SWOT analysis of Louisiana crayfish *Procambarus clarkii* (Girard, 1852) valorization in Morocco

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Abstract. The introduction of the Louisiana crayfish *Procambarus clarkii* can seriously impact the natural environment, biodiversity and the economy. In Morocco, this species is reported from the northwest (Gharb and Lower Loukkos) region. This perimeter is known by a large rice-growing activity which is not currently free from the influence of *P. clarkii*. The management of this invasive species through valorization represents a relevant solution. The SWOT analysis provided a global vision of the value-added, revealing that the strengths and opportunities identified can compensate for the weaknesses and protect against possible threats. This represents a promising framework for the development of a value chain for Louisiana crayfish in Morocco.
Key Words: *Procambarus clarkii*, SWOT analysis, Louisiana crayfish valorization, Morocco.

Introduction. Louisiana crayfish *Procambarus clarkii* is an effective colonizer that can quickly become established and have a devastating impact on colonized territories (Rodríguez et al 2005; Gherardi 2006; Souty-Grosset et al 2006). Its introduction can lead to spectacular changes in native plant and animal communities (Schleifstein & Fedeli 2003), particularly on native fish species with a very localized distribution area such as *Salaria atlantica* (Doadrio et al 2011) which is endemic to Sebou basin that *P. clarkii* is invading. It modifies the dynamics of ecosystems by intervening on food webs, on existing vegetation, on macro-invertebrates populations and fish habitats (Angeler et al 2001; Dorn & Wojdak 2004; Gherardi & Acquistapace 2007; Cruz et al 2008). In addition to its influence on ecosystems, *P. clarkii* can also have a considerable economic impact (Correia 1993; Holdrich 1999; Saguem & El Moutaouakil 2019).

In Morocco, *P. clarkii* is located in the northwest in the region of Gharb and Low Loukkos (EL Qoraychy et al 2015; Benyahkoub et al 2019a, b; Saguem & El Moutaouakil 2019; Saguem et al 2020). These areas are known by a great rice cultivation activity which is disturbed by the presence of *P. clarkii*. Indeed, the burrowing behavior destabilizes the banks and causes a great loss of water. A study conducted by Saguem & El Moutaouakil (2019) in the Gharb region demonstrated that the financial losses linked to the presence of *P. clarkii* are estimated at 4,224 MAD/ha and 4,752 MAD/ha (388.28 €/ha and 436.52 €/ha). Faced with this situation, farmers retaliate by using pesticides (Saguem et al 2020).

For the management of this invasive species, the valorization presents a relevant solution, which will make it possible both to control populations by reducing negative impacts and to bring added value to the local and national economy.

The present work is based on the diagnosis of the *P. clarkii* populations status carried out by the authors during the period 2017-2019. Its objective is to assess the valorization of this species in Morocco.

According to the European Commission services, SWOT analysis is a strategic analysis tool that combines the study of the strengths and weaknesses of an organization, plan or program with the study of the opportunities and threats of its environment, in order to help define a development strategy. In our case the SWOT

analysis will be applied to the valorization of *P. clarkii* in Morocco, this will provide a clearer and more accurate picture taking into account both internal factors (tools, resources, etc.) and external factors (legislation, market, etc.), highlighting the potential of strengths and opportunities and identifying the effects of weaknesses and threats. The SWOT analysis allows to reduce the grey areas and to refine the criteria surrounding the considered solution. Thus the result of this work will contribute to the popularization of the management proposal through valorization, by taking into account two pairs of opposite criteria (strengths # weaknesses and opportunities # threats). This represents a simplified vision of the situation, and provides to management authorities and economic actors some concrete elements for decision making.

Material and Method. The valuation of *P. clarkii* in Morocco is assessed by SWOT analysis. This analysis provides a synthetic vision by gathering and cross-referencing internal (strengths and weaknesses) and external (opportunities and threats) analysis with the micro and macro environments of the valorization. This analysis is an excellent tool to support the strategic planning process, contributing to the study of the relevance and coherence of future action and providing an initial idea of possible options (Akca et al 2006; Araya et al 2014). In order to be most effective, this analysis must be initiated in the early stages, as in the case of this study.

