Progress of Joint Cruise and Stock Assessment of Reef Systems
中美联合海上调查与礁区渔业资源评估工作进展情况

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汇报提纲Outline

1. 总体回顾-General Review

2. 中美联合海上调查进展情况-Progress of Joint Cruise

3. 礁区渔业资源评估工作进展情况-Progress of Stock Assessment of Reef Systems

4. 下一步工作计划-Next work Plan

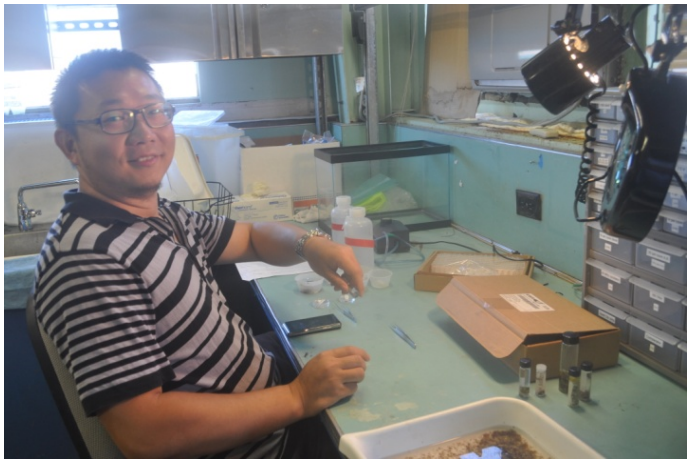
1. 总体回顾General Review

- 2012年8月2日-9月4日，南海所秦传新副研究员前往夏威夷火奴鲁鲁的NOAA太平洋岛屿渔业科学中心渔业资源评估项目组（Dr. Gerard DiNardo）开展了为期34天的合作交流；

- Dr. Chuanxin Qin , from SCSFRI carried out Scientific exchanges and cooperation for 34 days in PIFSC from Aug. 2 to Sep. 4, 2012.

总体回顾General Review

- 2012年7月22日-8月23日，唐振朝博士赴美NOAA太平洋岛屿渔业科学研究中心珊瑚生态系统研究组开展为期一个月的珊瑚礁监测系统交流学习；
- Dr.Tang Zhenzhao from SCSFRI was sent to CRED,PIFSC in Honolulu to exchange for a month from July 23- Aug.22, 2012.



总体回顾General Review

- 2013年7月27日-8月16日，秦传新博士与黎晓国助理研究员赴美参加联合海上调查；
- Dr. Chuanxin Qin and Xiaoguo Li , from SCSFRI carried out Scientific exchanges and cooperation for 34 days in PIFSC from Aug. 2 to Sep. 4, 2012.

2. 中美联合海上调查进展情况-Progress of Joint Cruise

•任务概述 Mission overview

–任务名Project - Scientists Exchange Program Between U.S. and China (The U.S.-China Meeting on Living Marine Resources: Habitat Monitoring, Assessment and Restoration of Reef Systems Project)

–地点Location- Honolulu

–时间Time – 2012

–NOAA Ship Oscar Elton Sette

•2011年，水科院和NOAA藉由在火奴鲁鲁召开的中美海洋生物资源会议开始推动双方科学家交流的计划，该计划最终在2012年开始启动。南海水产研究所于2012年派出唐振朝博士前往太平洋岛屿渔业科学研究中心珊瑚生态系统研究组进行了为期一个月的工作交流。In 2011, CAFS and NOAA discussed and began to push the scientists exchange program (the **U.S.-China Meeting on Living Marine Resources: Habitat Monitoring, Assessment and Restoration of Reef Systems Project** held on November 2011 in Honolulu). This program was finally started in 2012. In 2012, Dr. Tang from SCSFRI was sent to PIFSC to work on ARMS for a month.

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2. 中美联合海上调查进展情况-Progress of Joint Cruise

•任务概述 Mission overview

–任务名Project - PIFSC Research Project SE-13-06: Comparison of Fishery-Indepenent Sampling Methods for Hawaii Bottomfish

–地点Location- Hawaii

–时间Time – 28 July – 11August, 2013

–NOAA Ship Oscar Elton Sette

•渔业资源评估需要捕捞量、丰度和生活史三种类型的数据。本研究基于评估一套不同渔业资源独立调查设备开展综合调查分析的基础上，通过提供渔业独立样本、特定种类的种群结构来开展渔业资源评估。The Stock Assessment Process requires three main data types: catch, abundance, and life history. This study evaluates a suite of fishery-independent survey gears aimed at improving abundance data by providing fishery-independent species-specific size-structured abundance data for stock assessment.

2. 中美联合海上调查进展情况-Progress of Joint Cruise

- 任务概述 Mission overview
  - 1) 建立一套有效的适合夏威夷群岛底层鱼类资源调查的不同独立样本调查设备综合使用方法 to identify the most efficient suite of fishery-independent gears for sampling the Main Hawaiian Islands Bottomfish stock;
  - 2) 在多种设备联合评估中，定量比较不同设备获取数据的合适的校正系数，以确定可以在多种设备联合评估中应用to quantitatively compare gears to determine appropriate calibration factors allowing for data from multiple gear types to be appropriately used in a multi-gear assessment;
  - 3) 建立一整套可操作、多设备联合、渔业资源独立样本调查的夏威夷群岛底层鱼类资源调查评估方法to move towards a fully-operational, multi-gear, fishery-independent survey of the Main Hawaiian Islands bottomfish stock

中美联合海上调查进展情况-Progress of Joint Cruise

- 设备分类 Gear Classes
  - 捕捞Fishing
  - 光学Optics
  - 声学Acoustics

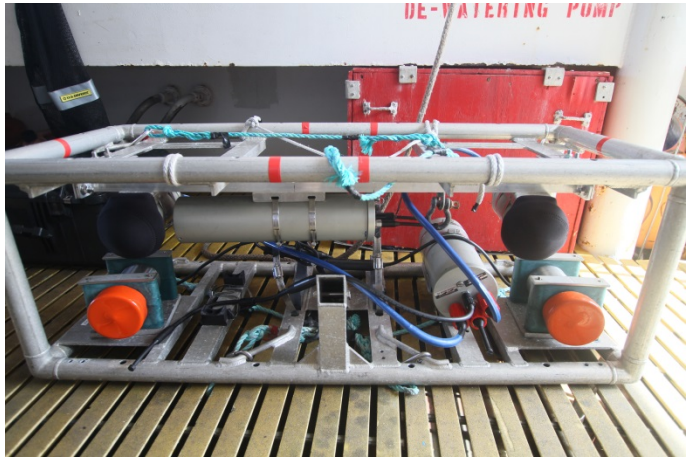
- 设备类型Gear Type
  - 标准化合作研究垂钓捕捞法Standardized Cooperative Research Hook & Line Fishing (fishing)
  - 海底静态照相机BotCam Stationary Stereo-Video Camera platform (optics)
  - 海底自动水下摄像机Seabed Autonomous Underwater Vehicle (AUV) Stereo-Video Camera platform (optics)
  - EK60水声仪EK60 Active Acoustics (acoustics)

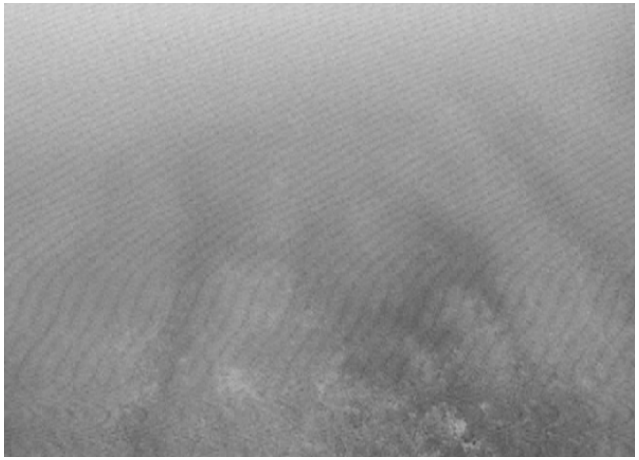
中美联合海上调查进展情况Progress of Joint Cruise

- 初步了解了美方利用捕捞、光学、声学方法开展渔业资源调查的手段方式和方法，探讨联合调查方法在我国岛礁及人工鱼礁区域渔业资源调查评估中的应用；
- The methods of fishing, optical, acoustic in USA which were carryed out to fishery-independent survey were preliminary understood. And the application of the efficient suite of fishery-independent gears for sampling China reef and artificial reefs fish stock were explored.

中美联合海上调查进展情况Progress of Joint Cruise

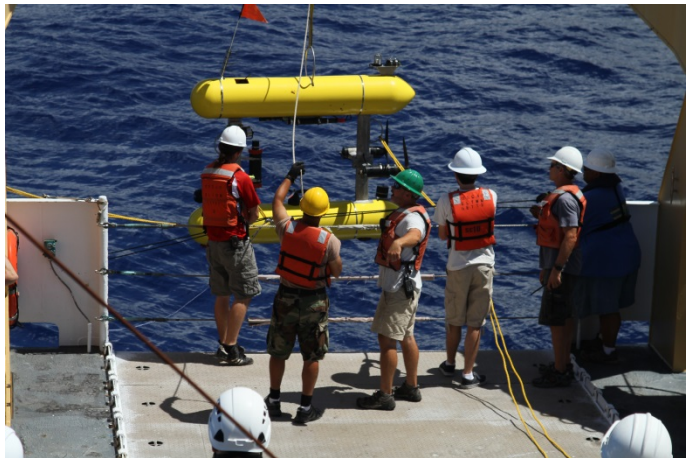
- 初步了解美方利用静态水下摄像机开展底层鱼类资源调查的方法，针对人工鱼礁区特性研究静态水下摄像机应用与礁区渔业资源调查的可行性；
- The use of BotCam Stationary Stereo-Video Camera platform for bottomfish survey in USA was preliminary understood, and the feasibility and application of BotCam in reef fishery resources survey were considered too.





