WCPFC-SC14-2018/MI-WP-08

# Estimates of the number of FADs active and FAD deployments per vessel in the WCPO

Lauriane Escalle, Stephen Brouwer, Graham Pilling and the PNA Office

## Overview

- Increase use of Fish Aggregating Devices (FAD) over the last decade

- Linked with the use of satellite buoys and satellite echo-sounder buoys

- Impact on tuna stocks → 3-4 months FAD closure

  High FAD density → Tuna school fragmentation ?

  Ecosystems impacts: bycatch, including entanglement, pollution and beaching in coastal areas

- Number of FADs deployed/used in the WCPO ??
  → estimated at 30,000–50,000 in 2013 (Gershman et al., 2015)

## Datasets

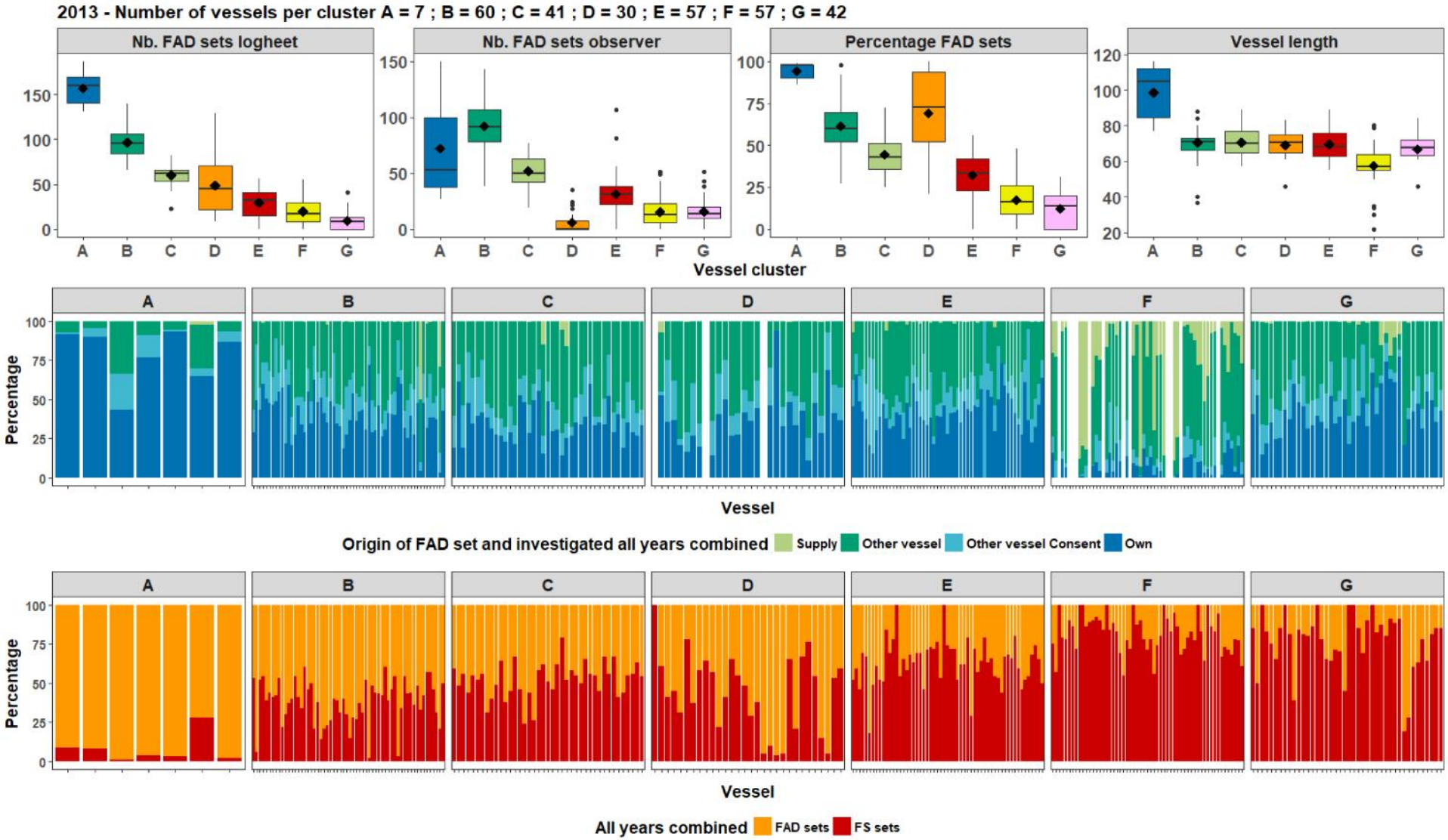
1) Observer: deployments of FAD and buoys (2011-2017)
   number of FAD/free school sets
   use of own FADs or other vessel FADs

2) Logsheet: number of FAD/free school sets, catch, CPUE (2011-2017)

3) PNA FAD tracking data (2016-2017)

## Methods

### Clustering to identify vessels with similar FAD fishing strategy



Pacific Community
Communauté du Pacifique

## 1) Estimates using fishery data only

**Few observer data already available for recent years**

## Vessel estimates

**Deployments + (Deployments * (1 - Observer coverage))**

## Standardization per cluster

**Min**
**Quantile 5%**
**Mean**
**Quantile 95%**
**Max**
} **Deployments**

**+ (**

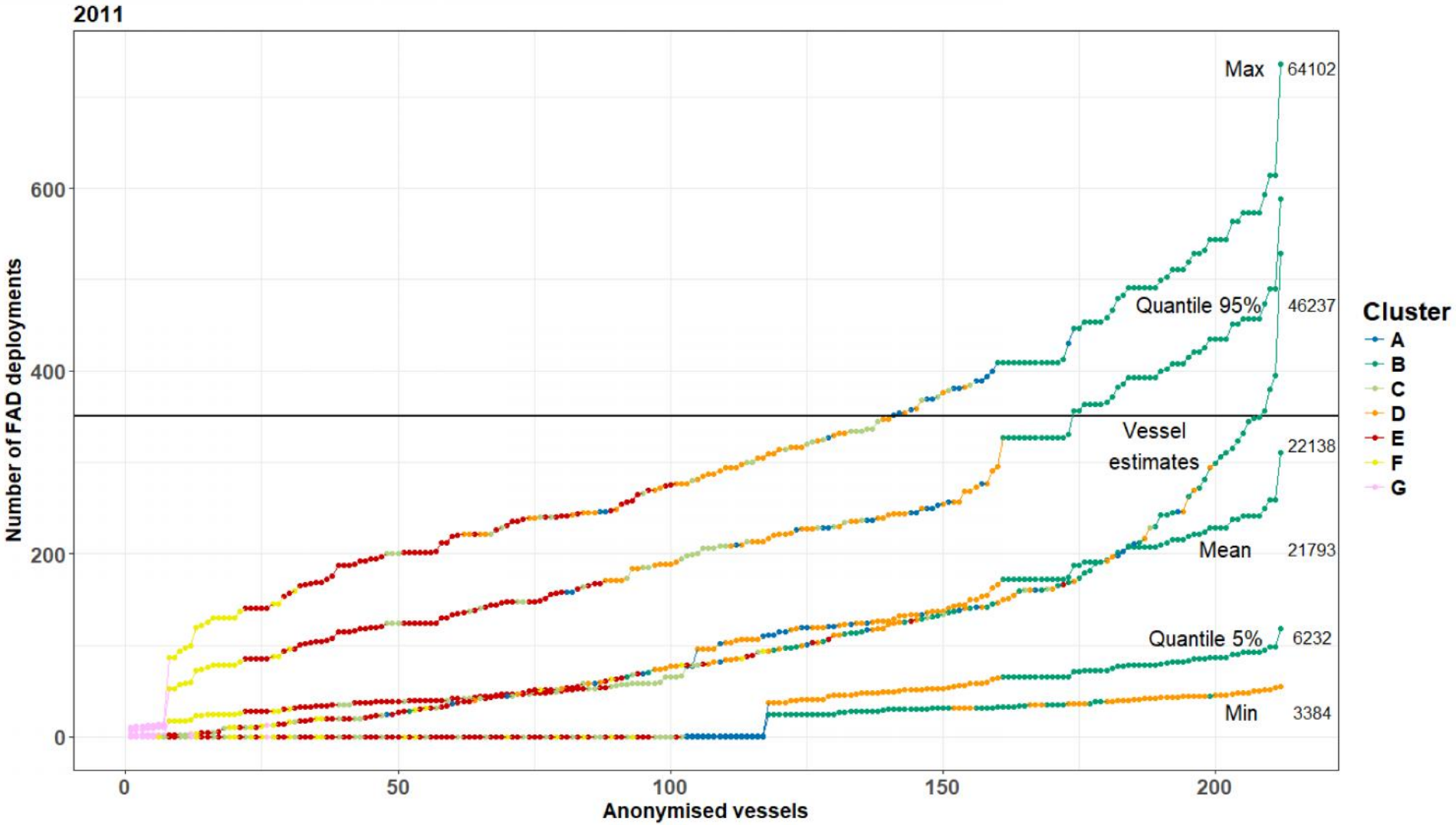
**Min**
**Quantile 5%**
**Mean**
**Quantile 95%**
**Max**
} **Deployments**

