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## Session B7: Efficiency and Suitability of the Fish Passage in River Ceyhan, Turkey

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# ◀ FISH PASSAGE 2015 ▶

International conference on river  
connectivity best practices and innovations

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## EFFICIENCY AND SUITABILITY OF THE FISH PASSAGES IN RIVER CEYHAN, TURKEY

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# INTRODUCTION

- ✓ Turkey has 596 huge state dams.
- ✓ None of them has any fish passages.
- ✓ *Anguilla anguilla* has become extinct in the inland section of Turkey.
- ✓ Sturgeons in the Black Sea Region is also almost extinct.
- ✓ Turkish inland waters have more than 300 fish species and about 70 of them are endemic.
- ✓ Unfortunately, there is no information about the impact of these dams on their status.



# INTRODUCTION

✓ In Turkey, 1250 small hydroelectric power plants (HPP) have been erected by private companies since 2001.



✓ These HPPs have to be fish passage legally.

✓ The effectiveness of these fish passages is unknown.



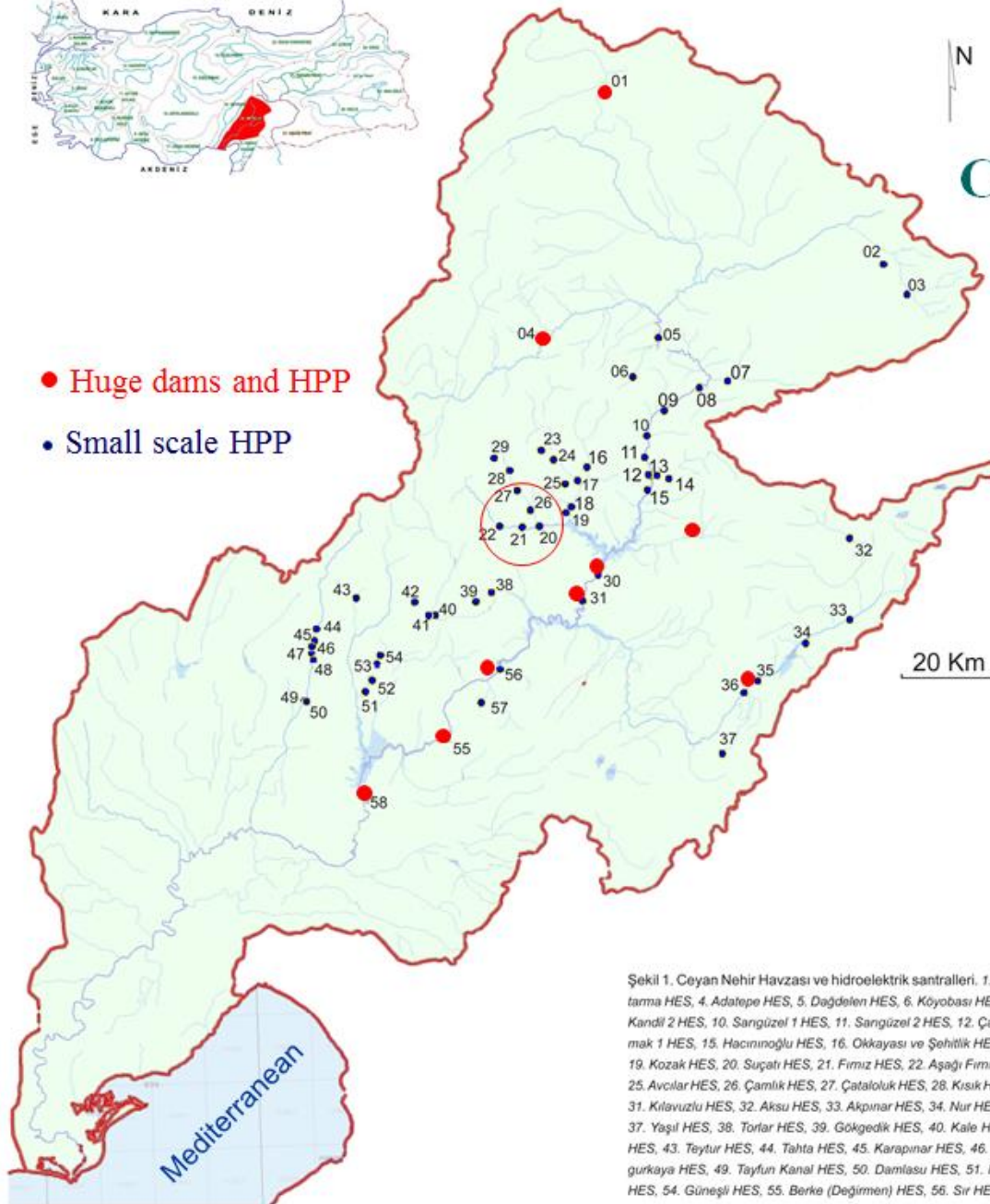


## SITE STUDY: CEYHAN RIVER BASIN

● Huge dams and HPP

● Small scale HPP

- Basin : 20670 km<sup>2</sup>
- 4% of the total flows in Turkey
- 9 huge dams
- 50 small HPP
- 25 fish species
- 5 of these endemic
- *Anguilla anguilla* is extinct



Şekil 1. Ceyhan Nehir Havzası ve hidroelektrik santralleri. 1. Karakuz HES, 2. Soğutlu 1 HES, 3. Kantarma HES, 4. Adatepe HES, 5. Dağdelen HES, 6. Köyobaşı HES, 7. Uzuntepe HES, 8. Kandil 1 HES, 9. Kandil 2 HES, 10. Sangüzel 1 HES, 11. Sangüzel 2 HES, 12. Çakmak 2 HES, 13. Soğutlu HES, 14. Çakmak 1 HES, 15. Hacınoğlu HES, 16. Okkayası ve Şehitlik HES, 17. Süleymanlı HES, 18. Zeytin HES, 19. Kozak HES, 20. Suçatlı HES, 21. Fırız HES, 22. Aşağı Fırız HES, 23. Sisne HES, 24. Sivritaş HES, 25. Avcılar HES, 