -Approximation of sea surface temperature
print (len(Control))
print (len(Waves1))
```

```
511
43643
```

Problem Statement and Background

Problem Statement and Background

Using data collected by buoys on oceanic wave patterns over a 30-month period, we will be looking at data dealing with wave height, energy, frequency, temperature, etc. during half hour intervals and attempting to find interactions between these columns, as well as plotting and predicting the wave pattern in the future given certain parameters base on the collected data. These are our main goals going into the research. To find interactions between data columns, if any exist (ex. Peak wave height and average wave height).Using the location and direction of the wave currents, being able to plot the patterns of the waves. Plot the patterns of ocean currents throughout a calendar year. Predict information about future wave patterns given a set of parameters such as time of year or ocean temperature. After analyzing what time and temperatures occur with the waves, it would be in our best interest if we could also investigate if they are related to the time and temperature that sharks often would attack. If there, is a relationship between shark attacks to wave occurrence we can see when it is safe to surf as well as should surfing not even be an option during certain times of the day / seasons. We know that shark attacks are not predictable so far because almost all beaches have shark nets for protection. So almost all shark attacks are random. We plan to use our data to see if these attacks are more than random occurrences.

Data Sources

The Data Source(s) You Intend to Use

https://www.kaggle.com/jolasa/waves-measuring-buoys-data-mooloolaba (https://www.kaggle.com/jolasa/waves-measuring-buoys-data-mooloolaba) https://www.data.qld.gov.au/dataset/coastal-data-system-waves-mooloolaba (https://www.data.qld.gov.au/dataset/coastal-data-system-waves-mooloolaba)

We found two datasets from kaggle that would be very beneficial for our project. The first dataset has 24000 rows and 6 columns. While the second dataset has 511 rows and 11 columns . I plan to collect more data as the project goes on because the more the better. For now, I have enough data to be satisfied for a quality project. I plan to join both datasets into one but it will take some time to figure out. The first dataset is stored in the Waves data frame in codio in the file (WavesCode) and the second dataset is stored in the “Control” data frame in the file (WavesCode). There is many data to work with so it should come out very clean and consistent.

Data Flaws/Weaknesses and Cleaning

Data Flaws/Weaknesses and Cleaning

I was able to successfully join the two datasets. Any errors I did have in my data I either manually fixed or wrote a function that would clean it.

In [126]:
```
#cleaning up the data
#Waves = Waves.rename(columns = {'Hs' : 'significant_wave_height' , 'Hmax' : 'maximum_wave_height', 'Tz' : 'zero_wave_period',
#'Tp' : 'peak_wave_period' , 'SST' : 'sea_surface_temperature' , 'Peak Direction' : 'peak_direction'})
```

In [ ]:
```
```

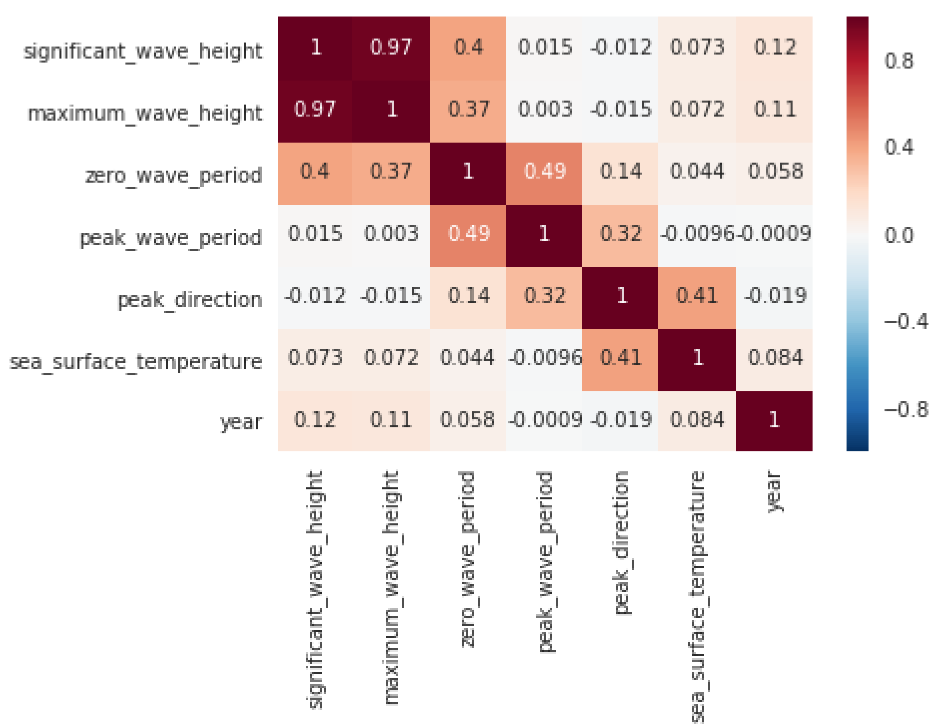
Basic Data Characteristics

Methodology

Basic Data Characteristics In my codio file I was able to look more into these types of graphs and display them better.

In [127]:
```
sns.heatmap(Waves1.corr(), annot=True)
```

Out[127]: <matplotlib.axes._subplots.AxesSubplot at 0x7f26f3458ac8>



In [128]:

