



**PROPOSAL FOR CONSERVATION OF QUEEN CONCH (*Strombus gigas*) IN THE
ALACRANES REEF.**

Dr. Alberto de Jesus Navarrete

El Colegio de la Frontera Sur-Unit Chetumal.

November 2014

Introduction

Coral reefs are highly complex and high diversity systems that are distributed in tropical and subtropical areas of the Planet (Ault *et al.*, 2005). From the economic point of view, are highly productive in terms of tourism and production of fishery resources, and other supplies for human consumption.

One of the fishery resources reefs Mexico is the queen conch (*Strombus gigas* L.) that is widely distributed from the Mexican Caribbean to the Gulf of Mexico in the state of Veracruz, but is currently limited to some reefs of the Gulf of Mexico and Caribbean sea (Baqueiro, *et al.* 1999).

This conch represented the second fishery resource, surpassed only by the spiny lobster (*Panulirus argus*) (Jesus-Navarrete *et al.*, 1992). Despite the different management strategies that include catch quotas, bans reproductive, and protected natural areas, as the Alacranes reef itself, resource recovery in Mexico and elsewhere in the Caribbean, has not been visible (Stone *r al.* 2012).

Importance of the Conservation Plan

The dynamics of the fishery in Alacranes reef was the same as in the Caribbean, with a maximum growth around the seventies and a drastic decline from the eighties, which led to the closure of the fishery in the Yucatan coast in 1988 (Official Journal of the Federation 1988), which later became a permanent ban from 1994 (Official Gazette, March 16, 1994).

The remoteness of the reef and perhaps the lack of enforcement were the two main problems for resource recovery.

After a lengthy ban (20 years) there are no signs of recovery queen conch in Alacranes reef, since the work to assess the density of organisms on the reef show no significant change. E n 1998, Perez *et al.*, r eportaron a density of 0.0084 organismos.m⁻² during the summer of 2002 the same authors sampled the resource again, finding a density of 0.0043 organismos.m⁻² including juveniles and adults, while De Jesus *et al.* (2014)

reported a density ($0.013 \text{ organisms.m}^{-2}$) with less than 38% of adults, so as you can see, there are no signs of recovery conch population.

This is complicated by the oceanographic conditions, possibly indicating that there is a significant flow of larvae from the Caribbean Sea, (Pérez and Aldana, 2003), as on sampling within the reef, the larvae collected corresponded with ages sizes between 520 and 990 microns, indicating develop within the reef lagoon, and therefore the conch population Alacranes depends on its own production of larvae. U n similar result was found by Paris et al. (2008) and the dynamics of the larvae, showed low larval connectivity to the Caribbean. E n consequence conch population in Alacranes, depends on a minimum density of adults, because the reproduction is not performed if the density is less than $0.0056 \text{ organisms.m}^{-2}$ and spawning will not be submitted if the density is less than $0.0048 \text{ organisms.m}^{-2}$ (Stoner and Ray, 2000).

While the status of the conch is considered commercially threatened, there is no risk of extinction of the species, since genetic diversity found in the reefs of the Mexican Caribbean is moderate to high, suggesting that there would be no threat to the species (Perez-Enriquez *et al.*, 2011).

Therefore conservation criteria conch in Alacranes reef should consider all stages and all the variables that affect their distribution and abundance, in order to achieve effective resource recovery in the medium term.

Fishery Problems

The take of queen conch in the Caribbean has followed international demand with catch peaks in the seventies and a gradual and sometimes drastic decrease in the fishery in several locations or countries (Bermuda, Cuba, Florida, Venezuela Virgin Islands US) Tewfik *et al.* (2003).

Despite the various measures of regulation and management, there are no signs of substantial recovery of the population (Stoner *et a l.*, 2012).

History of the fishery in Yucatan

In Yucatan, fishing conch was performed in Alacranes reef, located 120 km from the coast, this situation did not allow an adequate and constant vigilance so quickly recourse showed signs of deterioration. So a catch maximum of 333 tons in 1971, a gradual drop to 54 tonnes was recorded in 1975, causing a cancellation of fishing licenses (INP, 1976) (Fig.1).

