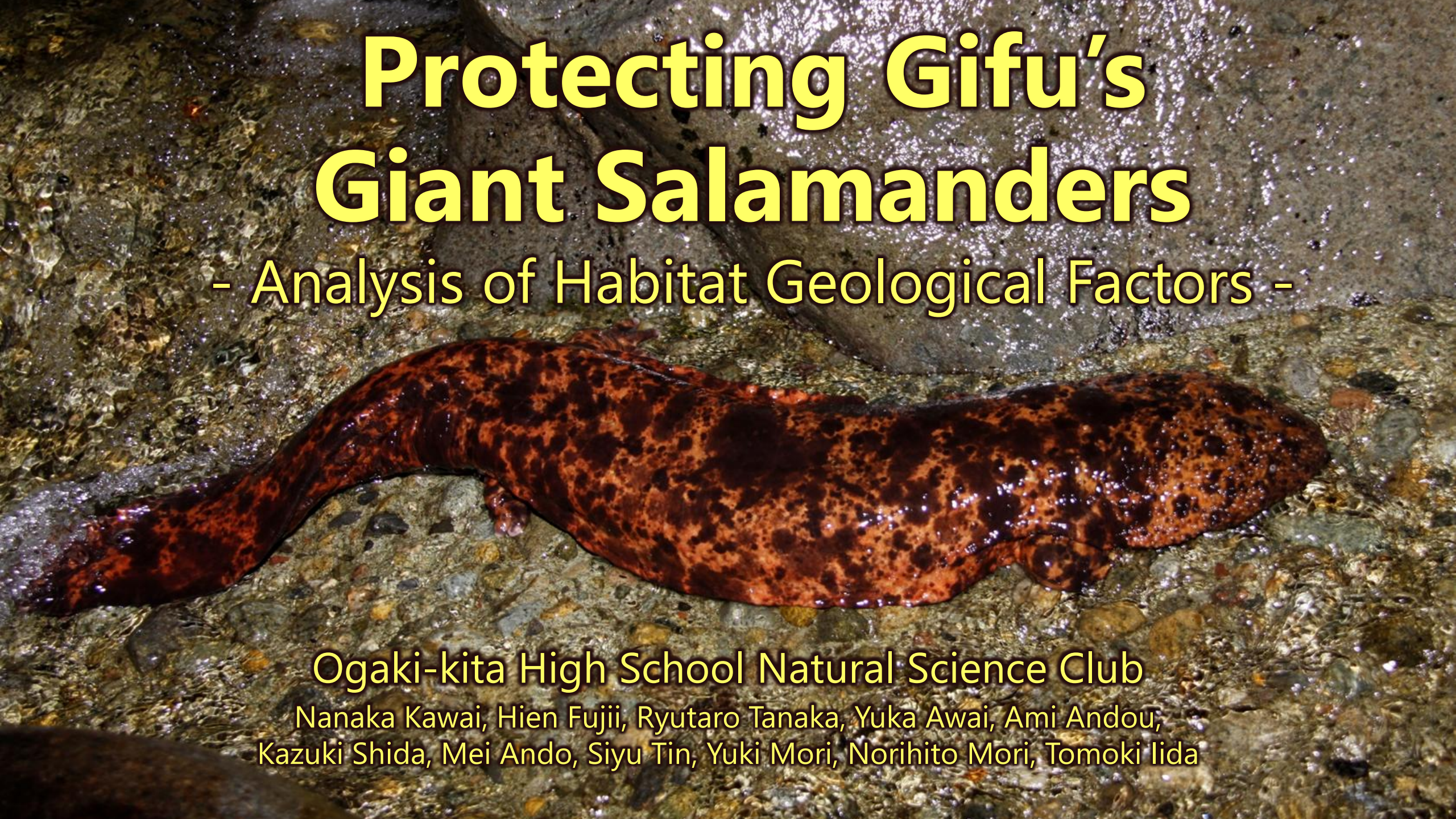
Protecting Gifu's Giant Salamanders

- Analysis of Habitat Geological Factors -



Ogaki-kita High School Natural Science Club

Nanaka Kawai, Hien Fujii, Ryutaro Tanaka, Yuka Awai, Ami Andou,
Kazuki Shida, Mei Ando, Siyu Tin, Yuki Mori, Norihito Mori, Tomoki Iida

1. Introduction

Fig. : Giant salamander (Photographed in Shirakawa-town, Gifu Prefecture)

Giant Salamander

- Special natural monument
- The world's largest amphibian
- Lives west of Gifu Prefecture

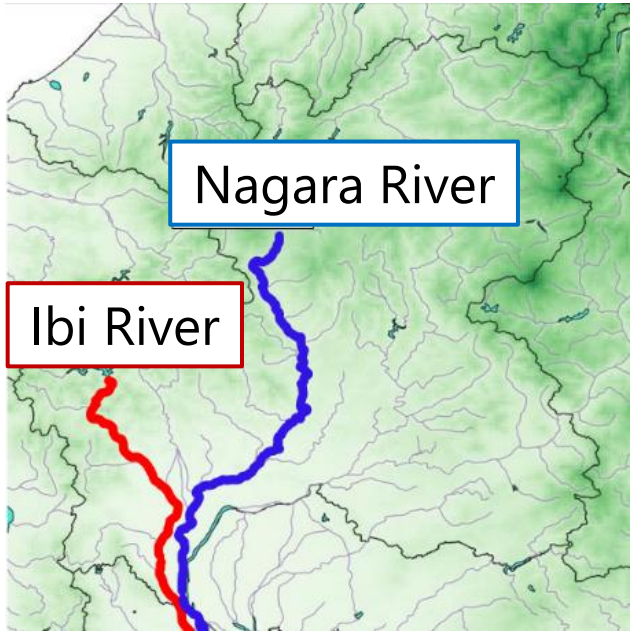


Fig. : Main stream of the Ibi River and Nagara Rivers

Habitat in Gifu Prefecture

✓ **Nagara River** ▶ **Inhabit**

✓ **Ibi River** ▶ **NOT inhabit**

Distribution and habitat conditions in Gifu Prefecture are NOT well surveyed yet!

