The impacts of the adoption of ITQs in the Tasmanian fishery for rock lobster (Jasus Edwardsii)

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Introduction

There is growing consensus internationally on the central role of the "race for fish" in the development of excess harvesting. The common-pool status of marine fish stocks leads to the existence of reciprocal negative externalities between fishing operators (Hardin, 1968). These externalities entail a divergence between individually and socially optimal choices, and to the development of excess fishing capacity: fishers tend to invest in more powerful and efficient fishing gear and techniques in order to stay in the race, leading to economic inefficiency, conflicts and social disruption, and in many cases to the depletion of fish stocks beyond safe biological limits (Thébaud et al., 2007).

These difficulties are not new, and have led to the development of fisheries management policies which can be broadly classified, according to their purpose, in two complementary sets of regulations (Troadec and Boncoeur, 2003): (i) measures aimed at the conservation of the productivity of fish resources, and (ii) measures aimed at the regulation of access to resources extraction possibilities.

Although such regulations have proved indispensable, their effectiveness has been limited by the fact that they do not tackle the economic and institutional roots of excess capacity. As stressed by FAO (2007), there is growing recognition that the allocation of individual access rights to fisheries and fish resources is at the heart of managing for sustainable fisheries.

In particular, implementing Individual Transferable Quotas (ITQs) has been proposed as an approach which can produce the incentives required for fishers to harvest fish stocks sustainably (Arnasson, 1990). The key idea is that fishers will seek to maximize profits within ITQ constraints (Dewees 1998), usually defined as shares of a given Total Allowable Catch (TAC). It is expected that the transferability of fishing rights will lead the most efficient fishers to buy additional quota shares from the least profitable fishing firms, thus reducing fishing capacity and improving the economic efficiency of fleets (see Copes 1986, McCay 1995, Clark 2006).

The objective of this paper is to examine the impacts of the adoption of ITQs in the Tasmanian fishery for rock lobster (*Jasus edwardsii*) from 1998. Based on the literature review, the key impacts expected from the implementation of ITQs in a fishery displaying excess capacity are identified, with which to confront the experience of the Tasmanian rock lobster fishery. The retrospective analysis was carried out with the aim to assess the changes

observed in the fishery. It is based on the compilation of different data sets describing the evolution of the status of the fishery over the last decade.

After a general presentation of the Tasmanian fishery for rock lobster and of the quota management system, changes in the exploitable biomass, in the fishing fleet, in the fishing strategy, consequences on ex-vessel prices and gross returns and on the concentration of activity are[1] analysed.

The Tasmanian fishery for rock lobster (Jasus edwardsii)

The fishery is currently generating a gross revenue of about 60 million AUD$ (ABARE, 2008). It is operated by more than 200 vessels, fishing with baited traps. Most lobster caught in Tasmania is exported overseas (approximately 74% according to Bradshaw, 2004). The annual commercial catch of lobster is limited by a TAC set at 1523 tonnes in 2008, and the fleet operates during the fishing season from March to February with a closure in October which is the period of moulting.

Tasmanian rock lobster has been exploited for more than two hundred years and was first managed in 1889 with the "Fisheries Act" following a decline in lobster abundance (Winstanley 1973). Until 1967, only technical conservation measures were implemented including gear restrictions, minimum landing size, seasonal closure, and a ban on the harvesting of egg-bearing, "berried", females. The sustainability of the stock remained threatened under those measures because of a continuous increase of fishing effort. In an attempt to curb this effort, input restrictions were implemented from the late 1960ies onwards, which capped the number of fishing licences and the number of traps used in the fishery. Despite these input controls, catch and catch rates continued to decline in the fishery and in 1996 the fishing industry voted in favour of an ITQ management system for the Tasmanian rock lobster fishery, after several years of debate involving the industry, scientists and managers.

