

## Diversity of some aquatic and aerial odonatus dwellers of the River Nile in Upper Egypt

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### ABSTRACT

The present work is aimed to study diversity of odonatus adults and naiads species encountered in the River Nile current throughout Upper Egypt. This study has been carried out in five stations for two sequence years. The odonatus diversity was investigated by monitoring numerical, locality abundance, and periodical abundance diversity.

The numerical diversity showed eight odonatus species. Moreover, the adults (54.75% of the total catches) dominated the naiads (45.25%) as well as Lestidae and *Lestes viridis* on the levels of the families and species.

Regarding locality diversity, the highest abundance of adults and nymphs were recorded in two different sites (El-Mashtal and Banana Island stations, respectively). Conversely, the lowest populations were recorded in Menshaa station.

On the other hand, the periodical abundance diversity indicated to importance of the two seasons, winter and summer during which the highest seasonal abundance for the naiads and the adults, respectively, in the most studied stations. In contrast, the minimum abundances of the naiads and adults were recorded during spring and winter, respectively. Thus, it could be seen seasonal abundant interference for both nymphs and adults, particularly, during spring. This result may be due to the long ages of the nymphs.

The variation of the seasonal abundance exceptive stations may not affect on the importance of winter and spring as the periods of the highest and lowest seasonal abundances because perhaps these stations, especially stations Ma, underwent some of the human activities of the commercial ports.

### INTRODUCTION

Ecological diversity represents the vertebrate of most various ecological sciences. That means, insect diversity supports and couple with other different insect ecologies for examples population ecology and systematic entomology even with insect microbiology. Entomo-ecological diversity could be performed by investigating abundance and dominance of the insect group. On the other hand, one of the very important insect groups is the odonates because of their ecological rule and biological control they play. Therefore, the odonatus species occupy an important position among the different hexapods.

All over the world, several authors studied the ecology of some species of order Odonata (Muller, 1993; Vantol and Rozendaal, 1995; Shukla and Shrivastava, 2003; Katherine, 2005; Mukherji *et al.*, (2005); Abushama (2006); Beschovski and Marinov (2007); Brooks (2008) Lorenzo-Carballa and Cordero-Rivera (2009). Abbott (2001) worked on the distribution of dragonflies and damselflies (Odonata) in Texas. In Malaysia, Norma-Rashid, *et al.* (2001) studied diversity and distribution of Odonata

in the fresh water swamp lake. Schultz *et al.*, (2003) studied the assessment of the ecological status of Danubian floodplains at Tulln (Lower Austria) based on the Odonata Habitat. Stoks and McPeck (2003) surveyed data from New England and showed that assemblages of *Lestes* damselflies are organized along the entire gradient of pond permanence and predator presence. Raab (2004) studied between 1995 and 2000, the floodplain of the River Danube near Regelsbrunn, Austria, for dragonfly species in a before and after study: Results indicated that 32 species were recorded at the before and 37 species at the after study with a total of 41 dragonfly species.

Several studies have been conducted on the abundance of Odonata species (Galbreath and Hendricks, 1992; Bath and Kaur, 1998; Alonso *et al.*, 2002 and Borisov, 2006). Olsvik and Dolmen (1992) studied distribution habitat, and conservation status of threatened Odonata in Norway. Ali *et al.*, (2002) investigated the abundance and biomass of the naiads of two odonata species, *Ischnura evanci* and *Brachythemis fuscopalliata*, in the Qaramat Ali region near Basrah. Abbott *et al.*, (2003) noticed the distribution of Odonata in the Texas Panhandle, with a summary of new state and county records. Bried *et al.*, (2005) studied the community and conservation ecology of dragonfly and damselfly adults in Mississippi wetlands. Hofmann and Christopher (2005) studied the influence of habitat characteristics on the distribution of larval and adult Odonata communities in a lowland river in eastern England. Butler and DeMaynadier (2007) studied the significance of littoral and shoreline habitat integrity to conservation of lacustrine damselflies (Odonata). Kalkman *et al.*, (2008) reported that the order Odonata is relatively well studied, and the actual number of species may be close to 7,000. Many species have small distributional ranges, and are habitat specialists, including inhabitants of alpine mountain bogs, seepage areas in tropical rain forests and waterfalls.