26. Çamlık HES, 27. Çataloluk HES, 28. Kısık HES, 29. Üçkaya HES, 30. Menzelet HES, 31. Kılavuzlu HES, 32. Aksu HES, 33. Akpınar HES, 34. Nur HES, 35. Kartalkaya HES, 36. Kesme HES, 37. Yaşıl HES, 38. Torlar HES, 39. Gökgedik HES, 40. Kale HES, 41. Karasu HES, 42. Değirmenüstü HES, 43. Teytut HES, 44. Tahta HES, 45. Karapınar HES, 46. Andırın HES, 47. Kargılık HES, 48. Bulgurlukaya HES, 49. Tayfun Kanal HES, 50. Damlasu HES, 51. Poyraz HES, 52. Sazak HES, 53. Çatak HES, 54. Güneşli HES, 55. Berke (Değirmen) HES, 56. Sır HES, 57. Güvercin HES, 58. Aslantas HES

# OBJECTIVES

- ✓ In River Ceyhan basin, 50 small hydroelectric power plants (HPP) exist.
- ✓ Only, 16 of them include fish passages.
- ✓ Unfortunately, we have no information about their efficiency and performance.
- ✓ This study aimed to determine the efficiency and performances of two fish passages in River Ceyhan Basin.

# METHOD

## 1. Trap application

- ✓ Traps were set up at the upstream exit pool of the fish passages.
- ✓ They were controlled in a few days and the fish in the traps were taken in a tank and anaesthetised by 2-phenoxyethanol
- ✓ After recording their number, total length, weight and sexes, they were released to the upper pool.





# METHOD

## 2. External tagging

- ✓ The fish were caught by electrofishing downstream of the fish passage.
- ✓ They were anaesthetised with 2-phenoxyethanol and their total length and weight measured and then tagged with external tags (T-Bar anchor tags)
- ✓ After recovery, they were released to downstream of the fish passages.
- ✓ Tagged fish into the traps were controlled in a few days.





# METHOD

## 3. PIT Telemetry:

- ✓ The square antenna was settled into the fish passage
- ✓ HPR Reader was positioned into a box and connected to a power.
- ✓ HPT 12 tags were inserted into the body cavity.
- ✓ And then they were released from the lower stream under the fish passage (2 km lower).