```
#Shows the average wave height from 2017-2019 throughout all 12 months o
f the year.
print(Waves1.pivot_table('significant_wave_height', index="month",column
s = 'year').plot(figsize=(20,5)))
Waves1[Waves1.significant_wave_height >0].pivot_table('significant_wave_
height', index='year',columns = "month")
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```

Out[128]:

month	01	02	03	04	05	06	07	08	
year									
2017	1.112207	1.261344	1.401723	1.600152	1.330598	1.242637	0.836827	0.866170	0
2018	1.164329	1.562520	1.721793	1.513944	1.176944	1.190878	0.875884	0.843514	1
2019	1.133123	1.973305	1.105316	1.593860	1.240443	1.256230	1.505330	1.400917	1

In [129]:
```
#Shows the average sea temperature by year from 2017-2019 throughout all
12 months of the year.
print(Waves1.pivot_table('sea_surface_temperature', index="month",column
s = 'year').plot(figsize=(20,5)))
Waves1[Waves1.sea_surface_temperature >0].pivot_table('sea_surface_tempe
rature', index='year',columns = "month")
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```

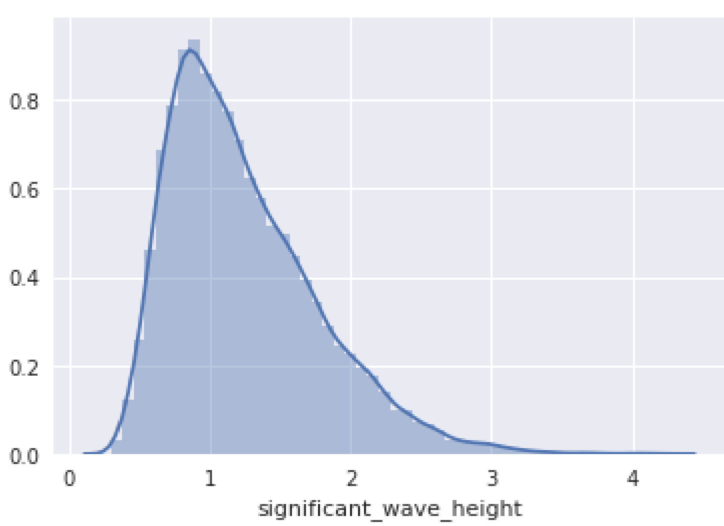
Out[129]:

month	01	02	03	04	05	06	07	
year								
2017	26.194448	27.177527	26.961186	24.399408	23.186741	22.286822	21.326078	21.
2018	26.742881	26.589829	26.265172	25.342708	23.418203	21.630694	20.764166	20.
2019	26.382846	26.273535	26.175881	24.770826	23.478292	22.462162	24.888368	24.

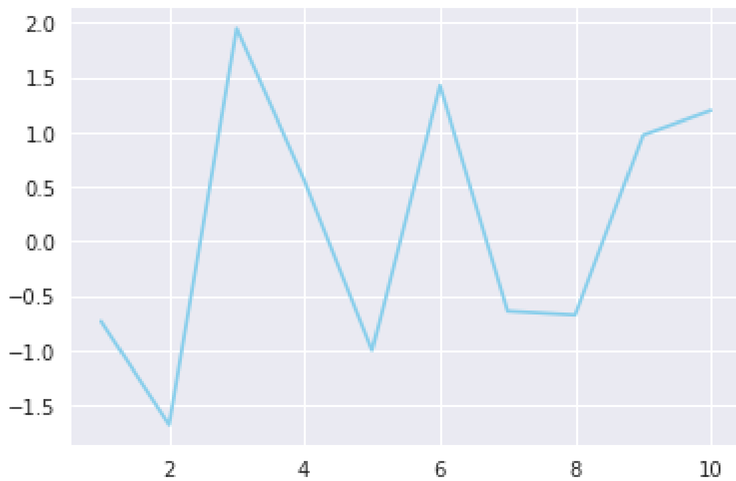
In [130]:
```
sns.distplot( Waves1["significant_wave_height"] )
```