In Africa, several studies have been carried out with Odonata. Samways and Steytler (1996) studied the dragonfly (Odonata) distribution patterns in urban and forest landscapes and stated recommendations for riparian management. Vick (2002) studied the preliminary biodiversity assessment of the Odonata fauna of the Takamanda Forest Reserve, Cameron. He stated that, the African dragonfly fauna about 900 species and 125 genera. Finch *et al.*, (2006) selected a simple modeling approach for the generation of distribution maps from a limited dataset, as a first step to the atlas sing of Odonata in South Africa.

In Egypt, few authors studied the ecology of aquatic insects such as Shoukry (1979) who conducted a survey of adult Odonata in Hihya, Abu Hammad, Zagazig and Minyat El-Kamh, he reported that, most species were found near aquatic habitats ponds, streams and the lake. Tawfik (1986) studied aquatic insect in swimming pools. Aly *et al.*, (1992) reported a general survey and seasonal distribution of aquatic insects in Qena Governorate, Egypt. Aly *et al.*, (1993) studied the seasonal abundance and effect of Chemo-physical factors on immature stages of order Odonata in Qena. Abdel-Aal *et al.*, (1998) studied the biological control and ecology of mosquitoes in Aswan. The species composition and relative abundance of some odonatous species encountered in the Red Sea Governorate were investigated by Osman, 2004. Mohamed (2004) studied the ecological and behaviors on some species of order Odonata in Qena Governorate (Egypt) and Northwestern (Germany).

This work is aimed to survey the odonatous species dwelling banks and gulfs of the River Nile and some of its channels. Moreover, it is purposed to show a primitive ecological comparison between abundance of the aquatic and aerial odonatous stages.

## MATERIALS AND METHODS

The present work was carried out in and around Luxor city (670 Km south of Cairo) for a period of two sequence years (from March 2005 till February 2007). Five stations were visited once a week during the day (9.30 a.m. - 1.30 p.m.), photos (1, 2 and 3).

The all stations are opened or semi-opened systems (Banana Island, Crocodile Island, El-Mashtal, El-Radwan and Menshaa station). The first, second and third stations are located 2.5, 3, 5 km far from Luxor City on the River Nile, respectively. However the fourth and fifth stations were located 5 and 6 km south and eastern on the River Nile (photos 1, 2 and 3).

On the other hand, there are some different plants on all stations (the vegetated area inside and around the stations) and it was consider the urban zones.

Conical sweeping net for collecting odonatous adults non cloth sweeping net for catching the nymph stages were used. Altogether, 10 sweepings formed the representative sample on each visit. These sweepings were applied at almost equal 10 meters of each station. The catch was sorted in to genera and species. Number of individuals of each species was counted.

### Identification of fauna:

Identification of the caught adult and nymph odonatous specimens was performed by two methods; the first was by rearing the nymph. However the second was done by using Key of Sternberg and Buchwald (Band 1, 1999 and Band 2, 2000).

Nymphs identification were conducted by using A Key to the Italian Odonata larvae (Gianmaria, 1983) after the microscopic examination under laboratory conditions of entomology at faculty of Science, Qena, South Valley University.

Seasonal abundance: The seasonal abundance of the various species, genera, families and all order collectively were represented by histograms using the computer with exception of species represented by few individuals.



Photo (1): Egypt map.



Photo (2): River Nile including location of Luxor City.

