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Invasion of non-indigenous mtDNA haplotypes of Japanese dace *Tribolodon hakonensis* from the Lake Biwa water system to rivers and dam lakes in Gifu Prefecture, central Japan

Sae Ihara, Daisuke Ishizaki and Takahiko Mukai*

Abstract Biological invasions by non-indigenous populations are one of the most serious problems for the conservation of genetic resources in natural environments, due to the likelihood of such populations becoming established and negatively impacting the genetic integrity of indigenous populations through hybridization and introgression. In central Japan, freshwater fish populations have been isolated by the Ibuki-Suzuka mountains between the Ise Bay basin (Gifu, Mie and Aichi prefectures on the eastern side of the mountains) and Lake Biwa water system (Shiga, Kyoto, Osaka and other prefectures on the western side), subsequently becoming genetically divergent. On the other hand, nonindigenous populations of freshwater fishes have been introduced to the rivers of the Ise Bay basin as a consequence of transplantation of commercially important Ayu (*Plecoglossus altivelis altivelis*) being accompanied by other species from Lake Biwa. Because some serious genetic disturbance of some species has already been reported from the former system, it is necessary to clarify the magnitude of such invasions and introduce measures for the conservation of native populations. This study focused on Japanese dace, *Tribolodon hakonensis*, one of the most common local fishes, which exhibits genetic differentiation between the Ise Bay basin and Lake Biwa system populations. Due to the superficial similarity between Japanese dace and Ayu, a bycatch of the former has been transported with Ayu from Lake Biwa to the other areas. To understand the magnitude of invasions from Lake Biwa, the PCR-RFLP method was used to discriminate between indigenous and non-indigenous mitochondrial DNA (mtDNA) haplotypes of Japanese dace in Gifu Prefecture rivers of the Ise Bay basin. Non-indigenous mtDNA haplotypes (Lake Biwa types) were found to be highly abundant in dam reservoirs, while less so in rivers, suggesting that Lake Biwa dace more easily adapt to the lacustrine environment of dam reservoirs than to river environments.

*(*Corresponding author: Faculty of Regional Studies, Gifu University, 1–1 Yanagido, Gifu 501–1193, Japan; e-mail: tmukai@gifu-u.ac.jp)*

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First Japanese record of *Mugilogobius flavomaculatus* (Gobiiformes: Gobiidae) from Iriomote-jima Island, Yaeyama Islands

Yuki Tomimori, Mizuki Matsunuma* and Toshiyuki Suzuki

Abstract *Mugilogobius flavomaculatus* Huang, Chen, Yung and Shao, 2016 (Gobiiformes: Gobiidae) previously known only from Taiwan was newly recorded from Japan, based on a

single specimen (30.9 mm standard length) from Iriomote-jima Island (24˚22'N, 123˚53'E), Yaeyama Islands, Okinawa Prefecture. The species is characterized by the following combination of characters: body with eight distinct black and seven yellow bands; cheek and operculum with dark net-like marking, surrounding five rounded pale blotches; caudal-fin base with a vertical black bar; first dorsal fin with a somewhat horizontal broad black band, rounded contour and non-filamentous spines; second dorsal- and anal-fin rays I, 8; and predorsal scales 19. Although *M. flavomaculatus* is similar to two presently unidentified Japanese congeners, *Mugilogobius* sp. 2 (Japanese name: Tanukihaze) and *Mugilogobius* sp. 3 (Mujina-haze), all three being assigned to the *M. mertoni* complex, the former is readily distinguished from the latter two species by the black and yellow bands on the body (body with X-shaped dusky markings in the latter), and (usually) I, 8 second dorsal- and anal-fin rays (usually I, 7). The new standard Japanese name Torahaze is proposed for the species.

*(*Corresponding author: Department of Environmental Management, Faculty of Agriculture, Kindai University, 3327–204 Nakamachi, Nara 631–8505, Japan; e-mail: matsunuma@nara.kindai.ac.jp)*

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Gonadal development and ovipositor morphology in the oily gudgeon, *Sarcocheilichthys variegatus variegatus*