ITQs were implemented in 1998, initial allocation was a particularly sensitive and strongly debated issue (see Ford and Nicol 2001 for details). The final allocation was primarily based on trap ownership, with a minor and decreasing share of the quota allocation based on catch history: during the first three years, the latter share represented respectively 9%, 5% and 2% of the TAC (Ford and Nicol, 2001). To limit aggregation of fishing rights, a limit of quota ownership was implemented (Fishery rules, Anon, 2005).

Changes in the exploitable biomass

The introduction of ITQs involved setting up a Total Allowable Catch (TAC) which had not been implemented before. The TAC remained stable around 1500t since its introduction (Haddon and Gardner, 2008). Total effort in the fishery started decreasing as soon as late 1997. This may be due to fishers building catch history up to October 1997 and then reducing their effort until the beginning of the first season under ITQ in March 1998. Fishing effort has decreased since the introduction of quota (Figure 1); meanwhile, following adoption of the

[1] The information on quota ownership is available, it will be included in a more detailed paper with a more detailed analysis, see: A retrospective analysis of the effects of adopting Individual Transferable Quotas (ITQs) in the Tasmanian rock lobster fishery, Aquatic Living Resources, *to be published*.

TAC, the stock has been rebuilding. The latest rock lobster assessment showed that exploitable biomass has doubled since its lowest level in 1994 (Haddon and Gardner, 2008). Both this recovery of the lobster stock and fleet rationalisation following introduction of individual quotas (see below) have probably contributed to the increase in average catch rates at the scale of the fishery: in 2006/2007, fishers undertook 20% less trap-lifts to catch the TAC than in 1998/1999 (Haddon and Gardner,2008).

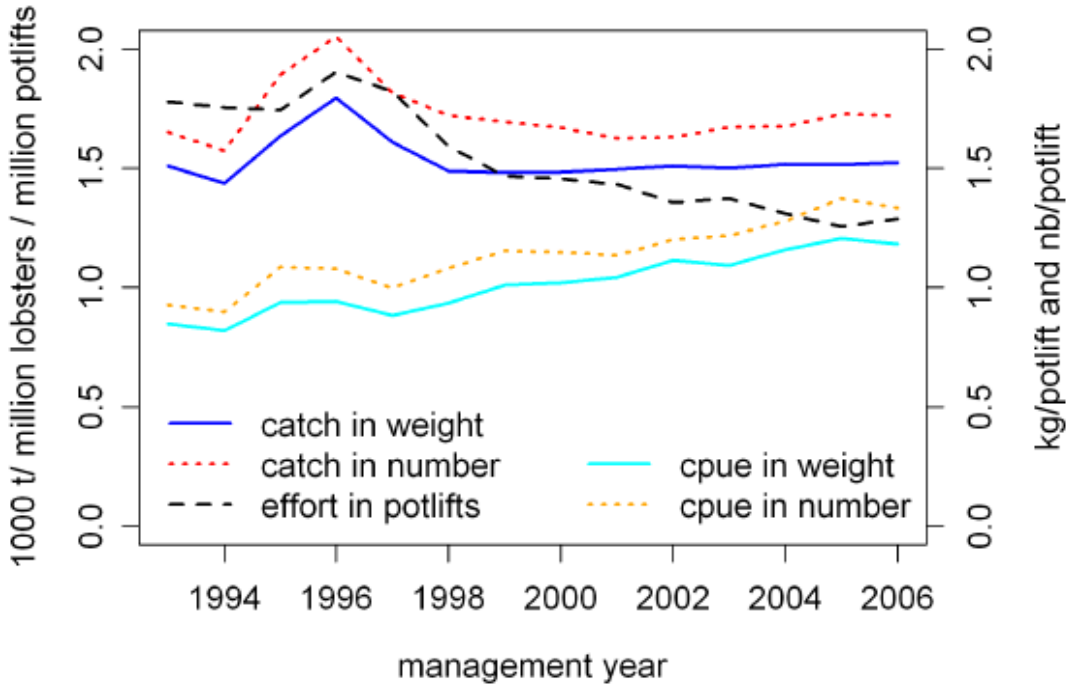


Figure 1 Annual trend in effort, catch and catch rates in Tasmanian rock lobster fishery

Changes in the fishing fleet

Rationalization of the fleet

The fleet was reduced by 25%, from 325 to 242 vessels, in the first 3 years of quota management. It then stabilized around 240 until 2004 before a further decline, with the latest estimate of the fleet size being 214 vessels in 2006.

