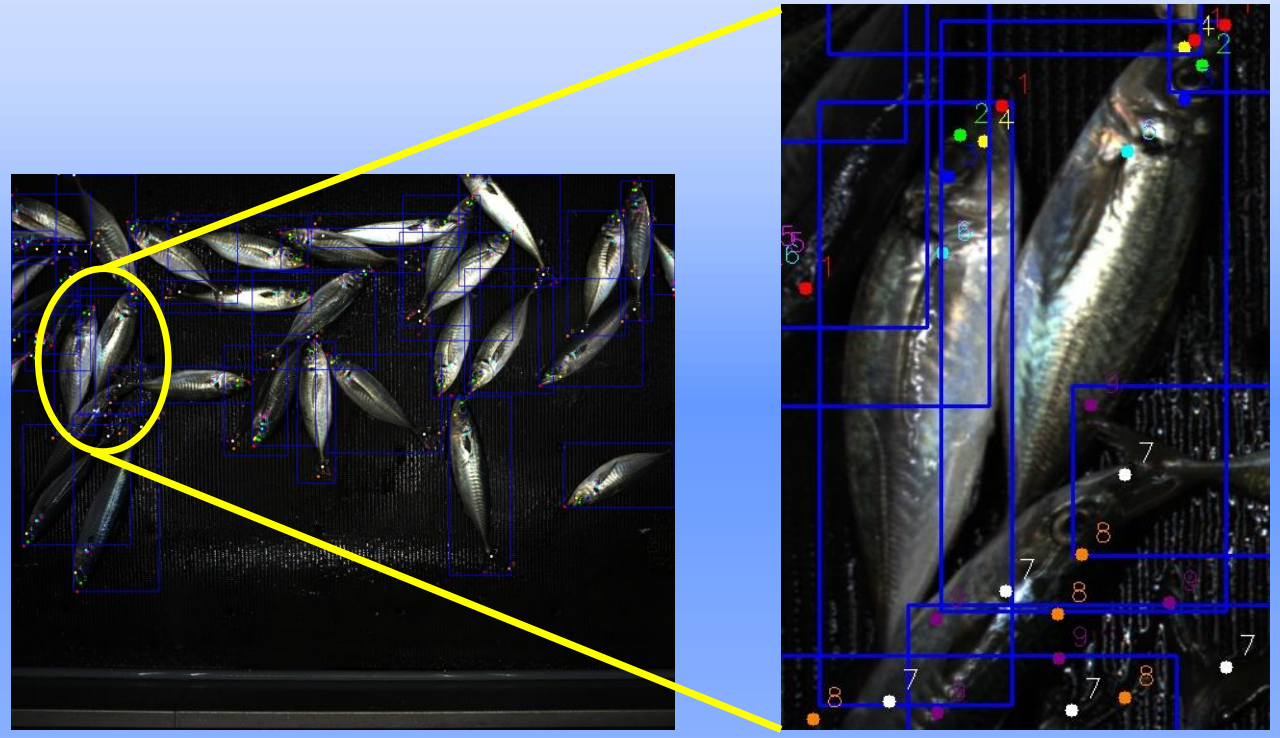
# Daily, vessel-specific, and species-specific length composition monitoring using the image analysis system FIAS-Deep



Imaging equipment and fish on the conveyor at Matsuura Fish Market, Nagasaki, Japan



Key-point estimation to obtain fork length using the image from imaging equipment

**Yasutoki Shibata**, Yuka Iwahara, Masahiro Manano (Japan Fisheries Research and Education Agency), Daiki Suzuki (CCS Inc.), Tomoya Nishino, Kota, Kurosawa (Computermind Corp.), Toru Kitamura, Yuka Murayama and Tomoyuki Kuwahara (Japan NUS Co., Ltd.)

PICES Annual Meeting 2026, Nanaimo, Canada

# Previous studies and limitation of Japanese case

【Stock assessment】

To scientifically evaluate whether the current catch of a target fish is sustainable for its stock status.



Fish length is measured manually

## Vessel-mounted electronic monitoring (EM) cameras



https://www.afma.gov.au/afma-leading-way-fisheries-technology



Modified and reproduced from Tseng and Kuo (2020)



https://www.youtube.com/watch?v=EZ1Xyg_mnhM&t=2s

| Country | Fishermen (persons) | Fishing vessels (units) | Ratio of vessels under 25 tons |
|---|---|---|---|
| Iceland | 6,300 | 826 | 0.63 |
| Norway | 22,916 | 8,664 | 0.89 |
| Denmark | 4,792 | 4,285 | 0.86 |
| United Kingdom | 19,044 | 9,562 | 0.82 |
| France | 26,113 | 6,586 | 0.78 |
| Canada | 84,775 | 18,280 | 0.74 |
| New Zealand | 2,227 | 1,375 | 0.74 |
| Spain | 75,434 | 15,243 | 0.76 |
| United States | 290,000 | 27,200 | 0.53 |
| South Korea | 180,649 | 50,398 | 0.90 |
| Japan | 278,200 | 219,466 | 0.98 |
| Australia | 13,500 | 5,000 | N.A. |

The data is based on calculations from FAO (1999), as referenced in *Institutional Analysis of Japan's Fisheries: Fisheries Management and Ecosystem Conservation* (2013) by Mitsutaku Makino.