Masayoshi Ban and Yasunori Koya*

Abstract Like bitterlings (Acheilognathinae), members of the genus *Sarcocheilichthys* (Gobioninae, Cyprinidae) spawn their eggs in freshwater bivalves, although their spawning method is somewhat different, the latter depositing their eggs instantaneously into the bivalve inhalent siphon. This study investigated annual changes in gonadal histology, and ovipositor morphology in the oily gudgeon, *Sarcocheilichthys variegatus variegatus*, so as to throw further light on the process of gonadal development in cyprinid fishes and the evolution of structures related to eggs deposition into bivalves. Gonadal development in both sexes was divided into gradual (September to February) and rapid phases (March). Oocyte development was of the group-synchronous type, based on the frequency distribution of oocyte diameters during the spawning period (April to July) indicating multiple spawning. After the spawning period (August), the gonads in both males and females were spent (degeneration of oocytes and termination of spermatogenesis). The ever present ovipositor, comprising thick proximal and thin distal portions, elongated to about 1.5 times normal length during the maturation period. The urinary duct, oviduct and intestinal duct, as seen in cross-section, were respectively arranged dorsoventrally, the urinary duct and oviduct becoming conjoined in the posterior proximal ovipositor portion, with the urogenital duct opening at the distal end of the ovipositor, an overall structure similar to that of Acheilognathinae. However, surface mucus cells on the ovipositor, as found in Acheilognathinae, were lacking, whereas a thick muscle layer surrounding the urogenital duct, and V-shaped dense connective tissue occupying the entire ovipositor ventral region were found only in oily gudgeon. The overall structural

features may enable the instantaneous discharge of eggs into the bivalve inhalent siphon.

*(*Corresponding author: Department of Biology, Faculty of Education, Gifu University, 1–1 Yanagido, Gifu 501–1193, Japan; e-mail: koya@gifu-u.ac.jp)*

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Gray Unicornfish, *Naso caesius* (Acanthuriformes: Acanthuridae), from Kita-daito-jima, Daito Islands, Okinawa Prefecture, Japan; first northwest Pacific record

Daichi Sasaki*, Yumeka Takahashi and Seishi Kimura

Abstract A single specimen of the acanthurid fish *Naso caesius* Randall and Bell, 1992 (Acanthuriformes), previously reported from Micronesia, Polynesia, Melanesia, eastern Indonesia, New Guinea and Australia, was recently collected from Kita-daito-jima, Daito Islands, Okinawa Prefecture, Japan, the northernmost record for the species and first from the northwest Pacific Ocean. *Naso caesius* differs from its congeners in having two semicircular keels lacking antrorse spines on the caudal peduncle bony plates, no hornshaped process on the forehead, VI–VII, 27–30 dorsal-fin rays, 28–31 anal-fin soft rays, 16–18 pectoral-fin rays, a truncate caudal fin in adults, vertically elongate pale blotches on the upper two-thirds of the body, and a white tongue and brown anal fin. The new standard Japanese name "Yumihari-tenguhagimodoki" is proposed for the species.

*(*Corresponding author: Mie Prefecture Fisheries Research Institute, 3564–3 Hamajima, Hamajima-cho, Shima, Mie 517–0404, Japan; e-mail: sasaki.dobo@gmail.com)*

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First Japanese record for a species of *Chaunax* (Acanthopterygii: Chaunacidae)

Yudai Koizumi* and Fumihito Tashiro

Abstract A single large specimen [197.8 mm standard length (SL)] of the genus *Chaunax* Lowe, 1846 (Lophiiformes: Chaunacidae), captured during a commercial bottom trawl at a depth of 150–250 m off Cape Daio-zaki, Shima, Mie Prefecture, Japan on November 2016. Lacked markings on the body surface, thereby differing clearly from the three Japanese congeners (*Chaunax fimbriatus* Hilgendorf, 1879, *Chaunax penicillatus* McCulloch, 1915 and *Chaunax abei* Le Danois, 1978) known to date. Subsequently identified as *Chaunax apus* Lloyd, 1909, the specimen was characterized as follows: body without marking, reddish dorsally and paler ventrally (fresh condition), becoming uniformly whitish (preserved); tips of cirri on esca partially dark; dorsal surface of head lacking cirri; head length 39.3% SL; and 3 neuromasts in upper preopercular series, 3 in lower preopercular series, and 15 in pectoral series. The specimen represents both the northernmost and easternmost records of the species in the Pacific Ocean, in addition to being the first from Japanese waters. Intraspecific variation was noted in the count of spinules bridging the lateral-line complex (4–5 pairs in the present specimen vs. usually 3 pairs in previous reports of the species). The need for reconsideration of two of the three species groups recognized in the genus *Chaunax* [*C. abei*

(including *C. apus*) and *C. fimbriatus* species groups] was discussed from the viewpoint of new morphological data obtained from the above specimen. The new standard Japanese name "Akafusen" is proposed for *C. apus*, in referring to its characteristic body shape and color.