Results and Discussion. The SWOT analysis presented below follows the results obtained from the study of *P. clarkii* populations in the Gharb and Lower Loukkos regions of northwestern Morocco. This study covered a 4-year period between 2017 and 2020, during which we studied biometric parameters, population dynamics, geographical distribution and stock estimates.

SWOT analysis

Strengths

Species known and sold internationally. *P. clarkii* is the second most produced crustacean species, accounting for 12% of global aquaculture production (FAO 2018). The main producing countries are the United States of America with 63,626 tons and China with 1,128,708 tons for the year 2017 (FAO 2019a). The analysis of the evolution of world aquaculture production between 2008 and 2017 (Table 1) shows that the quantity has tripled while the value has multiplied by 5, which means that not only is the market growing, but also that demand is greater marked by an increase in price, hence the difference between the evolution of quantity and value. As regards fisheries (Table 2), the FAO estimates (2019b) indicate low quantities in comparison with aquaculture production, with a world total of 5.6 thousand tons, mainly from Spain and Egypt. However, the quantities from the *P. clarkii* fishery more than tripled from 1.5 thousand tons in 2008 to 5.6 thousand tons in 2017.

Table 1

Aquaculture production of *Procambarus clarkii* between 2008 and 2017 (FAO 2019a)

Year	*China (t)*	*Italy (t)*	*USA (t)*	*Quantity (t)*	*Value (1,000 USD)*
2008	364,619	-	53,285	417,904	2,059,103
2009	471,590 F	-	46,717	518,307	2,694,931
2010	543,382 F	9	52,942	596,333	3,393,729
2011	459,619 F	33	53,435	513,087	3,408,218
2012	505,301 F	5	43,437	548,743	4,013,168
2013	548,659 F	7	48,500	597,166	4,654,992
2014	598,411 F	7	60,858	659,276	5,375,948
2015	656,388 F	8 F	63,690	720,086	5,829,951
2016	827,107	10 F	67,592	894,709	7,381,926
2017	1,129,708	10 F	63,626	1,193,344	10,003,537

F = estimations by FAO.

Table 2

Procambarus clarkii catches between 2008 and 2017 (FAO 2019b)

Year	*Egypt (t)*	*Kenya (t)*	*Spain (t)*	*Swiss (t)*	*Quantity (t)*
2008	-	19	1500 F	-	1519 F
2009	-	16	1500 F	-	1516 F
2010	-	20	1500 F	-	1520 F
2011	-	18	1500 F	-	1518 F
2012	-	22	1500 F	-	1522 F
2013	-	24	1500 F	-	1524 F
2014	-	27	1500 F	-	1527 F
2015	2 520	24	1500 F	-	4044 F
2016	3 659	24	1500 F	1	5184 F
2017	4 100 F	-	1500 F	-	5600 F

F = estimations by FAO.

Species compatible with different production ways. The adaptive and colonizing capacity of the environments means that *P. clarkii* can be produced in aquaculture alone or integrated into agricultural systems in combination with other crops such as rice or soybean (FAO 2009). It may also be fished in natural environments.

Species naturally available in a large area. In Morocco, the range of *P. clarkii* covers a large area in the northwest (Figures 1 and 2). In these areas *P. clarkii* occupies practically all aquatic environments: lagoon, irrigation and drainage channels, temporary Merjas and rice fields. This perimeter includes many sectors that are easily delineated and compatible with amodiation procedures for exploitation. These are mainly drainage canals such as the Nador Canal and watercourses such as the Drader river and the M'da river.