中美联合海上调查进展情况Progress of Joint Cruise

- 初步了解美方AUV的操作以及开展底层鱼类调查的方法，探讨AUV的在人工鱼礁区进行操作的可行性；
- With the help of the crews and researchers, learned to the use and operation of AUV in fishery resources survey, and have discussed the feasibility of AUV in coral reef and artificial reef fishery survey in China.



中美联合海上调查进展情况Progress of Joint Cruise

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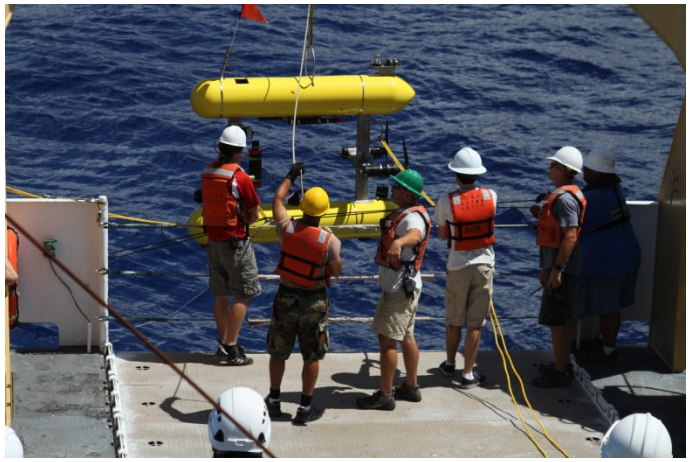


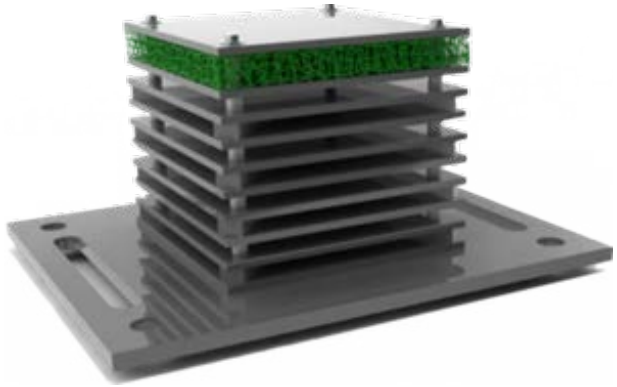
ARMS in China

Background

- 2011年，水科院和NOAA藉由在火奴鲁鲁召开的中美海洋生物资源会议开始推动双方科学家交流的计划，该计划最终在2012年开始启动。南海水产研究所于2012年派出唐振朝博士前往太平洋岛屿渔业科学研究中心珊瑚生态系统研究组进行了为期一个月的工作交流。
- In 2011, CAFS and NOAA discussed and began to push the scientists exchange program (the **U.S.-China Meeting on Living Marine Resources: Habitat Monitoring, Assessment and Restoration of Reef Systems Project** held on November 2011 in Honolulu). This program was finally started in 2012. In 2012, Dr. Tang from SCSFRI was sent to PIFSC to work on ARMS for a month.

What is ARMS?

- ARMS是自主式鱼礁生态系统的监测装置，用于模拟珊瑚礁的复杂空间并吸引无脊椎生物在内生活。
- ARMS is an inexpensive, simple, and standardized method designed to mimic the structural complexity of a coral reef and attract colonizing invertebrates. (Molly Timmers, CRED, PISFC)

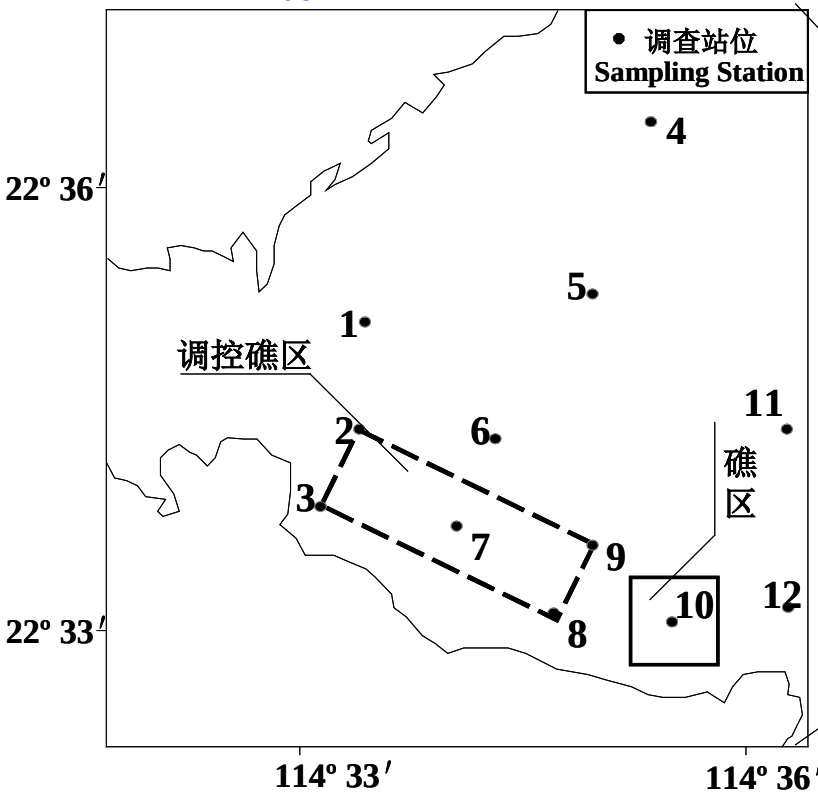


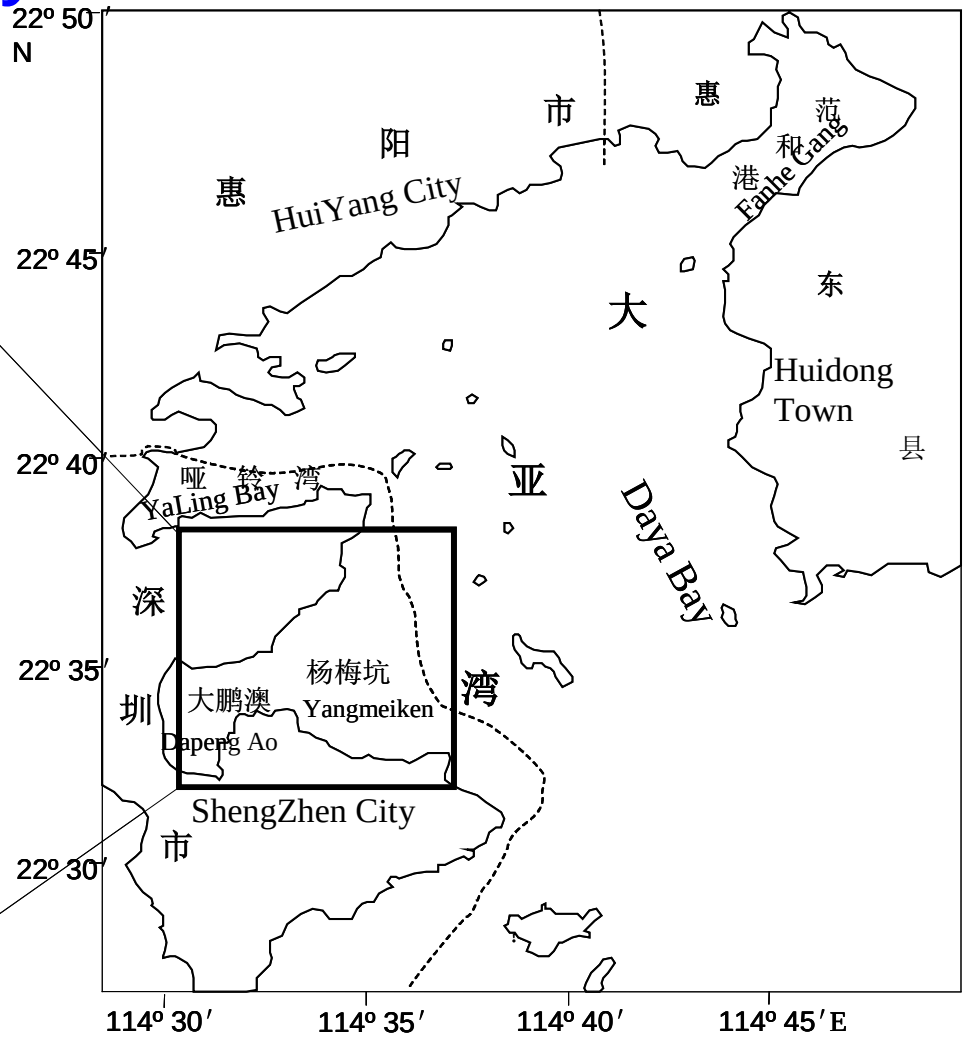
Progress of ARMS in China

- 2012年曾向农业部提交项目申请，但未获资助。The proposal on ARMS submitted to Ministry of Agriculture in 2012 was not funded.
- 与深圳渔业主管部门达成初步意向，拟申请资金支持在深圳海域进行ARMS的投放。Have reached an initial collaborative intention with Fishery Bureau of Shen Zhen to deploy ARMS in Shen Zhen.
- 计划在广东和海南的珊瑚礁与人工鱼礁区投放ARMS。A plan to conduct experimental deployment of ARMS in coral reef site and artificial reef site in Guangdong and Hainan has been made and might be carried out in 2014.