*** (1 - Observer coverage))**

## RESULTS Fishery data

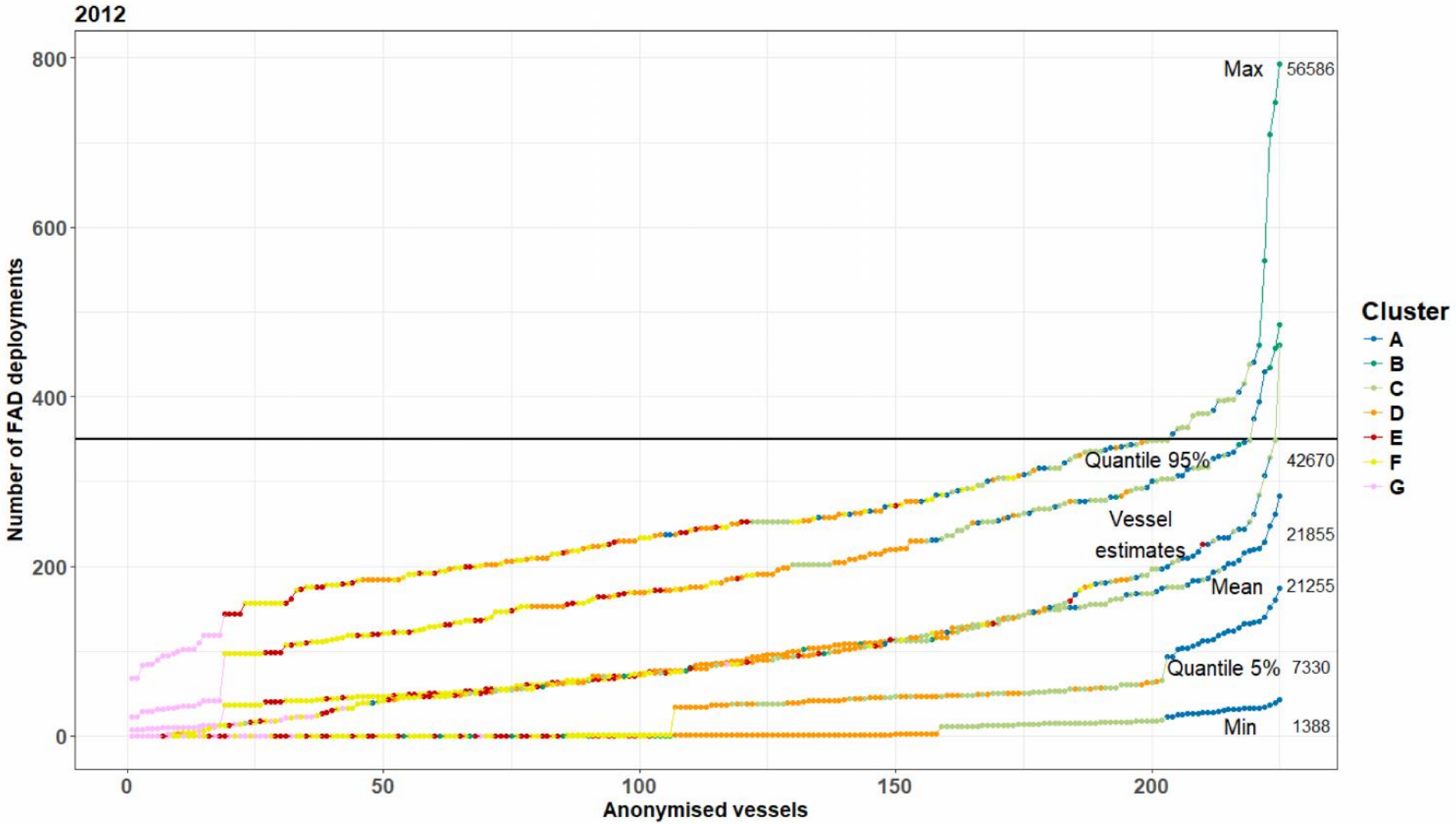
Pacific Community
Communauté du Pacifique

### Deployments / year



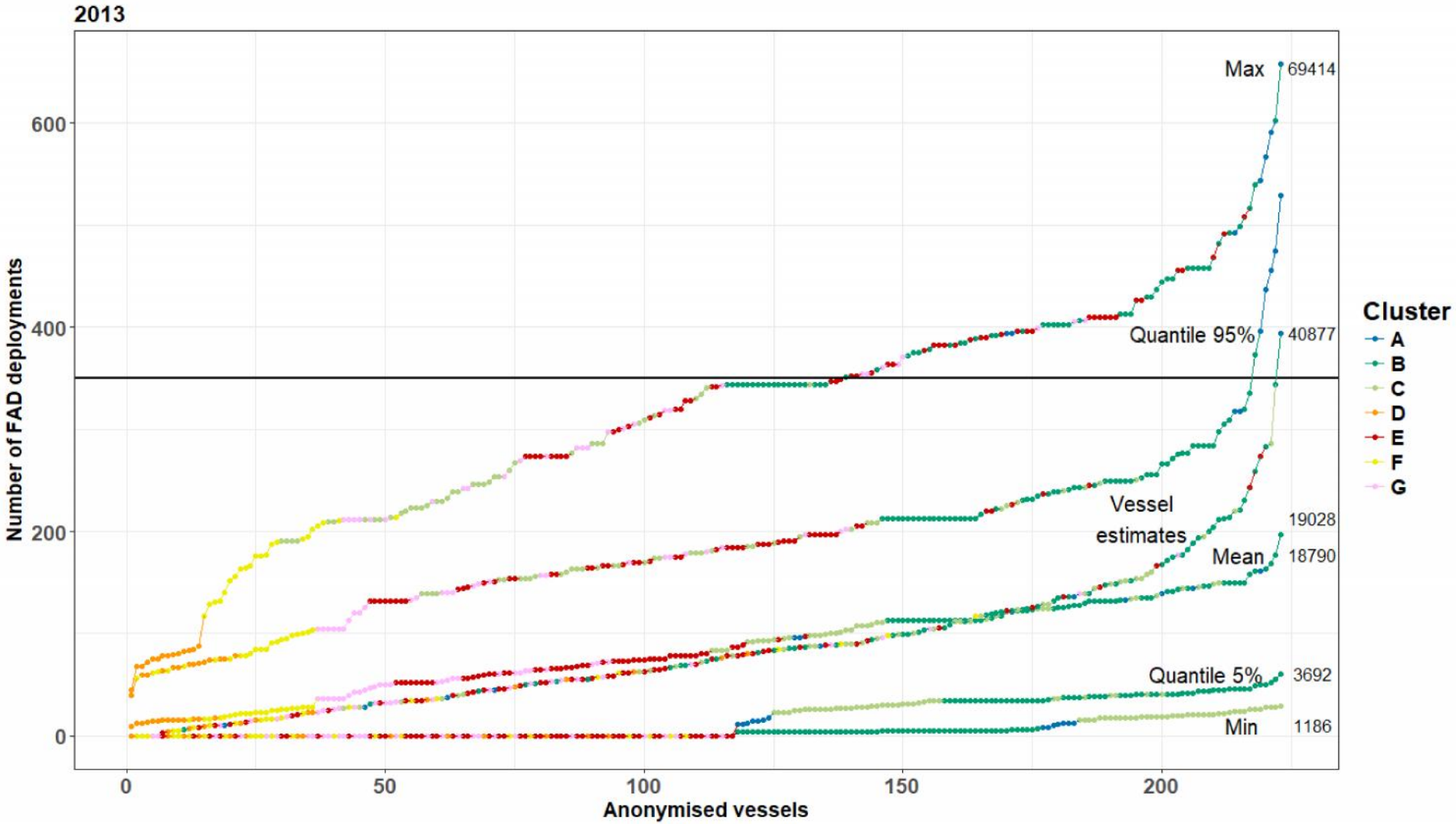
Pacific Community
Communauté du Pacifique

