

Short Communication

Black-winged Stilt *Himantopus himantopus* breeding in an industrial plant: long-term trend (2009-2024) following progressive burial of settling water basins

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Abstract - This note presents multi-year trends in the nesting of the Black-winged Stilt (*Himantopus himantopus*) within an industrial area, where the size of sedimentation basins (water collection tanks) suitable for breeding has changed due to progressive silting. Over time, we observed a gradual decline in the number of breeding pairs, with adults and chicks increasingly concentrated in the remaining available sites, resulting in a slight increase in nesting density, a possible “crowding effect”. Although water basins in industrial areas may offer certain advantages, such as stable water levels and reduced pressure from terrestrial predators and human disturbance, these benefits should be evaluated within a broader context that also considers the potential long-term costs of nesting in artificial habitats, including the accumulation of toxic substances in the birds’ tissues.

Key words: breeding pairs, crowding effect, trap effect, cost-benefit balance.

Riassunto - Riproduzione del cavaliere d’Italia (*Himantopus himantopus*) in un impianto industriale: andamento a lungo termine (2009-2024) a seguito del progressivo interrimento dei bacini di decantazione

Questa nota riporta le tendenze pluriennali relative ad abbondanza e densità di coppie riproduttive, adulti e pulli in un sito di nidificazione di Cavaliere d’Italia localizzato in un’area industriale che ha visto, in anni recenti, evidenti variazioni nella numerosità e superficie delle vasche di raccolta dell’acqua, a causa del progressivo interrimento delle stesse. Abbiamo osservato una progressiva riduzione dell’abbondanza di coppie riproduttive, adulti e pulcini concentrati nei siti rimanenti e un conseguente progressivo incremento della densità (“effetto affollamento”). Sebbene i

bacini idrici nelle aree industriali rappresentino un’opportunità a causa della ridotta presenza di minacce (scarsa oscillazione dei livelli delle acque e basso impatto da predatori terrestri e di disturbo antropico), tuttavia, questi benefici dovrebbero essere analizzati in una prospettiva più ampia che consideri anche i costi a lungo termine della nidificazione in questi siti artificiali (es., accumulo di sostanze tossiche nei tessuti).

Parole chiave: coppie nidificanti, effetto affollamento, effetto trappola, bilancio costi-benefici.

The Black-winged Stilt (*Himantopus himantopus*) is a migratory wader inhabiting wetlands in tropical, steppe, desert, and semi-desert landscapes across Eurasia (Mamedova & Chaplygina, 2021; Rajpar *et al.*, 2022). In Italy, the species is found in both coastal and inland wetlands, particularly in the Po Valley, the upper and central Tyrrhenian slopes, Apulia, and the major islands (Brichetti & Fracasso, 2018; Della Toffola & Tinarelli, 2022).

Breeding populations of the Black-winged Stilt exhibit interannual fluctuations in size and distribution, influenced by both large-scale factors (e.g., demographic dynamics in wintering areas; Tinarelli, 1992) and local-scale conditions. At the local level, the species depends on the availability of shallow, unstable, or ephemeral wet habitats (typically <20 cm in depth; e.g., Ferlini & Ferlini, 1997), which may include both natural/semi-natural environments (e.g., freshwater and saltwater marshes; Bologna *et al.*, 1978; Arcamone & Puglisi, 2008; Battisti *et al.*, 2015) and artificial habitats. These anthropogenic sites include salt pans (Casini, 1986; Tinarelli, 1990; Sofo *et al.*, 1999), irrigation reservoirs and restored wetlands (Bernoni, 1984; Barbera *et al.*, 1990; Marchesi & Tinarelli, 2007; Boschetti *et al.*, 2008; Nardotto & Bertolin, 2022), maritime port areas (Pietrelli *et al.*, 1994; Franceschi *et al.*, 2014), disused landfills and other abandoned areas (Biondi *et al.*, 2008; De Giacomo, 2016), and water basins of wastewater treatment facilities in sugar refineries (Cascianelli & Saracino, 1981; Schmidt, 1985; Tinarelli, 1988). Also, the presence of the species in industrial areas has been widely documented (Porto Torres: Delitala & Casu, 1995; Scarlino: Giovacchini & Radi, 2007; Bagnoli: Del Gaizo & Grotta, 1995; Marghera: Foschi, 1978; Baroni *et al.*, 1989; Livorno: Arcamone & Puglisi,

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2008; Arezzo: Ceccolini *et al.* 2014; Gela: Mascara, 1990, 2008; see also Tinarelli, 1990, 1992).

Many recent studies suggest that artificial water bodies — such as those found in industrial areas — may help compensate for natural wetland loss, therefore supporting waterbird conservation (Alexander *et al.*, 2011; Ashoori, 2011; Sebastián-González *et al.*, 2015). In these artificial settings, the presence of water in containment and lamination basins can enable breeding by the Black-winged Stilt, thanks to a range of structural features (e.g., shallow water depth, muddy substrates, minimal water level regulation, and low levels of disturbance) that make these habitats ecologically suitable for nesting.

Although the species is actively studied in various parts of the world — including Italy (e.g., Tinarelli, 1992), Spain (Cuervo, 2005), and Indonesia (Crossland & Sitorus, 2014) — long-term demographic data (>15 years) from breeding populations in industrial environments remain scarce. Even fewer studies have examined how trends in breeding numbers relate to changes in local habitat suitability.