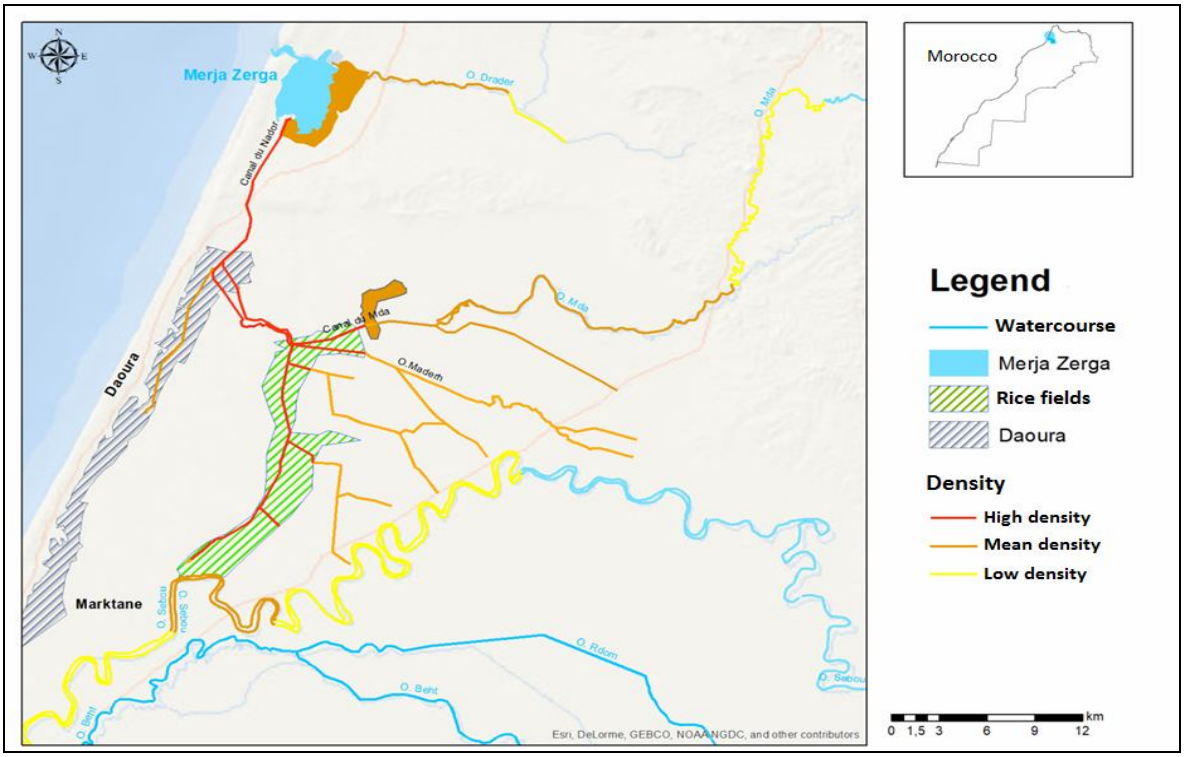

Figure 1. Density of *P. clarkii* in the Gharb region (Benyahkoub et al 2019a).