1. Introduction - Surveys Up until Last Year -

- The difference in the current gradient between rivers inhabited by giant salamanders and the Ibi river, where they don't inhabit
- The difference of watershed area, water quality, climate, and fish fauna between the Nagara and Ibi rivers

  ▶ **There's no big difference**

- Topography of the Nagara and Ibi Rivers during the most active period of the giant salamander's range expansion

  ✓ Nagara River : **well-developed river**

  ✓ Ibi River : **developing**

- Geology of the Nagara and Ibi River rivers

  ▶ **The habitat burrows are easily buried** by Masatsuchi in Ibi river (see phot at right)

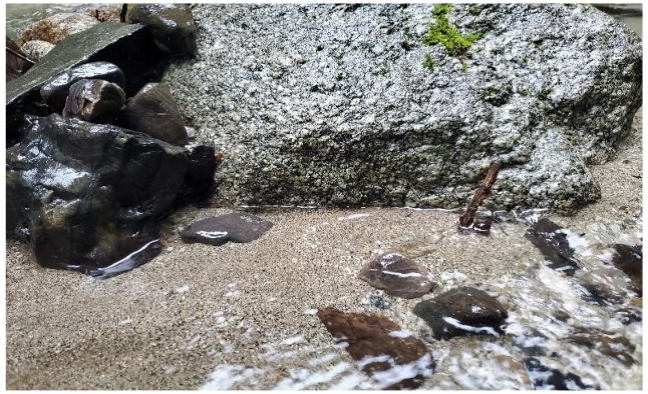


Fig. : Hole in a river buried by Masatsuchi

▼ Raising a Question

Are there **other factors** that affect salamander habitat?

▼ Survey Contents

Tributaries of the Nagara and Ibi Rivers

- Survey on tributary geomorphology
- Interviews on the distribution of giant salamanders

⇒ Analysis of habitat conditions

2. Survey and Analysis Methods

1. Investigation of the distribution of habitats

Interviews at 34 rivers tributary to Nagara and Ibi rivers

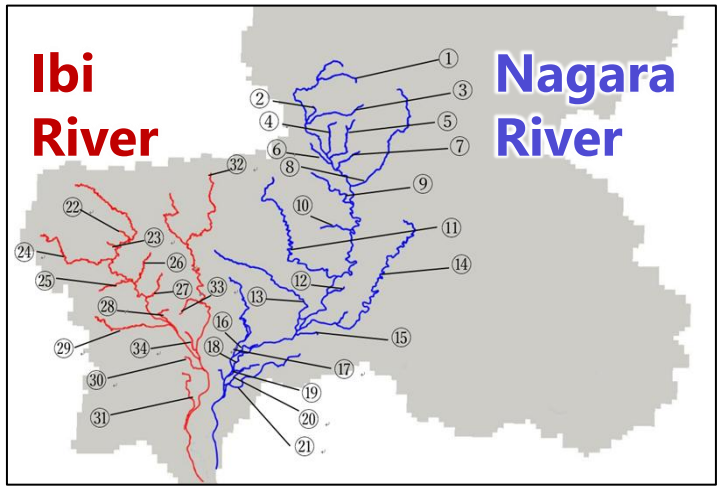


Fig. : Tributaries of the Nagara and Ibi Rivers studied

2. Investigation of geological factors

Four factor study using Google Earth Pro

Geological factors were investigated in each tributary

- **Length of river**
- **Elevation of headwaters**
- **Elevation of confluence**
- **Gradient of river**

Binomial logistic regression analysis was performed with presence/absence as the objective variable and the four factors above as explanatory variables.

3. Survey results

14 rivers upstream of the Nagara River were confirmed to be inhabited.

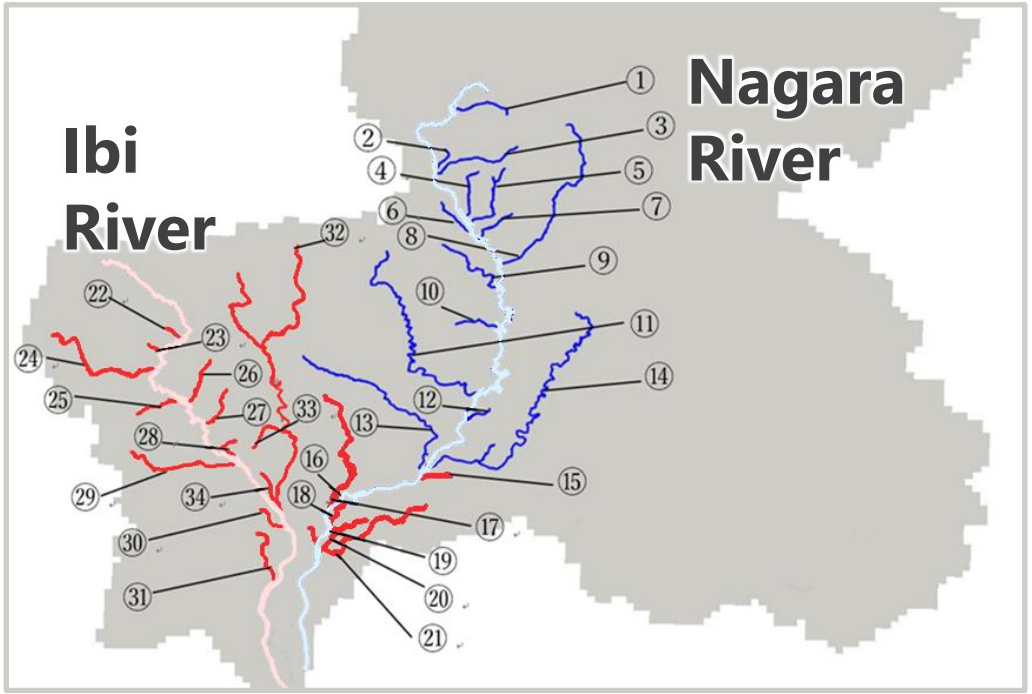


Fig. : Results of Interviews on the Ibi and Nagara Rivers

- Rivers inhabited by giant salamanders
- Rivers where giant salamanders do not inhabit