This note presents multi-year trends in the nesting of the Black-winged Stilt in an industrial area that, over nearly two decades, has experienced changes in the extent of settling basins (i.e., water collection tanks), which directly affected the surface area available for nesting.

We conducted a census of the Black-winged Stilt in muddy areas of the wastewater treatment facility at the

‘Huntsman-Tioxide’ plant (from 2018: ‘Venator’), located in ‘Il Casone’, within the municipality of Scarlino (Grosseto, central Italy; latitude 42° 54’ 46” N, longitude 10° 47’ 46” E). The study site is part of a large chemical industrial hub producing titanium dioxide and is adjacent to the Special Area of Conservation “Padule di Scarlino” (IT51A0006; EU “Habitats” Directive 92/43/EEC; also designated as a Ramsar site; Fig. 1).

The plant spans approximately 180 hectares (ha) on a flat plain located 1.5 km from the coastline. Of this area, 75 ha are occupied by industrial infrastructure, and 80 ha consist of gypsum embankments (a by-product of the wastewater treatment process) vegetated with species such as *Chenopodium* sp., *Inula viscosa*, *Cirsium* sp., *Bromus* sp., and *Solanum nigrum*, as well as scattered rows of trees and shrubs. The remaining surface includes settling basins used in the industrial water cycle, which vary in depth (up to 60 cm) and partially dry out over the year, exposing muddy substrates. While these basins are devoid of vegetation, surrounding ditches and canals support species such as *Phragmites* sp., *Aster tripolium*, and *Inula viscosa*. A short stretch of the Pecora River crosses the study area; its banks host dense herbaceous vegetation up to 1.5 m tall, including *Juncus* sp., *Carex* sp., and *Ranunculus* sp. (see Giovacchini & Radi, 2007, for further habitat details).

Field surveys were carried out during the breeding seasons from 2009 to 2024. Monitoring in the industrial area