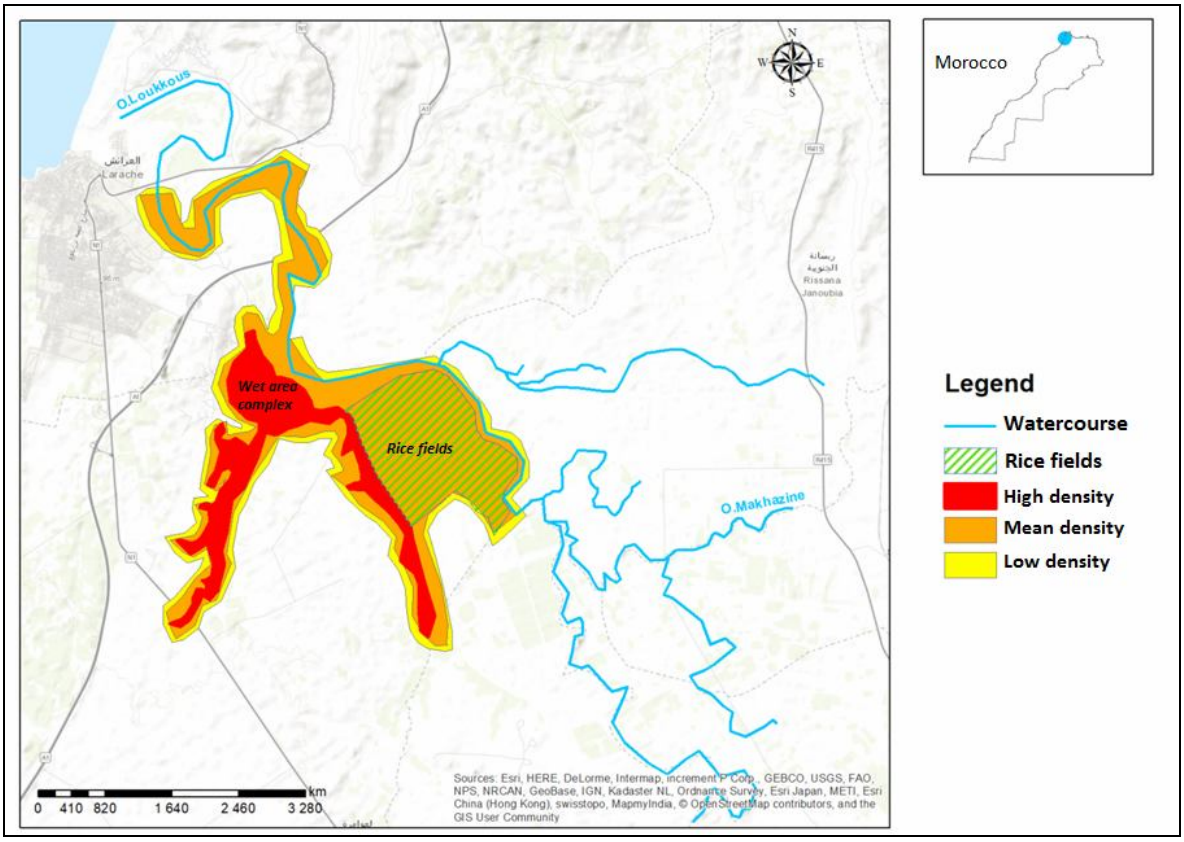

Figure 2. Density of *P. clarkii* in the wet zones and rice fields of Low Loukkos (Benyahkoub et al 2019a).

Very prolific invasive species that cannot be subject to catch restrictions. In Morocco, stocks of *P. clarkii* are estimated at 90.72 tons (Benyahkoub et al 2019a). The species is known to be particularly prolific compared to other European species (Table 3), including the red-legged crayfish (*Astacus astacus*) present in Morocco (Mouslih 1987). Egg production can be completed in six weeks, incubation and maternal attachment in three weeks, and maturation in eight weeks (Ackefors 1999). As a result, the species has not been subject to any catch restriction or quota system in the decree regulating the annual fishing in continental waters (2019-2020 season), which is elaborated by the Department of water representing the managing authority.

Table 3

Comparison of the different life history traits of *P. clarkii* against native and non-native crayfish in Europe (Trouilhé 2006)

	Austropotamobius pallipes	*Astacus astacus*	*Astacus leptodactylus*	*Pacifastacus leniusculus*	*Procambarus clarkii*	*Orconectes limosus*
Longevity (years)	10-12	10-15	6-9	9	2	4
Sexual maturity age (years)	3-4	3-4	2-3	1-2	< 1	2
Growth	Slow	Slow	Fast	Fast	Very fast	Fast
Maximum size (mm)	120	180	195	150	> 150	120
Eggs number	< 100	100-150	200-400	110-300	200-700	200-400
Reproduction numbers per year	1	1	1	1	Many times	Many times

Easy to collect. The most common technique for collecting *P. clarkii* is trapping by trap (FAO 2009). This consists of placing a bait in a trap for 24 hours and then returning to retrieve the traps with the crayfish. As a result, the operation does not require highly skilled labor.