# A fish image analysis system using deep learning (FIAS-Deep)

## FIAS-Deep

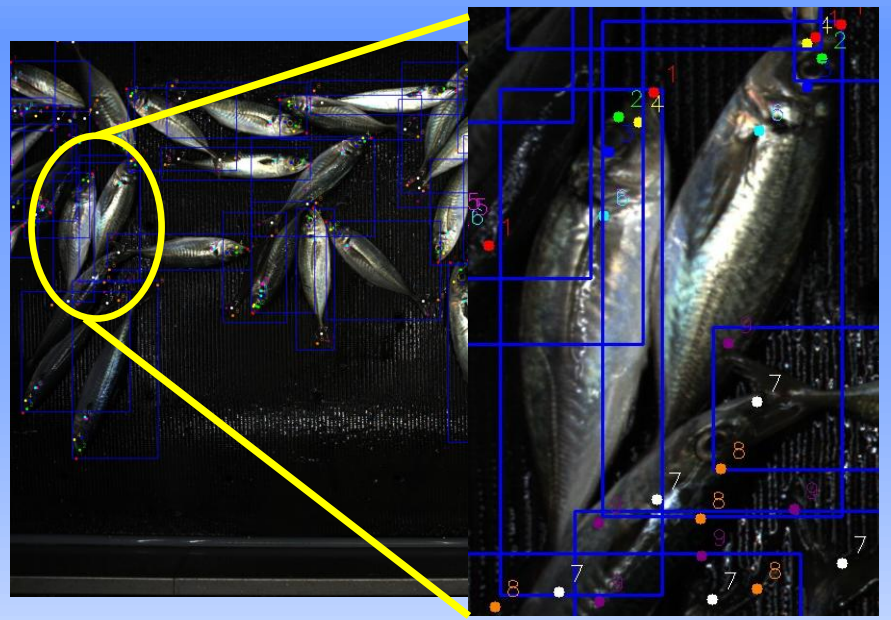
### 1. Image capture subsystem

This subsystem acquires images from cameras installed on conveyors and other equipment in a port.



### 2. Training and inference subsystem

This subsystem trains deep learning models and analyzes newly acquired images.