*(*Corresponding author: Laboratory of Marine Biology and Biodiversity (Systematic Ichthyology), Graduate school of Fisheries Science, Hokkaido University, 3–1–1 Minato-cho, Hakodate, Hokkaido 041–8611, Japan; e-mail: koican16@gmail.com)*

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First record of the deepsea tripod fish *Bathytyphlops marionae* (Aulopiforms: Ipnopidae) from Japan

Kazuki Mizowaki*, Hayato Yamaoka and Hiromitsu Endo

Abstract The genus *Bathytyphlops* Nybelin, 1957, belonging to the deep-sea benthic family Ipnopidae (including five genera and ca. 29 species), presently includes two valid species, *Bathytyphlops sewelli* (Norman, 1939) (type locality: Arabian Sea) and *Bathytyphlops marionae* Mead, 1958 (type locality: Caribbean Sea), the latter recorded in tropical to temperate waters in three of the world's oceans. *Bathytyphlops* differs from other ipnopid genera by having the following combination of characters: a very large head [head length 21–23% of standard length (SL)]; minute eyes; no elongated fin rays; and a single developed raker at the angle of the first gill arch. During an extensive trawl survey in the Okinawa Trough in the 1970s, operated by the Fisheries Agency of Japan, three ipnopid specimens (297–322 mm SL) were collected from depths of 750–1380 m, but have not been included in any subsequent ichthyofaunal reports. Recent examination of the specimens revealed them to be *B. marionae*, being characterized by 13 anal-fin rays (12–14 in *B. marionae* vs. 16 in *B. sewelli*), a long well developed raker on the first gill arch, its length 3.1–3.7% SL (3–5% SL vs. < 2% SL), and distinct eyes in larger specimens (vs. indistinct). Although *B. marionae* has been recorded worldwide in tropical to temperate waters, except in the eastern Pacific Ocean, it has not been reported from Japanese waters, the present specimens therefore representing the first record of the species from Japan. Standard Japanese names for the genus and species, "Soko-eso-zoku" and "Soko-eso", respectively, were proposed by Miyake and Aizawa (1983), based on four specimens collected off Suriname.

*(*Corresponding author: Laboratory of Marine Biology, Faculty of Science and Technology, Kochi University, 2–5–1 Akebono-cho, Kochi 780–8520, Japan; e-mail: b19m6c22@s.kochi-u.ac.jp)*

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Southernmost record of the Biwa salmon *Oncorhynchus masou* subsp. from Lake Biwa, Japan

Kohji Mabuchi*, Kazuya Nishida, Makoto A. Yoshida and Masayuki Kuwahara

Abstract A single mature migrating male (371 mm SL) Biwa salmon (*Oncorhynchus masou* subsp.), collected on 11 December 2019 off the mouth of the Yanagawa River, feeding the South Basin of Lake Biwa, Japan, represents the southernmost record of that subspecies from Lake Biwa and first specimen-based record from the South Basin. Together with anecdotal evidence, the record indicates that *O. masou* subsp. likely utilized South Basin feeder streams as spawning grounds before the latter were artificially revetmented.

*(*Corresponding author: NIES Lake Biwa Branch Office, National Institute for Environmental Studies, 5–34 Yanagasaki, Otsu, Shiga 520–0022, Japan; e-mail: mabuchi.koji@nies.go.jp)*

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Life stage-related changes in dietary habits and ecological niche of the Sakhalin taimen *Parahucho perryi* in the Shumarinai Lake system, Hokkaido, Japan

Kazutaka Shimoda*, Miyuki Nakajima and Hiloshi Kawamula

Abstract Changes in dietary habits and ecological niche of the Sakhalin taimen *Parahucho perryi* were estimated from the analyses of carbon and nitrogen stable isotope ratios in the Shumarinai Lake system, Hokkaido, Japan. Stable isotope ratios of both elements in 0+ fry in a feeder stream were within the range of stable isotope ratios in other fish species collected from the same stream, although nitrogen stable isotope ratios in co-existing 1+ juveniles were 0.84‰ to 2.10‰ higher than in the latter. Nitrogen stable isotope ratios in large individuals (54.5–69.5 cm fork length) in the lake were 1.40‰ to 4.28‰ higher than in other fishes. These results suggest that Sakhalin taimen begin predating other fishes at the 1+ juvenile stage, with larger individuals becoming a top predator in the Shumarinai Lake system.

