A Laboratory Produced Hybrid Between *Lutjanus Synagris* and *Ocyurus Chrysurus* and a Probable Hybrid Between *L. Griseus* and *0. Chrysurus* (Perciformes: Lutjanidae)

M. L. Domeier and M. E. Clarke

SEDAR64-RD-08

June 2019

A Laboratory Produced Hybrid Between Lutjanus Synagris and Ocyurus Chrysurus and a Probable Hybrid Between L. Griseus and O. Chrysurus (Perc....

Article *in* Bulletin of Marine Science -Miami- · May 1992

CITATIONS
16

READS
75

2 authors, including:

Michael L. Domeier
Marine Conservation Science Institute
63 PUBLICATIONS **2,968** CITATIONS

SEE PROFILE

A LABORATORY PRODUCED HYBRID BETWEEN *LUTJANUS SYNAGRIS* AND *OCYURUS CHRYSURUS* AND A PROBABLE HYBRID BETWEEN *L. GRISEUS* AND *O. CHRYSURUS* (PERCIFORMES: LUTJANIDAE)

M. L. Domeier and M. E. Clarke

ABSTRACT

Examples of natural hybridization are not uncommon among fishes. Fishes which are closely related are more likely to successfully hybridize than unrelated forms. Some hybrid fishes have been erroneously described as valid species, and have persisted in the literature due to lack of verification by laboratory crosses. We describe a laboratory cross between two species of western Atlantic snapper (Perciformes: Lutjanidae) the lane snapper, *Lutjanus synagris* (Linnaeus) and the yellowtail snapper *Ocyurus chrysurus* (Bloch). We also describe a wild caught hybrid snapper, which is an apparent cross between a grey snapper, *Lutjanus griseus* (Linnaeus), and *O. chrysurus*. The laboratory cross resulted in offspring which are identical to the species described as *Lutjanus ambiguus* (Poey). Our data show that *L. ambiguus* is not a valid species, but instead a naturally occurring hybrid between *L. synagris* and *O. chrysurus*. In light of the apparent ease with which *Ocyurus* hybridizes with *Lutjanus*, and the paucity of morphological characters to differentiate the two genera, we argue that *Ocyurus* should be synonymized with *Lutjanus*.

Several hundred cases of hybridization among fishes have been reported in the literature and recorded in lists (Hubbs, 1955; Slastenenko, 1957; Schwartz, 1972, 1981). Hubbs (1955) reviewed much of the work that had been done up to that point on hybrid fishes, pointing out that hybrids are almost always precisely intermediate in morphology to the parental types. The understanding of this phenomenon simplifies the identification of hybrids when the parental types are known species. The collection of hybrids in cases where the parental species are not described has led to the erroneous description of invalid species. Names of species described from hybrids have persisted through time in the literature for lack of verification through laboratory breeding experiments.

The possibility of *Ocyurus chrysurus* hybridizing with species of the genus *Lutjanus* has been confusing the taxonomy of western Atlantic snappers since the description of *L. lutjanoides* (Poey, 1870) and *L. ambiguus* (Poey, 1860). *Lutjanus lutjanoides* is known only from the holotype collected in Cuba. Poey stated that it might be a hybrid between *O. chrysurus* and *L. apodus*. Jordan and Evermann (1898) suggested the possibility of its being a hybrid between *O. chrysurus* and *L. jocu*. Anderson (1967) stated that he is uncertain of the status of *L. lutjanoides*. *Lutjanus ambiguus* was also described from a single specimen collected in Cuba (Poey, 1860). Poey stated that *L. ambiguus* was a rare hermaphroditic species considered by fishermen to be a hybrid between *L. synagris* and *Ocyurus chrysurus*. Subsequent authors have listed *L. ambiguus* as a valid species (Jordan and Swain, 1884; Pino, 1961; Duarte and Buesa, 1973; Allen, 1985, 1987), although all but Allen were careful to note the possibility of its being a hybrid. Anderson (1967) listed *L. ambiguus* as a nominal species of uncertain status. Pino (1961) collected 18 specimens from commercial fishermen which she concluded to be *Lutjanus ambiguus*. Her study determined the species to be morphologically intermediate to *L. synagris* and *O. chrysurus*, but she made no conclusions regarding the possibility of hybridization. She did, however, find the species to be gonochoristic,

contrary to Poey's original description. Allen (1985: p. 55) stated that *L. ambiguus* was "formerly thought to be a possible hybrid of *Lutjanus synagris* and *Ocyurus chrysurus*." He listed *L. ambiguus* as a valid species but gave no data to support his action.