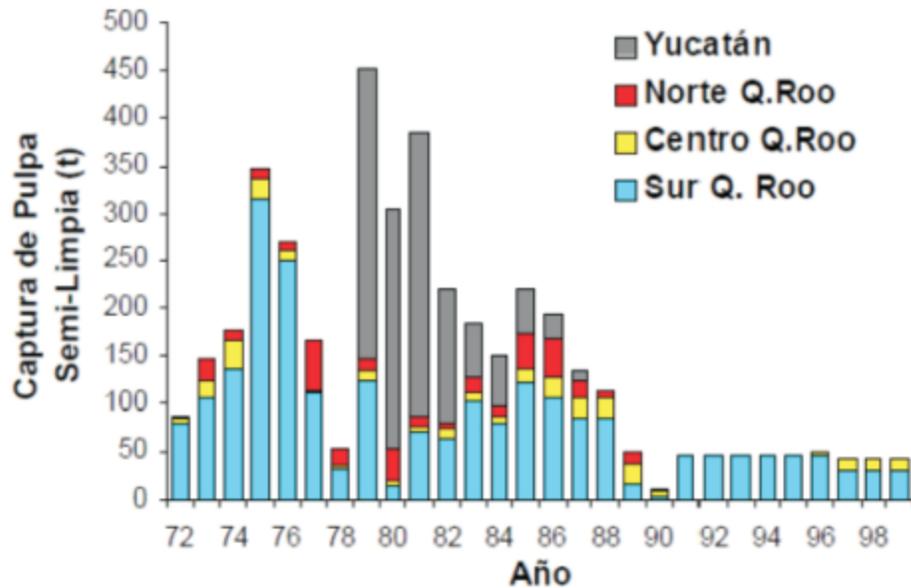


Figure 1. Evolution of catches staircase in the Yucatan Peninsula (Source: INAPESCA).

In 1979 the catch was started in the Yucatan coast, with species such as white conch (*Strombus costatus*) the lancet conch (*Strombus pugilis*), the punch (*Busycon sp*) and tomburro (*Xancus angulatus*) and major ports of landing jurisdiction in Celestun, Sisal, Rio Lagartos and Progress. Although the fishery remained fairly stable in the end showed signs of over-exploitation in 1987 (Fig. 2).

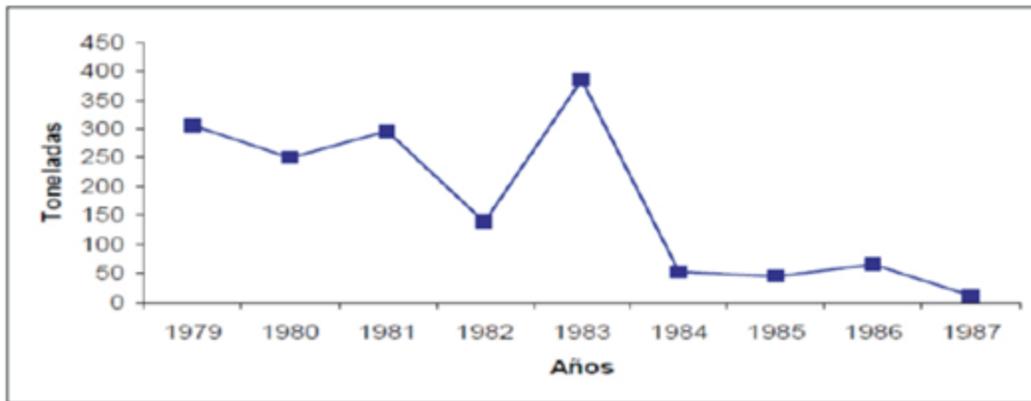


Fig. 2. Capture of conch *Strombus gigas* in Yucatan, (Source: SEPESCA, 1989).

This caused a permanent ban from 1988 and the cancellation of permits granted for inshore fishing establishment and Alacranes reef (DOF, July 25, 1988, Yañez-Arancibia, 1994, DOF, February 13, 2009).

The last assessment in Alacranes reef showed that densities remain low, and in some places the reef not had presence of the conch, as shown in the mollusk spatial distribution in the different months of collection. In September 2013, the sites A1, A8, A9, A15, conch were not present, while sites A2, A11 and A20 is less than 50 conch / ha), (Fig. 3).

