

Predators and predation at the  
intake to the Central Valley  
Project – preliminary study  
findings

By Brent Bridges, USBR

# Acknowledgements

- **Zak Sutphin**, USBR, Tracy
- **Ray Bark**, USBR, Denver Technical Service Center
- **Leslie Hanna**, USBR, Water Resources Research Lab
- **Lou Helfrich**, Virginia Polytechnic Institute



# Bureau of Reclamation

## Tracy Fish Facility Applied Research

Denver Technical Service Center and the  
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## *An Applied Research Program for Improving Fish Salvage at the Tracy Fish Collection Facility (TFCF)*

Our Goal is to develop and implement new fish collection, holding, transport, and release technology that will significantly improve fish protection at major water diversions in the South Delta region of the Central Valley of California. These research activities are funded by the Tracy Fish Facility Improvement Program (TFFIP) and other sources.

This website provides information, data, and reports for researchers and the public.

*Select from the options below:*

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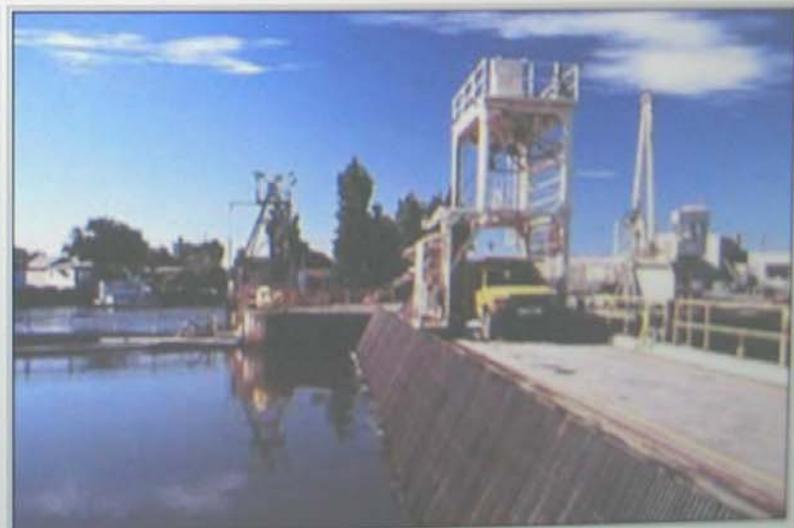
*Program History and Study Plans*

*Tracy Facility Schematic and Map*

*Red Bluff Research Pumping Plant*

*Tracy Research Photo Gallery*

*Technical Advisory Team*

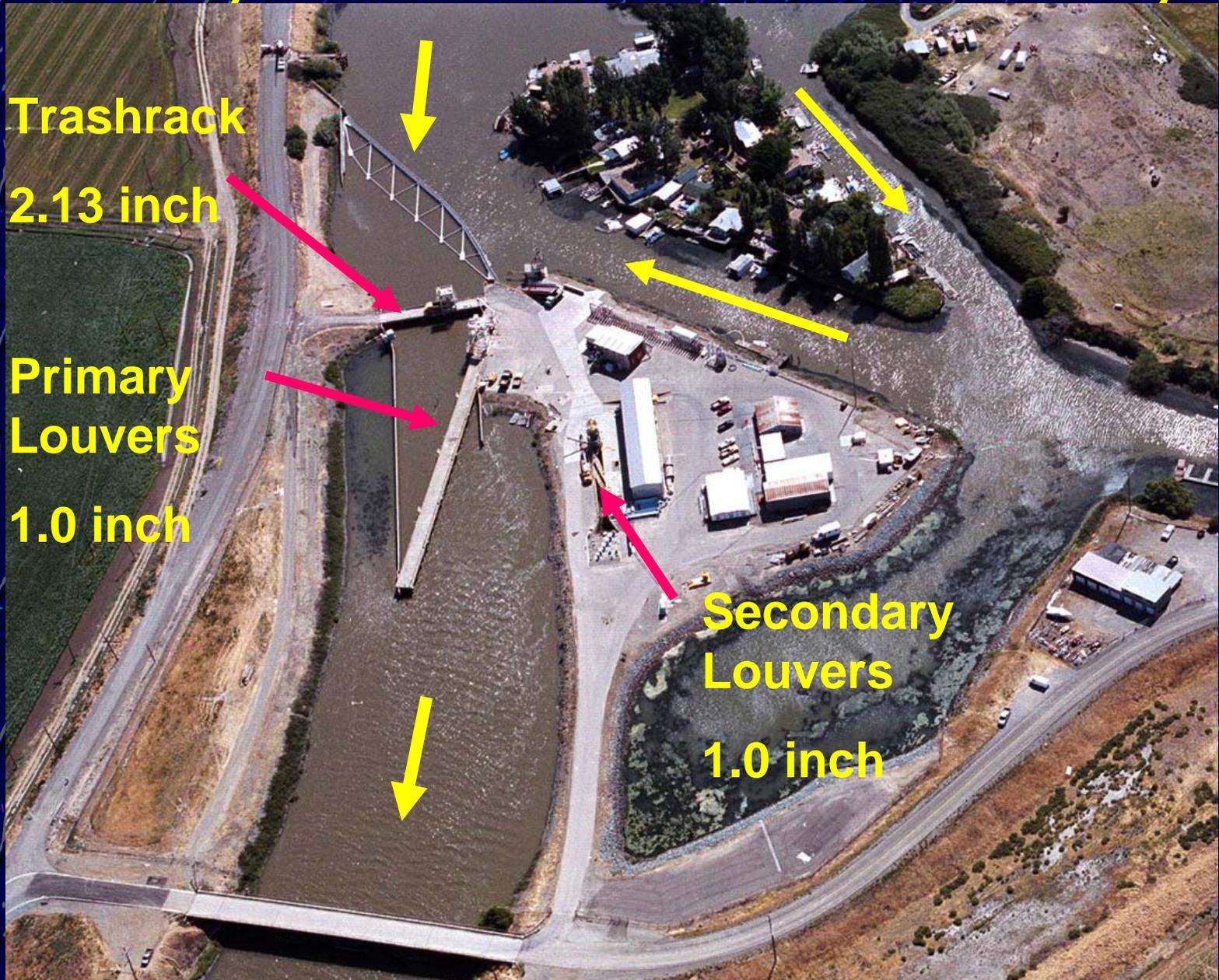


*The debris screen at the Tracy Fish Collection Facility.*

# Outline

- TFCF Structures
- Where are the predators
- Predator movement in the primary channel
- Predator diet and abundance in the secondary channel
- Future Studies

# Tracy Fish Collection Facility



Trashrack  
2.13 inch

Primary  
Louvers  
1.0 inch

Secondary  
Louvers  
1.0 inch

# Trashrack

1956 & 2005



# Trashrack

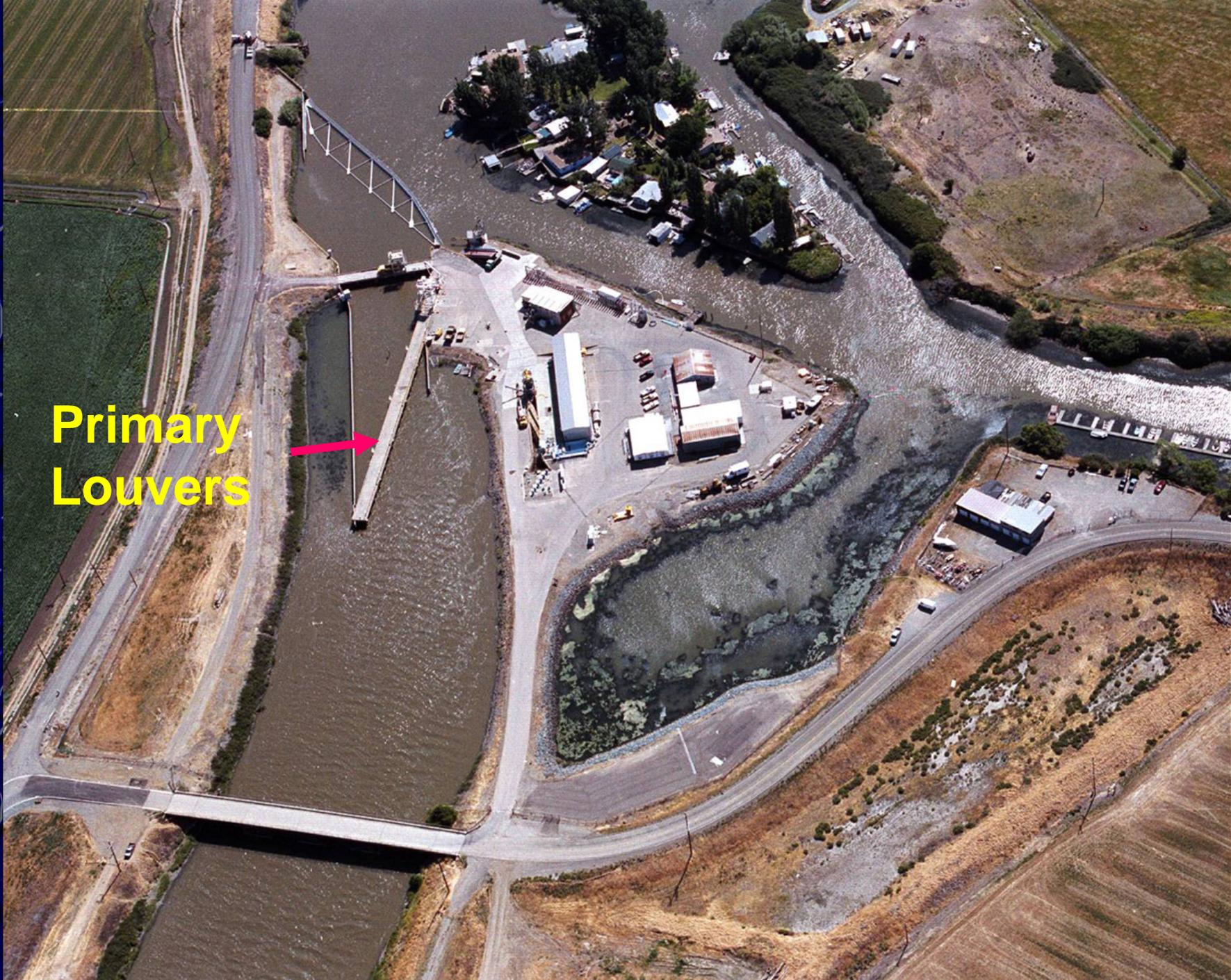
1956 & 2005

424 mm, 16.7 inch FL SB





**Primary  
Louvers**



# Behind Primary Louvers

1956 & 2005

211 mm, 8.3 inches FL



# Primary Louver Channel 1956







**Secondary Louvers**



# Secondary Channel

# How do we know where predators are located?

- Visual observation
- Hook and line

Front of Trashrack

339 mm FL,  
stdev = 52

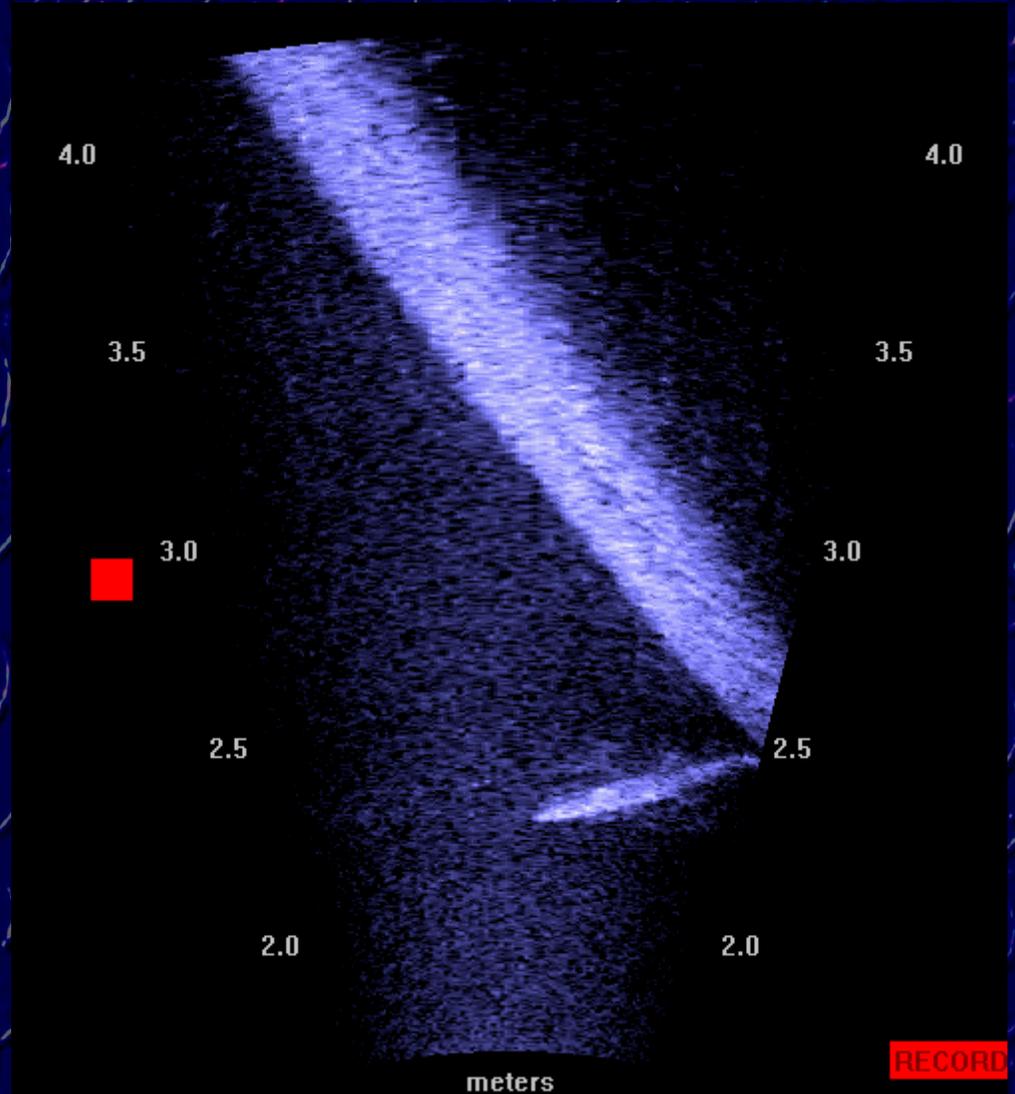
Behind Trashrack

651 mm FL,  
stdev = 73



# How do we know where predators are located?

- Visual observation
- Hook and line
- DIDSON



# Tracking Striped Bass in the TFCF

## Objectives:

- Characterize fish movement
- Determine rate of passage

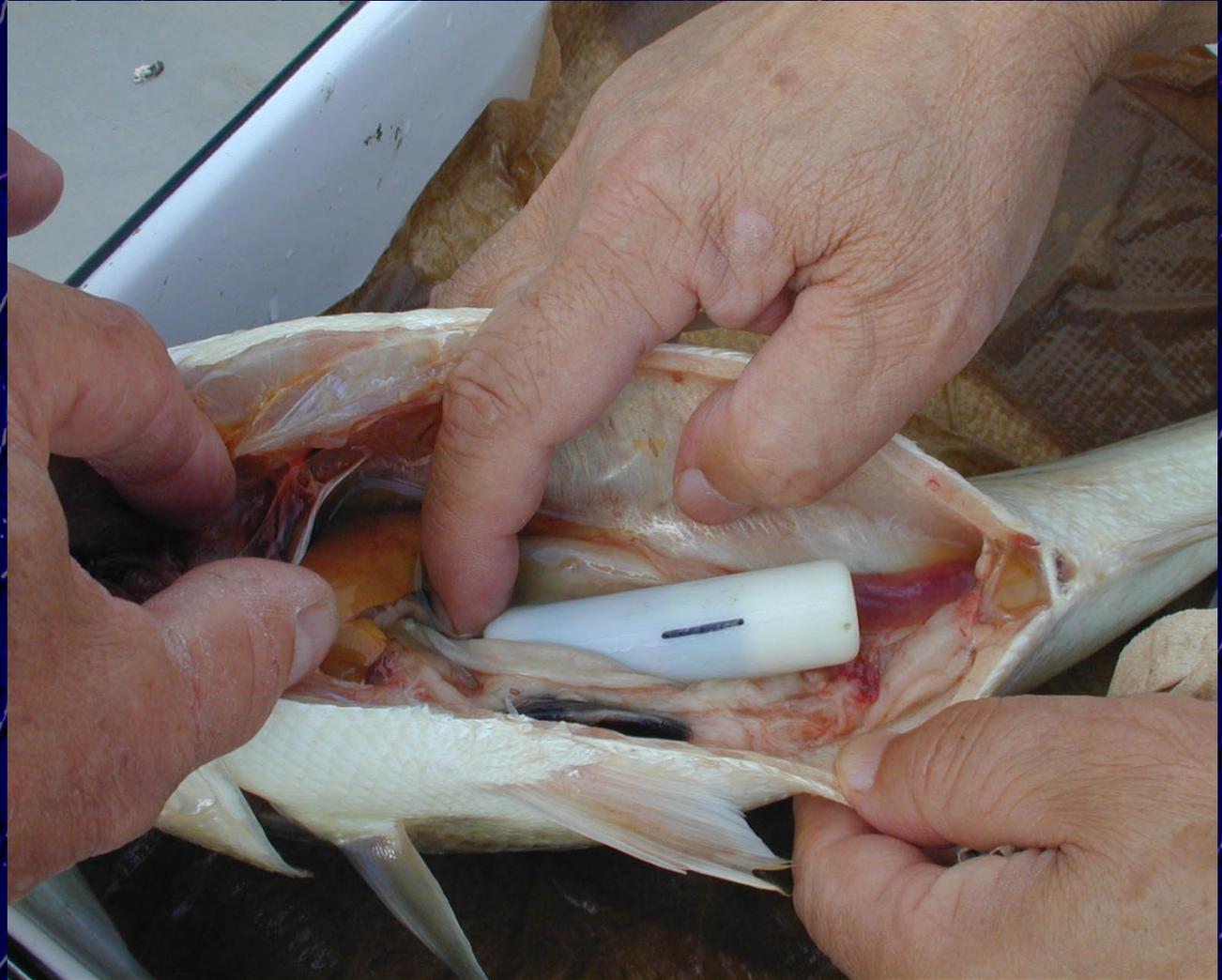


# Gastric Implant or External Mount with floy tags



# Sonronics, Coded Sonic Tags (CHP-S)

- **Ultrasonic**
  - Unique pulse
  - 70-82 kHz
- **Small**
  - 67 x 18 mm
- **Light**
  - 8 g
  - <2% BW
- **Lifetime**
  - 7 months
- **Range**
  - 3,000 m

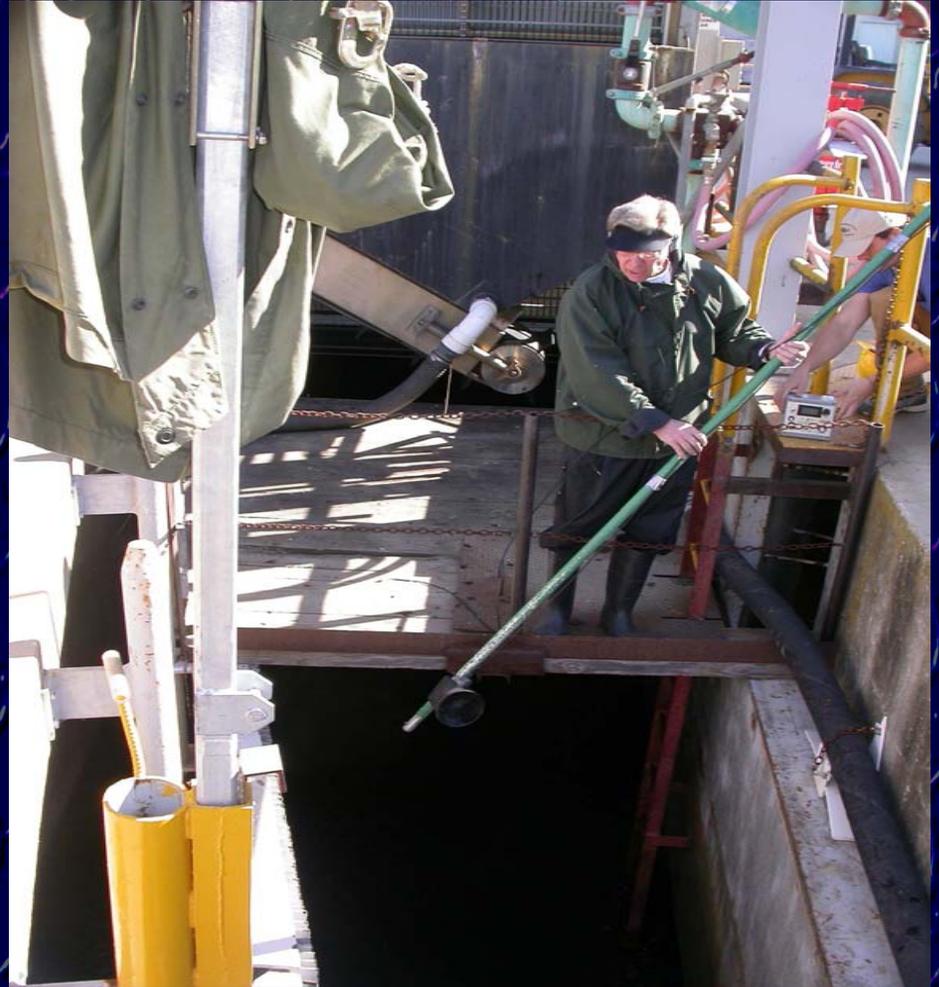


# Sontronics, Mini Sonic Tag (IBT-96)

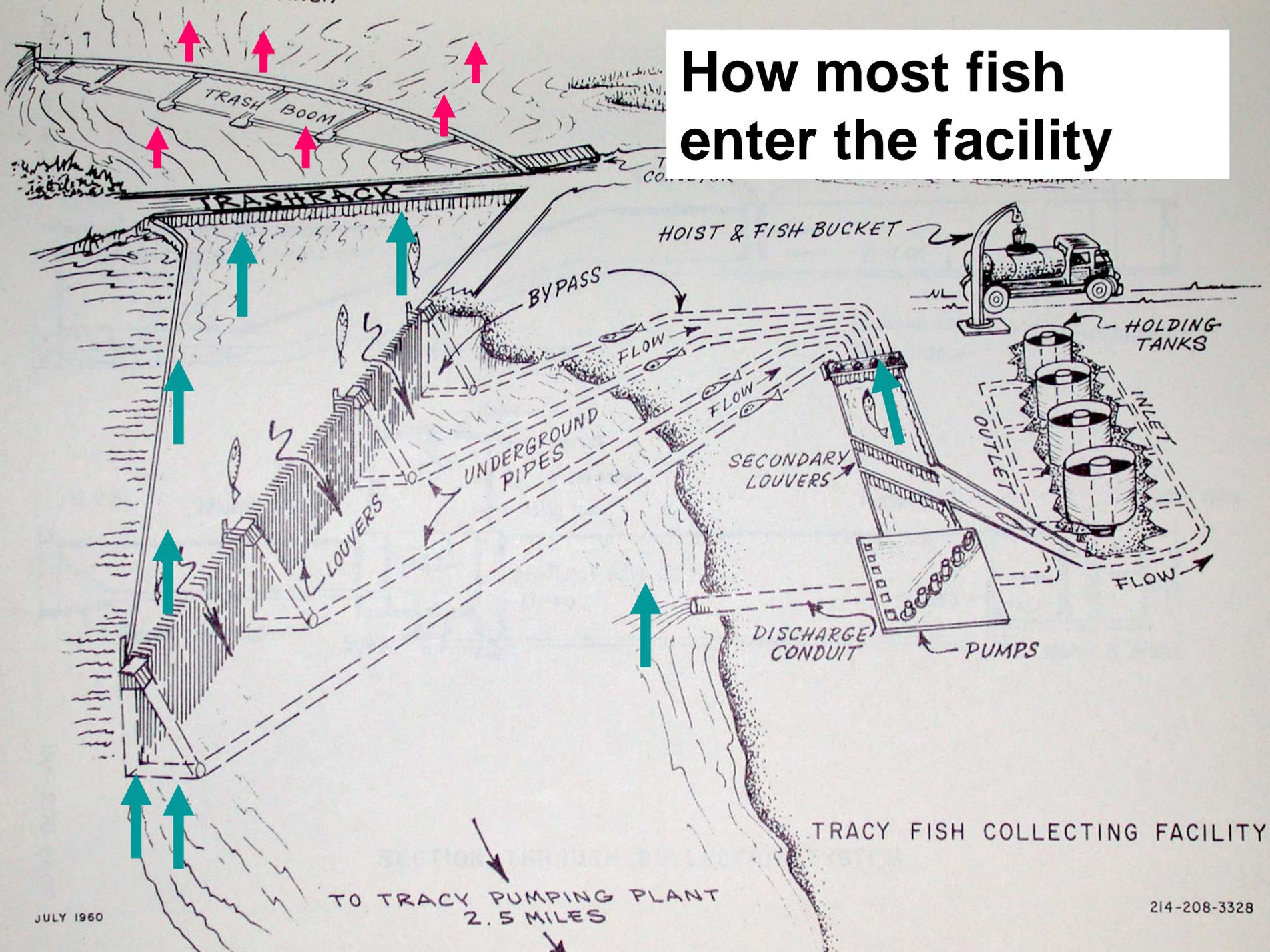
- **Ultrasonic**
  - 70 kHz
- **Small**
  - 23 x 8 mm
- **Light**
  - 1.5 g
  - <2% BW
- **Lifetime**
  - 21 days
- **Range**
  - 500 m