In an attempt to clear up some of this confusion we describe the results of a laboratory cross of *L. synagris* and *O. chrysurus,* and report a new record of a probable natural hybrid between *L. griseus* and *O. chrysurus.*

Materials and Methods

Adult specimens of *L. synagris* and *O. chrysurus* were collected with hook and line off Marathon Florida during March of 1989. The fish were brought live to the University of Miami's Experimental Fish Hatchery where they were injected with 500 International Units (IU's) of human chorionic gonadotropin (HCG) per kilogram fish. The injections produced one mature female *L. synagris* and mature *O. chrysurus* of both sexes. The eggs of *L. synagris* were fertilized with sperm from *O. chrysurus* and placed in 380-liter conical rearing tanks. The offspring of this cross were reared on a diet of rotifers, wild plankton, and *Artemia* sp. nauplii. Samples were preserved regularly in 70% ethanol as development progressed. Fish which survived through settlement were grown out on a diet of salmon pellets for 16 months before being examined closely for a resemblance to *L. ambiguus.*

A single specimen of a probable *L. griseus* × *O. chrysurus* hybrid was caught by a commercial fisherman near Ft. Jefferson, Dry Tortugas, during the summer of 1990 and brought to our attention due to its peculiarity.

Material Examined

Abbreviation.—UMML = Rosenstiel School of Marine and Atmospheric Science. Numbers in parenthesis indicate number of specimens in lot. For cases where there was insufficient museum material (<10 specimens) fresh wild caught specimens supplemented sample.

The following specimens of *L. synagris* were examined: UMML 4860 (3), UMML 12490 (1), UMML 6928 (1), fresh (5). Length range in mm standard length: 126.6–210.7.

The following specimens of *L. griseus* were examined: UMML 32018 (1), UMML 1056 (2), UMML 2737 (4), UMML 20028 (3). Length range in mm standard length: 56.9–228.0.

The following specimens of *O. chrysurus* were examined: UMML 20261 (6), UMML 20587 (4). Length range in mm standard length: 168.3–213.1. Ten hatchery reared specimens from the *L. synagris* × *O. chrysurus* cross were examined: UMML 34553 (1), UMML 34554 (2), UMML 34555 (5), UMML 34556 (5). Length range in mm standard length: 107.8–167.6. One wild caught probable *L. griseus* × *O. chrysurus* was examined: UMML 34557 (1). Length 228.6 mm standard length.

Relative lengths of the head, pectoral fin, pelvic fin, and upper lobe of caudal fin were taken on the wild caught specimens, hatchery reared hybrids, and museum specimens of *L. synagris, L. griseus* and *O. chrysurus.* These measurements were taken to obtain quantitative data relating the known and apparent hybrid types to their presumptive parental types. This technique can only be applied to characters in which the parental types are significantly different. To determine if the parental types are significantly different for the characters measured, non-parametric statistics were applied since the condition of homoscedasticity was not satisfied. A Kruskal-Wallis analysis of variance was followed by a posteriori comparison using a ranked multiple range test.

Results

Descriptions: Lutjanus synagris × Ocyurus chrysurus (Fig. 1).—Dorsal fin rays X, 13; anal fin rays III, 9; pectoral fin rays 16; scale formula 9-47-15; gill rakers first on arch 8+16 including rudiments—five rudiments and three developed rakers on lower limb, ten developed rakers and six rudiments on upper limb; branchiostegal rays 7. Lateral line arched and continuous. Scale rows horizontal below lateral line and rising obliquely above lateral line. Body depth 2.5 in standard length; dorsal profile of head nearly straight, slightly concave; snout pointed; tail forked. Teeth small with four small canines in front of upper jaw. Vomerine tooth patch triangular with short posterior median extension. Color in life: olive above grading to silvery white below with a faint yellow mid-body stripe extending from just behind orbit to caudal. This stripe covers all of one scale and half of another