Length composition can be obtained without manual measurements

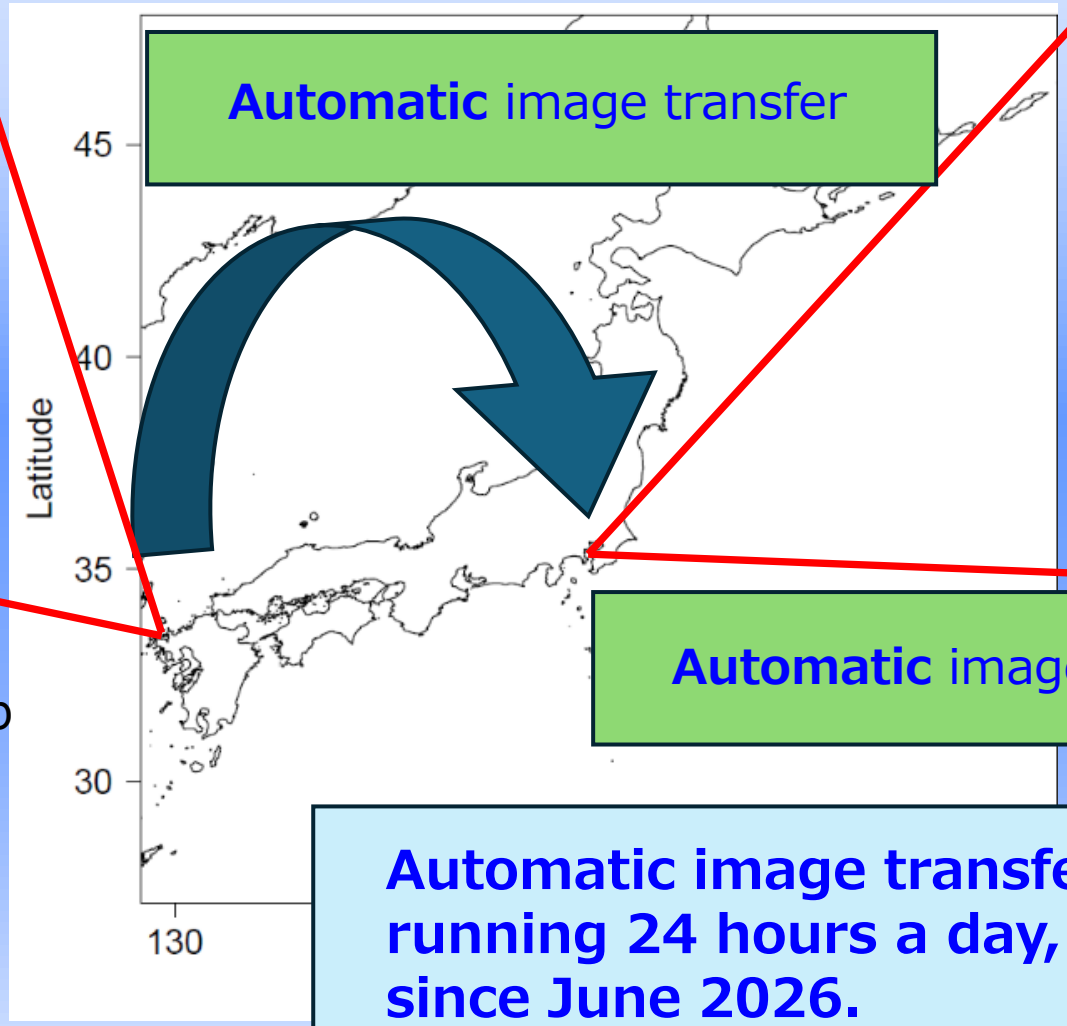
# FIAS-Deep's installation location

The image capture subsystem@Matsuura



Japan's No. 1 market for combined landings of Japanese jack mackerel, chub mackerel, and blue mackerel for the past three years!






**Automatic** image transfer

**Automatic** image analysis

The training and inference subsystem @Yokohama, FRA



**Automatic image transfer and analysis running 24 hours a day, 7 days a week since June 2026.**

# Objective

To compare and evaluate the length composition obtained using FIAS-Deep with that obtained from manual measurements.

⇨ Evaluation will help determine whether species-specific length composition from FIAS-Deep can be used in stock assessment or not.

After evaluation, we show examples of length composition by day, vessel, species and fishing area (June–Sept. 2026)

# Two types of sampling



Matsuura fish market, Nagasaki prefecture

I. Punching manually



II. Image capture subsystem

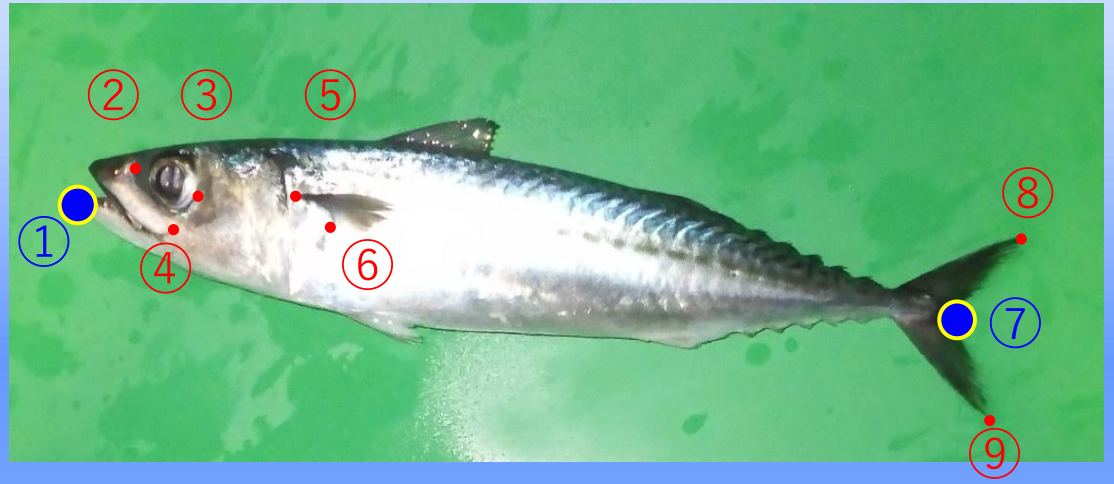


I. Eleven manual surveys (10 Dec 2025–24 Jul 2026), about 1,000 fish each.
Fork length measured for Japanese jack mackerels (*Trachurus japonicus*) and *Scomber* spp.(Both *Scomber japonicus* and *Scomber australasicus*).
(Pilot surveys had been carried out before June 2026 and those data were also used in evaluation)