## Deployments / year



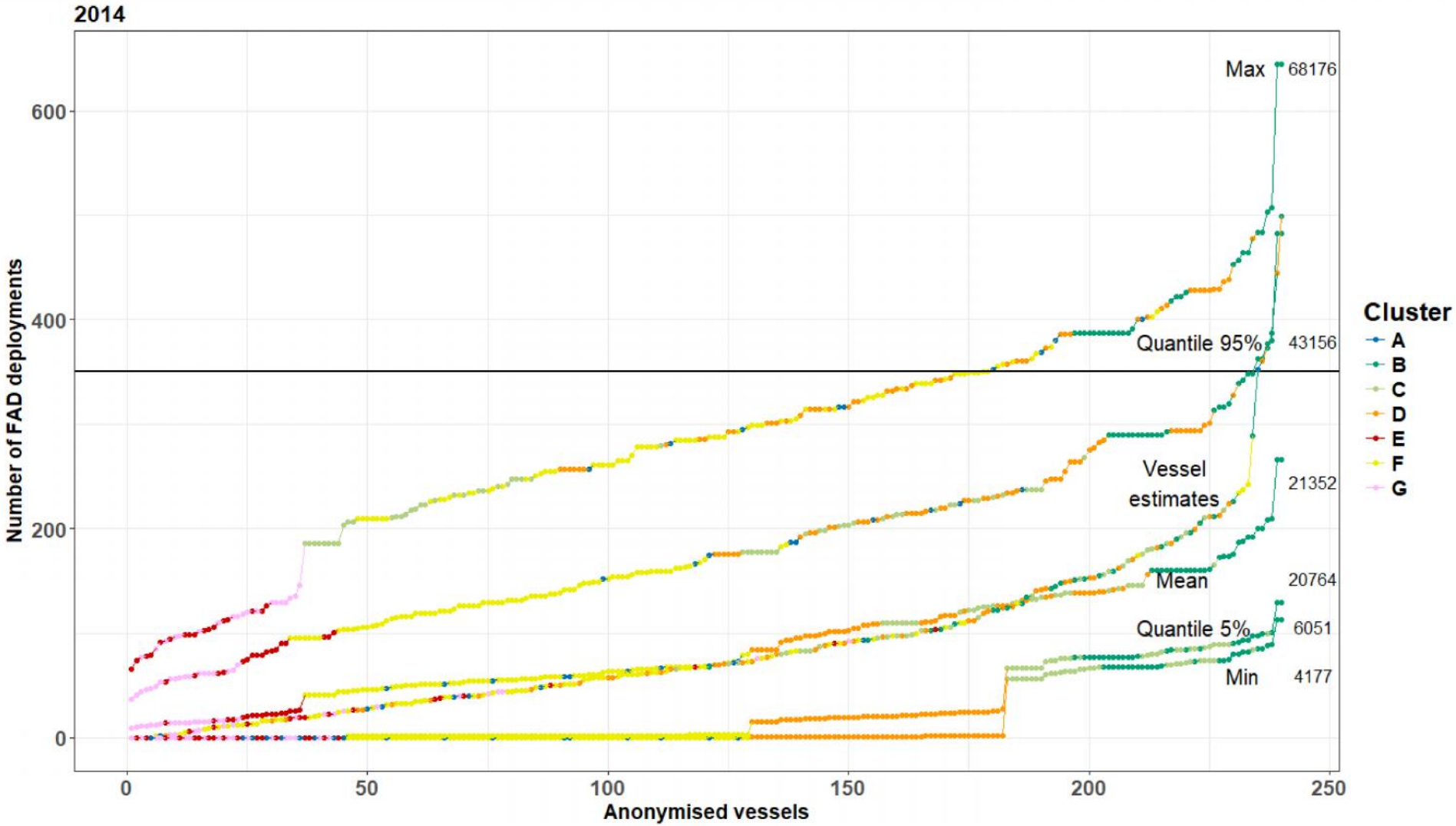
## RESULTS Fishery data

### Deployments / year



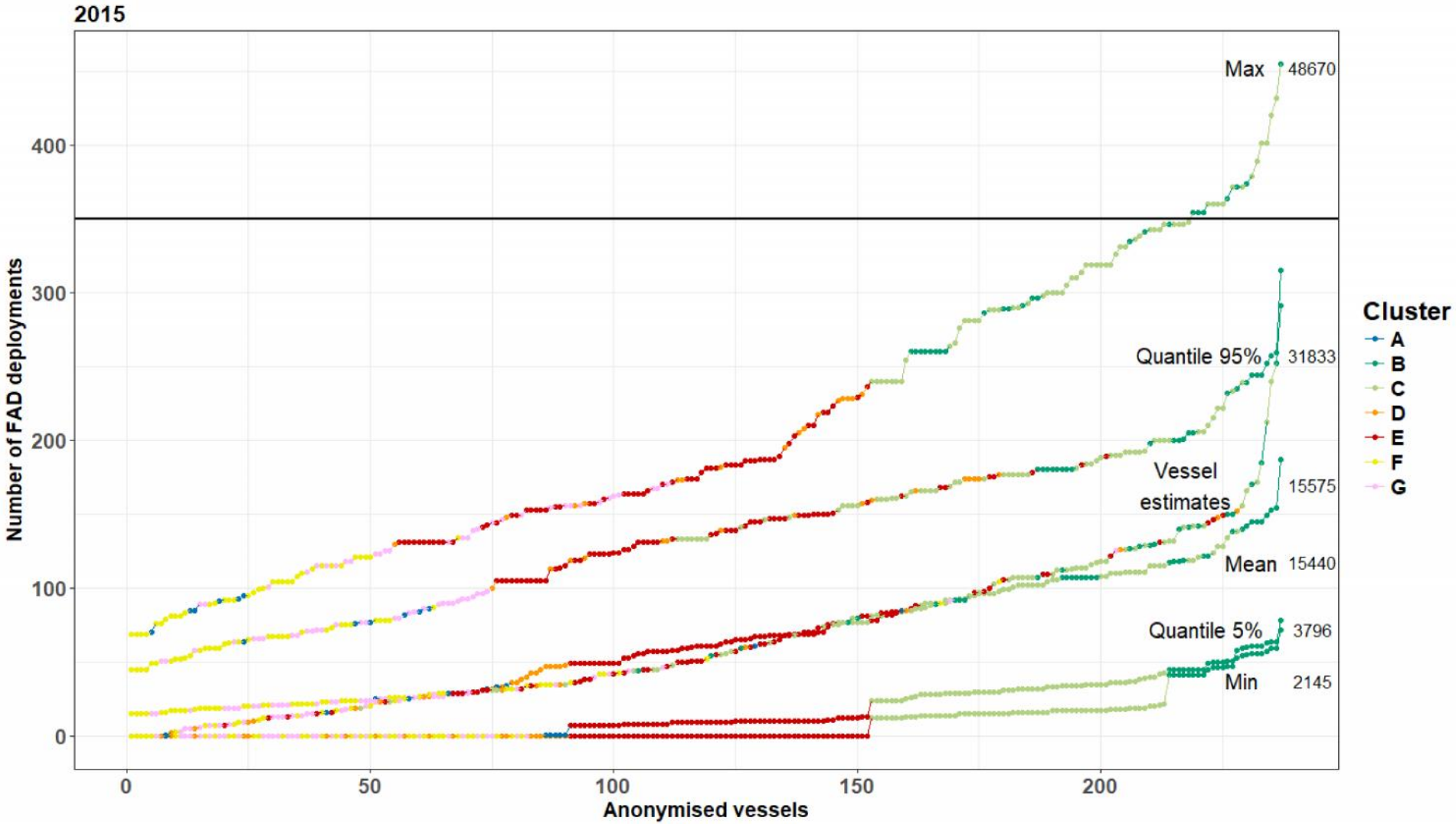
Pacific Community
Communauté du Pacifique

