Animal Remote Sensing Supports Antarctic Marine Protected Areas Zoning

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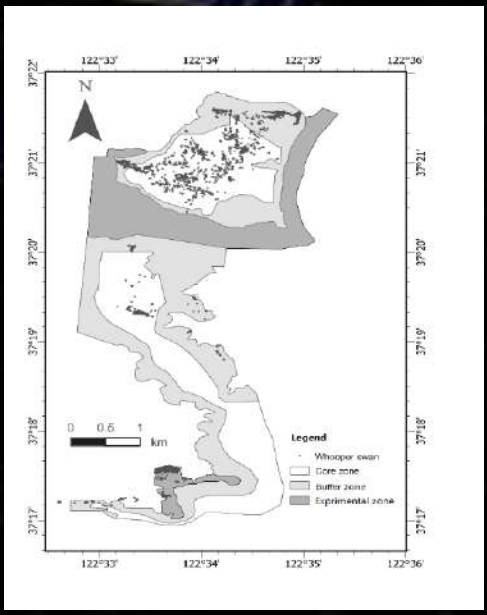
Remote Sensing Reveals the Earth's Details

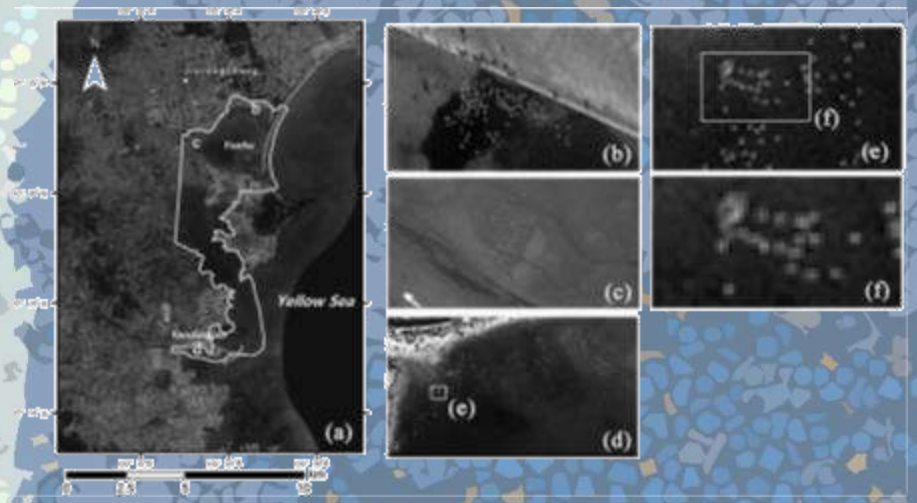
With increasing spectral and spatiotemporal resolution, remote sensing from satellites and drones has become a vital tool for revealing surface details.

Satellites	Launch Time	Nation	Spatial Resolution(m)*
WorldView-3/4	2014/2016	US	Pan: 0.31; MS: 1.24
WorldView-1/2	2007/2009	US	Pan: 0.46; MS: 1.84
GeoEye-1	2008	US	Pan: 0.46; MS: 1.84
Pleiades	2011	France	Pan: 0.5; MS: 2
SuperView-1	2016	China	Pan: 0.5; MS: 2
KOMPSAT-3A	2015	Korea	Pan: 0.55; MS: 2.2
Quickbird**	2001	US	Pan: 0.65; MS: 2.62
KOMPSAT-3	2012	Korea	Pan: 0.7; MS: 2.8
Gaofen-2	2014	China	Pan: 0.8; MS: 2.44
TripleSat	2015	India	Pan: 0.8; MS: 3.2
IKONOS***	1999	US	Pan: 0.82; MS: 3.28
SkySat-1/2	2013/2014	US	Pan: 0.9; MS: 2



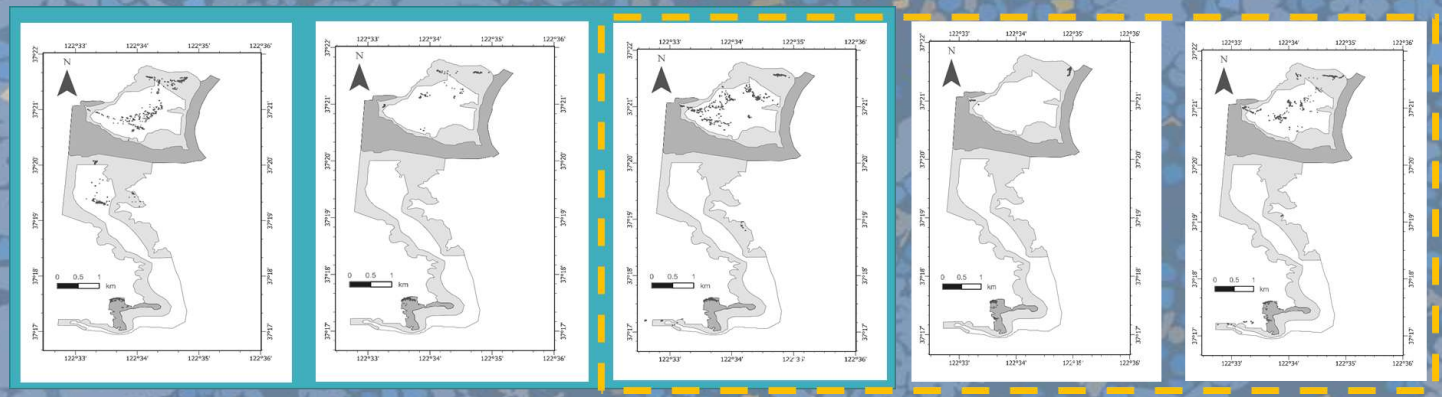
Counting Whooper Swans with Satellite Imagery