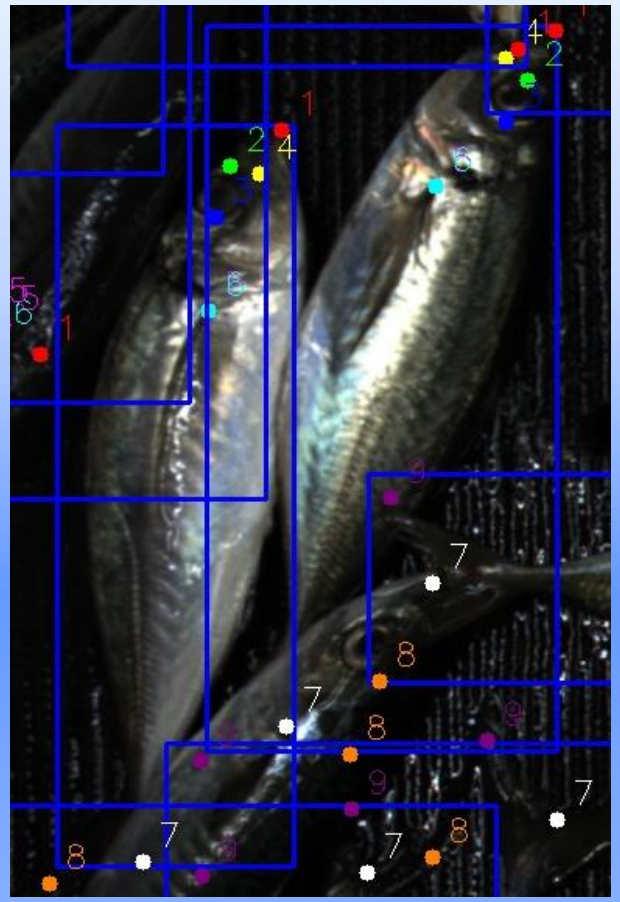
II. FIAS-Deep automatically estimates species-specific fork length composition.
(Training data are not detailed here.)

# Fork length estimation for occluded fish

## Keypoint estimation (HRformer, Yuan et al., 2021)




Keypoints used for body length calculation.
The distance between key-point 1 and 7 is equal to fork length.



*Modified and reproduced from* Shibata et al., 2025 Oral presentation in Ecological society

Even when a keypoint (KP) is occluded (overlapped), its position can be estimated from its spatial relationships with the other KPs.

Fork length can be estimated even when fish are partially occluded by other individuals.

# Target fish species and evaluation indices

## 【Target fish species for FIAS-Deep】

・Only for Japanese jack mackerels and *Scomber* spp.

(The species classification was performed using ResNet50, but details are omitted here. Only two species (chub mackerel and blue mackerel) were included in *Scomber* spp. They were distinguished by the model, but this distinction was not used in the present study.

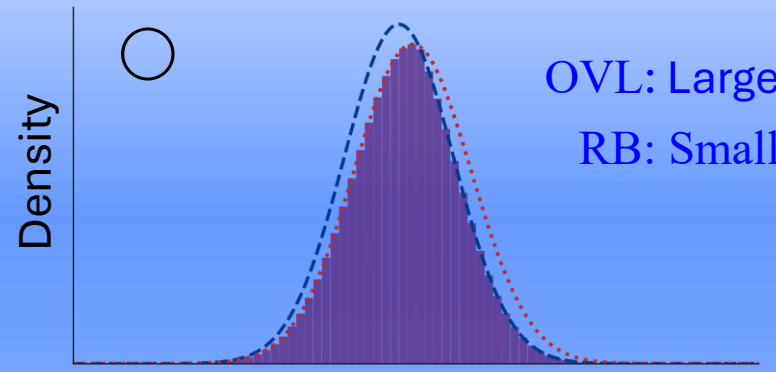


Japanese jack mackerels



*Scomber* spp. (Both chub mackerels and blue mackerels)

Purple area is equal to OVL




## 【Evaluation indices(Overlapping coefficient: OVL, Relative Bias: RB)】

$$OVL = \sum_i \min(p_i, q_i)$$

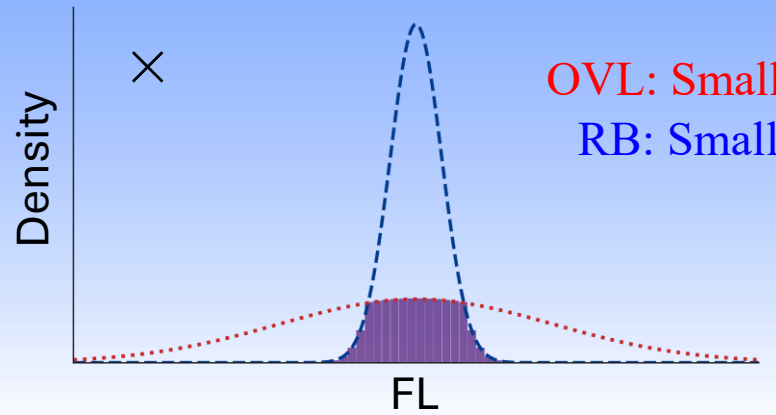
$p_i$: Density distribution of estimated fork lengths