Resistant species that can withstand packaging and live transport. Crayfish can be packaged in open-mesh plastic bags that hold approximately 18 kg (Figure 3). Healthy crayfish can be stored in humid temperatures of 4-8°C for 6-7 days (FAO 2009). This is a great advantage since a large proportion of wholesale and retail sales are of live crayfish.

Figure 3. *P. clarkii* packed live in open-mesh plastic bags.

Many options for marketing. *P. clarkii* can easily be marketed in the same way as other aquatic products. By following the classic distribution channels, going through fish markets and retailers or sold directly to processing plants and workshops, it can also be sold in small local markets or large supermarkets (FAO 2009). The best thing about *P. clarkii* is that it can be kept alive longer and more easily than other crustacean species, which helps to maintain its freshness longer. The price of live *P. clarkii* is influenced mainly by the interplay of supply and demand, so crayfish are more expensive at the beginning and end of the season when production is low, and are cheaper in mid-season when they are plentiful (FAO 2009). The price varies between $5.9 and $12.99/kg for Chinese production (proposed on alibaba.com) and between €7 and €10/kg in Europe, while the Louisiana production is offered between $5 and $11/lb, which means a price per kg between $11 and $24.5 (proposed by LOUISIANA CRAWFISH COMPANY on lacrawfish.com). Processed crayfish (cooked, peeled or in ready meals...) are often offered in small packages between 100 and 200 g up to 1 kg for a price between 35 and 45 €/kg on the European market. The selling price of Louisiana crayfish in Morocco can be established according to two parameters, the selling price in other countries and that of other species of crustaceans in the national market. And therefore, *P. clarkii* can be positioned in the same range as the small cicada and langoustine whose prices range from 9 to 12 €, this range is consistent with that applied at the regional level (Spain, Portugal, France ...). For processing products, they will be largely for export, especially to

Europe, to be competitive they can be offered at prices similar or lower than those of the competition (35-45 €/kg).

Weaknesses

Variability of production according to environmental conditions. For *P. clarkii*, the mating period, as well as recruitment and sexual maturation, vary according to the hydrographic period and environmental conditions (Sommer 1984; Alcorlo et al 2008). For large females (> 45 mm) to reproduce, it is necessary to have a hormonal induction induced by the photoperiod (Gutierrez-Yurrita & Montes 1999), a hydroperiod of more than four months, a temperature above 18°C and a pH between 7 and 8 (Gutierrez-Yurrita 1997). Optimal temperatures are 21 to 25°C with the highest egg-laying and fecundity rates at 21°C (Jin et al 2019). In Morocco the main elements that can strongly influence the production of *P. clarkii* are those related to hydrology. Indeed, Morocco is known for the irregularity of rainfall accentuated by the general evolution of the climate which shows a warming trend with episodes of extreme climatic events (mainly droughts) which are increasingly frequent and intense.

Species little known and in low demand at the national level. In Morocco there is no exploitation or marketing of *P. clarkii*, crayfish in the wild are rarely used and only for personal consumption of a few fishermen. According to our field survey, some people in the areas where *P. clarkii* occurs have tried to market small quantities in nearby towns but without much success. Concerning the resellers, the low proportion of flesh in relation to the total length is a great disadvantage that repels consumers. From a cultural point of view, crayfish are not part of the consumption habits of Moroccans and remain very little known.

Opportunities

Socio-economic context of the species range. *P. clarkii* is located in a large area characterized mainly by a population of farmers, farm workers and fishermen who can be the driving force behind a value chain. Its perimeters, whose activities are centered around agriculture and fishing, are home to a large rice growing activity that ensures the totality of the national production. It is known that the opportunity related to the recovery of *P. clarkii* in the rice fields of Gharb would have an estimated value of between 1,505 MAD/ha and 3,010 MAD/ha (i.e. 138.34 €/ha and 276.68 €/ha) (Saguem & El Moutaouakil 2019). In addition, its large rice-growing perimeters present a great opportunity for the integration of aquaculture of this species.