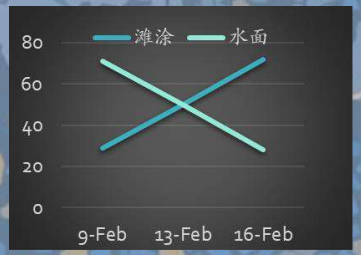
Common view

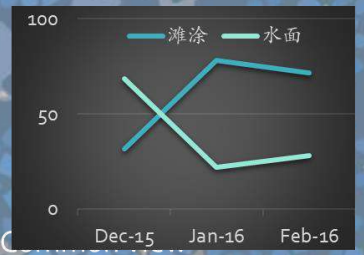


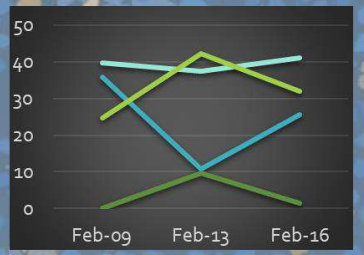
Satellite imagery

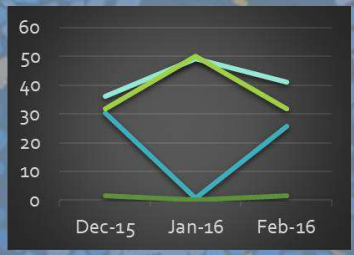
- identify target individuals from satellite imagery, there must be a recognizable difference between the individuals and their environmental background.







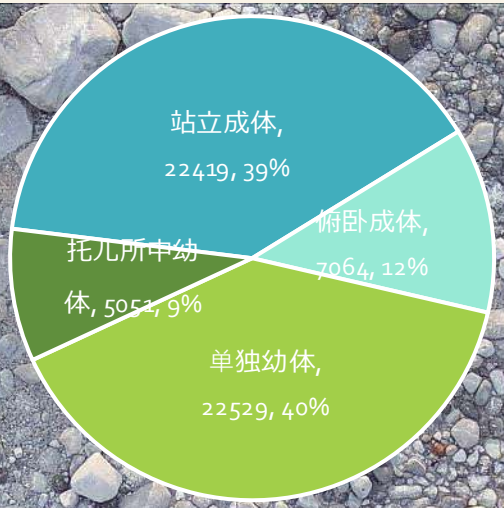


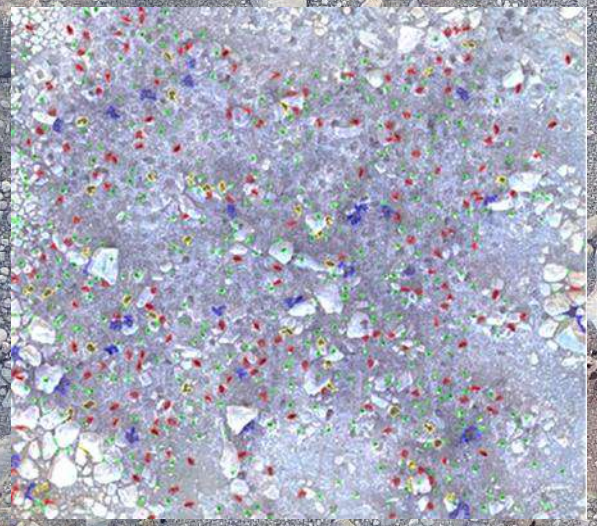


Potential Application

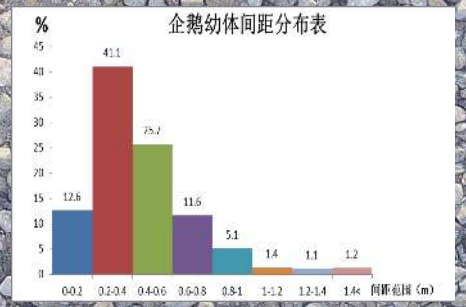
Other gregarious, uncovered animal populations

