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POPULATION GROWTH, SPREAD, AND PERSISTENCE OF PURPLE SWAMPHENS (*Porphyrio porphyrio*) IN FLORIDA

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Abstract.—Since their inadvertent release into Pembroke Pines, Broward County, during the 1990s, Purple Swamphens (*Porphyrio porphyrio*) have greatly expanded their range and increased their numbers in Florida. Their core area currently covers approximately 2,840 km^2 in Broward, Hendry, and Palm Beach counties, and a minimum convex polygon drawn around all swamphen locations encompasses an area of about 35,000 km^2. One swamphen photographed in southeastern Georgia in November 2009 may have dispersed more than 600 km. From October 2006 to December 2008, an eradication program by state agencies killed 3,187 swamphens on seven public wetlands in the Everglades-Lake Okeechobee watershed. The program was later deemed unsuccessful and was discontinued. Range expansion of Purple Swamphens into additional wetlands in Florida is predicted if not already underway.

The Purple Swamphen (*Porphyrio porphyrio*) is a wide-ranging species of Europe, Africa, southeastern Asia, Australia, New Zealand, and islands in the Pacific Ocean (Dickinson 2003). Thirteen subspecies are recognized (Dickinson 2003), which Sangster (1998) had previously proposed splitting into six species. Swamphens were first noted in Florida at Pembroke Pines, Broward County, around December 1996. Pranty and Schnitzius (1998) announced the discovery, speculated on the source, and presented results of initial surveys. Pranty et al. (2000) detailed the discovery and initial distribution of the population, provided a much more likely source, presented results of the first formal surveys and proof of breeding, and suggested that more than one swamphen subspecies may be present. Pranty (2001a) presented results of seven surveys and the first dispersals away from Pembroke Pines. Hardin et al. (2011) described an unsuccessful eradication effort by state agencies

that resulted in the shooting of 3,187 swamphens between October 2006 and December 2008. A study of the genetics of the introduced swamphens is underway (D. Williams *fide* S. Hardin in litt.). In this paper, I report the results of nine formal Purple Swamphen surveys at Pembroke Pines, characterize the current known distribution, and list additional dispersals, including one to southeastern Georgia.

Methods

Survey methods were described by Pranty et al. (2000) and Pranty (2001a). I obtained locations of Purple Swamphens from communication with the birding community and from reviews of the Field Observations section of *Florida Field Naturalist* since 1998, the archives of the Miami Bird Board since 2000 (Tropical Audubon Society 2011), Hardin et al. (2011), and the state's Early Detection and Distribution Mapping System (EDDMapS 2011). Many dispersal records are verifiable from archived photographic evidence. I ignored some web-published reports, such as those posted to eBird and the Great Backyard Bird Count, that may have represented misidentified Purple Gallinules (*Porphyrio martinica*). I entered all swamphen locations into ArcView GIS 3.1 (ESRI 1998) coverages. I followed Wunderlin and Hansen (2008) for the English names of plants.

Results

Discovery and surveys.—Purple Swamphens were discovered in Florida at the "SilverLakes" development, Pembroke Pines, Broward County, by Abigail, Kevin, and Kim Schnitzius. SilverLakes is a 1,000-ha medium-density development that features many shallow freshwater ponds and lakes created for wetlands mitigation and to provide wildlife habitat. Based on memory, the swamphens were thought to have been present since ca. December 1996 (Pranty et al. 2000). In 1997, one swamphen pair produced three young in a marsh behind the Schnitzius home (Pranty et al. 2000), furnishing the first breeding report. Kim Schnitzius obtained the first photographic evidence of swamphens in late March or early April 1998. The Schnitzius family soon found swamphens elsewhere in SilverLakes, counting 28 birds in July 1998 and 29 in August 1998 (Pranty et al. 2000; totals corrected from those published by Pranty and Schnitzius 1998). I first visited Pembroke Pines on 9 October 1998, when the Schnitzius family, Helen Lovell, and I counted 84 swamphens and instituted formal surveys. We searched areas within 1 km of the SilverLakes development and found additional swamphens (Table 1), indicating that colonization was already underway. We counted 134 swamphens on 21-22 February 1999, along with a road-killed swamphen found on 20 February. Fluctuations in swamphen numbers noted on subsequent surveys (e.g., Columns A-C in Table 1) suggested that variation in local water levels had encouraged some swamphens to disperse. We ended formal surveys in February 2003, partly because vegetation planted along the