### Equipment:

- ✓ Biomark HPT 12 tags,
- ✓ HPR Reader,
- ✓ 24" Square Pass-Through Antenna



# METHOD

## 4. Radio Telemetry:

- ✓ The transmitters were inserted into the body cavity with a surgical operation.
- ✓ After recovery, the fish were released from the lower stream under the fish passage (2 km lower)
- ✓ Radio tracking was performed by SRX 400 telemetry receiver and yagi antenna

## Equipment:

- ✓ Lotek MST930 transmitters
- ✓ SRX 400 Radio receiver
- ✓ Yagi antenna



# RESULTS

## 1. The fish in the trap

Table 1. The number, total length and sex ratio of *Capoeta angora* in the trap in a vertical slot fish passage. N: Fish number, TL: Total length of the fish

Date (2012)	N	TL (cm)	Sex ratio M:F
20 April	Trap establishment		
01 May	12	21.9	5.00:1.00
08 May	47	20.6	2.92:1.00
21 May	164	22.7	0.96:1.00
06 June	97	18.9	0.67:1.00
20 June	64	19.2	0.49:1.00
03 July	43	18.9	0.39:1.00
13 July	0	0	
Total	428	20.9 (13.0-43.0)	
Migration duration: 63 days			

Date (2013)	N	TL (cm)	Sex ratio M:F
20 April	Trap establishment		
28 April	0		
01 May	24	18.5	7.00:1.00
06 May	54	19.1	1.57:1.00
17 May	145	19.7	0.73:1.00
06 June	231	19.4	0.41:1.00
15 June	18	18.6	0.39:1.00
23 June	0		
Toatl	472	19.4 (11.2-39.7)	
Migration duration: 46 days			

# RESULTS

Table 2. The number of *Alburnus kotschyi* in the trap in the vertical slot fish passage and their total lengths

Date (2012)	N	TL (cm)
<b>20 April</b>	<b>Trap establishment</b>	
01 May	0	
08 May	8	15.7
21 May	42	15.4
06 June	87	14.1
20 June	51	14.6
03 July	74	14.8
13 July	0	
<b>Total</b>	<b>262</b>	<b>14.7 (10.0-23.0)</b>
<b>Migration duration: 57 days</b>		

Date (2013)	N	TL (cm)
<b>20 April</b>	<b>Trap establishment</b>	
28 April	0	
01 May	18	14.0
06 May	5	16.2
17 May	18	16.6
06 June	185	15.8
15 June	27	16.8
23 June	5	15.9
08 July	0	
<b>Total</b>	<b>258</b>	<b>15.8 (10.2-22.5)</b>
<b>Migration duration: 54 days</b>		





## Length distribution of fish in the trap

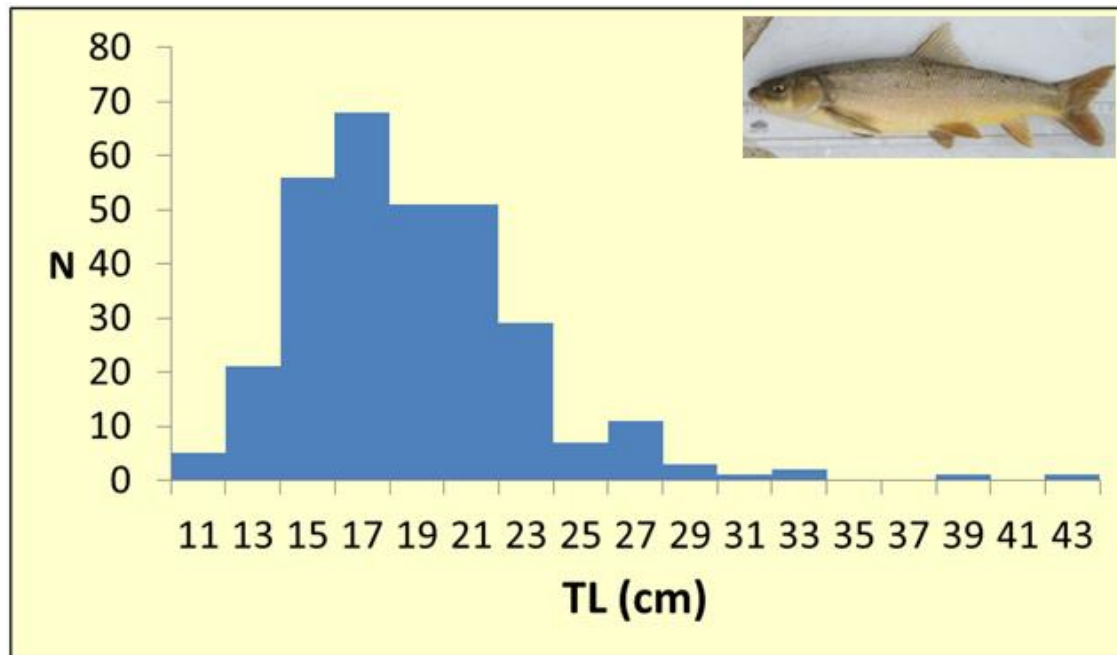


Figure 1. Length distribution of *Capoeta angorae* in the trap in a vertical slot fish passage