```
/usr/local/lib/python3.4/dist-packages/matplotlib-2.1.1+1236.g869c984f5
-py3.4-linux-x86_64.egg/matplotlib/axes/_axes.py:6408: UserWarning: The
'normed' kwarg is deprecated, and has been replaced by the 'density' kw
arg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```

Out[130]: `<matplotlib.axes._subplots.AxesSubplot at 0x7f26f31004a8>`

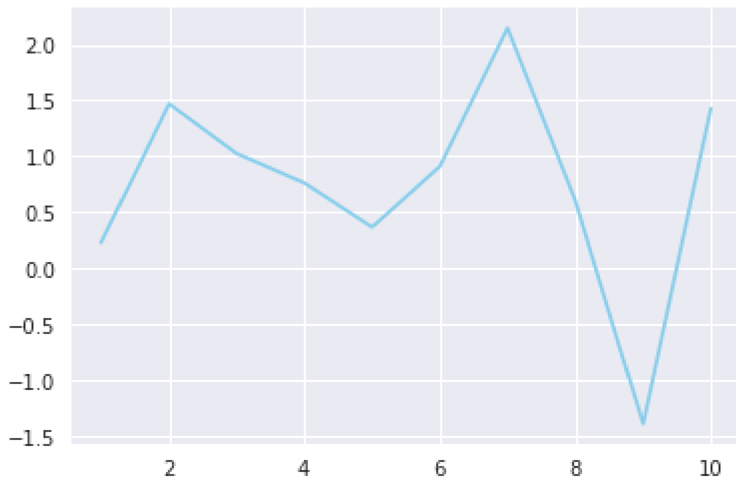


In [131]:
```
Waves1=pd.DataFrame({'sea_surface_temperature': range(1,11), 'maximum_wa
ve_height': np.random.randn(10) })
plt.plot( 'sea_surface_temperature', 'maximum_wave_height', data=Waves1,
color='skyblue')
plt.show()
#Displays a relationship of the max wave height in comparison to the app
roximate sea surface temperature.
```



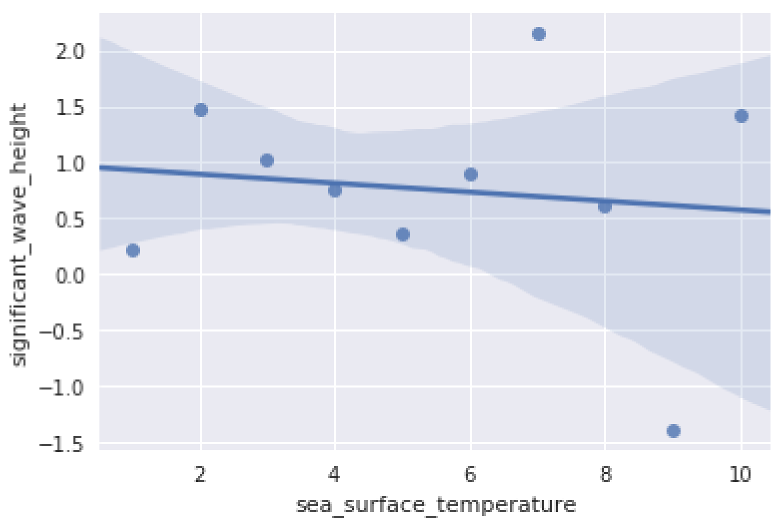
In [132]:
```
Waves1=pd.DataFrame({'sea_surface_temperature': range(1,11), 'significan
t_wave_height': np.random.randn(10) })
plt.plot( 'sea_surface_temperature', 'significant_wave_height', data=Wav
es1, color='skyblue')
print(plt.show())

sns.regplot(x=Waves1["sea_surface_temperature"], y=Waves1["significant_w
ave_height"])
#Displays a relationship of the significant wave height in comparison to
the approximate sea surface temperature.
```