Penguin Population Size Estimation and Distribution Mapping



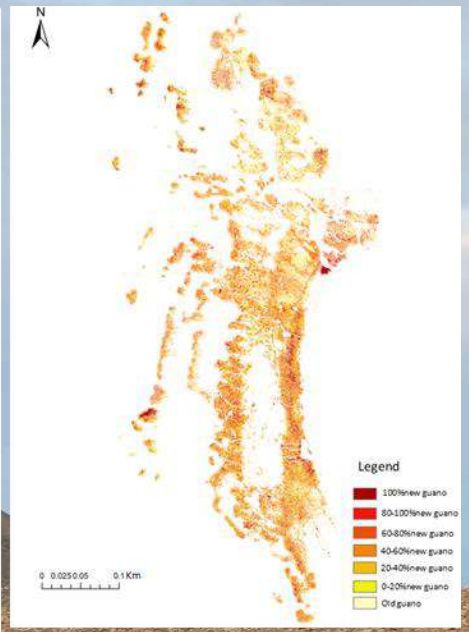


Object-Oriented Penguin Individual Extraction

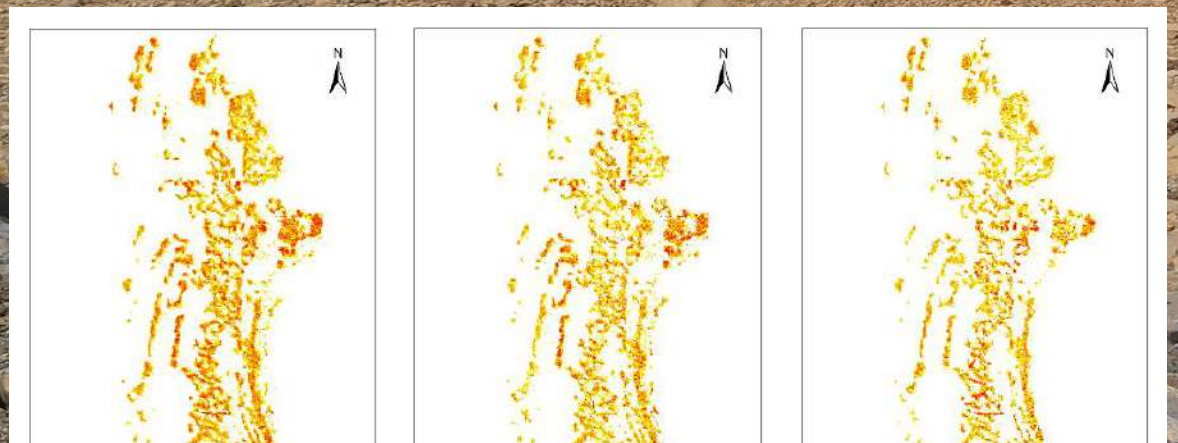


- On January 10, 2019, 、 57,063 adult penguins and 1,163 creche were recorded.
- Adult to juvenile ratio: 1:1
- Accuracy: 87.4% ± 2.06%
- Adult penguin "social distance" (0.77m) = penguin body length (0.71m)
- Over 90% of chicks are within 0.8m distance
- Over 90% of creche have adults within a 0.2m range

Satellite Remote Sensing of Penguin Population



	TP mean error	LP mean error	SP mean error
U	2.98%	-15.20%	19.61%
M	-9.01%	-2.38%	-15.36%
L	-3.23%	2.03%	-9.60%
whole	-8.61%	-0.45%	-5.66%