Presence/absence of salamanders and geological factors measured

		河川名	生息の有無	河川長(km)	源流の標高(m)	合流点の標高(m)	河床勾配
長良川	1	鷲見川	有	10.21	1119	567	0.05406
	2	曽部地川	有	3.13	461	354	0.03419
	3	牛道川	有	14.47	1291	346	0.06531
	4	大間見川	有	8.29	486	271	0.02593
	5	栗巣川	有	13.14	971	265	0.05373
	6	落部谷川	有	6.37	515	256	0.04066
	7	神路川	有	7.89	561	239	0.04081
	8	吉田川	有	32.10	977	207	0.02399
	9	亀尾島川	有	12.32	495	198	0.02411
	10	粥川	有	7.19	534	140	0.05480
	11	板取川	有	50.80	894	69	0.01624
	12	余取川	有	3.77	136	57	0.02095
	13	武儀川	有	29.10	335	32	0.01041
	14	津保川	有	55.66	566	28	0.00967
	15	山田川	無	4.49	68	26	0.00935
	16	両満川	無	3.24	15	5	0.00309
	17	新堀川	無	4.66	15	12	0.00064
	18	論田川	無	4.77	13	4	0.00189
	19	荒田川	無	6.78	8	0	0.00118
	20	大江川	無	5.19	8	2	0.00116
	21	境川	無	22.24	22	4	0.00081
揖斐川	22	原谷川	無	4.06	736	226	0.12562
	23	親谷	無	4.00	472	193	0.06975
	24	坂内川	無	18.75	764	193	0.03045
	25	日坂川	無	12.22	1077	99	0.08003
	26	高知川	無	9.90	333	98	0.02374
	27	飛鳥川	無	5.80	180	90	0.01552
	28	粕川	無	21.07	639	34	0.02871
	29	桂川	無	7.74	67	27	0.00517
	30	平野井川	無	7.74	20	9	0.00142
	31	水門川	無	17.26	10	1	0.00052
	32	根尾東谷川	無	22.59	559	159	0.01771
	33	管瀬川	無	6.64	75	57	0.00271
	34	花田川	無	4.11	22	15	0.00170

4. Analysis

❶ Selecting the Best Model

Selection of explanatory variables with high accuracy

Table: AIC for each combination

variable	AIC	ΔAIC
river length / confluence elevation	31.08	-
confluence elevation	36.67	5.59

Note : Show excerpts from all combinations

Minimum AIC model selection results the combination of **river length** and **confluence elevation** is the most accurate.

❷ Partial Regression Coefficient

Relationship between explanatory and objective variables

Table : Comparison of Partial Regression Coefficients, P-values, and Standard Deviations for Each Explanatory Variable

	Partial regression coefficient	P-vlaue
River length [km]	0.1010	0.0316
confluence elevation [m]	0.0170	0.0028
Constant term	-4.0105	0.0023

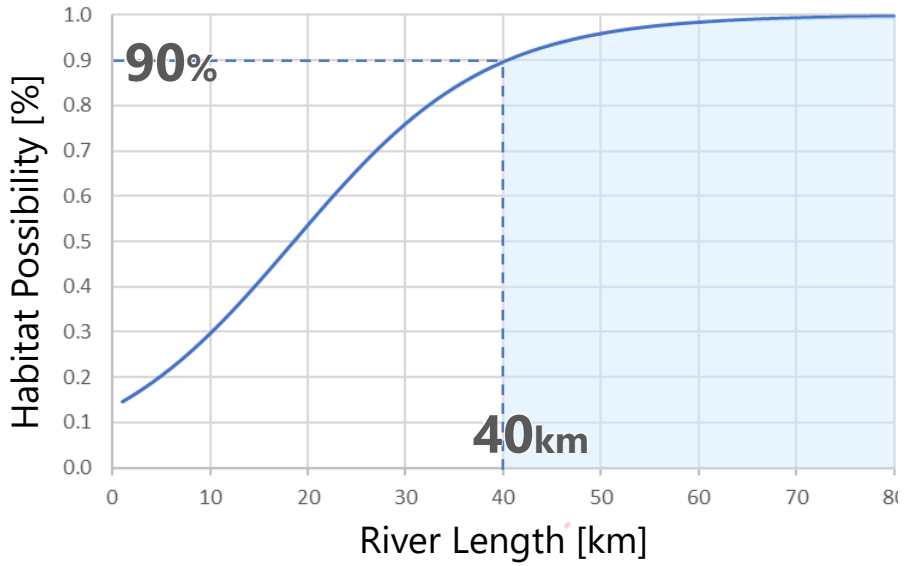
Partial regression coefficient of river length and confluence elevation
⇒ **Positive**

4. Analysis

3 Response Curve Creation

Response curve for river length [km]

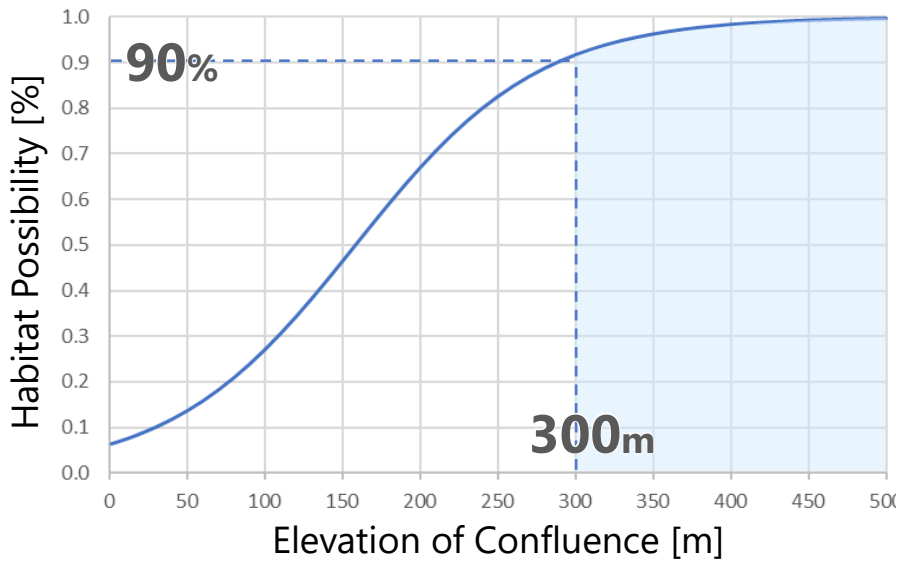
When the river length is the average of the two rivers