None

Out[132]: <matplotlib.axes._subplots.AxesSubplot at 0x7f26f2f6cc18>



In [133]:
```
#print(sns.regplot(x=Waves1["maximum_wave_height"], y=Waves1["sea_surfac
e_temperature"],fit_reg=False))
```

In [134]:
```
#print(sns.regplot(x=Waves1["maximum_wave_height"], y=Waves1["peak_direc
tion"],fit_reg=True))
```

Surprises

Surprises I did not have any surprises so far in my data. The majority of shark attacks occur near the shore and in the surf zone because their natural preys live in these areas. But attacks also take place in steep underwater drop-offs, where divers often swim. The wave height should not be a surprise where the attacks will take place.

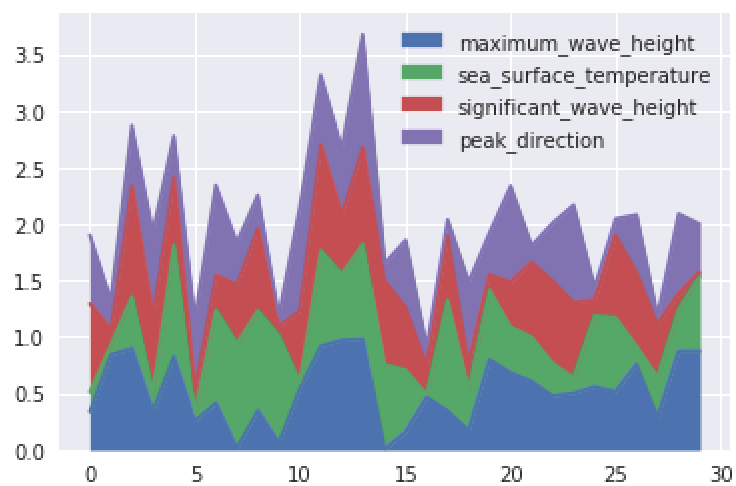
Next Steps, any Obstacles

My next step would be to join the two datasets, which may take some time. Once I do this, it should be much easier to work with. I also plan to use another kaggle file that I was not able to download due to the size of the file. It is not much of an obstacle but it does briefly delay our coding. The file contained moon phases, which we could study and possibly link to our wave data. With this information, we could look at if there was a three-way relationship between waves, sharks attacks, and moon phases.