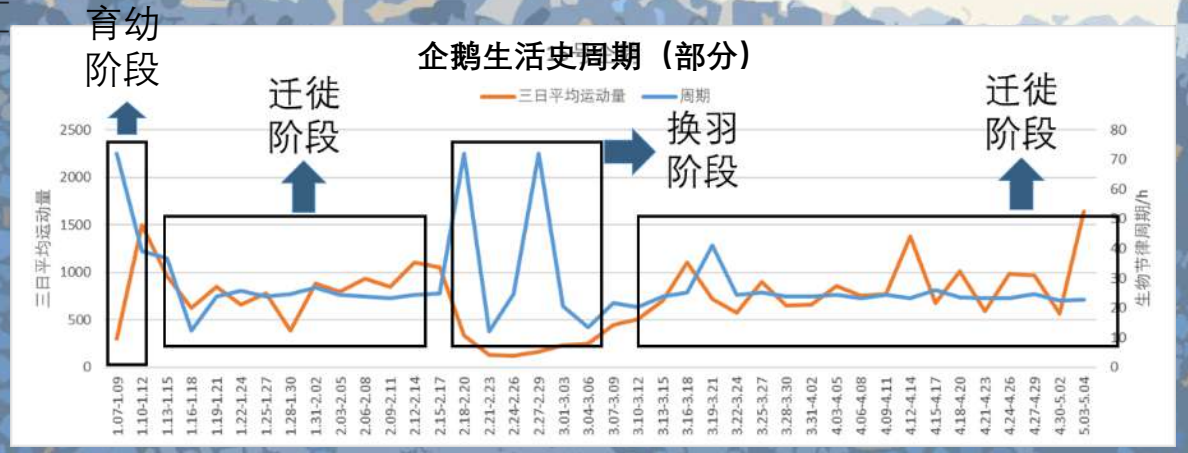


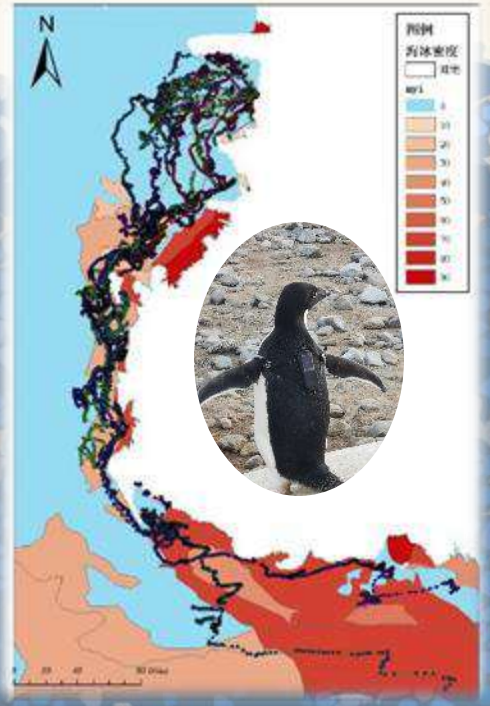
背景：无人机在营地降落

Penguin Tracking - Activity Rhythm

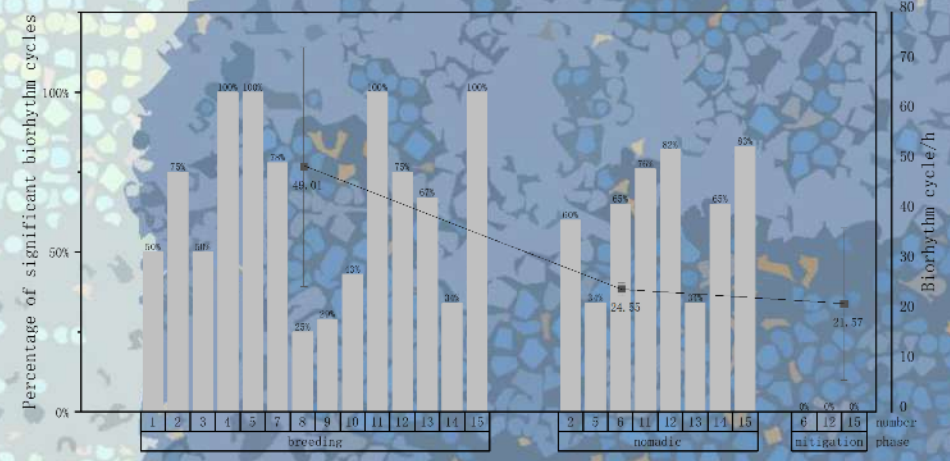
追踪器数据信息

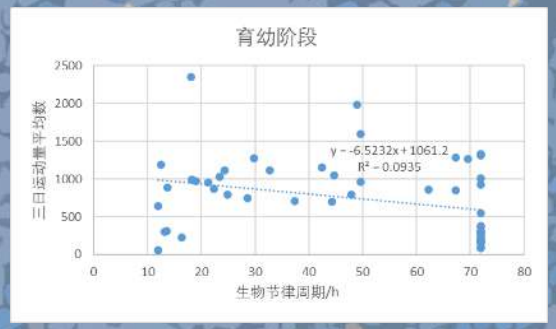
企鹅编号	采集时间	终止时间	移动路程/km
1	2020.1.6	2020.1.18	213
2	2020.1.6	2020.2.2	354
3	2020.1.6	2020.1.21	237
4	2020.1.6	2020.1.16	156
5	2020.1.6	2020.2.21	589
6	2020.1.6	2020.5.19	2501
7	2020.1.6	2020.2.4	1035
8	2020.1.6	2020.2.5	1004
9	2020.1.6	2020.2.3	819
10	2020.1.6	2020.2.1	94
11	2020.1.6	2020.3.14	1388
12	2020.1.6	2020.3.21	1291
13	2020.1.6	2020.2.2	400
14	2020.1.6	2020.2.28	1169
15	2020.1.6	2020.5.5	1922

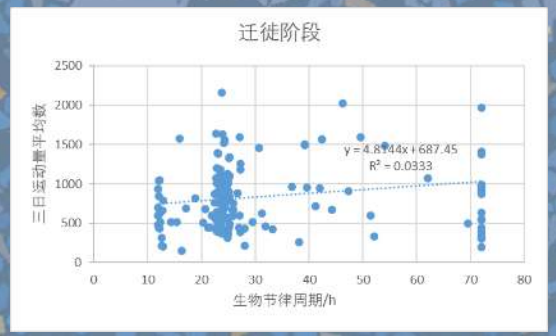




企鹅迁徙路径



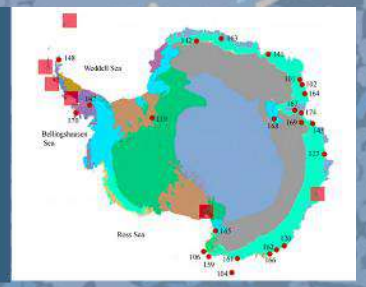




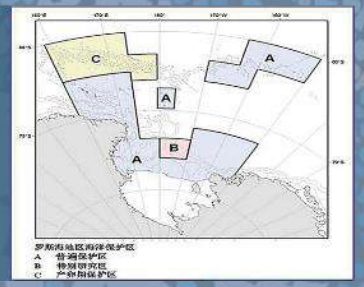
- Day and night changes do not affect the activity rhythm of penguins;
- During the migration phase, the activity rhythm of penguins is 24 hours;
- During the chick-rearing phase, the activity rhythm significantly increases, while there is no activity rhythm;
- During the molting phase;There is no correlation between activity level and activity rhythm.