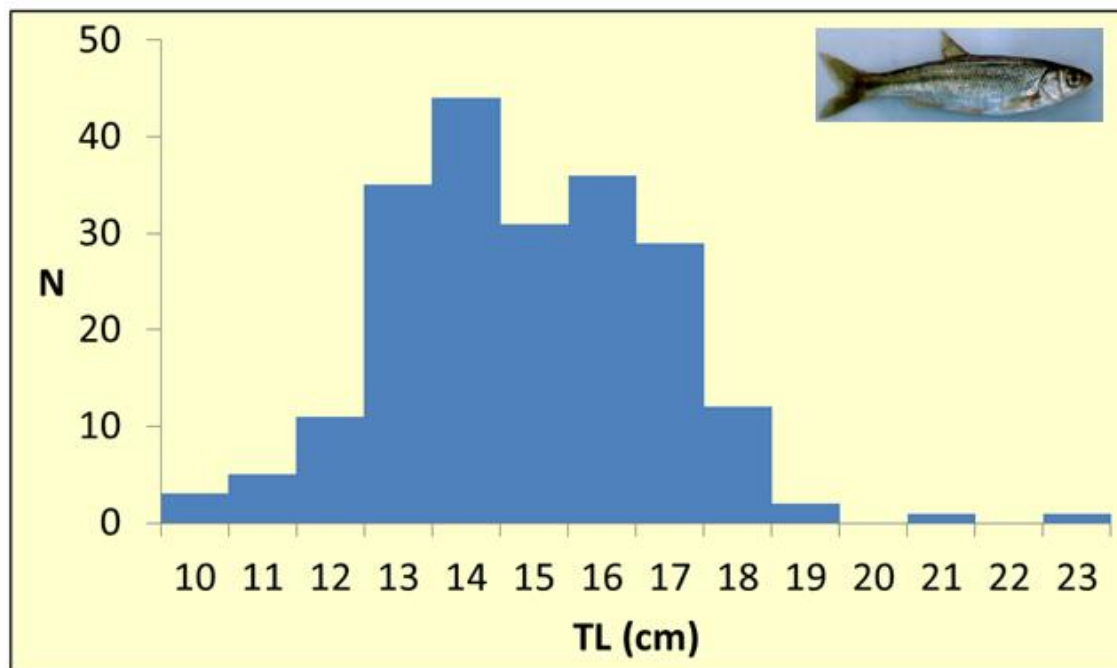


Figure 2. Length distribution of *Alburnus kotschy* in the trap in a vertical slot fish passage