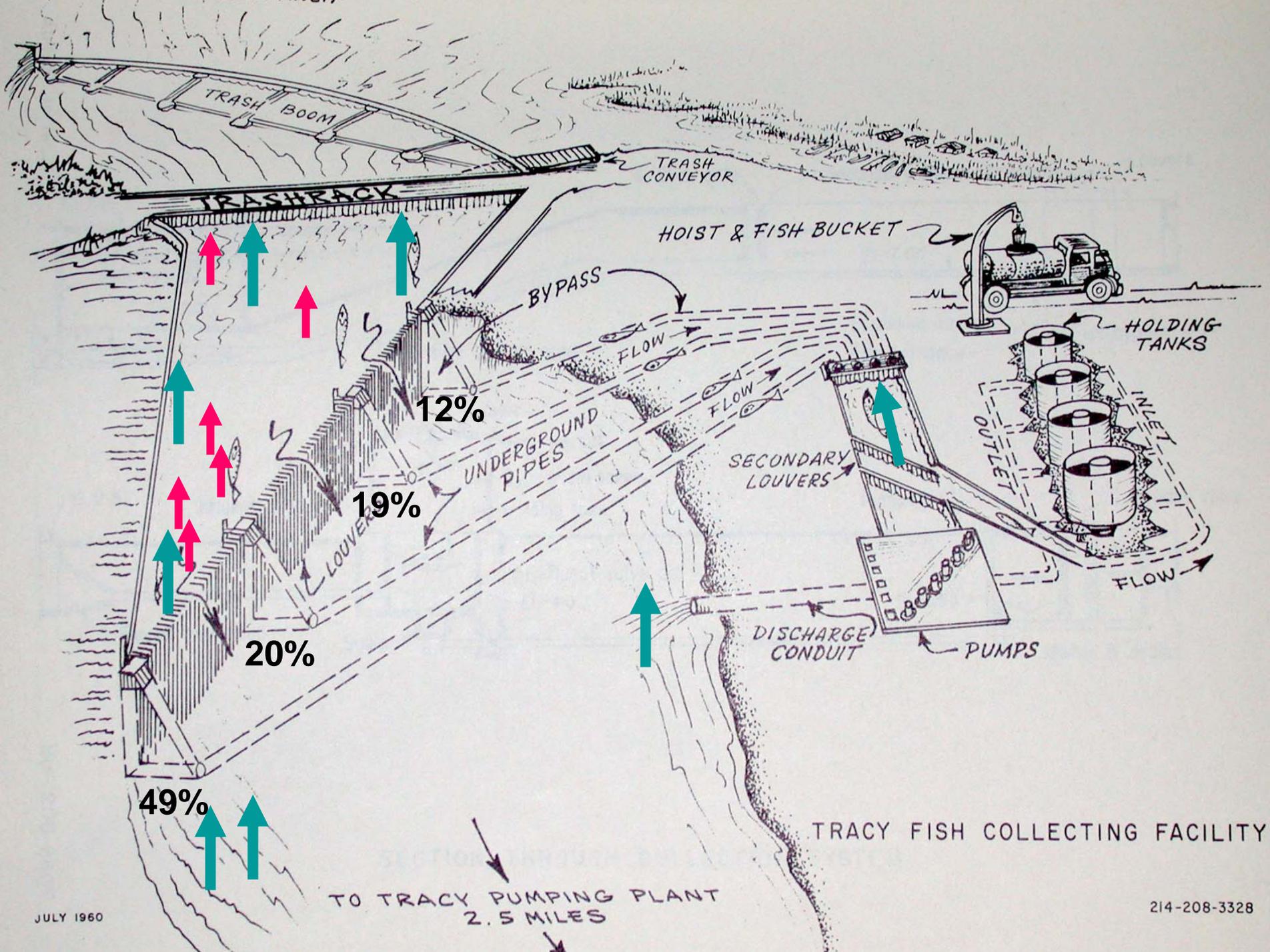


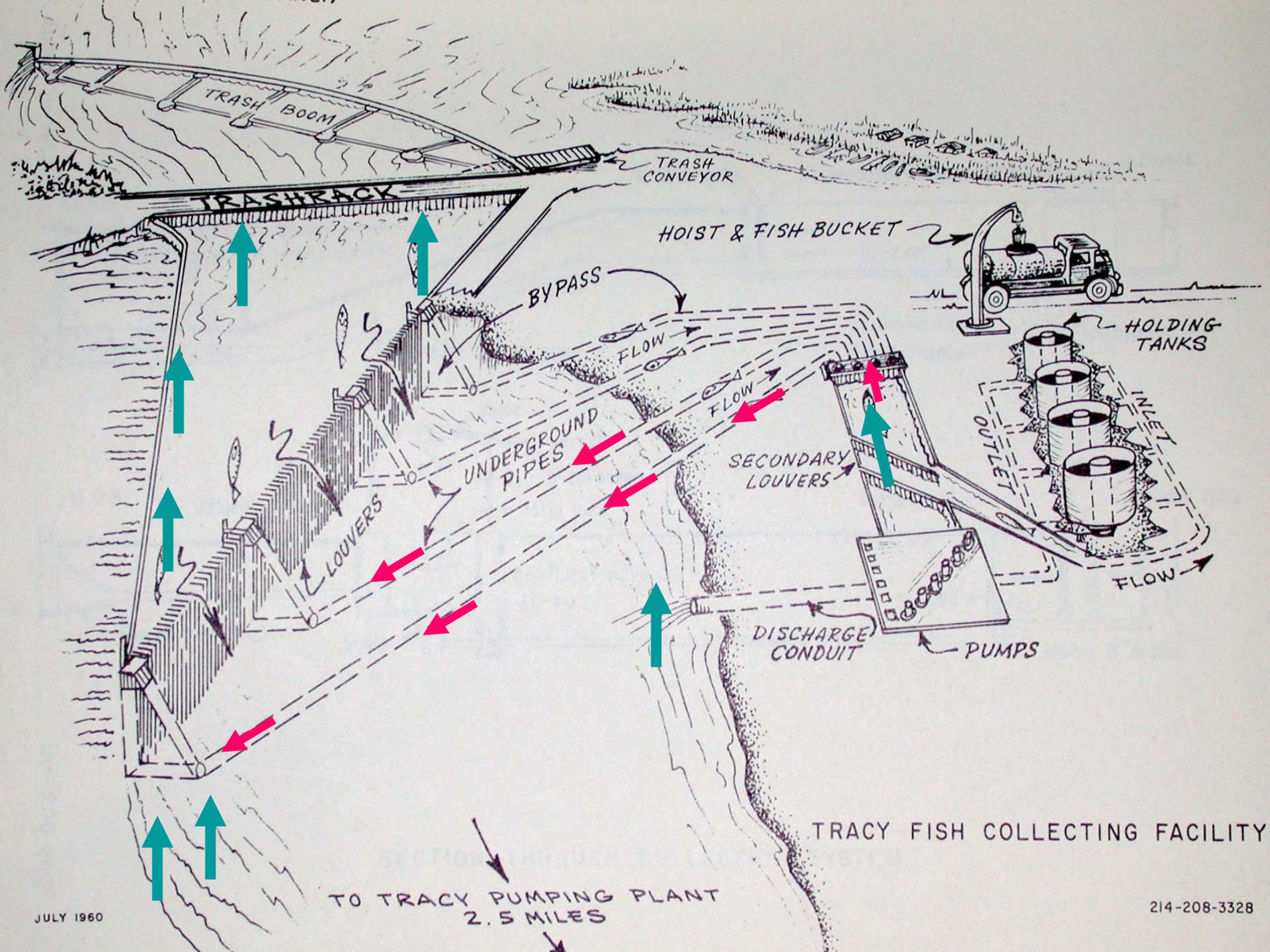
# Locating Fish with Hydrophone

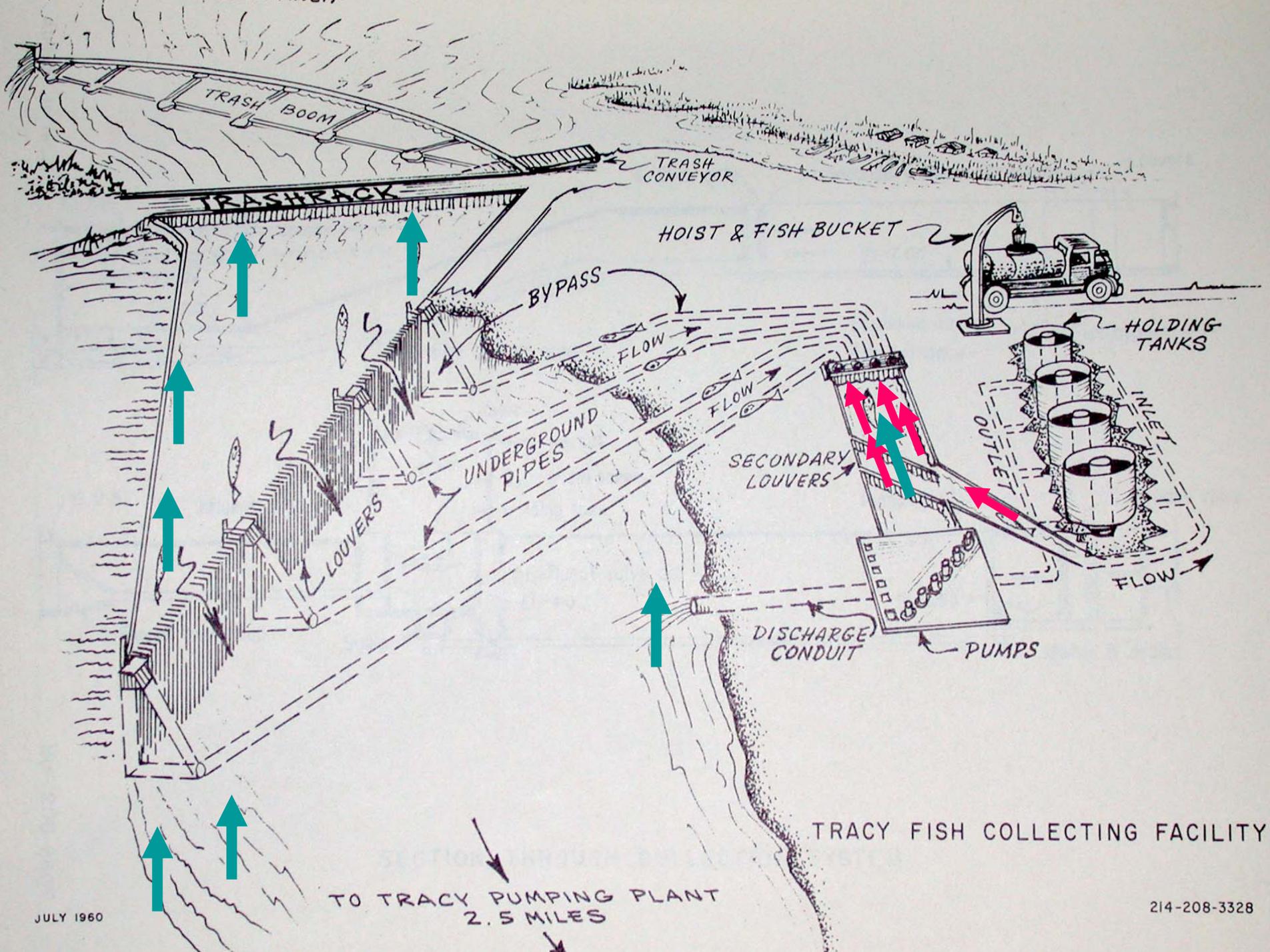


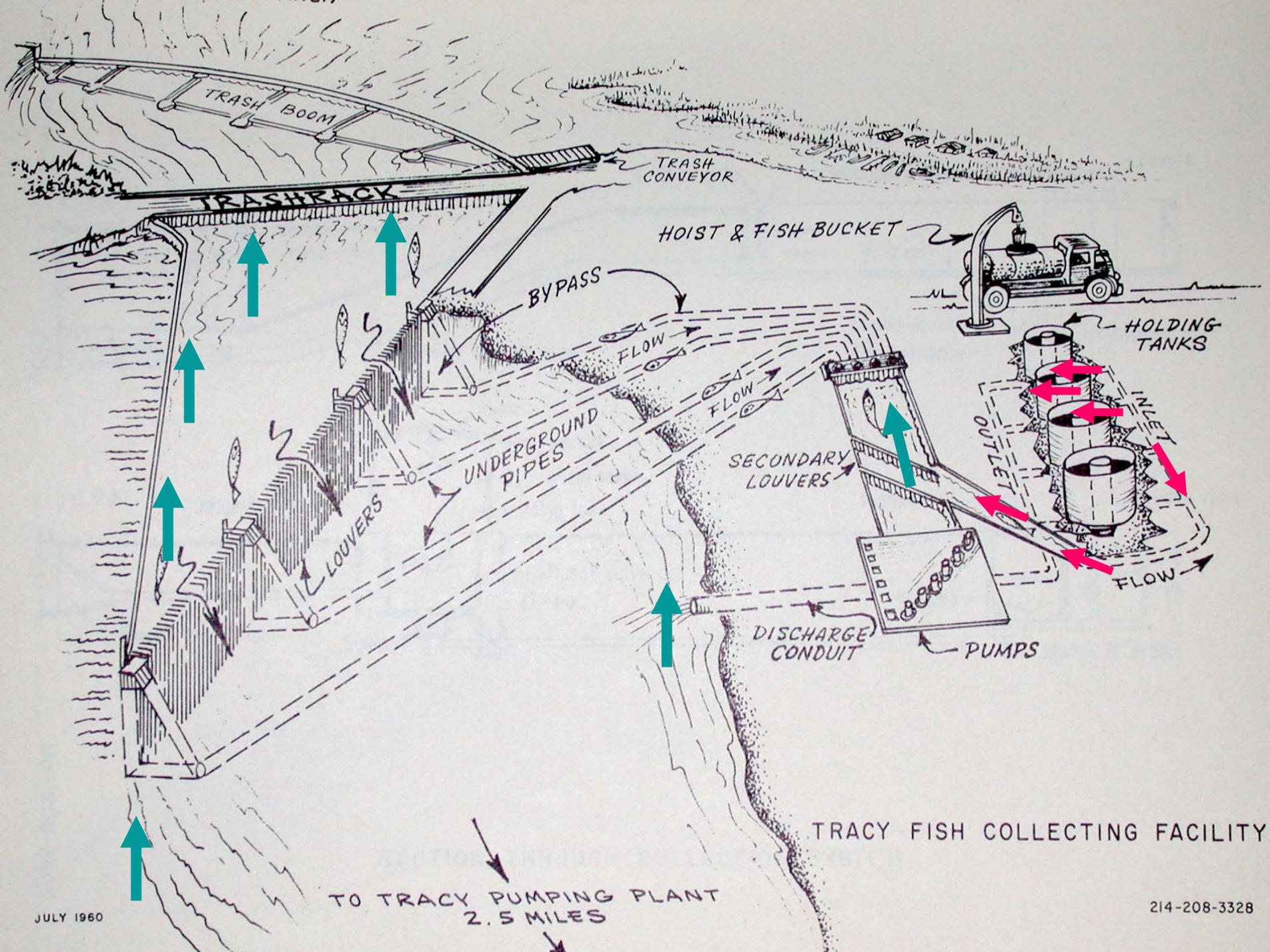
# How most fish enter the facility











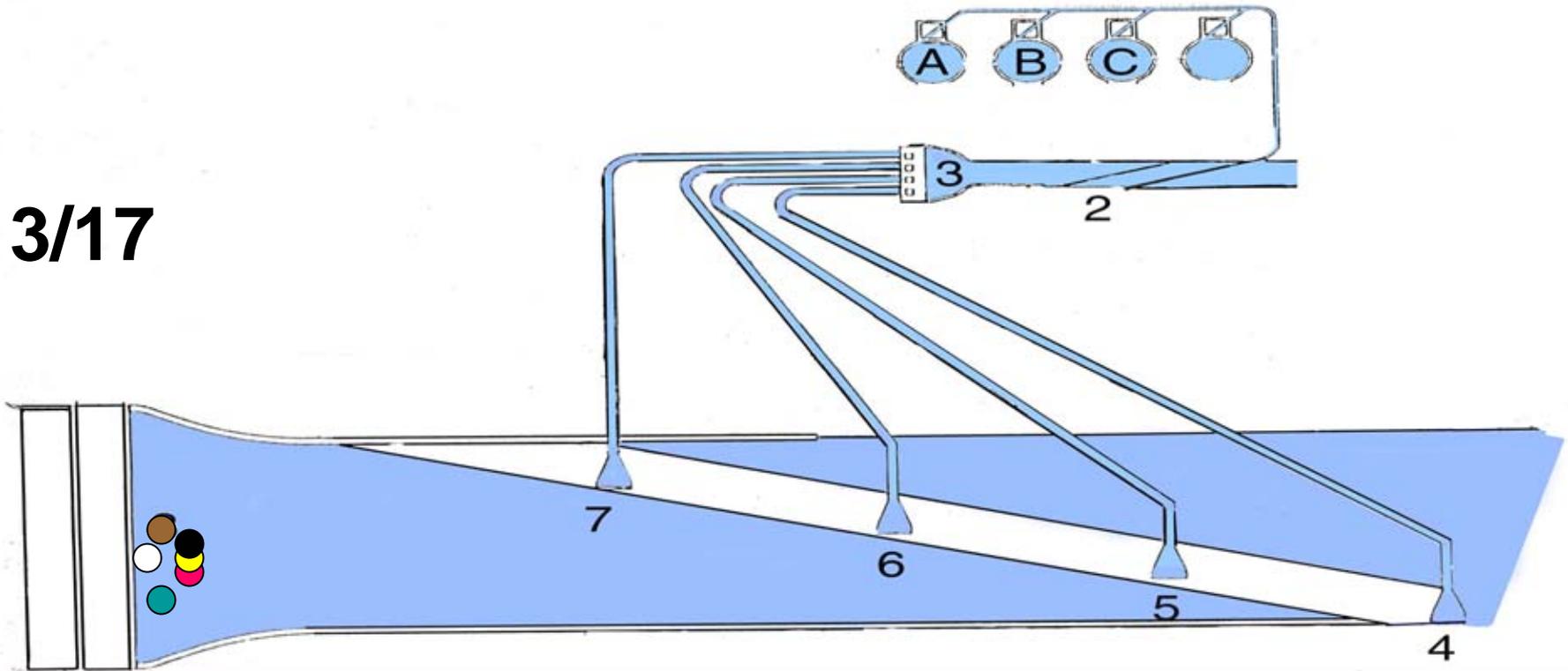
Primary louvers are lifted and this potentially allows predators to enter the facility from downstream



	N =	# Reaching Holding Tank	Mean Time (hrs)
Floy Tag, 2003	91	40	18
Sonic Tag, 2003	49	22	28
Floy Tag, 2004	172	79	38
Sonic Tag, 2004	13	4	17