$q_i$: Density distribution of observed fork lengths

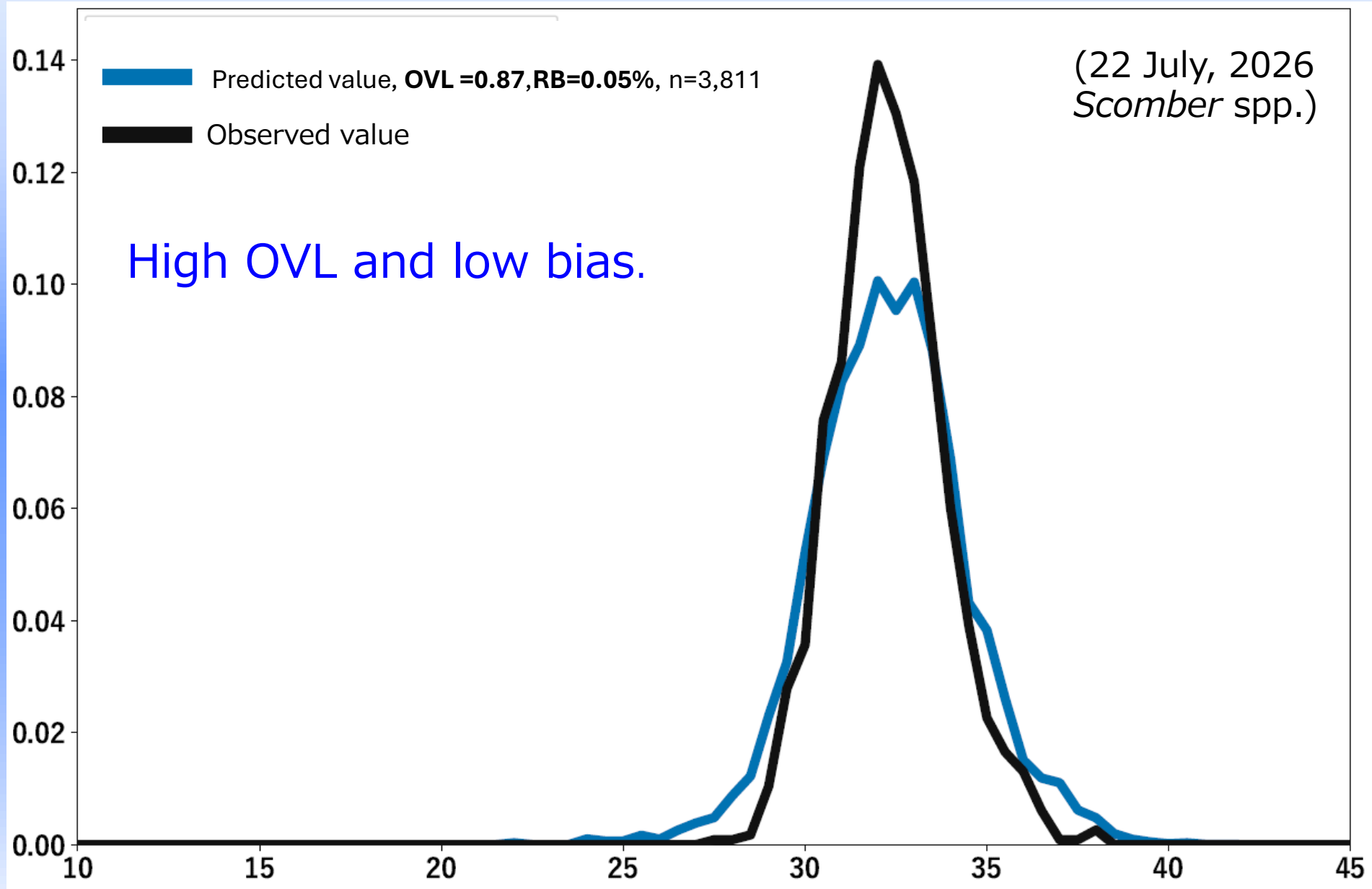
$$RB = \frac{\mu_{est} - \mu_{obs}}{\mu_{obs}} \times 100$$