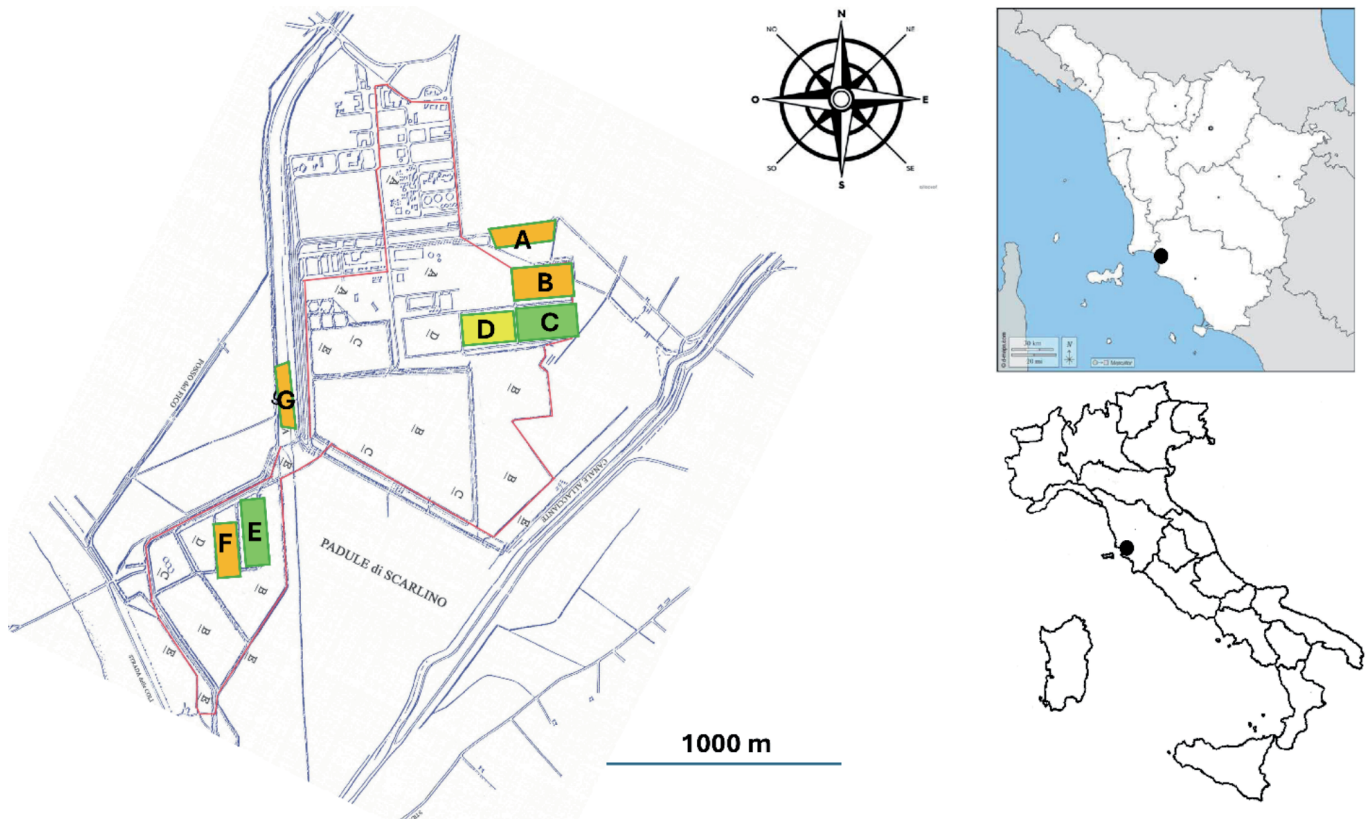


Fig. 1 – Map of the study area. The wastewater treatment plant (Huntsman-Tioxide plant; from 2018 Venator, Il Casone, Scarlino; Grosseto, central Italy) with the water basins hosting breeding pairs, adults and pulli of Black-winged stilt in 2009-2024 period (A to G; orange, always flooded; yellow: filled in 2010; green, filled in 2017; details in text; modified from Giovacchini & Radi) / Mappa dell’area di studio. L’impianto di depurazione delle acque reflue (impianto Huntsman-Tioxide; dal 2018 Venator, Il Casone, Scarlino; Grosseto, Italia centrale) con le vasche d’acqua che ospitano coppie nidificanti, adulti e pulcini di cavaliere d’Italia nel periodo 2009-2024 (da A a G; arancione: sempre allagato; giallo: riempito nel 2010; verde: riempito nel 2017; dettagli nel testo; modificato da Giovacchini & Radi).

was conducted once annually in mid-June along an approximately 3-km route within the plant (survey effort: ~2 hours per visit), covering artificial water bodies such as ponds, a water collection basin, and a short stretch of the Pecora River between the connecting canal and the artificial embankments, and recording all breeding pairs, adults, and chicks (hereafter “pulli”). Equipment included Swarovski 7×42 binoculars and an AT 80 Swarovski spotting scope.

We considered seven basins within the industrial site that were occupied by Black-winged Stilts at least once during the study period (2009–2024): A: 0.8 ha; B: 4.5; C: 4.5 (filled in 2017); D: 4.2 (filled in 2010); E: 4.2 (filled in 2017); F: 4.2; G (Pecora River basin, outside the industrial process area but affected by the water system): 1.2 (Fig. 1).

All basins were active in 2009. From 2010 onwards, some were progressively filled in. Of the seven basins active in 2009 (totaling 23.6 ha), only four (totaling 10.7 ha) remained active from 2017 to 2024, representing a reduction in suitable nesting habitat of over 50% (Tab. 1 and Fig. 1).

Abundance data — including the number of breeding pairs (n. pa), adults (n. ad), and pulli (n. pu) (Fig. 2) — were converted into density values (individuals per hectare; n. ind./ha), accounting for variations in the size of suitable

water tank surfaces. Both abundance and density data were grouped into 4-year periods, for which mean values and standard deviations were calculated. Median values across these 4-year periods were compared using the Kruskal-Wallis test for equal medians, with the Mann–Whitney U test applied in pairwise comparisons.

We also performed ordinary least squares regression analyses (with 95% bootstrapped confidence intervals, n=1999) to examine trends in the number of breeding pairs, adults, and pulli over time (i.e., year-by-year: Dytham, 2011). The significance level (α) was set at 0.05.

Over the study period (>15 years), the progressive infilling of water tanks led to a marked reduction (>50%) in the surface area suitable for nesting. This, in turn, resulted in a decline in the number of breeding pairs, adults, and pulli: linear regressions showed a significant year-by-year decline in the mean abundance of breeding pairs, adults, and chicks (Tab. 1; Figs. 3-5). The reduction was particularly pronounced in the median number of pulli, which showed a statistically significant drop between the periods 2009-2012 and 2017-2020 (Mann-Whitney U test, p=0.04). Given the ongoing infilling of basins, a significant decline in the abundance of adults and breeding pairs may also become apparent in future comparisons across 4-year intervals.

Tab. 1 – Abundance of pairs (n pa), adults (n ad) and pulli (n pu) and density (in n. ind./hectares, ha; respectively: pa/ha, ad/ha, pu/ha) of Black-winged Stilt sampled in water tanks (A to G: in grey the water collection tanks subjected to burial) with the total of suitable (flooded) area (in ha). Mean values (and standard deviation) and comparisons with the Kruskal-Wallis test for equal medians (among 4-year period; H and p-values) have been reported. / Abbondanza di coppie (n pa), adulti (n ad) e pulcini (n pu) e densità (in n. ind./ettaro, ha; rispettivamente: pa/ha, ad/ha, pu/ha) di cavaliere d’Italia campionato in vasche d’acqua (da A a G: in grigio le raccolte dell’acqua soggette a interrimento) con la superficie totale dell’area idonea (allagata) (in ha). Sono stati riportati i valori medi (e la deviazione standard) e i confronti con il test di Kruskal-Wallis per l’uguaglianza delle mediane (tra il periodo di 4 anni; H e valori p).