3.礁区渔业资源评估工作进展情况-Progress of Stock Assessment of Reef Systems

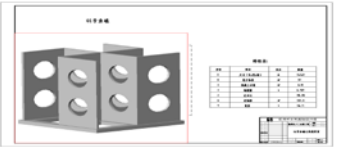
- Sampling areas:
  - Yangmeikeng, Shenzhen, China
  - (10-20 m depth)
  - 2.65 km²



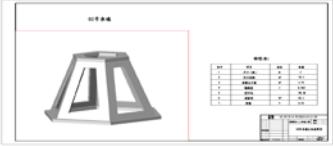


礁区渔业资源评估工作进展情况-Progress of Stock Assessment of Reef Systems

杨梅坑人工鱼礁区所采用的礁型Reef modules in Yangmeikeng reef



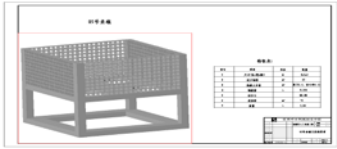
01 号鱼礁



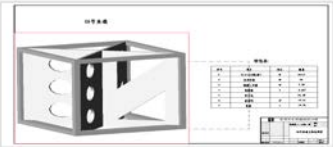
02 号鱼礁

03 号鱼礁

04 号鱼礁

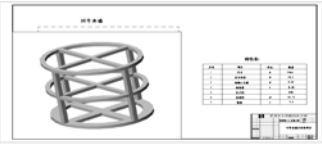


05 号鱼礁

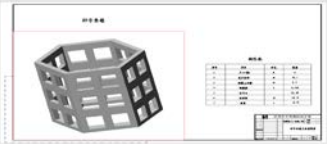


06 号鱼礁

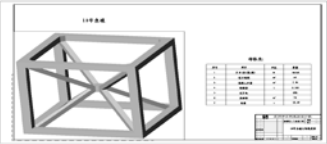
07 号鱼礁



08 号鱼礁



09 号鱼礁



10 号鱼礁

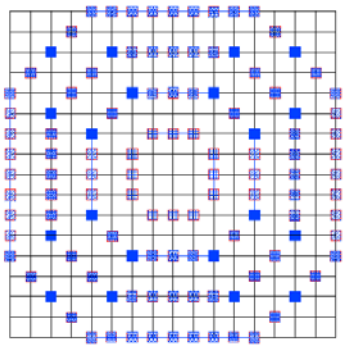
11 号鱼礁

12 号鱼礁

杨梅坑人工鱼礁区礁体组合Reef group in Yangmeikeng reef

Reef group 1

1号礁群



007号礁体 12　008号礁体 20
009号礁体 18　010号礁体 20
011号礁体 25　012号礁体 25

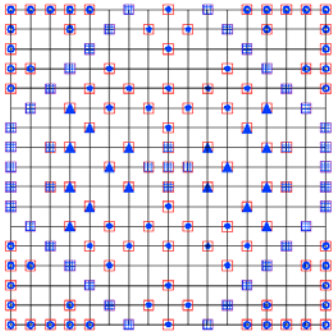
特性表:

礁体编号	空方（m³）	数量（个）	总空方（m³）
007	27.0	12	324
008	50.2	20	1004
009	41.5	18	747
010	64.0	20	1280
011	144.0	25	3600
012	96.0	25	2400
合计		120	9355
备注	1号礁群共4个		

深圳市水利规划设计院

Reef group 2

3号礁群



003号礁体 44　004号礁体 32
005号礁体 18　007号礁体 43

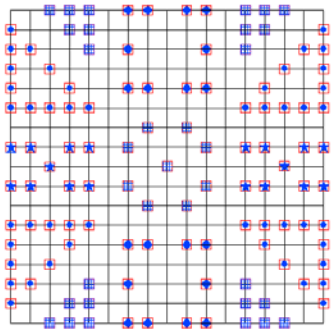
特性表:

礁体编号	空方（m³）	数量（个）	总空方（m³）
003	36	44	1584
004	90	32	2880
005	27	18	486
007	27	43	1161
合计		137	6111
备注	3号礁群共7个		

深圳市水利规划设计院

Reef group 3

2号礁群

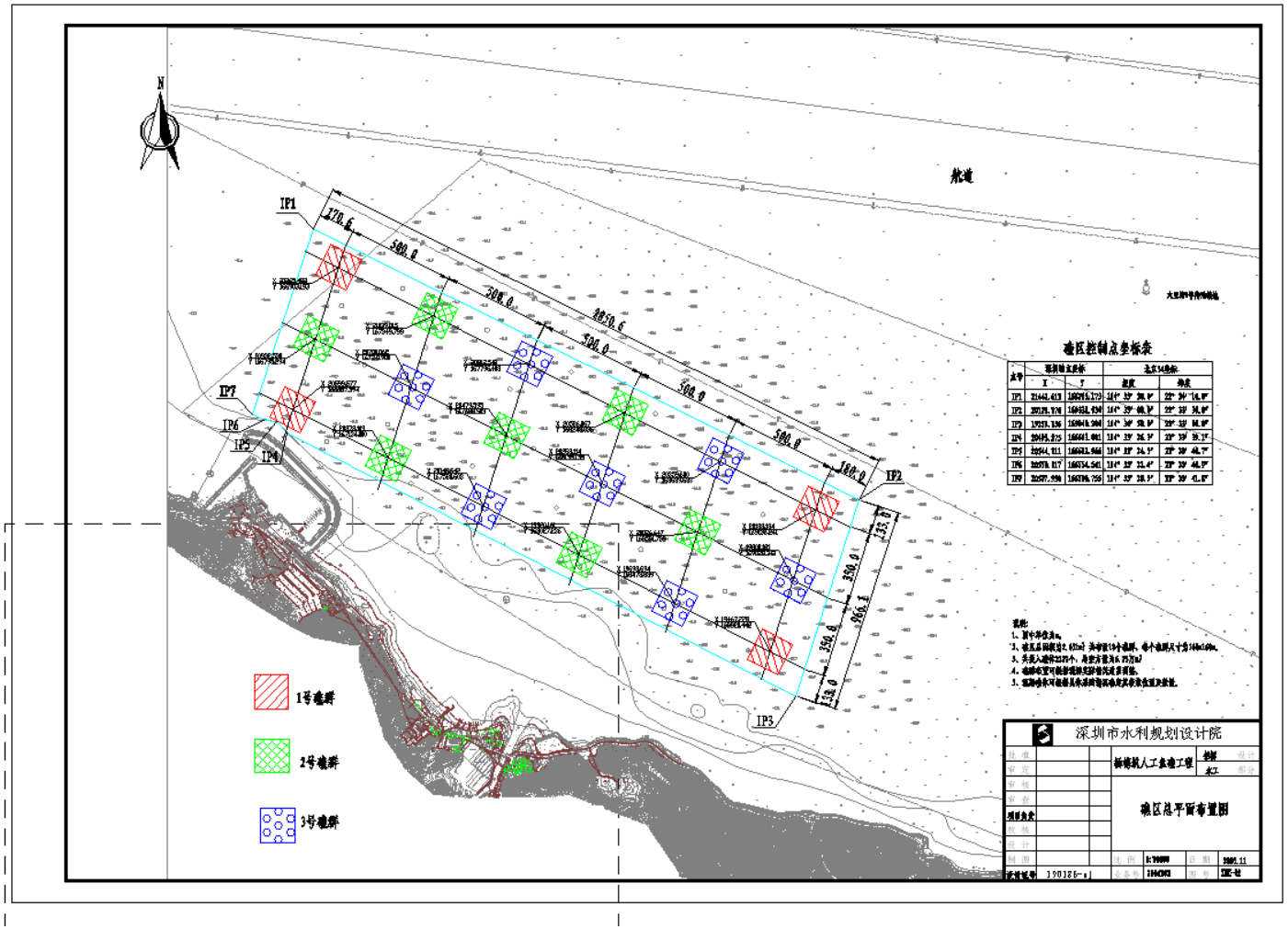


001号礁体 18　002号礁体 48
006号礁体 20　007号礁体 33

特性表:

礁体编号	空方（m³）	数量（个）	总空方（m³）
001	64.0	18	1152
002	37.1	48	1780.8
006	64.0	20	1280
007	27.0	33	891
合计		119	5103.8
备注	2号礁群共7个		

深圳市水利规划设计院



杨梅坑人工鱼礁区Reef complex in Yangmeikeng reef

礁区渔业资源评估工作进展情况-Progress of Stock Assessment of Reef Systems

•礁区于2008年建设完毕Artificial reefs were deployed in 2008.

•投礁前后采用拖网和刺网对礁区开展调查，以评估礁区建设对渔业资源的影响Both trawl and gillnet surveys were conducted before and after the effect.