Habitat probability exceeds **90%** when the river length exceeds **40 km**

Response curve for elevation [m]

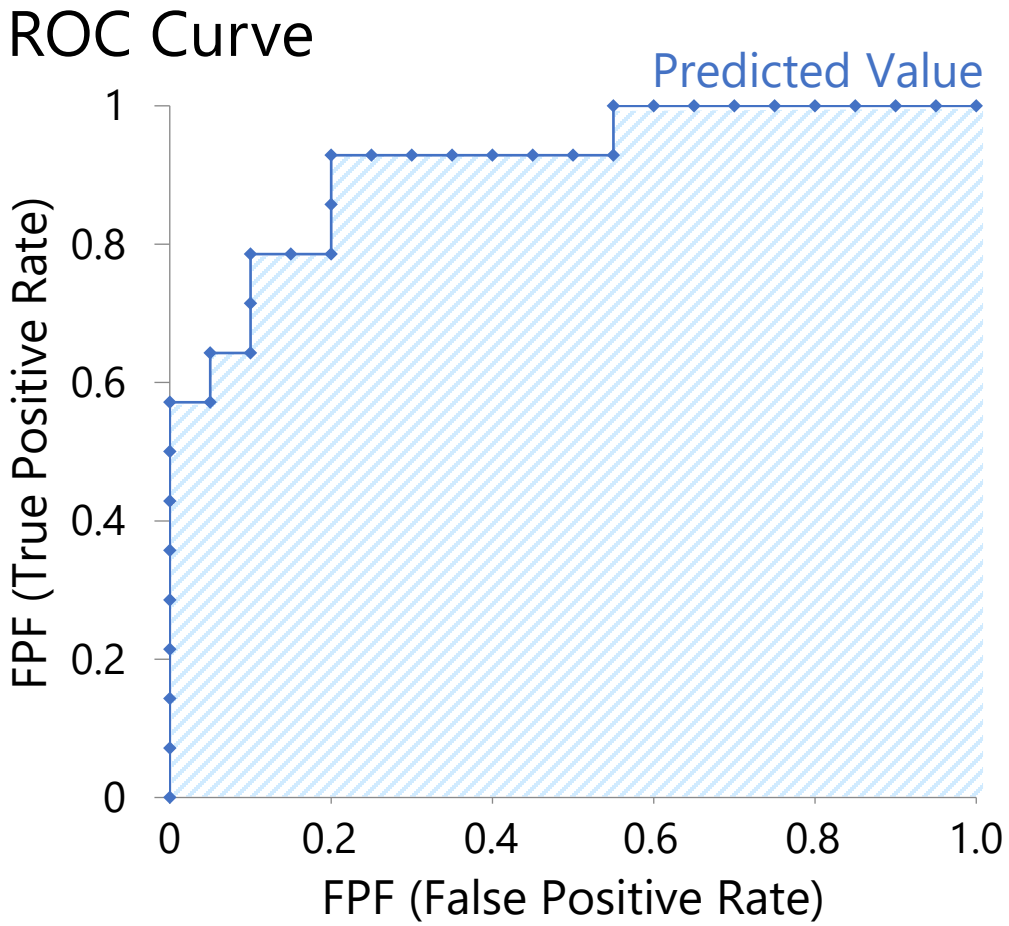
When elevation at the confluence is the average of Nagara and Ibi Rivers



Habitat probability exceeds **90%** when elevation of river confluence exceeds **300 meters**

❹ ROC Curve

Checking the accuracy of regression equations



The area under the ROC curve is **0.9143** (>0.7)

The regression equation is accurate in this case.

5. Consideration

▼ Conclusion

The greater the river length and the higher the elevation of the confluence, the better the habitat for the giant salamander.

▼ Consideration

- Larger river lengths increase the size of the habitat

  Larger habitat size ⇒ larger population ⇒ maintenance of diversity ⇒ less likely to become extinct ⇒ advantageous for habitat

- The higher the elevation, the lower the water temperature, which is suitable for their inhabit.

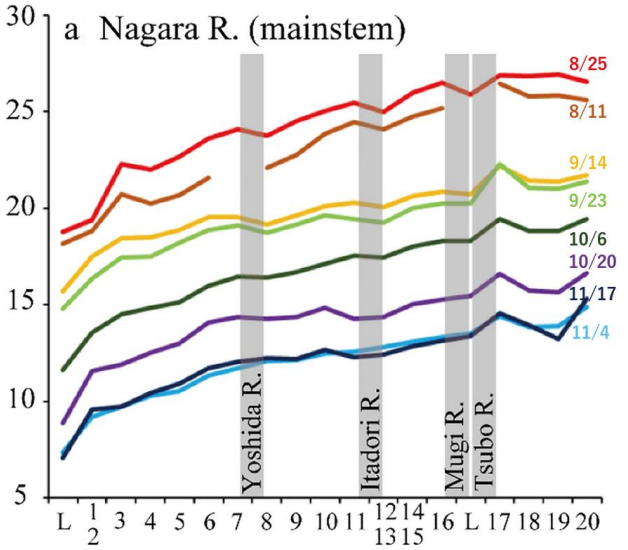
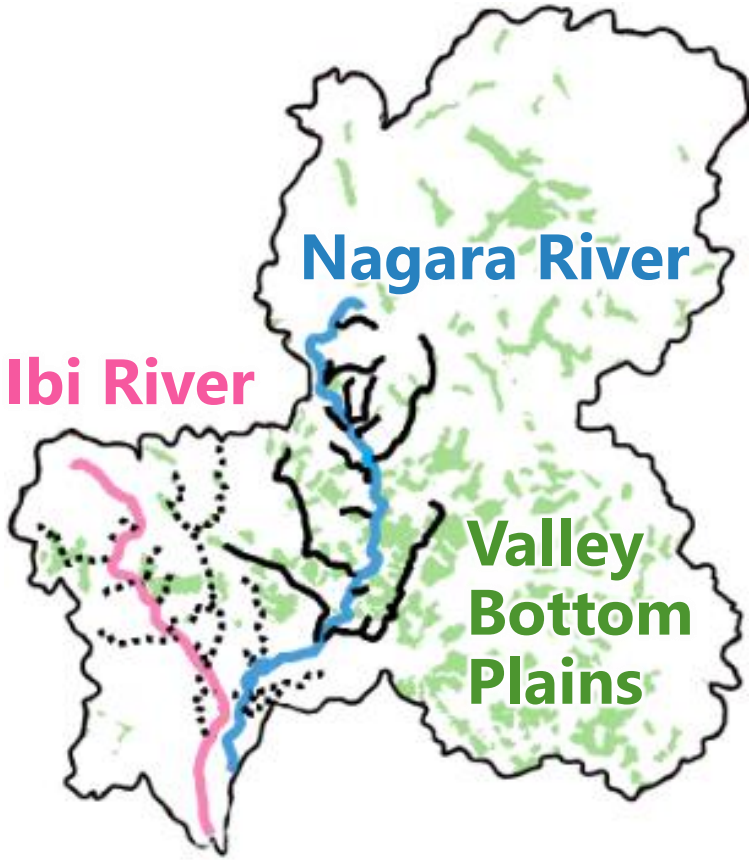


Figure: Nagara River water temperature (modified from S.Nagayama.et al.2023)

5. Consideration



Valley Bottom Plain
Rivers inhabited by salamanders
Rivers where giant salamanders do not inhabit

Fig : Valley bottom plains in Gifu Prefecture
modified from the Gifu Prefecture Landscape Formation Guidelines

Valley Bottom Plain (谷底平野)

- Its distribution coincides with that of the giant salamander.
- They are formed when sediment from upstream is deposited in the bottom of V-shaped valleys in the mountains.
- Many watersheds have a slow flow.

Many rivers in the valley bottom plains are habitat-rich for the giant salamander

6. Proposal - Conservation of the Japanese Giant Salamander-

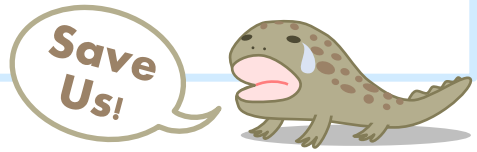
Rivers with larger river lengths and higher confluence elevations in valley bottom plains are more habitat-rich for the giant salamander.

Fig. : Weir with a slope on the Muro River in Nara Prefecture

Need various efforts like…

- Weirs that make it easier for giant salamanders to migrate upstream
- Seawall with artificial burrows

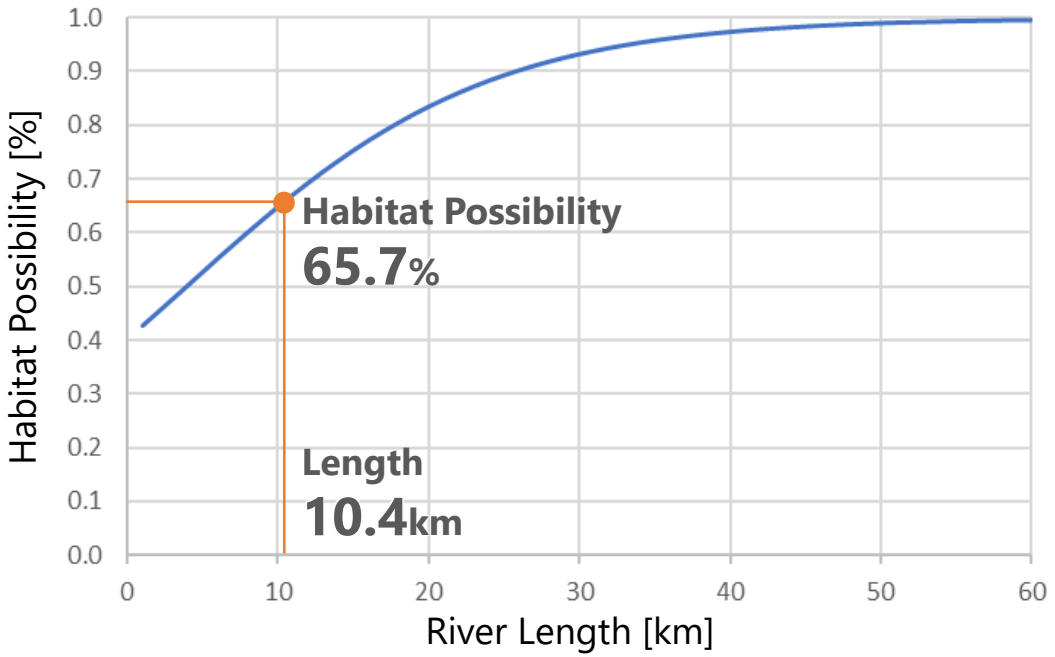
Let's create more habitat conductive rivers!



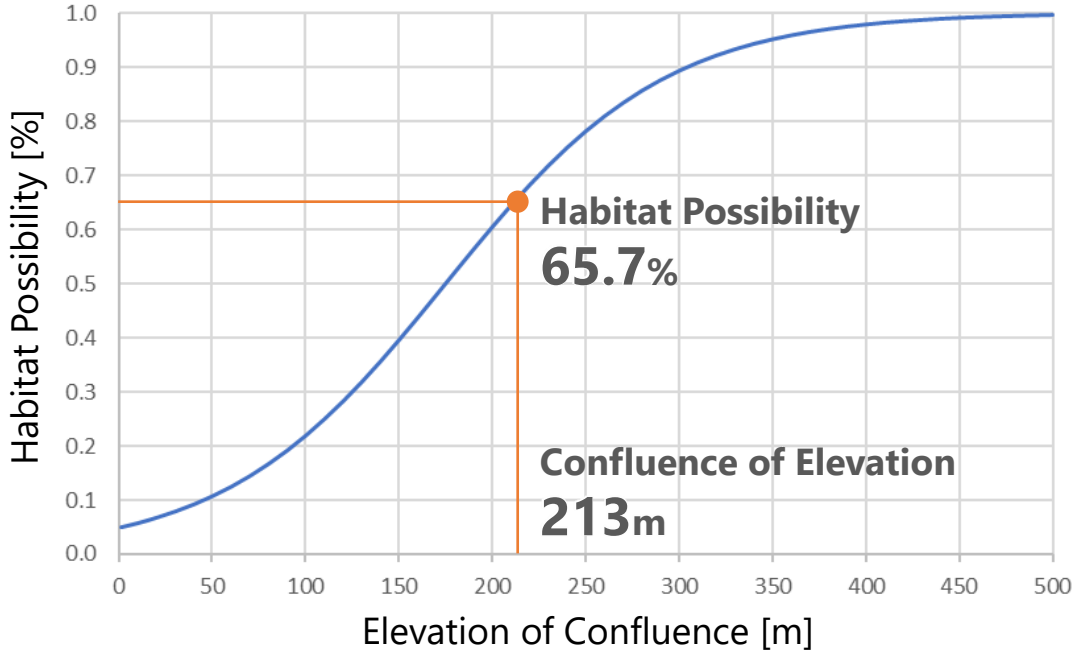
7. Hybridization Problem in Gifu Prefecture

We conducted additional fieldwork on the **Sugata River**, where our analysis indicates that the probability of habitation is over **65%.**

Response curve for river length of Sugata River [km]



Response curve for elevation of Sugata River [m]



7. Hybridization Problem in Gifu Prefecture

Gifu's FIRST hybrid individual discovered in Sugata River!

Domestic Individual

Hybrids with Chinese Species

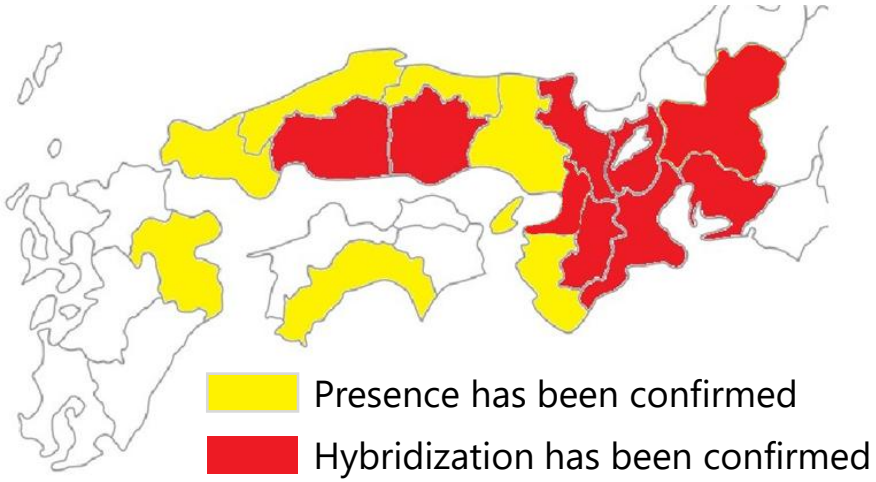


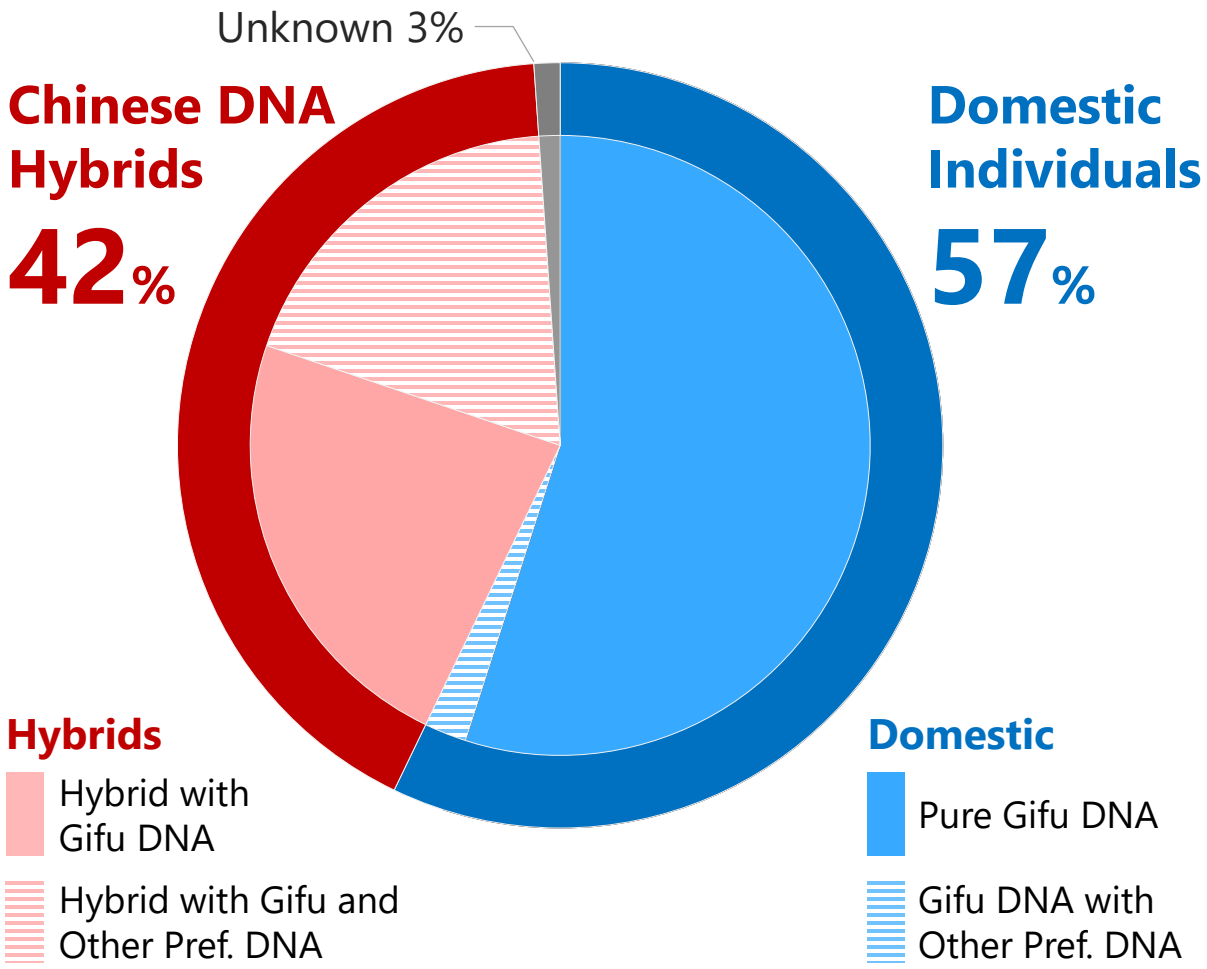
Fig.: Prefectures where hybridization with the Chinese salamander has been confirmed