Year	Abundance							tot ha	Density				
	n pa	n ad	n pu	A	B	C	D		E	F	G	pa/ha	ad/ha
2009	12	49	18	x	x	x	x	x	x	x	23.6	0.508	2.076
2010	6	22	7	x	x	x		x	x	x	19.4	0.309	1.134
2011	8	21	9	x	x	x		x	x	x	19.4	0.412	1.082
2012	15	37	12	x	x	x		x	x	x	19.4	0.773	1.907
Mean (sd)	10.25 (4.03)	32.25 (13.35)	11.5 (4.80)									0.50 (0.2)	1.55 (0.51)
2013	14	47	15	x	x	x		x	x	x	19.4	0.722	2.423
2014	6	22	6	x	x	x		x	x	x	19.4	0.309	1.134
2015	11	26	6	x	x	x		x	x	x	19.4	0.567	1.340
2016	5	19	3	x	x	x		x	x	x	19.4	0.258	0.979
Mean (sd)	9 (4.24)	28.5 (12.66)	7.5 (5.20)									0.46 (0.22)	1.47 (0.65)
2017	7	28	6	x	x				x	x	10.7	0.654	2.617
2018	1	29	1	x	x				x	x	10.7	0.093	2.710
2019	6	11	3	x	x				x	x	10.7	0.561	1.028
2020	4	20	7	x	x				x	x	10.7	0.374	1.869
Mean (sd)	4.5 (2.65)	22 (8.37)	4.25 (2.75)									0.42 (0.2)	2.06 (0.63)
2021	5	32	4	x	x				x	x	10.7	0.467	2.991
2022	7	31	4	x	x				x	x	10.7	0.654	2.897
2023	4	22	8	x	x				x	x	10.7	0.374	2.056
2024	3	6	2	x	x				x	x	10.7	0.280	0.561
Mean (sd)	4.75 (1.71)	22.75 (12.04)	4.5 (2.52)									0.44 (0.18)	2.13 (0.76)
KW test (H)	6,569	1.27	6.49									0.314	1.73
p	0.09	0.74	0.09									0.957	0.63

sd, standard deviation; KW, Kruskal-Wallis.



Fig. 2 – Adults and pulli of Black-winged Stilt. Box bottom right: adult on the nest. Photo: Giacomo Radi. / Adulti e pulcini di Cavaliere d’Italia. In basso a destra nel riquadro: adulto sul nido. Foto: Giacomo Radi.

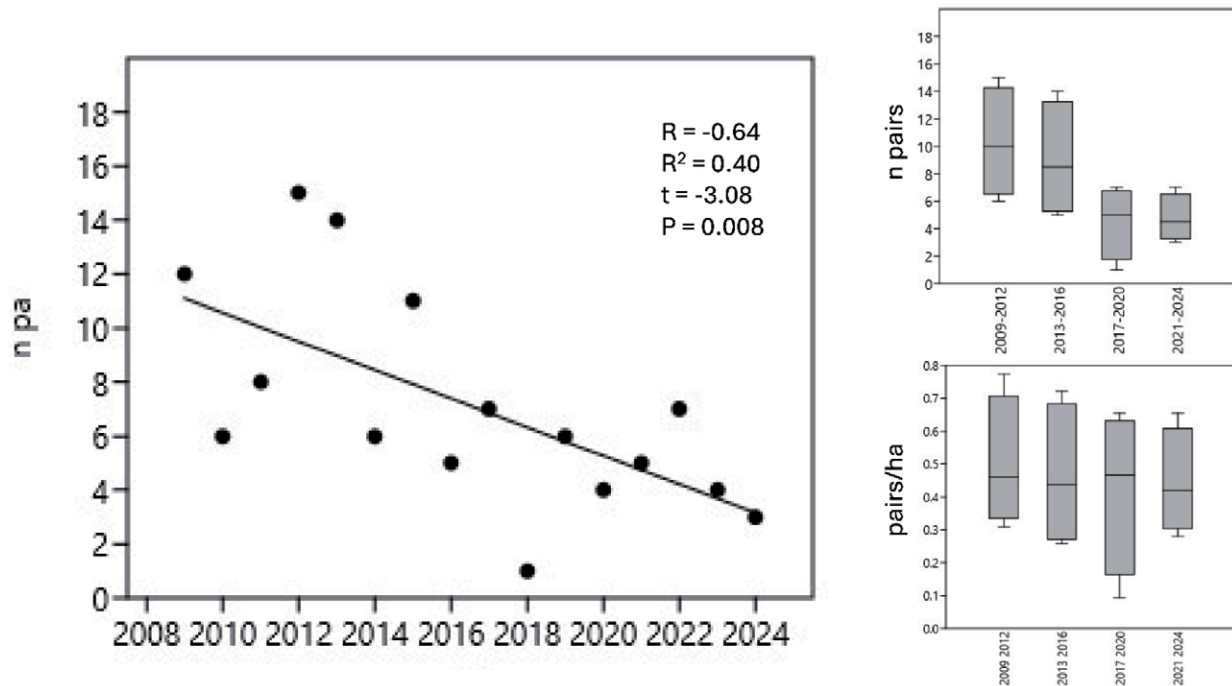


Fig. 3 – Abundance of breeding pairs (number of pairs, n pa) of Black-winged Stilt along the 2009-2024 period (ordinary least squares regression, 95% bootstrapped confidence intervals; n=1999). Right: box plots of median values (top) and median density (bottom) for 4-year sub-periods. The minimal and maximal values are shown with short horizontal lines (“whiskers”); 25-75 percentiles are drawn using a box; horizontal line shows the median values. / Abbondanza di coppie nidificanti (numero di coppie, n pa) di cavaliere d’Italia nel periodo 2009-2024 (regressione dei minimi quadrati ordinari, intervalli di confidenza bootstrap al 95%; n=1999). A destra: box plot dei valori medi (in alto) e della densità mediana (in basso) per sottoperiodi di 4 anni. I valori minimi e massimi sono indicati con brevi linee orizzontali (“baffi”); i percentili 25-75 sono rappresentati da un box; la linea orizzontale indica i valori medi.