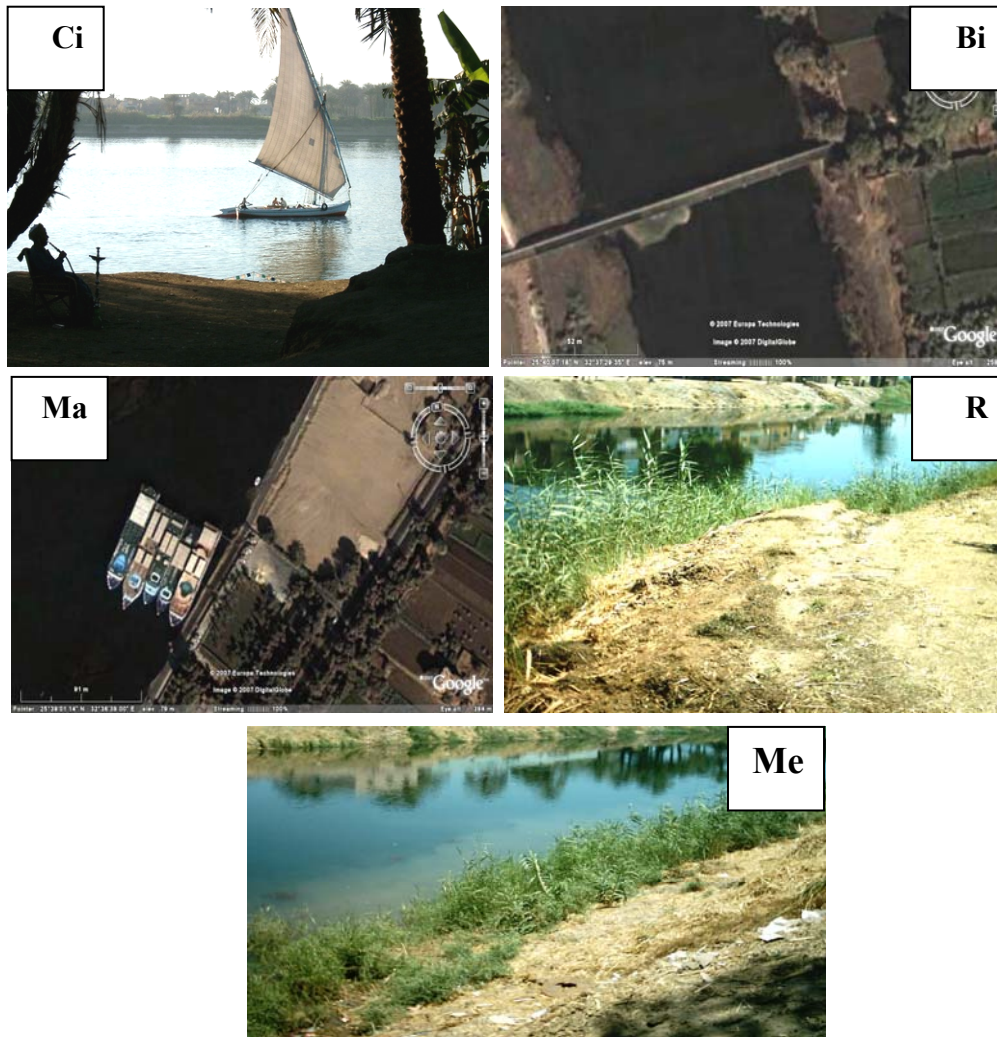


Photo (3): Pictures of Stations involving:  
 (Bi): Banana Island, (Ci): Crocodile Island,  
 (Ma): El-Mashtal, (R): El-Radwanian and  
 (Me): Menshaa station.



Photo 4: Some species of adults and nymphs Odonata taken by [www.ucmp.berkeley.edu/.../odonatoida.html](http://www.ucmp.berkeley.edu/.../odonatoida.html)  
 and [www.mdfrc.org.au/BugGuide/](http://www.mdfrc.org.au/BugGuide/)

## RESULTS AND DISCUSSION

Results on the diversity of the odonatus showed eight species belonging to eight genera under five families. These identified families are Aeshnidae, Coenagrionidae, Gomphidae, Lestidae and Libellulidae, while their species are *Aeschna cyanea*, *Anax imperator*, *Crocothemis erythraea*, *Enallagma cyathigerum*, *Ischnura elegans*, *Lestes viridis*, *Libellula fulva* and *Onychogomphus forcipatus*, (table 1 and photo 6). On the other hand, the diversity of these odonatus is recognised as numerical, seasonal, locality, evolutionary abundance and dominance of some species.

### I- Numerical Diversity of Naiads and Adults:

Numerical diversity of the odonatus naiads and adults was expressed by the total catches of all order, the different families and species. As shown in table (1), the total numbers of adult and nymph catches at all stations for two sequent years were represented by 54.75% and 45.25% of all caught odonatus, respectively. The previous result perhaps indicates to dominate adult odonatus stage comparing with other immature stages during all studied period.