Characteristics of the vessels

The size composition of the fleet changed over the years. Most vessels measure between 10 and 18 meters. This fleet segment rose from 83% in 1997 to 90% in 2000. Most of the smaller vessels left the fishery in the first three years of quota. One segment, the small vessels was strongly reduced. From the 39 vessels less than 10 meters in length catching rock lobster in 1997, only a third, 12, remained in 2000. The biggest vessels in the fleet, however, did not leave the fishery, vessels bigger than 18 meters became more important, they accounted for 13% of the capacity of the fleet in 1997, 20% in 2004 and 16% in 2006.

The evolution of the size distribution of the fleet might be related to sea conditions. The development of winter fishing for Asian market in early 1990's led to the construction of bigger vessels, more suitable for winter and west coast rough weather conditions. It is also

likely that the carrying limit of traps onboard influenced this distribution. De facto, only vessels longer than 18m and bigger than 30t can carry the maximum amount of traps.

Changes in fishing strategy

There is no clear evidence that high-grading has increased in the rock lobster fishery after the introduction of individual quotas, and discards have been assumed to have remained constant over the period. What more, discards are mainly composed of egg-bearing females and undersized lobsters which are returned to the place of capture unharmed. On the other hand, changes in fishing strategy were expected to occur with fishers seeking to maximise the value of their quota allocation (see Frusher et al 2003 and Bradshaw 2004). The market quality of a lobster depends on several factors including (i) physical condition, (ii) colour and (iii) weight. These different categories result in "split" prices, "premium" lobsters having a rigid shell (i.e. not soft due to recent moulting), completely red in colour, and weighting between 0.8 kg and 2 kgs receiving up to AUD$ 10 more per kilogram (C. Gardner, pers. comm.). These characteristics are affected by spatial and temporal parameters allowing fishers to target specific stock segments by adjusting their spatial and seasonal allocation of fishing effort. Tasmanian fishers would thus have been expected to fish more in shallow areas favourable to the dark red coloration of lobsters, to fish more in winter when lobster beach price is higher, and to land premium size fish.

Seasonal distribution of fishing activity

The end of the moulting period in November was historically the beginning of the fishing season: once the exoskeleton has begun to harden, lobsters are highly catchable as they attempt to replenish their food reserves. However, those lobsters are in poor physical condition due to starvation during moult and processors are often reluctant to purchase them because of large mortality rates of lobsters during live shipments to the Asian market. Softer lobsters are thus normally retailed on the domestic market at lower prices.
Immediately at the introduction of ITQs in 1998, the proportion of fishing effort allocated to the winter season increased (figure 2). Fisher response to the new regulation was extremely fast, and it may have been facilitated by the change which occurred in the regulatory dates of the management year. Managers decided to set the official fishing season from March to February (keeping the seasonal closure in October for the moult), instead of the traditional fishing season from November to August in which fishers would have been tempted to secure the catch of most of their quota in summer. Indeed, keeping quota for winter would have been risky as catch rates are lower and weather conditions can prevent fishers from going out at sea. With the current fishing season starting in March, fishers can plan their fishing calendar without fear of having a portion of their quota uncaught at the end of the season. Despite, the winter allocation of effort being variable due to weather conditions, the proportion of winter effort remained stable around 50% since the introduction of ITQs. The Severe Acute Respiratory Syndrome (SARS) breakout in Asia in 2003-2004 affected tourism in Asia and, as a result, the demand for high value food products on Asian markets decreased (Harcourt, 2003). During that period, the winter price was low resulting in a smaller proportion of winter fishing.