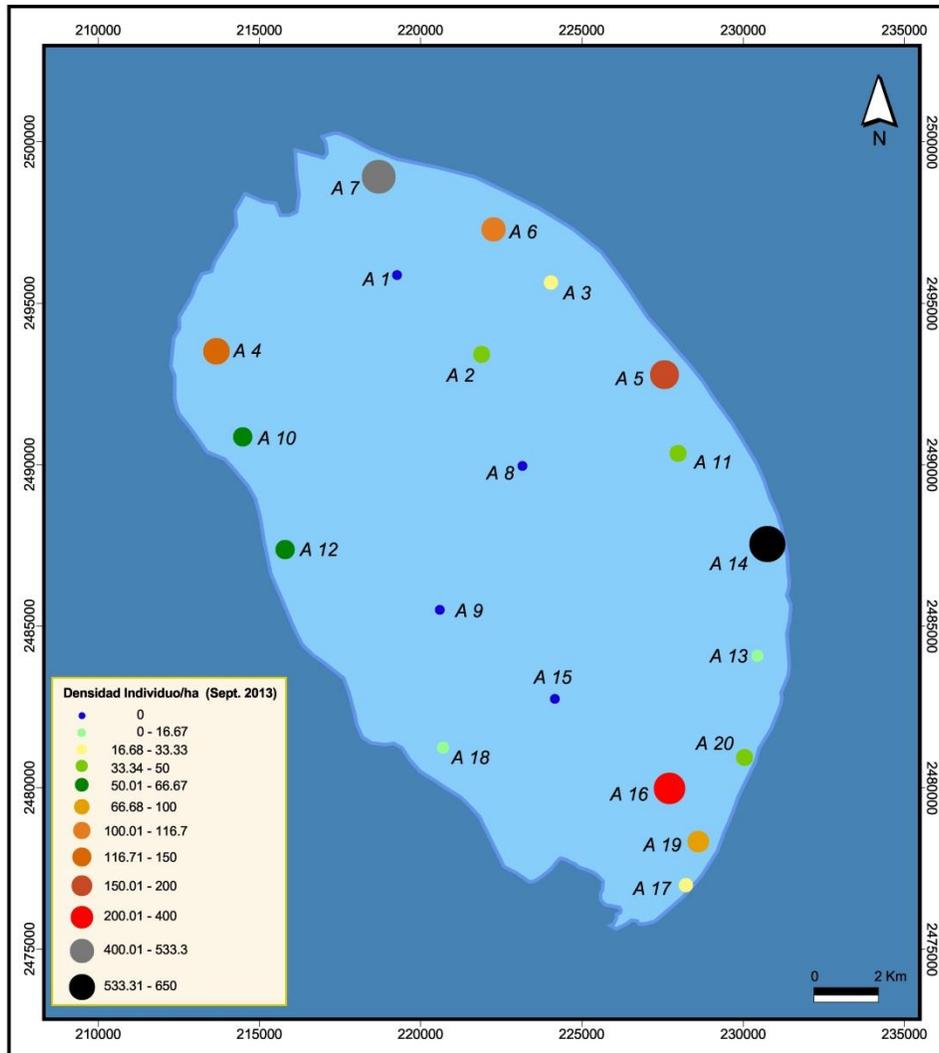


Fig. 3. Spatial distribution of conch at Alacranes reef, September 2013.

The rest of the sites showed densities above 50 conch / ha, and may not have problems with reproductive encounters.

In March 2014, the behavior of the spatial distribution of the conch was similar (Fig. 4).