## Deployments / year



Pacific Community
Communauté du Pacifique

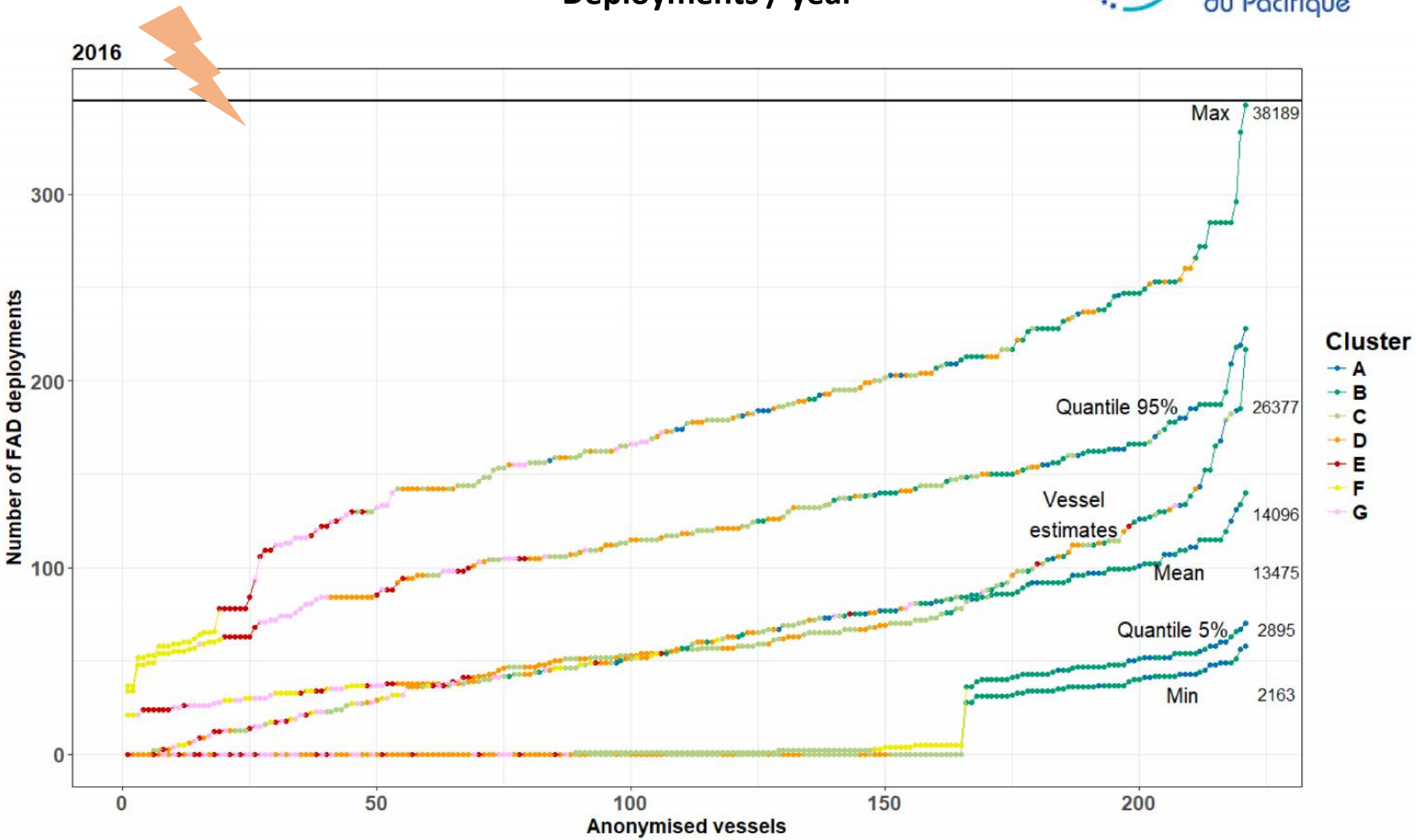
## Deployments / year



## RESULTS Fishery data

Pacific Community
Communauté du Pacifique

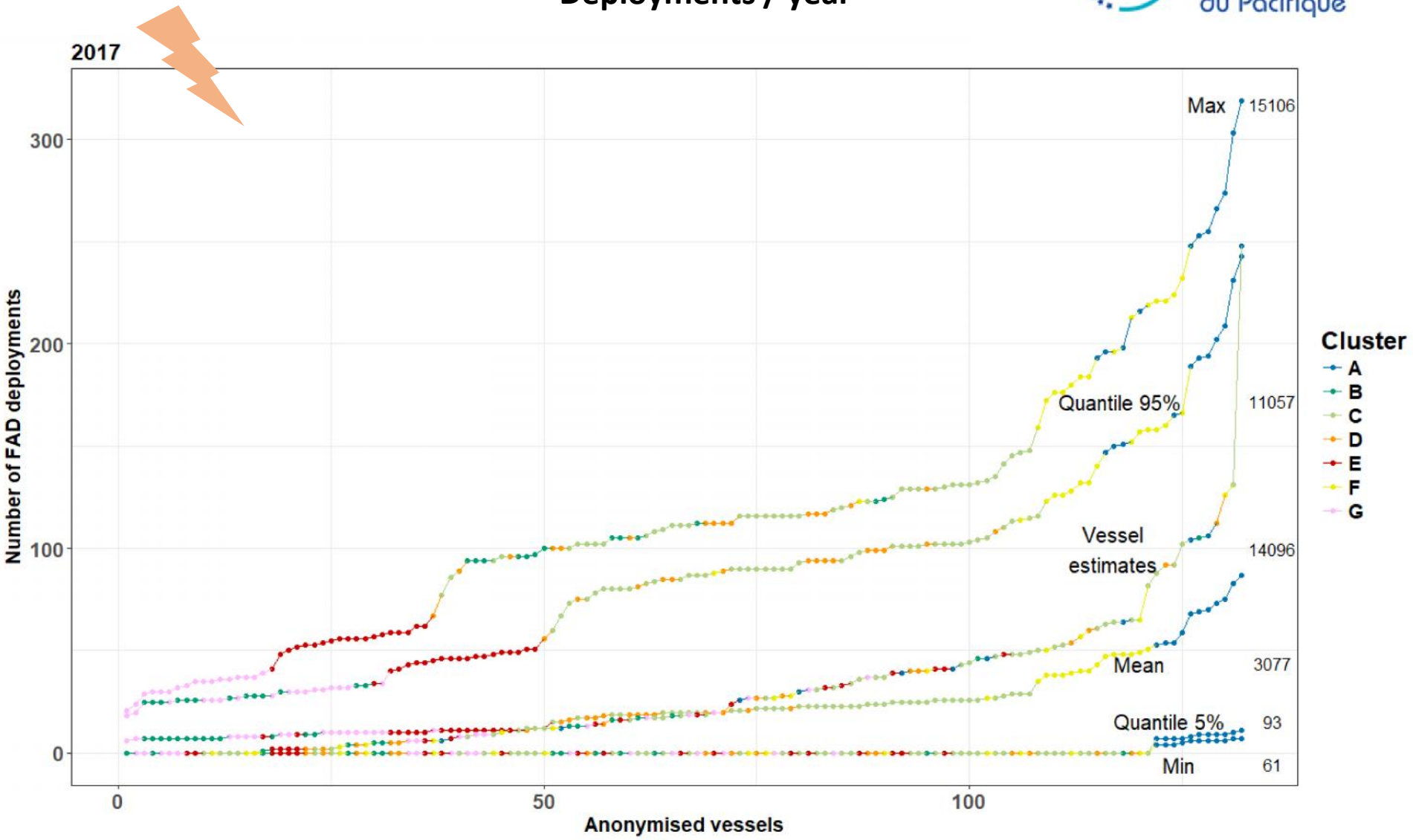
### Deployments / year



## RESULTS Fishery data

Pacific Community
Communauté du Pacifique

### Deployments / year



## 2) Estimates combining fishery and FAD tracking data

2016 (lower transmission rate) and 2017

Only 77 and 102 owner vessels identified in FAD tracking data

+ 110 and 104 vessels with only fishing company known