Table (1): Families, genera, species and numbers of the odonatus individuals.

| Families       | No. of genera |    | No. of species |    | No. of individuals |      | % of the total catch |         |
|----------------|---------------|----|----------------|----|--------------------|------|----------------------|---------|
|                | A.            | N. | A.             | N. | A.                 | N.   | A.                   | N.      |
| Aeshnidae      | 2             | 2  | 2              | 2  | 17                 | 199  | 0.18/08              | 2.51/92 |
| Coenagrionidae | 2             | 2  | 2              | 2  | 2217               | 3024 | 23.10/               | 38.11   |
| Gomphidae      | 1             | 1  | 1              | 1  | 430                | 5    | 4.48                 | 0.06    |
| Lestidae       | 1             | 1  | 1              | 1  | 3517               | 4127 | 36.63                | 52.01   |
| Libellulidae   | 2             | 1  | 2              | 1  | 3418               | 580  | 35.61                | 7.31    |
| Total          | 8             | 7  | 8              | 7  | 9599               | 7935 | 54.74                | 45.25   |

A.: Adults

N.: Nymphs

Regarding the different odonatus families, the results showed that Lestidae was recorded by the highest odonatus number of individuals (43.6% of the total number of odonatan individuals). In contrast, only 0.02% of catches was of Gomphidae representing the lowest odonatus populations.

Lestid adults were the highest odonatus number of individuals (52.01% of the total odonatus individual number as well as lestid nymphs also was registered by the maximum population ratio (36.63% of all catches). Conversely, the minimum nymphal and adults populations were found among both the gomphids and Aeshnids (0.06% and 0.18%, respectively) (Table, 1).

Regarding abundance of each species, the most abundant species was *Lestes viridis* representing 3517 adult individuals (36.64% of all individuals) and 4125 nymph individuals (52.01% of all individuals). However, the next abundant species was *Crocothemis erythraea* where 2376 adult (24.75% of all individuals) were trapped. In relation to *Ischnura elegans* 3012 nymph individuals (37.96% of all individuals) were captured. In contrast, the lowest abundant populations were *Anax imperator* and *Onychogomphus fercipitus* of which only 8 adults and 5 nymphs were recorded. On the other hand, one species collected as adult only called *Libellula fulva* where its nymphs did not appear during the present study.

## II- Locality Abundance Diversity of Naiads and Adults:

On the other hand, table (2) show abundance of odonatous populations according to the stations the encountered in. The highest population of adults was recorded in El-Mashtal station in which (33.82% of all adult individuals) was collected, while the highest populations of nymphs were recorded in Banana Island station (25.55% of all nymph individuals). The followed highest station was Crocodile Island (23.02% of all adult individuals) and (22.37% of all nymph individuals). Conversely, the lowest populations were recorded in Menshaa station from which 1035 adult individuals and 1155 nymph representing 10.78% and 14.56% of all adult and nymph individuals were captured, respectively.

Table 2: The catches of Odonata from different stations at Luxor city collected during the period from March 2005 till February 2007.

| Families & species                         | Stations |      |      |      |      |      |      |      |      |      | Total |      |  |
|--|----------|------|------|------|------|------|------|------|------|------|-------|------|--|
|  | Bi       |      | Ci   |      | Ma   |      | R    |      | Me   |      | A.    | N.   |  |
|  | A.       | N.   | A.   | N.   | A.   | N.   | A.   | N.   | A.   | N.   |       |      |  |
| Aeshnidae                                  |          |      |      |      |      |      |      |      |      |      |       |      |  |
| <i>Aeshna cyanea</i> (Müller)              | 0        | 31   | 7    | 37   | 0    | 49   | 2    | 17   | 0    | 3    | 9     | 137  |  |
| <i>Anax imperator</i> (Leach)              | 6        | 18   | 0    | 13   | 0    | 23   | 2    | 7    | 0    | 1    | 8     | 62   |  |
| Coenagrionidae                             |          |      |      |      |      |      |      |      |      |      |       |      |  |
| <i>Enallagma cyathigerum</i> (Charpentier) | 48       | 0    | 41   | 0    | 68   | 8    | 12   | 4    | 6    | 0    | 175   | 12   |  |
| <i>Ischnura elegans</i> (Vander L.)        | 394      | 844  | 622  | 755  | 518  | 795  | 299  | 319  | 209  | 299  | 2042  | 3012 |  |
| Gomphidae                                  |          |      |      |      |      |      |      |      |      |      |       |      |  |
| <i>Onychogomphus forcipatus</i> (Linnaeus) | 138      | 4    | 113  | 1    | 126  | 0    | 40   | 0    | 13   | 0    | 430   | 5    |  |
| Lestidae                                   |          |      |      |      |      |      |      |      |      |      |       |      |  |
| <i>Lestes viridis</i> (Vander L.)          | 706      | 978  | 1002 | 789  | 840  | 692  | 545  | 871  | 424  | 797  | 3517  | 4127 |  |
| Libellulidae                               |          |      |      |      |      |      |      |      |      |      |       |      |  |
| <i>Crocothemis erythraea</i> (Brulle)      | 424      | 152  | 361  | 180  | 930  | 95   | 361  | 98   | 300  | 55   | 2376  | 580  |  |
| <i>Libellula fulva</i> (Müller)            | 84       | 0    | 64   | 0    | 764  | 0    | 47   | 0    | 83   | 0    | 1042  | 0    |  |
| Total                                      | 1800     | 2027 | 2210 | 1775 | 3246 | 1662 | 1308 | 1316 | 1035 | 1155 | 9599  | 7935 |  |