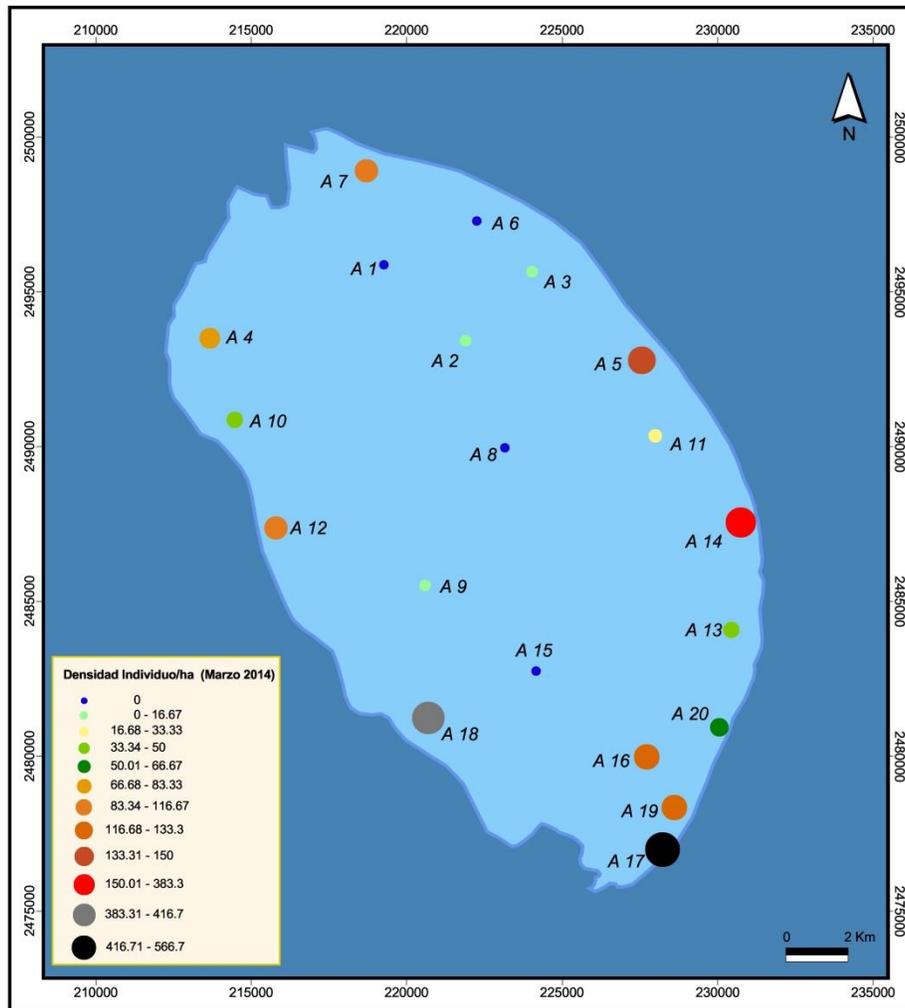


Figure 4. Spatial distribution of the density of conch in March 2014.

Sites A1, A6, A8 and A15 had no presence of organisms, while sites: A9, A10 and A13 had a density less than 50 conch / ha. The remaining sites showed greater than 50 to 586 conch densities and / ha. In particular the site A17, close to Isla Perez, had the highest density and is possibly one of the sites conducive to move to larger conch, places without the presence of organisms.

In July, a similar pattern to previous months was found, in Figure 5 we can see the spatial distribution of conch in Alacranes reef, and in September 2013 and March 2014 or densities ranged from 616 conch / ha.