Vessels not present at all in the FAD tracking data

## RESULTS Fishery data + FAD tracking data

- **Matching between Observer and FAD tracking data**

  → **FAD trajectories and set or deployments by position and time**

- **Vessels in the FAD tracking dataset**

**Total Deployments = Deployments + (Deployments * (1 – Matching rate ))**

**Total Active FADs = Active FADs + (Active FADs * (1 – Matching rate ))**

**Other vessels, estimates by cluster → Total number in the WCPO**

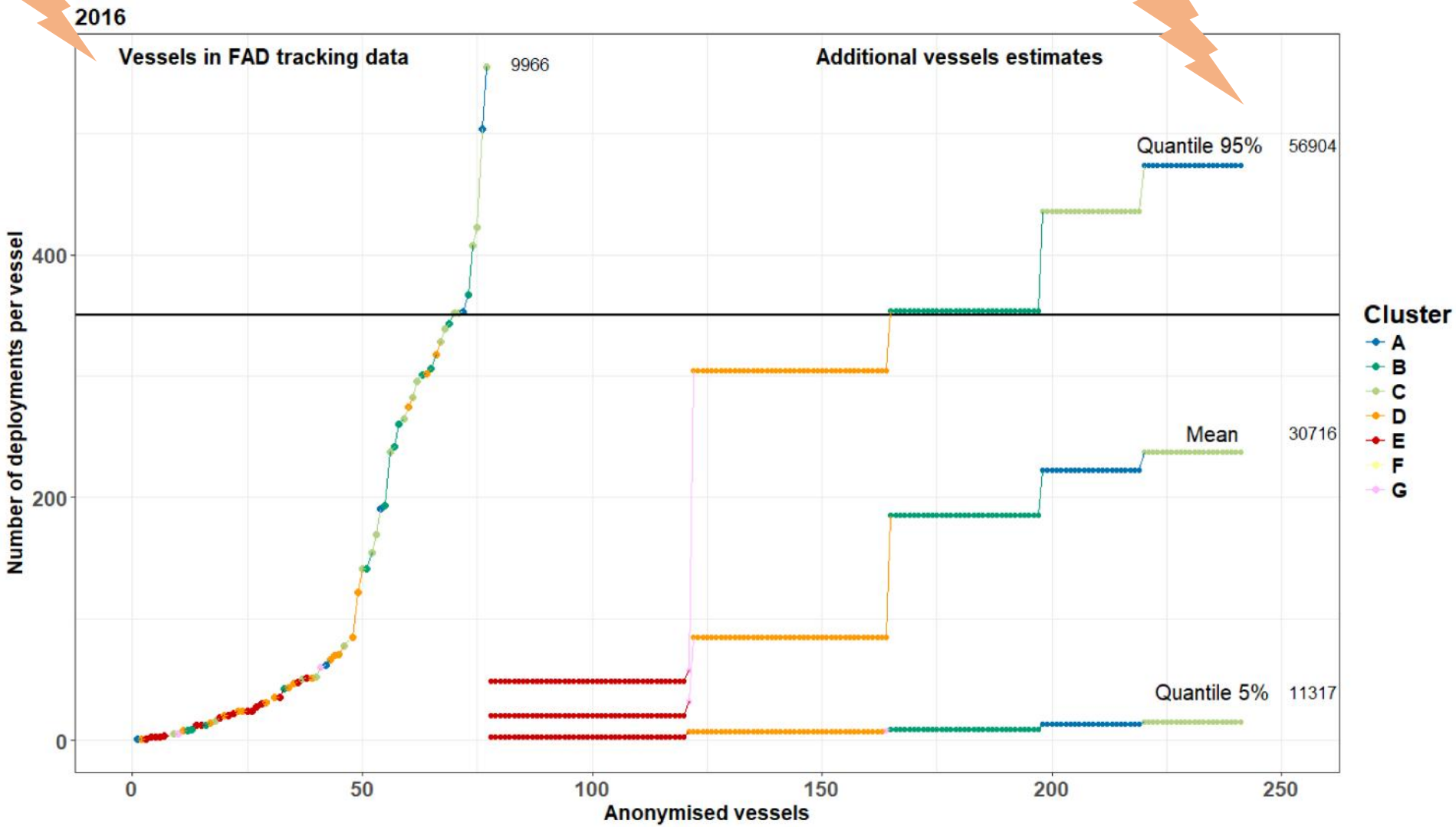
**Quantile 5%**
**Mean**
**Quantile 95%**