Table 1. Results of the nine formal Purple Swamphen surveys at Pembroke Pines, Broward County, Florida, 1998-2003. A = SilverLakes, Schnitzius backyard; B = SilverLakes, Sheridan Street; C = SilverLakes, 172nd Avenue; D = SilverLakes, various interior roads; E = SilverLakes, 184th Avenue; F = Pembroke Isles at 172nd Avenue and Pines Boulevard; and G = Southwest Broward Regional Library pond at Sheridan Street and Jaguar Way. Sites not surveyed are designated by a hyphen; results of partial surveys are listed in parentheses. Formal surveys ended in early 2003, partly because vegetation planted along the shorelines of surveyed wetlands had grown so tall as to hamper observations. *Includes one road-killed swamphen salvaged on 20 February 1999.

Date	A	B	C	D	E	F	G	Totals
9 October 1998	4	32	48	—	—	—	—	84
21-22 February 1999	5	29	80	10	1	9	—	135*
25 July 1999	3	22	41	17	3	9	—	95
16 November 1999	3	14	33	—	—	9	—	59
26 August 2000	0	4	26	—	—	—	(0)	30
18 January 2001	0	20	33	—	9	13	12	87
28 May 2001	1	13	31	—	(1)	10	24	80
10 November 2001	0	8	25	5	8	11	16	73
1 February 2003	0	8	13	—	—	4	—	25

lakeshores had grown so tall as to greatly limit views of the marshes and the swamphens that occupied them.

Source.—Pranty and Schnitzius (1998) speculated that the source of the naturalized population was Miami MetroZoo, 43 km to the south. But Pranty et al. (2000) subsequently concluded that the likely source was one or two aviculturists who lived within 600 m of SilverLakes. These aviculturists collectively owned as many as 13 pairs of swamphens, obtained beginning in 1992. The swamphens were not pinioned and were permitted to roam the neighborhoods surrounding the aviculturists' homes (Pranty et al. 2000). A few of these swamphens evidently wandered away from the aviculturists, found suitable habitat, and began breeding. Neither aviculturist had been aware of the naturalized population of swamphens breeding nearby (D. Mhoon pers. comm., February 1999, H. Sardou pers. comm., February 1999).

Subspecific identification.—Most Purple Swamphens in Florida appear to be the gray-headed subspecies, *P. p. poliocephalus*, native from the Indian subcontinent to southern Asia (Pranty pers. obs., S. Hardin in litt.). Three Florida specimens (UF 40766, GEW 6016, and UCF 2387) are *poliocephalus* (Kratter et al. 2002, G. E. Woolfenden pers. comm., B. H. Anderson in litt.). A few swamphens with entirely blue heads were observed in Florida as early as 1998 and were thought to represent a second subspecies, although lighting and viewing angle affected apparent head color to some degree (Pranty 2001a). One of the aviculturists mentioned above owned a mixed pair of swamphens (a gray-headed male and a blue-headed female) that produced numerous young (Pranty et al. 2000). If any of the potential intergrade young

Table 2. Locations (n = 30) occupied by Purple Swamphens, ca. December 1996-April 2011, arranged chronologically by the date of the first observation. Stormwater Treatment Area 3/4 is also known as Harold Campbell Public Use Area; Arthur R. Marshall Loxahatchee NWR (= National Wildlife Refuge) is also known as WCA 1. The Distance column, which refers to the number of km a site is located from the SilverLakes development, is intended to represent distances from the source site, and is not meant to imply that every dispersal originated from Pembroke Pines. In the Reference column, records are notated if known to be verifiable from specimen (†) or photographic (*) evidence; the latter evidence will be archived on DVDs associated with the revision of Robertson and Woolfenden (1992).