Significant decrease in the availability of shrimp accompanied by an increase in their price. According to the National Institute of Fisheries Research in Morocco, the most important shrimp species in terms of catch is the large rose shrimp *Parapenaeus longirostris*. The analysis of the evolution of the total quantities caught at the international level between 2008 and 2017 (FAO 2019b) shows an increasing trend to reach 30,454 t in 2017. However, in Morocco this species has been less and less available for more than a decade. This situation is accompanied by a gradual increase in price, which has almost doubled at present. This represents a favorable framework for the penetration of *P. clarkii* in the Moroccan market.

Presence of a Moroccan industry of shrimp shelling. Shrimp shelling is a recent activity in Morocco. It only started in the early 1990s but has grown in recent years. According to the Department of Maritime Fishing, the country currently has 11 shrimp shelling units distributed mainly in the North between the cities of Tangier (6), Tetouan (1) and Nador (4). This activity relies mainly on the temporary importation of North Sea shrimp that are peeled in approved Moroccan establishments. These products are then re-exported to their origin countries. With the automation of this practice abroad, this industry is in

danger of seeing its activity decline. It is then that the valorization and integration of *P. clarkii* in the husking circuit will allow the industrialists to make up for the lost turnovers.

Changing consumption habits with a trend towards increased consumption of aquatic products. According to QU Dongyu, Director-General of the FAO, fish and fishery products are considered to be among the healthiest foods on the planet and also have the lowest impact on the natural environment. According to the report on the State of World Fisheries and Aquaculture (FAO 2020), total fish production is expected to reach 204 million tons in 2030, an increase of 15% compared to 2018 (with the aquaculture sector accounting for 46%). This increase is more or less half of that recorded in the previous decade and, with it, annual consumption of fishery products could reach 21.5 kg per person in 2030. This reflects the growing interest in aquatic products that is favorable to the valorization of *P. clarkii*.

Moroccan context of economic recovery. The Moroccan economy has been strongly impacted by the health crisis related to the Covid-19 pandemic. In order to revive the economy, several support measures for rescuing companies and supporting the creation of economic activity have been put in place. The latest one is the "Mohammed VI Fund for Investment". Initiated by His Majesty King Mohammed VI, the fund is valued at 120 billion dirhams, equivalent to 11% of the national GDP. This plan includes two main schemes: a state-guaranteed loan scheme and a Strategic Investment Fund.

Threats

Lack of a clear and species-specific legal framework. The management authorities had suspected the existence of *P. clarkii* since at least the year 2010. However, it was not until 2019 that it was included by the Department of Water and Forests in the decree regulating annual fishing in continental waters and setting reserves for the 2019-2020 season under the name Louisiana crayfish. This makes it the first piece of legislation mentioning this species. From the analysis of this text it appears that *P. clarkii* is considered like the other freshwater species and does not benefit from special measures encouraging its exploitation. This text is the only one that directly concerns the species. However, given that the management authorities are still working on the issue and have not yet announced any orientation, it remains difficult to plan management by valorization.

Large Chinese production that can control prices. In constant increase for a decade, Chinese production of *P. clarkii* amounted to 1,128,708 tons in 2017 (FAO 2019a) representing more than 90% of the world production of the species. Offered at a price between $5.9 and $12.99/kg, it remains the cheapest in the world. This rank of the most important producer gives China a strong position in the market of *P. clarkii*. Thus, the price proposed for the Chinese production will necessarily have a direct repercussion on the price of *P. clarkii* at the international level.

The use of pesticides in the context of a shared hydraulic system. The area of distribution of *P. clarkii* covers a large area of rice cultivation favorable to the collection and valorization of the species. However, its rice farms share the same hydraulic system, so it has been reported that once pesticide treatment begins, the effects of the treatment are noticeable even in plots that have not yet started. Therefore, if the initiative is not carried out in common agreement with all the stakeholders of the agricultural system in question, this parameter seriously threatens the valorization of *P. clarkii* in a perspective of combined rice-crayfish production.