→ **Total Active FADs or Total Deployments**

## RESULTS Fishery data + FAD tracking data

Pacific Community
Communauté du Pacifique

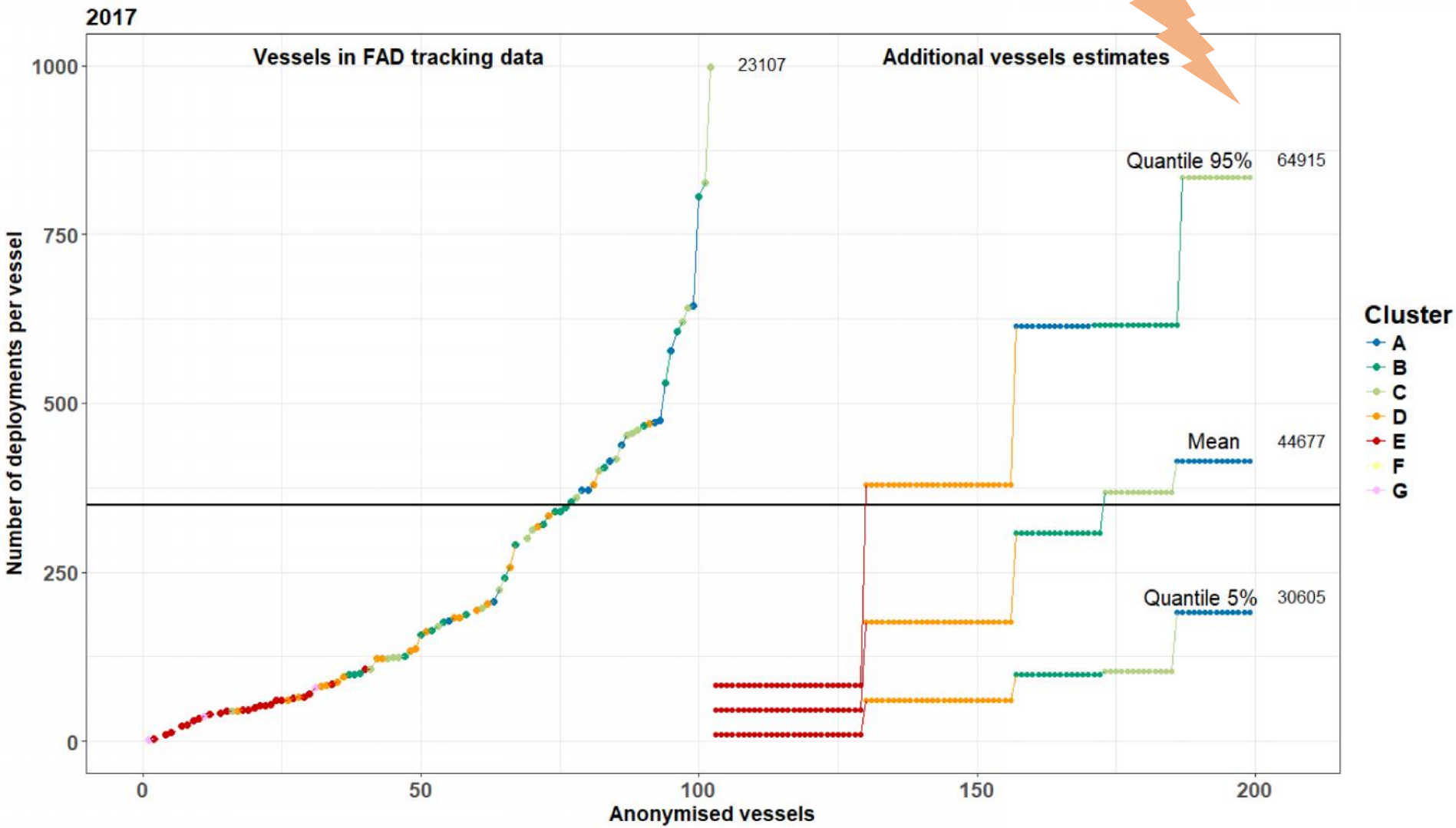
### Deployments / year



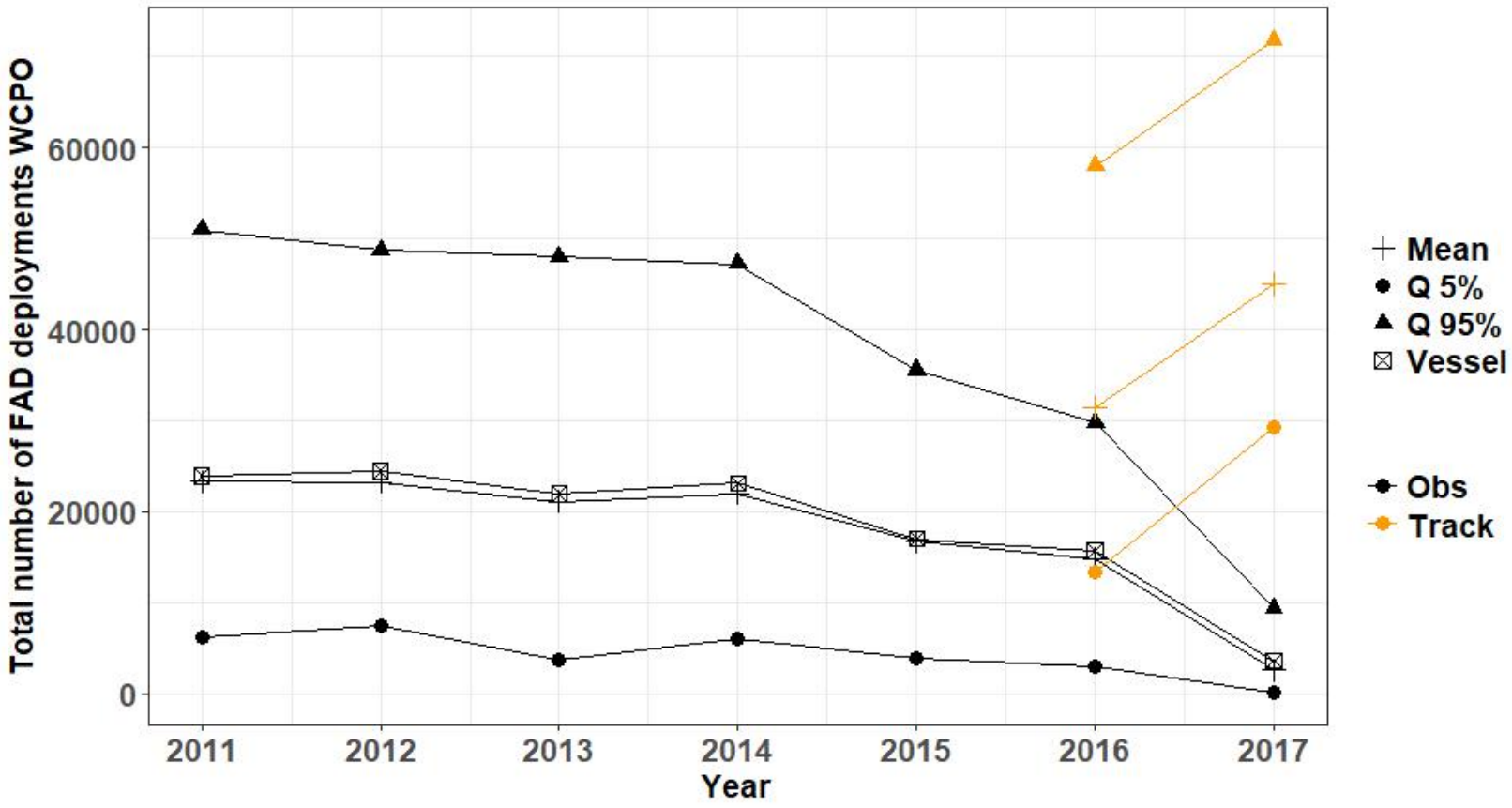
## RESULTS Fishery data + FAD tracking data

Pacific Community
Communauté du Pacifique

### Deployments / year



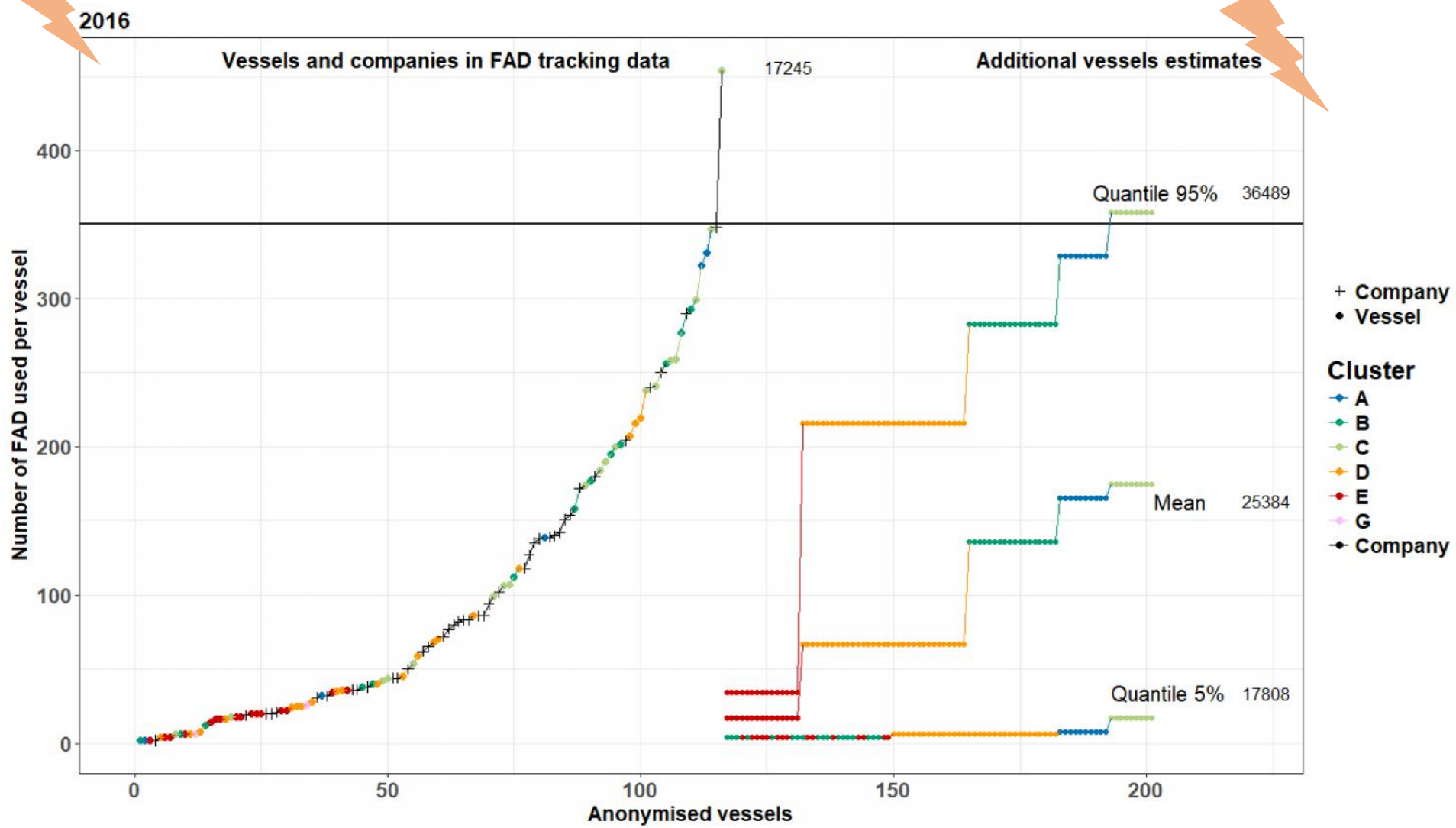
## RESULTS Fishery data + FAD tracking data