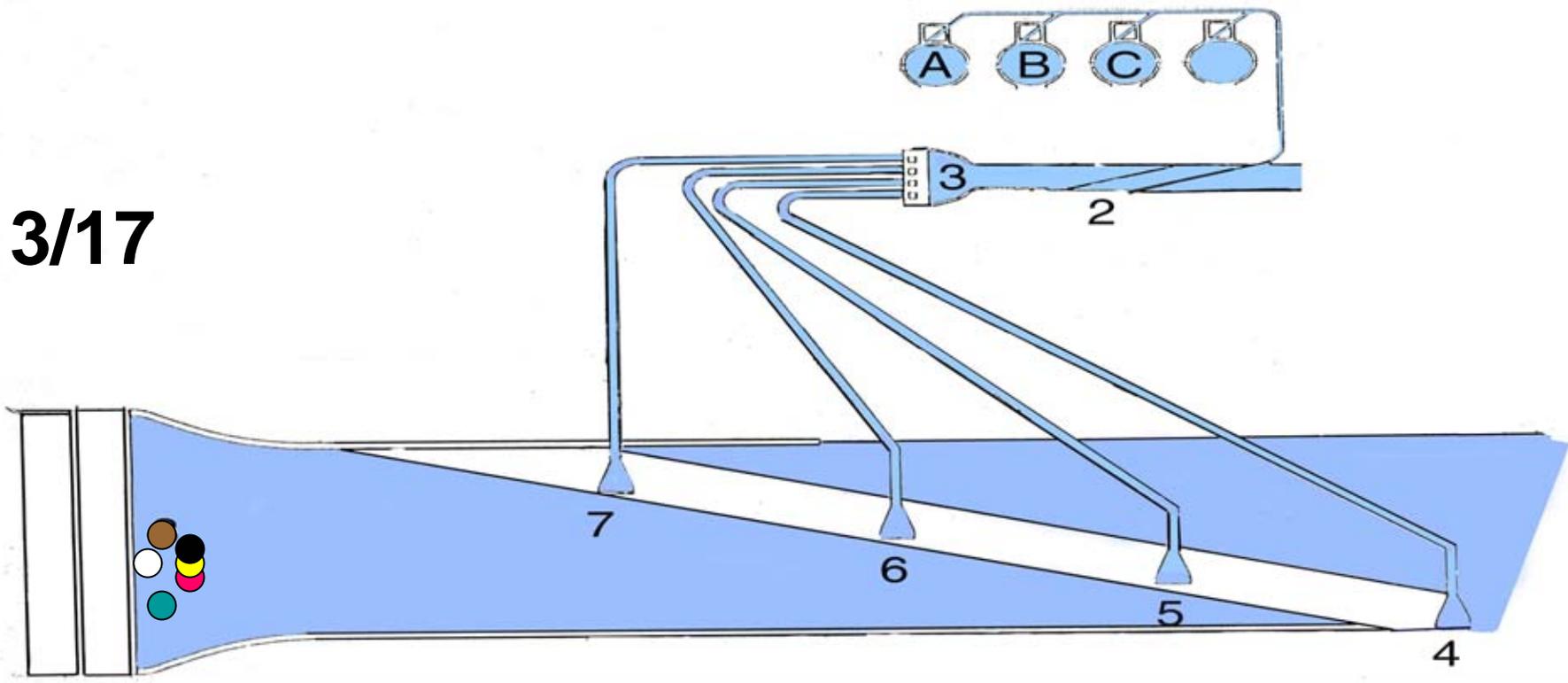
# Tracking Fish 2005 3/17-6/13/05

3/17



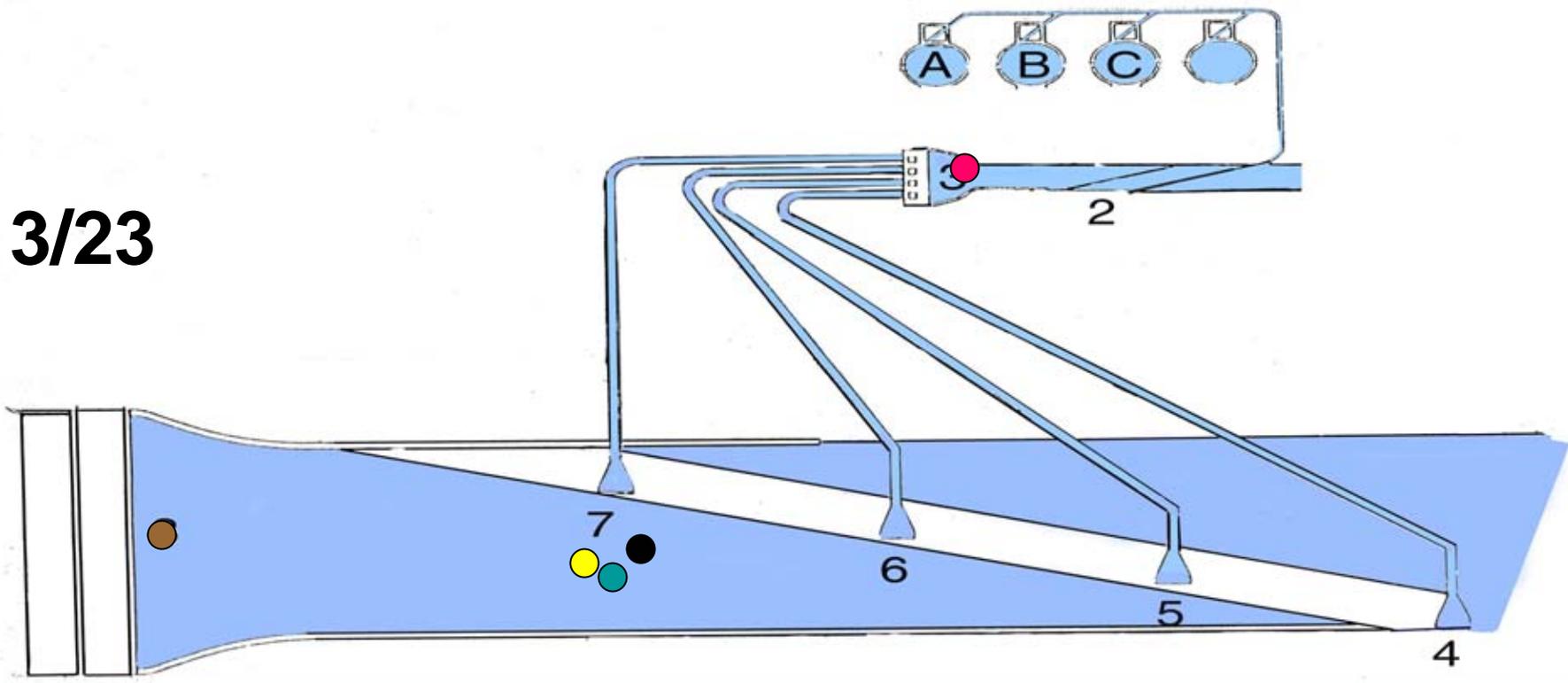
# Tracking Fish

3/17



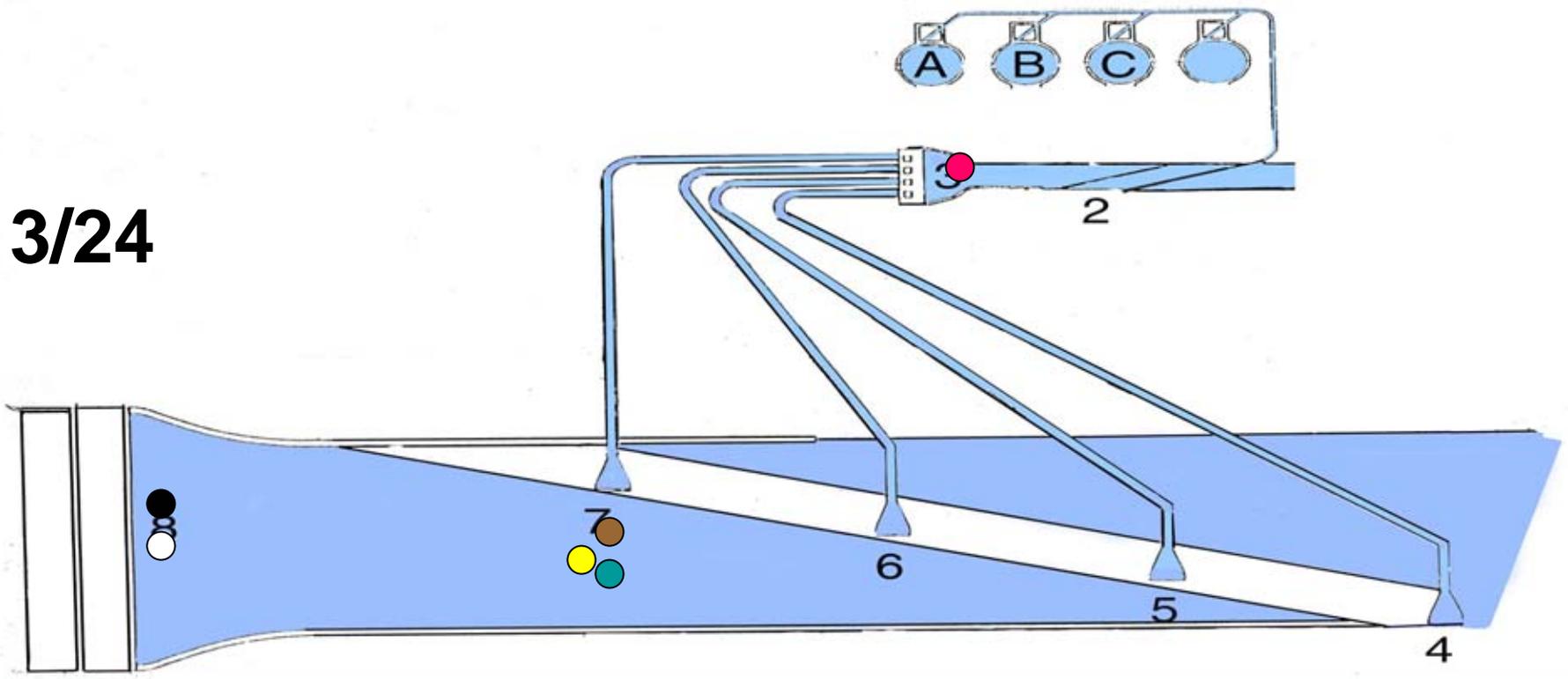
# Tracking Fish

3/23



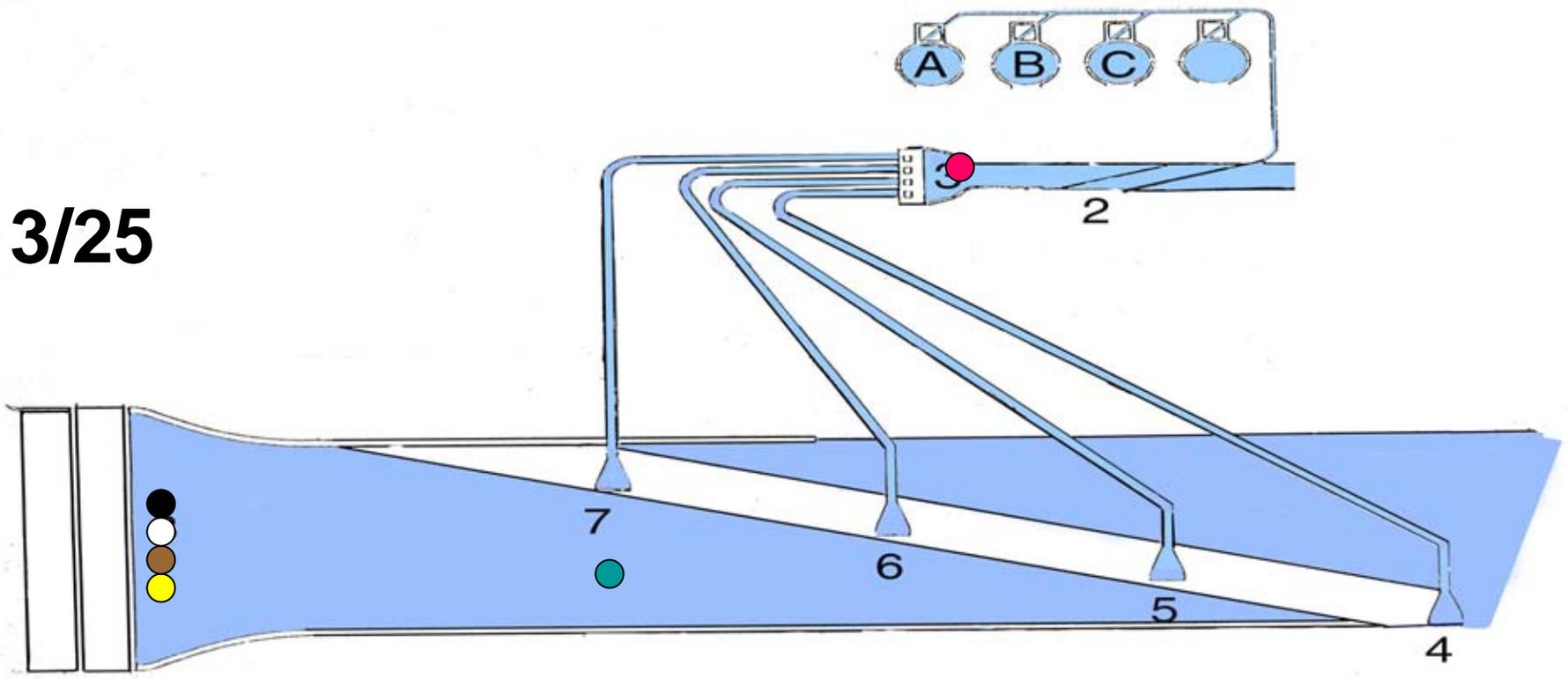
# Tracking Fish

3/24



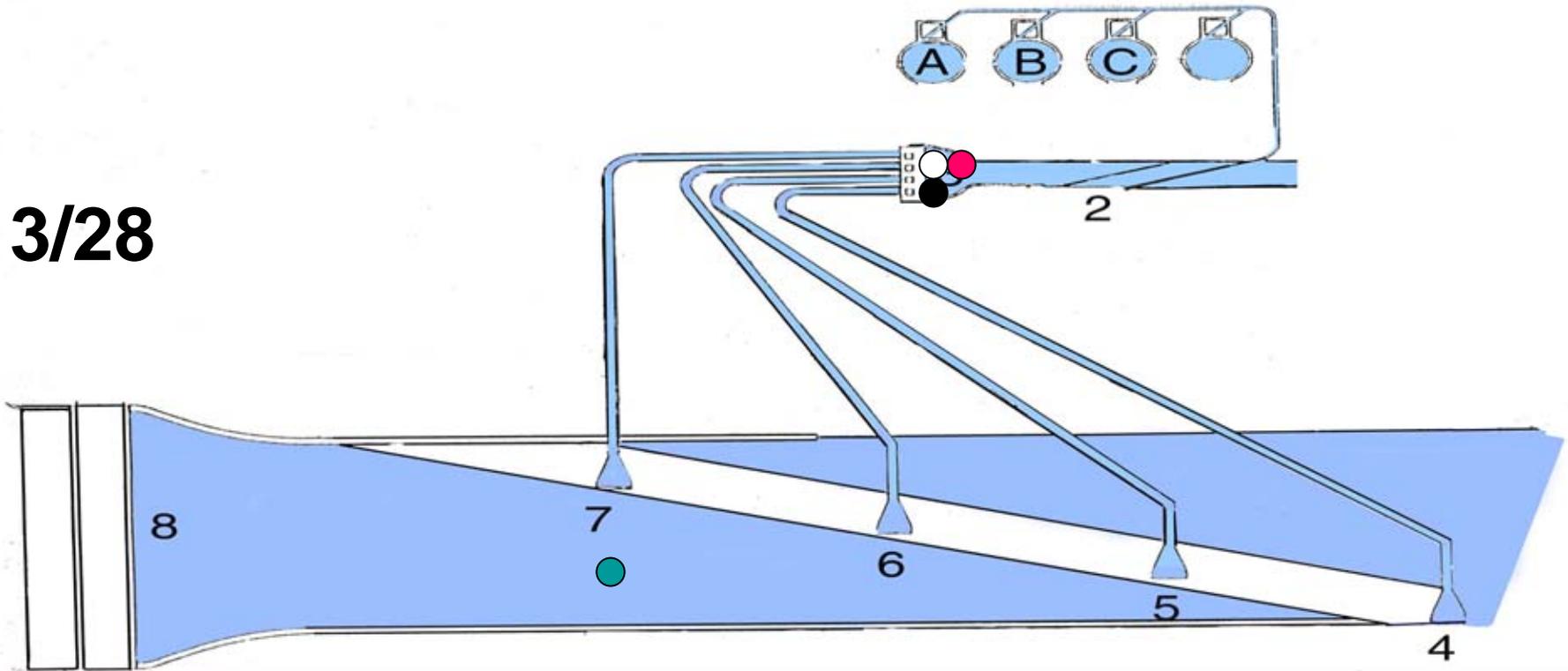
# Tracking Fish

3/25



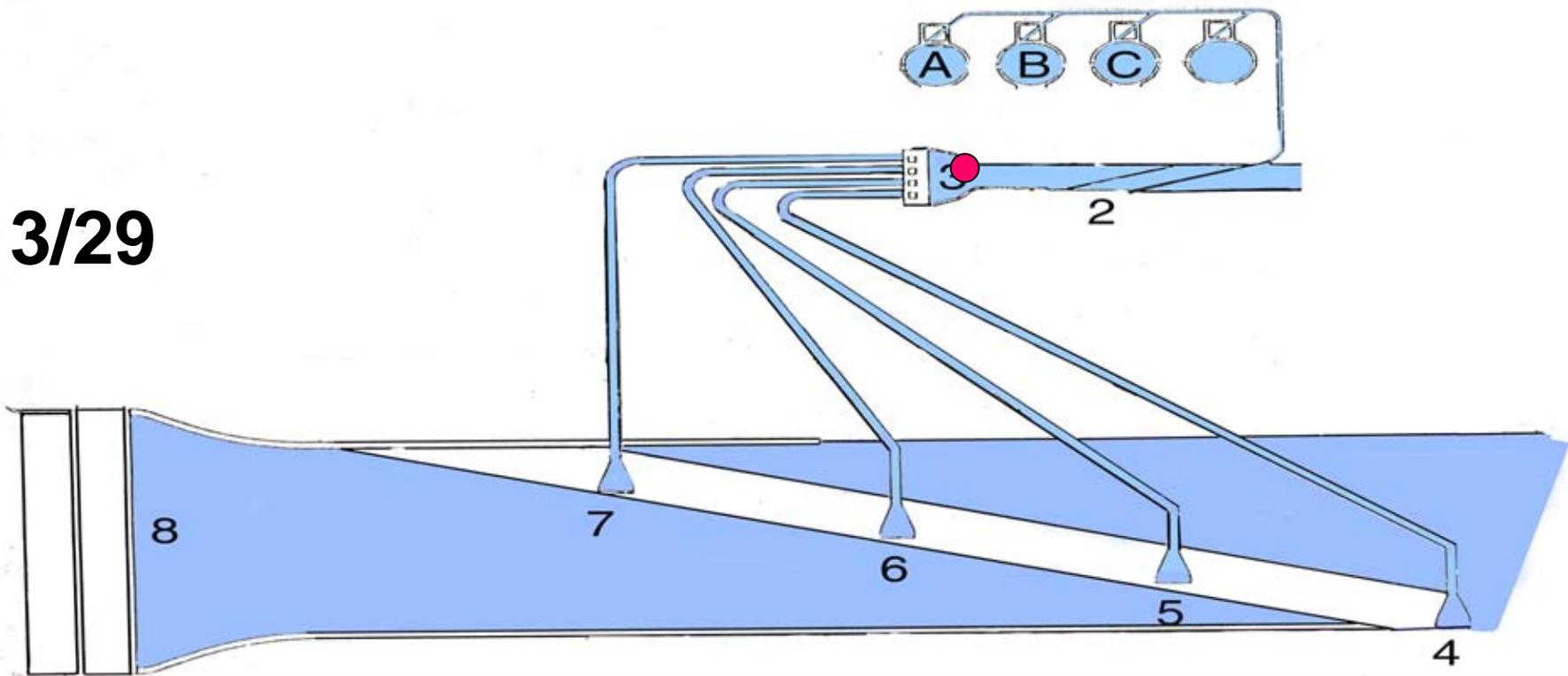
# Tracking Fish

3/28

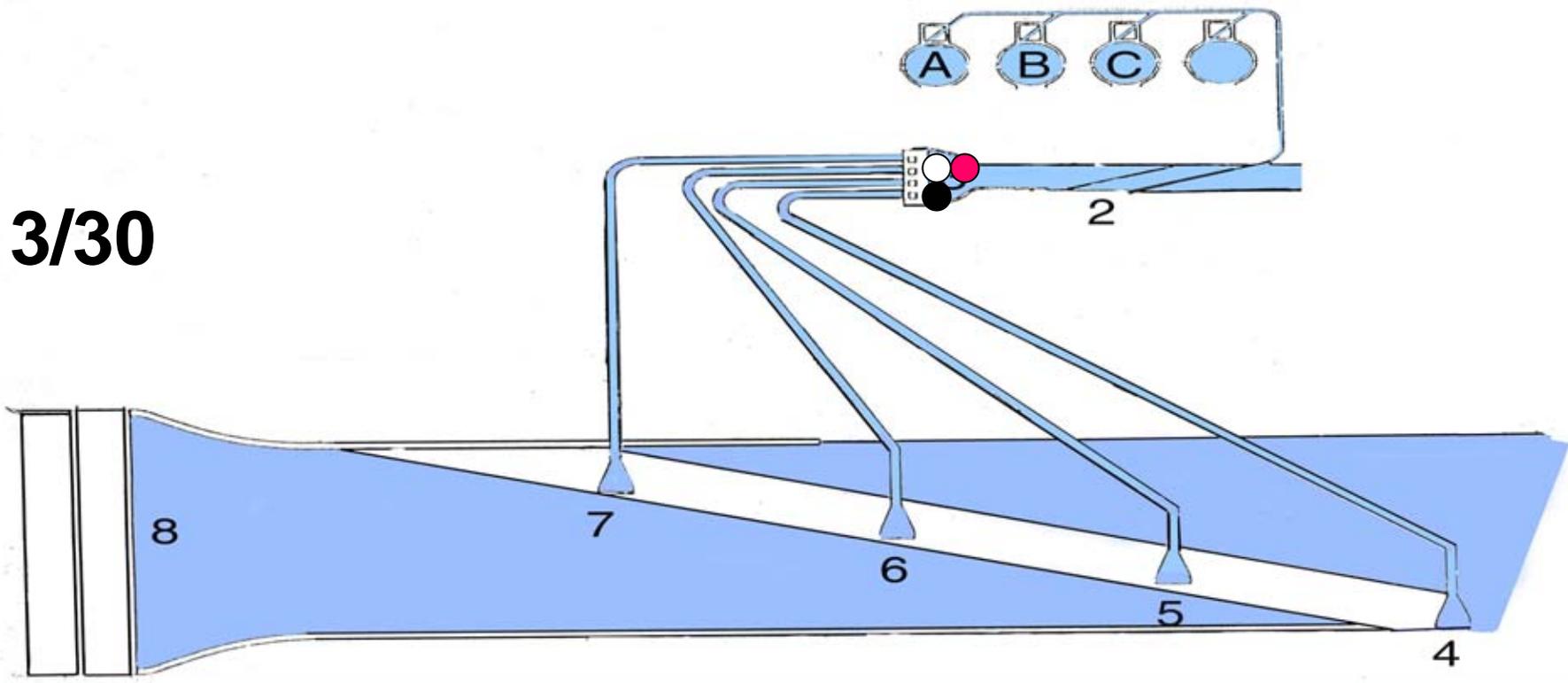


# Tracking Fish

3/29

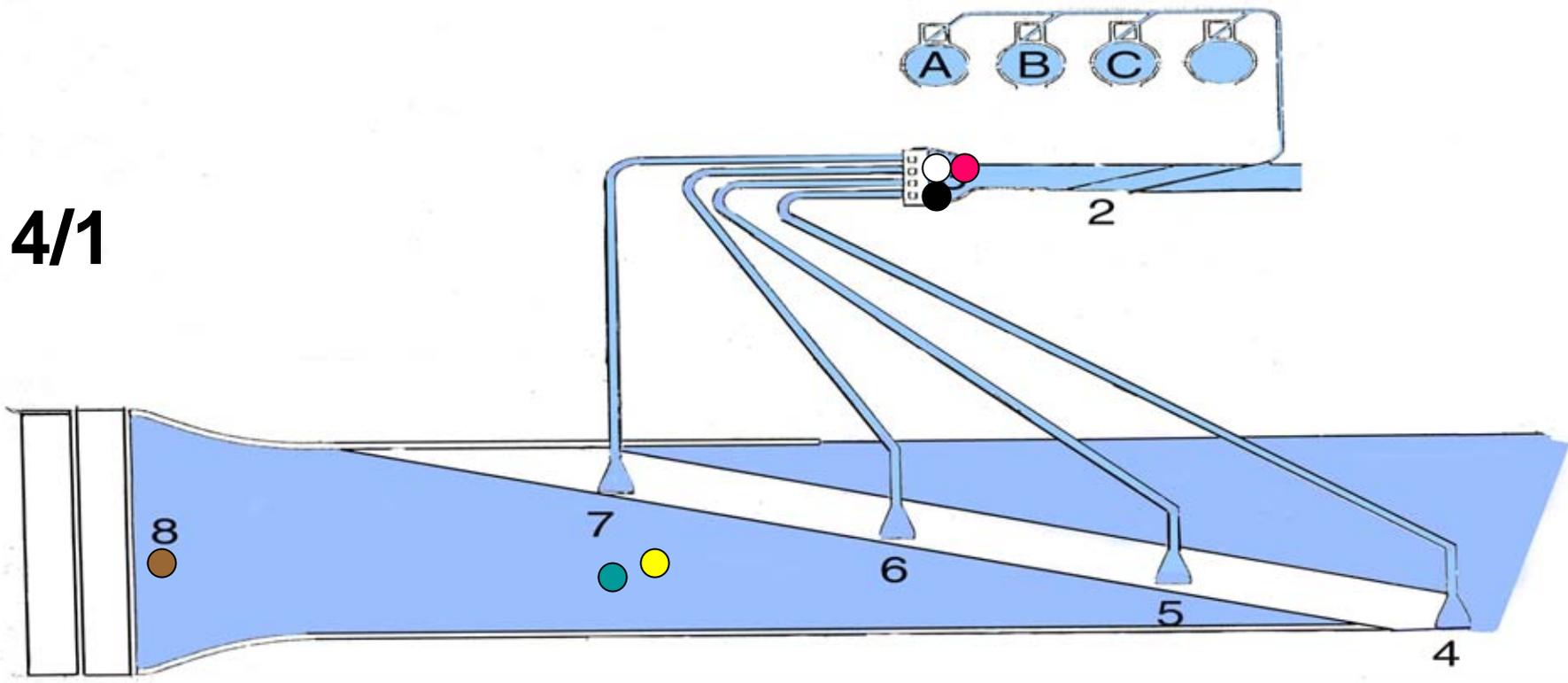