Depth of fishing activity

The colour of rock lobster depends on the depth of its habitat. In shallow waters (less than 40 meters) the lobster is uniformly bright red. In depths greater than 40 meters lobsters become paler and their appearance is speckled. Following introduction of individual quotas, the

proportion of fishing effort in shallow waters tended to increase, most probably due to a targeting of these premium lobsters: before 1998, around 70% of trap-lifts were made in shallow waters; this proportion increased to 80% in 2002. Another factor which may also have contributed to this change in effort allocation is the fact that fishing in shallow waters reduces travelling time, and fuel costs.

Lobster size

To assess the change in fishing strategy regarding the size of lobsters we used the average lobster size per trip (total weight of lobster caught divided by their number). Before 1998, the proportion of trips with average lobster size in the premium size range (0.8 to 2 kg) was slightly above 55% while since 1998, the proportion of trips with premium average size has grown to around 70% of total effort.

From this quick outlook, it seems obvious that fishers have been responding to the market demand in term of providing fish of high quality, thus improving their return per quota unit. This effect is clear from 1998, the allocation of effort increased by 5 to 10% for all the observed factors. After a slight decrease the second year of quota, the allocation of effort toward premium size and colour of lobster seems to have reached and stabilized at its highest levels. The winter fishing proportion seems more variable but is also constrained by uncontrolled parameters like the weather.

Consequences on ex-vessel prices and gross returns

Most of the Tasmanian rock lobster is exported to the Asian live lobster market (Bradshaw 2004). The beach price of rock lobster is therefore highly influenced by the Chinese market and exchange rates. This can be observed by looking at the trend line computed with the Hodrick-Prescott filter applied to the nominal prices (figure 2). The increase in lobster price in the early 1990's corresponds to the development of exports of live Tasmanian rock lobster to Asian markets. The decline observed in 2003 is due to the SARS episode in Asia (Harcourt, 2003).