## RESULTS Fishery data + FAD tracking data

Pacific Community
Communauté du Pacifique

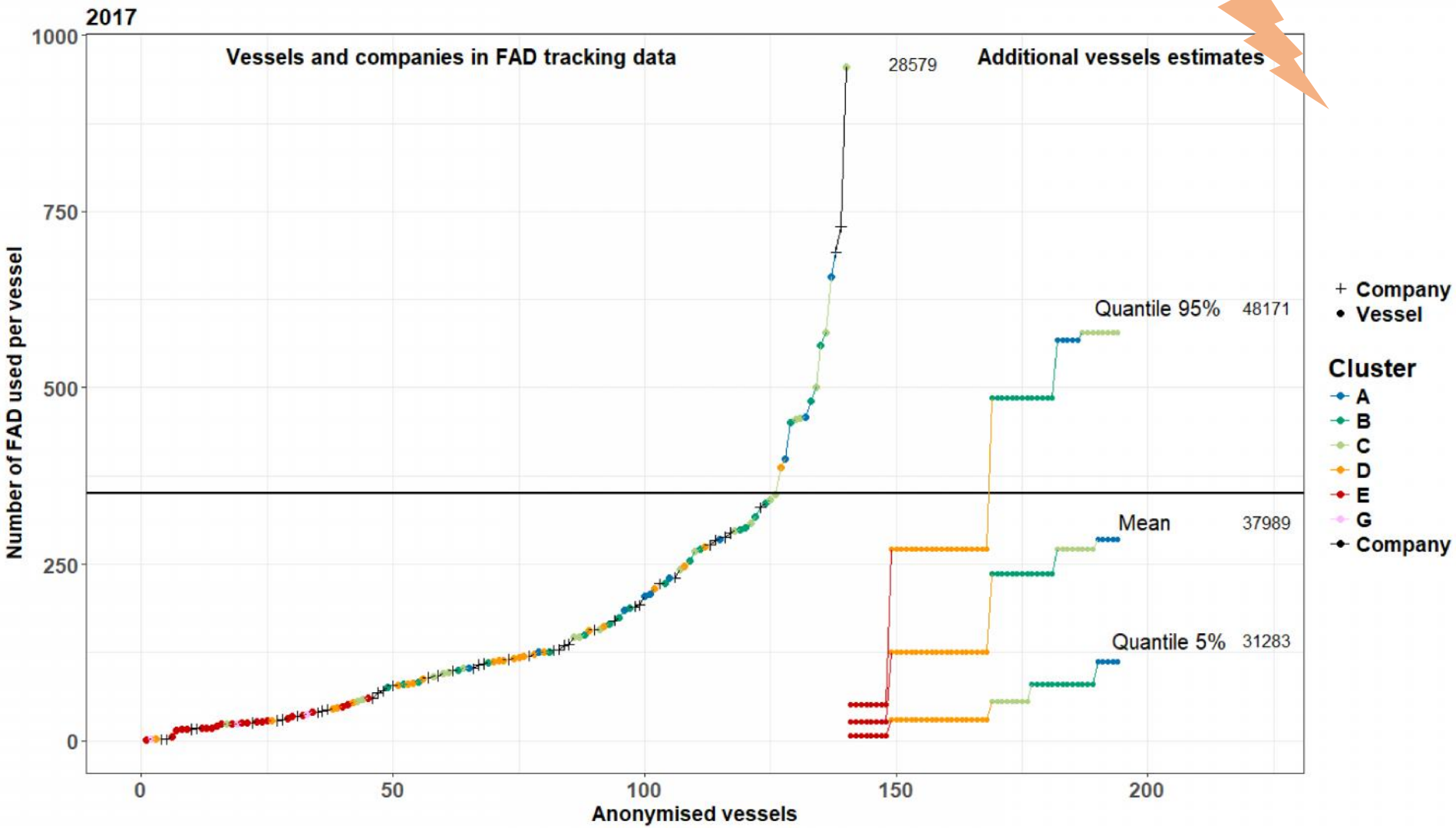
### Active FADs / year



## RESULTS Fishery data + FAD tracking data

Pacific Community
Communauté du Pacifique

### Active FADs / year



Pacific Community
Communauté du Pacifique

## Estimates of FAD use per vessel and per year

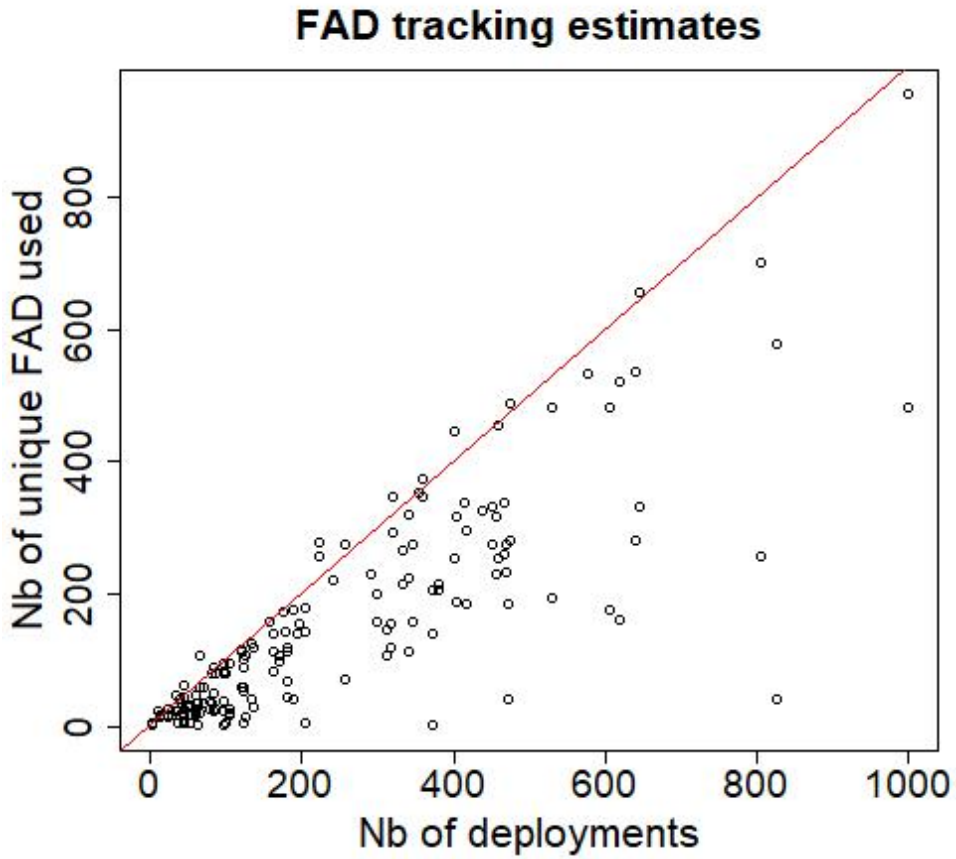
| | Vessels with ≥350 **deployments** per year by estimation method | | | | Vessels with ≥350 **active** FADs per year | Vessels with ≥150 **active** FADs per day |
|---|---|---|---|---|---|---|
| | Vessel | Mean | Quantile 95% | FAD tracking* | FAD tracking* | FAD tracking* |
| 2011 | 1.9 % | 0 % | 18.4 % | - | - | - |
| 2012 | 0.4 % | 0 % | 2.7 % | - | - | - |
| 2013 | 0.4 % | 0 % | 2.7 % | - | - | - |
| 2014 | 2.5 % | 0 % | 2.5 % | - | - | - |
| 2015 | 0 % | 0 % | 0 % | - | - | - |
| 2016 | 0 % | 0 % | 0 % | 10.4 % | 1.1 % | 0 % |
| 2017 | 0 % | 0 % | 0 % | 25.5 % | 15.7 % | 3.9 % |