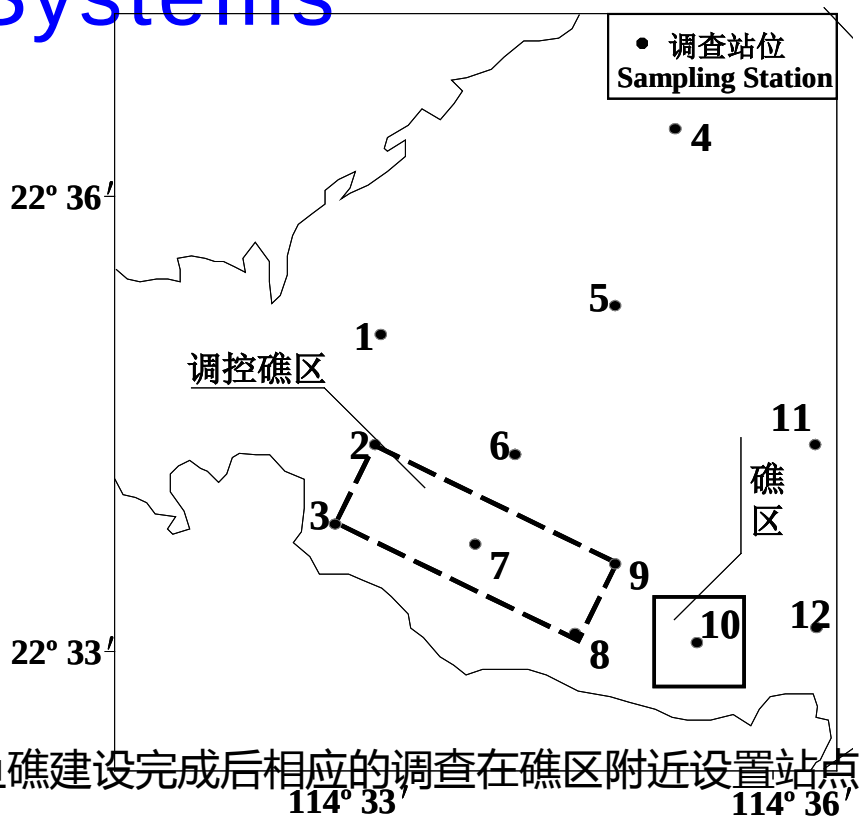
2007年1个航次2007: 1 survey (Apr)

2008年4个航次2008: 4 surveys (Mar, May, Aug, Nov)

2009年1个航次2009: 1 survey (May)

礁区渔业资源评估工作进展情况-Progress of Stock Assessment of Reef Systems

- 拖网Trawl
  - Stations: 1, 4, 5, 6, 7 ,10, 11, 12
- 刺网Gillnet
  - Stations: 4, 7



- 注：在礁区禁止开展捕捞作业，因此鱼礁建设完成后相应的调查在礁区附近设置站点。Note: fishing activities are prohibited in reef areas. Survey was conducted near reef.

Sampling method

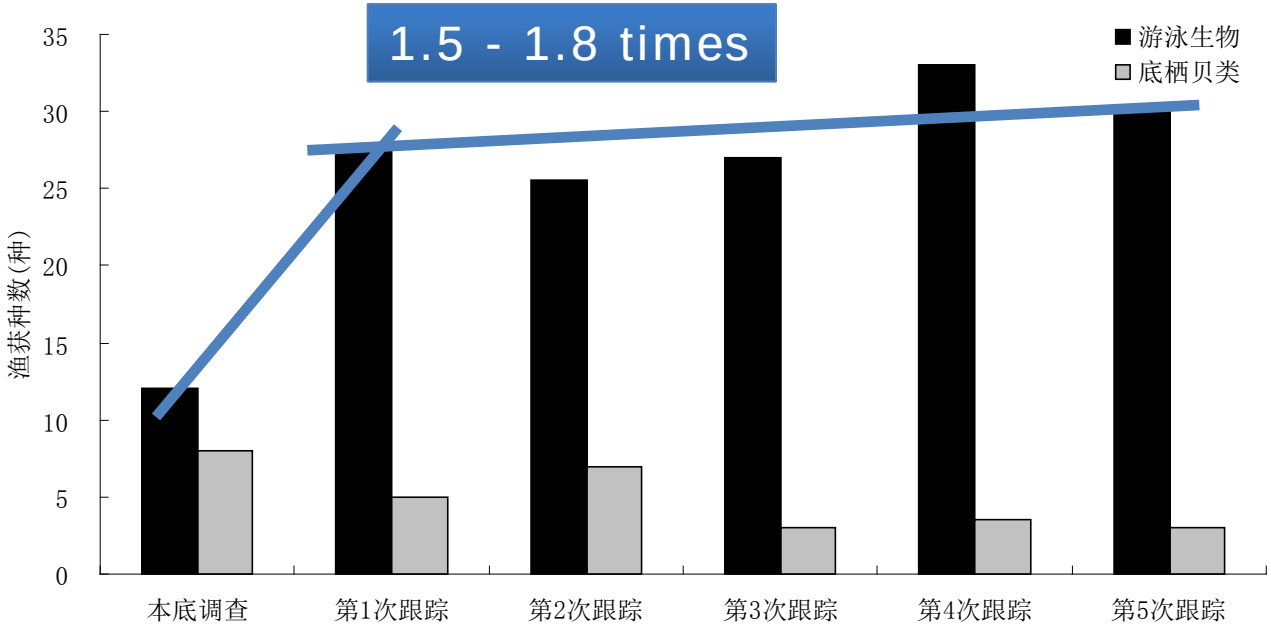
	Trawl	Gillnet
种类鉴定 Identify species	所有渔获All catch	所有渔获All catch
抽样方法（称重和个体数目统计）Sampling catch (in no and weight)	大部分鱼类抽取100%或25%的个体，而甲壳类也是采用抽取100%、6%、12.5%或25%）Most fish were 100% sampled or subsample (25%). Crustacean were either 100% sampled or subsampled (6%, 12.5%, or 25%)	抽取所有样品100% sampled
个体重和体长 Individual length and weight	抽取最大个体和最小个体Max and min	抽取最大个体和最小个体 Max and min

Gillnet survey data

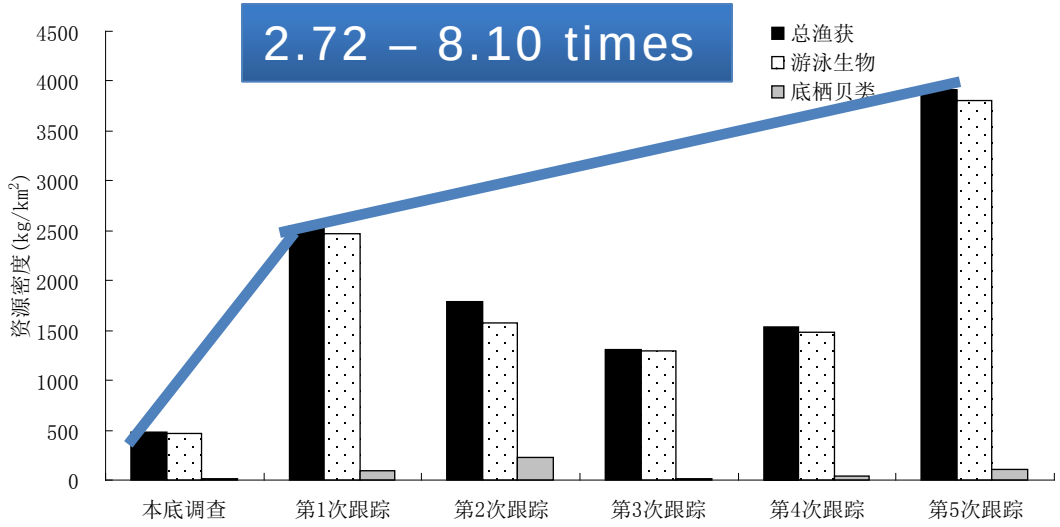
Year	M	Station	net_long_m	height_m	h	species	weight_g	kg	no	min_length_mm	max_length_mm	min_weight_g	max_weight_g	sample
2007	Apr	S4	600	1.4	3	Crustacean009	15	0.015	1	35		15		1
2007	Apr	S4	600	1.4	3	Crustacean048	72	0.072	6	25	29	9	15	1
2007	Apr	S4	600	1.4	3	Fish039	25	0.025	3	34	90	0.9	18	1
2007	Apr	S4	600	1.4	3	Fish042	36	0.036	1	115		36		1
2007	Apr	S7	600	1.4	3	Crustacean029	92	0.092	1	54		92		1
2007	Apr	S7	600	1.4	3	Fish004	22	0.022	1	116		22		1
2007	Apr	S7	600	1.4	3	Fish023	23	0.023	1	89		23		1
2007	Apr	S7	600	1.4	3	Fish042	190	0.19	4	116	143	34	71	1
2007	Apr	S7	600	1.4	3	Fish050	8.9	0.0089	2	47	48	4.2	4.7	1
2007	Apr	S7	600	1.4	3	Fish051	74	0.074	1	136		74		1
2007	Apr	S7	600	1.4	3	Fish056	64	0.064	1	132		64		1
2008	Aug	S4	500	1.4	2	Fish002	50	0.05	1	130		50		1
2008	Aug	S4	500	1.4	2	Fish005	102	0.102	7	95	108	12	18	1
2008	Aug	S4	500	1.4	2	Fish047	105	0.105	3	78	119	20	55	1
2008	Aug	S4	500	1.4	2	Fish044	220	0.22	13	67	93	13	30	1
2008	Aug	S4	500	1.4	2	Crustacean050	14	0.014	1	17		14		1
2008	Aug	S4	500	1.4	2	Fish050	41	0.041	3	64	75	10	18	1
2008	Aug	S4	500	1.4	2	Fish051	160	0.16	1	165		160		1
2008	Aug	S4	500	1.4	2	Fish007	800	0.8	29	125	160	27	54	1
2008	Aug	S4	500	1.4	2	Crustacean051	41	0.041	1	23		41		1
2008	Aug	S4	500	1.4	2	Fish001	21	0.021	1	108		21		1
2008	Aug	S4	500	1.4	2	Fish036	33	0.033	1	117		33		1
2008	Aug	S4	500	1.4	2	Fish023	52	0.052	1	115		52		1
2008	Aug	S4	500	1.4	2	Fish060	21	0.021	1	70		21		1
2008	Aug	S4	500	1.4	2	Fish045	52	0.052	3	82	89	16	20	1
2008	Aug	S4	500	1.4	2	Fish004	210	0.21	16	93	95	12	18	1
2008	Aug	S7	500	1.4	2	Fish063	84	0.084	3	106	117	24	32	1
2008	Aug	S7	500	1.4	2	Fish009	460	0.46	7	123	197	25	100	1
2008	Aug	S7	500	1.4	2	Fish047	43	0.043	1	120		43		1
2008	Aug	S7	500	1.4	2	Fish044	85	0.085	4	85	93	22	23	1