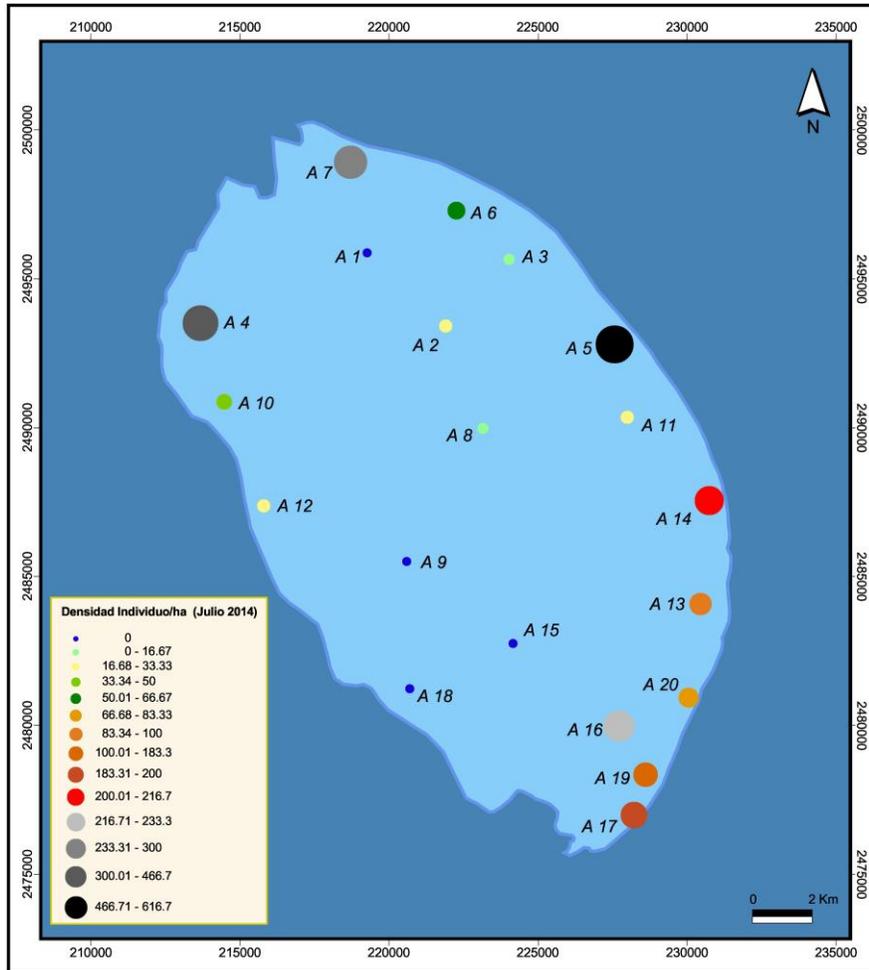


Figure 5. Spatial distribution of the density of conch in July 2014.

Again the A1, A9, A15 and A18 sites had no presence of conch. The A2, A8 and A10, sites had less than 50 conch / ha. The remaining sites showed densities greater than 50 conch / ha, highlighting A4, A5 and A7 sites had a density of more than 300 conch / ha. Should be noted that in all cases we are talking about a density which includes juveniles and adults, so that high values could be misleading.

Legal Framework

The Law of Fisheries and Aquaculture sustainable (LGPAS) states in its article 8 that the regulation, promotion and management of fishery resources accruing to the Secretariat of Agriculture, Livestock, Fishing and Food (SAGARPA), through the National Commission Aquaculture and Fisheries (CONAPESCA).

The conch fishery in Mexico is regulated by NOM-013 PESC-1994, which establishes the conditions and procedures for the operation of conch species in the waters of Federal jurisdiction, this standard complements the NOM-009-PESC-1993 establishing procedures for determining the times and closed areas, to catch the action, establishes the minimum legal size for the capture of species: for *Strombus gigas* (200 mm shell length), capturing procedures dictate, which is semi-autonomous and autonomous (lung and SCUBA) diving, and is determined to catch quotas are established in accordance with the monitoring carried out by the National Fisheries Institute.

These fishery management strategies have not been effective because: 1) the closure established from March to November each year does not correspond to all the months in which females are reproducing, as it has been shown that there is not a correlation between the closure and reproductive capacity because egg laying females have been observed throughout the year in the Mexican Caribbean (Corral and Ogawa, 1985).

The legal minimum size of 200 mm shell length is another measure that has been established, but it is not an effective tool because it has been shown that at that size, many conch have not yet formed a lip, or there is no correlation between shell length and gonadal maturity, as Aldana and Frenquiel, (1998) have shown for different sites in the Caribbean.

Based on this concern, it has recently been proposed to use the thickness of the lip as management criteria to separate sexually mature adults from juveniles (Stoner *et al.*, (2012), however, this academic proposal has not been incorporated by the countries that share the resource, so from a legal point of view there are no substantial changes in local populations.

As most problematic resource mentioned has to do with the lack of monitoring in the coastal area in general and particularly in marine protected areas as park rangers have no authority to stop or punish the offenders, so that there is a loophole.