*based on a limited number of vessels

See Table 4 for estimates of other hypothetical limits

Pacific Community
Communauté du Pacifique

**Ratio number of deployments / number of active FADs per vessel per year**

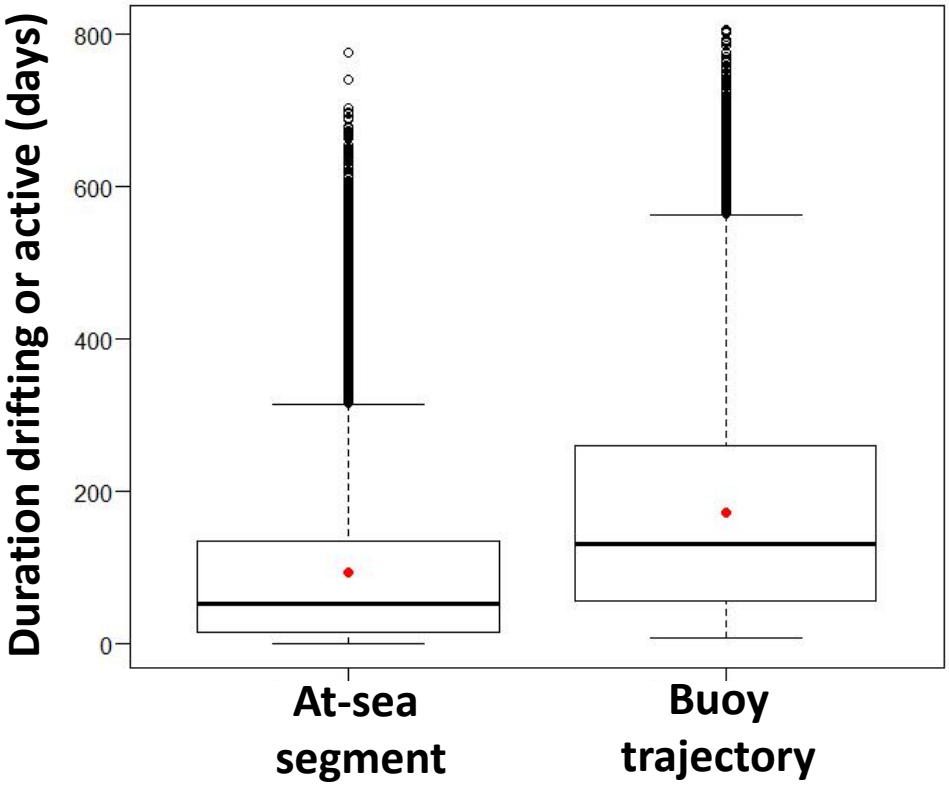



**Average =**

**1.48**

Pacific Community
Communauté du Pacifique

**FAD active duration recorded in the FAD tracking data**




**Average =**

**6 months**

See WCPFC-SC14-MI-WP-XX for details

Pacific Community
Communauté du Pacifique

## Relation deployments, FAD active /year and /day

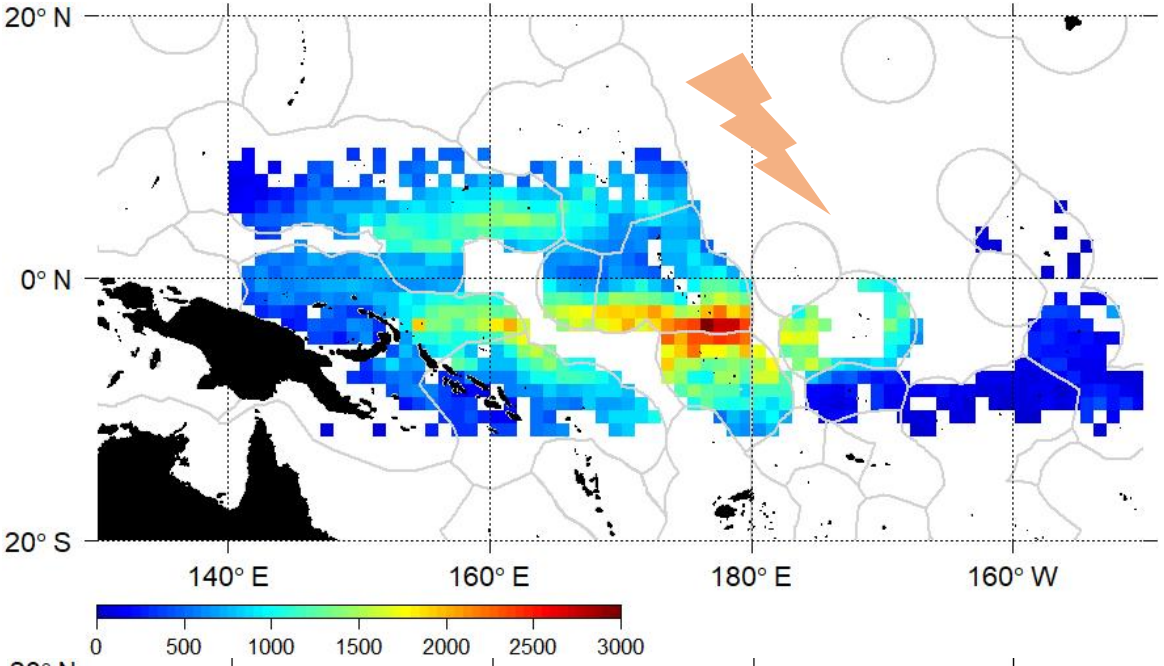
| Nb. deployments / year | Nb. active FADs / year | Nb. active FADs / day |
|---|---|---|
| **D** | **D / 1.5** | **D / 1.5 / 2** |
| 150 | 100 | 50 |
| 200 | 133 | 67 |
| 250 | 167 | 84 |
| 300 | 200 | 100 |
| 350 | 233 | 117 |
| 400 | 267 | 133 |
| 450 | 300 | 150 |
| 500 | 333 | 167 |
| 550 | 367 | 183 |
| 600 | 400 | 200 |

## 3) Influence of FAD densities on CPUE, total catch and occurrence of FAD and free school sets

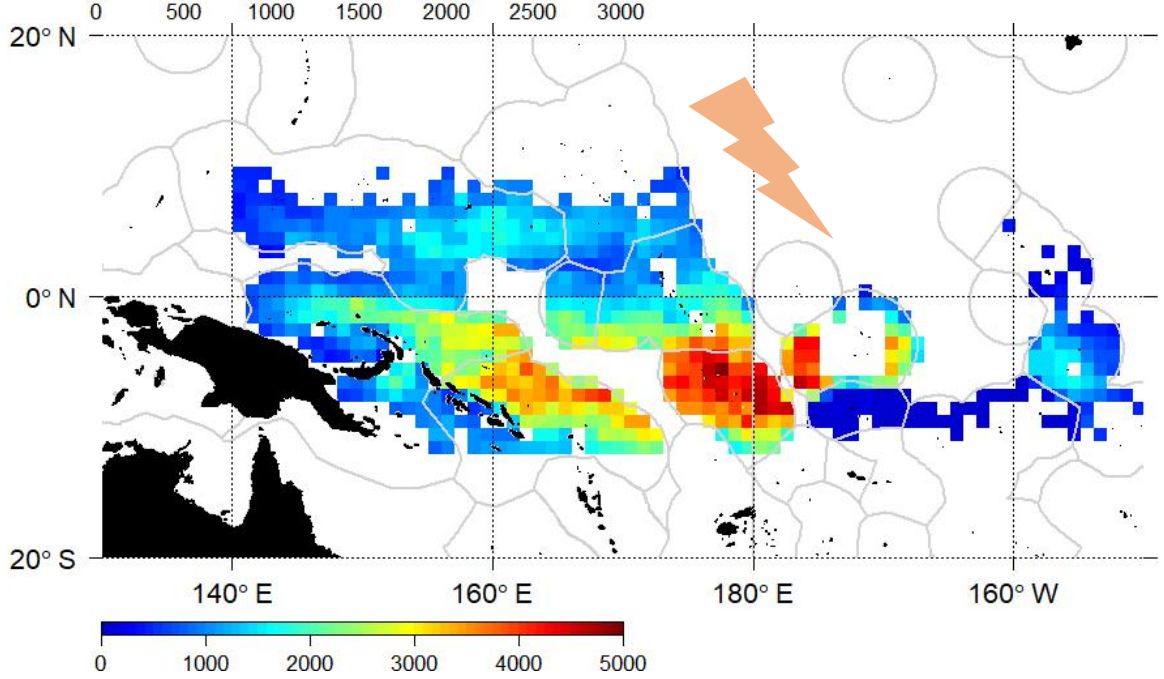
- Modified FAD tracking data (no transmission outside PNA waters)
- Underestimated FAD densities ?

## RESULTS Influence of FAD density

2016




2017




**FAD density**

**- Outside PNA waters**

**- Cell with associated fishing sets**

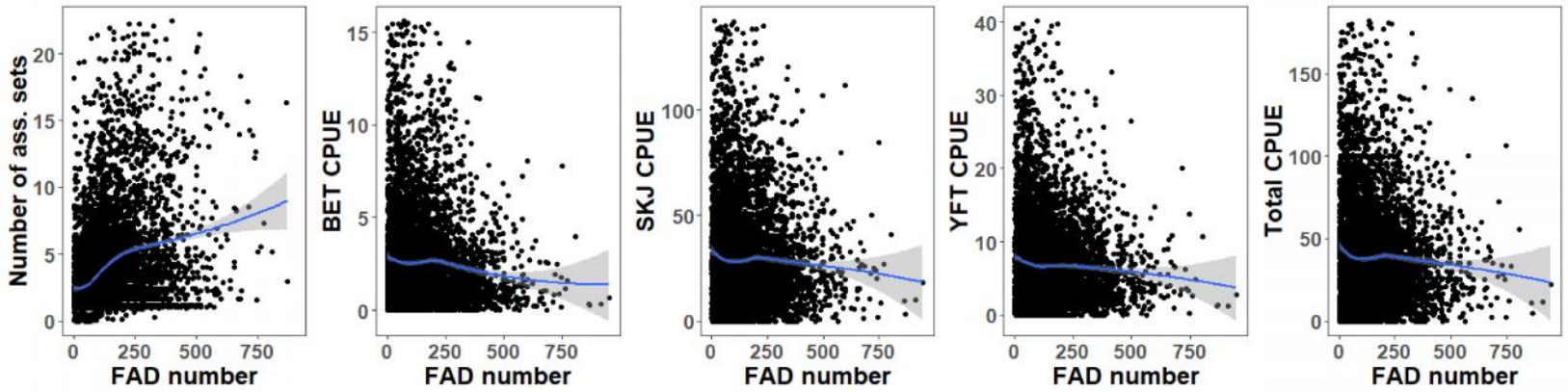
see WCPFC-SC14-MI-WP-09 for complete density maps

## RESULTS Influence of FAD density

Pacific Community
Communauté du Pacifique

### Relationships per 1° grid cell and month

**Observed (S-BEST)**



## Estimates of the number of FAD use per vessel

- Very few vessels deploy more than 350 FADs / year,
- Average value of the ratio between deployments and active FADs is 1.5 and average active life of a FAD is 6 months
- Therefore corresponding to a maximum of 117 active FADs / vessel at any given time.

## FAD density and CPUE

- Increase in the number of FAD sets with FAD density
- Slight decrease of FAD CPUEs with FAD density
- Maximum skipjack and total CPUE achieved with FAD density ~250 / 1° cell / month
- No clear influence on non-associated sets, catch and CPUE

## Recommendation to WCPFC-SC14

- **Note the progress being made by PNA in FAD tracking for the purpose of improving FAD management in PNA waters.**

- **Note the analysis of the number of FAD deployments and active FADs per vessel and the challenges encountered in this analysis.**

- **Note the conclusion that FAD density appears to influence CPUE, with a slight decrease of skipjack, bigeye, yellowfin and total CPUE with increasing FAD density although this still needs further investigation.**

# Thanks for your attention

**Acknowledgments**

**We thank the members of the Parties to the Nauru Agreement for data access and the Pew Charitable Trusts for the funding provided to support these analyses**