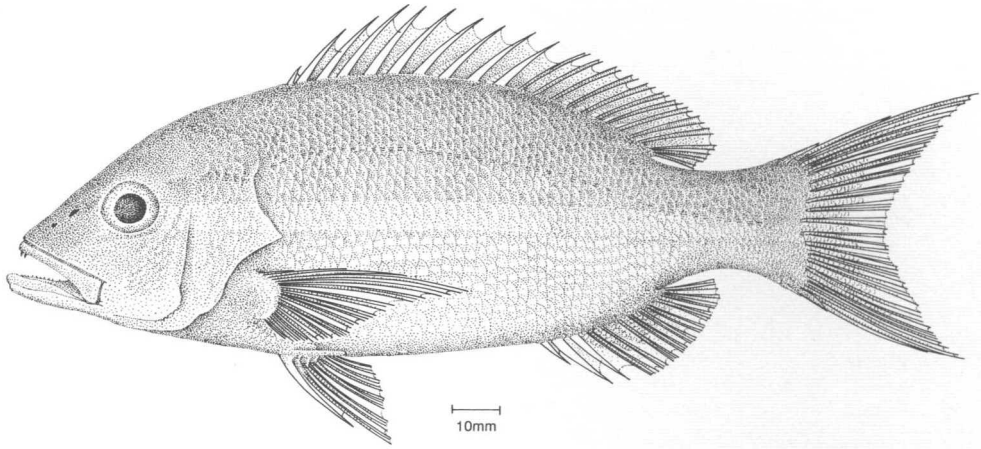

Figure 1. Laboratory produced hybrid between *Lutjanus synagris* and *Ocyurus chrysurus* (187 mm).

both above and below the middle scale; stripe does not broaden posteriorly as in *O. chrysurus*. Caudal reddish with fine black edge. Five or six narrow yellow stripes ventral to mid-body stripe. Coloration and morphology is intermediate to parental types.

Description: Wild Caught Hybrid (Fig. 2).—Dorsal-fin rays XI, 13; anal-fin rays III, 9; pectoral-fin rays 15; scale formula 7-48-14; gill rakers on first arch 8+16 including rudiments; branchiostegal rays 7. Scale rows horizontal below lateral line and rising obliquely above lateral line. Body depth 3.2 in standard length; dorsal profile of head slightly concave; snout ponted; tail forked. Teeth more developed than in above but smaller than in *L. griseus*; four canines in front of upper jaw. Vomerine tooth patch triangular with short posterior median extension. Color in life: gray to olive above, grading to pinkish white below with a faint yellow mid-body stripe extending from just behind orbit to caudal; stripe does not broaden posteriorly as in *O. chrysurus*. Caudal silvery gray. Many narrow bronze colored stripes rising obliquely above lateral line; six narrow yellow hor-

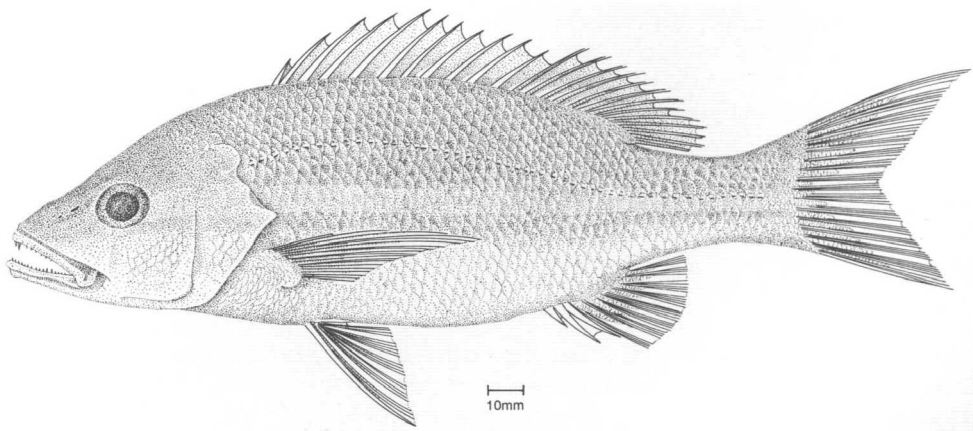

Figure 2. Apparent wild caught hybrid between *Lutjanus griseus* and *Ocyurus chrysurus* (229 mm).