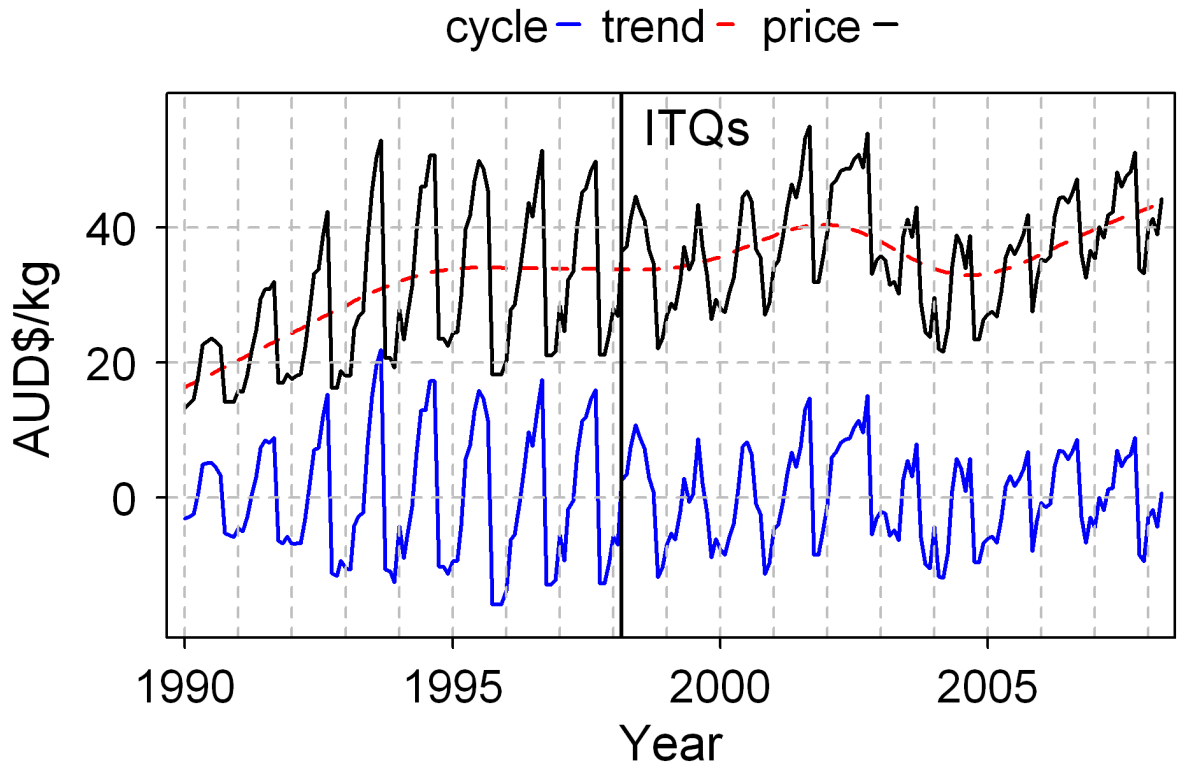


Figure 2 Hodrick-Prescott filter ex-vessel prices effects of Tasmanian rock lobster

Because of this incident in 2003, the long-term effect of ITQs on beach price for lobster, which would be expected from the changes in the composition of landings described above, is difficult to clearly identify at the scale of the study period. However, in the first few years following the introduction of ITQs, the trend price increased from around 34 AUD$/kg (1995–1997) to more than 40 AUD$/kg in 2002 in nominal terms (i.e. non deflated). This was largely due, at least in the initial years, to an increase in summer prices which, prior to the introduction of ITQs, were low. The fact that landings in the summer season decreased after the quota system was implemented, as effort was reallocated to seasons when lobsters fetch higher prices, may contribute to explain this increase.

This redistribution of effort throughout the year may also help to explain the strong modification which was observed in the intra-annual price variability for lobster, which is shown by the cyclical term of the Hodrick-Prescott filter (figure 2). After 1998, the variability of ex-vessel prices decreased to an approximately AUD$20 average difference between summer prices and winter prices, whereas this difference was around AUD$30 prior ITQ. Overall, and excluding the SARS episode, while high prices in the winter season have a tendency to increase less, low prices in the summer season decrease much less than previously, and the intra-annual price variability has been significantly reduced, particularly after the SARS episode.

The consequences of this in terms of the total value of rock lobster catch can be estimated, based on the product of the monthly catch and the average monthly beach price (figure 3). To analyse the evolution of the value of lobster catch, we consider deflated prices and correct gross value by the Australian consumer price index (CPI) relative to 2006 ($CPI_{2006} = 1$). The TAC, set in 1998, was below the pre-ITQ catch and resulted in a decline in the total value of the fishery in 1998 and 1999. The large increase in the value of the catch in the following years (2000 – 2002) is likely to have resulted from the changes in fishing strategies explained

previously. The drop observed for the following years was fully due to the decrease in the price of lobster due to SARS as the quantity landed did not change.