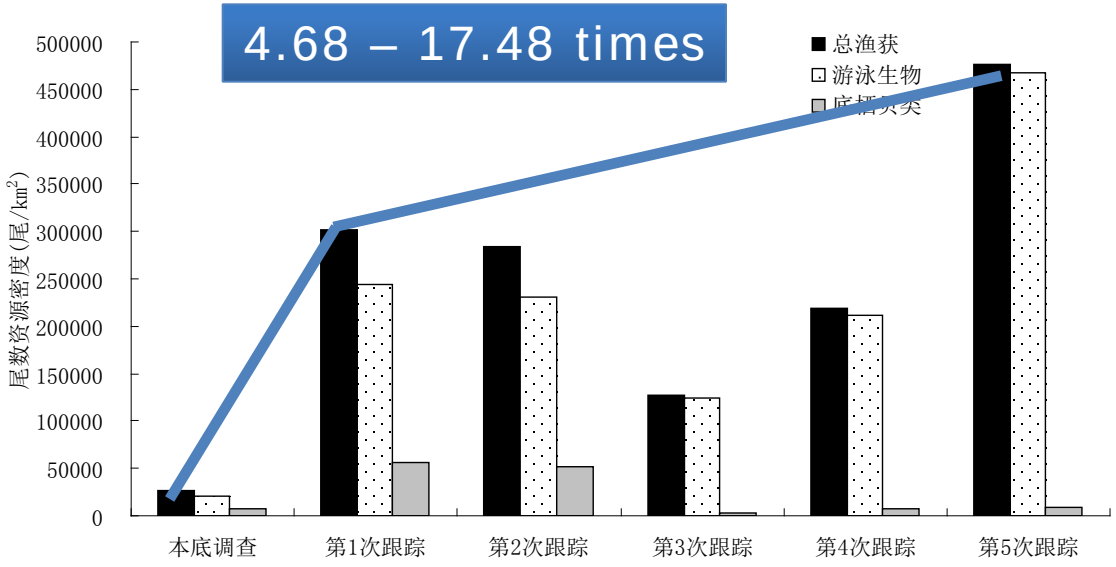
Trawl data preliminary results

- 拖网累计发现167种海洋生物种类，其中包括74种鱼类，30种蟹类，4种虾类，8种头足类，35种贝类。167 species: 74 fish, 30 crab, 4 shrimp, 8 cephalopod, 35 shellfish.



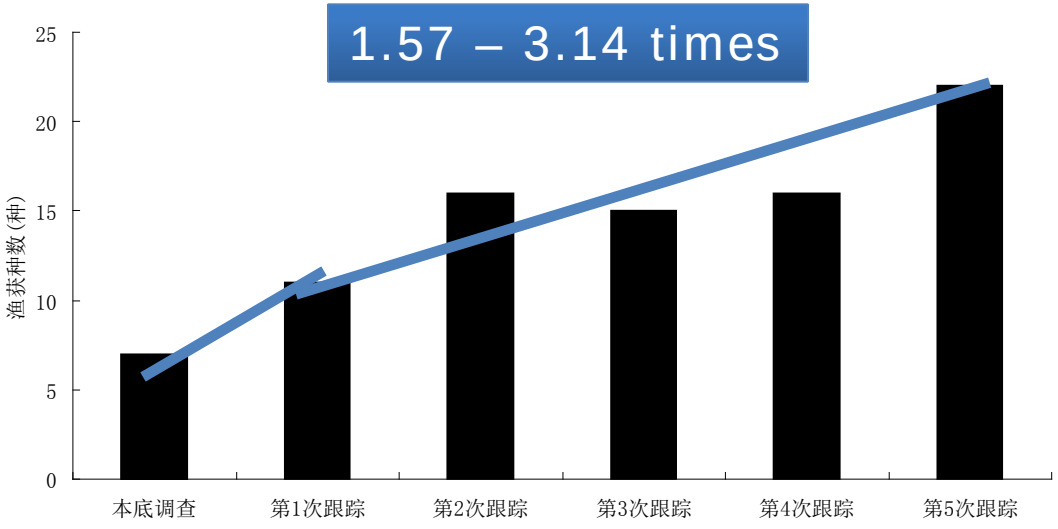
Survey fishery species in Yangmeikeng reef

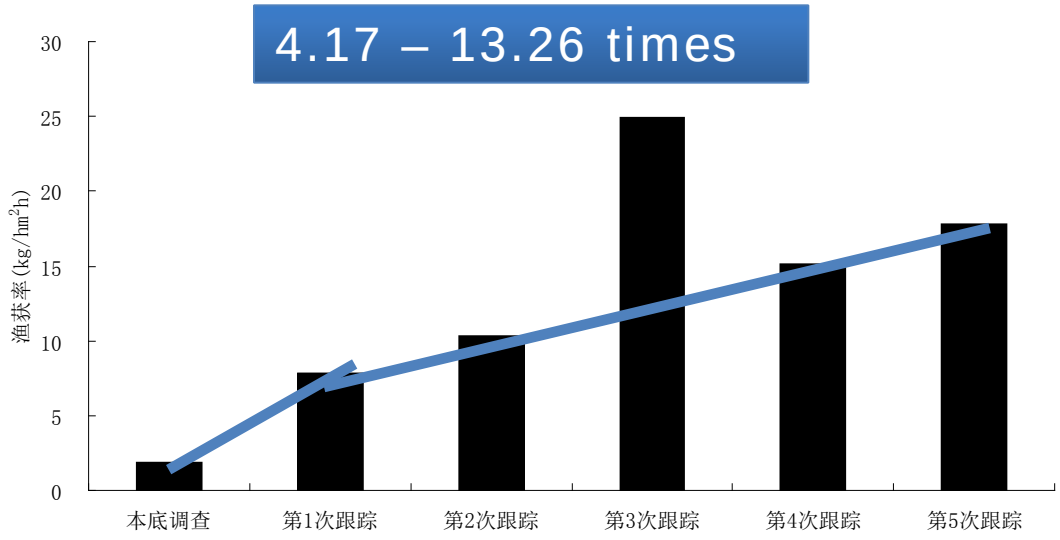

2.72 – 8.10 times
总渔获
游泳生物
底栖贝类
资源密度(kg/km²)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
本底调查
第1次跟踪
第2次跟踪
第3次跟踪
第4次跟踪
第5次跟踪


4.68 – 17.48 times
总渔获
游泳生物
底栖贝类
尾数资源密度(尾/km²)
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
本底调查
第1次跟踪
第2次跟踪
第3次跟踪
第4次跟踪
第5次跟踪