# Tracking Fish



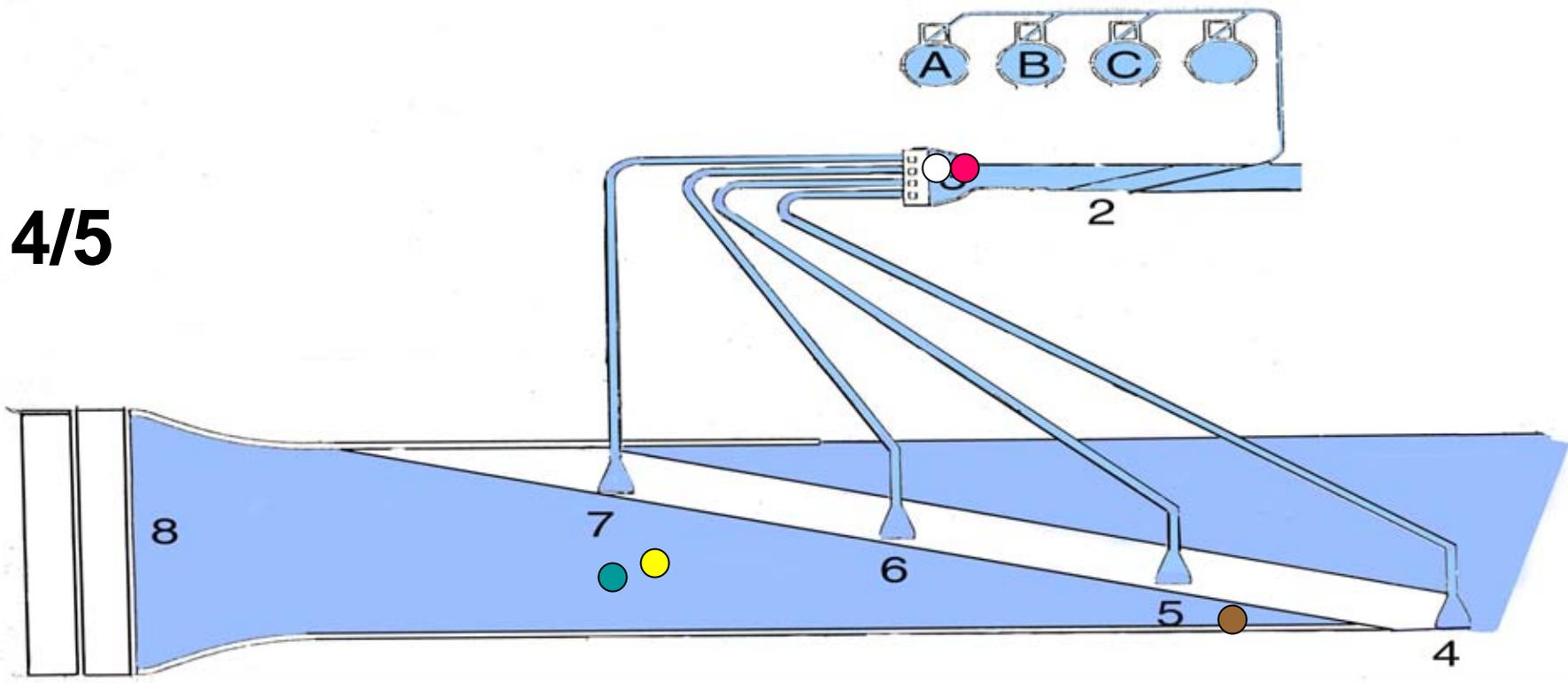
3/30

# Tracking Fish

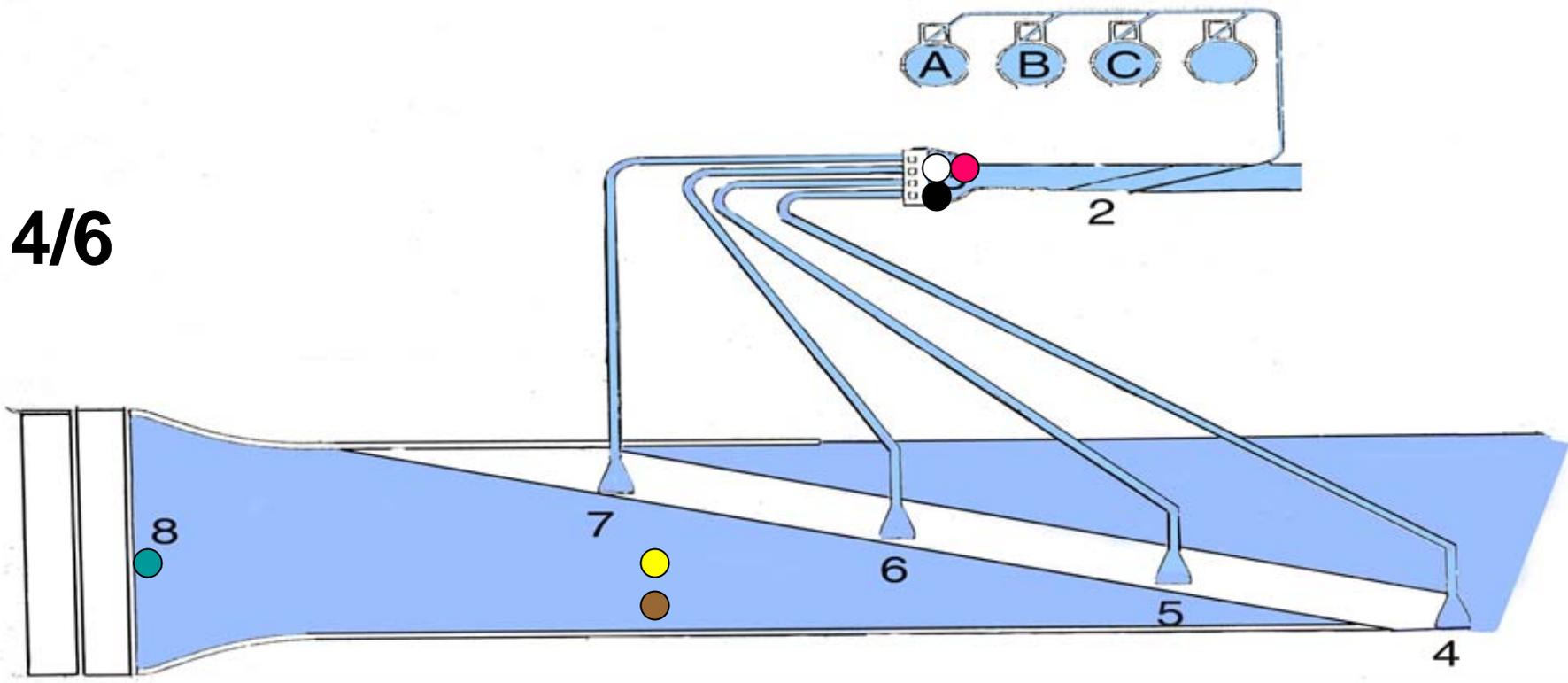


4/1

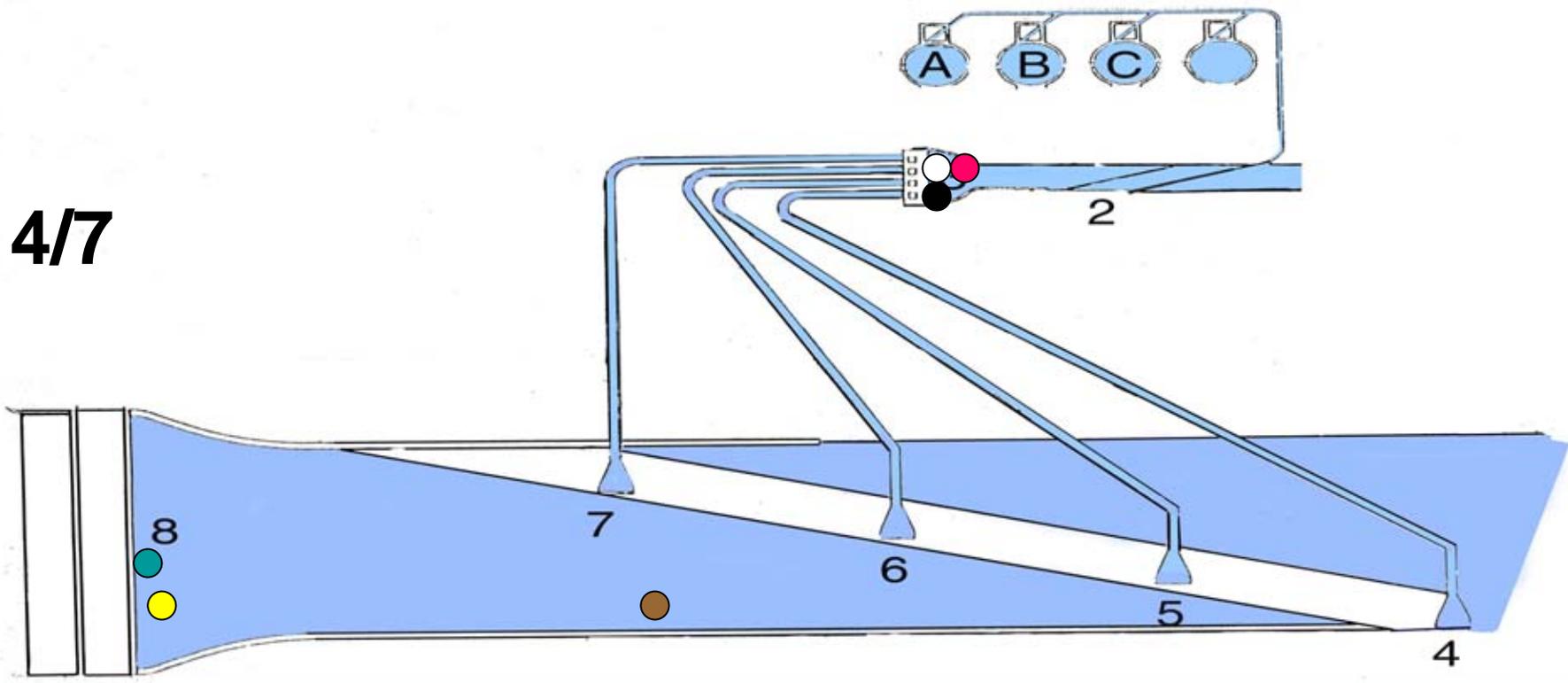
# Tracking Fish



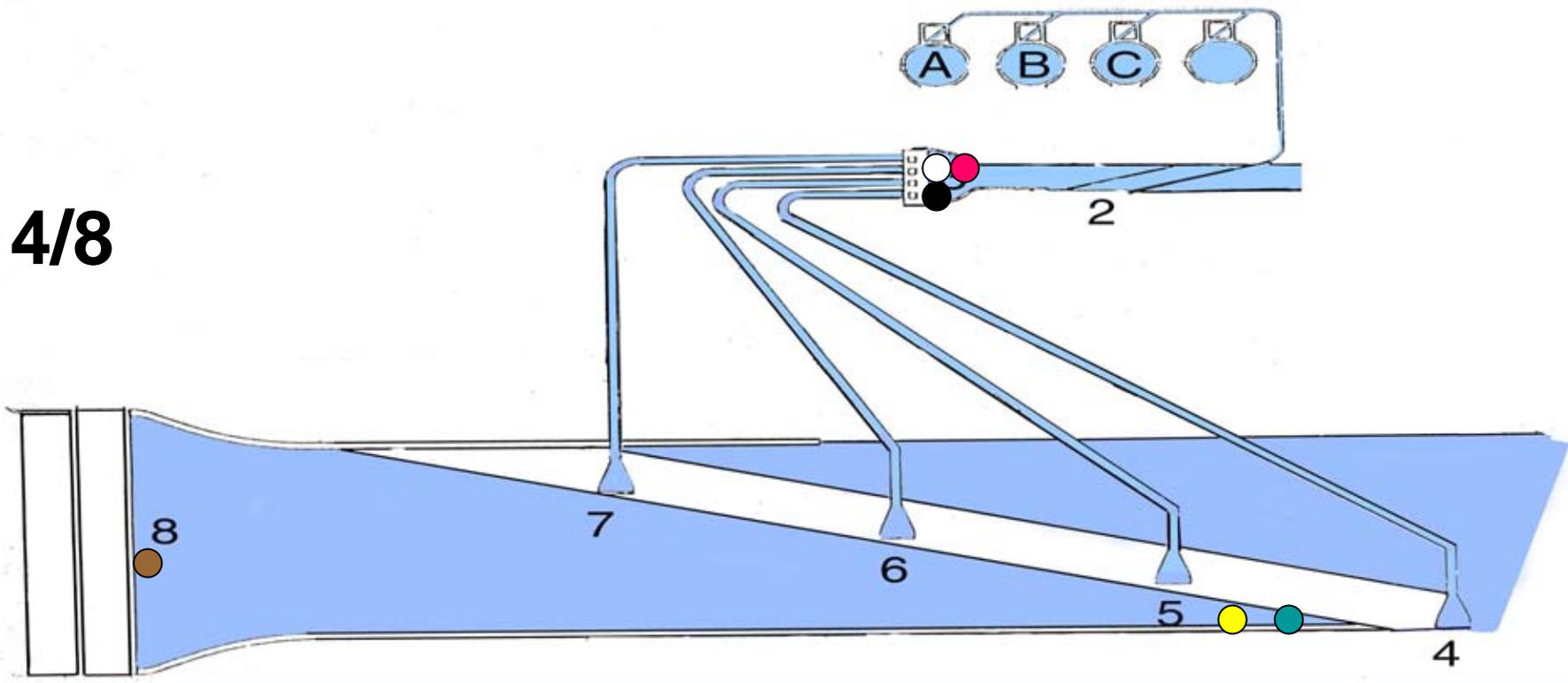
# Tracking Fish



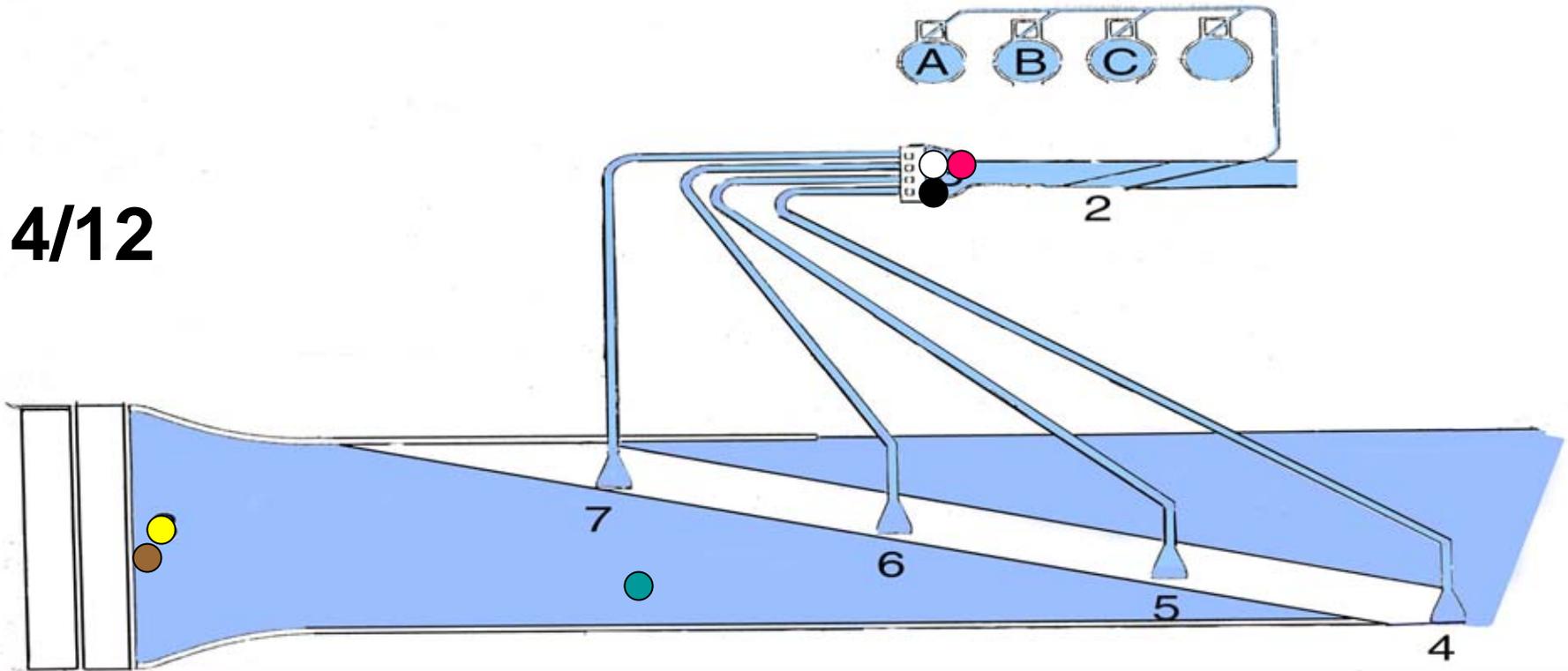
# Tracking Fish



# Tracking Fish

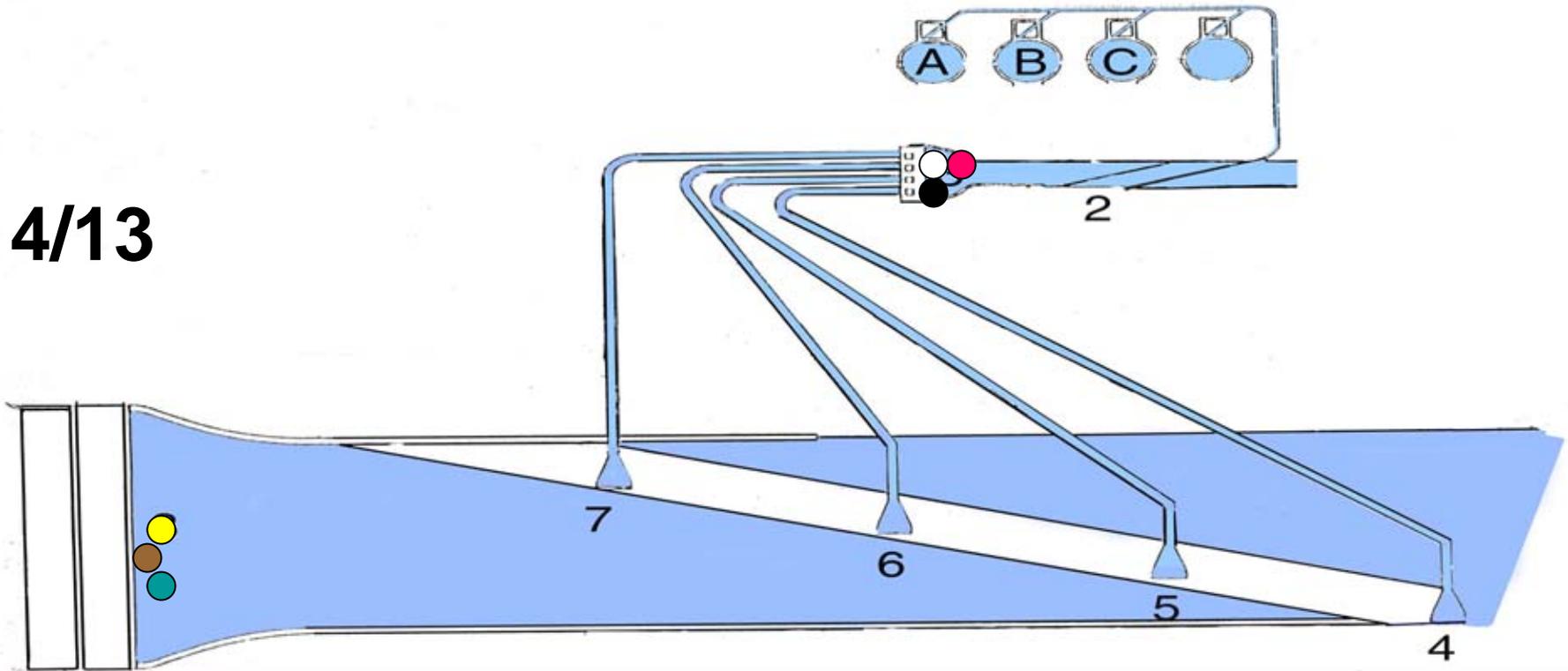


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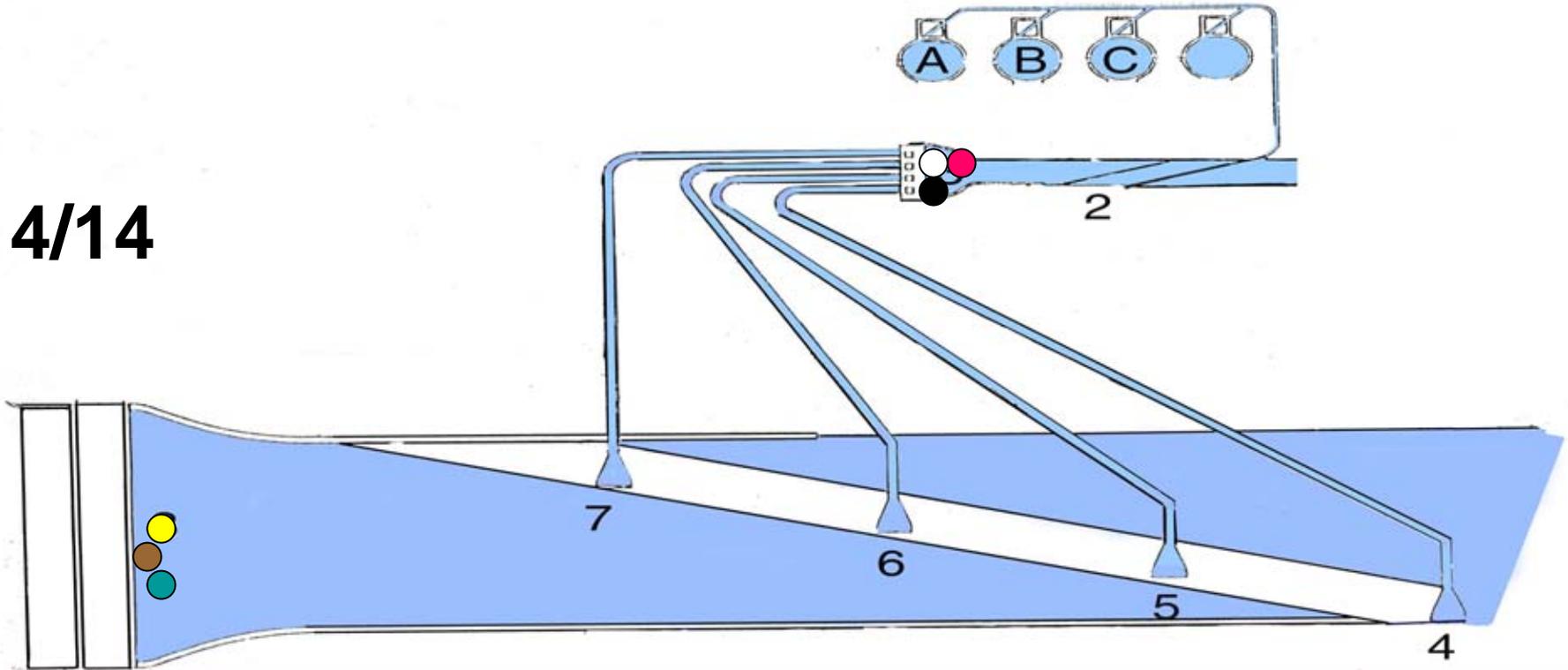
# Tracking Fish