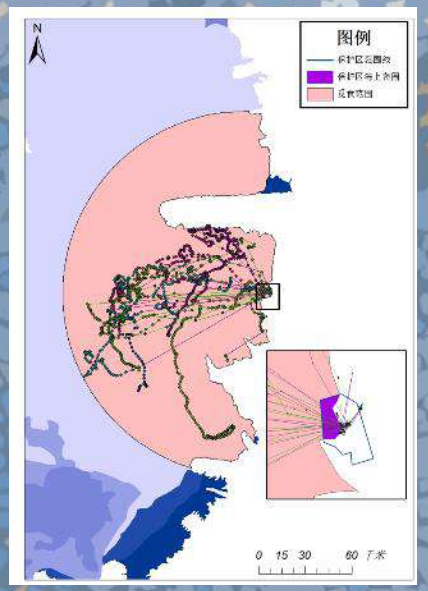
Protected Areas Zoning and Evaluation

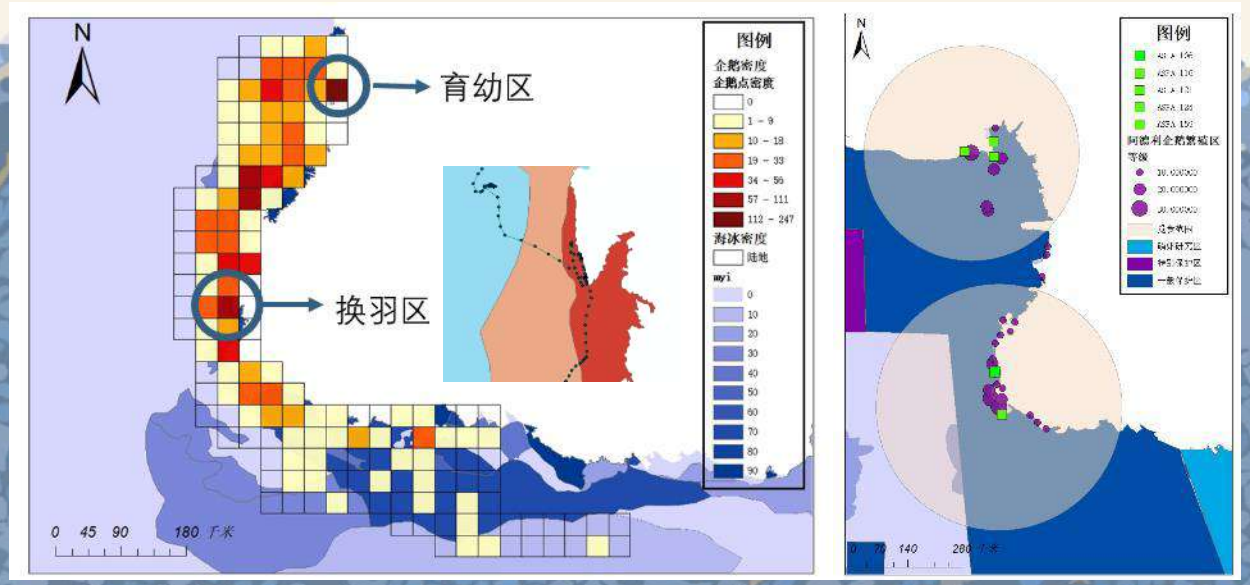
南极陆地保护区



南极海洋保护区

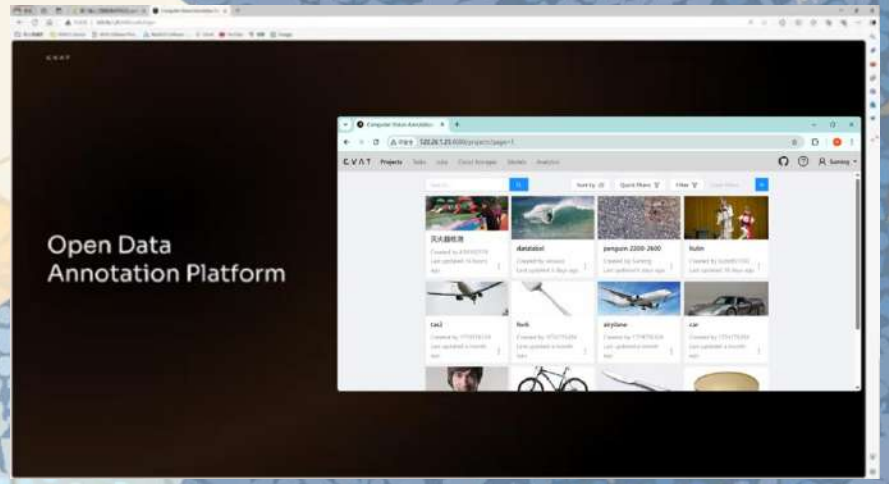






- Boundaries of terrestrial and marine areas of the protected areas
- Antarctic protected area network
- Trade-offs between large and small habitats
- Fishery management measures in migration corridors