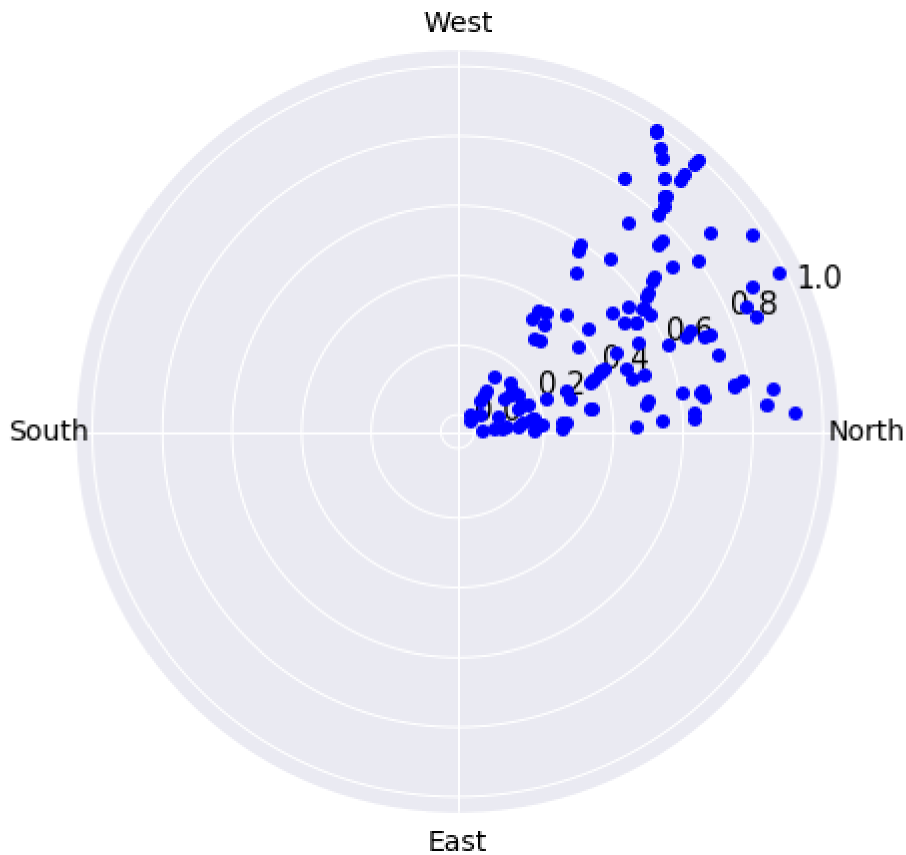
In [135]:
```
Waves1 = pd.DataFrame(np.random.rand(30, 4), columns=['maximum_wave_heig
ht', 'sea_surface_temperature', 'significant_wave_height',
'peak_direction'])

# plot
Waves1.plot.area()
# The height of each coloured stack represents the percentage proportion
of that category at a given point in time. For this
# I wanted to see the the categories of the maximum height, sea surface
 temperature, significant wave height, and the peak
#direction of where the waves are coming from.
```

Out[135]: <matplotlib.axes._subplots.AxesSubplot at 0x7f26f2914828>

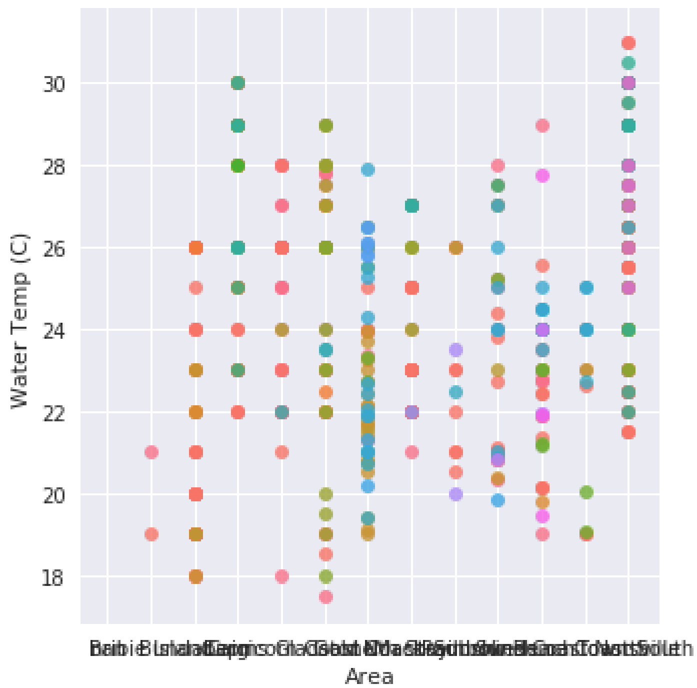


In [136]:
```
from math import pi
y1 = Waves1[Waves1.peak_direction > 0].values
x1 = Waves1[Waves1.peak_direction > 0].sea_surface_temperature
categories = ["North","West","South","East"]
N = len(categories)
plt.rcParams['figure.figsize'] = (7, 7)
plt.axes(projection='polar')
angles = [n / float(N) * 2 * pi for n in range(N)]
angles += angles[:1]
plt.xticks(angles[:-1], categories, color='black', size=14)
plt.yticks(color="black", size=15)
plt.polar(x1, y1,  'ro', color= "blue")
plt.show()
```