Due to the low densities of conch found at Alacranes reef (Average = 0.013 ind.m⁻²) it is not appropriate to speak about restoring the fishery, or generate or propose management strategies, but rather it is more appropriate to establish conservation measures that restore the conditions required for the viability of the species, to promote a greater number of reproductive encounters and management of organisms to increase their density. Therefore the following measures are proposed:

1) Translocate conch from deep to shallow waters area.

At Alacranes, the reef management authority, using the fishing sector and coordinated by academics, should implement this strategy, which would improve the number of adults and induce reproductive meetings. To do that, first determine the sites of "origin" that match similar genetic characteristics between conch and second, establish the areas where the conch, having the biological conditions of shelter and food to sustain the biomass of organisms to be introduced. Naturally, consideration should also be given to sites where increased surveillance will be possible. This measure has already been implemented elsewhere (Delgado *et al.*, 2004) and has demonstrated that transplants can improve density and reproductive encounters. Having a conch control through tagging can help determine their activities and home range of the species. Some studies have previously been performed to determine the characteristics of habitats or micro-habitats for conch translocation, for example to ensure enough food. Within this measure, and perhaps on a larger scale, studies could be conducted to determine genetic "distances" or genetic similarities among different populations and move only those that exhibit high affinity (Landines, *et al.*, 2011).

2) Assess the reproductive activities of adults. It is important to know if there have been changes in reproductive activities of conch resulting from the low density of organisms. In the latest stock assessment (Jesus-Navarrete *et al.* 2014), no

reproductive activities of conch were observed in all of the Alacranes reef lagoon. Perez and Aldana (2003) reported that reproductive activities such as coupling, occurred from January to October, that spawning was related to water temperature and were more common from February to September, and apparently do not stop when cooler northerly weather systems are affecting in the area. Egg masses were visible in April and May. Although we did not find that there are any significant differences in densities between our study (average 0.013 ind.m^{-2}) and those of Perez and Aldana, 2003, they observed a greater number of reproductive activities, despite have lower densities (0.004 , 0.003 , and 0.035 ind.m^{-2}).

3) Determine the abundance of larvae and locate recruitment sites of juveniles.

It is necessary to know the abundance of veligers, their size distribution and periods of maximum abundance and to relate to reproductive activities of adults. The larval abundance should correlate with the abundance of juveniles in the benthos, for which we must conduct studies to meet the settlements of juveniles, since this way you can also protect through increased surveillance and promote further growth of organisms. It has been established that there are "biological keys" for the recruitment of conch (Davis, 1994) and there is an ontogenetic separation between the organisms with juveniles, associated mainly with seagrass beds, where they find shelter and food (Stoner et al. 1996) and in areas of coral where they frequently form aggregations (Dany Ichuck *et al.*, 2003). Once these sites are identified, they could be proposed as the core area or dedicated solely to research, where fishing is prohibited.

4) Local captive breeding of conch larvae and juveniles to seed recovery sites in Alacranes reef. It is important to consider which institutions could provide necessary human resources and infrastructure for captive breeding and out-planting of individuals raised this way. This aspect would have to be designed to

generate juveniles 3-4 cm in length that can be tagged and out-planted in the Alacranes reef, which will allow observations of growth rates, juvenile behavior and the association with different micro-environments on the reef.

In conclusion, densities of *Strombus gigas* appear to have increased slightly since 1988 (0.00048 individuals.m⁻²) to the present day (0.013 individuals. M⁻².) but this density is mainly composed of juveniles and few adults, so it is not possible to re-establish fishing activities. It is necessary to establish scientific committees, or take advantage of the members of the Scientific Council of the Park, to discuss the most feasible options for the conservation and recovery proposals and to obtain national and international funding for the activities proposed.

Acknowledgements

Thanks to Holger Wiessenberger, MSc for mapping the distribution of sampling sites and density maps on the Reef.