Date	County	Location	Distance	Reference
ca. Dec 1996	Broward	Pembroke Pines, "SilverLakes"	n/a	†, *Pranty et al. 2000; UF 40766
21 Feb 1999	Broward	Pembroke Pines, "Pembroke Isles"	1	*Pranty 2001a
22 Jun 2000	Palm Beach	Delray Beach, Wakodahatchee Wetlands	68	*Pranty 2001a, b
18 Jan 2001	Broward	Pembroke Pines, Southwest Broward Library	1	*Pranty 2001a
24 Feb 2001	Palm Beach	Lake Okeechobee, Belle Glade Marina	89	*Pranty 2001a, c
26 Feb 2001	Palm Beach	Stormwater Treatment Area 1W	75	†Pranty 2001a, c; GEW 6016
16 Mar 2002	Broward	Fort Lauderdale, Powerline Road	32	†UCF 2387
10 Apr 2002	Collier	west of Carnestown	97	*Pranty 2002
28 Nov 2002	Broward	Water Conservation Area 2B, se. corner	17	*Pranty 2003a, b
7 Dec 2003	Hendry	Stormwater Treatment Area 5	71	Pranty 2004
11 Feb 2004	Glades	Lake Okeechobee, Moonshine Bay	119	Pranty 2004
Mar 2004	Broward	Pembroke Pines, "Laguna Isles"	1	L. Manfredi in litt.
19 Jul 2004	Palm Beach	Everglades Ag. Area, Brown's Farm Road	~76	Pranty 2005a
10 Sep 2004	Lake	Emeralda Marsh Conservation Area	351	*Pranty 2005b
29 Jan 2005	Palm Beach	Arthur R. Marshall Loxahatchee NWR	58	*Pranty 2005c
10 May 2006	Miami-Dade	Everglades National Park, S334 structure	27	T. Dean in EDDMapS
10 Sep 2007	Palm Beach	Boynton Beach, Green Cay Wetlands	60	Anonymous in litt.
30 Nov 2007	Brevard	Viera, "Viera Wetlands"	250	*Pranty 2008
? 2007	Palm Beach	Stormwater Treatment Area 2	47	Hardin et al. 2011
? 2007	Palm Beach	Stormwater Treatment Area 3/4	43	Hardin et al. 2011
11 Jun 2007	Palm Beach	Everglades Ag. Area, east of US-27	~64	Pearlstine 2007
Jan 2008	Highlands	Lake Istokpoga	62	Hardin et al. 2011

Table 2. (Continued) Locations (n = 30) occupied by Purple Swamphens, ca. December 1996-April 2011, arranged chronologically by the date of the first observation. Stormwater Treatment Area 3/4 is also known as Harold Campbell Public Use Area; Arthur R. Marshall Loxahatchee NWR (= National Wildlife Refuge) is also known as WCA 1. The Distance column, which refers to the number of km a site is located from the SilverLakes development, is intended to represent distances from the source site, and is not meant to imply that every dispersal originated from Pembroke Pines. In the Reference column, records are notated if known to be verifiable from specimen (†) or photographic (*) evidence; the latter evidence will be archived on DVDs associated with the revision of Robertson and Woolfenden (1992).

Date	County	Location	Distance	Reference
? 2008	Hendry	Stormwater Treatment Area 6	75	Hardin et al. 2011
17 Jan 2009	Broward	Tamarac, Hiatus Road	17	J. Wilcox in litt.
5 Jun 2009	Broward	Pembroke Pines, Chapel Trail Preserve	3	Pranty 2010
16 Jul 2009	Miami-Dade	Pennsuco Wetlands	~16	fide S. Hardin in litt.
21 Nov 2009	Tattnall, GA	Glennville	680	*Blankenship and Southern 2010
? 2009	Broward	Hollywood, NW 202nd Street	9	A. Abreu in litt.
11 Mar 2011	Lake	Lake Apopka N. Shore Restoration Area	323	H. Robinson in litt.
3 Apr 2011	Orange	Orlando Wetlands Park	292	*fide* B. H. Anderson in litt.

joined the naturalized population, they might have accounted for the differences in head color noted. Preliminary genetic analysis of the Purple Swamphen population in Florida has revealed two different sequences in mitochondrial DNA, suggesting the presence of two taxonomic forms (D. Williams *fide* S. Hardin in litt.).