In [137]:
```
sns.lmplot( x="Area", y="Water Temp (C)", data=Control, fit_reg=False, h
ue='Species Name', legend=False)
# Shows the area and water temperature with what species of shark attack
ed.
# Will adjust X and Y axis later once I figure out how to.
```

Out[137]: <seaborn.axisgrid.FacetGrid at 0x7f26f26b02b0>



In [138]:
```
Control.head()
```

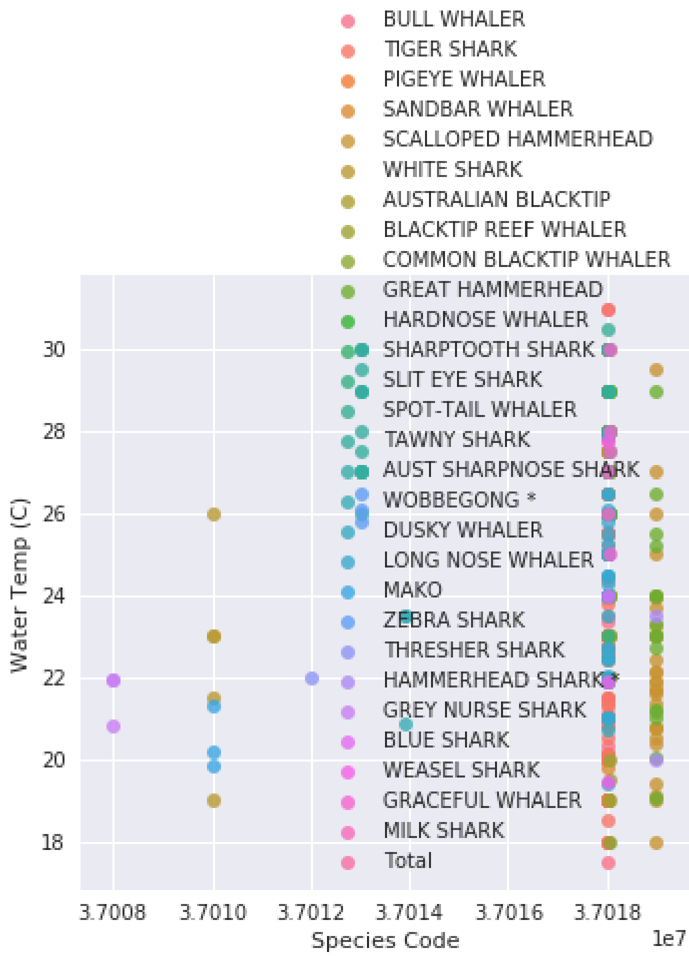
Out[138]:

	Species Name	Species Code	Date	Area	Location	Latitude	Longitude	
0	BULL WHALER	37018021.0	8/4/2017	Bribie Island	Woorim (Bribie Island)	-27.06835189	153.2113376	De
1	TIGER SHARK	37018022.0	8/8/2017	Bribie Island	Woorim (Bribie Island)	27.06511	153.2108	Eu
2	BULL WHALER	37018021.0	3/3/2017	Bundaberg	Neilson Park	-24.80429012	152.4641092	De
3	BULL WHALER	37018021.0	3/3/2017	Bundaberg	Kellys Beach	-24.83788865	152.4673179	De
4	BULL WHALER	37018021.0	17/03/2017	Bundaberg	Neilson Park	-24.80864323	152.4327342	De

In [139]:
```
sns.lmplot( x="Species Code", y="Water Temp (C)", data=Control, fit_reg=
False, hue='Species Name', legend=False)

plt.legend(loc='lower right')
```

Out[139]: <matplotlib.legend.Legend at 0x7f26f28f6c88>



In [ ]: