NORTHERN COMMITTEE
Twenty-First Regular Session

14 – 15 July 2025
Toyama, Japan (Hybrid)

Stock Structure and Distribution of Pacific Bluefin tuna

WCPFC-NC21-2025/WP-08

Pacific Bluefin Tuna Working Group
ISC[1]

[1] International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean

Stock Structure and Distribution of Pacific Bluefin tuna

Bluefin tunas in the Pacific and Atlantic Oceans were once considered a single species (*Thunnus thynnus*) with two subspecies (*Thunnus thynnus orientalis* and *Thunnus thynnus thynnus*, respectively), but are now recognized as distinct species (*Thunnus orientalis* and *Thunnus thynnus* for Pacific and Atlantic bluefin tunas, respectively) based on genetic and morphometric studies (Collette 1999). This taxonomic distinction is adopted by pertinent tuna RFMOs, the Food and Agriculture Organization of the United Nations (FAO), and ISC.

PBF are mainly distributed in subtropical and temperate latitudes between 20°N and 50°N, although they are occasionally encountered in tropical waters and in the southern hemisphere (Fujioka et al. 2015). There are several spawning grounds of PBF in the western North Pacific Ocean (WPO) (Ohshimo et al. 2018, Tanaka et al. 2020), and two of them have been considered major spawning grounds: 1) waters between the Ryukyu Islands in Japan and the eastern coast of Taiwan islands; and 2) the southern portion of the Sea of Japan (Schaefer 2001). Conversely, no evidence of PBF reproduction has been observed in the eastern Pacific Ocean (EPO) despite there being enough older PBF for reproduction (Dewar et al. 2022). A study on the natal origin of adult PBF caught either in the waters around the Ryukyu Islands or in the Sea of Japan indicated that they originated from both of these spawning grounds (Uematsu et al. 2018). Similarly, elemental analysis of otoliths from adult PBFs caught in the waters around Taiwan indicated that they also originated from both known spawning grounds (Rooker et al. 2021). Additionally, age-1 PBFs caught in the EPO have been traced back to both known spawning grounds using trace elements in their otoliths (Wells et al. 2020). These findings support the notion of a single stock for PBF, as there is no significant difference in the natal origin between the two known spawning grounds. Genetics and tagging studies (e.g., Bayliff 1994, Tseng and Smith 2012) further support the assumption of a single stock for PBF. A review conducted by Nakatsuka (2019) concluded that there is no evidence exclusively suggesting the existence of multiple stocks after examining available genetic and reproductive information, otolith and vertebrae data, and fishery data. As a result, a single highly migrating stock is assumed in the PBF assessment within the ISC and is acknowledged by the RFMOs (WCPFC and IATTC).

Despite substantial inter-annual variations in movement in terms of the numbers of migrants, timing of migration, and migration routes, the movements of PBFs are among the most extensively documented among highly migratory species. Mature adults in the WPO typically migrate northward to feeding grounds following spawning (Fujioka et al. 2025), although a small proportion of fish may move southward or eastward (Itoh 2006). Fish aged 0-1 that have hatched in the waters surrounding the Ryukyu Islands and eastern Taiwan main Island migrate northward with the Kuroshio Current during the summer as they grow, while age-0 fish that have hatched in the Sea of Japan migrate along the coastlines of Japan and Korea (Inagake et al. 2001, Itoh et al. 2003). Depending on oceanic conditions, an undetermined portion of immature fish aged 1-3 in the WPO makes a seasonal clockwise eastward migration across the North Pacific Ocean

(stable isotope in muscle tissues: Tawa et al. 2017, Madigan et al. 2017), spending several years as juveniles in the EPO before returning to the WPO (Inagake et al. 2001). The drivers behind this trans-Pacific migration have been hypothesized to be limitations in food sources in the WPO and favorable oceanographic conditions (Polovina 1996). While PBFs are in the EPO, juveniles make seasonal north-south migrations along the west coast of North America (Kitagawa et al. 2007, Boustany et al. 2010). In spring, they are found in the waters off the southern coast of Baja California, and as summer approaches and waters warm, they move northwest into the southern California Bight. By fall, PBF distribute in the waters off central and northern California. After spending 3-4 years in the EPO, PBF migrate westward, presumably for spawning, as no spawning grounds have been observed outside of the WPO. This westward migration typically occurs from December to March as they begin their migration along the coast of California (Boustany et al. 2010). The considerable seasonal (Fujioka et al. 2021) and interannual variations in trans-Pacific movement make it challenging to quantify migration rates accurately. A certain, albeit limited, number of individuals migrate to the southern hemisphere, especially waters off Australia and New Zealand, and most of the observed fish in that region were relatively large PBF, exceeding 180 cm in length (Bayliff 1994). However, information on these southern hemisphere migrants is limited due to the paucity of observations in the area.

1. References

Bayliff, W. H. 1994. A review of the biology and fisheries for northern bluefin tuna, *Thunnus thynnus*, in the Pacific Ocean. FAO Fish. Tech. Pap. 336/2: 244-295.

Boustany, A. M., Matteson, R., Castleton, M., Farwell, C. and Block, B. A. 2010. Movements of pacific bluefin tuna (*Thunnus orientalis*) in the Eastern North Pacific revealed with archival tags. Progress in Oceanography 86 (1-2), 94-104.

Collette, B. B. 1999. Mackerels, molecules, and morphology. In Séret, B. and Sire, J.-Y. (eds.), Proceedings of 5th IndoPacific Fish Conference, Nouméa, New Caledonia, 1997. Société Française d'Ichthyologie, Paris, France. pp. 149-164.

Dewar, H., Snodgrass, O. E., Muhling, B. A. and Schaefer, K. M. 2022. Recent and historical data show no evidence of Pacific bluefin tuna reproduction in the southern California Current system. PLoS ONE 17(5): e0269069.

Fujioka, K., Masujima, M., Boustany, A. M., and Kitagawa, T. 2015. Horizontal movements of Pacific bluefin tuna. In Kitagawa, T. and Kimura, S. (eds.), Biology and ecology of bluefin tuna. CRC Press, Boca Raton London, New York. pp. 101-122.

Fujioka, K., K. Sasagawa, Kuwahara, T., Estess, E. E., Takahara, Y., Komeyama, K., Kitagawa, T., Farwell, C. J., Furukawa, S., Kinoshita, J., Fukuda, H., Kato, M., Aoki, A., Abe, O., Ohshimo, S. and Suzuki, N. 2021. Habitat use of adult Pacific bluefin tuna *Thunnus orientalis* during

the spawning season in the Sea of Japan: evidence for a trade-off between thermal preference and reproductive activity. Mar. Ecol. Prog. Ser. 668: 1-20. https://doi.org/10.3354/meps13746.

Fujioka, K., Hiraoka, Y., Kuwahara, T., Tsukahara Y., Fukuda, H. 2025. Post-spawning migration and habitat use of adult Pacific bluefin tuna (*Thunnus orientalis*) in the western North Pacific. Marine Biology. 172:34. https://doi.org/10.1007/s00227-025-04596-6

Inagake, D., Yamada, H., Segawa, K., Okazaki, M., Nitta, A. and Itoh., T. 2001. Migration of young bluefin tuna, *Thunnus orientalis* Temminck et Schlegel, through archival tagging experiments and its relation with oceanographic condition in the western North Pacific. Bull. Natl. Res. Inst. Far Seas Fish. 38: 53-81.

Itoh, T. 2006. Sizes of adult bluefin tuna *Thunnus orientalis* in different areas of the western Pacific Ocean. Fish. Sci. 72: 53–62.

Itoh, T., Tsuji, S. and Nitta, A. 2003. Migration patterns of young PBF (*Thunnus orientalis*) determined with archival tags. Fish. Bull. 101: 514-534.

Kitagawa, T., Boustany, A. M, Farwell, C. J., Williams, T. D., Castleton, M.R. and Block, B.A. 2007. Horizontal and vertical movements of juvenile bluefin tuna (*Thunnus orientalis*) in relation to seasons and oceanographic conditions in the eastern Pacific Ocean. Fisheries Oceanography 16(5): 409-421.

Madigan, D. J., Boustany, A. and Collette, B. B. 2017. East not least for Pacific bluefin tuna. Science 357:356–357.

Nakatsuka, S. 2019. Stock Structure of Pacific Bluefin Tuna (*Thunnus orientalis*) for Management Purposes—A Review of Available Information, Reviews in Fisheries Science & Aquaculture, 28(2), 170–181. https://doi.org/10.1080/23308249.2019.1686455

Ohshimo, S., Sato, T., Okochi, Y., Tanaka, S., Ishihara, T., Ashida, H. and Suzuki, N. 2018. Evidence of spawning among Pacific bluefin tuna, *Thunnus orientalis*, in the Kuroshio and Kuroshio-Oyashio transition area. Aquat. Living Resour., 31: 33. https://doi.org/10.1051/alr/2018022

Polovina, J. J. 1996. Decadal variation in the Trans-Pacific migration of northern Bluefin tuna (*Thunnus thynnus*) coherent with climate-induced change in prey abundance. Fish. Oceanogr. 5:114-119.

Rooker, J.R., Wells, R. J. D., Block, B. A., Lui, H., Baumann, H., Chiang, W.-C., Zapp Sluis, M., Miller, N. R., Mohan, J. A., Ohshimo, S., Tanaka, Y., Dance, M. A., Dewar, H., Snodgrass, O. E. and

Shiao, J.-C. 2021. Natal origin and age-specific egress of Pacific bluefin tuna from coastal nurseries revealed with geochemical markers. Scientific Reports 11: 14216.

Schaefer, K. 2001. Reproductive biology of tunas. in B. A. Block and E. D. Stevens. (eds.), Tuna - Physiology, Ecology, and Evolution. Academic Press, San Diego. pp. 225-270.

Tanaka, Y., Tawa, A., Ishihara, T., Sawai, E., Nakae, M., Masujima M. and Kodama, T. 2020. Occurrence of Pacific bluefin tuna *Thunnus orientalis* larvae off the Pacific coast of Tohoku area, northeastern Japan: possibility of the discovery of the third spawning ground. Fisheries Oceanography 29: 46–51.

Tawa, A., Ishihara, T., Uematsu, Y., Ono, T. and Ohshimo, S. 2017. Evidence of westward transoceanic migration of Pacific bluefin tuna in the Sea of Japan based on stable isotope analysis. Mar Biol 164, 94. https://doi.org/10.1007/s00227-017-3127-8

Tseng, M.-C. and Smith, P.J . 2012. Lack of genetic differentiation observed in Pacific bluefin tuna (*Thunnus orientalis*) from Taiwanese and New Zealand waters using mitochondrial and nuclear DNA markers. Marine and Freshwater Research 63(3) 198-209.

Uematsu, Y., Ishihara, T., Hiraoka, Y., Shimose, T. and Ohshimo, S. 2018. Natal origin identification of Pacific bluefin tuna (*Thunnus orientalis*) by vertebral first annulus. Fish. Res. 199: 26–31.

Wells R. J. D., Mohan J. A., Dewar H., Rooker J. R., Tanaka Y. and Snodgrass O. E. 2020. Natal origin of Pacific bluefin tuna from the California Current Large Marine Ecosystem. Biol Lett. 16: 20190878. http://dx.doi.org/10.1098/rsbl.2019.0878.