Hybrids had NOT been discovered in Gifu until this survey.

No survey has been conducted, and the **progress of hybridization is unknown yet**.

7. Hybridization Problem in Gifu Prefecture

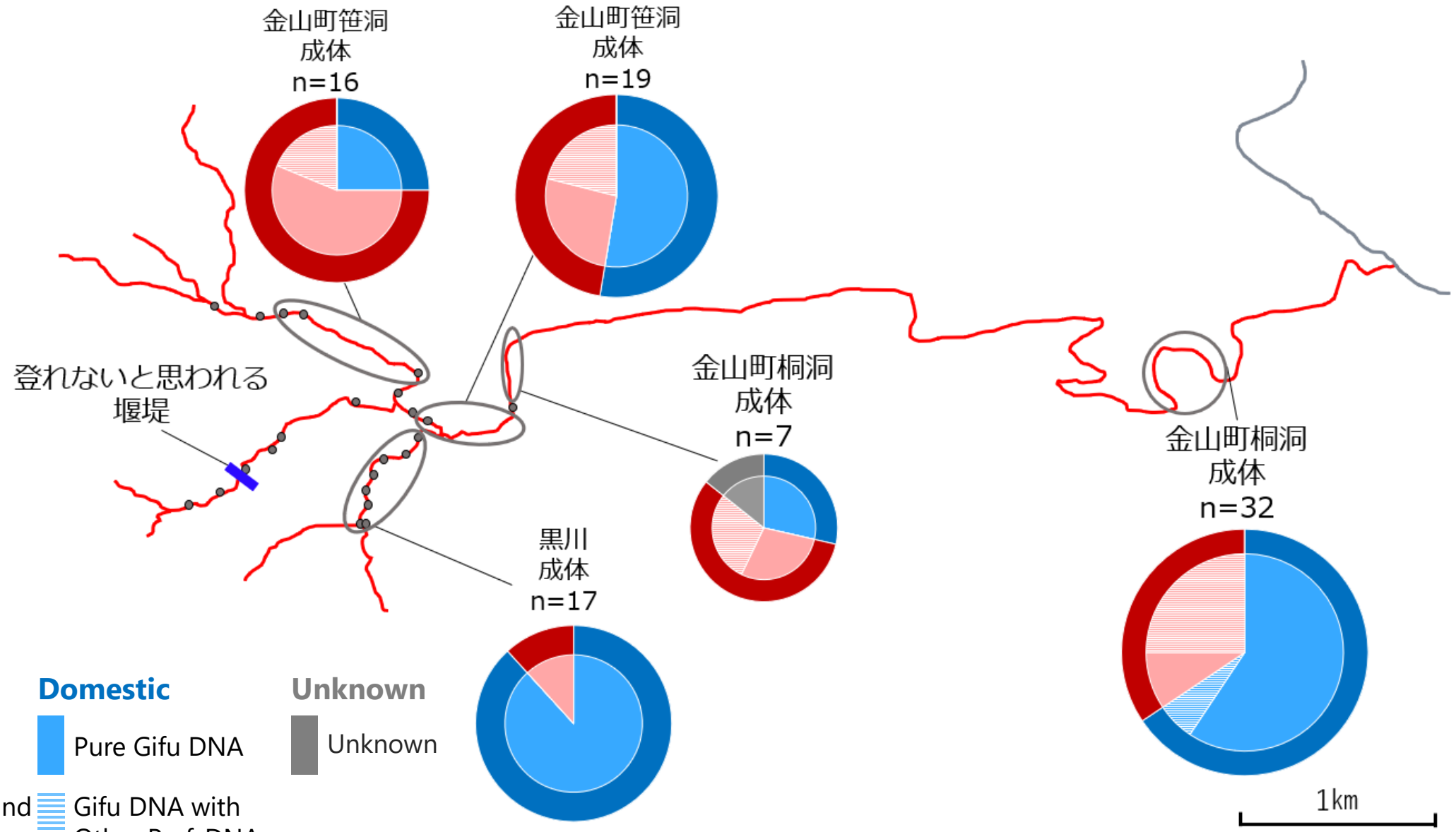
Breakdown of 91 individuals' DNA studied in Sugata River