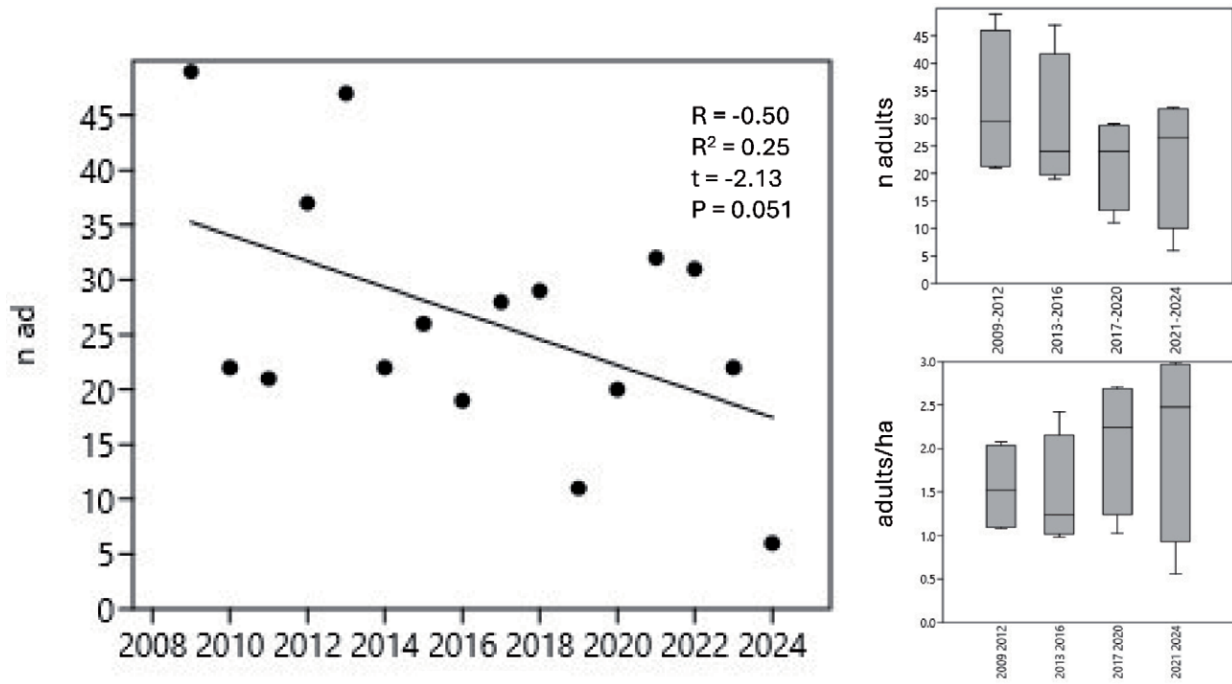


Fig. 4 – Abundance of adults (n_{ad}) of Black-winged Stilt along the 2009-2024 period (ordinary least squares regression, 95% bootstrapped confidence intervals; $n=1999$). Right: box plots of median values (top) and median density (bottom, adults/ha) for 4-year sub-periods. The minimal and maximal values are shown with short horizontal lines (“whiskers”); 25-75 percentiles are drawn using a box; horizontal line shows the median values. / Abbondanza di adulti (n_{ad}) di cavaliere d’Italia nel periodo 2009-2024 (regressione dei minimi quadrati ordinari, intervalli di confidenza bootstrap al 95%; $n=1999$). A destra: box plot dei valori medi (in alto) e densità mediana (in basso, adulti/ha) per sottoperiodi di 4 anni. I valori minimi e massimi sono indicati con brevi linee orizzontali (“baffi”); i percentili 25-75 sono rappresentati da un box; la linea orizzontale indica i valori medi.