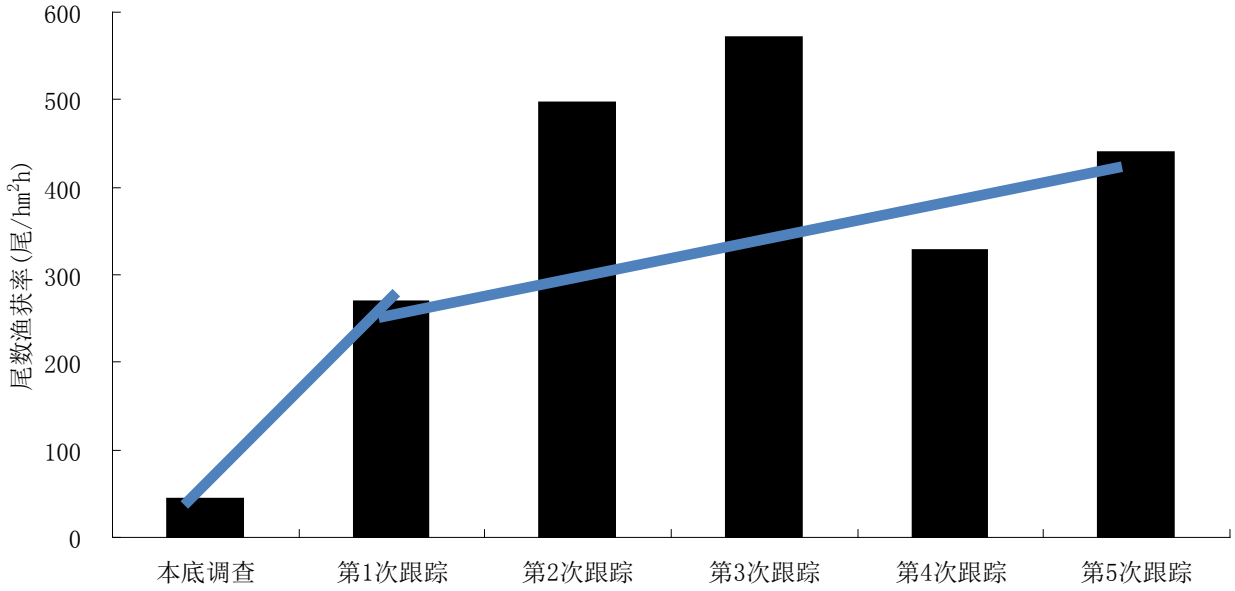
刺网共捕获海洋生物75种，其中，59种鱼、3种虾、7种蟹、4种虾姑、2种头足类

Gill net data; Total 75: 59 fish, 3 shrimp, 7 crab, 4 squilla, 2 cephalopod





6.16 – 13.04 times

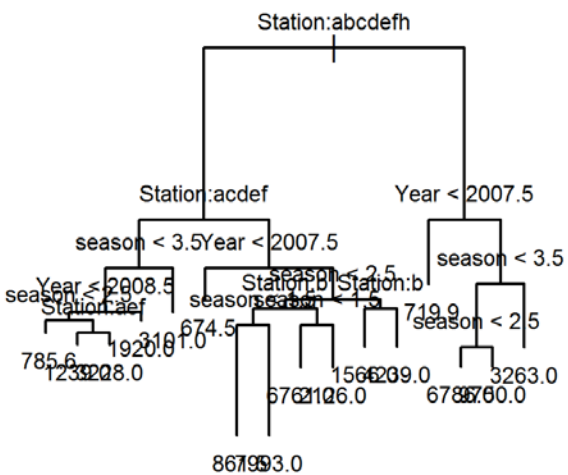


Trawl survey data – Regression Tree

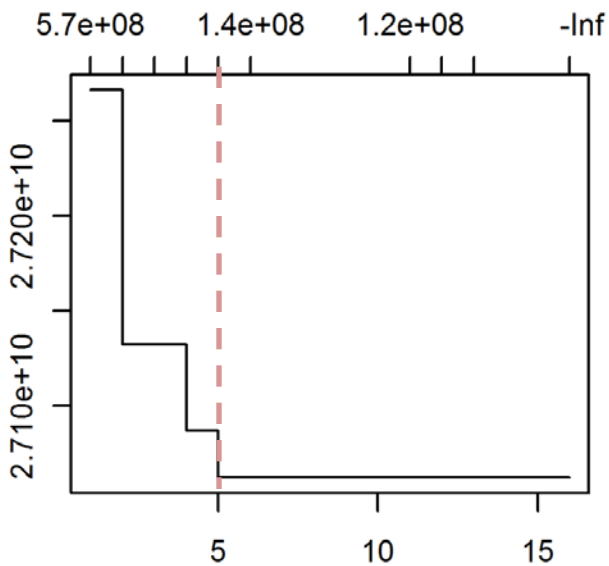
<u>Fish sets</u> (included all species)

CPUE ~ Year + season + Station, CPUE=no/swept_area(km^2)

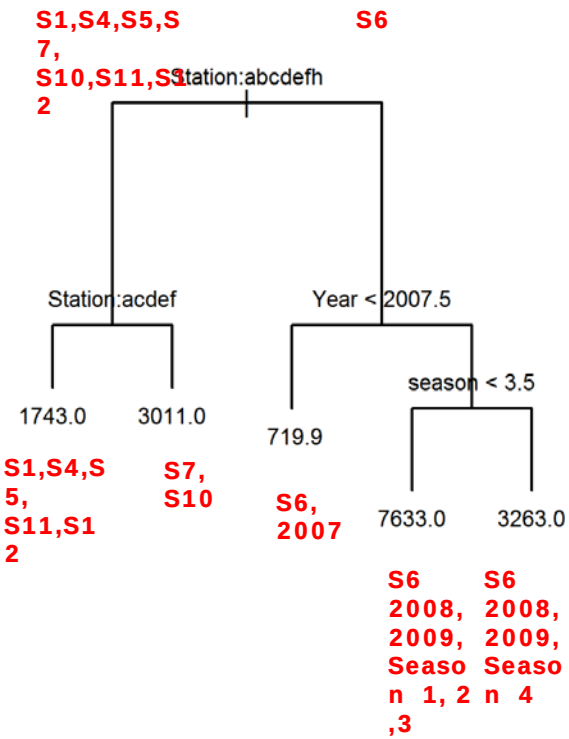
Fit all data (largest tree)



Cross-validation



Pruned tree based on the min deviance

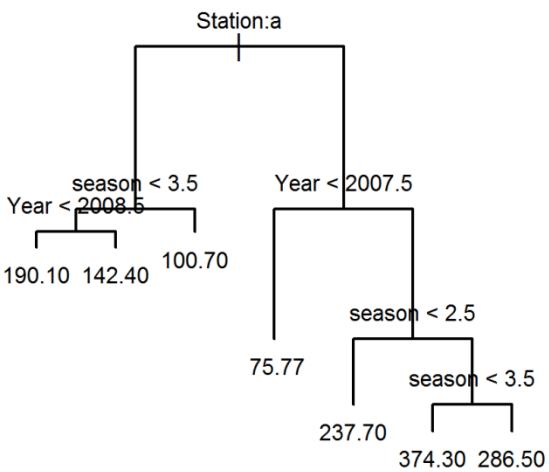


Gillnet survey data – Regression Tree

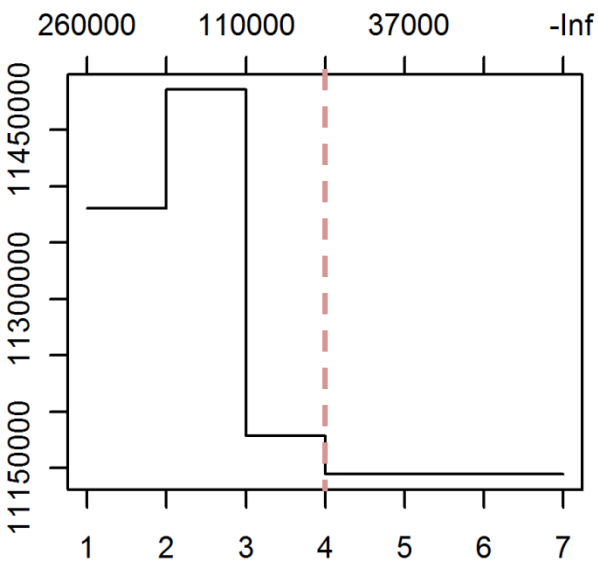
<u>Fish sets</u> (included all species)

CPUE ~ Year + season + Station, CPUE=kg/swept_area(km^2)

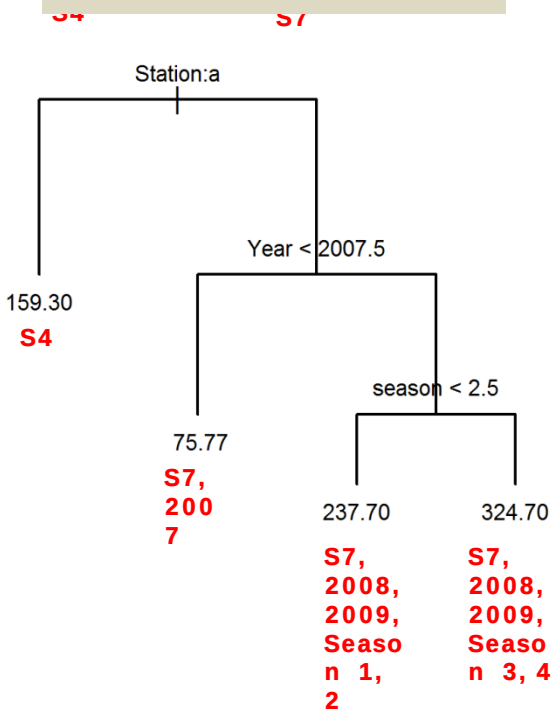
Fit all data (largest tree)