*(*Corresponding author: Hokkaido Research Organization Salmon and Freshwater Fisheries Research Institute, 3–373 Kitakashiwagicho, Eniwa, Hokkaido 061–1433, Japan; e-mail: shimoda-kazutaka@hro.or.jp)*

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Early development of the manefishes *Caristius macropus* and *Paracaristius nudarcus* (Caristiidae), based on aquarium-reared specimens

Makoto Okamoto*, Makoto Kuraishi, Kaori Fujii and Toshiaki Mori

Abstract Fertilized eggs of two manefishes (*Caristius macropus* and *Paracaristius nudarcus*) were collected off Shionomisaki, Wakayama Prefecture, Japan and hatched in an aquarium. Descriptions are provided for early-life stages of both species [*C. macropus* (6 specimens: 8.9–125.9 mm in standard length: SL; maximum rearing period 255 days) and *P. nudarcus* (26.8 mm SL; 64 days)], based on the reared larval and juvenile specimens. Characters known to be diagnostic for the genus *Caristius*, including small sized lateralline scales and serrated lower caudal-fin rays, appeared from 80.9 mm SL in juvenile *C. macropus*.

Juveniles of the two species differed in dorsal fin shape and meristic characters. The occurrence of fertilized eggs in waters off Wakayama Prefecture, Japan indicated that *C. macropus* and *P. nudarcus* both spawn in Kuroshio waters.

*(*Corresponding author: Marine Fisheries Research and Development Center, Japan Fisheries Research and Education Agency, 15F Queen's Tower B, 2–3–3 Minatomirai, Nishi-ku, Yokohama, Kanagawa 220–6115, Japan; e-mail: epigonidae@gmail.com)*

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Invasion through the sea of a brown trout *Salmo trutta* in a small river, southern Hokkaido

Akihiko Goto, Mari Kuroki and Kentaro Morita*

Abstract A non-native brown trout *Salmo trutta* (407 mm in fork length, 717 g in body weight) was collected from the Otsukushinai River, southern Hokkaido, Japan, in 2019. This specimen was an immature male (0.4 g in gonad weight). The otolith Sr:Ca ratio profile and annual rings suggested that the specimen had migrated to the sea at the age of 4+ years and ascended the Otsukushinai River in the year of the seaward migration. This study is the first record of invasion of anadromous brown trout through the sea in Japan.

*(*Corresponding author: Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, 2–2 Nakanoshima, Toyohira-ku, Sapporo, Hokkaido 062–0922, Japan; e-mail: moritak@affrc.go.jp)*

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Record of a juvenile specimen of the flying fish *Cypselurus starksi* from the Seto Inland Sea

Hitomi Yamano*, Asano Tsuhako and Naoki Yagishita

Abstract A single juvenile specimen (35.0 mm standard length) of the flying fish *Cypselurus starksi* Abe in Tomiyama and Abe, 1953 was collected at Obatake fishing port (Seto Inland Sea), Kurashiki, Okayama Prefecture, Japan. Records of the species in the Seto Inland Sea are restricted to listings only (no descriptions or photos) in two reports published prior to 1962, there having been no reports since that date. In addition, very little is known regarding the occurrence of juveniles of the species. The newly-collected specimen is described herein, being the only known voucher specimen from the Seto Inland Sea. In addition, the mitochondrial cytochrome c oxidase subunit I (COI) DNA barcode sequence of the specimen is reported.

*(*Corresponding author: Department of Life Science, Faculty of Life Science, Kurashiki University of Science and the Arts, 2640 Nishinoura, Tsurajima-cho, Kurashiki, Okayama 712–8505, Japan; e-mail: h-yamano@sci.kusa.ac.jp)*

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Testing the effect of mimicry using a color variant of the false cleanerfish *Aspidontus taeniatus*

Hajime Sato*, Yoichi Sakai and Tetsuo Kuwamura

Abstract *Aspidontus taeniatus* (Blenniidae) mimics the bluestreak cleaner wrasse, *Labroides dimidiatus* in both shape and color. We found a small brownish color variant of *A. taeniatus*, which was suitable for testing the effect of mimicry. Comparison with the feeding behavior of typically-colored individuals indicated no significant differences between the two in feeding frequency (bites on tubeworm tentacles, boring-clam mantles, and fish fins), suggesting that coloration had no effect on such activity. It is likely that the abundant availability of the former two benthic foods on the study reef may have caused the very low frequency of fin biting, which may have resulted in no differences between the two color patterns.