Conclusions and outlook. The SWOT analysis reveals that the strengths and opportunities identified can help offset weaknesses and protect against potential threats. This represents a promising framework for the development of a value chain for *P. clarkii* in Morocco.

The valorization of *P. clarkii* in Morocco has great development prospects, moving in the medium term from a small activity on a local scale to a more important production at the regional level and then to a solid sector capable of being competitive at the international level. This sector also paves the way for the emergence of production methods that combine aquaculture and agriculture to increase farm productivity and yield.

In order to maintain its primary objective of controlling *P. clarkii* populations, with a view to protecting the environment and biodiversity, it is imperative to ensure that the valorization of this species is established and evolves within the framework of an approach that respects the principles of sustainable development.

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References

Ackefors H., 1999 The positive effects of established crayfish introductions in Europe. In: Crayfish in Europe as alien species: how to make the best of a bad situation? Gherardi F., Holdich D. M. (eds), A. A. Balkema, Rotterdam, Netherlands, pp. 49-62.

Akca H., Kayim M., Sayili M., 2006 SWOT analysis of fishery sector in Turkey. Journal of Applied Sciences 6(8):1863-1867.

Alcorlo P., Geiger W., Otero M., 2008 Reproductive biology and life cycle of the invasive crayfish *Procambarus clarkii* (Crustacea: Decapoda) in diverse aquatic habitats of South-Western Spain: implications for population control. Fundamental and Applied Limnology 173(3):197-212.

Angeler D. G., Sanchez-Carrillo S., Garcia G., Alvarez-Cobelas M., 2001 The influence of *Procambarus clarkii* (Cambaridae, Decapoda) on water quality and sediment characteristics in a Spanish floodplain wetland. Hydrobiologia 464:89-98.

Araya T. M Krishnan M., Venugopalan R., 2014 Swot analysis and recommended policies and strategies of Eritrean fisheries. IIFET 2014 Australia Conference Proceedings, 12 pp.

Benyahkoub Y., Fekhaoui M., El Qoraychy I., Yahyaoui A., 2019a Current state of knowledge on Louisiana crawfish (*Procambarus clarkii* Girard, 1852) in Morocco. AACL Bioflux 12(2):618-628.

Benyahkoub Y., Fekhaoui M., El Abidi A., Yahyaoui A., 2019b Study of metallic trace elements and pesticides in the Louisiana crawfish (*Procambarus clarkii* Girard, 1852) in the Gharb and the Low Loukkos regions, Morocco. AACL Bioflux 12(5):1929-1937.

Correia A. M., 1993 [Status of the acclimatization of the red swamp crayfish *Procambarus clarkii* in Portugal]. L'Astaciculteur de France 35:2-9. [in French]

Cruz M. J., Segurado P., Sousa M., Rebelo R., 2008 Collapse of the amphibian community of the Paul do Boquilobo Natural Reserve (central Portugal) after the arrival of the exotic American crayfish *Procambarus clarkii*. Herpetological Journal 18:197-204.

Doadrio I., Perea S., Yahyaoui A., 2011 Morphological and molecular analyses of freshwater blennids: a new species of the genus *Salaria* Forsskål, 1775 (Actinopterygii, Blennidae) in Morocco. Graellsia 67(2):151-173.

Dorn N. J., Wojdak J. M., 2004 The role of omnivorous crayfish in littoral communities. Oecologia 140(1):150-159.

El Qoraychy I., Fekhaoui M., El Abidi A., Yahyaoui A., 2015 Biometry and demography of *Procambarus clarkii* in Rharb Region, Morocco. AACL Bioflux 8(5):751-760.

FAO, 2009 *Procambarus clarkii*. In: Cultured aquatic species fact sheets. Text by: McAlain W. R., Romaire R. P.; Crespi V., New M. (eds). Available at: http://www.fao.org/tempref/FI/CDrom/aquaculture/I1129m/file/fr/fr_redswampcrawfish.htm.