Identify Animals by AI



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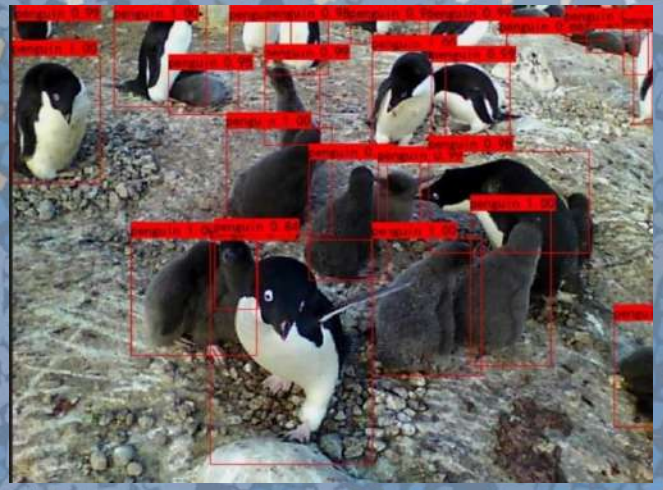
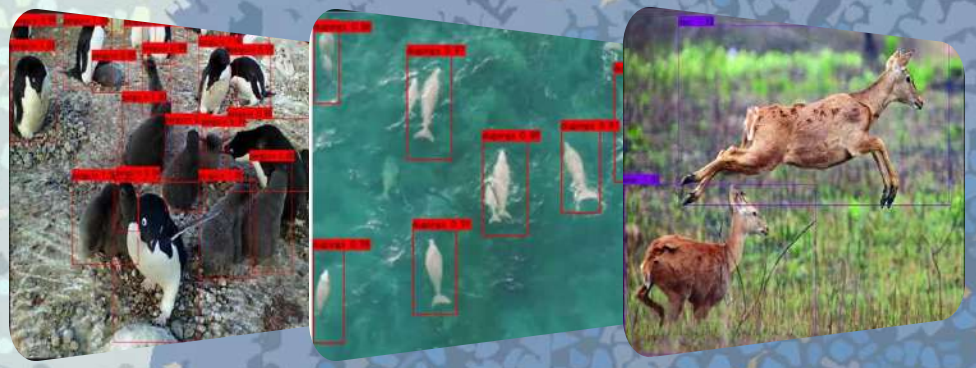
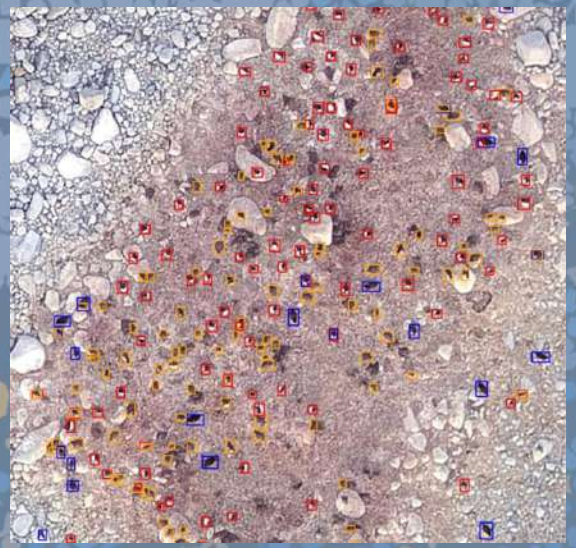
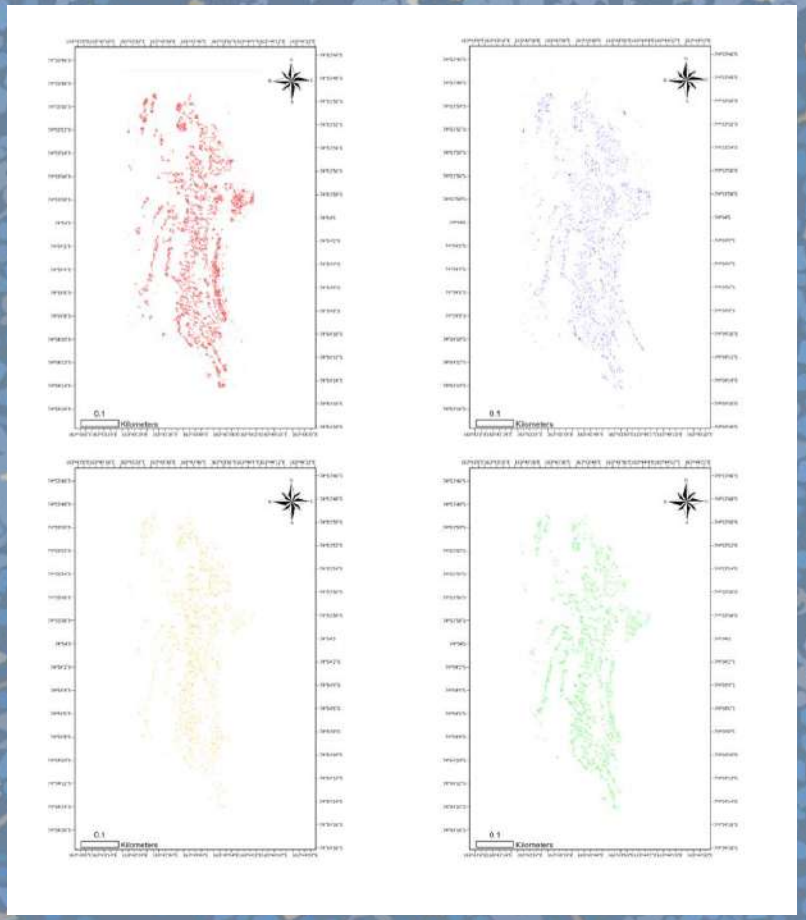