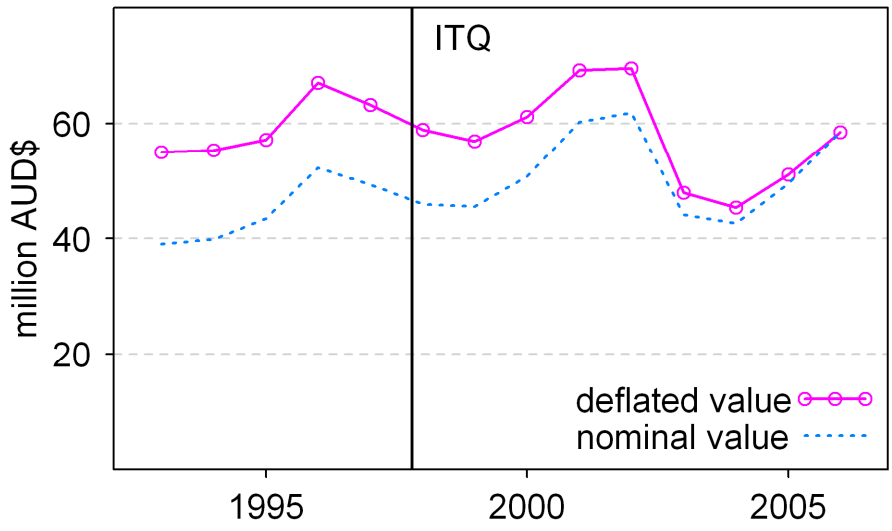
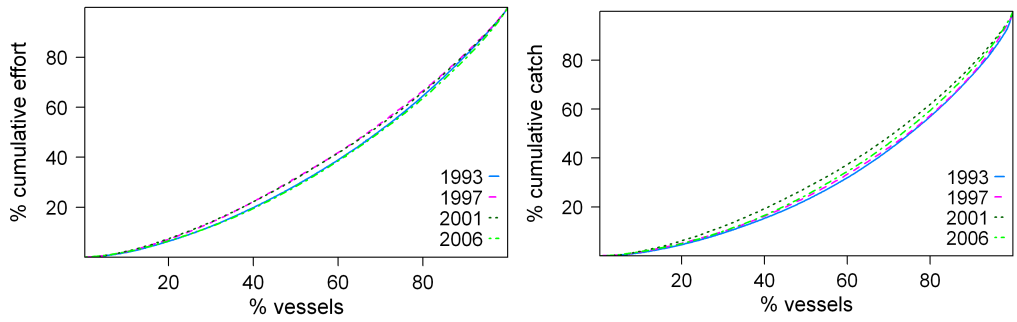


Figure 3 Evolution of the total annual value of the Tasmanian rock lobster catch, CPI corrected

Concentration of activity

Concentration of quota was not regarded as major issue in the Tasmanian lobster fishery because the aggregation limit per quota owner was set relatively low (2% of the TAC). Due to lack of data on quota ownership, we looked at the concentration of activity in the fishery. When looking at the concentration profiles of effort and catch by vessels, it seems that the distribution of the catch and effort amongst the operators of the fishery has been maintained at a constant level (fig 4a and 4b). The distribution of activity can also be assessed by looking at the Gini index (Gini, 1921). Both catch and effort exhibit low Gini indices (around 0.35 and 0.28 respectively) suggesting a rather homogenous repartition of labour in the fishery. No clear trend can be identified in the evolution of the indices, while the catch repartition seems to have remained stable, from 0.37 in 1997 to 0.36 in 2006 with a historically low level of 0.32 in 2001, effort concentrated slightly from 0.26 in 1997 to 0.30 in 2006.



a) **b)**

Figure 4 Concentration profiles of a) effort and b) catch by level

Conclusion and perspectives

The Tasmanian rock lobster fishery has been deeply modified by the implementation of the quota management system in 1998. Most of those changes were expected and even wished by the managers. These are the decrease of total effort, the reduction of fleet size and the change of effort allocation towards premium lobsters which led to higher average beach prices and a lower variability of price around the year. The TAC was set at a value to encourage rebuilding of the stock which has been successful with exploitable biomass doubling since the historically low level of 1994 (Haddon and Gardner 2008). The changes in term of structure of the fleet have been significant.

Tasmanian rock lobster fishers adapted their fishing strategies to maximize their return per kg of lobster. They chose to reallocate their effort, both spatially and seasonally, towards more valuable lobsters for export to Asia. This new fishing behaviour has had a direct impact on the average price of lobster which grew fast in the years after quota introduction.