Population increase and range expansion.—Beginning shortly after their discovery and continuing to the present, Purple Swamphens have been noted at several other sites in the peninsula and beyond (Table 2). Because swamphens are infrequent in avicultural collections (e.g., <www.softbillsforsale.com>), I believe that dispersal from Pembroke Pines explains the presence of swamphens elsewhere in the state. The first known dispersal was to Wakodahatchee Wetlands, Palm Beach County, in June 2000, a distance of 68 km. Numerous other dispersals followed, including six greater than 100 km (Table 2). By April 2011, Purple Swamphens had been reported from 30 sites in ten counties in the Florida peninsula, including swamphens found in Brevard, Collier, Lake, and Orange counties (Table 2, Fig. 1). By far the longest dispersal to date was one adult gray-headed swamphen photographed at Glennville, Tattnall County, Georgia, on 21 November 2009 (Blankenship and Southern 2010, Table 2), a site 680 km from Pembroke Pines. Long-distance movements have been reported for Purple Swamphens in other parts of their range. One swamphen at Catalonia, Spain in 1984 was more than 1,000 km from the nearest breeding population (Grussu 1999). Another swamphen, apparently *P. p. madagascariensis*, photographed at Bernard Park, Bermuda, on 26 October 2008 (Norton et al. 2010), may have flown more than 6,500 km from western Africa.

Most swamphen dispersals in Florida have been to the north or northwest, with only one dispersal to the west and two to the south (Fig. 1). Considering that most of the Big Cypress-Everglades-Lake Okeechobee region is relatively inaccessible to birders, Purple Swamphens may be much more widely distributed than is known. For instance, swamphens have been observed in all six Stormwater Treatment Areas (STAs), two of the three Water Conservation Areas (WCAs), and both of the recently-constructed birding wetlands (Green Cay and Wakodahatchee) in Palm Beach County (Table 2). Review of Google Earth imagery of the areas north and south of Pembroke Pines shows hundreds of km^2 of developments with dozens of shallow wetlands interspersed—habitats that appear very similar to those at SilverLakes.

Drawing a polygon around all sites where swamphens are known or presumed to be breeding results in a core range of approximately 2,840 km^2 (smaller polygon in Fig. 1). A minimum convex polygon drawn around all swamphen locations in Florida encompasses an area of about 35,000 km^2 (larger polygon in Fig. 1). Expansion of Purple