FAO, 2018 The state of world fisheries and aquaculture 2018: meeting the sustainable development goals. FAO, Rome, 210 pp.
FAO, 2019a Yearbook: fishery and aquaculture statistics: aquaculture production. FAO, Rome, 253 pp.
FAO, 2019b Yearbook: fishery and aquaculture statistics: capture production. FAO, Rome, 639 pp.
FAO, 2020 The state of world fisheries and aquaculture: sustainability in action. FAO, Rome, 244 pp.
Gherardi F., 2006 Crayfish invading Europe: the case study of *Procambarus clarkii.* Marine and Freshwater Behaviour and Physiology 39(3):175-191.
Gherardi F., Acquistapace P., 2007 Invasive crayfish in Europe: the impact of *Procambarus clarkii* on the littoral community of a Mediterranean lake. Freshwater Biology 52(7):1249-1259.
Gutierrez-Yurrita P. J., 1997 El papel ecolŏgico del cangrejo rojo (*Procambarus clarkii*), en los ecosistemas acuáticos del Parque National de Doňana. Una perspectiva ecofisiologica y bioenĕrtica. PhD Thesis, Facultad de Ciencias, Universidad Autonoma de Madrid, Madrid, 376 pp. [in Spanish]
Gutierrez-Yurrita P. J., Montes C., 1999 Bioenergetics and phenology of reproduction of the introduced red swamp crayfish, *Procambarus clarkii*, in Donana National Park, Spain, and implications for species management. Freshwater Biology 42(3):561-574.
Holdich D. M., 1999 The negative effects of established crayfish populations. In: Crayfish in Europe as alien species: how to make the best of a bad situation? Gherardi F., Holdich D. M. (eds), A. A. Balkema, Rotterdam, Netherlands, pp. 31-48.
Jin S., Jacquin L., Huang F., Xiong M., Li R., Lek S., Li W., Liu J., Zhang T., 2019 Optimizing reproductive performance and embryonic development of red swamp crayfish *Procambarus clarkii* by manipulating water temperature. Aquaculture 510: 32-42.
Mouslih M., 1987 Introductions de poisons et d'écrevisses au Maroc. Hydrobiolgie Tropicale 20(1):65-72. [in French]
Rodríguez C. F., Bécares E., Fernández-Aláez M., Fernández-Aláez C., 2005 Loss of diversity and degradation of wetlands as a result of introducing exotic crayfish. Biological Invasions 7(1):75-85.
Saguem S., El Moutaouakil M. E. A., 2019 Study on the spread of *Procambarus clarkii* at Gharb (Morocco) and its impact on rice growing. Journal of Agricultural Science and Technology A 9:81-92.
Saguem S., Sahli A., Madi A., El Jdi H., El Moutaouakil M. E. A., 2020 Socioeconomic impact following the introduction of the red swamp crayfish *Procambarus clarkii* (Girard, 1852) in Morocco. International Journal of Engineering, Science and Mathematics 9(2):8-17.
Schleifstein M., Fedeli D., 2003 Louisiana crawfish invade ponds across the globe. New Orleans Times-Picayune (April 14).
Sommer T. R., 1984 The biological response of the crayfish *Procambarus clarkii* to transplantation into California ricefields. Aquaculture 41(4):373-384.
Souty-Grosset C., Holdich D. M., Noel P. Y., Reynolds J. D., Haffner P. (eds), 2006 Atlas of crayfish in Europe. Museum national d'Histoire naturelle, Paris, Patrimoines naturels 64, 187 pp.
Trouilhé M. C., 2006 Etude biotique et abiotique de l'habitat préférentiel de l'écrevisse à pattes blanches (*Austropotamobius pallipes*) dans l'ouest de la France: implications pour sa gestion et sa conservation. Theses, Ecologie, Environnement, Université de Poitiers, 261 pp. [in French]

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