$\mu_{est}$: Average of estimated fork lengths

$\mu_{obs}$: Average of observed fork lengths

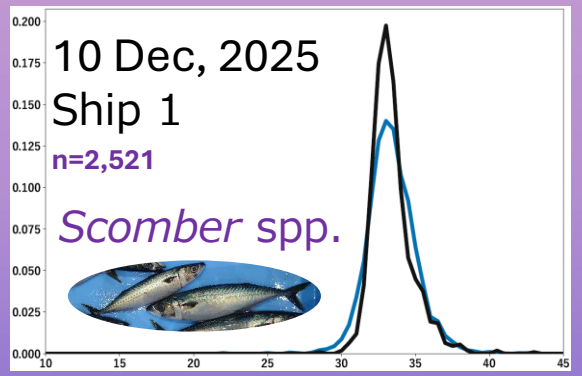


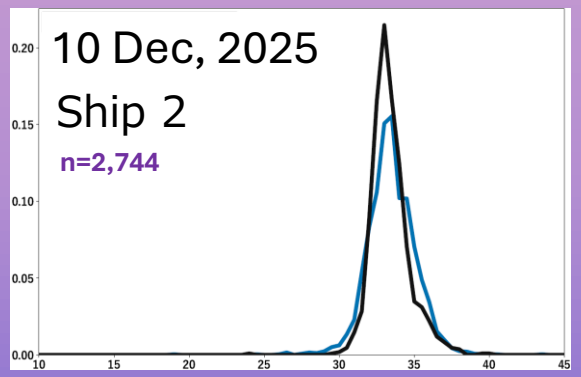
# Comparison to observed value

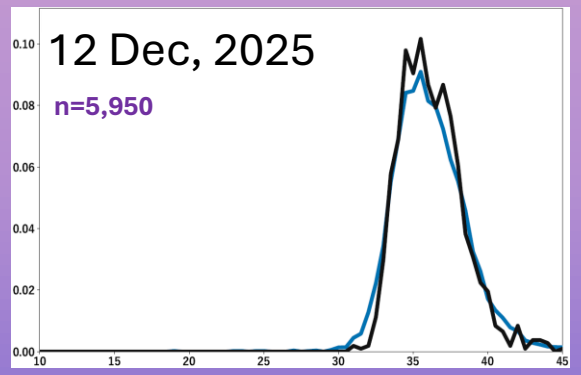


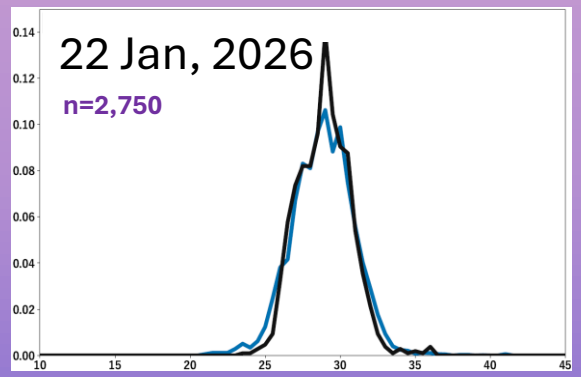
# Comparison to observed value (continued)