4/13



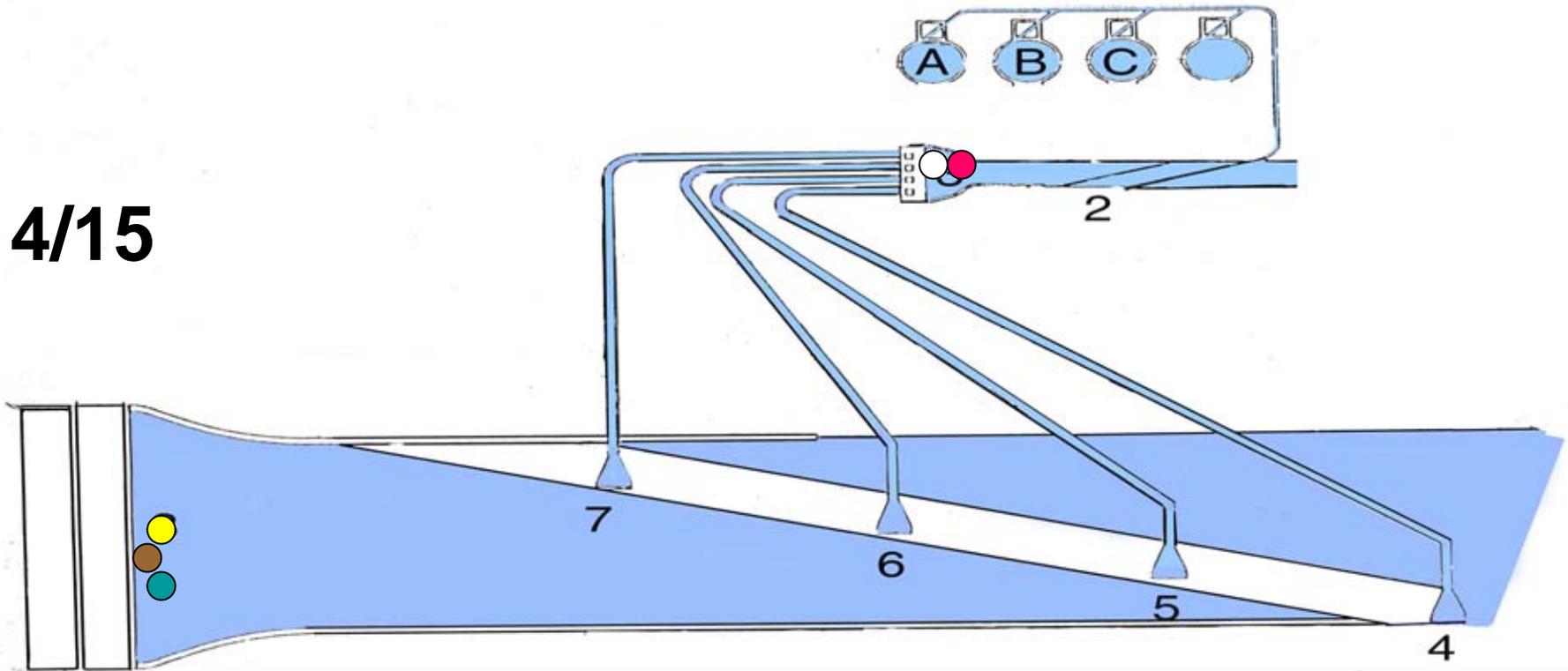
# Tracking Fish

4/14



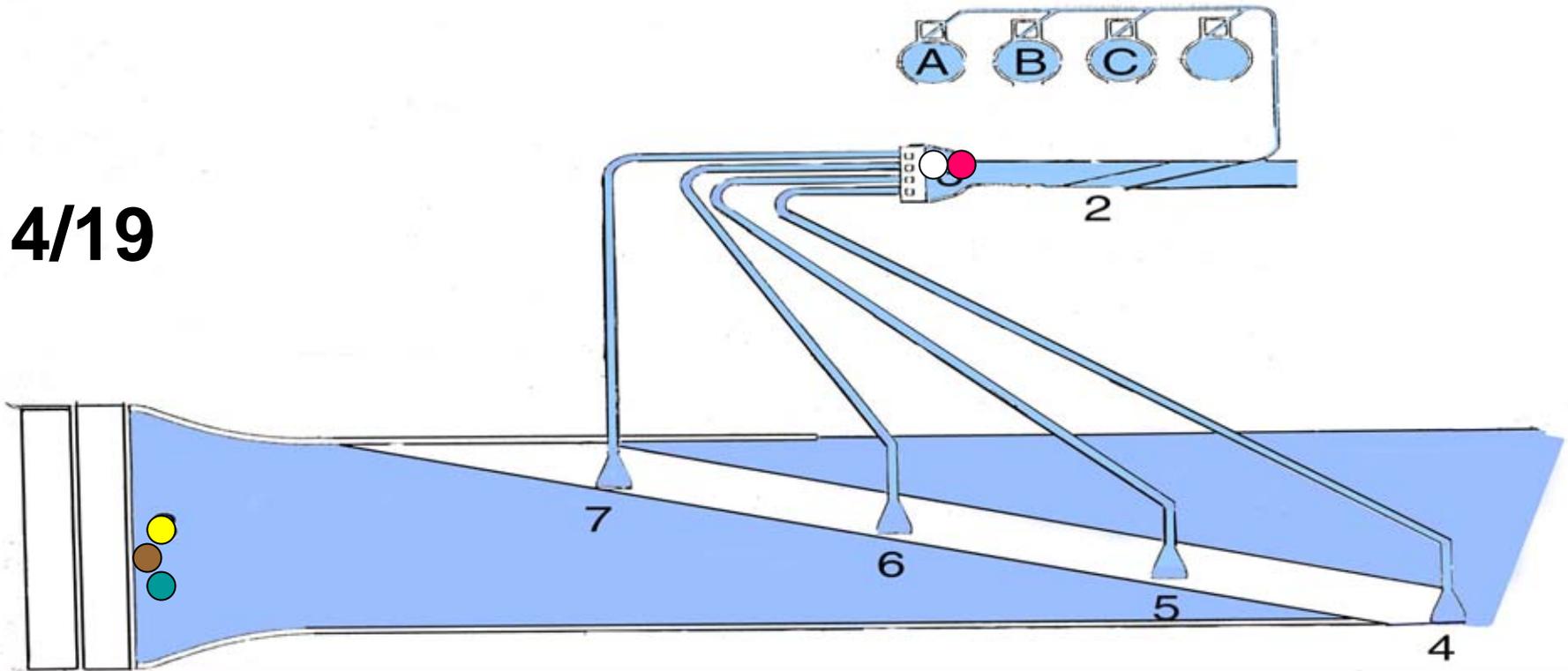
# Tracking Fish

4/15



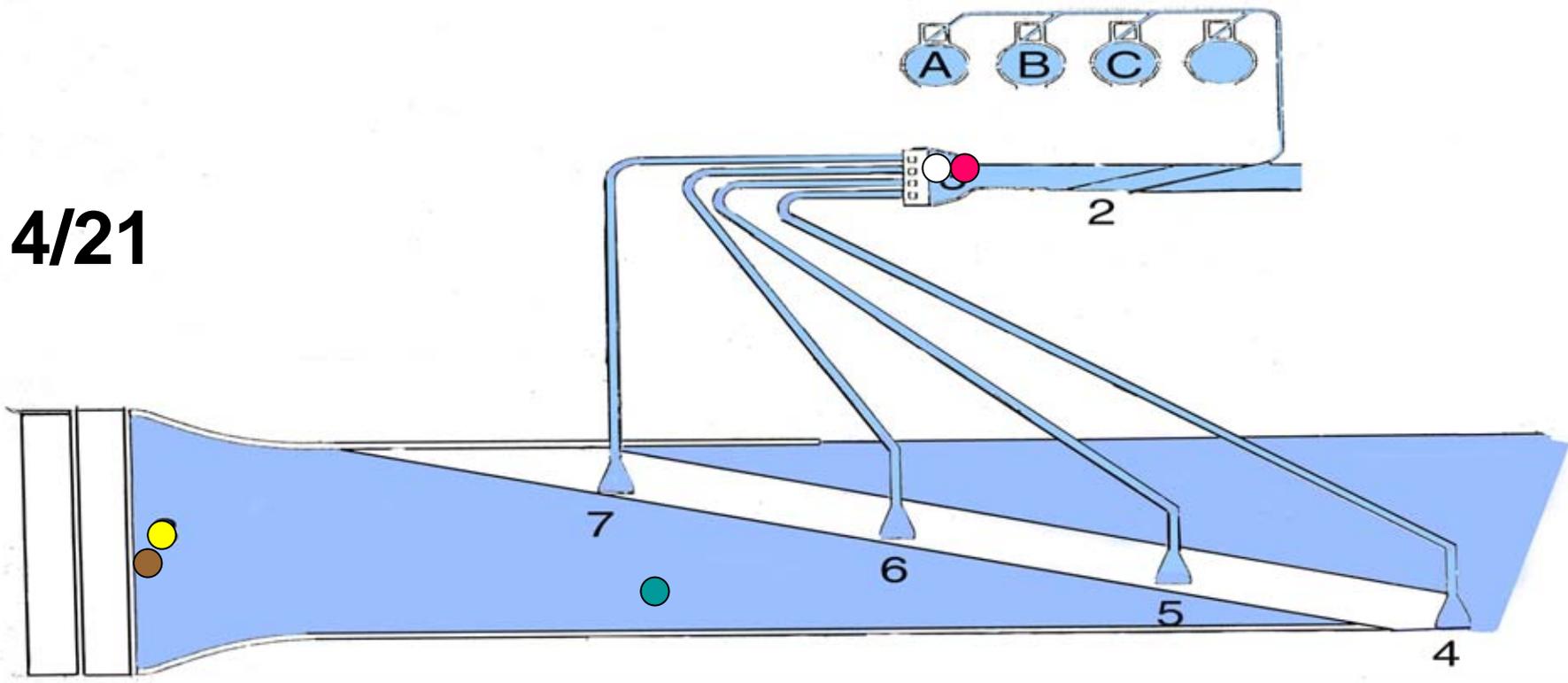
# Tracking Fish

4/19



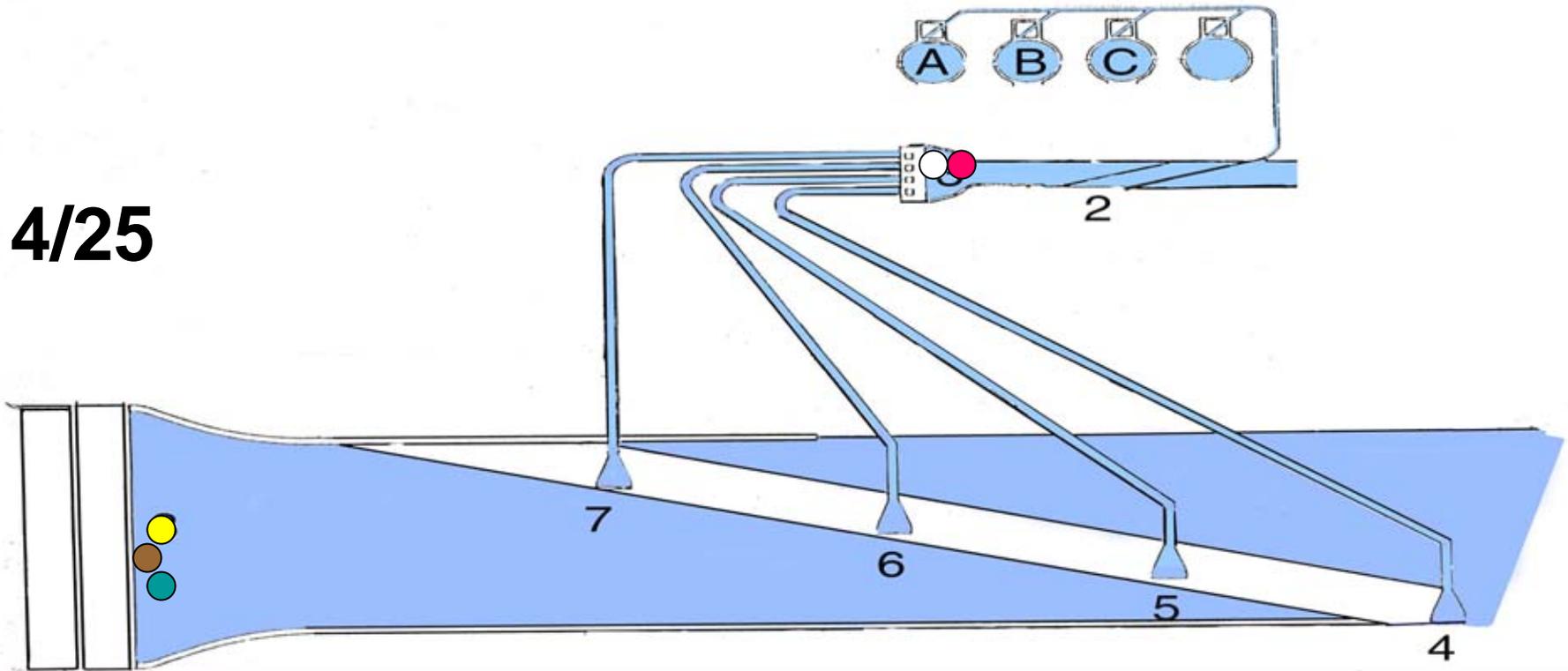
# Tracking Fish

4/21



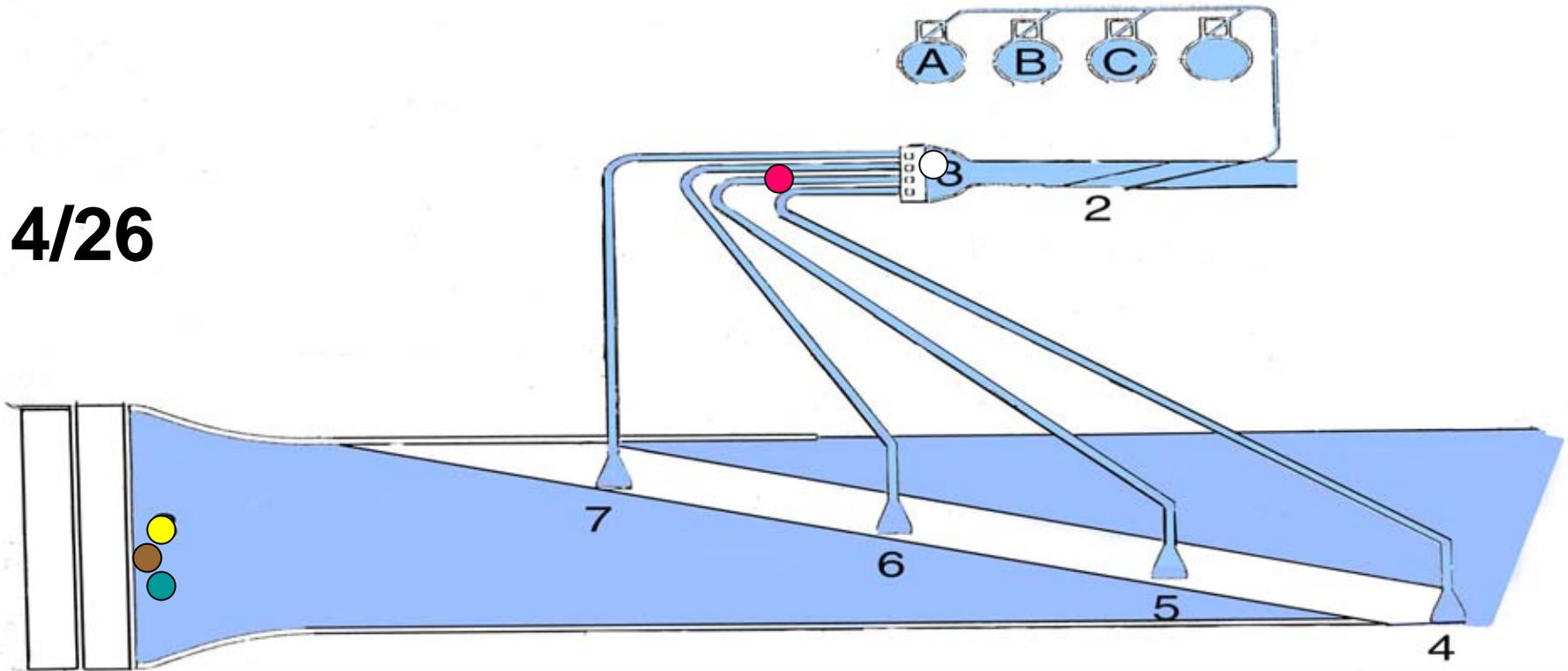
# Tracking Fish

4/25



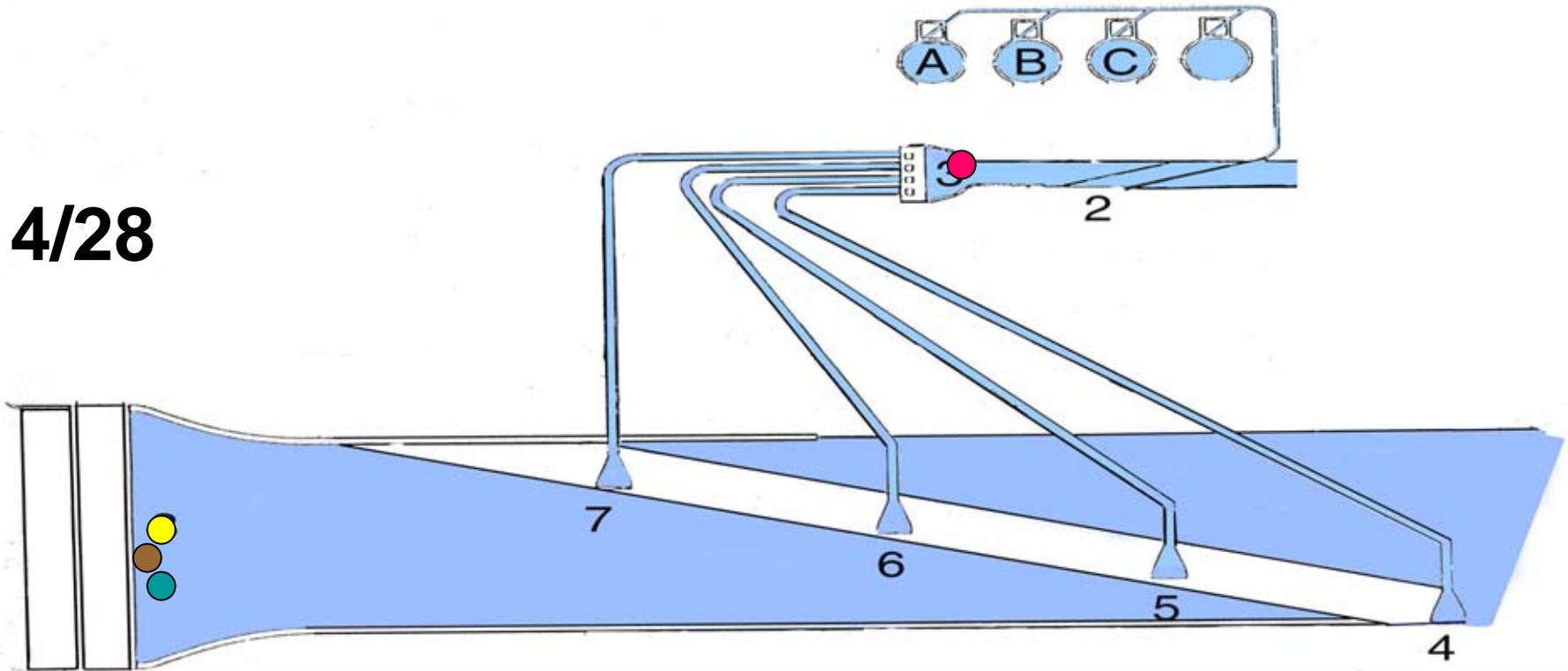
# Tracking Fish

4/26



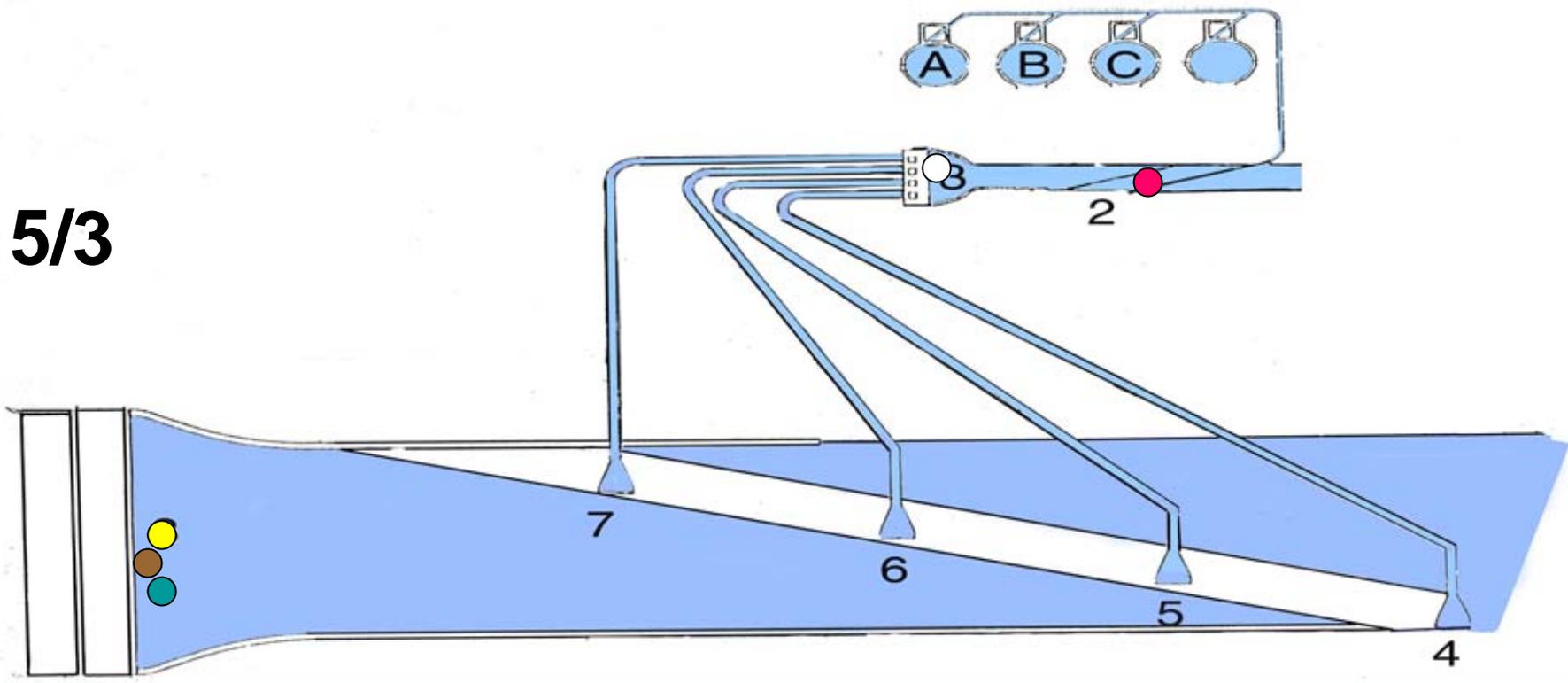
# Tracking Fish

4/28

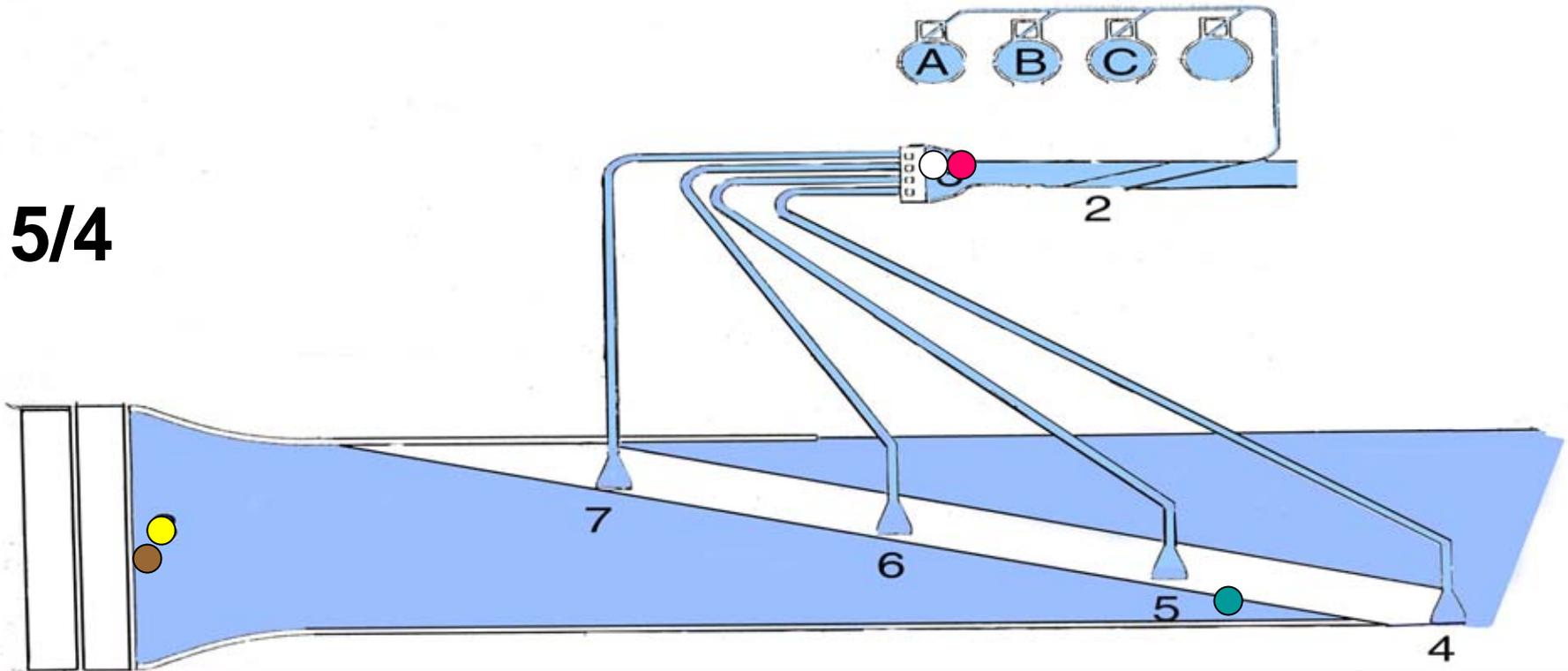


# Tracking Fish

5/3

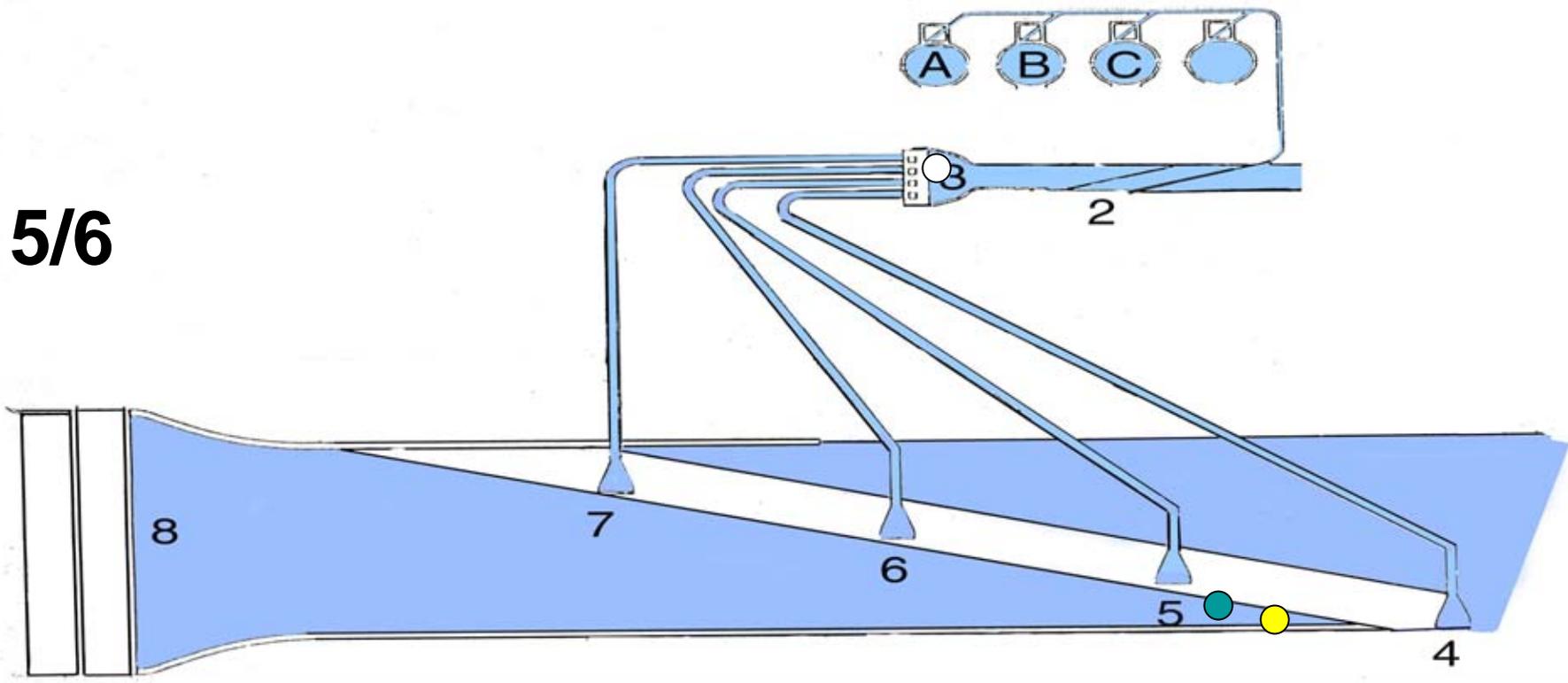


# Tracking Fish



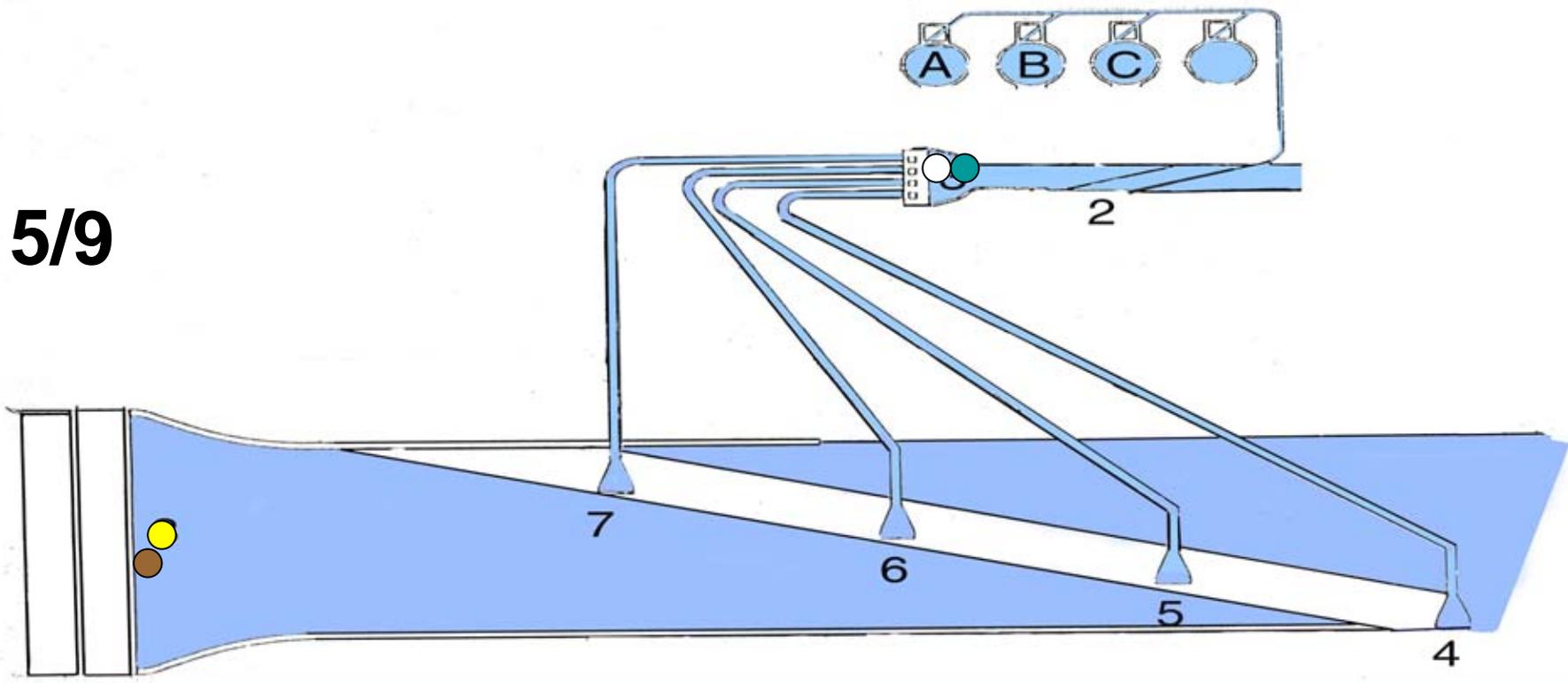
# Tracking Fish

5/6



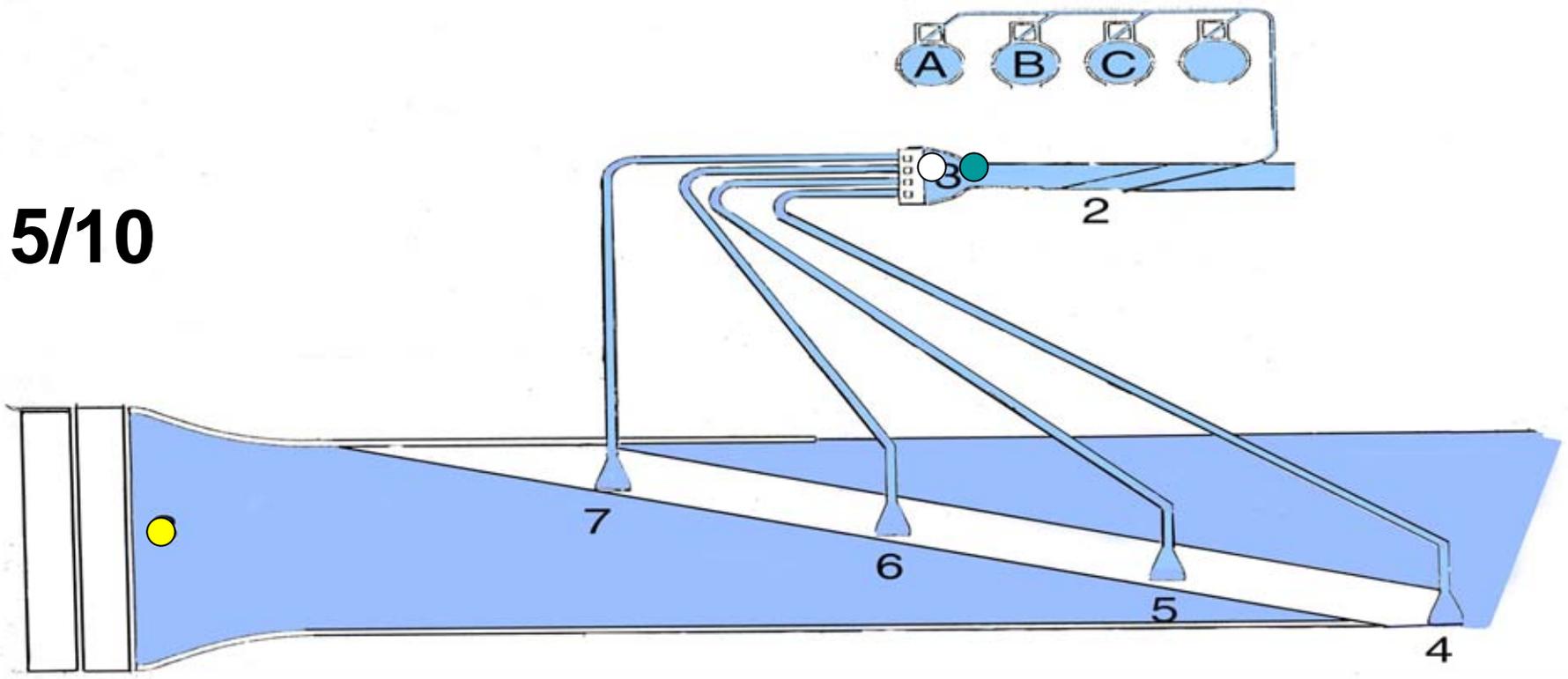
# Tracking Fish

5/9



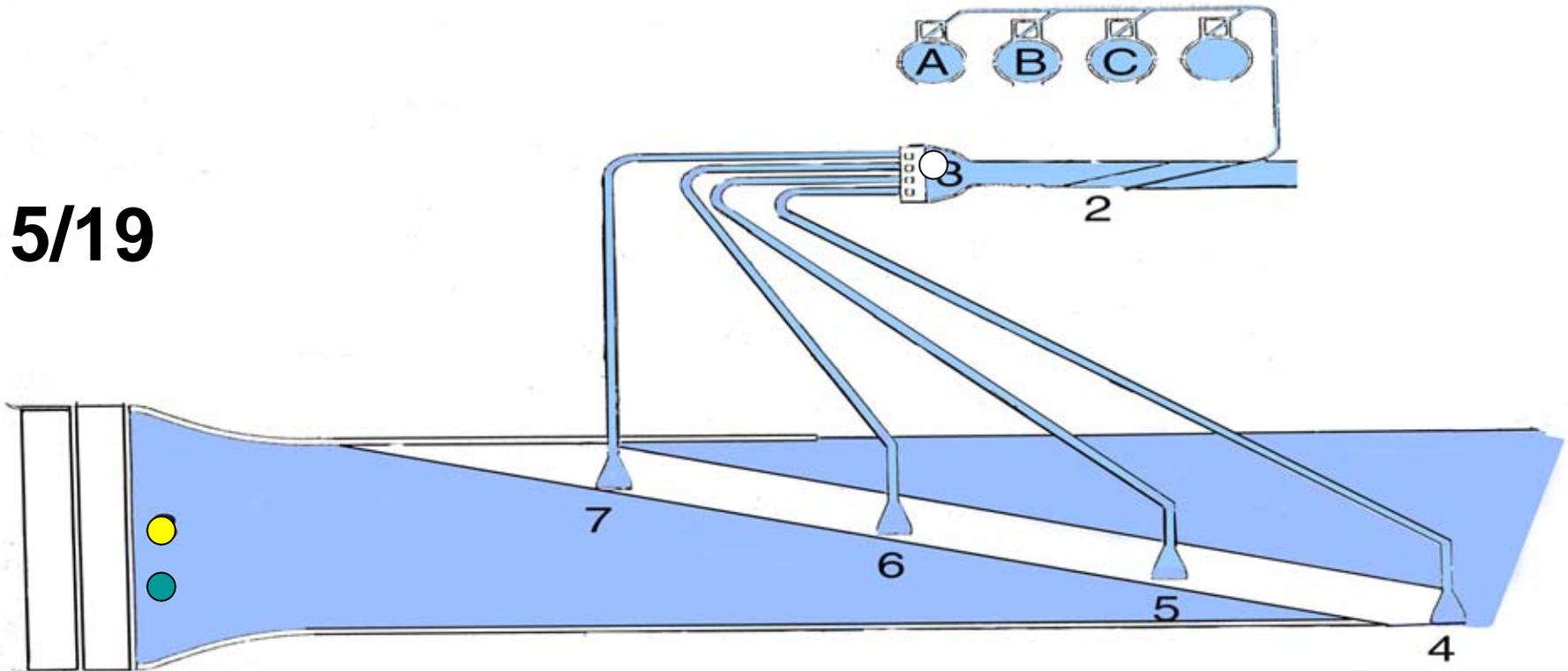
# Tracking Fish

5/10



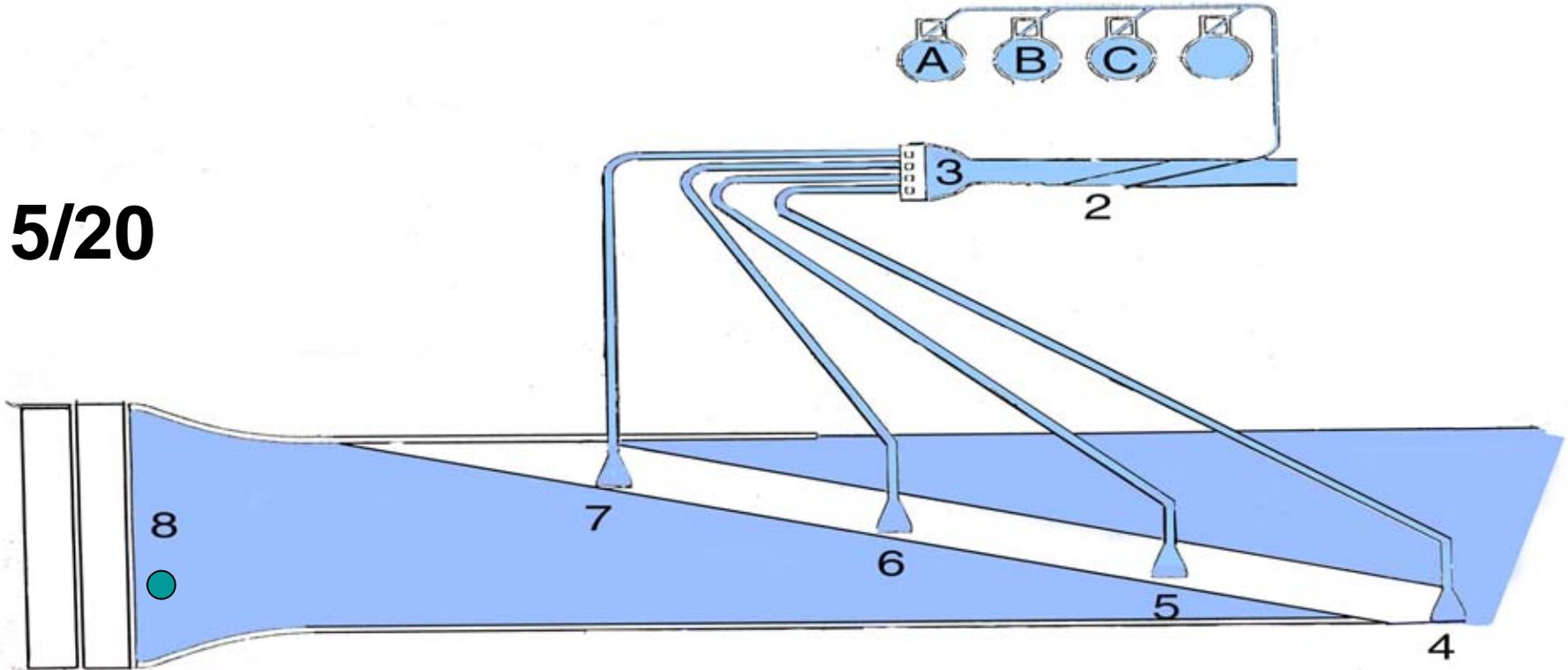
# Tracking Fish

5/19



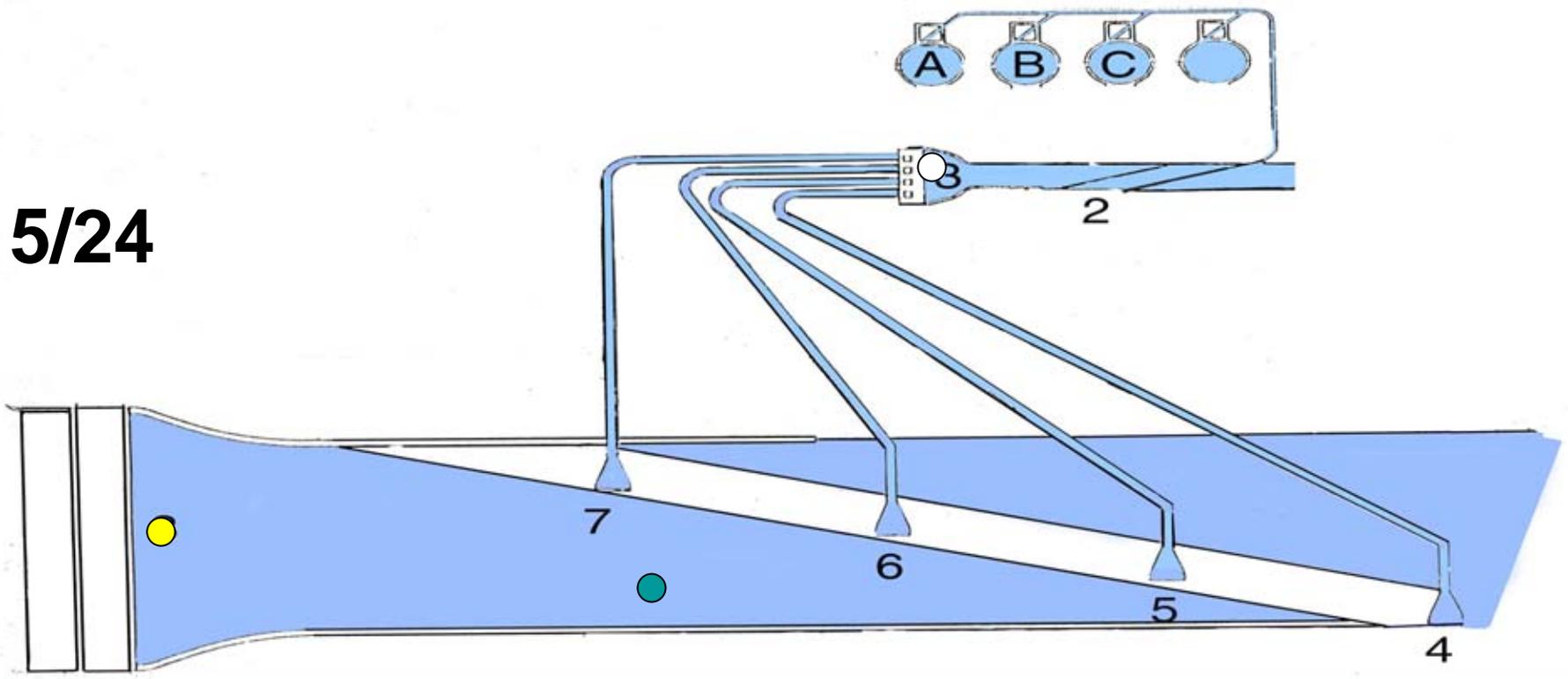