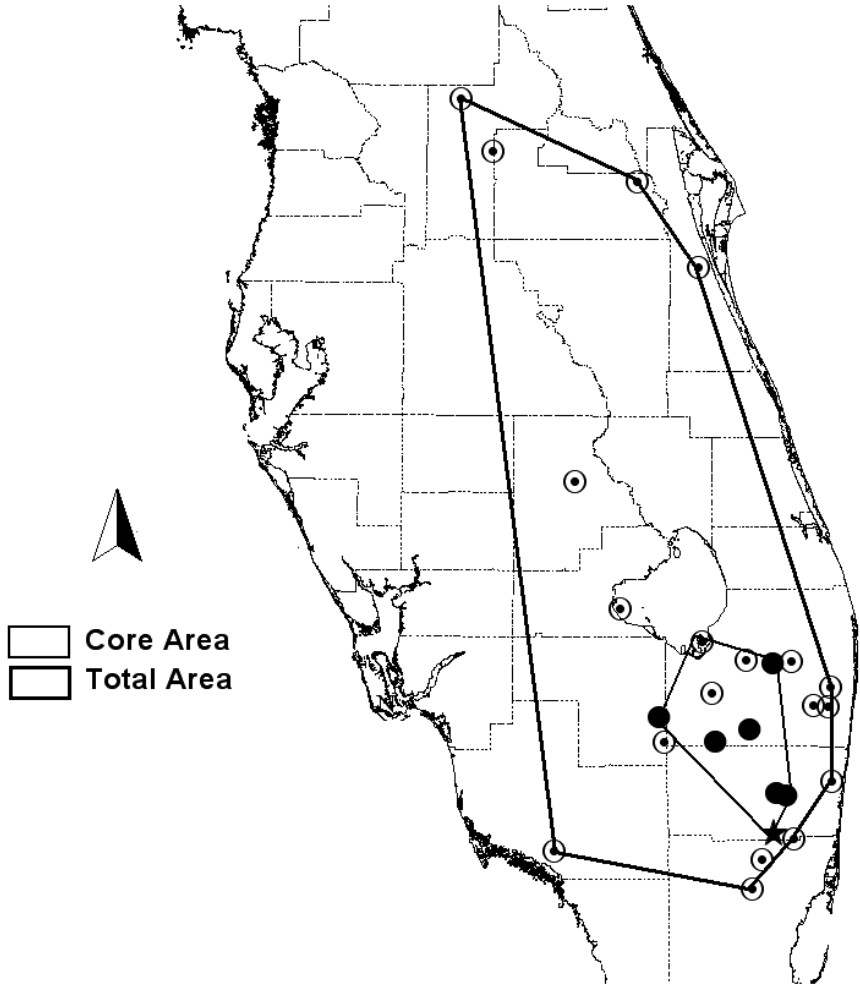

Figure 1. Locations of Purple Swamphens in Florida, ca. December 1996-April 2011. Based on a minimum convex polygon drawn around all Florida locations—and intentionally ignoring the recent record from southeastern Georgia—the occupied range of swamphens includes an area about 35,000 km². This range is bounded by Emeralda Marsh Conservation Area to the northwest, Orlando Wetlands Park and "Viera Wetlands" to the northeast, Fort Lauderdale to the southeast, Everglades National Park to the south, and Carnestown to the southwest. The core breeding area of swamphens in Florida is much smaller, perhaps 2,840 km² in Broward, Hendry, and Palm Beach counties.

★ = Pembroke Pines (discovery and source site)
● and ★ = breeding sites
⊙ = non-breeding site

Swamphens into additional watersheds, such as Myakka Lake and River, the Kissimmee Chain of Lakes, and the Upper St. Johns River, is predicted if not already underway.

Breeding evidence.—It is clear from the population increase and range expansion that Purple Swamphens in Florida are breeding prolifically. Breeding populations are known from only Broward, Hendry, and Palm Beach counties (Fig. 1), but access limitations prevent assessment of other populations, such as those at Lake Okeechobee, where swamphens have been present since February 2001 (Table 2, Hardin et al. 2011). The captive swamphens that presumably were the source of the naturalized population produced two or three broods annually, and the pair in the Schnitzius yard produced two broods during 1998 (Pranty et al. 2000). During 1998 and 1999, I and others observed swamphen chicks at Pembroke Pines in eight calendar months (January-May, July, August, and October), suggesting that swamphens may breed nearly year-round (Pranty and Schnitzius 1998, Pranty et al. 2000). I photographed one swamphen nest with five eggs at Pembroke Pines on 25 July 1999 (Pranty et al. 2000), and ca. 15 other nests have been found in the state (Pranty 2001a, Hardin et al. 2011).

Population size.—No estimate is available for the size of the Purple Swamphen population in Florida. However, the eradication effort undertaken by staff of the Florida Fish and Wildlife Conservation Commission (FWC) and South Florida Water Management District indicates that the size of the population is large. The eradication effort began in August 2006, when four swamphens were scooped up in dip nets from airboats (Hardin et al. 2011). Afterward, swamphens were shot-gunned from airboats or earthen levees. Between October 2006 and December 2008, 3,187 swamphens were shot at seven sites, all of them public wetlands (Hardin et al. 2011; Table 3). In March 2009, the eradication effort was deemed unsuccessful and was discontinued. Despite claims to the contrary (e.g., Clary 2009, Pranty et al. 2010), no estimate was made of the number of swamphens that survived (S. Hardin in litt.). Many swamphens occupied thick stands of cattail (*Typha*) where they were well concealed, and some swamphens may have dispersed from areas where they were subject to intense shooting pressure (Hardin et al. 2011). None of the swamphens within private wetlands (e.g., those at Pembroke Pines) were targeted for eradication, which may have aided growth and expansion of the overall population. Large numbers of swamphens were shot at some sites (i.e., STA 1W, STA 3/4, and WCA 2B; Table 3), but it is not known whether local breeding was solely responsible for such numbers, or whether swamphens had immigrated from nearby areas.

Table 3. Numbers of Purple Swamphens shot in Florida from October 2006 to December 2008 (Hardin et al. 2011). All sites are public wetlands. STA = Stormwater Treatment Area; WCA = Water Conservation Area. Sites not hunted are designated by a hyphen. STAs 1-4 are in Palm Beach County, STAs 5 and 6 are in Hendry County, and WCA 2B is in Broward County. The swamphens shot at Lake Okeechobee were thought to be in Glades and Hendry counties (S. Hardin in litt.).