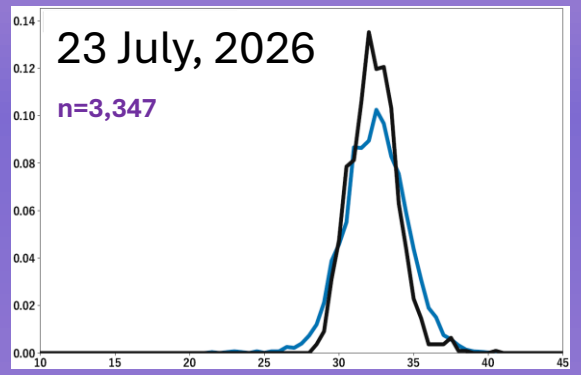


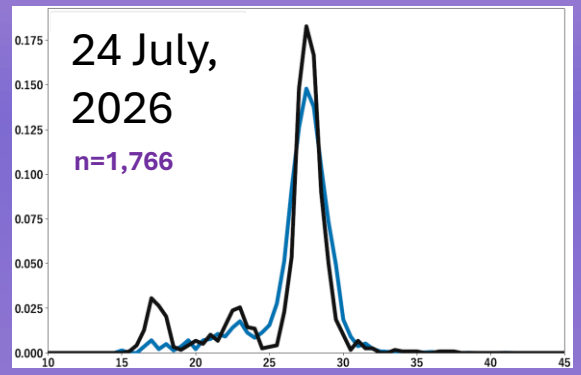


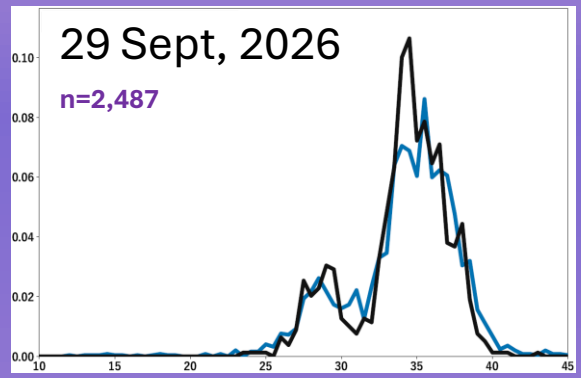



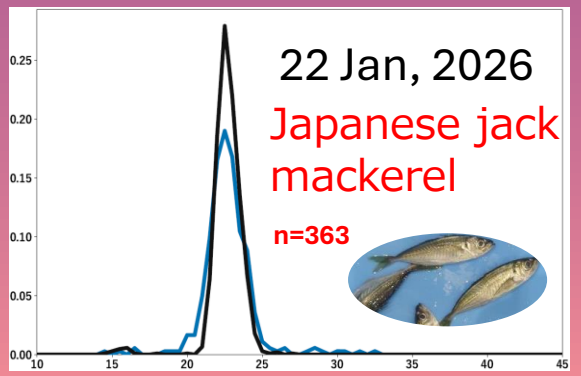



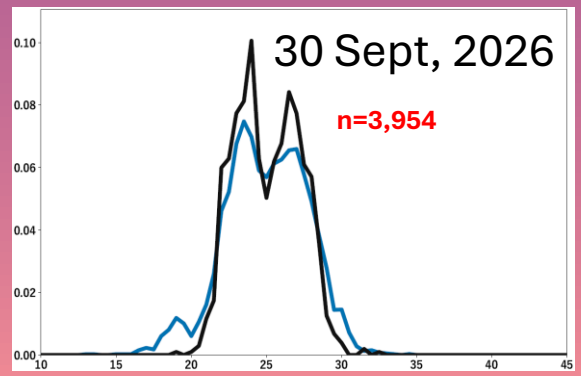



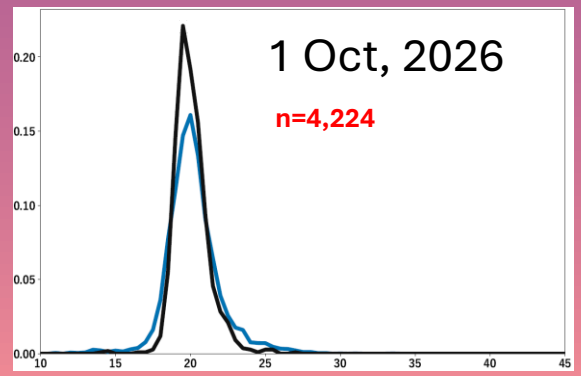




Also, high OVL (0.79~0.92) and low bias(-0.20~3.31).



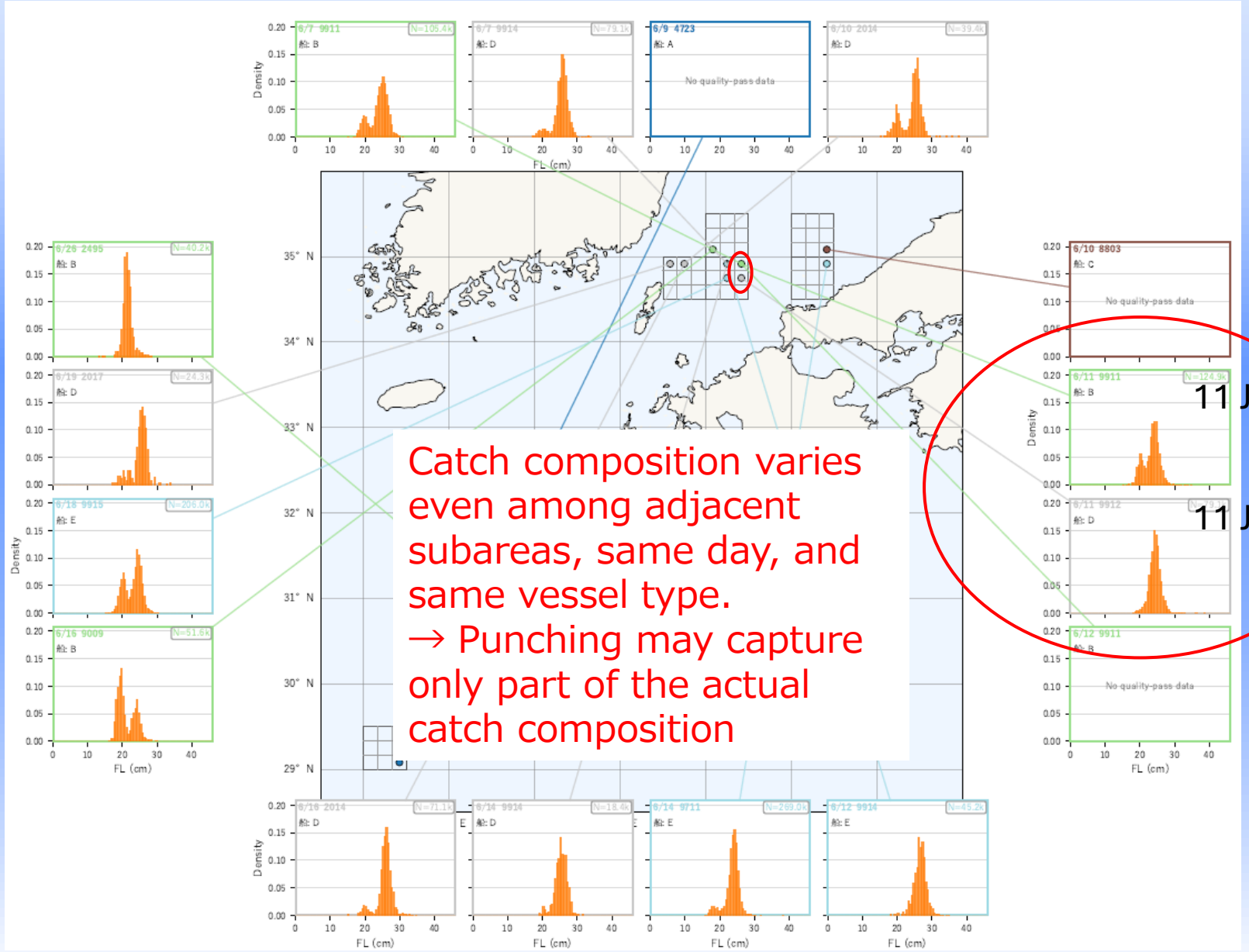

Predicts from FIAS-Deep can be used for monitoring of catch and stock assessment.