# Tracking Fish

5/20



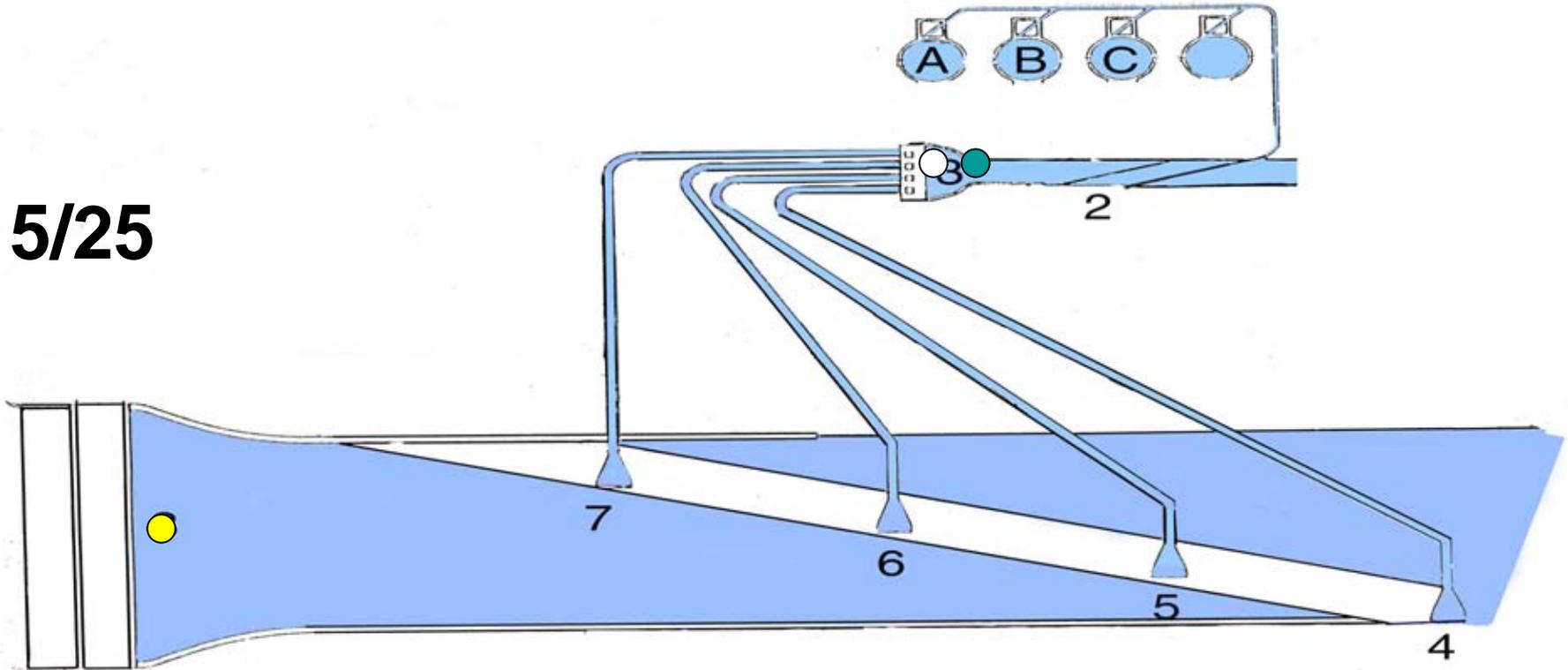
# Tracking Fish

5/24



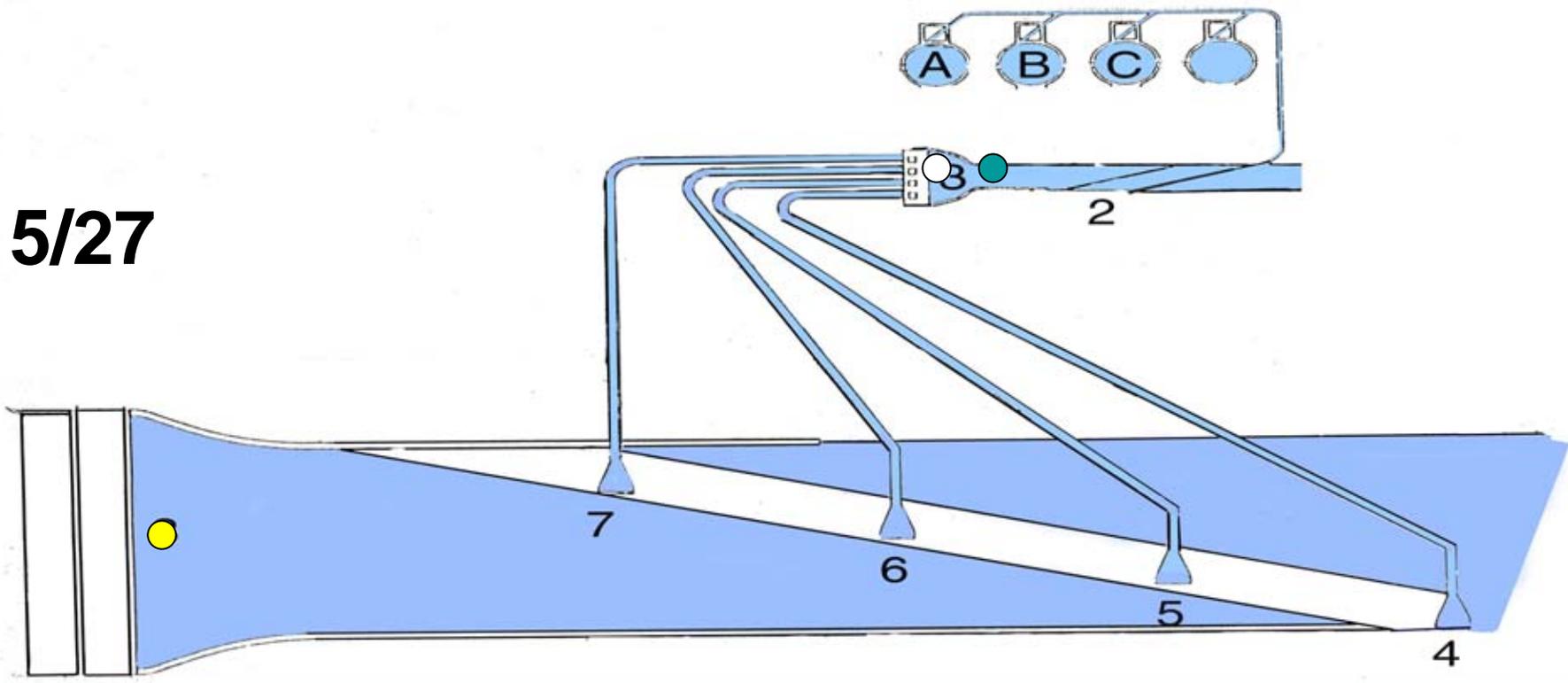
# Tracking Fish

5/25



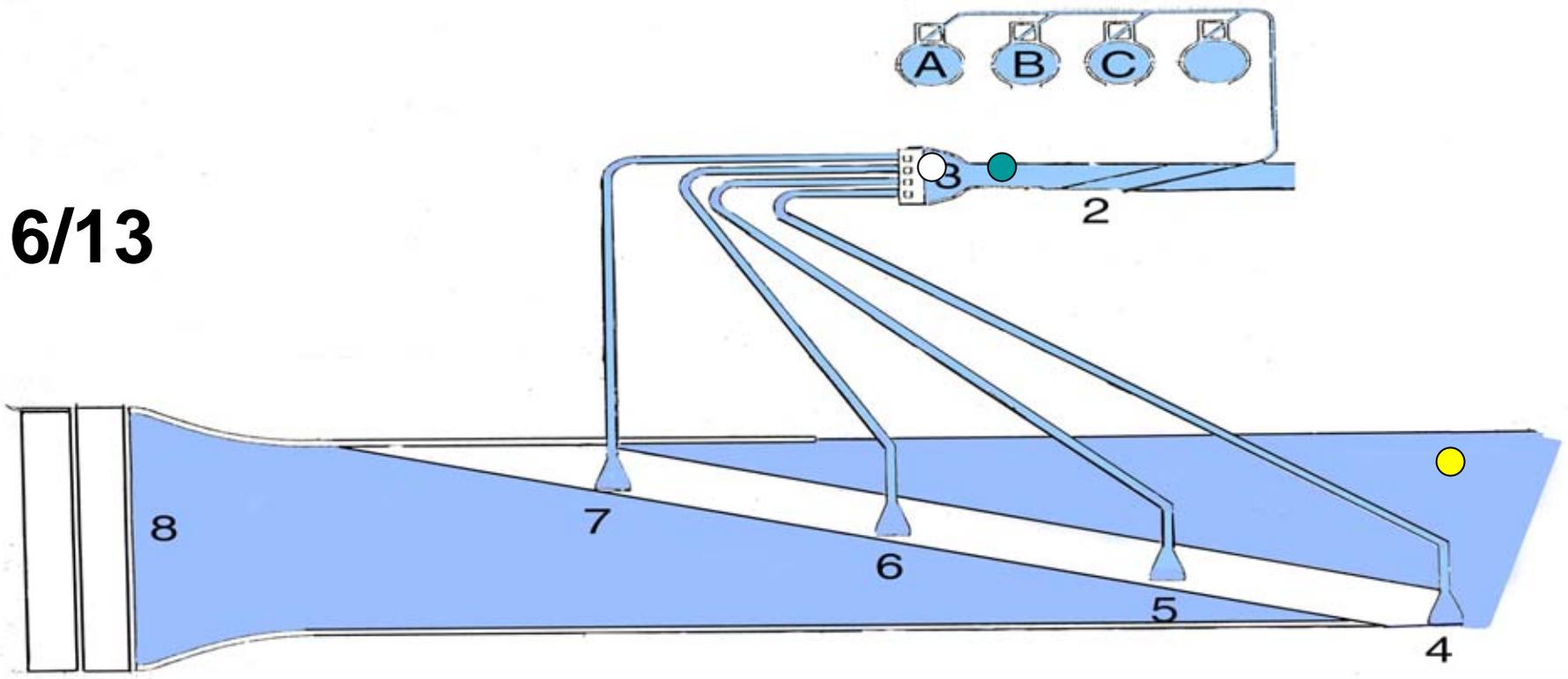
# Tracking Fish

5/27



# Tracking Fish

6/13



# Automatic Tag Detection



# Preliminary Observations of Tracking Large SB

- The time to reach the holding tanks varied greatly (0.1 hours to > 5 days).
- Fish stay in position over a wide range of water velocities (1 to 5 fps)
- Once collected, fish remain in the holding tanks until hauled out

# Preliminary Observations of Tracking Large SB Continued

- Fish stay in position near walls, and structures with reduced velocities
- Fish appear to hold near the old velocity meter pole in center of channel
- Fish move freely from the secondary to the primary channel
- Fish did not move from downstream of louvers to upstream in primary channel