Cross-validation

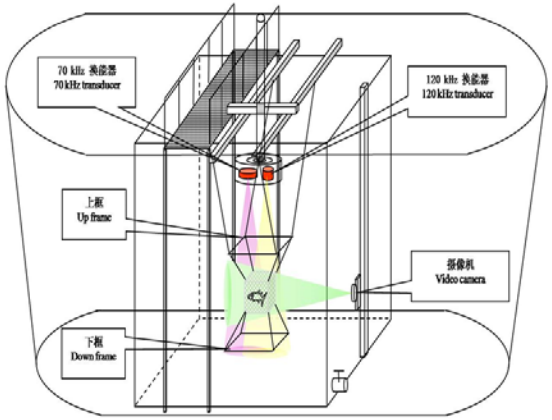


Pruned tree based on the min deviance

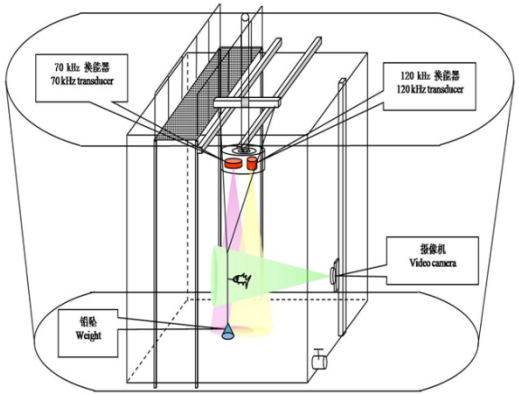


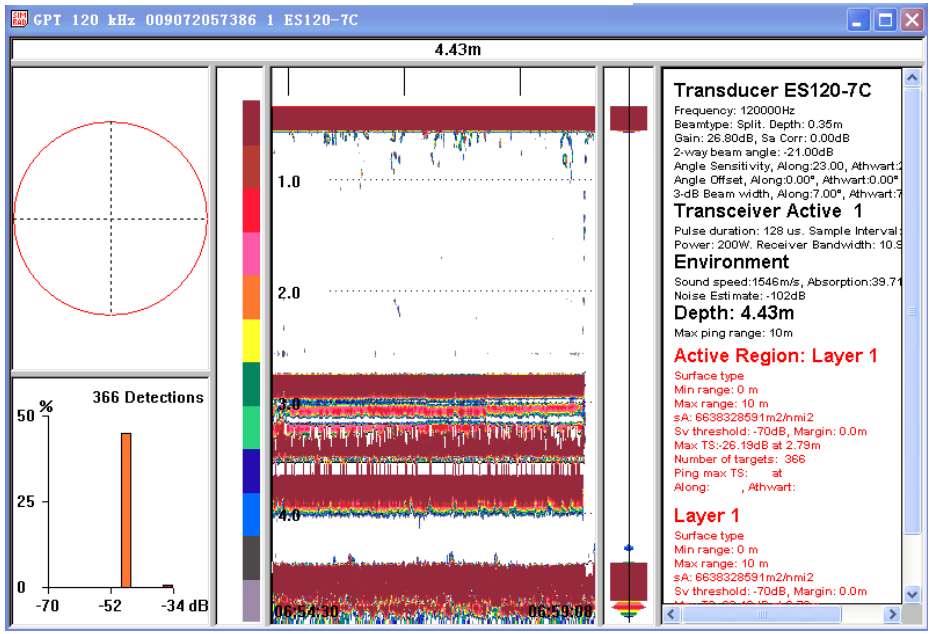
南海人工鱼礁区重要鱼类目标强度测量途径的建立

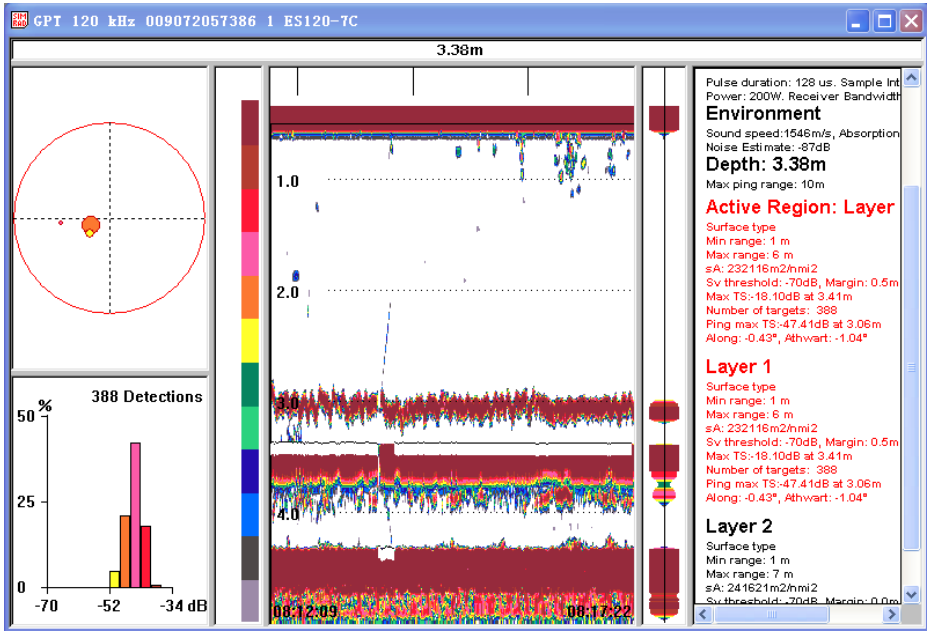
网箱法Schematic diagram of the caging experiment



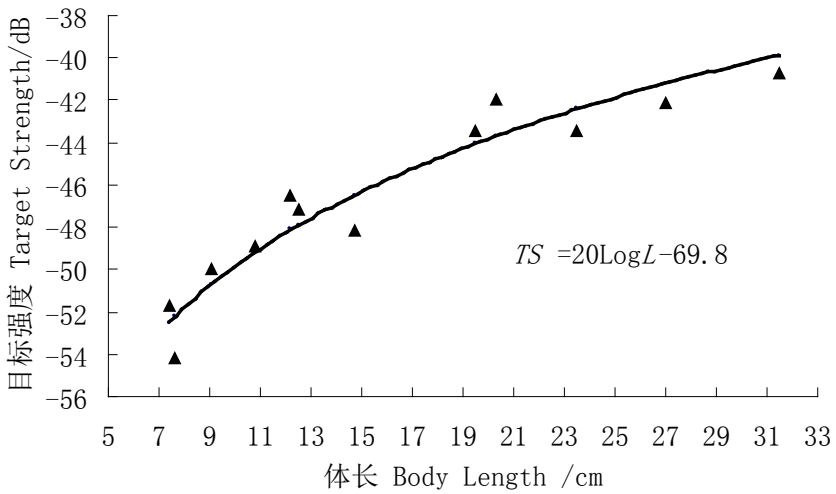
线悬挂法Schematic diagram of the tethering experiment