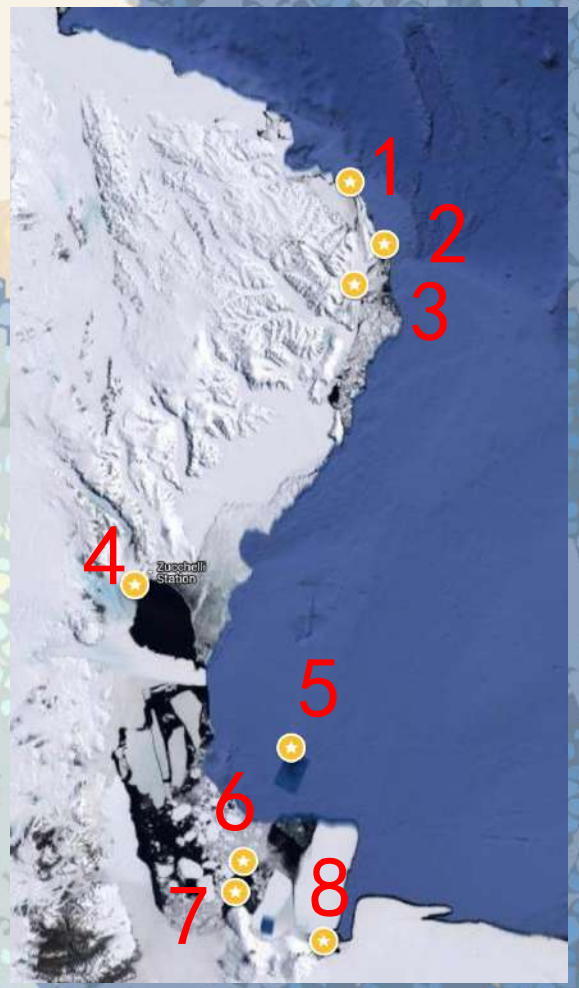






Estimate Penguin Dynamic by AI

研究区域



罗斯海主要阿德利企鹅栖息地

1、阿代尔角

2、珀泽申群岛

3、哈勒特角

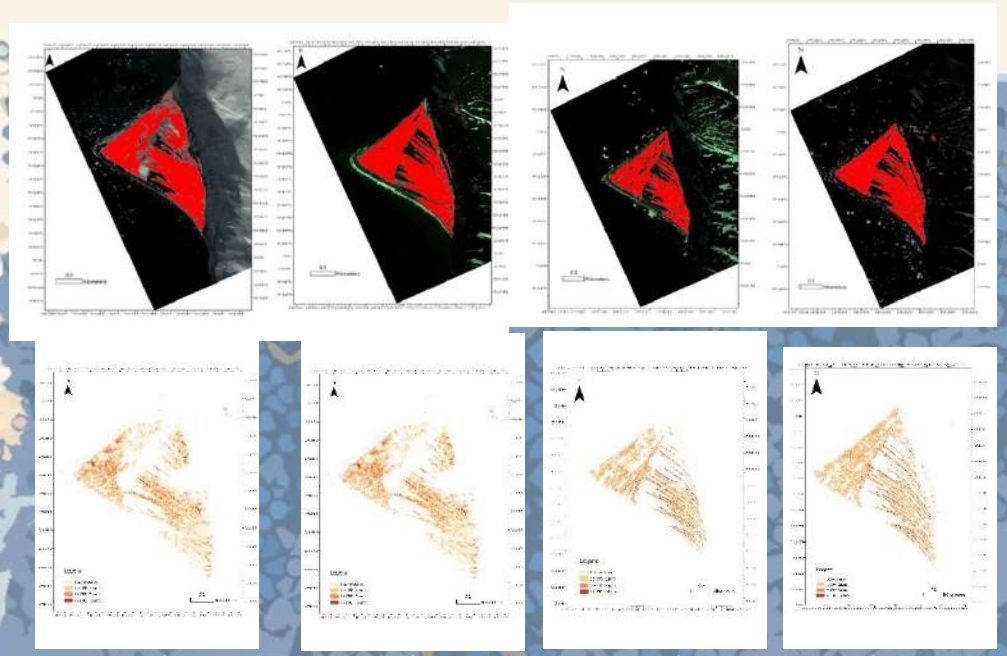
4、难言岛

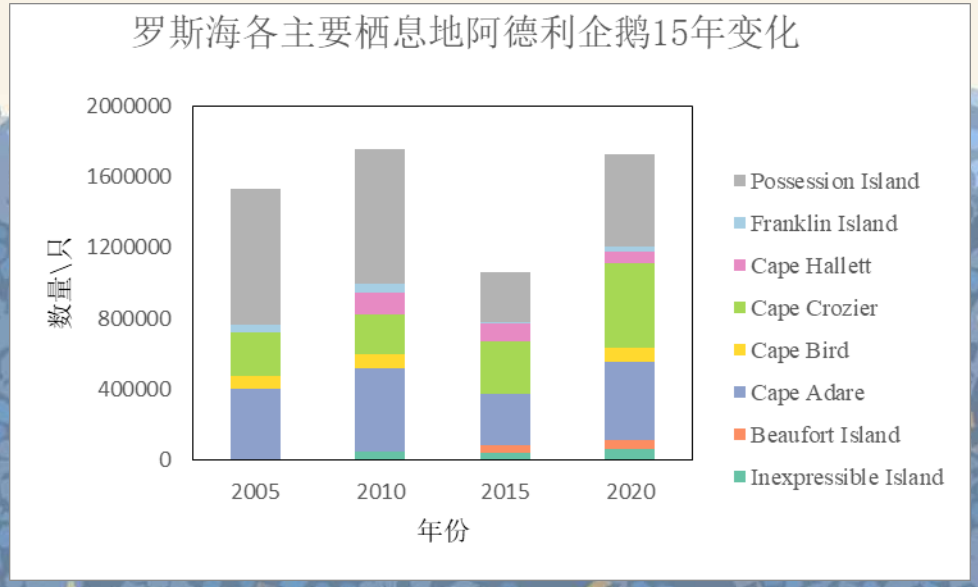
5、富兰克林岛

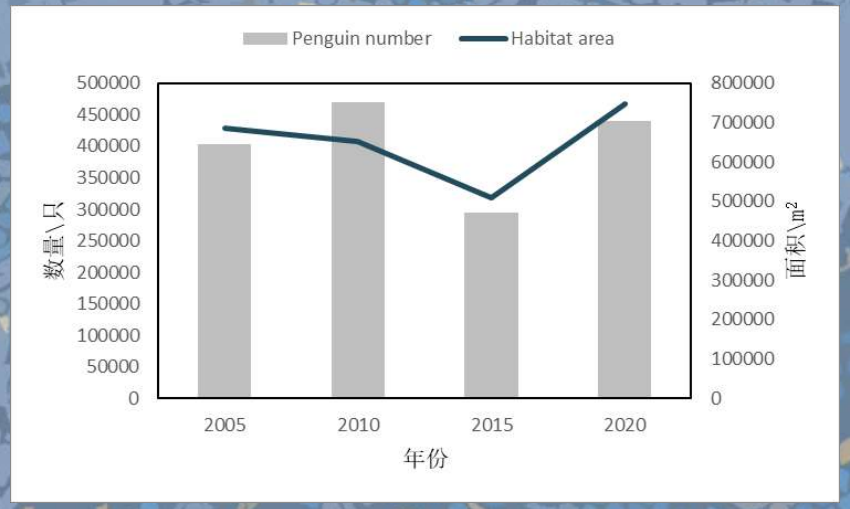
6、博福特岛

7、伯德角

8、克罗泽角


2005年
2010年
2015年
2020年


罗斯海各主要栖息地阿德利企鹅15年变化
数量\只
2000000
1600000
1200000
800000
400000
0
2005
2010
2015
2020
年份
Possession Island
Franklin Island
Cape Hallett
Cape Crozier
Cape Bird
Cape Adare
Beaufort Island
Inexpressible Island


Penguin number
Habitat area
数量\只
面积\m²