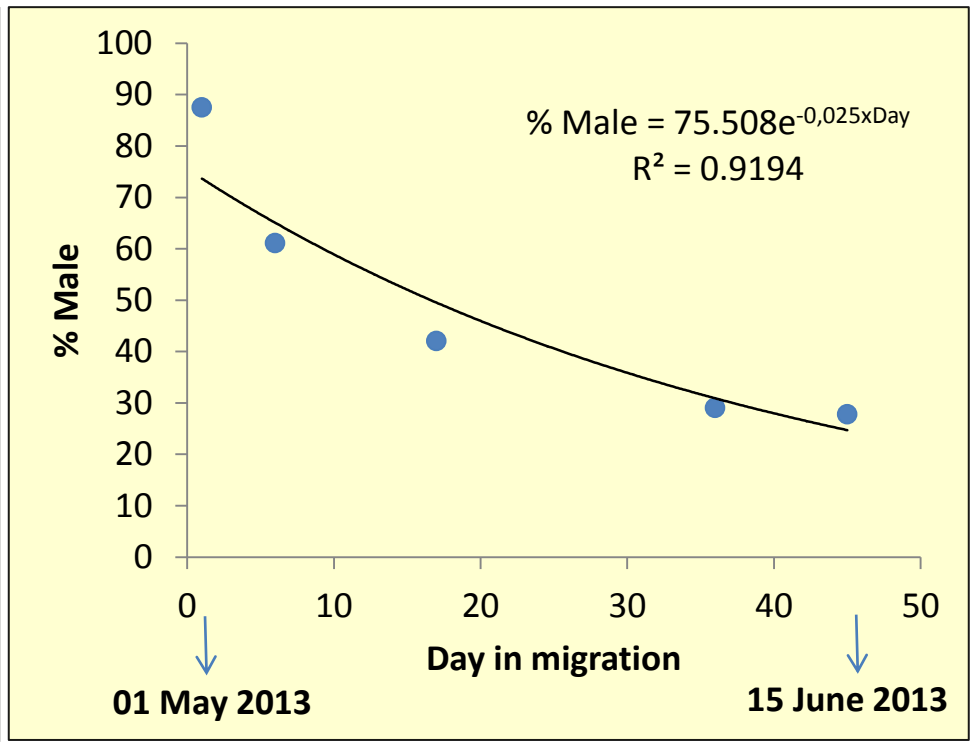
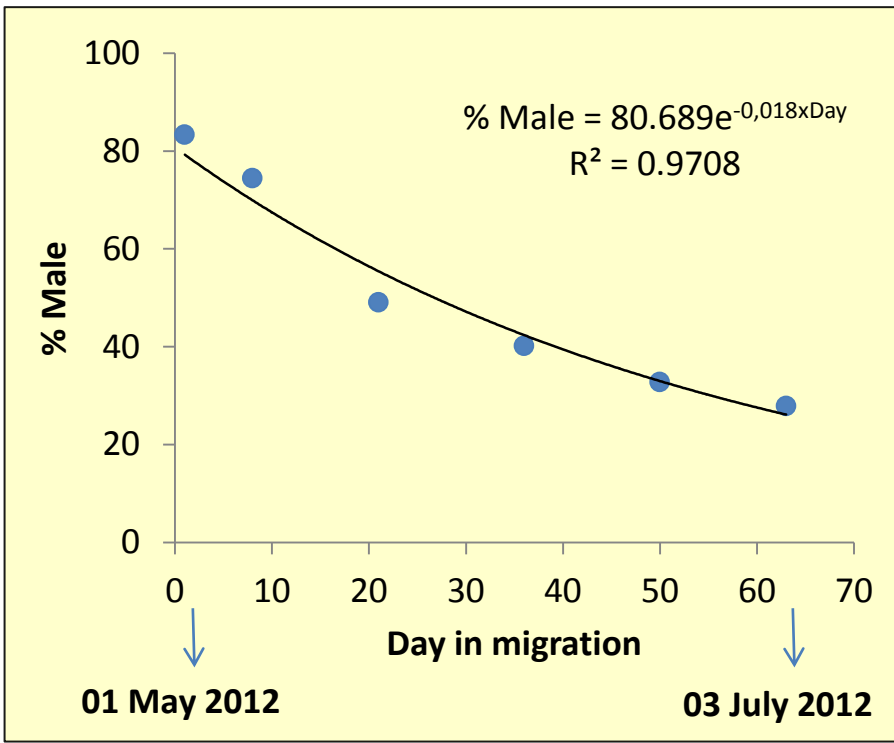


Figure 3. Sex ratio of *Capoeta anguare* in the trap according to date in 2012 and 2013

## 2. External tagged fish (T-Bar Anchor Tagged fish)

✓ A total of 172 *C. angorae* were tagged with T-Bar anchor tags in 2 fish passages.

✓ Total length of the tagged fish: 13.0-26.5 cm ( $19.8 \pm 2.75$  cm)

Table 3. According to external tagging applications, the effectiveness of two fish passages in River Ceyhan basin.

Stream	Tagged Fish (N)	Number of the passed fish (N)	Type of the fish passage	Performancy (%)	TL (cm) of the passed fish
Tekir Stream	122	13	Vertical slot	10.7	18.6-24.0 ( $20.5 \pm 1.72$ )
Firnız Stream	50	0	Pool and orifices	0	



### 3. PIT Telemetry

✓ A total of 156 *C. angorae* were tagged with PIT tags in Tekir Stream.





Table 4. PIT tagged *C. angorae* individuals passed through fish passage

No	PIT Tag No	TL (cm)	Time (date)	Time (hour)
1	989 002 0007 39977	20.0	05.05.2014	13.11.13
2	989 002 0007 86586	24.1	07.05.2014	03.38.36
3	989 002 0007 07037	19.4	08.05.2014	02.54.47
4	989 002 0007 30687	22.8	10.05.2014	04.43.41
5	989 002 0008 46289	17.2	13.05.2014	08.41.00
6	989 002 0007 43689	25.4	13.05.2014	04.18.14
7	989 002 0008 13556	21.1	14.05.2014	05.19.48
8	989 002 0007 06514	20.1	14.05.2014	04.14.42
9	989 002 0008 88935	27.6	15.05.2014	03.05.27
10	989 002 0007 31766	23.2	15.05.2014	06.05.58
11	989 002 0008 11670	24.4	15.05.2014	06.38.59
12	989 002 0007 45787	22.4	15.05.2014	12.28.35
13	989 002 0008 44208	21.2	15.05.2014	03.05.27
14	989 002 0007 93608	21.9	15.05.2014	06.52.55
15	989 002 0008 50454	25.5	16.05.2014	04.37.44
16	989 002 0008 14027	16.5	18.05.2014	15.50.31
17	989 002 0008 06163	28.3	20.05.2014	04.15.44
18	989 002 0008 37818	15.6	22.05.2014	03.50.22
19	989 002 0008 90309	22.3	06.07.2014	18.01.37
20	989 002 0008 53416	13.7	07.07.2014	17.51.32
21	989 002 0008 51300	25.2	12.07.2014	07.52.39
22	989 002 0008 08502	24.5	18.07.2014	06.33.12
23	989 002 0008 55120	23.7	20.07.2014	06.21.22
24	989 002 0008 14586	22.6	21.07.2014	06.24.45