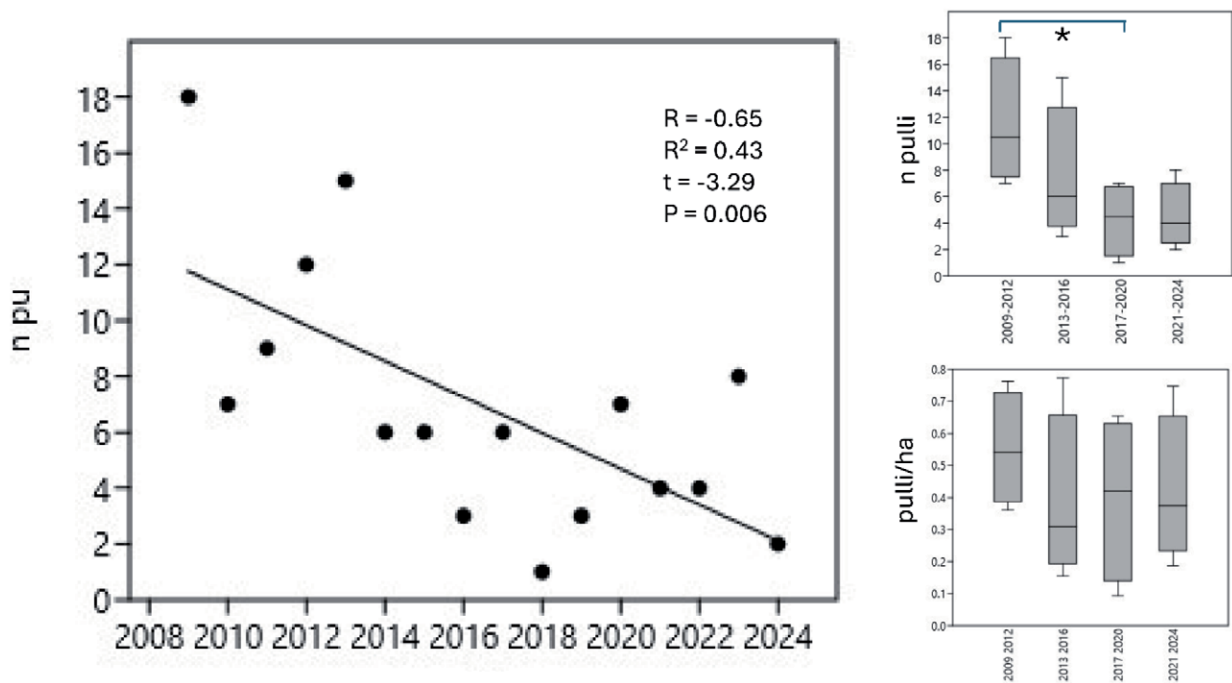


Fig. 5 – Abundance of pulli (n_{pu}) of Black-winged Stilt along the 2009-2024 period (ordinary least squares regression, 95% bootstrapped confidence intervals; $N=1999$). Right: box plots of median values (top) and median density (bottom, pulli/ha) for 4-year sub-periods. The minimal and maximal values are shown with short horizontal lines (“whiskers”); 25-75 percentiles are drawn using a box; horizontal line shows the median values. * $p < 0.05$. / Abbondanza di pulli (n_{pu}) di cavaliere d’Italia nel periodo 2009-2024 (regressione dei minimi quadrati ordinari, intervalli di confidenza bootstrap al 95%; $N=1999$). A destra: box plot dei valori medi (in alto) e densità mediana (in basso, pulli/ha) per sottoperiodi di 4 anni. I valori minimi e massimi sono indicati con brevi linee orizzontali (“baffi”); i percentili 25-75 sono rappresentati da un box; la linea orizzontale indica i valori medi. * $p < 0,05$.

Despite declining abundance, the reduction in available habitat surface area has allowed for the maintenance of stable or slightly increasing density values — although these increases were not statistically significant over the study period. This “crowding effect” (i.e., increased bird density resulting from habitat contraction), a phenomenon documented in studies on habitat loss (Schmiegelow *et al.*, 1997), may induce an increase in intraspecific competition for nesting sites, with potential repercussions at the community level, such as disruption of wader assemblages (Vallejos *et al.*, 2020). Moreover, the progressive silting of basins may turn these habitats into ecological traps (Hale & Swearer, 2016), attracting individuals to sites that appear suitable but pose long-term survival or reproductive risks.

Industrial ponds demonstrate high short-term suitability for waders due to the reduced presence of several common threats. Indeed, in these sites, water level fluctuations, abundance of terrestrial predators (e.g., non volant mammals excluded due to perimeter fencing that restricts access) and others anthropogenic disturbances (e.g., absence of drones, ultralight aircraft, human transit, and hunting activity) are limited. However, these apparent advantages must be weighed against long-term risks associated with these artificial habitats, for example, considering: i) the potential accumulation of toxic substances in bird tissues (Hoffman *et al.*, 2002; Raza *et al.*, 2013; Tian *et al.*, 2025), which may interfere with embryonic development and lead to hepatotoxicity and oxidative stress in hatchlings (Tavares *et al.*, 2004; Tavares *et al.*, 2007; see also Toral *et al.*, 2015 for the impact of pesticides); and ii) the high degree of habitat dynamism and degradation (e.g., infilling) driven by the operational needs of the industrial plant.

Thus, while it is true that disturbed environments can paradoxically offer refuge and opportunities for biodiversity (Warren *et al.*, 2007; Spiridonov *et al.*, 2011), the presence of species of ecological and conservation concern in such settings must be evaluated within a cost-benefit framework, particularly when considering the long-term viability of these populations.