Bi: Banana Island station

A.: Adults

Ci: Crocodile Island station

N.: Nymphs

Ma: El-Mashtal station

R: El-Radwan station

Me: El-Menshaa station

## III- Periodical abundance Diversity of the odonatous insects:

Periodical abundance of order Odonata, collectively, and three families namely: Coenagrionidae, Lestidae and Libellulidae were expressed as the seasonal abundance of their adults and nymphs during two years at five different stations as shown in tables (4, 5, 6 and 7). Because the families of Aeshnidae and Gomphidae were represented by few numbers of individuals, then it was difficult to calculate the seasonal abundance of them.

### 1-Seasonal abundance of order Odonata, collectively:

#### A: Adults:

The results showed that, the seasonal abundance of order Odonata, collectively, arrived the maximum during summer in the two years at all stations, while the lowest population occurred during spring at station all stations during the two studied years. This stability of the results probably due to adults ability adapting with the meteorological variations they face.

#### B: Nymphs:

Regarding the first year, the all odonatous nymphs reached their maximum abundance during winter in all studied stations. In contrast, the lowest abundance differed from station to other recording the lowest abundance in stations Bi and Me during spring, in station Ci during summer and in station during autumn.

However, during the second year, winter showed the maximum abundance in all stations except for station Ma in which these abundance were recorded during

autumn. Conversely, the lowest seasonal nymph abundance was found during spring in all stations except for station Me showing dropping in abundance during summer.

## **2-Seasonal abundance of the different odonatus families:**

### **A- adults:**

All odonatus families showed their highest abundance during summer, while their lowest abundance was recorded during winter without exceptions in the different stations.

### **B-Nymphs:**

The coenagrionid, lestid and libellulid nymphs showed their maximum abundance during winter of two studied years. In contrast, the minimum abundance of the two last families was during spring of two years. All stations follow the previous result with exception of station Ma exhibiting the highest and the coenagrionid lowest abundance during spring and winter, respectively, maximum and minimum lestid nymph abundance during autumn and winter, respectively.

In general, numerical diversity of the odonates and locality abundance showed little number of the odonatus species (only 9 species. This little bid number may be resulted from working on, relatively, narrow distance, or the different site had no observed variety. This result was disagree with that obtained by Abbott (2001) who worked on Distribution of dragonflies and damselflies (Odonata) in Texas and collected two hundred and five species of Odonata from Texas (USA). The last author interpreted his high recorded number as Texas contains highly diverse odonates, because of its unique geographic position and highly variable physical composition relative to other physiographic provinces.

Regarding the seasonal abundance, generally, the results indicate to importance of the two seasons, winter and spring. The highest and lowest seasonal abundance occurred during these two seasons in most studied stations. The variation of the seasonal abundance exceptive stations may not affect on the importance of winter and spring as the periods of the highest and lowest seasonal abundances because perhaps these stations, especially stations Ma, underwent some of the human activities. Therefore they were disturbed stations. Thus the seasonal abundance was not clear or accurate. These results agree with Aly *et al.*, (1993) who found that the population of Odonata was well represented all over the year especially during winter and spring. Furthermore, Jason (2005) confirmed our results recording a drop in the odonatus individuals during July and August. In contrast, Crowley *et al.*, (1987) disagreed with this result, where they concluded that, the maximum emergence of damselflies was occurred during spring, summer and autumn.