# Examples of daily, vessel-specific, species-specific, and area-specific length composition

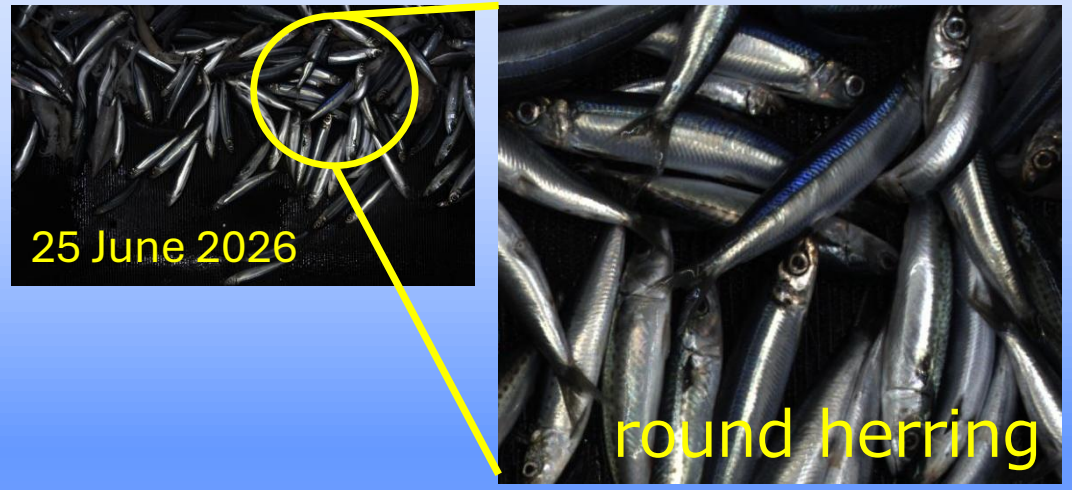
(Japanese jack mackerel)



Vessel-name matching with ministerial fishery catch reports enables area-specific mapping.



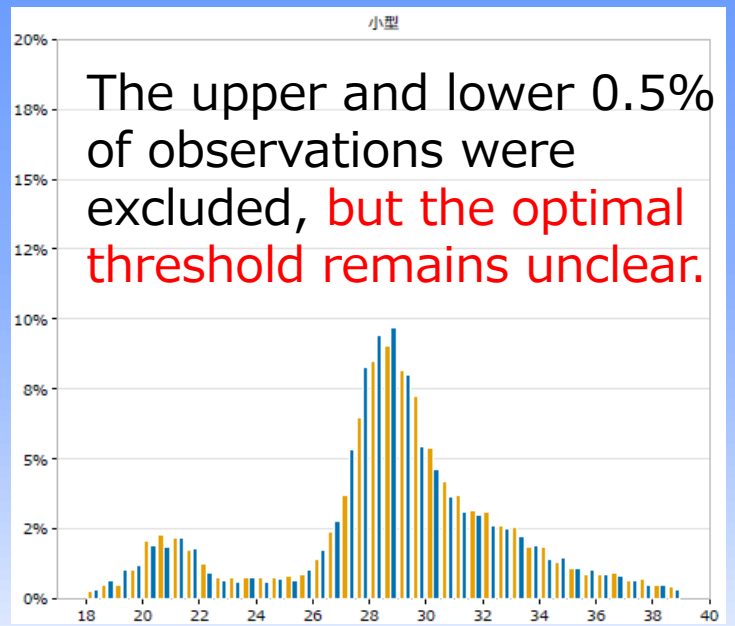
# Future works




Untrained species (e.g., round herring) are misclassified as either *Scomber* spp. or Japanese jack mackerel

➡ Add daily landing images as training data, or use the results only when market data indicate landings consist solely of those species.



# Summary

FIAS-Deep is now operational, enabling continuous 24/7 monitoring of fish length composition.

Species-specific length compositions were highly consistent with survey data, supporting the use of FIAS-Deep as an alternative to field measurements.

Untrained species may be misclassified; use only on days with no reported landings of species other than *Scomber* spp. or Japanese jack mackerel.

Non-fish objects cannot be fully learned. Tail-trimming criteria need to be optimized.

We gratefully acknowledge the substantial support provided by Nishinihon Uoichi Co., Ltd. throughout this study.