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REFERENCES

- Alexander K., Sebastián-González E., Botella F. & Sánchez-Zapata J., 2011 – Occupancy patterns of irrigation ponds by black-winged stilts *Himantopus himantopus*. *Ardeola*, 58: 175-82.
- Arcamone E. & Puglisi L., 2008 – Cronaca ornitologica toscana. *Alula*, 15: 3-122.
- Ashoori A., 2011 – Breeding ecology of the black-winged stilt *Himantopus himantopus* in Boujagh National Park, Gilan Province, Northern Iran. *Podoces*, 6: 87-91.
- Barbera G. G., Sendin J. F., Selma M. A., Gil V. H. & Robledano, F., 1990 – Importance of small man-made wetlands for breeding waders in south-eastern Spain. *Wader Study Group Bulletin*, 60: 24-6.
- Baroni A., Scarton F. & Schmidt N., 1989 – Un ecosistema in ambiente industriale: lo stagno Monte dipe a Porto Marghera (VE). *Acqua Aria*, 8: 919-29.
- Battisti C., Boano A., Cento M., Circosta A. & Muratore S., 2015 – Waders (Aves, Charadriiformes) in a Mediterranean remnant wetland: a year-round pilot study evidences contrasting patterns in diversity metrics. *Rivista Italiana di Ornitologia*, 85: 61-6.
- Bernoni M., 1984 – Il metodo del mappaggio in una zona umida del Lazio: le Vasche di Maccarese. *Rivista Italiana di Ornitologia*, 54: 235-43.
- Biondi M., Pietrelli L., Orteni D., Cecchetti S. & Mocci E., 2008 – Nuove riproduzioni di Cavaliere d'Italia *Himantopus himantopus* nel Lazio (2008). *Alula*, 15: 123-8.
- Bologna G., Calchetti L. & Petretti, F., 1978 – La nidificazione del cavaliere d'Italia *Himantopus himantopus* nella laguna di Orbetello: dati preliminari. *Avocetta*, 1: 25-39.
- Boschetti E., Benà M., Crestani F., Benetti G. & Vallarini C., 2008 – Valle della Buora di Salvaterra, Badia Polesine (RO): un progetto di ripristino ambientale ai fini faunistici: In: Atti 5° Convegno Faunisti Veneti. Bon M., Bonato L., Scarton F. (eds.). *Bollettino Museo civico Storia Naturale Venezia*, 58: 134-9.
- Brichetti P. & Fracasso G., 2018 – The birds of Italy. Volume 1. Anatidae-Alcidae. Latina: *Edizioni Belvedere*.
- Cascianelli D. & Saracino U., 1981 – Nidificazione del Cavaliere d'Italia *Himantopus himantopus* (Recurvirostridae) e del Cuculo dal ciuffo *Clamator glandarius* nella pianura Pontina-Lazio con riferimento al loro “status” nel Parco Nazionale del Circeo. Atti I Convegno Italiano di Ornitologia, Aulla (MS): 45.
- Casini L., 1986 – Nidificazione di Cavaliere d'Italia, *Himantopus himantopus*, ed Avocetta, *Recurvirostra avocetta*, nella Salina di Cervia (Ravenna). *Rivista Italiana di Ornitologia*, 56: 181-96.
- Ceccolini F., Barbagli F. & Tellini Florenzano G., 2014 – L'avifauna di un'area umida artificiale in provincia di Arezzo: le vasche abbandonate dello zuccherificio di Castiglion Fiorentino. In: Atti XVI Convegno Italiano di Ornitologia. Cervia (RA), 22-25 settembre 2011. Tinarelli R., Andreotti A., Baccetti N., Melega L., Roscelli F., Serra L., Zenatello M. (eds.). *Scritti, Studi e Ricerche di Storia Naturale della Repubblica di San Marino*, 321-3.
- Crossland A. A. & Sitorus A. W., 2014 – Further Records of Black-winged Stilt *Himantopus h. himantopus* in North Sumatra. *Kukila*, 18: 17-21.
- Cuervo J. J., 2005 – Hatching success in Avocet *Recurvirostra avocetta* and Black-winged Stilt *Himantopus himantopus*. *Bird Study*, 52: 166-72.
- De Giacomo U., 2016 – Nidificazione di Cavaliere d'Italia *Himantopus himantopus* in una discarica dismessa (Malagrotta – RM, Italia centrale). *Gli Uccelli d'Italia*, 41: 153-6.
- Del Gaizo S. & Grotta M., 1995 – Prime indagini sulla comunità ornitiche di un'area industriale dismessa: ILVA di Bagnoli, Napoli. In: Atti del Sesto Congresso Nazionale della Società Italiana di Ecologia, Venezia, 26-29 settembre 1994. Ravera O., Anelli A. (eds.). S.It.E. (Società Italiana di Ecologia).
- Delitala G. M. & Casu S., 1995 – Osservazioni sull'avifauna dell'area industriale Enichem di Porto Torres: maggio 1989 - dicembre 1990. In: Studio, gestione e conservazione della fauna selvatica in Sardegna. Cossu S., Onida P., Torre A. (eds.). *Edizione del Sole e Amministrazione Provinciale di Oristano*, 291-5.
- Della Toffola M. & Tinarelli R., 2022 – Cavaliere d'Italia *Himantopus himantopus*. In: Atlante degli uccelli nidificanti in Italia. Lardelli R., Bogliani G., Brichetti P., Caprio E., Celada C., Conca G., Fraticelli F., Gustin M., Janni O., Pedrini P., Puglisi L., Rubolini D., Ruggieri L., Spina F., Tinarelli R., Calvi G., Brambilla M. (eds.). *Edizioni Belvedere*, 202-3.
- Dytham C., 2011 – Choosing and using statistics: a biologist's guide. New York: *John Wiley & Sons*.
- Ferlini F. & Ferlini R., 1997 – Status e biologia riproduttiva del Cavaliere d'Italia (*Himantopus himantopus*) in provincia di Pavia. *Gli Uccelli d'Italia*, 22: 70-81.
- Foschi F., 1978 – L'osservatorio ornitologico di Porto Marghera. *Gli Uccelli d'Italia*, 3: 168-172.
- Franceschi A., Arcamone E., Mainardi R. & Meschini E., 2014 – Uccelli acquatici nidificanti in ambienti artificiali: l'esempio del porto di Livorno. In: Atti XVI Convegno Italiano di Ornitologia. Cervia (RA), 22-25 settembre 2011. Tinarelli R., Andreotti A., Baccetti N., Melega