Literature cited

- Aldana-Aranda, D. & L. Frenquiel. 2007. Lip Thickness of *Strombus gigas* (Mollusca: Gastropoda) Versus Maturity: A Management Measure. Proc. Gulf and Carib. Fish Inst. 58th: 407-418.
- Ault, J. S. S. G. Smith and J. A. Bohnsack. (2005). Evaluation of average length as an estimator of exploitation status for the Florida coral-reef fish community. ICES Journal of Marine Science, 62: 417-423.
- Baqueiro, C. E., M. Medina, y H., Ramírez. 1999. Conch fishery of Campeche. Proc Gulf and Carib Fish Inst 45:982-986.
- Corral, J.L. & J. Ogawa. 1985. Cultivo masivo de larvas de caracol *Strombus gigas* en estanques de concreto Proc.GulfCaribb. Fish. Inst. 38:345-351.
- Danylchuck, A. Rudd, M. A., Giles, I. & K. Baldwin, 2003. Size-dependent habitat, use of queen conch (*Strombus gigas*) in East Harbor lobster and conch reserve, Turk and Caicos, BWI, 54th Proc. Gulf and Caribb. Fish. Inst. 241-273.
- Davis, M. 1994. Mariculture techniques for queen conch for queen conch (*Strombus gigas*, L.) egg mass to juvenile stage. In: R. S. Appeldoorn B. Rodriguez Q. (Editors) Queen Conch Biology, Fisheries and Mariculture Fundaci6nCientficaLos Rcques.Caracas.Ven.320 p.

De Jesús-Navarrete, A.; E. González; J. Oliva; A. Pelayo & G. Medina. 1992. Advances over some ecological aspects of queen conch *Strombus gigas*, L. in the southern Quintana Roo , Mexico. *Proc. GCFI. 45th Ann. Meeting*: p 18.

Delgado, G. C. T. Bardels, R. A. Glazer, Brown-Paterson, N. J., McCarthy, K.J. 2004. Traslocation as a strategy to rehabilitate the queen conch (*Strombus gigas*) population in the Florida keys. *Fish. Bull.* 102:278-288.

(DOF, 25 de julio de 1988,

DOF, 13 febrero 2009

Landines-García, R, E. Márquez, Rangel-Medrano, JG. & Castro-González, E. 2011. Variación genética temporal del caracol pala (*Strombus gigas*) evidenciada por microsatélites en el Atolón Bolívar, Archipiélago de San Andrés, Providencia y Santa Catalina. *Cuadernos del Caribe*, 14:75-82

Paris, C. B, Aldana-Aranda, D. Pérez Pérez, M. & J. Kool. 2008. Connectivity of Queen conch, *Strombus gigas*, populations from Mexico. *Proceedings of the 11th International Coral Reef Symposium*, Ft. Lauderdale, Florida, 7-11 July.

Pérez, M. & D. Aldana-Aranda, 2003. Actividad reproductiva de *Strombus gigas* (Mesogastropoda: Strombidae) En diferentes hábitats del arrecife Alacranes Yucatán, México. *Revista de Biología Tropical*. 51(4):119-126.

Pérez, M., R. Burgos, K. Cervera & C. Espinoza. 2000. Situación pesquera del caracol *Strombus gigas* en Yucatán. *Foro Regional del caracol del Golfo de México y Mar Caribe*. 25 pp.

Pérez-Enríquez, R., Garcia-Rodriguez, F. J. Mendoza-Carrión, G. & Claudia Padilla. 2011. Geographical variation in the genetic diversity and composition of the endangered Queen Conch *Strombus gigas* (Mesogastropoda: Strombidae) from Yucatán, México. *Revista de Biología Tropical*, 59(3): 1115-1126.

Stoner, A. W. & M. Ray-Culp. 2000. Evidence for Allee effects in an over-harvested marine gastropod: density-dependent mating and egg production. *Mar. Ecol. Prog. Ser.* 202:297-302.

Stoner, A.W., P.A. Pitts & R. A. Armstrong. 1996. Interaction of physical and biological large scale distribution of juvenile queen conch in seagrass meadows. *Bulletin of Marine Sciences*. 58: 217-233.

Tewfik, A. H. M. Guzman. 2003. Shallow-water distribution and population characteristics of *Strombus gigas* and *S. costatus* (Gastropoda: Strombidae) in Bocas del Toro Panama. *J. Shelfish. Res.* 22(3):789-794.

Yáñez-Arancibia, A. 1994. Recursos Faunísticos del Litoral de la Península de Yucatán. EPOMEX Serie científica 2. Universidad Autónoma de Yucatán.