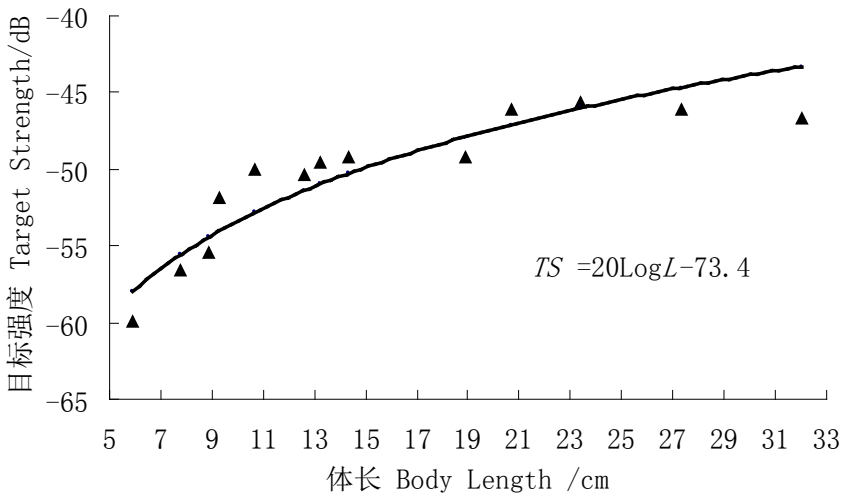




测量方法的比较

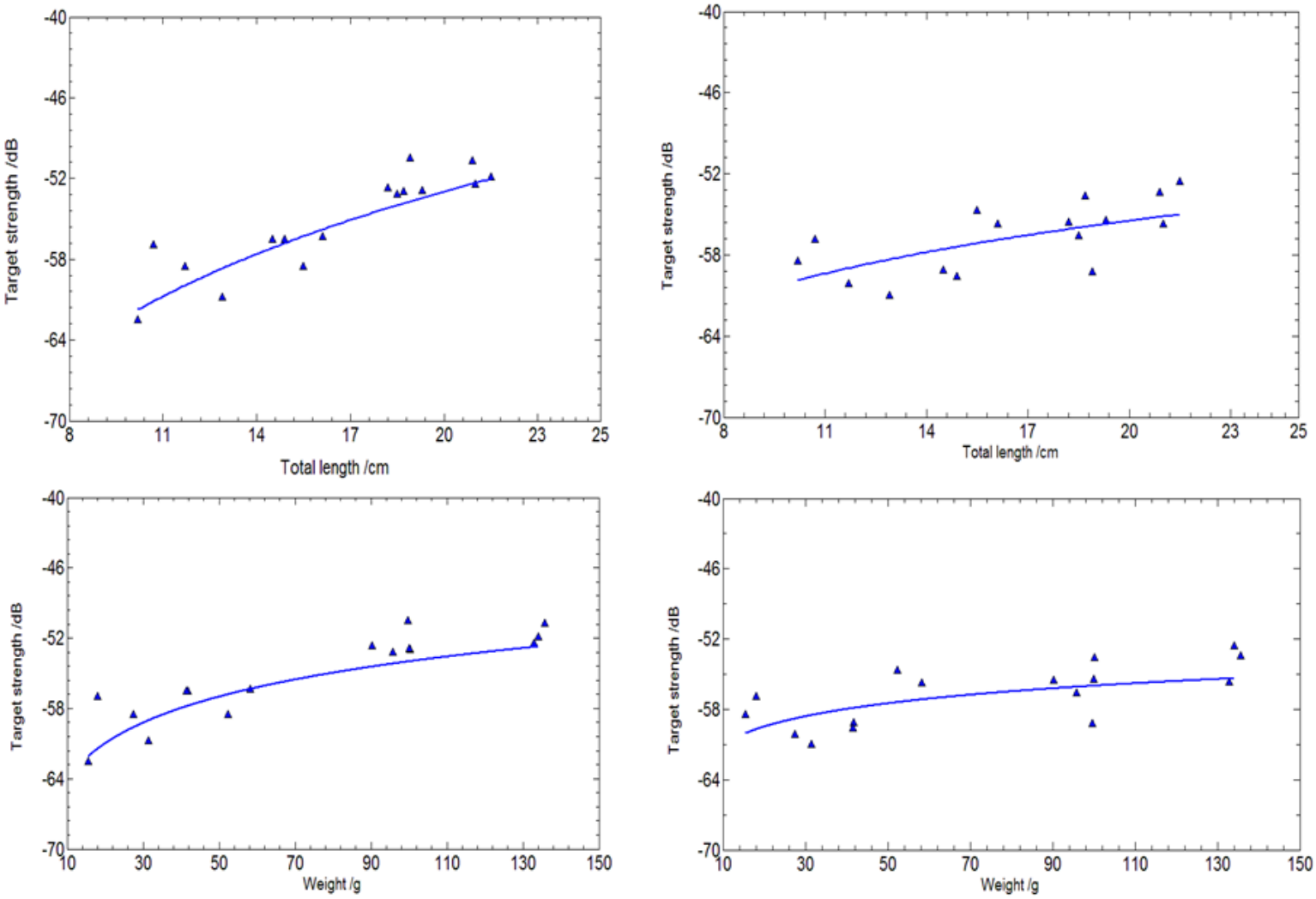


网箱控制实验法the caging experiment



绳系控制实验法the tethering experiment

绳系控制实验法和网箱控制实验法各有优缺点，可针对不同研究目的而参考不同结果。**The caging experiment and the tethering experiment has its advantages and disadvantages, and the reference methods to the different results for different research purpose.**



不同频率换能器下青石斑鱼目标强度（TS，dB）与其全长（TL，cm）和体重（W，g）之间的关系

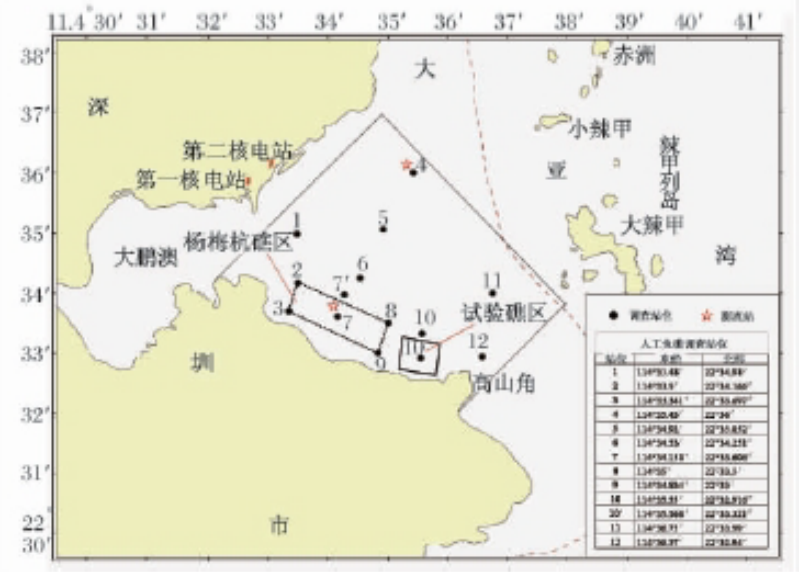


图 1　杨梅坑人工鱼礁区位置、声学评估范围和生物学取样站位示意图

Fig. 1　The location of artificial reef area, scope of surveys and sampling stations in artificial reef area of Yangmeikeng in Daya Bay

表 1　调查航次统计表

Tab. 1　The statistics of acoustic surveys

航次 survey	时间 date	有效声学航程/n mile effective track
1	2007-04	16.40
2	2008-03	24.05
3	2008-05	21.55
4	2008-08	12.78
5	2008-11	21.53
6	2009-05	26.23

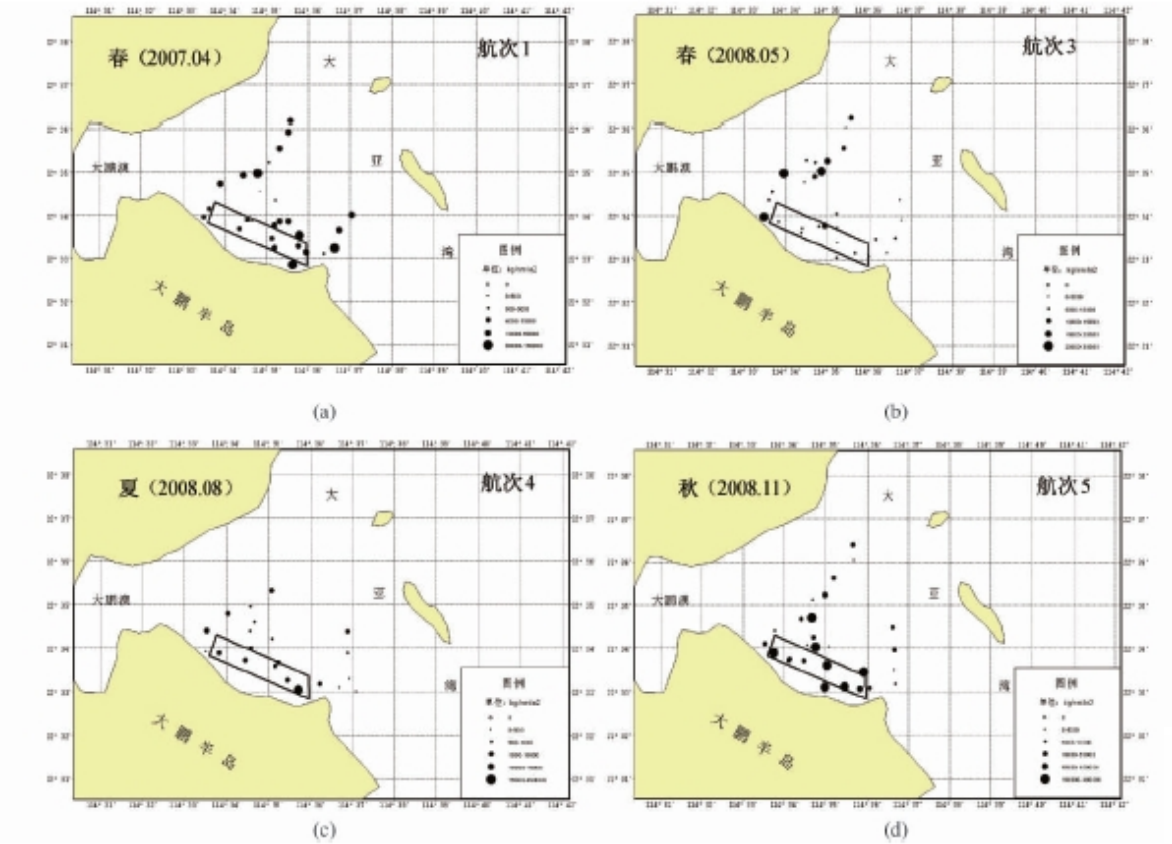


图3　各航次声学调查生物资源量密度分布

Fig. 3　The distribution of biomass density of different surveys

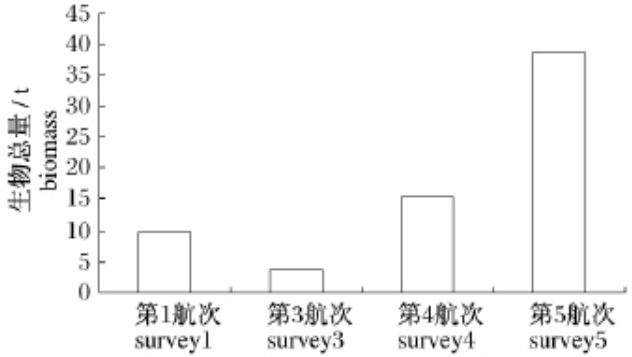


图4　各航次声学调查礁区内水域生物总量比较

Fig. 4　The comparison of biomass of different surveys inside the arrificial reef area

礁区渔业资源评估工作进展情况-Progress of Stock Assessment of Reef Systems

- 结果表明：初步的回归树分析表明采用栖息地修复和资源增殖对于近海渔业资源修复有较好的效果，下一步的将针对整个数据进行分析。

- Conclusion: Preliminary regression tree analyses also detect changes in catch associated with the implementation of habitat and stock enhancements. Further analyses on the full data set are required to look for benefits.

4. 下一步工作计划-Next work Plan

- 总结分析中国渔业资源管理现状，开展渔业资源管理策略研究Complete paper describing fisheries management in Guangdong
- 完成与Dr. Gerard DiNardo合作项目的申请，争取获得资助Complete the proposal of Restoration techniques and effect assessment of important fishery resources with Dr. Gerard DiNardo (PIFSC), fight to acquire funding from government
- 在广东省形成基于资源增殖与栖息地修复的礁区种类渔业资源评估模型 Develop stock assessment models for reef species in Guangdong province that specifically account for habitat and stock enhancements.

Thank you

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scslch@vip.163.com/ chunhou@scsfri.ac.cn

Thank you