Table 1. Comparison of various meristic characters for six types of snapper

Species	Dorsal	Anal	Pectoral	Gill rakers Anterior arch	Lateral line scales	Source
Lutjanus synagris	X, 12–13	III, 8(9)	15–16	6–7+(12)13–14(15)	47(48–50)	Anderson (1967)
L. synagris × *Ocyurus chrysurus*	X, 13	III, 9	16	8+16	47	Present study
L. ambiguus†	X, 13	III, 9	16	8–9+16–18	48–49	Anderson (1967)
O. chrysurus	X, 12–13	III, (8)9	15–16	9–10 + 21–22 (23)	46–49	Anderson (1967)
L. griseus × *O. chrysurus*	XI, 13	III, 9	15	8+16	48	Present study
L. griseus	X, 14	III, 7–8	(15)16–17	6–8+12–14	(43)44–47	Anderson (1967)

Counts in parentheses are rare.
† Two specimens examined.

izontal stripes ventral to mid-body stripe. Coloration and morphology is intermediate to *L. griseus* and *O. chrysurus*.

Table 1 compares the meristic data of the hybrid specimens to that of the theoretical parental types. Meristic data for the specimens described as *Lutjanus ambiguus* are also presented for comparison. This table shows the hybrid meristic data to fall within the range of the proposed parental types. The meristic data for the dorsal fin, gill rakers and lateral line scales are in fact intermediate to the parental types. One exception is the spiny dorsal fin ray count of XI in the wild caught specimen; this highly unusual count is not found in any western Atlantic member of *Lutjanus*. The meristic data for the hatchery produced hybrids fall within those described for *L. ambiguus* (Poey, 1860; Jordan and Swain, 1884; Pino, 1961; Anderson, 1967; Duarte and Buesa, 1973; Allen, 1985, 1987).

Comparisons of general morphology are found in Table 2. All but the relative pectoral fin lengths of the known parental types of the hatchery cross—*L. synagris* × *O. chrysurus*—were found to be significantly different using a non-parametric multiple range test ($P < 0.05$). Disregarding the relative pectoral fin length since we have just concluded it is not a good character, we see the means of the relative lengths taken for the hybrid fall between the means of the parental types. In the case of *L. griseus, O. chrysurus,* and their apparent hybrid, all of the relative lengths are significantly different between the apparent parental types ($P < 0.05$ according to ranked multiple range test) and therefore are good characters for comparison. For the case of the proposed *L. griseus* × *O. chrysurus* specimen, the mean relative lengths are only intermediate to the parental types in the case of the caudal fin.

Table 2 also compares descriptive morphological characteristics of the caudal fin, teeth and gill rakers. These characters show the intermediate relationship between hybrids and parental types in all cases.

Discussion

Our laboratory cross of *L. synagris* with *O. chrysurus* resulted in offspring identical in morphology and coloration to that of the species described as *L. ambiguus*. This indicates that *L. ambiguus* is not a valid species but in fact a natural hybrid between *L. synagris* and *O. chrysurus*. This conclusion is mutually

Table 2. Morphological characteristics of five types of snappers. Measurements expressed as mean percent of standard length (mm) (N = 10 for all but one type). For a more detailed analysis of natural hybrids (*L. ambiguus*) see Loftus (in press)

Species	Head†	P1†	P2†	Caudal**	Caudal shape	Teeth	Gill raker length
Lutajanus synagris	39	31	23	28	emarginate	moderate canines	short
L. synagris × *Ocyurus chrysurus*	36	28	22	29	forked	small canines	medium
O. chrysurus	34	30	20	39	deeply forked	conical	long
L. griseus × *O. chrysurus**	34	27	20	30	forked	moderate canines	medium
L. griseus	38	27	23	27	emarginate	large canines	short

Head = head length; P1 = pectoral fin length; P2 = pelvic fin length; Caudal = length of upper caudal fin lobe.
* Only one specimen.
** ANOVA significant $P < 0.05$.
† Kruskall-Wallace test significant $P < 0.05$.

supported by our results and the results of detailed morphological and meristic studies by Loftus (1992). According to the rules of nomenclature, *Lutjanus ambiguus* is not available as a name since it was based on a hybrid (International Code of Zoological Nomenclature, 1985: articles 1, 17).