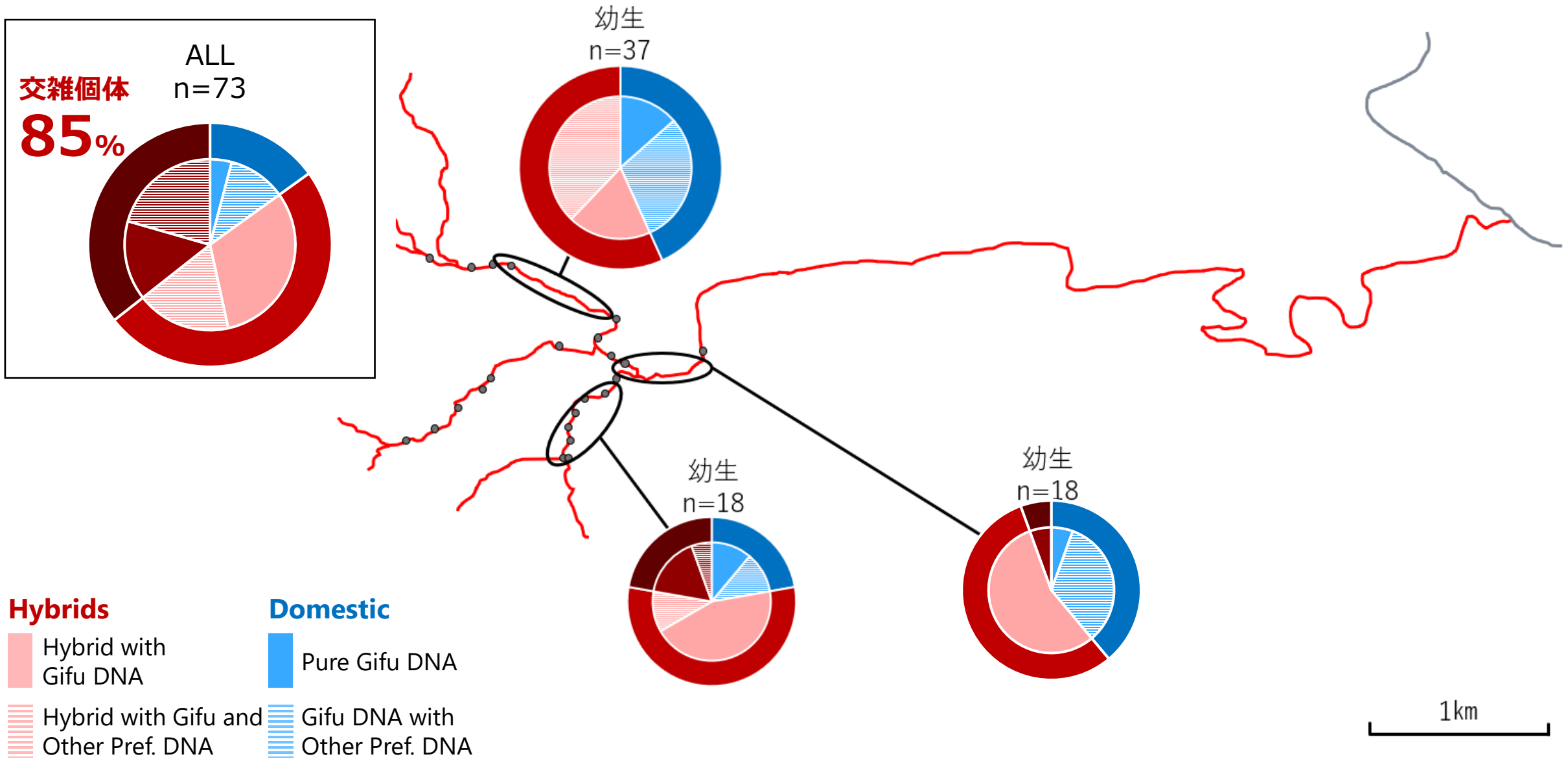
What should we do to eradicate the hybrids?

- Find and preserve environments where only native Japanese species inhabit
- Continue to study and eradicate hybrid individuals

7. Hybridization Problem in Gifu Prefecture-Adult-



7. Hybridization Problem in Gifu Prefecture-Larvae-



8. Future Prospects

- We hope to use trends related to salamander habitat obtained from this survey for our field research and conservation efforts.
- We will analyze other environmental factors as well.
- Through field surveys and environmental DNA studies, we hope to better understand the current status of the Gifu Salamander and its hybrids.

9. Acknowledgements

In conducting this study, we are grateful to Kazuki Kanno, a researcher at the National Research Institute of Public Works, for his advice on binomial logistic regression analysis. For the distribution survey of Japanese giant salamanders, we are also grateful to the Gifu Prefecture and Gujo City departments, fishery cooperatives, and researchers for their willingness to provide information.

1. 鷲谷いづみ, 矢原徹一 , 1996, 保全生態学入門, 文一総合出版, 東京
2. 秋山美奈子, 武藤鉄司, 2006, 下流域沖積河川系における河岸段丘の形成機構：水路実験における複雑応答説の検証
3. 山本康仁, 千賀裕太郎, 2012, 都市化により分断化された水田におけるトウキョウダルマガエル Rana porosa porosa の分布と環境要因の関係
4. 幡谷竜太, 2017,「長期的な大地の動きを探る」隆起と沈降、堆積と侵食
5. 松原典孝, 2019, 河川の特徴とそれにかかわる地学的要因
6. 岐阜県景観形成ガイドライン | https://www.pref.gifu.lg.jp/uploaded/attachment/17833.pdf
7. Google Earth Pro
8. Bellcurve for Excel（version4.04）
9. QGISダウンロードサイト | https://qgis.org/ja/site
10. Shigeya Nagayama,Masanao Sueyoshi,Ryoji Fujii,Morihiro Harada,Basin-scale spatiotemporal distribution of ayu Plecoglossus altivelis and its relationship with water temperature from summer growth to autumn spawning periods