Site	2006	2007	2008	Totals
STA 1W	151	521	251	**923**
STA 2	—	30	9	**39**
STA 3/4	—	440	745	**1,185**
STA 5	5	181	13	**199**
STA 6	—	—	14	**14**
WCA 2B	177	273	340	**790**
Lake Okeechobee	—	—	37	**37**
Totals	**333**	**1,445**	**1,409**	**3,187**

Natural history in Florida.—Except for the genetic analysis now underway (D. Williams *fide* S. Hardin in litt.), no formal study of the biology of the Purple Swamphen population in Florida has been undertaken; the sparse information known is from opportunistic observations. Habitats occupied by swamphens at Pembroke Pines are shallowly-flooded wetlands with open or semi-open, emergent vegetation such as Gulf Coast spikerush (*Eleocharis cellulosa*), arrowhead (*Sagittaria* spp.), pickerelweed (*Pontederia cordata*), and water lily (*Nymphaea* spp.) (Pranty et al. 2000)—reference to horsetail (*Equisetum* spp.) was based on a misidentification of spikerush (Pranty pers. obs.). Habitats used at WCA 2B are Gulf Coast spikerush glades interspersed with patches of southern cattail (*Typha domingensis*), broadleaf cattail (*T. latifolia*), Jamaica swamp sawgrass (*Cladium jamaicense*), and Carolina willow (*Salix caroliniana*), with a water depth typically above 0.85 m (Hardin et al. 2011). Cattail marshes form a greater component at the STAs (Hardin et al. 2011). Perhaps because of habitat succession, swamphens have declined in abundance from many wetlands at Pembroke Pines that previously were more open (Pranty pers. obs., L. Manfredi in litt.).

Observations of foraging swamphens at Pembroke Pines suggest that they are largely herbivorous, and also take some invertebrate prey, such as worms (Pranty et al. 2000). STA 1W in Palm Beach County was planted with rice (*Oryza sativa*) to attract waterfowl and waterfowl hunters, and the stomachs of some swamphens shot there were nearly bursting with rice grains (D. Eggeman pers. comm.). Stomachs from other swamphens contained cattail fibers (S. Hardin in litt.) or bits of unidentified vegetation (GEW 6016, G. E. Woolfenden pers. comm.). Hardin et al. (2011) mention a swamphen that was observed carrying an object thought to have been a Black-necked Stilt (*Himantopus*

mexicanus) chick at STA 1W on 17 June 2010. This report, if accurate, may furnish the only observation of a swamphen in Florida taking vertebrate prey, although swamphens probably often take small-vertebrate prey such as fish and frogs. Predators of swamphens or their eggs in Florida probably include American alligators (*Alligator mississippiensis*), various mammals, and snakes. Kim Schnitzius observed a Great Blue Heron (*Ardea herodias*) take a swamphen chick at SilverLakes on 29 March 1999 (Pranty et al. 2000, Pranty 2001a).

Most of the swamphens shot during the eradication effort were left to lie where they fell; many could not be retrieved from dense cattail stands (S. Hardin in litt.). At my urging, perhaps 200 swamphen carcasses were salvaged by Dave Eggeman of FWC, and these were delivered to Archbold Biological Station, where they await preparation and analyses. It is anticipated that examination of these specimens will result in several publications, such as those on morphometrics, sex ratios, molt sequence and timing, stomach contents, internal and external parasites, and taxonomy.

Establishment in Florida.—Purple Swamphens in Florida were first observed to breed in 1997 (Pranty et al. 2000) but the numbers of swamphens found in late 1998 and early 1999 (Table 1) suggest that reproduction outside of captivity may have begun a few to several years earlier. In 2009, the Florida Ornithological Society Records Committee (FOSRC) voted against adding the swamphen (FOSRC 09-728) to its Official State List on the grounds that swamphens may have been breeding for only 13 years, rather than the requisite 15 or more years. However, FOSRC members felt that "there was little doubt that the [swamphen] population would meet the Persistence Criterion in the next few years" (Kratter 2010). A re-vote by the FOSRC in 2011 was again not resolved. Two members felt that it was premature to consider the species as established in light of potential control efforts by FWC in the future; the matter will come up for a vote again in 2012 (A. W. Kratter in litt.).

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