It is very unlikely that the unusual snapper we describe as a *L. griseus* × *O. chrysurus* hybrid from the Dry Tortugas is a new species. The amount of fishing and SCUBA diving which goes on in this area would certainly have turned up other specimens of this snapper if it were a true species. The coloration and morphology of this specimen lead us to believe that it is a natural hybrid between *L. griseus* and *O. chrysurus* or a back cross. Coloration is not typically used as a decisive character when conducting systematic studies since the specimens lose much of their true colors when preserved. We were fortunate to observe this specimen when it was fresh so it was possible to document the true color patterns of this fish. The difficulty in quantifying color patterns did not allow us to present a detailed analysis of coloration, but the importance of this character when available should be emphasized. The intermediate coloration between *O. chrysurus* and *L. griseus* of our sample was obvious, the analysis of other characters presented here merely support the conclusion reached by assessing the color patterns. The presence of a forked tail and 24 total gill rakers on the first arch are enough to single out *O. chrysurus* as one of the parents. The relatively large canine teeth and coloration in life indicate *L. griseus* as the other parent. The hybrid was found to be intermediate in morphology in 7 out of the 12 characters examined. Of the remaining five characters, four were within the range of one or the other of the parental types. The spiny dorsal fin ray count was unusual as mentioned above. *Rhomboplites* has a spiny dorsal fin ray count of XII which could account for a count of XI in a hybrid, but the presence of large canines and uncharacteristic coloration rule out *Rhomboplites* as a parent type.

Hubbs (1955) indicates that there is a close correlation between hybridization and phylogeny. The closer two individual species are related to each other the more likely they are capable of successfully hybridizing. Hybridization between genera is rare within the families Hubbs (1955) listed as naturally hybridizing; he discusses two cases where species of different genera were found to hybridize, but upon reexamination the fish in question were combined into a single genus (brook trout × lake trout and whitefish × lake herring). We have provided two examples of natural hybridization between *Ocyurus* and *Lutjanus*; the literature (see Anderson, 1967) provides a likely third example in *L. lutjanoides* (Poey, 1870). The

apparent ease with which *Ocyurus* hybridizes with *Lutjanus* brings into question the validity of *Ocyurus* as a genus.

Ocyurus is a monotypic genus separated from *Lutjanus* by a few morphological characters, all of which are adaptations for a more pelagic lifestyle. This snapper feeds primarily on zooplankton (Randall, 1967) and therefore is adapted for swimming and feeding in the water column. A forked tail and fusiform body provide more efficient swimming (Gero, 1952); the canine teeth are greatly reduced giving way to smaller teeth which are more adapted for feeding on zooplankton. An increase in number and length of gill rakers is also indicative of a planktonic feeder. The bones of the jaw and head are reduced since they need not support strong grinding muscles (Davis and Birdsong, 1973). Although these differences exist, the number of meristic and morphological similarities between *Ocyurus* and *Lutjanus* are far greater. For example, the following meristic data for *Ocyurus* fall within the range of *Lutjanus*: dorsal fin spines, dorsal fin rays, anal fin spines, anal fin rays, pectoral fin rays and lateral line scales (Anderson, 1967).

Do the adaptations to a changed mode of existence found in *O. chrysurus* warrant a distinct genus from *Lutjanus*? At the time of its description (Gill, 1862), *Ocyurus* was a controversial genus; Jordan and Swain did not admit *Ocyurus* as a distinct genus from *Lutjanus* until 1884 (Jordan and Swain, 1884). Within the same volume Jordan (1884) lists this species as *Lutjanus chrysurus*. Jordan and Swain had not been able to distinguish *Ocyurus* from *Lutjanus* by "any single external character of high importance" (Jordan and Swain, 1884: p. 427). They state that it was Gill who convinced them to recognize *Ocyurus* based upon differences of the cranium (Jordan and Swain, 1884), which we know now to be adaptations to a planktiphagous lifestyle. Given the morphological, meristic and hybridization data, *Ocyurus* does not represent a distinct evolutionary lineage from *Lutjanus*. This conclusion is supported by Akazaki and Iwatsuki (1986) who list *Ocyurus* as a subgenus of *Lutjanus*, and Chow and Walsh (in press) who found very minor protein differences in their electrophoretic work. Recognizing *Ocyurus* as a distinct genus from *Lutjanus* makes *Lutjanus* a paraphyletic group. Since *Ocyurus* does not meet criterion of genus status according to Wiley (1981), *Ocyurus* should be synonymized with *Lutjanus*.

Acknowledgments

We wish to thank C. R. Robins for reviewing the text and making valuable suggestions, K. C. Lindeman for pointing out the significance of our hybridization, P. Sullivan of Eureka Seafood Inc. for giving us the wild caught hybrid, W. Loftus and S. Chow for reviewing their manuscripts, and D. Yeider and K. Ludwig for their assistance in fishing. This research was supported by NOAA/CIMAS contract NA85-WC-H-06134.