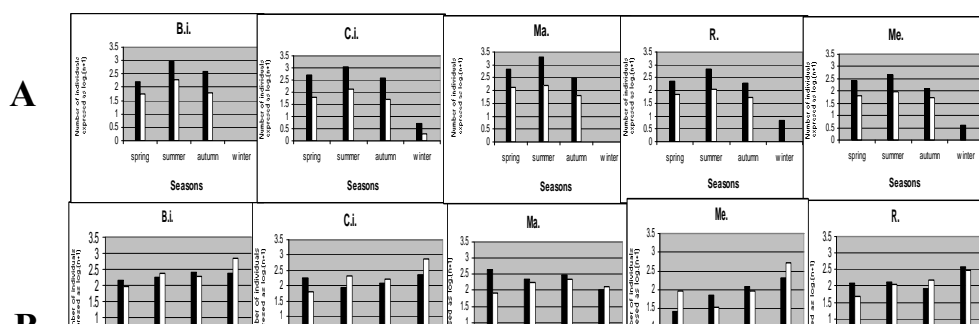
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**B**

Fig. 4: Distribution of A) adults and B) nymphs of: I) All of order Odonata and families II) Coenagrionidae; III) Lestidae and IV) Libellulidae at stations (Bi), (Ci), (Ma), (R) and (Me) in the first year (■) and in the second year (□).

**ARABIC SUMMARY**

دراسة تنوع الاطوار اليافعة وغير اليافعة من رتبة الرعاشات التي تم جمعها من نهر النيل في منطقة جنوب مصر

محمد زكي يوسف على<sup>1</sup> - خالد سعيد محمد عثمان<sup>2</sup> - إبراهيم عيسى عيسى<sup>3</sup> - أحمد محمد نور<sup>4</sup>  
قسم علم الحيوان - كلية العلوم - جامعة جنوب الوادي

يهدف هذا البحث الى دراسة تنوع الاطوار اليافعة و الغير يافعة من رتبة الرعاشات التي تم جمعها من نهر النيل في منطقة جنوب مصر. و لقد نفذت هذه الدراسة على خمسة مواقع لمدة سنتين متتاليتين. و قد تمت دراسة هذا التنوع من حيث الكثافة العددية و المكانية و الزمنية للأفراد و الاطوار المختلفة. و لقد اظهر التنوع العددي التعرف على ثمانية أنواع مختلفة من الرعاشات في هذه المنطقة و كذلك سيادة الكثافة العددية للاطوار اليافعة (54.75% من كل الافراد) على حساب الاطوار الغير يافعة (45.25% من كل الافراد). اما على مستوى الانواع فقد اثبتت النتائج سيادة عددية لكثافة نوع ليستس فيرايدس على كل الانواع. و اما بالنسبة للتنوع المكاني عبر مواقع الدراسة المختلفة فقد سجلت اكثر كثافة لكل الافراد (اليافعة و الغير يافعة) في كل من موقع المشتل و جزيرة الموز، على التوالي. و على العكس من ذلك فقد وجدت اقل كثافة عددية في موقع المنشأة. و اما من ناحية التنوع الزمني او الموسمي للكثافات المختلفة فقد تبينت أهمية خاصة لموسمى الشتاء و الصيف خلال معظم محطات الدراسة. ففيهما تم جمع أعلى عدد من أفراد الأَطوار الغير يافعة و اليافعة، على الترتيب. و العكس صحيح بالنسبة لموسمى الربيع و الشتاء و الذين خلالهما أظهرت الأَطوار السابقة الكثافة الموسمية الأدنى، على التوالي. مما يعنى وجود تداخل في الكثافات الموسمية لهذه الأَطوار في موسم الربيع. و قد يفسر هذا التداخل نتيجة لطول أعمار الأَطوار الغير بالغة. أما بالنسبة لتلك المواقع التي لم تتأثر أو لم تظهر تنوعاً زمنياً خلال الموسمين الذكورين فقد فسر استثنائها الى احتمالية عدم استقرارها بسبب بعض النشاطات الأدمية التجارية في المناطق التي تقع خلالها تلك المحطات.