At the fishery level, most of the effects expected with the introduction of an ITQ system were observed suggesting that the ITQ did achieve the desired objectives. The price and value analysis were strongly disturbed by the SARS outbreak in 2003-2004 showing how vulnerable the fishery is to disturbance in their major export market. The study presented in this paper is part of an ongoing PhD project and will be completed by the modeling of the dynamics of the fishery at a finer level (individuals or homogenous fleet segments) and the analysis of lobster price and quota market.

References

ABARE, 2008. Australian Fisheries Statistics 2007. *Australian Bureau of Agricultural and Resource Economics*, Canberra. [online] available on (consulted the 19.08.2008) http://www.abareconomics.com/publications_html/fisheries/fisheries_08/08_fishstats.pdf

Anon., 2005. Draft Fisheries (Rock lobster) Rules 2005. *Tasmanian parliament*.[online] available at (consulted the 15.07.2008) http://www.dpiw.tas.gov.au/inter.nsf/Attachments/HMUY-6FE75R/$FILE/rocklobster_DRAFT_rules.pdf

Bradshaw, M., 2004. A combination of state and market through ITQs in the Tasmanian commercial rock lobster fishery: the tail wagging the dog? *Fisheries Research* 67, 99-109.

Clark, C.W., 2006. The worldwide crisis in fisheries. Economic Models and Human Behavior. *Cambridge University Press*. 263pp.

Copes, P., 1986. A Critical Review of the Individual Quota as a Device in Fisheries Management. *Lands Economics* 62, 278-291.

Dewees, C.M., 1998. Effects of individual quota systems on New Zealand and British Columbia fisheries. *Ecological Applications* 8, S133-S138.

FAO, 2007. The State of World Fisheries and Aquaculture - 2006 (SOFIA). *Food and Agriculture Organization of the United Nations*, Rome.

Ford, W., Nicol, D., 2001. The initial allocation of Individual Transferable Quotas in the Tasmanian Rock Lobster and Abalone Fisheries. *FAO Fisheries Technical Papers* 411.

Frusher, S., Eaton, L., Bradshaw, M., 2003. Impact of management change to an ITQ system in the Tasmanian Rock Lobster Fishery. *Tasmanian Aquaculture and Fisheries Institute.*

Gini, C., 1921. Measurement of Inequality of Incomes. *The Economic Journal* 31, 124–126.
Haddon, M., Gardner, C., 2008. Tasmanian rock lobster fishery 2006/2007. *Tasmanian Aquaculture and Fisheries Institute.*
Harcourt, T. 2003. The economic effects of SARS: what do we know so far? *Australian Trade Commission.* [online] http://www.austrade.gov.au/The-economic-effects-of-SARS-what-do-we-know-so-far-/default.aspx (consulted the 15.08.2008).
Hardin, G., 1968. Tragedy of the Commons. *Science* 162, 1243-1248.
Hodrick, R.J., Prescott, E.C., 1997. Postwar US business cycles: An empirical investigation. *Journal of Money Credit and Banking* 29, 1-16.
McCay, B.J., 1995. Social and ecological implications of ITQs: An overview. *Ocean & Coastal Management* 28, 3-22.
Thébaud O., Boncoeur J., Berthou P., 2007. Regulating access to marine fisheries in the coastal zone: key issues. *Amure working Paper Series* D22-2007 [online] available on http://www.univ-brest.fr/gdr-amure/documents/gdr-amure-D-22-2007.pdf (consulted the 15.10.2008).
Troadec J.P., Boncoeur J., 2003. La régulation de l'accès. In Laubier L. (animateur), *Exploitation et surexploitation des ressources marines vivantes*. Académie des Sciences, Rapport sur la Science et la Technologie (17), Paris.
Winstanley, R., 1973. Rock lobster fishing in Tasmania, 1904-1972. *Tasmanian Fisheries research* 7, 1-23.