Literature Cited

Allen, G. R. 1985. FAO species catalogue. Snappers of the world. An annotated and illustrated catalogue of lutjanid fishes known to date. FAO Fish. Synop. (125), 6: 1–208.

———. 1987. Synopsis of the circumtropical fish genus *Lutjanus* (Lutjanidae). Pages 33–37 *in* S. Ralston and J. J. Polovina, eds. Biology and fisheries management of tropical groupers and snappers. Westview Press, Boulder, Colorado.

Anderson, W. D. 1967. Field guide to the snappers (Lutjanidae) of the western Atlantic. U.S. Fish. Wildl. Serv. Circ. 252: 1–14.

Akazaki, M. and Y. Iwatsuki. 1986. Generic relationships in four subfamilies of the Lutjanidae. Pages 600–601 *in* T. Uyeno, R. Arai, T. Taniuchi and K. Matsuura, eds. Indo-Pacific fish biology: Proc. 2nd Int. Conf. Indo-Pac. Fishes. Ichthy. Soc. Jap., Tokyo.

Chow, S. and P. J. Walsh. 1992. Biochemical and morphometric analyses for phylogenic relationships between seven snapper species (subfamily Lutjaninae) of the western Atlantic. Bull. Mar. Sci. 50:

Davis, W. P. and R. S. Birdsong. 1973. Coral reef fishes which forage in the water column. Helgoländer wiss. Meeresunters. 24: 292–306.
Duarte, P. P. and R. J. Buesa. 1973. Catalogue de peces Cubanos. Ciencias, Investigaciones Marinas 8(3): 144.
Gero, D. R. 1952. The hydrodynamic aspects of fish propulsion. Am. Mus. Nov. 1061. 32 pp.
Gill, T. N. 1862. Remarks on the relations of the genera and other groups of the Cuban fishes. Proc. Acad. Nat. Sci. Phila. 14: 235–242.
Hubbs, C. L. 1955. Hybridization between fish species in nature. Syst. Zool. 4(1): 1–20.
International Code of Zoological Nomenclature. 1985. British Museum (Natural History), London; University of California Press, Berkeley and Los Angeles. Articles 1, 17. 338 pp.
Jordan, D. S. 1884. List of fishes collected at Key West, Florida, with notes and descriptions. Proc. U.S. Natl. Mus. 7(8): 103–150.
——— and B. W. Evermann. 1898. The fishes of North and Middle America: a descriptive catalogue of the species of fish-like vertebrates found in the waters of North America, north of the Isthmus of Panama. Bull. U.S. Natl. Mus. 47(1): 1–1240.
——— and J. Swain. 1884. A review of the species of Lutjaninae and Hoplapagrinae found in American waters. Proc. U.S. Natl. Mus. 7(449): 427–474.
Loftus, W. F. 1992. *Lutjan ambiguus* (Poey), a natural intergeneric hybrid of *Ocyurus chrysurus* (Bloch) and *Lutjanus synagris* (Linnaeus). Bull. Mar. Sci. 50:
Pino, Z. R. 1961. *Lutjanus ambiguus*. Cent. Invest. Pesq. 14: 1–21.
Poey, F. 1860. Memorias sobre la Historia Natural de la Isla de Cuba. 2: 97–336.
———. 1870. New species of Cuban fish. Ann. Lyceum Natur. Hist. New York 9: 317–322.
Randall, J. E. 1967. Food habits of reef fishes of the West Indies. Stud. Trop. Oceanogr. 5: 665–847.
Schwartz, F. T. 1972. World literature to fish hybrids with an analysis by family, species, and hybrid. Publs. Gulf Coast Res. Lab. Mus. 3. 328 pp.
———. 1981. World literature to fish hybrids with an analysis by family, species, and hybrid: suppl. 1. NOAA Tech. Rept. NMFS SSRF-750. 507 pp.
Slastenenko, E. P. 1957. A list of natural hybrids of the world. Hidrobiologi (B)4: 76–97.
Wiley, E. O. 1981. The theory and practice of phylogenetics. Wiley Interscience Publications, New York. 439 pp.

DATE ACCEPTED: September 3, 1991.

ADDRESS: *Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149-1098.*