- L., Roscelli F., Serra L., Zenatello M. (eds.). *Scritti, Studi e Ricerche di Storia Naturale della Repubblica di San Marino*, 362-4.
- Giovacchini P. & Radi G., 2007 – Un anno di osservazioni sull'avifauna dell'area industriale Huntsman-Tioxide di Scarlino (GR). *Etruria Natura*, 4: 65-72.
- Hale R. & Swearer SE., 2016 – Ecological traps: current evidence and future directions. *Proceedings of the Royal Society B: Biological Sciences*, 283: 20152647.
- Hoffman D. J., Marn C. M., Marois K. C., Sproul E., Dunne M. & Skorupa, J. P., 2002 – Sublethal effects in avocet and stilt hatchlings from selenium-contaminated sites. *Environmental toxicology and chemistry*, 21: 561-6.
- Mamedova Y. P. & Chaplygina A. B., 2021 – Breeding of black-winged stilt *Himantopus himantopus* in muddy sites of a wastewater treatment plant. *Biosystems Diversity*, 29: 286-93.
- Marchesi F. & Tinarelli R., 2007 – Misure agroambientali in Emilia Romagna. *Regione Emilia Romagna*.
- Mascara R., 1990 – Espansione del Cavaliere d'Italia nell'area di Gela (Caltanissetta, Sicilia). *Rivista Italiana di Ornitologia*, 60: 96.
- Mascara R., 2008 – Censimento della popolazione nidificazione di Svasso maggiore, *Podiceps cristatus*, Cicogna bianca, *Ciconia ciconia* e Cavaliere d'Italia, *Himantopus himantopus*, nell'area della Piana di Gela (Sicilia). *Picus*, 34: 39-42.
- Nardotto A. & Bertolin C., 2022 – Recenti nidificazioni di Cavaliere d'Italia *Himantopus himantopus* in provincia di Treviso. *Picus*, 48: 27-30.
- Pietrelli L., Biondi M. & Guerrieri G., 1994 – Insediamento di una colonia di Cavaliere d'Italia, *Himantopus himantopus*, nel Lazio. *Rivista Italiana di Ornitologia*, 63: 222-5.
- Rajpar M. N., Ahmad S., Zakaria M., Ahmad A., Guo X., Nabi G. & Wanghe K., 2022 – Artificial wetlands as alternative habitat for a wide range of waterbird species. *Ecological Indicators*, 138: 108855.
- Raza N., Saqib T. A., Azmi M. A., Tariq R. M. & Naqvi S. N. H., 2013 – Study of bioaccumulation of metals in tissues of *Himantopus himantopus* (black winged stilt) from coastal areas of Karachi, Pakistan. *International Journal of Biology Research*, 1: 81-5.
- Schmiegelow F. K., Machtans C. S. & Hannon S. J., 1997 – Are boreal birds resilient to forest fragmentation? An experimental study of short-term community responses. *Ecology*, 78: 1914-32.
- Schmidt F. U., 1985 – The use of setting ponds of sugar-factories by breeding and resting waders. *Wader Study Group Bulletin*, 43: 34-6.
- Sebastián-González E. & Green Andy J., 2015 – Reduction of avian diversity in created versus natural and restored wetlands. *Ecography*, 39: 1736.
- Sofa A., Scillitani G. & Scalera-Liaci L., 1999 – Successo riproduttivo del Cavaliere d'Italia *Himantopus himantopus* nelle Saline di Margherita di Savoia nel triennio 1996-1998. *Avocetta*, 23: 61.
- Spiridonov S. N., Sarychev V. S., Okolelov A. Y., Isakov G. N. & Sukharev E. A., 2011 – Industrial wetlands as refuges for bird biodiversity conservation in the forest-steppe zone. *Biology Bulletin*, 38: 1037-42.
- Tavares P. C., Monteiro L. R., Lopes R. J. & Santos M. C., 2004 – Intra-specific variation of mercury contamination in chicks of Black-Winged Stilt (*Himantopus himantopus*) in Coastal. *Bulletin of Environmental Contamination and Toxicology*, 72: 437-44.
- Tavares P. C., Kelly A., Lopes R. J., Pereira M. E., Duarte A. C. & Furness R. W., 2007 – The influence of dietary specialization and trophic status on mercury levels in two species using common coastal wetlands, *Himantopus himantopus* and *Sterna albifrons*. *Ardeola*, 54: 275-288.
- Tian J., Li Q., Li W., Yang W. & Yang Y., 2025 – Heavy metal exposure risk to black-winged stilt (*Himantopus himantopus*) in a typical industrial city in northwest of China. *Environmental Science: Processes & Impacts*, 27: 1389-400.
- Tinarelli R., 1988 – Importanza dei bacini di decantazione degli zuccherifici per la nidificazione e la sosta dell'avifauna acquatica. *Picus*, 14: 31-39.
- Tinarelli R., 1990 – Risultati dell'indagine nazionale sul Cavaliere d'Italia *Himantopus himantopus* (Linnaeus, 1758). *Ricerche di Biologia della Selvaggina*, 87: 1-102.
- Tinarelli R., 1992 – Habitat preference and breeding performances of the Black-winged Stilt (*Himantopus himantopus*) in Italy. *Wader Study Group Bulletin*, 65: 58-62.
- Toral G. M., Baouab R. E., Martinez-Haro M., Sánchez-Barbudo I. S., Broggi J., Martínez-de la Puente J., Viana D., Mateo R. & Figuerola J., 2015 – Effects of agricultural management policies on the exposure of Black Winged Stilts (*Himantopus himantopus*) chicks to cholinesterase-inhibiting pesticides in rice fields. *PLoS One* 10: e0126738.
- Vallejos M. A. V., Padial A. A., Vitule J. R. S. & Monteiro-Filho E. L. D. A., 2020 – Effects of crowding due to habitat loss on species assemblage patterns. *Conservation Biology*, 34: 405-415.
- Warren S. D., Holbrook S. W., Dale D. A., Whelan N. L., Elyn M., Grimm W. & Jentsch A., 2007 – Biodiversity and the heterogeneous disturbance regime on military training lands. *Restoration Ecology*, 15: 606-612.