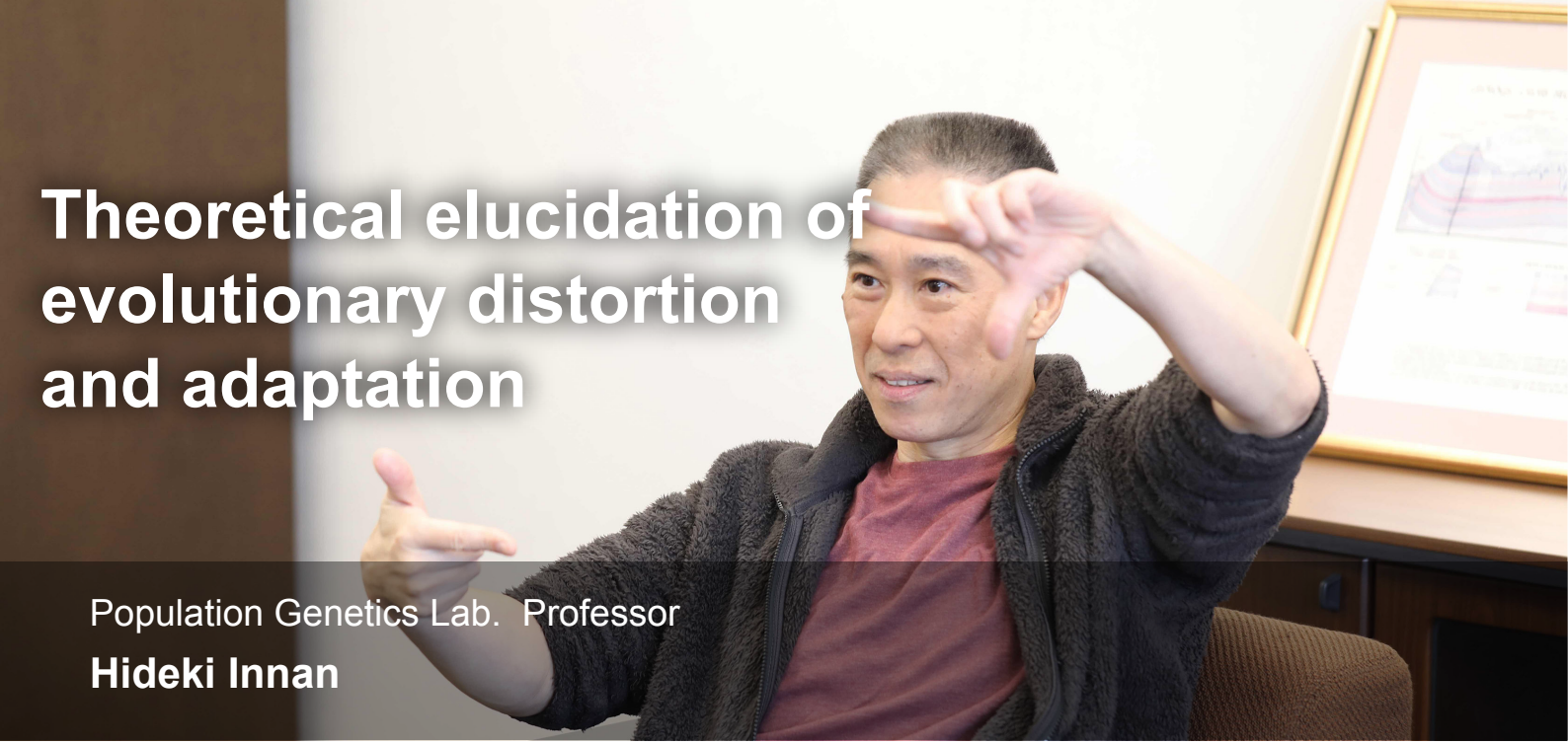

Theoretical elucidation of evolutionary distortion and adaptation

Population Genetics Lab. Professor
Hideki Innan

Q: What is the one thing you want to know the most right now?

When a system undergoes significant evolution, distortions inevitably arise. Overcoming these distortions often comes with pain. This phenomenon is not limited to living organisms; it applies to all domains, including society and the economy. I aim to theoretically elucidate this process.

Currently, I am particularly focusing on biological systems, exploring how numerous genes within the genome interact and contribute to large-scale system evolution. To achieve this, I am advancing genetic theories and expanding our understanding of evolutionary mechanisms.

Q: What do you mean by “large-scale system evolution” ?

For example, during the several decades following the late Edo period, approximately 200 years ago, Japan underwent a dramatic transformation in its social structure. The political decision-making system changed drastically, and the class system was also reformed. Throughout this process, various conflicting interests clashed, and much blood was shed.

However, Japan did not discard everything from the Edo period and rebuild society from scratch. Certain elements, such as the legal system and the merchant culture, remained. What is particularly fascinating is that Japan reutilized the imperial system as the central framework of the state, despite it having been politically dormant at the time.

The evolution of biological systems shares similar aspects. Although rare, there are moments when the environment undergoes drastic changes, forcing organisms to undergo significant transformations to adapt. In such cases, species try to evolve as efficiently as possible by utilizing the systems they have built over time.

During this process, previously used but now inactive systems may sometimes be repurposed. Understanding the underlying mechanisms behind such system evolution from a theoretical perspective remains a major challenge.

Q: What does it mean to understand something theoretically?

It means grasping everything through logical reasoning, identifying the fundamental essence of a phenomenon, and organizing it to the point where it can be quantitatively or probabilistically expressed in mathematical equations.

By doing so, evolution can not only be discussed within a general framework but also be used to predict future changes that may occur.

Q: Could you share your thoughts on the future prospects of this field?

Biological systems can be represented as gene regulatory networks composed of numerous interacting genes. Advances in molecular biology have significantly deepened our understanding of gene functions. Consequently, our ability to unravel the complexities of higher-order biological systems is accelerating. Moving forward, I aim to refine theoretical frameworks with greater precision, leveraging technologies such as AI. Although indirect, these advancements should also contribute to understanding and predicting societal evolution.

For instance, with the emergence of blockchain technology, the traditional financial system—centered around national banks—is being reevaluated. Throughout this transformation, various conflicts and distortions will arise, eventually leading to the stabilization of a new economic system. If we can understand and predict this process logically, it could translate into lucrative business opportunities.

In this way, our research on biological evolution extends beyond life sciences, offering insights applicable to a broader perspective. This integrative approach to evolution is precisely what our research center defines as “Integrative Evolutionary Science.”

Q: Do you have a message for undergraduate and graduate students who are interested in joining your lab?

I love gambling. I might even be addicted to it (haha). But I have absolutely no interest in games of pure luck. What truly matters is thinking through every possibility, anticipating all possible scenarios, calculating relentlessly (this is key!), and making a bold move when the time is right. The thrill of making the right call and seeing the results follow is strikingly similar to the sense of achievement when research goes well.

For example, in games like mahjong or poker, where probability and logic are key to finding the winning move, luck alone is never enough to consistently win. Research is the same—it requires analyzing data, thinking logically, and sometimes making bold hypotheses. In this sense, I feel that the essence of gambling and research are fundamentally connected.

If you're undefeated in mahjong or poker, a high-level player in Go or chess, a professional gambler in pachinko or slots, or consistently profitable in stocks, FX, or cryptocurrency trading—then welcome. And of course, even beyond that, anyone who can approach unsolved problems with logic and persistently seek solutions is well-suited for theoretical evolutionary science.