✓ Of the 156 PIT tagged fish, 24 passed through the vertical slot fish passage.

✓ The performance of fish passage was determined as 15.4%.

✓ The length of the PIT tagged fish: 11.1 - 28.3 cm ( $16.6 \pm 3.6$  cm)

✓ Total length of the PIT tagged fish passed through fish passage: 13.7 - 28.3 cm ( $22.0 \pm 3.6$  cm)

## Length distribution of PIT tagged fish

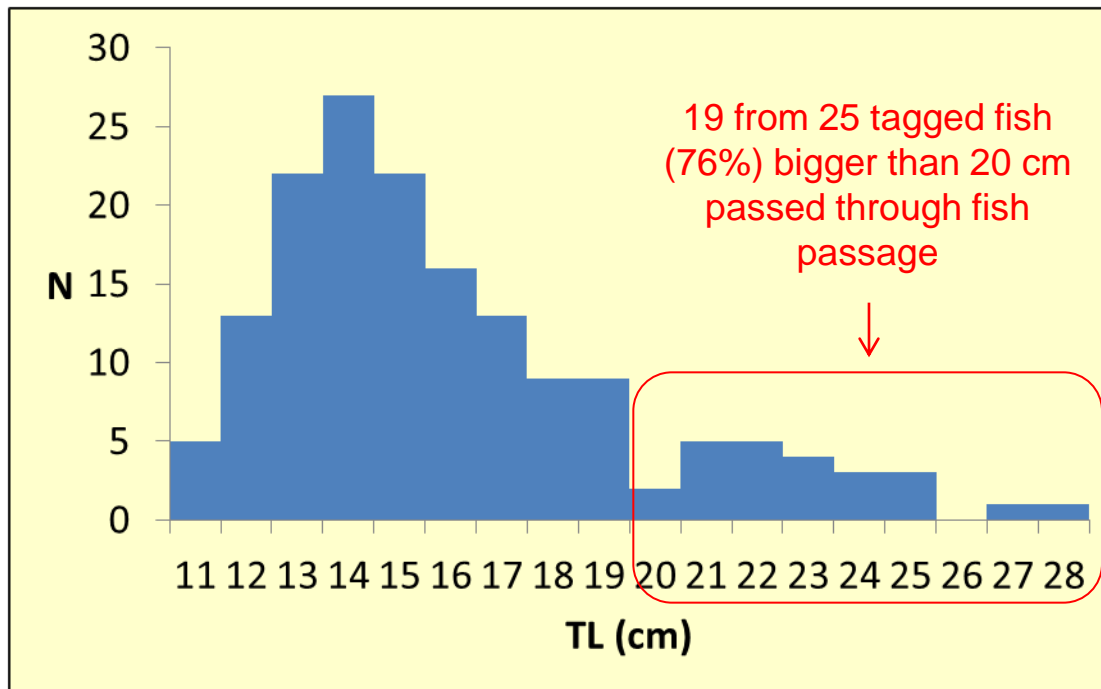


Figure 4. Length distribution of PIT tagged *Capoeta angorae*

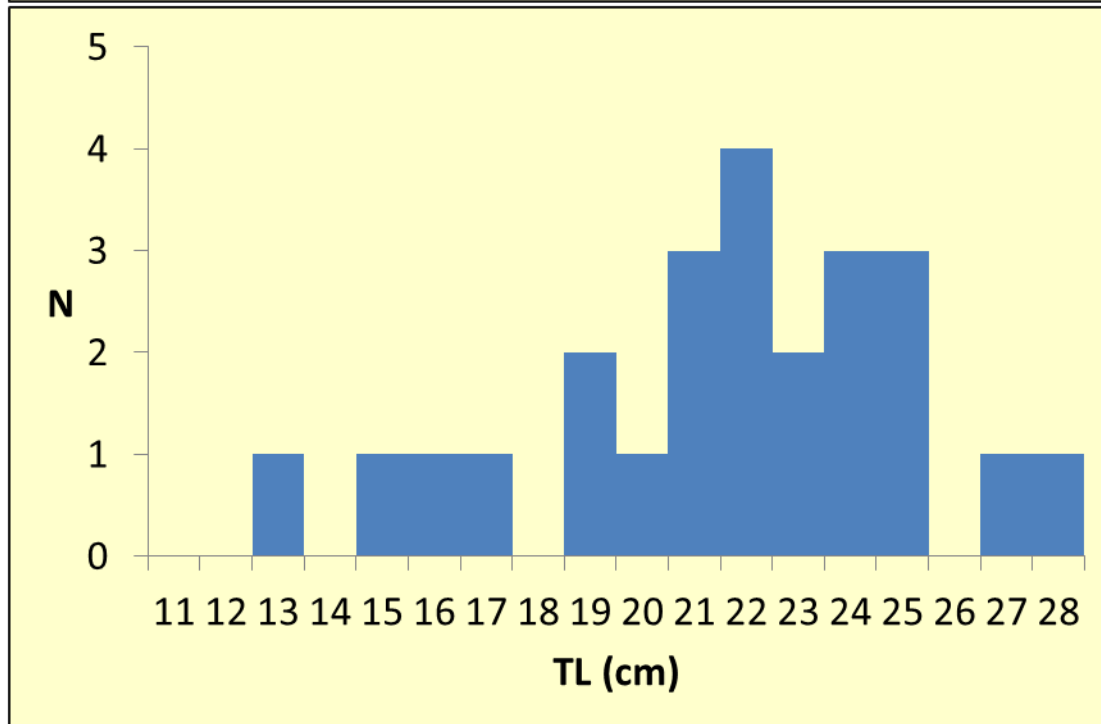


Figure 5. Length distribution of PIT tagged *Capoeta angorae* passed through fish passage

## 4. Radio Telemetry

- ✓ A total of 49 *Capoeta angora* were tagged with coded radio transmitters
- ✓ From 24 radio tagged fish, 18 individuals passed through the fish passage in Tekir Stream.
- ✓ The performance of the vertical slot fish passage was determined as 75.0%.
  - ✓ Total length of the radio tagged fish: 24.5-46.4 cm ( $31.3 \pm 5.85$  cm)
  - ✓ Total length of the radio tagged fish passed through fish passage: 25.5-46.4 cm ( $31.5 \pm 6.17$ )