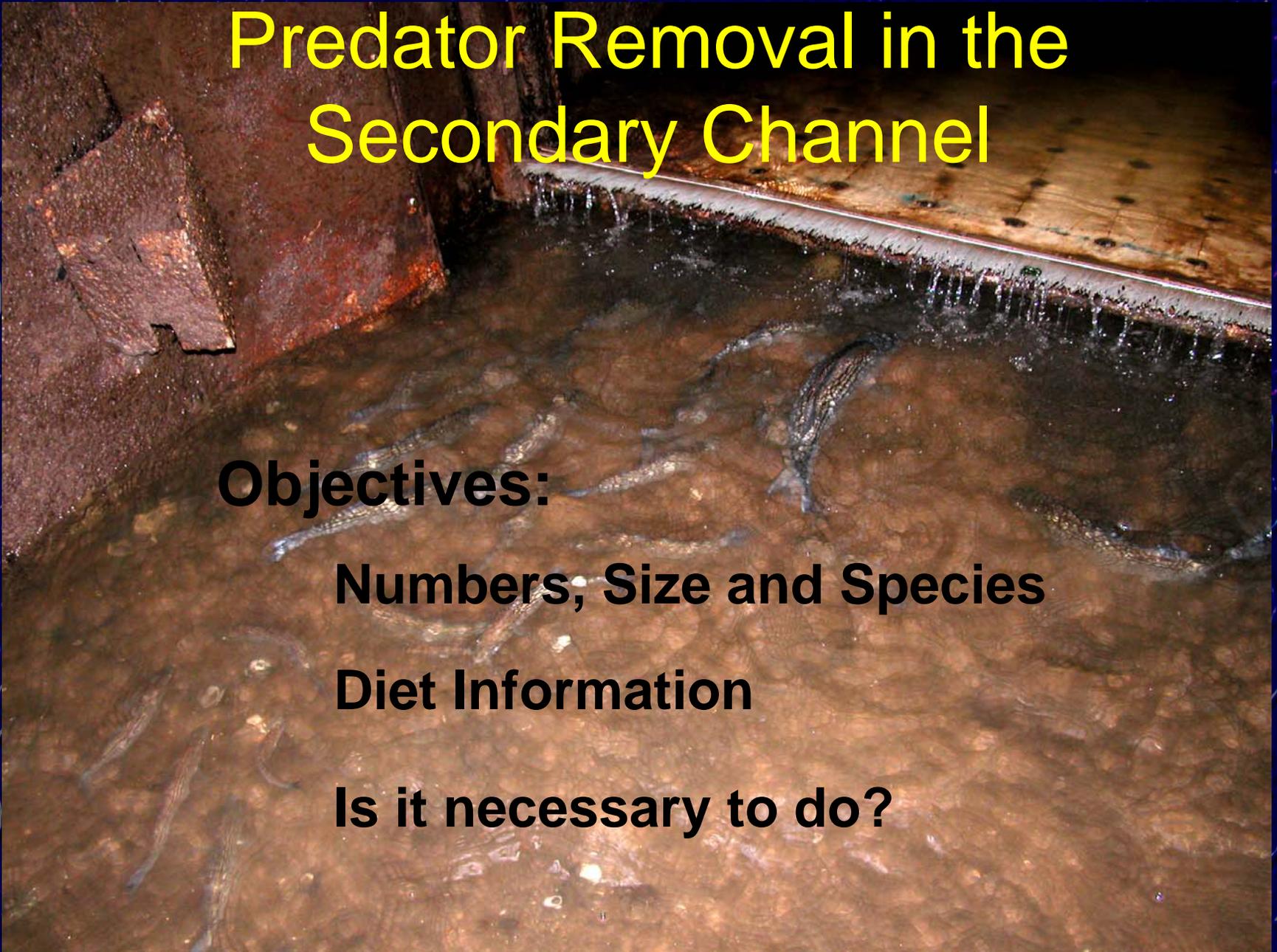
# Predator Removal in the Secondary Channel

**Objectives:**

**Numbers, Size and Species**

**Diet Information**

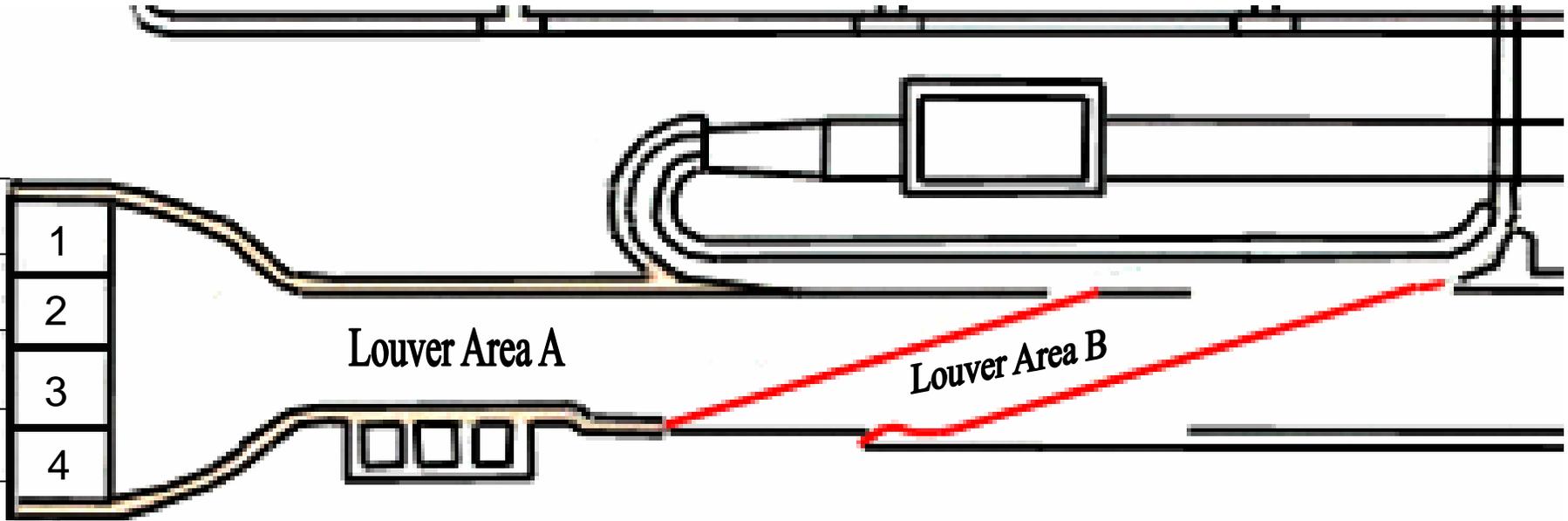
**Is it necessary to do?**



An aerial photograph of a water treatment facility. A large, dark, rectangular pond is on the left. A concrete structure, the secondary louver, extends from the pond towards the center. A red arrow points to this structure. To the right of the pond is a paved area with several buildings, including a large white one and a smaller blue one. A road curves around the bottom right. The background shows a river and some residential or industrial buildings. The text 'Secondary Louvers' is written in yellow, bold font, with a red arrow pointing to the structure.

**Secondary Louvers**

# TFCF Secondary Predator Removal



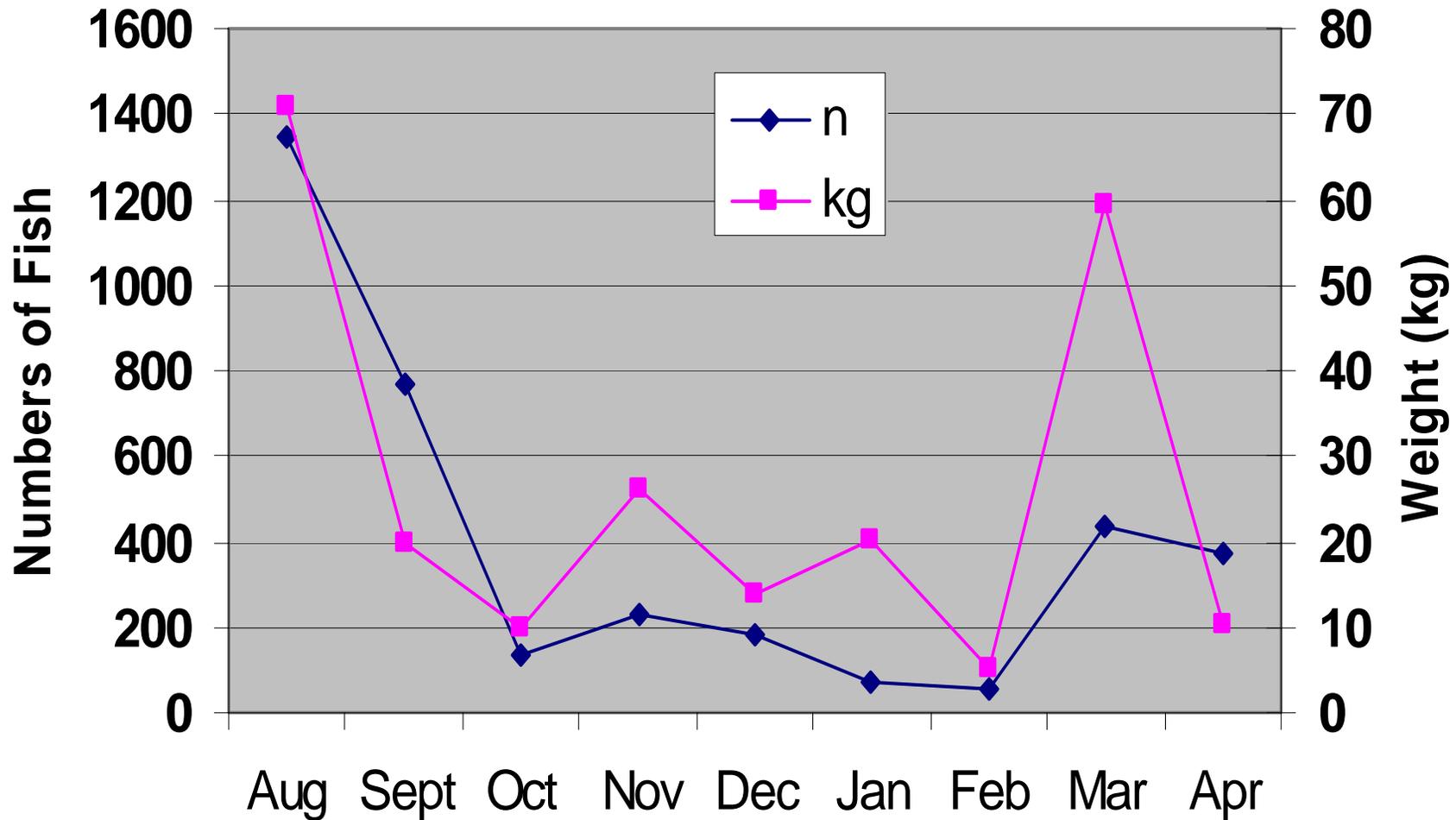
# The Usual Suspects



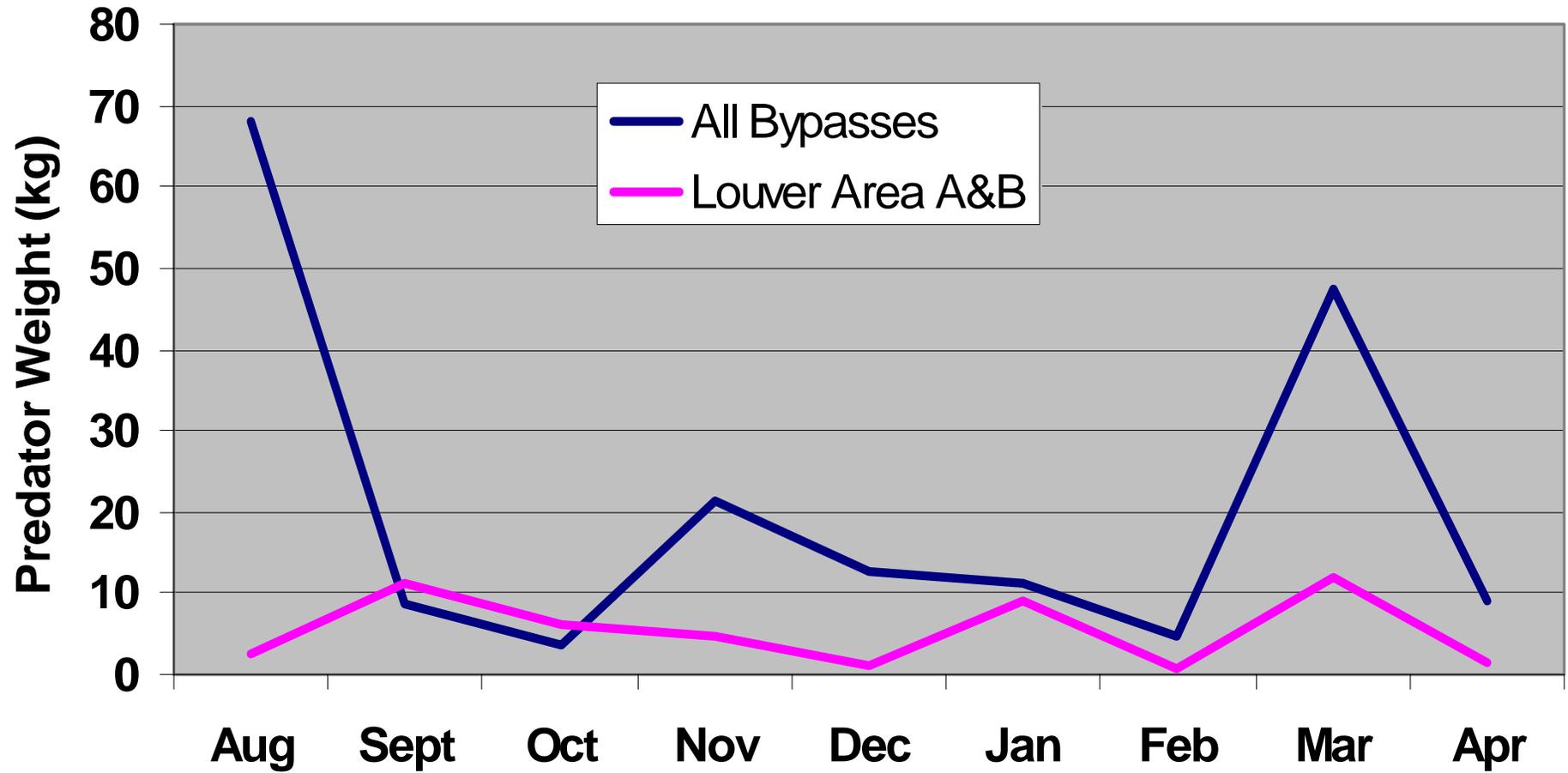
# Predator Removal Samples



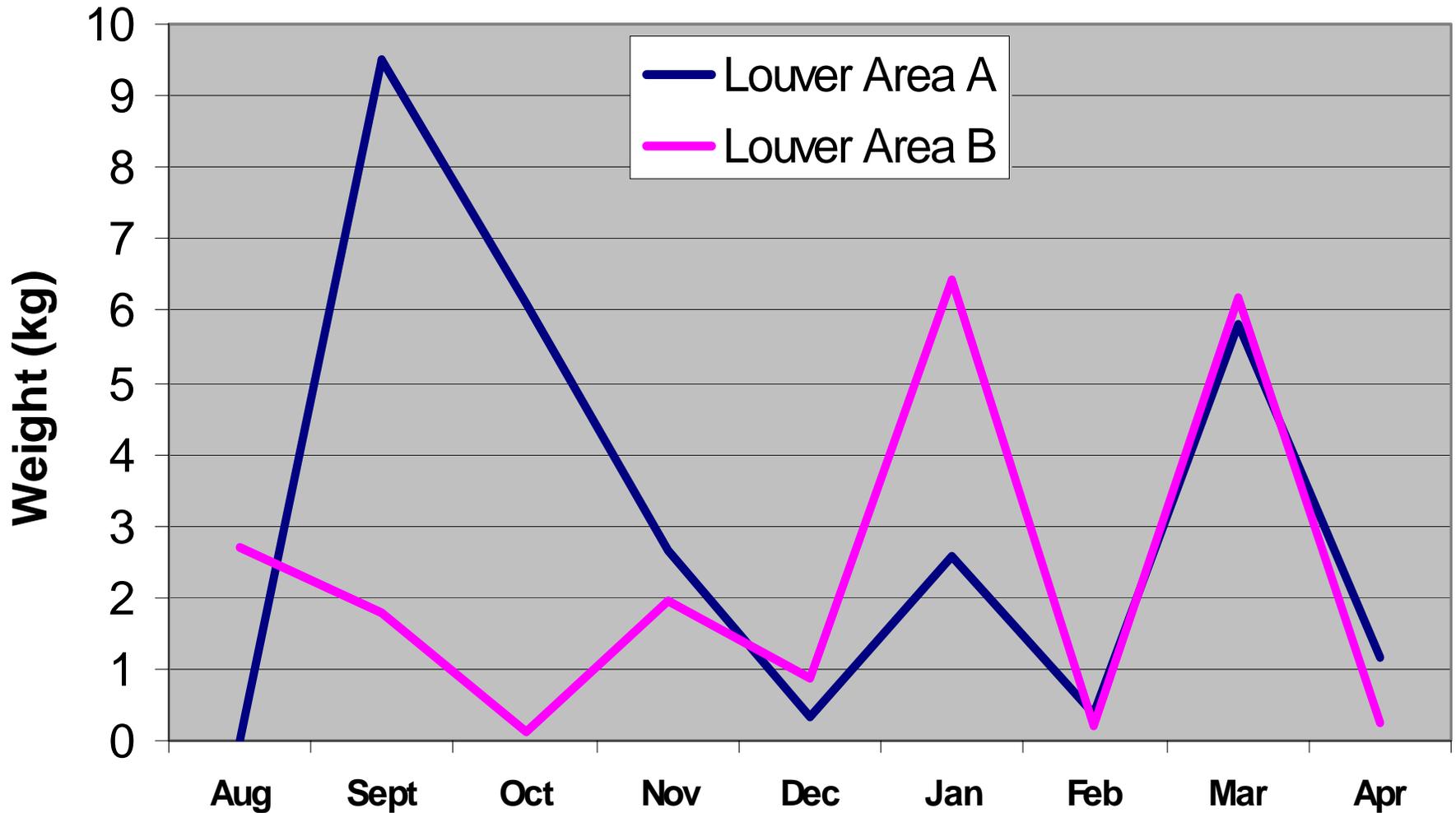
# Predator Number and Weight in Secondary by Month for Predator Removals



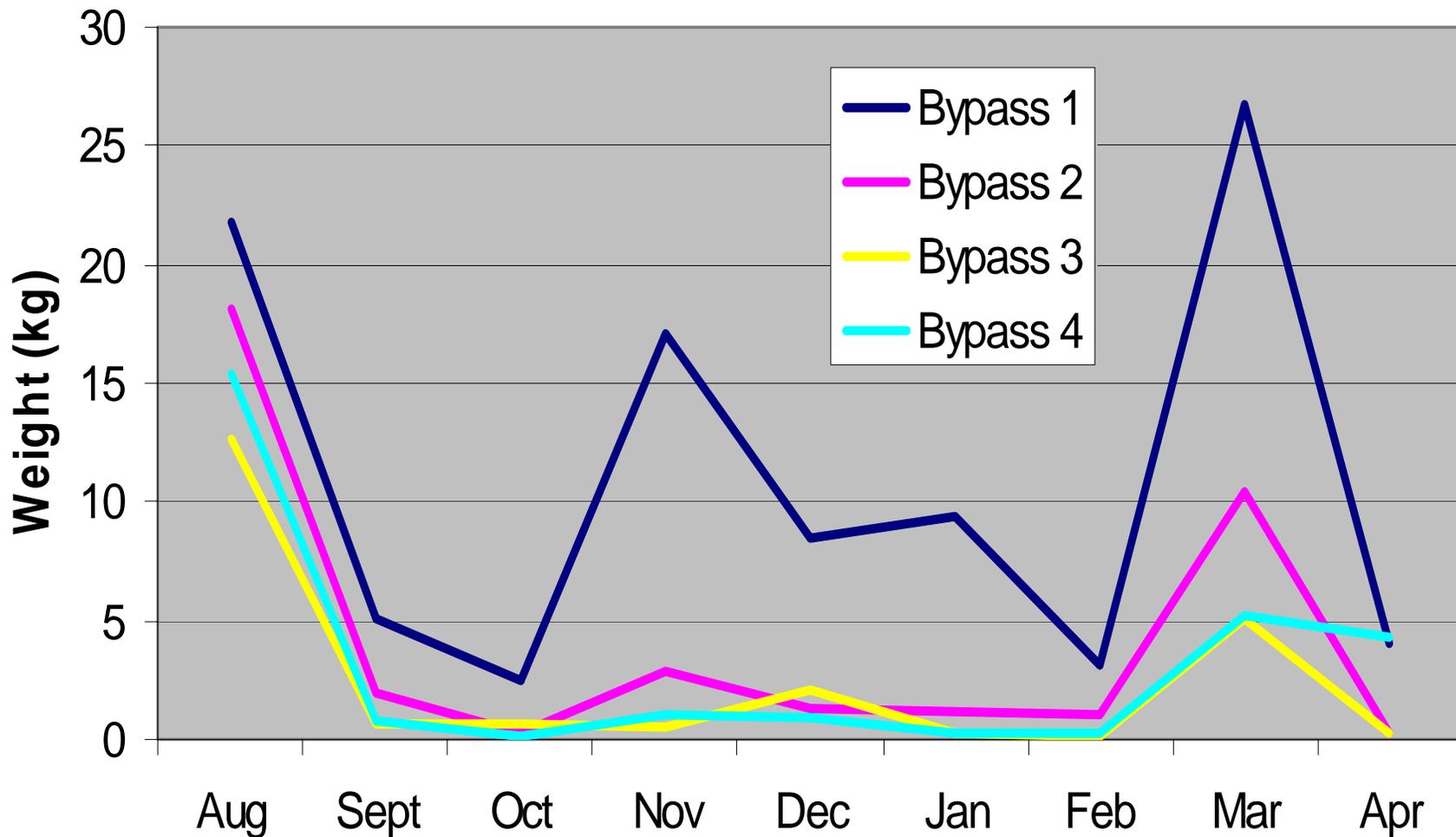
# Total Weight of Predators Collected in the Secondary Channel by Month



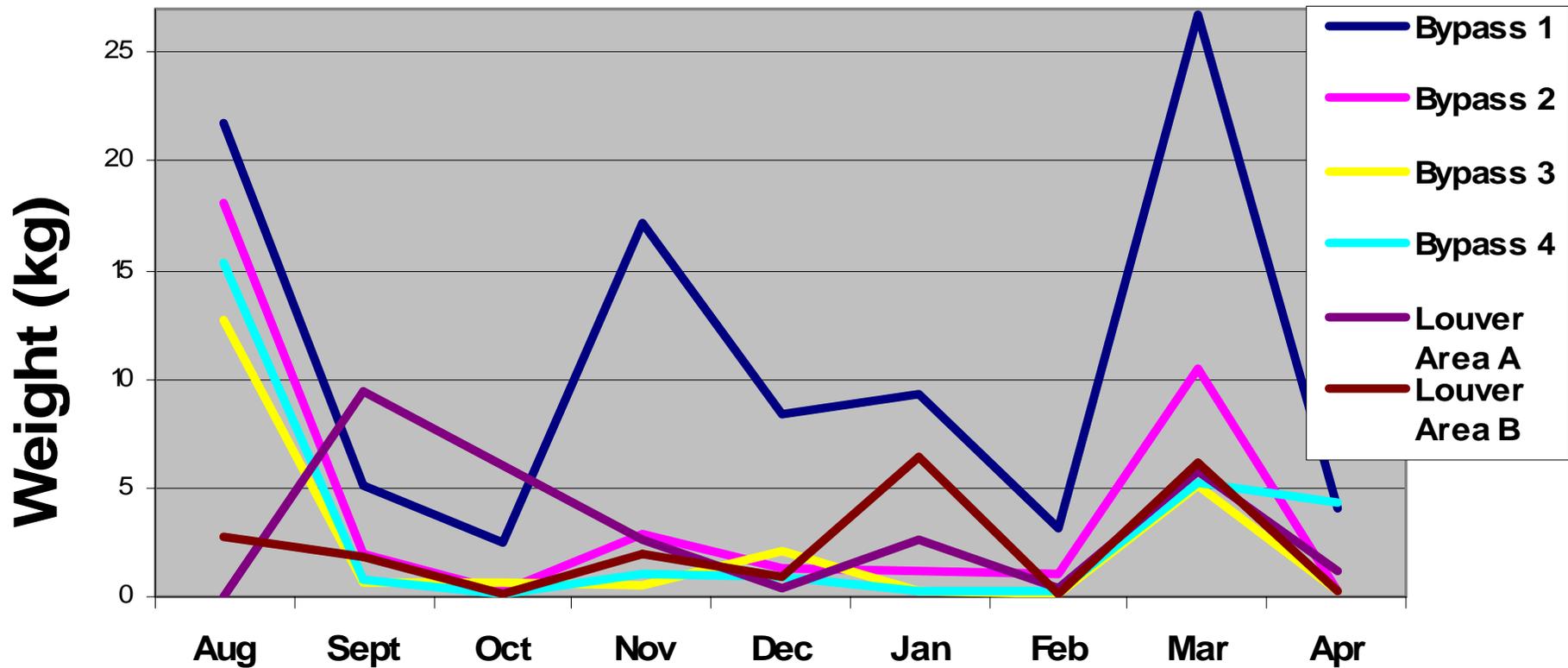
# Total Weight of Predators Removed Each Month Near Secondary Louvers