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400000
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300000
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200000
150000
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800000
700000
600000
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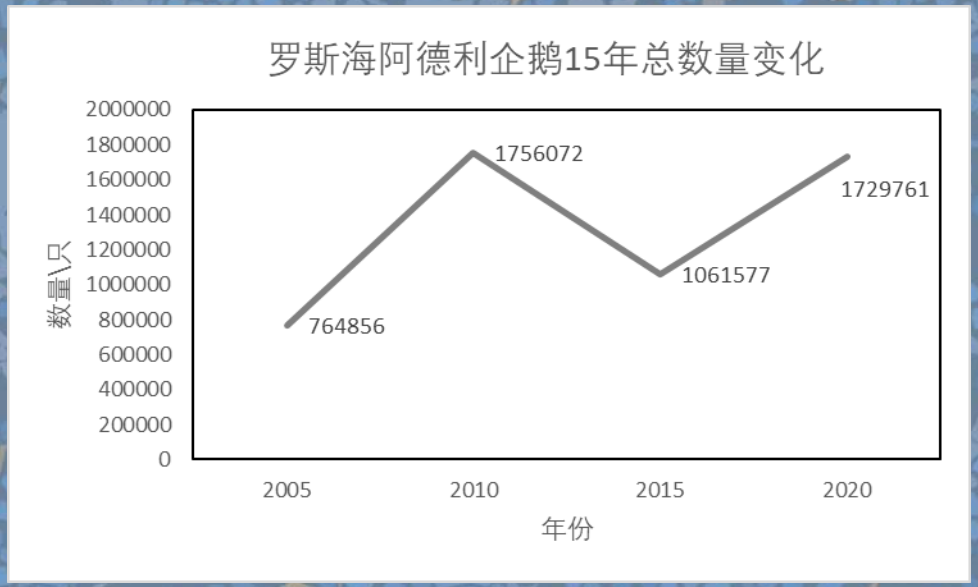
300000
200000
100000
0
2005
2010
2015
2020
年份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400000
200000
0
1756072
1729761
1061577
764856
2005
2010
2015
2020
年份

Looking forward Cooperation !

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