- ✓ None of individual from 25 radio tagged fish passed through pool-orifices fish passage in Fırnız Stream.



Table 5. Radio tagged *Capoeta angorae* individuals and their passing status through the vertical slot fish passage.

Frequencies of the tags	Code of the tag	TL (cm)	
149.420	11	38.3	Dead
149.420	12	29.0	Dead
150.300	115	31.3	Passed
150.320	116	36.6	Passed
149.480	48	44.8	Passed
149.480	46	30.0	Passed
150.300	84	26.7	Passed
149.480	45	26.0	Passed
149.480	49	24.5	Did not pass
150.300	83	25.5	Passed
150.300	80	25.8	Passed
150.300	81	25.2	Did not pass
150.300	111	28.9	Passed

Frequencies of the tags	Code of the tag	TL (cm)	
150.300	110	46.4	Passed
149.420	14	35.9	Passed
149.420	13	35.5	Passed
149.480	60	27.0	Passed
149.480	62	29.7	Passed
149.480	63	28.4	Passed
150.300	88	37.5	Did not pass
149.480	68	34.6	Did not pass
148.480	65	32.7	Did not pass
149.480	61	31.4	Passed
150.300	103	30.0	Passed
150.300	104	29.0	Did not pass
150.300	101	27.0	Passed



# CONCLUSION

✓ In Ceyhan River basin three types of fish passages have been constructed:

- ✓ Pool-orifices passes,
- ✓ Vertical slot passes and
- ✓ Denil Passes

✓ Majority of these are often unsuitable:

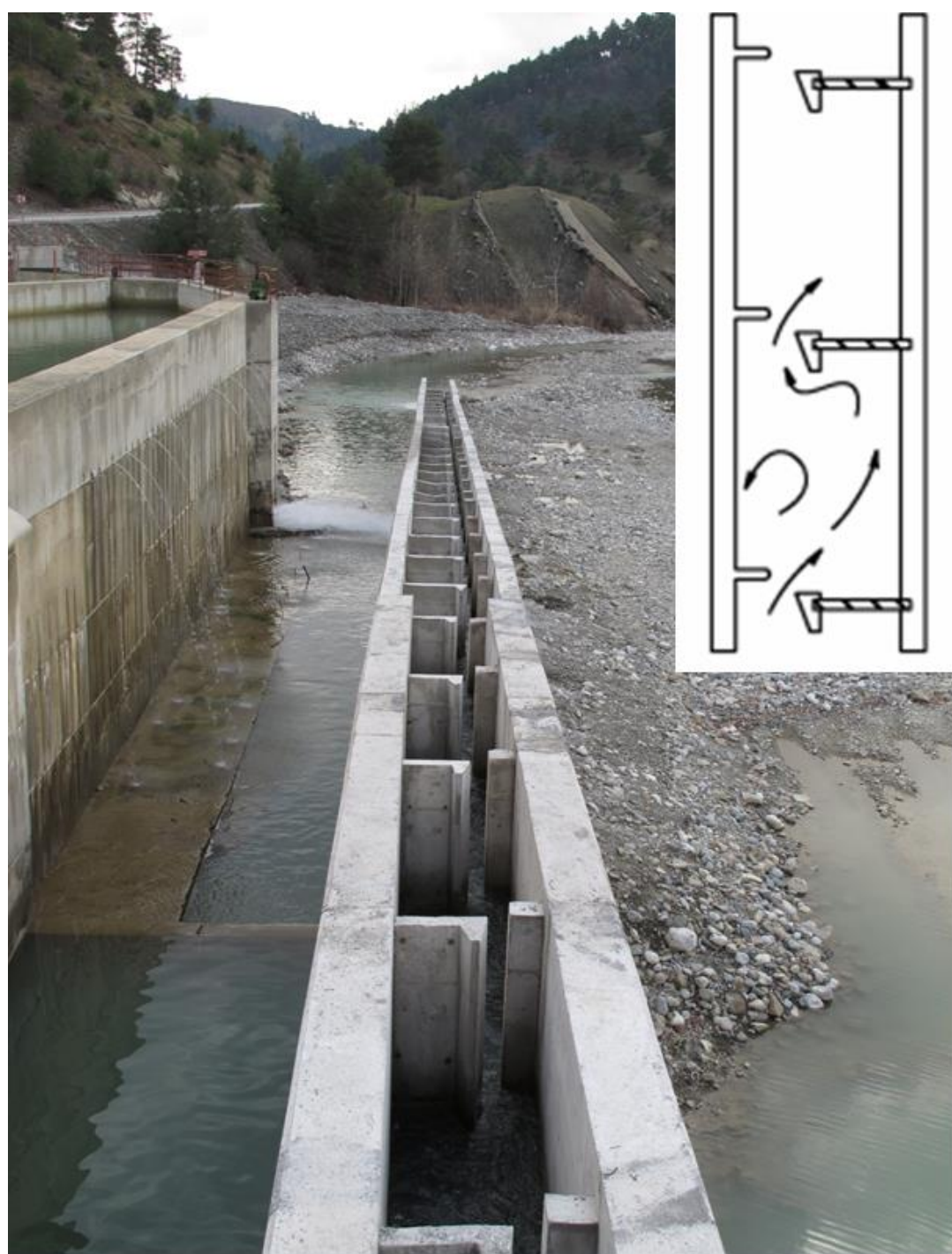
- ✓ in terms of structure and
- ✓ due to inadequate environmental flows in the streams.

✓ In addition, some of them have been destroyed.















# CONCLUSION

- ✓ Pool type fish passage was determined as ineffective due to inadequate environmental flows and weirs before the fish passage.
- ✓ A total of 400-500 *C. angorare* and 250-300 *Alburnus kotschy* passed through the vertical slot fish passage annually.
- ✓ The performance of the vertical flow fish passage was:
  - ✓ 10.7% according to external tagging,
  - ✓ 20.0% according to PIT telemetry,
  - ✓ 75.0% according to radio telemetry
- ✓ These differences resulted from the size of the tagged fish.
- ✓ Because, majority of the *Capoeta angorae* passed through the fish passage have bigger than 20 cm in length.
- ✓ In radio telemetry, the bigger fish were used while smaller fish were used in the external tagging and PIT telemetry.

# Acknowledgements

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**Thank you for  
your attention.**

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