*(*Corresponding author: Graduate School of Integrated Sciences for Life, Hiroshima University, Higashi-Hiroshima, Hiroshima 739–8528, Japan; e-mail: hsato98@outlook.jp)*

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Reproductive interference and inhibition of reproductive behaviour between rosy bitterling (*Rhodeus ocellatus ocellatus*) and Itasenpara bitterling (*Acheilognathus longipinnis*)

Ryosuke Kawakami*, Tomonori Kawamoto and Masaki Nishio

Abstract Reproductive interference and inhibition of reproductive behaviour between two sympatric bitterlings (Itasenpara bitterling, *Acheilognathus longipinnis*, and rosy bitterling, *Rhodeus ocellatus ocellatus*) were observed in the Moo River, Himi City, Toyama Prefecture, Japan. Male rosy bitterling and female Itasenpara bitterling individuals formed pairs, subsequently exhibiting interspecific reproductive behaviour. However, female Itasenpara bitterlings failed to lay eggs. Furthermore, rosy bitterlings attacked male Itasenpara bitterlings that defended territories around freshwater mussels, resulting in the latter abandoning their territories. This is the first report of rosy bitterlings negatively impacting the reproductive behaviour of Itasenpara bitterlings.

*(*Corresponding author: Specified Nonprofit Corporation Bio Club, 1927 Soryo, Himi, Toyama 935–0113, Japan; e-mail: bioclub.npo@gmail.com)*

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New distributional records of trawled fishes off the Pacific coasts of Tohoku District, northern Japan

Ryo Misawa*, Katsuya Kimura, Kaito Mizumachi, Tsutomu Hattori, Yoji Narimatsu, Yuto Suzuki, Eisuke Morikawa, Shun Tokioka, Jiro Nagao, Yasutoki Shibata, Hiromitsu Endo, Fumihito Tashiro and Yoshiaki Kai

Abstract New distributional records of forty-five fish species off the Pacific coast of Tohoku District, northern Japan are reported, based on specimens trawled by the R/V Wakataka-maru (Japan Fisheries Research and Education Agency) during surveys in autumn of each year from 1995 to 2019. The records include northern distribution range extensions of 19 species, distribution gaps filled for 17 species, and northern and southern limits along the Pacific coast of Japan for eight and one species, respectively. Twenty-seven species were recorded off Tohoku District for the first time. In addition, taxonomic notes for each species, including some meristic and morphometric data from the collected specimens, are also provided.

*(*Corresponding author: Demersal Fish Resources Division, Fisheries Stock Assessment Center, Fisheries Resources Institute, Japan Fisheries Research and Education Agency, 25-259 Shimomekurakubo, Same, Hachinohe, Aomori 031-0841, Japan; e-mail: batoideafish@gmail.com)*

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Diet of the Ryukyu-ayu *Plecoglossus altivelis ryukyuensis* in subtropical rivers of Amami-oshima Island, southern Japan revealed by gut content analysis and inferred from stable isotope signatures

Yutaka Nakano, Toru Kobari, Atsuko Yamaguchi and Gen Kume*

Abstract The diet of the critically endangered Ryukyu-ayu *Plecoglossus altivelis ryukyuensis* in the middle reaches of the Kawauchi, Sumiyo, and Yakugachi Rivers, Amami-oshima Island, southern Japan was examined by gut content analysis and inferred from stable isotope signatures. No clear differences in diet composition were apparent among the rivers. Microalgae, such as diatoms and cyanobacteria, generally considered as important food, were only rarely observed in gut contents, whereas detritus was almost exclusively found. However, stable isotope signatures indicated that detritus was not directly utilized as a nutritional source, indicating that food availability was an issue for *P. a. ryukyuensis*.

*(*Corresponding author: Faculty of Fisheries, Kagoshima University, 4–50–20 Shimoarata, Kagoshima, Kagoshima 890–0056; e-mail: kume@fish.kagoshima-u.ac.jp)*

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Host mussel utilization by the red tabira bitterling, *Acheilognathus tabira erythropterus*, in a drainage ditch of Kitakami river system, Japan

Jyun-ichi Kitamura

Abstract Bitterling are fishes that use freshwater mussels for oviposition. Mussel utilization by the red tabira bitterling, *Acheilognathus tabira erythropterus*, which spawning season is spring, was investigated in an agricultural draining ditch. Twenty-three freshwater mussels *Pronodularia* cf. *japanensis* 3 (sensu Lopes-Lima, 2020) (25.8% of 89 individuals examined) hosted eggs and embryos of *A. t. erythropterus* mainly in their suprabranchial

cavity. In contrast, 27 *Buldowskia kamiyai* did not host any egg or embryo. This may indicate the preference of *P.* cf. *japanensis* 3 by *A. t. erythropterus* as a host mussel.

*(*Corresponding author: Mie Prefectural Museum, 3060 Isshinden-kouzubeta, Tsu, Mie 514–0061, Japan; e-mail: kitamura@bio.sci.toho-u.ac.jp)*