# Weight of Predators Removed Each Month From Bypass Tubes



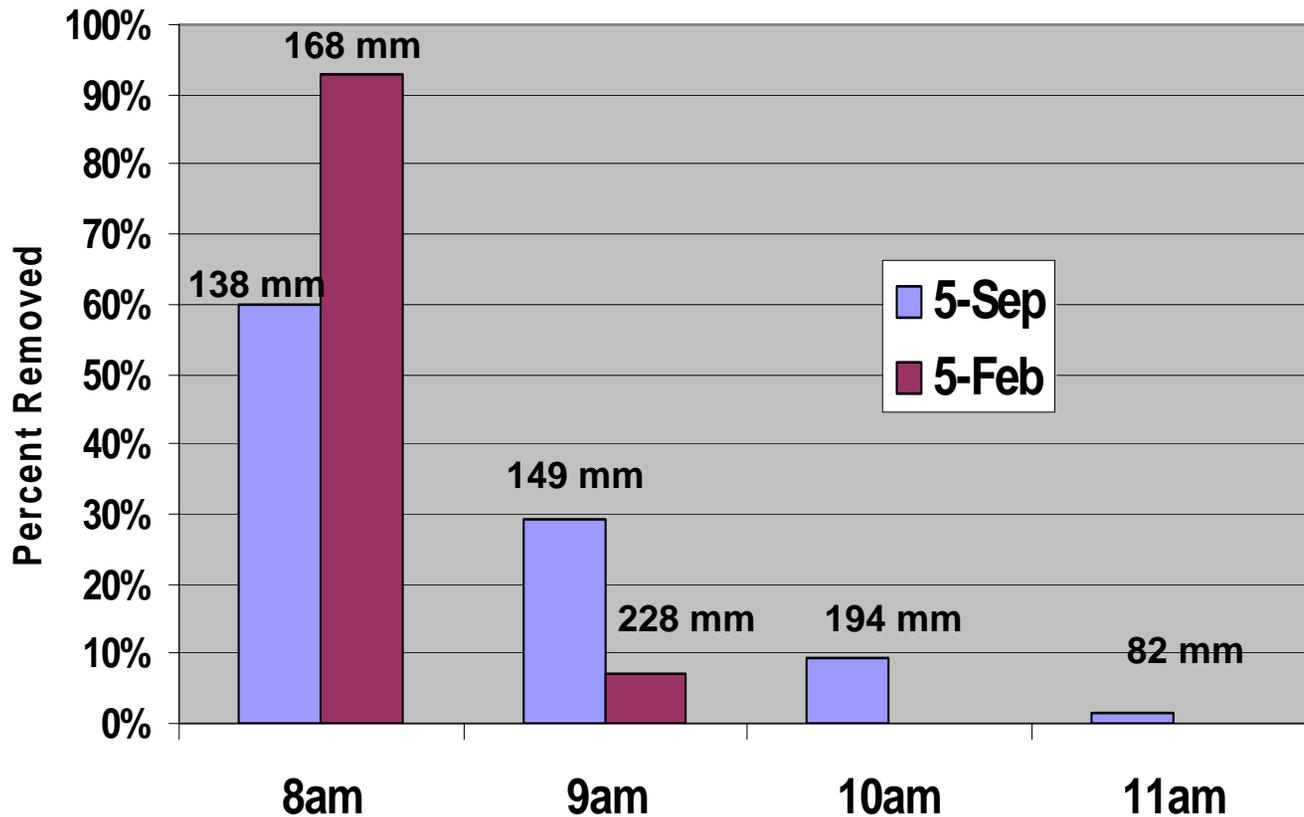
# Predator Weight vs. Month & Area Collected



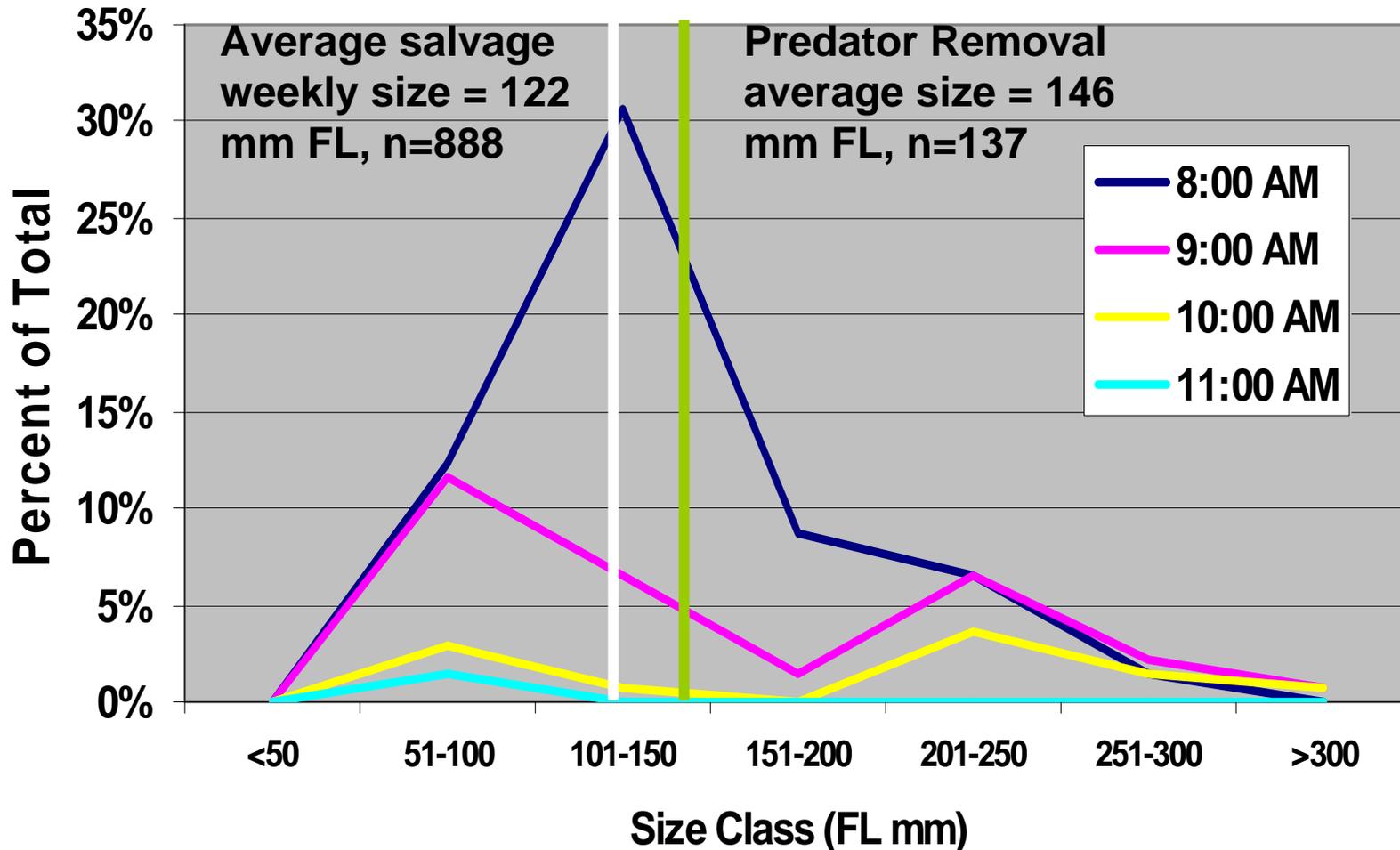
<b>Total (n):</b>	<b>1349</b>	<b>770</b>	<b>134</b>	<b>233</b>	<b>185</b>	<b>71</b>	<b>52</b>	<b>439</b>	<b>376</b>
<b>Total (kg):</b>	<b>70.7</b>	<b>19.9</b>	<b>9.9</b>	<b>26.2</b>	<b>14.0</b>	<b>20.1</b>	<b>5.2</b>	<b>59.4</b>	<b>10.3</b>
<b>Avg FL (mm):</b>	<b>82</b>	<b>95</b>	<b>145</b>	<b>164</b>	<b>165</b>	<b>225</b>	<b>167</b>	<b>193</b>	<b>76</b>

# How effective is the removal process?

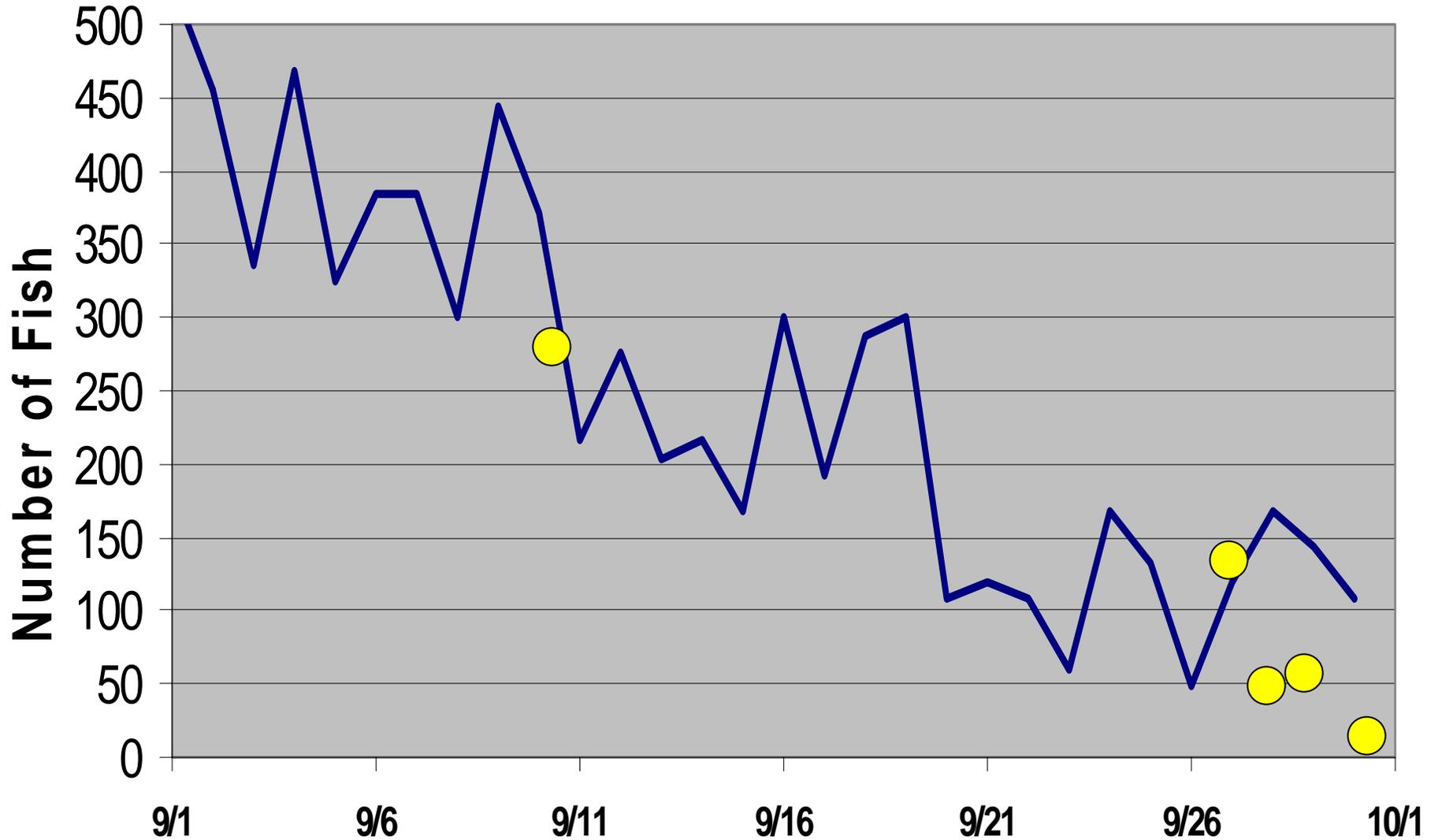
Percent of Striped Bass Removed During Four Consecutive Removals



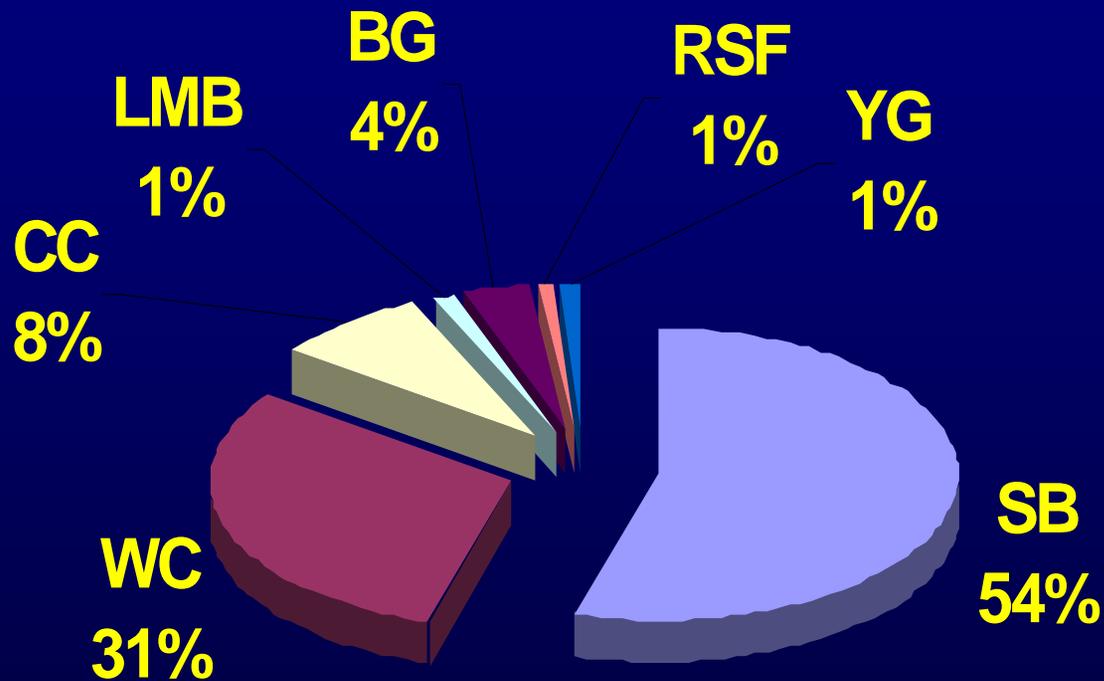
# Percent of Striped Bass Removed (September 27, 2004) During Four Consecutive Removals



# Daily Salvage of Striped Bass in September, 2004



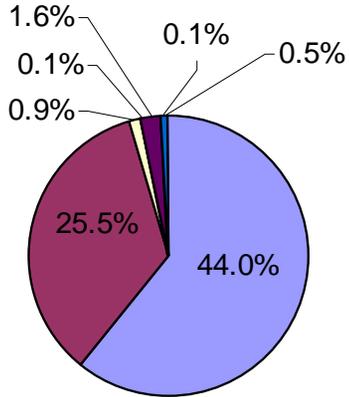
# Percentage of Predator Species from August 2004 to March 2005



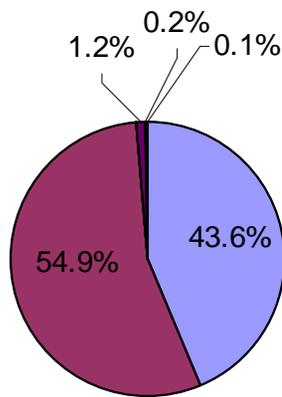
# Predatory Species Occurrence

SB WC CC LMB BG RSF YG

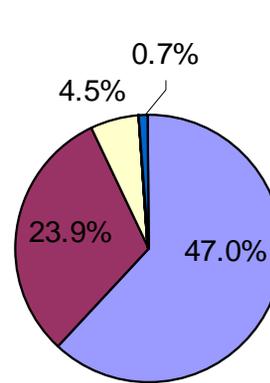
August



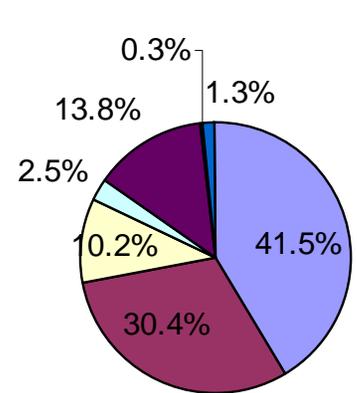
September



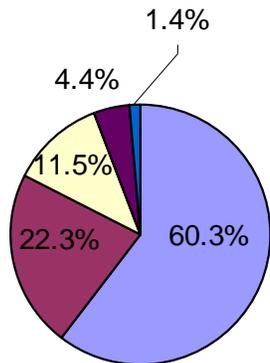
October



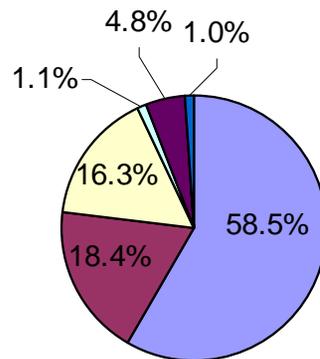
November



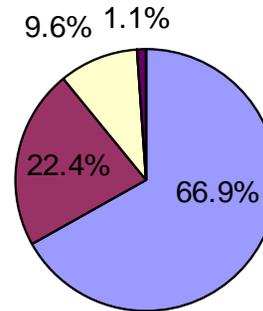
December



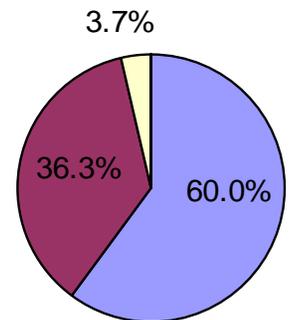
January



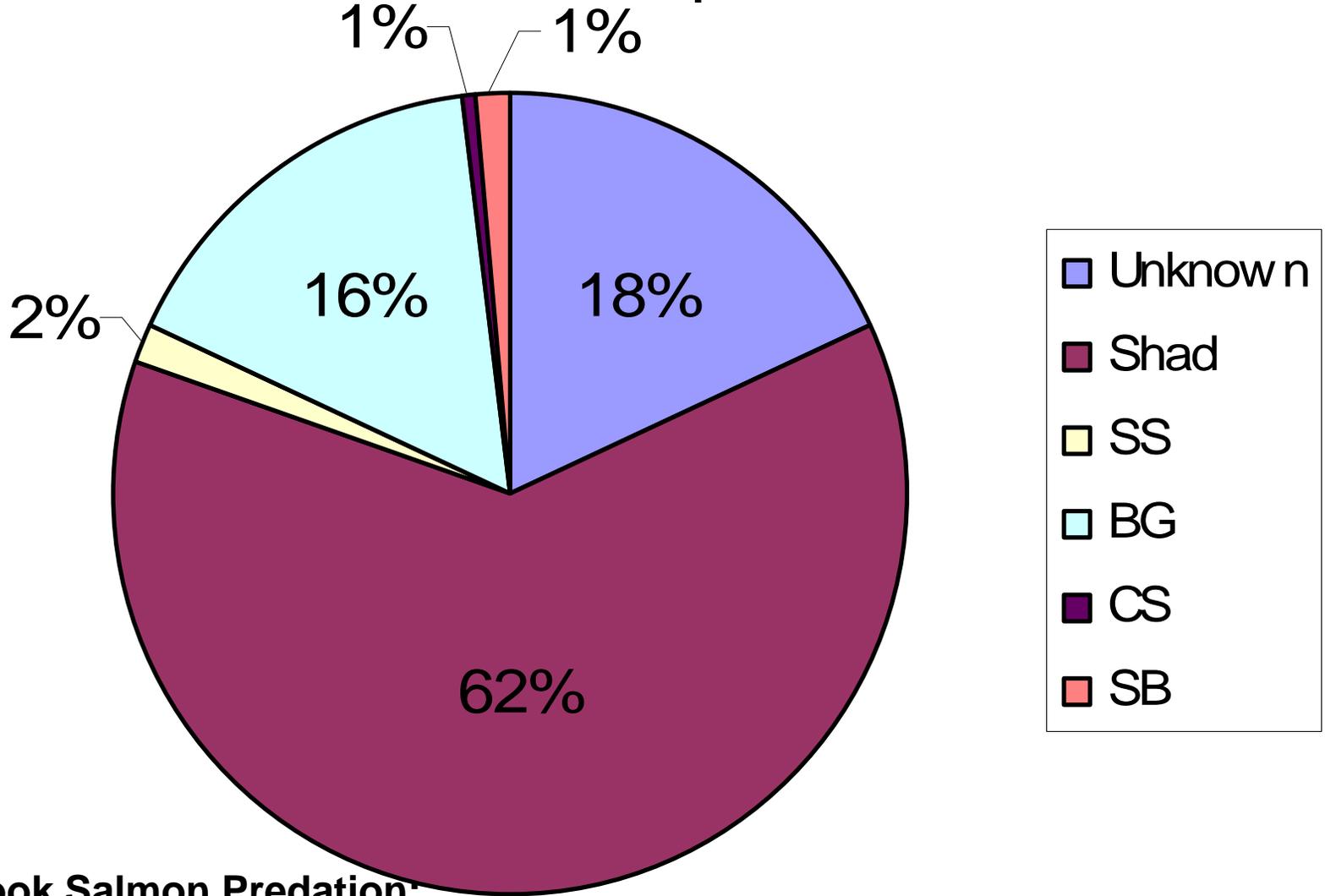
February



March



# Percentage of Fish Species Eaten (8/04-4/05) by all Size Classes of Striped Bass.



## Chinook Salmon Predation:

April 18, 2005 2 CS (70 mm Mean FL) by SB (238 mm FL, 155 g)

April 29, 2005 3 CS (74 mm Mean FL) by SB (260 mm FL, 257 g)

# Preliminary Observations of Predator Removals

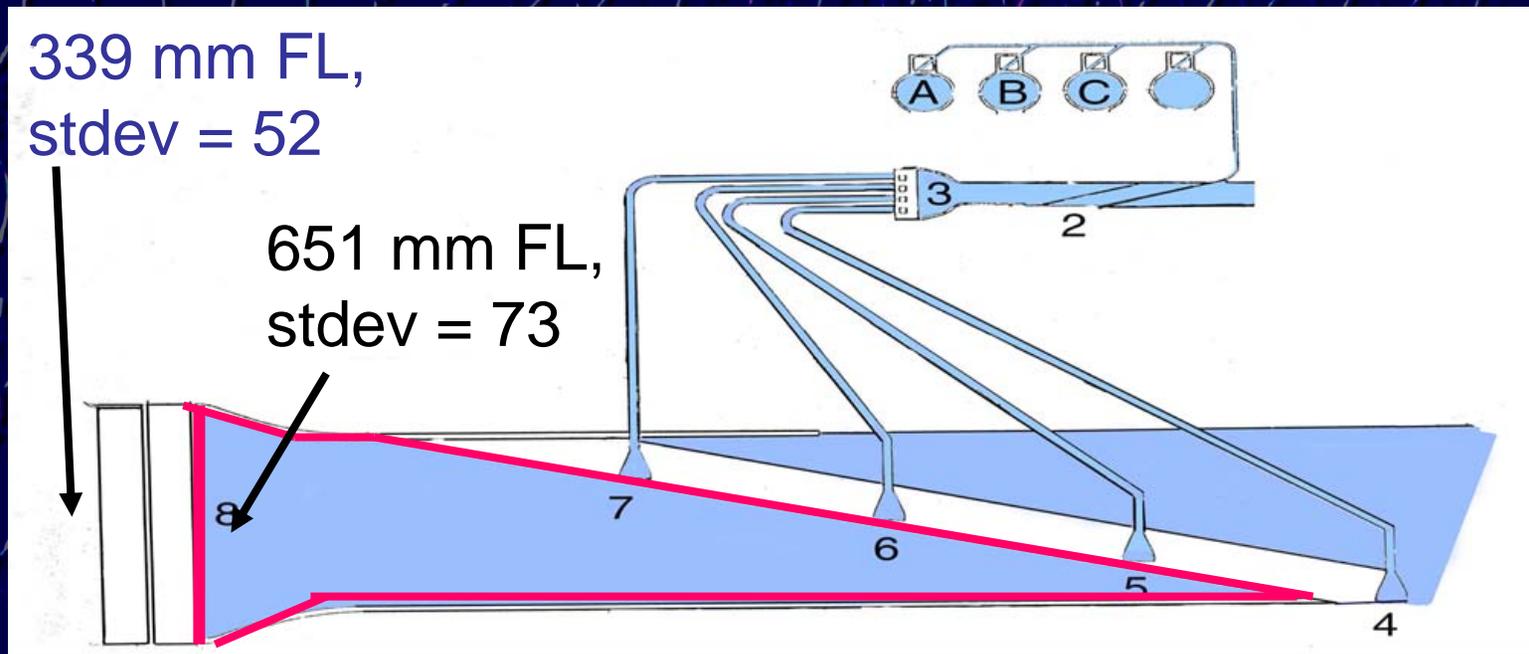
- Only 60-90% of predators removed with current technique
- More than half the predators are removed from the bypass tubes
- Striped bass and white catfish are the primary predators year round

# Preliminary Observations of Predator Removals

- Shad make up the majority of the SB diet
- Only 25 fish were collected that were too big to go through the trashrack

# Future Studies

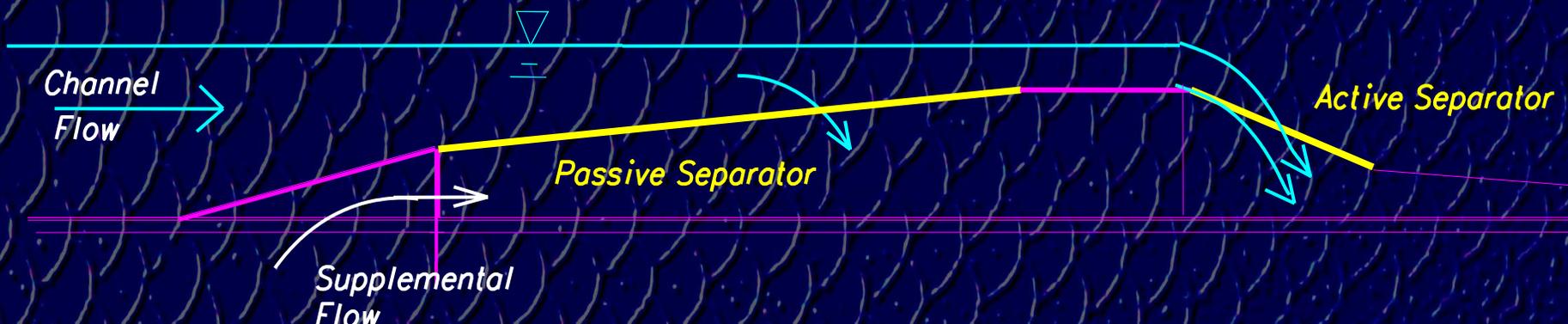
- Peterson mark recapture in primary channel to check for large SB?



# Conclusions

- Large SB move freely in primary channel
- Large SB have a long delay time in reaching the holding tanks
- The current predator removal technique is approximately 60-90% effective at removing predators
- The diet of predators found in the secondary channel is mostly shad
- Only two predators in the secondary channel were found eating salmon

# Passive/Active Separator



# Passive sorter

